

P-Channel Enhancement Mode MOSFET with Schottky Diode

Features

MOSFET

- 20V/-2.3A,
 $R_{DS(ON)} = 85m\Omega(\text{typ.}) @ V_{GS} = -4.5V$
 $R_{DS(ON)} = 120m\Omega(\text{typ.}) @ V_{GS} = -2.5V$
- Super High Dense Cell Design
- Reliable and Rugged
- Lead Free and Green Device Available (RoHS Compliant)

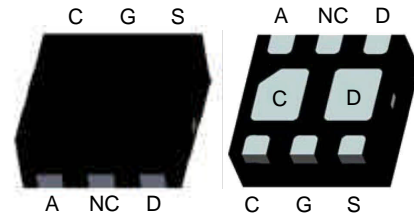
SBD

- $V_F = 0.45V(\text{typ.}) @ I_f = 500mA.$

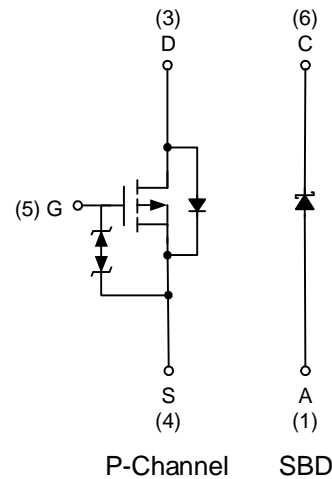
Applications

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

Pin Description



Top View of TDFN2x2-6A



P-Channel

SBD

Ordering and Marking Information

| | |
|--|---|
| <p>APM2807 □□□-□□□</p> <p> □□□ - Assembly Material □□ - Handling Code □ - Temperature Range □□□ - Package Code </p> | <p>Package Code QB : TDFN2x2-6A Operating Junction Temperature Range C : -55 to 150 °C Handling Code TR : Tape & Reel Assembly Material G : Halogen and Lead Free Device</p> |
| <p>APM2807 QB : .M07X</p> | <p>X - 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-020D 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 | |
|-------------------|--|---------------------------|------------------|--------------------|
| [MOSFET] | | | | |
| V_{DSS} | Drain-Source Voltage | -20 | V | |
| V_{GSS} | Gate-Source Voltage | ± 10 | | |
| I_D^* | Continuous Drain Current | $V_{GS} = -4.5\text{V}$ | A | |
| I_{DM}^* | 300 μs Pulsed Drain Current | | | -7 |
| I_S^* | Diode Continuous Forward Current | -1.4 | A | |
| T_J | Maximum Junction Temperature | 150 | $^\circ\text{C}$ | |
| T_{STG} | Storage Temperature Range | -55 to 150 | | |
| P_D^* | Maximum Power Dissipation | $T_A = 25^\circ\text{C}$ | 1.45 | W |
| | | $T_A = 100^\circ\text{C}$ | 0.55 | |
| $R_{\theta JA}^*$ | Thermal Resistance-Junction to Ambient | 1 in ² Pad | 85 | $^\circ\text{C/W}$ |
| | | Minimum foot print | 180 | |
| [SBD] | | | | |
| V_{RRM} | Repetitive Peak Reverse Voltage | 20 | V | |
| V_R | DC Blocking Voltage | 20 | V | |
| I_F | Average Rectified Forward Current | Steady State | 1 | A |
| | | t 5s | 2 | A |
| $R_{\theta JA}$ | Thermal Resistance-Junction to Ambient | Steady State | 140 | $^\circ\text{C/W}$ |
| | | t 5s | 90 | |

Note: *Surface Mounted on 1in² pad area, t ≤ 5sec.

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

| Symbol | Parameter | Test Conditions | APM2807QB | | | Unit |
|-------------------------------|----------------------------------|--|-----------|------|----------|---------------|
| | | | Min. | Typ. | Max. | |
| [MOSFET] | | | | | | |
| Static Characteristics | | | | | | |
| BV_{DSS} | Drain-Source Breakdown Voltage | $V_{GS} = 0\text{V}, I_{DS} = -250\mu\text{A}$ | -20 | - | - | V |
| I_{DSS} | Zero Gate Voltage Drain Current | $V_{DS} = -16\text{V}, V_{GS} = 0\text{V}$ $T_J = 85^\circ\text{C}$ | - | - | -1 | μA |
| | | | - | - | -30 | |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS} = V_{GS}, I_{DS} = -250\mu\text{A}$ | -0.45 | -0.7 | -1 | V |
| I_{GSS} | Gate Leakage Current | $V_{GS} = \pm 10\text{V}, V_{DS} = 0\text{V}$ | - | - | ± 10 | μA |
| $R_{DS(ON)}^a$ | Drain-Source On-state Resistance | $V_{GS} = -4.5\text{V}, I_{DS} = -2.3\text{A}$ | - | 85 | 110 | m Ω |
| | | $V_{GS} = -2.5\text{V}, I_{DS} = -2\text{A}$ | - | 120 | 160 | |

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

| Symbol | Parameter | Test Conditions | APM2807QB | | | Unit |
|--|------------------------------|--|-----------|------|------|---------------|
| | | | Min. | Typ. | Max. | |
| [MOSFET] | | | | | | |
| Diode Characteristics | | | | | | |
| V_{SD}^a | Diode Forward Voltage | $I_{SD}=-1.4\text{A}, V_{GS}=0\text{V}$ | - | -0.7 | -1.3 | V |
| t_{rr} | Reverse Recovery Time | $I_{DS}=-2.3\text{A}, dI_{SD}/dt=100\text{A}/\mu\text{s}$ | - | 13.5 | - | ns |
| Q_{rr} | Reverse Recovery Charge | | - | 4 | - | nC |
| Dynamic Characteristics^b | | | | | | |
| C_{iss} | Input Capacitance | $V_{GS}=0\text{V},$ $V_{DS}=-10\text{V},$ Frequency=1.0MHz | - | 400 | - | pF |
| C_{oss} | Output Capacitance | | - | 70 | - | |
| C_{riss} | Reverse Transfer Capacitance | | - | 50 | - | |
| $t_{d(ON)}$ | Turn-on Delay Time | $V_{DD}=-10\text{V}, R_L=10\Omega,$ $I_{DS}=-1\text{A}, V_{GEN}=-4.5\text{V},$ $R_G=6\Omega$ | - | 6 | 13 | ns |
| T_r | Turn-on Rise Time | | - | 14 | 29 | |
| $t_{d(OFF)}$ | Turn-off Delay Time | | - | 28 | 55 | |
| T_f | Turn-off Fall Time | | - | 20 | 39 | |
| Gate Charge Characteristics^b | | | | | | |
| Q_g | Total Gate Charge | $V_{DS}=-10\text{V}, V_{GS}=-4.5\text{V},$ $I_{DS}=-2.3\text{A}$ | - | 4.5 | 6 | nC |
| Q_{gs} | Gate-Source Charge | | - | 0.7 | - | |
| Q_{gd} | Gate-Drain Charge | | - | 1.8 | - | |
| [SBD] | | | | | | |
| V_R | Reverse Voltage | $I_R=0.5\text{A}$ | 20 | - | - | V |
| V_{F1} | Forward Voltage | $I_F=500\text{mA}$ | - | 0.45 | - | V |
| V_{F2} | | $I_F=500\text{mA}, T_A=125^\circ\text{C}$ | - | 0.37 | - | V |
| I_{R1} | Reverse Current | $V_R=10\text{V}$ | - | 2 | 10 | μA |
| I_{R2} | Reverse Current | $V_R=20\text{V}$ | - | 10 | 40 | μA |
| C^b | Junction Capacitance | $V_R=10\text{V},$ Frequency=1.0MHz | - | 14 | - | pF |

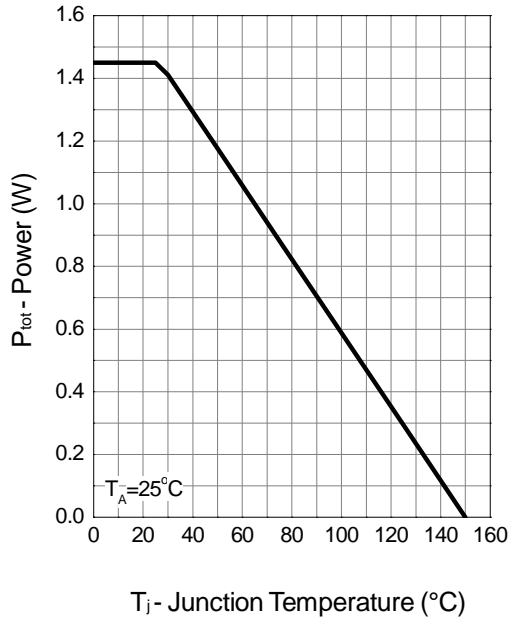
Note a : Pulse test ; pulse width $\leq 300\mu\text{s}$, duty cycle $\leq 2\%$.

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

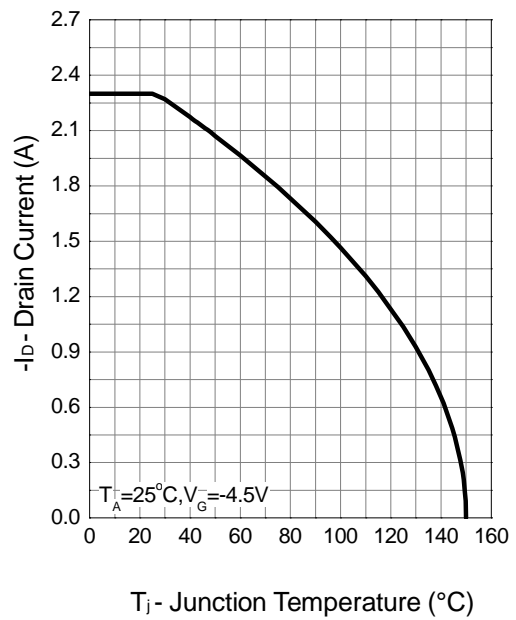
Typical Characteristics

P-Channel

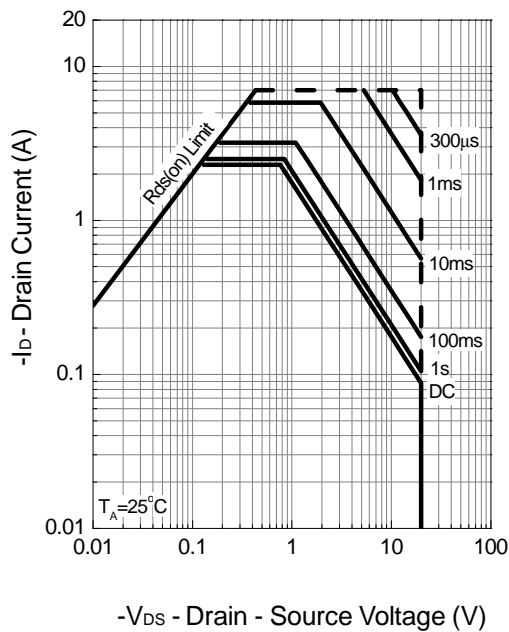
Power Dissipation



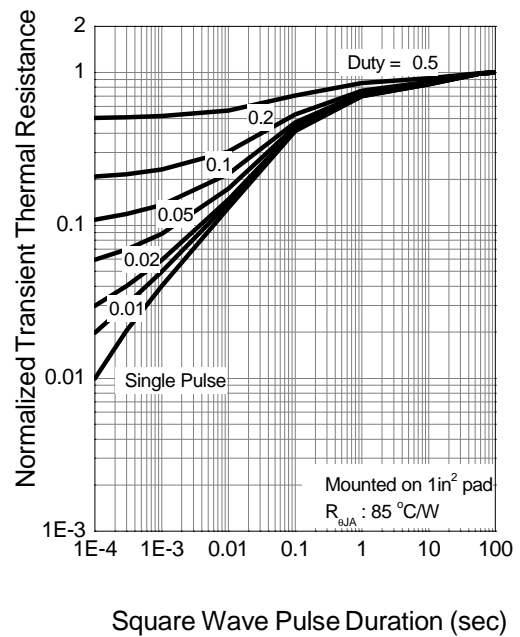
Drain Current



Safe Operation Area



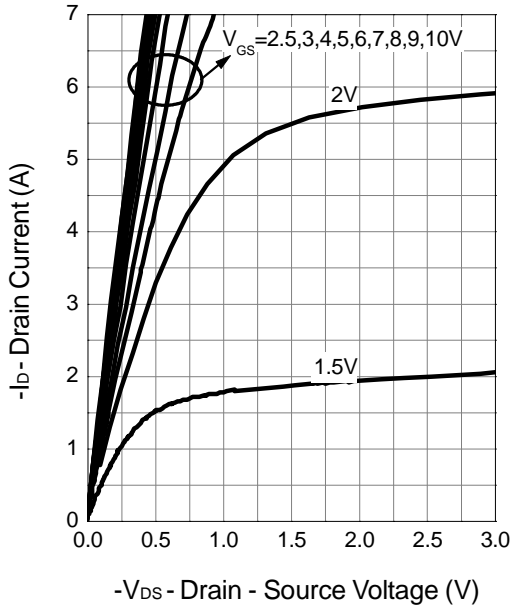
Thermal Transient Impedance



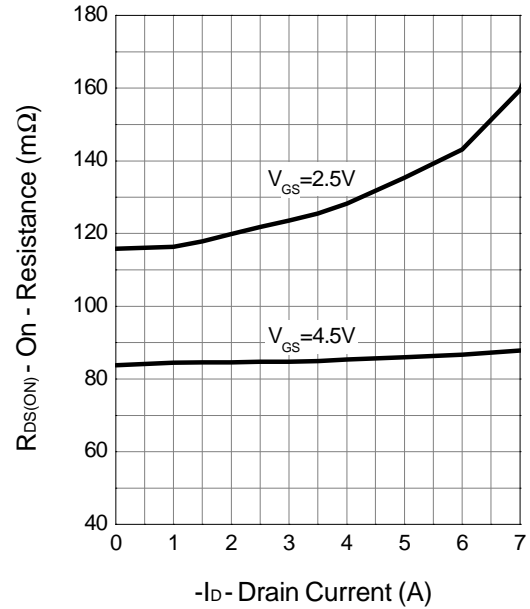
Typical Characteristics (Cont.)

P-Channel

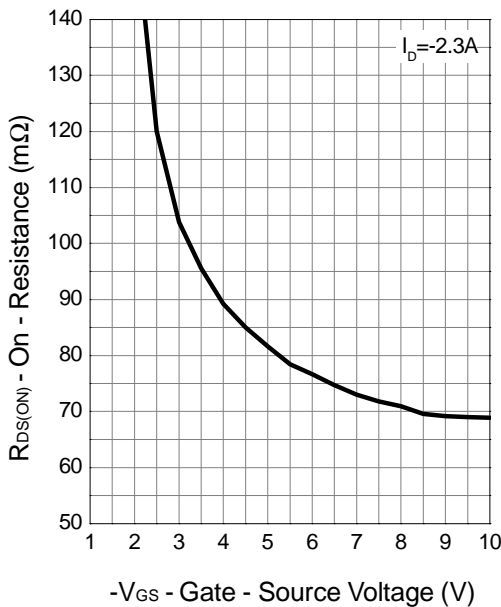
Output Characteristics



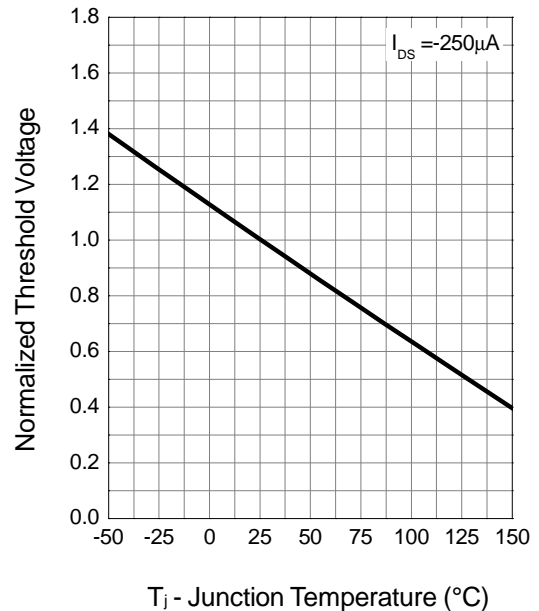
Drain-Source On Resistance



Drain-Source On Resistance



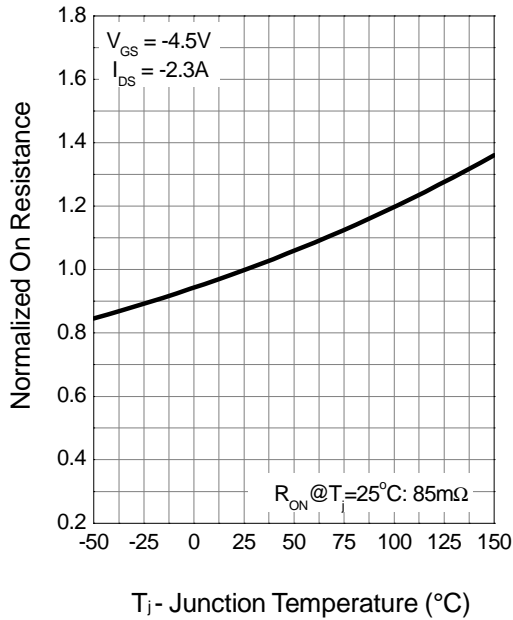
Gate Threshold Voltage



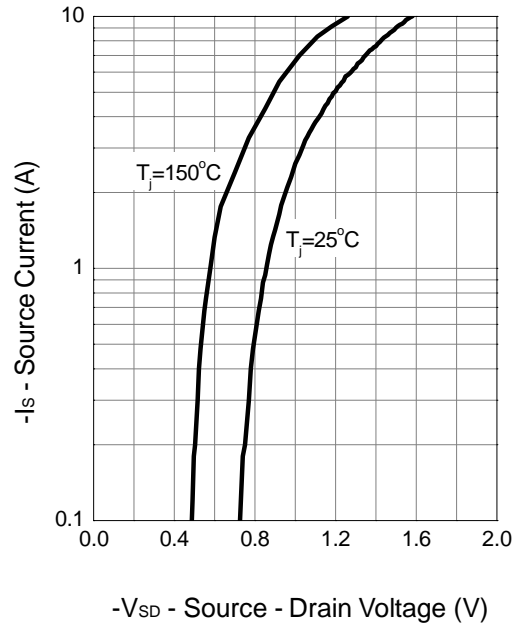
Typical Characteristics (Cont.)

P-Channel

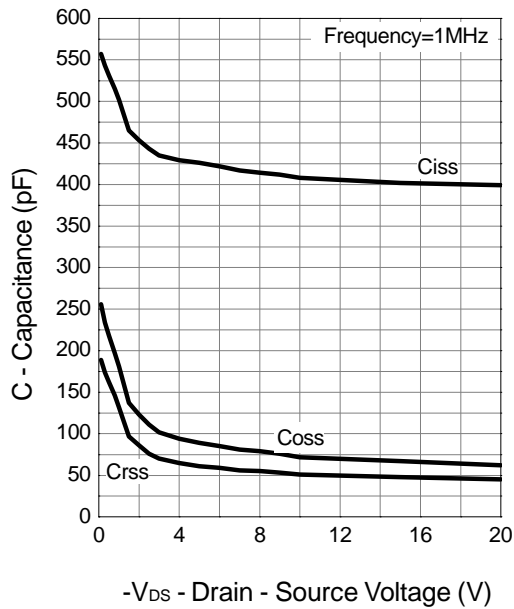
Drain-Source On Resistance



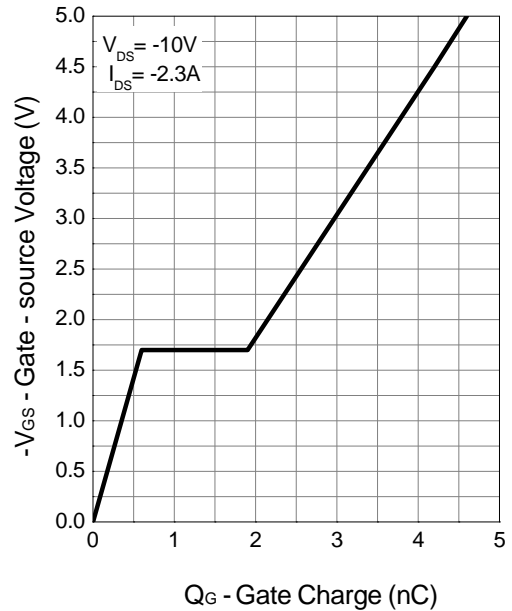
Source-Drain Diode Forward



Capacitance

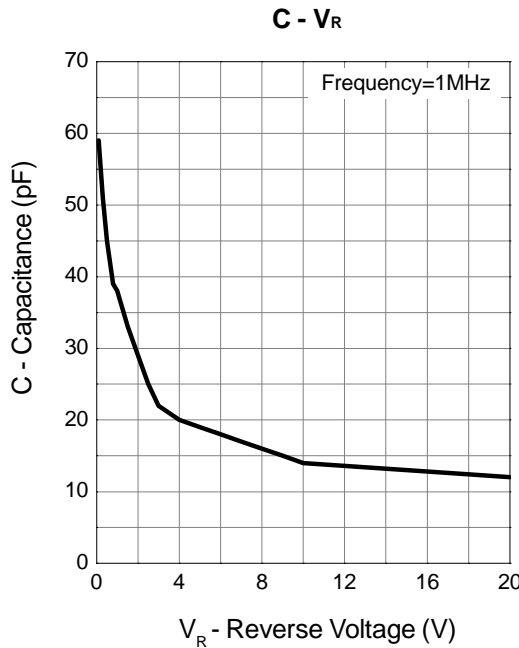
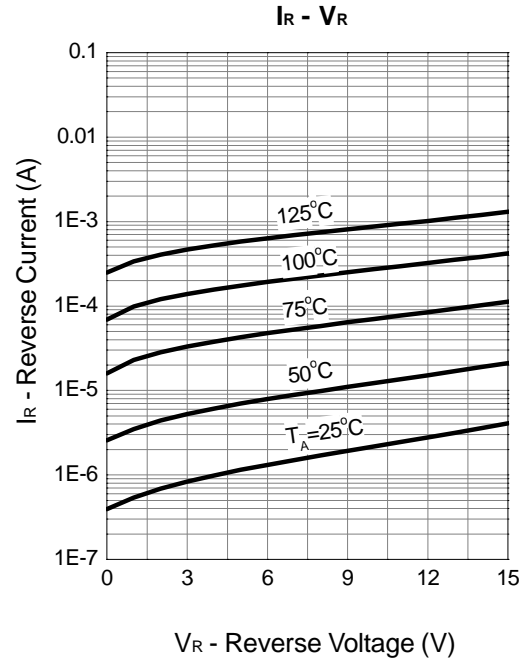
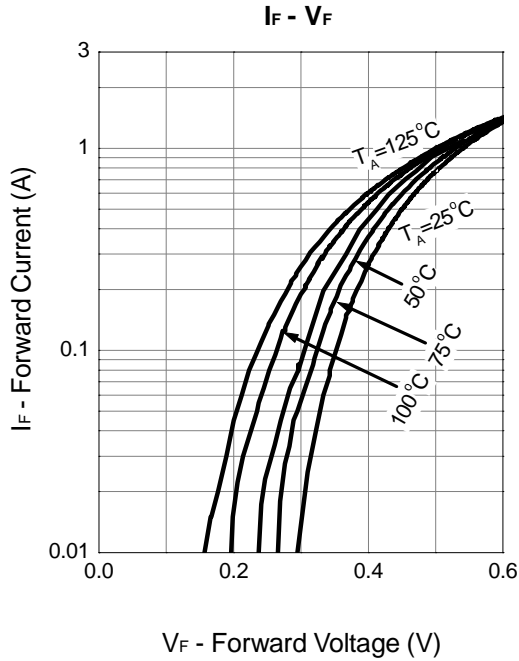


Gate Charge



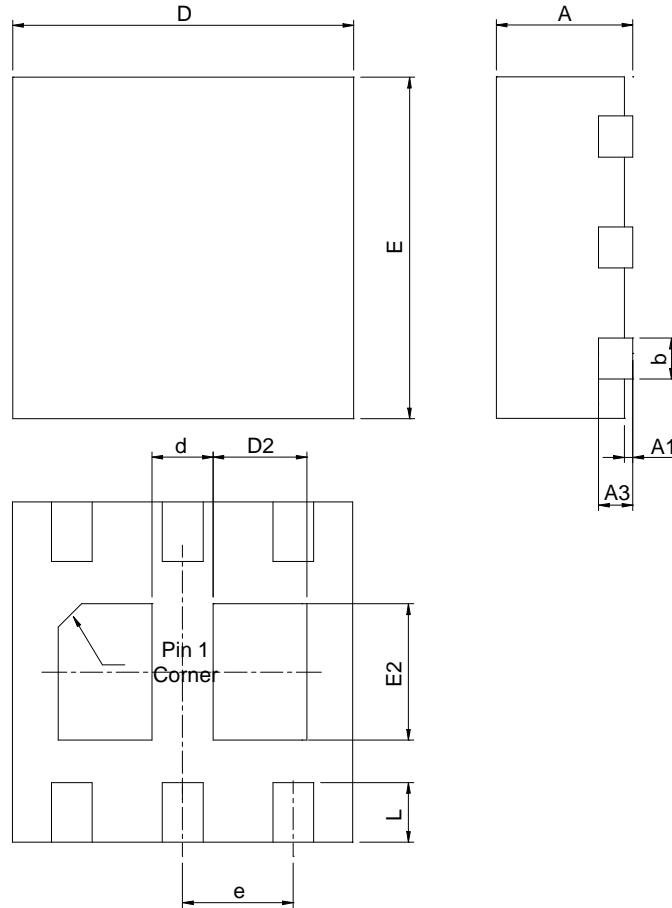
Typical Characteristics (Cont.)

SBD



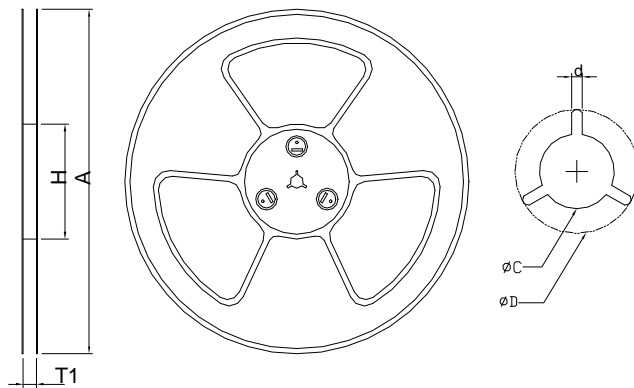
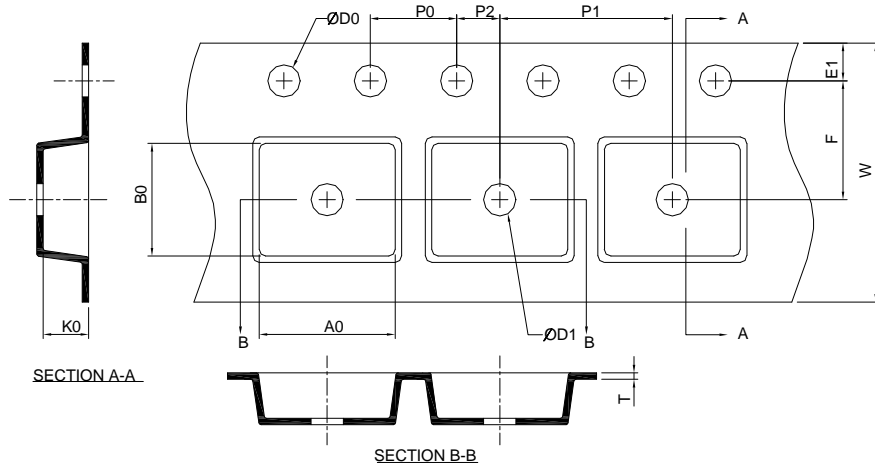
Package Information

TDFN2x2-6A



| SYMBOL | TDFN2x2-6A | | | |
|--------|-------------|------|-----------|-------|
| | MILLIMETERS | | INCHES | |
| | MIN. | MAX. | MIN. | MAX. |
| A | 0.70 | 0.80 | 0.028 | 0.031 |
| A1 | 0.00 | 0.05 | 0.000 | 0.002 |
| A3 | 0.20 REF | | 0.008 REF | |
| b | 0.18 | 0.30 | 0.007 | 0.012 |
| D | 1.90 | 2.10 | 0.075 | 0.083 |
| D2 | 0.50 | 0.60 | 0.020 | 0.024 |
| E | 1.90 | 2.10 | 0.075 | 0.083 |
| E2 | 0.70 | 0.90 | 0.028 | 0.035 |
| e | 0.65 BSC | | 0.026 BSC | |
| L | 0.30 | 0.45 | 0.012 | 0.018 |
| d | 0.35 REF | | 0.014 REF | |

Carrier Tape & Reel Dimensions



| Application | A | H | T1 | C | d | D | W | E1 | F |
|-------------|-------------|-----------|-------------------|--------------------|----------|------------------|-----------|------------|------------|
| TDFN2x2-6A | 178.0 ±2.00 | 50 MIN. | 8.4+2.00 -0.00 | 13.0+0.50 -0.20 | 1.5 MIN. | 20.2 MIN. | 8.0 ±0.20 | 1.75 ±0.10 | 3.50 ±0.05 |
| | P0 | P1 | P2 | D0 | D1 | T | A0 | B0 | K0 |
| | 4.0 ±0.10 | 4.0 ±0.10 | 2.0 ±0.05 | 1.5+0.10 -0.00 | 1.5 MIN. | 0.6+0.00 -0.4 | 2.35 MIN | 2.35 MIN | 1.30 ±0.20 |

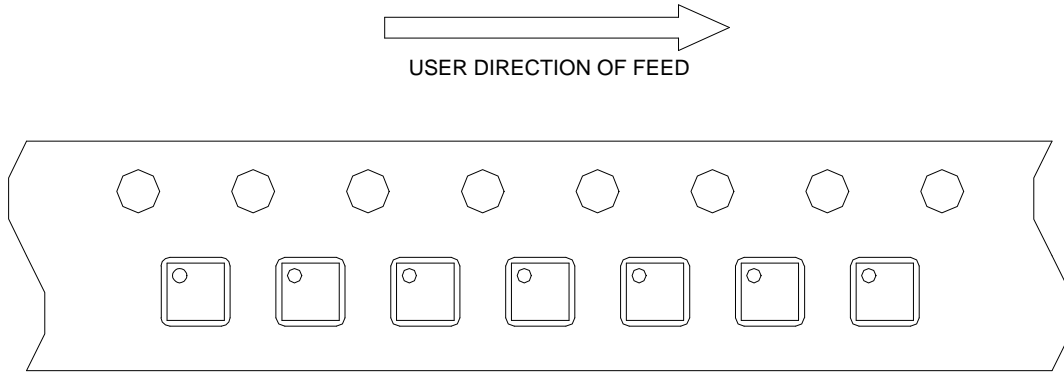
(mm)

Devices Per Unit

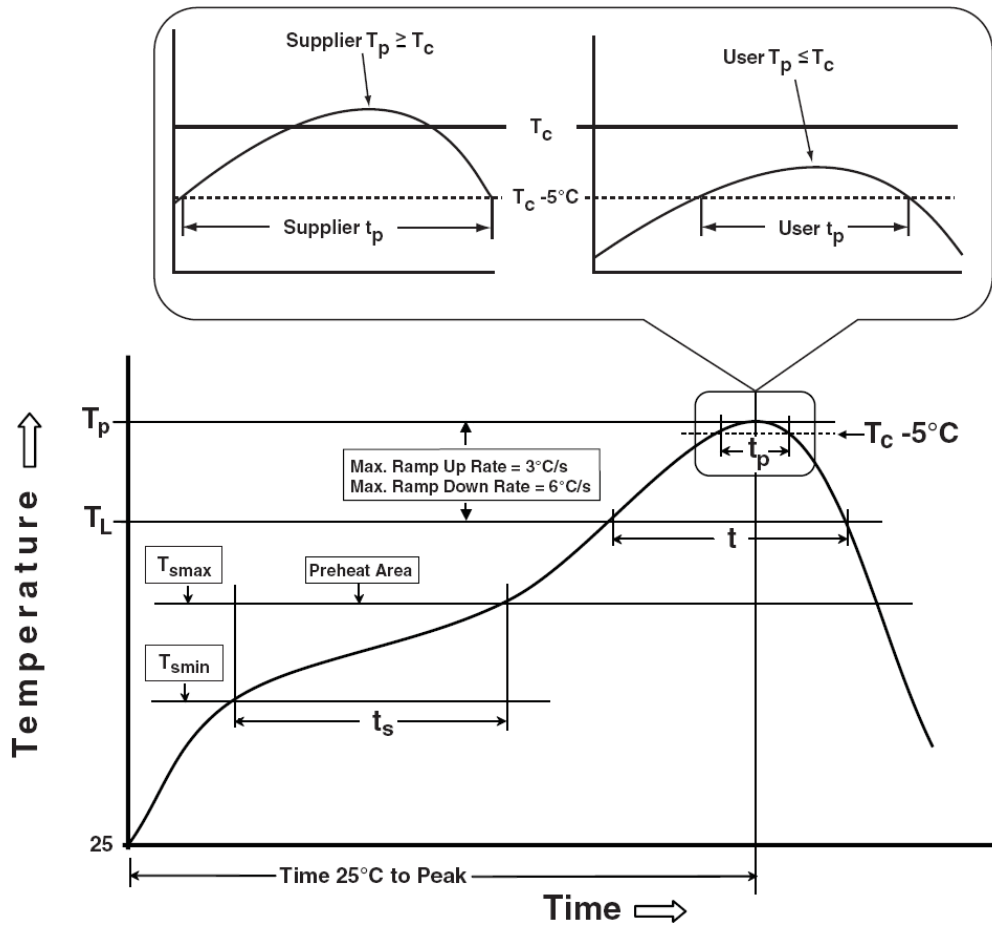
| Package Type | Unit | Quantity |
|--------------|-------------|----------|
| TDFN2x2-6A | Tape & Reel | 3000 |

Taping Direction Information

TDFN2x2-6A



Classification Profile



Classification Reflow Profiles

| Profile Feature | Sn-Pb Eutectic Assembly | Pb-Free Assembly |
|--|------------------------------------|------------------------------------|
| Preheat & Soak | | |
| Temperature min (T_{smin}) | 100 °C | 150 °C |
| Temperature max (T_{smax}) | 150 °C | 200 °C |
| Time (T_{smin} to T_{smax}) (t_s) | 60-120 seconds | 60-120 seconds |
| Average ramp-up rate (T_{smax} to T_p) | 3 °C/second max. | 3°C/second max. |
| Liquidous temperature (T_L) | 183 °C | 217 °C |
| Time at liquidous (t_L) | 60-150 seconds | 60-150 seconds |
| Peak package body Temperature (T_p)* | See Classification Temp in table 1 | See Classification Temp in table 2 |
| Time (t_p)** within 5°C of the specified classification temperature (T_c) | 20** seconds | 30** seconds |
| Average ramp-down rate (T_p to T_{smax}) | 6 °C/second max. | 6 °C/second max. |
| Time 25°C to peak temperature | 6 minutes max. | 8 minutes max. |
| * Tolerance for peak profile Temperature (T_p) is defined as a supplier minimum and a user maximum. | | |
| ** Tolerance for time at peak profile temperature (t_p) is defined as a supplier minimum and a user maximum. | | |

Table 1. SnPb Eutectic Process – Classification Temperatures (T_c)

| Package Thickness | Volume mm ³ <350 | Volume mm ³ ≥350 |
|-------------------|-----------------------------|-----------------------------|
| <2.5 mm | 235 °C | 220 °C |
| ≥2.5 mm | 220 °C | 220 °C |

Table 2. Pb-free Process – Classification Temperatures (T_c)

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

Reliability Test Program

| Test item | Method | Description |
|---------------|---------------|------------------------------|
| SOLDERABILITY | JESD-22, B102 | 5 Sec, 245°C |
| HOLT | JESD-22, A108 | 1000 Hrs, Bias @ 125°C |
| PCT | JESD-22, A102 | 168 Hrs, 100%RH, 2atm, 121°C |
| TCT | JESD-22, A104 | 500 Cycles, -65°C~150°C |

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