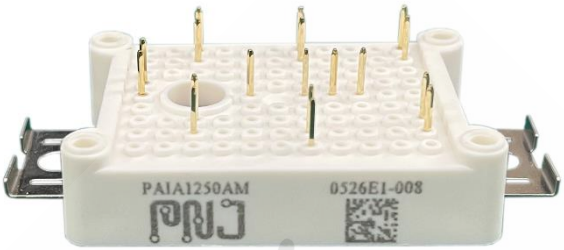
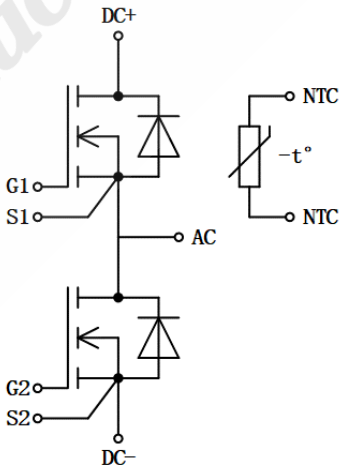
# SiC Half-Bridge Module
# PAIA1250AM




## Features

- High blocking voltage
- Low on-State resistance
- Low stray inductance
- Low switching loss
- Low thermal resistance




## Applications

- High-frequency switching application
- DC/DC converter
- Motor drives
- Solar inverter
- Electric vehicle
- UPS systems

## Standards Benefits

- Improve system efficiency
- Improve power density
- Reduce cooling requirement
- Reduce system cost

## Order Information

| Part Number | Package | Marking |
|---|---|---|
| PAIA1250AM | EASY 1B | PAIA1250AM |

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## 1. Maximum Ratings

At $T_J$= 25℃, unless specified otherwise

| Parameter | Symbol | Value | Unit | Test Conditions |
|---|---|---|---|---|
| Drain - Source Voltage | $V_{DSmax}$ | 1200 | V | $V_{GS}$=0V<br>$I_D$= 100μA |
| Gate - Source Voltage (Dynamic) | $V_{GSmax}$ | -8 / +21 | V | AC (f >1Hz) |
| Gate - Source Voltage(static)<br>turn-on gate voltage<br>turn-off gate voltage | <br>$V_{GS,on}$<br>$V_{GS,off}$ | <br>+15 / +18<br>-3 | V | Static |
| Continuous Drain Current | $I_D$ | 80 | A | $V_{GS}$ =15V<br>$T_C$ = 25℃<br>$T_J$ = 150℃ |
| | | 50 | | $V_{GS}$ =15V<br>$T_C$ = 100℃<br>$T_J$ = 150℃ |
| Operating Junction Temperature | $T_J$ | -40 To +150 | ℃ | |

## 2. Electrical Characteristics

At $T_J$= 25℃, unless specified otherwise (Per Position)

| Parameter | Symbol | Value | | | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Drain-Source Breakdown Voltage | $V_{(BR)DSS}$ | 1200 | / | / | V | $V_{GS}$=0V |
| Gate Threshold Voltage | $V_{GS(th)}$ | 1.8 | 2.7 | / | V | $V_{DS}$= $V_{GS}$<br>$I_D$= 17.7mA<br>$T_J$= 25℃ |
| Reverse Bias Drain Current | $I_{DSS}$ | / | 1 | 100 | μA | $V_{GS}$= 0V<br>$V_{DS}$= 1200V |

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| Parameter | Symbol | Value | | | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate-Source Leakage Current | $I_{GSS}$ | / | 20 | 250 | nA | $V_{GS}$= 15V<br>$V_{DS}$= 0V |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | / | 25 | 35 | mΩ | $V_{GS}$= 15V<br>$I_D$= 50A |
| Transconductance | $g_{fs}$ | / | 28 | / | S | $V_{DS}$= 20V<br>$I_{DS}$= 50A<br>$T_J$= 25℃ |
| Turn-on Energy | $E_{on}$ | / | 0.31 | / | mJ | $V_{DS}$= 600V<br>$I_{DS}$= 50A<br>$V_{GS}$= -3V/15V<br>$R_G$= 1.0Ω<br>L= 100μH |
| Turn-off Energy | $E_{off}$ | / | 0.18 | / | | |
| Turn-On Delay Time | $T_{d(on)}$ | / | 18.2 | / | nS | |
| Rise Time | $T_r$ | / | 26.7 | / | | |
| Turn-Off Delay Time | $T_{d(off)}$ | / | 40.0 | / | | |
| Fall Time | $T_f$ | / | 12.8 | / | | |
| Internal Gate Resistance | $R_{G(int)}$ | / | 3.0 | / | Ω | f= 100kHz<br>$V_{AC}$= 25mV |
| Input Capacitance | $C_{iss}$ | / | 2.0 | / | nF | $V_{GS}$= 0V<br>$V_{DS}$= 800V<br>f= 100kHz<br>$V_{AC}$= 25mV |
| Output Capacitance | $C_{oss}$ | / | 0.07 | / | nF | |
| Reverse Transfer Capacitance | $C_{rss}$ | / | 6.4 | / | pF | |
| Thermal Resistance from Junction to Case | $R_{\theta JC}$ | / | 0.40 | / | ℃/W | |

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## 3. Reverse Diode Characteristics

At $T_J$= 25℃, unless specified otherwise (Per Position)

| Parameter | Symbol | Value | | Unit | Test Conditions |
|---|---|---|---|---|---|
| | | Typ. | Max. | | |
| Diode Forward Voltage | $V_{SD}$ | 5.2 | / | V | $V_{GS}$= -3V<br>$I_{SD}$= 25A<br>$T_J$= 25℃ |
| | | 4.6 | / | V | $V_{GS}$= -3V<br>$I_{SD}$= 25A<br>$T_J$= 150℃ |
| Continuous Diode Forward Current | $I_S$ | 50 | / | A | $V_{GS}$= -3V |
| Reverse Recover Time | $t_{rr}$ | 13.4 | / | ns | $V_{GS}$= -3/15V<br>$I_{SD}$= 50A<br>$V_R$= 600V<br>$d_{if}/d_t$= 5300A/μs<br>$R_G$ =1.0Ω<br>$T_J$= 25℃ |
| Reverse Recovery Charge | $Q_{rr}$ | 0.55 | / | μC | |
| Peak Reverse Recovery Current | $I_{rrm}$ | 74.6 | / | A | |
| Reverse Recovery Energy | $E_{RR}$ | 0.27 | / | mJ | $V_R$= 600V<br>$I_{SD}$= 50A<br>$V_{GS}$= -3V/15V<br>$R_G$= 1.0Ω<br>L= 100μH |

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## 4. Module Physical Characteristics

| Parameter | Symbol | Value | | | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Case Temperature | $T_C$ | -40 | / | 125 | ℃ | |

| Parameter | Symbol | Value | | | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Weight | W | / | 23 | / | g | |
| Mounting Force Per Clamp | F | 20 | / | 50 | N | |
| Case Isolation Voltage | $V_{isol}$ | / | 3 | / | kV | AC, 50Hz, 1min |
| Comparative Tracking Index | CTI | 200 | / | / | | |

## 5. NTC Thermistor Characteristics

| Parameter | Symbol | Value | | | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Rated Resistance | $R_{NTC}$ | / | 5 | / | kΩ | $T_{NTC}$= 25℃ |
| Resistance Tolerance | △R/R | -5 | / | 5 | % | $T_{NTC}$= 25℃ |
| B-value | $B_{25/50}$ | / | 3380 | / | K | $T_2$= 50℃ |
| B-value | $B_{25/85}$ | / | 3435 | / | K | $T_2$= 80℃ |
| B-value | $B_{25/100}$ | / | 3485 | / | K | $T_2$= 100℃ |
| Power Dissipation | $P_{NTC}$ | / | / | 10 | mW | $T_{NTC}$= 25℃ |

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# 6. Typical Performance

At $T_J$= 25℃, unless specified otherwise (Per Position)

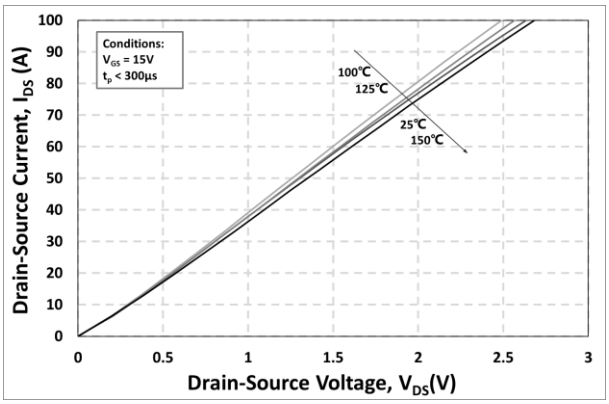


Figure 1. Output Characteristics for Various Junction Temperatures

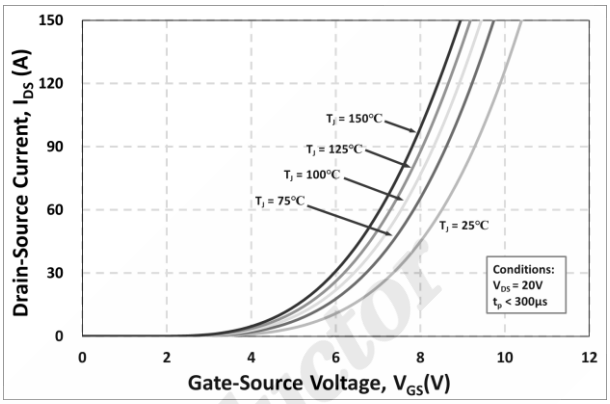


Figure 2. Transfer Characteristic for Various Junction Temperatures -State Resistance vs. Junction Temperature

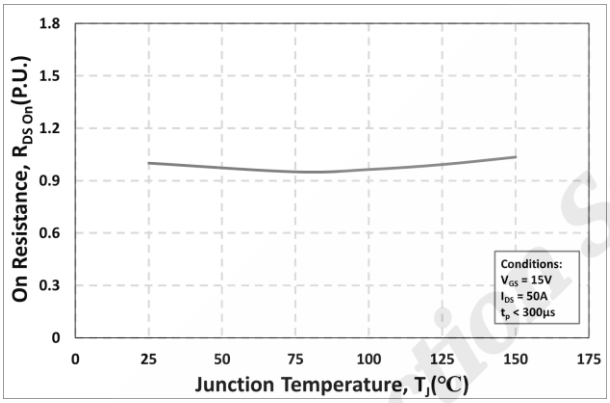


Figure 3. Normalized On-State Resistance vs. Junction Temperature

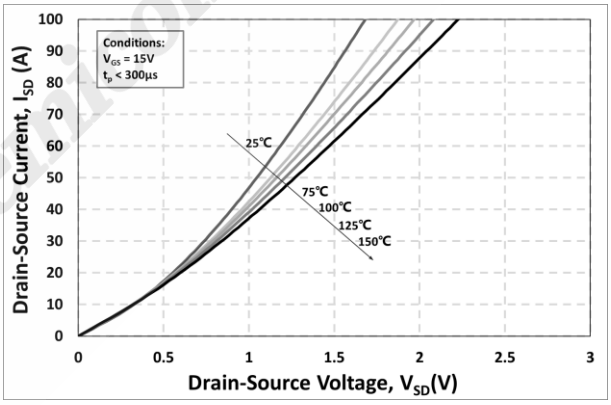


Figure 4. 3rd Quadrant Characteristic vs. Junction Temperatures at $V_{GS}$ =15V

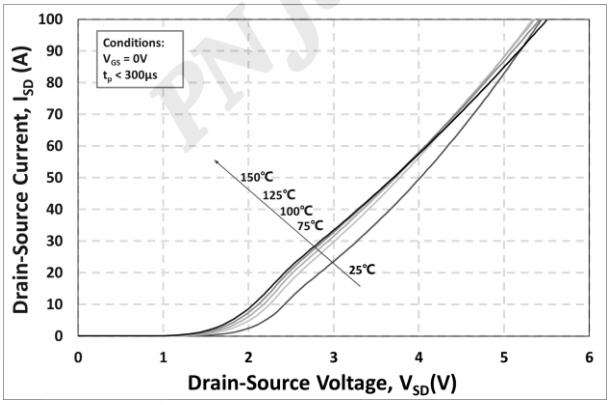


Figure 5. 3rd Quadrant Characteristic vs. Junction Temperatures at $V_{GS}$ = 0V (Body Diode)

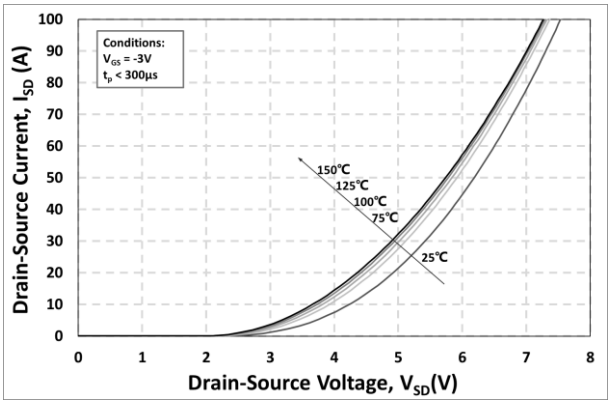


Figure 6. 3rd Quadrant Characteristic vs. Junction Temperatures at $V_{GS}$ = -3V (Body Diode)

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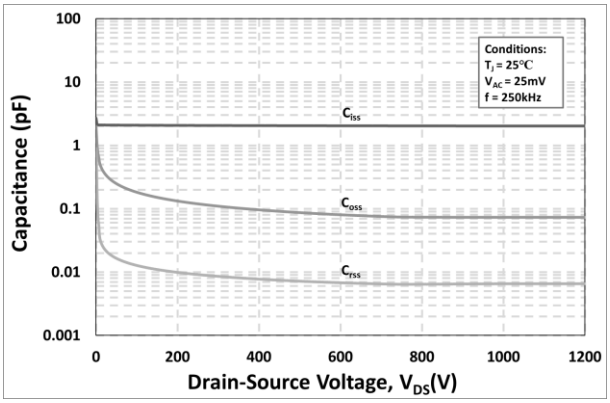


Figure 7. Capacitances vs. Drain-Source Voltage (0 - 1200V)

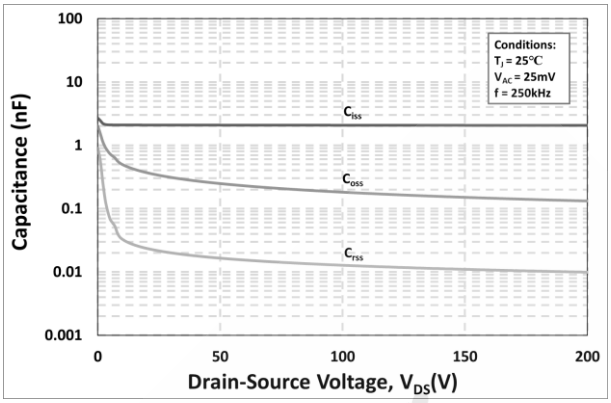


Figure 8. Capacitances vs. Drain-Source Voltage (0 - 200V)

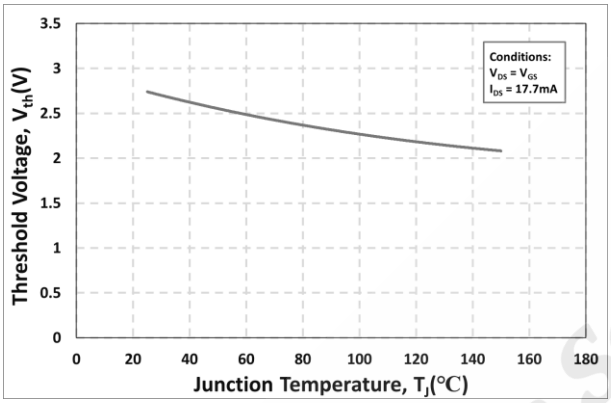


Figure 9. Threshold Voltage vs. Junction Temperature

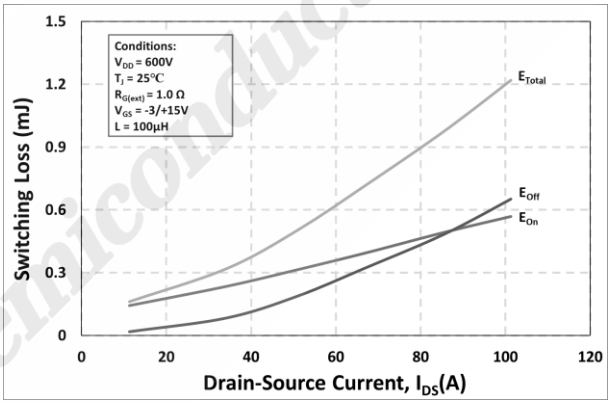


Figure 10. Switching Loss vs. Drain-Source Current ($V_{DS}$ = 600 V)

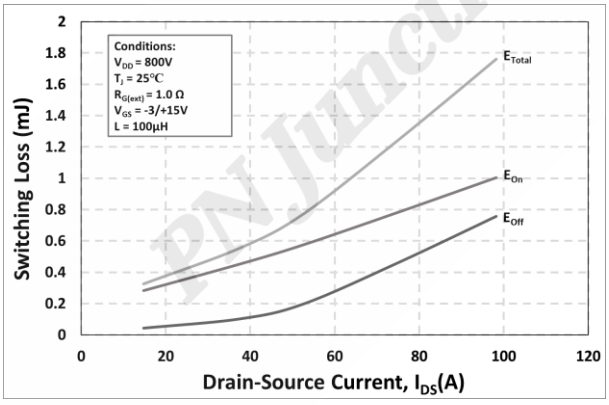


Figure 11. Switching Loss vs. Drain-Source Current ($V_{DS}$ = 800 V)

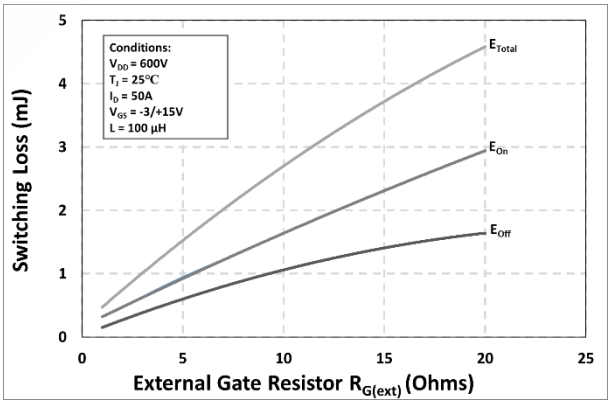


Figure 12. Switching Loss vs. External Gate Resistance

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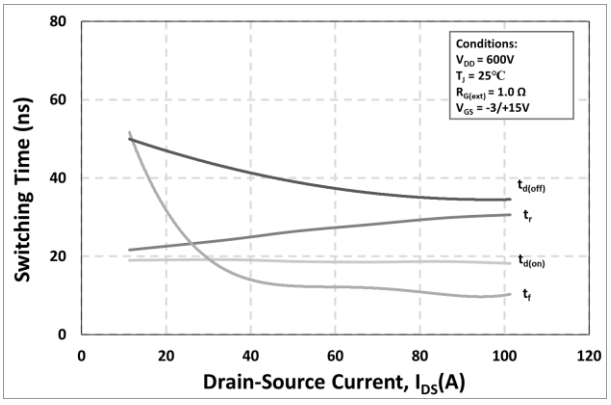


Figure 13. Switching Times vs. Drain-Source Current

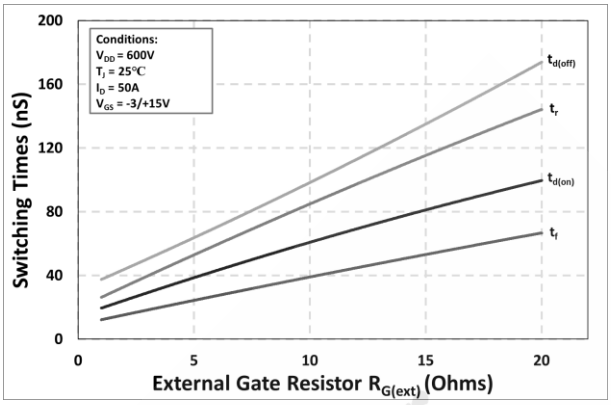


Figure 14. Switching Times vs. External Gate Resistance

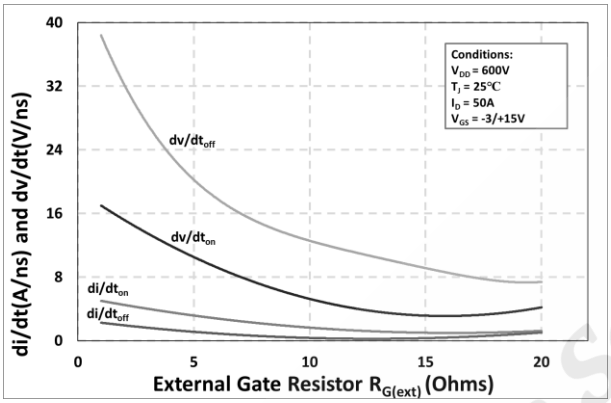


Figure 15. dv/dt and di/dt vs. External Gate Resistance

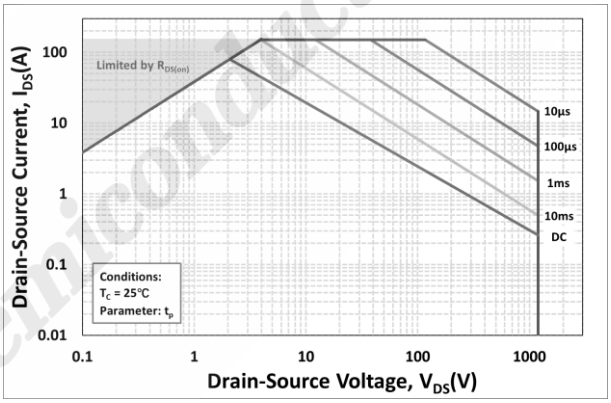


Figure 16. Forward Bias Safe Operating Area (FBSOA)

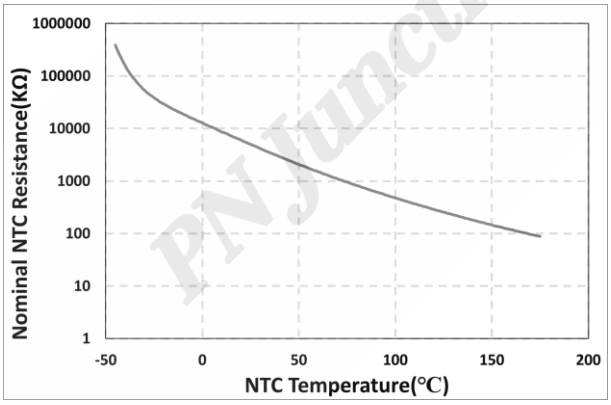


Figure 17. Nominal NTC Resistance vs. NTC Temperature

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# 7. Definitions

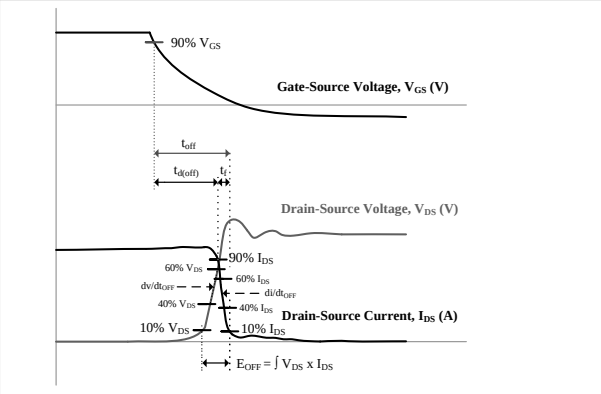


Figure 18. Turn-off Transient Definitions

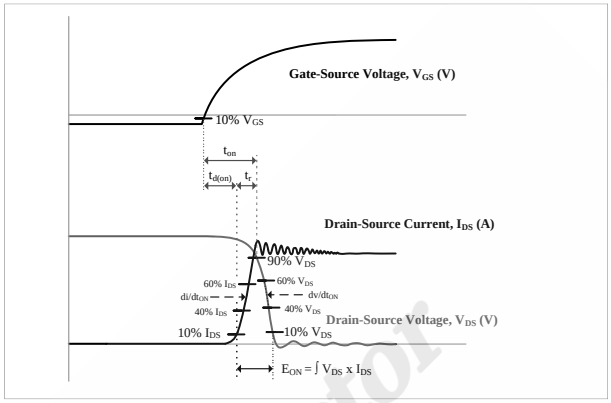


Figure 19. Turn-on Transient Definitions

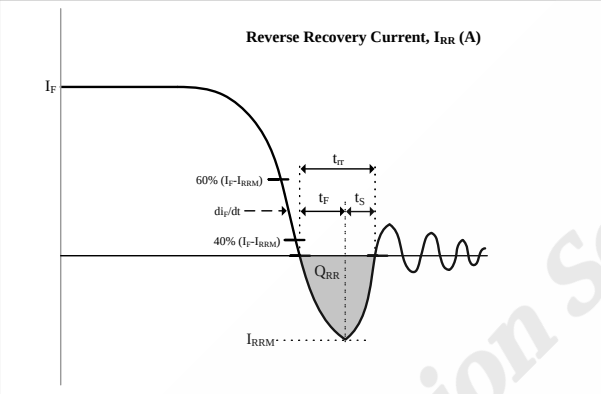


Figure 20. Reverse Recovery Definitions

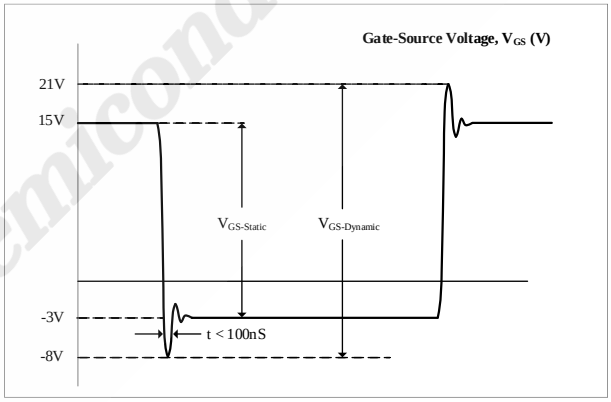


Figure 21. vgs Transient Definitions

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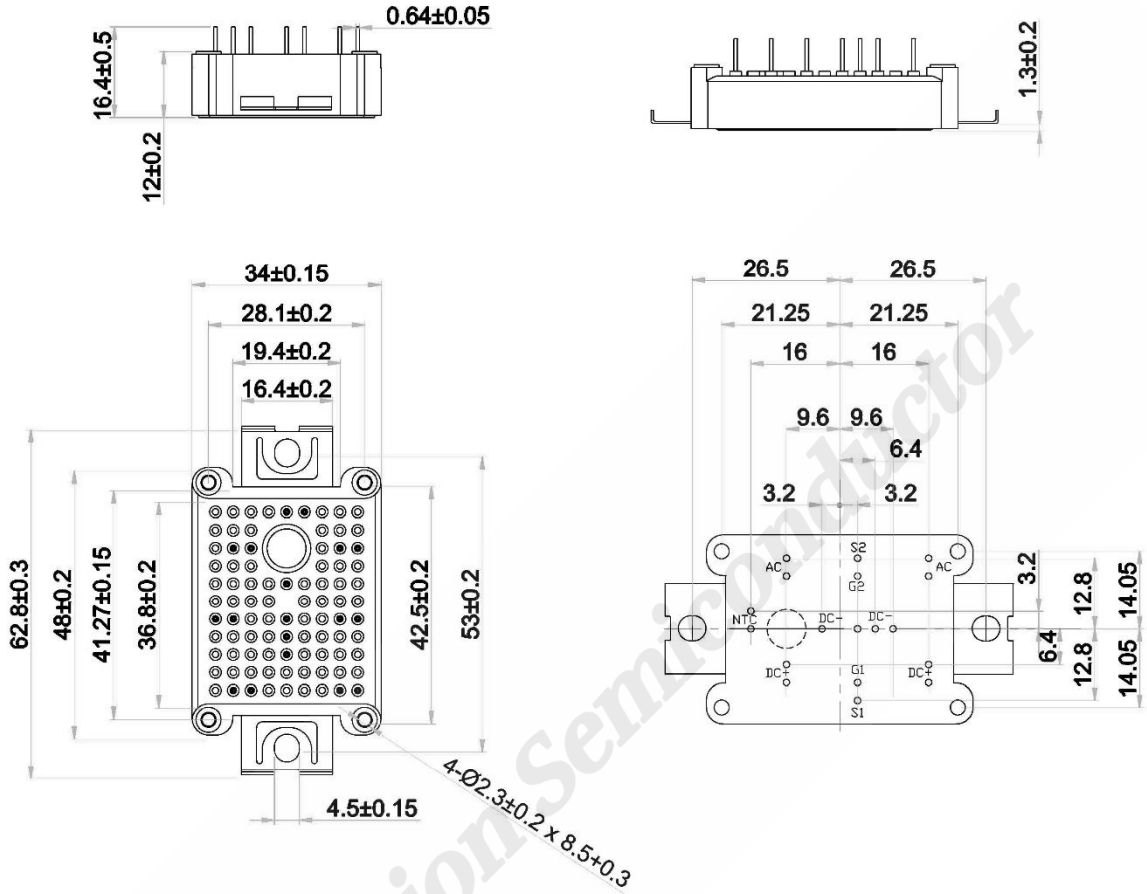
## 8. Package Outlines




Drawing and Dimensions

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