

## IMBG120R017M2HXTMA1-VB Datasheet

### N-Channel 1200V (D-S) SiC Power MOSFET

#### PRODUCT SUMMARY

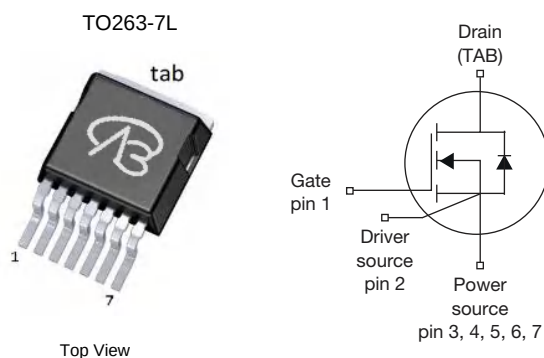
|                                    |                 |       |
|------------------------------------|-----------------|-------|
| $V_{DS}$ (V)                       | 1200            |       |
| $R_{DS(on)}$ at 25 °C ( $\Omega$ ) | $V_{GS} = 18$ V | 0.015 |
| $Q_g$ (nC)                         | 200             |       |

#### FEATURES

- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Higher robustness and system reliability
- Kelvin source provides up to 4 times lower switching losses
- Ultra low gate charge ( $Q_g$ )
- Avalanche energy rated (UIS)

#### APPLICATIONS

- Server and telecom power supplies
- EV charging infrastructure
- Solar PV inverters
- DC/DC converter



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

| PARAMETER                                                 |                         |                         | SYMBOL                            | LIMIT       | UNIT |
|-----------------------------------------------------------|-------------------------|-------------------------|-----------------------------------|-------------|------|
| Drain-Source Voltage                                      |                         |                         | V <sub>DS</sub>                   | 1200        | V    |
| Gate-Source Voltage                                       |                         |                         | V <sub>GS</sub>                   | -10 / +22   |      |
| Continuous Drain Current (T <sub>J</sub> = 175 °C)        | V <sub>GS</sub> at 18 V | T <sub>C</sub> = 25 °C  | I <sub>D</sub>                    | 142         | A    |
|                                                           |                         | T <sub>C</sub> = 100 °C |                                   | 100         |      |
| Pulsed Drain Current <sup>a</sup>                         |                         |                         | I <sub>DM</sub>                   | 310         |      |
| Linear Derating Factor                                    |                         |                         |                                   | 2.1         | W/°C |
| Single Pulse Avalanche Energy <sup>b</sup>                |                         |                         | E <sub>AS</sub>                   | 625         | mJ   |
| Maximum Power Dissipation                                 |                         |                         | P <sub>D</sub>                    | 535         | W    |
| Operating Junction and Storage Temperature Range          |                         |                         | T <sub>J</sub> , T <sub>stg</sub> | -55 to +175 | °C   |
| Drain-Source Voltage Slope                                | T <sub>J</sub> = 125 °C |                         | dV/dt                             | 150         | V/ns |
| Reverse Diode dV/dt <sup>d</sup>                          |                         | 100                     |                                   |             |      |
| Soldering Recommendations (Peak Temperature) <sup>c</sup> | for 10 s                |                         |                                   | 260         | °C   |

#### Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 50$  V, starting  $T_J = 25$  °C,  $L = 0.5$  mH,  $R_g = 25$   $\Omega$ .
- 1.6 mm from case.
- $I_{SD} \leq I_D$ ,  $dI/dt = 100$  A/ $\mu$ 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) | $R_{thJC}$ | -    | 0.28 |      |

**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 <sub>DS</sub>                  | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA                                                                                                             |                                                | 1200 | -     | -    | V    |
| V <sub>DS</sub> Temperature Coefficient                   | ΔV <sub>DS</sub> /T <sub>J</sub> | Reference to 25 °C, I <sub>D</sub> = 1 mA                                                                                                                |                                                | -    | 0.70  | -    | V/°C |
| Gate-Source Threshold Voltage (N)                         | V <sub>GS(th)</sub>              | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 5 mA                                                                                                |                                                | 2    | -     | 4    | V    |
| Gate-Source Leakage                                       | I <sub>GSS</sub>                 | V <sub>GS</sub> = +18 V                                                                                                                                  |                                                | -    | -     | 100  | nA   |
|                                                           |                                  | V <sub>GS</sub> = - 8 V                                                                                                                                  |                                                | -    | -     | 100  | nA   |
| Zero Gate Voltage Drain Current                           | I <sub>DSS</sub>                 | V <sub>DS</sub> = 1200V, V <sub>GS</sub> = 0 V                                                                                                           |                                                | -    | -     | 100  | μA   |
|                                                           |                                  | V <sub>DS</sub> = 1200 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C                                                                                 |                                                | -    | -     | 200  |      |
| Drain-Source On-State Resistance                          | R <sub>DS(on)</sub>              | V <sub>GS</sub> = 18 V                                                                                                                                   | I <sub>D</sub> = 100A                          | -    | 0.015 | -    | Ω    |
| Forward Transconductance                                  | g <sub>fs</sub>                  | V <sub>DS</sub> = 0 V, I <sub>D</sub> = 100 A                                                                                                            |                                                | -    | 50    | -    | S    |
| Dynamic                                                   |                                  |                                                                                                                                                          |                                                |      |       |      |      |
| Input Capacitance                                         | C <sub>iss</sub>                 | V <sub>GS</sub> = 0 V,<br>V <sub>DS</sub> = 800 V,<br>f = 100 KHz                                                                                        |                                                | -    | 6800  | -    | pF   |
| Output Capacitance                                        | C <sub>oss</sub>                 |                                                                                                                                                          |                                                | -    | 300   | -    |      |
| Reverse Transfer Capacitance                              | C <sub>rss</sub>                 |                                                                                                                                                          |                                                | -    | 15    | -    |      |
| Effective Output Capacitance, Energy Related <sup>a</sup> | C <sub>o(er)</sub>               | V <sub>DS</sub> = 0 V to 800 V, V <sub>GS</sub> = 0 V                                                                                                    |                                                | -    | 230   | -    |      |
| Effective Output Capacitance, Time Related <sup>b</sup>   | C <sub>o(tr)</sub>               |                                                                                                                                                          |                                                | -    | 320   | -    |      |
| Total Gate Charge                                         | Q <sub>g</sub>                   | V <sub>GS</sub> = -5/18 V                                                                                                                                | I <sub>D</sub> = 50 A, V <sub>DS</sub> = 800 V | -    | 200   | -    | nC   |
| Gate-Source Charge                                        | Q <sub>gs</sub>                  |                                                                                                                                                          |                                                | -    | 80    | -    |      |
| Gate-Drain Charge                                         | Q <sub>gd</sub>                  |                                                                                                                                                          |                                                | -    | 60    | -    |      |
| Turn-On Delay Time                                        | t <sub>d(on)</sub>               | V <sub>DD</sub> = 800 V, I <sub>D</sub> =50A<br><br>V <sub>GS</sub> = -5/18 V                                                                            |                                                | -    | 15    | 20   | ns   |
| Rise Time                                                 | t <sub>r</sub>                   |                                                                                                                                                          |                                                | -    | 40    | -    |      |
| Turn-Off Delay Time                                       | t <sub>d(off)</sub>              |                                                                                                                                                          |                                                | -    | 60    | -    |      |
| Fall Time                                                 | t <sub>f</sub>                   |                                                                                                                                                          |                                                | -    | 30    | -    |      |
| Gate Input Resistance                                     | R <sub>g</sub>                   | f = 1 MHz, open drain                                                                                                                                    |                                                | -    | 8.5   | -    | Ω    |
| Drain-Source Body Diode Characteristics                   |                                  |                                                                                                                                                          |                                                |      |       |      |      |
| Continuous Source-Drain Diode Current                     | I <sub>S</sub>                   | MOSFET symbol showing the integral reverse p - n junction diode<br> |                                                | -    | -     | 60   | A    |
| Pulsed Diode Forward Current                              | I <sub>SM</sub>                  |                                                                                                                                                          |                                                | -    | -     | 150  |      |
| Diode Forward Voltage                                     | V <sub>SD</sub>                  | T <sub>J</sub> = 25 °C, I <sub>S</sub> = 50 A, V <sub>GS</sub> = 0                                                                                       |                                                | -    | -     | 4.1  | V    |
| Reverse Recovery Time                                     | t <sub>rr</sub>                  | T <sub>J</sub> = 25 °C, I <sub>F</sub> = I <sub>S</sub> = 50 A,<br>dI/dt = 1000 A/μs, V <sub>R</sub> = 800 V                                             |                                                | -    | 35    | -    | ns   |
| Reverse Recovery Charge                                   | Q <sub>rr</sub>                  |                                                                                                                                                          |                                                | -    | 1.5   | -    | μC   |
| Reverse Recovery Current                                  | I <sub>RRM</sub>                 |                                                                                                                                                          |                                                | -    | 15    | -    | 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 60 %  $V_{DSS}$ .  
 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 60 %  $V_{DSS}$ .

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)

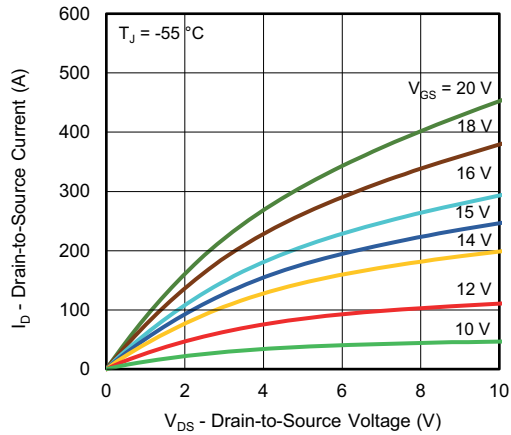


**Fig. 1 - Typical Output Characteristics**

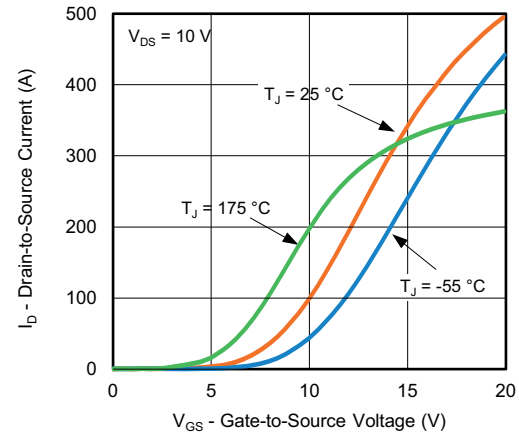


**Fig. 4 - Typical Transfer Characteristics**

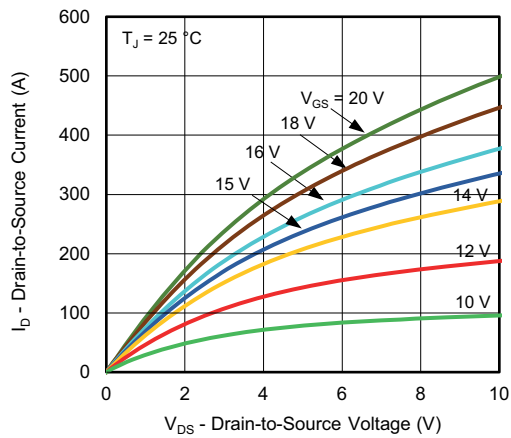


**Fig. 2 - Typical Output Characteristics**

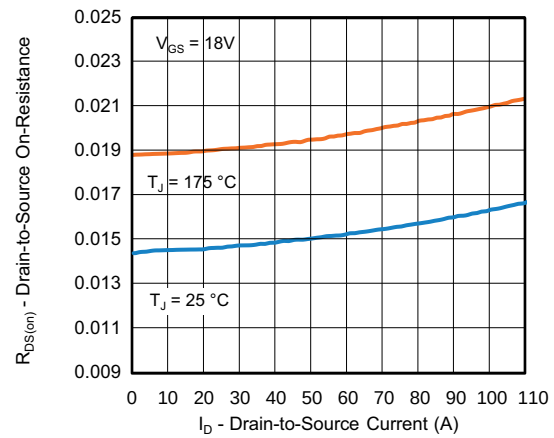


**Fig. 5 - Normalized On-Resistance vs. Drain Current**

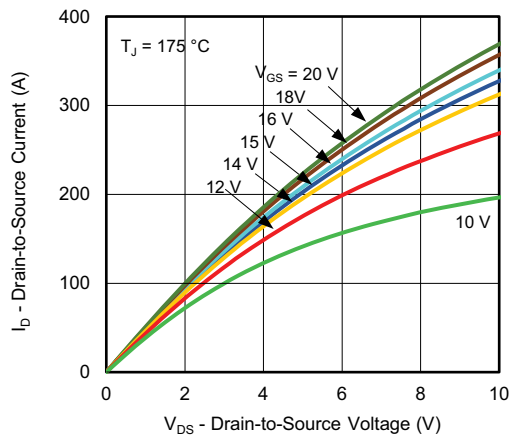


**Fig. 3 - Typical Output Characteristics**

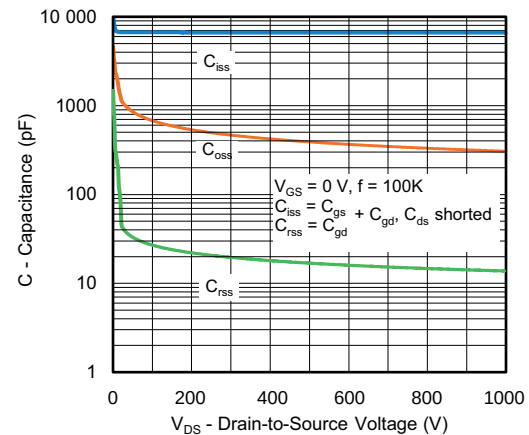


**Fig. 6 - Typical Capacitance vs. Drain-to-Source Voltage**

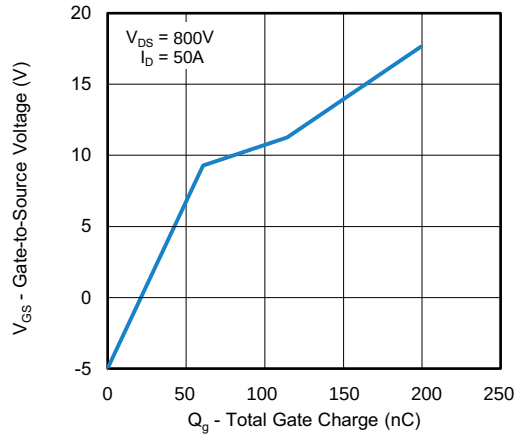


**Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage**

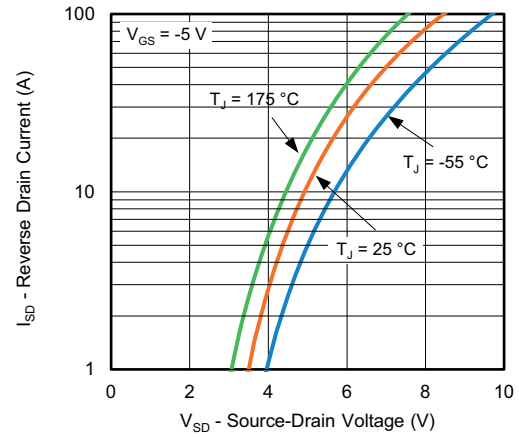


**Fig. 10 - Typical Source-Drain Diode Forward Voltage**

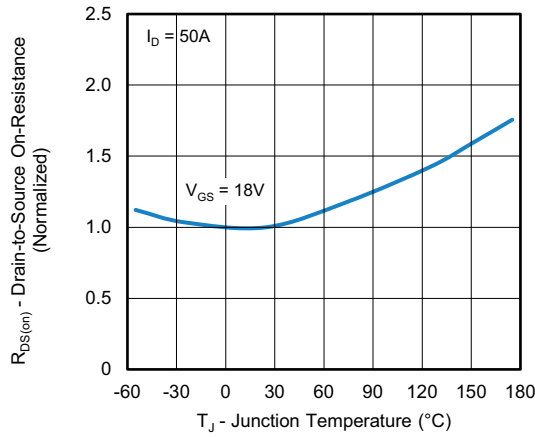


**Fig. 8 - Normalized On-Resistance vs. Temperature**

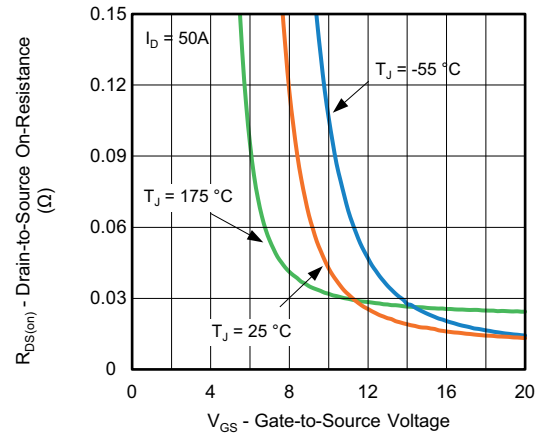


**Fig. 11 - On-Resistance vs. Gate-to-Source Voltage**

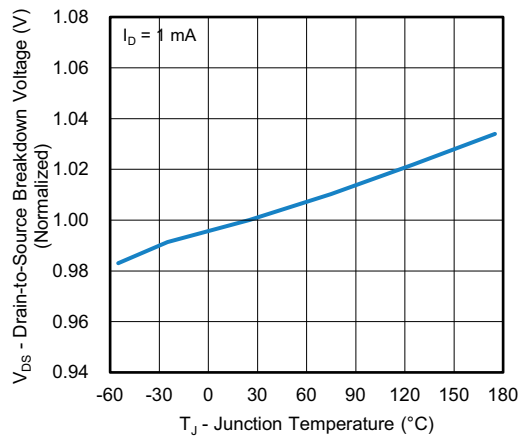


**Fig. 9 - Drain-to-Source Voltage vs. Temperature**

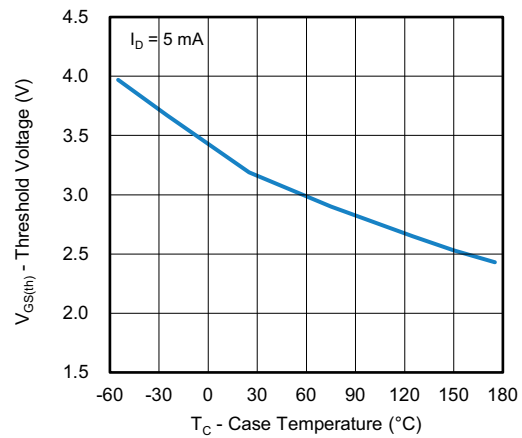


**Fig. 12 - Threshold Voltage vs. Case Temperature**

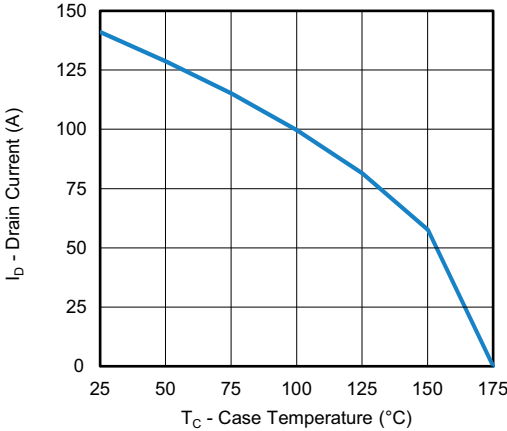


Fig. 13 - Drain Current vs. Case Temperature

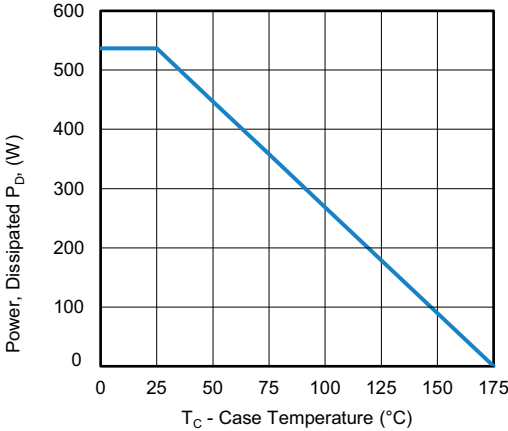


Fig. 15 - Power, Dissipated  $P_D$  vs. Case Temperature

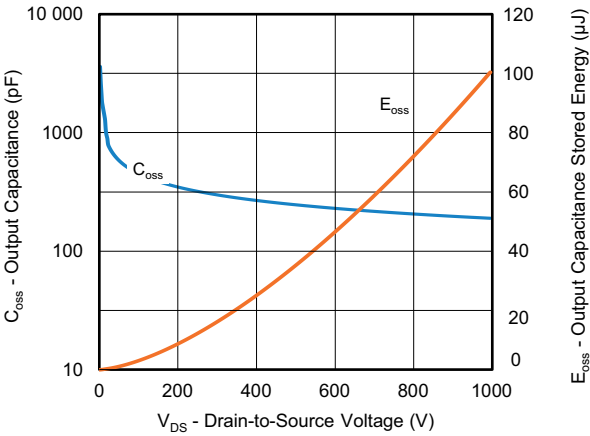


Fig. 14 - Output Capacitance and its Stored Energy vs. Drain-to-Source Voltage

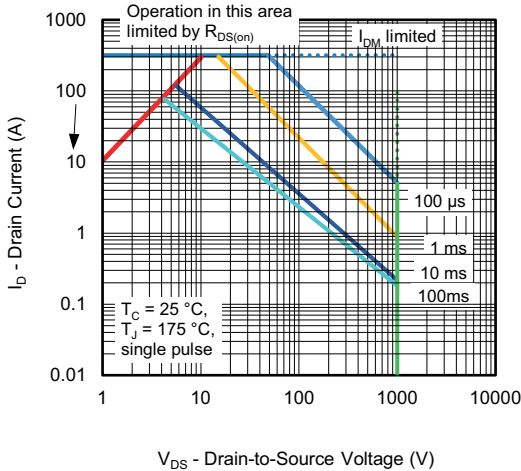


Fig. 16 - Safe Operating Area

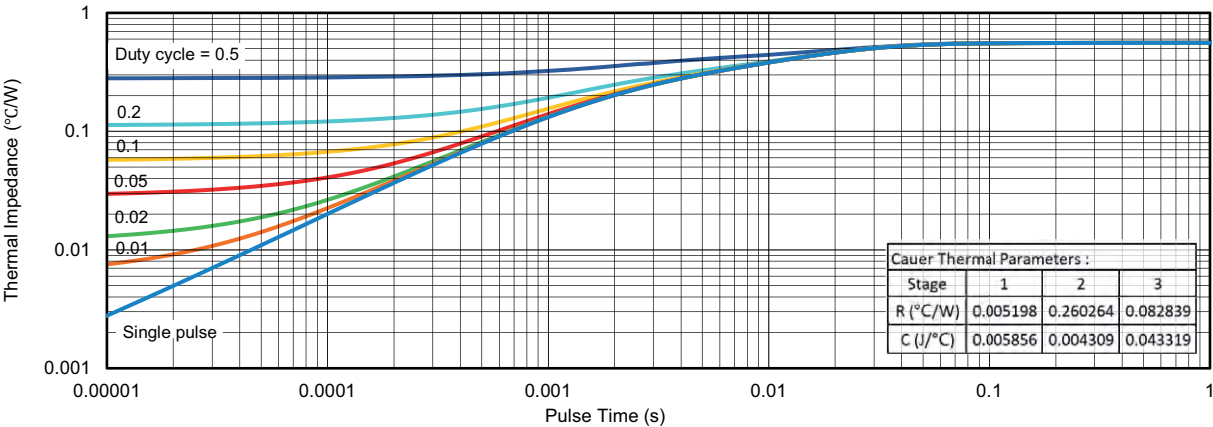


Fig. 17 - Transient Thermal Impedance

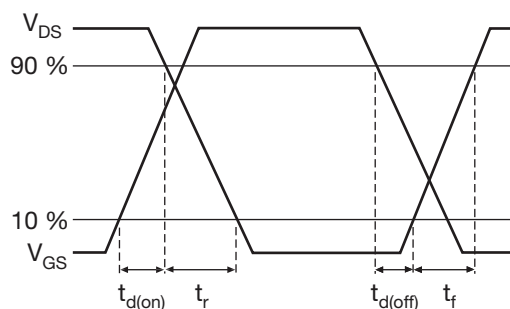


Fig. 18 - Waveforms of Switching Time

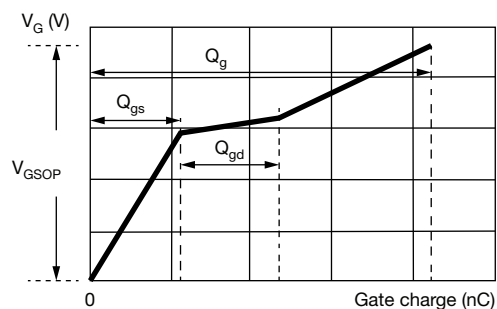


Fig. 21 - Waveforms for Gate Charge

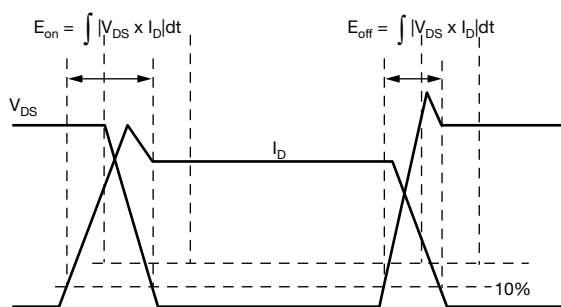


Fig. 19 - Waveforms for Switching Energy

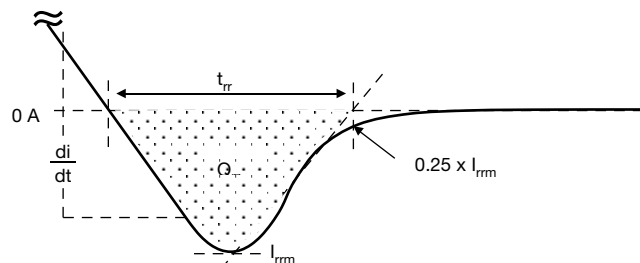


Fig. 22 - Waveforms for Reverse Recovery

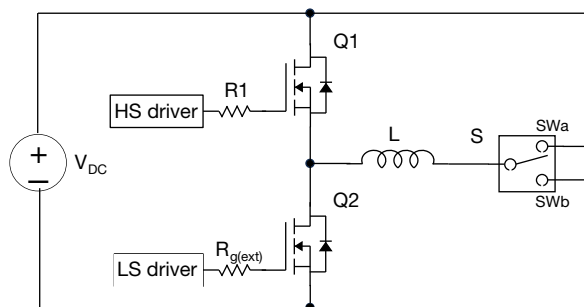


Fig. 20 - Switching and Reverse Diode Characteristics Measurement Circuit

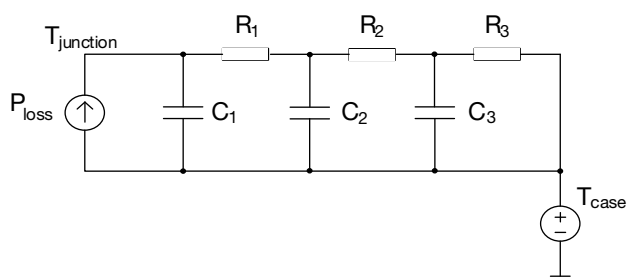
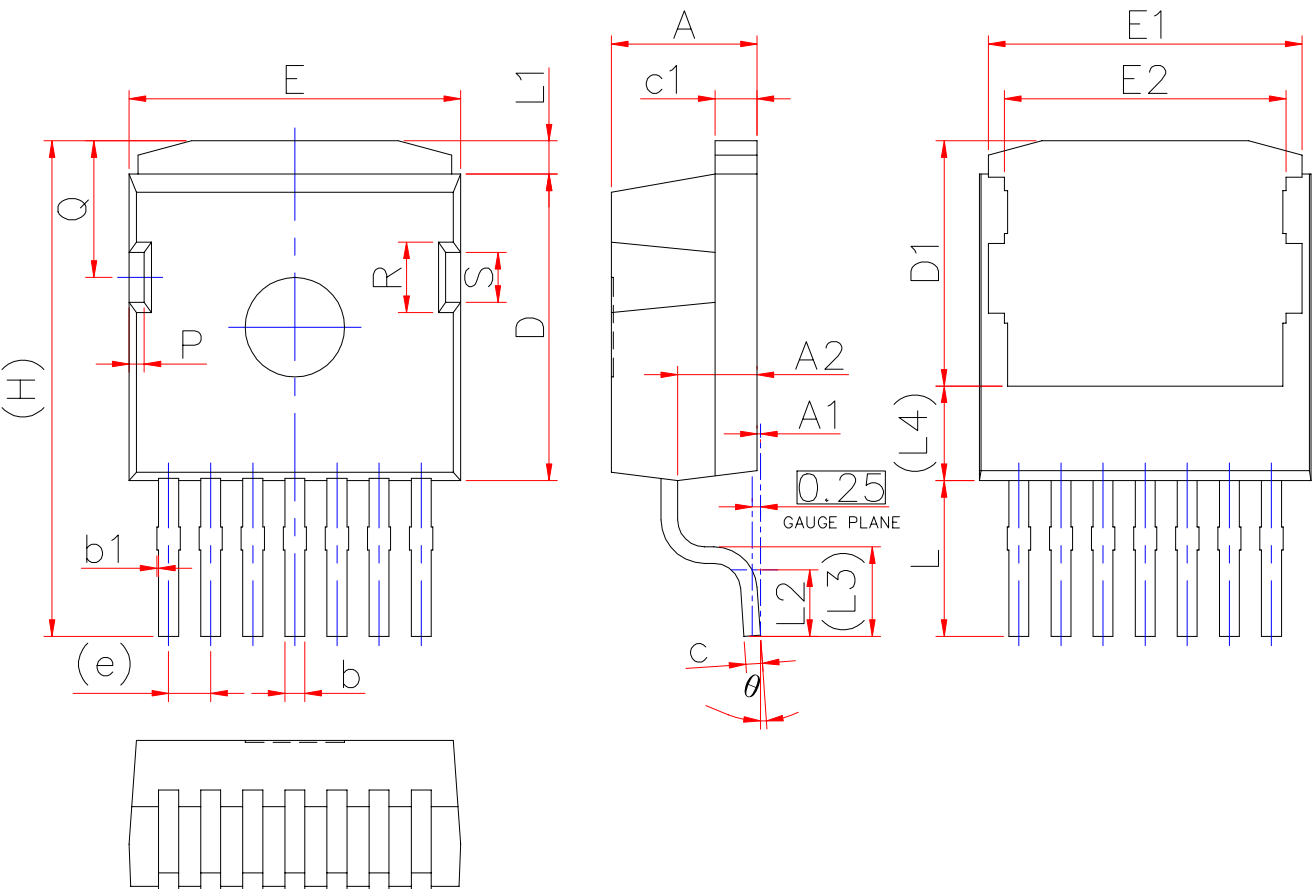


Fig. 23 - Thermal Equivalent Circuit

TO-263-7L(HV) PACKAGE OUTLINE DIMENSIONS



| Symbol | Dimensions In Millimeters |        |        | Dimensions In Inches |       |       |
|--------|---------------------------|--------|--------|----------------------|-------|-------|
|        | Min.                      | Nom.   | Max.   | Min.                 | Nom.  | Max.  |
| A      | 4.300                     | 4.400  | 4.500  | 0.169                | 0.173 | 0.177 |
| A1     | 0.000                     | 0.100  | 0.200  | 0.000                | 0.004 | 0.008 |
| A2     | 2.300                     | 2.400  | 2.500  | 0.091                | 0.094 | 0.098 |
| b      | 0.500                     | 0.600  | 0.700  | 0.020                | 0.024 | 0.028 |
| b1     | 0.000                     | 0.075  | 0.150  | 0.000                | 0.003 | 0.006 |
| c      | 0.400                     | 0.500  | 0.600  | 0.016                | 0.020 | 0.024 |
| c1     | 1.170                     | 1.270  | 1.370  | 0.046                | 0.050 | 0.054 |
| D      | 9.050                     | 9.250  | 9.450  | 0.356                | 0.364 | 0.372 |
| D1     | 7.300                     | 7.400  | 7.500  | 0.287                | 0.291 | 0.295 |
| E      | 9.800                     | 10.000 | 10.200 | 0.386                | 0.394 | 0.402 |
| E1     | 9.360                     | 9.460  | 9.560  | 0.369                | 0.372 | 0.376 |
| E2     | 8.400                     | 8.500  | 8.600  | 0.331                | 0.335 | 0.339 |
| e      | 1.270 REF.                |        |        | 0.050 REF.           |       |       |
| H      | 15.000 REF.               |        |        | 0.591 REF.           |       |       |
| L      | 4.200                     | 4.700  | 5.200  | 0.165                | 0.185 | 0.205 |
| L1     | 0.700                     | 1.000  | 1.300  | 0.028                | 0.039 | 0.051 |
| L2     | 1.700                     | 2.000  | 2.300  | 0.067                | 0.079 | 0.091 |
| L3     | 2.700 REF.                |        |        | 0.106 REF.           |       |       |
| L4     | 2.850 REF.                |        |        | 0.112 REF.           |       |       |
| P      | 0.350                     | 0.450  | 0.550  | 0.014                | 0.018 | 0.022 |
| Q      | 4.020                     | 4.120  | 4.220  | 0.158                | 0.162 | 0.166 |
| R      | 2.030                     | 2.130  | 2.230  | 0.080                | 0.084 | 0.088 |
| S      | 1.400                     | 1.500  | 1.600  | 0.055                | 0.059 | 0.063 |
| θ      | 0°                        | 4°     | 8°     | 0°                   | 4°    | 8°    |

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