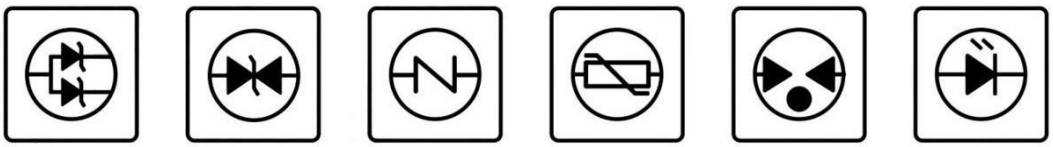
MSKSEMI 美森科
SEMICONDUCTOR




# 2N7002KDW

**Product specification**

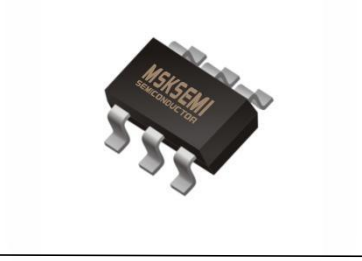
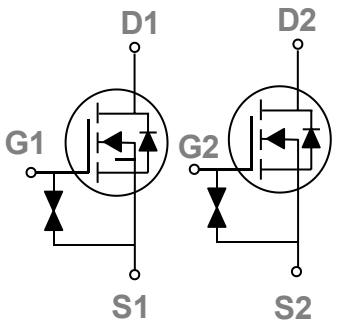
## General Features

- 60V,0.3A,RDS(ON)=1.8Ω@VGS=10V
  Improved dv/dt capability
- Fast switching
- Green Device Available
- G-S ESD Protection Diode Embedded

## Application

- Motor Drive
- Power Tools
- LED Lighting

## Reference News

| PACKAGE OUTLINE | Pin Configuration | Marking |
|---|---|---|
|  SOT-363 |  |  |

## Absolute Maximum Ratings (TA=25℃ unless otherwise

| Symbol | Parameter | Rating | Units |
|---|---|---|---|
| $V_{DS}$ | Drain- Source Voltage | 60 | V |
| $V_{GS}$ | Gate- Source Voltage | ±20 | V |
| $I_D$ | Drain Current – Continuous ($T_A$=25℃) | 0.3 | A |
| | Drain Current – Continuous ($T_A$=70℃) | 0.24 | A |
| $I_{DM}$ | Drain Current – Pulsed[1] | 1.2 | A |
| $P_D$ | Power Dissipation ($T_A$=25℃) | 0.28 | W |
| | Power Dissipation – Derate above 25℃ | 0.002 | W/℃ |
| $T_{STG}$ | Storage Temperature Range | -50 to 150 | ℃ |
| $T_J$ | Operating Junction Temperature Range | -50 to 150 | ℃ |

## Thermal Characteristics

| Symbol | Parameter | Typ. | Max. | Unit |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance Junction to ambient | --- | 450 | ℃/W |

## ElectricalCharacteristics(TJ=25℃,unlessotherwise noted) Off Characteristics

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| BVDSS | Drain- Source Breakdown Voltage | VGS=0V , ID=250uA | 60 | --- | --- | V |
| △BVDSS/△TJ | BVDSS Temperature Coefficient | Reference to 25℃, ID=1mA | --- | 0.04 | --- | V/℃ |
| IDSS | Drain- Source Leakage Current | VDS=60V , VGS=0V , TJ=25℃ | --- | --- | 1u | A |
| | | VDS=48V , VGS=0V , TJ=125℃ | --- | --- | 100u | A |
| IGSS | Gate- Source Leakage Current | VGS= ±20V , VDS=0V | --- | --- | ±10 | A |

## On Characteristics

| | | | | | | |
|---|---|---|---|---|---|---|
| RDS(ON) | Static Drain- Source On- Resistance | VGS=10V , ID=0.3A | --- | 1.8 | 2.8 | Ω |
| | | VGS=4.5V , ID=0.2A | --- | 2.2 | 3 | Ω |
| VGS(th) | Gate Threshold Voltage | VGS=VDS , ID =250uA | 1 | 1.6 | 2.5 | V |
| △VGS(th) | VGS(th) Temperature Coefficient | | --- | -4 | --- | Mv/℃ |
| gfs | Forward Transconductance | VDS=10V , ID=0. 1A | --- | 0.24 | --- | S |

## Dynamic and switching Characteristics

| | | | | | | |
|---|---|---|---|---|---|---|
| Qg | Total Gate Charge[2,3] | VDS=30V , VGS=10V , ID=0.2A | --- | 1.1 | | nC |
| Qgs | Gate-Source Charge[2,3] | | --- | 0.1 | | |
| Qgd | Gate-Drain Charge[2,3] | | --- | 0.23 | | |
| Td(on) | Turn-On Delay Time[2,3] | VDD=30V , VGS=10V , RG=6Ω ID=0.2A | --- | 3 | | nS |
| Tr | Rise Time[2,3] | | --- | 5 | | |
| Td(off) | Turn-Off Delay Time[2,3] | | --- | 14 | | |
| Tf | Fall Time[2,3] | | --- | 9 | | |
| Ciss | Input Capacitance | VDS=10V , VGS=0V , F=1MHz | --- | 30.6 | | pF |
| Coss | Output Capacitance | | --- | 5.5 | | |
| Crss | Reverse Transfer Capacitance | | --- | 4 | | |

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| IS | Continuous Source Current | VG=VD=0V , Force Current | --- | --- | 0.3 | A |
| ISM | Pulsed Source Current | | --- | --- | 0.6 | A |
| VSD | Diode Forward Voltage | VGS=0V , IS=1A , TJ=25°C | --- | --- | 1.2 | V |

Note :

1. Repetitive Rating : Pulsed width limited by maximum junction temperature.
2. The data tested by pulsed , pulse width ≦ 300us , duty cycle ≦ 2%.
3. Essentially independent of operating temperature.

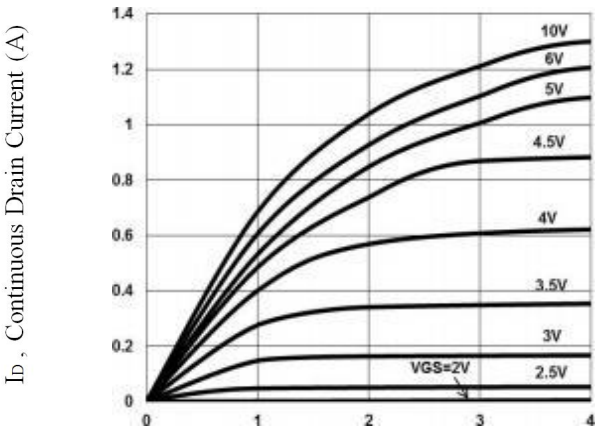



**Fig. 1 Output Characteristics**

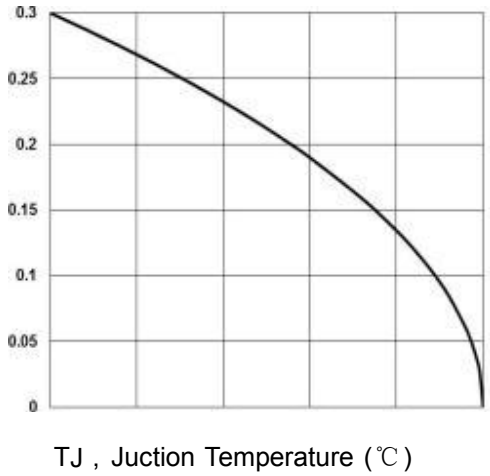



**Fig. 2 Continuous Drain Current vs. TJ**

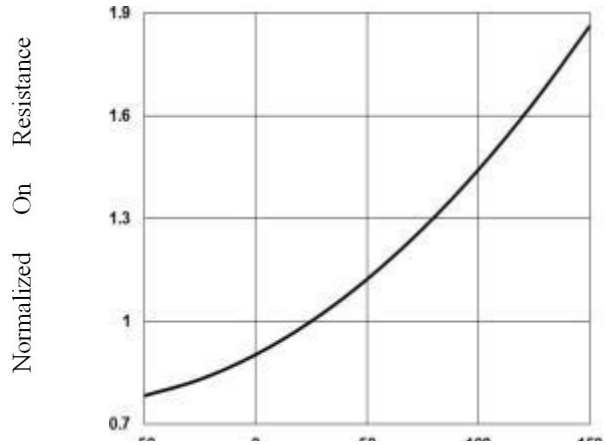



**Fig. 3 Normalized RDSON vs. TJ**

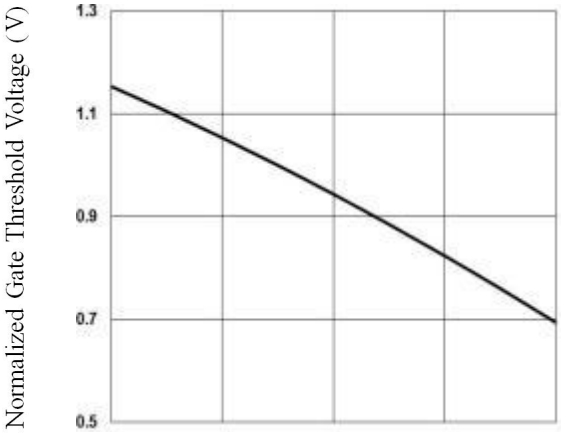



**Fig. 4 Normalized Vth vs. TJ**

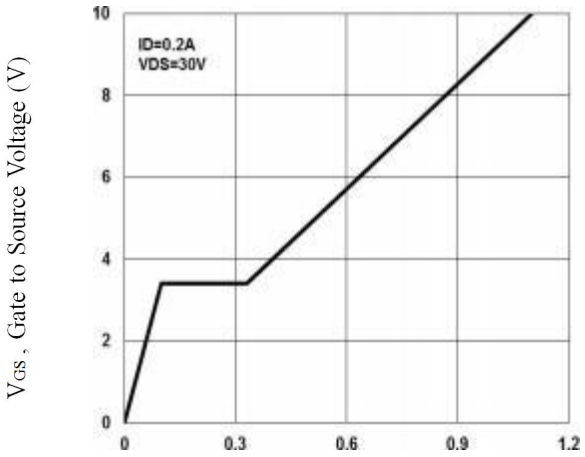



**Fig. 5 Gate Charge Waveform**

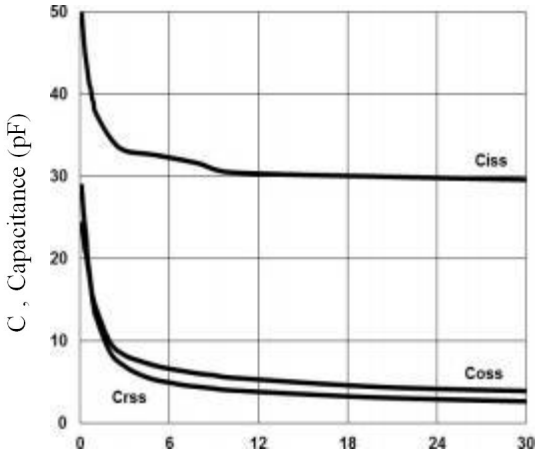



**Fig. 6 Capacitance Characteristics**

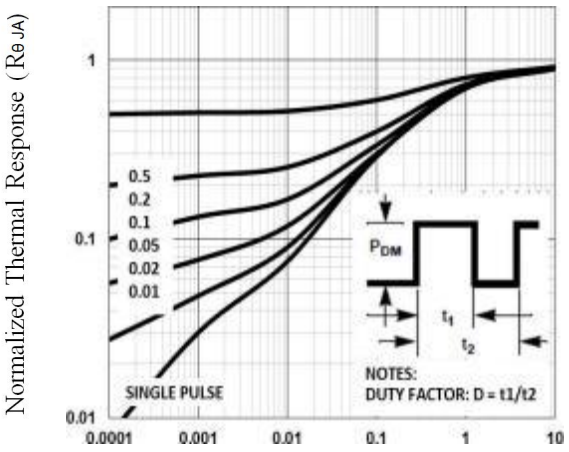



Fig. 7 Normalized Transient Impedance

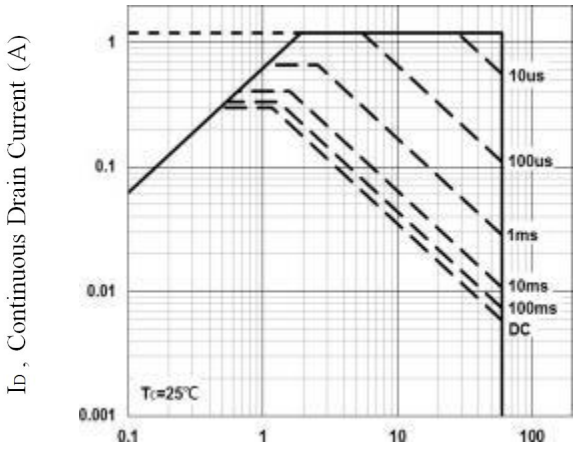



Fig. 8 Maximum Safe Operation Area

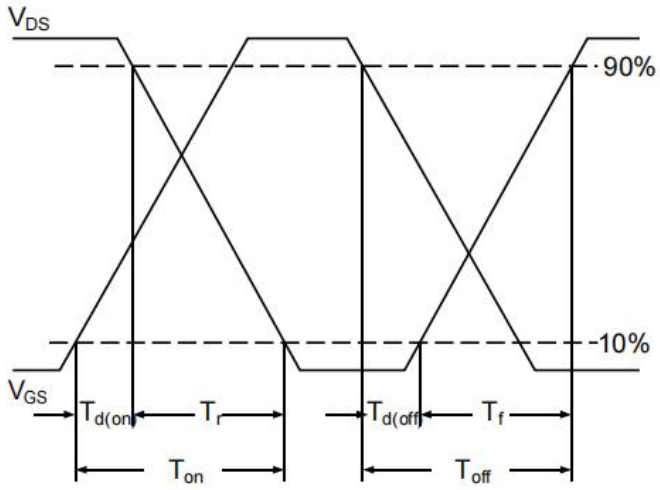
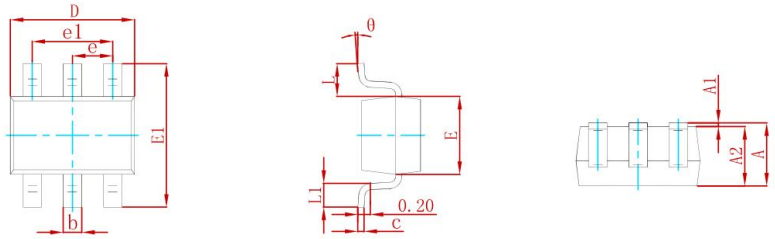


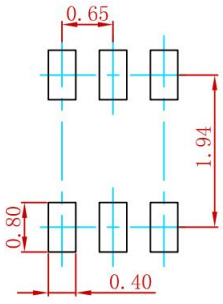

**Fig.9 Switching Time Waveform**

## PACKAGE MECHANICAL DATA




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| A | 0.900 | 1.100 | 0.035 | 0.043 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 0.900 | 1.000 | 0.035 | 0.039 |
| b | 0.150 | 0.350 | 0.006 | 0.014 |
| c | 0.100 | 0.150 | 0.004 | 0.006 |
| D | 2.000 | 2.200 | 0.079 | 0.087 |
| E | 1.150 | 1.350 | 0.045 | 0.053 |
| E1 | 2.150 | 2.400 | 0.085 | 0.094 |
| e | 0.650 TYP | | 0.026 TYP | |
| e1 | 1.200 | 1.400 | 0.047 | 0.055 |
| L | 0.525 REF | | 0.021 REF | |
| L1 | 0.260 | 0.460 | 0.010 | 0.018 |
| θ | 0° | 8° | 0° | 8° |

## Suggested Pad Layout




Note:
1.Controlling dimension:In millimeters.
2.General tolerance:± 0.05mm.
3.The pad layout is for reference purposes only.

## REEL

| P/N | PKG | QTY |
|---|---|---|
| 2N7002KDW | SOT-363 | 3000 |

# Attention

■ Any and all MSKSEMI Semiconductor 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 MSKSEMI Semiconductor representative nearest you before using any MSKSEMI Semiconductor products described or contained herein in such applications.

■ MSKSEMI Semiconductor 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 specificationsof any andall MSKSEMI Semiconductor products described orcontained herein.

■ Specifications of any and all MSKSEMI Semiconductor 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'sproducts orequipment.

■ MSKSEMI Semiconductor. strives to supply high-quality high-reliability products. However, any and all semiconductor products fail with someprobability. It is possiblethat 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 anderror prevention circuitsfor safedesign, redundant design, and structural design.

■ In the event that any or all MSKSEMI Semiconductor 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 theauthorities 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 MSKSEMI Semiconductor.

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

■ Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. Whendesigning equipment, referto the "Delivery Specification" for the MSKSEMI Semiconductor productthat you intend to use.