# N-Channel NexFET™ Power MOSFET

**Check for Samples: CSD16321Q5**

## FEATURES

- **Optimized for 5V Gate Drive**
- **Ultra Low Qg and Qgd**
- **Low Thermal Resistance**
- **Avalanche Rated**
- **Pb Free Terminal Plating**
- **RoHS Compliant**
- **SON 5mm × 6mm Plastic Package**

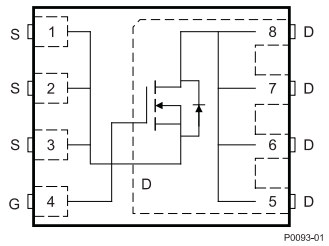
## APPLICATIONS

- **Point-of-Load Synchronous Buck Converter for Applications in Networking, Telecom and Computing Systems**
- **Optimized for Synchronous FET Applications**

## DESCRIPTION

The NexFET™ power MOSFET has been designed to minimize losses in power conversion applications.

**Top View**




## PRODUCT SUMMARY

| | | | | |
|---|---|---|---|---|
| $V_{DS}$ | Drain to Source Voltage | 25 | | V |
| $Q_g$ | Gate Charge Total (4.5V) | 14 | | nC |
| $Q_{gd}$ | Gate Charge Gate to Drain | 2.5 | | nC |
| $R_{DS(on)}$ | Drain to Source On Resistance | $V_{GS}$ = 3V | 2.8 | mΩ |
| | | $V_{GS}$ = 4.5V | 2.1 | mΩ |
| | | $V_{GS}$ = 8V | 1.9 | mΩ |
| $V_{GS(th)}$ | Threshold Voltage | 1.1 | | V |

## ORDERING INFORMATION

| Device | Package | Media | Qty | Ship |
|---|---|---|---|---|
| CSD16321Q5 | SON 5 × 6 Plastic Package | 13-inch reel | 2500 | Tape and Reel |

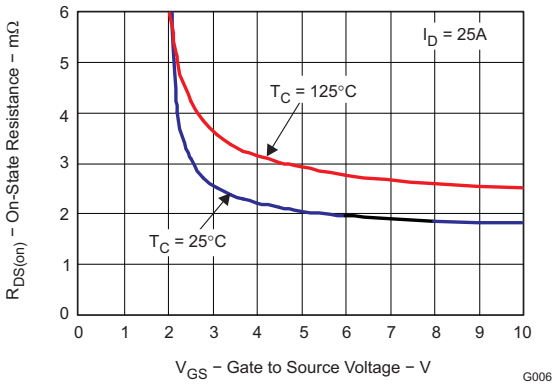
## ABSOLUTE MAXIMUM RATINGS

| $T_A$ = 25°C unless otherwise stated | | VALUE | UNIT |
|---|---|---|---|
| $V_{DS}$ | Drain to Source Voltage | 25 | V |
| $V_{GS}$ | Gate to Source Voltage | +10 / –8 | V |
| $I_D$ | Continuous Drain Current, $T_C$ = 25°C | 100 | A |
| | Continuous Drain Current(1) | 31 | A |
| $I_{DM}$ | Pulsed Drain Current, $T_A$ = 25°C(2) | 200 | A |
| $P_D$ | Power Dissipation(1) | 3.1 | W |
| $T_J$, $T_{STG}$ | Operating Junction and Storage Temperature Range | –55 to 150 | °C |
| $E_{AS}$ | Avalanche Energy, single pulse $I_D$ = 66A, L = 0.1mH, $R_G$ = 25Ω | 218 | mJ |

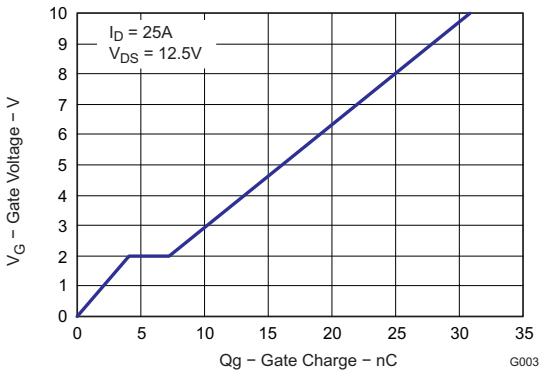
(1) Typical $R_{\theta JA}$ = 39°C/W on 1in$^2$ Cu (2 oz.) on 0.060" thick FR4 PCB.

(2) Pulse width ≤300μs, duty cycle ≤2%

**$R_{DS(ON)}$ vs $V_{GS}$**




**Gate Charge**

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NexFET is a trademark of Texas Instruments.

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

## ELECTRICAL CHARACTERISTICS

($T_A$ = 25°C unless otherwise stated)

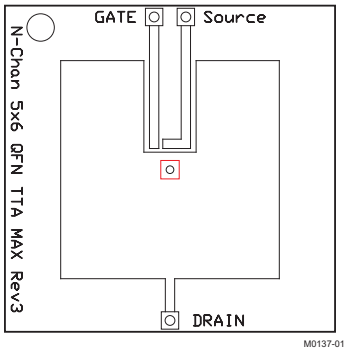
| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| **Static Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain to Source Voltage | $V_{GS}$ = 0V, $I_D$ = 250µA | 25 | | | V |
| $I_{DSS}$ | Drain to Source Leakage Current | $V_{GS}$ = 0V, $V_{DS}$ = 20V | | | 1 | µA |
| $I_{GSS}$ | Gate to Source Leakage Current | $V_{DS}$ = 0V, $V_{GS}$ = +10 / -8V | | | 100 | nA |
| $V_{GS(th)}$ | Gate to Source Threshold Voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250µA | 0.9 | 1.1 | 1.4 | V |
| $R_{DS(on)}$ | Drain to Source On Resistance | $V_{GS}$ = 3V, $I_D$ = 25A | | 2.8 | 3.8 | mΩ |
| | | $V_{GS}$ = 4.5V, $I_D$ = 25A | | 2.1 | 2.6 | mΩ |
| | | $V_{GS}$ = 8V, $I_D$ = 25A | | 1.9 | 2.4 | mΩ |
| $g_{fs}$ | Transconductance | $V_{DS}$ = 12.5V, $I_D$ = 25A | | 150 | | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{GS}$ = 0V, $V_{DS}$ = 12.5V, f = 1MHz | | 2360 | 3100 | pF |
| $C_{oss}$ | Output Capacitance | | | 1700 | 2200 | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 115 | 150 | pF |
| $R_G$ | Series Gate Resistance | | | 1.5 | 3 | Ω |
| $Q_g$ | Gate Charge Total (4.5V) | $V_{DS}$ = 12.5V, $I_D$ = 25A | | 14 | 19 | nC |
| $Q_{gd}$ | Gate Charge Gate to Drain | | | 2.5 | | nC |
| $Q_{gs}$ | Gate Charge Gate to Source | | | 4 | | nC |
| $Q_{g(th)}$ | Gate Charge at Vth | | | 2.1 | | nC |
| $Q_{oss}$ | Output Charge | $V_{DS}$ = 15V, $V_{GS}$ = 0V | | 36 | | nC |
| $t_{d(on)}$ | Turn On Delay Time | $V_{DS}$ = 12.5V, $V_{GS}$ = 4.5V, $I_D$ = 25A, $R_G$ = 2Ω | | 9 | | ns |
| $t_r$ | Rise Time | | | 15 | | ns |
| $t_{d(off)}$ | Turn Off Delay Time | | | 27 | | ns |
| $t_f$ | Fall Time | | | 17 | | ns |
| **Diode Characteristics** | | | | | | |
| $V_{SD}$ | Diode Forward Voltage | $I_{SD}$ = 25A, $V_{GS}$ = 0V | | 0.8 | 1 | V |
| $Q_{rr}$ | Reverse Recovery Charge | $V_{DD}$ = 13V, $I_F$ = 25A, di/dt = 300A/µs | | 33 | | nC |
| $t_{rr}$ | Reverse Recovery Time | $V_{DD}$ = 13V, $I_F$ = 25A, di/dt = 300A/µs | | 32 | | ns |

## THERMAL CHARACTERISTICS

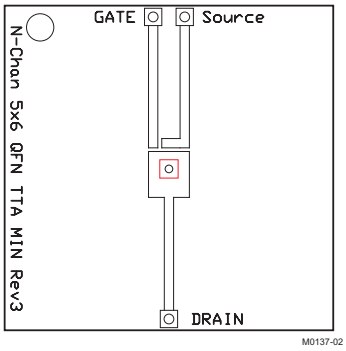
($T_A$ = 25°C unless otherwise stated)

| PARAMETER | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance Junction to Case(1) | | | 1.1 | °C/W |
| $R_{\theta JA}$ | Thermal Resistance Junction to Ambient(1) (2) | | | 48 | °C/W |

(1) $R_{\theta JC}$ is determined with the device mounted on a 1 inch square 2 oz. Cu pad on a 1.5 × 1.5 in .060 inch thick FR4 board. $R_{\theta JC}$ is specified by design while $R_{\theta JA}$ is determined by the user's board design.
(2) Device mounted on FR4 Material with 1 $inch^2$ of 2 oz. Cu.




Max $R_{\theta JA}$ = 48°C/W when mounted on 1 inch$^2$ of 2 oz. Cu.




Max $R_{\theta JA}$ = 115°C/W when mounted on minimum pad area of 2 oz. Cu.

## TYPICAL MOSFET CHARACTERISTICS

($T_A$ = 25°C unless otherwise stated)

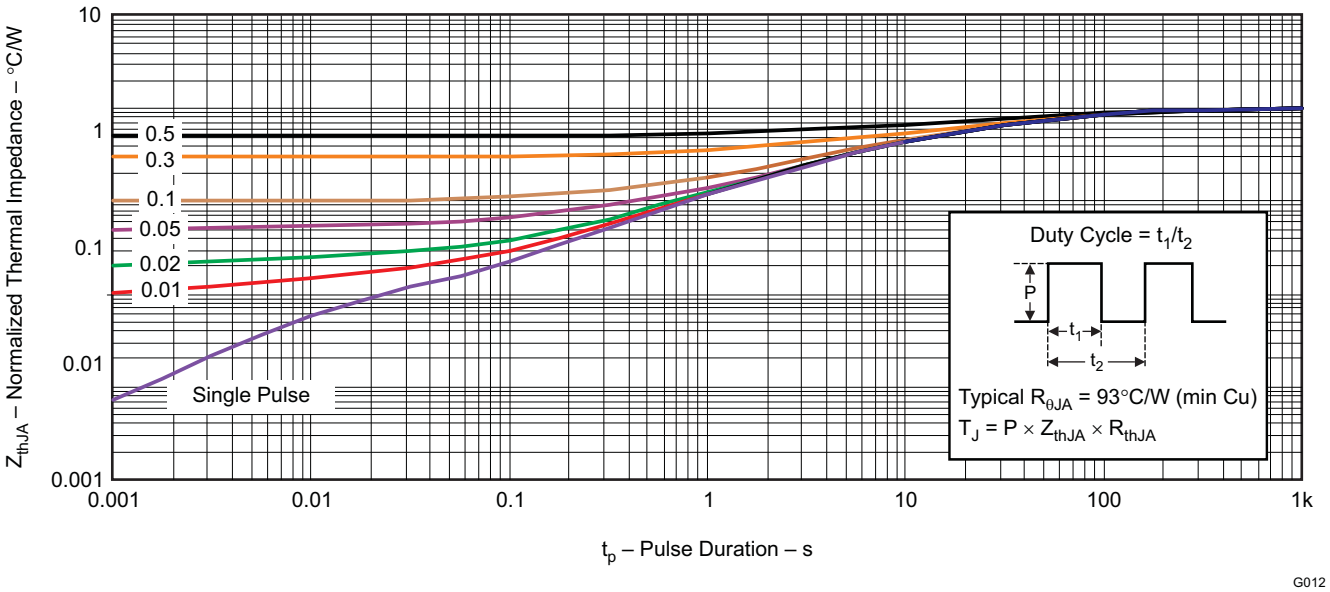



**Figure 1. Transient Thermal Impedance**

## TYPICAL MOSFET CHARACTERISTICS (continued)

($T_A$ = 25°C unless otherwise stated)

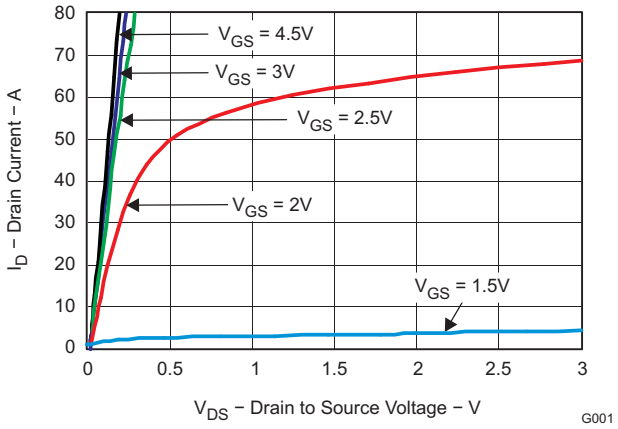



**Figure 2. Saturation Characteristics**

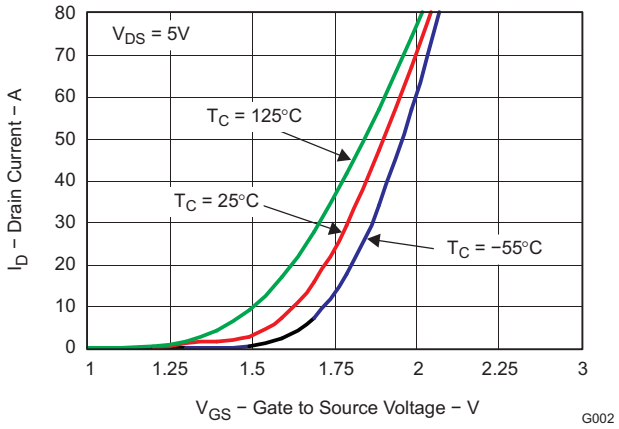



**Figure 3. Transfer Characteristics**

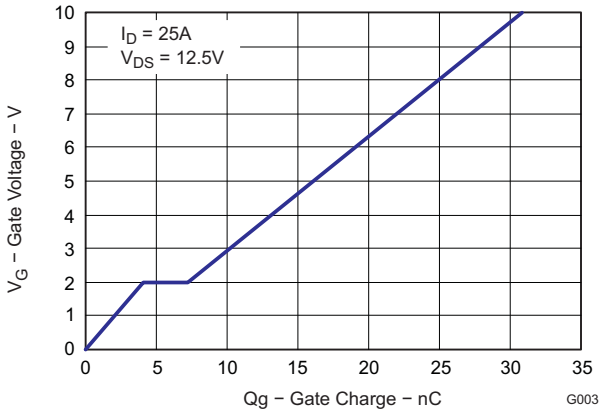



**Figure 4. Gate Charge**

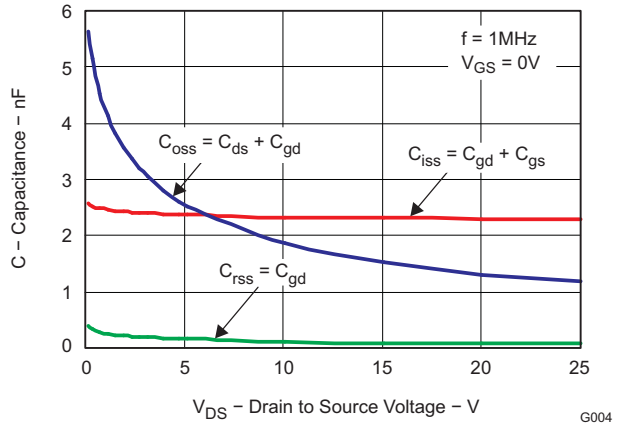



**Figure 5. Capacitance**

## TYPICAL MOSFET CHARACTERISTICS (continued)

($T_A$ = 25°C unless otherwise stated)

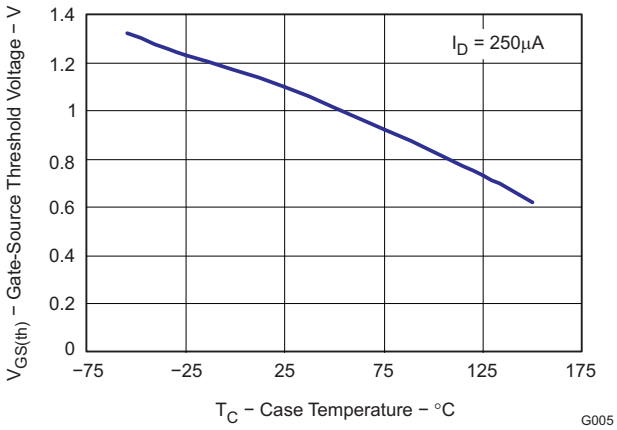



**Figure 6. Threshold Voltage vs. Temperature**

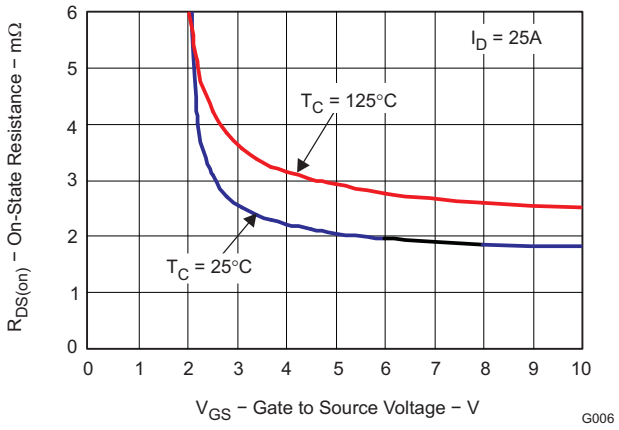



**Figure 7. On Resistance vs. Gate Voltage**

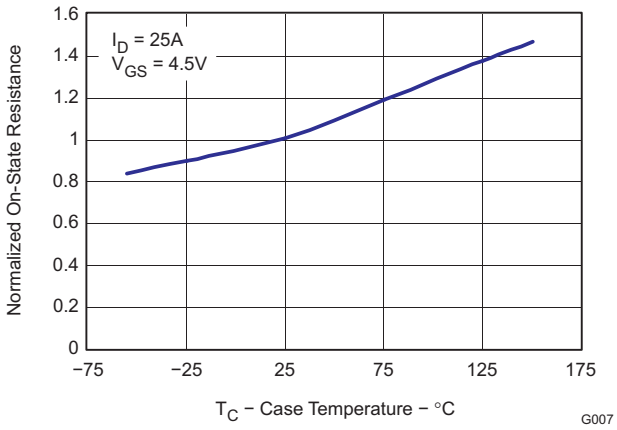



**Figure 8. On Resistance vs. Temperature**

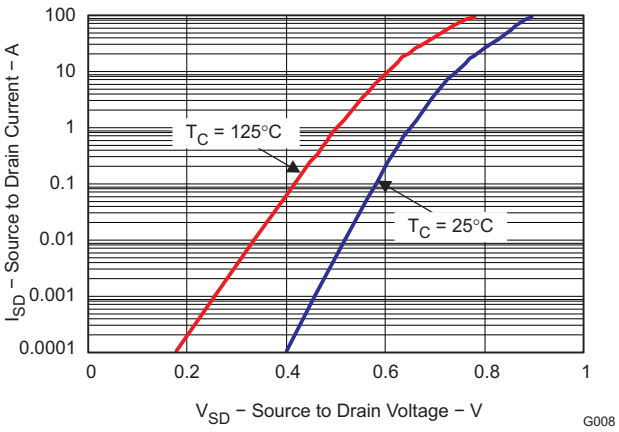



**Figure 9. Typical Diode Forward Voltage**

## TYPICAL MOSFET CHARACTERISTICS (continued)

($T_A$ = 25°C unless otherwise stated)

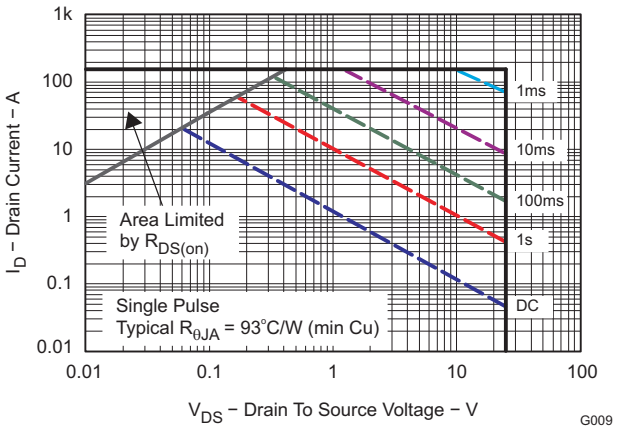



**Figure 10. Maximum Safe Operating Area**

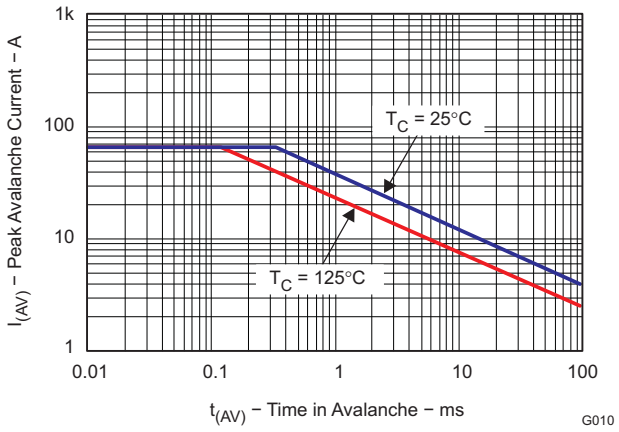



**Figure 11. Single Pulse Unclamped Inductive Switching**

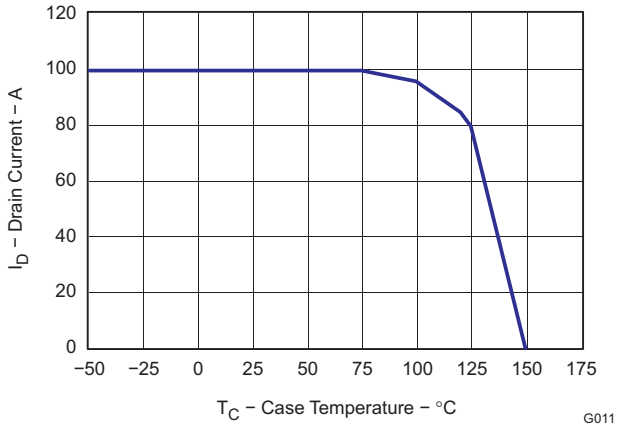
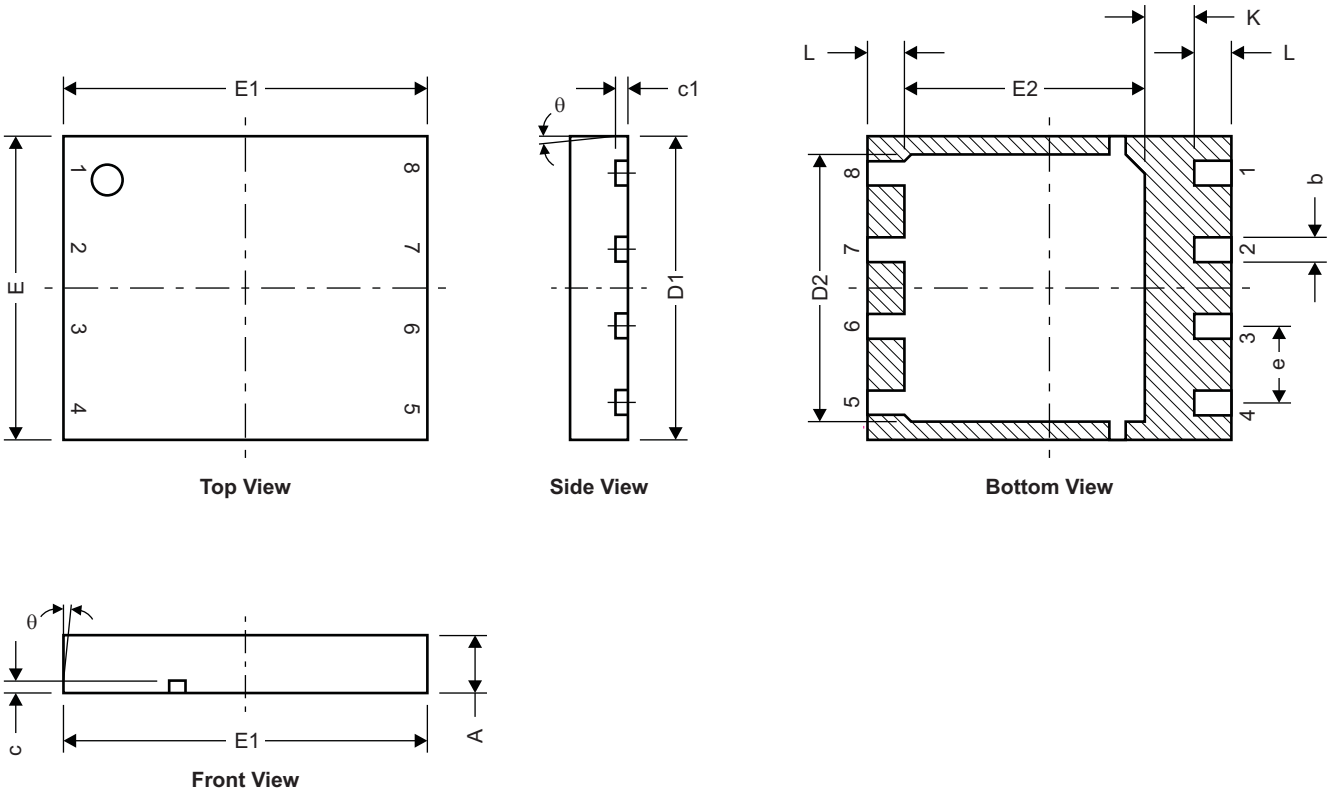



**Figure 12. Maximum Drain Current vs. Temperature**

# MECHANICAL DATA

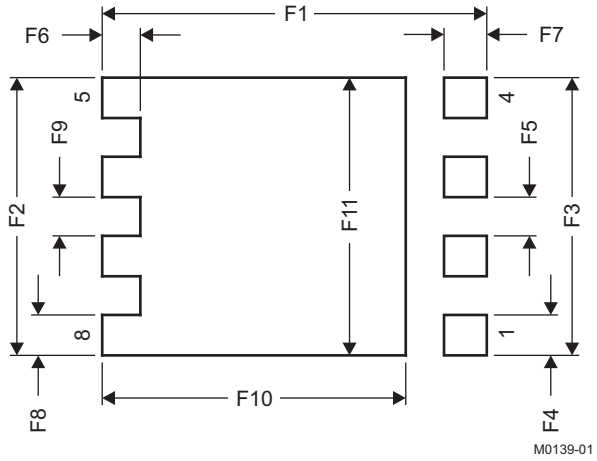
## Q5 Package Dimensions




M0140-01

| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 0.950 | 1.050 | 0.037 | 0.039 |
| b | 0.360 | 0.460 | 0.014 | 0.018 |
| c | 0.150 | 0.250 | 0.006 | 0.010 |
| c1 | 0.150 | 0.250 | 0.006 | 0.010 |
| D1 | 4.900 | 5.100 | 0.193 | 0.201 |
| D2 | 4.320 | 4.520 | 0.170 | 0.178 |
| E | 4.900 | 5.100 | 0.193 | 0.201 |
| E1 | 5.900 | 6.100 | 0.232 | 0.240 |
| E2 | 3.920 | 4.12 | 0.154 | 0.162 |
| e | 1.27 TYP | | 0.050 | |
| K | 0.760 | | 0.030 | |
| L | 0.510 | 0.710 | 0.020 | 0.028 |
| θ | 0.00 | | | |

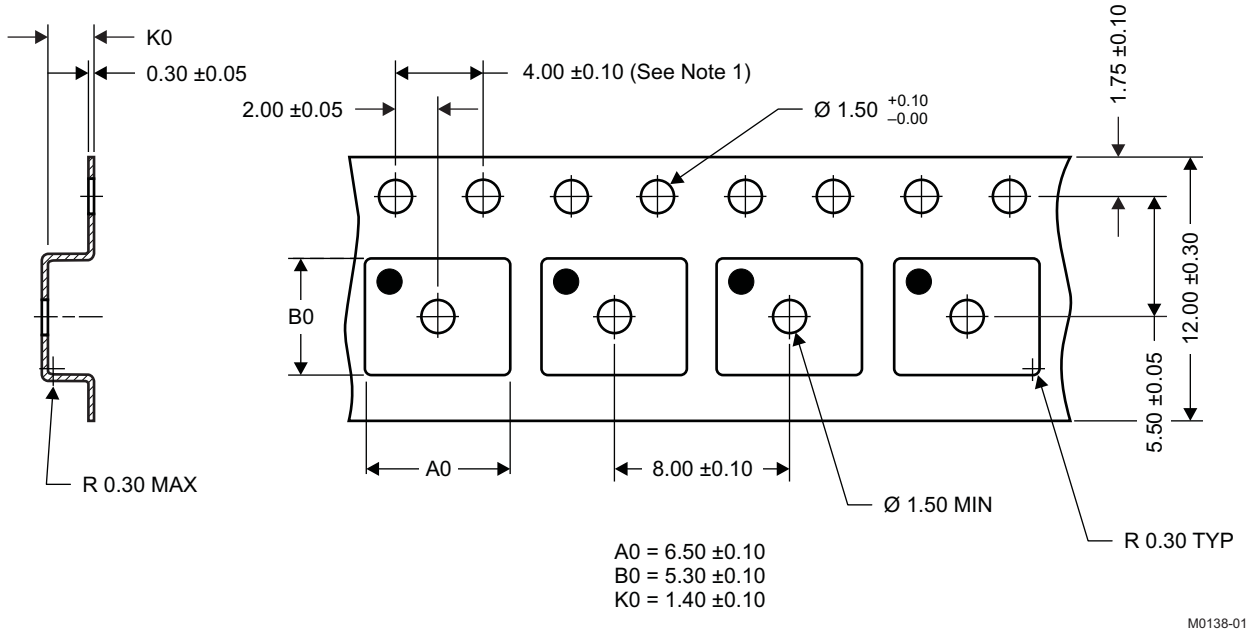
**Recommended PCB Pattern**




| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| F1 | 6.205 | 6.305 | 0.244 | 0.248 |
| F2 | 4.460 | 4.560 | 0.176 | 0.180 |
| F3 | 4.460 | 4.560 | 0.176 | 0.180 |
| F4 | 0.650 | 0.700 | 0.026 | 0.028 |
| F5 | 0.620 | 0.670 | 0.024 | 0.026 |
| F6 | 0.630 | 0.680 | 0.025 | 0.027 |
| F7 | 0.700 | 0.800 | 0.028 | 0.031 |
| F8 | 0.650 | 0.700 | 0.026 | 0.028 |
| F9 | 0.620 | 0.670 | 0.024 | 0.026 |
| F10 | 4.900 | 5.000 | 0.193 | 0.197 |
| F11 | 4.460 | 4.560 | 0.176 | 0.180 |

For recommended circuit layout for PCB designs, see application note SLPA005 – *Reducing Ringing Through PCB Layout Techniques*.

## Q5 Tape and Reel Information




**Notes:**

1. 10 sprocket hole pitch cumulative tolerance ±0.2
2. Camber not to exceed 1mm IN 100mm, noncumulative over 250mm
3. Material:black static dissipative polystyrene
4. All dimensions are in mm (unless otherwise specified)
5. ThickNess: 0.30 ±0.05mm
6. MSL1 260°C (IR and Convection) PbF Reflow Compatible

# REVISION HISTORY

**Changes from Original (August 2009) to Revision A** **Page**

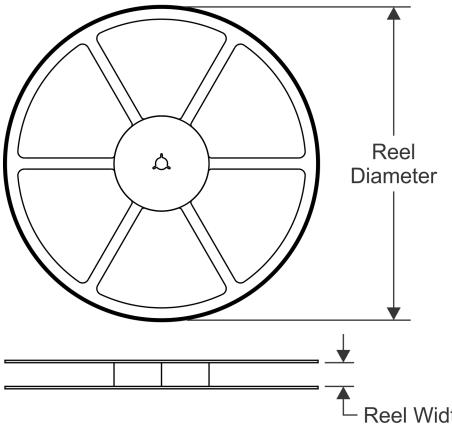
- Changed the labels on the Top View pinout image ..... 1
- Changed Note 1 of the ABSOLUTE MAXIMUM RATINGS From: $R_{\theta JA}$ = 39°C/W To: Typical $R_{\theta JA}$ = 39°C/W ..... 1
- Changed Figure 1 text From: $R_{\theta JA}$ = 92°C/W To: Typical $R_{\theta JA}$ = 93°C/W ..... 3
- Changed Figure 10 text From: $R_{\theta JA}$ = 92°C/W To: Typical $R_{\theta JA}$ = 93°C/W ..... 6
- Changed Figure 11 X-axis values ..... 6

**Changes from Revision A (Jaunary 2010) to Revision B** **Page**

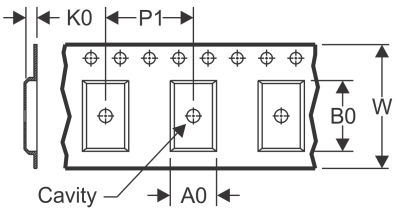
- Changed $R_{DS(on)}$ - $V_{GS}$ = 3V, $I_D$ = 25A MAX value From: 3.5 To: 3.8 ..... 2
- Deleted the Package Marking Information section ..... 8

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

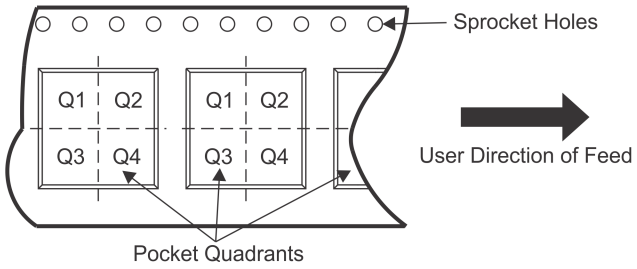



**TAPE DIMENSIONS**




| | |
|---|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

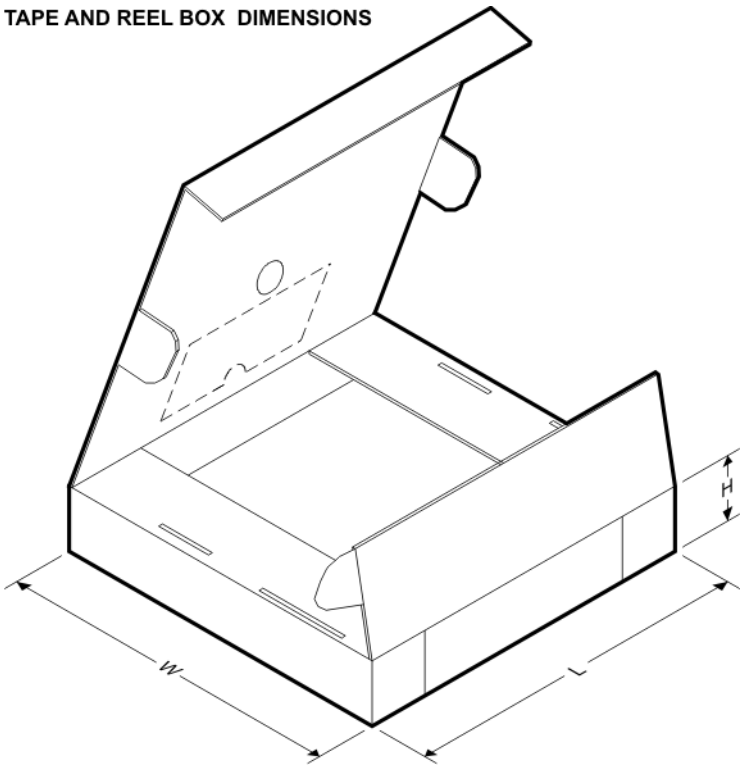
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**




*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CSD16321Q5 | VSON-CLIP | DQH | 8 | 2500 | 330.0 | 12.8 | 6.5 | 5.3 | 1.4 | 8.0 | 12.0 | Q1 |

**TAPE AND REEL BOX DIMENSIONS**




*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| CSD16321Q5 | VSON-CLIP | DQH | 8 | 2500 | 335.0 | 335.0 | 32.0 |

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| **Products** | | **Applications** | |
|---|---|---|---|
| Audio | www.ti.com/audio | Automotive and Transportation | www.ti.com/automotive |
| Amplifiers | amplifier.ti.com | Communications and Telecom | www.ti.com/communications |
| Data Converters | dataconverter.ti.com | Computers and Peripherals | www.ti.com/computers |
| DLP® Products | www.dlp.com | Consumer Electronics | www.ti.com/consumer-apps |
| DSP | dsp.ti.com | Energy and Lighting | www.ti.com/energy |
| Clocks and Timers | www.ti.com/clocks | Industrial | www.ti.com/industrial |
| Interface | interface.ti.com | Medical | www.ti.com/medical |
| Logic | logic.ti.com | Security | www.ti.com/security |
| Power Mgmt | power.ti.com | Space, Avionics and Defense | www.ti.com/space-avionics-defense |
| Microcontrollers | microcontroller.ti.com | Video and Imaging | www.ti.com/video |
| RFID | www.ti-rfid.com | | |
| OMAP Applications Processors | www.ti.com/omap | **TI E2E Community** | e2e.ti.com |
| Wireless Connectivity | www.ti.com/wirelessconnectivity | | |

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