## Features

- High Speed Switching
- High Blocking Voltage with Low $R_{DS(on)}$
- Easy to Parallel
- Simple to Drive
- RoHS Compliant

## Benefits

- Increased Power Density
- Faster Operating Frequency
- Reduction of Heat Sink Requirements
- Higher Efficiency
- Reduced EMI

## Applications

- Power Factor Correction Modules
- Switch Mode Power Supplies
- DC-AC Inverters
- High Voltage DC/DC Converters

## Description

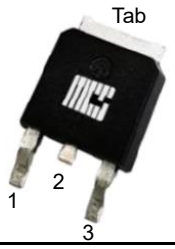
Pin 1 - Gate

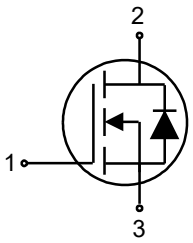
Pin 2 - and Backside - Drain

Pin 3 –Source

| Part NO. | | HX2M500065E |
|---|---|---|
| $V_{DS}$ | = | 650 V |
| $I_D(T_c=25℃)$ | = | 7 A |
| $R_{DS(on)}$ | = | 490 mΩ |

TO-252-2L




Halogen

RoHS

## Table of Contents

**Features** ..... **1**
**Benefits** ..... **1**
**Applications** ..... **1**
**Description** ..... **1**
**Table of Contents** ..... **2**
**Maximum Ratings** ..... **3**
**Thermal Characteristics** ..... **3**
**Electrical Characteristics** ..... **4**
Static Characteristics ..... 4
Dynamic Characteristics ..... 4
Switching Characteristics ..... 5
Reverse Diode Characteristics ..... 5
**Typical Performance** ..... **7**
**Package Outlines** ..... **14**
**Revision History** ..... **15**
**Information** ..... **15**
**Disclaimer** ..... **15**

## Maximum Ratings ($T_j$=25°C unless otherwise specified)

| Symbol | Parameter | Test conditions | Value | Unit |
|---|---|---|---|---|
| $V_{DS}$ | Drain-Source Voltage | | 650 | V |
| $I_D$ | Continuous Drain Current | $V_{GS}$=18V<br>$T_c$=25°C<br>$T_c$=100°C | 7<br>5 | A |
| $I_{DM}$ | Peak Drain Current | Pulse width $t_p$ limited by $T_{jmax}$ | 13 | A |
| $V_{GSmax}$ | Gate-Source Voltage, max. Transient Voltage | $t_p$≤0.5μs, $D$<0.001 | -8/+22 | V |
| $V_{GSmax}$ | Gate-Source Voltage | | -8/+22 | V |
| $V_{GSop}$ | Recommend Gate-Source Voltage | | -4/+18 | V |
| $P_{tot}$ | Power Dissipation | $T_c$=25°C<br>$T_c$=100°C | 35<br>17 | W |
| $T_j$ | Operating Junction Temperature | | -40~175 | °C |
| $T_{stg}$ | Storage Temperature | | -40~150 | °C |
| $T_{sold}$ | Soldering Temperature | 1.6mm (0.063″) from case for 10s | 260 | °C |

## Thermal Characteristics

| Symbol | Parameter | Value | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| $R_{th(j-c)}$ | Thermal Resistance from Junction to Case | | 4.3 | | °C/W |

## Electrical Characteristics

### Static Characteristics

| Symbol | Parameter | Test conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $V_{(BR)DSS}$ | Drain-Source Breakdown Voltage | $I_D$=100μA, $V_{GS}$=0V | 650 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=650V, $V_{GS}$=0V | | 1 | 10 | μA |
| $I_{GSS}$ | Gate-Source Leakage Current | $V_{DS}$=0V, $V_{GS}$=18V | | | 250 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$, $I_D$=1mA<br>$T_j$=25°C<br>$T_j$=175°C | 2 | 2.9<br>2.1 | 4 | V |
| $R_{DS(on)}$ | Drain-Source On-State Resistance | $V_{GS}$=15V, $I_D$=3.3A<br>$T_j$=25°C<br>$T_j$=175°C | | 640<br>670 | 864 | mΩ |
| | | $V_{GS}$=18V, $I_D$=3.3A<br>$T_j$=25°C<br>$T_j$=175°C | | 490<br>610 | 637 | mΩ |
| $g_{fs}$ | Forward Transconductance | $V_{DS}$=20V, $I_D$=3.3A | | 2.1 | | S |

### Dynamic Characteristics

| Symbol | Parameter | Test conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$=600V, $f$=1MHz, $V_{GS}$=0V | | 116 | | pF |
| $C_{oss}$ | Output Capacitance | | | 18 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 2.8 | | pF |
| $E_{oss}$ | $C_{oss}$ Stored Energy | | | 2.4 | | μJ |
| $R_{G(int)}$ | Internal Gate Resistance | $f$=1MHz | | 36 | | Ω |
| $Q_g$ | Total Gate Charge | $V_{DS}$=400V, $I_D$=3.3A, $V_{GS}$=-4V/18V | | 7 | | nC |
| $Q_{gs}$ | Gate to Source Charge | | | 1.3 | | nC |
| $Q_{gd}$ | Gate to Drain Charge | | | 4.2 | | nC |

## Switching Characteristics

| Symbol | Parameter | Test conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$=400V, $I_D$=3.3A, $V_{GS}$=-4V/18V, $R_{G(ext)}$=2.5Ω, $L$=200μH, $T_j$=25°C | | 3 | | ns |
| $t_r$ | Rise Time | | | 12 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 9 | | ns |
| $t_f$ | Fall Time | | | 18 | | ns |
| $E_{on}$ | Turn-On Energy | | | 24 | | μJ |
| $E_{off}$ | Turn-Off Energy | | | 4 | | μJ |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$=400V, $I_D$=3.3A, $V_{GS}$=-4V/18V, $R_{G(ext)}$=2.5Ω, $L$=200μH, $T_j$=175°C | | 3 | | ns |
| $t_r$ | Rise Time | | | 11 | | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 10 | | ns |
| $t_f$ | Fall Time | | | 19 | | ns |
| $E_{on}$ | Turn-On Energy | | | 22 | | μJ |
| $E_{off}$ | Turn-Off Energy | | | 4 | | μJ |

## Reverse Diode Characteristics

| Symbol | Parameter | Test conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $V_{SD}$ | Diode Forward Voltage | $V_{GS}$=-4V, $I_{SD}$=1.7A<br>$T_j$=25°C<br>$T_j$=175°C | | <br>4.8<br>4.3 | | V |
| $I_S$ | Continuous Diode Forward Current | $V_{GS}$=0V<br>$T_c$=25°C<br>$T_c$=100°C | | <br>7<br>3 | | A |

**Reverse Diode Characteristics (Continued)**

| Symbol | Parameter | Test conditions | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$=-4V, $I_{SD}$=1.7A, $V_R$=400V, di/dt=1990A/μs, $T_j$=25°C | | 45 | | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | | 54 | | nC |
| $I_{rrm}$ | Peak Reverse Recovery Current | | | 2 | | A |
| $t_{rr}$ | Reverse Recovery Time | $V_{GS}$=-4V, $I_{SD}$=1.7A, $V_R$=400V, di/dt=1990A/μs, $T_j$=175°C | | 48 | | ns |
| $Q_{rr}$ | Reverse Recovery Charge | | | 52 | | nC |
| $I_{rrm}$ | Peak Reverse Recovery Current | | | 2.3 | | A |

## Typical Performance

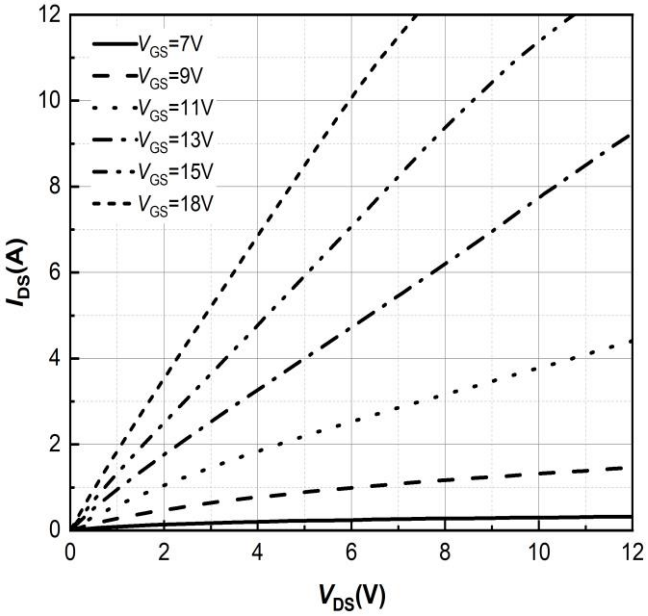



Figure 1. **Output Characteristics $T_j$=-40°C**

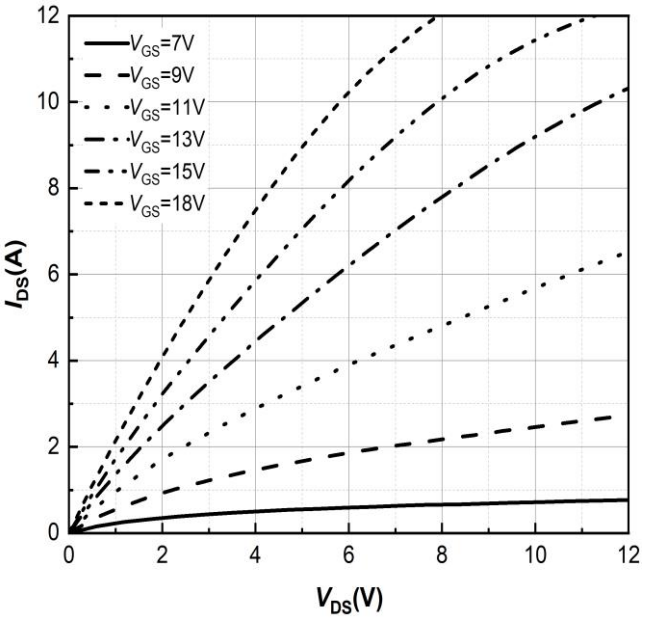



Figure 2. **Output Characteristics $T_j$=25°C**

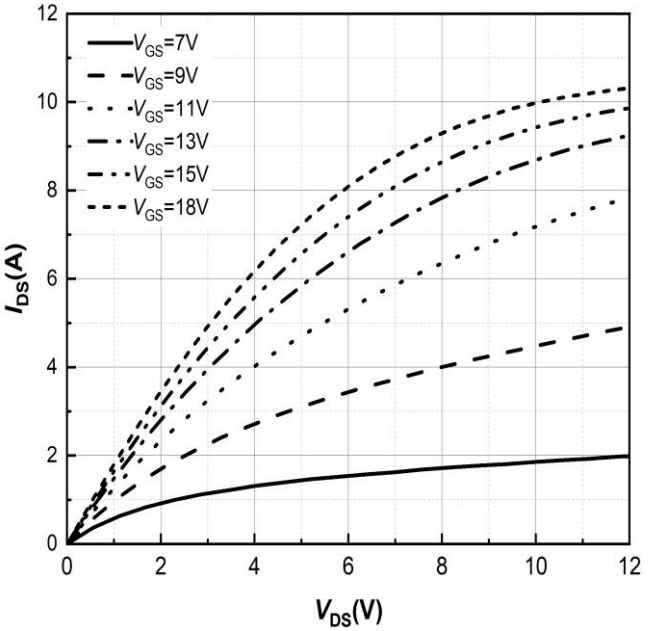



Figure 3. **Output Characteristics $T_j$=175°C**

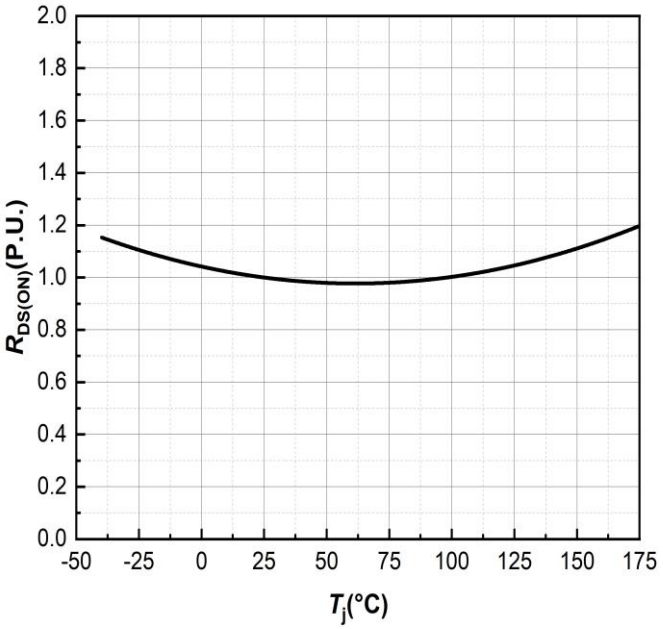



Figure 4. **Normalized On-Resistance vs. Temperature**

## Typical Performance

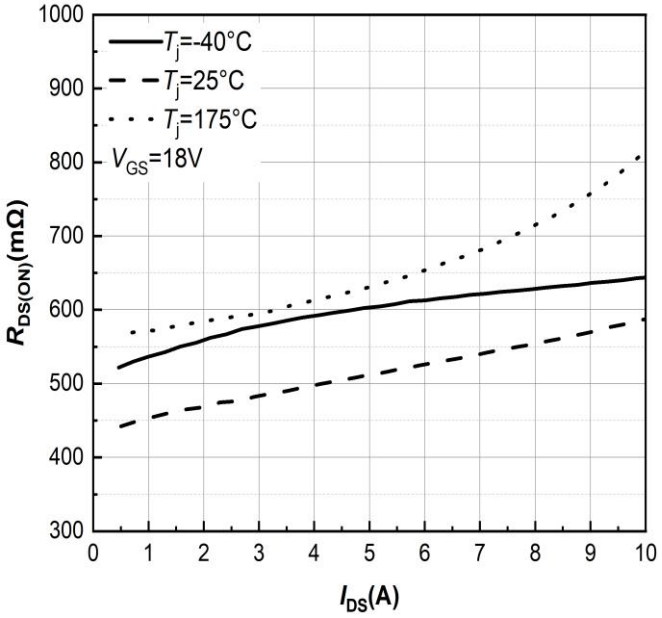



Figure 5. **On-Resistance vs. Drain Current For Various Temperatures**

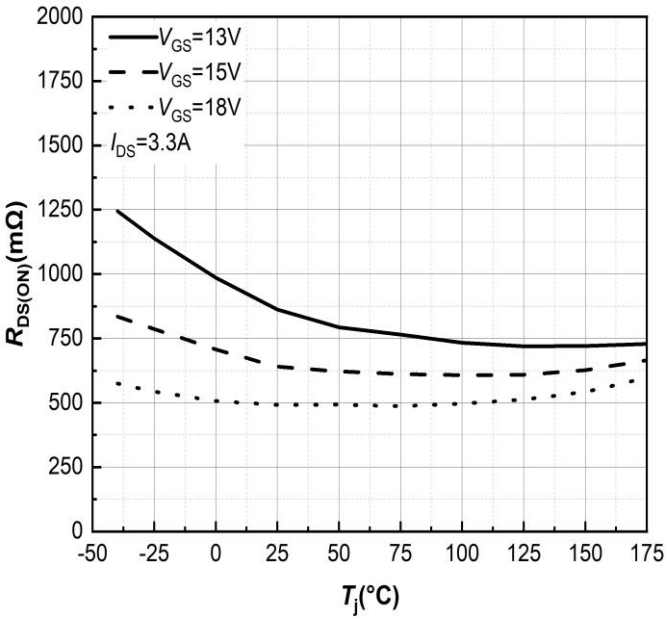



Figure 6. **On-Resistance vs. Temperature For Various Gate Voltage**

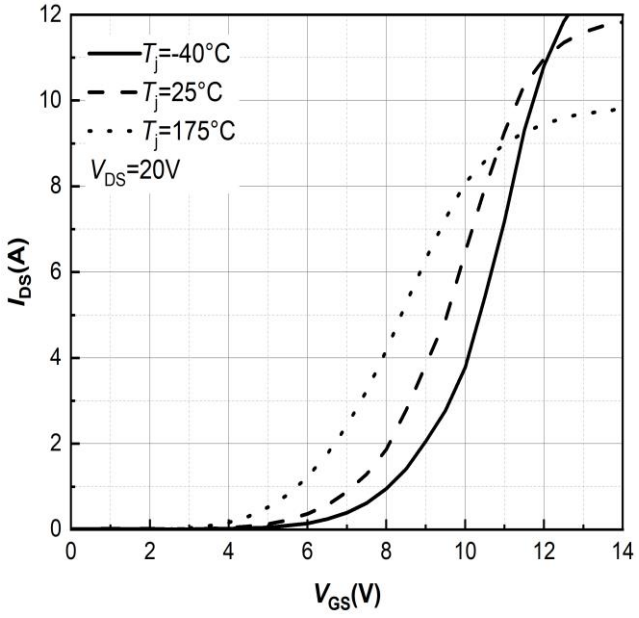



Figure 7. **Transfer Characteristic for Various Junction Temperatures**

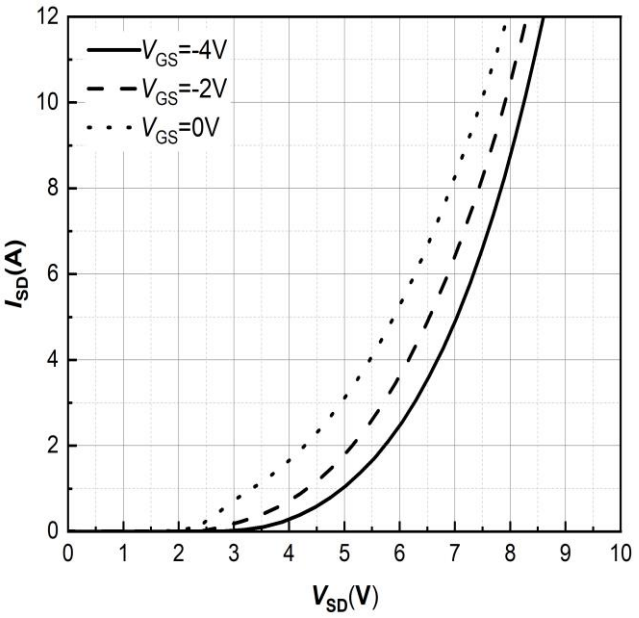



Figure 8. **Body Diode Characteristic $T_j$=-40°C**

## Typical Performance

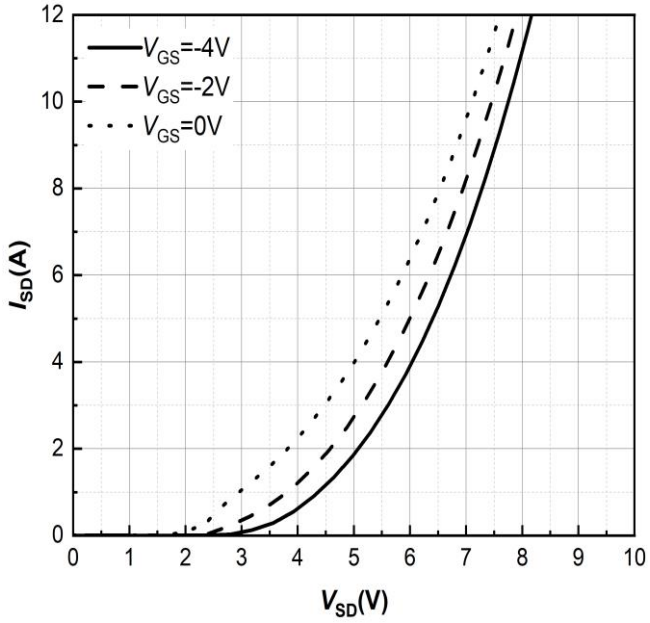



Figure 9. **Body Diode Characteristic $T_j$=25°C**

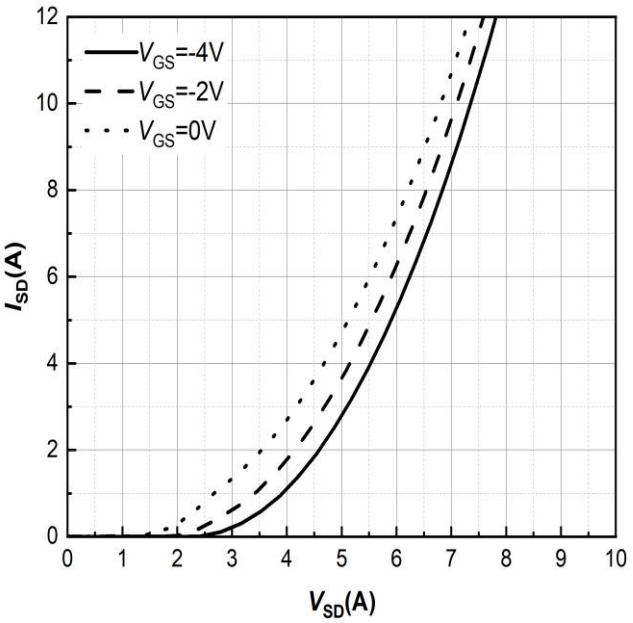



Figure 10. **Body Diode Characteristic $T_j$=175°C**

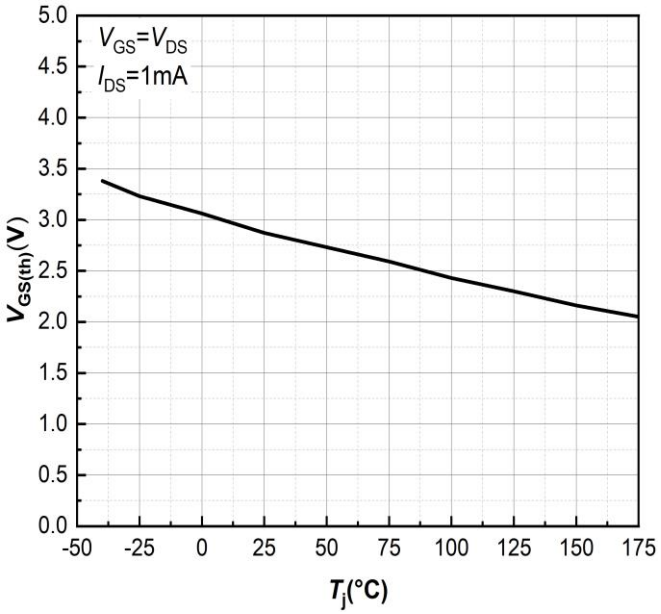



Figure 11. **Threshold Voltage vs. Temperature**

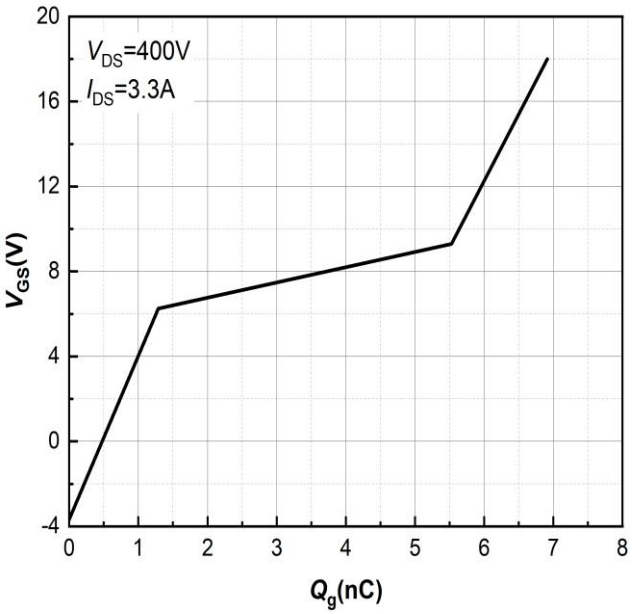



Figure 12. **Gate Charge Characteristics**

## Typical Performance

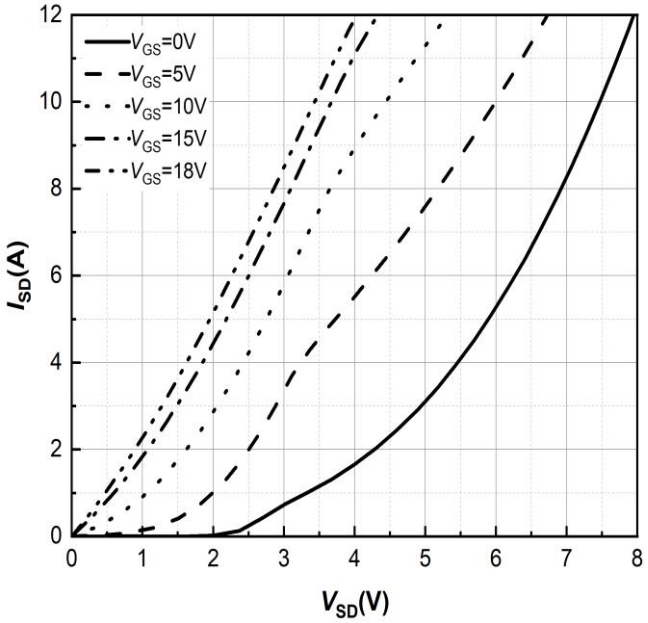



Figure 13. **3rd Quadrant Characteristic $T_j$=-40°C**

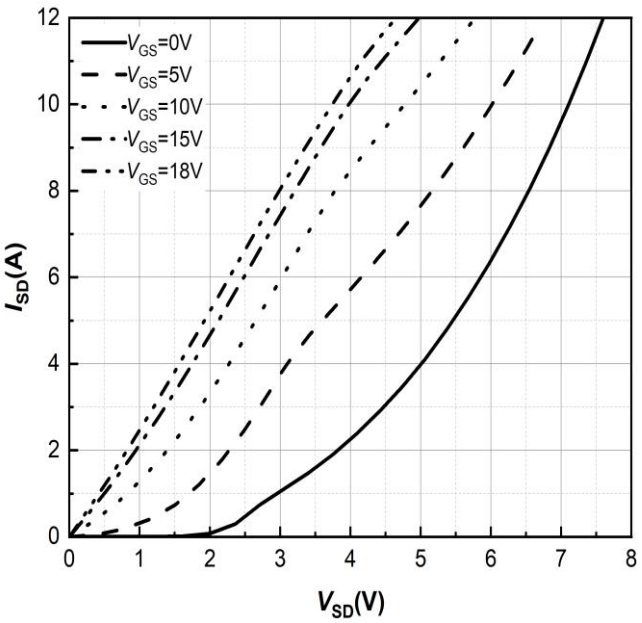



Figure 14. **3rd Quadrant Characteristic $T_j$=25°C**

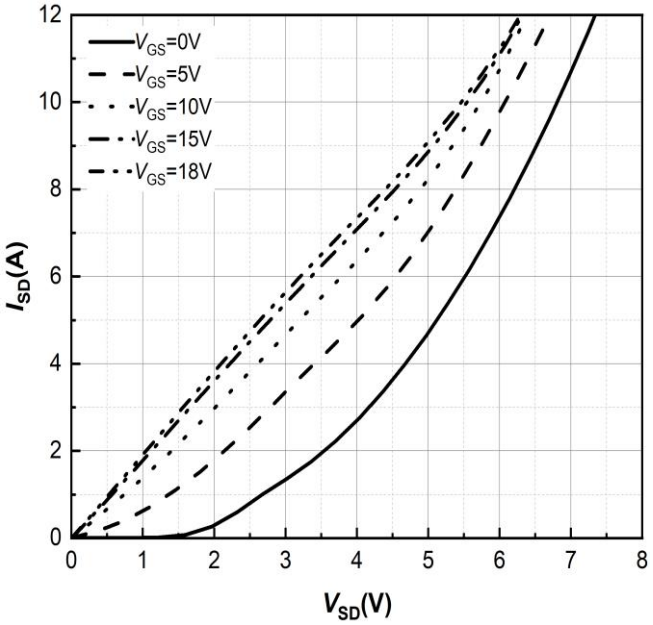



Figure 15. **3rd Quadrant Characteristic $T_j$=175°C**

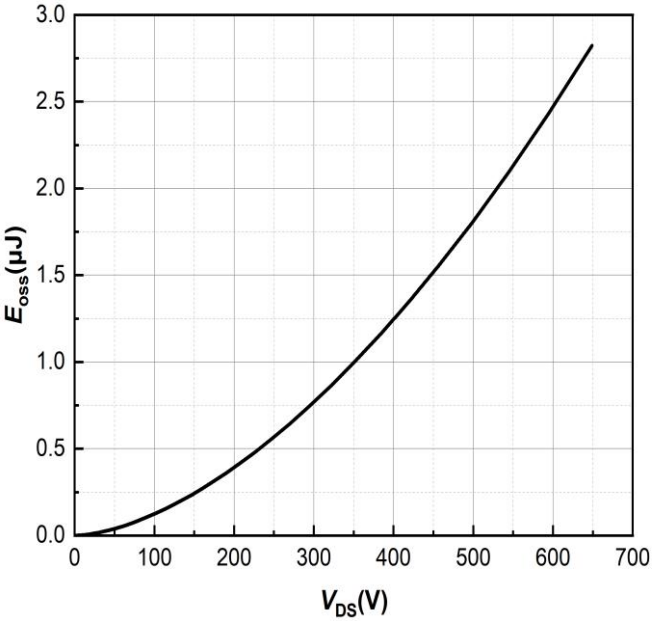



Figure 16. **Output Capacitor Stored Energy**

## Typical Performance

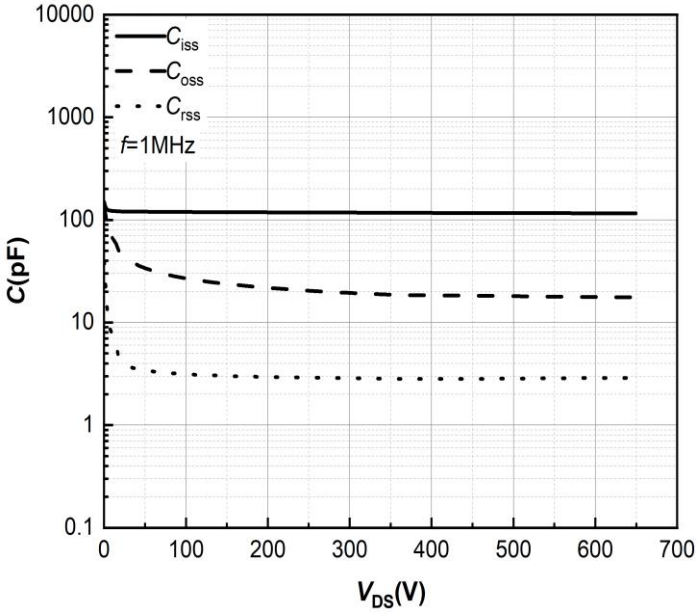



Figure 17. **Capacitances vs. Drain-Source**

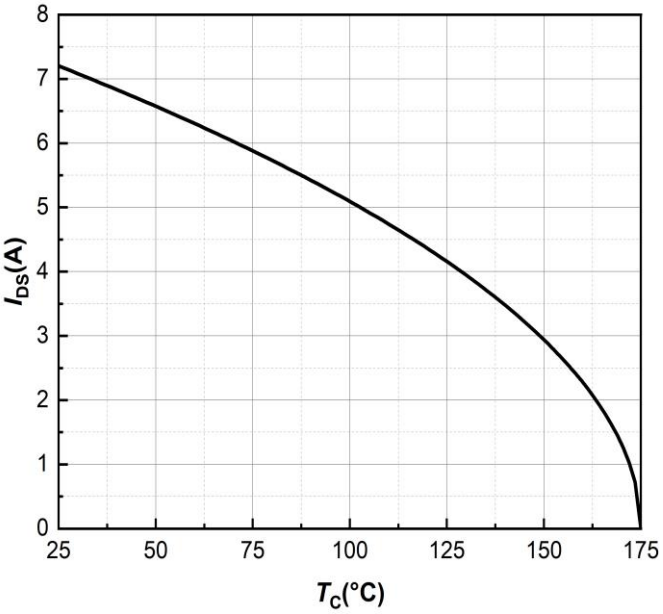



Figure 18. **Continuous Drain Current Derating vs. Case Temperature**

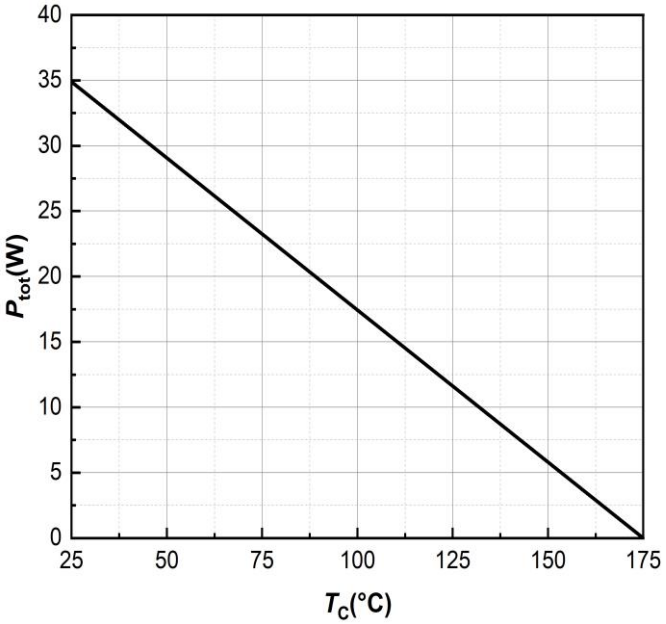



Figure 19. **Maximum Power Dissipation Derating vs. Case Temperature**

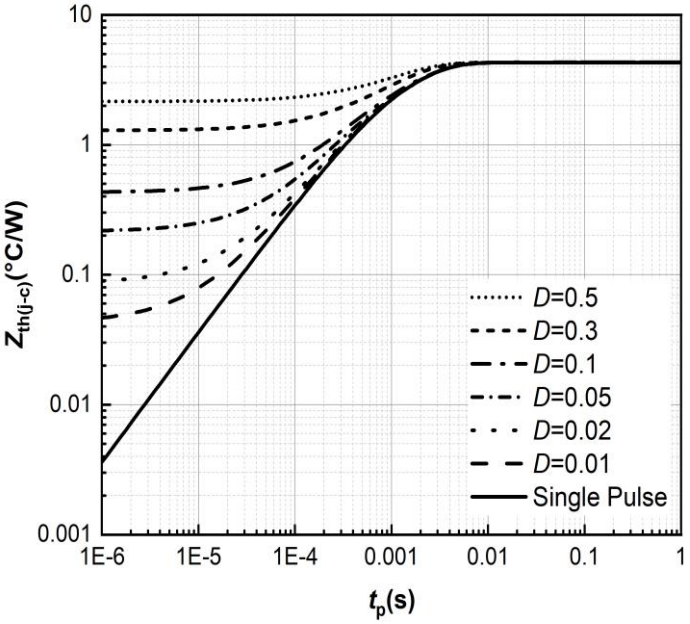



Figure 20. **Transient Thermal Impedance**

## Typical Performance

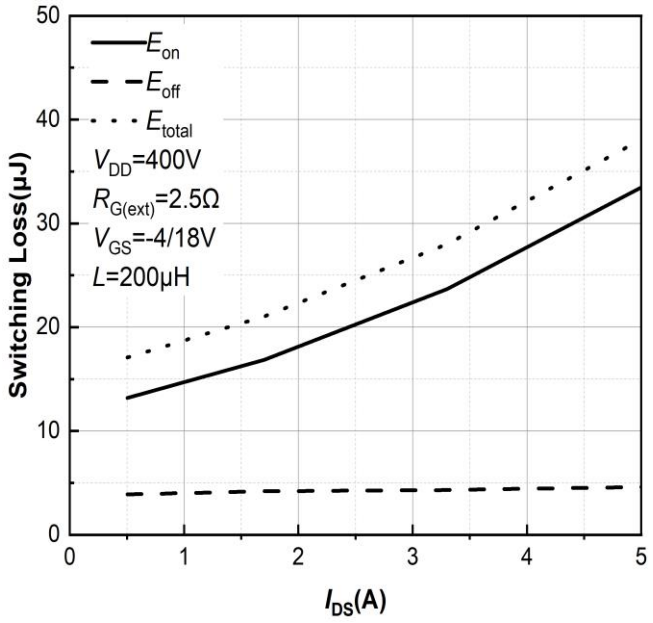



Figure 21. **Clamped Inductive Switching Energy vs. Drain Current $T_j$=25°C**

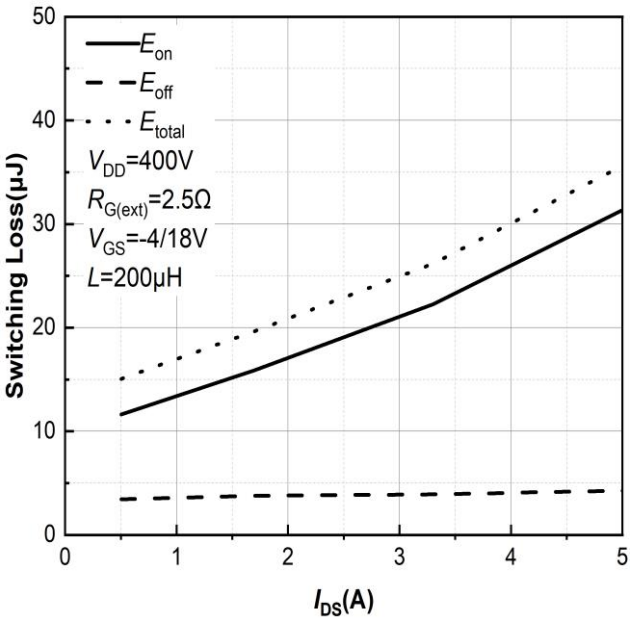



Figure 22. **Clamped Inductive Switching Energy vs. Drain Current $T_j$=175°C**

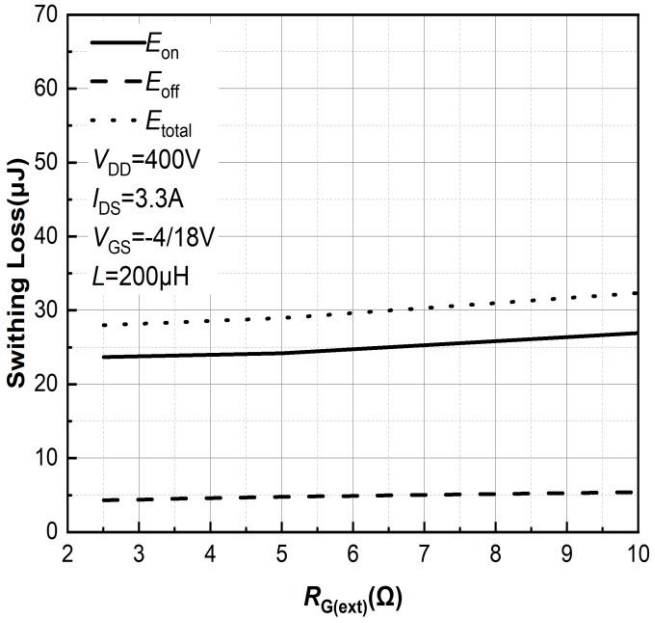



Figure 23. **Clamped Inductive Switching Energy vs. $R_{G(ext)}$ $T_j$=25°C**

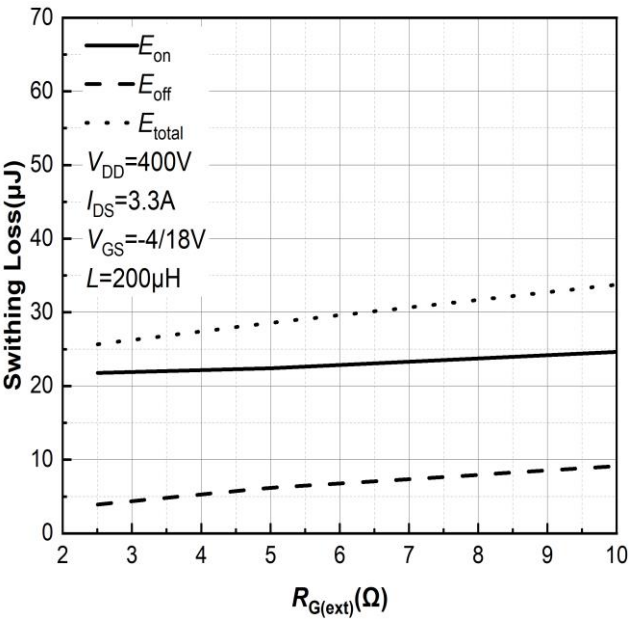



Figure 24. **Clamped Inductive Switching Energy vs. $R_{G(ext)}$ $T_j$=175°C**

## Typical Performance

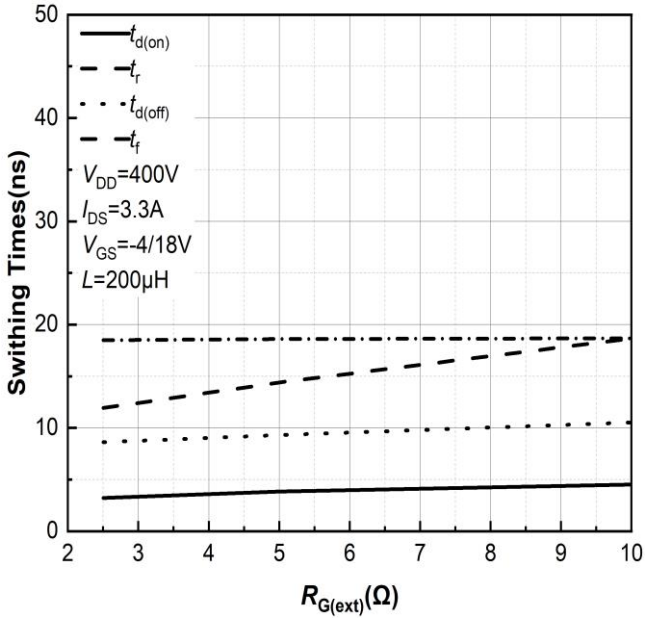



Figure 25. **Switching Times vs. $R_{G(ext)}$ $T_j$=25°C**

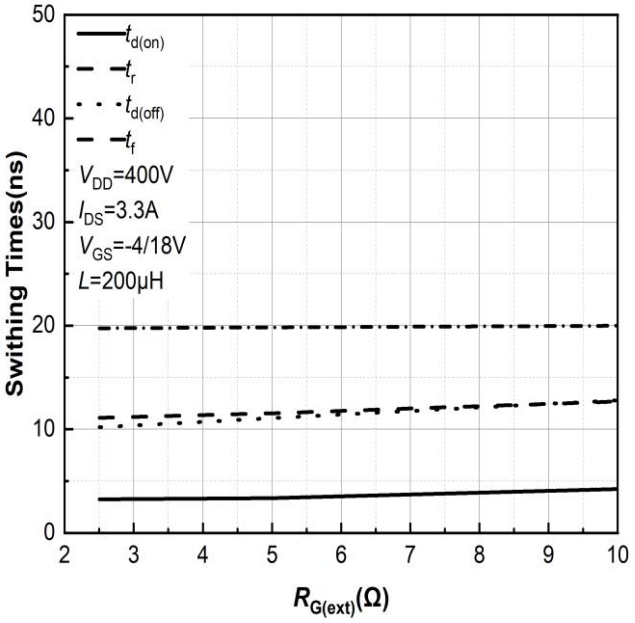



Figure 26. **Switching Times vs. $R_{G(ext)}$ $T_j$=175°C**

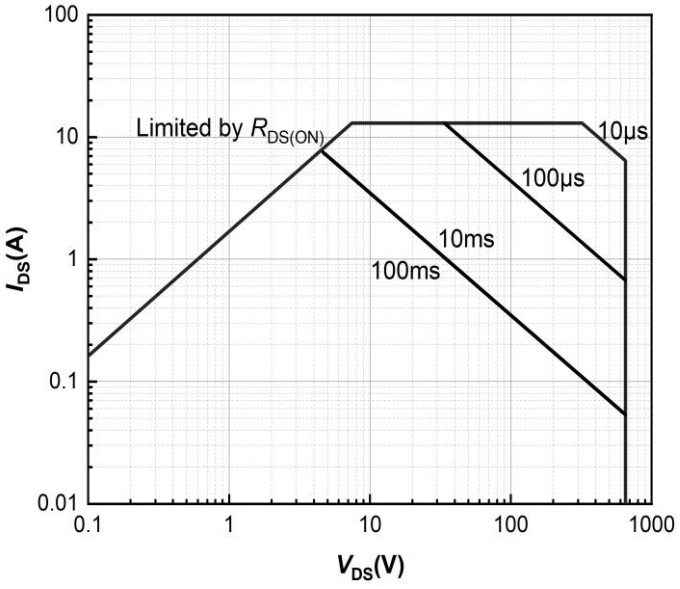
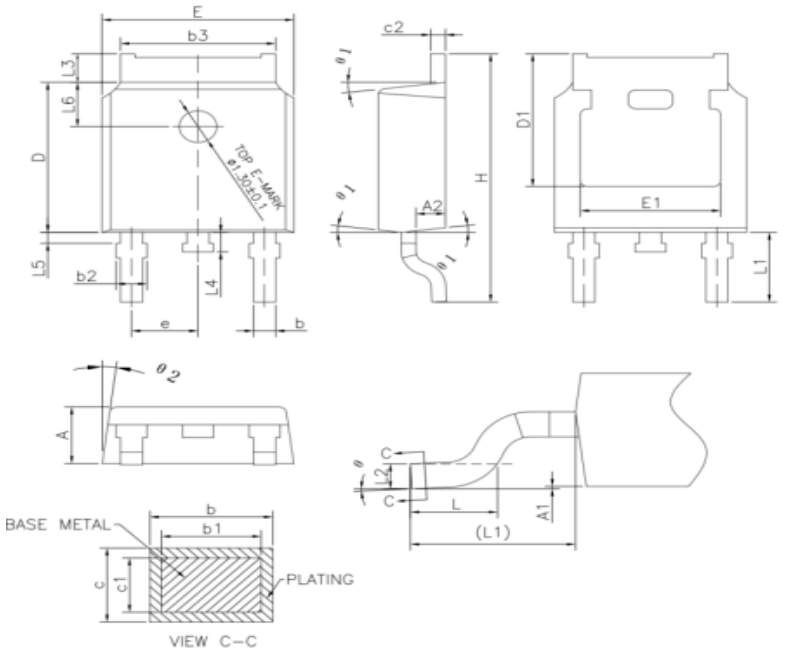



Figure 27. **Safe Operating Area**

## Package Outlines




| SYMBOL | Unit:mm | | |
|---|---|---|---|
| | MIN | NOM | MAX |
| A | 2.20 | 2.30 | 2.38 |
| A1 | 0 | - | 0.10 |
| A2 | 0.90 | 1.01 | 1.10 |
| b | 0.72 | - | 0.85 |
| b1 | 0.71 | 0.76 | 0.81 |
| b2 | 0.72 | - | 0.90 |
| b3 | 5.13 | 5.33 | 5.46 |
| c | 0.47 | - | 0.60 |
| c1 | 0.46 | 0.51 | 0.56 |
| c2 | 0.47 | - | 0.60 |
| D | 6.00 | 6.10 | 6.20 |
| D1 | 5.25 | - | - |
| E | 6.50 | 6.60 | 6.70 |
| E1 | 4.70 | - | - |
| e | 2.186 | 2.286 | 2.386 |
| H | 9.80 | 10.10 | 10.40 |
| L | 1.40 | 1.50 | 1.70 |
| L1 | 2.90 REF | | |
| L2 | 0.50 BSC | | |
| L3 | 0.90 | - | 1.25 |
| L4 | 0.60 | 0.80 | 1.00 |
| L5 | 0.15 | - | 0.75 |
| L6 | 1.80 REF | | |
| θ | 0° | - | 8° |
| θ1 | 5° | 7° | 9° |
| θ2 | 5° | 7° | 9° |

## Revision History

| Document Version | Date of Release | Description of Changes |
|---|---|---|
| Rev. A | 2025-07-11 | Release of the datasheet. |

**Macrocore Semiconductor Ltd.**

**Suzhou, China**

**All Rights Reserved.**

## Information

For further information on technology, delivery terms and conditions and prices, please contact the nearest MCS office.

## Disclaimer

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device. Hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.