


Hybrid Power Module

Integrated Power Stage for 1.0 hp Motor Drives

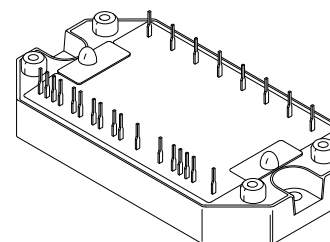
(This device is not recommended for new designs)
(This device is replaced by MHPM7A10E60DC3)

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 μ s @ 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/>

MHPM7B15A60A

**15 AMP, 600 VOLT
HYBRID POWER MODULE**



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



MHPM7B15A60A

MAXIMUM DEVICE RATINGS (continued) ($T_J = 25^\circ\text{C}$ 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 ($T_C = 95^\circ\text{C}$) | PD | 55 | W |
| Peak Repetitive Output Diode Reverse Voltage ($T_J = 125^\circ\text{C}$) | 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 | $^\circ\text{C}$ |
| Storage Temperature Range | T_{stg} | -40 to +125 | $^\circ\text{C}$ |
| Mounting Torque | — | 6.0 | lb-in |

ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|--|-----------------|--------|-------------|----------|--------------------|
| INPUT RECTIFIER BRIDGE | | | | | |
| Reverse Leakage Current ($V_{RRM} = 600\text{ V}$) | I_R | — | 5.0 | 50 | μA |
| Forward Voltage ($I_F = 15\text{ A}$) | V_F | — | 1.05 | 1.5 | V |
| Thermal Resistance (Each Die) | $R_{\theta JC}$ | — | — | 2.9 | $^\circ\text{C/W}$ |
| OUTPUT INVERTER | | | | | |
| Gate-Emitter Leakage Current ($V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$) | I_{GES} | — | — | ± 20 | μA |
| Collector-Emitter Leakage Current ($V_{CE} = 600\text{ V}$, $V_{GE} = 0\text{ V}$) $T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$ | I_{CES} | — — | 6.0 2000 | 100 — | μA |
| Gate-Emitter Threshold Voltage ($V_{CE} = V_{GE}$, $I_C = 1.0\text{ mA}$) | $V_{GE(th)}$ | 4.0 | 6.0 | 8.0 | V |
| Collector-Emitter Breakdown Voltage ($I_C = 10\text{ mA}$, $V_{GE} = 0$) | $V_{(BR)CES}$ | 600 | — | — | V |
| Collector-Emitter Saturation Voltage ($V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$) | $V_{CE(SAT)}$ | — | 2.7 | 3.5 | V |
| Input Capacitance ($V_{GE} = 0\text{ V}$, $V_{CE} = 10\text{ V}$, $f = 1.0\text{ MHz}$) | C_{ies} | — | 2300 | — | pF |
| Input Gate Charge ($V_{CE} = 300\text{ V}$, $I_C = 15\text{ A}$, $V_{GE} = 15\text{ V}$) | Q_T | — | 75 | — | nC |
| Fall Time — Inductive Load ($V_{CE} = 300\text{ V}$, $I_C = 15\text{ A}$, $V_{GE} = 15\text{ V}$, $R_{G(off)} = 20\ \Omega$) | t_f | — | 210 | 500 | ns |
| Turn-On Energy ($V_{CE} = 300\text{ V}$, $I_C = 15\text{ A}$, $V_{GE} = 15\text{ V}$, $R_{G(on)} = 180\ \Omega$) | E_{on} | — | — | 1.0 | mJ |
| Turn-Off Energy ($V_{CE} = 300\text{ V}$, $I_C = 15\text{ A}$, $V_{GE} = 15\text{ V}$, $R_{G(off)} = 20\ \Omega$) | E_{off} | — | — | 1.0 | mJ |
| Free Wheeling Diode Forward Voltage ($I_F = 15\text{ A}$, $V_{GE} = 0\text{ V}$) | V_F | — | 1.3 | 2.0 | V |
| Free Wheeling Diode Reverse Recovery Time ($I_F = 15\text{ A}$, $V = 300\text{ V}$, $di/dt = 100\text{ A}/\mu\text{s}$) | t_{rr} | — | 140 | 200 | ns |
| Free Wheeling Diode Stored Charge ($I_F = 15\text{ A}$, $V = 300\text{ V}$, $di/dt = 100\text{ A}/\mu\text{s}$) | Q_{rr} | — | — | 900 | nC |
| Thermal Resistance — IGBT (Each Die) | $R_{\theta JC}$ | — | — | 1.9 | $^\circ\text{C/W}$ |
| Thermal Resistance — Free-Wheeling Diode (Each Die) | $R_{\theta JC}$ | — | — | 3.7 | $^\circ\text{C/W}$ |

(2) 1.0 ms = 1.0% duty cycle

ELECTRICAL CHARACTERISTICS (continued) ($T_J = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|--|-----------------|--------|-------------|----------|--------------------|
| BRAKE CIRCUIT | | | | | |
| Gate-Emitter Leakage Current ($V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$) | I_{GES} | — | — | ± 20 | μA |
| Collector-Emitter Leakage Current ($V_{CE} = 600\text{ V}$, $V_{GE} = 0\text{ V}$) $T_J = 25^\circ\text{C}$ $T_J = 125^\circ\text{C}$ | I_{CES} | — — | 6.0 2000 | 100 | μA |
| Gate-Emitter Threshold Voltage ($V_{CE} = V_{GE}$, $I_C = 1.0\text{ mA}$) | $V_{GE(th)}$ | 4.0 | 6.0 | 8.0 | V |
| Collector-Emitter Breakdown Voltage ($I_C = 10\text{ mA}$, $V_{GE} = 0$) | $V_{(BR)CES}$ | 600 | — | — | V |
| Collector-Emitter Saturation Voltage ($V_{GE} = 15\text{ V}$, $I_C = 15\text{ A}$) | $V_{CE(SAT)}$ | — | 2.7 | 3.5 | V |
| Input Capacitance ($V_{GE} = 0\text{ V}$, $V_{CE} = 10\text{ V}$, $f = 1.0\text{ MHz}$) | C_{ies} | — | 2300 | — | pF |
| Input Gate Charge ($V_{CE} = 300\text{ V}$, $I_C = 15\text{ A}$, $V_{GE} = 15\text{ V}$) | Q_T | — | 75 | — | nC |
| Fall Time — Inductive Load ($V_{CE} = 300\text{ V}$, $I_C = 15\text{ A}$, $V_{GE} = 15\text{ V}$, $R_{G(off)} = 20\ \Omega$) | t_f | — | 210 | 500 | ns |
| Turn-On Energy ($V_{CE} = 300\text{ V}$, $I_C = 15\text{ A}$, $V_{GE} = 15\text{ V}$, $R_{G(on)} = 180\ \Omega$) | $E_{(on)}$ | — | — | 1.0 | mJ |
| Turn-Off Energy ($V_{CE} = 300\text{ V}$, $I_C = 15\text{ A}$, $V_{GE} = 15\text{ V}$, $R_{G(off)} = 20\ \Omega$) | $E_{(off)}$ | — | — | 1.0 | mJ |
| Output Diode Forward Voltage ($I_F = 15\text{ A}$) | V_F | — | 1.3 | 2.0 | V |
| Output Diode Reverse Leakage Current | I_R | — | — | 50 | μA |
| Thermal Resistance — IGBT | $R_{\theta JC}$ | — | — | 1.9 | $^\circ\text{C/W}$ |
| Thermal Resistance — Output Diode | $R_{\theta JC}$ | — | — | 3.7 | $^\circ\text{C/W}$ |

Typical Characteristics

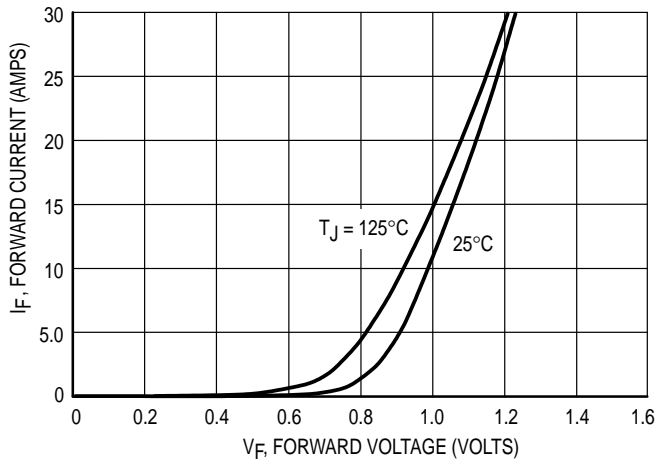


Figure 1. Forward Characteristics — Input Rectifier

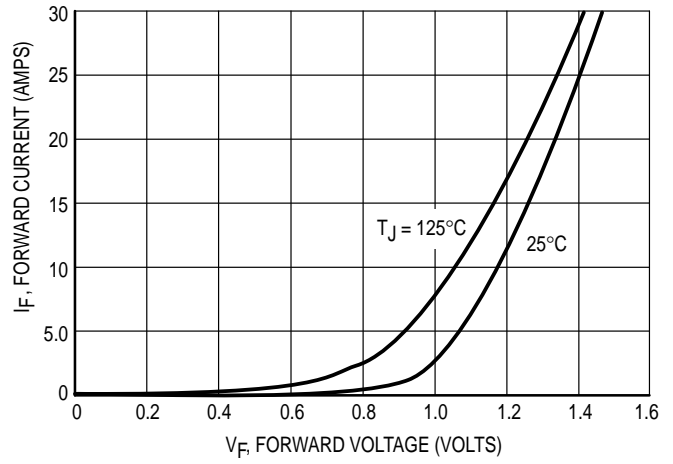


Figure 2. Forward Characteristics — Free-Wheeling Diode

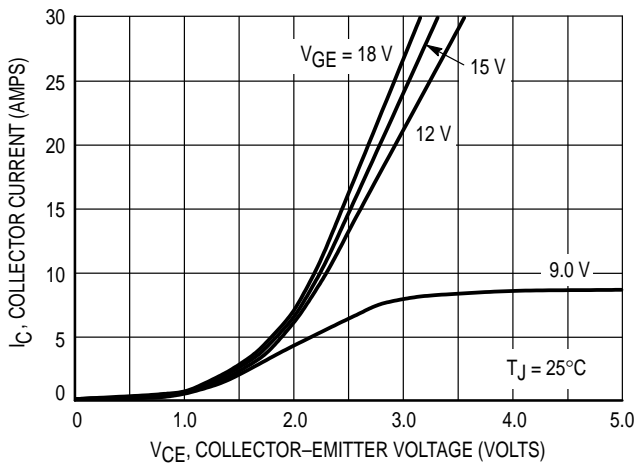


Figure 3. Forward Characteristics, $T_J = 25^\circ\text{C}$

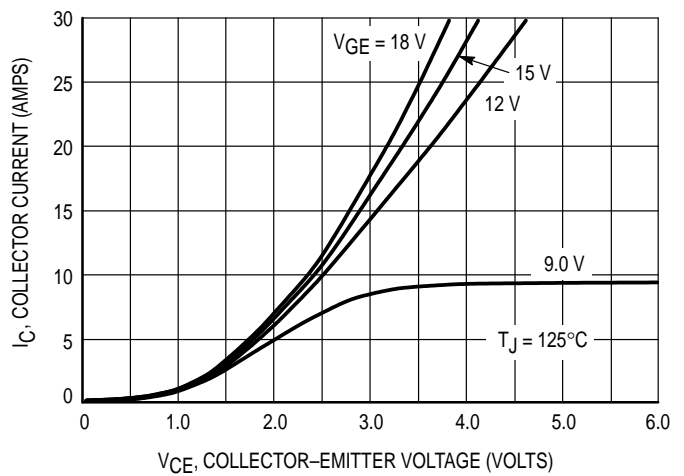


Figure 4. Forward Characteristics, $T_J = 125^\circ\text{C}$

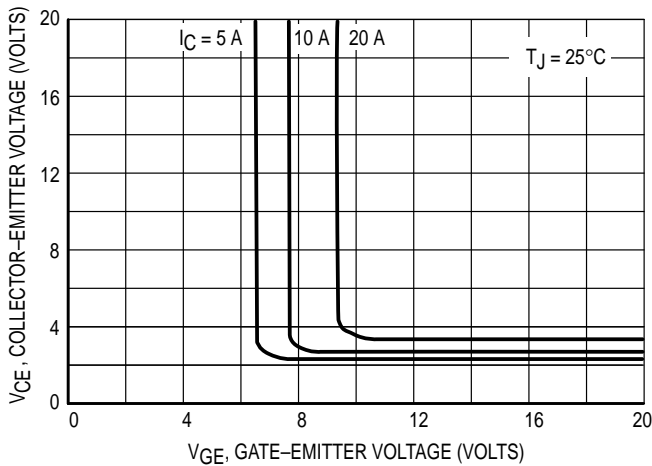


Figure 5. Collector-Emitter Voltage versus Gate-Emitter Voltage

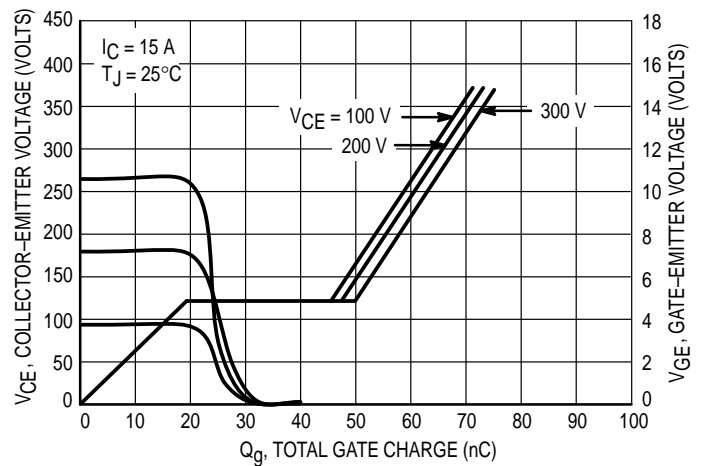


Figure 6. Collector-Emitter and Gate-Emitter Voltages versus Total Gate Charge

Typical Characteristics

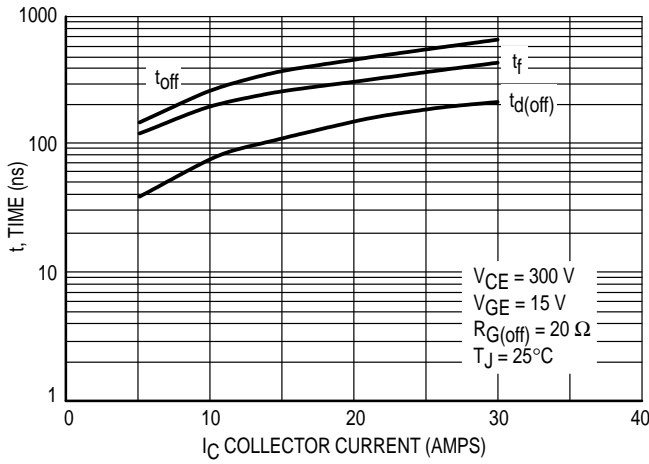


Figure 7. Inductive Switching Times versus Collector Current, $T_J = 25^\circ\text{C}$

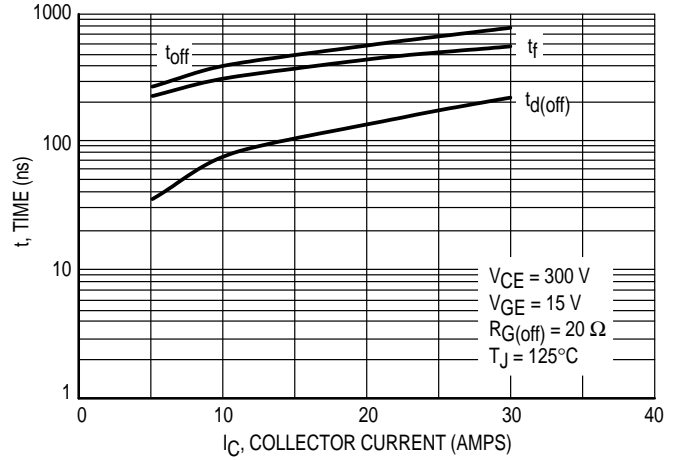


Figure 8. Inductive Switching Times versus Collector Current, $T_J = 125^\circ\text{C}$

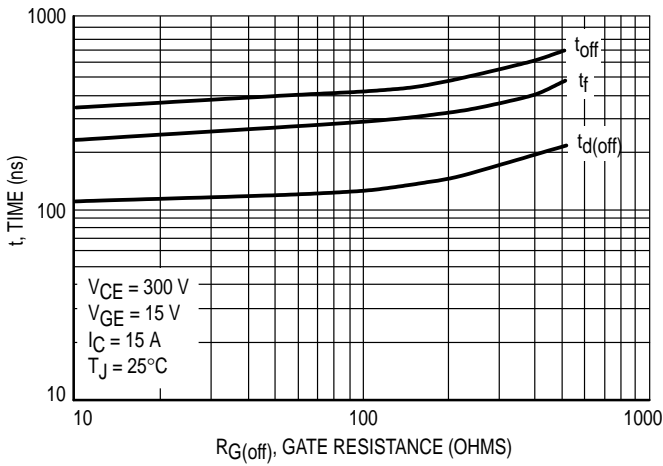


Figure 9. Inductive Switching Times versus Gate Resistance

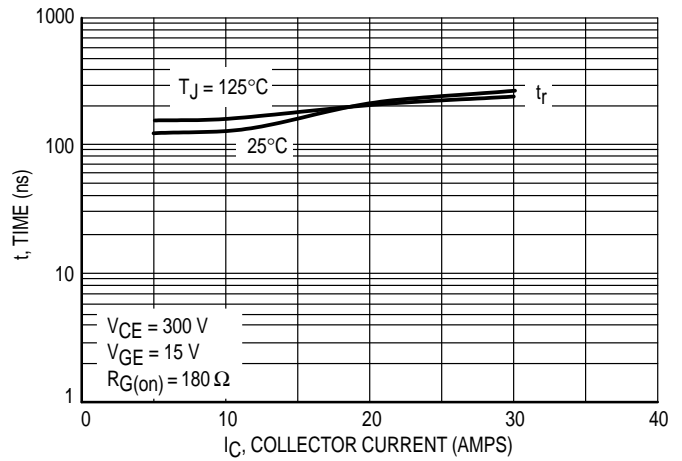


Figure 10. Inductive Switching Times versus Collector Current

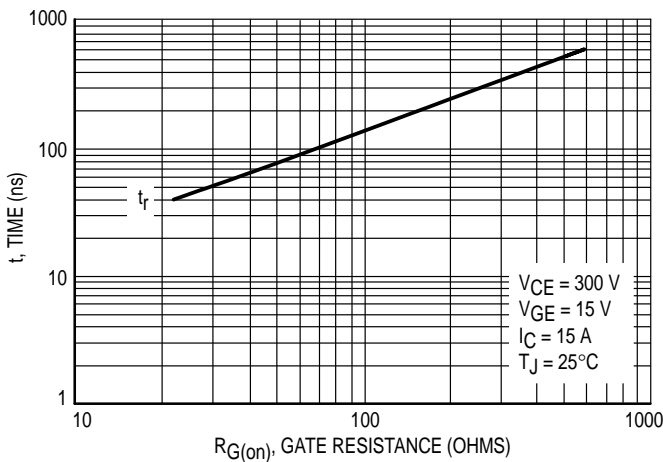


Figure 11. Inductive Switching Times versus Gate Resistance

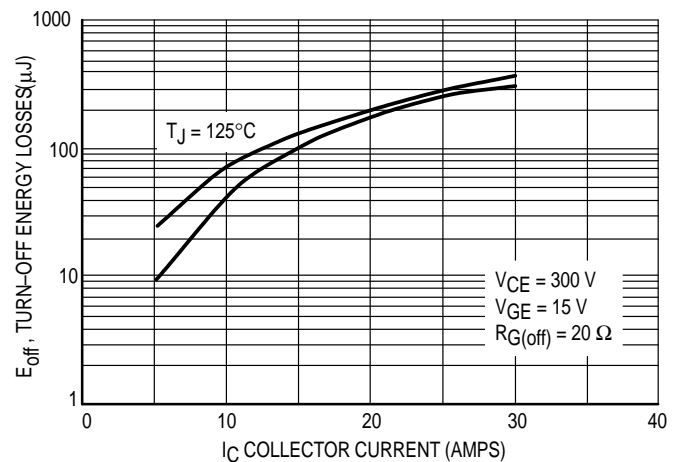


Figure 12. Turn-Off Energy Losses versus Collector Current

Typical Characteristics

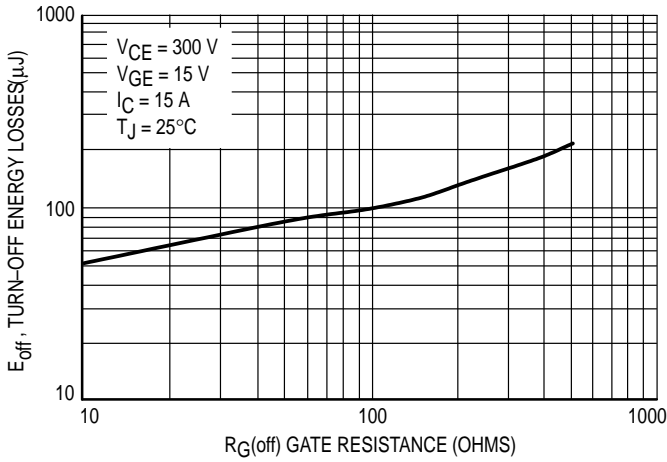


Figure 13. Turn-Off Energy Losses versus Gate Resistance

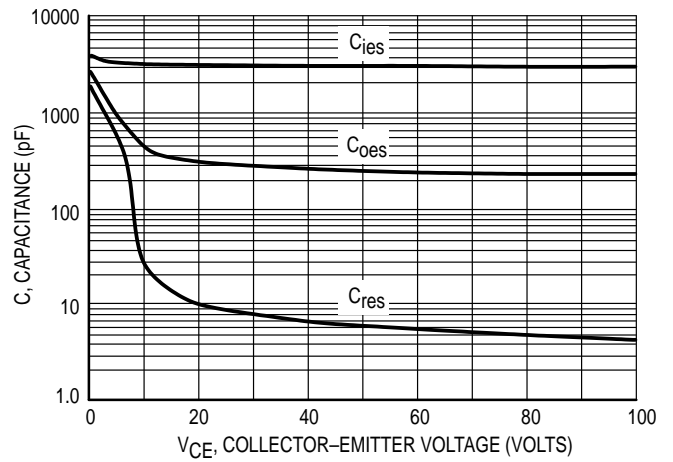


Figure 14. Capacitance Variation

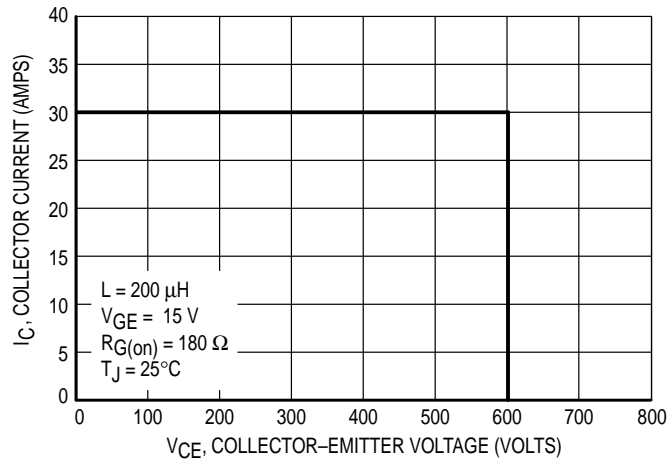


Figure 15. Reverse Biased Safe Operating Area (RBSOA)

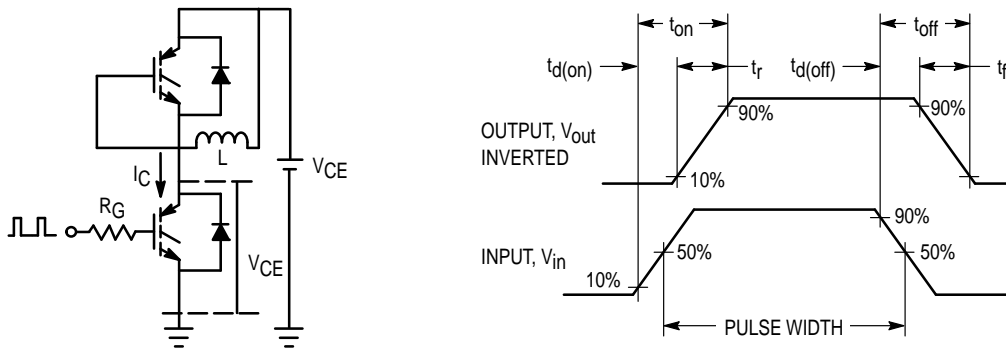


Figure 16. Inductive Switching Time Test Circuit and Timing Chart

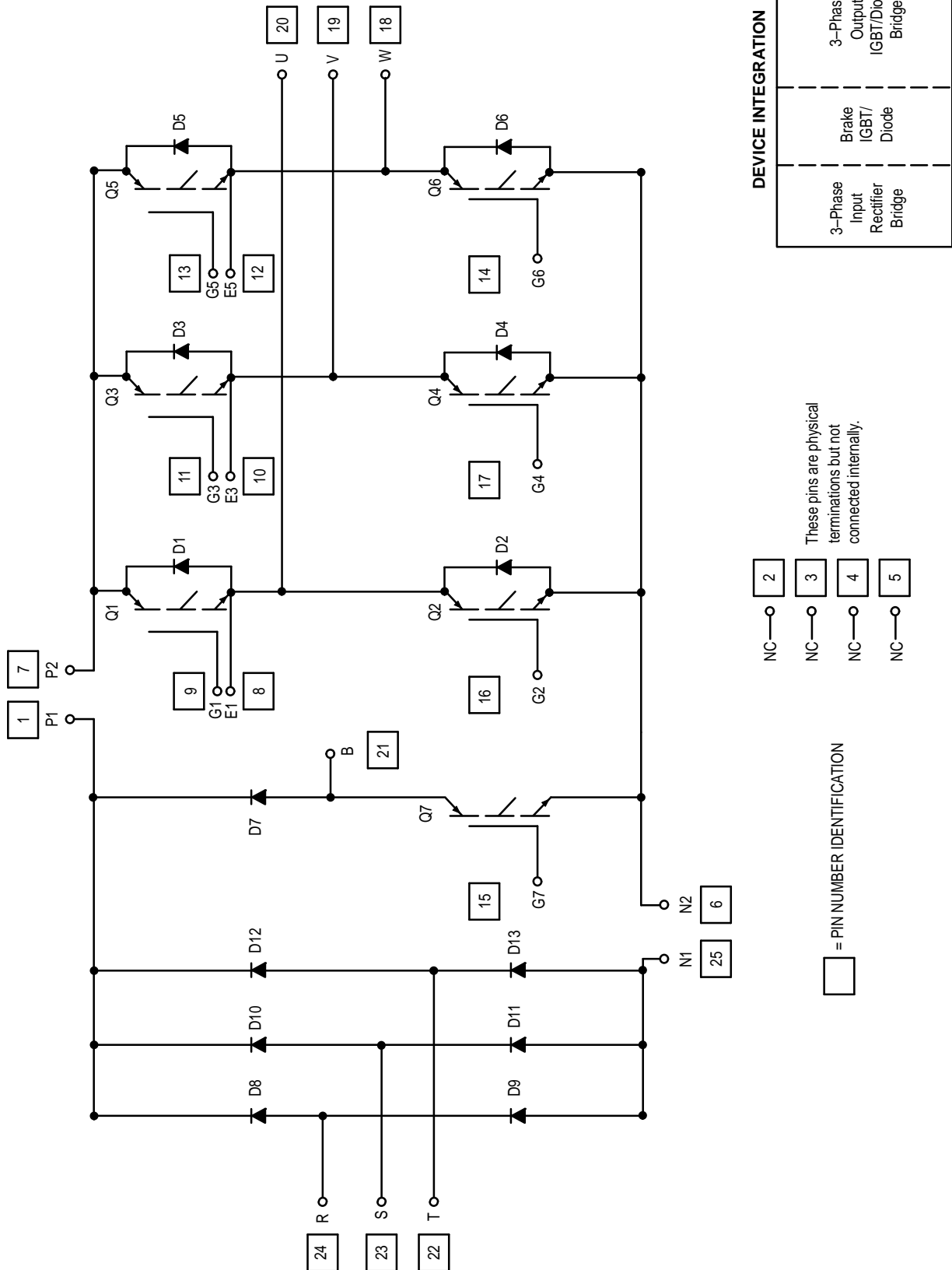
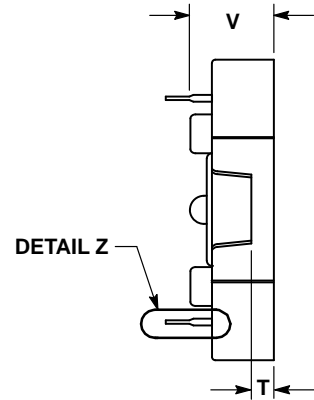
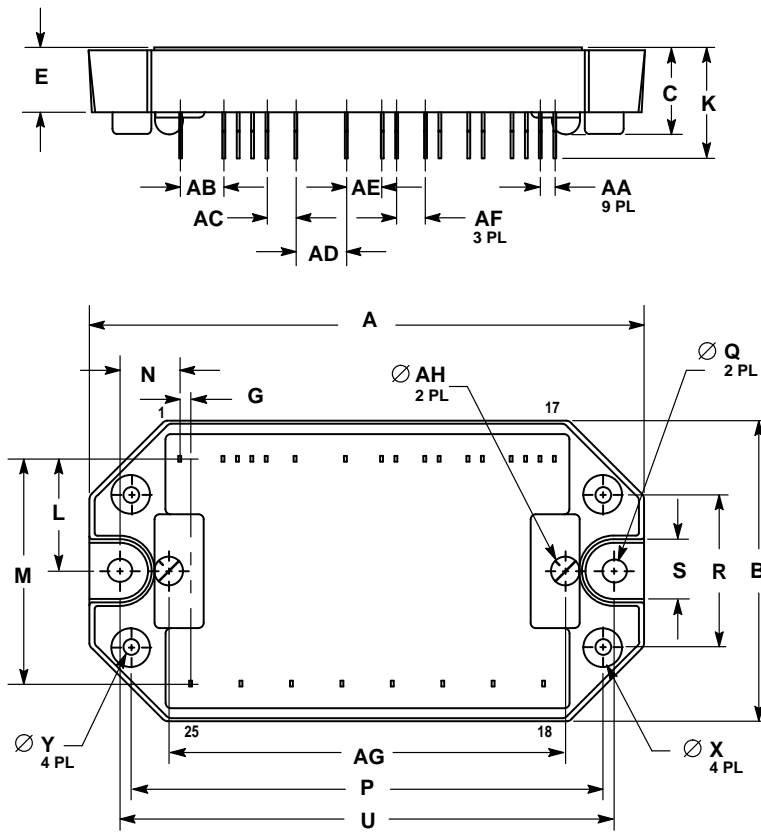
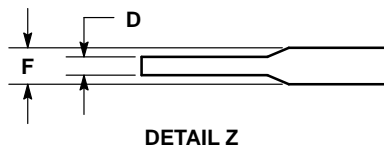
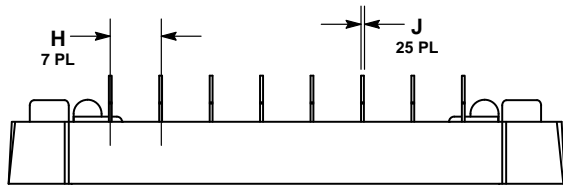


Figure 17. Integrated Power Stage Schematic

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.



| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|-------|--------|-------|
| | 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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