

### Product Summary

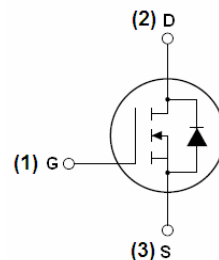
| Part #     | V <sub>DS</sub> | R <sub>DS(on).typ</sub><br>(@V <sub>GS</sub> =10V) | R <sub>DS(on).typ</sub><br>(@V <sub>GS</sub> =4.5V) | I <sub>D</sub> |
|------------|-----------------|----------------------------------------------------|-----------------------------------------------------|----------------|
| EFM060N03F | 30V             | 6mΩ                                                | 10mΩ                                                | 60A            |

### Description

- The EFM060N03F is the high cell density trenched
- N-ch MOSFETs which provide excellent
- RDSON and gate charge for most of the
- synchronous buck converter applications.
- The EFM060N03F meet the RoHS and Green
- Product requirement, 100 % EAS guaranteed
- with full function reliability approved.

### Application

- Super Low Gate Charge 100% EAS Guaranteed
- Green Device Available Excellent CdV/dt effect decline
- Advanced high cell density Trench technology



N-Channel MOSFET



PDFN5\*6-8L

### Ordering Information:

|                           |               |
|---------------------------|---------------|
| Part NO.                  | EFM060N03F    |
| Marking                   | 060N03F ***** |
| Packing Information       | REEL TAPE     |
| Basic ordering unit (pcs) | 5000          |

### Absolute Maximum Ratings (T<sub>C</sub>=25°C)

| Parameter                                        | Symbol                            | Limit      | Unit |
|--------------------------------------------------|-----------------------------------|------------|------|
| Drain-Source Voltage                             | V <sub>DS</sub>                   | 30         | V    |
| Gate-Source Voltage                              | V <sub>GS</sub>                   | ±20        | V    |
| Drain Current-Continuous                         | I <sub>D</sub>                    | 60         | A    |
| Drain Current-Pulsed <sup>(Note 1)</sup>         | I <sub>DM</sub>                   | 120        | A    |
| Maximum Power Dissipation                        | P <sub>D</sub>                    | 48         | W    |
| Operating Junction and Storage Temperature Range | T <sub>J</sub> , T <sub>STG</sub> | -55 To 150 | °C   |

### Thermal Characteristic

|                                                             |                  |     |      |
|-------------------------------------------------------------|------------------|-----|------|
| Thermal Resistance, Junction-to-Ambient <sup>(Note 2)</sup> | R <sub>θJC</sub> | 2.5 | °C/W |
|-------------------------------------------------------------|------------------|-----|------|

## • Static Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise stated)

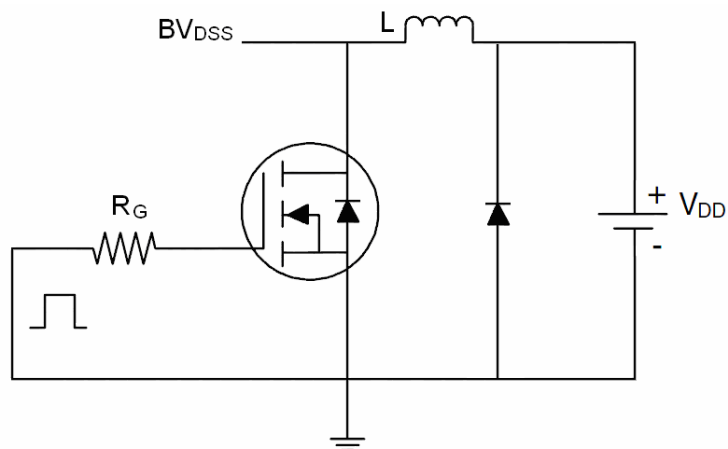
| Parameter                          | Symbol              | Condition                                                                                  | Min | Typ  | Max  | Unit |
|------------------------------------|---------------------|--------------------------------------------------------------------------------------------|-----|------|------|------|
| Off Characteristics                |                     |                                                                                            |     |      |      |      |
| Drain-Source Breakdown Voltage     | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =250uA                                                  | 30  | --   | --   | V    |
| Zero Gate Voltage Drain Current    | I <sub>DSS</sub>    | V <sub>DS</sub> =30V V <sub>GS</sub> =0V                                                   | --  | --   | 1    | nA   |
| Gate-Body Leakage Current          | I <sub>GSS</sub>    | V <sub>GS</sub> =±20V V <sub>DS</sub> =0V                                                  | --  | --   | ±100 | nA   |
| On Characteristics (Note 3)        |                     |                                                                                            |     |      |      |      |
| Gate Threshold Voltage             | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> I <sub>D</sub> =250uA                                     | 1.0 | 1.6  | 2.5  | V    |
| Drain-Source On-State Resistance   | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V I <sub>D</sub> =20A                                                   | --  | 6    | 7.5  | mΩ   |
|                                    |                     | V <sub>GS</sub> =4.5V I <sub>D</sub> =20A                                                  | --  | 10   | 12   | mΩ   |
| Forward Transconductance           | g <sub>FS</sub>     | V <sub>DS</sub> =5V I <sub>D</sub> =20A                                                    | --  | 20   | --   | S    |
| Dynamic Characteristics (Note4)    |                     |                                                                                            |     |      |      |      |
| Input Capacitance                  | C <sub>ISS</sub>    | V <sub>DS</sub> =15V V <sub>GS</sub> =0V<br><br>F=1.0MHz                                   | --  | 2000 | --   | PF   |
| Output Capacitance                 | C <sub>OSS</sub>    |                                                                                            | --  | 280  | --   | PF   |
| Reverse Transfer Capacitance       | C <sub>RSS</sub>    |                                                                                            | --  | 210  | --   | PF   |
| Switching Characteristics (Note 4) |                     |                                                                                            |     |      |      |      |
| Turn-on Delay Time                 | t <sub>d(on)</sub>  | V <sub>DD</sub> =15V I <sub>D</sub> =20A<br><br>V <sub>GS</sub> =10V R <sub>G</sub> =1.8Ω, | --  | 10   | --   | nS   |
| Turn-on Rise Time                  | t <sub>r</sub>      |                                                                                            | --  | 8    | --   | nS   |
| Turn-Off Delay Time                | t <sub>d(off)</sub> |                                                                                            | --  | 25   | --   | nS   |
| Turn-Off Fall Time                 | t <sub>f</sub>      |                                                                                            | --  | 5    | --   | nS   |
| Total Gate Charge                  | Q <sub>g</sub>      | V <sub>DS</sub> =15V I <sub>D</sub> =20A<br><br>V <sub>GS</sub> =10V                       | --  | 32   | --   | nC   |
| Gate-Source Charge                 | Q <sub>gs</sub>     |                                                                                            | --  | 4.9  | --   | nC   |
| Gate-Drain Charge                  | Q <sub>gd</sub>     |                                                                                            | --  | 6.9  | --   | nC   |
| Drain-Source Diode Characteristics |                     |                                                                                            |     |      |      |      |
| Diode Forward Voltage (Note 3)     | V <sub>SD</sub>     | V <sub>GS</sub> =0V I <sub>S</sub> =20A                                                    | --  | 0.85 | 1.2  | V    |
| Diode Forward Current (Note 2)     | I <sub>S</sub>      |                                                                                            | --  | --   | 50   | A    |

### Notes:

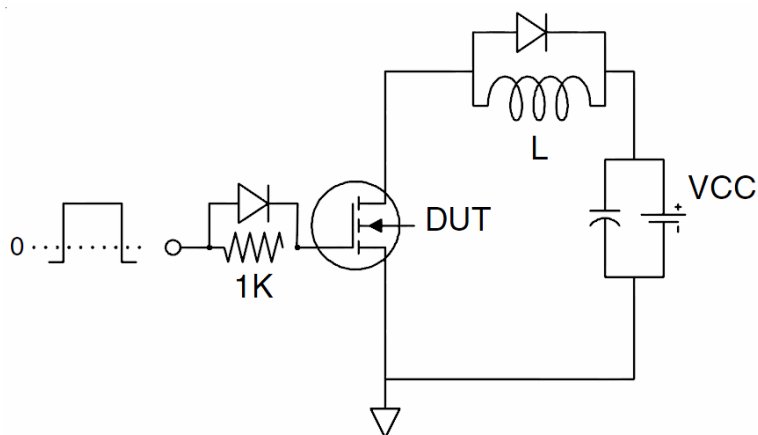
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board, t ≤ 10 sec.
3. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
4. Guaranteed by design, not subject to production
5. EAS condition: T<sub>J</sub>=25°C, V<sub>DD</sub>=15V, V<sub>G</sub>=10V, L=0.5mH, R<sub>G</sub>=25Ω

## • Typical Characteristics

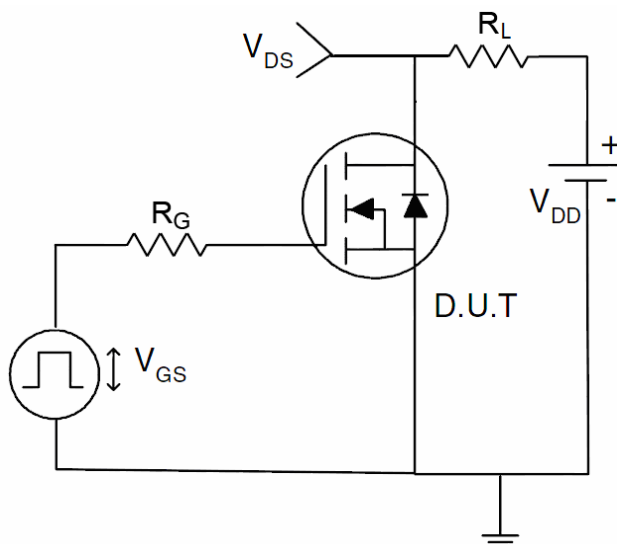
### 1) $E_{AS}$ test Circuits

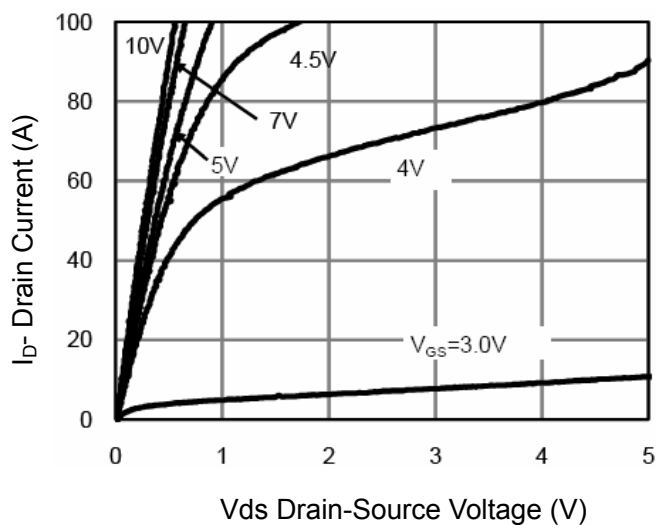


### 2) Gate charge test Circuit:

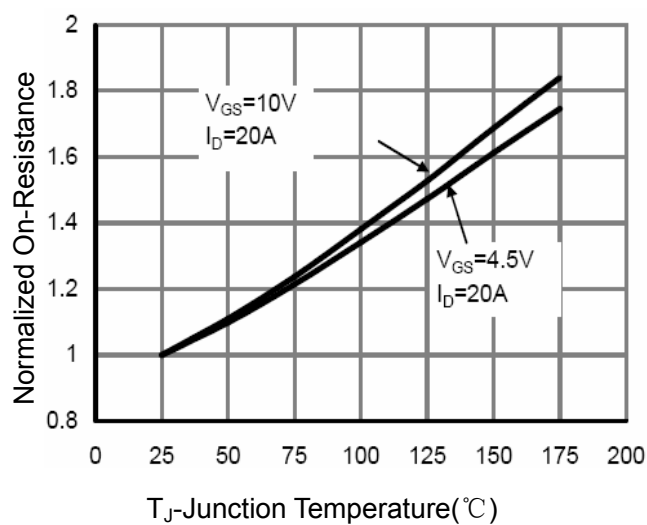


### 3) Switch Time Test Circuit:

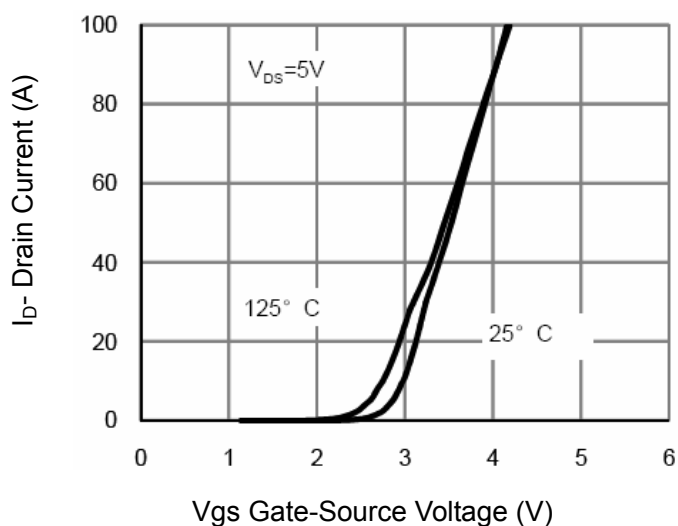




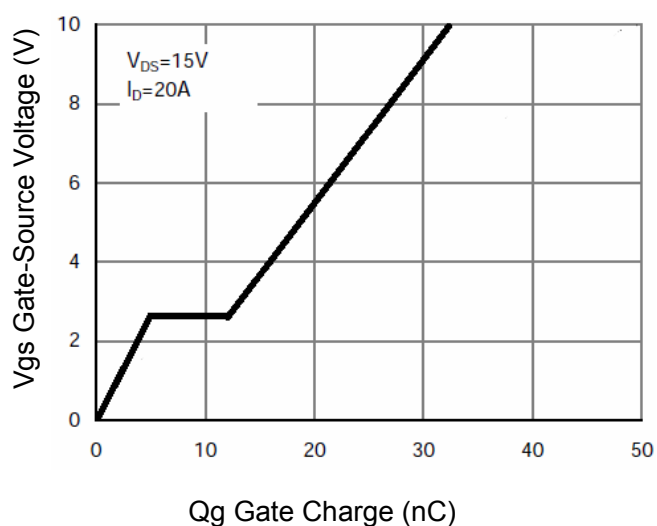
**Figure 1 Output Characteristics**



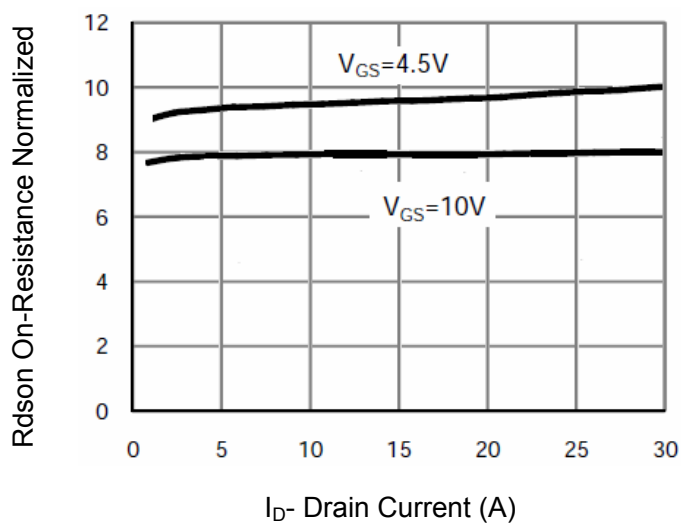
**Figure 4 Rdson-Junction Temperature**



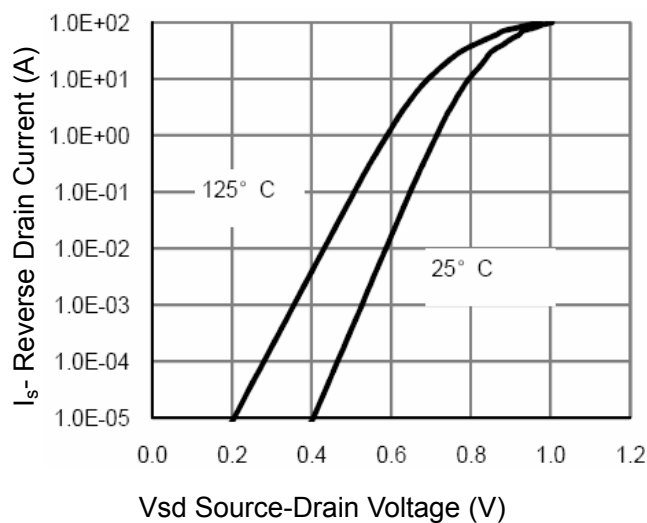
**Figure 2 Transfer Characteristics**



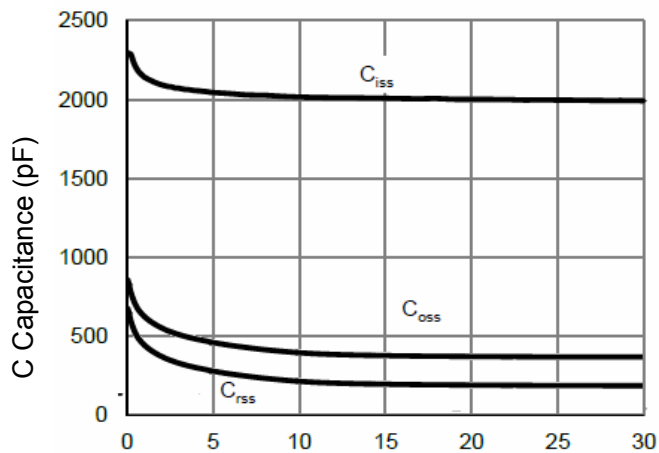
**Figure 5 Gate Charge**



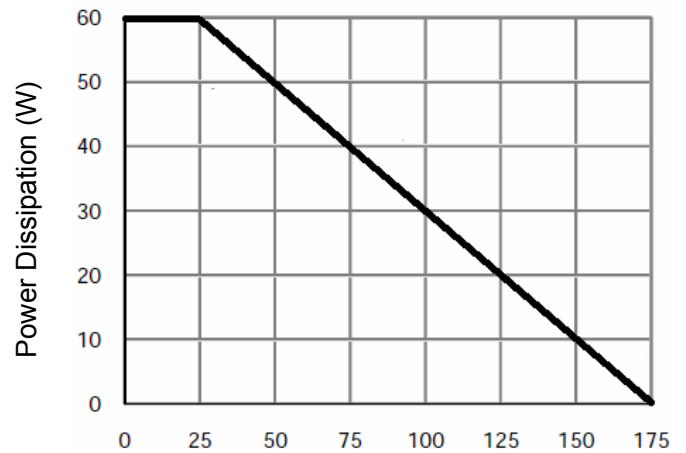
**Figure 3 Rdson- Drain Current**



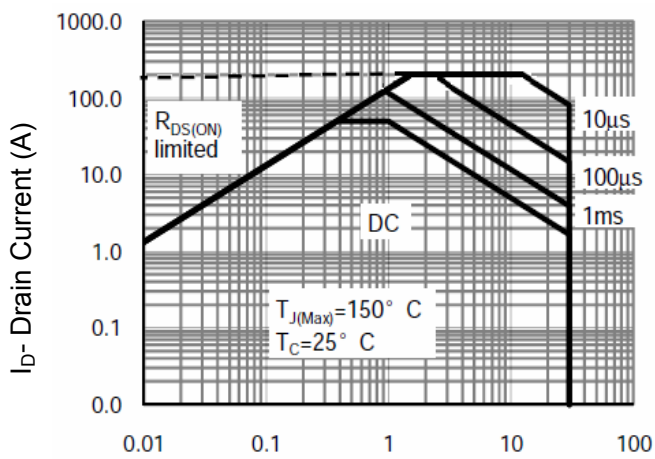
**Figure 6 Source- Drain Diode Forward**



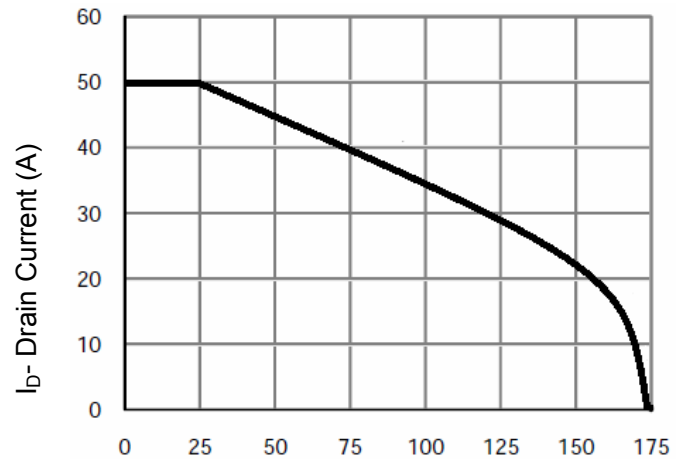
Vds Drain-Source Voltage (V)  
**Figure 7 Capacitance vs Vds**



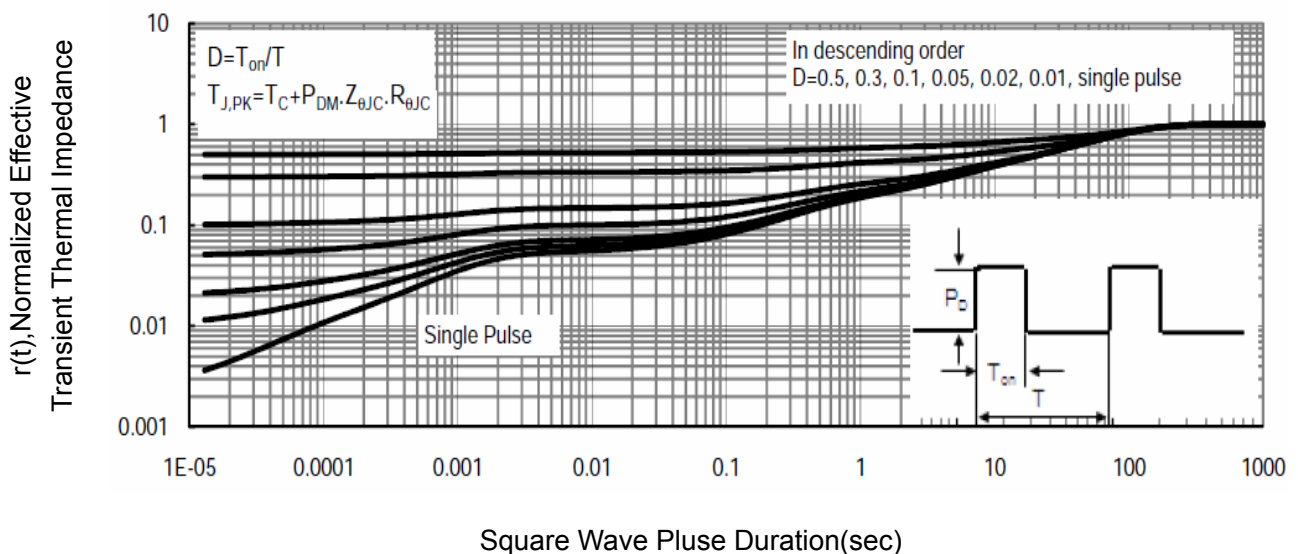
TJ-Junction Temperature(°C)  
**Figure 9 Power De-rating**



Vds Drain-Source Voltage (V)  
**Figure 8 Safe Operation Area**

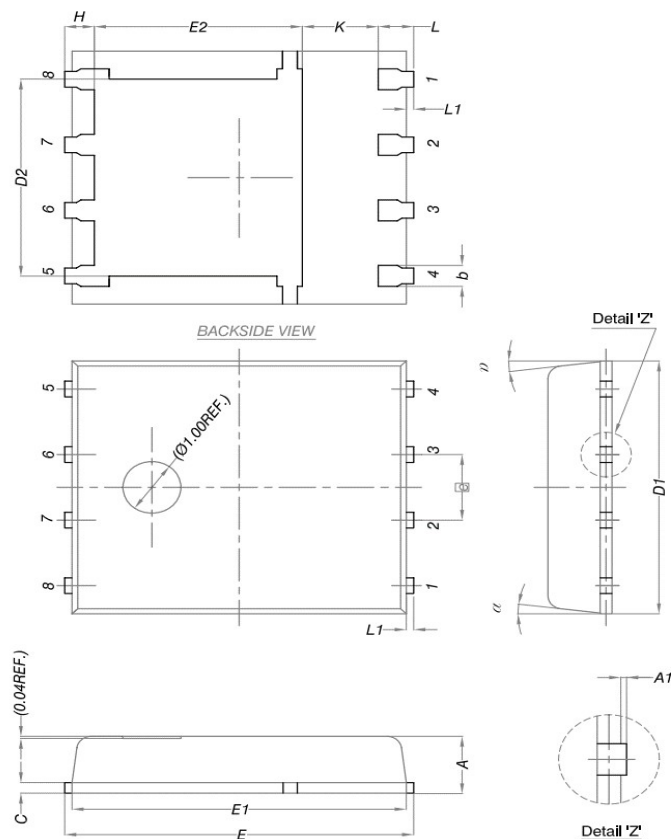


TJ-Junction Temperature(°C)  
**Figure10 ID Current- Junction Temperature**



**Normalized Maximum Transient Thermal Impedance**

## •DFN5\*6 Package Outline



| DIM. | MILLIMETERS |      |      |
|------|-------------|------|------|
|      | MIN.        | NOM. | MAX. |
| A    | 0.90        | 1.00 | 1.10 |
| A1   | 0           | -    | 0.05 |
| b    | 0.33        | 0.41 | 0.51 |
| C    | 0.20        | 0.25 | 0.30 |
| D1   | 4.80        | 4.90 | 5.00 |
| D2   | 3.61        | 3.81 | 3.96 |
| E    | 5.90        | 6.00 | 6.10 |
| E1   | 5.70        | 5.75 | 5.80 |
| E2   | 3.38        | 3.58 | 3.78 |
| e    | 1.27 BSC    |      |      |
| H    | 0.41        | 0.51 | 0.61 |
| K    | 1.10        | -    | -    |
| L    | 0.51        | 0.61 | 0.71 |
| L1   | 0.06        | 0.13 | 0.20 |
| α    | 0°          | -    | 12°  |