

# WM2HA240120N

## N-Channel SiC Power MOSFET

### G2 MOSFET Technology

|                   |   |      |    |
|-------------------|---|------|----|
| $V_{DS}$          | = | 1200 | V  |
| $R_{DS(on)}$      | = | 240  | mΩ |
| $I_D@25^{\circ}C$ | = | 12.8 | A  |

#### Features

- High Blocking Voltage with Low On-Resistance
- High Speed Switching with Low Capacitance
- Easy to Parallel and Simple to Drive

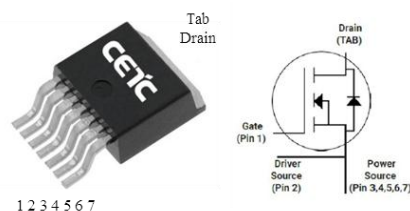
#### Benefits

- Higher System Efficiency
- Reduced Cooling Requirements
- Increased Power Density
- Increased System Switching Frequency

#### Applications

- Solar and UPS inverters
- EV motor drive
- High voltage DC/DC converters
- Switched mode power supplies
- Load switch

#### Package



| Part Number  | Package   | Marking      |
|--------------|-----------|--------------|
| WM2HA240120N | TO-263-7H | WM2HA240120N |

#### Maximum Ratings ( $T_c=25^{\circ}C$ unless otherwise specified)

| Symbol         | Parameter                                   | Value       | Unit        | Test Conditions                         | Note    |
|----------------|---------------------------------------------|-------------|-------------|-----------------------------------------|---------|
| $V_{DSmax}$    | Drain-Source Voltage                        | 1200        | V           | $V_{GS}=0V, I_D=100\mu A$               |         |
| $V_{GSmax}$    | Gate-Source Voltage                         | -10/+23     | V           | Absolute maximum values                 |         |
| $V_{GSop}$     | Gate-Source Voltage                         | -5/+18      | V           | Recommended operational values          |         |
| $I_D$          | Continuous Drain Current                    | 12.8        | A           | $V_{GS}=18V, T_c=25^{\circ}C$           | Fig. 19 |
|                |                                             | 9           |             | $V_{GS}=18V, T_c=100^{\circ}C$          |         |
| $I_{D(pulse)}$ | Pulsed Drain Current                        | 26.3        | A           | Pulse width $t_p$ limited by $T_{Jmax}$ | Fig. 22 |
| $P_D$          | Power Dissipation                           | 78          | W           | $T_c=25^{\circ}C, T_J=175^{\circ}C$     | Fig. 20 |
| $T_J, T_{STG}$ | Operating Junction and Storage Temperature  | -55 to +175 | $^{\circ}C$ |                                         |         |
| $T_L$          | Solder Temperature, 1.6mm from case for 10s | 260         | $^{\circ}C$ |                                         |         |

**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          | $V_{GS}=0V, I_D=100\mu A$                                                      |            |
| $V_{GS(th)}$  | Gate Threshold Voltage           | 2.0  | 2.8  | 4.0  | V          | $V_{DS}=V_{GS}, I_D=1.4mA$                                                     | Fig. 11    |
|               |                                  | /    | 2.0  | /    |            | $V_{DS}=V_{GS}, I_D=1.4mA, T_J=175^{\circ}\text{C}$                            |            |
| $I_{DSS}$     | Zero Gate Voltage Drain Current  | /    | 1    | 50   | $\mu A$    | $V_{DS}=1200V, V_{GS}=0V$                                                      |            |
| $I_{GSS+}$    | Gate-Source Leakage Current      | /    | 10   | 50   | nA         | $V_{DS}=0V, V_{GS}=23V$                                                        |            |
| $I_{GSS-}$    | Gate-Source Leakage Current      | /    | 10   | 50   | nA         | $V_{DS}=0V, V_{GS}=-10V$                                                       |            |
| $R_{DS(on)}$  | Drain-Source On-State Resistance | /    | 295  | 380  | m $\Omega$ | $V_{GS}=15V, I_D=5A$                                                           | Fig. 4,5,6 |
|               |                                  | /    | 420  | /    | m $\Omega$ | $V_{GS}=15V, I_D=5A, T_J=175^{\circ}\text{C}$                                  |            |
|               |                                  | /    | 240  | 312  | m $\Omega$ | $V_{GS}=18V, I_D=5A$                                                           |            |
|               |                                  | /    | 360  | /    | m $\Omega$ | $V_{GS}=18V, I_D=5A, T_J=175^{\circ}\text{C}$                                  |            |
| $g_{fs}$      | Transconductance                 | /    | 2.9  | /    | S          | $V_{DS}=20V, I_{DS}=5A$                                                        | Fig. 7     |
|               |                                  | /    | 2.8  | /    |            | $V_{DS}=20V, I_{DS}=5A, T_J=175^{\circ}\text{C}$                               |            |
| $C_{iss}$     | Input Capacitance                | /    | 481  | /    | pF         | $V_{GS}=0V$                                                                    | Fig. 17,18 |
| $C_{oss}$     | Output Capacitance               | /    | 19.5 | /    |            | $V_{DS}=1000V$                                                                 |            |
| $C_{rss}$     | Reverse Transfer Capacitance     | /    | 2.2  | /    |            | $f=1MHz$                                                                       |            |
| $E_{oss}$     | $C_{oss}$ Stored Energy          | /    | 9.6  | /    | $\mu J$    | $V_{AC}=25mV$                                                                  | Fig. 16    |
| $E_{ON}$      | Turn-On Switching Energy         | /    | 82   | /    | $\mu J$    | $V_{DS}=800V, V_{GS}=-5V/18V$                                                  |            |
| $E_{OFF}$     | Turn-Off Switching Energy        | /    | 12   | /    |            | $I_D=5A, R_{G(ext)}=2.5\Omega, L=100\mu H$                                     |            |
| $t_{d(on)}$   | Turn-On Delay Time               | /    | 5.5  | /    | ns         | $V_{DS}=800V, V_{GS}=-5V/18V, I_D=5A$<br>$R_{G(ext)}=2.5\Omega, R_L=160\Omega$ |            |
| $t_r$         | Rise Time                        | /    | 4.3  | /    |            |                                                                                |            |
| $t_{d(off)}$  | Turn-Off Delay Time              | /    | 16.6 | /    |            |                                                                                |            |
| $t_f$         | Fall Time                        | /    | 5.1  | /    |            |                                                                                |            |
| $R_{G(int)}$  | Internal Gate Resistance         | /    | 7.2  | /    | $\Omega$   | $f=1MHz, V_{AC}=25mV$                                                          |            |
| $Q_{GS}$      | Gate to Source Charge            | /    | 2.9  | /    | nC         | $V_{DS}=800V$                                                                  | Fig. 12    |
| $Q_{GD}$      | Gate to Drain Charge             | /    | 4.4  | /    |            | $V_{GS}=-5V/18V$                                                               |            |
| $Q_G$         | Total Gate Charge                | /    | 17.5 | /    |            | $I_D=5A$                                                                       |            |

**Reverse Diode Characteristics**

| Symbol    | Parameter                        | Typ. | Max. | Unit | Test Conditions                                    | Note        |
|-----------|----------------------------------|------|------|------|----------------------------------------------------|-------------|
| $V_{SD}$  | Diode Forward Voltage            | 4.2  | /    | V    | $V_{GS}=-5V, I_{SD}=2.5A, T_J=25^{\circ}\text{C}$  | Fig. 8,9,10 |
|           |                                  | 3.6  | /    |      | $V_{GS}=-5V, I_{SD}=2.5A, T_J=175^{\circ}\text{C}$ |             |
| $I_S$     | Continuous Diode Forward Current | /    | 12.8 | A    | $T_c=25^{\circ}\text{C}$                           |             |
| $t_{rr}$  | Reverse Recover Time             | 11.4 | /    | ns   | $V_R=800V, I_{SD}=5A$                              |             |
| $Q_{rr}$  | Reverse Recovery Charge          | 16.2 | /    | nC   |                                                    |             |
| $I_{rrm}$ | Peak Reverse Recovery Current    | 1.5  | /    | A    |                                                    |             |

### Thermal Characteristics

| Symbol          | Parameter                                   | Typ. | Max. | Unit                        | Test Conditions | Note    |
|-----------------|---------------------------------------------|------|------|-----------------------------|-----------------|---------|
| $R_{\theta JC}$ | Thermal Resistance from Junction to Case    | 1.95 | /    | $^{\circ}\text{C}/\text{W}$ |                 | Fig. 21 |
| $R_{\theta JA}$ | Thermal Resistance from Junction to Ambient | /    | 40   |                             |                 |         |

## Typical Performance

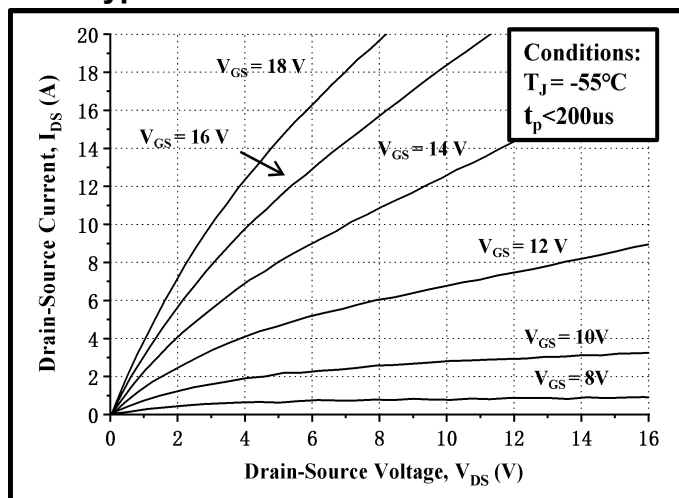


Figure 1. Output Characteristics  $T_J = -55^{\circ}\text{C}$

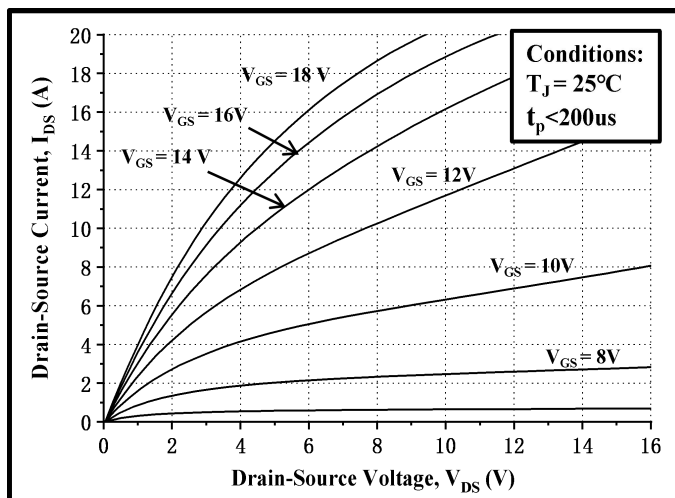


Figure 2. Output Characteristics  $T_J = 25^{\circ}\text{C}$

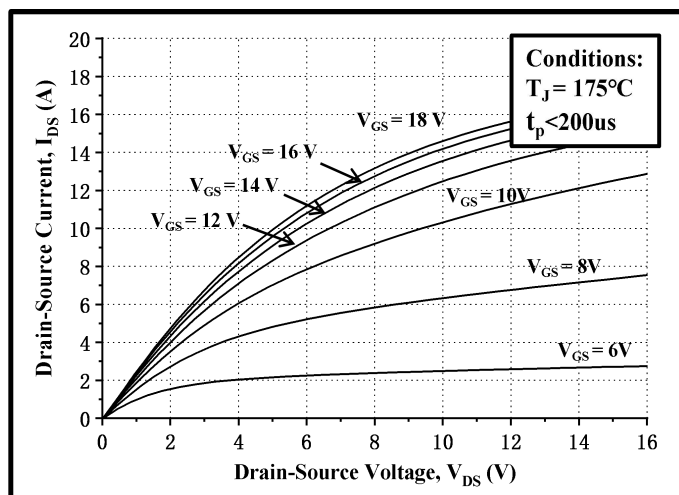


Figure 3. Output Characteristics  $T_J = 175^{\circ}\text{C}$

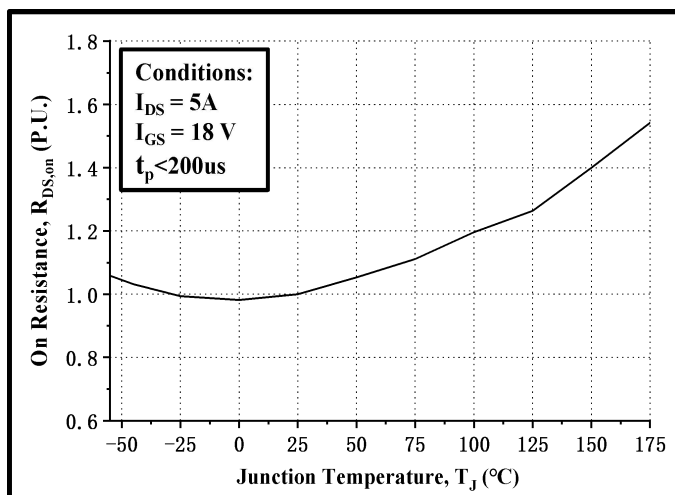


Figure 4. Normalized On-Resistance vs. Temperature

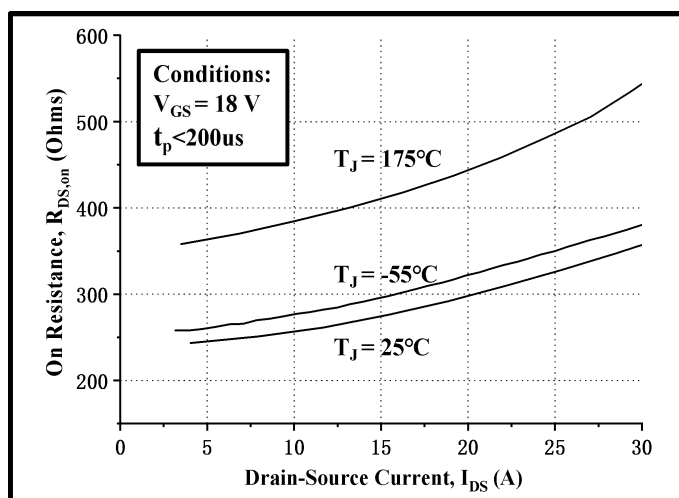


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

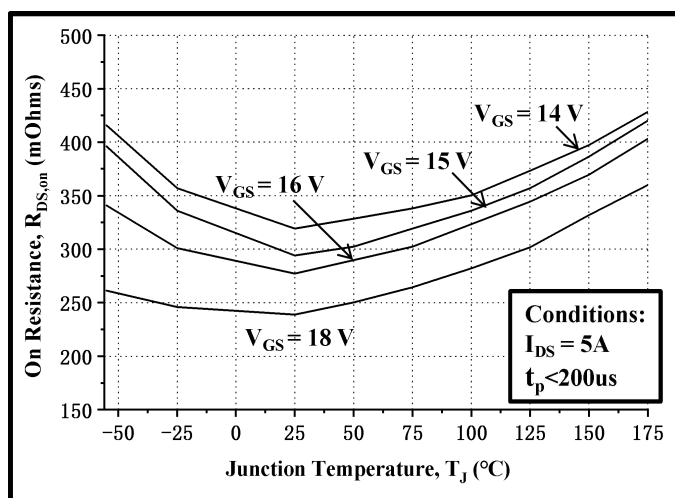


Figure 6. On-Resistance vs. Temperature For Various Gate Voltage

## Typical Performance

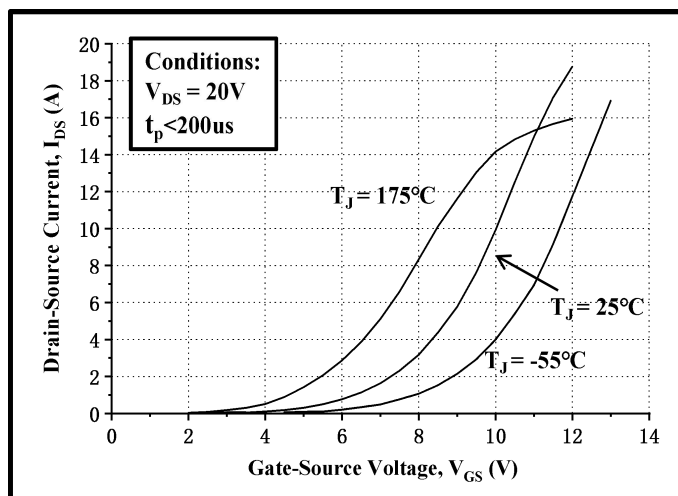


Figure 7. Transfer Characteristic for Various Junction Temperatures

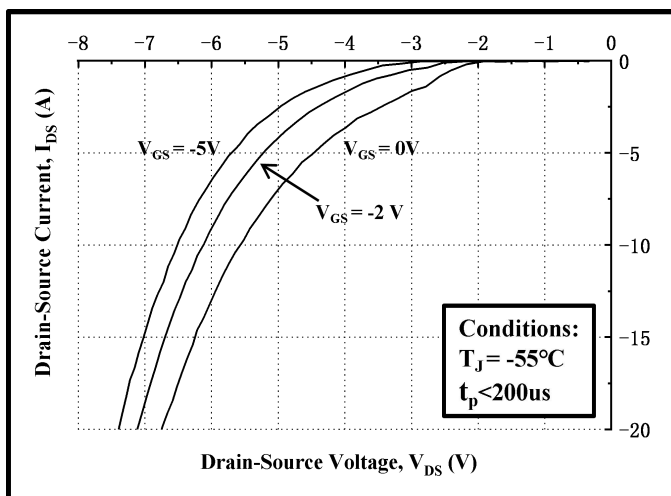


Figure 8. Body Diode Characteristic at  $-55^\circ\text{C}$

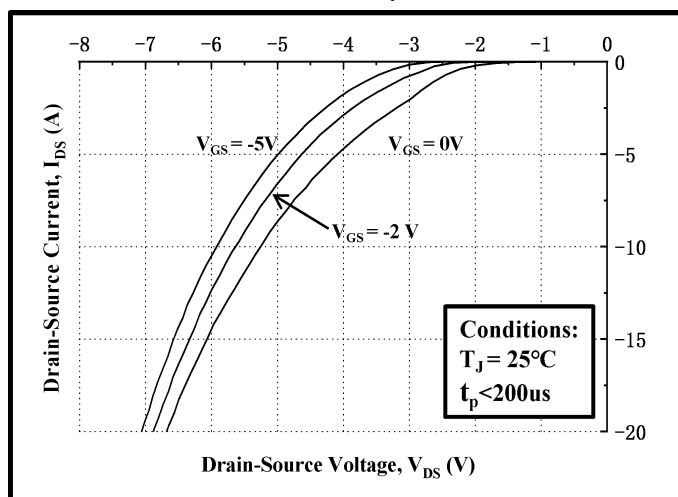


Figure 9. Body Diode Characteristic at  $25^\circ\text{C}$

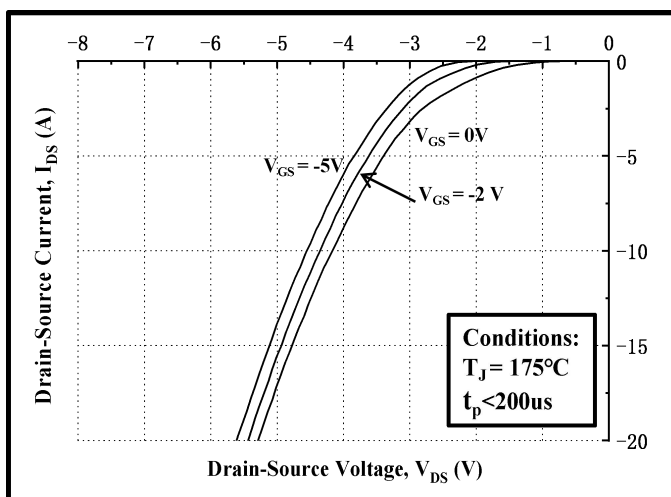


Figure 10. Body Diode Characteristic at  $175^\circ\text{C}$

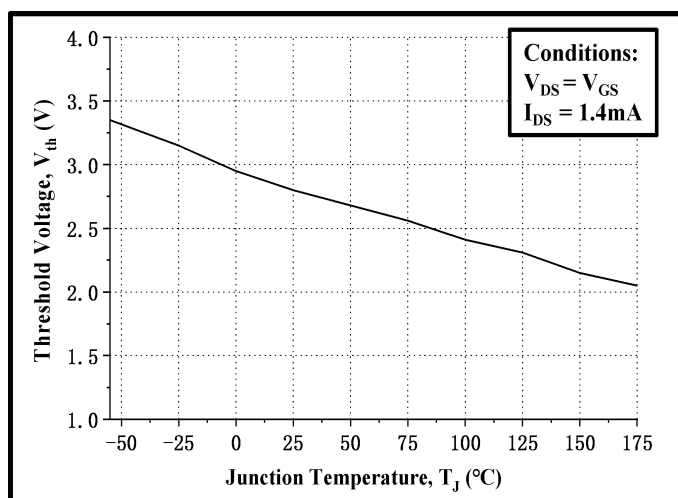


Figure 11. Threshold Voltage vs. Temperature

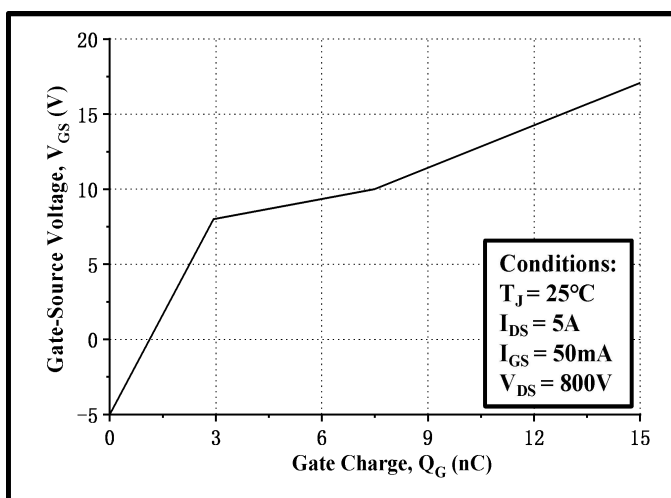


Figure 12. Gate Charge Characteristics

## Typical Performance

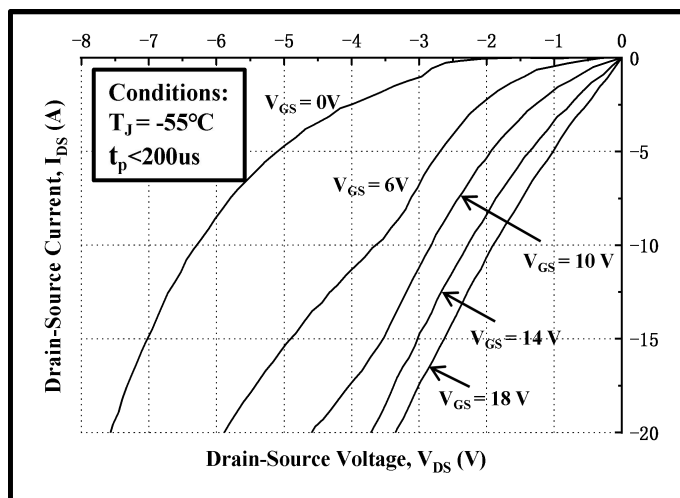


Figure 13. 3rd Quadrant Characteristic at

$-55^\circ\text{C}$

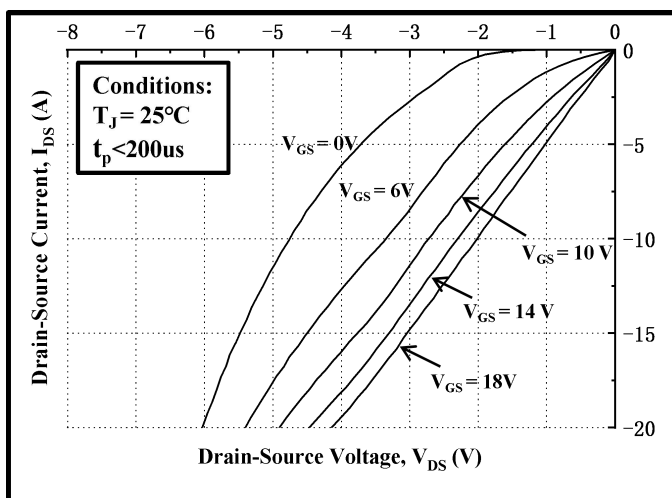


Figure 14. 3rd Quadrant Characteristic at  $25^\circ\text{C}$

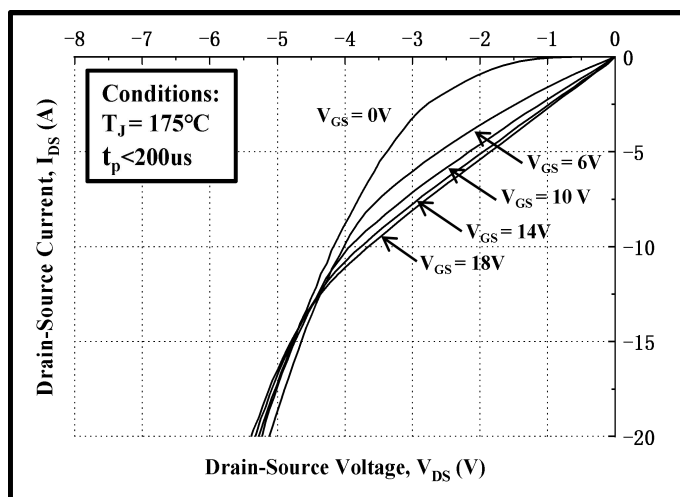


Figure 15. 3rd Quadrant Characteristic at  $175^\circ\text{C}$

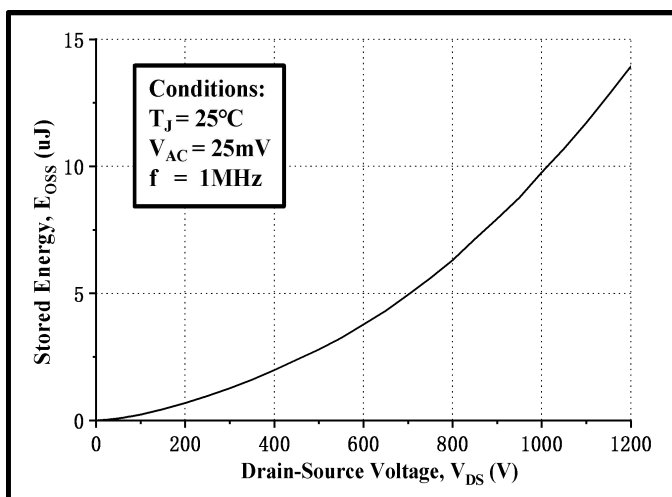


Figure 16. Output Capacitor Stored Energy

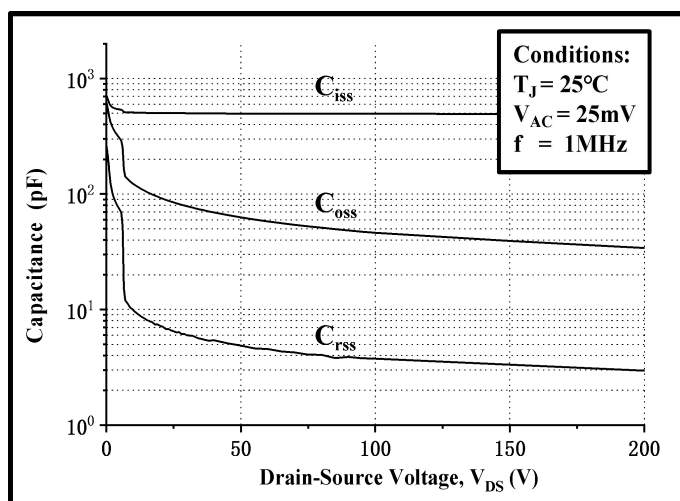


Figure 17. Capacitances vs. Drain-Source Voltage  
(0 - 200V)

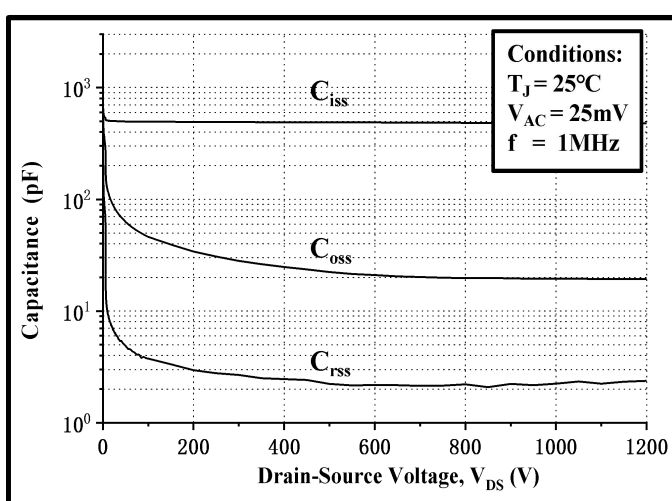


Figure 18. Capacitances vs. Drain-Source Voltage  
(0 - 1200V)

## Typical Performance

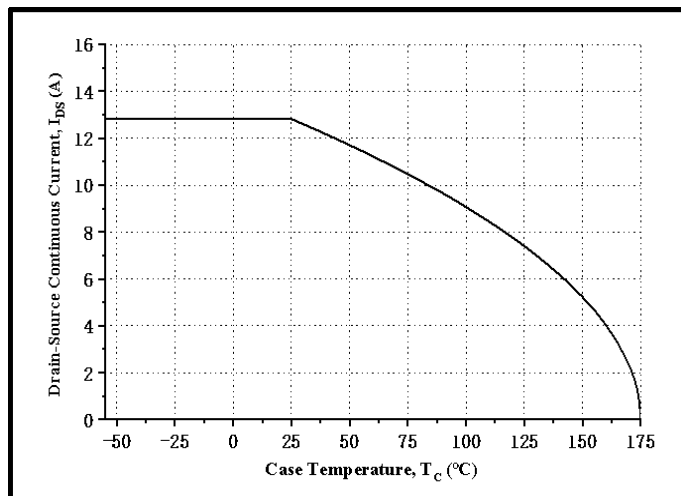


Figure 19. Continuous Drain Current vs. Case Temperature

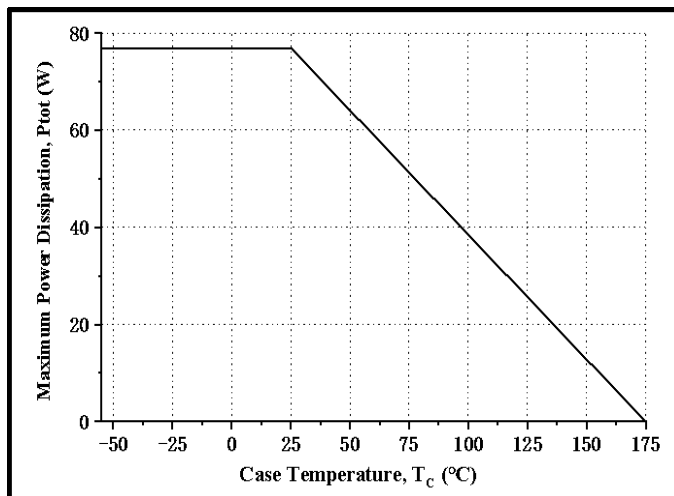


Figure 20. Maximum Power Dissipation vs. Case Temperature

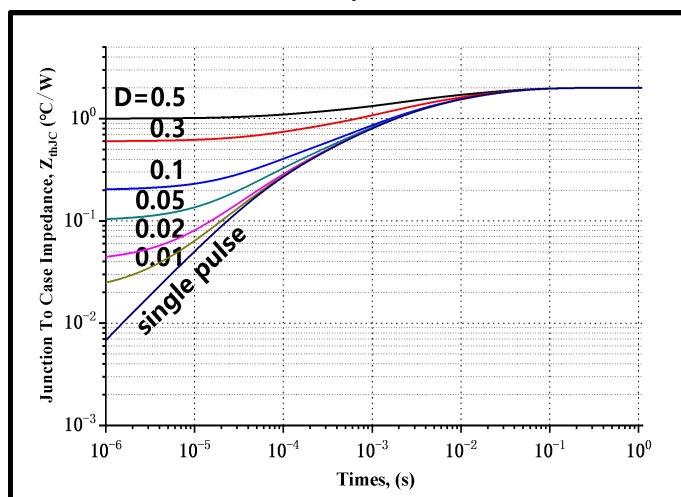


Figure 21. Continuous Drain Current vs. Case Temperature

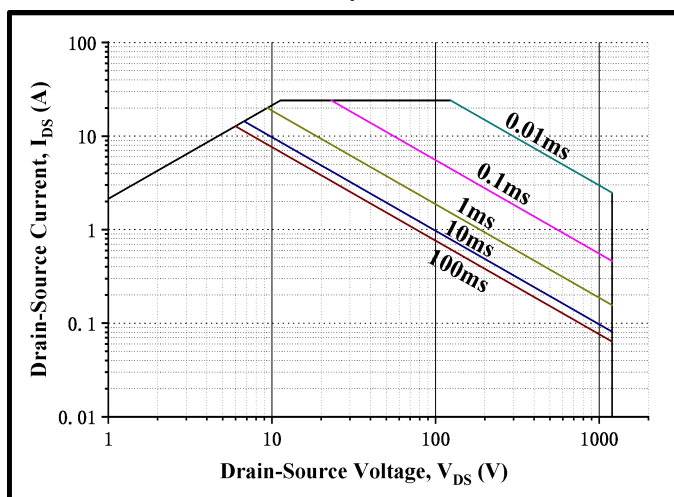
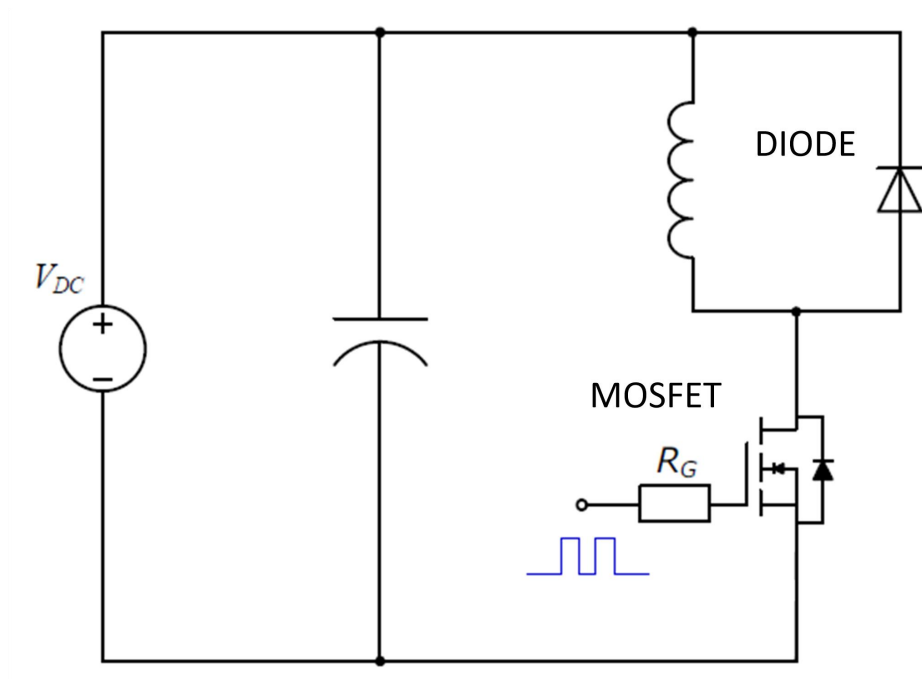


Figure 22. Maximum Power Dissipation vs. Case Temperature

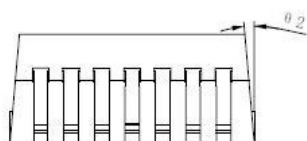
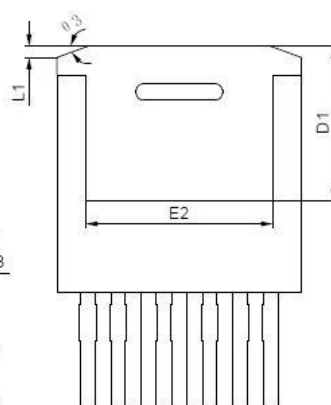
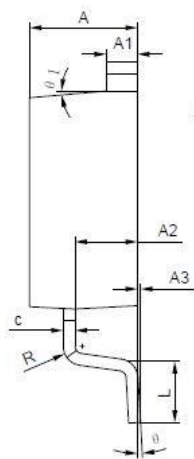
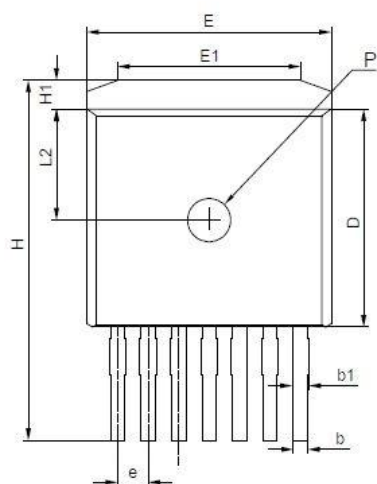
**Test Circuit Schematic**



**Figure 23. Clamped Inductive Switching  
Waveform Test Circuit**

## Package Dimensions

Package TO-263-7H



| SYMBOLS    | DIMENSIONS<br>MILLIMETERS |       |       |
|------------|---------------------------|-------|-------|
|            | MIN                       | NOR   | MAX   |
| A          | 4.40                      | 4.50  | 4.60  |
| A1         | 1.25                      | 1.30  | 1.4   |
| A2         | 2.45                      | 2.6   | 2.70  |
| A3         | 0.05                      | 0.13  | 0.20  |
| b          | 0.50                      | 0.60  | 0.70  |
| b1         | 0.60                      | 0.70  | 0.85  |
| c          | 0.45                      | 0.50  | 0.60  |
| D          | 8.88                      | 9.08  | 9.28  |
| D1         | 6.25                      | 6.45  | 6.65  |
| E          | 9.18                      | 10.18 | 10.28 |
| E1         | 6.67                      | 7.07  | 7.47  |
| E2         | 7.67                      | 7.82  | 7.97  |
| e          | 1.27bsc                   |       |       |
| H          | 14.75                     | 15    | 15.25 |
| H1         | 1.10                      | 1.20  | 1.30  |
| L          | 2.35                      | 2.55  | 2.75  |
| L1         | 0.37                      | 0.57  | 0.77  |
| L2         | 4.48                      | 4.63  | 4.78  |
| $\theta$   | 0°                        | 3°    | 5°    |
| $\theta_1$ | 3°                        | 5°    | 7°    |
| $\theta_2$ | 3°                        | 5°    | 7°    |
| $\theta_3$ | 15°                       | 20°   | 25°   |
| R          | 0.75                      | 0.8   | 0.85  |
| p          | 1.7                       | 1.8   | 1.9   |

## Notes

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