# MSH080120M1 / MSK080120M1

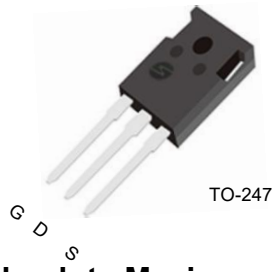
## Silicon Carbide Power MOSFET
## N-Channel Enhancement Mode

LEAD FREE RoHS

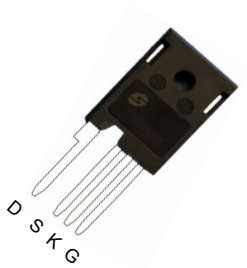
### Benefits
- Higher System Efficiency
- Reduced Cooling Requirements
- Increased Power Density
- Increased System Switching Frequency

### Applications
- Solar Inverters
- Switch Mode Power Supplies
- High Voltage DC/DC Converters
- IBattery Chargers
- Motor Drives
- Pulsed Power applications

### Features
- High Blocking Voltage with Low On-Resistance
- High Speed Switching with Low Capacitances
- Easy to Parallel and Simple to Drive
- Avalanche Ruggedness
- Halogen Free, RoHS Compliant



TO-247



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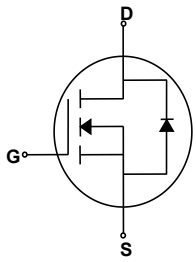



## Absolute Maximum Ratings

$T_C$ = 25°C unless otherwise noted

| Symbol | Parameter | MSH080120M1 / MSK080120M1 | Units |
|---|---|---|---|
| $V_{DSSmax}$ | Drain-Source Voltage,$V_{GS}$=0V,ID=100μA | 1200 | V |
| $I_D$ | Continuous Drain Current - VGS=20V , ($T_C$ = 25℃) | 28 | A |
| | - VGS=20V , ($T_C$ = 100℃) | 20 | A |
| $V_{GSmax}$ | Gate-Source Voltage, Absolute maximum values | -10/+25 | V |
| $VG_{Sop}$ | Gate-Source Voltage, Recommended operational values | -5/+20 | V |
| $P_D$ | Power Dissipation ($T_C$ = 25℃) TJ=150˚C | 166 | W |
| $T_J$, $T_{STG}$ | Operating Junction and Storage Temperature | -55 to +150 | ℃ |
| $T_L$ | Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds | 300 | ℃ |

* Drain current limited by maximum junction temperature.

## Thermal Characteristics

| Symbol | Parameter | Typ | Units |
|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case | 0.75 | ℃/W |
| $R_{\theta JS}$ | Thermal Resistance, Case-to-Sink Typ. | -- | ℃/W |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 35 | ℃/W |

## Electrical Characteristics

$T_C$ = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| $V_{(BR)DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$ = 0 V, $I_D$ = 100 uA | 1200 | -- | -- | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$ =1200 V, $V_{GS}$ = 0 V | -- | 2 | 100 | uA |
| $I_{GSSF}$ | Gate-Source Leakage Current | $V_{GS}$ = 20 V, $V_{DS}$ = 0 V | -- | 50 | 200 | nA |
| **On Characteristics** | | | | | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$ = $V_{GS}$, IDS=5mA,TC=25˚C | 1.8 | 2.25 | 3.0 | V |
| | | $V_{DS}$ = $V_{GS}$, IDS=5mA,TC=175˚C | - | 1.60 | - | V |
| $R_{DS(on)}$ | Static Drain-Source On-Resistance | $V_{GS}$ = 20 V, $I_D$ = 20A, TC=25˚C | -- | 80 | 95 | mΩ |
| | | $V_{GS}$=20V, ID=20A, TC=150˚C | | 118 | | mΩ |
| $g_{fS}$ | Forward Transconductance | $V_{GS}$ = 20 V, $I_D$ = 20A, TC=25˚C | -- | 5.6 | -- | S |
| | | $V_{GS}$=20V, ID=20A, TC=150˚C | -- | 5.8 | -- | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$=0V, VDS=1000 V, f=1MHz $V_{AC}$=25 mV | -- | 1710 | -- | pF |
| $C_{oss}$ | Output Capacitance | | -- | 54 | -- | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | -- | 37 | -- | pF |
| **Switching Characteristics** | | | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | $V_{DD}$=800V, $V_{GS}$= -5/20 V $I_D$= 20A, RG(ext) = 5 Ω , $R_L$=40Ω , Timing relative to VDS | -- | 23 | -- | ns |
| $t_r$ | Turn-On Rise Time | | -- | 60 | -- | ns |
| $t_{d(off)}$ | Turn-Off Delay Time | | -- | 17 | -- | ns |
| $t_f$ | Turn-Off Fall Time | | -- | 12 | -- | ns |
| $Q_g$ | Total Gate Charge | $V_{DD}$ = 800 V, $I_D$ =20A, $V_{GS}$ = -5/20 V | -- | 85 | -- | nC |
| $Q_{gs}$ | Gate-Source Charge | | -- | 23 | -- | nC |
| $Q_{gd}$ | Gate-Drain Charge | | -- | 26 | -- | nC |
| RG(int) | Internal Gate Resistance | f=1 MHz, VAC=25mV | - | 2.8 | - | Ω |
| $E_{ON}$ | Turn-On Switching Energy | $V_{DS}$=800V, $V_{GS}$=-5/20V, $I_D$= 20A, RG(ext) = 5Ω, L= 142 μH | | 180 | | μJ |
| $E_{OFF}$ | Turn-Off Switching Energy | | | 70 | | |

## Drain-Source Diode Characteristics and Maximum Ratings

| | | | | | | |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Drain-Source Diode Forward Current,TC = 25˚C | | - | 15 | - | A |
| $V_{SD}$ | Drain-Source Diode Forward Voltage | $V_{GS}$ = -5V, $I_{SD}$ = 10 A, $T_J$ = 25 °C | -- | 7.9 | - | V |
| | | $V_{GS}$ =- 5V, $I_{SD}$ =10 A, $T_J$ = 150 °C | - | 7.0 | - | |

## Typical Characteristics

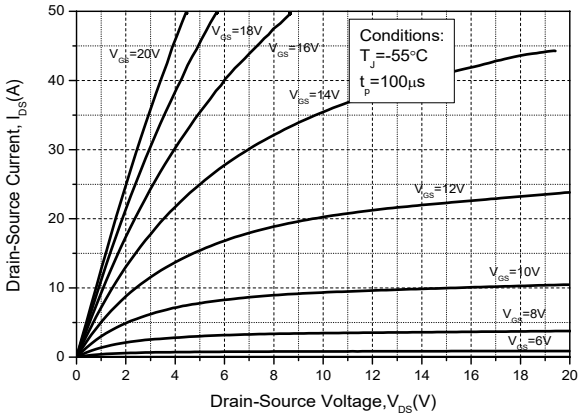



**Figure 1. On-Region CharacteristicsTJ = -40 °C**

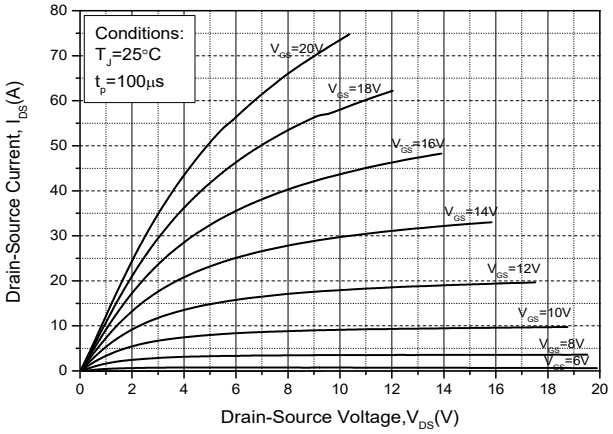



**Figure 2. Output Characteristics TJ = 25 °C**

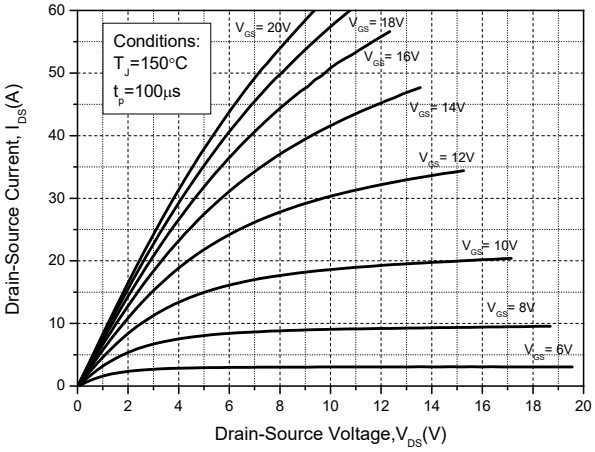



**Figure 3.Output Characteristics TJ =175 °C**

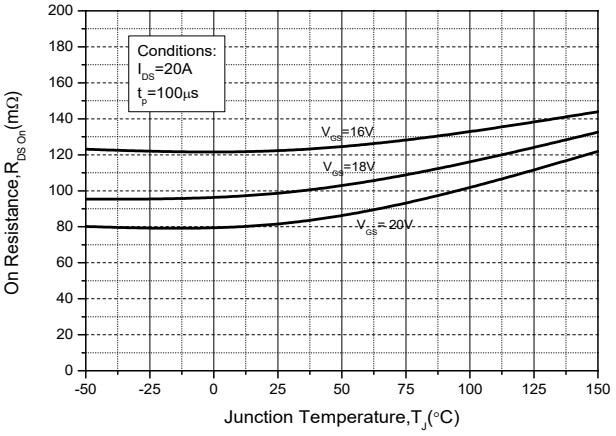



**Figure 4. On-Resistance For Various Gate Voltage**

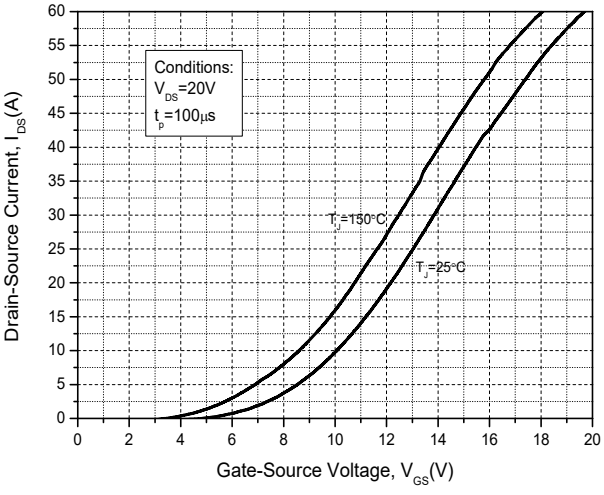



**Figure 5. Transfer Characteristic for Various Junction Temperatures**

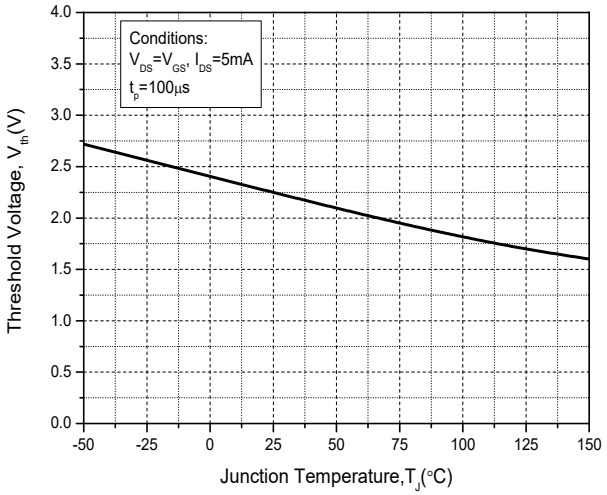



**Figure 6. Threshold Voltage vs. Temperature**

## Typical Characteristics (Continued)

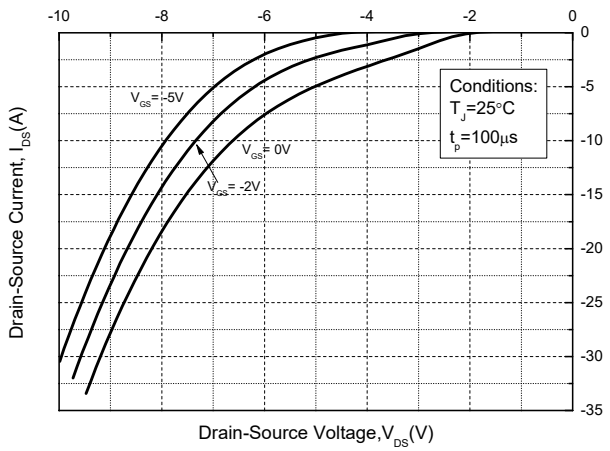



**Figure 7. Body Diode Characteristics**

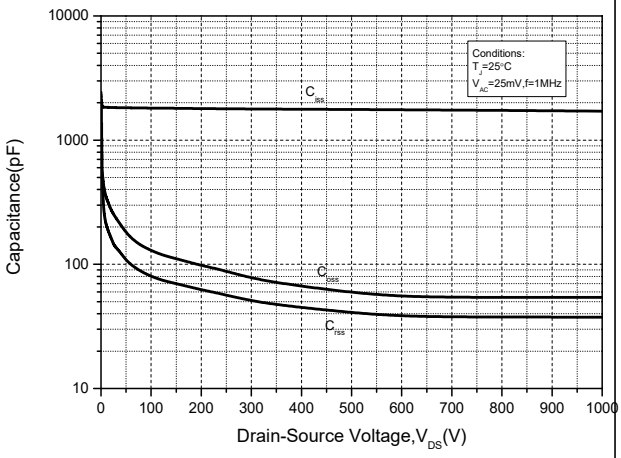



**Figure 8. Capacitances vs. Drain-Source Voltage**

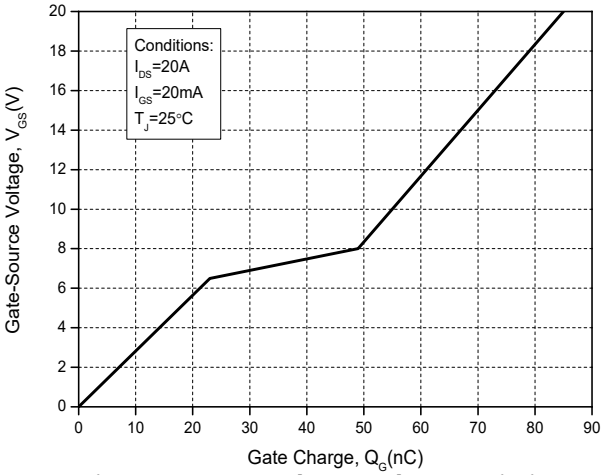



**Figure 9. Gate Charge Characteristics**

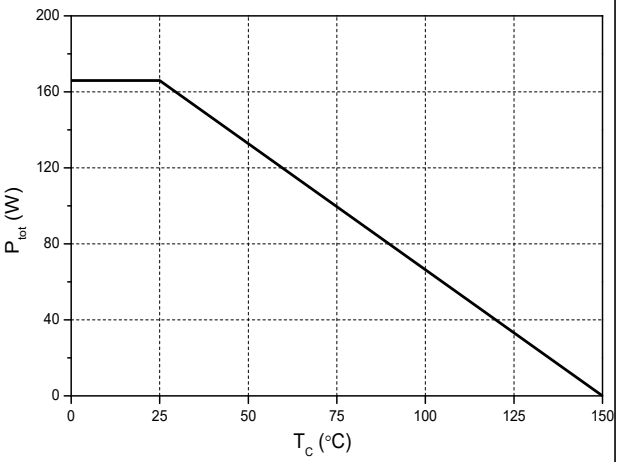



**Figure 10. Power Dissipation Derating**

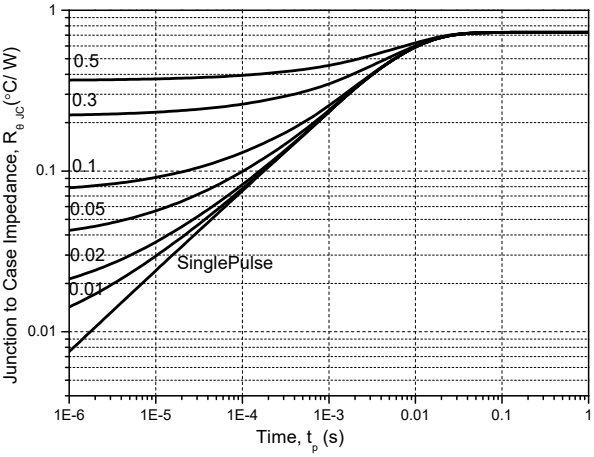
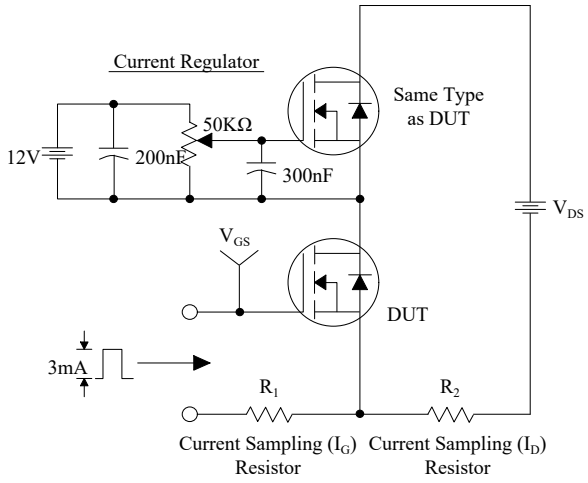
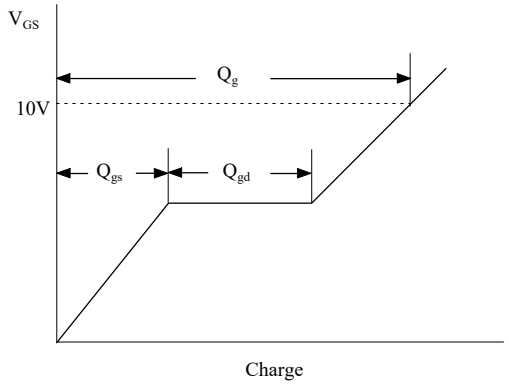


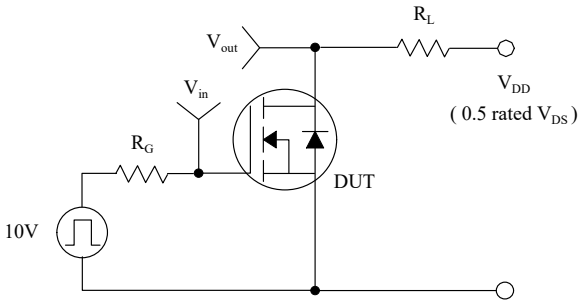

**Figure 11. Transient Thermal Impendance**

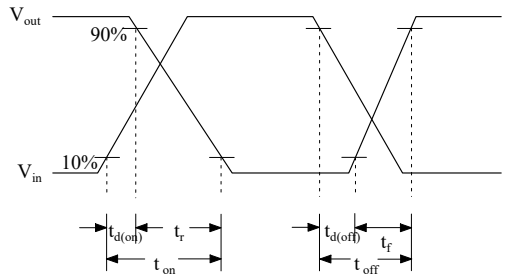
## Gate Charge Test Circuit & Waveform



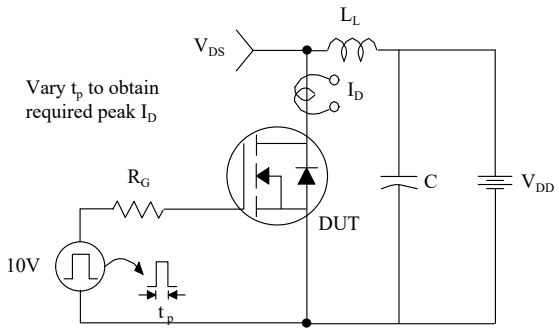




## Resistive Switching Test Circuit & Waveforms

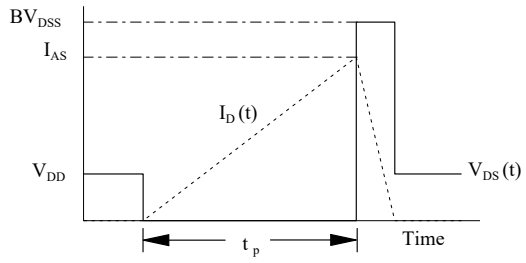



## Unclamped Inductive Switching Test Circuit & Waveforms




$$E_{AS} = \frac{1}{2} L_L I_{AS}^2 \frac{BV_{DSS}}{BV_{DSS} - V_{DD}}$$



## Peak Diode Recovery dv/dt Test Circuit & Waveforms