International
IOR Rectifier

IRAM109-015SD

iMOTION™ Series

H-Bridge 1A, 500V

Integrated Power Hybrid IC for
Appliance Motor Drive Applications

Description

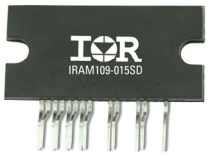
International Rectifier's IRAM109-015SD is a multi-chip Hybrid IC developed for low power appliance motor control applications such as Fans, Pumps, refrigerator compressors, etc. The compact Single in line (SIP-S) package minimizes PCB space.

Several built-in protection features such as temperature feedback, shoot through prevention, under voltage lockout, and shutdown input makes this a very robust solution. The internal shunt resistor saves board space and provides clean current feedback. The combination of highly efficient high voltage MOSFETs, the industry benchmark Half-Bridge HVIC driver (3.3V/5V input compatible) and thermally enhanced package makes this a highly competitive solution.

The bootstrapped power supplies for the high side drivers can be generated using internal bootstrap diodes eliminating the need for isolated power supplies. This feature reduces the component count, board space, and cost of the system.

Features

- Motor Power range 60~250W / 85~253 Vac.
- Integrated Gate Drivers and Bootstrap Diodes.
- Shut-Down input turns off both channels.
- Under-voltage lockout for all switches.
- Matched propagation delay.
- Schmitt-triggered input logic.
- Cross-conduction prevention logic.
- Low di/dt switching for better noise immunity.
- Internal Current Shunt.
- Internal thermistor for temperature feedback.



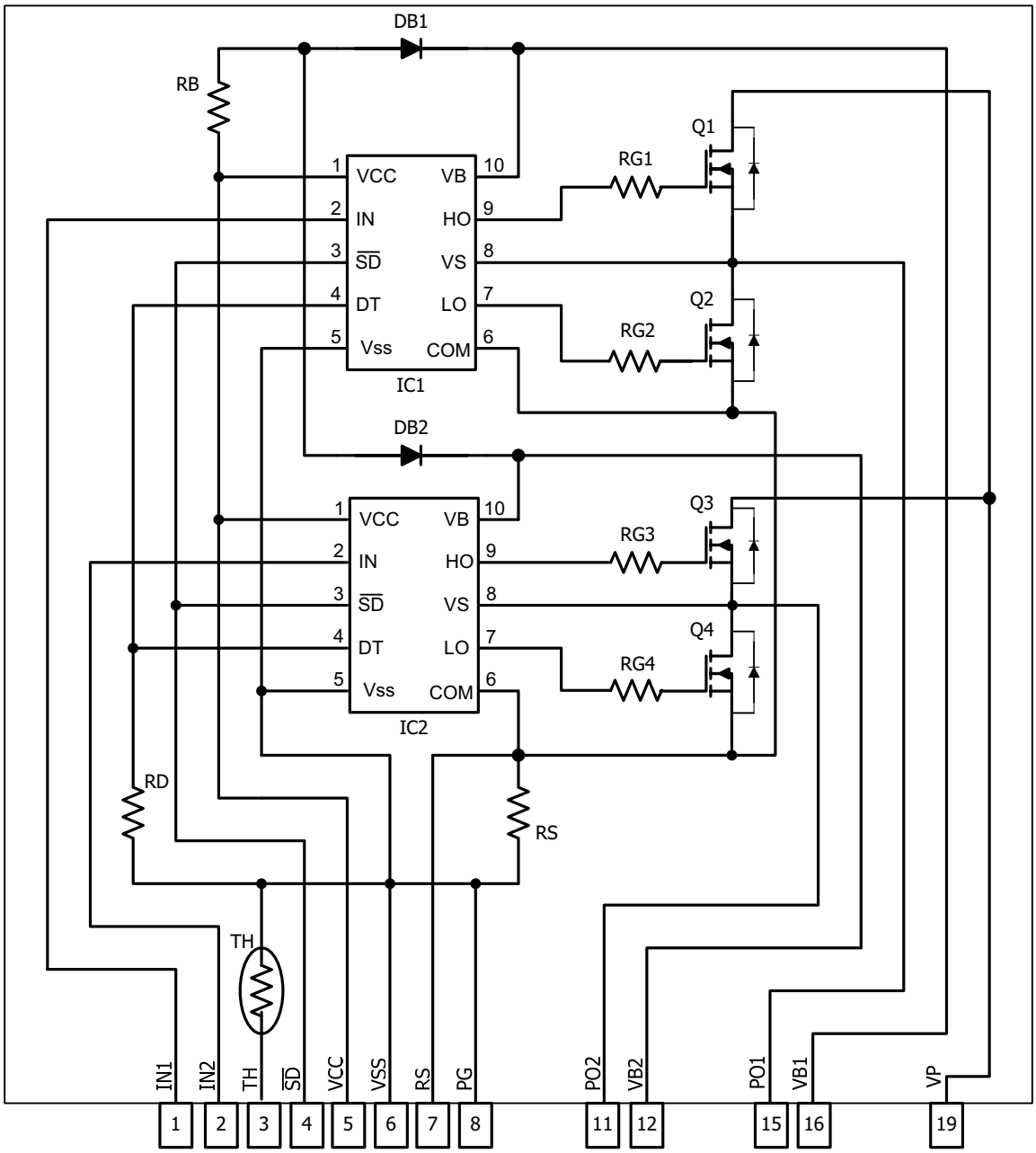
Absolute Maximum Ratings

Absolute maximum ratings indicate sustained limits beyond which damage to the device may occur. All voltage parameters are absolute voltages referenced to COM.

V_{DSS}	MOSFET Blocking Voltage	500	V
Vbus	Positive DC Bus Input Voltage	400	V
I_o @ T_C=25°C	RMS Phase Current	2.0	A
I_o @ T_C=100°C	RMS Phase Current (Note 1)	1.0	
I_{pk} @ T_C=25°C	Maximum Peak Phase Current (tp<100µs)	5.0	
P_d	Maximum Power dissipation per FET @ T_C =25°C	18	W
T_J (MOSFET & IC)	Maximum Operating Junction Temperature	+150	°C
T_C	Operating Case Temperature Range	-20 to +100	
T_{STG}	Storage Temperature Range	-40 to +125	
T	Mounting torque Range (M3 screw)	0.6	Nm

Note 1: Sinusoidal Modulation at V^+=360V, T_J=150°C, F_{PWM}=20kHz, F_{MOD}=50Hz, MI=0.8, PF=0.6, See Figure 5.

Internal Electrical Schematic – IRAM109-015SD



Absolute Maximum Ratings (Continued)

Symbol	Parameter	Min	Max	Units	Conditions
BV_R	Bootstrap Diode Reverse Breakdown Voltage	600	---	V	T_J = 25°C, I_R=1mA
$P_{BR\ Peak}$	Bootstrap Resistor Peak Power (Single Pulse)	---	25.0	W	t_P=100µs, T_C =100°C
$V_{S1,2,3}$	High side floating supply offset voltage	$V_{B1,2,3}$ - 20	$V_{B1,2,3}$ +0.3	V	
$V_{B1,2,3}$	High side floating supply voltage	-0.3	500	V	
V_{DD}	Low Side and logic fixed supply voltage	-0.3	20	V	
V_{IN}	Input voltage IN1, IN2	-0.3	Lower of (V_{SS}+15V) or V_{DD}+0.3V	V	

Electrical Characteristics (T_J= 25°C Unless Otherwise Specified)

Symbol	Parameter	Min	Typ	Max	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	500	---	---	V	V_{IN}=5V, I_D=250µA
$R_{DS(ON)}$	Drain-to-Source On Resistance	---	2.2	2.7	Ω	I_D=1A, V_{DD}=15V
		---	5.5	---		I_D=1A, V_{DD}=15V, T_J=150°C
I_{DSS}	Drain-to-Source Leakage Current	---	10	100	µA	V_{IN}=5V, V^+=500V
V_{FM}	Diode Forward Voltage Drop	---	0.87	1.1	V	I_F=1A
		---	0.70	---		I_F=1A, T_J=150°C
V_{BDFM}	Bootstrap Diode Forward Voltage Drop	---	---	1.25	V	I_F=1A
R_{BR}	Bootstrap Resistor Value	---	22	---	Ω	T_J=25°C
$\Delta R_{BR}/R_{BR}$	Bootstrap Resistor Tolerance	---	---	±5	%	T_J=25°C

Recommended Operating Conditions

The Input/Output logic timing diagram is shown in Figure 1. For proper operation the device 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.

Symbol	Definition	Min	Typ	Max	Units
V^+	Positive Bus Input Voltage	---	---	360	V
$V_{B1,2,3}$	High side floating supply voltage	V_S+10	V_S+15	V_S+20	
V_{DD}	Low side and logic fixed supply voltage	10	15	20	V
V_{IN}	Logic input voltage (IN & SD) - Note 2	V_{SS}	---	V_{DD}	V
F_p	PWM Carrier Frequency	---	20	---	KHz

Note 2: Logic operational for V_s from COM-5V to COM+500V. Logic state held for V_s from COM-5V to COM-V_{BS}. (please refer to DT97-3 for more details).

Static Electrical Characteristics (T_J= 25°C Unless Otherwise Specified)

V_{BIAS} (V_{DD}, $V_{BS1,2,3}$)=15V, unless otherwise specified. The V_{IN} and I_{IN} parameters are referenced to COM and are applicable to all channels (Static Electrical Characteristics are Based on Driver IC Data Sheet).

Symbol	Definition	Min	Typ	Max	Units
V_{DDUV+}, V_{BSUV+}	V_{DD} and V_{BS} supply undervoltage, Positive going threshold	8	8.9	9.8	V
V_{DDUV-}, V_{BSUV-}	V_{DD} and V_{BS} supply undervoltage, Negative going threshold	7.4	8.2	9	V
I_{QBS}	Quiescent V_{BS} supply current	20	75	130	µA
I_{QDD}	Quiescent V_{DD} supply current	0.4	1	1.6	mA
I_{LK}	Offset Supply Leakage Current	---	---	50	µA

Dynamic Electrical Characteristics (T_J= 25°C Unless Otherwise Specified)

Symbol	Parameter	Min	Typ	Max	Units	Conditions
T_{ON}	Input to Output propagation turn-on delay time (see fig. 13a)	---	2.4	---	µs	I_D=1.5A, V^+=360V
T_{OFF}	Input to Output propagation turn-off delay time (see fig. 13b)	---	570	---	ns	

Internal Current Sensing Resistor - Shunt Characteristics

Symbol	Parameter	Min	Typ	Max	Units	Conditions
R_{Shunt}	Resistance	218	220	222	mΩ	T_C = 25°C
T_{Coeff}	Temperature Coefficient	0	---	200	ppm/°C	
T_{Range}	Temperature Range	0	---	125	°C	

Thermal and Mechanical Characteristics

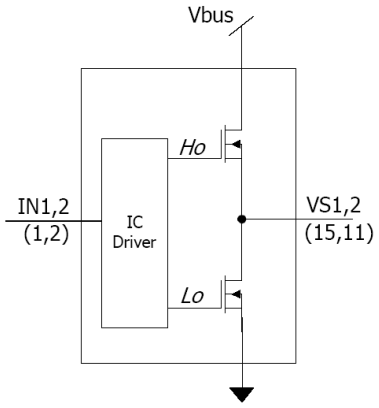
Symbol	Parameter	Min	Typ	Max	Units	Conditions
$R_{th(J-C)}$	Thermal resistance, per FET	---	5.1	6.9	°C/W	Flat, Insulation Material

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		---	1.0	---	mW/°C	T_C = 25°C

Input-Output Logic Level Table

$\overline{SD}$	IN1,2	$V_{S1,2}$
1	1	V^+
1	0	0
0	x	Off



Timing Parameter Definitions

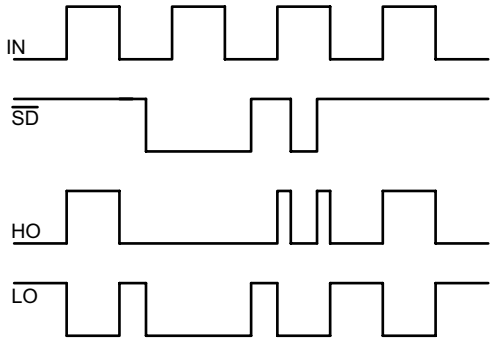


Figure 1. Input/Output Timing Diagram

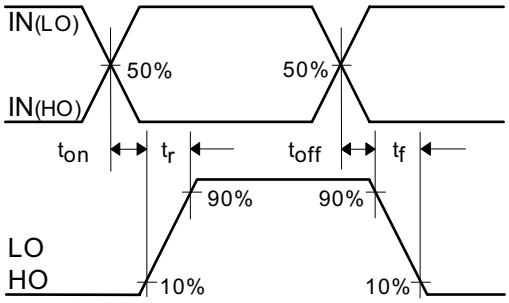


Figure 2. Switching Time Waveform Diagram

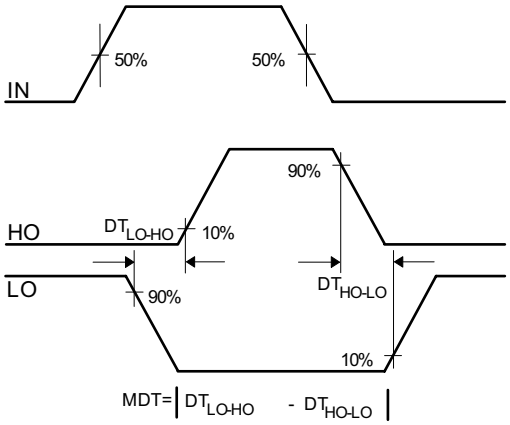


Figure 3. Deadtime Waveform Diagram

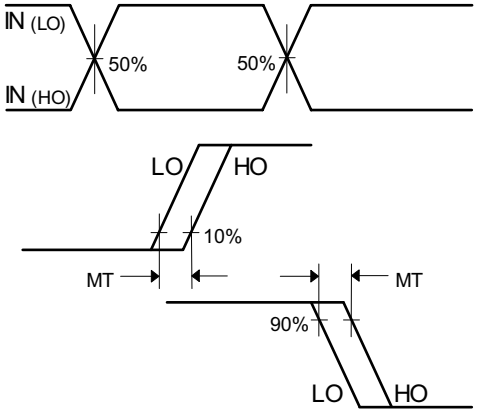
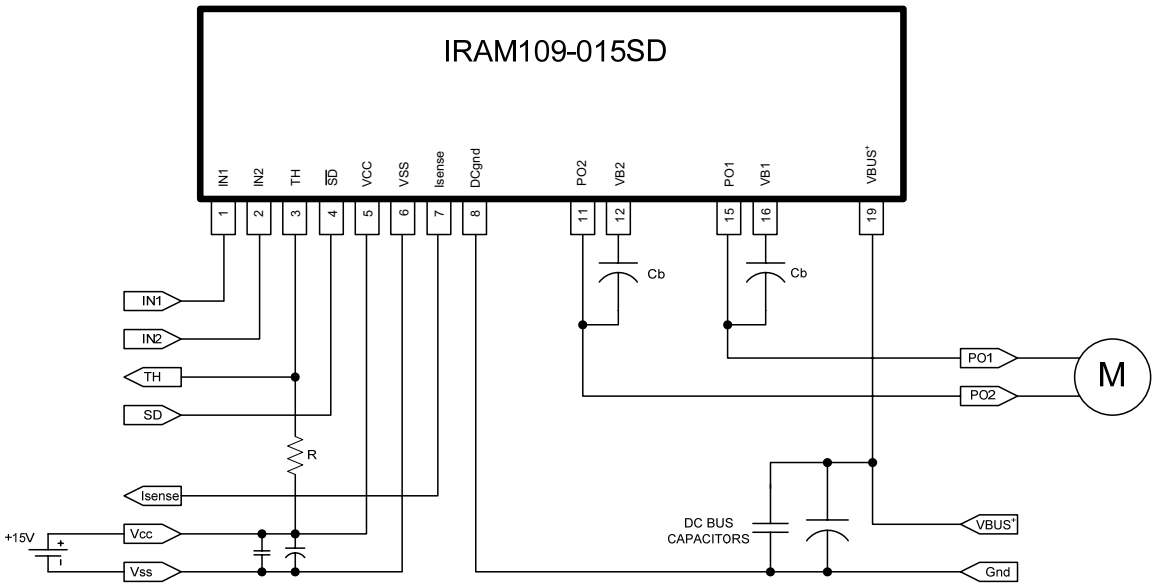


Figure 4. Delay Matching Waveform Diagram

Typical Application Connection – IRAM109-015SD



Application Circuit Recommendation

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.

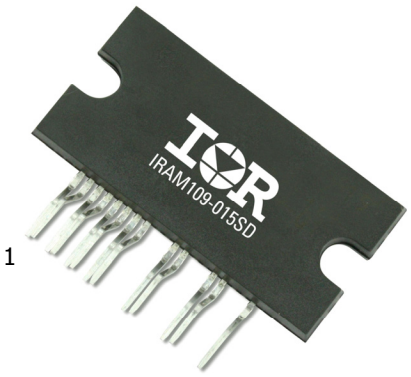
2. In order to provide good decoupling between VCC-VSS and PO1,2-VB1,2 terminals, and the capacitors shown connected between these terminals should be located very close to the module pins. Additional high frequency capacitors, typically 0.1µF, are strongly recommended.

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 12. Bootstrap capacitor value must be selected to limit the power dissipation of the internal resistor in series with V_{CC} (See maximum ratings Table on page 3).

4. The case of the module is connected to the negative DC Bus and is NOT Isolated. It is recommended to provide isolation material between case and heat sink to avoid electrical shock.

Module Pin-Out Description

Pin	Name	Description
1	IN1	Logic Input Gate Driver - Phase 1
2	IN2	Logic Input Gate Driver - Phase 2
3	V_{TH}	Temperature Feedback
4	$\overline{SD}$	Shun-down Function
5	V_{DD}	+15V Main Supply
6	V_{SS}	Negative Main Supply
7	I_{SENSE}	Current Feedback
8	V^-	Negative Bus Input Voltage
9	NA	none
10	NA	none
11	V_{S2}	Output 2 - High Side Floating Supply Offset Voltage
12	V_{B2}	High Side Floating Supply voltage 2
13	NA	none
14	NA	none
15	V_{S1}	Output 1 - High Side Floating Supply Offset Voltage
16	V_{B1}	High Side Floating Supply voltage 1
17	NA	none
18	NA	none
19	V^+	Positive Bus Input Voltage



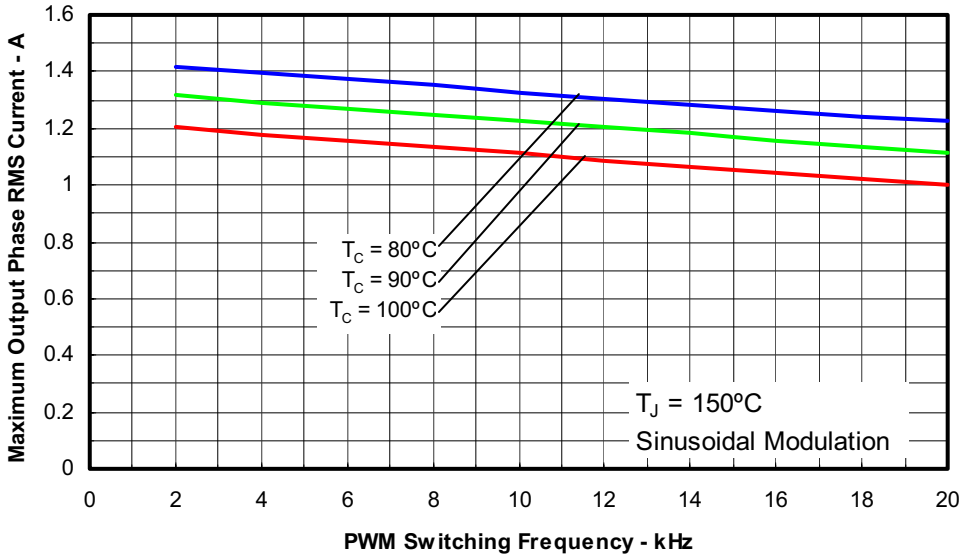


Figure 5. Maximum Sinusoidal Phase Current vs. PWM Switching Frequency
Sinusoidal Modulation, V^+=360V, T_J=150°C, F_{MOD}=50Hz, MI=0.8, PF=0.6

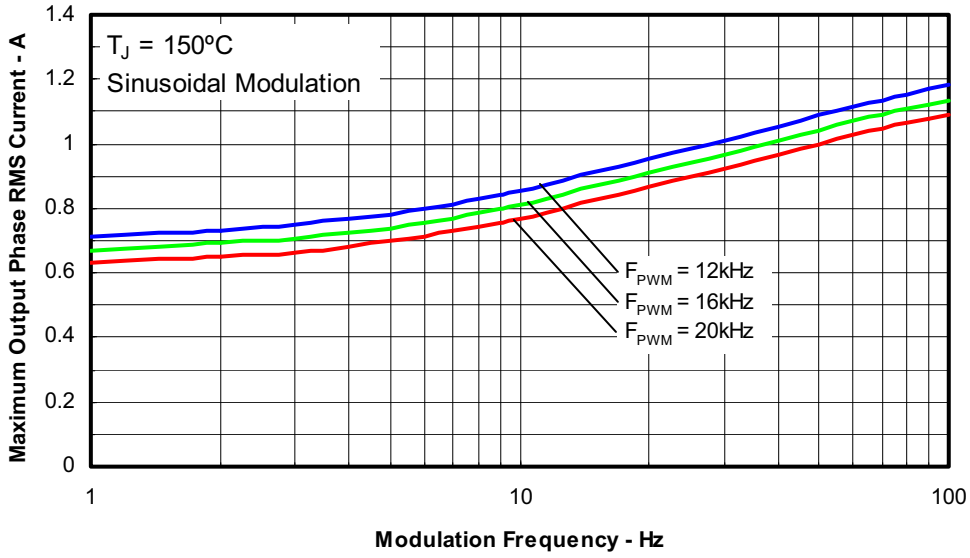


Figure 6. Maximum Sinusoidal Phase Current vs. Modulation Frequency
Sinusoidal Modulation, V^+=360V, T_J=150°C, MI=0.8, PF=0.6

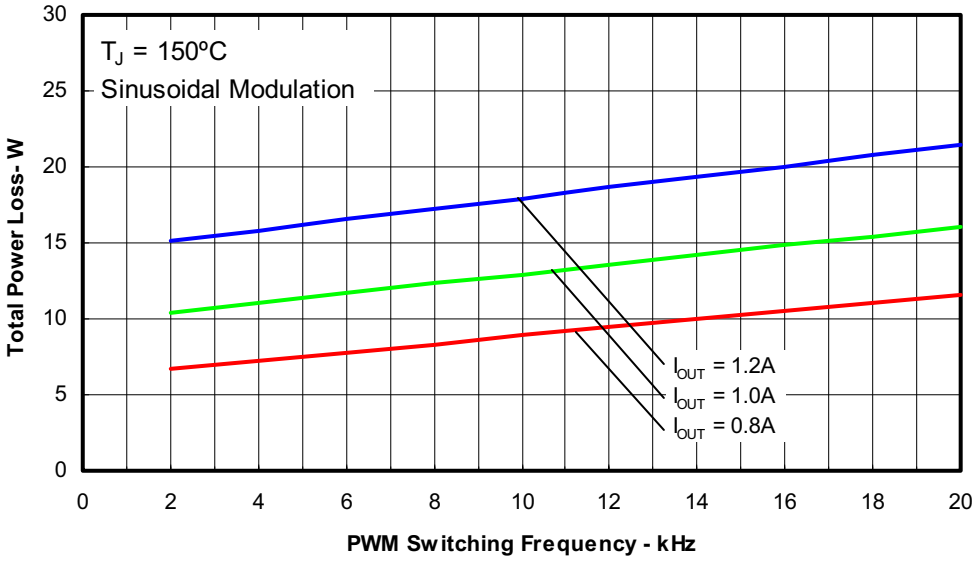


Figure 7. Total Power Losses vs. PWM Switching Frequency
Sinusoidal Modulation, V^+=360V, T_J=150°C, MI=0.8, PF=0.6

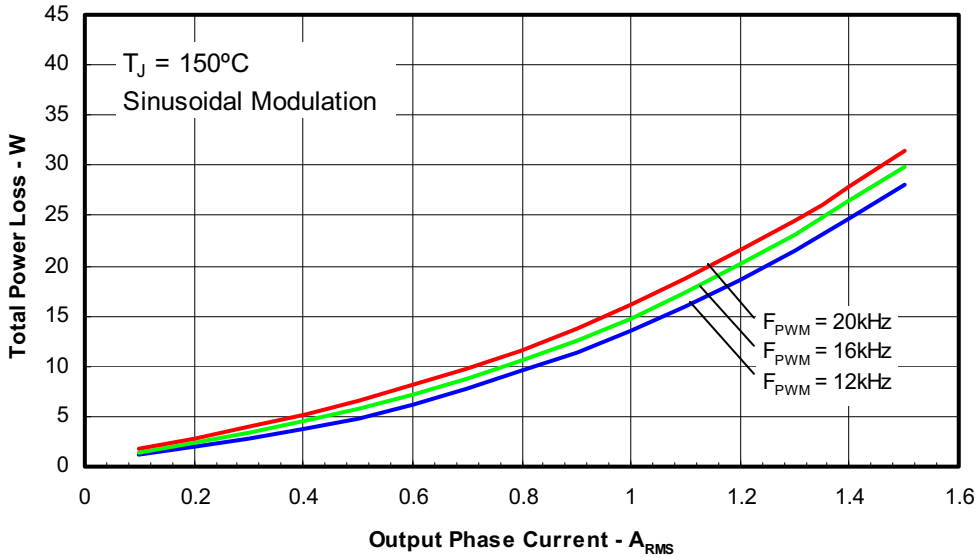


Figure 8. Total Power Losses vs. Output Phase Current
Sinusoidal Modulation, V^+=360V, T_J=150°C, MI=0.8, PF=0.6

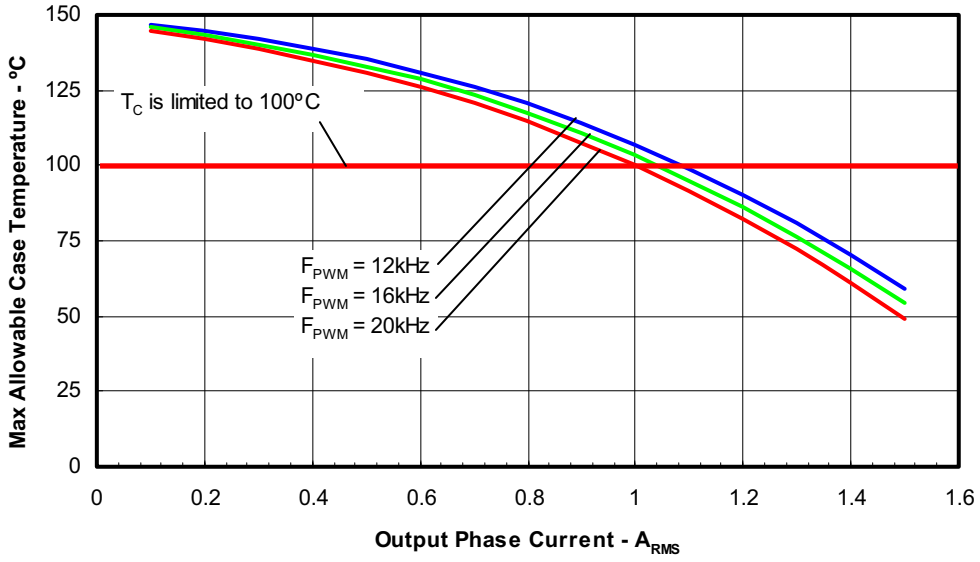


Figure 9. Maximum Allowable Case Temperature vs. Output RMS Current per Phase Sinusoidal Modulation, V^+=360V, T_J=150°C, Modulation Depth=0.8, PF=0.6

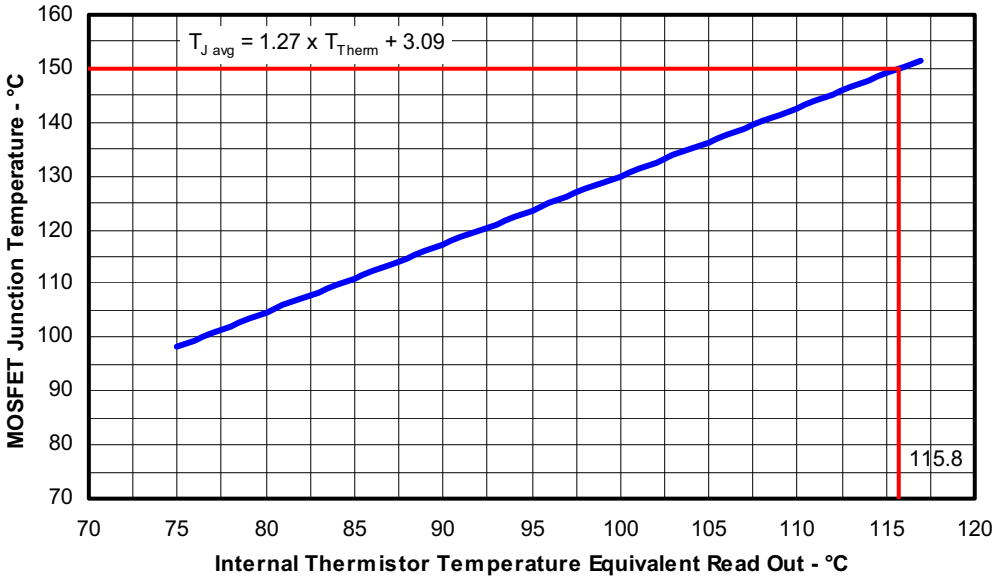
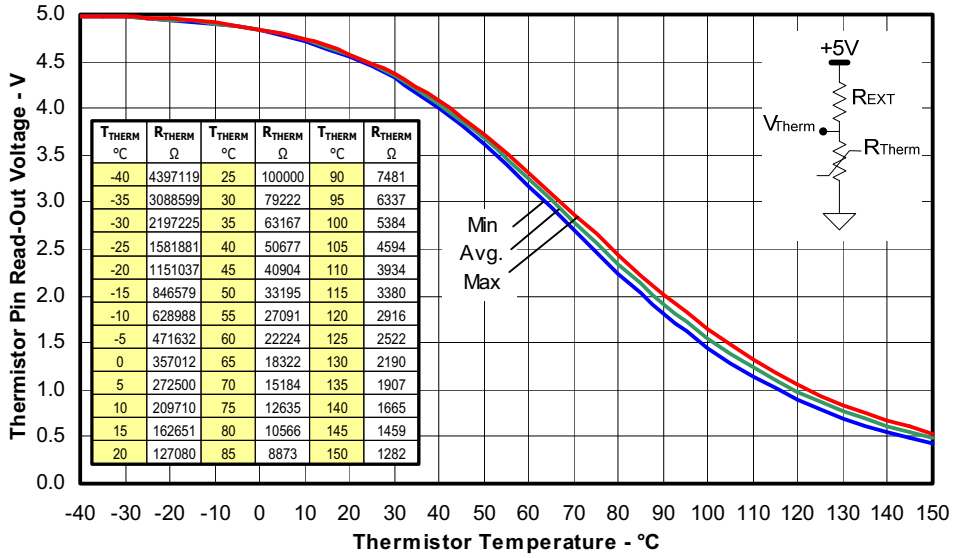


Figure 10. Estimated Maximum MOSFET Junction Temperature vs. Thermistor Temperature



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 11. Thermistor Readout vs. Temperature (12Kohm pull-up resistor, 5V) and Normal Thermistor Resistance values vs. Temperature Table.

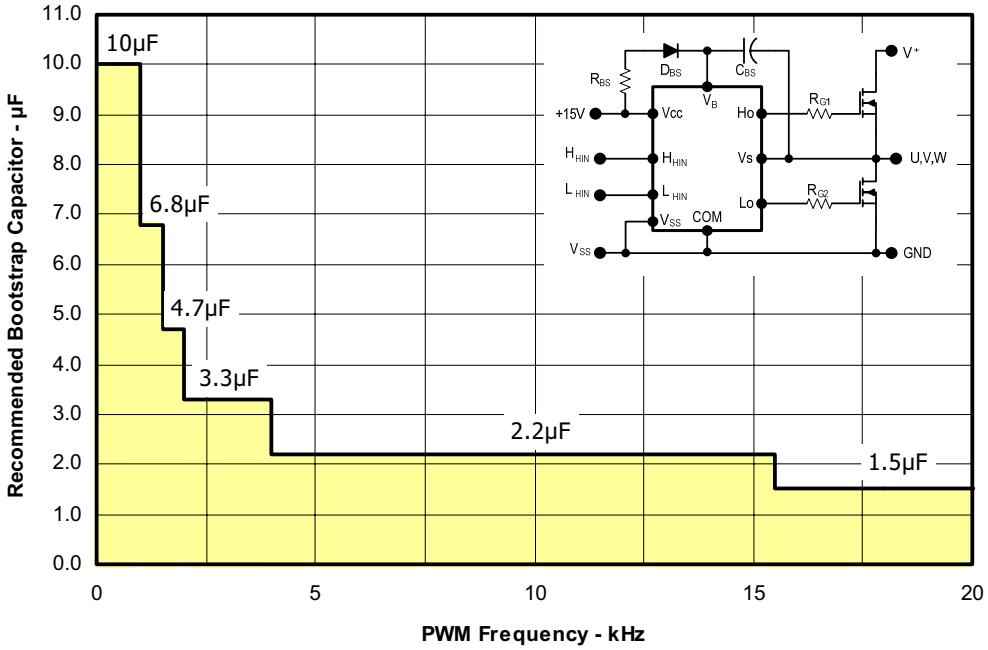


Figure 12. Recommended Bootstrap Capacitor Value vs. Switching Frequency

Figure 13. Switching Parameter Definitions

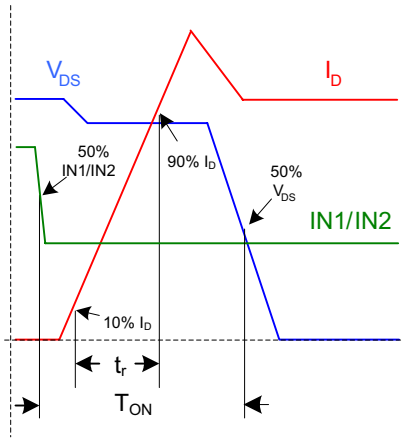


Figure 13a. Input to Output propagation turn-on delay time.

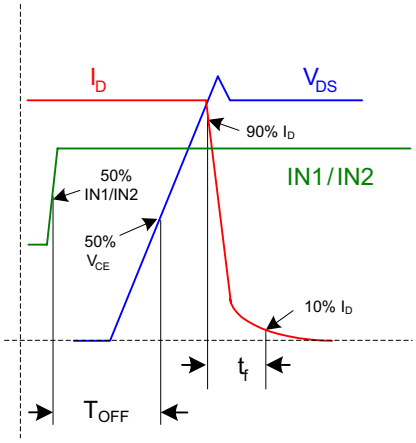


Figure 13b. Input to Output propagation turn-off delay time.

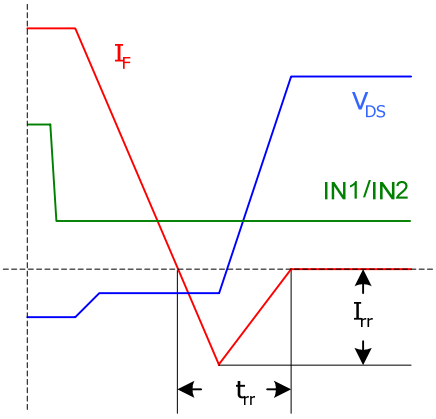


Figure 13c. Diode Reverse Recovery.

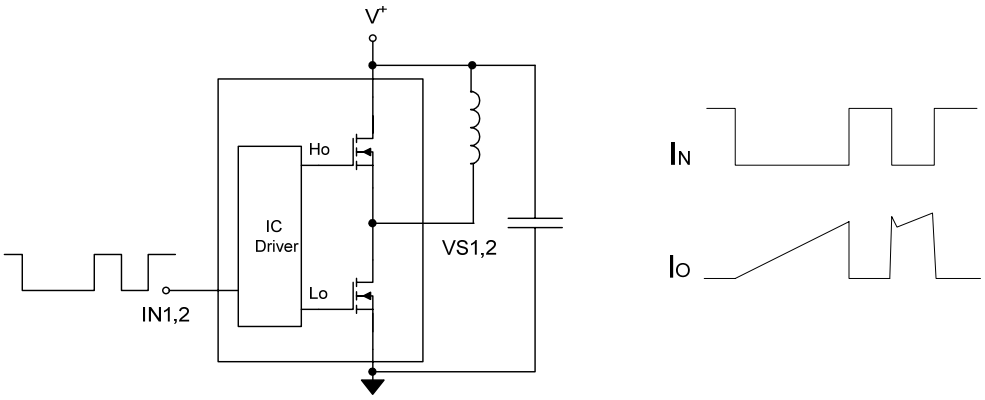
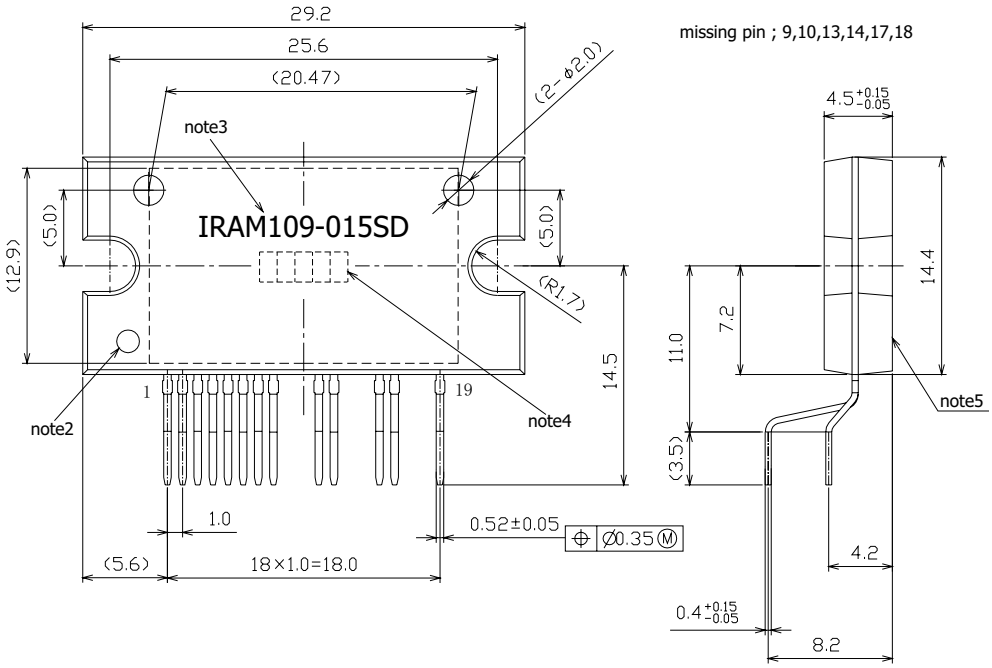


Figure CT1. Switching Loss Circuit

Package Outline IRAM109-015SD



note1: Unit Tolerance is ±0.4mm,
Unless Otherwise Specified.
note2: Mirror Surface Mark indicates Pin1 Identification.
note3: 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: Non-Isolated Back Side.

For mounting instruction see AN-1049

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