

# TM40P03DF

## P -Channel Enhancement Mosfet

### General Description

- Low  $R_{DS(ON)}$
- RoHS and Halogen-Free Compliant

### Applications

- Load switch
- PWM

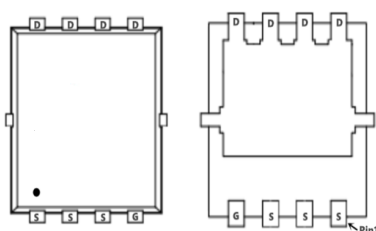
### General Features

$V_{DS} = -30V$   $I_D = -40A$

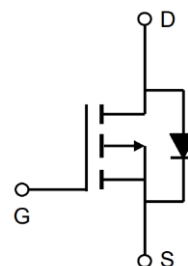
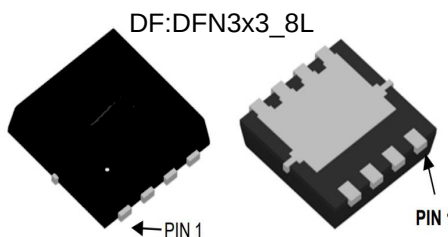
$R_{DS(ON)} = 12m\Omega (typ.) @ V_{GS} = -10V$

100% UIS Tested

100%  $R_g$  Tested



Marking:40P03



### Absolute Maximum Ratings ( $T_A = 25^\circ C$ , unless otherwise noted)

| Symbol                    | Parameter                                   | Rating     |              | Units      |
|---------------------------|---------------------------------------------|------------|--------------|------------|
|                           |                                             | 10s        | Steady State |            |
| $V_{DS}$                  | Drain-Source Voltage                        | -30        |              | V          |
| $V_{GS}$                  | Gate-Source Voltage                         | $\pm 20$   |              | V          |
| $I_D @ T_C = 25^\circ C$  | Continuous Drain Current, $V_{GS} @ -10V^1$ | -40        |              | A          |
| $I_D @ T_C = 100^\circ C$ | Continuous Drain Current, $V_{GS} @ -10V^1$ | -25        |              | A          |
| $I_{DM}$                  | Pulsed Drain Current <sup>2</sup>           | -120       |              | A          |
| EAS                       | Single Pulse Avalanche Energy <sup>3</sup>  | 105        |              | mJ         |
| $I_{AS}$                  | Avalanche Current                           | -50        |              | A          |
| $P_D @ T_A = 25^\circ C$  | Total Power Dissipation <sup>4</sup>        | 15         |              | W          |
| $T_{STG}$                 | Storage Temperature Range                   | -55 to 150 |              | $^\circ C$ |
| $T_J$                     | Operating Junction Temperature Range        | -55 to 150 |              | $^\circ C$ |

### Thermal Data

| Symbol          | Parameter                                        | Typ. | Max. | Unit         |
|-----------------|--------------------------------------------------|------|------|--------------|
| $R_{\theta JA}$ | Thermal Resistance Junction-Ambient <sup>1</sup> | ---  | 66   | $^\circ C/W$ |

**Electrical Characteristics** ( $T_J=25^{\circ}\text{C}$  unless otherwise specified)

| Symbol                                                 | Parameter                                                 | Test Condition                                                                                  | Min. | Typ. | Max. | Units |
|--------------------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------------------------------|------|------|------|-------|
| Off Characteristic                                     |                                                           |                                                                                                 |      |      |      |       |
| V <sub>(BR)DSS</sub>                                   | Drain-Source Breakdown Voltage                            | V <sub>GS</sub> =0V, I <sub>D</sub> = -250μA                                                    | -30  | -    | -    | V     |
| I <sub>DSS</sub>                                       | Zero Gate Voltage Drain Current                           | V <sub>DS</sub> = -30V, V <sub>GS</sub> =0V,                                                    | -    | -    | -1   | μA    |
| I <sub>GSS</sub>                                       | Gate to Body Leakage Current                              | V <sub>DS</sub> =0V, V <sub>GS</sub> = ±20V                                                     | -    | -    | ±100 | nA    |
| On Characteristics                                     |                                                           |                                                                                                 |      |      |      |       |
| V <sub>GS(th)</sub>                                    | Gate Threshold Voltage                                    | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> = -250μA                                      | -1.0 | -1.5 | -2.5 | V     |
| R <sub>DS(on)</sub>                                    | Static Drain-Source on-Resistance<br><small>Note3</small> | V <sub>GS</sub> = -10V, I <sub>D</sub> = -10A                                                   | -    | 12   | 18   | mΩ    |
|                                                        |                                                           | V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -5A                                                   | -    | 18   | 27   |       |
| Dynamic Characteristics                                |                                                           |                                                                                                 |      |      |      |       |
| C <sub>iss</sub>                                       | Input Capacitance                                         | V <sub>DS</sub> = -15V, V <sub>GS</sub> =0V,<br>f=1.0MHz                                        | -    | 1330 | -    | pF    |
| C <sub>oss</sub>                                       | Output Capacitance                                        |                                                                                                 | -    | 183  | -    | pF    |
| C <sub>rss</sub>                                       | Reverse Transfer Capacitance                              |                                                                                                 | -    | 156  | -    | pF    |
| Q <sub>g</sub>                                         | Total Gate Charge                                         | V <sub>DS</sub> = -15V, I <sub>D</sub> = -5A,<br>V <sub>GS</sub> = -10V                         | -    | 22   | -    | nC    |
| Q <sub>gs</sub>                                        | Gate-Source Charge                                        |                                                                                                 | -    | 1.0  | -    | nC    |
| Q <sub>gd</sub>                                        | Gate-Drain(“Miller”) Charge                               |                                                                                                 | -    | 1.8  | -    | nC    |
| Switching Characteristics                              |                                                           |                                                                                                 |      |      |      |       |
| t <sub>d(on)</sub>                                     | Turn-on Delay Time                                        | V <sub>DD</sub> = -15V, I <sub>D</sub> = -10A,<br>V <sub>GS</sub> =-10V, R <sub>GEN</sub> =2.5Ω | -    | 9    | -    | ns    |
| t <sub>r</sub>                                         | Turn-on Rise Time                                         |                                                                                                 | -    | 13   | -    | ns    |
| t <sub>d(off)</sub>                                    | Turn-off Delay Time                                       |                                                                                                 | -    | 48   | -    | ns    |
| t <sub>f</sub>                                         | Turn-off Fall Time                                        |                                                                                                 | -    | 20   | -    | ns    |
| Drain-Source Diode Characteristics and Maximum Ratings |                                                           |                                                                                                 |      |      |      |       |
| I <sub>s</sub>                                         | Maximum Continuous Drain to Source Diode Forward Current  |                                                                                                 | -    | -    | -40  | A     |
| I <sub>SM</sub>                                        | Maximum Pulsed Drain to Source Diode Forward Current      |                                                                                                 | -    | -    | -90  | A     |
| V <sub>SD</sub>                                        | Drain to Source Diode Forward Voltage                     | V <sub>GS</sub> =0V, I <sub>S</sub> = -15A                                                      | -    | -0.8 | -1.2 | V     |
| t <sub>rr</sub>                                        | Reverse Recovery Time                                     | T <sub>J</sub> =25℃,                                                                            | -    | 64   | -    | ns    |
| Q <sub>rr</sub>                                        | Reverse Recovery Charge                                   | V <sub>DD</sub> = -24V, I <sub>F</sub> =-2.8A,<br>dI/dt=-100A/μs                                | -    | 25   | -    | nC    |

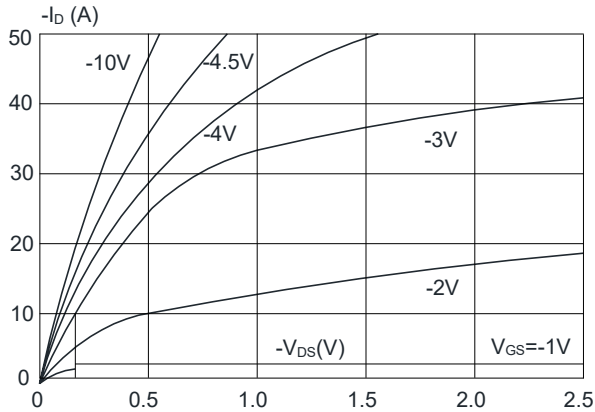
Notes: 1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature

2. EAS condition:  $T_J=25^{\circ}\text{C}$ ,  $V_{GS}=10V$ ,  $R_G=25\Omega$ ,  $L=0.5mH$ ,  $I_{AS}=-12.7A$

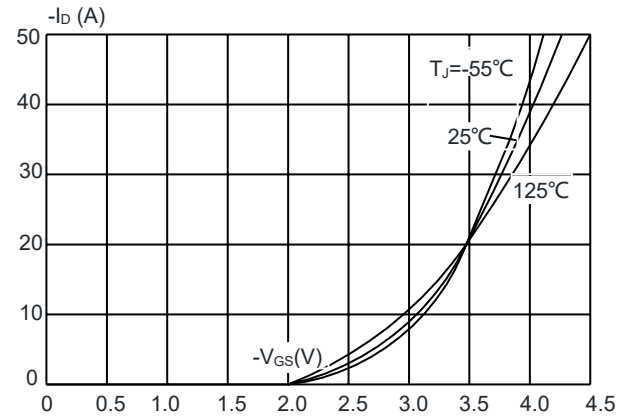
3. Pulse Test: Pulse Width $\leq 300\mu s$ , Duty Cycle $\leq 0.5\%$

## Typical Performance Characteristics

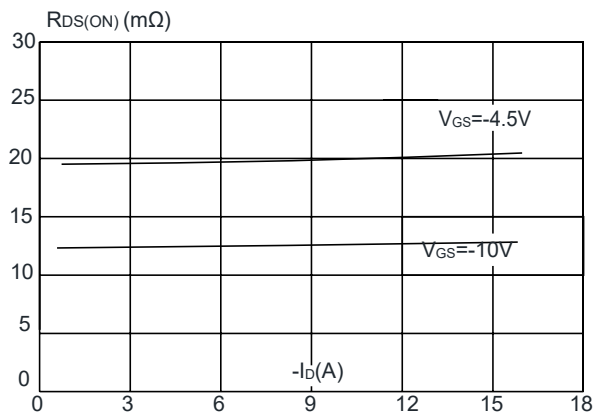
**Figure1: Output Characteristics**



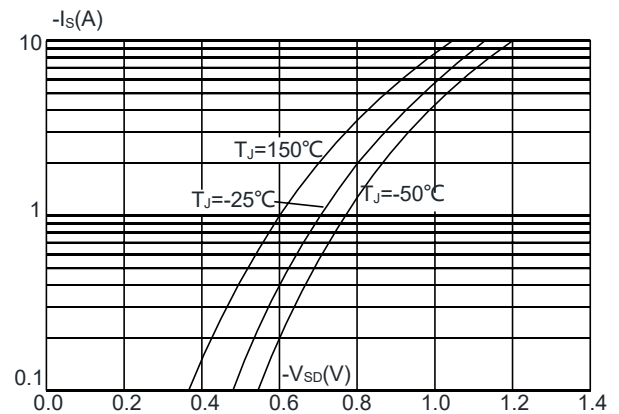
**Figure 2: Typical Transfer Characteristics**



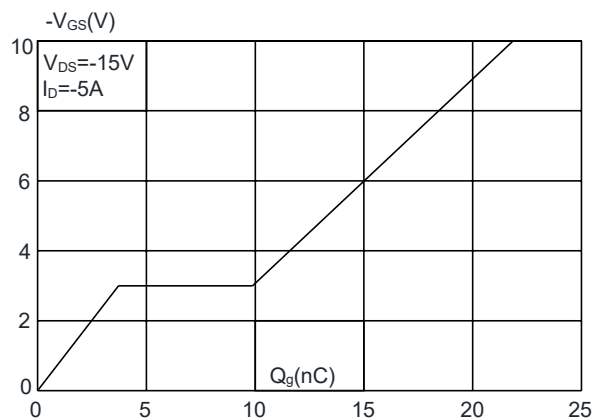
**Figure 3: On-resistance vs. Drain Current**



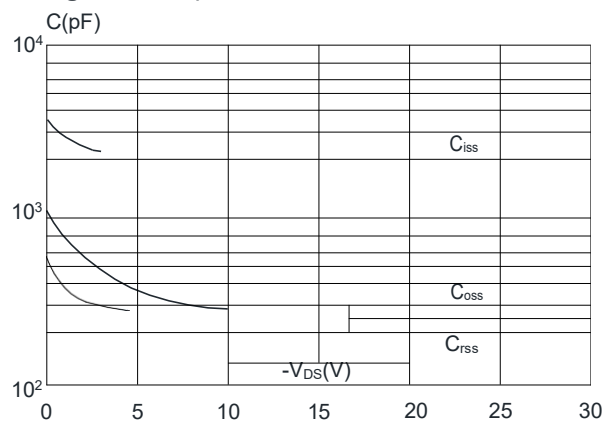
**Figure 4: Body Diode Characteristics**



**Figure 5: Gate Charge Characteristics**

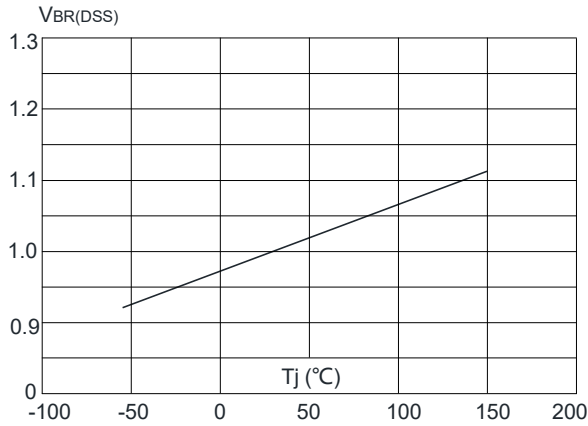


**Figure 6: Capacitance Characteristics**

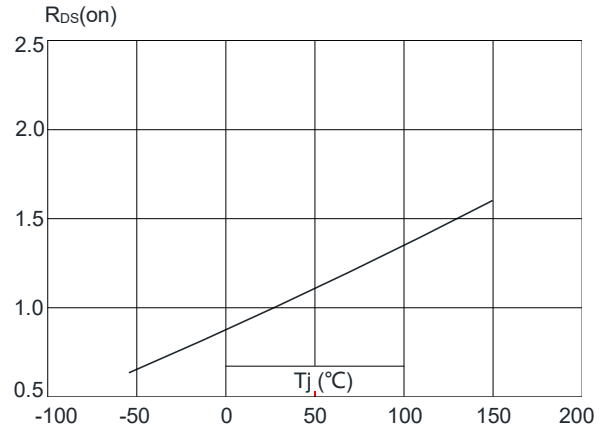


**P -Channel Enhancement Mosfet**

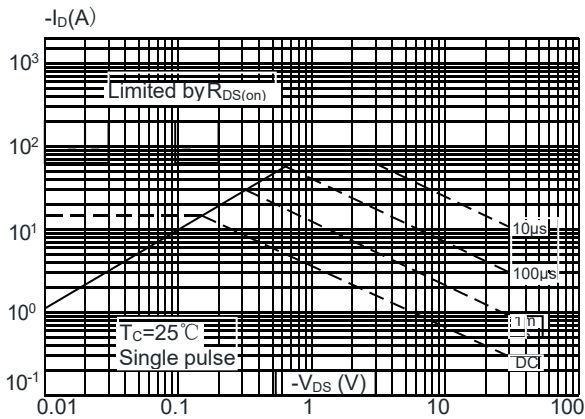
**Figure 7:** Normalized Breakdown Voltage vs. Junction Temperature



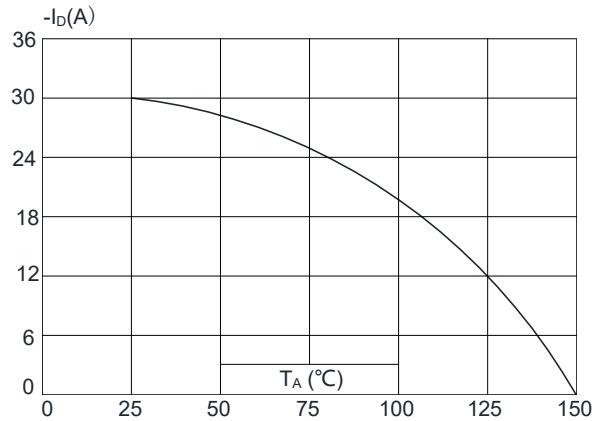
**Figure 8:** Normalized on Resistance vs. Junction Temperature



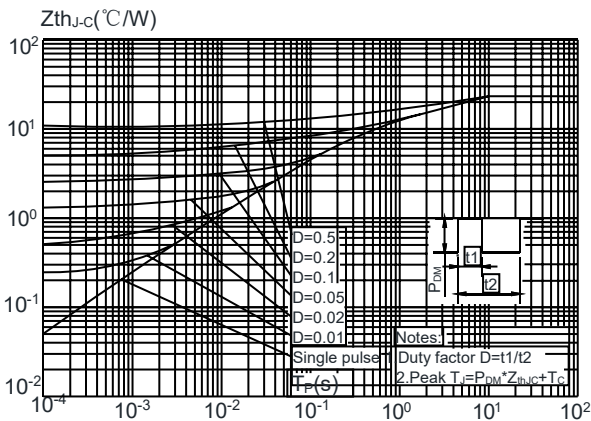
**Figure 9:** Maximum Safe Operating Area



**Figure 10:** Maximum Continuous Drain Current vs. Ambient Temperature



**Figure.11:** Maximum Effective Transient Thermal Impedance, Junction-to-Case

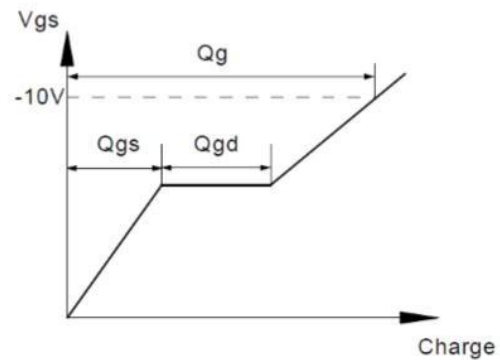
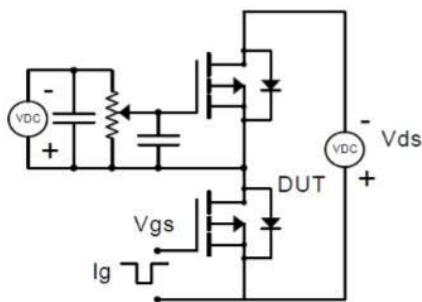




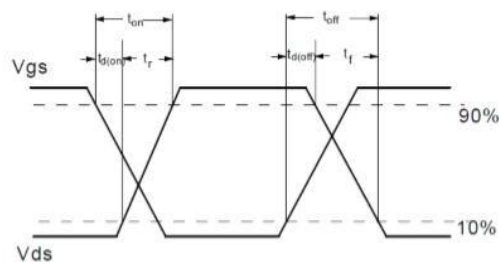
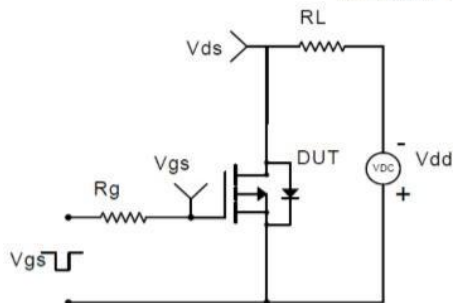


## Test Circuit

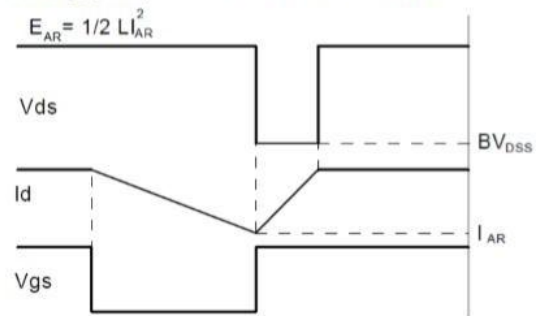
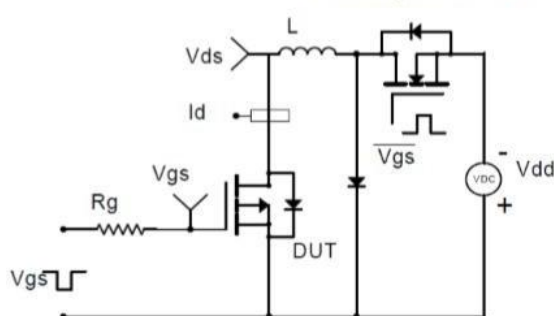
Gate Charge Test Circuit &amp; Waveform



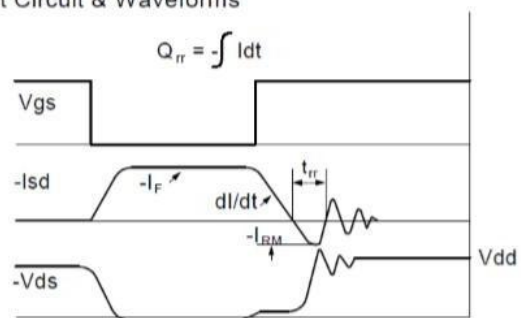
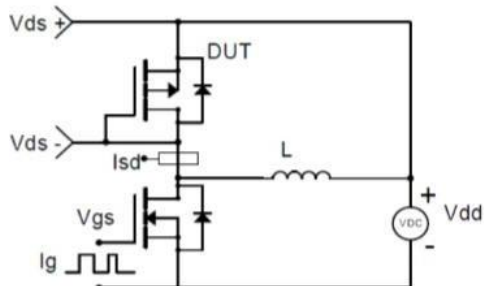
Resistive Switching Test Circuit &amp; Waveforms



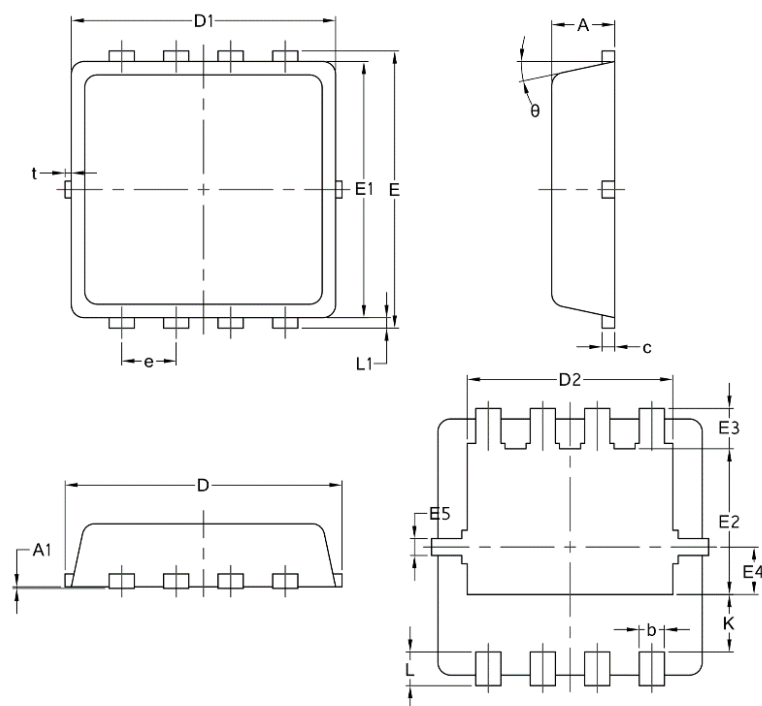
Unclamped Inductive Switching (UIS) Test Circuit &amp; Waveforms



Diode Recovery Test Circuit &amp; Waveforms



## Package Mechanical Data:DFN3x3-8L



| Symbol | Common |       |      |
|--------|--------|-------|------|
|        | mm     |       |      |
|        | Mim    | Nom   | Max  |
| A      | 0.70   | 0.75  | 0.85 |
| A1     | /      | /     | 0.05 |
| b      | 0.20   | 0.30  | 0.40 |
| c      | 0.10   | 0.152 | 0.25 |
| D      | 3.15   | 3.30  | 3.45 |
| D1     | 3.00   | 3.15  | 3.25 |
| D2     | 2.29   | 2.45  | 2.65 |
| E      | 3.15   | 3.30  | 3.45 |
| E1     | 2.90   | 3.05  | 3.20 |
| E2     | 1.54   | 1.74  | 1.94 |
| E3     | 0.28   | 0.48  | 0.65 |
| E4     | 0.37   | 0.57  | 0.77 |
| E5     | 0.10   | 0.20  | 0.30 |
| e      | 0.60   | 0.65  | 0.70 |
| K      | 0.59   | 0.69  | 0.89 |
| L      | 0.30   | 0.40  | 0.50 |
| L1     | 0.06   | 0.125 | 0.20 |
| t      | 0      | 0.075 | 0.13 |
| $\Phi$ | 10     | 12    | 14   |