

# N-Channel NexFET™ Power MOSFET

Check for Samples: [CSD16414Q5](#)

## FEATURES

- Ultra Low Qg and Qgd
- Low Thermal Resistance
- Avalanche Rated
- Pb Free Terminal Plating
- RoHS Compliant
- Halogen Free
- SON 5mm × 6mm Plastic Package

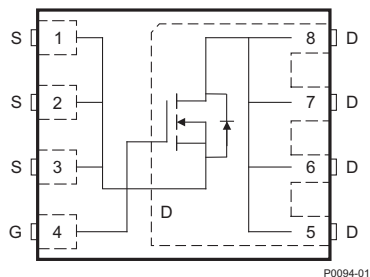
## APPLICATIONS

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

## DESCRIPTION

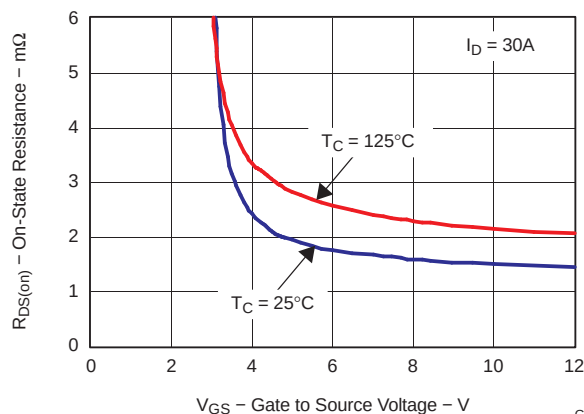
The NexFET™ power MOSFET has been designed to minimize losses in power conversion applications.

Top View



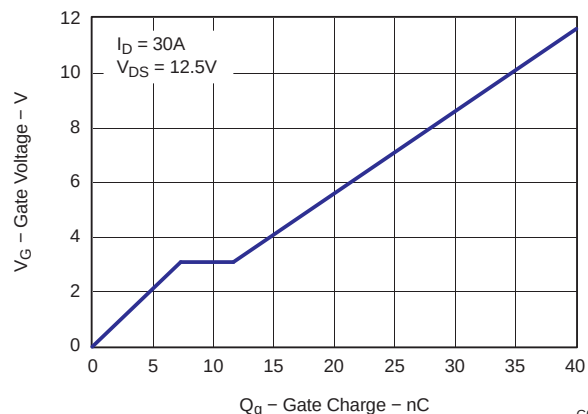
P0094-01

R<sub>DS(on)</sub> vs V<sub>GS</sub>



G006

Gate Charge



G003

## PRODUCT SUMMARY

|                     |                               |                        |        |
|---------------------|-------------------------------|------------------------|--------|
| V <sub>DS</sub>     | Drain to Source Voltage       | 25                     | V      |
| Q <sub>g</sub>      | Gate Charge Total (4.5V)      | 16.6                   | nC     |
| Q <sub>gd</sub>     | Gate Charge Gate to Drain     | 4.4                    | nC     |
| R <sub>DS(on)</sub> | Drain to Source On Resistance | V <sub>GS</sub> = 4.5V | 2.1 mΩ |
|                     |                               | V <sub>GS</sub> = 10V  | 1.5 mΩ |
| V <sub>GS(th)</sub> | Threshold Voltage             | 1.6                    | V      |

## ORDERING INFORMATION

| Device     | Package                   | Media        | Qty  | Ship          |
|------------|---------------------------|--------------|------|---------------|
| CSD16414Q5 | SON 5 × 6 Plastic Package | 13-inch reel | 2500 | Tape and Reel |

## ABSOLUTE MAXIMUM RATINGS

|                                               |                                                                                          |            |      |
|-----------------------------------------------|------------------------------------------------------------------------------------------|------------|------|
| T <sub>A</sub> = 25°C unless otherwise stated |                                                                                          | VALUE      | UNIT |
| V <sub>DS</sub>                               | Drain to Source Voltage                                                                  | 25         | V    |
| V <sub>GS</sub>                               | Gate to Source Voltage                                                                   | +16 / -12  | V    |
| I <sub>D</sub>                                | Continuous Drain Current, T <sub>C</sub> = 25°C                                          | 100        | A    |
|                                               | Continuous Drain Current <sup>(1)</sup>                                                  | 34         | A    |
| I <sub>DM</sub>                               | Pulsed Drain Current, T <sub>A</sub> = 25°C <sup>(2)</sup>                               | 213        | A    |
| P <sub>D</sub>                                | Power Dissipation <sup>(1)</sup>                                                         | 3.2        | W    |
| T <sub>J</sub> , T <sub>STG</sub>             | Operating Junction and Storage Temperature Range                                         | -55 to 150 | °C   |
| E <sub>AS</sub>                               | Avalanche Energy, single pulse<br>I <sub>D</sub> = 100A, L = 0.1mH, R <sub>G</sub> = 25Ω | 500        | mJ   |

(1) R<sub>θJA</sub> = 39°C/W on 1in<sup>2</sup> Cu (2 oz.) on 0.060" thick FR4 PCB.

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



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NexFET is a trademark of Texas Instruments.

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## ELECTRICAL CHARACTERISTICS

(T<sub>A</sub> = 25°C unless otherwise stated)

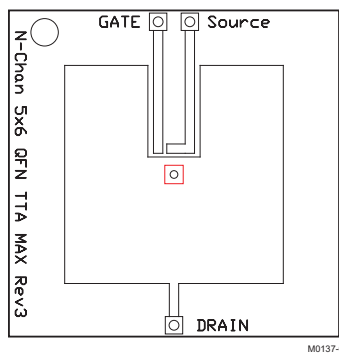
| PARAMETER               |                                  | TEST CONDITIONS                                                                              | MIN  | TYP  | MAX | UNIT |
|-------------------------|----------------------------------|----------------------------------------------------------------------------------------------|------|------|-----|------|
| Static Characteristics  |                                  |                                                                                              |      |      |     |      |
| BV <sub>DSS</sub>       | Drain to Source Voltage          | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA                                                 | 25   |      |     | V    |
| I <sub>DSS</sub>        | Drain to Source Leakage Current  | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 20V                                                  |      |      | 1   | μA   |
| I <sub>GSS</sub>        | Gate to Source Leakage Current   | V <sub>DS</sub> = 0V, V <sub>GS</sub> = +16/−12V                                             |      |      | 100 | nA   |
| V <sub>GS(th)</sub>     | Gate to Source Threshold Voltage | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA                                   | 1.3  | 1.6  | 2   | V    |
| R <sub>DS(on)</sub>     | Drain to Source On Resistance    | V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 30A                                                 |      | 2.1  | 2.6 | mΩ   |
|                         |                                  | V <sub>GS</sub> = 10V, I <sub>D</sub> = 30A                                                  |      | 1.5  | 1.9 | mΩ   |
| g <sub>fs</sub>         | Transconductance                 | V <sub>DS</sub> = 15V, I <sub>D</sub> = 30A                                                  |      | 138  |     | S    |
| Dynamic Characteristics |                                  |                                                                                              |      |      |     |      |
| C <sub>ISS</sub>        | Input Capacitance                | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 12.5V, f = 1MHz                                      | 2810 | 3650 |     | pF   |
| C <sub>OSS</sub>        | Output Capacitance               |                                                                                              | 2040 | 2650 |     | pF   |
| C <sub>RSS</sub>        | Reverse Transfer Capacitance     |                                                                                              | 140  | 180  |     | pF   |
| R <sub>g</sub>          | Series Gate Resistance           |                                                                                              | 1.4  | 2.8  |     | Ω    |
| Q <sub>g</sub>          | Gate Charge Total (4.5V)         | V <sub>DS</sub> = 12.5V, I <sub>D</sub> = 30A                                                | 16.6 | 21   |     | nC   |
| Q <sub>gd</sub>         | Gate Charge Gate to Drain        |                                                                                              | 4.4  |      |     | nC   |
| Q <sub>gs</sub>         | Gate Charge Gate to Source       |                                                                                              | 7.3  |      |     | nC   |
| Q <sub>g(th)</sub>      | Gate Charge at V <sub>th</sub>   |                                                                                              | 4.5  |      |     | nC   |
| Q <sub>OSS</sub>        | Output Charge                    | V <sub>DS</sub> = 13.5V, V <sub>GS</sub> = 0V                                                | 40   |      |     | nC   |
| t <sub>d(on)</sub>      | Turn On Delay Time               | V <sub>DS</sub> = 12.5V, V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 30A<br>R <sub>G</sub> = 2Ω | 15   |      |     | ns   |
| t <sub>r</sub>          | Rise Time                        |                                                                                              | 24   |      |     | ns   |
| t <sub>d(off)</sub>     | Turn Off Delay Time              |                                                                                              | 18.4 |      |     | ns   |
| t <sub>f</sub>          | Fall Time                        |                                                                                              | 11.1 |      |     | ns   |
| Diode Characteristics   |                                  |                                                                                              |      |      |     |      |
| V <sub>SD</sub>         | Diode Forward Voltage            | I <sub>S</sub> = 30A, V <sub>GS</sub> = 0V                                                   | 0.81 |      | 1   | V    |
| Q <sub>rr</sub>         | Reverse Recovery Charge          | V <sub>dd</sub> = 13.5V, I <sub>F</sub> = 30A, di/dt = 300A/μs                               | 44   |      |     | nC   |
| t <sub>rr</sub>         | Reverse Recovery Time            | V <sub>dd</sub> = 13.5V, I <sub>F</sub> = 30A, di/dt = 300A/μs                               | 35   |      |     | ns   |

## THERMAL CHARACTERISTICS

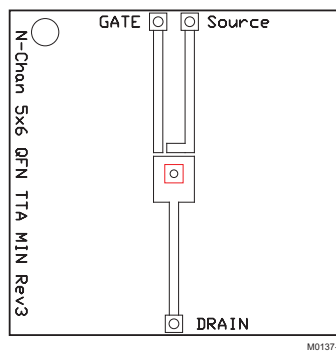
(T<sub>A</sub> = 25°C unless otherwise stated)

| PARAMETER        |                                                           | MIN | TYP | MAX | UNIT |
|------------------|-----------------------------------------------------------|-----|-----|-----|------|
| R <sub>θJC</sub> | Thermal Resistance Junction to Case <sup>(1)</sup>        |     |     | 1.1 | °C/W |
| R <sub>θJA</sub> | Thermal Resistance Junction to Ambient <sup>(1) (2)</sup> |     |     | 50  | °C/W |

- (1) R<sub>θJC</sub> is determined with the device mounted on a 1 inch square 2 oz. Cu pad on a 1.5 × 1.5 in 0.060 inch thick FR4 board. R<sub>θJC</sub> is specified by design while R<sub>θJA</sub> is determined by the user's board design.
- (2) Device mounted on FR4 Material with 1 inch<sup>2</sup> of 2 oz. Cu.



Max  $R_{\theta JA} = 50^{\circ}\text{C/W}$   
when mounted on  
 $1\text{inch}^2$  of 2 oz. Cu.



Max  $R_{\theta JA} = 122^{\circ}\text{C/W}$   
when mounted on  
minimum pad area of 2  
oz. Cu.

## TYPICAL MOSFET CHARACTERISTICS

( $T_A = 25^{\circ}\text{C}$  unless otherwise stated)

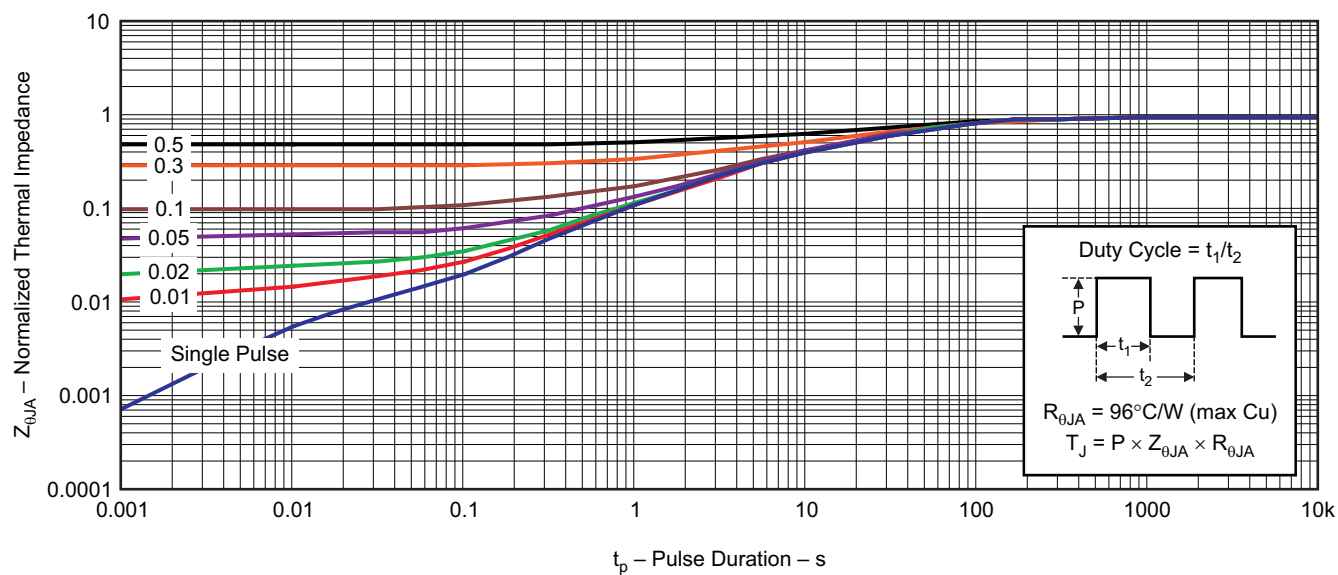


Figure 1. Transient Thermal Impedance

## TYPICAL MOSFET CHARACTERISTICS (continued)

( $T_A = 25^\circ\text{C}$  unless otherwise stated)

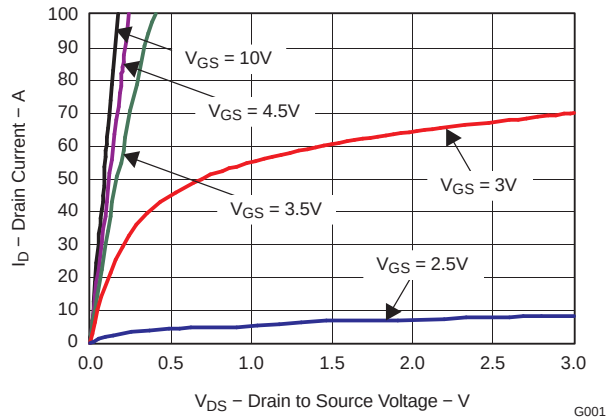


Figure 2. Saturation Characteristics

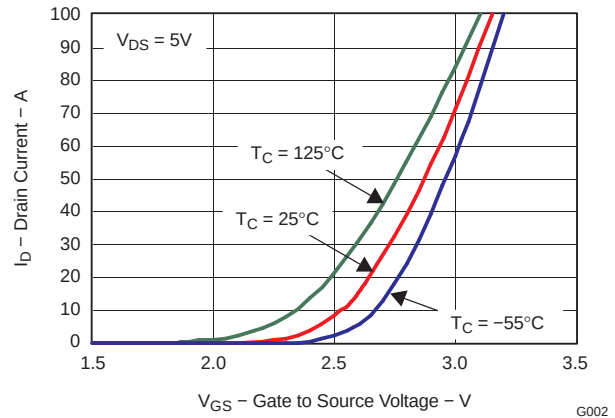


Figure 3. Transfer Characteristics

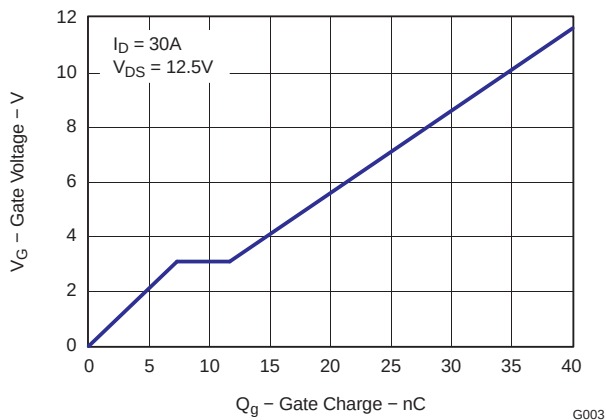


Figure 4. Gate Charge

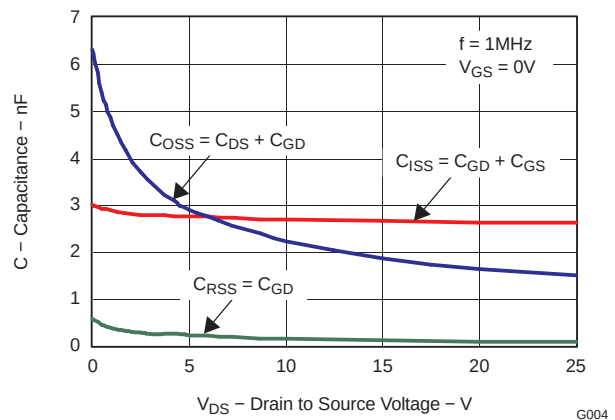


Figure 5. Capacitance

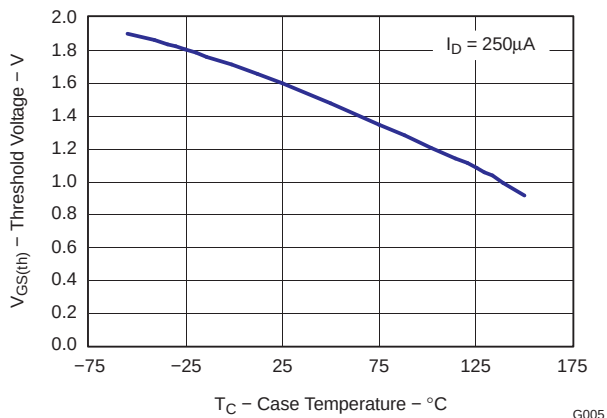


Figure 6. Threshold Voltage vs. Temperature

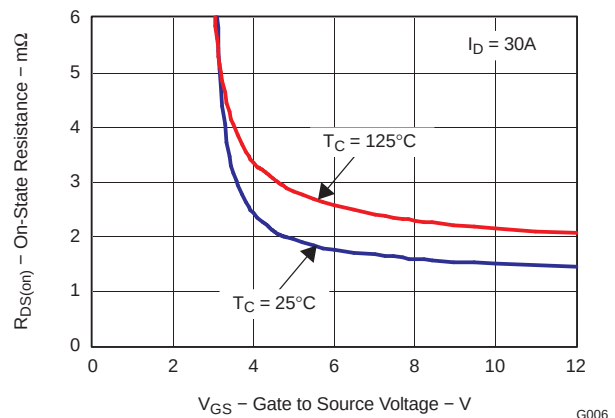
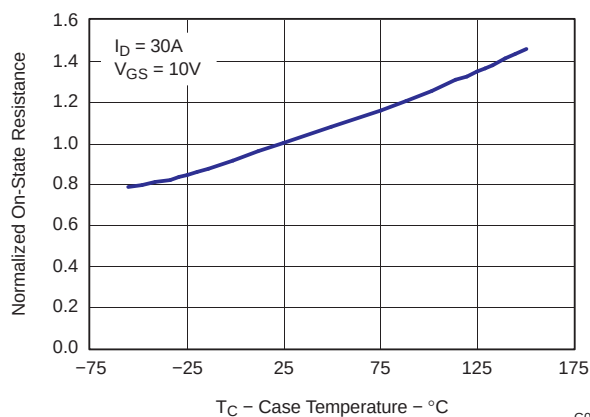


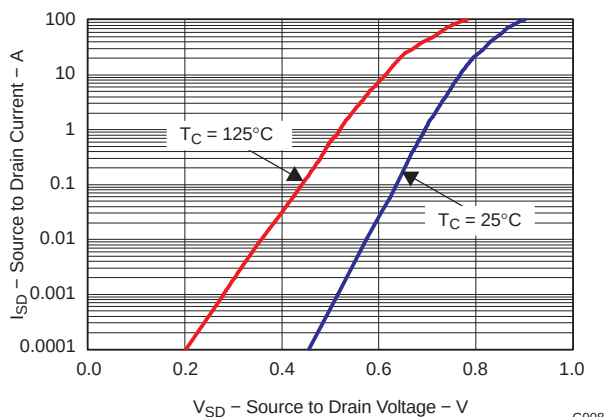
Figure 7. On Resistance vs. Gate Voltage

## TYPICAL MOSFET CHARACTERISTICS (continued)

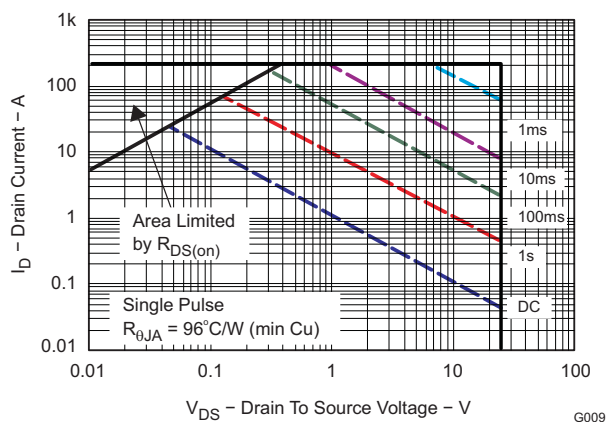
( $T_A = 25^\circ\text{C}$  unless otherwise stated)



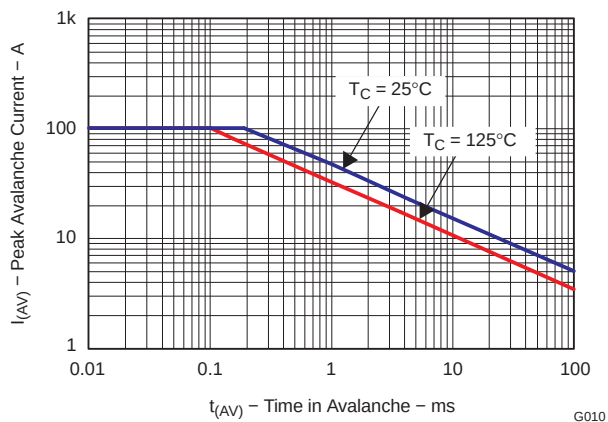
**Figure 8. On Resistance vs. Temperature**



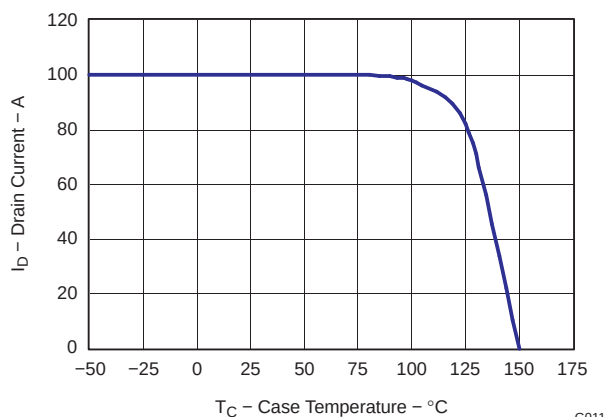
**Figure 9. Typical Diode Forward Voltage**



**Figure 10. Maximum Safe Operating Area**



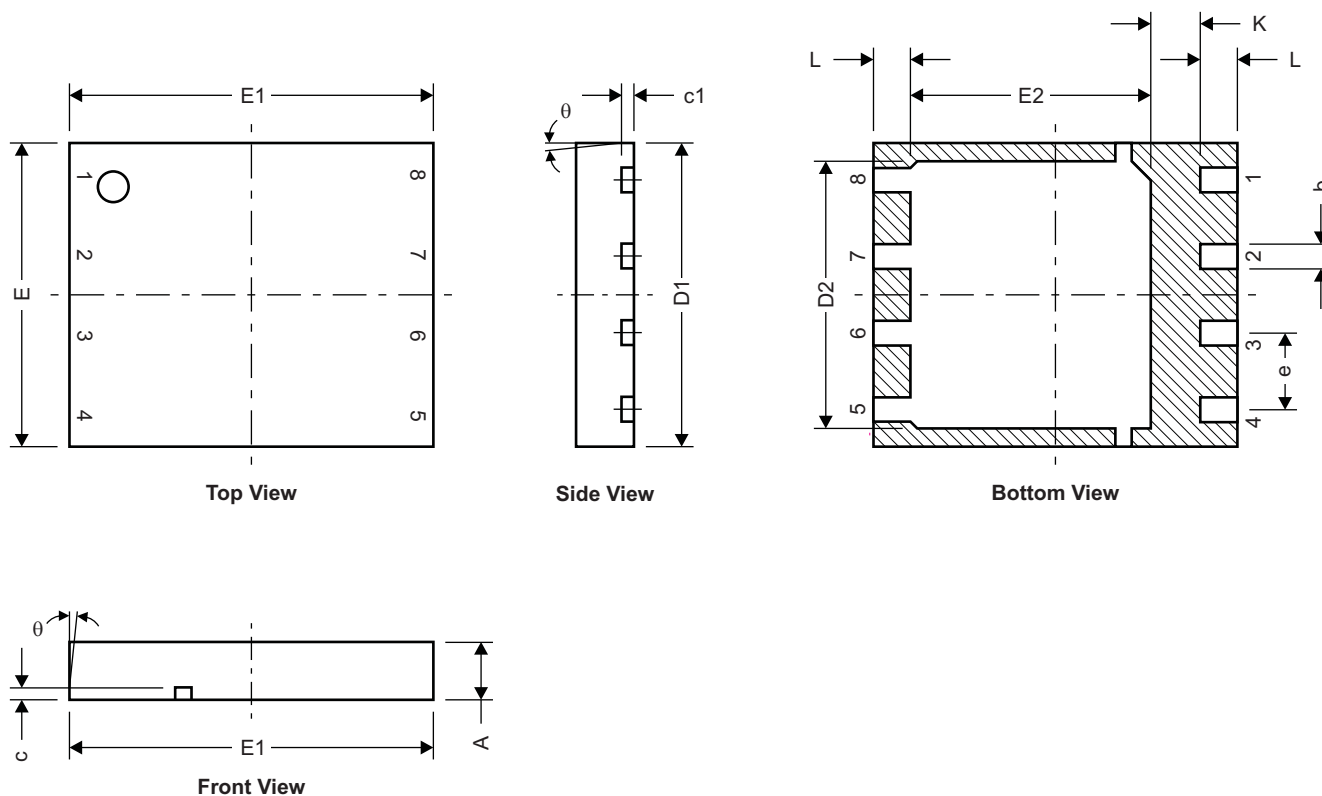
**Figure 11. Single Pulse Unclamped Inductive Switching**



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

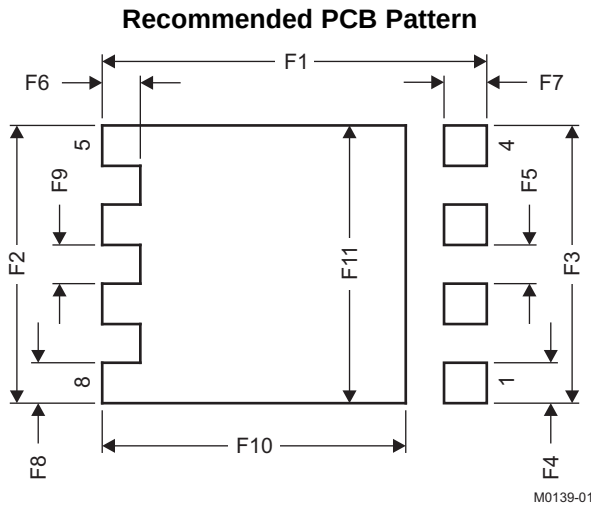
## MECHANICAL DATA

### Q5 Package Dimensions



M0140-01

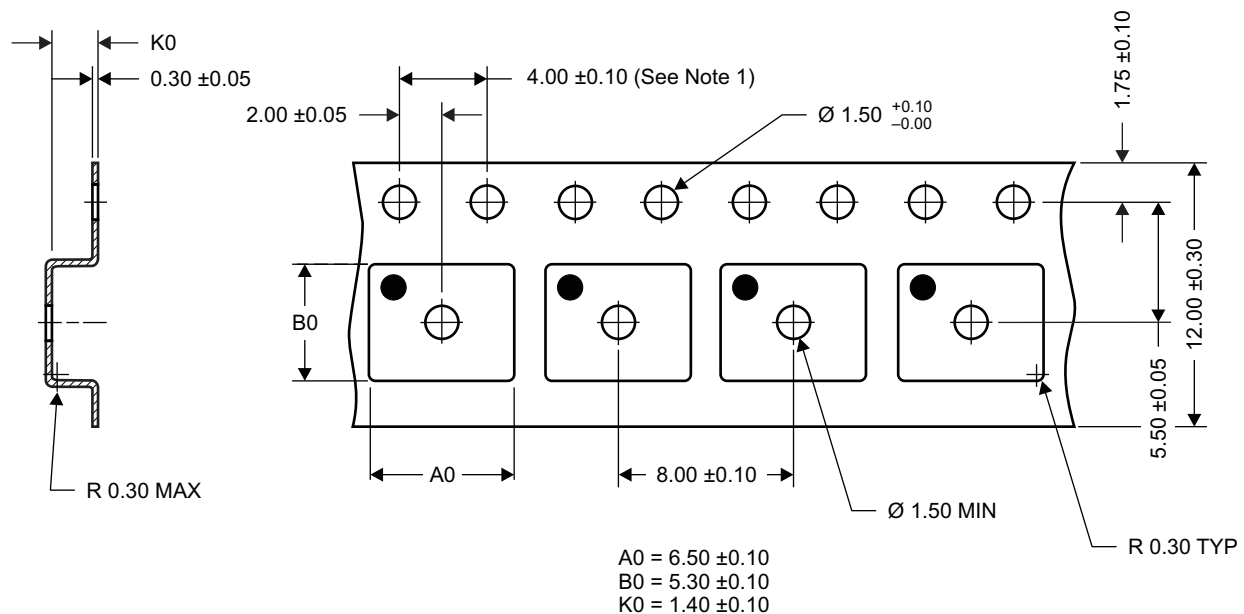
| DIM      | MILLIMETERS |       | INCHES |       |
|----------|-------------|-------|--------|-------|
|          | MIN         | MAX   | MIN    | MAX   |
| A        | 0.950       | 1.050 | 0.037  | 0.039 |
| b        | 0.360       | 0.460 | 0.014  | 0.018 |
| c        | 0.150       | 0.250 | 0.006  | 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 |
| $\theta$ | 0.00        |       |        |       |



| 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  $\pm 0.2$
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:  $0.30 \pm 0.05$ mm
6. MSL1 260°C (IR and Convection) PbF Reflow Compatible

REVISION HISTORY

| Changes from Original (August 2009) to Revision A       | Page              |
|---------------------------------------------------------|-------------------|
| • Deleted the Package Marking Information section ..... | <a href="#">7</a> |



PACKAGING INFORMATION

| Orderable part number | Status<br>(1) | Material type<br>(2) | Package   Pins      | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|-----------------------|---------------|----------------------|---------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| CSD16414Q5            | Active        | Production           | VSON-CLIP (DQH)   8 | 2500   LARGE T&R      | ROHS Exempt | SN                                   | Level-1-260C-UNLIM                | -55 to 150   | CSD16414            |
| CSD16414Q5.B          | Active        | Production           | VSON-CLIP (DQH)   8 | 2500   LARGE T&R      | ROHS Exempt | SN                                   | Level-1-260C-UNLIM                | -55 to 150   | CSD16414            |

- <sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).
- <sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.
- <sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.
- <sup>(4)</sup> **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.
- <sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.
- <sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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