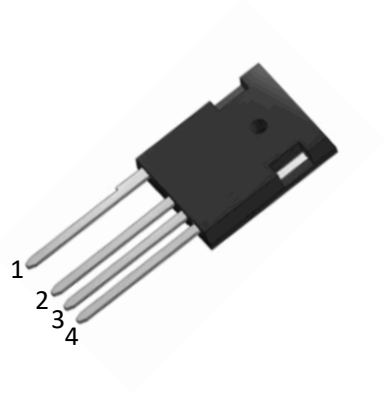
# HC3M0045065K1

SiC Power MOSFET N-Channel Enhancement Mode

## Features

- 3rd generation SiC MOSFET technology
- Optimized package with separate driver source pin
- High blocking voltage with low on-resistance
- High-speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery ($Q_{rr}$)
- Halogen free, RoHS compliant



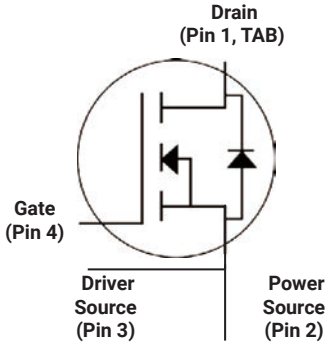

TO-247-4L
Package

## Benefits

- Reduce switching losses and minimize gate ringing
- Higher system effciency
- Reduce cooling requirements
- Increase power density
- Increase system switching frequency

## Applications

- Renewable energy
- EV battery chargers
- High voltage DC/DC converters
- Switch Mode Power Supplies




| Ordering Part Number | Package | Marking |
|---|---|---|
| HC3M0045065K1 | TO-247-4L | HC3M0045065K1 |

## Maximum Ratings ($T_C$ = 25 °C unless otherwise specifed)

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Drain-source voltage | $V_{DS}$ | 650 | V |
| Continuous drain current<br>$T_C$ = 25°C<br>$T_C$ = 100°C | $I_D$ | <br>49<br>53 | A |
| Pulsed drain current ($T_C$ = 25°C, $t_p$ limited by $T_{jmax}$) | $I_{D\ pulse}$ | 123 | A |
| Avalanche energy, single pulse (L=10mH) | $E_{AS}$ | 1000 | mJ |
| Gate-Source voltage | $V_{GS}$ | -5/+20 | V |
| Gate-Source voltage（dynamic,Absolute maximum values） | $V_{GSmax}$ | -10/+25 | V |
| Power dissipation ($T_C$ = 25°C) | $P_{tot}$ | 242 | W |
| Operating junction and storage temperature | $T_j$ , $T_{stg}$ | -55...+175 | °C |

## Thermal Resistance

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Thermal resistance, junction – case. Max | $R_{thJC}$ | 0.62 | °C/W |
| Thermal resistance, junction – ambient. Max | $R_{thJA}$ | 40 | |

## Electrical Characteristic (at Tj = 25 °C, unless otherwise specified)

| Parameter | Symbol | Value | | | Unit | Test Condition |
|---|---|---|---|---|---|---|
| | | min. | typ. | max. | | |
| **Static Characteristic** | | | | | | |
| Drain-source breakdown voltage | $BV_{DSS}$ | 650 | - | - | V | $V_{GS}$=0V, $I_D$=250uA |
| Gate threshold voltage | $V_{GS(th)}$ | 2 | - | 4 | V | $V_{DS}$=$V_{GS}$,$I_D$=7mA |
| Zero gate voltage drain current | $I_{DSS}$ | -<br>- | 1<br>10 | 100<br>- | μA | $V_{DS}$=650V,$V_{GS}$=0V<br>$T_j$=25°C<br>$T_j$=175°C |
| Gate-source leakage current | $I_{GSS}$ | - | | 250 | nA | $V_{GS}$=20V,$V_{DS}$=0V |
| Drain-source on-state resistance | $R_{DS(on)}$ | - | 45 | - | mΩ | $V_{GS}$=18V, $I_D$=17.6A, |
| | | -<br>- | 33<br>50 | 49<br>- | | $V_{GS}$=20V, $I_D$=17.6A,<br>$T_j$=25°C<br>$T_j$=175°C |
| Transconductance | $g_{fs}$ | - | 5.6 | - | S | $V_{DS}$=20V,$I_D$=17.6A |
| **Dynamic Characteristic** | | | | | | |
| Input Capacitance | $C_{iss}$ | - | 1823 | - | pF | $V_{DS}$ = 650V<br>$V_{GS}$ = 0V<br>$T_J$ = 25°C<br>$V_{AC}$ = 25mV<br>f = 1MHz |
| Output Capacitance | $C_{oss}$ | - | 190 | - | | |
| Reverse Transfer Capacitance | $C_{rss}$ | - | 19 | - | | |
| Gate Total Charge | $Q_G$ | - | 96 | - | nC | $V_{DS}$ = 400V<br>$V_{GS}$ = -5/20V<br>$I_D$ = 17.6A |
| Gate-Source charge | $Q_{gs}$ | - | 25 | - | | |
| Gate-Drain charge | $Q_{gd}$ | - | 26 | - | | |
| Turn-On Switching Energy | $E_{ON}$ | - | 188 | - | μJ | $V_{DD}$ = 400V<br>$V_{GS}$ = -5/+20V<br>$I_D$ = 17.6A<br>$R_G$ = 10Ω<br>L = 100uH |
| Turn-Off Switching Energy- | $E_{OFF}$ | - | 19 | | | |
| Turn-on delay time | $t_{d(on)}$ | - | 20 | - | ns | |
| Rise time | $t_r$ | - | 26 | - | | |
| Turn-off delay time | $t_{d(off)}$ | - | 48 | - | | |
| Fall time | $t_f$ | - | 15 | - | | |
| Gate resistance | $R_G$ | - | 1.7 | - | Ω | $V_{AC}$ = 25mV, f=1MHz |

## Body Diode Characteristic

| Parameter | Symbol | Value | | | Unit | Test Condition |
|---|---|---|---|---|---|---|
| | | min. | typ. | max. | | |
| Body Diode Forward Voltage | $V_{SD}$ | | 3.2 | | V | $V_{GS}$=0V,$I_{SD}$=8.8A, $T_J$=25°C |
| | | | 2.6 | | | $V_{GS}$=0V,$I_{SD}$=8.8A, $T_J$=175°C |
| Body Diode Reverse Recovery Time | $t_{rr}$ | - | 40 | - | ns | $V_R$ = 400V, $I_D$ = 17.6A di/dt = 1000A/μS |
| Body Diode Reverse Recovery Charge | $Q_{rr}$ | - | 156 | - | nC | |

## Typical Performance Characteristics

**Fig 1. Output Characteristic ($T_J$=-55℃)**

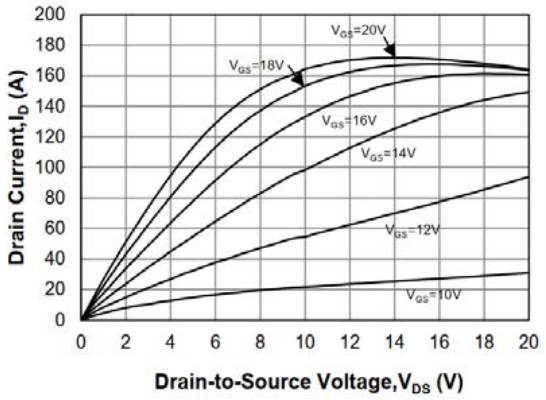



**Fig 2. Output Characteristic ($T_J$=25℃)**

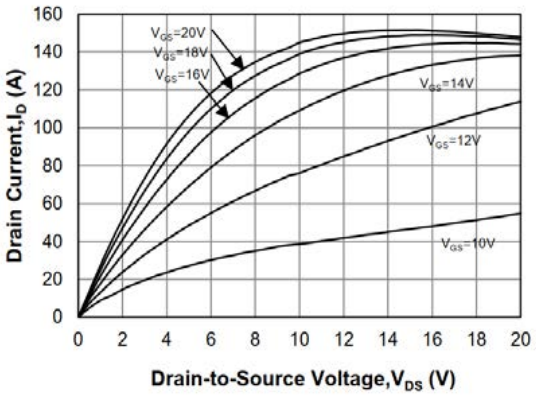



**Fig 3. Output Characteristic ($T_J$=175℃)**

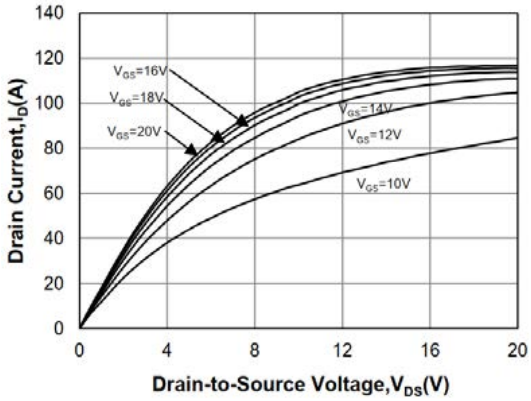



**Fig 4: Rdson Vs Ids Characteristic**

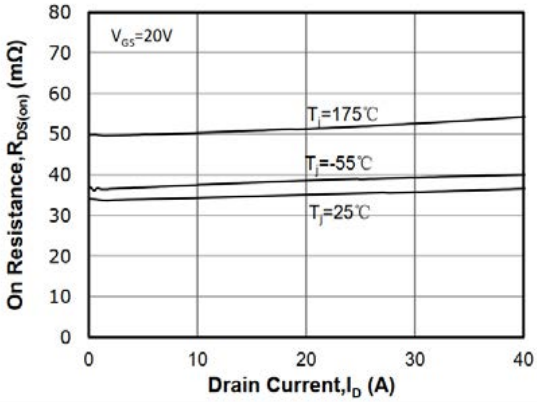



**Fig 5: Rds(on) vs. Temperature**

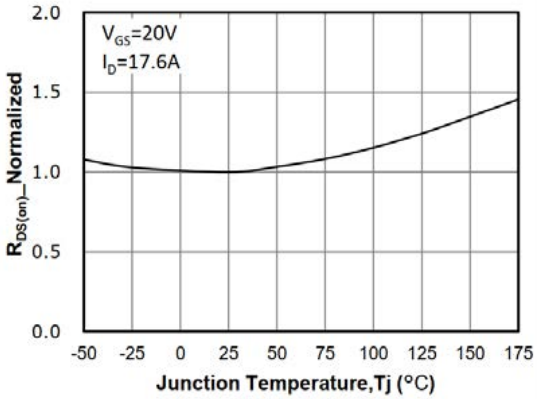



**Fig 6: Transfer Characteristic**

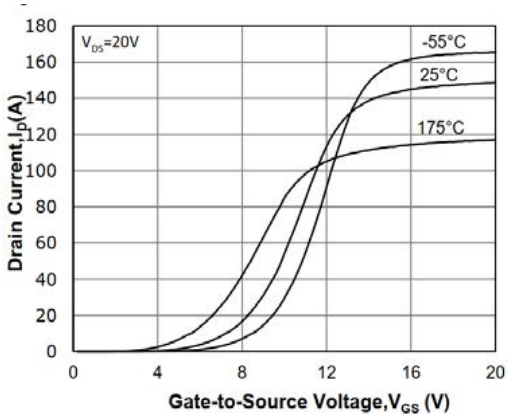


**Fig 7: Body-diode Characteristic**

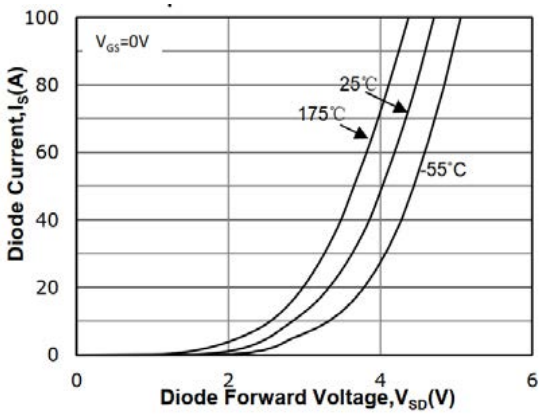



**Fig 8: $V_{TH}$ Vs $T_J$ Temperature Characteristic**

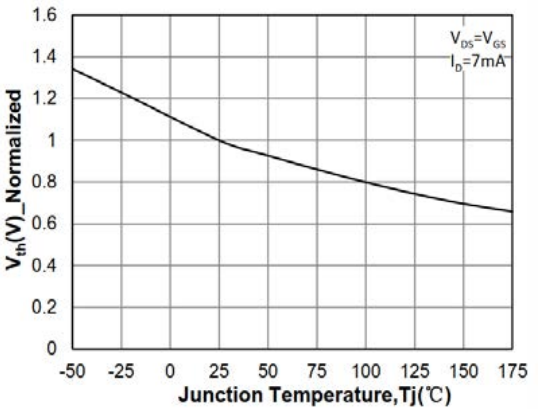



**Fig 9: Gate Charge Characteristics**

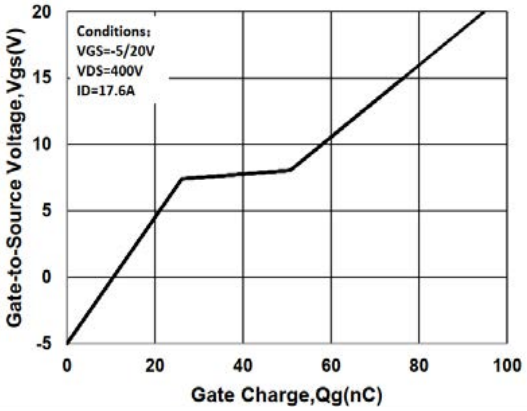



**Fig 10:Continuous Drain Current vs.Case Temperature**

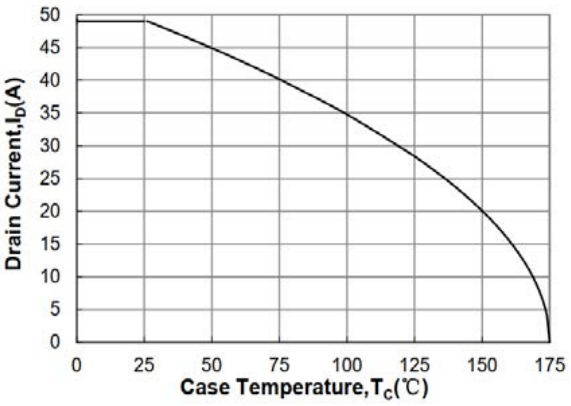



**Fig 11: Safe Operating Area**

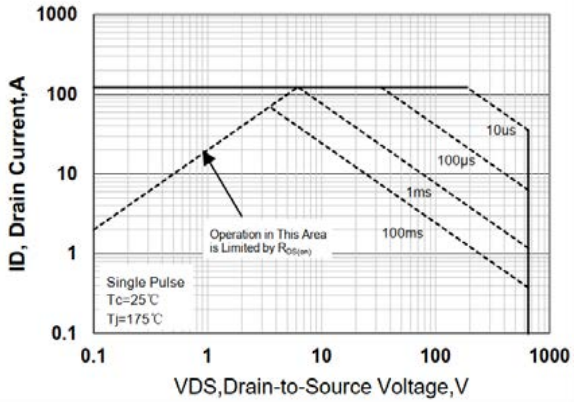



**Fig 12: Capacitance Characteristics**

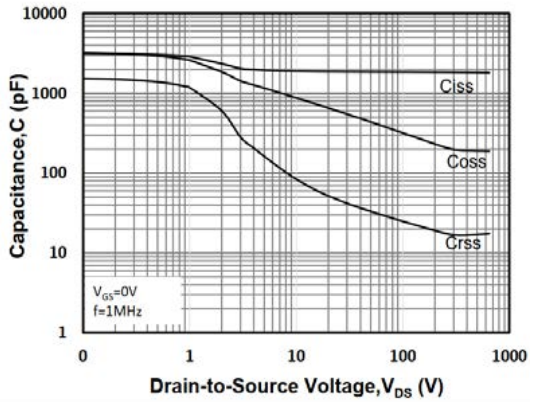
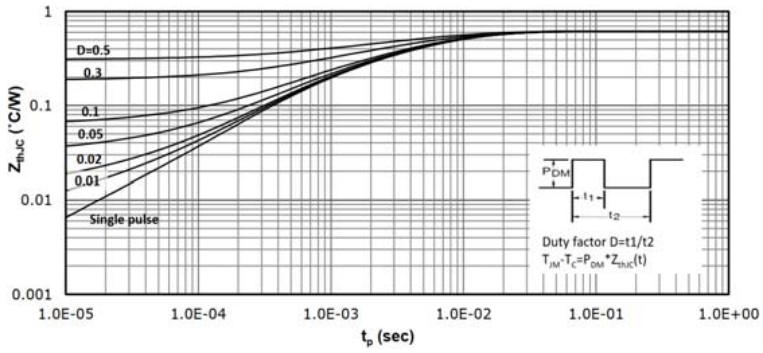


**Fig 13: Transient Thermal Impedance**




## Test Circuit & Waveform

**Figure A. Definition of switching times**

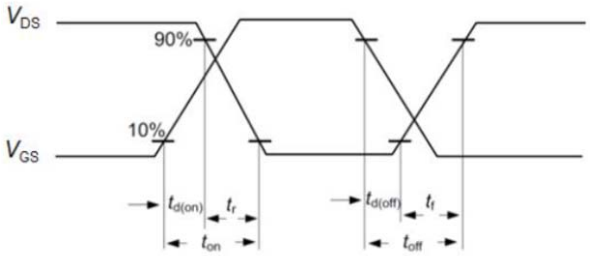



**Figure B. Dynamic test circuit**

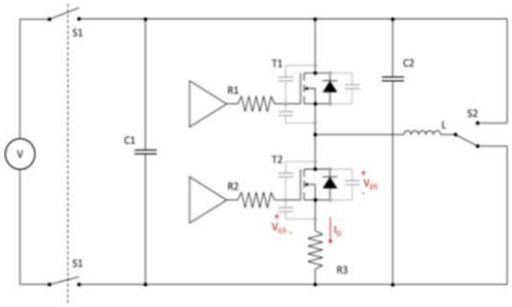
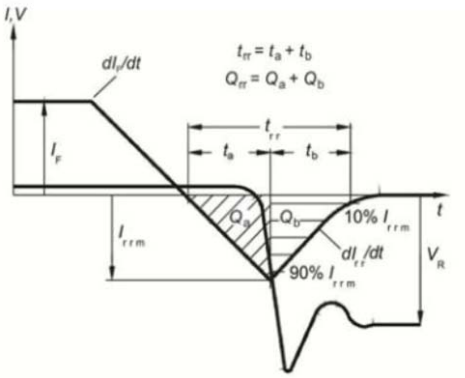
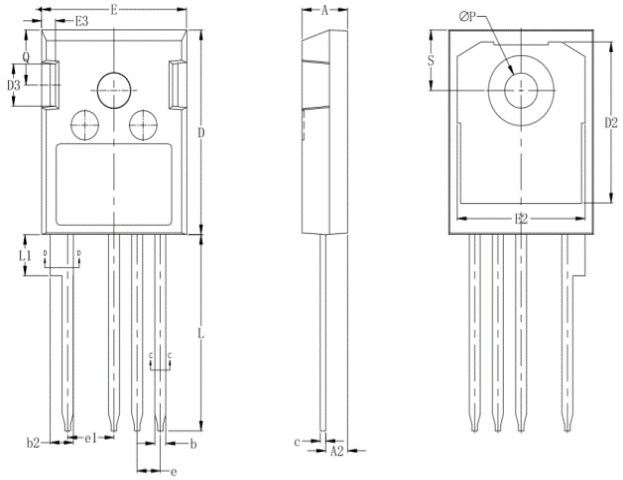



**Figure C. Definition of body diodeswitching characteristics**



## Package Dimensions

Package TO-247-4L




| Items | Values(mm) | |
|---|---|---|
| | MIN | MAX |
| A | 4.8 | 5.2 |
| A2 | 2.2 | 2.6 |
| b | 1.05 | 1.4 |
| b2 | 2.4 | 2.75 |
| c | 0.5 | 0.75 |
| D | 20 | 21.5 |
| D2 | 15.5 | 17.2 |
| D3 | 4 | 5 |
| E | 15.5 | 16.1 |
| E2 | 13 | 15 |
| E3 | 1 | 2 |
| e | 2.54 BSC. | |
| e1 | 5.08 BSC. | |
| L | 19 | 21 |
| L1 | 4 | 4.45 |
| ΦP | 3.5 | 3.7 |
| Q | 5.4 | 5.9 |
| S | 5.9 | 6.4 |

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