Hybrid Power Module

Integrated Power Stage for 1.0 hp Motor Drives

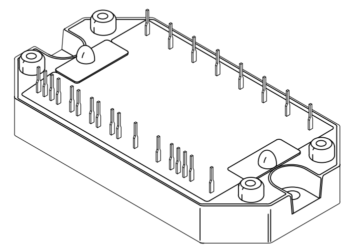
(This device is not recommended for new designs)
(This device is replaced by MHPM7A10E60DC3)

MHPM7B15A60A

15 AMP, 600 VOLT
HYBRID POWER MODULE

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, 300V
- Pin-to-Baseplate Isolation exceeds 2500 Vac (rms)
- Convenient Package Outline
- UL Recognized
- Access to Positive and Negative DC Bus
- Visit our website at http://www.mot–sps.com/tsg/



PLASTIC PACKAGE
CASE 440-02, Style 1

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

Rating	Symbol	Value	Unit
INPUT RECTIFIER BRIDGE			
Peak Repetitive Reverse Voltage (T_J = 125°C)	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_{Cmax}	15	A
Peak Repetitive IGBT Collector Current(2)	$I_{C(pk)}$	30	A
Continuous Free-Wheeling Diode Current	I_{Fmax}	15	A
Peak Repetitive Free-Wheeling Diode Current(2)	$I_{F(pk)}$	30	A
IGBT Power Dissipation per die (T_C = 95°C)	P_D	55	W
Free-Wheeling Diode Power Dissipation per die (T_C = 95°C)	P_D	30	W
Junction Temperature Range	T_J	– 40 to +125	°C
Short Circuit Duration (V_{CE} = 300V, T_J = 25°C)	t_{sc}	10	µs

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

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_{Cmax}	15	A
Peak Repetitive IGBT Collector Current(2)	$I_{C(pk)}$	30	A
IGBT Power Dissipation (T_C = 95°C)	PD	55	W
Peak Repetitive Output Diode Reverse Voltage (T_J = 125°C)	V_{RRM}	600	V
Continuous Output Diode Current	I_{Fmax}	15	A
Peak Output Diode Current(2)	$I_{F(pk)}$	30	A
TOTAL MODULE			
Isolation Voltage (47–63 Hz, 1.0 Minute Duration)	V_{ISO}	2500	Vac
Operating Case Temperature Range	T_C	– 40 to + 90	°C
Storage Temperature Range	T_{stg}	– 40 to +125	°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	—	5.0	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}	 — —	 6.0 2000	 100 —	µA
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	—	—	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)	C_{ies}	—	2300	—	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, $R_{G(off)}$ = 20 Ω)	t_f	—	210	500	ns
Turn-On Energy (V_{CE} = 300 V, I_C = 15 A, V_{GE} = 15 V, $R_{G(on)}$ = 180 Ω)	E_{on}	—	—	1.0	mJ
Turn-Off Energy (V_{CE} = 300 V, I_C = 15 A, V_{GE} = 15 V, $R_{G(off)}$ = 20 Ω)	E_{off}	—	—	1.0	mJ
Free Wheeling Diode Forward Voltage (I_F = 15 A, V_{GE} = 0 V)	V_F	—	1.3	2.0	V
Free Wheeling Diode Reverse Recovery Time (I_F = 15 A, V = 300 V, di/dt = 100 A/µs)	t_{rr}	—	140	200	ns
Free Wheeling Diode Stored Charge (I_F = 15 A, V = 300 V, di/dt = 100 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) T_J = 25°C T_J = 125°C	I_{CES}	— —	6.0 2000	100	µA
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	—	—	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)	C_{ies}	—	2300	—	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, $R_{G(off)}$ = 20 Ω)	t_f	—	210	500	ns
Turn-On Energy (V_{CE} = 300 V, I_C = 15 A, V_{GE} = 15 V, $R_{G(on)}$ = 180 Ω)	$E_{(on)}$	—	—	1.0	mJ
Turn-Off Energy (V_{CE} = 300 V, I_C = 15 A, V_{GE} = 15 V, $R_{G(off)}$ = 20 Ω)	$E_{(off)}$	—	—	1.0	mJ
Output Diode Forward Voltage (I_F = 15 A)	V_F	—	1.3	2.0	V
Output Diode Reverse Leakage Current	I_R	—	—	50	µA
Thermal Resistance — IGBT	$R_{\theta JC}$	—	—	1.9	°C/W
Thermal Resistance — Output Diode	$R_{\theta JC}$	—	—	3.7	°C/W

Typical Characteristics

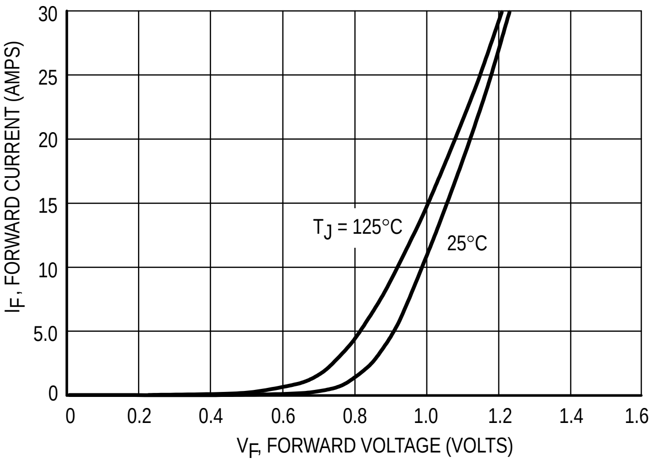


Figure 1. Forward Characteristics — Input Rectifier

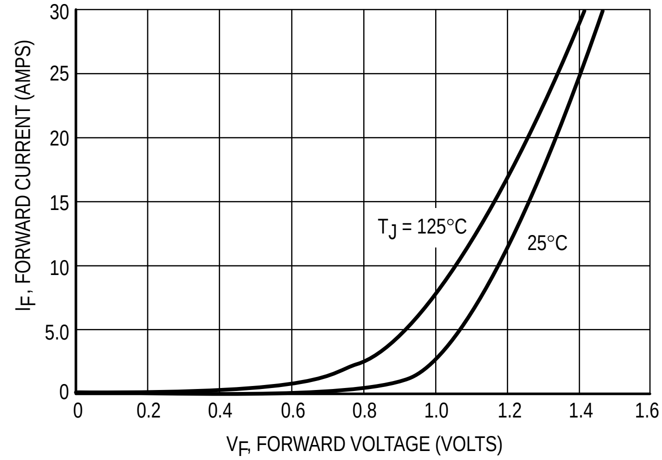


Figure 2. Forward Charactristics — Free–Wheeling Diode

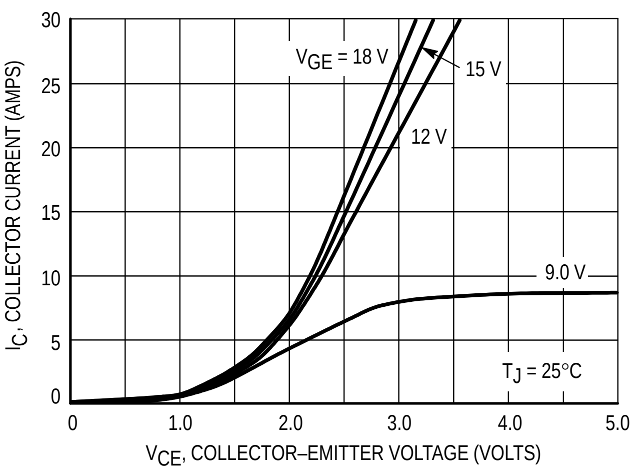


Figure 3. Forward Characteristics, T_J = 25°C

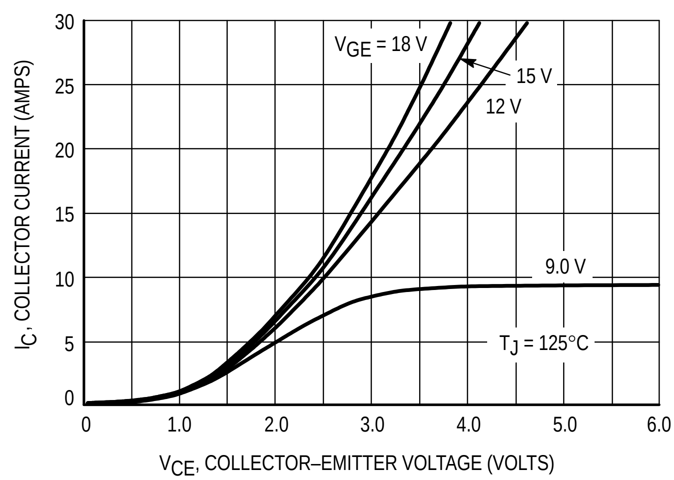


Figure 4. Forward Characteristics, T_J = 125°C

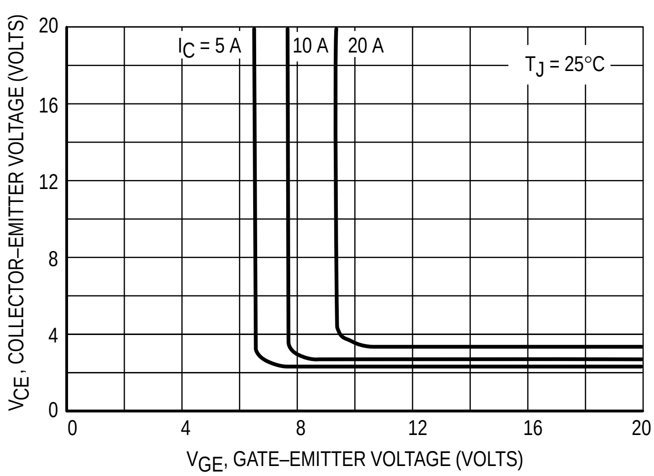


Figure 5. Collector–Emitter Voltage versus Gate–Emitter Voltage

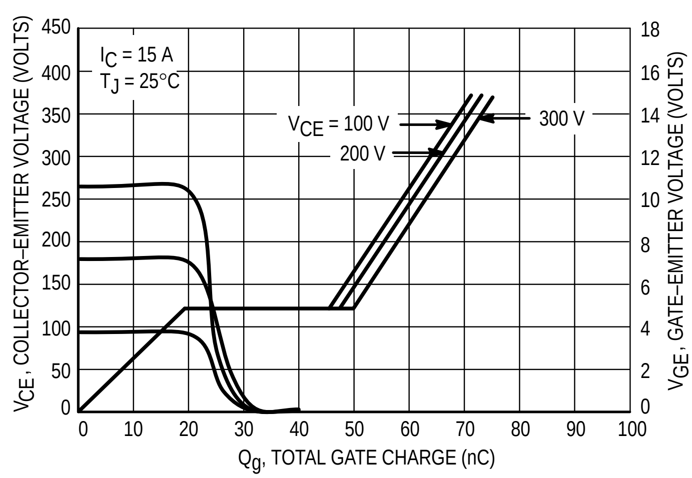


Figure 6. Collector–Emitter and Gate–Emitter Voltages versus Total Gate Charge

Typical Characteristics

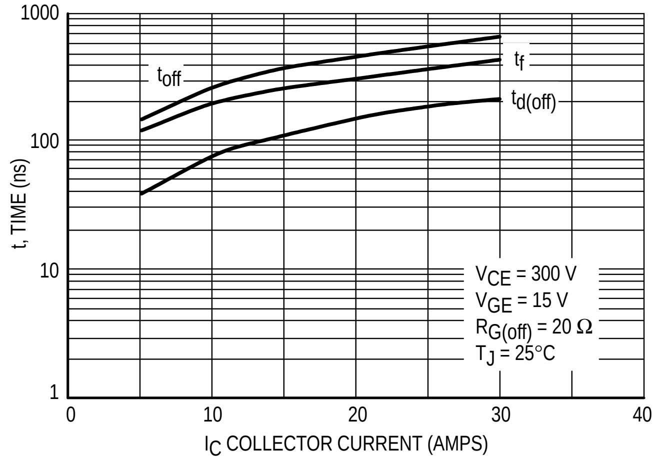


Figure 7. Inductive Switching Times versus Collector Current, T_J = 25°C

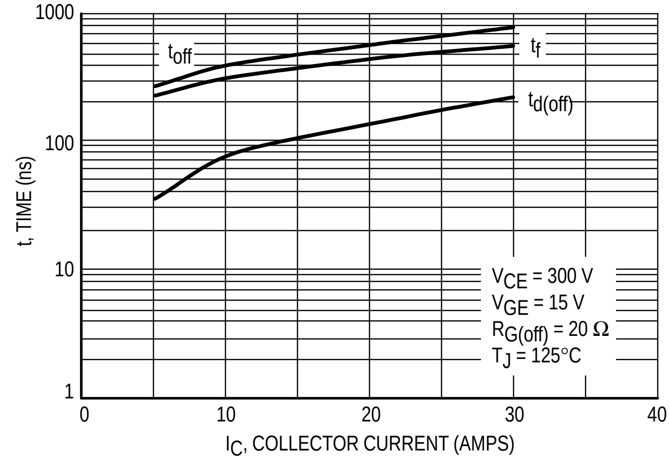


Figure 8. Inductive Switching Times versus Collector Current, T_J = 125°C

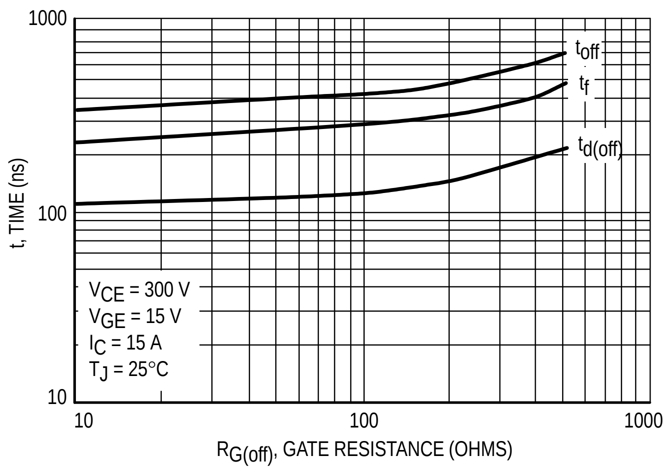


Figure 9. Inductive Switching Times versus Gate Resistance

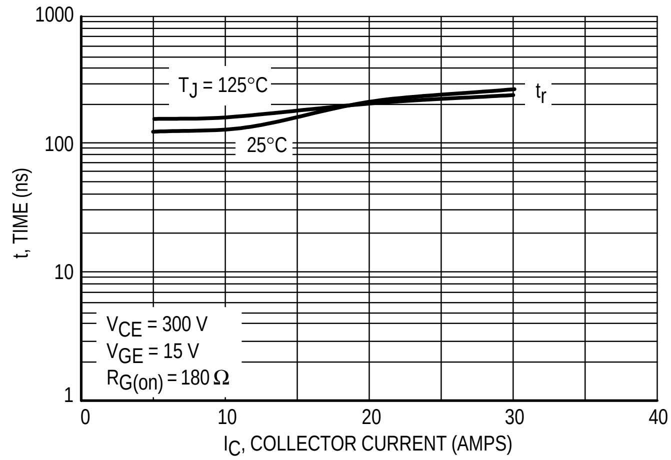


Figure 10. Inductive Switching Times versus Collector Current

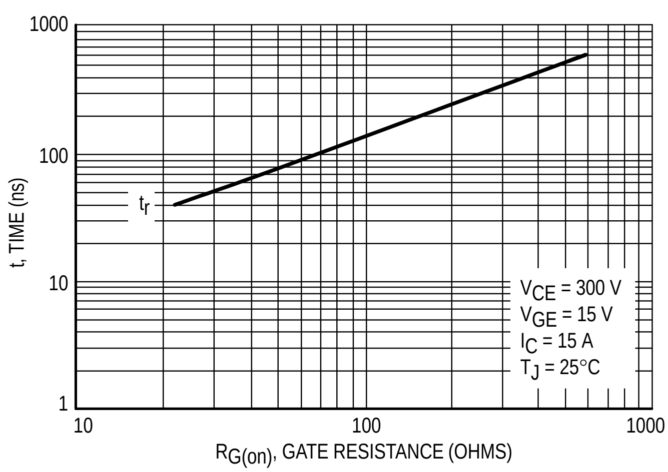


Figure 11. Inductive Switching Times versus Gate Resistance

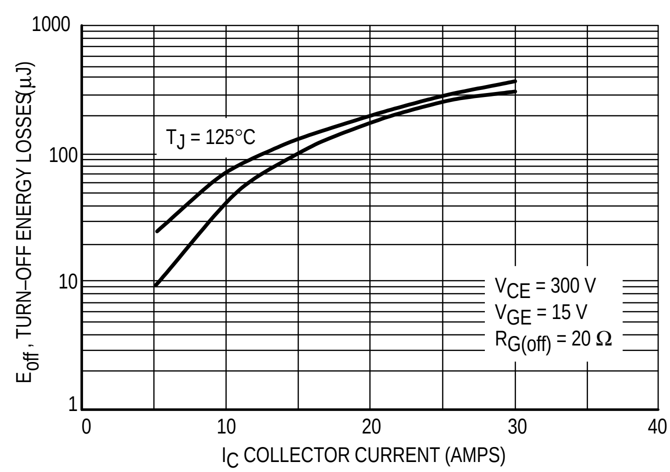


Figure 12. Turn–Off Energy Losses versus Collector Current

Typical Characteristics

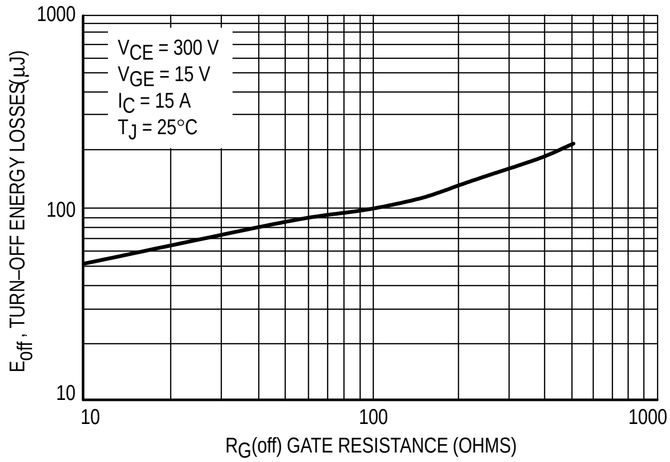


Figure 13. Turn–Off Energy Losses versus Gate Resistance

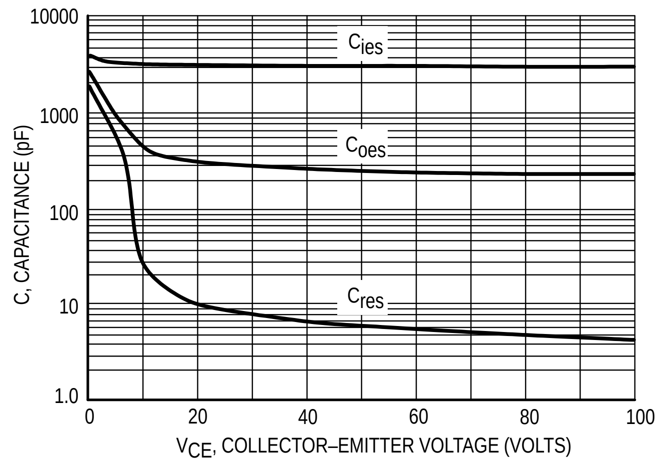


Figure 14. Capacitance Variation

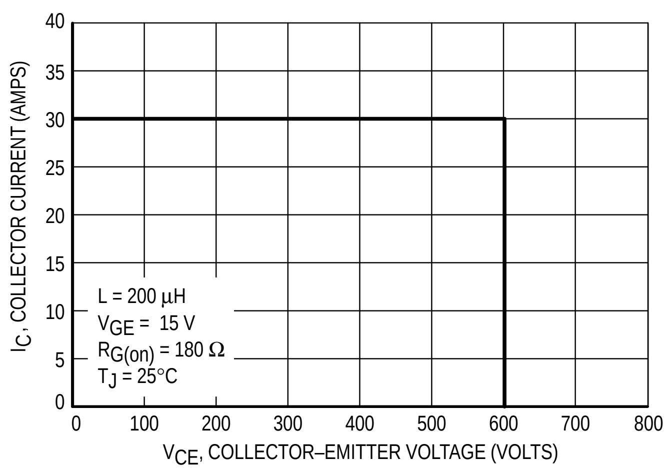


Figure 15. Reverse Biased Safe Operating Area (RBSOA)

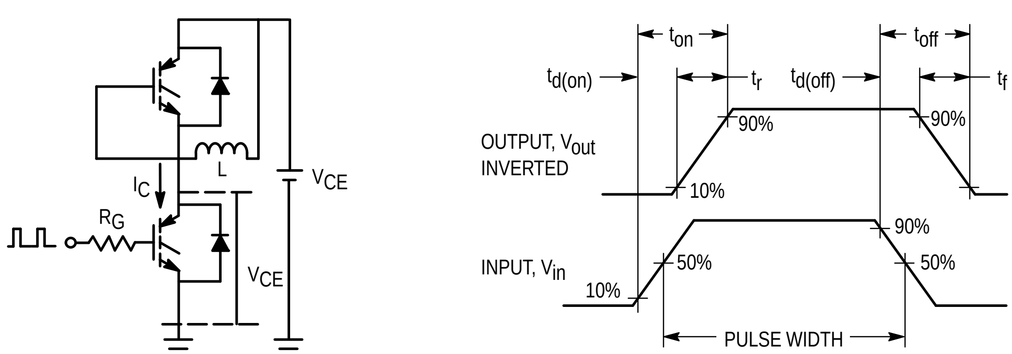


Figure 16. Inductive Switching Time Test Circuit and Timing Chart

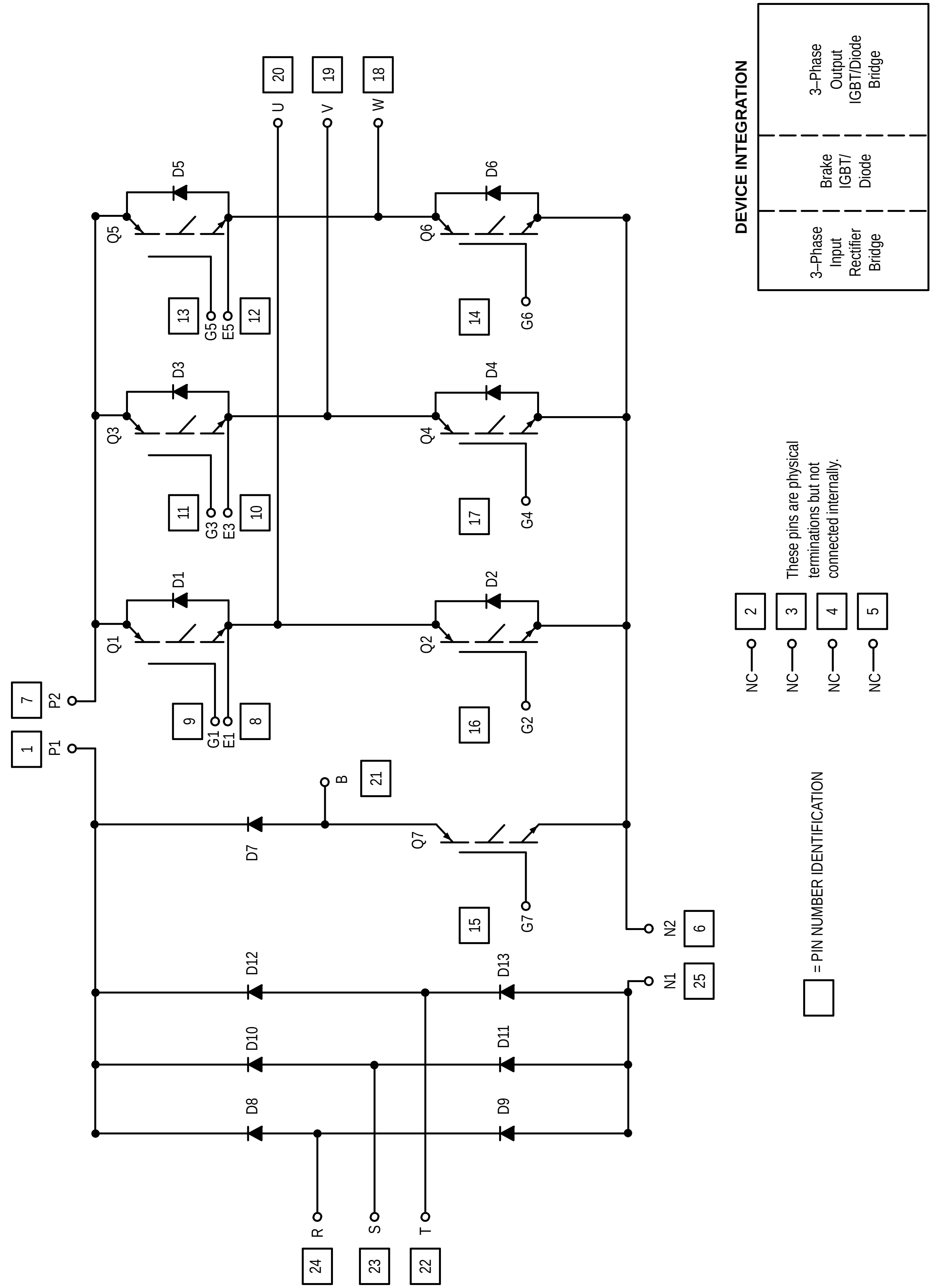
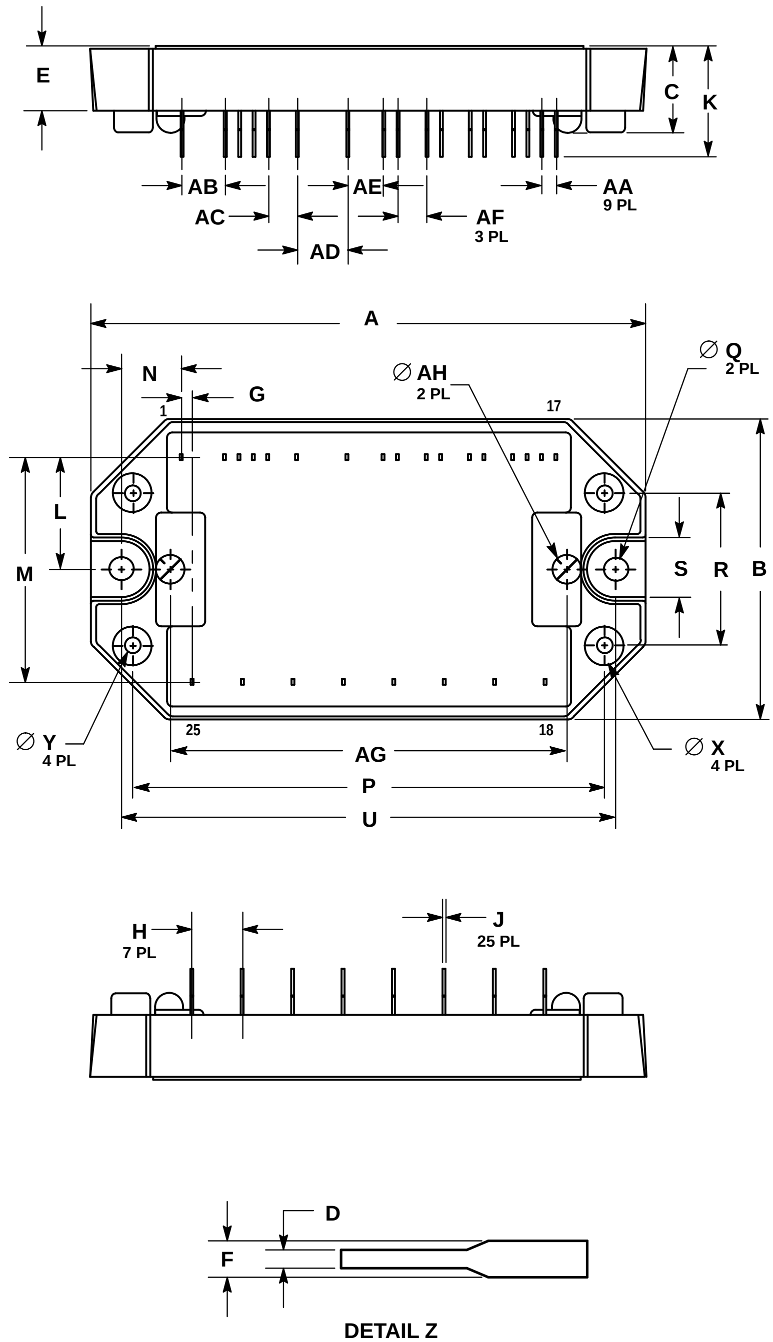
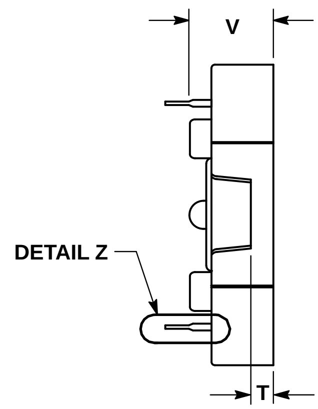


Figure 17. Integrated Power Stage Schematic

PACKAGE DIMENSIONS





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

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	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
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

CASE 440-02
ISSUE A

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