



Description

The SI4559ADY uses advanced trench technology to provide excellent $R_{DS(ON)}$, low gate charge and operation with gate voltages as low as 4.5V. This device is suitable for use as a Battery protection or in other Switching application.



SOP-8

General Features

$V_{DS} = 60V$ $I_D = 6A$

$R_{DS(ON)} < 48m\Omega @ V_{GS}=10V$

$V_{DS} = -60V$ $I_D = -5A$

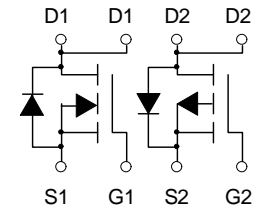
$R_{DS(ON)} < 85 m\Omega @ V_{GS}=-10V$

Application

Wireless charging

Boost driver

Brushless motor



N-Channel and P-Channel

Package Marking and Ordering Information

| Product ID | Pack | Marking | Qty(PCS) |
|------------|-------|---------|----------|
| SI4559ADY | SOP-8 | 4559XXX | 3000 |

Absolute Maximum Ratings ($T_C=25^\circ C$ unless otherwise noted)

| Symbol | Parameter | Rating | | Units |
|------------------------|--|------------|------------|--------------|
| | | N-Channel | P-Channel | |
| VDS | Drain-Source Voltage | 60 | -60 | V |
| VGS | Gate-Source Voltage | ± 20 | ± 20 | V |
| $I_D @ T_A=25^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V^1$ | 6.0 | -5.0 | A |
| $I_D @ T_A=70^\circ C$ | Continuous Drain Current, $V_{GS} @ 10V^1$ | 4.0 | -3.5 | A |
| IDM | Pulsed Drain Current ² | 11 | -8.5 | A |
| EAS | Single Pulse Avalanche Energy ³ | 22.5 | 35.3 | mJ |
| IAS | Avalanche Current | 22.6 | -26.6 | A |
| $P_D @ T_A=25^\circ C$ | Total Power Dissipation ⁴ | 2.5 | 2.5 | W |
| TSTG | Storage Temperature Range | -55 to 150 | -55 to 150 | $^\circ C$ |
| T_J | Operating Junction Temperature Range | -55 to 150 | -55 to 150 | $^\circ C$ |
| $R_{\theta JA}$ | Thermal Resistance Junction-Ambient ¹ | 85 | | $^\circ C/W$ |
| $R_{\theta JC}$ | Thermal Resistance Junction-Case ¹ | 62.5 | | $^\circ C/W$ |



N-Channel Electrical Characteristics (T_J=25 °C, unless otherwise noted)

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Units |
|---|---|---|------|------|------|-------|
| Off Characteristic | | | | | | |
| V _{(BR)DSS} | Drain-Source Breakdown Voltage | V _{GS} =0V, I _D =250μA | 60 | - | - | V |
| I _{DSS} | Zero Gate Voltage Drain Current | V _{DS} =60V, V _{GS} = 0V, | - | - | 1.0 | μA |
| I _{GSS} | Gate to Body Leakage Current | V _{DS} =0V, V _{GS} = ±20V | - | - | ±100 | nA |
| On Characteristics | | | | | | |
| V _{GS(th)} | Gate Threshold Voltage | V _{DS} =V _{GS} , I _D =250μA | 1.0 | 1.6 | 2.5 | V |
| R _{DS(on)} | Static Drain-Source on-Resistance <small>note3</small> | V _{GS} =10V, I _D =5A | - | 40 | 48 | mΩ |
| | | V _{GS} =4.5V, I _D =3A | - | 48 | 60 | |
| Dynamic Characteristics | | | | | | |
| C _{iss} | Input Capacitance | V _{DS} =25V, V _{GS} =0V, f=1.0MHz | - | 1148 | - | pF |
| C _{oss} | Output Capacitance | | - | 58.5 | - | pF |
| C _{rss} | Reverse Transfer Capacitance | | - | 49.4 | - | pF |
| Q _g | Total Gate Charge | V _{DS} =30V, I _D =2.5A, V _{GS} =10V | - | 20.3 | - | nC |
| Q _{gs} | Gate-Source Charge | | - | 3.7 | - | nC |
| Q _{gd} | Gate-Drain("Miller") Charge | | - | 5.3 | - | nC |
| Switching Characteristics | | | | | | |
| t _{d(on)} | Turn-on Delay Time | V _{DS} =30V, I _D =5A, R _G =1.8Ω, V _{GS} =10V | - | 7.6 | - | ns |
| t _r | Turn-on Rise Time | | - | 20 | - | ns |
| t _{d(off)} | Turn-off Delay Time | | - | 15 | - | ns |
| t _f | Turn-off Fall Time | | - | 24 | - | ns |
| Drain-Source Diode Characteristics and Maximum Ratings | | | | | | |
| I _S | Maximum Continuous Drain to Source Diode Forward Current | | - | - | 6 | A |
| I _{SM} | Maximum Pulsed Drain to Source Diode Forward Current | | - | - | 20 | A |
| V _{SD} | Drain to Source Diode Forward Voltage | V _{GS} =0V, I _S =5A | - | - | 1.2 | V |
| t _{rr} | Body Diode Reverse Recovery Time | I _F =5A, dI/dt=100A/μs | - | 29 | - | ns |
| Q _{rr} | Body Diode Reverse Recovery Charge | | - | 43 | - | nC |

- Notes:1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature
2. EAS condition : T_J=25 °C, V_{DD}=30V, V_G=10V, L=0.5mH, R_G=25Ω, I_{AS}=8.7A
3. Pulse Test: Pulse Width≤300μs, Duty Cycle≤0.5%



P-Channel Electrical Characteristics ($T_J=25$, unless otherwise noted)

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|--------------|--|--|------|------|-----------|------------|
| BV_{DSS} | Drain-Source Breakdown Voltage | $V_{GS}=0V, I_D=-250\mu A$ | -60 | --- | --- | V |
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance ² | $V_{GS}=-10V, I_D=-3.5A$ | --- | 70 | 100 | m Ω |
| | | $V_{GS}=-4.5V, I_D=-3.1A$ | --- | 100 | 115 | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}=V_{DS}, I_D=-250\mu A$ | -1.0 | --- | -2.5 | V |
| I_{DSS} | Drain-Source Leakage Current | $V_{DS}=-48V, V_{GS}=0V, T_J=25^\circ C$ | --- | --- | 1 | μA |
| | | $V_{DS}=-48V, V_{GS}=0V, T_J=55^\circ C$ | --- | --- | 5 | |
| I_{GSS} | Gate-Source Leakage Current | $V_{GS}=\pm 20V, V_{DS}=0V$ | --- | --- | ± 100 | nA |
| g_{fs} | Forward Transconductance | $V_{DS}=-5V, I_D=-3A$ | --- | 8.5 | --- | S |
| Q_g | Total Gate Charge (-4.5V) | $V_{DS}=-48V, V_{GS}=-4.5V, I_D=-3A$ | --- | 12.1 | --- | nC |
| Q_{gs} | Gate-Source Charge | | --- | 2.2 | --- | |
| Q_{gd} | Gate-Drain Charge | | --- | 6.3 | --- | |
| $T_{d(on)}$ | Turn-On Delay Time | $V_{DD}=-15V, V_{GS}=-10V, R_G=3.3\Omega, I_D=-1A$ | --- | 9.2 | --- | ns |
| T_r | Rise Time | | --- | 20.1 | --- | |
| $T_{d(off)}$ | Turn-Off Delay Time | | --- | 46.7 | --- | |
| T_f | Fall Time | | --- | 9.4 | --- | |
| C_{iss} | Input Capacitance | $V_{DS}=-15V, V_{GS}=0V, f=1MHz$ | --- | 1137 | --- | pF |
| C_{oss} | Output Capacitance | | --- | 76 | --- | |
| C_{riss} | Reverse Transfer Capacitance | | --- | 50 | --- | |
| I_S | Continuous Source Current ^{1,5} | $V_G=V_D=0V, \text{Force Current}$ | --- | --- | -6.0 | A |
| V_{SD} | Diode Forward Voltage ² | $V_{GS}=0V, I_S=-1A, T_J=25^\circ C$ | --- | --- | -1.2 | V |

Note :

- 1.The data tested by surface mounted on a 1 inch² FR-4 board with 2OZ copper.
- 2.The data tested by pulsed , pulse width $\leq 300\mu s$, duty cycle $\leq 2\%$
- 3.The EAS data shows Max. rating . The test condition is $V_{DD}=-25V, V_{GS}=-10V, L=0.1mH, I_{AS}=-24A$
- 4.The power dissipation is limited by 150°C junction temperature
- 5.The data is theoretically the same as I_D and I_{DM} , in real applications , should be limited by total power dissipation.



N-Channel Typical Characteristics

Figure 1: Output Characteristics

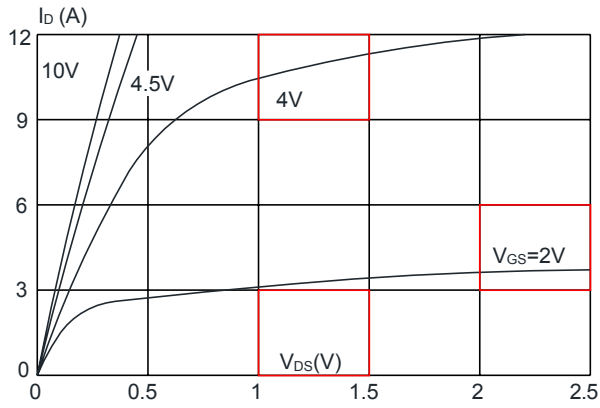


Figure 2: Typical Transfer Characteristics

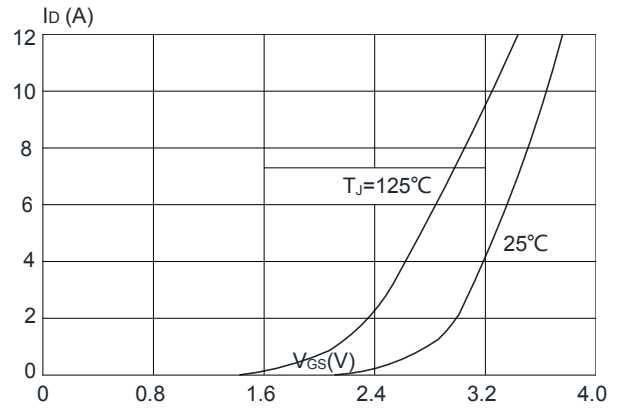


Figure 3: On-resistance vs. Drain Current

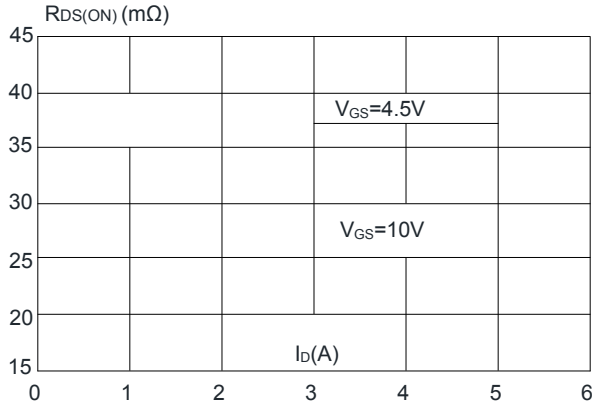


Figure 4: Body Diode Characteristics

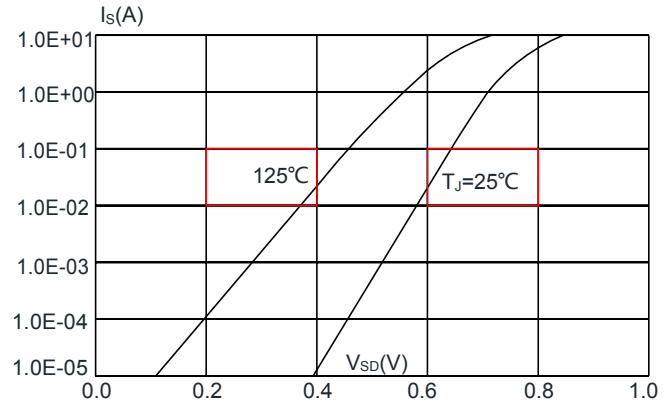


Figure 5: Gate Charge Characteristics

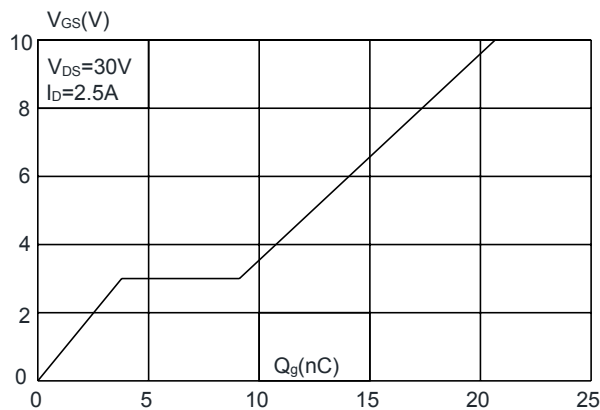


Figure 6: Capacitance Characteristics

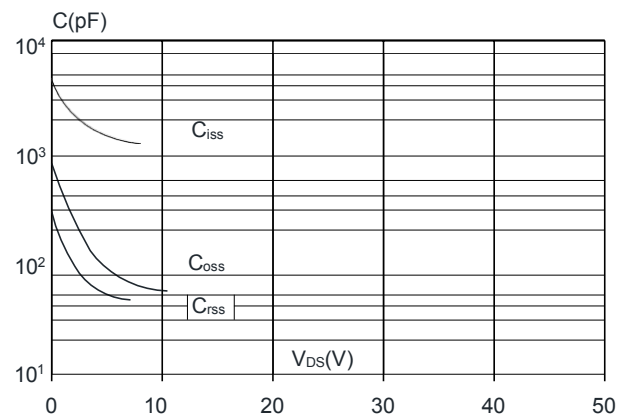




Figure 7: Normalized Breakdown Voltage vs. Junction Temperature

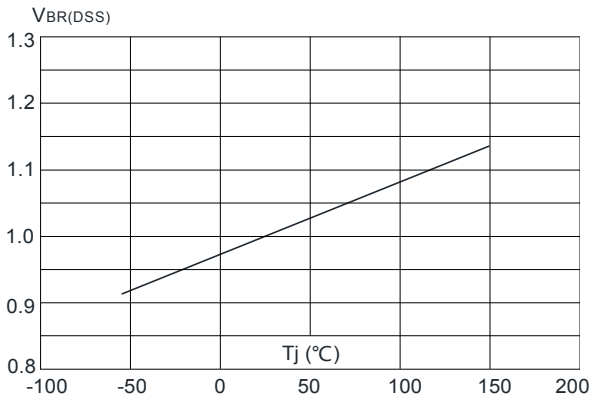


Figure 8: Normalized on Resistance vs. Junction Temperature

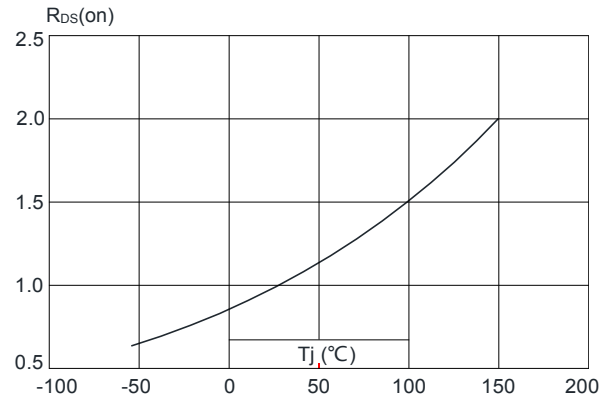


Figure 9: Maximum Safe Operating Area

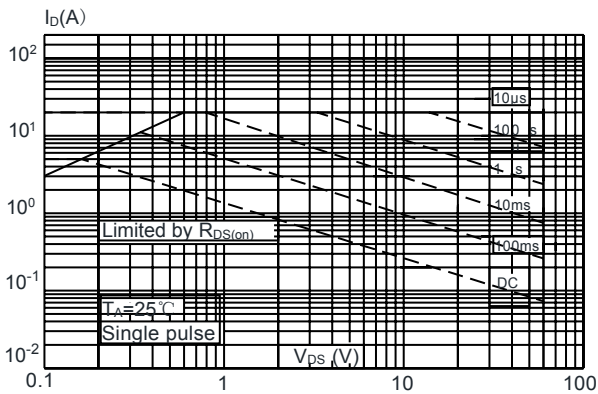


Figure 10: Maximum Continuous Drain Current vs. Ambient Temperature

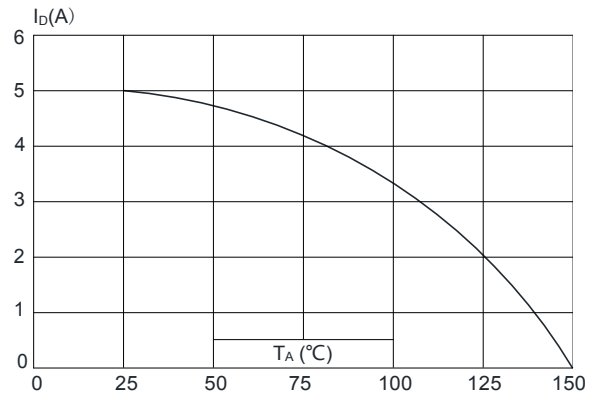
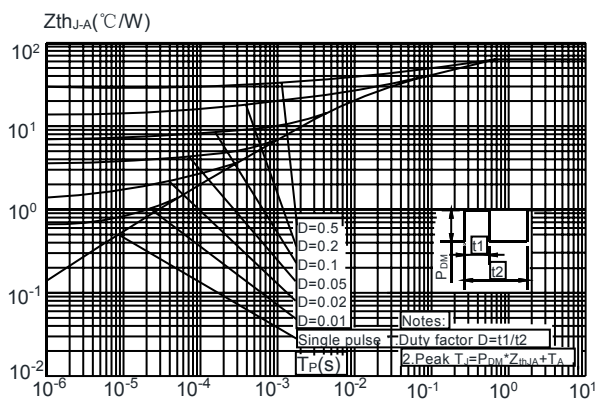


Figure.11: Maximum Effective Transient Thermal Impedance, Junction-to-Ambient





P-Channel Typical Characteristics

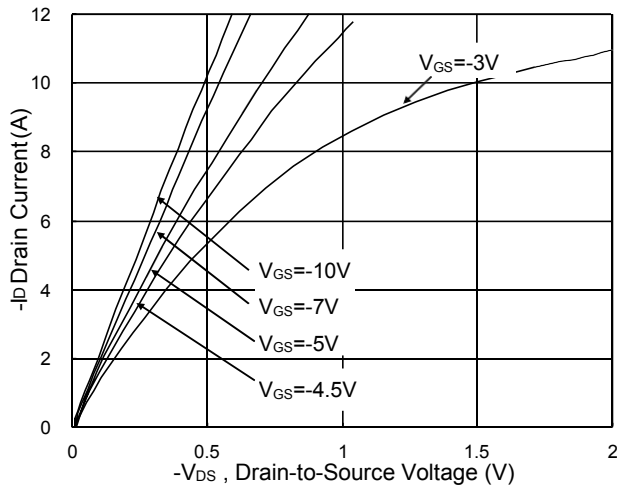


Fig.1 Typical Output Characteristics

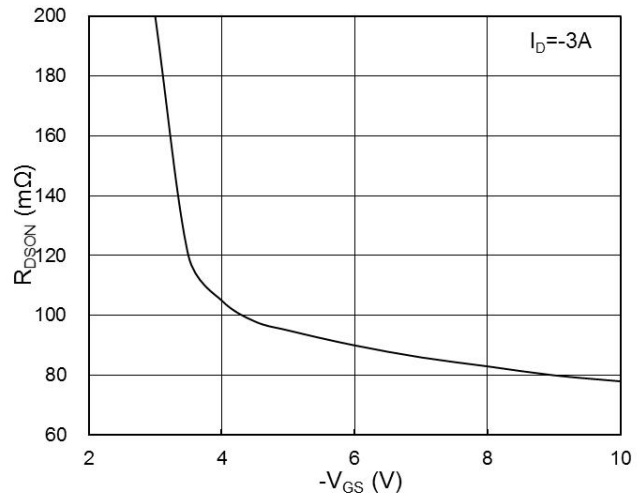


Fig.2 On-Resistance vs. G-S Voltage

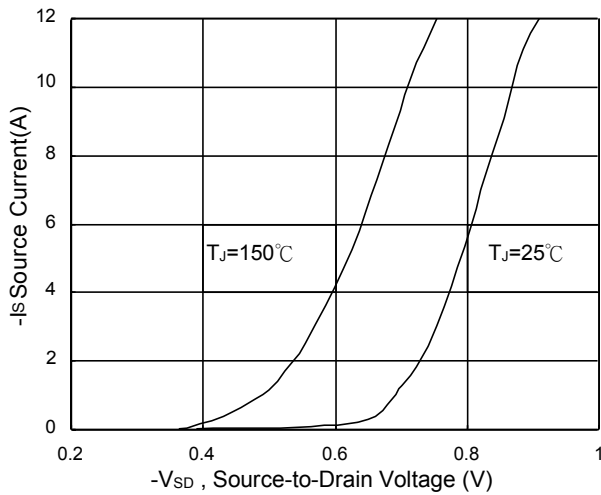


Fig.3 Source Drain Forward Characteristics

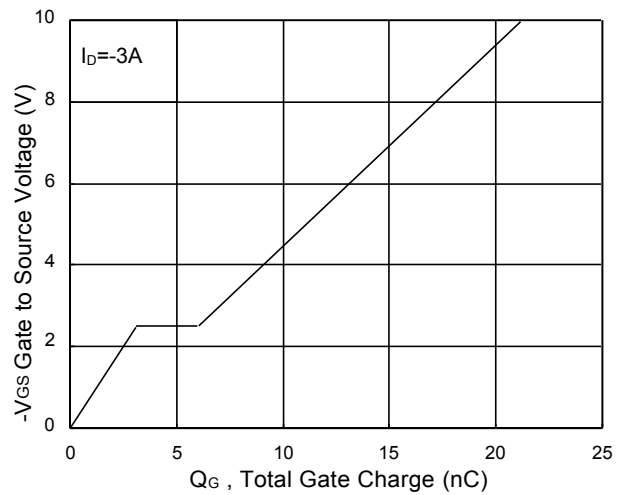


Fig.4 Gate-Charge Characteristics

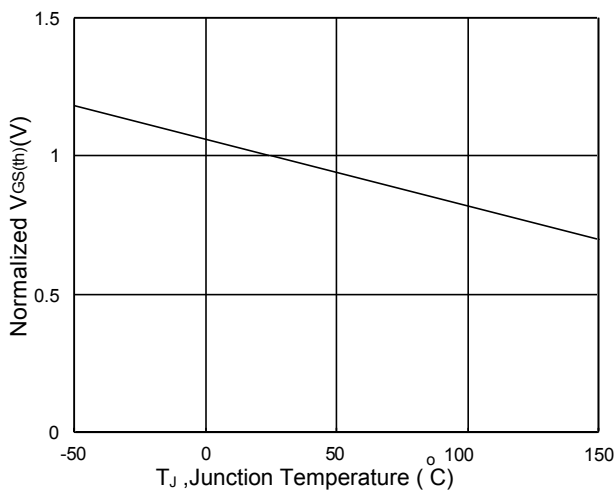


Fig.5 Normalized $V_{GS(th)}$ vs. T_J

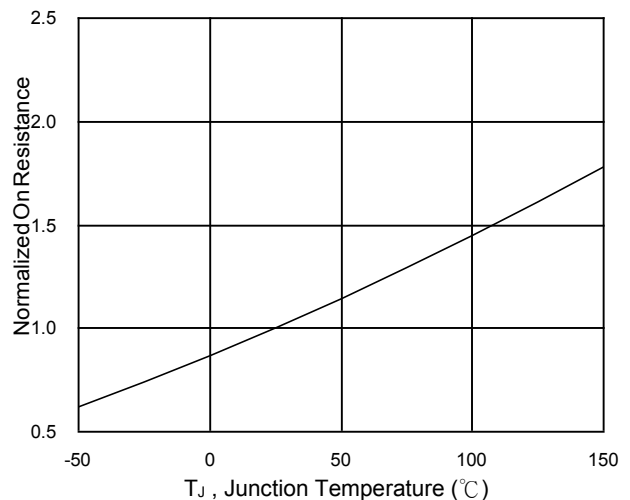


Fig.6 Normalized $R_{DS(on)}$ vs. T_J

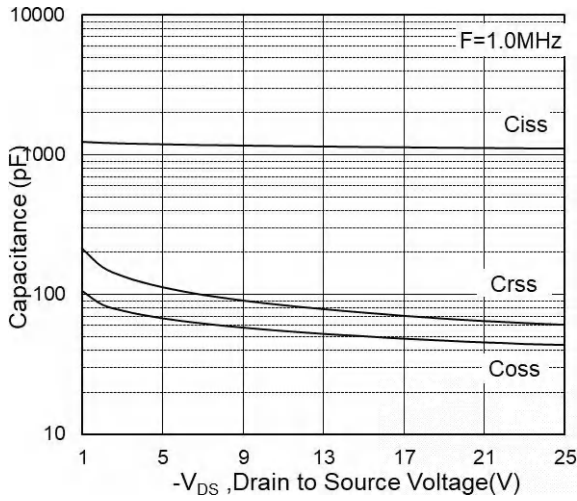


Fig.7 Capacitance

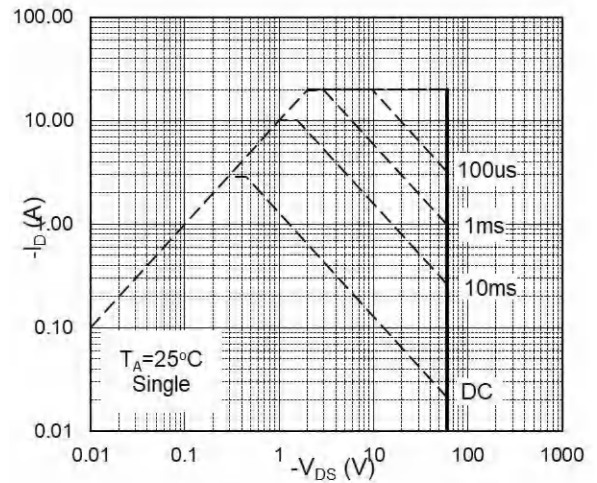


Fig.8 Safe Operating Area

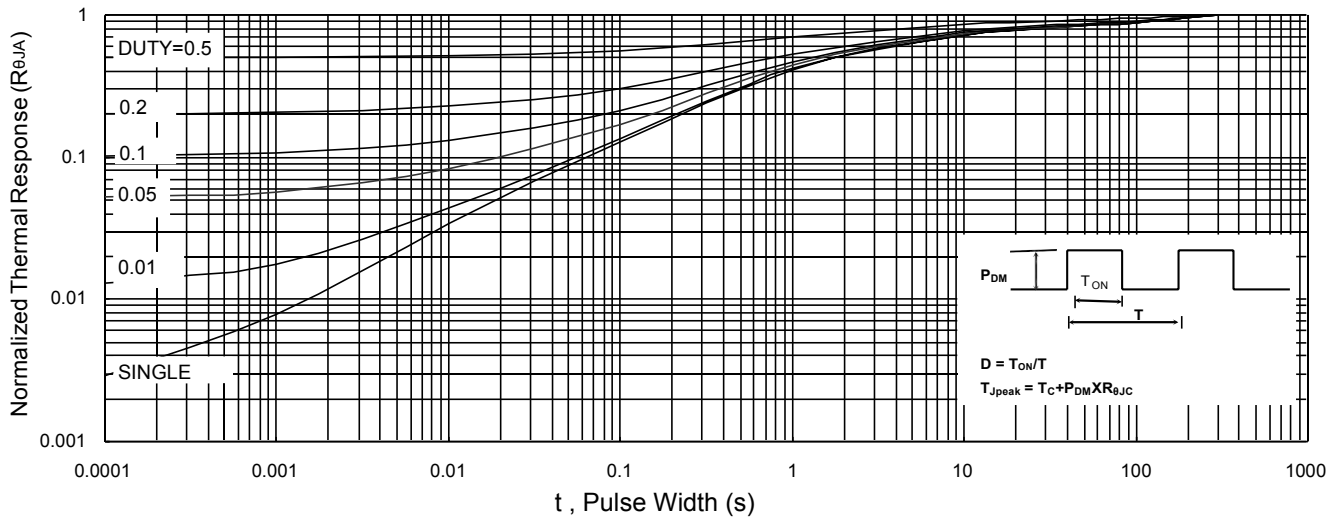


Fig.9 Normalized Maximum Transient Thermal Impedance

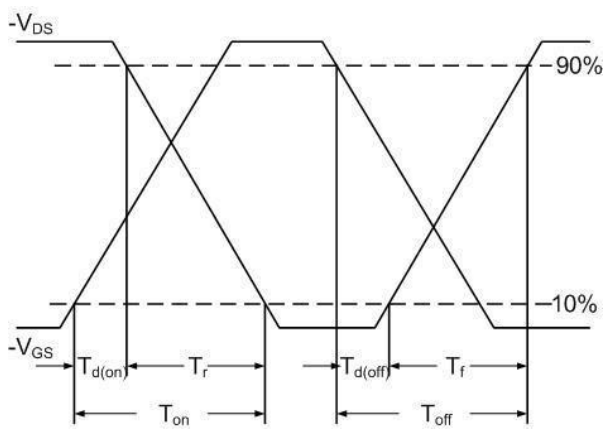


Fig.10 Switching Time Waveform

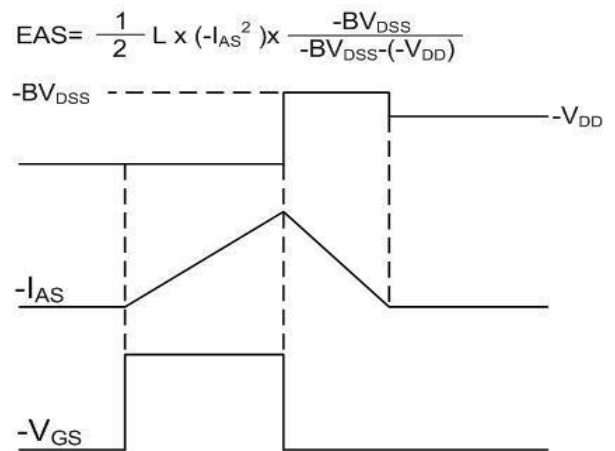
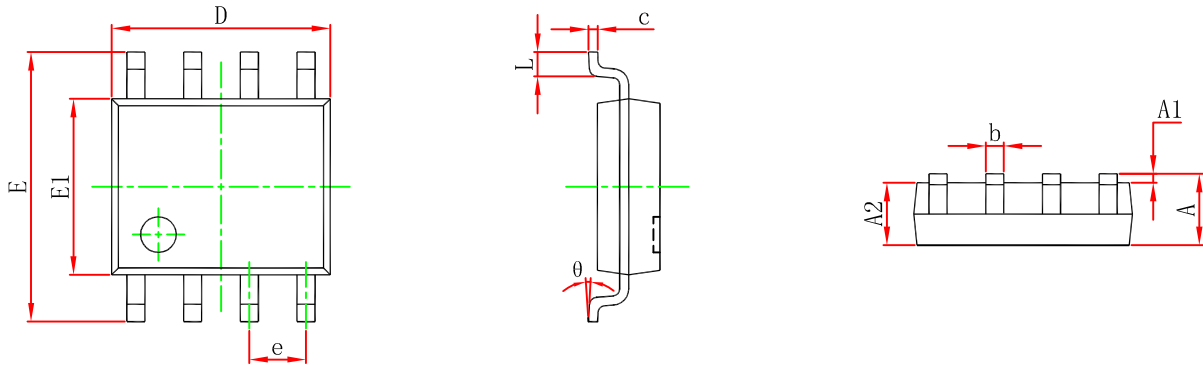


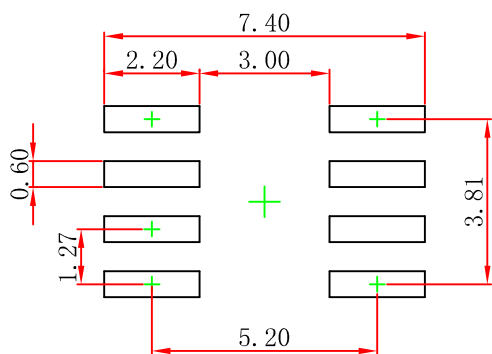
Fig.11 Unclamped Inductive Waveform



SOP-8 Package Outline Dimensions



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|-------|----------------------|-------|
| | Min | Max | Min | Max |
| A | 1.350 | 1.750 | 0.053 | 0.069 |
| A1 | 0.100 | 0.250 | 0.004 | 0.010 |
| A2 | 1.350 | 1.550 | 0.053 | 0.061 |
| b | 0.330 | 0.510 | 0.013 | 0.020 |
| c | 0.170 | 0.250 | 0.007 | 0.010 |
| D | 4.800 | 5.000 | 0.189 | 0.197 |
| e | 1.270 (BSC) | | 0.050 (BSC) | |
| E | 5.800 | 6.200 | 0.228 | 0.244 |
| E1 | 3.800 | 4.000 | 0.150 | 0.157 |
| L | 0.400 | 1.270 | 0.016 | 0.050 |
| θ | 0° | 8° | 0° | 8° |



- Note:
1. Controlling dimension: in millimeters.
 2. General tolerance: $\pm 0.05\text{mm}$.
 3. The pad layout is for reference purposes only.



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[MCQ7328-TP](#) [SSM3J143TU,LXHF](#) [DMN12M3UCA6-7](#) [PJMF280N65E1_T0_00201](#) [PJMF380N65E1_T0_00201](#)
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