

## N-Channel Enhancement Mode MOSFET

### 1. Product Information

#### 1.1 Features

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

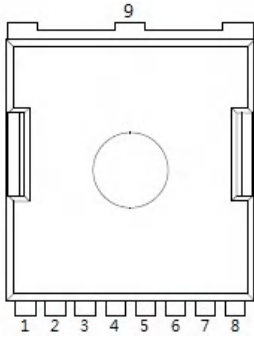
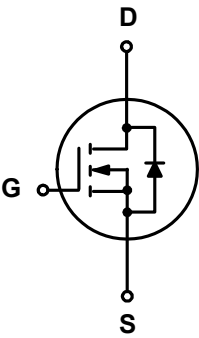
#### 1.2 Applications

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

#### 1.3 Quick reference

- ☑  $BV \geq 60V$
- ☑  $P_{tot} \leq 230W$
- ☑  $I_D \leq 272A$
- ☑  $R_{DS(ON)} \leq 0.98 m\Omega @ V_{GS} = 10 V$
- ☑  $R_{DS(ON)} \leq 1.65 m\Omega @ V_{GS} = 6 V$

### 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)    |                                                                                                               |                                                                                       |

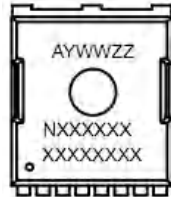
## 3. Limiting Values

| Symbol               | Parameter                               | Conditions                                                | Min | Max      | Unit                 |
|----------------------|-----------------------------------------|-----------------------------------------------------------|-----|----------|----------------------|
| $V_{DS}$             | Drain-Source Voltage                    | $T_C = 25\text{ }^{\circ}\text{C}$                        | -   | 60       | V                    |
| $V_{GS}$             | Gate-Source Voltage                     | $T_C = 25\text{ }^{\circ}\text{C}$                        | -   | $\pm 20$ | V                    |
| $I_D^*$              | Drain Current ( DC )                    | $T_C = 25\text{ }^{\circ}\text{C}, V_{GS} = 10\text{ V}$  | -   | 272      | A                    |
|                      |                                         | $T_C = 100\text{ }^{\circ}\text{C}, V_{GS} = 10\text{ V}$ | -   | 192      | A                    |
| $I_{DM}^*$           | Drain Current ( Pulsed )                | $T_C = 25\text{ }^{\circ}\text{C}, V_{GS} = 10\text{ V}$  | -   | 1088     | A                    |
| $P_{tot}$            | Drain power dissipation                 | $T_C = 25\text{ }^{\circ}\text{C}$                        | -   | 230      | W                    |
| $T_{stg}$            | Storage Temperature                     |                                                           | -55 | 175      | $^{\circ}\text{C}$   |
| $T_J$                | Junction Temperature                    |                                                           | -   | 175      | $^{\circ}\text{C}$   |
| $I_S$                | Continuous-Source Current               | $T_C = 25\text{ }^{\circ}\text{C}$                        | -   | 272      | A                    |
| $E_{AS}$             | Single Pulsed Avalanche Energy          | $V_{DD}=50\text{ V}, L=1.0\text{ mH}$                     | -   | 3042     | mJ                   |
| $R_{\theta JA}^{**}$ | Thermal Resistance- Junction to Ambient |                                                           | -   | 47       | $^{\circ}\text{C/W}$ |
| $R_{\theta JC}^{**}$ | Thermal Resistance- Junction to Case    |                                                           | -   | 0.65     |                      |

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                                                                               |
|--------------|---------------------------------------------------------------------------------------|
| UP60T241T    |  |

## 5. Ordering Code

| Product Name | Package | Reel Size | Tape width | Quantity | Note |
|--------------|---------|-----------|------------|----------|------|
| UP60T241T    | 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                                                                               | 60  | -     | -    | 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> = 48 V, 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                                                                                | -   | 0.9   | 0.98 | mΩ   |
|                                          |                                | V <sub>GS</sub> = 6 V, I <sub>DS</sub> = 30 A                                                                                 | -   | 1.4   | 1.65 |      |
|                                          |                                |                                                                                                                               |     |       |      |      |
| 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                                              | -   | 31    | -    | nS   |
| Q <sub>rr</sub>                          | Reverse Recovery Charge        |                                                                                                                               | -   | 20    | -    | nC   |
| Dynamic Characteristics <sup>b</sup>     |                                |                                                                                                                               |     |       |      |      |
| C <sub>iss</sub>                         | Input Capacitance              | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 30 V<br>Frequency = 1 MHz                                                            | -   | 38092 | -    | pF   |
| C <sub>oss</sub>                         | Output Capacitance             |                                                                                                                               | -   | 1310  | -    |      |
| C <sub>rss</sub>                         | Reverse Transfer Capacitance   |                                                                                                                               | -   | 1075  | -    |      |
| t <sub>d(on)</sub>                       | Turn-on Delay Time             | V <sub>DS</sub> = 30 V, V <sub>GEN</sub> = 10 V,<br>R <sub>G</sub> = 3.9 Ω, R <sub>L</sub> = 0.6 Ω,<br>I <sub>DS</sub> = 50 A | -   | 91    | -    | nS   |
| t <sub>r</sub>                           | Turn-on Rise Time              |                                                                                                                               | -   | 160   | -    |      |
| t <sub>d(off)</sub>                      | Turn-off Delay Time            |                                                                                                                               | -   | 357   | -    |      |
| t <sub>f</sub>                           | Turn-off Fall Time             |                                                                                                                               | -   | 629   | -    |      |
| Gate Charge Characteristics <sup>b</sup> |                                |                                                                                                                               |     |       |      |      |
| Q <sub>g</sub>                           | Total Gate Charge              | V <sub>DS</sub> = 30 V, V <sub>GS</sub> = 10 V,<br>I <sub>DS</sub> = 50 A                                                     | -   | 592   | -    | nC   |
| Q <sub>gs</sub>                          | Gate-Source Charge             |                                                                                                                               | -   | 196   | -    |      |
| Q <sub>gd</sub>                          | Gate-Drain Charge              |                                                                                                                               | -   | 96    | -    |      |

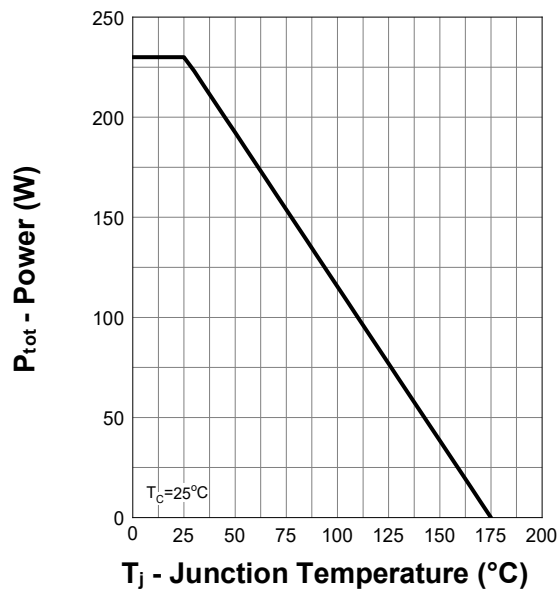
Notes :

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

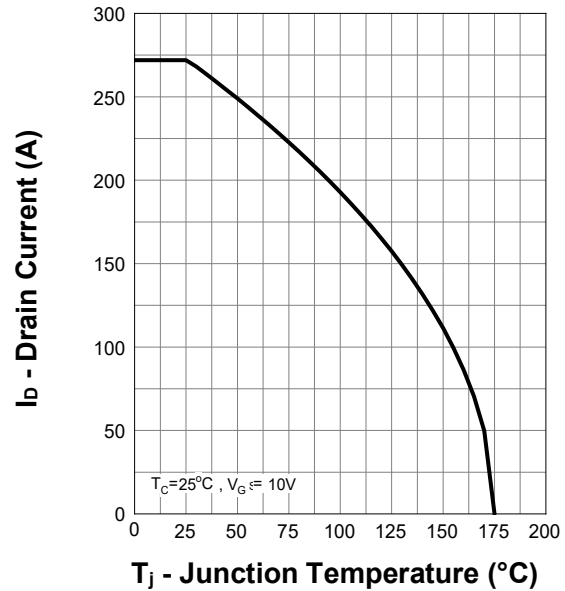
b : Guaranteed by design, not subject to production testing

## 7. Typical Characteristics

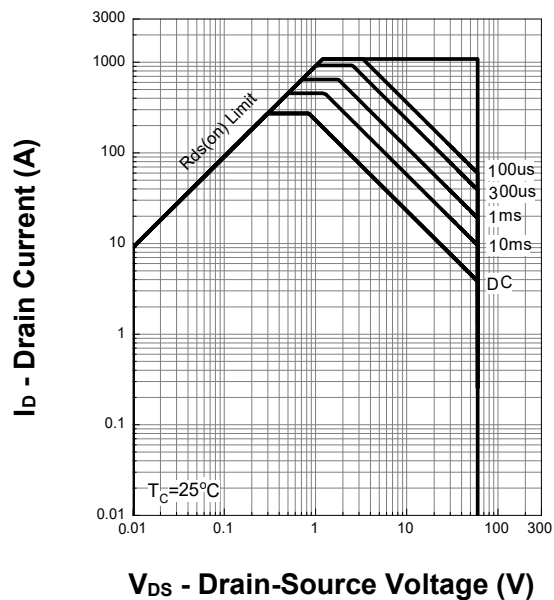
Power Capability



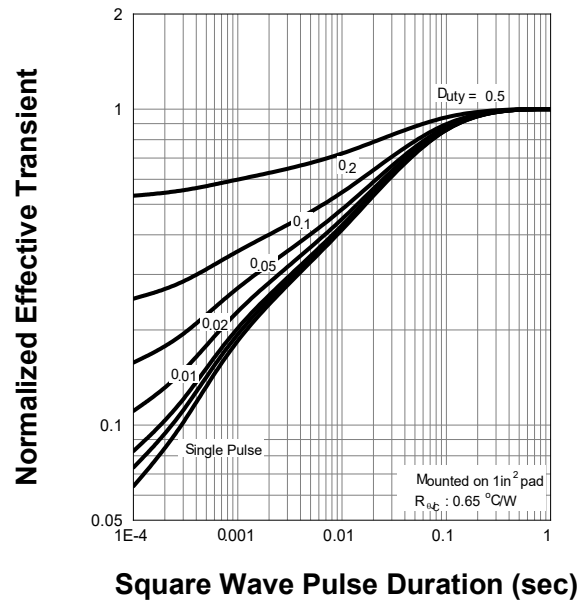
Current Capability



Safe Operating Area

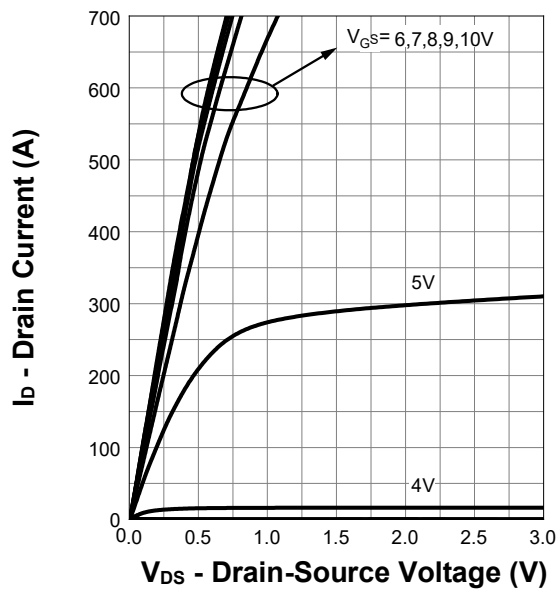


Transient Thermal Impedance

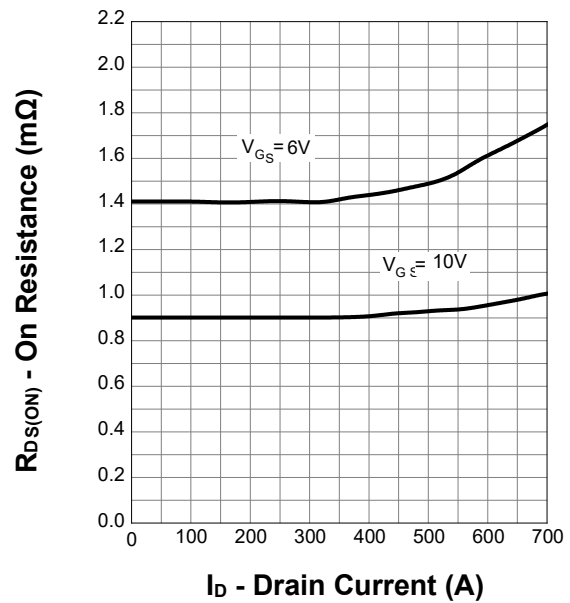


## 7. Typical Characteristics (cont.)

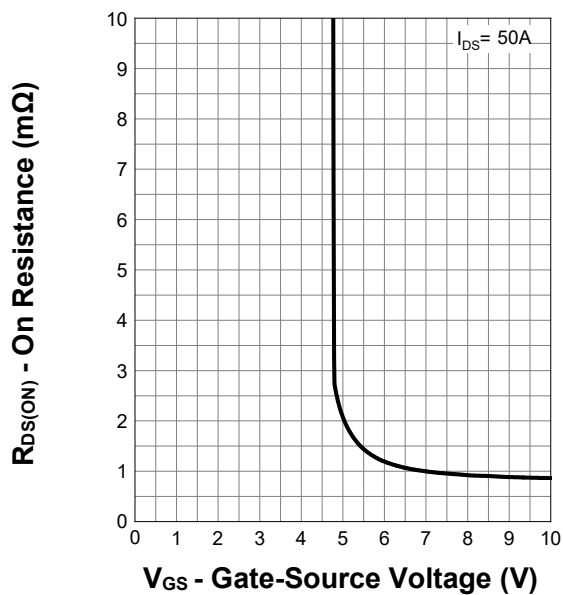
Output Characteristics



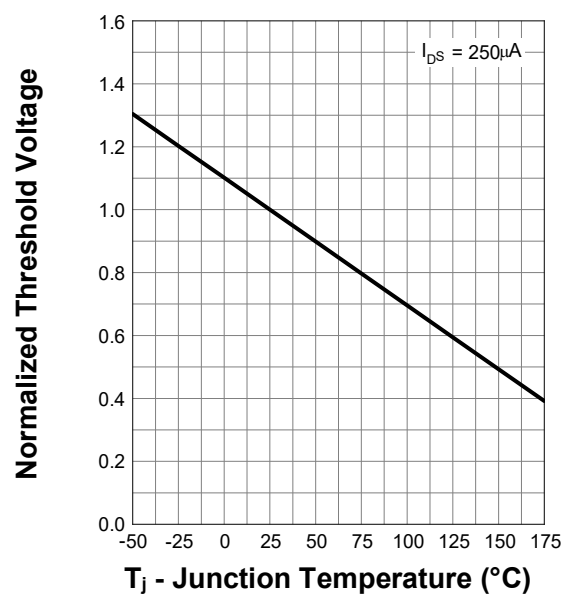
On Resistance



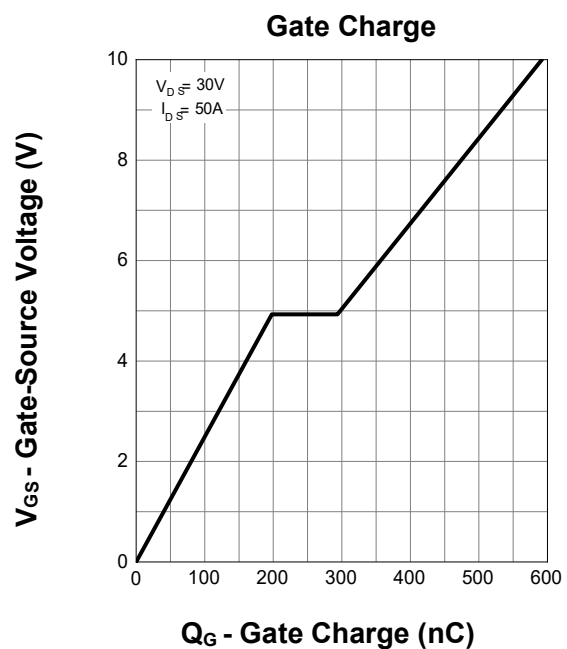
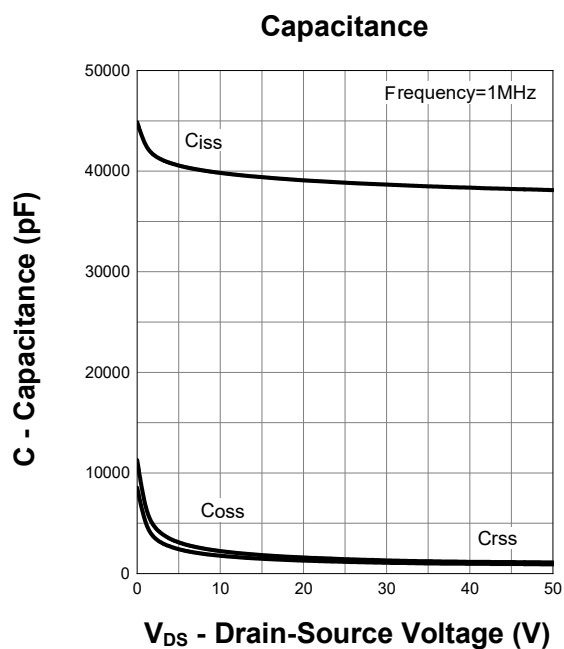
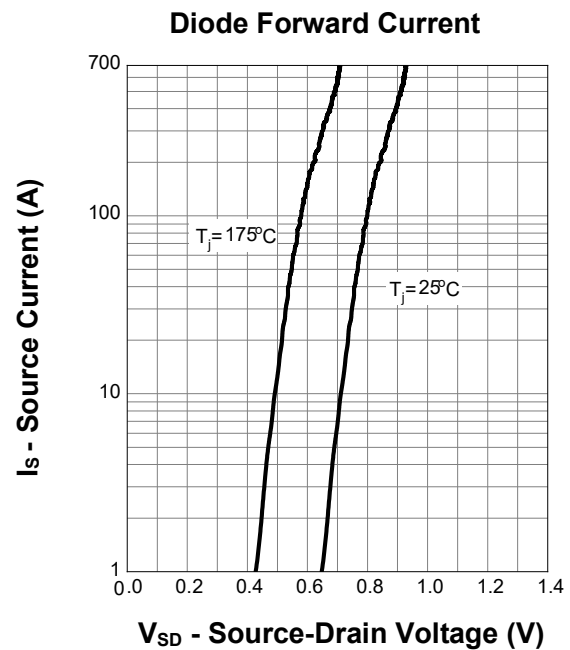
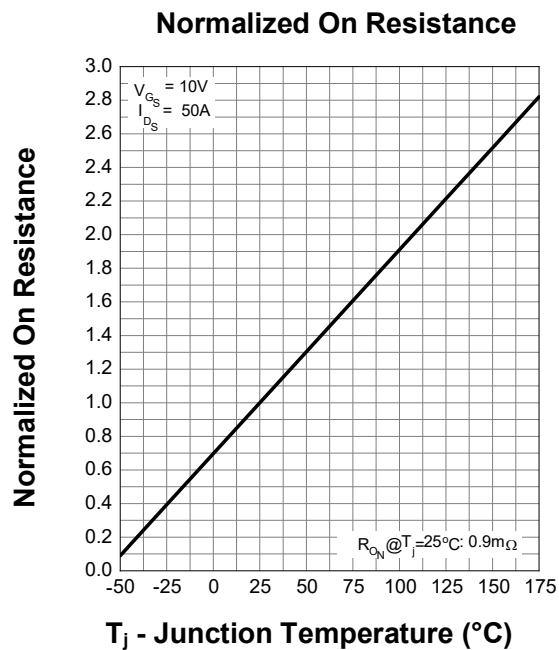
Transfer Characteristics



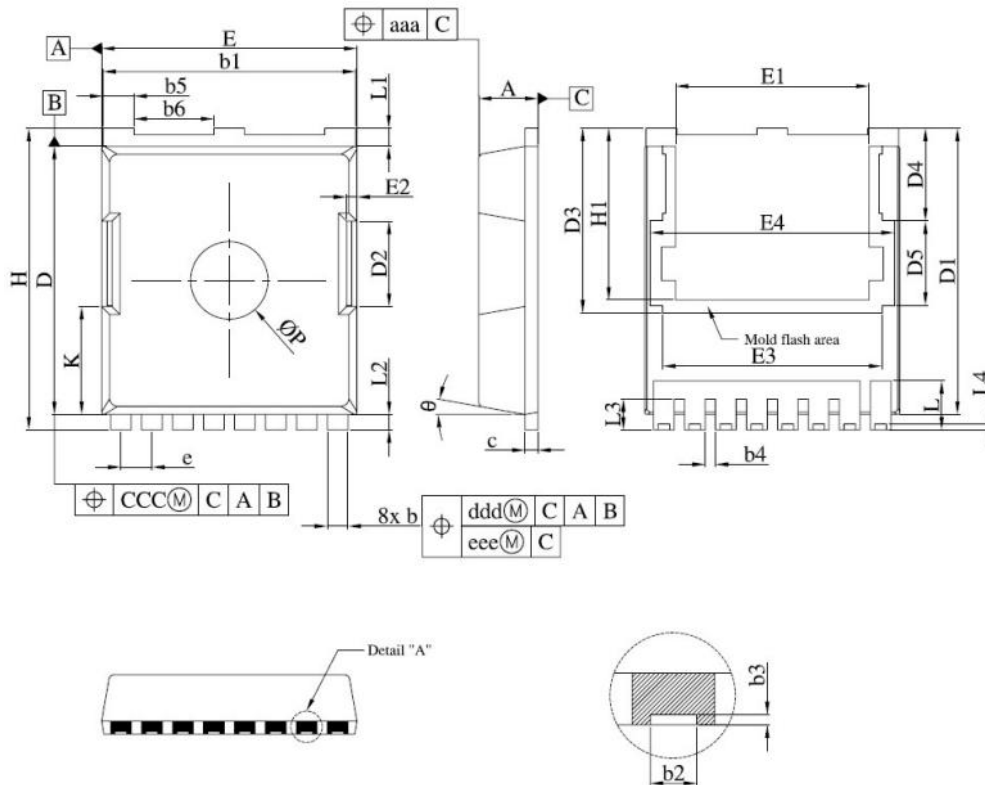
Normalized Threshold Voltage



## 7. Typical Characteristics (cont.)



## 8. Package Dimensions TOLL-8L Package



| Symbol | Dimensions In Millimeters |       |
|--------|---------------------------|-------|
|        | MIN.                      | MAX.  |
| A      | 2.20                      | 2.40  |
| b      | 0.70                      | 0.90  |
| b1     | 9.70                      | 9.90  |
| b2     | 0.36                      | 0.55  |
| b3     | 0.05                      | /     |
| b4     | 0.30                      | 0.50  |
| b5     | 1.10                      | 1.30  |
| b6     | 3.00                      | 3.20  |
| c      | 0.40                      | 0.60  |
| D      | 10.28                     | 10.55 |
| D1     | 10.98                     | 11.18 |
| D2     | 3.20                      | 3.40  |
| D3     | 7.15                      |       |
| D4     | 3.59                      |       |
| D5     | 3.26                      |       |
| e      | 1.10                      | 1.30  |
| E      | 9.80                      | 10.00 |
| E1     | 7.40                      | 7.60  |

| Symbol   | Dimensions In Millimeters |       |
|----------|---------------------------|-------|
|          | MIN.                      | MAX.  |
| E2       | 7.40                      | 7.60  |
| E3       | 8.50                      |       |
| E4       | 9.46                      |       |
| H        | 11.50                     | 11.85 |
| H1       | 6.55                      | 6.75  |
| K        | 4.08                      | 4.28  |
| L        | 1.60                      | 2.10  |
| L1       | 0.50                      | 0.90  |
| L2       | 0.50                      | 0.70  |
| L3       | 1.00                      | 1.30  |
| L4       | 0.13                      | 0.33  |
| P        | 2.85                      | 3.15  |
| $\theta$ | 10°REF                    |       |
| aaa      | 0.20                      |       |
| ccc      | 0.20                      |       |
| ddd      | 0.25                      |       |
| eee      | 0.20                      |       |