

## N-Channel Enhancement Mode MOSFET

### 1. Product Information

#### 1.1 Features

- ☑ Surface-mounted package
- ☑ Advanced trench cell design

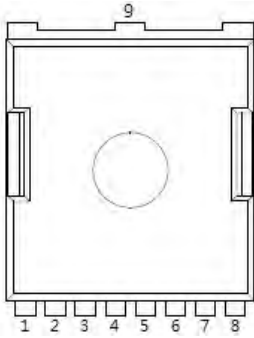
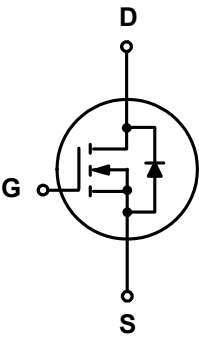
#### 1.2 Applications

- ☑ LCD TV appliances
- ☑ LCDM appliances
- ☑ High power inverter system

#### 1.3 Quick reference

- ☑  $BV \geq 120V$
- ☑  $P_{tot} \leq 375W$
- ☑  $I_D \leq 217A$
- ☑  $R_{DS(ON)} \leq 3.0\ m\Omega @ V_{GS} = 10\ V$
- ☑  $R_{DS(ON)} \leq 4.0\ m\Omega @ V_{GS} = 6\ V$

### 2. Pin Description

| Pin           | Description | Simplified Outline                                                                                            | Symbol                                                                                |
|---------------|-------------|---------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 1             | Gate(G)     |  <p>Top View<br/>TOLL</p> |  |
| 2,3,4,5,6,7,8 | Source(S)   |                                                                                                               |                                                                                       |
| 9             | Drain(D)    |                                                                                                               |                                                                                       |

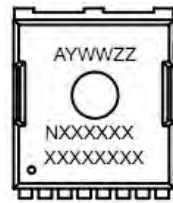
## 3. Limiting Values

| Symbol               | Parameter                               | Conditions                                                | Min | Max      | Unit                 |
|----------------------|-----------------------------------------|-----------------------------------------------------------|-----|----------|----------------------|
| $V_{DS}$             | Drain-Source Voltage                    | $T_C = 25\text{ }^{\circ}\text{C}$                        | -   | 120      | V                    |
| $V_{GS}$             | Gate-Source Voltage                     | $T_C = 25\text{ }^{\circ}\text{C}$                        | -   | $\pm 20$ | V                    |
| $I_D^*$              | Drain Current ( DC )                    | $T_C = 25\text{ }^{\circ}\text{C}, V_{GS} = 10\text{ V}$  | -   | 217      | A                    |
|                      |                                         | $T_C = 100\text{ }^{\circ}\text{C}, V_{GS} = 10\text{ V}$ | -   | 153      | A                    |
| $I_{DM}^*$           | Drain Current ( Pulsed )                | $T_C = 25\text{ }^{\circ}\text{C}, V_{GS} = 10\text{ V}$  | -   | 868      | A                    |
| $P_{tot}$            | Drain power dissipation                 | $T_C = 25\text{ }^{\circ}\text{C}$                        | -   | 375      | W                    |
| $T_{stg}$            | Storage Temperature                     |                                                           | -55 | 175      | $^{\circ}\text{C}$   |
| $T_J$                | Junction Temperature                    |                                                           | -   | 175      | $^{\circ}\text{C}$   |
| $I_S$                | Continuous-Source Current               | $T_C = 25\text{ }^{\circ}\text{C}$                        | -   | 217      | A                    |
| $E_{AS}$             | Single Pulsed Avalanche Energy          | $V_{DD}=50\text{ V}, L=1.0\text{ mH}$                     | -   | 1800     | mJ                   |
| $R_{\theta JA}^{**}$ | Thermal Resistance- Junction to Ambient |                                                           | -   | 40       | $^{\circ}\text{C/W}$ |
| $R_{\theta JC}^{**}$ | Thermal Resistance- Junction to Case    |                                                           | -   | 0.4      |                      |

Notes :

- \* Pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$
- \*\* Surface Mounted on  $1\text{ in}^2$  pad area,  $t \leq 10\text{ sec}$
- \*\*\* Limited by bonding wire

## 4. Marking Information

| Product Name | Marking                                                                               |
|--------------|---------------------------------------------------------------------------------------|
| UP028N12CT   |  |

## 5. Ordering Code

| Product Name | Package | Reel Size | Tape width | Quantity | Note |
|--------------|---------|-----------|------------|----------|------|
| UP028N12CT   | TOLL-8L |           |            | 2000     |      |

## 6. Electrical Characteristics (T<sub>A</sub> = 25 °C Unless Otherwise Noted)

| Symbol                                   | Parameter                      | Conditions                                                                                                                    | Min | Typ  | Max  | Unit |
|------------------------------------------|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-----|------|------|------|
| Static Characteristics                   |                                |                                                                                                                               |     |      |      |      |
| BV <sub>DSS</sub>                        | Drain-Source Breakdown Voltage | V <sub>GS</sub> = 0 V, I <sub>DS</sub> = 250 μA                                                                               | 120 | -    | -    | V    |
| V <sub>GS(th)</sub>                      | Gate Threshold Voltage         | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>DS</sub> = 250 μA                                                                  | 2   | -    | 4    | V    |
| I <sub>DSS</sub>                         | Drain Leakage Current          | V <sub>DS</sub> = 96V, V <sub>GS</sub> = 0 V                                                                                  | -   | -    | 1    | μA   |
| I <sub>GSS</sub>                         | Gate Leakage Current           | V <sub>GS</sub> = 0 V, V <sub>GS</sub> = ± 20 V                                                                               | -   | -    | ±100 | nA   |
| R <sub>DS(ON)</sub> <sup>a</sup>         | On-State Resistance            | V <sub>GS</sub> = 10 V, I <sub>DS</sub> = 50 A                                                                                | 2.4 | 2.6  | 3.0  | m Ω  |
|                                          |                                | V <sub>GS</sub> = 6 V, I <sub>DS</sub> = 30 A                                                                                 | 2.8 | 3.2  | 4.0  |      |
| Diode Characteristics                    |                                |                                                                                                                               |     |      |      |      |
| V <sub>SD</sub> <sup>a</sup>             | Diode Forward Voltage          | I <sub>SD</sub> = 50 A, V <sub>GS</sub> = 0 V                                                                                 | -   | -    | 1.3  | V    |
| t <sub>rr</sub>                          | Reverse Recovery Time          | I <sub>DS</sub> = 50 A, V <sub>GS</sub> = 0 V<br>dI <sub>SD</sub> /dt = 100 A/μs                                              | -   | 121  | -    | nS   |
| Q <sub>rr</sub>                          | Reverse Recovery Charge        |                                                                                                                               | -   | 342  | -    | nC   |
| Dynamic Characteristics <sup>b</sup>     |                                |                                                                                                                               |     |      |      |      |
| C <sub>iss</sub>                         | Input Capacitance              | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 60 V<br>Frequency = 1 MHz                                                            | -   | 9292 | -    | pF   |
| C <sub>oss</sub>                         | Output Capacitance             |                                                                                                                               | -   | 1092 | -    |      |
| C <sub>rss</sub>                         | Reverse Transfer Capacitance   |                                                                                                                               | -   | 87   | -    |      |
| t <sub>d(on)</sub>                       | Turn-on Delay Time             | V <sub>DS</sub> = 60 V, V <sub>GEN</sub> = 10 V,<br>R <sub>G</sub> = 3.9 Ω, R <sub>L</sub> = 1.2 Ω,<br>I <sub>DS</sub> = 50 A | -   | 27   | -    | nS   |
| t <sub>r</sub>                           | Turn-on Rise Time              |                                                                                                                               | -   | 91   | -    |      |
| t <sub>d(off)</sub>                      | Turn-off Delay Time            |                                                                                                                               | -   | 111  | -    |      |
| t <sub>f</sub>                           | Turn-off Fall Time             |                                                                                                                               | -   | 89   | -    |      |
| Gate Charge Characteristics <sup>b</sup> |                                |                                                                                                                               |     |      |      |      |
| Q <sub>g</sub>                           | Total Gate Charge              | V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 10 V,<br>I <sub>DS</sub> = 50 A                                                     | -   | 167  | -    | nC   |
| Q <sub>gs</sub>                          | Gate-Source Charge             |                                                                                                                               | -   | 47   | -    |      |
| Q <sub>gd</sub>                          | Gate-Drain Charge              |                                                                                                                               | -   | 44   | -    |      |

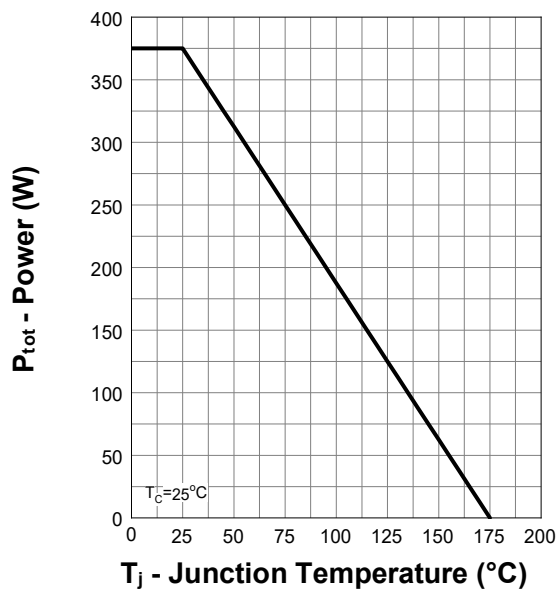
Notes :

a : Pulse test ; pulse width ≤ 300 μs, duty cycle ≤ 2%

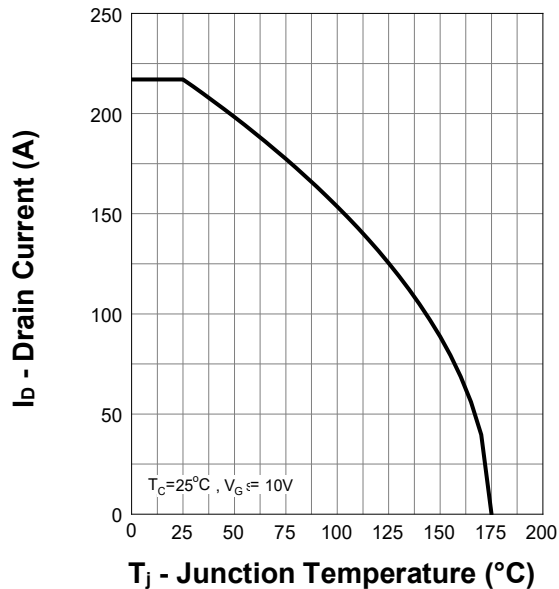
b : Guaranteed by design, not subject to production testing

## 7. Typical Characteristics

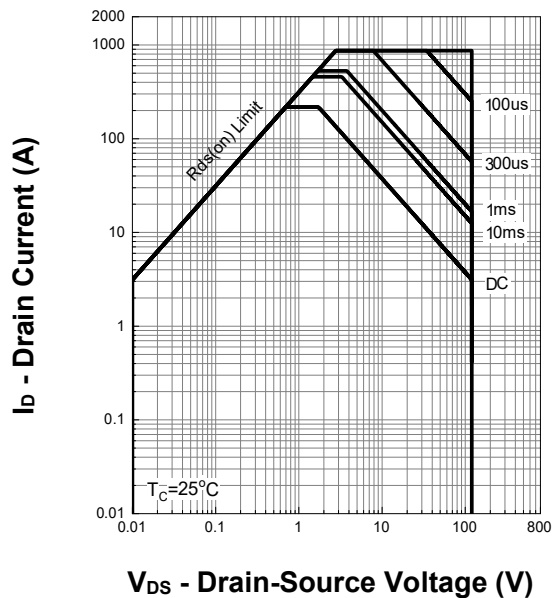
Power Capability



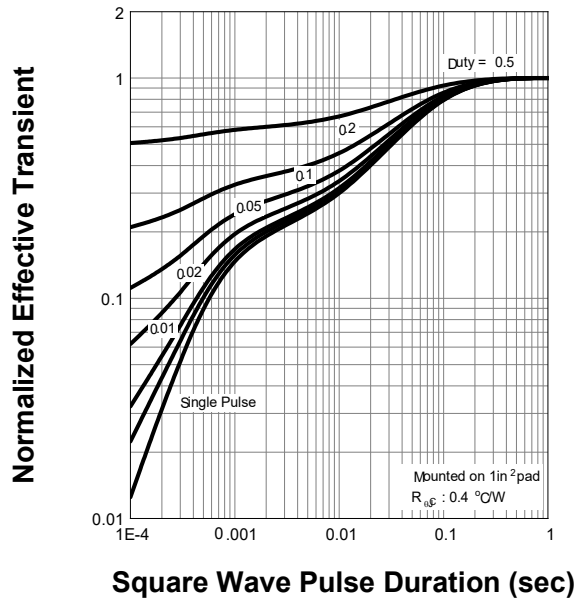
Current Capability



Safe Operating Area

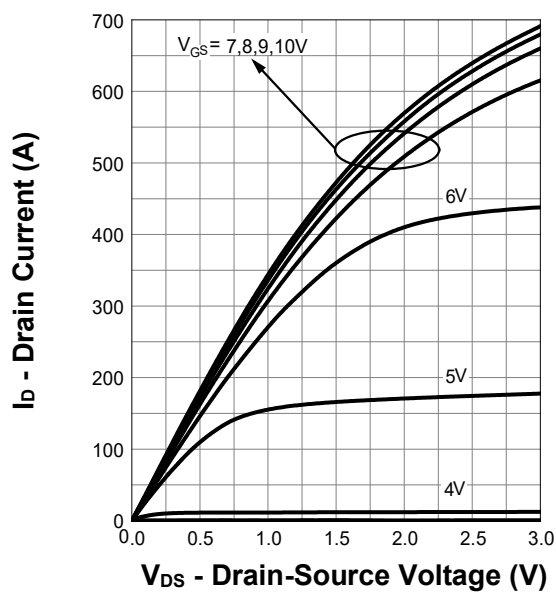


Transient Thermal Impedance

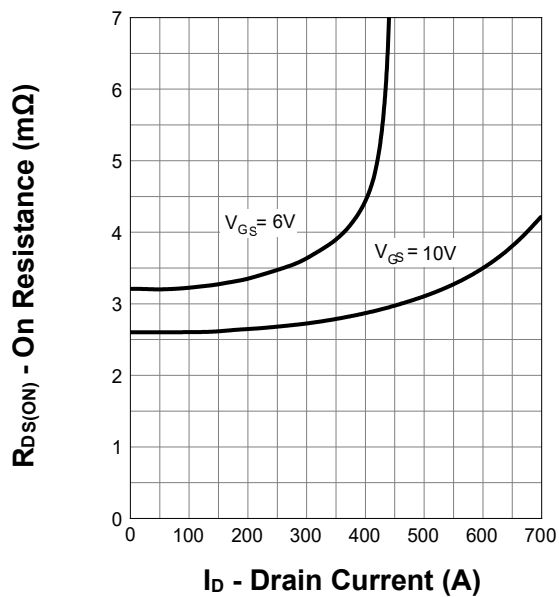


## 7. Typical Characteristics (cont.)

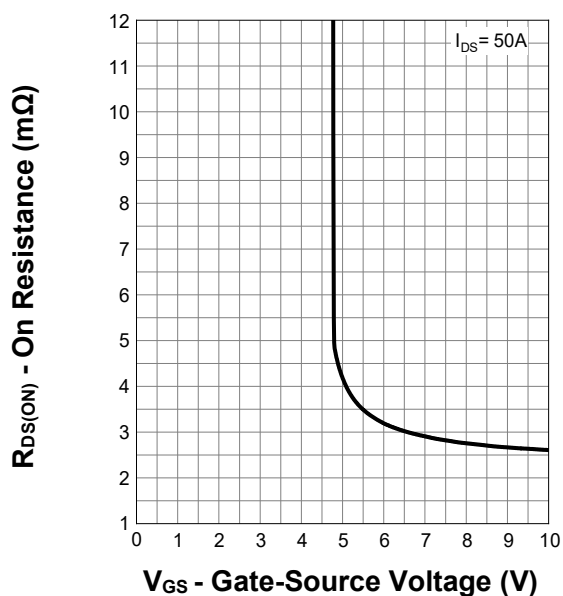
Output Characteristics



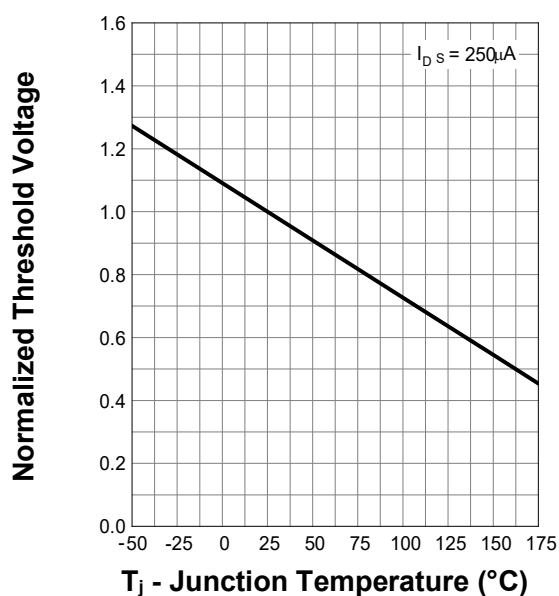
On Resistance



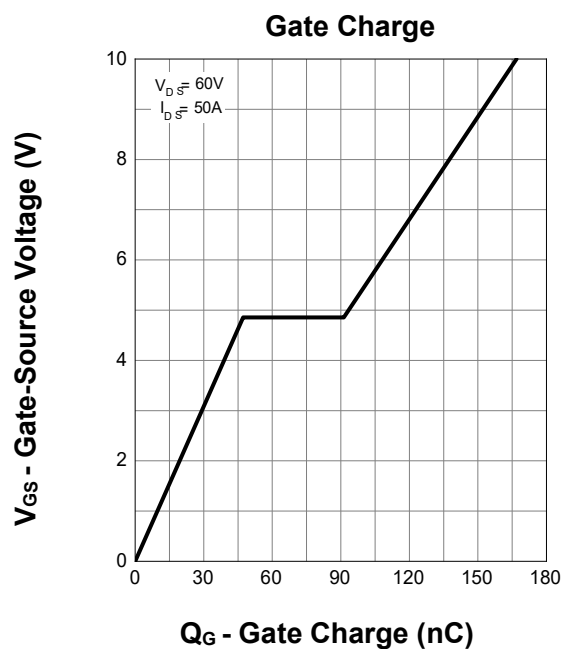
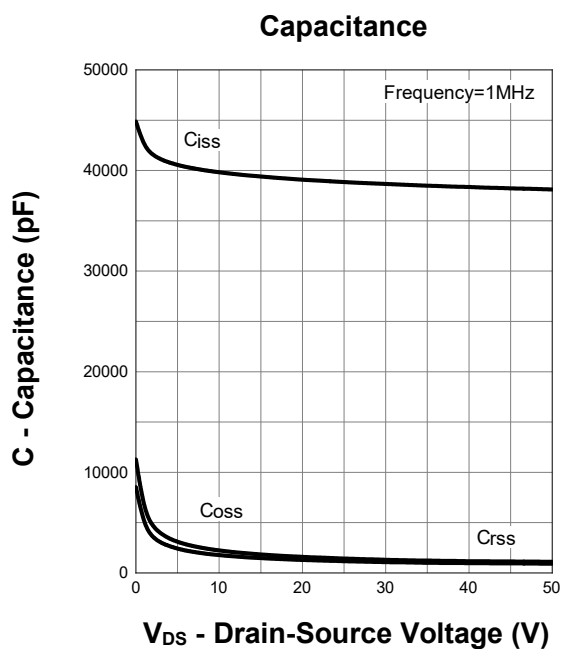
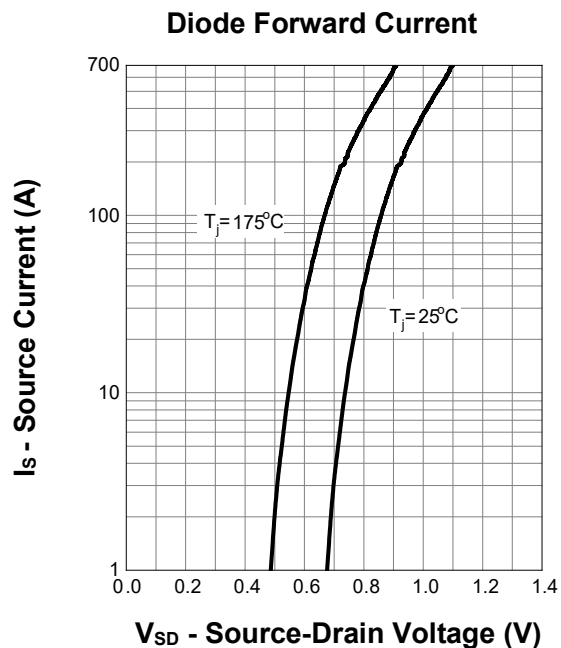
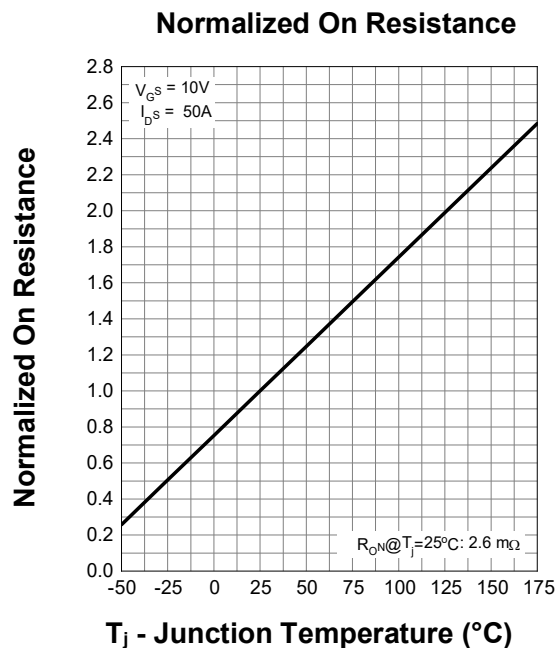
Transfer Characteristics



Normalized Threshold Voltage

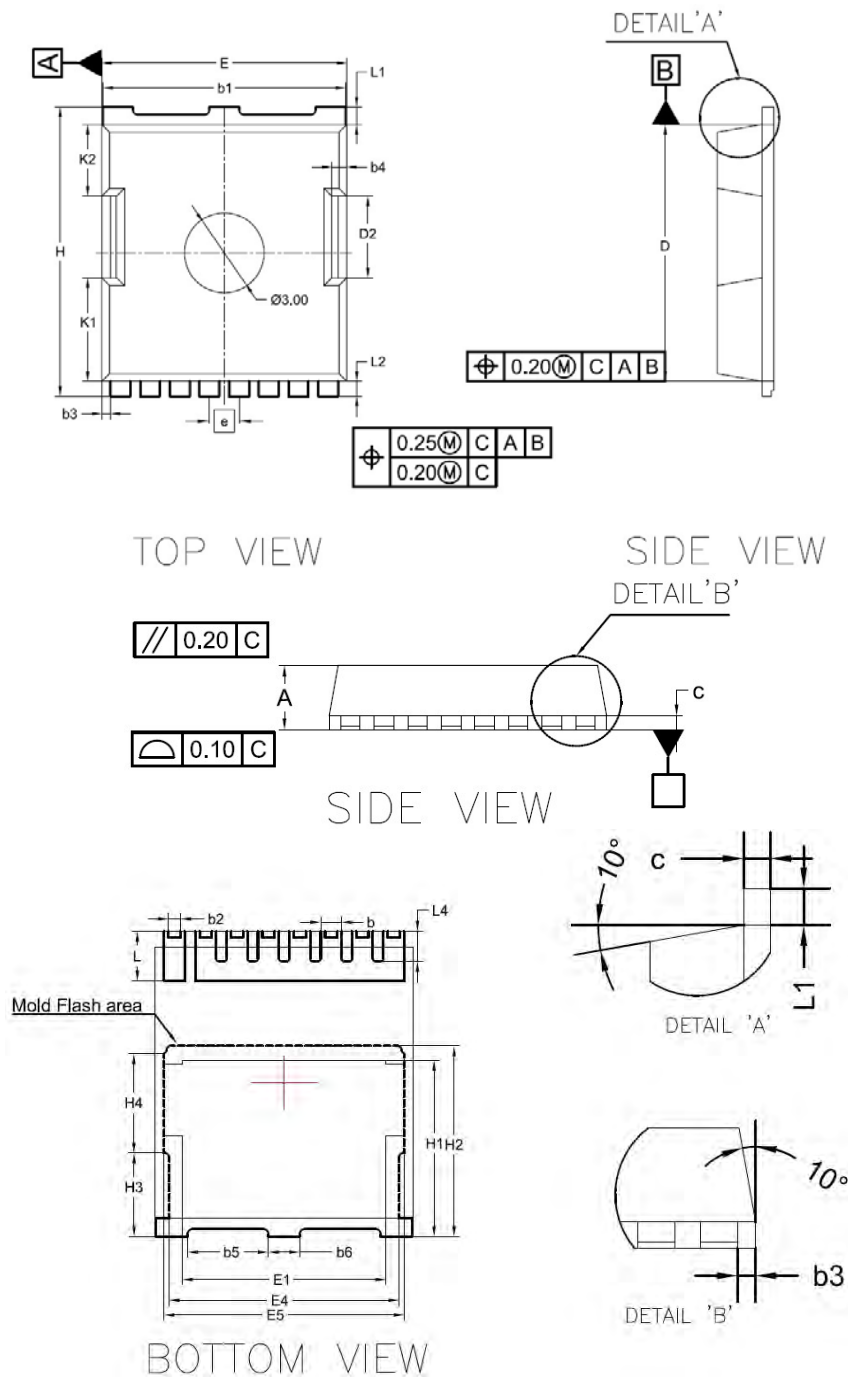


## 7. Typical Characteristics (cont.)



## 8. Package Dimensions

### TOLL-8L Package



## 8. Package Dimensions

### TOLL-8L Package

| Symbol | Dimensions In Millimeters |        |        | Dimensions In INCHES |       |       |
|--------|---------------------------|--------|--------|----------------------|-------|-------|
|        | MIN.                      | NOM.   | MAX.   | MIN.                 | NOM.  | MAX.  |
| A      | 2.200                     | 2.300  | 2.400  | 0.087                | 0.091 | 0.094 |
| c      | 0.492                     | 0.500  | 0.508  | 0.019                | 0.020 | 0.021 |
| D      | 10.280                    | 10.380 | 10.480 | 0.405                | 0.409 | 0.413 |
| E      | 9.800                     | 9.900  | 10.000 | 0.386                | 0.390 | 0.394 |
| e      | 1.20 BSC                  |        |        | 0.047 BSC            |       |       |
| H      | 11.580                    | 11.680 | 11.780 | 0.456                | 0.460 | 0.464 |
| H1     | 6.650                     | 6.750  | 6.850  | 0.262                | 0.266 | 0.270 |
| H2     | 7.300                     |        |        | 0.287                |       |       |
| H3     | 3.200                     |        |        | 0.126                |       |       |
| H4     | 3.800                     |        |        | 0.150                |       |       |
| K1     | 4.180                     |        |        | 0.165                |       |       |
| K2     | 2.900                     |        |        | 0.114                |       |       |
| D2     | 3.300                     |        |        | 0.130                |       |       |
| b      | 0.700                     | 0.800  | 0.900  | 0.028                | 0.031 | 0.035 |
| b1     | 9.700                     | 9.800  | 9.900  | 0.382                | 0.386 | 0.390 |
| b2     | 0.420                     | 0.460  | 0.500  | 0.017                | 0.018 | 0.020 |
| b3     | 0.350                     |        |        | 0.014                |       |       |
| b4     | 0.600                     |        |        | 0.024                |       |       |
| b5     | 3.100                     |        |        | 0.122                |       |       |
| b6     | 1.200                     |        |        | 0.047                |       |       |
| L      | 1.700                     | 1.900  | 2.100  | 0.067                | 0.075 | 0.083 |
| L1     | 0.700                     |        |        | 0.028                |       |       |
| L2     | 0.600                     |        |        | 0.024                |       |       |
| L4     | 1.050                     | 1.150  | 1.250  | 0.041                | 0.045 | 0.049 |
| L5     | 0.500                     | 0.600  | 0.700  | 0.020                | 0.024 | 0.028 |
| E1     | 7.800                     |        |        | 0.310                |       |       |
| E4     | 8.800                     |        |        | 0.350                |       |       |
| E5     | 9.200                     |        |        | 0.360                |       |       |