International
IOR Rectifier

Half-Bridge FredFET
and Integrated Driver

IR3103

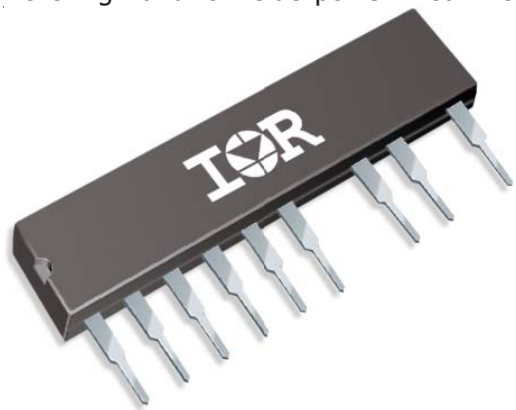
iMOTION™ Series

0.75A, 500V

Description

The IR3103 is a gate driver IC integrated with a half bridge FredFET designed for motor drive applications up to 180W (heatsink-less). The sleek and compact single-in-line package is optimized for electronic motor control in appliance applications such as fans and compressors for refrigerators. The IR3103 offers an extremely compact, high performance half-bridge inverter in a single isolated package for two-phase and three-phase motor drivers.

Proprietary HVIC and latch immune CMOS technologies, along with the HEXFET® power FredFET technology (HEXFET® MOSFET with ultra-fast recovery body diode characteristics), enable efficient and rugged single package construction. Propagation delays for the high and low side power FredFETs are matched thanks to advanced IC technology.



Features

- Output Power FredFET in Half-Bridge Configuration
- High Side Gate Drive Designed for Bootstrap Operation
- Bootstrap Diode Integrated into Package
- Lower Power Level-Shifting Circuit
- Lower di/dt Gate Drive for Better Noise Immunity
- Excellent Latch Immunity on All Inputs and Outputs
- ESD Protection on All Leads
- Isolation 1500 V_{RMS} min.

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. Power dissipation is measured under board mounted and still air conditions.

Parameter	Description	Max. Value	Units
V_{DS}	Drain to Source Blocking Voltage	500	V
V_{DD}	DC Bus Supply Voltage (No Switching Operation)	500	V
I_O (T_A=25°C)	Continuous Output Current (1)	0.7	A
I_O (T_A=55°C)	Continuous Output Current (1)	0.6	A
I_O (T_A=25°C)	Pulsed Output Current (2)	2.7	A
P_d	Package Power Dissipation @$T_A \leq$ 55°C (3)	1.4	W
V_{ISO}	Isolation Voltage (1min)	1500	V_{RMS}
T_J	Junction Temperature (Power MOSFET)	-40 to +150	°C
T_S	Storage Temperature	-40 to +150	°C
T_L	Lead Temperature (soldering, 10 seconds)	300	°C
T_S	Storage Temperature	-40 to +150	°C

Note 1: See figure 3, f_{PWM}=16kHz

Note 2: T_P=100ms, other conditions as per Figure 3, f_{PWM}=16kHz

Note 3: Single Device Operating

Absolute Maximum Ratings (Continued)

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

Symbol	Parameter	Min	Max	Units	Conditions
I_{BDF}	Bootstrap Continuous Diode Forward Current	---	0.3	A	T_J = 150°C, T_A=55°C
V_B	High Side Floating Supply Absolute Voltage	-0.3	525	V	
V_O	High Side Floating Supply Offset Voltage	V_B - 25	V_B +0.3	V	
V_{CC}	Low Side and Logic Fixed Supply Voltage	-0.3	25	V	
V_{IN}	Input Voltage L_{IN}, H_{IN}	V_{SS}-0.3	V_{CC}+0.3V	V	
V_{SS}	Logic Ground	V_{CC}-25	V_{CC}+0.3V	V	

Recommended Operating Conditions Driver Function

For proper operation the device should be used within the recommended conditions. All voltages are absolute referenced to COM. The V_S and V_O offset are tested with all supplies biased at 15V differential.

Symbol	Definition	Min	Max	Units
V_B	High Side Floating Supply Absolute Voltage	V_O+10	V_O+20	V
V_{DD}	High Voltage Supply	Note 4	400	V
V_{CC}	Low Side and Logic Fixed Supply Voltage	10	20	V
V_{IN}	Logic Input Voltage	V_{SS}	V_{CC}	V
V_{SS}	Logic Ground	-5	5	V

Note 4: Logic operation for V_O of -5 to +500V. Logic state held for V_O of -5V to -V_{BO}. (Please refer to the Design Tip DT97-3 for more details).

Half Bridge Electrical Characteristics @T_J= 25°C

V_{CC}=V_{BO}=15V and T_J=25°C unless otherwise specified. V_{DD} and V_{IN} parameters referenced to COM

Symbol	Parameter	Min	Typ	Max	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	500	---	---	V	V_{IN}=0V, I_{DD}/I_O=250µA
I_{HS-LK}	Low Side Leakage Current	---	5	50	µA	V_{DS}=500V, V_{IN}=0V
		---	80			V_{DS}=500V, V_{IN}=0V, T_J=150°C
I_{LS-LK}	Low Side Leakage Current	---	5	105	µA	V_{DS}=500V, V_{IN}=0V
		---	100			V_{DS}=500V, V_{IN}=0V, T_J=150°C
$R_{DS(ON)}$	Drain-to-Source ON Resistance	---	1.9	2.5	Ω	I_O = 0.75A, V_{IN}=5V
V_{SD}	Diode Forward Voltage	---	0.8	0.9	V	I_O = 0.75A, V_{IN}=0V
$R_{DS(ON)}$	Drain-to-Source ON Resistance	---	4.6	6.5	Ω	I_O = 0.75A, V_{IN}=5V, T_J=150°C
V_{SD}	Diode Forward Voltage	---	0.6	0.75	V	I_O = 0.75A, V_{IN}=0V, T_J=150°C
V_{BDFM}	Bootstrap Diode Forward Voltage Drop	---	---	1.25	V	I_F=1A
		---	---	1.10		I_F=1A, T_J=125°C
E_{ON}	Turn-On Energy Losses	---	55	75	µJ	I_{DD}/I_O = 0.75A, V_{DD}=300V, V_{BO}/V_{CC}=15V, L= 6.3mH
E_{OFF}	Turn-Off Energy Losses	---	4	10	µJ	
E_{TOT}	Total Energy Losses	---	59	85	µJ	
E_{REC}	Body-Diode Reverse Recovery Losses	---	2	5	µJ	Energy Losses include Body-Diode Reverse Recovery
t_{RR}	Reverse Recovery Time	---	70	---	ns	
E_{ON}	Turn-On Energy Losses	---	85	115	µJ	I_{DD}/I_O = 0.75A, V_{DD}=300V, V_{BO}/V_{CC}=15V, L=6.3mH T_J=150°C
E_{OFF}	Turn-Off Energy Losses	---	5	11	µJ	
E_{TOT}	Total Energy Losses	---	90	126	µJ	
E_{REC}	Body-Diode Reverse Recovery Losses	---	6	11	µJ	Energy Losses include Body-Diode Reverse Recovery
t_{RR}	Reverse Recovery Time	---	90	---	ns	
Q_G	Turn-ON MOSFET Gate Charge	---	15	21	nC	V_{DD}=250V, I_O=3.2A. Note 5
C_{OSS}	Output Capacitance	---	12	---	pF	V_{DD}=400V, f=1MHz. Note 5
C_{OSS} eff.	Effective Output Capacitance	---	30	---	pF	V_{DD}=0V to 400V. Note 5,6
SCSOA	Short Circuit Safe Operating Area	10	---	---	µs	T_J=150°C, V_P=450V, V^+= 320V,V_{CC}=+15V
I_{SC}	Short Circuit Drain Current	---	18.5	---	A	T_J=150°C, V_P=450V, t_{SC}<10µs V^+= 320V, V_{GE}=15V, V_{CC}=+15V

Note 5: Characterized on FREDFET die level, not measured at EOL
Note 6: C_{OSS} eff. is a fixed capacitance that gives same charging time as C_{OSS} while V_{DS} is rising from 0 to 80% V_{DSS}.

Thermal Resistance

Thermal Resistance is measured under board mounted and still air conditions.

Symbol	Parameter	Min	Typ	Max	Units	Conditions
$Rth_{JA\ self}$	Self Thermal resistance, junction to ambient (note 7,8)	---	---	70	°C/W	No airflow
$Rth_{JA\ mutual}$	Mutual Thermal resistance, junction to ambient (note 7,8)	---	---	45	°C/W	

Note 7: under normal operational conditions: both power devices working, no heatsink
Note 8: TJ=RthJA_self*PA+RthJA_mutual*PB

Static Electrical Characteristics Driver Function

V_{BIAS} (V_{CC}, V_O)=15V, V_{SS}=COM and T_A=25°C, unless otherwise specified. V_{DD}, V_{IN} and I_{IN} parameters are referenced to COM.

Symbol	Definition	Min	Typ	Max	Units	Conditions
$V_{IN,th}$	Logic "1" Input Voltage	2.9	---	---	V	
$V_{IN,th}$	Logic "0" Input Voltage	---	---	0.8	V	
V_{CCUV+} V_{BO}	V_{CC} and V_{BO} Supply Undervoltage Positive Going Threshold	8.0	8.9	9.8	V	
V_{CCUV-} V_{BO}	V_{CC} and V_{BO} Supply Undervoltage Negative Going Threshold	7.4	8.2	9.0	V	
V_{CCUVH} V_{BO}	V_{CC} and V_{BO} Supply Undervoltage Lock-Out Hysteresis	0.3	0.7	---	V	
I_{LK}	Offset Supply Leakage Current	---	---	50	µA	V_B=V_O=600V
I_{QBS}	Quiescent V_{BO} Supply Current	---	75	130	µA	V_{IN}=0V to 5V
I_{QCC}	Quiescent V_{CC} Supply current	---	120	180	µA	V_{IN}=0V to 5V
I_{IN+}	Input Bias Current	---	5	20	µA	V_{IN}=5V
I_{IN-}	Input Bias Current	---	---	2	µA	V_{IN}=0V

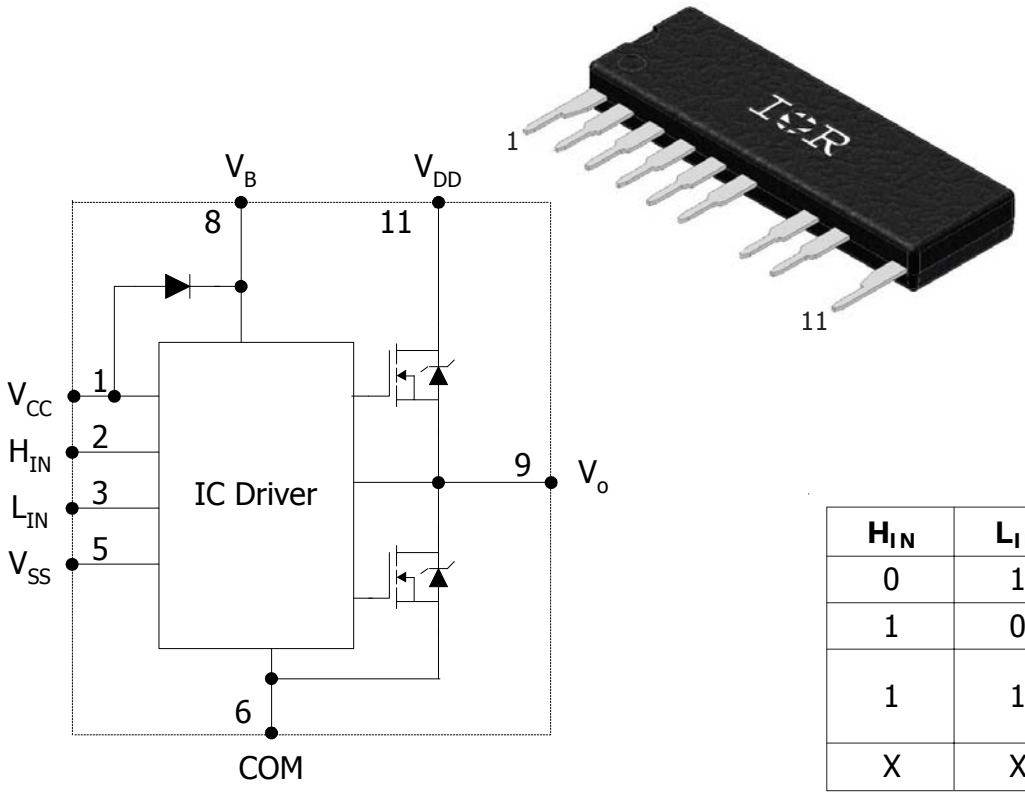
Dynamic Electrical Characteristics Driver Function

Driver only timing unless otherwise specified.

Symbol	Definition	Min	Typ	Max	Units	Conditions
T_{ON}	Input to Output Propagation Turn-on Delay Time (see fig. 2)	---	300	---	ns	V_{CC}=V_{BO}= 15V, I_O=0.75A, V_{DD}=300V
T_{OFF}	Input to Output Propagation Turn-off Delay Time (see fig. 2)	---	400	---	ns	
M_T	Matching Propagation Delay Time (On & Off)	---	0	30	ns	V_{CC}= V_{BO}= 15V

Pin-Out Description

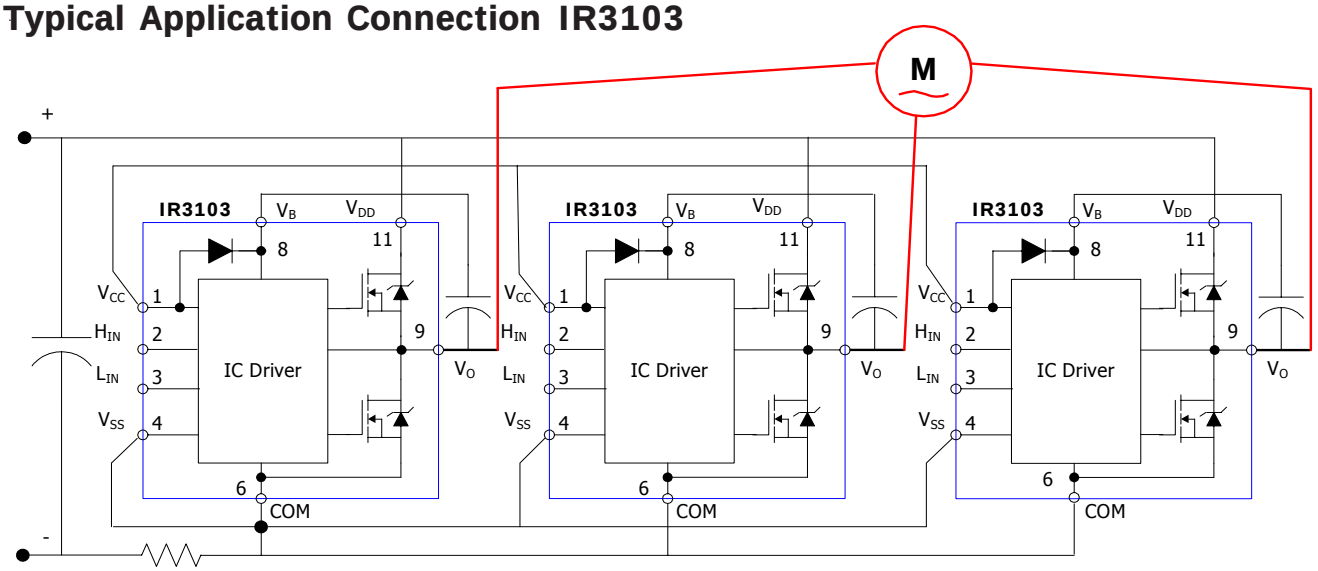
Pin	Name	Description
1	V_{CC}	Logic and Internal Gate Drive Supply
2	H_{IN}	Logic Input for High Side Gate Output
3	L_{IN}	Logic Input For Low Side Gate Output
4	NC	Not Connected
5	V_{SS}	Logic Ground
6	COM	Low Side MOSFET Gate Return
7	NC	Not Connected
8	V_B	High Side Gate Drive Floating Supply
9	V_O	Half Bridge Output
10	NC	Not Connected
11	V_{DD}	High Voltage Supply



H_{IN}	L_{IN}	V_O
0	1	0
1	0	V_{DD}
1	1	Shoot-Through condition
X	X	X

Figure 1: Driver Input/Output relation

Typical Application Connection IR3103



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

2. In order to provide good decoupling between V_{cc}-V_{SS} and V_B-V_O terminals, a capacitor connected between these terminals is recommended and should be located very close to the module pins. Additional high frequency capacitors, typically 0.1mF, are strongly recommended.

3. Low inductance shunt resistor should be used for phase leg current sensing. Similarly, the length of the traces from the pin to the corresponding shunt resistor should be kept as small as possible.

4. Value of the bootstrap capacitors depends upon the switching frequency. Their selection should be made based on IR design tip DN 98-2a or Figure 8.

5. Application conditions should guarantee minimum dead-time of 400ns

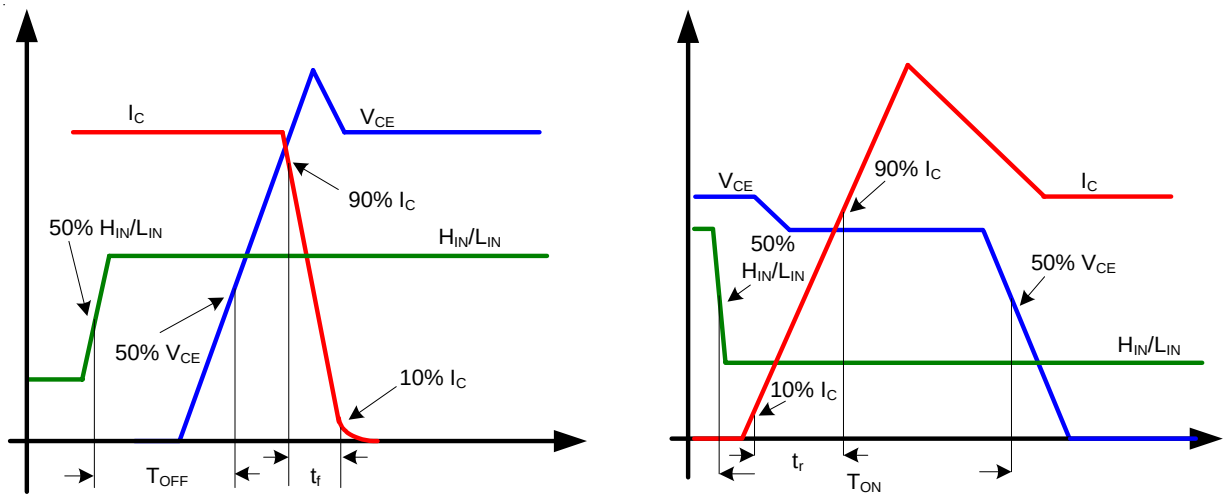


Figure 2. T_{ON} and T_{OFF} Definitions.

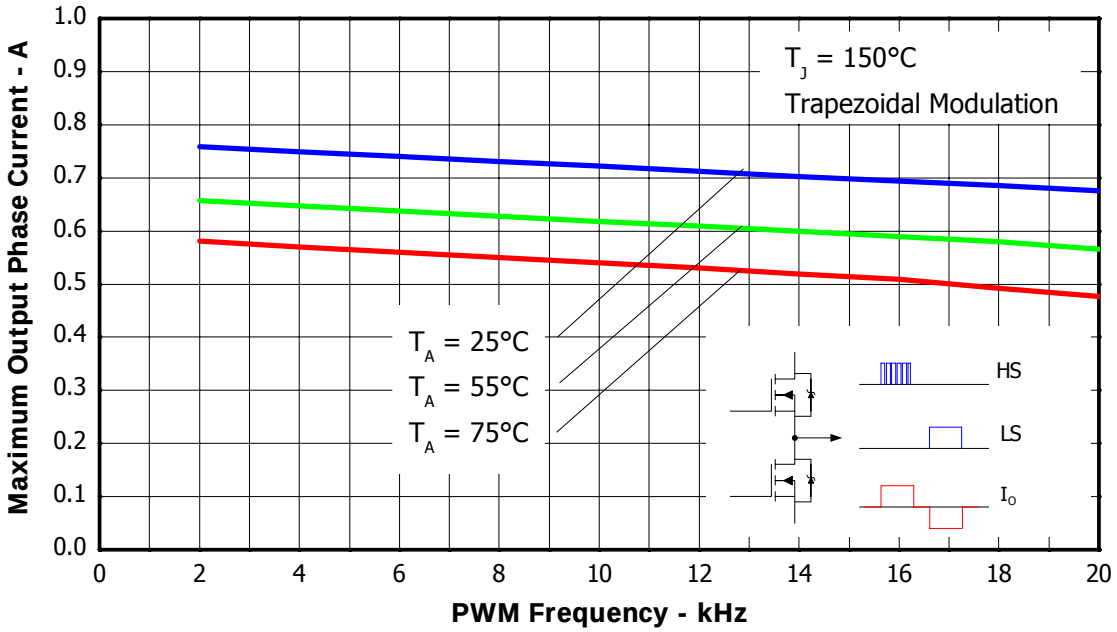


Figure 3. Maximum RMS Phase Current vs. PWM Switching Frequency
V_{DD}=300V , T_J=150°C, Modulation Depth=0.5, PF=0.99

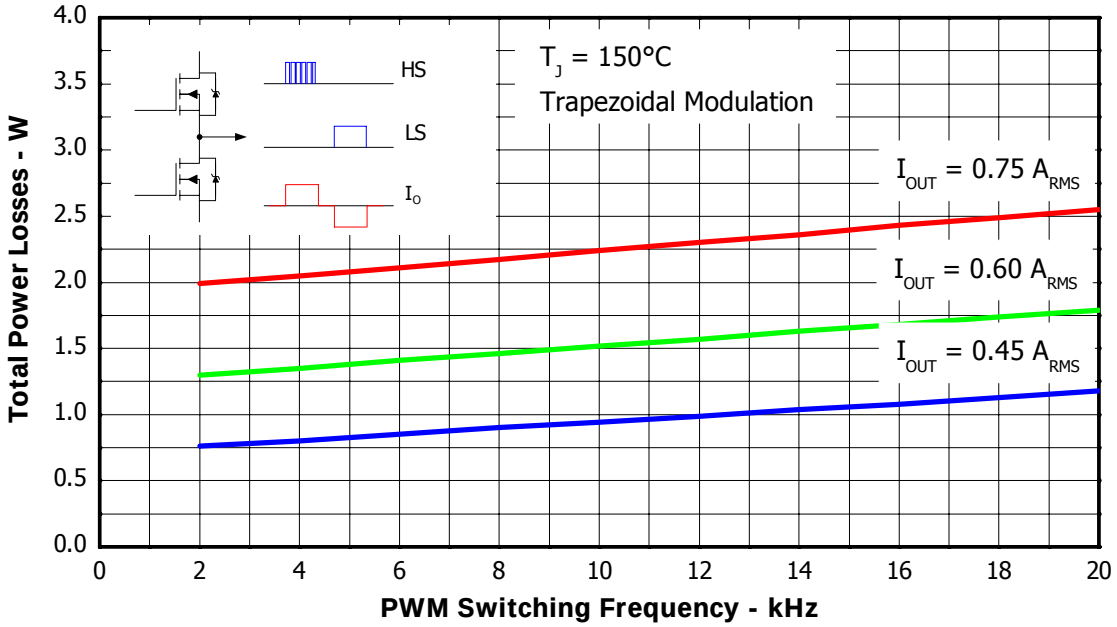


Figure 4. Total Power Losses as Function of Switching Frequency
V_{DD}=300V, T_J=150°C, Modulation Depth=0.5, PF=0.99

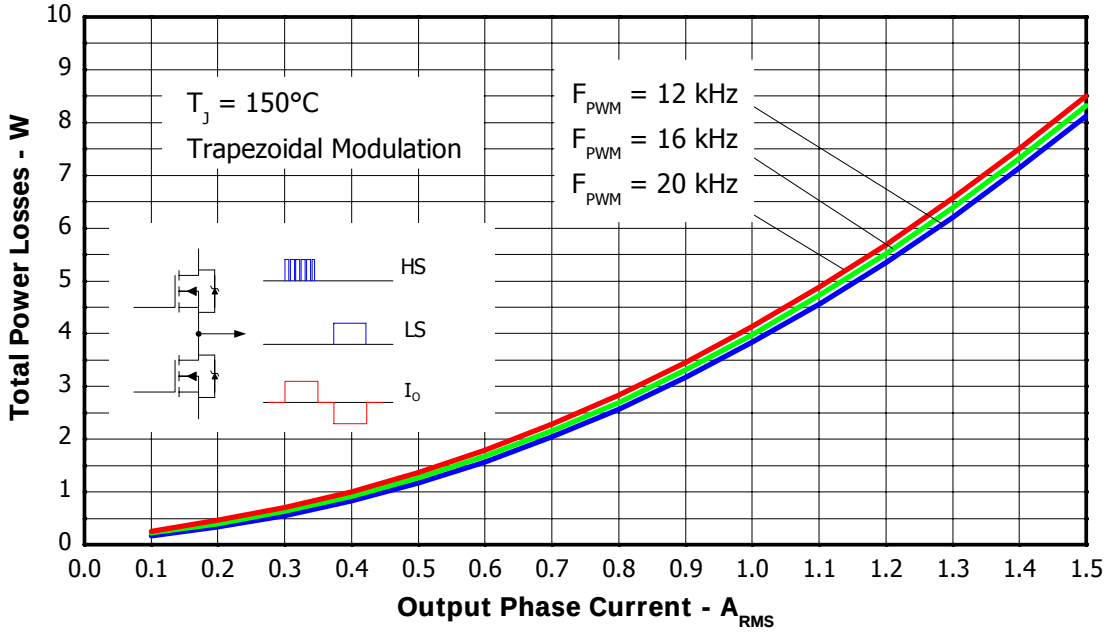


Figure 5. Total Power Losses as Function of Output Phase Current
V_{DD}=300V, T_J=150°C, Modulation Depth=0.5, PF=0.99

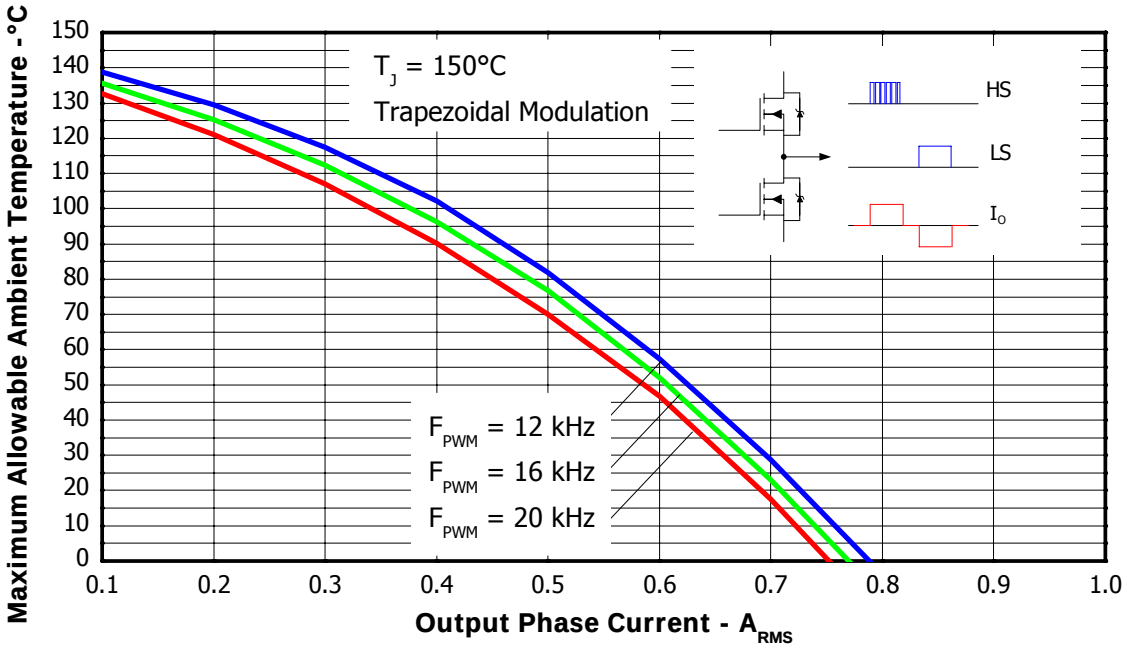


Figure 6. Maximum Allowable Ambient Temperature vs. Output Phase Current
V_{DD}=300V, T_J=150°C, Modulation Depth=0.5, PF=0.99

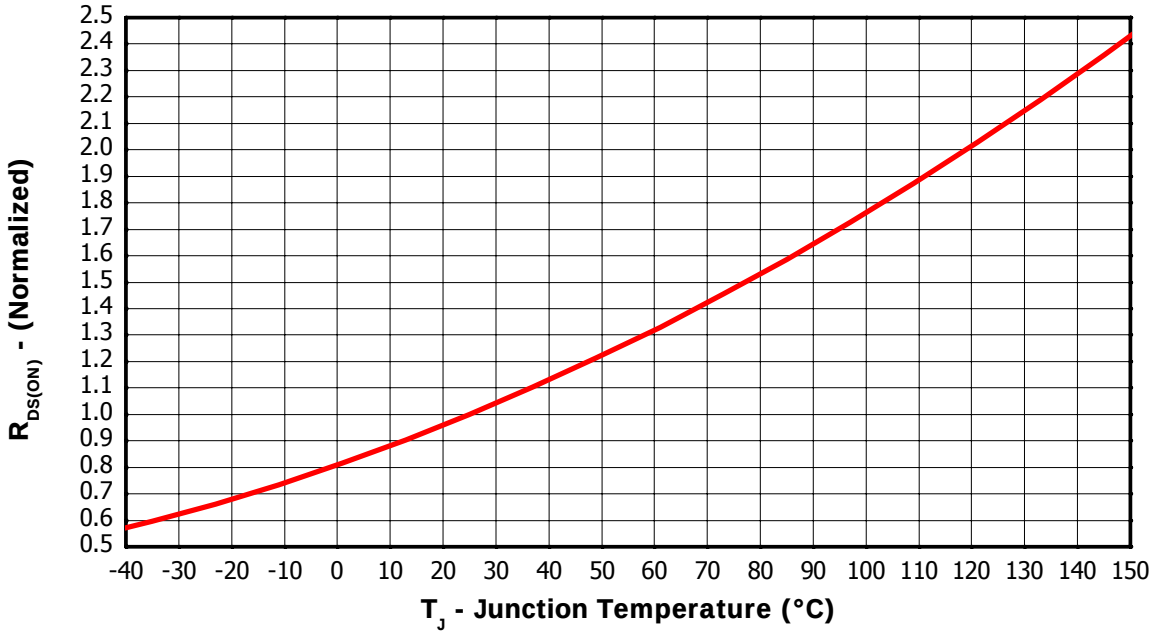


Figure 7. Normalized Drain to Source Resistance vs Junction Temperature

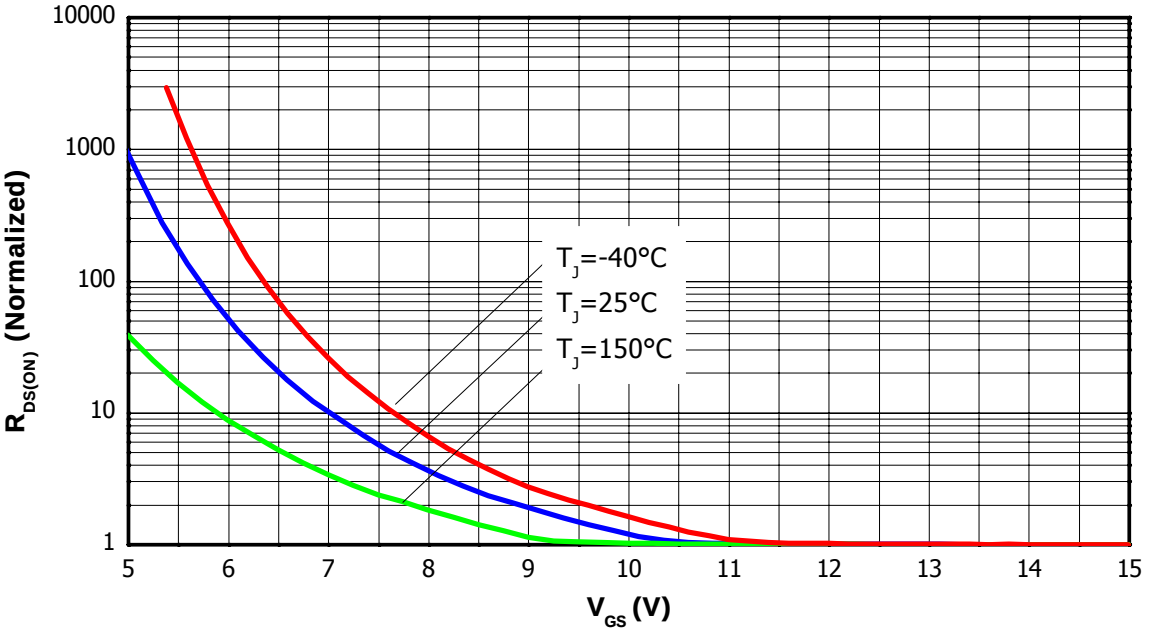


Figure 8. Normalized Drain to Source Resistance vs Gate Source Voltage

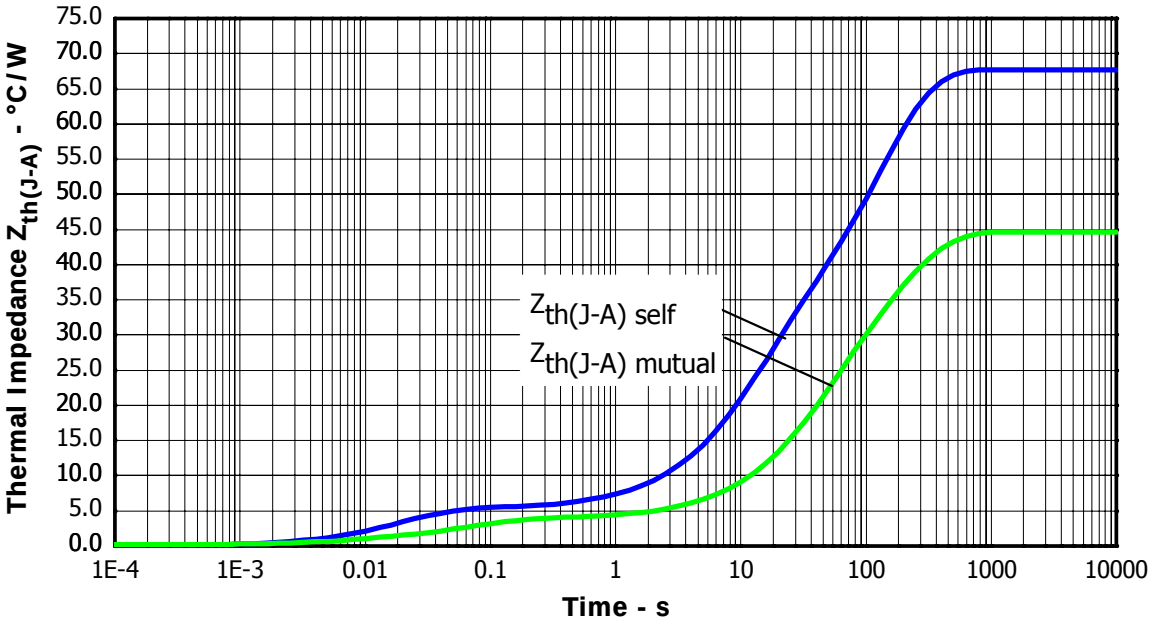


Figure 9. Thermal Impedance vs. Time

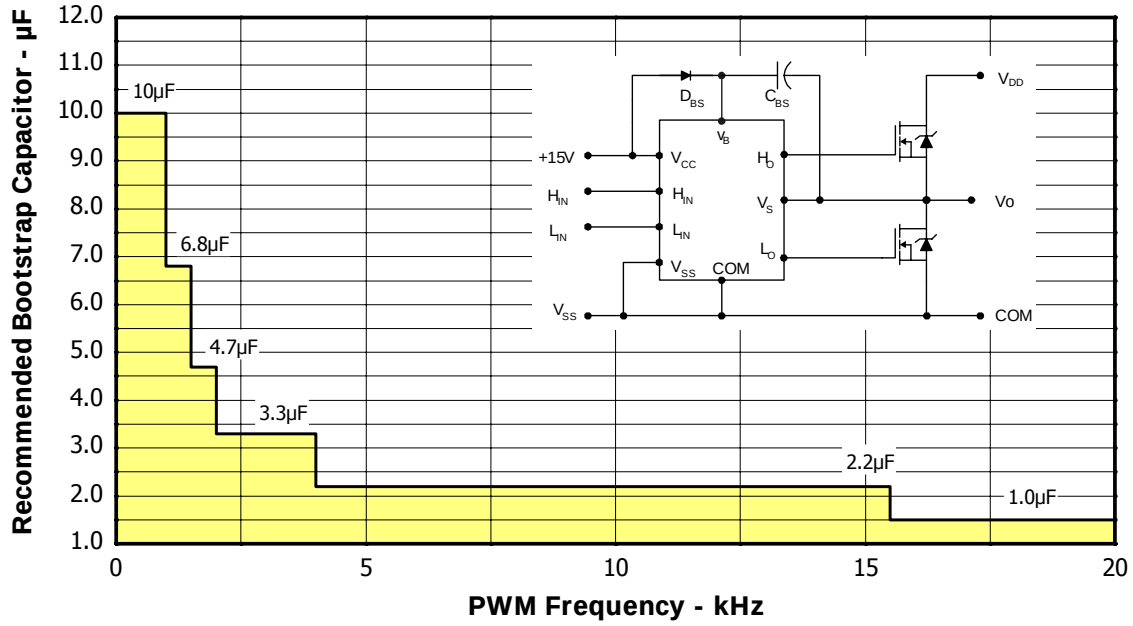
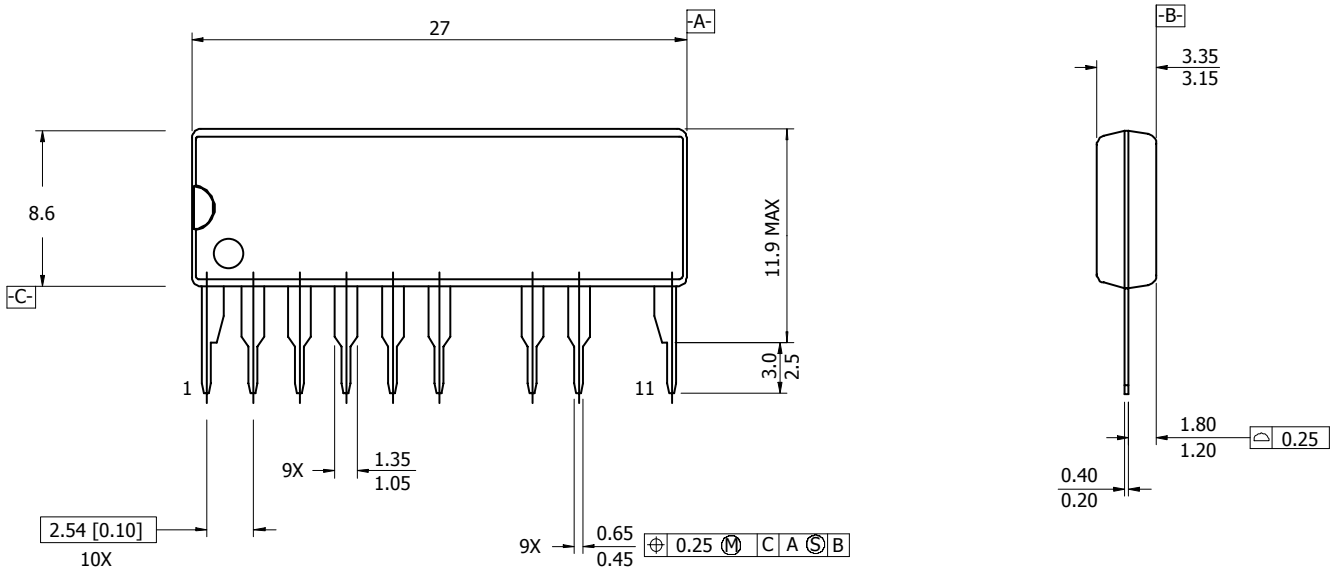


Figure 10. Recommended Bootstrap Capacitor Value vs. Switching Frequency

Package Outline



Note 1: Marking for pin 1 identification
Note 2: Product Part Number
Note 3: Lot and Date code marking
Dimensioning and Tolerancing per ANSY Y14.5M-1992
Controlling Dimensions: INCH
Dimensions are shown in millimeters [inches]

Data and Specifications are subject to change without notice

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