MHPM7A15A60A

Motorola Preferred Device

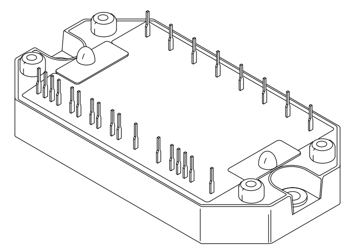
Hybrid Power Module

Integrated Power Stage for 1.0 hp Motor Drives

15 AMP, 600 VOLT
HYBRID POWER MODULE

The MHPM7A15A60A module integrates a 3-phase input rectifier bridge, 3-phase output inverter, brake transistor/diode, current sense resistor and temperature sensor in a single convenient package.The output inverter utilizes advanced insulated gate bipolar transistors (IGBT) matched with free-wheeling diodes to give optimal dynamic performance. It has been configured for use as a three-phase motor drive module or for many other power switching applications. The top connector pins have been designed for easy interfacing to the user's control board.

- DC Bus Current Sense Resistor Included
- Short Circuit Rated 10 µs @ 25°C
- Temperature Sensor Included
- Pin-to-Baseplate Isolation exceeds 2500 Vac (rms)
- Convenient Package Outline
- UL Recognized and Designed to Meet VDE
- Access to Positive and Negative DC Bus



PLASTIC PACKAGE
CASE 440-01, Style 1

MAXIMUM DEVICE RATINGS (T_J = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
INPUT RECTIFIER BRIDGE			
Repetitive Peak Reverse Voltage	V_{RRM}	600	V
Average Output Rectified Current	I_O	15	A
Peak Non-repetitive Surge Current — (1/2 Cycle) (1)	I_{FSM}	200	A
OUTPUT INVERTER			
IGBT Reverse Voltage	V_{CES}	600	V
Gate-Emitter Voltage	V_{GES}	± 20	V
Continuous IGBT Collector Current	I_C	15	A
Peak IGBT Collector Current — (PW = 1.0 ms) (2)	$I_{C(pk)}$	30	A
Continuous Free-Wheeling Diode Current	I_F	15	A
Peak Free-Wheeling Diode Current — (PW = 1.0 ms) (2)	$I_{F(pk)}$	30	A
IGBT Power Dissipation	P_D	55	W
Free-Wheeling Diode Power Dissipation	P_D	30	W
IGBT Junction Temperature Range	T_J	– 40 to +125	°C
Free-Wheeling Diode Junction Temperature Range	T_J	– 40 to +125	°C

(1) 1 cycle = 50 or 60 Hz
(2) 1.0 ms = 1.0% duty cycle

Preferred devices are Motorola recommended choices for future use and best overall value.

MAXIMUM DEVICE RATINGS (continued) (T_J = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
BRAKE CIRCUIT			
IGBT Reverse Voltage	V_{CES}	600	V
Gate-Emitter Voltage	V_{GES}	± 20	V
Continuous IGBT Collector Current	I_C	15	A
Peak IGBT Collector Current (PW = 1.0 ms) (2)	$I_{C(pk)}$	30	A
IGBT Power Dissipation	PD	55	W
Diode Reverse Voltage	V_{RRM}	600	V
Continuous Output Diode Current	I_F	15	A
Peak Output Diode Current (PW = 1.0 ms) (2)	$I_{F(pk)}$	30	A
TOTAL MODULE			
Isolation Voltage — (47–63 Hz, 1.0 Minute Duration)	V_{ISO}	2500	VAC
Ambient Operating Temperature Range	T_A	– 40 to + 85	°C
Operating Case Temperature Range	T_C	– 40 to + 90	°C
Storage Temperature Range	T_{stg}	– 40 to +150	°C
Mounting Torque	—	6.0	lb–in

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
INPUT RECTIFIER BRIDGE					
Reverse Leakage Current (V_{RRM} = 600 V)	I_R	—	10	50	µA
Forward Voltage (I_F = 15 A)	V_F	—	1.05	1.5	V
Thermal Resistance (Each Die)	$R_{\theta JC}$	—	—	2.9	°C/W
OUTPUT INVERTER					
Gate-Emitter Leakage Current (V_{CE} = 0 V, V_{GE} = ± 20 V)	I_{GES}	—	—	± 20	µA
Collector-Emitter Leakage Current (V_{CE} = 600 V, V_{GE} = 0 V) T_J = 25°C T_J = 125°C	I_{CES}	 — —	 — —	 200 2.0	 µA mA
Gate-Emitter Threshold Voltage (V_{CE} = V_{GE}, I_C = 1.0 mA)	$V_{GE(th)}$	4.0	6.0	8.0	V
Collector-Emitter Breakdown Voltage (I_C = 10 mA, V_{GE} = 0)	$V_{(BR)CES}$	600	700	—	V
Collector-Emitter Saturation Voltage (V_{GE} = 15 V, I_C = 15 A)	$V_{CE(SAT)}$	—	2.7	3.5	V
Input Capacitance (V_{GE} = 0 V, V_{CE} = 10 V, f = 1.0 MHz)	Cies	—	950	—	pF
Input Gate Charge (V_{CE} = 300 V, I_C = 15 A, V_{GE} = 15 V)	Q_T	—	75	—	nC
Fall Time — Inductive Load (V_{CE} = 300 V, I_C = 15 A, V_{GE} = 15 V, RG = 150 Ω)	t_{fi}	—	200	350	ns
Turn-On Energy (V_{CE} = 300 V, I_C = 15 A, V_{GE} = 15 V, RG = 150 Ω)	$E_{(on)}$	—	—	1.0	mJ
Turn-Off Energy (V_{CE} = 300 V, I_C = 15 A, V_{GE} = 15 V, RG = 150 Ω)	$E_{(off)}$	—	—	1.0	mJ
Diode Forward Voltage (I_F = 15 A, V_{GE} = 0 V)	V_F	—	1.5	2.0	V
Diode Reverse Recovery Time (I_F = 15 A, V = 400 V, dI/dt = 50 A/µs)	t_{rr}	—	140	200	ns
Diode Stored Charge (I_F = 15 A, V = 400 V, di/dt = 50 A/µs)	Q_{rr}	—	—	900	nC
Thermal Resistance — IGBT (Each Die)	$R_{\theta JC}$	—	—	1.9	°C/W
Thermal Resistance — Free-Wheeling Diode (Each Die)	$R_{\theta JC}$	—	—	3.7	°C/W

(2) 1.0 ms = 1.0% duty cycle

ELECTRICAL CHARACTERISTICS (continued) (T_J = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
BRAKE CIRCUIT					
Gate-Emitter Leakage Current (V_{CE} = 0 V, V_{GE} = ± 20 V)	I_{GES}	—	—	± 20	µA
Collector-Emitter Leakage Current (V_{CE} = 600 V, V_{GE} = 0 V) (1) T_J = 25°C T_J = 125°C	I_{CES}	 — —	 — —	 200 2.0	 µA mA
Gate-Emitter Threshold Voltage (V_{CE} = V_{GE}, I_C = 1.0 mA)	$V_{GE(th)}$	4.0	6.0	8.0	V
Collector-Emitter Breakdown Voltage (I_C = 10 mA, V_{GE} = 0)	$V_{(BR)CES}$	600	700	—	V
Collector-Emitter Saturation Voltage (V_{GE} = 15 V, I_C = 15 A) (1)	$V_{CE(SAT)}$	—	2.7	3.5	V
Input Capacitance (V_{GE} = 0 V, V_{CE} = 10 V, f = 1.0 MHz)	Cies	—	950	—	pF
Input Gate Charge (V_{CE} = 300 V, I_C = 15 A, V_{GE} = 15 V)	Q_T	—	75	—	nC
Fall Time — Inductive Load (V_{CE} = 300 V, I_C = 15 A, V_{GE} = 15 V, R_G = 150 Ω)	t_{fi}	—	200	350	ns
Turn-On Energy (V_{CE} = 300 V, I_C = 15 A, V_{GE} = 15 V, R_G = 150 Ω)	$E_{(on)}$	—	—	1.0	mJ
Turn-Off Energy (V_{CE} = 300 V, I_C = 15 A, V_{GE} = 15 V, R_G = 150 Ω)	$E_{(off)}$	—	—	1.0	mJ
Diode Forward Voltage (I_F = 15 A)	V_F	—	1.5	2.0	V
Diode Reverse Leakage Current	I_R	—	—	50	µA
Thermal Resistance — IGBT	$R_{\theta JC}$	—	—	1.9	°C/W
Thermal Resistance — Diode	$R_{\theta JC}$	—	—	3.7	°C/W
SENSE RESISTOR					
Resistance	R_{sense}	—	10	—	mΩ
Resistance Tolerance	R_{tol}	–1.0	—	+1.0	%
TEMPERATURE SENSE DIODE					
Forward Voltage (@ I_F = 1.0 mA)	V_F	—	0.660	—	V
Forward Voltage Temperature Coefficient (@ I_F = 1.0 mA)	TC_{VF}	—	–1.95	—	mV/°C

(1) 1 cycle = 50 or 60 Hz.

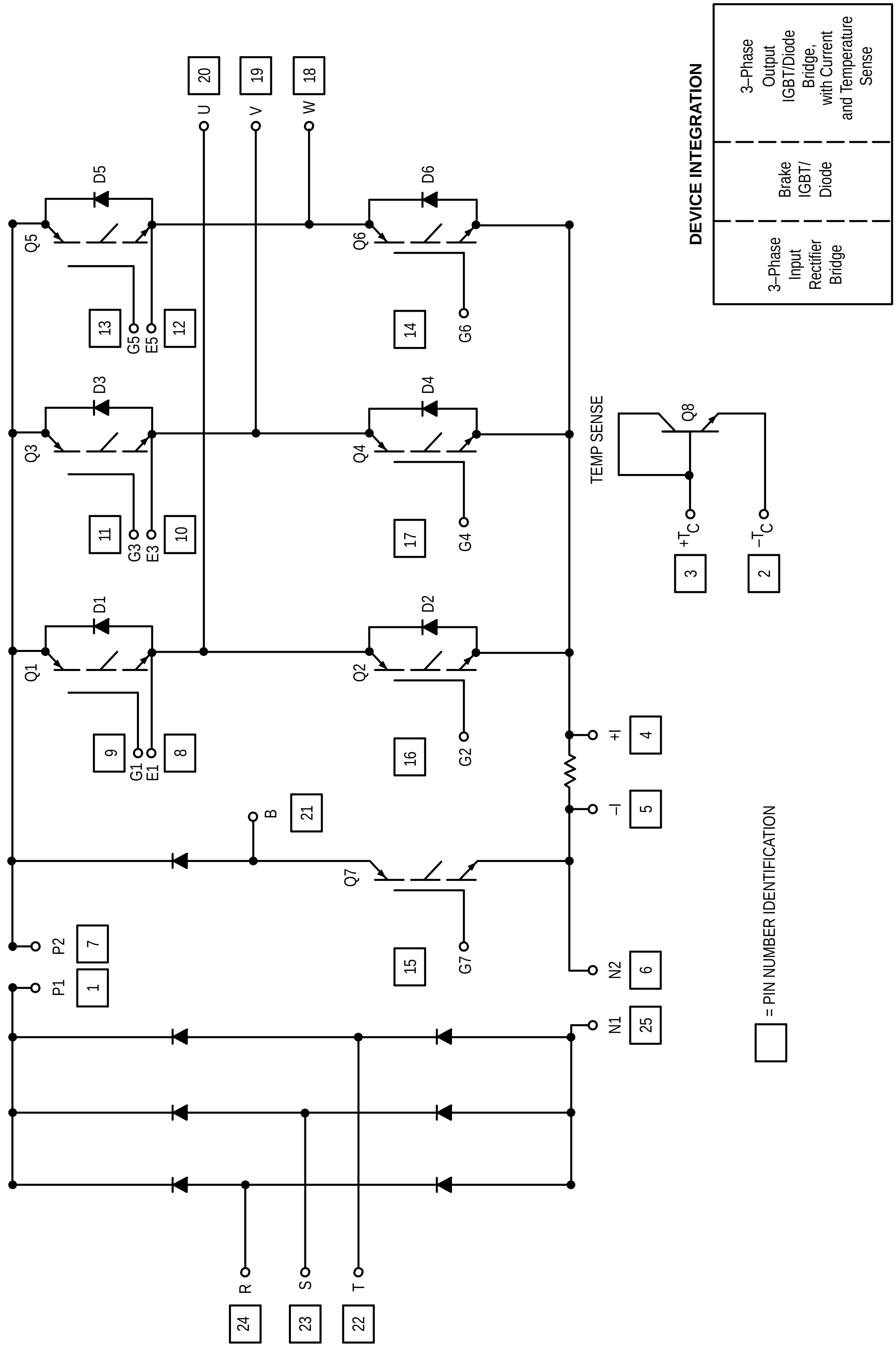


Figure 1. Integrated Power Stage Schematic

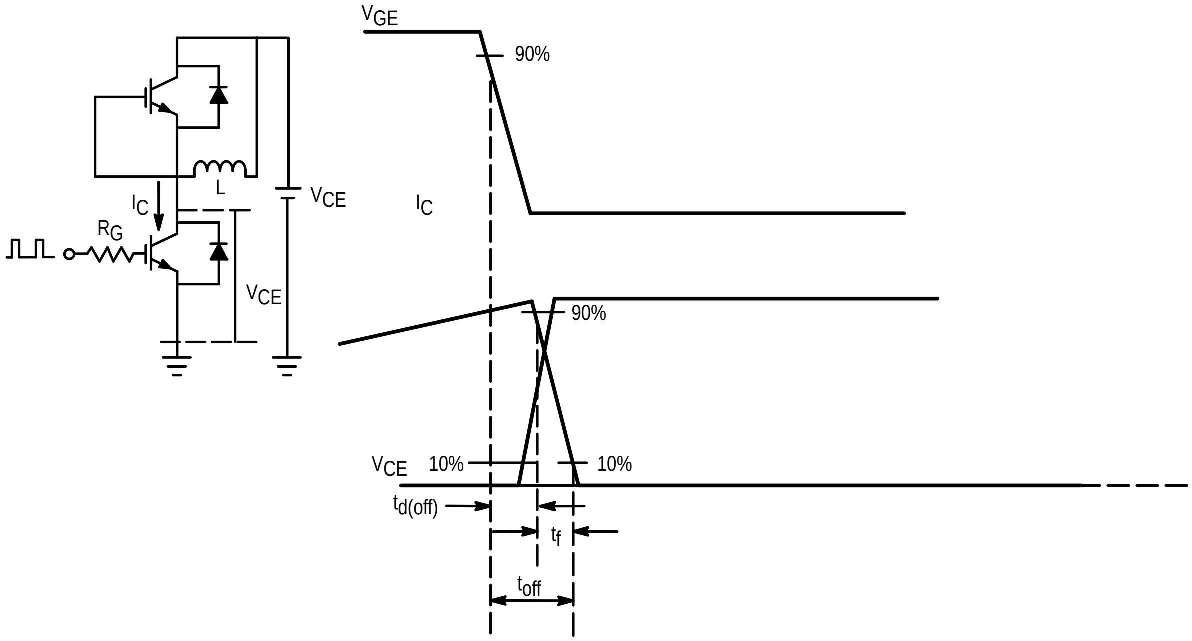


Figure 2. Inductive Switching Time Test Circuit and Timing Chart

Typical Characteristics

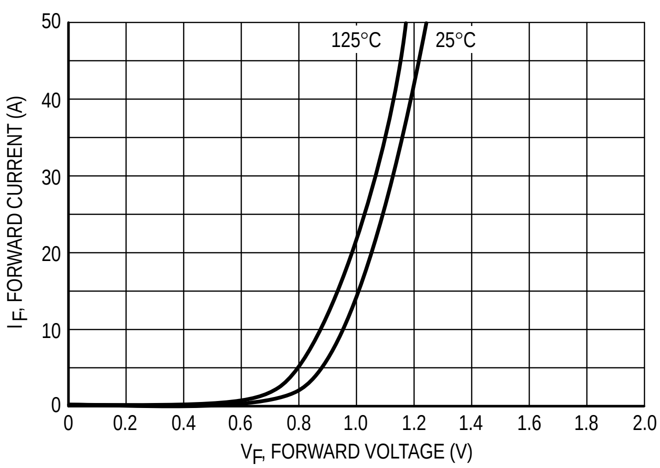


Figure 3. Input Bridge Forward Current versus Forward Voltage

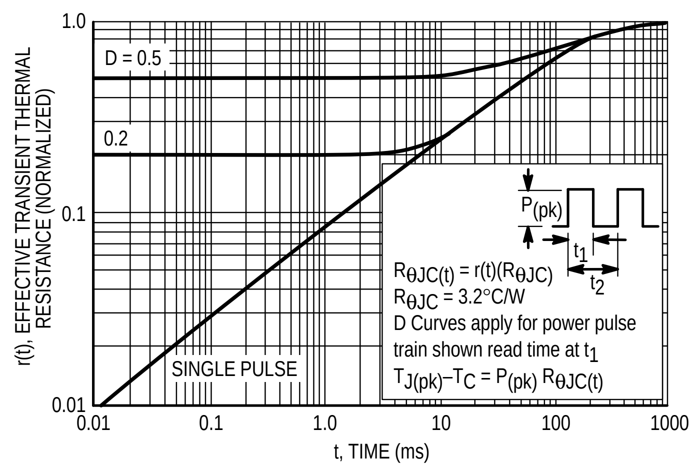


Figure 4. Input Rectifier Bridge Thermal Response

Typical Characteristics

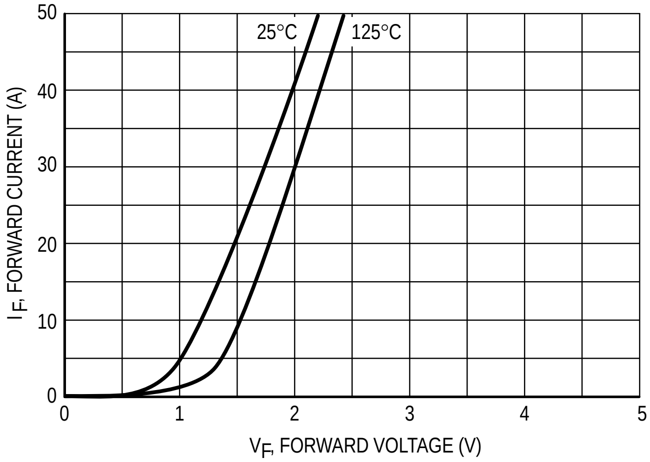


Figure 5. Output Inverter Diode Forward Currrent versus Forward Voltage

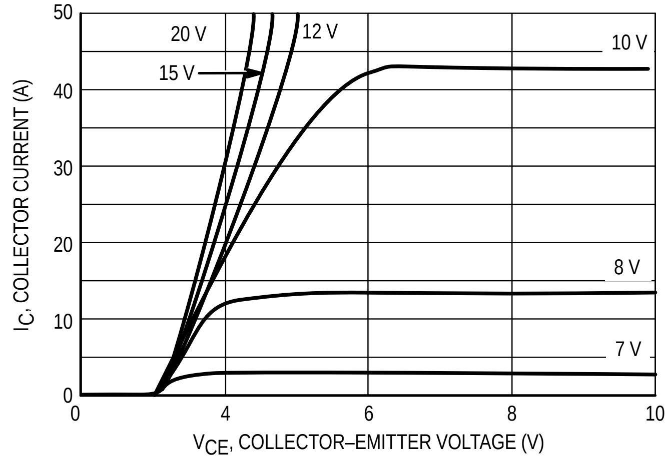


Figure 6. Output Inverter Collector-Current versus Collector-Emitter Voltage

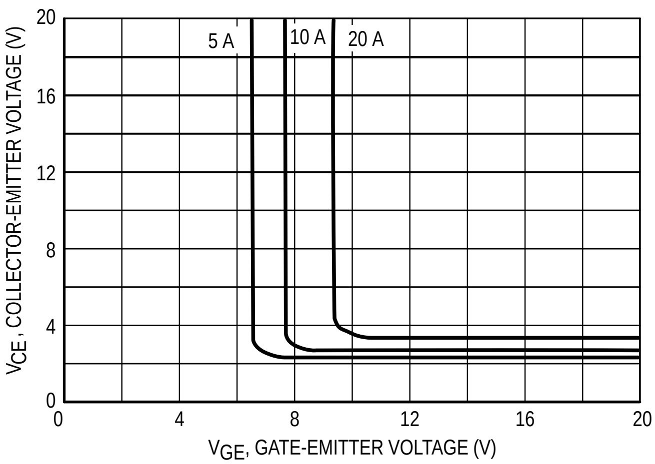


Figure 7. Output Inverter Collector-Emitter Voltage versus Gate-Emitter Voltage

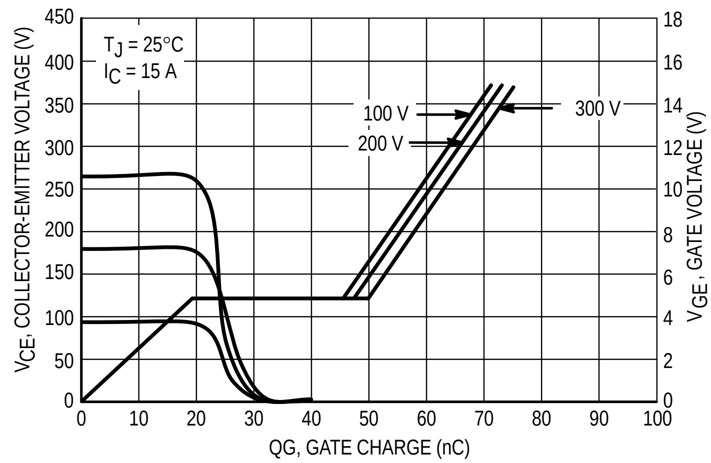


Figure 8. Gate–to–Emitter Voltage versus Gate Charge

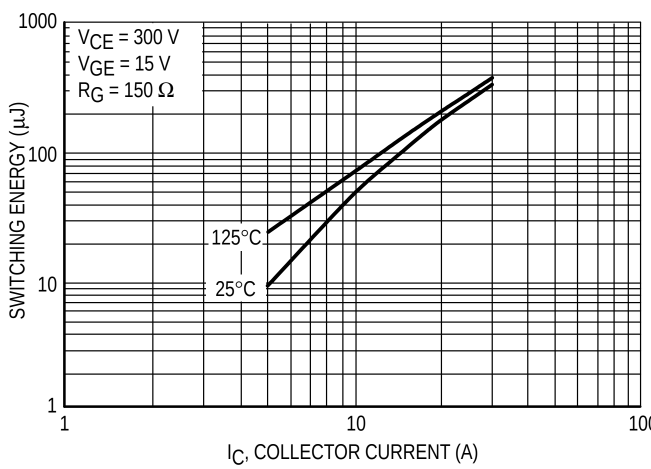


Figure 9. Inverter Switching Energy $E_{(off)}$ versus Collector Current I_C

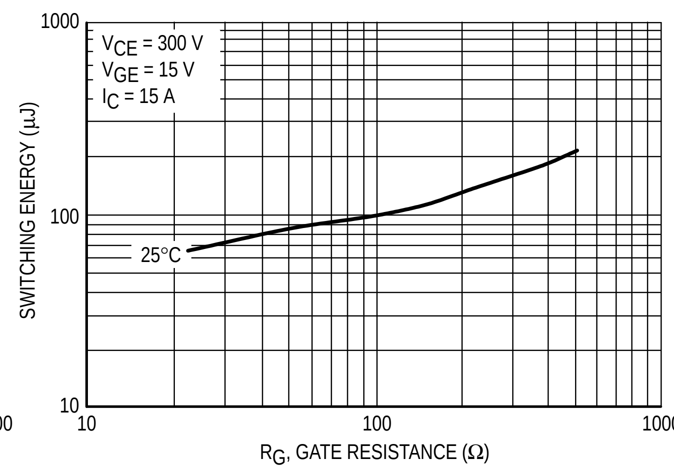


Figure 10. Inverter Switching Energy $E_{(off)}$ versus Gate Resistance R_G

Typical Characteristics

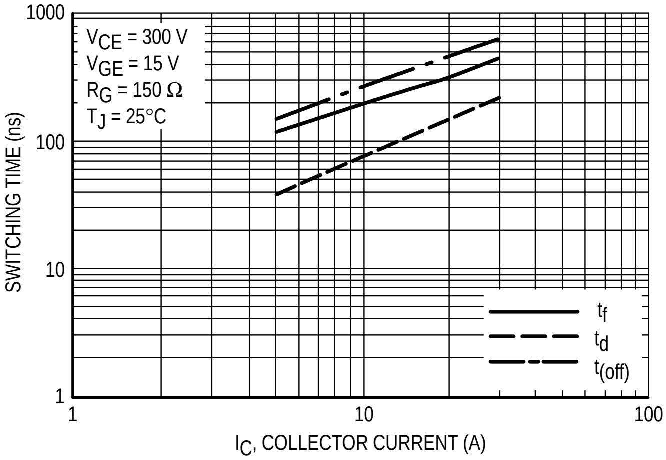


Figure 11. Inverter Switching Time t_f, t_d, $t_{(off)}$ versus Collector Current I_C

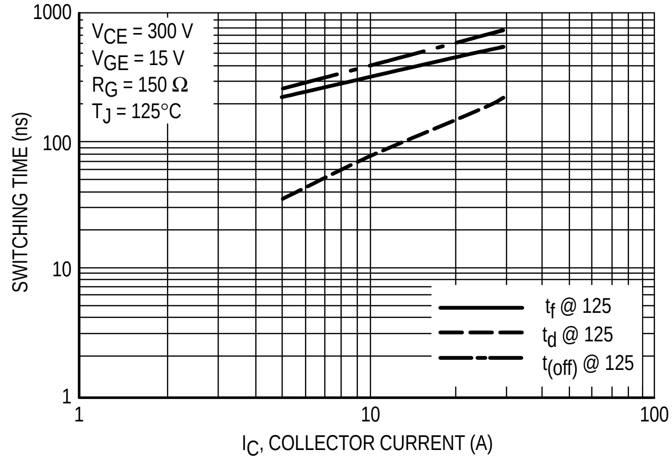


Figure 12. Inverter Switching Time t_f, t_d, $t_{(off)}$ versus Collector Current I_C

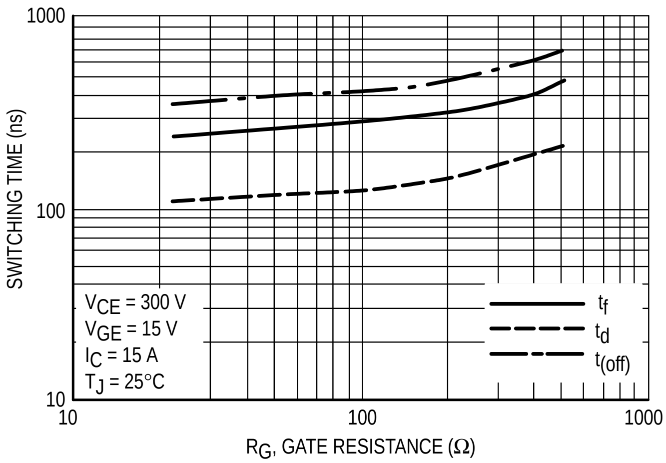


Figure 13. Inverter Switching Time t_f, t_d, $t_{(off)}$ versus Gate Resistance R_G

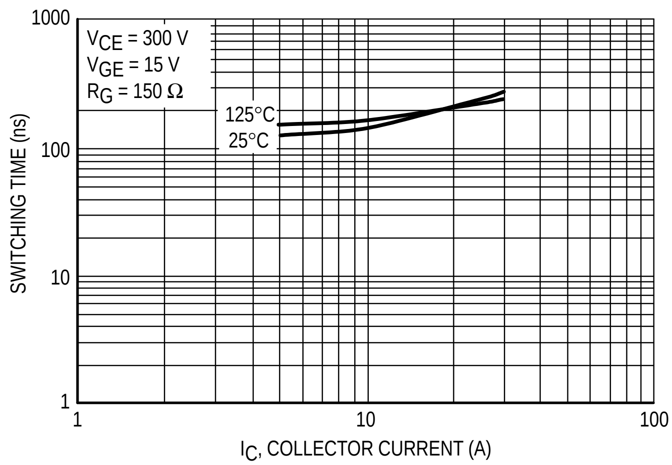


Figure 14. Inverter Switching Time t_r versus Collector Current I_C

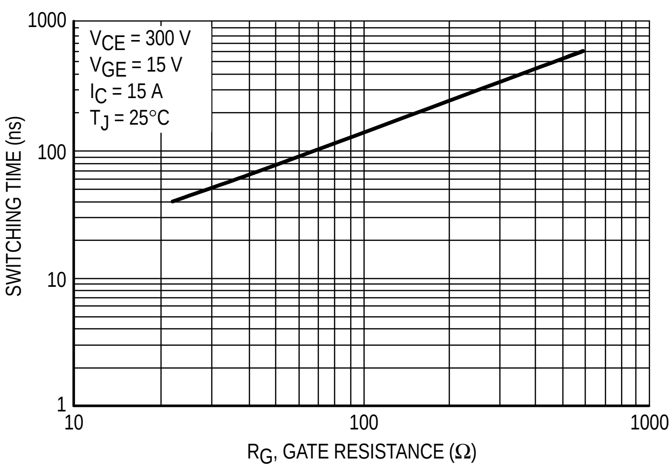


Figure 15. Inverter Switching Time t_r versus Gate Resistance R_G

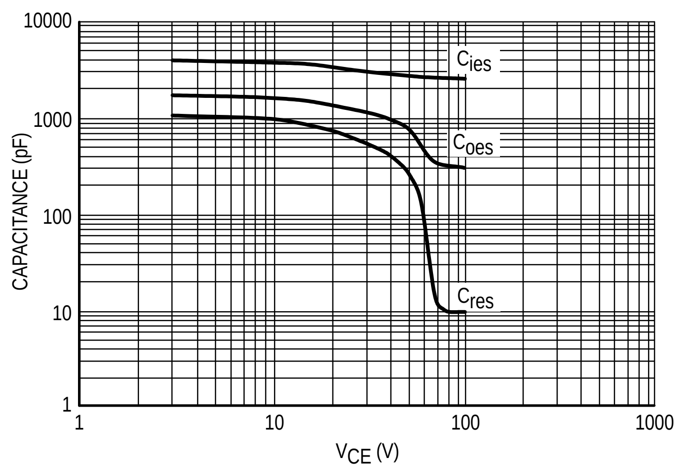


Figure 16. Inverter Capacitance versus V_{CE}

Typical Characteristics

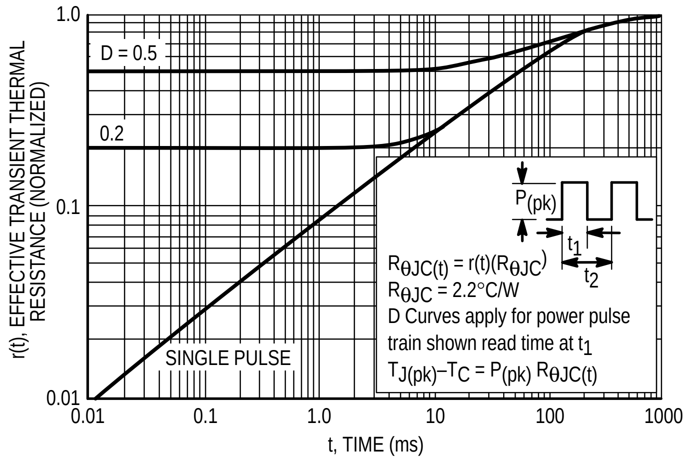


Figure 17. Ouput Inverter IGBT Thermal Response

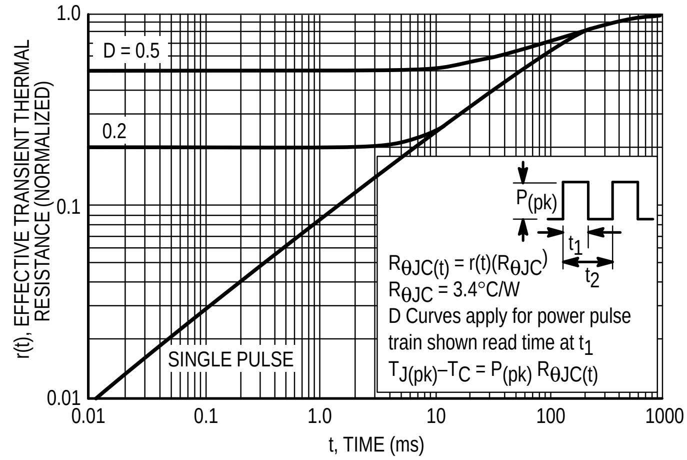


Figure 18. Output Diode Thermal Response

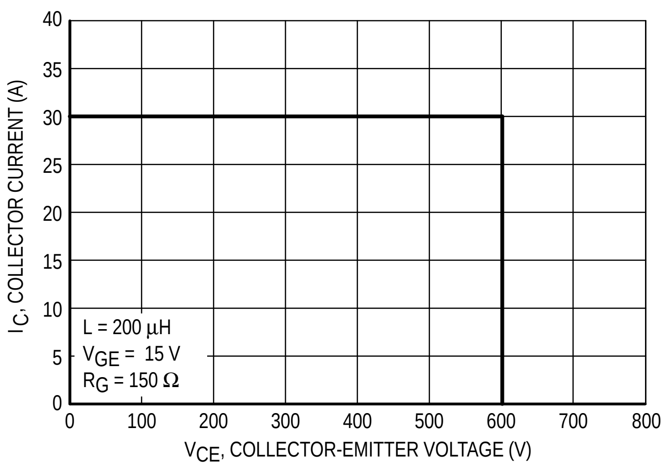
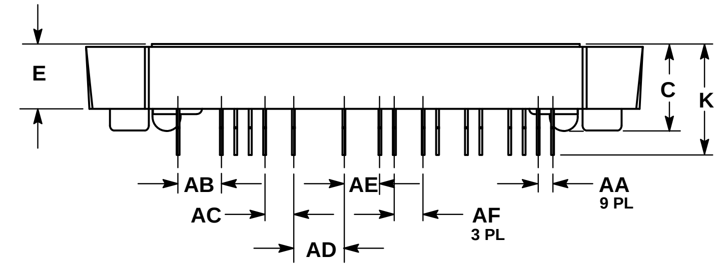
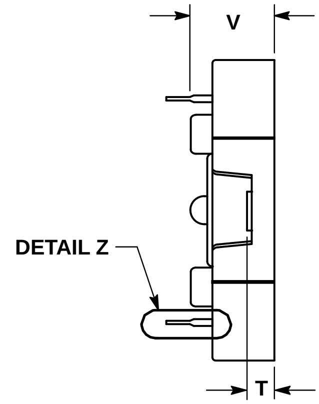
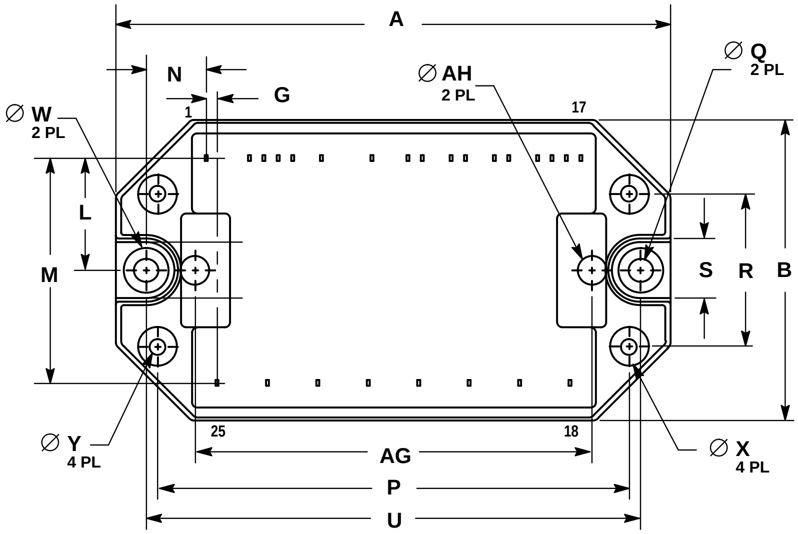


Figure 19. Output Inverter Reverse Bias Safe Operating Area (RBSOA)

PACKAGE DIMENSIONS

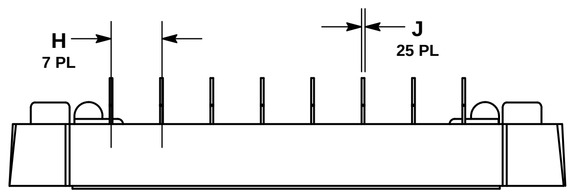


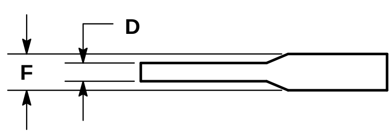




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. LEAD LOCATION DIMENSIONS (ie: M, B. AA...) ARE TO THE CENTER OF THE LEAD.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	97.54	98.55	3.840	3.880
B	52.45	53.47	2.065	2.105
C	14.60	15.88	0.575	0.625
D	0.43	0.84	0.017	0.033
E	10.80	12.06	0.425	0.475
F	0.94	1.35	0.037	0.053
G	1.60	2.21	0.063	0.087
H	8.58	9.19	0.338	0.362
J	0.30	0.71	0.012	0.028
K	18.80	20.57	0.74	0.81
L	19.30	20.32	0.760	0.800
M	38.99	40.26	1.535	1.585
N	9.78	11.05	0.385	0.435
P	82.55	83.57	3.250	3.290
Q	4.01	4.62	0.158	0.182
R	26.42	27.43	1.040	1.080
S	12.06	12.95	0.475	0.515
T	4.32	5.33	0.170	0.210
U	86.36	87.38	3.400	3.440
V	14.22	15.24	0.560	0.600
W	7.62	8.13	0.300	0.320
X	6.55	7.16	0.258	0.282
Y	2.49	3.10	0.098	0.122
AA	2.24	2.84	0.088	0.112
AB	7.32	7.92	0.288	0.312
AC	4.78	5.38	0.188	0.212
AD	8.58	9.19	0.338	0.362
AE	6.05	6.65	0.238	0.262
AF	4.78	5.38	0.188	0.212
AG	69.34	70.36	2.730	2.770
AH	—	5.08	—	0.200





DETAIL Z

STYLE 1:

PIN 1. P1	PIN 6. N2	PIN 11. G3	PIN 16. G2	PIN 21. B
2. T–	7. P2	12. K5	17. G4	22. T
3. T+	8. K1	13. G5	18. W	23. S
4. I+	9. G1	14. G6	19. V	24. R
5. I–	10. K3	15. G7	20. U	25. N1

CASE 440-01
ISSUE O

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MOTOROLA

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