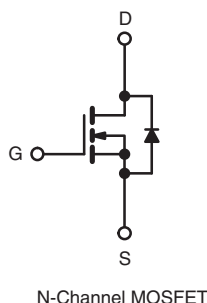
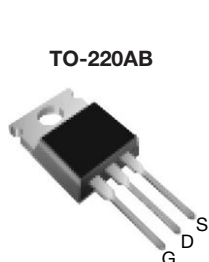


E Series Power MOSFET

PRODUCT SUMMARY

| | | |
|---|-----------------|------|
| V_{DS} (V) at T_J max. | 650 | |
| $R_{DS(on)}$ max. at 25 °C (Ω) | $V_{GS} = 10$ V | 0.38 |
| Q_g max. (nC) | 58 | |
| Q_{gs} (nC) | 6 | |
| Q_{gd} (nC) | 13 | |
| Configuration | Single | |



FEATURES

- Low Figure-of-Merit (FOM) $R_{on} \times Q_g$
- Low Input Capacitance (C_{iss})
- Reduced Switching and Conduction Losses
- Ultra Low Gate Charge (Q_g)
- Avalanche Energy Rated (UIS)
- Material categorization: For definitions please see www.vishay.com/doc?99912



RoHS
COMPLIANT
HALOGEN
FREE
Available

APPLICATIONS

- Server and Telecom Power Supplies
- Switch Mode Power Supplies (SMPS)
- Power Factor Correction Power Supplies (PFC)
- Lighting
 - High-Intensity Discharge (HID)
 - Fluorescent Ballast Lighting
- Industrial
 - Welding
 - Induction Heating
 - Motor Drives
 - Battery Chargers
 - Renewable Energy
 - Solar (PV Inverters)

ORDERING INFORMATION

| | |
|---------------------------------|----------------|
| Package | TO-220AB |
| Lead (Pb)-free | SiHP12N60E-E3 |
| Lead (Pb)-free and Halogen-free | SiHP12N60E-GE3 |

ABSOLUTE MAXIMUM RATINGS ($T_C = 25$ °C, unless otherwise noted)

| PARAMETER | SYMBOL | LIMIT | UNIT |
|--|------------------|----------------|------|
| Drain-Source Voltage | V_{DS} | 600 | V |
| Gate-Source Voltage | V_{GS} | ± 20 | |
| Gate-Source Voltage AC ($f > 1$ Hz) | | 30 | |
| Continuous Drain Current ($T_J = 150$ °C) | V_{GS} at 10 V | $T_C = 25$ °C | A |
| | | $T_C = 100$ °C | |
| Pulsed Drain Current ^a | I_{DM} | 27 | W/°C |
| Linear Derating Factor | | 1.2 | |
| Single Pulse Avalanche Energy ^b | E_{AS} | 117 | mJ |
| Maximum Power Dissipation | P_D | 147 | W |
| Operating Junction and Storage Temperature Range | T_J, T_{stg} | - 55 to + 150 | °C |
| Drain-Source Voltage Slope | dV/dt | $T_J = 125$ °C | V/ns |
| Reverse Diode dV/dt ^d | | 5 | |
| Soldering Recommendations (Peak Temperature) | for 10 s | 300° | °C |


Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 50$ V, starting $T_J = 25$ °C, $L = 11.6$ mH, $R_g = 25$ Ω , $I_{AS} = 4.5$ A.
- 1.6 mm from case.
- $I_{SD} \leq I_D$, $dI/dt = 100$ A/ μ s, starting $T_J = 25$ °C.

**THERMAL RESISTANCE RATINGS**

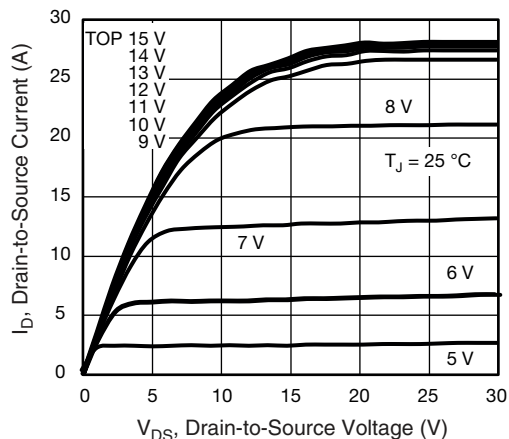
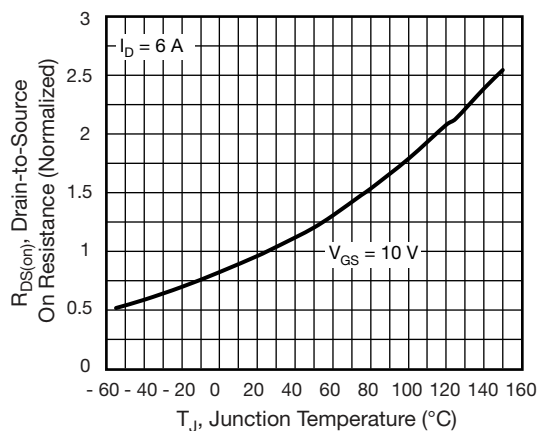
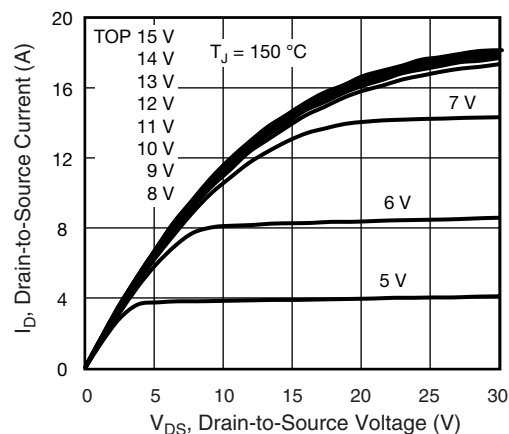
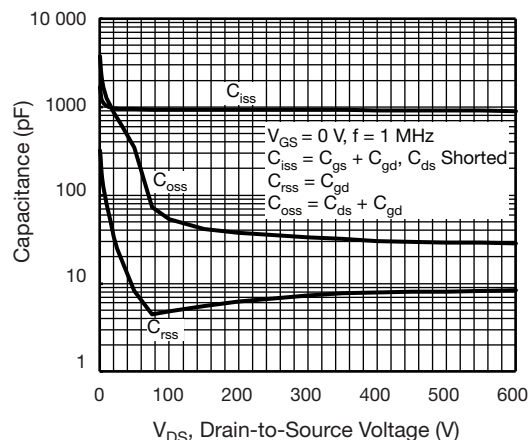
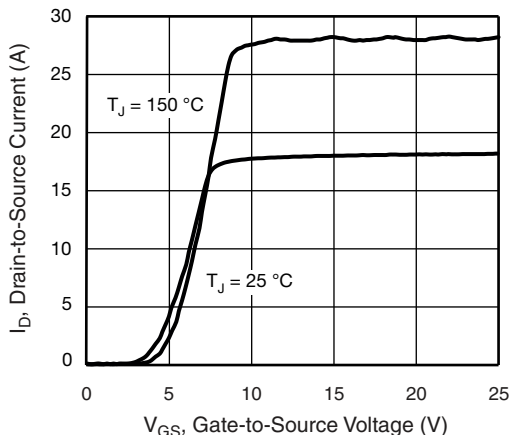
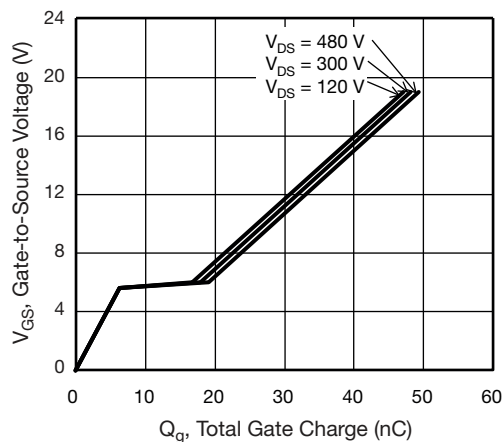
| PARAMETER | SYMBOL | TYP. | MAX. | UNIT |
|----------------------------------|------------|------|------|------|
| Maximum Junction-to-Ambient | R_{thJA} | - | 62 | °C/W |
| Maximum Junction-to-Case (Drain) | R_{thJC} | - | 0.85 | |

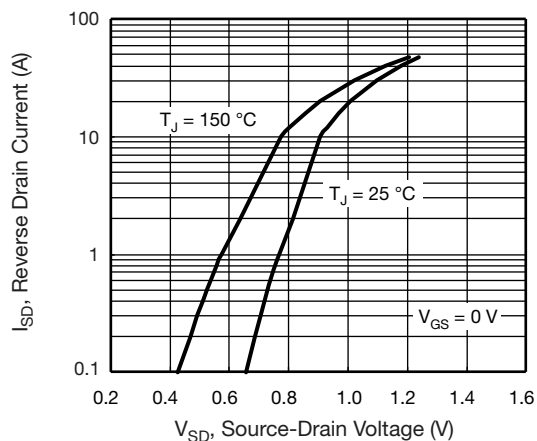
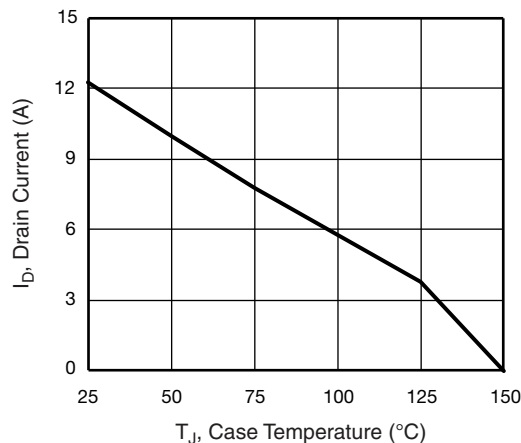
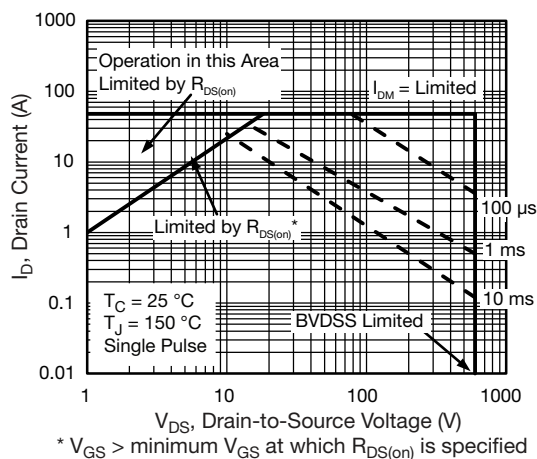
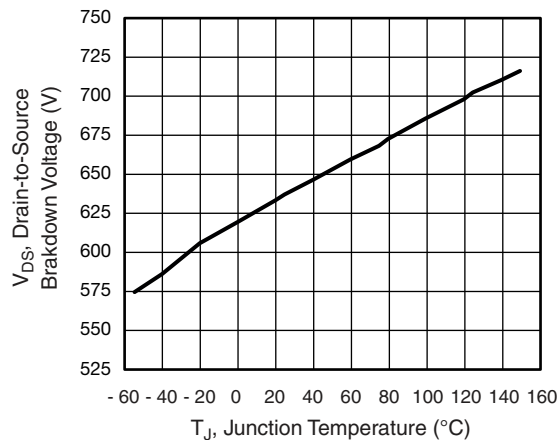
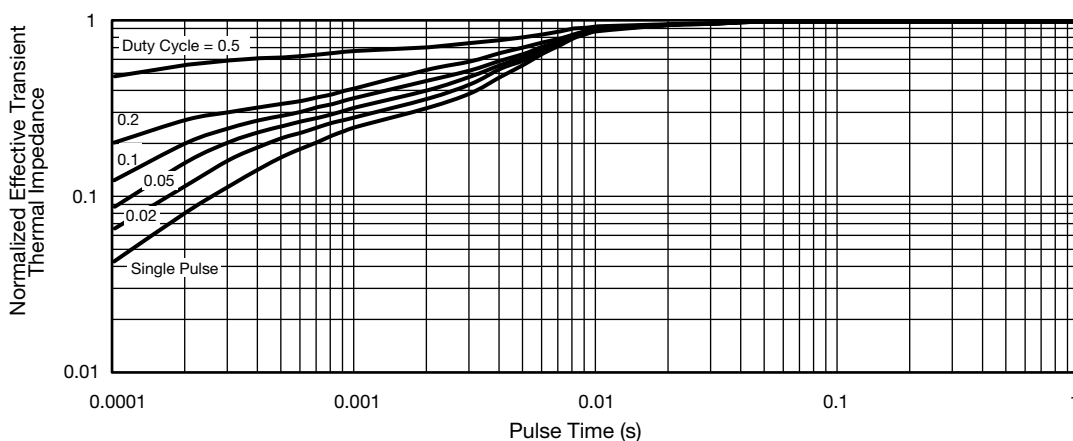
SPECIFICATIONS ($T_J = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

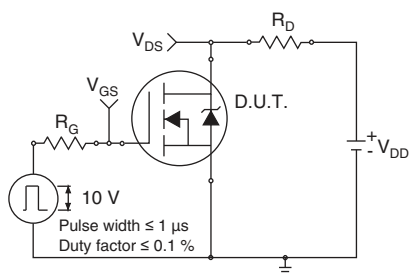
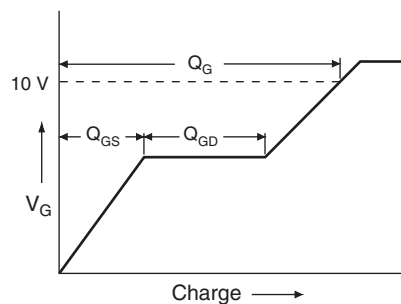
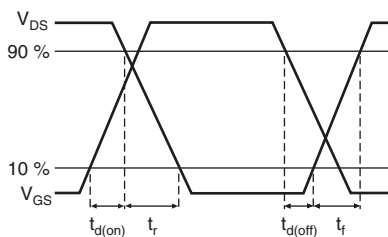
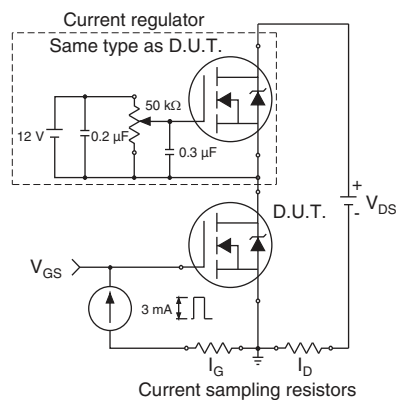
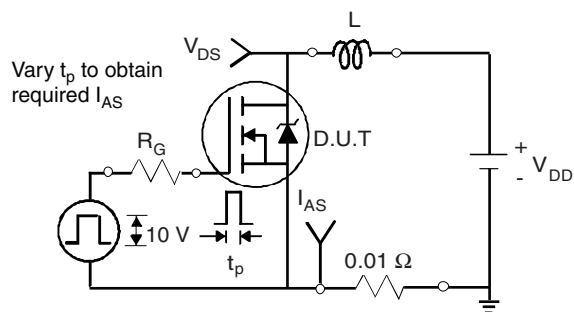
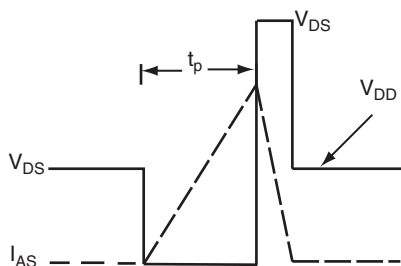
| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNIT |
|---|----------------------------------|--|---|------|------|-------|------|
| Static | | | | | | | |
| Drain-Source Breakdown Voltage | V _{DS} | V _{GS} = 0 V, I _D = 250 μA | | 600 | - | - | V |
| V _{DS} Temperature Coefficient | ΔV _{DS} /T _J | Reference to 25 °C, I _D = 1 mA | | - | 0.71 | - | V/°C |
| Gate-Source Threshold Voltage (N) | V _{GS(th)} | V _{DS} = V _{GS} , I _D = 250 μA | | 2 | - | 4 | V |
| Gate-Source Leakage | I _{GSS} | V _{GS} = ± 20 V | | - | - | ± 100 | nA |
| Zero Gate Voltage Drain Current | I _{DSS} | V _{DS} = 600 V, V _{GS} = 0 V | | - | - | 1 | μA |
| | | V _{DS} = 480 V, V _{GS} = 0 V, T _J = 125 °C | | - | - | 10 | |
| Drain-Source On-State Resistance | R _{DS(on)} | V _{GS} = 10 V | I _D = 6 A | - | 0.32 | 0.38 | Ω |
| Forward Transconductance | g _{fs} | V _{DS} = 40 V, I _D = 8 A | | - | 3.8 | - | S |
| Dynamic | | | | | | | |
| Input Capacitance | C _{iss} | V _{GS} = 0 V, V _{DS} = 100 V, f = 1 MHz | | - | 937 | - | pF |
| Output Capacitance | C _{oss} | | | - | 53 | - | |
| Reverse Transfer Capacitance | C _{rss} | | | - | 5 | - | |
| Effective Output Capacitance, Energy Related ^a | C _{o(er)} | V _{DS} = 0 V to 480 V, V _{GS} = 0 V | | - | 41 | - | |
| Effective Output Capacitance, Time Related ^b | C _{o(tr)} | | | - | 136 | - | |
| Total Gate Charge | Q _g | V _{GS} = 10 V | I _D = 6 A, V _{DS} = 480 V | - | 29 | 58 | nC |
| Gate-Source Charge | Q _{gs} | | | - | 6 | - | |
| Gate-Drain Charge | Q _{gd} | | | - | 13 | - | |
| Turn-On Delay Time | t _{d(on)} | V _{DD} = 480 V, I _D = 6 A, V _{GS} = 10 V, R _g = 9.1 Ω | | - | 14 | 28 | ns |
| Rise Time | t _r | | | - | 19 | 38 | |
| Turn-Off Delay Time | t _{d(off)} | | | - | 35 | 70 | |
| Fall Time | t _f | | | - | 19 | 38 | |
| Gate Input Resistance | R _g | f = 1 MHz, open drain | | - | 1.1 | - | Ω |
| Drain-Source Body Diode Characteristics | | | | | | | |
| Continuous Source-Drain Diode Current | I _S | MOSFET symbol showing the integral reverse p - n junction diode  | | - | - | 12 | A |
| Pulsed Diode Forward Current | I _{SM} | | | - | - | 48 | |
| Diode Forward Voltage | V _{SD} | T _J = 25 °C, I _S = 6 A, V _{GS} = 0 V | | - | - | 1.2 | V |
| Reverse Recovery Time | t _{rr} | T _J = 25 °C, I _F = I _S = 6 A, dI/dt = 100 A/μs, V _R = 25 V | | - | 350 | - | ns |
| Reverse Recovery Charge | Q _{rr} | | | - | 4 | - | μC |
| Reverse Recovery Current | I _{RRM} | | | - | 19 | - | A |

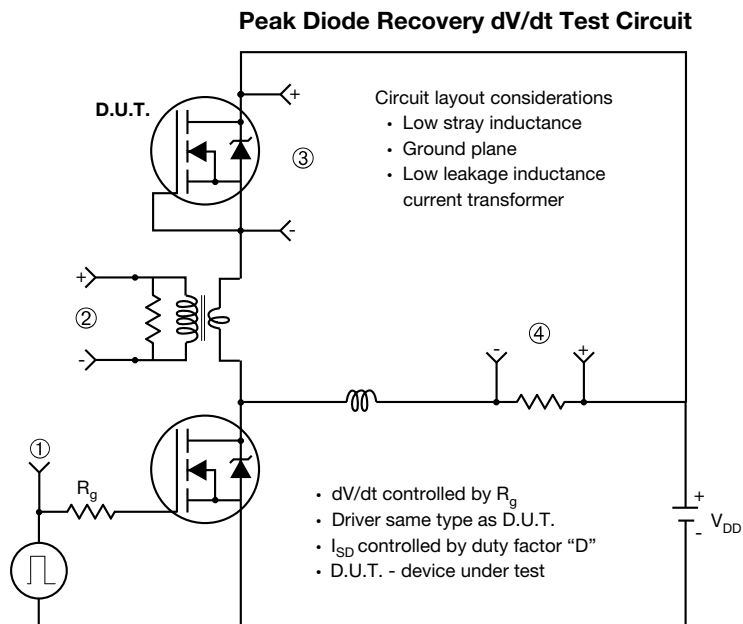
Notes

- a. $C_{oss(er)}$ is a fixed capacitance that gives the same energy as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DSS} .
b. $C_{oss(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 % to 80 % V_{DSS} .

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

Fig. 1 - Typical Output Characteristics

Fig. 4 - Normalized On-Resistance vs. Temperature

Fig. 2 - Typical Output Characteristics

Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

Fig. 3 - Typical Transfer Characteristics

Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage


Fig. 7 - Typical Source-Drain Diode Forward Voltage

Fig. 9 - Maximum Drain Current vs. Case Temperature

Fig. 8 - Maximum Safe Operating Area

Fig. 10 - Temperature vs. Drain-to-Source Voltage

Fig. 11 - Normalized Thermal Transient Impedance, Junction-to-Case


Fig. 12 - Switching Time Test Circuit

Fig. 16 - Basic Gate Charge Waveform

Fig. 13 - Switching Time Waveforms

Fig. 17 - Gate Charge Test Circuit

Fig. 14 - Unclamped Inductive Test Circuit

Fig. 15 - Unclamped Inductive Waveforms


Note

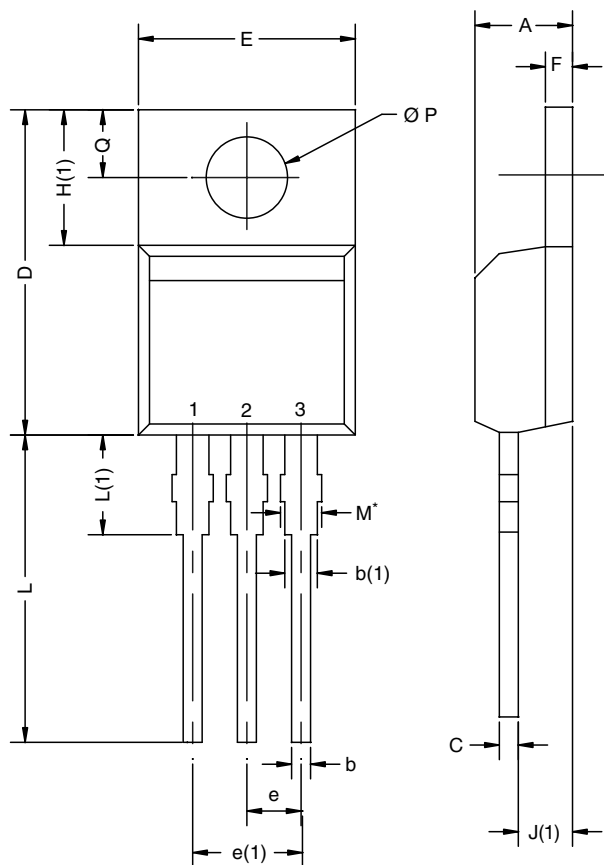
a. $V_{GS} = 5\text{ V}$ for logic level devices

Fig. 18 - For N-Channel

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TO-220AB



| DIM. | MILLIMETERS | | INCHES | |
|------|-------------|-------|--------|-------|
| | MIN. | MAX. | MIN. | MAX. |
| A | 4.25 | 4.65 | 0.167 | 0.183 |
| b | 0.69 | 1.01 | 0.027 | 0.040 |
| b(1) | 1.20 | 1.73 | 0.047 | 0.068 |
| c | 0.36 | 0.61 | 0.014 | 0.024 |
| D | 14.85 | 15.49 | 0.585 | 0.610 |
| E | 10.04 | 10.51 | 0.395 | 0.414 |
| e | 2.41 | 2.67 | 0.095 | 0.105 |
| e(1) | 4.88 | 5.28 | 0.192 | 0.208 |
| F | 1.14 | 1.40 | 0.045 | 0.055 |
| H(1) | 6.09 | 6.48 | 0.240 | 0.255 |
| J(1) | 2.41 | 2.92 | 0.095 | 0.115 |
| L | 13.35 | 14.02 | 0.526 | 0.552 |
| L(1) | 3.32 | 3.82 | 0.131 | 0.150 |
| Ø P | 3.54 | 3.94 | 0.139 | 0.155 |
| Q | 2.60 | 3.00 | 0.102 | 0.118 |

ECN: T13-0724-Rev. O, 14-Oct-13
DWG: 5471

Note

* M = 1.32 mm to 1.62 mm (dimension including protrusion)
Heatsink hole for HVM



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