

Dual Enhancement Mode MOSFET (N- and P-Channel)

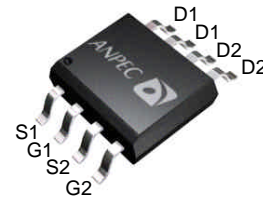
Features

- N-Channel
40V/6.5A,
 $R_{DS(ON)} = 20m\Omega$ (typ.) @ $V_{GS} = 10V$
 $R_{DS(ON)} = 28m\Omega$ (typ.) @ $V_{GS} = 4.5V$
- P-Channel
-40V/-5A,
 $R_{DS(ON)} = 35m\Omega$ (typ.) @ $V_{GS} = -10V$
 $R_{DS(ON)} = 48m\Omega$ (typ.) @ $V_{GS} = -4.5V$
- Super High Dense Cell Design
- Reliable and Rugged
- Lead Free and Green Devices Available (RoHS Compliant)

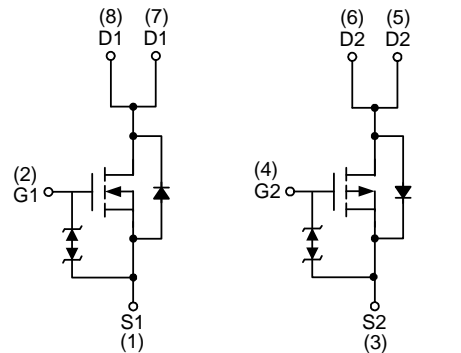
Applications

- Power Management in Notebook Computer, Portable Equipment and Battery Powered Systems

Pin Description



Top View of SOP – 8



N-Channel MOSFET P-Channel MOSFET

Ordering and Marking Information

| | |
|--|--|
| <p>APM4568A</p> | <p>Package Code K : SOP-8 Operating Junction Temperature Range C : -55 to 150 °C Handling Code TR : Tape & Reel Assembly Material G : Halogen and Lead Free Device</p> |
| <p>APM4568A K : APM4568A XXXXX</p> | <p>XXXXX - Date Code</p> |

Note: ANPEC lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS. ANPEC lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J-STD-020C for MSL classification at lead-free peak reflow temperature. ANPEC defines "Green" to mean lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

ANPEC reserves the right to make changes to improve reliability or manufacturability without notice, and advise customers to obtain the latest version of relevant information to verify before placing orders.

Absolute Maximum Ratings ($T_A = 25^\circ\text{C}$ unless otherwise noted)

| Symbol | Parameter | Rating | | Unit |
|-------------------|--|-------------------------|-----------|--------------------|
| | | N Channel | P Channel | |
| V_{DSS} | Drain-Source Voltage | 40 | -40 | V |
| V_{GSS} | Gate-Source Voltage | ± 16 | ± 16 | |
| I_D^* | Continuous Drain Current | 6.5 | -5 | A |
| I_{DM}^* | Pulsed Drain Current | 25 | -20 | |
| I_S^* | Diode Continuous Forward Current | 2.5 | -2.5 | A |
| T_J | Maximum Junction Temperature | 150 | | $^\circ\text{C}$ |
| T_{STG} | Storage Temperature Range | -55 to 150 | | |
| P_D^* | Power Dissipation | $T_A=25^\circ\text{C}$ | 2 | W |
| | | $T_A=100^\circ\text{C}$ | 0.8 | |
| $R_{\theta JA}^*$ | Thermal Resistance-Junction to Ambient | 62.5 | | $^\circ\text{C/W}$ |

Note : *Surface Mounted on 1in² pad area, $t \leq 10\text{sec}$.

Electrical Characteristics ($T_A = 25^\circ\text{C}$ unless otherwise noted)

| Symbol | Parameter | Test Conditions | APM4568AK | | | Unit | |
|-------------------------------|----------------------------------|--|-----------|------|------|----------|------------------|
| | | | Min. | Typ. | Max. | | |
| Static Characteristics | | | | | | | |
| BV_{DSS} | Drain-Source Breakdown Voltage | $V_{GS}=0V, I_{DS}=250\mu\text{A}$ | N-Ch | 40 | - | - | V |
| | | $V_{GS}=0V, I_{DS}=-250\mu\text{A}$ | P-Ch | -40 | - | - | |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS}=32V, V_{GS}=0V$ $T_J=85^\circ\text{C}$ | N-Ch | - | - | 1 | μA |
| | | | P-Ch | - | - | -1 | |
| | | $V_{DS}=-32V, V_{GS}=0V$ $T_J=85^\circ\text{C}$ | N-Ch | - | - | 30 | |
| | | | P-Ch | - | - | -30 | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}=V_{GS}, I_{DS}=250\mu\text{A}$ | N-Ch | 1.3 | 2 | 2.5 | V |
| | | $V_{DS}=V_{GS}, I_{DS}=-250\mu\text{A}$ | P-Ch | -1.3 | -1.9 | -2.5 | |
| I_{GSS} | Gate Leakage Current | $V_{GS}=\pm 16V, V_{DS}=0V$ | N-Ch | - | - | ± 10 | μA |
| | | $V_{GS}=\pm 16V, V_{DS}=0V$ | P-Ch | - | - | ± 10 | |
| $R_{DS(ON)}^a$ | Drain-Source On-State Resistance | $V_{GS}=10V, I_{DS}=6.5A$ | N-Ch | - | 20 | 28 | $\text{m}\Omega$ |
| | | $V_{GS}=-10V, I_{DS}=-5A$ | P-Ch | - | 35 | 48 | |
| | | $V_{GS}=4.5V, I_{DS}=4.5A$ | N-Ch | - | 28 | 42 | |
| | | $V_{GS}=-4.5V, I_{DS}=-3A$ | P-Ch | - | 48 | 68 | |

Electrical Characteristics (Cont.) ($T_A = 25^\circ\text{C}$ unless otherwise noted)

| Symbol | Parameter | Test Conditions | APM4568AK | | | Unit | |
|--|------------------------------|---|-----------|------|------|------|----------|
| | | | Min. | Typ. | Max. | | |
| Diode Characteristics | | | | | | | |
| V_{SD}^a | Diode Forward Voltage | $I_{SD}=2.5A, V_{GS}=0V$ | N-Ch | - | 0.8 | 1.1 | V |
| | | $I_{SD}=-2.5A, V_{GS}=0V$ | P-Ch | - | -0.8 | -1.1 | |
| t_{rr} | Reverse Recovery Time | N-Channel $I_{SD}=6.5A, dI_{SD}/dt=100A/\mu s$ | N-Ch | - | 18 | - | ns |
| | | | P-Ch | - | 17 | - | |
| Q_{rr} | Reverse Recovery Charge | P-Channel $I_{SD}=-5A, dI_{SD}/dt=100A/\mu s$ | N-Ch | - | 11 | - | nC |
| | | | P-Ch | - | 8 | - | |
| Dynamic Characteristics^b | | | | | | | |
| R_G | Gate Resistance | $V_{GS}=0V, V_{DS}=0V, F=1MHz$ | N-Ch | - | 4 | - | Ω |
| | | | P-Ch | - | 9 | - | |
| C_{iss} | Input Capacitance | N-Channel $V_{GS}=0V, V_{DS}=20V,$ Frequency=1.0MHz | N-Ch | - | 1020 | - | pF |
| C_{oss} | Output Capacitance | | P-Ch | - | 1075 | - | |
| C_{rss} | Reverse Transfer Capacitance | P-Channel $V_{GS}=0V, V_{DS}=-20V,$ Frequency=1.0MHz | N-Ch | - | 120 | - | |
| | | | P-Ch | - | 130 | - | |
| $t_{d(ON)}$ | Turn-on Delay Time | N-Channel $V_{DD}=20V, R_L=20\Omega,$ $I_{DS}=1A, V_{GEN}=10V,$ $R_G=6\Omega$ | N-Ch | - | 8 | 15 | ns |
| | | | P-Ch | - | 10 | 19 | |
| T_r | Turn-on Rise Time | | N-Ch | - | 10 | 19 | |
| | | | P-Ch | - | 12 | 23 | |
| $t_{d(OFF)}$ | Turn-off Delay Time | P-Channel $V_{DD}=-20V, R_L=20\Omega,$ $I_{DS}=-1A, V_{GEN}=-10V,$ $R_G=6\Omega$ | N-Ch | - | 37 | 68 | |
| | | | P-Ch | - | 46 | 84 | |
| T_f | Turn-off Fall Time | | N-Ch | - | 10 | 19 | |
| | | | P-Ch | - | 18 | 33 | |
| Gate Charge Characteristics^b | | | | | | | |
| Q_g | Total Gate Charge | N-Channel $V_{DS}=20V, V_{GS}=10V,$ $I_{DS}=6.5A$ | N-Ch | - | 22 | 30 | nC |
| | | | P-Ch | - | 18.5 | 26 | |
| Q_{gs} | Gate-Source Charge | P-Channel $V_{DS}=-20V, V_{GS}=-10V,$ $I_{DS}=-5A$ | N-Ch | - | 2.5 | - | |
| | | | P-Ch | - | 2.6 | - | |
| Q_{gd} | Gate-Drain Charge | | N-Ch | - | 5.2 | - | |
| | | | P-Ch | - | 4 | - | |

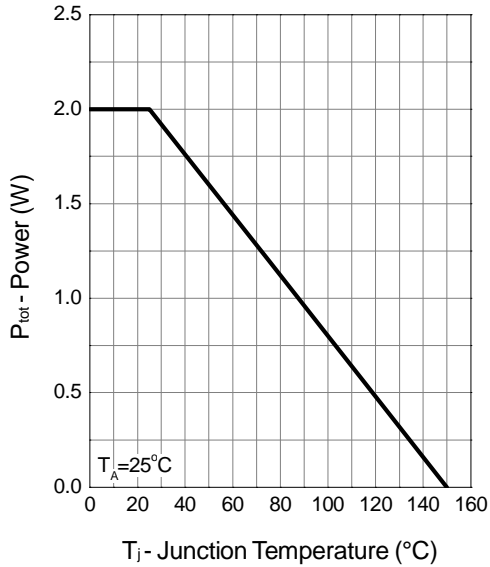
Note a : Pulse test ; pulse width $\leq 300\mu s$, duty cycle $\leq 2\%$.

Note b : Guaranteed by design, not subject to production testing.

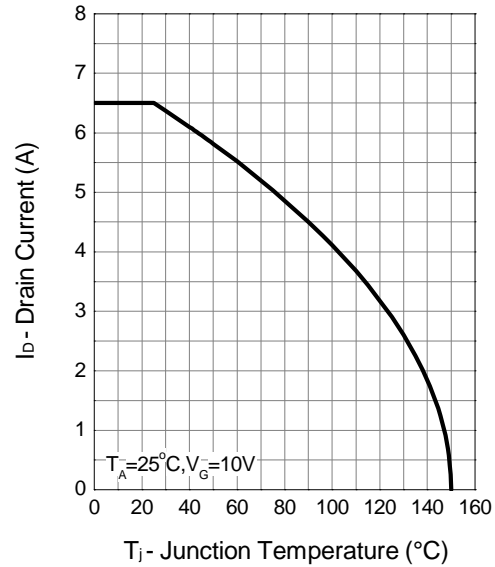
Typical Operating Characteristics

N-Channel

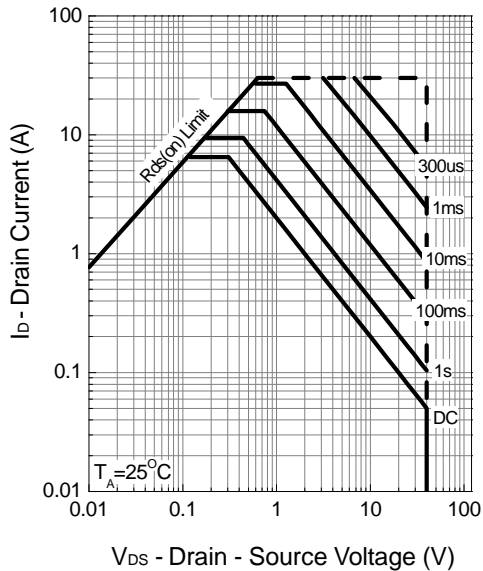
Power Dissipation



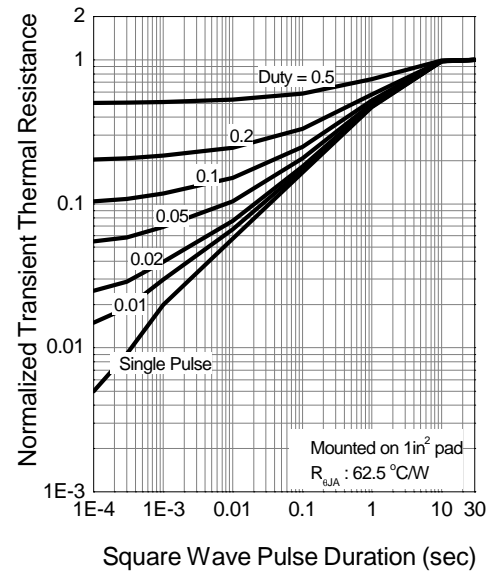
Drain Current



Safe Operation Area

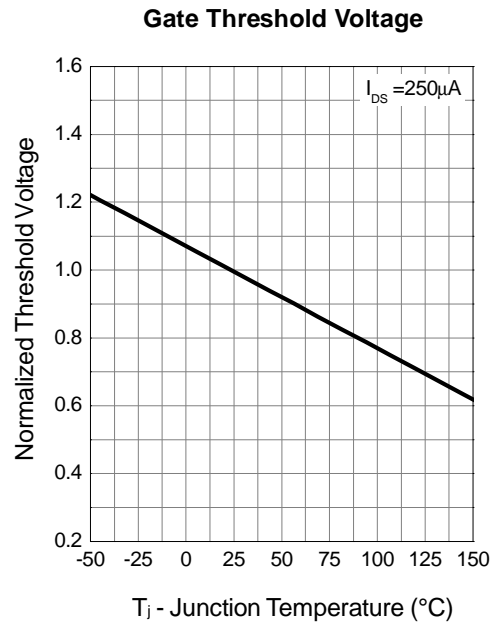
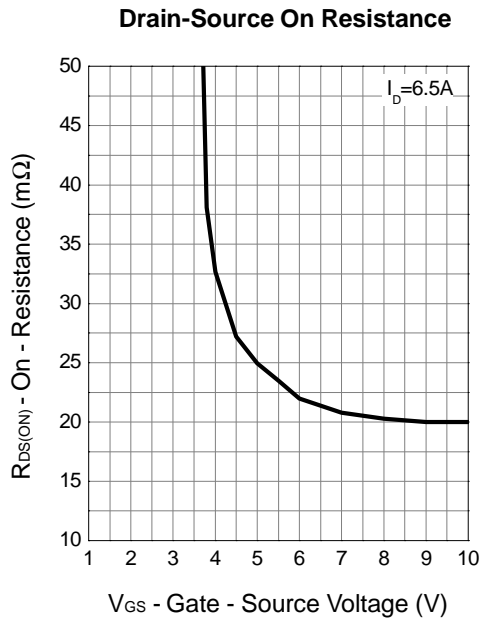
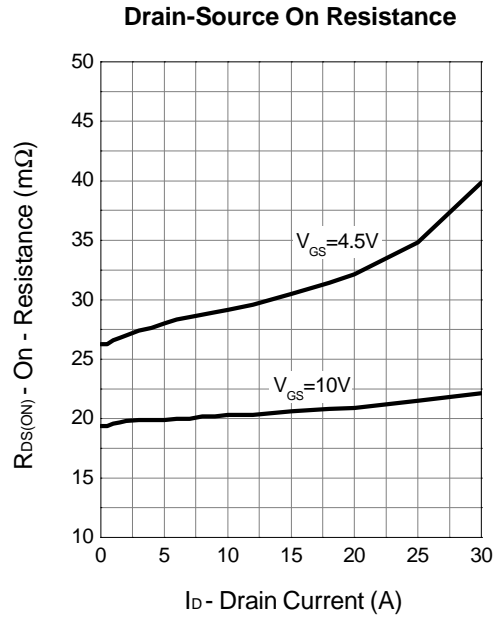
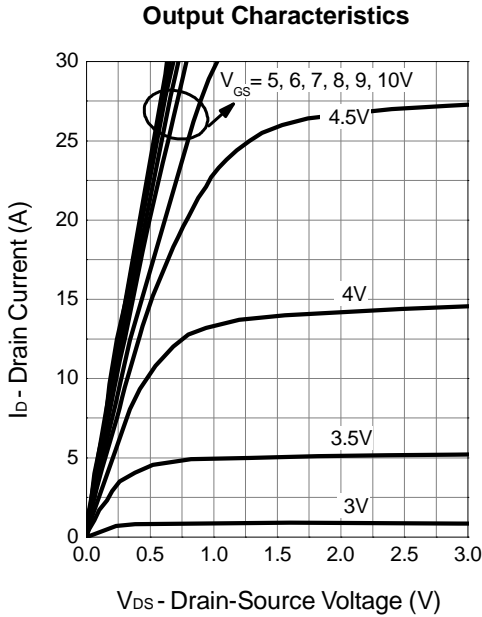


Thermal Transient Impedance



Typical Operating Characteristics (Cont.)

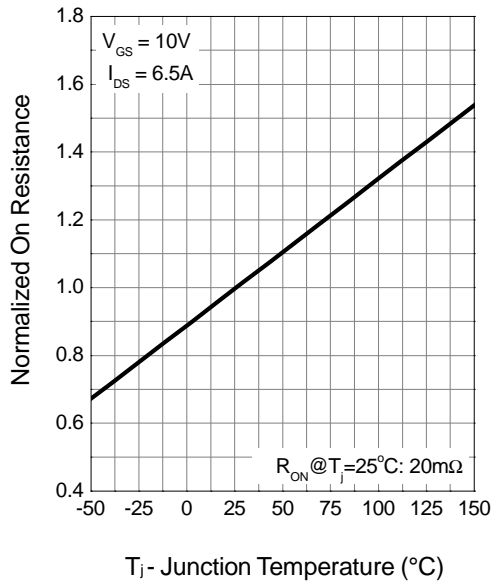
N-Channel



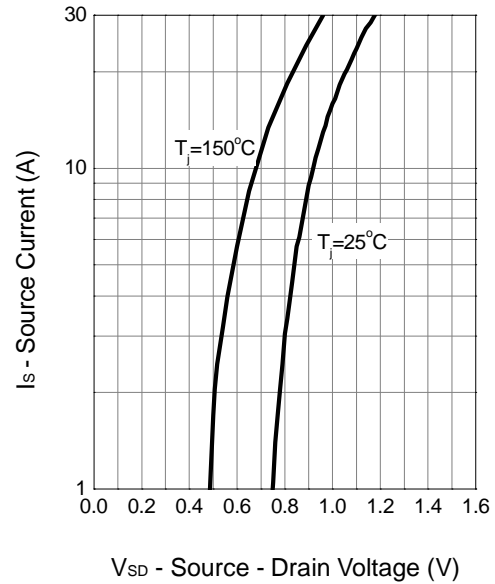
Typical Operating Characteristics (Cont.)

N-Channel

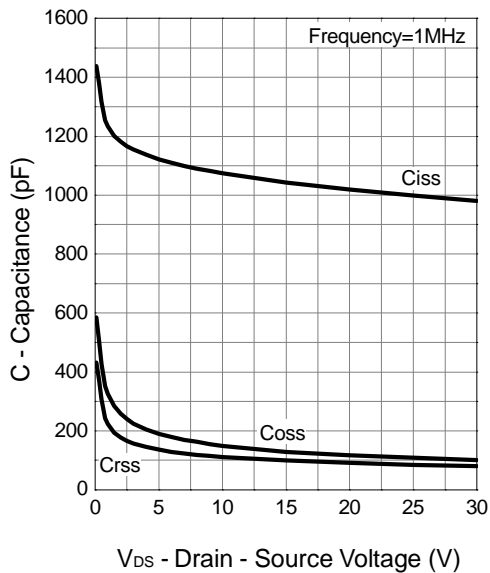
Drain-Source On Resistance



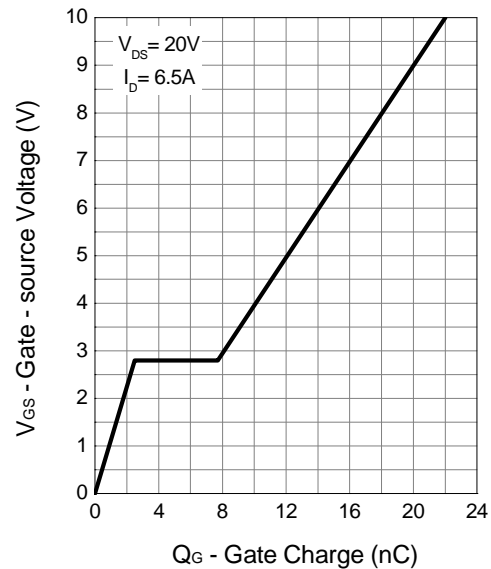
Source-Drain Diode Forward



Capacitance



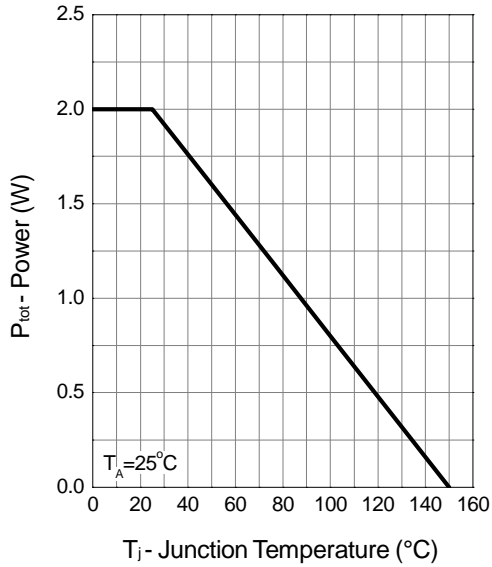
Gate Charge



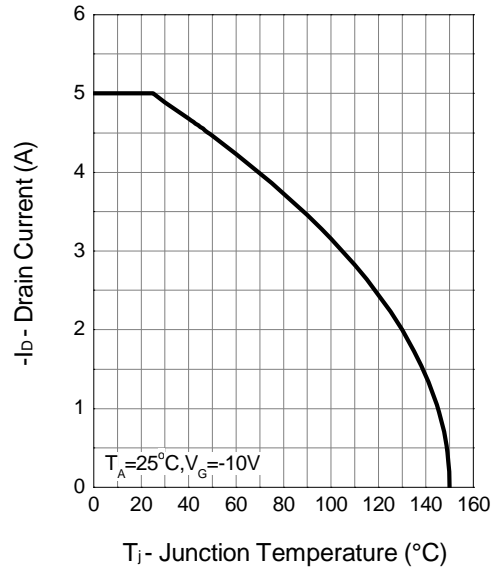
Typical Operating Characteristics (Cont.)

P-Channel

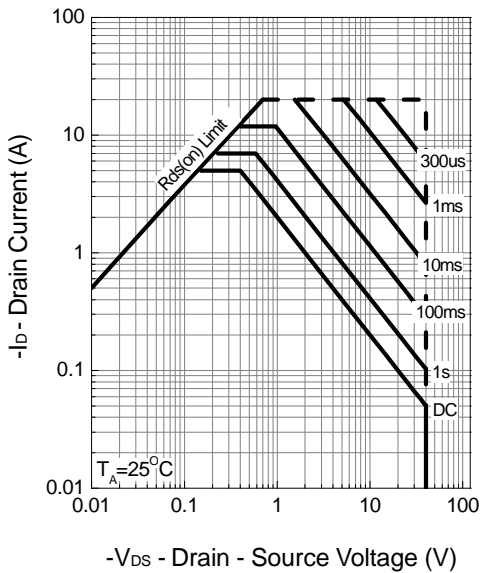
Power Dissipation



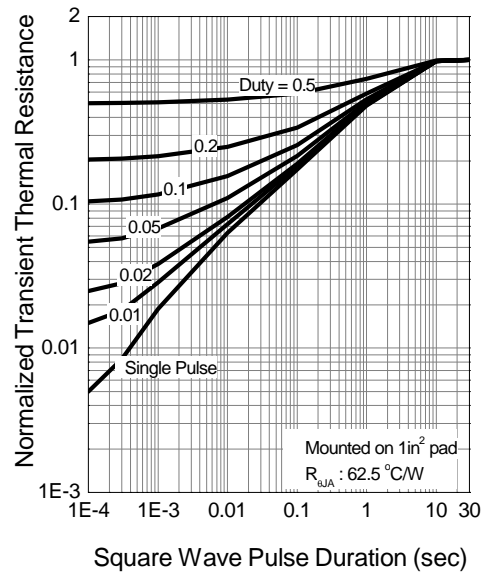
Drain Current



Safe Operation Area



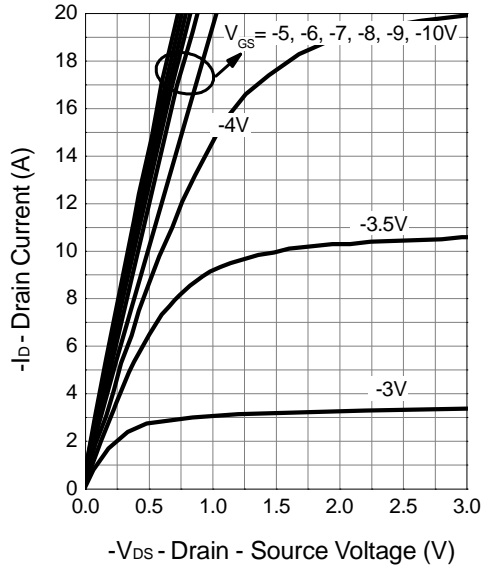
Thermal Transient Impedance



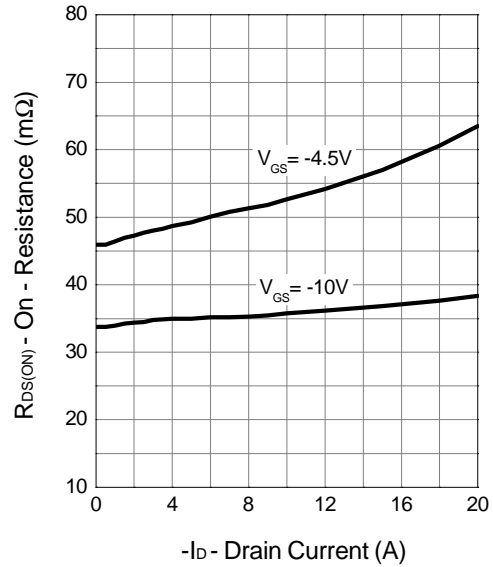
Typical Operating Characteristics (Cont.)

P-Channel

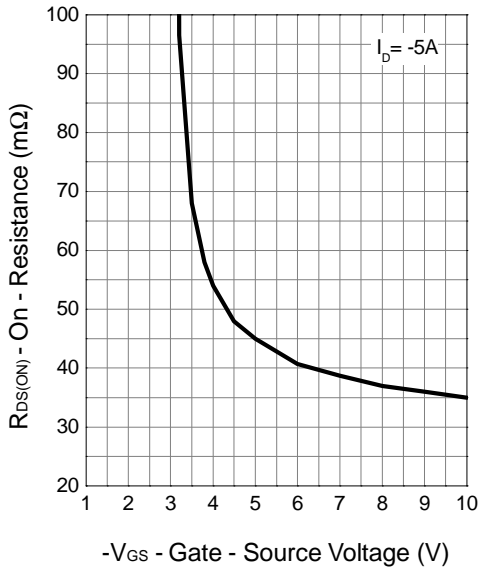
Output Characteristics



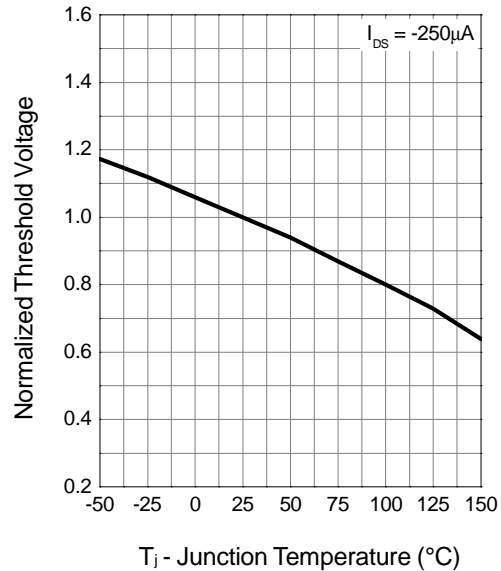
Drain-Source On Resistance



Drain-Source On Resistance



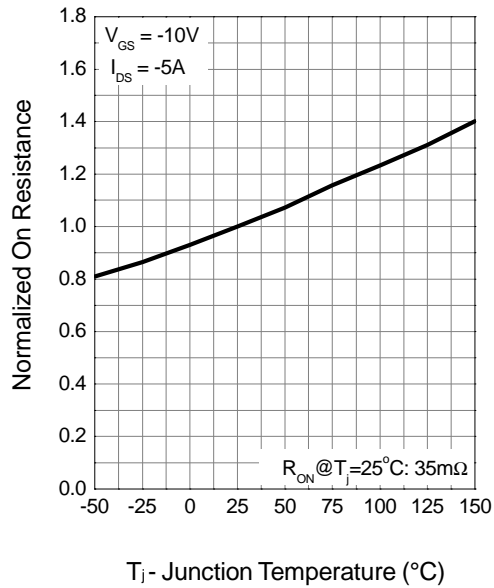
Gate Threshold Voltage



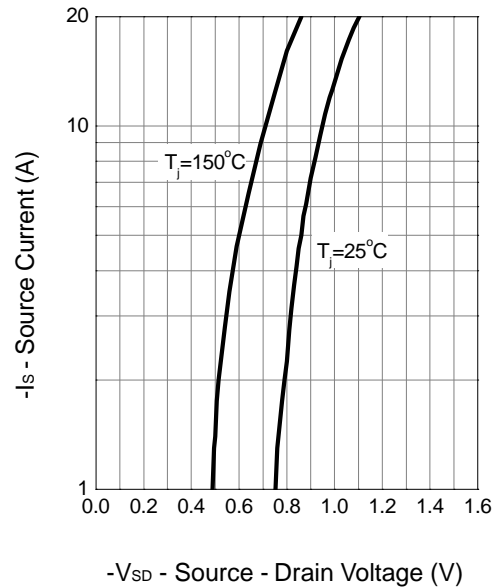
Typical Operating Characteristics (Cont.)

P-Channel

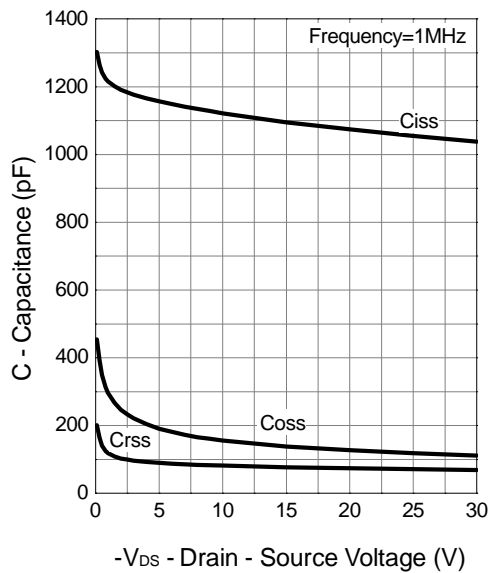
Drain-Source On Resistance



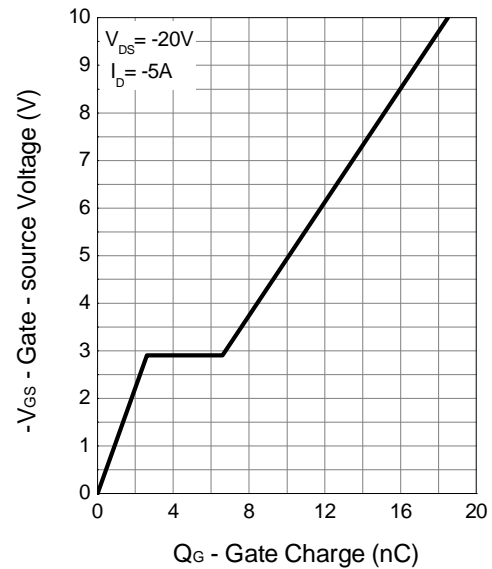
Source-Drain Diode Forward



Capacitance

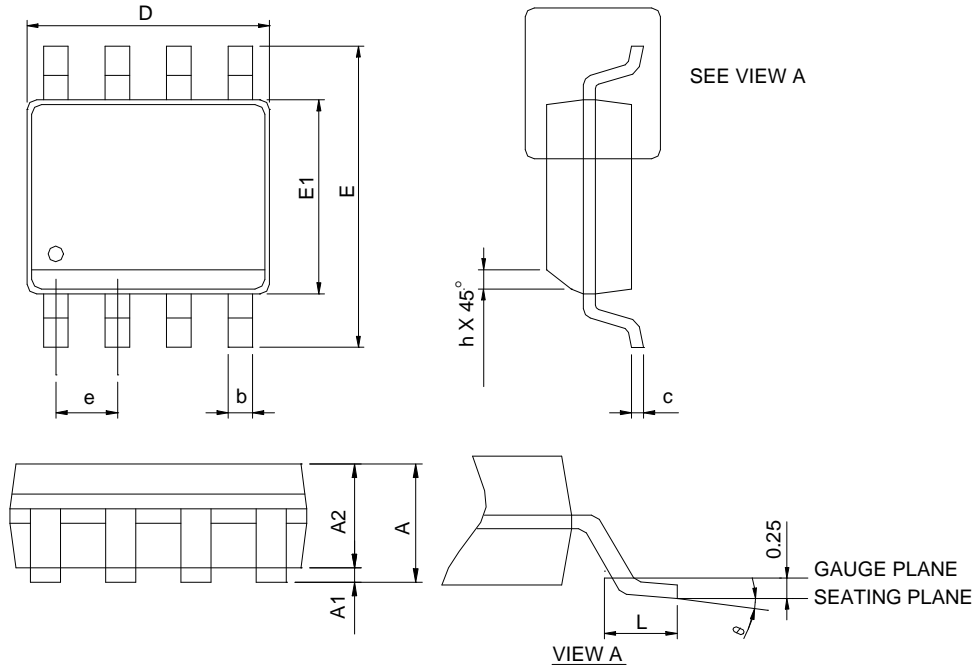


Gate Charge



Package Information

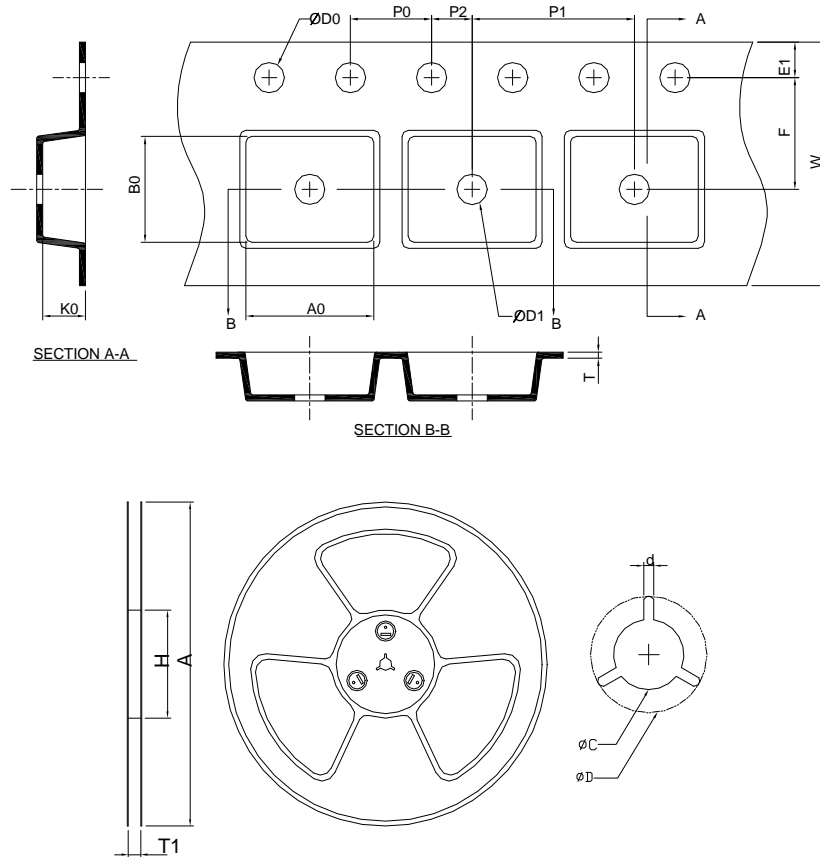
SOP-8



| SYMBOL | SOP-8 | | | |
|----------|-------------|------|-----------|-------|
| | MILLIMETERS | | INCHES | |
| | MIN. | MAX. | MIN. | MAX. |
| A | | 1.75 | | 0.069 |
| A1 | 0.10 | 0.25 | 0.004 | 0.010 |
| A2 | 1.25 | | 0.049 | |
| b | 0.31 | 0.51 | 0.012 | 0.020 |
| c | 0.17 | 0.25 | 0.007 | 0.010 |
| D | 4.80 | 5.00 | 0.189 | 0.197 |
| E | 5.80 | 6.20 | 0.228 | 0.244 |
| E1 | 3.80 | 4.00 | 0.150 | 0.157 |
| e | 1.27 BSC | | 0.050 BSC | |
| h | 0.25 | 0.50 | 0.010 | 0.020 |
| L | 0.40 | 1.27 | 0.016 | 0.050 |
| θ | 0° | 8° | 0° | 8° |

- Note: 1. Follow JEDEC MS-012 AA.
 2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side.
 3. Dimension "E" does not include inter-lead flash or protrusions. Inter-lead flash and protrusions shall not exceed 10 mil per side.

Carrier Tape & Reel Dimensions



| Application | A | H | T1 | C | d | D | W | E1 | F |
|-------------|--------------|-----------|--------------------|--------------------|-----------|-------------------|------------|------------|------------|
| SOP-8 | 330.0 ± 2.00 | 50 MIN. | 12.4+2.00 -0.00 | 13.0+0.50 -0.20 | 1.5 MIN. | 20.2 MIN. | 12.0 ±0.30 | 1.75 ±0.10 | 5.5 ±0.05 |
| | P0 | P1 | P2 | D0 | D1 | T | A0 | B0 | K0 |
| | 4.0 ±0.10 | 8.0 ±0.10 | 2.0 ±0.05 | 1.5+0.10 -0.00 | 1.5 MIN. | 0.6+0.00 -0.40 | 6.40 ±0.20 | 5.20 ±0.20 | 2.10 ±0.20 |

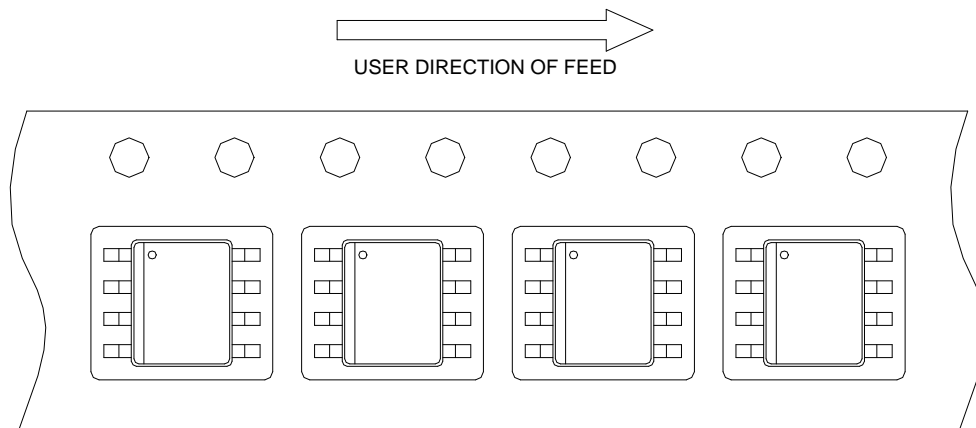
(mm)

Devices Per Unit

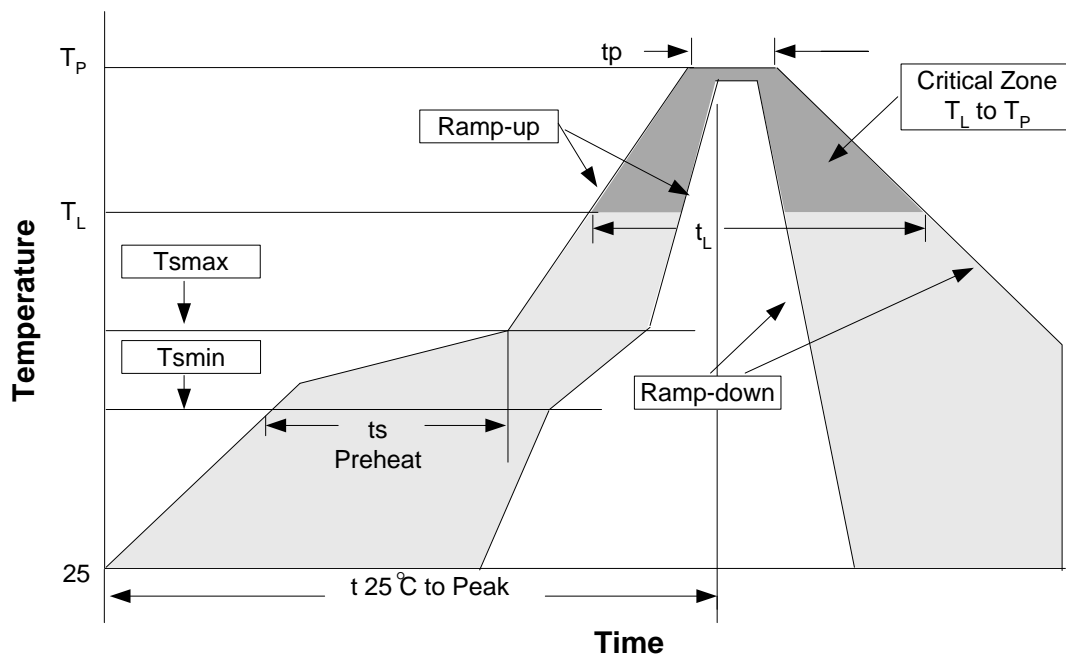
| Package Type | Unit | Quantity |
|--------------|-------------|----------|
| SOP-8 | Tape & Reel | 2500 |

Taping Direction Information

SOP-8



Reflow Condition (IR/Convection or VPR Reflow)



Reliability Test Program

| Test item | Method | Description |
|---------------|---------------------|-------------------------|
| SOLDERABILITY | MIL-STD-883D-2003 | 245°C, 5 sec |
| HOLT | MIL-STD-883D-1005.7 | 1000 Hrs Bias @ 125°C |
| PCT | JESD-22-B, A102 | 168 Hrs, 100%RH, 121°C |
| TST | MIL-STD-883D-1011.9 | -65°C~150°C, 200 Cycles |

Classification Reflow Profiles

| Profile Feature | Sn-Pb Eutectic Assembly | Pb-Free Assembly |
|---|-------------------------|------------------|
| Average ramp-up rate (T_L to T_P) | 3°C/second max. | 3°C/second max. |
| Preheat | | |
| - Temperature Min (T_{smin}) | 100°C | 150°C |
| - Temperature Max (T_{smax}) | 150°C | 200°C |
| - Time (min to max) (ts) | 60-120 seconds | 60-180 seconds |
| Time maintained above: | | |
| - Temperature (T_L) | 183°C | 217°C |
| - Time (t_L) | 60-150 seconds | 60-150 seconds |
| Peak/Classification Temperature (T_P) | See table 1 | See table 2 |
| Time within 5°C of actual Peak Temperature (t_P) | 10-30 seconds | 20-40 seconds |
| Ramp-down Rate | 6°C/second max. | 6°C/second max. |
| Time 25°C to Peak Temperature | 6 minutes max. | 8 minutes max. |

Note: All temperatures refer to topside of the package. Measured on the body surface.

Table 1. SnPb Eutectic Process – Package Peak Reflow Temperatures

| Package Thickness | Volume mm ³ <350 | Volume mm ³ ≥350 |
|-------------------|--------------------------------|--------------------------------|
| <2.5 mm | 240 +0/-5°C | 225 +0/-5°C |
| ≥2.5 mm | 225 +0/-5°C | 225 +0/-5°C |

Table 2. Pb-free Process – Package Classification Reflow Temperatures

| Package Thickness | Volume mm ³ <350 | Volume mm ³ 350-2000 | Volume mm ³ >2000 |
|-------------------|--------------------------------|------------------------------------|---------------------------------|
| <1.6 mm | 260 +0°C* | 260 +0°C* | 260 +0°C* |
| 1.6 mm – 2.5 mm | 260 +0°C* | 250 +0°C* | 245 +0°C* |
| ≥2.5 mm | 250 +0°C* | 245 +0°C* | 245 +0°C* |

*Tolerance: The device manufacturer/supplier **shall** assure process compatibility up to and including the stated classification temperature (this means Peak reflow temperature +0°C. For example 260°C+0°C) at the rated MSL level.

Customer Service

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