

## 650V N-Channel Silicon Carbide Power MOSFET

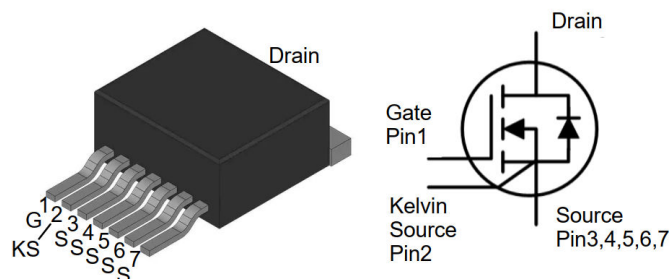
### Features:

- High blocking voltage with low on-resistance
- High speed switching with low capacitance
- High operating junction temperature capability
- Very fast and robust intrinsic body diode
- Kelvin gate input easing driver circuit design

### Applications:

- Solar inverters
- UPS
- Motor drivers
- High voltage DC/DC converters
- Switch mode power supplies

### Package:



Top View

| Part Number | Package   |
|-------------|-----------|
| DTK47N65SC7 | TO-263-7L |

### Absolute Maximum Ratings ( $T_c=25^\circ\text{C}$ unless otherwise specified)

| Symbol    | Parameter                      | Value      | Unit             | Test Conditions  | Note    |
|-----------|--------------------------------|------------|------------------|--|---------|
| $V_{DS}$  | Drain-Source voltage           | 650        | V                | $V_{GS}=0\text{V}$ , $I_D=100\mu\text{A}$                      |         |
| $V_{GS}$  | Gate-Source voltage            | -8 to 20   | V                | Recommended maximum  |         |
| $I_D$     | Drain current (continuous)     | 47         | A                | $V_{GS}=20\text{V}$ , $T_c=25^\circ\text{C}$                   | Fig. 9  |
|           |                                | 34         | A                | $V_{GS}=20\text{V}$ , $T_c=100^\circ\text{C}$                  |         |
| $I_{DM}$  | Drain current (pulsed)         | 132        | A                | Pulse width limited by SOA                                     | Fig. 11 |
| $P_{TOT}$ | Total power dissipation        | 148        | W                | $T_c=25^\circ\text{C}$   | Fig. 12 |
| $T_{stg}$ | Storage temperature range      | -55 to 175 | $^\circ\text{C}$ |  |         |
| $T_J$     | Operating junction temperature | -55 to 175 | $^\circ\text{C}$ |  |         |
| $T_L$     | Solder Temperature             | 260        | $^\circ\text{C}$ | Wave soldering only allowed at leads, 1.6mm from case for 10 s |         |

### Thermal Data

| Symbol            | Parameter                                | Value | Unit               | Note    |
|-------------------|--|-------|--------------------|---------|
| $R_{\theta(J-C)}$ | Thermal Resistance from Junction to Case | 0.88  | $^\circ\text{C/W}$ | Fig. 13 |

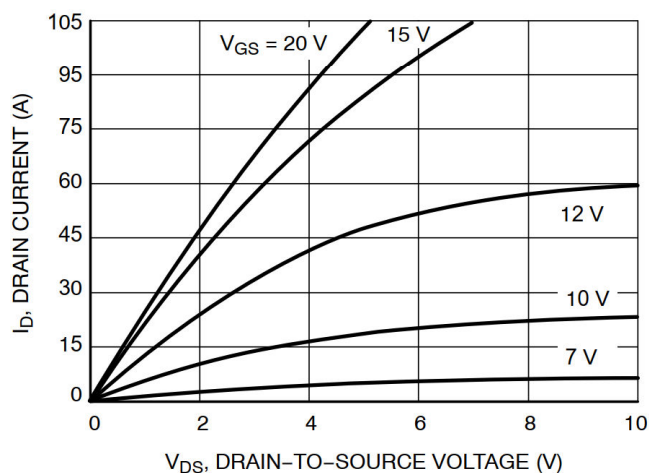
**Electrical Characteristics** ( $T_c=25^{\circ}\text{C}$  unless otherwise specified)

| Symbol              | Parameter                         | Value |      |      | Unit | Test Conditions  | Note         |
|---------------------|-----------------------------------|-------|------|------|------|--|--------------|
|                     |                                   | Min.  | Typ. | Max. |      |  |              |
| I <sub>DSS</sub>    | Zero gate voltage drain current   |       | 5    | 150  | μA   | V <sub>DS</sub> =650V, V <sub>GS</sub> =0V   |              |
| I <sub>GSS</sub>    | Gate leakage current              |       | 1    | ±100 | nA   | V <sub>DS</sub> =0V, V <sub>GS</sub> = -20V  |              |
| V <sub>TH</sub>     | Gate threshold voltage            |       | 2.5  |      | V    | V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =5mA   |              |
|                     |                                   |       | 2.1  |      |      | V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =5mA<br>@ T <sub>c</sub> =175°C                                    |              |
| R <sub>ON</sub>     | Static drain-source on-resistance |       | 45   | 60   | mΩ   | V <sub>GS</sub> =20V, I <sub>D</sub> =20A<br>@T <sub>J</sub> =25°C   | Fig. 2, 3, 4 |
|                     |                                   |       | 62   |      | mΩ   | V <sub>GS</sub> =20V, I <sub>D</sub> =20A<br>@T <sub>J</sub> =175°C  |              |
| C <sub>iss</sub>    | Input capacitance                 |       | 1510 |      | pF   | V <sub>DS</sub> =400V, V <sub>GS</sub> =0V,<br>f=1MHz  | Fig. 8       |
| C <sub>Oss</sub>    | Output capacitance                |       | 98   |      | pF   |  |              |
| C <sub>rss</sub>    | Reverse transfer capacitance      |       | 6    |      | pF   |  |              |
| E <sub>Oss</sub>    | C <sub>Oss</sub> stored energy    |       | 12   |      | μJ   |  |              |
| Q <sub>g</sub>      | Total gate charge                 |       | 59   |      | nC   | V <sub>DS</sub> =400V, I <sub>D</sub> =20A,<br>V <sub>GS</sub> = -5 to 15V   | Fig. 7       |
| Q <sub>gs</sub>     | Gate-source charge                |       | 18   |      | nC   |  |              |
| Q <sub>gd</sub>     | Gate-drain charge                 |       | 14   |      | nC   |  |              |
| R <sub>g</sub>      | Gate input resistance             |       | 3    |      | Ω    | f=1MHz   |              |
| E <sub>ON</sub>     | Turn-on switching energy          |       | 39   |      | μJ   | V <sub>DS</sub> =400V, I <sub>D</sub> =20A,<br>V <sub>GS</sub> = -5 to 15V,<br>R <sub>G(ext)</sub> =2.5Ω,<br>L=100μH |              |
| E <sub>OFF</sub>    | Turn-off switching energy         |       | 10   |      | μJ   |  |              |
| t <sub>d(on)</sub>  | Turn-on delay time                |       | 9    |      | ns   |  |              |
| t <sub>r</sub>      | Rise time                         |       | 10   |      |      |  |              |
| t <sub>d(off)</sub> | Turn-off delay time               |       | 18   |      |      |  |              |
| t <sub>f</sub>      | Fall time                         |       | 7    |      |      |  |              |

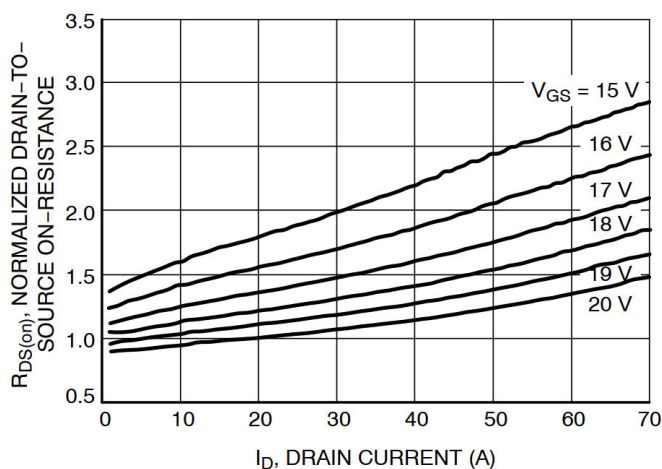
**Reverse Diode Characteristics** ( $T_c=25^{\circ}\text{C}$  unless otherwise specified)

| Symbol    | Parameter                     | Value |      |      | Unit | Test Conditions   | Note   |
|-----------|-------------------------------|-------|------|------|------|---|--------|
|           |                               | Min.  | Typ. | Max. |      |   |        |
| $V_{SD}$  | Diode forward voltage         |       | 4.2  |      | V    | $I_{SD}=10\text{A}$ , $V_{GS}=0\text{V}$                                      | Fig. 6 |
|           |                               |       | 3.8  |      | V    | $I_{SD}=10\text{A}$ , $V_{GS}=0\text{V}$ ,<br>$T_J=175^{\circ}\text{C}$       |        |
| $t_{rr}$  | Reverse recovery time         |       | 13   |      | ns   | $I_{SD}=10\text{A}$ , $V_R=400\text{V}$ ,<br>$di/dt=1000\text{A}/\mu\text{s}$ |        |
| $Q_{rr}$  | Reverse recovery charge       |       | 101  |      | nC   |   |        |
| $I_{RRM}$ | Peak reverse recovery current |       | 8.5  |      | A    |   |        |

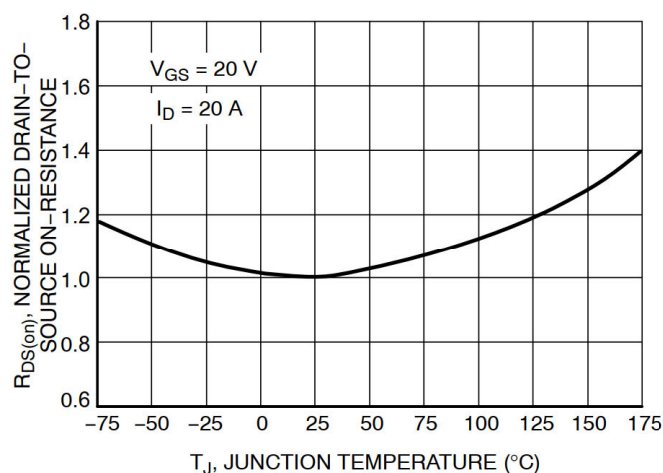
## Typical Performance (curves)



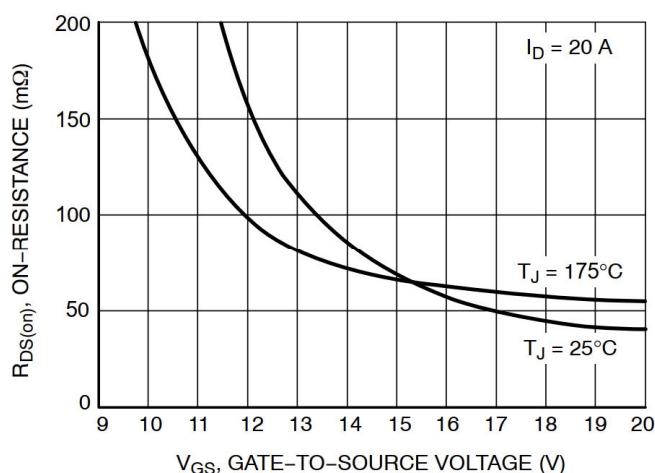
**Figure 1. On-Region Characteristics**



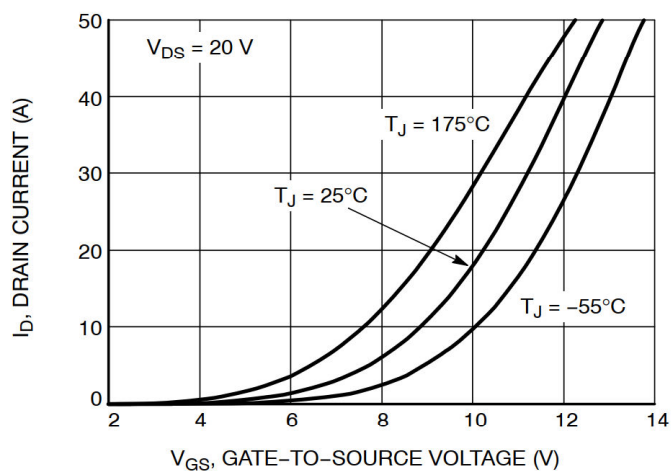
**Figure 2. Normalized On-Resistance vs. Drain Current and Gate Voltage**



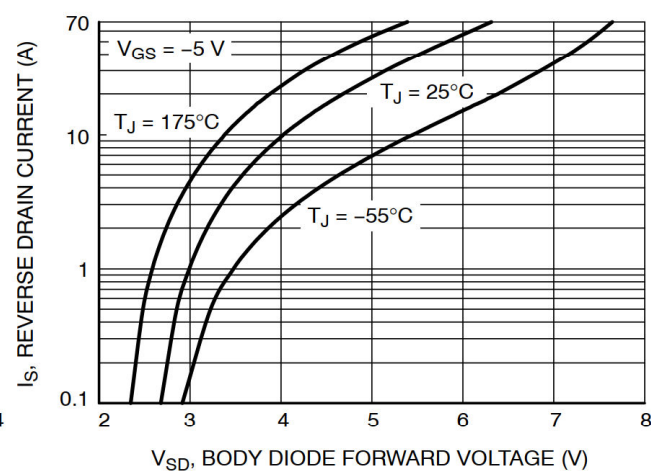
**Figure 3. On-Resistance Variation with Temperature**



**Figure 4. On-Resistance vs. Gate-to-Source Voltage**

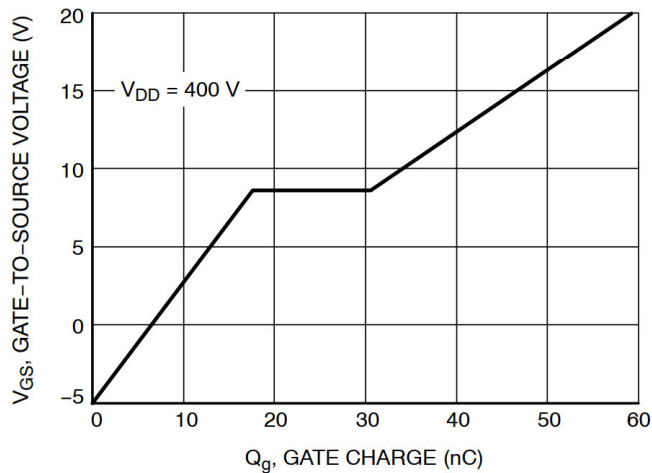


**Figure 5. Transfer Characteristics**

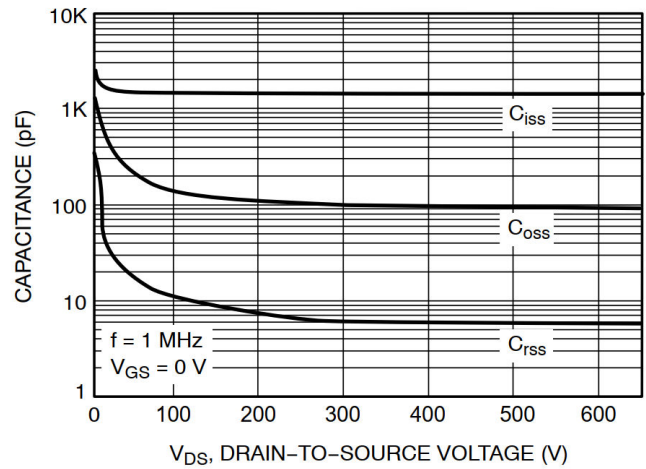


**Figure 6. Diode Forward Voltage vs. Current**

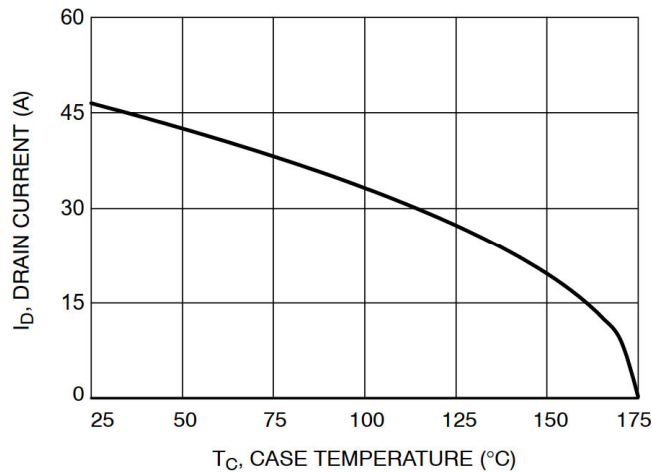
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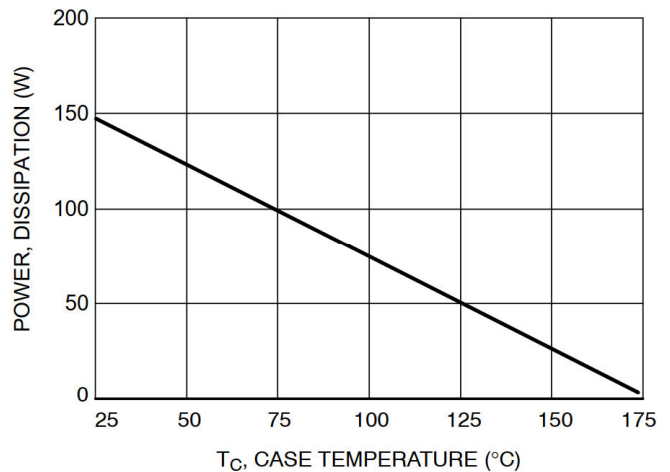
**Figure 7. Gate-to-Source Voltage vs. Total Charge**



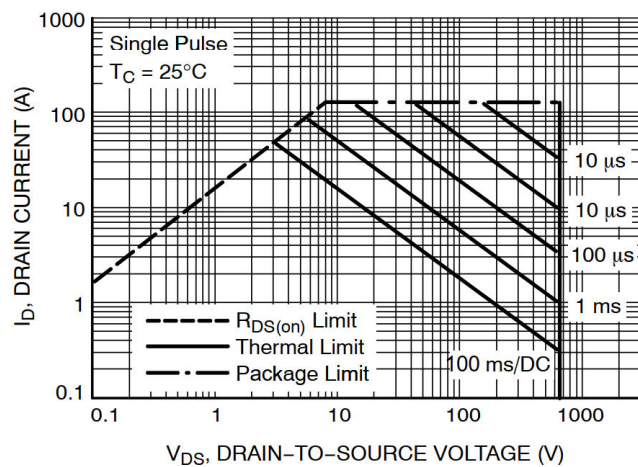
**Figure 8. Capacitance vs. Drain-to-Source Voltage**



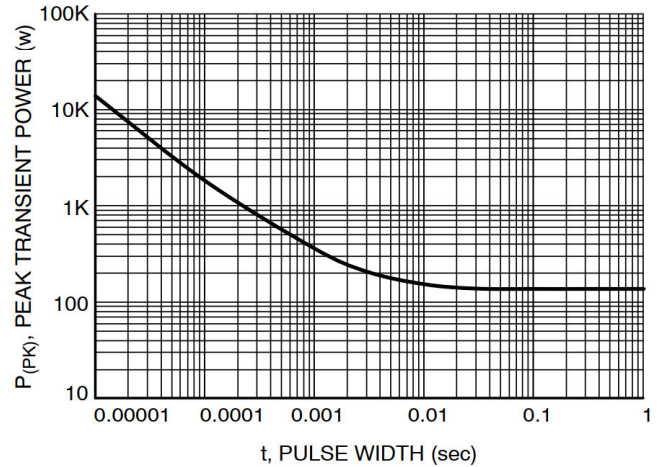
**Figure 9. Maximum Continuous Drain Current vs. Case Temperature**



**Figure 10. Maximum Power Dissipation Derating vs. Case Temperature**



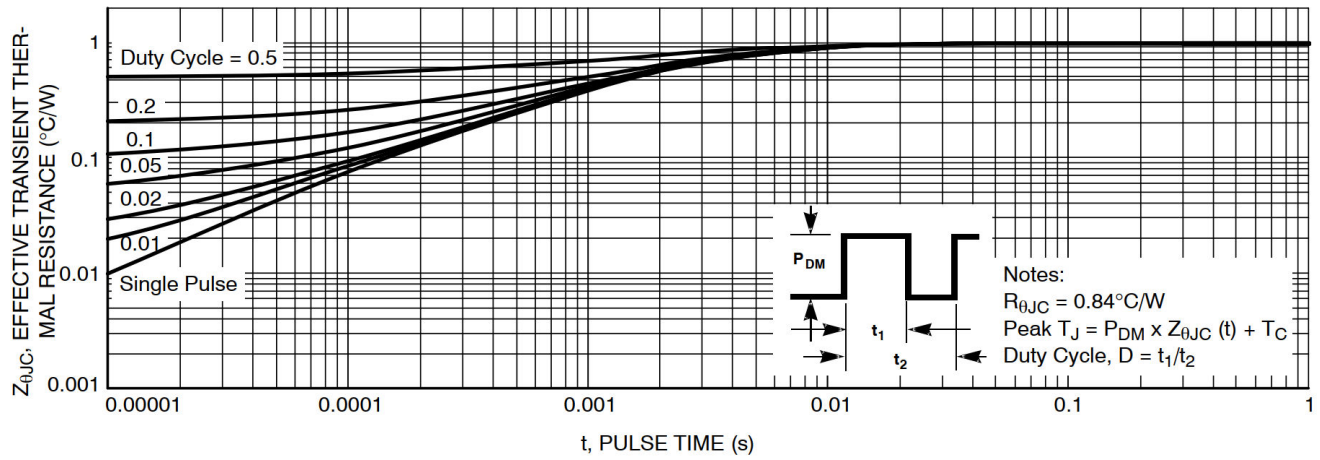
**Figure 11. Safe Operating Area**



**Figure 12. Single Pulse Maximum Power Dissipation**

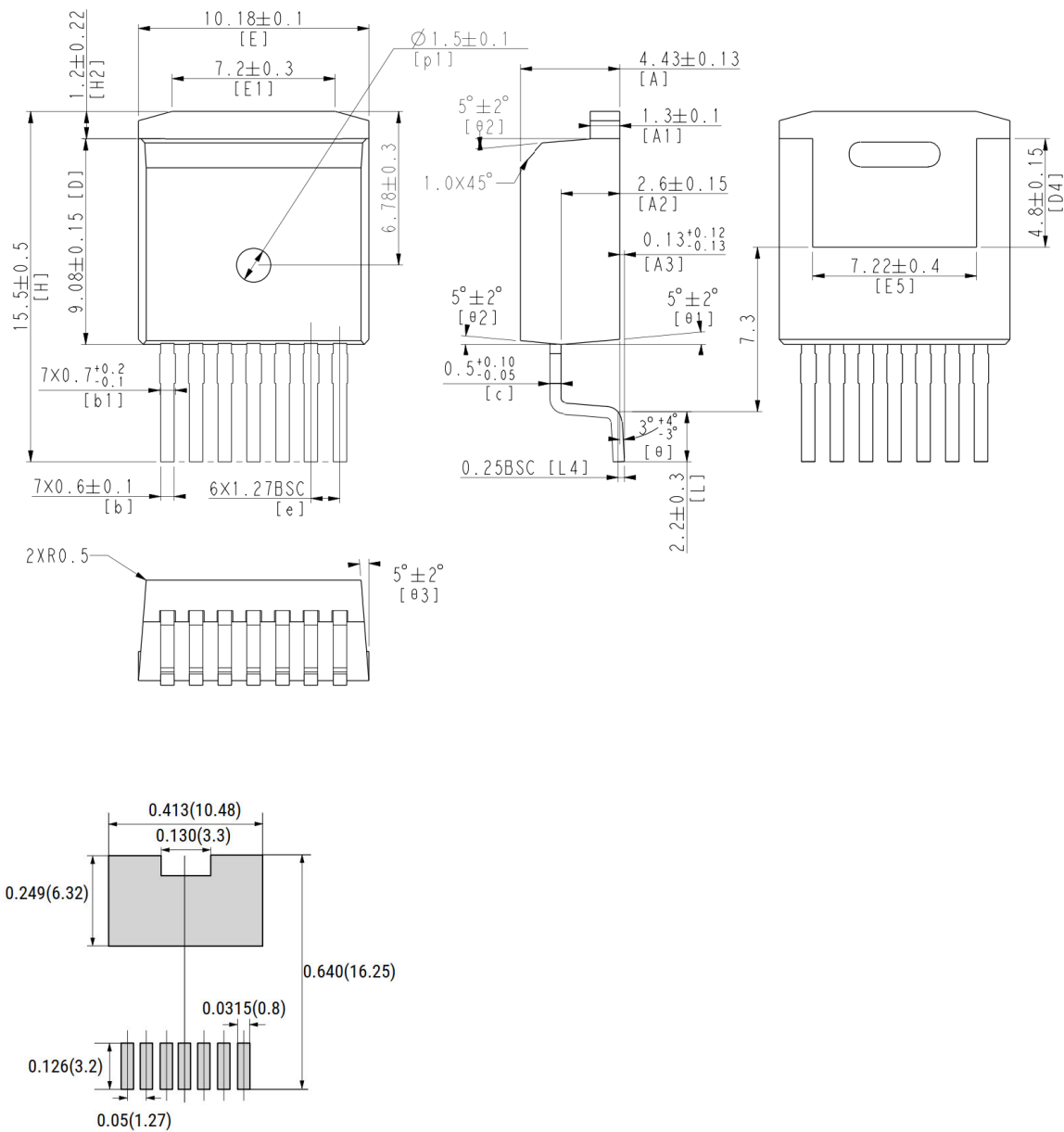


## Typical Performance (curves)



**Figure 13. Junction-to-Case Transient Thermal Response Curve**

# TO-263-7L Package Dimensions



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