MHPM7B12A120A

Motorola Preferred Device

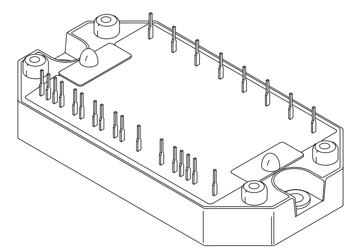
Hybrid Power Module

Integrated Power Stage for 2.0 hp Motor Drives

This module integrates a 3–phase input rectifier bridge, 3–phase output inverter and brake transistor/diode 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.

- Short Circuit Rated 10 µs @ 25°C
- 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

12 AMP, 1200 VOLT
HYBRID POWER MODULE



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}	1200	V
Average Output Rectified Current (1)	I_O	12	A
Peak Non-repetitive Surge Current	I_{FSM}	200	A
OUTPUT INVERTER			
IGBT Reverse Voltage	V_{CES}	1200	V
Gate-Emitter Voltage	V_{GES}	± 20	V
Continuous IGBT Collector Current	I_C	12	A
Peak IGBT Collector Current – (PW = 1.0 ms) (2)	$I_{C(pk)}$	24	A
Continuous Free-Wheeling Diode Current	I_F	12	A
Peak Free-Wheeling Diode Current – (PW = 1.0 ms) (2)	$I_{F(pk)}$	24	A
IGBT Power Dissipation	P_D	60	W
Free-Wheeling Diode Power Dissipation	P_D	40	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 ms = 1.0% duty cycle

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

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

Rating	Symbol	Value	Unit
BRAKE CIRCUIT			
IGBT Reverse Voltage	V_{CES}	1200	V
Gate-Emitter Voltage	V_{GES}	± 20	V
Continuous IGBT Collector Current	I_C	12	A
Peak IGBT Collector Current (PW = 1.0 ms) (2)	$I_{C(pk)}$	24	A
IGBT Power Dissipation	PD	60	W
Diode Reverse Voltage	V_{RRM}	1200	V
Continuous Output Diode Current	I_F	12	A
Peak Output Diode Current (PW = 1.0 ms) (2)	$I_{F(pk)}$	24	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} = 1200 V)	I_R	–	10	50	µA
Forward Voltage (I_F = 12 A)	V_F	–	1.03	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} = 1200 V, V_{GE} = 0 V) T_J = 25°C T_J = 125°C	I_{CES}	 – –	 – –	 100 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)	$V_{(BR)CES}$	1200	1300	–	V
Collector-Emitter Saturation Voltage (I_C = 12 A, V_{GE} = 15 V)	$V_{CE(SAT)}$	–	2.4	3.5	V
Input Capacitance (V_{GE} = 0 V, V_{CE} = 10 V, f = 1.0 MHz)	Cies	–	1800	–	pF
Input Gate Charge (V_{CE} = 600 V, I_C = 12 A, V_{GE} = 15 V)	Q_T	–	65	–	nC
Fall Time – Inductive Load (V_{CE} = 600 V, I_C = 12 A, V_{GE} = 15 V, R_G = 150 Ω)	t_{fi}	–	300	500	ns
Turn-On Energy (V_{CE} = 600 V, I_C = 12 A, V_{GE} = 15 V, R_G = 150 Ω)	$E_{(on)}$	–	–	2.0	mJ
Turn-Off Energy (V_{CE} = 600 V, I_C = 12 A, V_{GE} = 15 V, R_G = 150 Ω)	$E_{(off)}$	–	–	2.0	mJ
Diode Forward Voltage (I_F = 12 A, V_{GE} = 0 V)	V_F	–	1.7	2.2	V
Diode Reverse Recovery Time (I_F = 12 A, V = 600 V, dI/dt = 100 A/µs)	t_{rr}	–	160	200	ns
Diode Stored Charge (I_F = 12 A, V = 600 V, di/dt = 100 A/µs)	Q_{rr}	–	800	950	nC
Thermal Resistance – IGBT (Each Die)	$R_{\theta JC}$	–	–	1.7	°C/W
Thermal Resistance – Free-Wheeling Diode (Each Die)	$R_{\theta JC}$	–	–	2.7	°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} = 1200 V, V_{GE} = 0 V)	I_{CES}				
T_J = 25°C		–	–	100	µA
T_J = 125°C		–	–	2.0	mA
Gate-Emitter Threshold Voltage (V_{CE} = V_{GE}, I_C = 10 mA)	$V_{GE(th)}$	4.0	6.0	8.0	V
Collector-Emitter Breakdown Voltage (I_C = 10 mA, V_{GE} = 0)	$V_{(BR)CES}$	1200	1300	–	V
Collector-Emitter Saturation Voltage (V_{GE} = 15 V, I_C = 12 A)	$V_{CE(SAT)}$	–	2.4	3.5	V
Input Capacitance (V_{GE} = 0 V, V_{CE} = 10 V, f = 1.0 MHz)	Cies	–	1800	–	pF
Input Gate Charge (V_{CE} = 600 V, I_C = 12 A, V_{GE} = 15 V)	Q_T	–	65	–	nC
Fall Time – Inductive Load (V_{CE} = 600 V, I_C = 12 A, V_{GE} = 15 V, R_G = 150 Ω)	t_{fi}	–	300	500	ns
Turn-On Energy (V_{CE} = 600 V, I_C = 12 A, V_{GE} = 15 V, R_G = 150 Ω)	$E_{(on)}$	–	–	2.0	mJ
Turn-Off Energy (V_{CE} = 600 V, I_C = 12 A, V_{GE} = 15 V, R_G = 150 Ω)	$E_{(off)}$	–	–	2.0	mJ
Diode Forward Voltage (I_F = 12 A	V_F	–	1.7	2.2	V
Diode Reverse Leakage Current	I_R	–	–	50	µA
Thermal Resistance – IGBT	$R_{\theta JC}$	–	–	1.7	°C/W
Thermal Resistance – Diode	$R_{\theta JC}$	–	–	2.7	°C/W

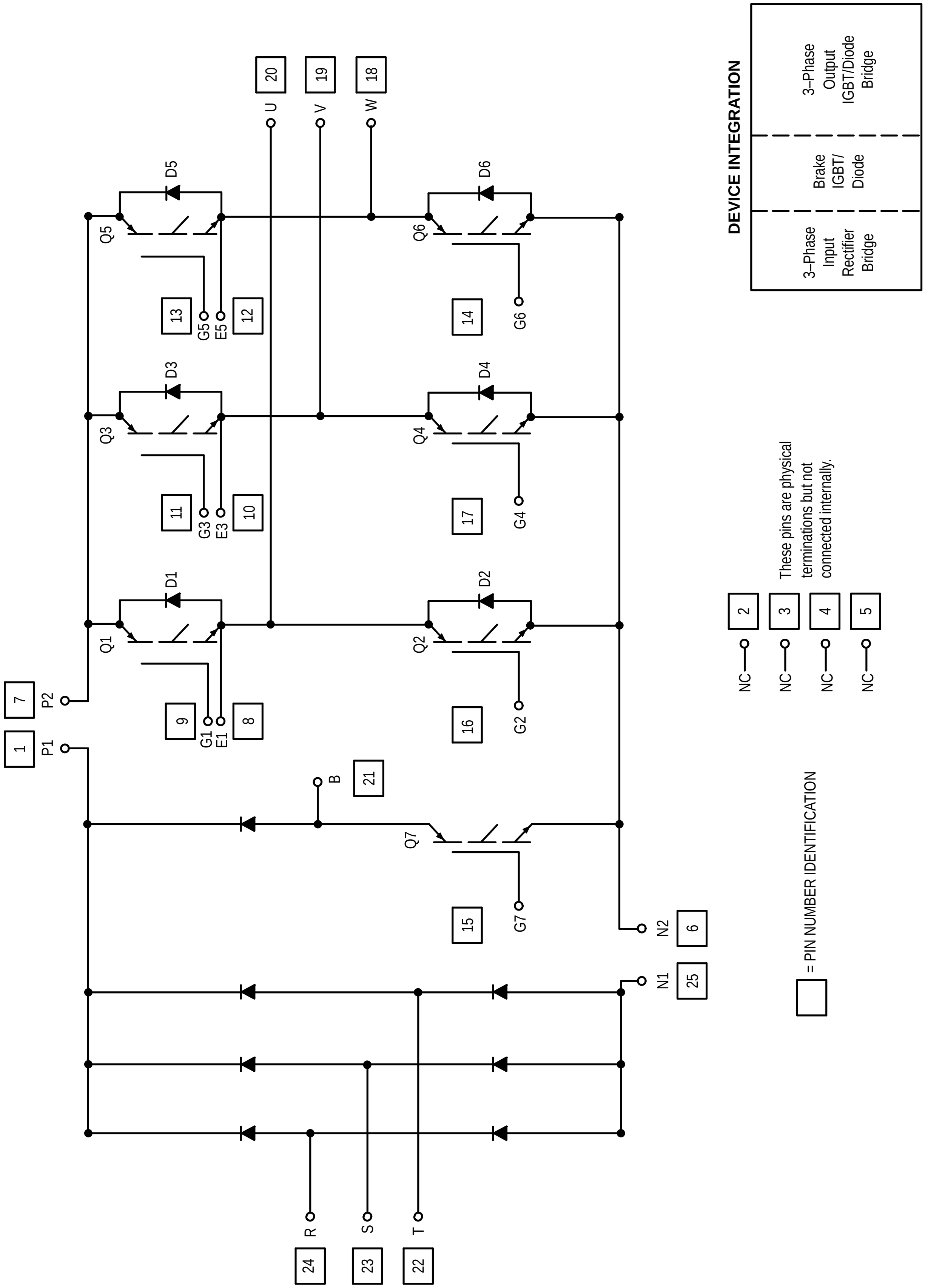


Figure 1. Integrated Power Stage Schematic

Typical Characteristics

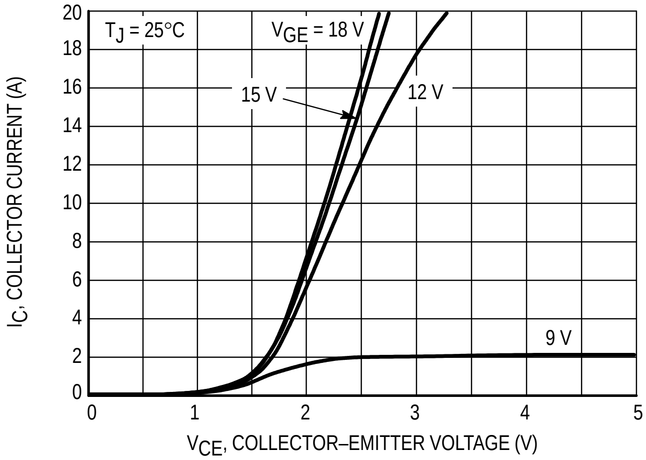


Figure 2. Output Inverter Collector Current I_C versus Collector–Emitter Voltage V_{CE}

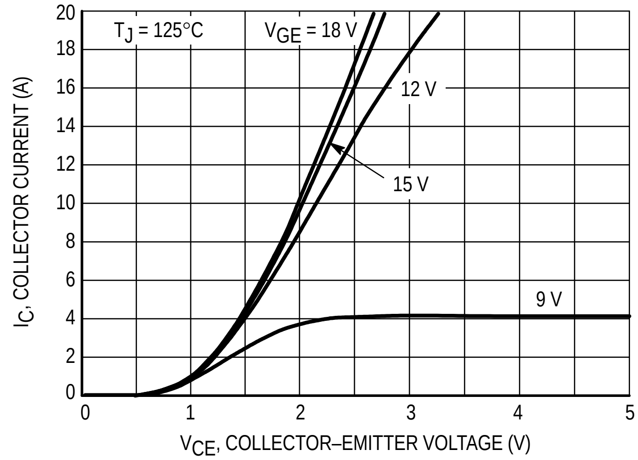


Figure 3. Output Inverter Collector Current I_C versus Collector–Emitter Voltage V_{CE}

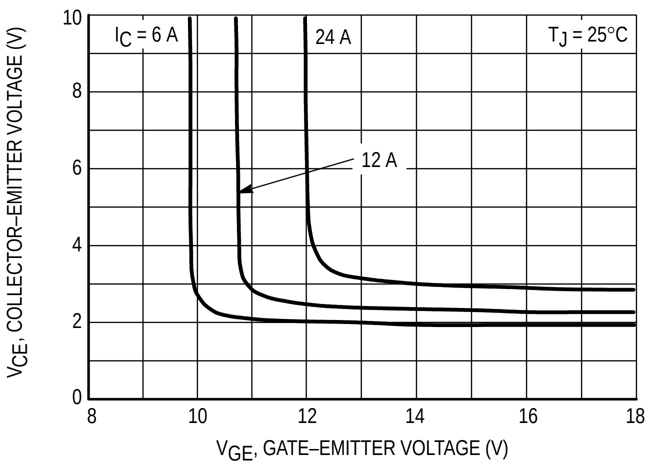


Figure 4. Inverter Collector–Emitter Voltage V_{CE} versus Gate–Emitter Voltage V_{GE}

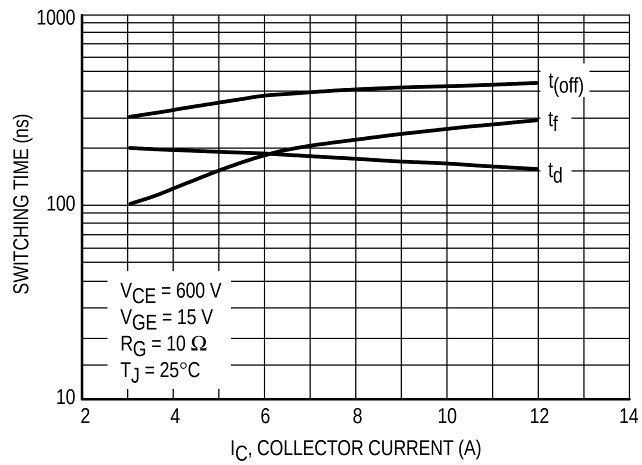


Figure 5. Inverter Switching Time t_d, t_f, $t_{(off)}$ versus Collector Current I_C

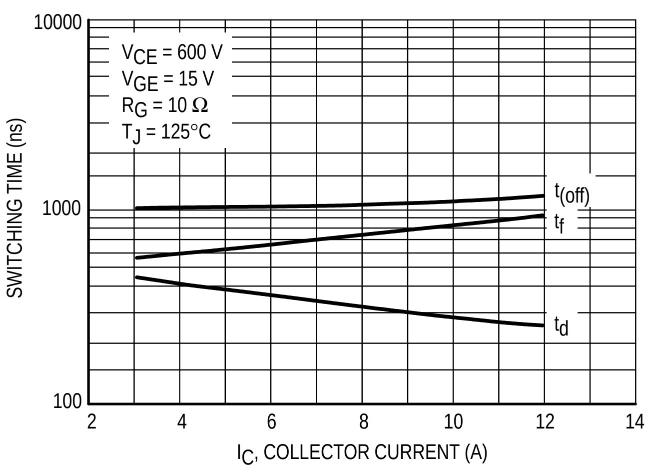


Figure 6. Inverter Switching Time t_d, t_f, $t_{(off)}$ versus Collector Current I_C

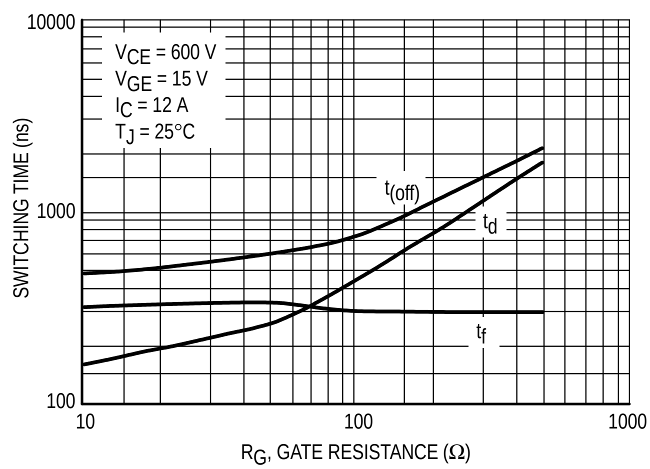


Figure 7. Inverter Switching Time t_d, t_f, $t_{(off)}$ versus Gate Resistance R_G

Typical Characteristics

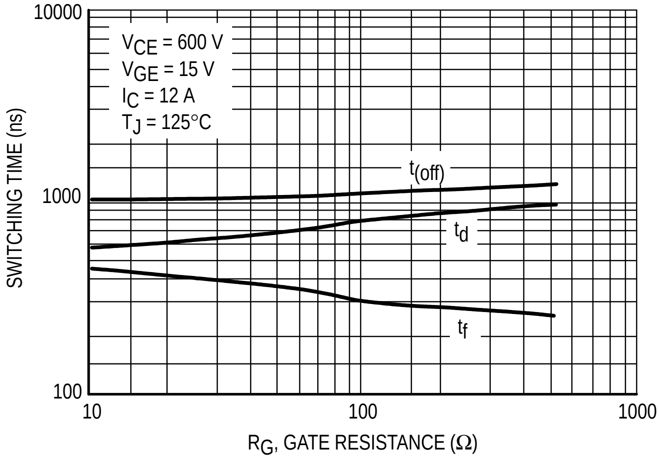


Figure 8. Inverter Switching Time t_d, t_f, $t_{(off)}$ versus Gate Resistance R_G

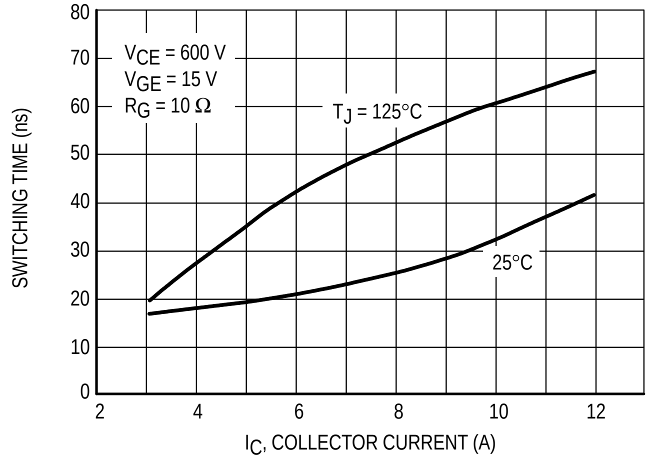


Figure 9. Inverter Switching Time t_r versus Collector Current I_C

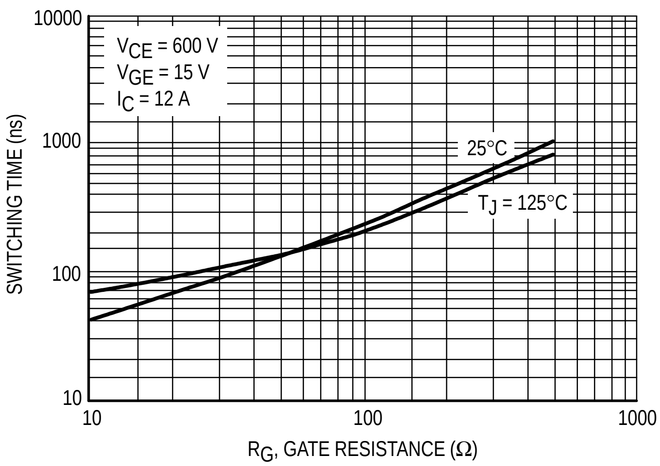


Figure 10. Inverter Switching Time t_r versus Gate Resistance R_G

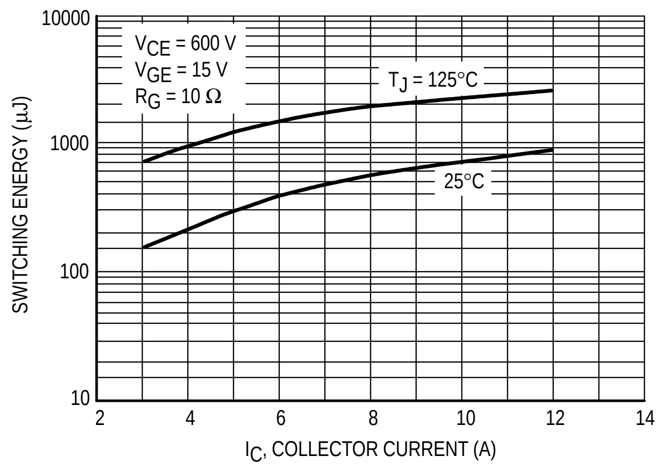


Figure 11. Inverter Switching Energy $E_{(off)}$ versus Collector Current I_C

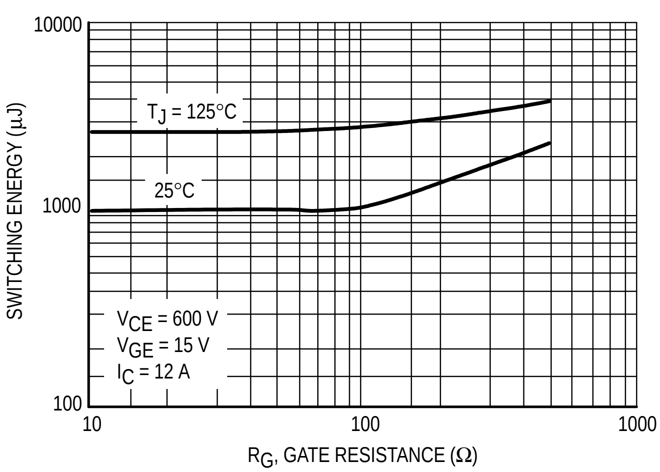


Figure 12. Inverter Switching Energy $E_{(off)}$ versus Gate Resistance R_G

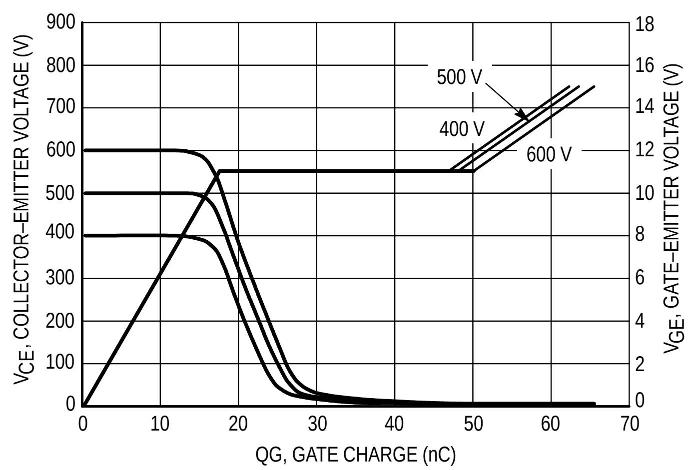


Figure 13. Gate–to–Emitter Voltage versus Gate Charge

Typical Characteristics

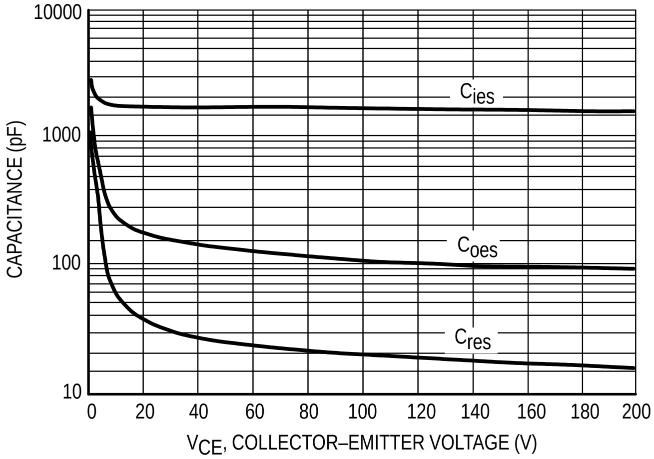


Figure 14. Output Inverter Capacitance versus Collector Voltage V_{CE}

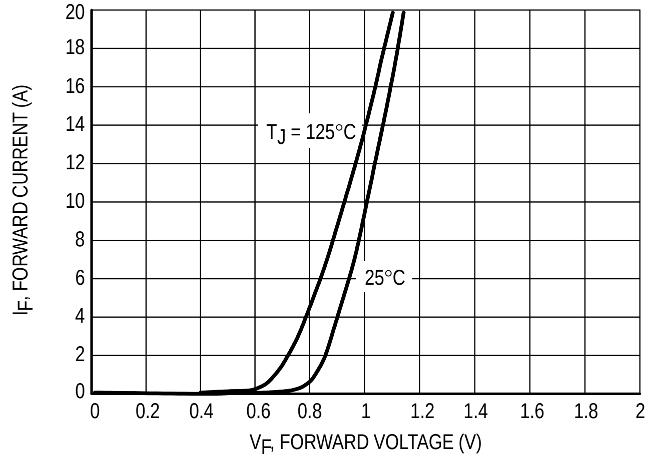


Figure 15. Input Bridge Forward Current I_F versus Forward Voltage V_F

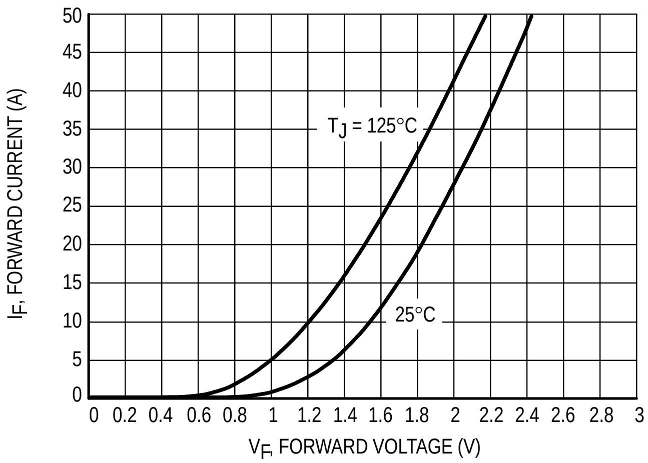


Figure 16. Output Inverter Forward Current I_F versus Forward Voltage V_F

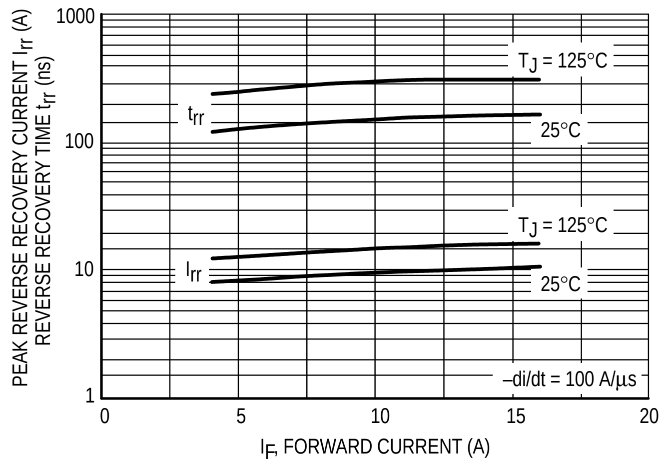


Figure 17. Output Inverter Reverse Recovery t_{rr}, I_{rr} versus Forward Current I_F

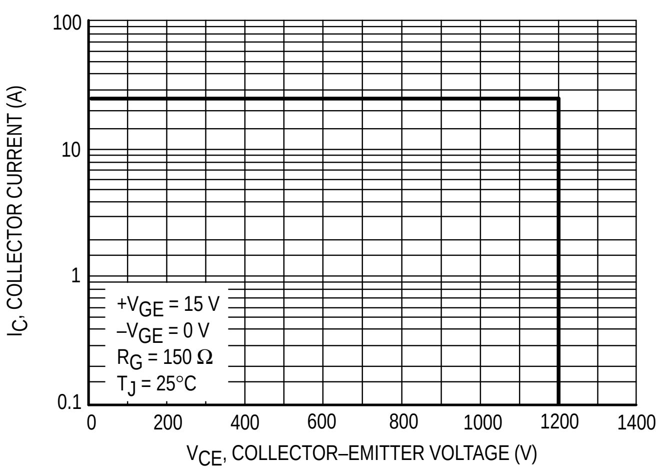


Figure 18. Output Inverter Reversed Biased Safe Operating Area

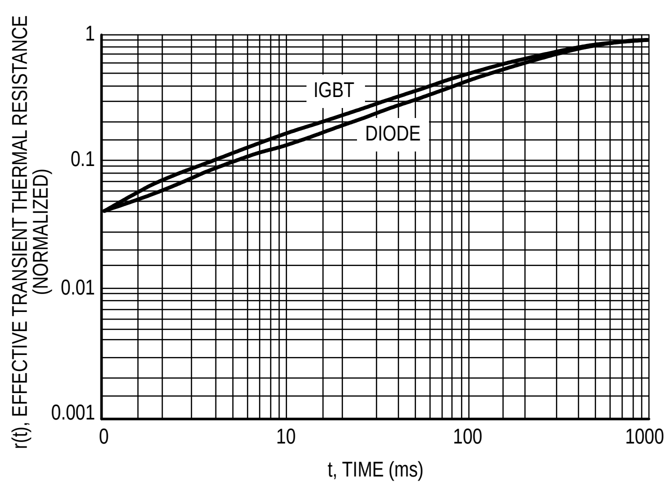
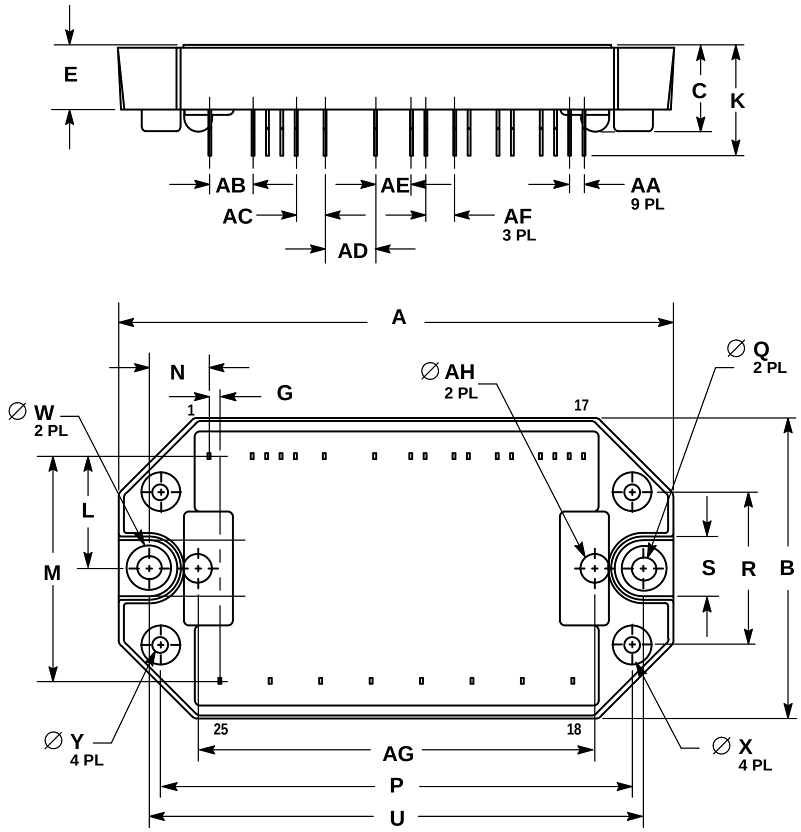
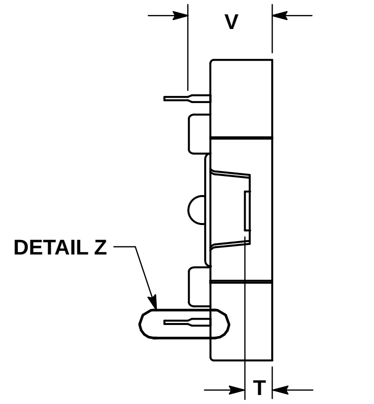
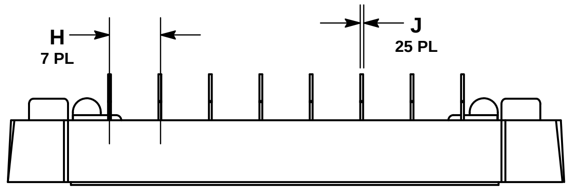


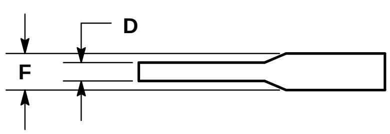
Figure 19. Transient Thermal Resistance

PACKAGE DIMENSIONS









DETAIL Z

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

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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