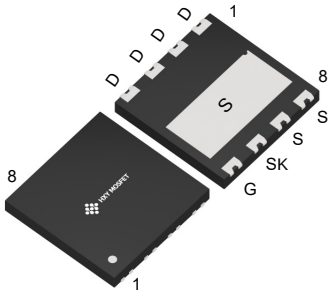
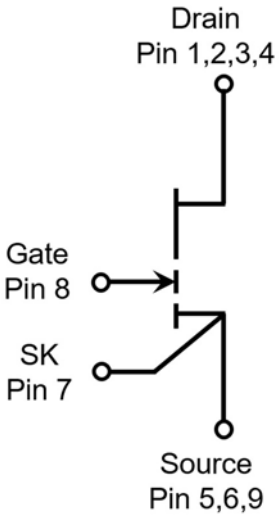
## General Description

650V GaN-on-Silicon Enhancement-mode Power Transistor in Dual Flat No-lead Package (DFN) with 8 mm × 8 mm size.




## Features

- Enhancement-mode transistor - normally-OFF power switch
- Ultra-high switching frequency
- No reverse-recovery charge
- Low gate charge, low output charge
- Qualified for industrial applications according to JEDEC Standards
- ESD safeguard
- RoHS, Pb-free, REACH-compliant




## Applications

- AC-DC converters
- DC-DC converters
- Totem pole PFC
- Fast battery charging
- High-density power conversion
- High-efficiency power conversion

| | |
|---|---|
| Gate | 8 |
| Drain | 1, 2, 3, 4 |
| Kelvin Source | 7 |
| Source | 5, 6, 9 |

## Maximum Ratings

at $T_j$ = 25 °C unless otherwise specified. Continuous application of maximum ratings can deteriorate transistor lifetime. For further information, contact CloudSemi sales office.

**Table 3 Maximum rating**

| Parameters | Symbols | Values | | | Units | Notes/Test Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Drain-source voltage | $V_{DS, max}$ | - | - | 650 | V | $V_{GS}$ = 0 V, $I_D$ = 10 µA |
| Drain-source voltage transient [1] | $V_{DS, transient}$ | - | - | 750 | V | $V_{GS}$ = 0 V, $V_{DS}$ = 750 V |
| Continuous current, drain-source | $I_D$ | - | - | 10 | A | $T_c$ = 25 °C |
| Pulsed current, drain-source [2] | $I_{D, pulse}$ | - | - | 18 | A | $T_c$ = 25 °C; $V_G$ = 6 V |
| Pulsed current, drain-source [2] | $I_{D, pulse}$ | - | - | 10 | A | $T_c$ = 125 °C; $V_G$ = 6 V |
| Gate-source voltage, continuous [3] | $V_{GS}$ | -1.4 | - | +7 | V | $T_j$ = -55 °C to 150 °C |
| Gate-source voltage, pulsed | $V_{GS, pulse}$ | - | - | +10 | V | $T_j$ = -55 °C to 150 °C; $t_{Pulse}$ = 50 ns, f = 100 kHz; open drain |
| Power dissipation | $P_{tot}$ | - | - | 75 | W | $T_c$ = 25 °C |
| Operating temperature | $T_j$ | -55 | - | +150 | °C | |
| Storage temperature | $T_{stg}$ | -55 | - | +150 | °C | |

1. $V_{DS, transient}$ is intended for surge rating during non-repetitive events, $t_{Pulse}$ < 1 µs.
2. Pulse width = 10 µs.
3. The minimum $V_{GS}$ is clamped by ESD protection circuit, as shown in Figure 8.

## Thermal Characteristics

**Table 4 Thermal characteristics**

| Parameters | Symbols | Values | | | Units | Notes/Test Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Thermal resistance, junction-case | $R_{thJC}$ | - | - | 1.65 | °C/W | |
| Reflow soldering temperature | $T_{sold}$ | - | - | 260 | °C | MSL3 |

## Electrical Characteristics

at $T_j$ = 25 °C, unless specified otherwise.

**Table 5 Static characteristics**

| Parameters | Symbols | Values | | | Units | Notes/Test Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate threshold voltage | $V_{GS(TH)}$ | 1.2 | 1.6 | 2.5 | V | $I_D$ = 11 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 25 °C |
| | | - | 1.6 | - | | $I_D$ = 11 mA; $V_{DS}$ = $V_{GS}$; $T_j$ = 125 °C |
| Drain-source leakage current | $I_{DSS}$ | - | 0.4 | 20 | µA | $V_{DS}$ = 650 V; $V_{GS}$ = 0 V; $T_j$ = 25 °C |
| | | - | 4 | - | | $V_{DS}$ = 650 V; $V_{GS}$ = 0 V; $T_j$ = 125 °C |
| Gate-source leakage current | $I_{GSS}$ | - | - | 200 | µA | $V_{GS}$ = 6 V; $V_{DS}$ = 0 V |
| Drain-source on-state resistance | $R_{DS(on)}$ | - | 160 | 200 | mΩ | $V_{GS}$ = 6 V; $I_D$ = 3 A; $T_j$ = 25 °C |
| | | - | 330 | - | mΩ | $V_{GS}$ = 6 V; $I_D$ = 3 A; $T_j$ = 125 °C |
| Gate resistance | $R_G$ | - | 3.5 | - | Ω | f = 5 MHz; open drain |

**Table 6 Dynamic characteristics**

| Parameters | Symbols | Values | | | Units | Notes/Test Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance | $C_{iss}$ | - | 83 | - | pF | $V_{GS}$ = 0 V; $V_{DS}$ = 400 V; f = 100 kHz |
| Output capacitance | $C_{oss}$ | - | 27 | - | pF | $V_{GS}$ = 0 V; $V_{DS}$ = 400 V; f = 100 kHz |
| Reverse transfer capacitance | $C_{rss}$ | - | 0.4 | - | pF | $V_{GS}$ = 0 V; $V_{DS}$ = 400 V; f = 100 kHz |
| Effective output capacitance, energy related [1] | $C_{o(er)}$ | - | 35 | - | pF | $V_{GS}$ = 0 V; $V_{DS}$ = 0 to 400 V |
| Effective output capacitance, time related [2] | $C_{o(tr)}$ | - | 54 | - | pF | $V_{GS}$ = 0 V; $V_{DS}$ = 0 to 400 V |
| Output charge | $Q_{OSS}$ | - | 22 | - | nC | $V_{GS}$ = 0 V; $V_{DS}$ = 0 to 400 V |
| Turn-on delay time | $t_{d(on)}$ | - | 2 | - | ns | $V_{DS}$ = 400 V; $I_D$ = 6 A; L = 318 µH; $V_{GS}$ = 6 V; $R_{on}$ = 10 Ω; $R_{off}$ = 2 Ω |
| Turn-off delay time | $t_{d(off)}$ | - | 4 | - | ns | |
| Rise time | $t_r$ | - | 5 | - | ns | |
| Fall time | $t_f$ | - | 6 | - | ns | |

1. $C_{o(er)}$ is the fixed capacitance that gives the same stored energy as $C_{OSS}$ while $V_{DS}$ is rising from 0 to 400 V.
2. $C_{o(tr)}$ is the fixed capacitance that gives the same charging time as $C_{OSS}$ while $V_{DS}$ is rising from 0 to 400 V.

**Table 7 Gate charge characteristics**

| Parameters | Symbols | Values | | | Units | Notes/Test Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate charge | $Q_G$ | - | 2.3 | - | nC | $V_{GS}$ = 0 to 6 V; $V_{DS}$ = 400 V; $I_D$ = 3 A |
| Gate-source charge | $Q_{GS}$ | - | 0.2 | - | nC | |
| Gate-drain charge | $Q_{GD}$ | - | 0.9 | - | nC | |
| Gate plateau voltage | $V_{Plat}$ | - | 2.4 | - | V | $V_{DS}$ = 400 V; $I_D$ = 3 A |

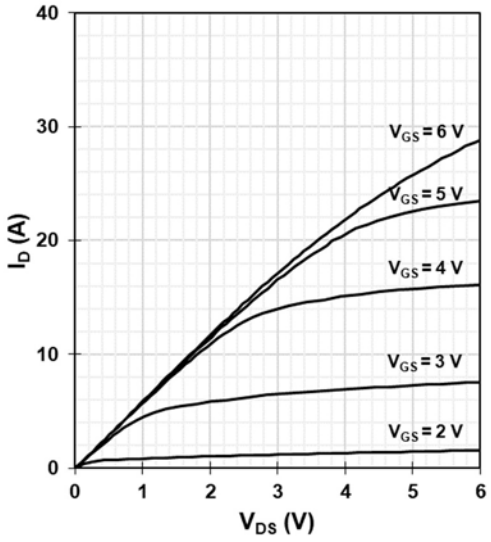
**Table 8 Reverse conduction characteristics**

| Parameters | Symbols | Values | | | Units | Notes/Test Conditions |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Source-drain reverse voltage | $V_{SD}$ | - | 2.5 | - | V | $V_{GS}$ = 0 V; $I_{SD}$ = 3 A |
| Pulsed current, reverse | $I_{S,\ pulse}$ | - | 20 | - | A | $V_{GS}$ = 6 V |
| Reverse recovery charge | $Q_{rr}$ | - | 0 | - | nC | $I_{SD}$ = 3 A; $V_{DS}$ = 400 V |
| Reverse recovery time | $t_{rr}$ | - | 0 | - | ns | |
| Peak reverse recovery current | $I_{rrm}$ | - | 0 | - | A | |

## Electrical Characteristics Diagrams

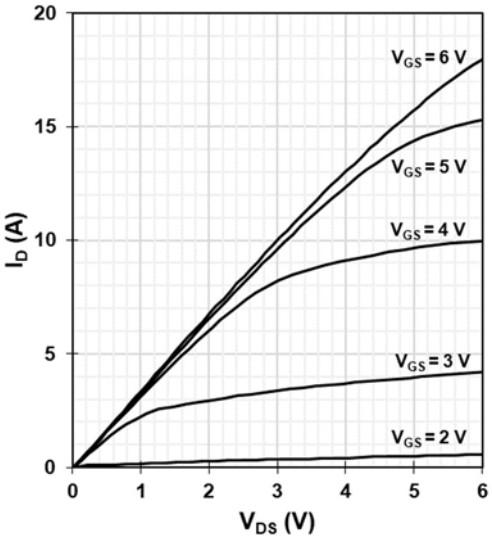
at $T_j$ = 25 °C, unless specified otherwise.

**Figure 1 Typ. output characteristics**



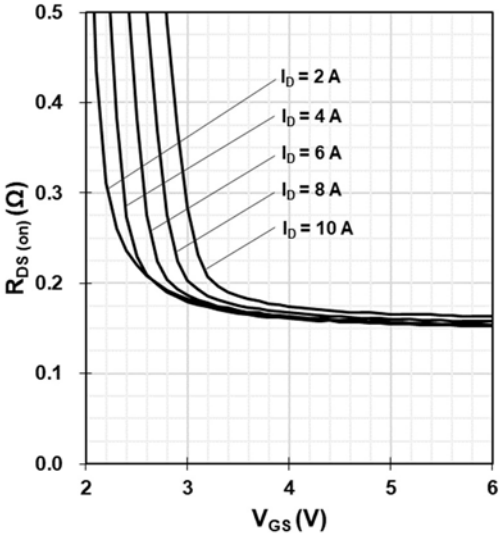

$I_D = f(V_{DS}, V_{GS})$; $T_j$ = 25 °C

**Figure 2 Typ. output characteristics**



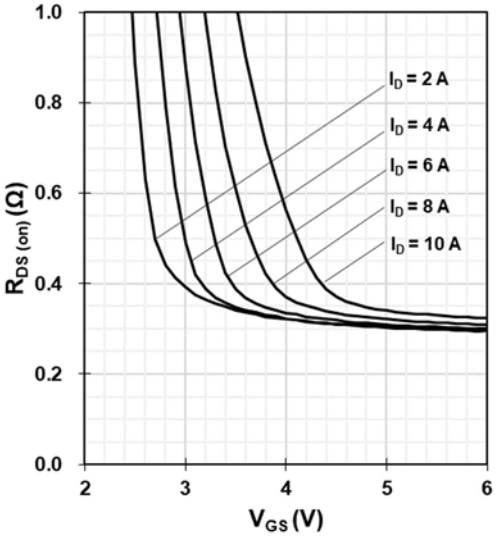

$I_D = f(V_{DS}, V_{GS})$; $T_j$ = 125 °C

**Figure 3 Typ. drain-source on-state resistance**



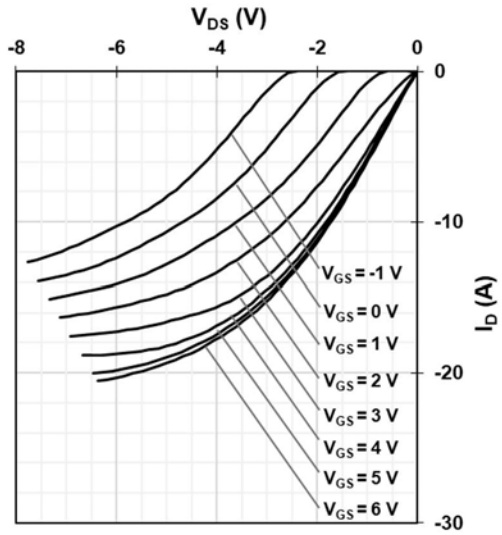

$R_{DS(on)} = f(I_{DS}, V_{GS})$; $T_j$ = 25 °C

**Figure 4 Typ. drain-source on-state resistance**



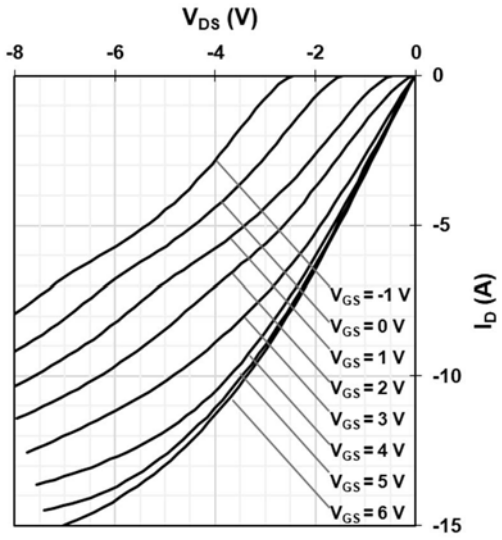

$R_{DS(on)} = f(I_{DS}, V_{GS})$; $T_j$ = 125 °C

**Figure 5 Typ. channel reverse characteristics**



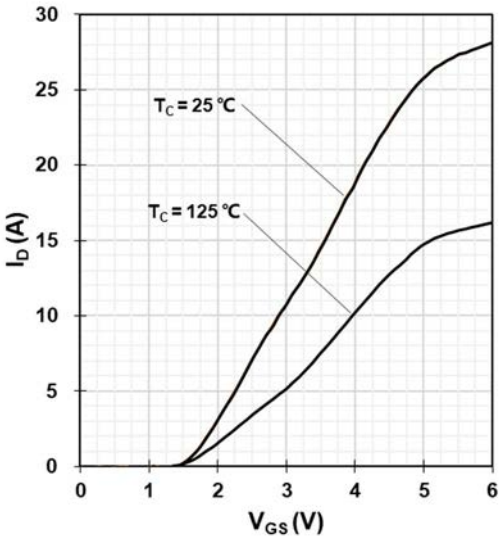

$I_D = f(V_{DS}, V_{GS})$; $T_j$ = 25 °C

**Figure 6 Typ. channel reverse characteristics**



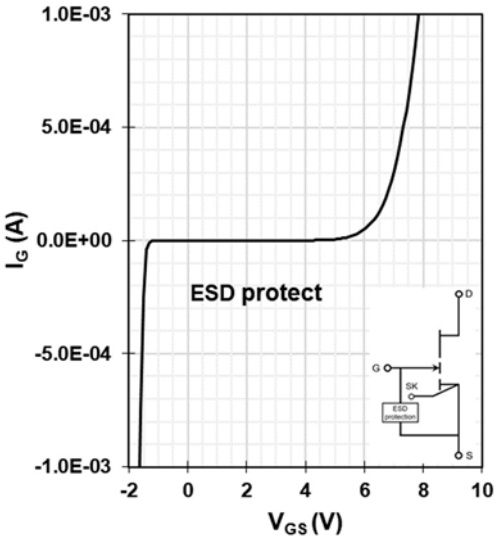

$I_D = f(V_{DS}, V_{GS})$; $T_j$ = 125 °C

**Figure 7 Typ. transfer characteristics**



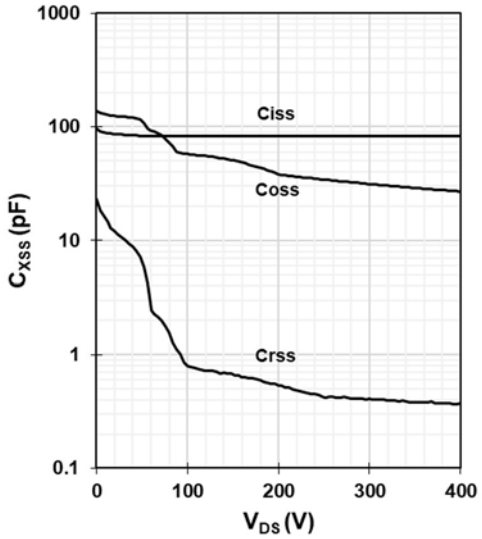

$I_D = f(V_{GS})$; $V_{DS}$ = 5 V

**Figure 8 Typ. gate-to-source leakage**



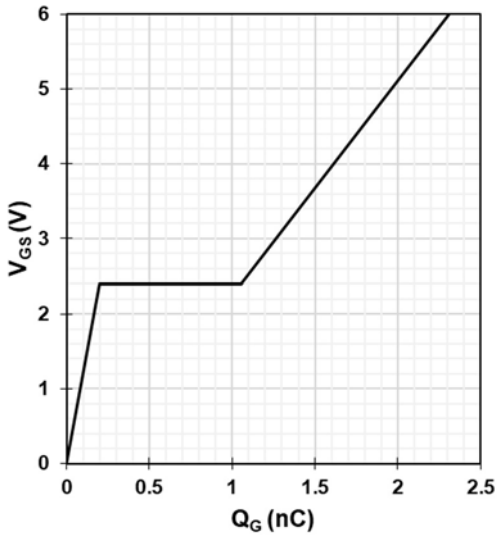

$I_G = f(V_{GS})$; $I_G$ reverse turn on by ESD unit; $V_D$ = open

**Figure 9 Typ. capacitances**



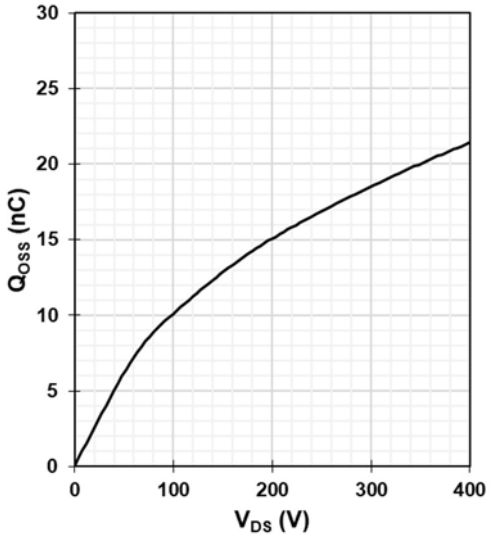

$C_{XSS}$ = f($V_{DS}$); Freq. = 100 kHz

**Figure 10 Typ. gate charge**



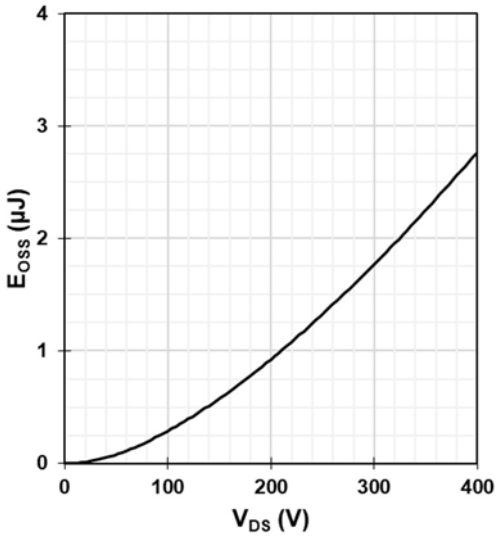

$V_{GS}$ = f($Q_G$); $V_{DC-LINK}$ = 400 V; $I_D$ = 3 A

**Figure 11 Typ. output charge**



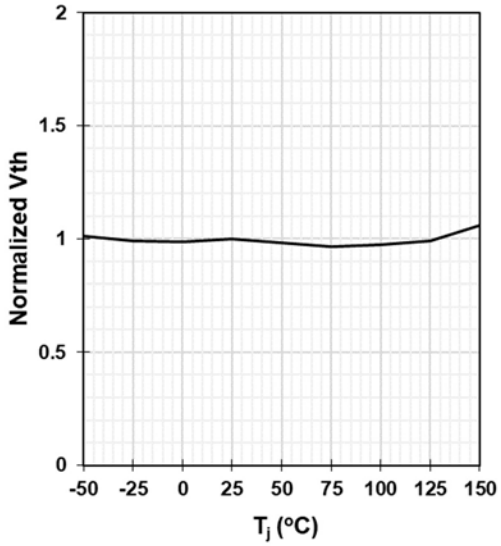

$Q_{OSS}$ = f($V_{DS}$); Freq. = 100 kHz

**Figure 12 Typ. $C_{oss}$ stored energy**



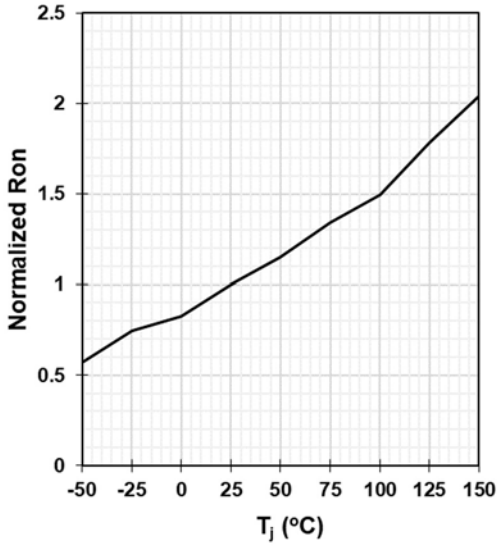

$E_{OSS}$ = f($V_{DS}$); Freq. = 100 kHz

**Figure 13 Gate threshold voltage**



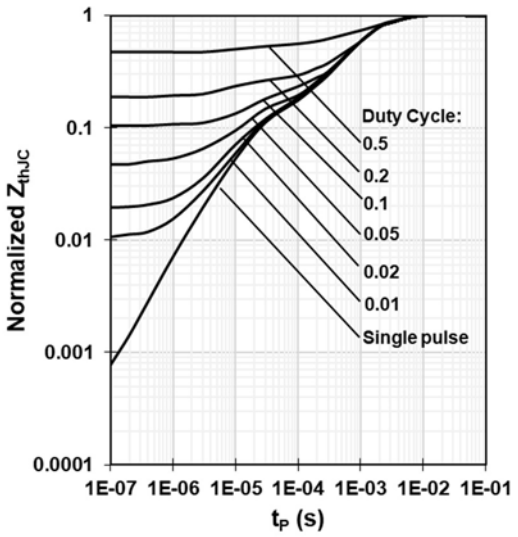

$V_{TH} = f(T_j)$; $V_{GS} = V_{DS}$; $I_D$ = 11 mA

**Figure 14 Drain-source on-state resistance**



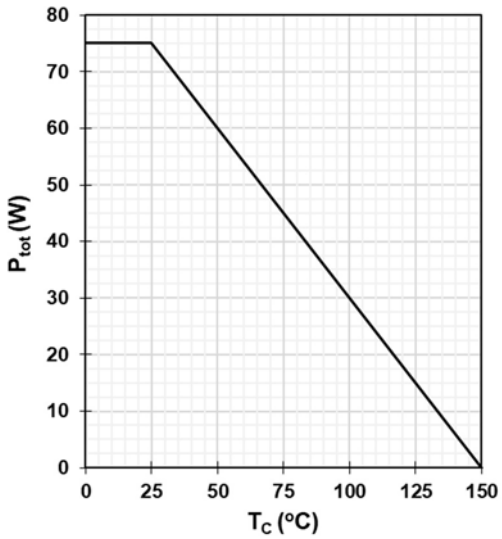

$R_{DS(on)} = f(T_j)$; $I_D$ = 3 A; $V_{GS}$ = 6 V

**Figure 15 Max. transient thermal impedance**



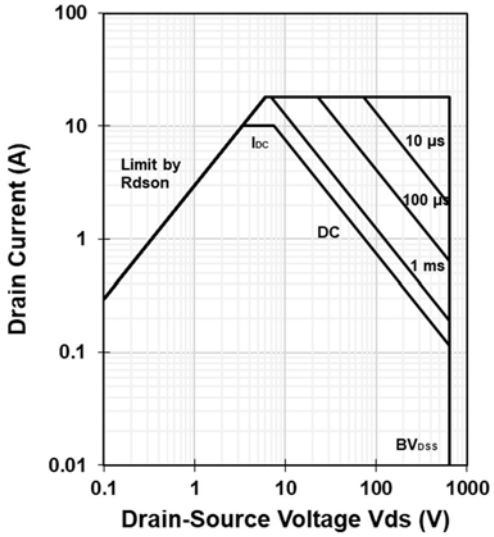

$Z_{thJC} = f(t_P, D)$

**Figure 16 Power dissipation**



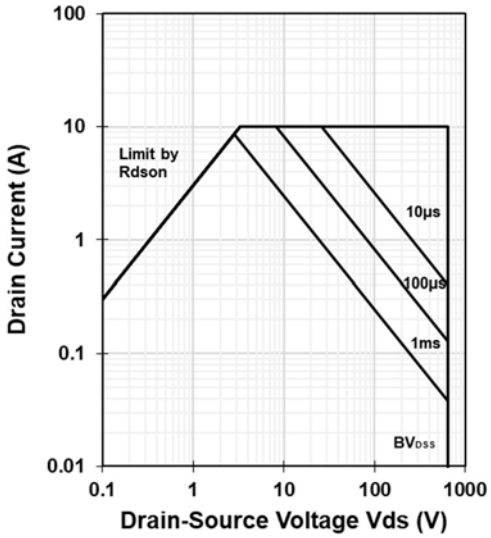

$P_{tot} = f(T_C)$

**Figure 17 Safe operating area**



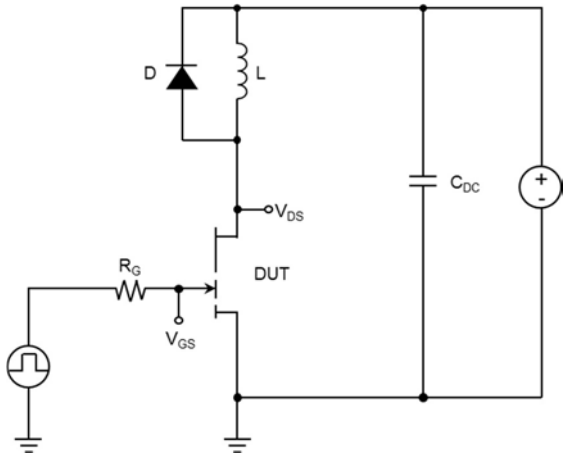

$I_D = f(V_{DS})$; $T_C$ = 25 °C

**Figure 18 Safe operating area**




$I_D = f(V_{DS})$; $T_C$ = 125 °C

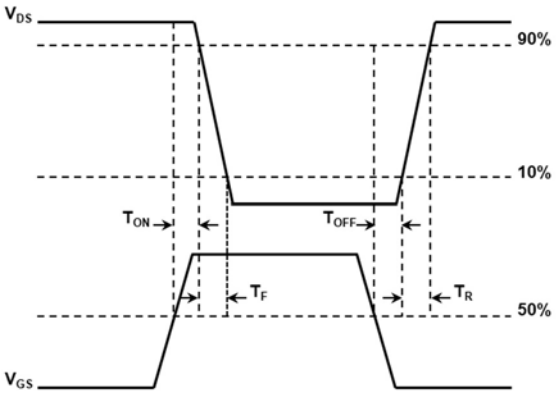
**Figure 19 Max. transient thermal impedance**



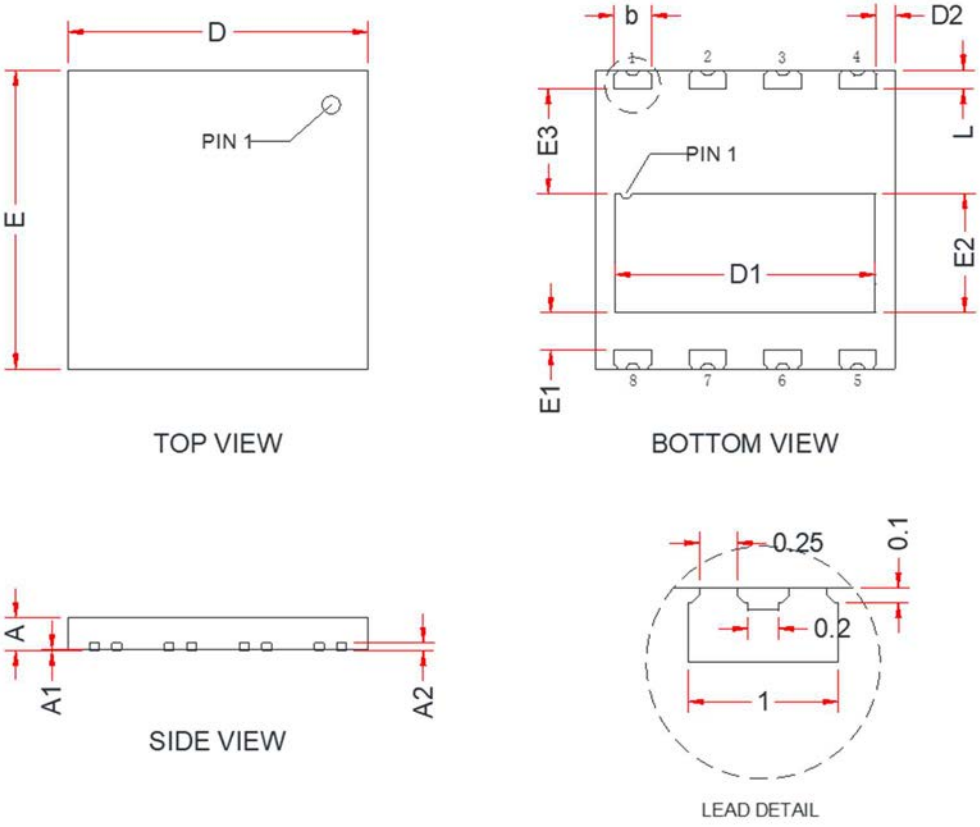

$V_{DS}$ = 400 V, $I_D$ = 6 A, L = 318 µH, $V_{GS}$ = 6 V,

$R_{on}$ = 10 Ω, $R_{off}$ = 2 Ω

**Figure 20 Typ. switching times waveform**

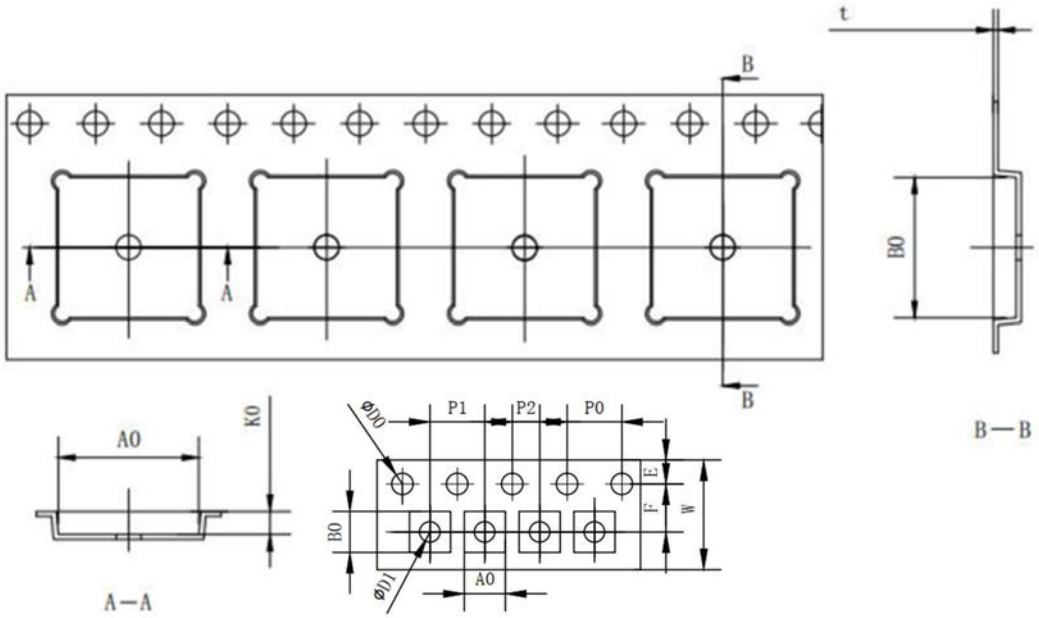


## Package Outlines

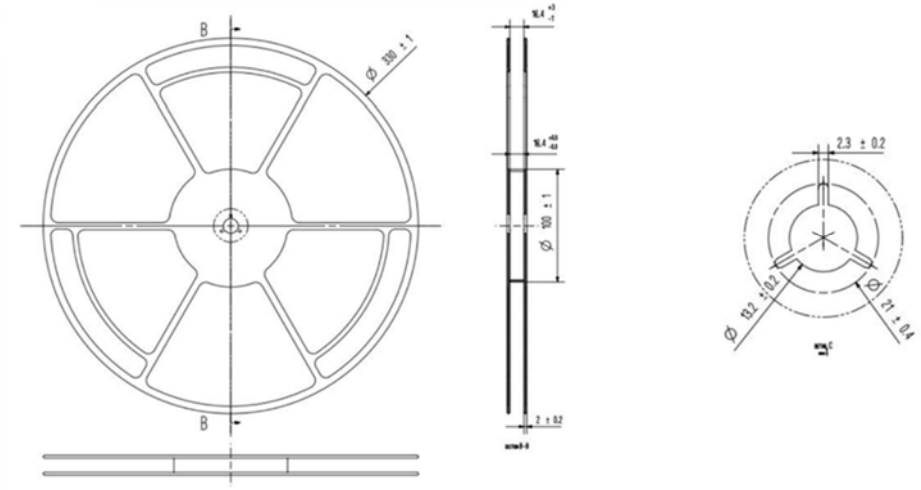



| | MIN | MID | MAX |
|---|---|---|---|
| A | 0.75 | 0.85 | 0.95 |
| A1 | 0.00 | 0.02 | 0.05 |
| A2 | | 0.203REF | |
| b | 0.95 | 1.00 | 1.05 |
| D | | 8.00BSC | |
| D1 | 6.84 | 6.94 | 7.04 |
| D2 | 0.40 | 0.50 | 0.60 |
| E | | 8.00BSC | |
| E1 | 0.90 | 1.00 | 1.10 |
| E2 | 3.10 | 3.20 | 3.30 |
| E3 | 2.70 | 2.80 | 2.90 |
| e | | 2.00BSC | |
| L | 0.40 | 0.50 | 0.60 |

## Reel Information




| SYMBOL | DIMENSION | SYMBOL | DIMENSION |
|---|---|---|---|
| W | 16.00±0.30 | 10P0 | 40.00±0.20 |
| E | 1.75±0.10 | P1 | 12.00±0.10 |
| F | 7.50±0.10 | A0 | 8.30±0.10 |
| D0 | 1.50±0.10 | B0 | 8.30±0.10 |
| D1 | 1.50±0.10 | K0 | 1.10±0.10 |
| P0 | 4.00±0.10 | T | 0.30±0.05 |
| P2 | 2.00±0.10 | | |



## Attention

■ Any and all HUA XUAN YANG ELECTRONICS products described or contained herein do not have specifications that can handle applications that require extremely high levels of reliability, such as life-support systems, aircraft's control systems, or other applications whose failure can be reasonably expected to result in serious physical and/or material damage. Consult with your HUA XUAN YANG ELECTRONICS representative nearest you before using any HUA XUAN YANG ELECTRONICS products described or contained herein in such applications.

■ HUA XUAN YANG ELECTRONICS assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all HUA XUAN YANG ELECTRONICS products described or contained herein.

■ Specifications of any and all HUA XUAN YANG ELECTRONICS products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.

■ HUA XUAN YANG ELECTRONICS CO.,LTD. strives to supply high-quality high-reliability products. However, any and all semiconductor products fail with some probability. It is possible that these probabilistic failures could
give rise to accidents or events that could endanger human lives, that could give rise to smoke or fire, or that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.

■ In the event that any or all HUA XUAN YANG ELECTRONICS products(including technical data, services) described or contained herein are controlled under any of applicable local export control laws and regulations, such products must not be exported without obtaining the export license from the authorities concerned in accordance with the above law.

■ No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written permission of HUA XUAN YANG ELECTRONICS CO.,LTD.

■ Information (including circuit diagrams and circuit parameters) herein is for example only ; it is not guaranteed for volume production. HUA XUAN YANG ELECTRONICS believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.

■ Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the HUA XUAN YANG ELECTRONICS product that you intend to use.

# Unikeyic Electronics

Global Electronic Components Distributor

Click to view pricing, inventory, delivery, and lifecycle information:

## HXY MOSFET:

DMN2041L-7 HAQ4024-01FTG-C HGSOT36C-HE3-08 SMF33CA AOTL66912 HCEZ36V,L3F HGSOT24C-HG3-08 HGSOT36C-HG3-08 HLY323BC1524L PESD12VU1UT,215 DMN3042L DMP3130LQ-7 HESD5V0D5B-TP HNUP2115LT3G HUCD32C05L01-AT HPTVSUC3D5VB NVTFS5C478NL SMAJ16CA DMP3160L HACPDQC5V0-HF IRFH8318TRPBF ZXMN2F34FH DMN2046U-7 RRR030P03TL RZR025P01TL HC3D02120E HGSOT36C-E3-08 HUDD32C12L01 3DD13003 AON6362