# Half-Bridge IPM for Small Appliance Motor Drive Applications

μIPM™

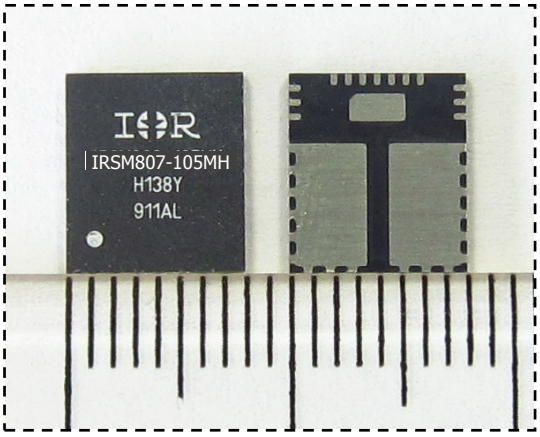
10A, 500V

## Description

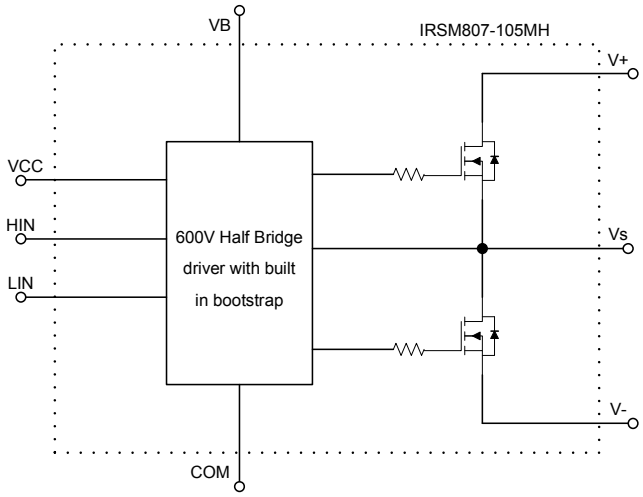
IRSM807-105MH is a 10A, 500V half-bridge module designed for advanced appliance motor drive applications such as energy efficient fans and pumps. IR's technology offers an extremely compact, high performance half-bridge topology in an isolated package. This advanced IPM offers a combination of IR's low $R_{DS(on)}$ Trench FREDFET technology and the industry benchmark half-bridge high voltage, rugged driver in a small PQFN package. At only 8x9mm and featuring integrated bootstrap functionality, the compact footprint of this surface-mount package makes it suitable for applications that are space-constrained. IRSM807-105MH functions without a heat sink.

## Features

- Integrated gate drivers and bootstrap functionality
- Suitable for sinusoidal modulation applications
- Low $R_{DS(on)}$ Trench FREDFET
- Under-voltage lockout for both channels
- Matched propagation delay for all channels
- Optimized dV/dt for loss and EMI trade offs
- 3.3V input logic compatible
- Active high HIN and LIN
- Motor Power range 80-200W
- Isolation 1500$V_{RMS}$ min
- ROHS compliant




## Internal Electrical Schematic




## Ordering Information

| Orderable Part Number | Package Type | Form | Quantity |
|---|---|---|---|
| IRSM807-105MH | PQFN 8x9mm | Tray | 1300 |

| | | | |
|---|---|---|---|
| IRSM807-105MHTR | PQFN 8x9mm | Tape and Reel | 2000 |

## Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the module may occur. These are not tested at manufacturing. All voltage parameters are absolute voltages referenced to $V_{SS}$ unless otherwise stated in the table. The thermal resistance rating is measured under board mounted and still air conditions.

| Symbol | Description | Min | Max | Unit |
|---|---|---|---|---|
| $BV_{DSS}$ | MOSFET Blocking Voltage | --- | 500 | V |
| $I_O$ | DC output current per MOSFET @ $T_C$=25°C (Note1) | --- | 10 | A |
| $P_d$ | Power dissipation per MOSFET @ $T_C$ =100°C | --- | - | W |
| $T_J$ (MOSFET & IC) | Maximum Operating Junction Temperature | --- | 150 | °C |
| $T_L$ | Lead temperature (soldering 30 seconds) | --- | 260 | °C |
| $T_S$ | Storage Temperature Range | -40 | 150 | °C |
| $V_B$ | High side floating supply voltage | -0.3 | $V_S$ + 20 | V |
| $V_S$ | High side floating supply offset voltage | $V_B$ - 20 | $V_B$ +0.3 | V |
| $V_{CC}$ | Low Side fixed supply voltage | -0.3 | 20 | V |
| $V_{IN}$ | Logic input voltage LIN, HIN | -0.3 | $V_{CC}$ +0.3 | V |
| $V_{ISO}$ | Isolation voltage (1min) (Note2) | --- | 1500 | $V_{RMS}$ |

Note1: Calculated based on maximum junction temperature. Bond wires current limit is 3.5A. Note2: Characterized, non tested at manufacturing

## Recommended Operating Conditions

| Symbol | Description | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| $V^+$ | Positive DC Bus Input Voltage | --- | --- | 400 | V | |
| $V_{S1,2,3}$ | High Side Floating Supply Offset Voltage | (Note 3) | --- | 400 | V | |
| $V_{B1,2,3}$ | High Side Floating Supply Voltage | $V_S$+12 | --- | $V_S$+20 | V | |
| $V_{CC}$ | Low Side and Logic Supply Voltage | 13.5 | --- | 16.5 | V | |
| $V_{IN}$ | Logic Input Voltage | COM | --- | $V_{CC}$ | V | |
| $F_p$ | PWM Carrier Frequency | --- | --- | 20 | kHz | |

For proper operation the module should be used within the recommended conditions. All voltages are absolute referenced to COM. The $V_S$ offset is tested with all supplies biased at 15V differential.
Note 3: Logic operational for $V_s$ from COM-8V to COM+500V. Logic state held for $V_s$ from COM-8V to COM-$V_{BS}$.

## Static Electrical Characteristics

$V_{BIAS}$ ($V_{CC}$, $V_{BS}$)=15V, $T_J$=25ºC, unless otherwise specified. The $V_{IN}$, and $I_{IN}$ parameters are referenced to COM

| Symbol | Description | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain-to-Source Breakdown Voltage | 500 | --- | --- | V | $T_J$=25°C, $I_{LK}$=3mA |
| $I_{LKH}$ | Leakage Current of High Side FET's in Parallel | --- | 15 | --- | µA | $T_J$=25°C, $V_{DS}$=500V |
| $I_{LKL}$ | Leakage Current of Low Side FET's in Parallel Plus Gate Drive IC | --- | 20 | --- | µA | $T_J$=25°C, $V_{DS}$=500V |
| $R_{DS(ON)}$ | Drain to Source ON Resistance | --- | 0.58 | 0.8 | Ω | $T_J$=25°C, $V_{CC}$=10V, Id = 6A |
| | | --- | 1.60 | --- | | $T_J$=150°C, $V_{CC}$=10V, Id = 6A (Note 4) |
| $V_{SD}$ | Diode Forward Voltage | --- | 0.85 | --- | V | $T_J$=25°C, $V_{CC}$=10V, Id = 6A |
| $V_{HIN/LIN}$ | Logic "1" input voltage for HIN & "0" for LIN | 2.2 | --- | --- | V | |
| $V_{HIN/LIN}$ | Logic "0" input voltage for HIN & "1" for LIN | --- | --- | 0.8 | V | |
| $V_{CCUV+}$, $V_{BSUV+}$ | $V_{CC}$ and $V_{BS}$ Supply Under-Voltage, Positive Going Threshold | 8 | 8.9 | 9.8 | V | |
| $V_{CCUV-}$, $V_{BSUV-}$ | $V_{CC}$ and $V_{BS}$ supply Under-Voltage, Negative Going Threshold | 7.4 | 8.2 | 9.0 | V | |
| $V_{CCUVH}$, $V_{BSUVH}$ | $V_{CC}$ and $V_{BS}$ Supply Under-Voltage Lock-Out Hysteresis | --- | 0.7 | --- | V | |
| $I_{QBS}$ | Quiescent $V_{BS}$ Supply Current $V_{IN}$=0V | --- | 45 | 70 | µA | |
| $I_{QCC}$ | Quiescent $V_{CC}$ Supply Current $V_{IN}$=0V | --- | 1100 | 1800 | µA | |
| $I_{HIN+}$ | Input Bias Current $V_{IN}$=4V | --- | 5 | 20 | µA | |
| $I_{LIN-}$ | Input Bias Current $V_{IN}$=0V | --- | 1 | 2 | µA | |
| $R_{BR}$ | Internal Bootstrap Equivalent Resistor Value | --- | 200 | --- | Ω | $T_J$=25°C |

Note 4: Characterized, not tested at manufacturing

## MOSFET Avalanche Characteristics

| Symbol | Description | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| EAS | Single Pulse Avalanche Energy | --- | 216 | --- | mJ | $T_J$=25°C, L=3mH, VDD=100V, IAS=12A, TO-220 package. |

## Dynamic Electrical Characteristics

$V_{BIAS}$ ($V_{CC}$, $V_{BS}$)=15V, TJ=25ºC, unless otherwise specified. Driver only timing unless otherwise specified.

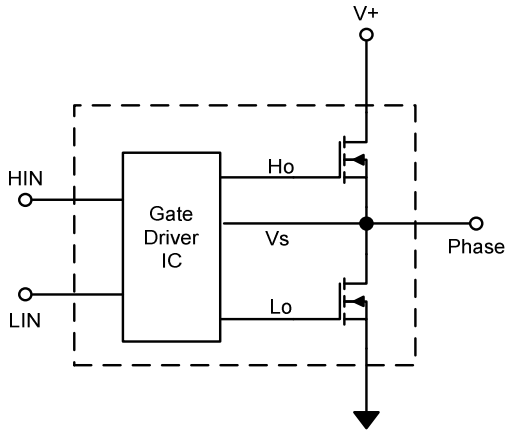
| Symbol | Description | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| $T_{ON}$ | Input to Output Propagation Turn-On Delay Time | --- | 0.8 | 1.3 | µs | $I_D$=1mA, $V^+$=50V |
| $T_{OFF}$ | Input to Output Propagation Turn-Off Delay Time | --- | 0.8 | 1.3 | µs | Gate Driver; $V_{LIN}$=0 & $V_{HIN}$=5V with no external deadtime |
| $T_{FIL,IN}$ | Input Filter Time (HIN, LIN) | --- | 300 | --- | ns | |

## Thermal and Mechanical Characteristics

| Symbol | Description | Min | Typ | Max | Units | Conditions |
|---|---|---|---|---|---|---|
| $R_{th(J-B)}$ | Thermal resistance, junction to mounting pad, each MOSFET | --- | 0.9 | --- | °C/W | Standard reflow-solder process |
| $R_{th(J-A)}$ | Thermal resistance, junction to ambient, each MOSFET | --- | TBD | --- | °C/W | |

## Input-Output Logic Level Table




| HIN | LIN | Phase |
|---|---|---|
| HI | LO | V+ |
| LO | HI | 0 |
| LO | LO | * |
| HI | HI | ** |

* V+ if motor current is flowing into Vs, 0 if current is flowing out of Vs into the motor winding
** Shoot-through condition

Target Qualification†

| | | |
|---|---|---|
| **Qualification Level** | | Industrial†† (per JEDEC JESD 47) |
| **Moisture Sensitivity Level** | | MSL3††† (per IPC/JEDEC J-STD-020) |
| **ESD** | Human Body Model | Class 1C (per JEDEC standard ANSI/ESDA/JEDEC JS-001) |
| | Machine Model | Class A (per EIA/JEDEC standard JESD22-A115) |
| **RoHS Compliant** | | Yes |

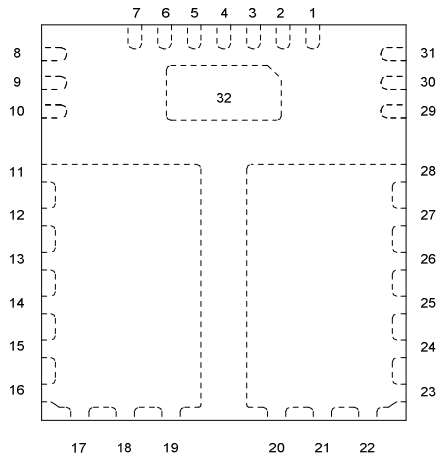
† Qualification standards can be found at International Rectifier's web site http://www.irf.com/

†† Higher qualification ratings may be available should the user have such requirements. Please contact your International Rectifier sales representative for further information.

††† Higher MSL ratings may be available for the specific package types listed here. Please contact your International Rectifier sales representative for further information.

## Module Pin-Out Description

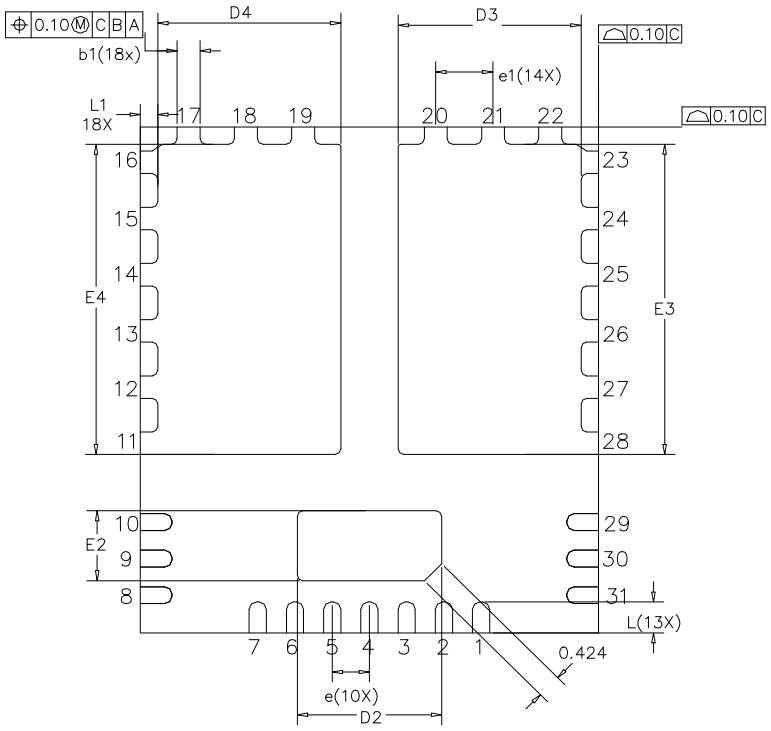
| Pin | Name | Description |
|---|---|---|
| 1, 4, 7, 32 | COM | Low Side Gate Drive Return |
| 2 | VCC | 15V Gate Drive Supply |
| 3 | HIN | Logic Input for High Side (Active High) |
| 5 | LIN | Logic Input for Low Side (Active High) |
| 8, 9, 10 | V- | Low Side Source Connection |
| 11 – 19 | VS | Phase Output |
| 20 – 28 | V+ | DC Bus |
| 29 – 30 | VS | Phase Output (-ve Bootstrap Cap Connection) |
| 31 | VB | High Side Floating Supply (+ve Bootstrap Cap Connection) |




Exposed pad (Pin 32) has to be connected to COM for better electrical performance

## Package Outline IRSM807-105MH (Bottom View), 1 of 2

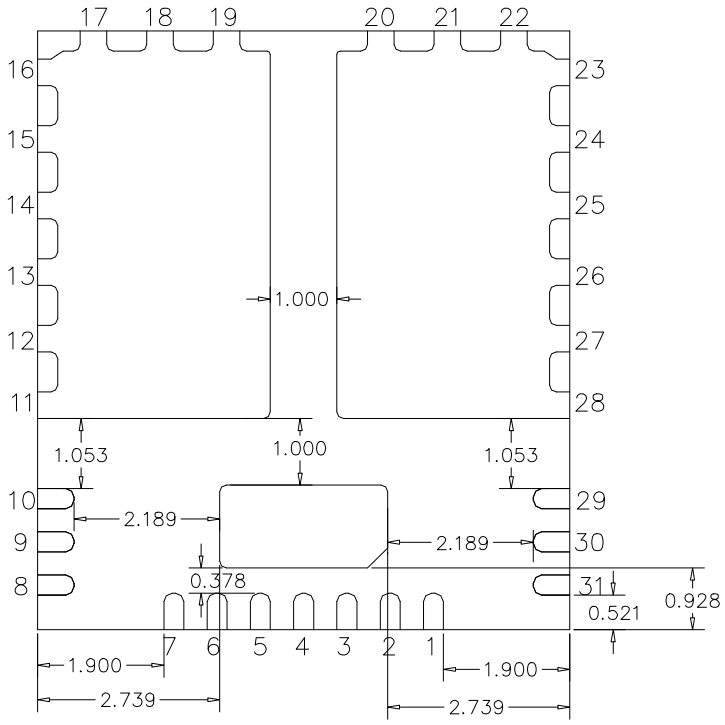



| SYMBOL | DIMENSIONS IN MILLIMETER | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | 0.800 | 0.900 | 1.000 |
| A1 | 0.000 | | 0.050 |
| A3 | 0.203 REF. | | |
| b | 0.250 | 0.300 | 0.350 |
| b1 | 0.350 | 0.400 | 0.450 |
| D | 7.900 | 8.000 | 8.100 |
| E | 8.900 | 9.000 | 9.100 |
| D2 | 2.472 | 2.522 | 2.572 |
| E2 | 1.197 | 1.247 | 1.297 |
| D3 | 3.147 | 3.197 | 3.247 |
| E3 | 5.472 | 5.522 | 5.572 |
| D4 | 3.147 | 3.197 | 3.247 |
| E4 | 5.472 | 5.522 | 5.572 |
| e | 0.650 BSC | | |
| e1 | 1.000 BSC | | |
| e2 | 1.403 BSC | | |
| e3 | 2.318 BSC | | |
| L | 0.500 | 0.550 | 0.600 |
| L1 | 0.253 | 0.303 | 0.353 |

Dimensions in mm

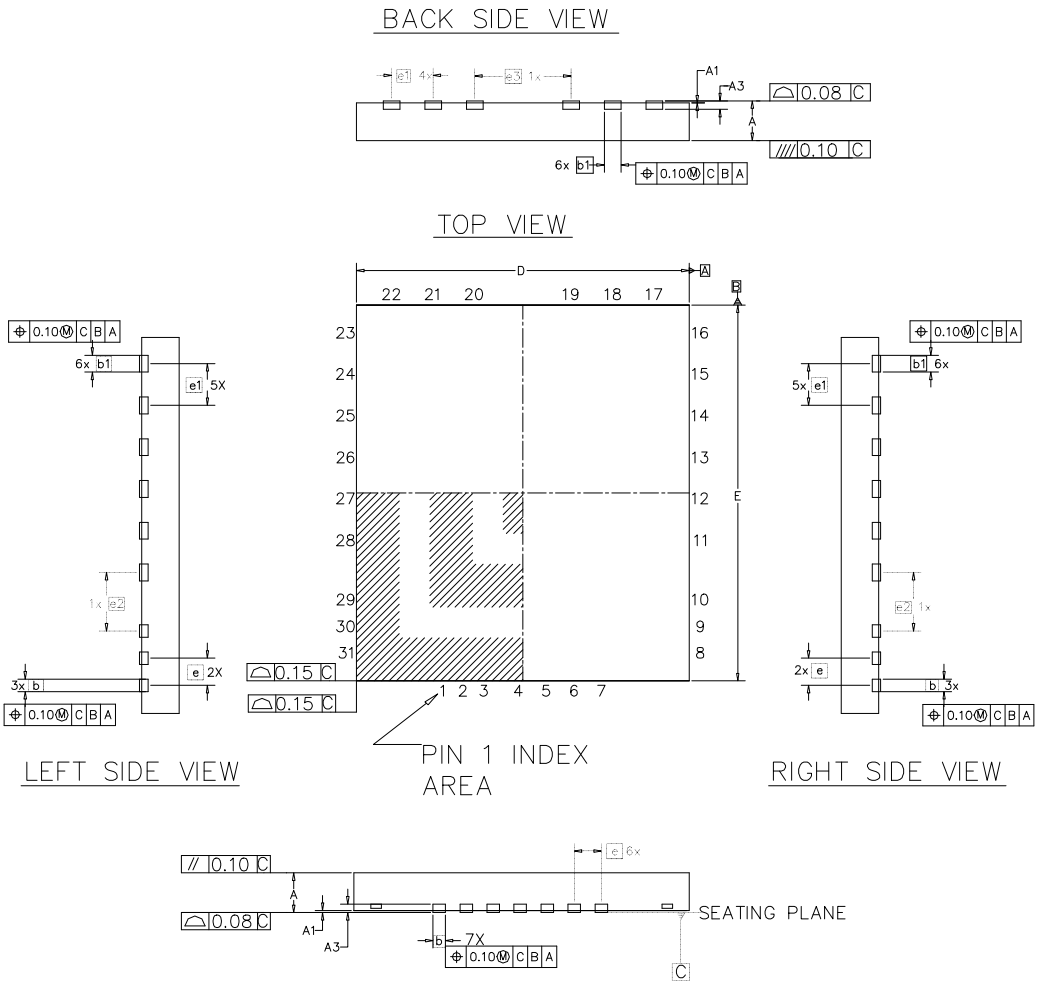
## Package Outline IRSM807-105MH (Bottom View), 2 of 2




Dimensions in mm

## Package Outline IRSM807-105MH (Top & Side View)

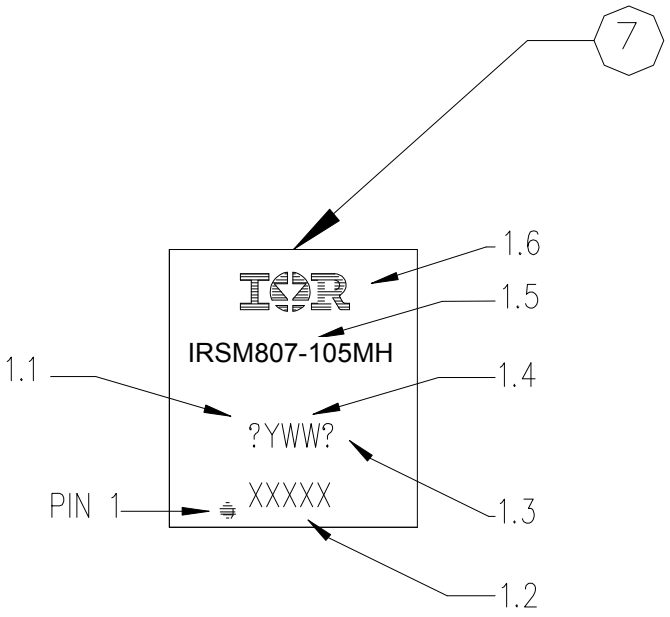



| SYMBOL | DIMENSIONS IN MILLIMETER | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | 0.800 | 0.900 | 1.000 |
| A1 | 0.000 | | 0.050 |
| A3 | 0.203 REF. | | |
| b | 0.250 | 0.300 | 0.350 |
| b1 | 0.350 | 0.400 | 0.450 |
| D | 7.900 | 8.000 | 8.100 |
| E | 8.900 | 9.000 | 9.100 |
| D2 | 2.472 | 2.522 | 2.572 |
| E2 | 1.197 | 1.247 | 1.297 |
| D3 | 3.147 | 3.197 | 3.247 |
| E3 | 5.472 | 5.522 | 5.572 |
| D4 | 3.147 | 3.197 | 3.247 |
| E4 | 5.472 | 5.522 | 5.572 |
| e | 0.650 BSC | | |
| e1 | 1.000 BSC | | |
| e2 | 1.403 BSC | | |
| e3 | 2.318 BSC | | |
| L | 0.500 | 0.550 | 0.600 |
| L1 | 0.253 | 0.303 | 0.353 |

Dimensions in mm

## Top Marking




TOP MARKING

NOTES, MARKING:
1.1) SITE CODE: X
1.2) LAST 4 CHARACTER OF SPN/NANA CODE: XXXX
1.3) LEADFREE INDICATOR: P
1.4) DATE CODE: YWW
1.5) PART NUMBER: IRSM607-105MH
1.6) IR LOGO
1.7) MEDIUM:
1.7.1) TOP:LASER
1.7.2) BOTTOM: NONE

## Typical Application Connection IRS807-105MH

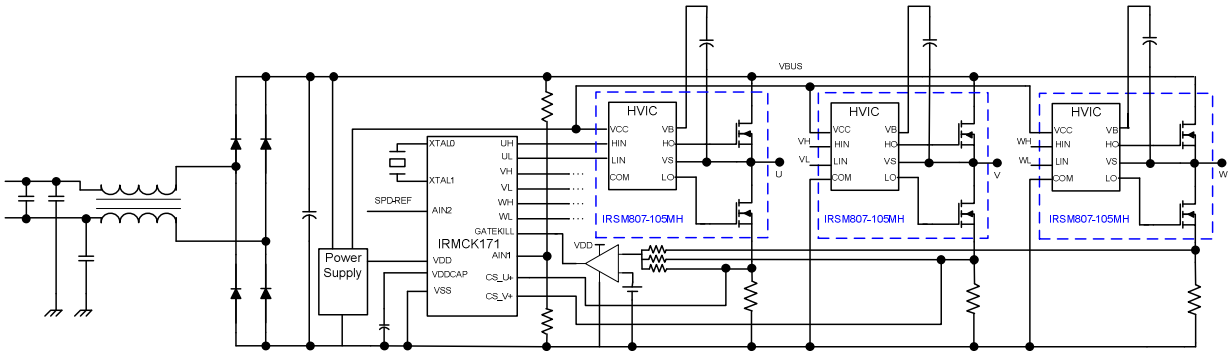



Figure 1: Typical Application Connection

1. 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 a good decoupling between VCC-VSS abd VB-VS terminals, the capaciotrs shown connected at these terminals should be located very close to the module pins. Additional high frequency capacitors, typically 0.1uF, are recommended.
3. Value of the boot-strap capacitors depends upon the switching frequency. Their selection should be made based on IR Design tip DT04-4 or application note AN-1044.

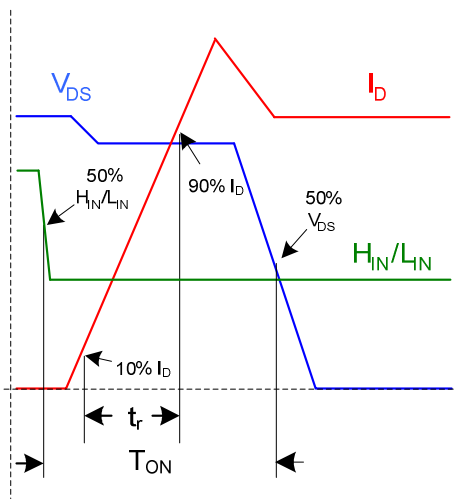



Figure 3a. Input to Output propagation turn-on delay time.

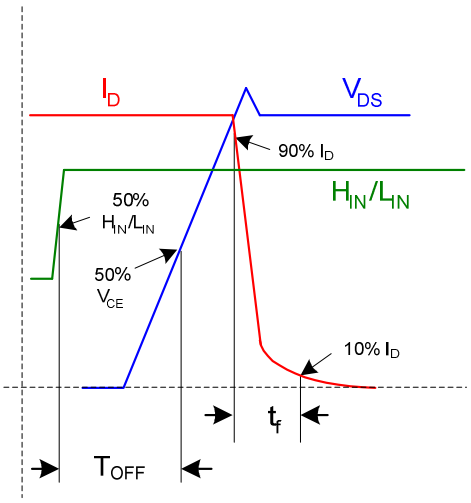



Figure 3b. Input to Output propagation turn-off delay time.

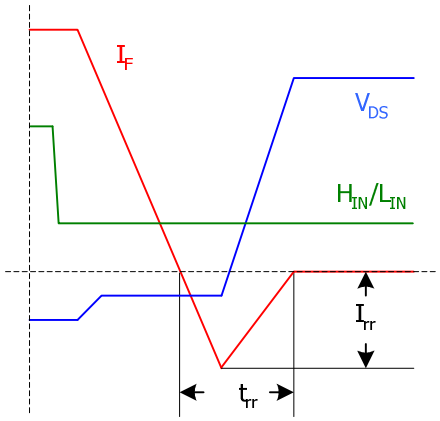



Figure 3c. Diode Reverse Recovery

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