

# C4MS036120K1

Silicon Carbide Power MOSFET  
Switching Optimized 1200V 36mΩ Industrial  
N-Channel Enhancement Mode

## Features

- Industry compatible drive voltage 15V...18V/-5V...0V
- Soft body diode with low Vds overshoot and ringing
- Low Rds(on) at high operating temperatures
- Improved device capacitances ratio (Ciss/Crss)
- High transient voltage robustness with improved lifetime
- Halogen free, RoHS compliant

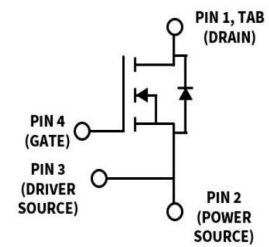
## Benefits

- Higher efficiency with lower switching losses and EMI
- Faster switching operation enabling high power density
- Enables system level price performance optimization
- Reduction in system level cooling requirements

## Typical Applications

- EV Chargers
- Solar/ESS
- Motor Control
- Industrial Power Supplies
- High Voltage DC/DC Converters

## Package



| Orderable Part number | Package type | Marking      |
|-----------------------|--------------|--------------|
| C4MS036120K1          | TO-247-4 LP  | C4MS036120K1 |

## Key Parameters

| Parameter                                  | Symbol         | Min. | Typ. | Max  | Unit       | Conditions                                                           | Note   |
|--------------------------------------------|----------------|------|------|------|------------|----------------------------------------------------------------------|--------|
| Drain - Source Voltage                     | $V_{DS}$       |      |      | 1200 | V          |                                                                      |        |
| Transient Drain - Source Voltage           |                |      |      | 1300 |            | <100hrs of lifetime                                                  | Note 1 |
| Maximum Gate - Source Voltage              |                | -10  |      | +23  |            |                                                                      | Note 2 |
| DC Continuous Drain Current                | $I_D$          |      | 60   |      | A          | $V_{GS} = 18V, T_C = 25^\circ C, T_J \leq 175^\circ C$               | Note 3 |
|                                            |                |      | 44   |      |            | $V_{GS} = 18V, T_C = 100^\circ C, T_J \leq 175^\circ C$              |        |
| Pulsed Drain Current                       | $I_{DM}$       |      |      | 193  |            | $t_{Pmax}$ limited by $T_{Jmax}$<br>$V_{GS} = 18V, T_C = 25^\circ C$ |        |
| Power Dissipation                          | $P_D$          |      | 272  |      | W          | $T_C = 25^\circ C, T_J = 175^\circ C$                                | Note 4 |
| Operating Junction and Storage Temperature | $T_J, T_{stg}$ | -40  |      | +175 | $^\circ C$ |                                                                      |        |
| Solder Temperature                         | $T_L$          |      |      | 260  |            | According to JEDEC J-STD-020                                         |        |

Note (1): 100 hours of total accumulated lifetime of the product.

Note (2): When applying IPC-9592B derating it is permissible to use Maximum Vgs of +25V

Note (3): Current limit calculated by  $I_{D(max)} = \sqrt{(P_D / R_{DS(typ)}) \cdot (T_{J(max)} / I_{D(max)})}$

Note(4):  $P_D = (T_J - T_C) / R_{th(JC,typ)}$


**Electrical Characteristics** ( $T_c = 25^\circ\text{C}$  unless otherwise specified)

| Symbol             | Parameter                                                              | Min. | Typ.      | Max. | Unit          | Test Conditions                                                                                                                                            | Note               |
|--------------------|------------------------------------------------------------------------|------|-----------|------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| $V_{(BR)DSS}$      | Drain-Source Breakdown Voltage                                         | 1200 |           |      | V             | $V_{GS} = 0\text{ V}, I_D = 100\text{ }\mu\text{A}$                                                                                                        |                    |
| $V_{GS(th)}$       | Gate Threshold Voltage                                                 | 2    | 2.6       | 3.9  | V             | $V_{DS} = V_{GS}, I_D = 7.6\text{ mA}$                                                                                                                     | Fig. 11            |
|                    |                                                                        |      | 2.0       |      | V             | $V_{DS} = V_{GS}, I_D = 7.6\text{ mA}, T_J = 175^\circ\text{C}$                                                                                            |                    |
| $I_{DSS}$          | Zero Gate Voltage Drain Current                                        |      | 1         | 50   | $\mu\text{A}$ | $V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$                                                                                                              |                    |
| $I_{GSS}$          | Gate-Source Leakage Current                                            |      | 10        | 250  | nA            | $V_{GS} = 18\text{ V}, V_{DS} = 0\text{ V}$                                                                                                                |                    |
| $V_{GS(op)}$       | Recommended Turn on Gate-Source Voltage                                |      | +15...+18 |      | V             |                                                                                                                                                            | Refer to PRD-09634 |
|                    | Recommended Turn off Gate-Source Voltage                               |      | -5...0    |      |               |                                                                                                                                                            |                    |
| $R_{DS(on)}$       | Drain-Source On-State Resistance                                       |      | 36        | 47   | m $\Omega$    | $V_{GS} = 18\text{ V}, I_D = 27.6\text{ A}$                                                                                                                | Fig. 4, 5, 6       |
|                    |                                                                        |      | 66        |      |               | $V_{GS} = 18\text{ V}, I_D = 27.6\text{ A}, T_J = 175^\circ\text{C}$                                                                                       |                    |
|                    |                                                                        |      | 42        |      |               | $V_{GS} = 15\text{ V}, I_D = 27.6\text{ A}$                                                                                                                |                    |
| $g_{fs}$           | Transconductance                                                       |      | 20        |      | S             | $V_{DS} = 20\text{ V}, I_D = 27.6\text{ A}, T_J = 25^\circ\text{C}$                                                                                        | Fig. 7             |
|                    |                                                                        |      | 19        |      |               | $V_{DS} = 20\text{ V}, I_D = 27.6\text{ A}, T_J = 175^\circ\text{C}$                                                                                       |                    |
| $R_{DS(on)Tempco}$ | On resistance temperature coefficient                                  |      | 1.88      |      |               | $V_{GS} = 18\text{ V}, I_D = 27.6\text{ A}$                                                                                                                | Note 5             |
| $C_{iss}$          | Input Capacitance                                                      |      | 2164      |      | pF            | $V_{GS} = 0\text{ V}, V_{DS} = 1000\text{ V}$<br>$f = 100\text{ kHz}$<br>$V_{AC} = 25\text{ mV}$                                                           | Fig. 17, 18        |
| $C_{oss}$          | Output Capacitance                                                     |      | 72        |      |               |                                                                                                                                                            |                    |
| $C_{rss}$          | Reverse Transfer Capacitance                                           |      | 3.2       |      |               |                                                                                                                                                            |                    |
| $C_{iss}/C_{rss}$  | Capacitance Ratio                                                      |      | 630       |      |               |                                                                                                                                                            | Note 6             |
| $E_{oss}$          | $C_{oss}$ Stored Energy                                                |      | 46        |      | $\mu\text{J}$ |                                                                                                                                                            | Fig. 16            |
| $C_{o(er)}$        | Effective Output Capacitance (Energy Related)                          |      | 106       |      | pF            | $V_{GS} = 0\text{ V}, V_{DS} = 0...800\text{ V}$                                                                                                           |                    |
| $C_{o(tr)}$        | Effective Output Capacitance (Time Related)                            |      | 173       |      |               |                                                                                                                                                            |                    |
| $E_{on}$           | Turn-On Switching Energy (Body Diode FWD)<br>$T_J = 25^\circ\text{C}$  |      | 303       |      | $\mu\text{J}$ | $V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/18\text{ V}, I_D = 27.6\text{ A},$<br>$R_{G(ext)} = 2\Omega, L_\sigma = 25\text{ nH}$                         | Fig. 26, 29, 31    |
|                    | $T_J = 175^\circ\text{C}$                                              |      | 393       |      |               |                                                                                                                                                            |                    |
| $E_{off}$          | Turn-Off Switching Energy (Body Diode FWD)<br>$T_J = 25^\circ\text{C}$ |      | 18        |      |               |                                                                                                                                                            | Fig. 26, 29, 32    |
|                    | $T_J = 175^\circ\text{C}$                                              |      | 26        |      |               |                                                                                                                                                            |                    |
| $t_{d(on)}$        | Turn-On Delay Time                                                     |      | 12        |      | ns            | $V_{DD} = 800\text{ V}, V_{GS} = -4\text{ V}/18\text{ V}$<br>$I_D = 27.6\text{ A}, R_{G(ext)} = 2\Omega,$<br>Timing relative to $V_{DS}$<br>Inductive load | Fig. 27, 28        |
| $t_r$              | Rise Time                                                              |      | 3         |      |               |                                                                                                                                                            |                    |
| $t_{d(off)}$       | Turn-Off Delay Time                                                    |      | 29        |      |               |                                                                                                                                                            |                    |
| $t_f$              | Fall Time                                                              |      | 4         |      |               |                                                                                                                                                            |                    |
| $R_{G(int)}$       | Internal Gate Resistance                                               |      | 2.4       |      | $\Omega$      | $f = 1\text{ MHz}$                                                                                                                                         |                    |
| $Q_{gs}$           | Gate to Source Charge                                                  |      | 24        |      | nC            | $V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/18\text{ V}$<br>$I_D = 27.6\text{ A}, T_J = 25^\circ\text{C}$<br>Per IEC60747-8-4 pg 21                       | Fig. 12            |
| $Q_{gd}$           | Gate to Drain Charge                                                   |      | 23        |      |               |                                                                                                                                                            |                    |
| $Q_g$              | Total Gate Charge                                                      |      | 88        |      |               |                                                                                                                                                            |                    |

Note (5):  $R_{DS(on)Tempco}$  refers to  $R_{DS(on)}$  at  $175^\circ\text{C}$  /  $R_{DS(on)}$  at  $25^\circ\text{C}$ , C4MS 1200V product family value

Note (6): Capacitance ratio is a FOM for Partial turn-on immunity PRD-06933, C4MS 1200V product family value

$C_{o(er)}$ , a lumped capacitance that gives the same stored energy as  $C_{oss}$  while  $V_{ds}$  is rising from 0 to 800V

$C_{o(tr)}$ , a lumped capacitance that gives the same charging time as  $C_{oss}$  while  $V_{ds}$  is rising from 0 to 800V



Reverse Diode Characteristics (T<sub>c</sub> = 25°C unless otherwise specified)

| Symbol           | Parameter                        | Typ. | Max. | Unit | Test Conditions                                                                                                      | Note          |
|------------------|----------------------------------|------|------|------|----------------------------------------------------------------------------------------------------------------------|---------------|
| V <sub>SD</sub>  | Diode Forward Voltage            | 5.2  |      | V    | V <sub>GS</sub> = -4 V, I <sub>SD</sub> = 13.8 A, T <sub>j</sub> = 25 °C                                             | Fig. 8, 9, 10 |
|                  |                                  | 4.6  |      | V    | V <sub>GS</sub> = -4 V, I <sub>SD</sub> = 13.8 A, T <sub>j</sub> = 175 °C                                            |               |
| I <sub>S</sub>   | Continuous Diode Forward Current | 40   |      | A    | V <sub>GS</sub> = -4 V, T <sub>c</sub> = 25°C                                                                        |               |
| I <sub>SM</sub>  | Diode Pulse Current              |      | 193  | A    | V <sub>GS</sub> = -4 V, pulse width t <sub>p</sub> limited by T <sub>jmax</sub>                                      |               |
| t <sub>rr</sub>  | Reverse Recovery Time            | 11   |      | ns   | V <sub>GS</sub> = -4 V, I <sub>S</sub> = 27.6 A, V <sub>SD</sub> = 800V<br>T <sub>j</sub> = 175°C, diF/dt = 7.6 A/ns |               |
| Q <sub>rr</sub>  | Reverse Recovery Charge          | 335  |      | nC   |                                                                                                                      |               |
| I <sub>RRM</sub> | Peak Reverse Recovery current    | 49   |      | A    |                                                                                                                      |               |
| E <sub>RR</sub>  | Reverse recovery Energy          |      |      |      | V <sub>DS</sub> = 800 V, I <sub>D</sub> = 27.6 A,                                                                    |               |
|                  | T <sub>j</sub> = 25C             | 29   |      | μJ   | V <sub>GS</sub> = -4V/18V, R <sub>Gi(on)</sub> = 2 Ω, Lσ = 25nH                                                      |               |
|                  | T <sub>j</sub> = 175C            | 35   |      |      |                                                                                                                      |               |

Thermal Characteristics

| Symbol           | Parameter                                | Typ. | Unit | Test Conditions | Note |
|------------------|------------------------------------------|------|------|-----------------|------|
| R <sub>θJC</sub> | Thermal Resistance from Junction to Case | 0.55 | °C/W |                 |      |

## Typical Performance

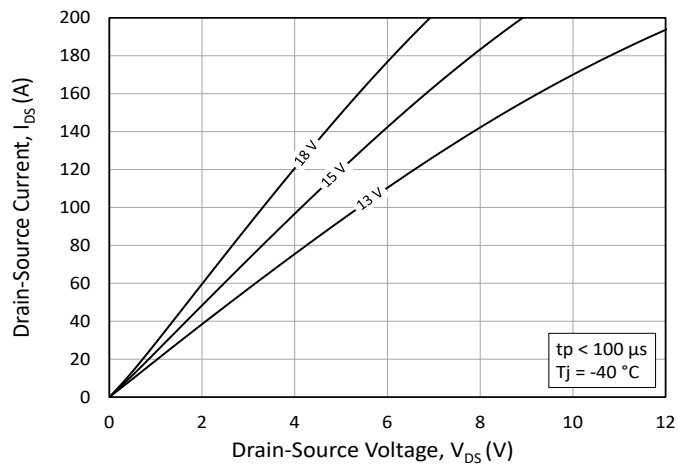
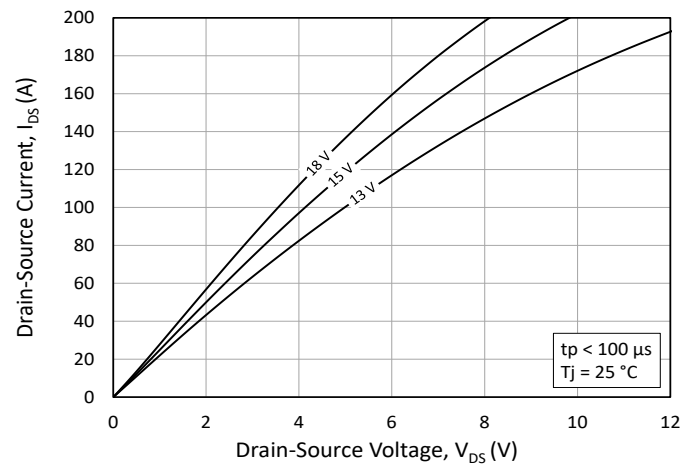
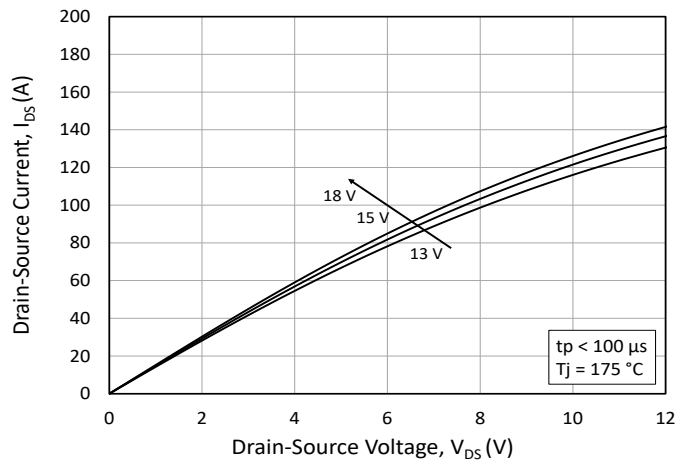
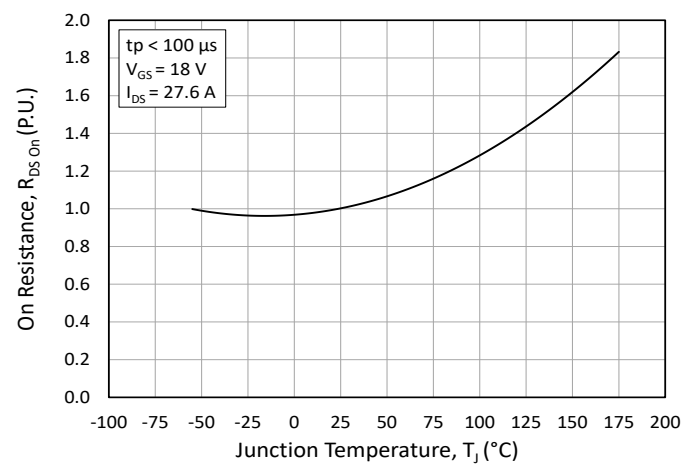
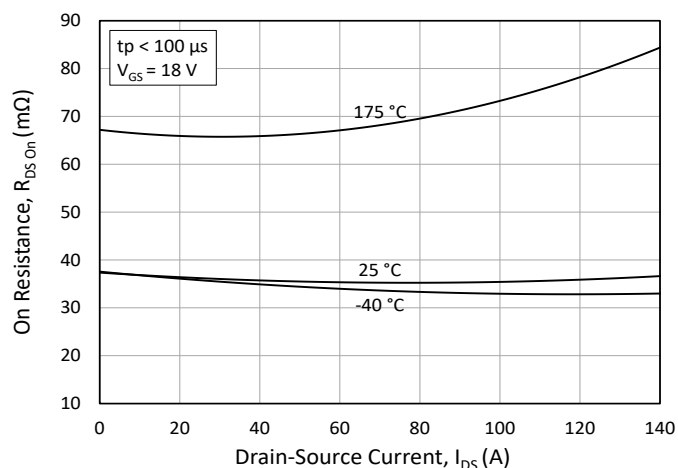
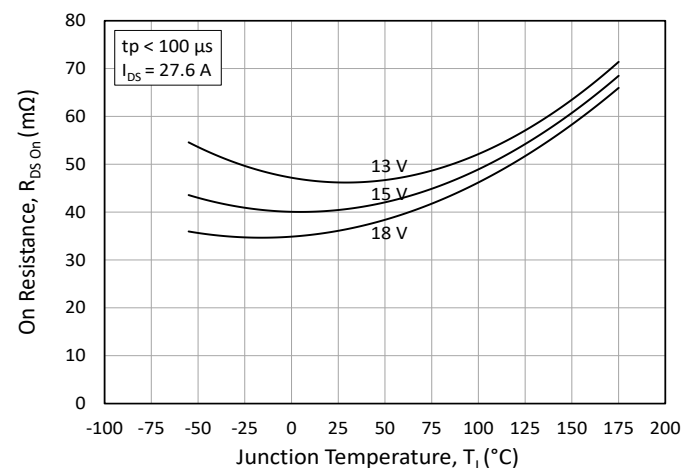
Figure 1. Output Characteristics  $T_j = -40^{\circ}\text{C}$ Figure 2. Output Characteristics  $T_j = 25^{\circ}\text{C}$ Figure 3. Output Characteristics  $T_j = 175^{\circ}\text{C}$ 

Figure 4. Normalized On-Resistance vs. Temperature

Figure 5. On-Resistance vs. Drain Current  
For Various TemperaturesFigure 6. On-Resistance vs. Temperature  
For Various Gate Voltage



## Typical Performance

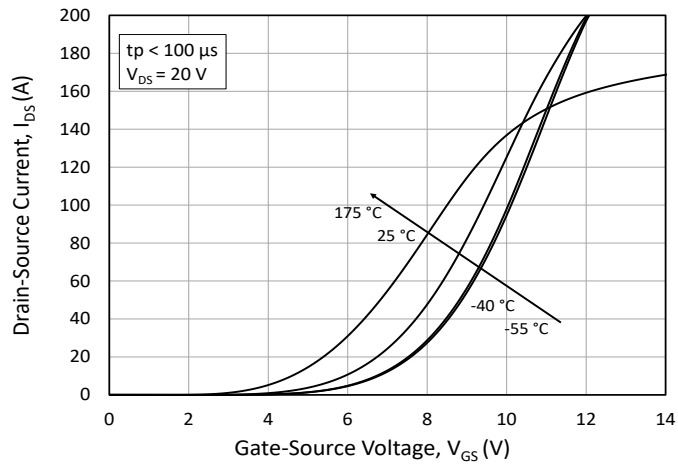


Figure 7. Transfer Characteristic for Various Junction Temperatures

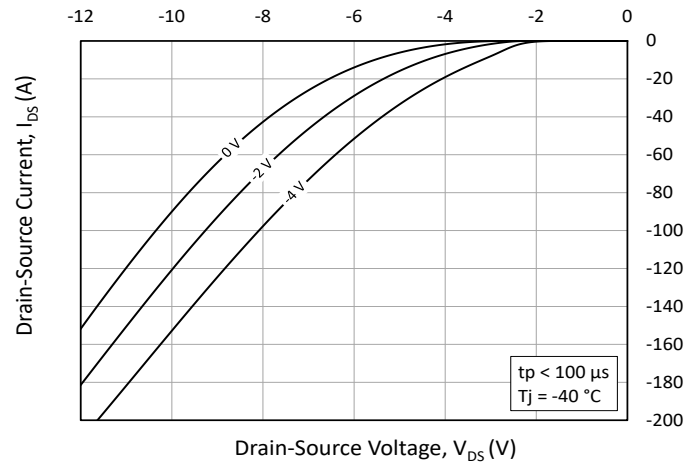


Figure 8. Body Diode Characteristic at -40 °C

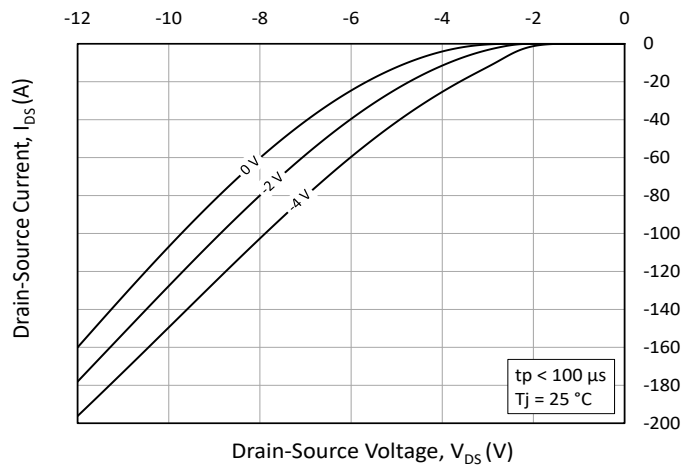


Figure 9. Body Diode Characteristic at 25 °C

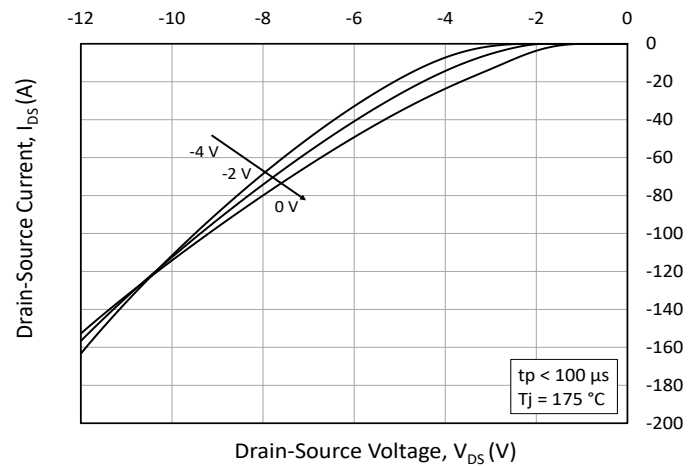


Figure 10. Body Diode Characteristic at 175 °C

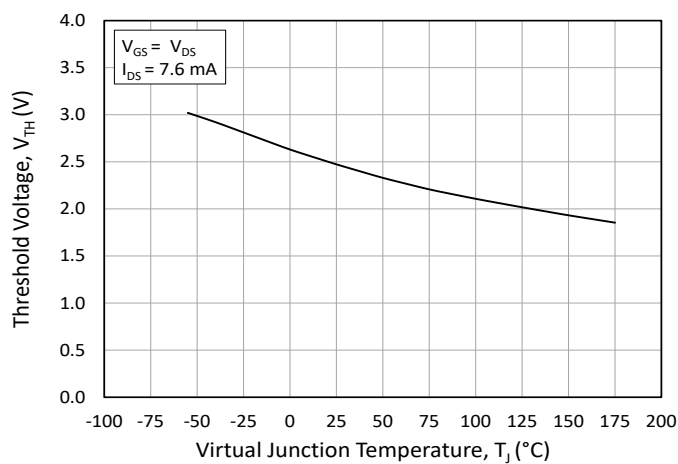


Figure 11. Threshold Voltage vs. Temperature

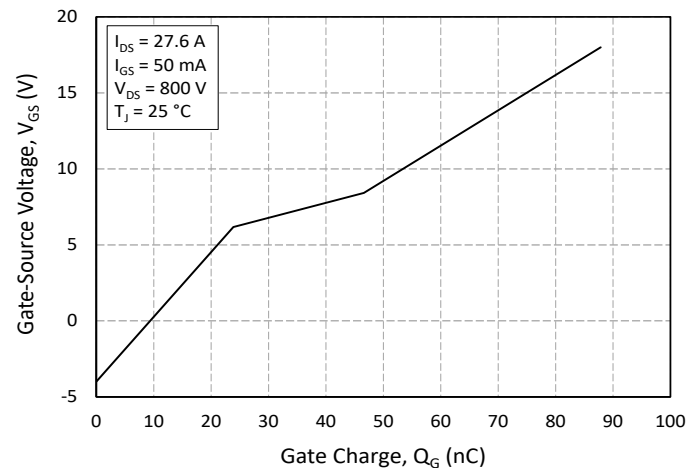


Figure 12. Gate Charge Characteristics

## Typical Performance

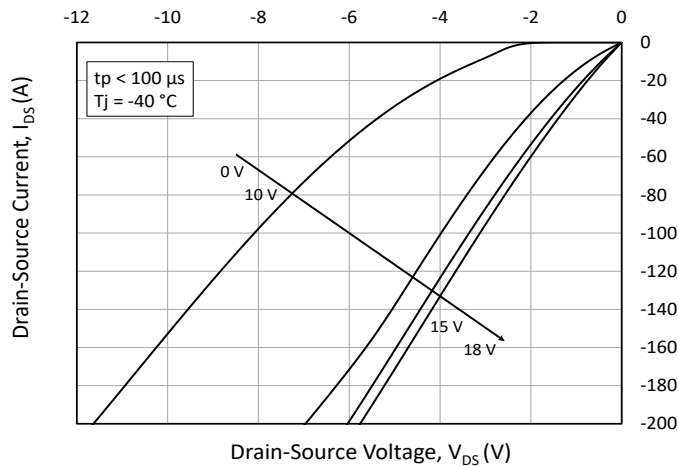


Figure 13. 3rd Quadrant Characteristic at -40°C

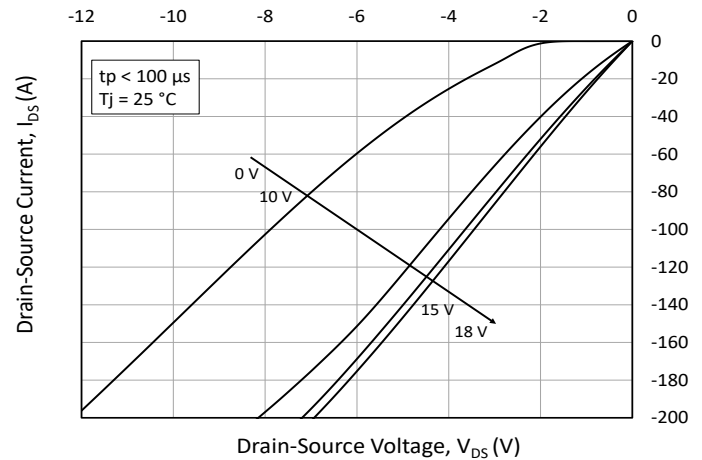


Figure 14. 3rd Quadrant Characteristic at 25°C

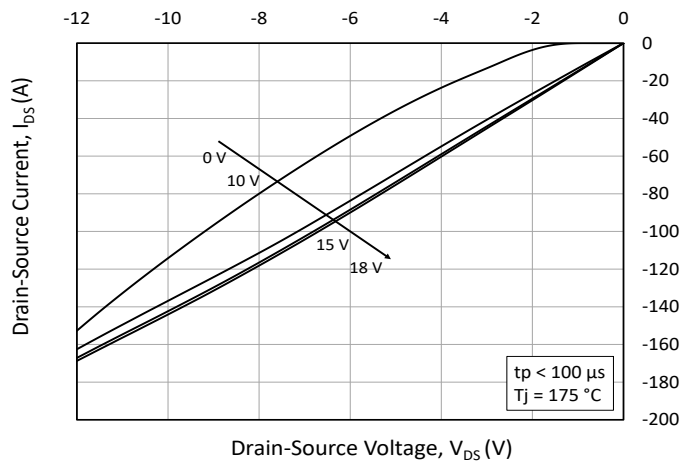


Figure 15. 3rd Quadrant Characteristic at 175°C

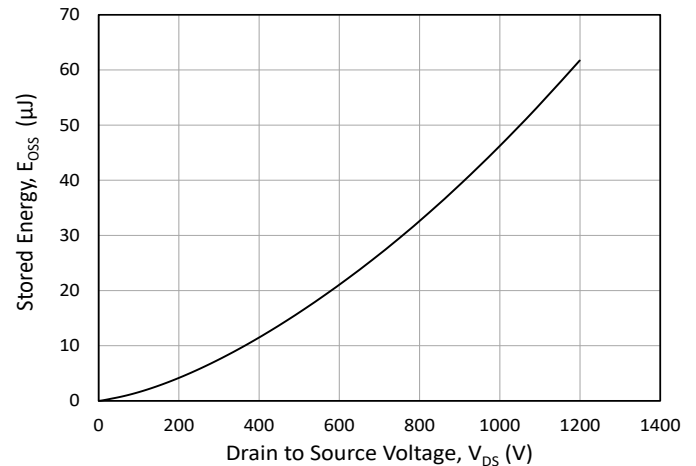


Figure 16. Output Capacitor Stored Energy

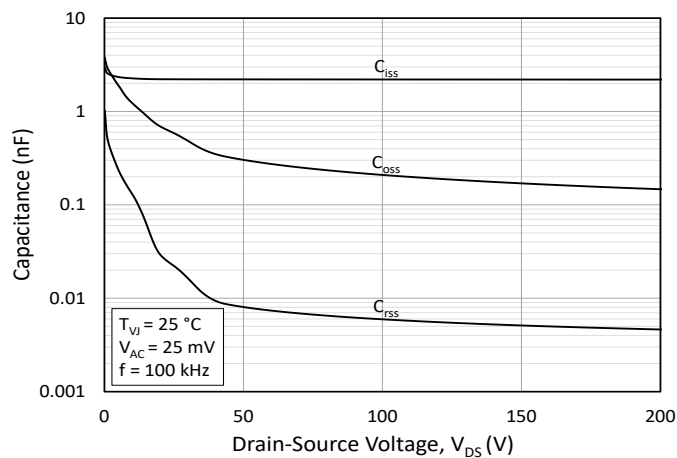


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200 V)

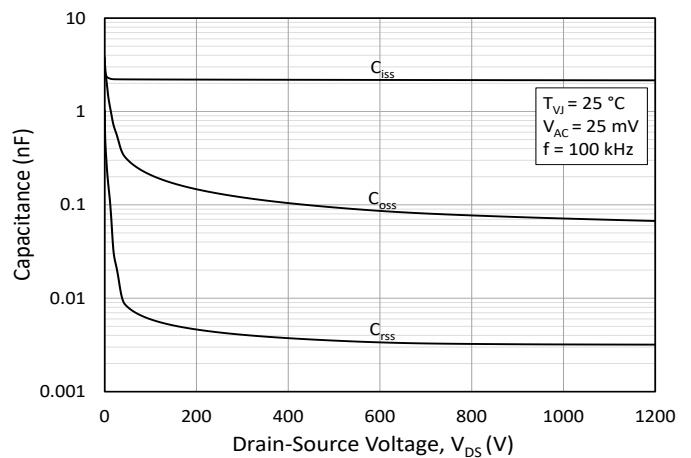


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1200 V)

## Typical Performance

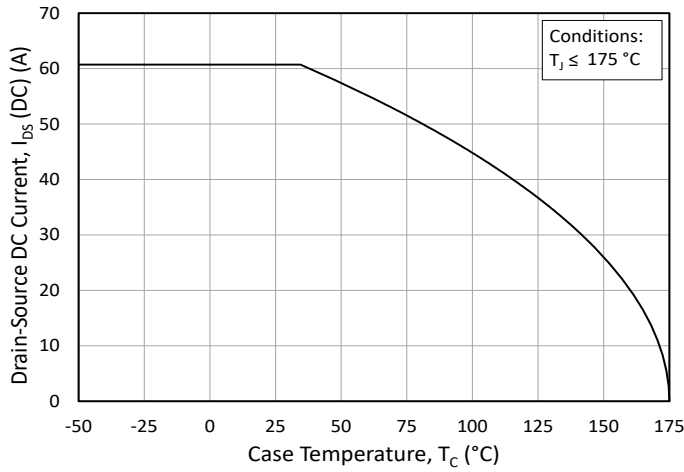


Figure 19. Continuous Drain Current Derating vs. Case Temperature

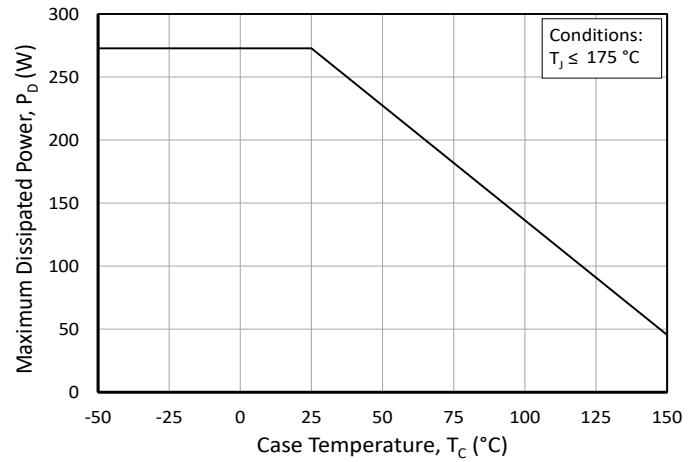


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

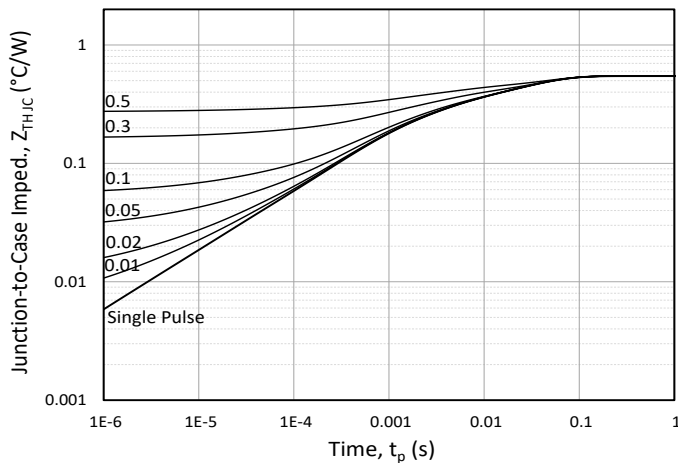


Figure 21. Transient Thermal Impedance (Junction - Case)

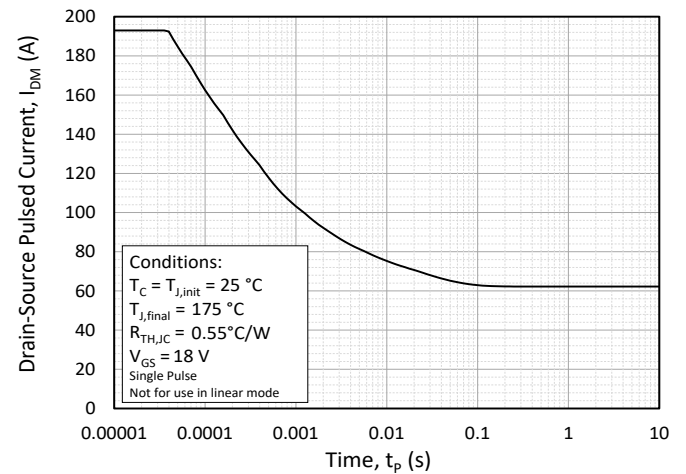
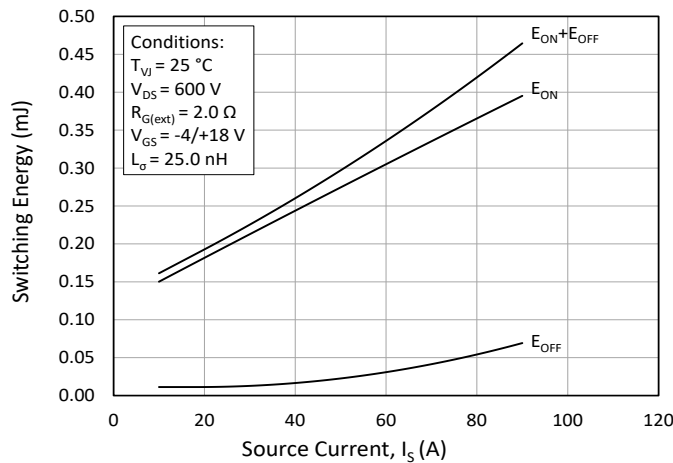
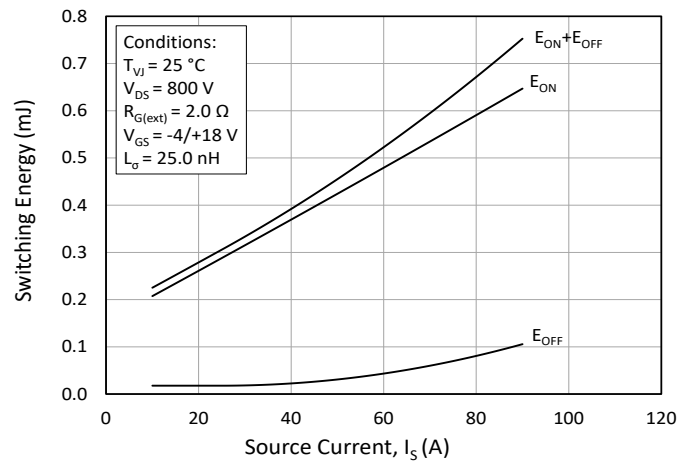


Figure 22. Safe Operating Area

Figure 23. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 600$  V)Figure 24. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 800$  V)

## Typical Performance

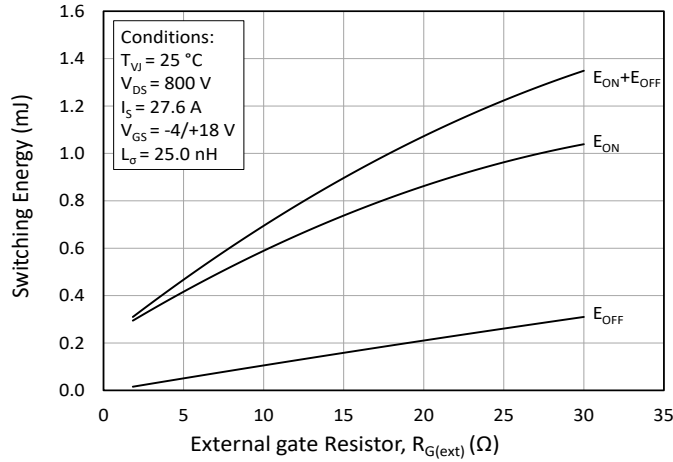
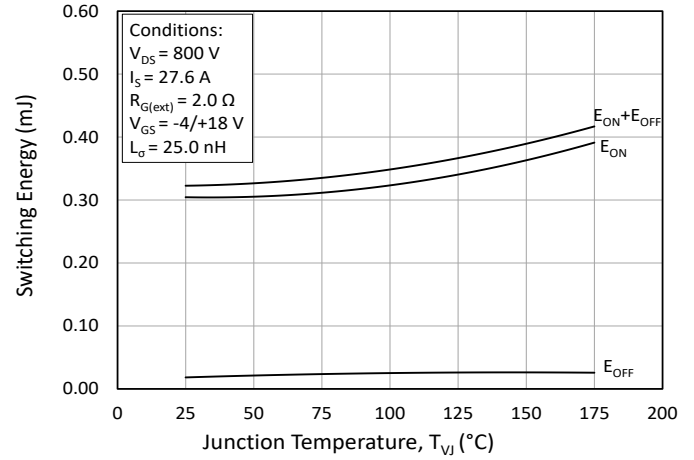
Figure 25. Clamped Inductive Switching Energy vs.  $R_{G(ext)}$ 

Figure 26. Clamped Inductive Switching Energy vs. Temperature

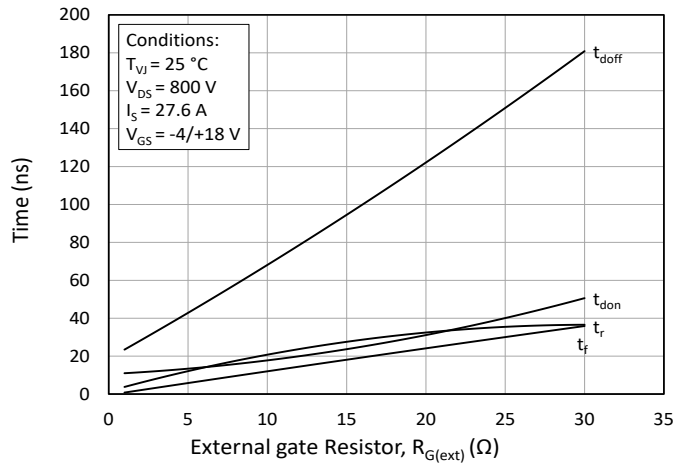
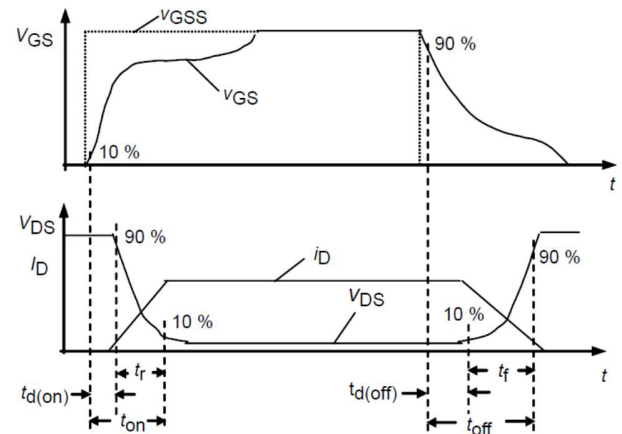
Figure 27. Switching Times vs.  $R_{G(ext)}$ 

Figure 28. Switching Times Definition

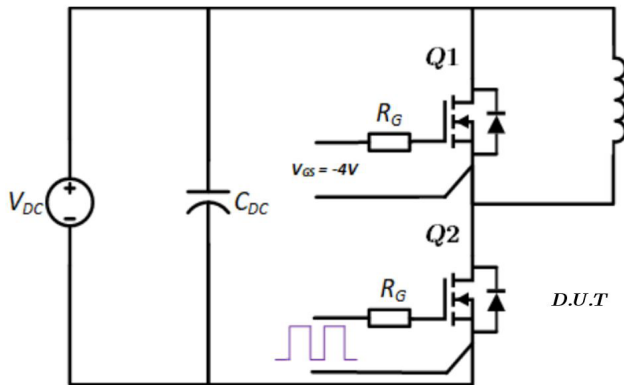


Figure 29. Clamped Inductive MOSFET Switching Waveform Test Circuit

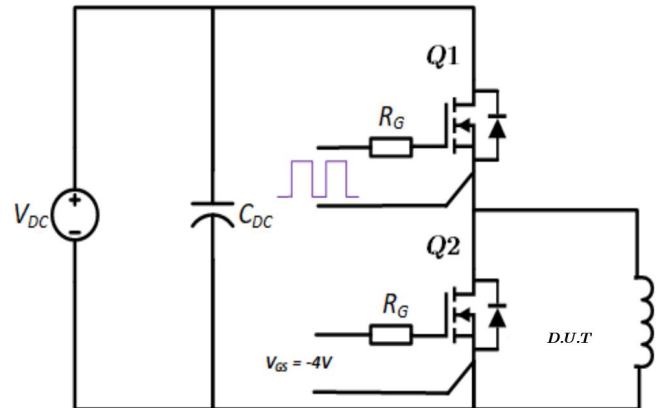
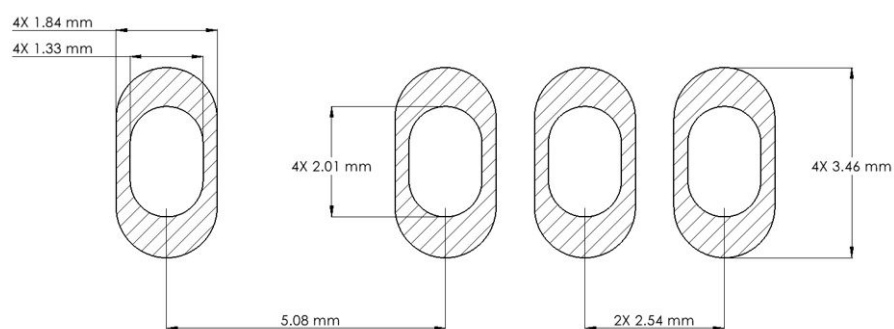


Figure 30. Clamped Inductive Body diode Switching Waveform Test Circuit



**Recommended Solder Pad Layout**

All dimensions in mm





**Revision history**

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| Document Version | Date of release | Description of changes |
|------------------|-----------------|------------------------|
| 1                | November 2025   | Initial release        |



## Notes & Disclaimer

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