

N0438N

N-channel MOSFET

40 V, 52 A, 7.5 mΩ

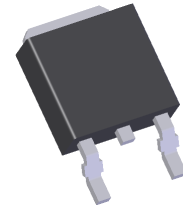
R07DS1416EJ0100

Rev.1.00

2019.9.30

Features

- Low on-state resistance :
 $R_{DS(on)} = 7.5 \text{ m}\Omega \text{ max. (} V_{GS} = 10 \text{ V, } I_D = 26 \text{ A)}$
- Low Ciss : $C_{iss} = 1900 \text{ pF typ. (} V_{DS} = 25 \text{ V)}$
- High current : $I_{D(DC)} = \pm 52 \text{ A}$
- RoHS Compliant
- Quality Grade : Standard
- Applications : For high current switching



TO-252

Ordering Information

Orderable Part Number	Package	Packing
N0438N-ZK-E1-AY	TO-252, Pb-free ^{Note1}	3000 pcs / Tape and Reel

Note: 1. Pb-free means that this product does not contain lead in the external electrode.

Absolute Maximum Ratings ($T_A = 25^\circ\text{C}$)

Item	Symbol	Ratings	Unit
Drain to Source Voltage ($V_{GS} = 0 \text{ V}$)	V_{DSS}	40	V
Gate to Source Voltage ($V_{DS} = 0 \text{ V}$)	V_{GSS}	± 20	V
Drain Current (DC) ($T_C = 25 \text{ }^\circ\text{C}$)	$I_{D(DC)}$	± 52	A
Drain Current (pulse) ^{Note2}	$I_{D(pulse)}$	± 104	A
Total Power Dissipation ($T_C = 25 \text{ }^\circ\text{C}$)	P_{T1}	50.2	W
Total Power Dissipation ($T_A = 25 \text{ }^\circ\text{C}$)	P_{T2}	1.0	W
Channel Temperature	T_{ch}	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to 150	$^\circ\text{C}$
Single Avalanche Current ^{Note3}	I_{AS}	24	A
Single Avalanche Energy ^{Note3}	E_{AS}	57	mJ

Note : Continuous heavy condition (e.g. high temperature/voltage/current or high variation of temperature) may affect a reliability even if it is within the absolute maximum ratings. Please consider derating condition for appropriate reliability in reference Renesas Semiconductor Reliability Handbook (Recommendation for Handling and Usage of Semiconductor Devices) and individual reliability data.

Notes: 2. $PW \leq 10 \text{ }\mu\text{s}$, Duty Cycle $\leq 1\%$

3. Starting $T_{ch} = 25^\circ\text{C}$, $V_{DD} = 20 \text{ V}$, $R_G = 25 \text{ }\Omega$, $V_{GS} = 20 \rightarrow 0 \text{ V}$, $L = 100 \text{ }\mu\text{H}$

Thermal Resistance

Item	Symbol	Max. Value ^{Note4}	Unit
Channel to Case Thermal Resistance	$R_{th(ch-C)}$	2.5	$^\circ\text{C/W}$
Channel to Ambient Thermal Resistance	$R_{th(ch-A)}$	125	$^\circ\text{C/W}$

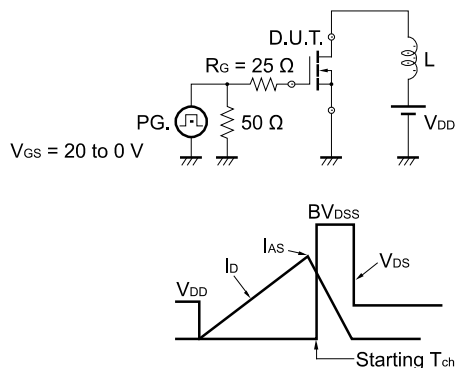
Notes: 4. This data is the designed target maximum value on Renesas's measurement condition. (Not tested)

Electrical Characteristics (T_A = 25°C)

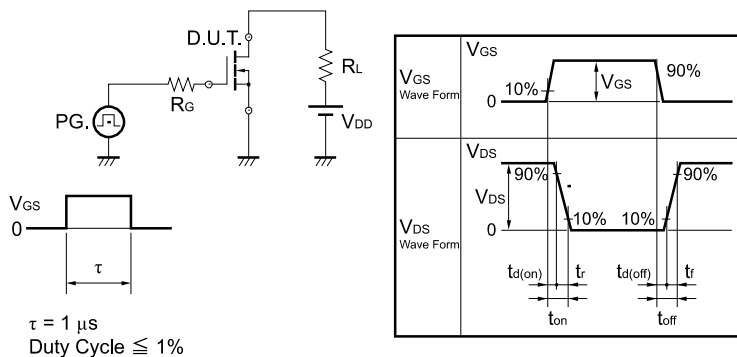
Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Zero Gate Voltage Drain Current	I _{DSS}			1	μA	V _{DS} = 40 V, V _{GS} = 0 V
Gate Leakage Current	I _{GSS}			±100	nA	V _{GS} = ± 20 V, V _{DS} = 0 V
Gate to Source Cut-off Voltage	V _{GS(off)}	2.0		4.0	V	V _{DS} = 10 V, I _D = 1 mA
Forward Transfer Admittance ^{Note5}	y _{fs}		32		S	V _{DS} = 5 V, I _D = 26 A
Drain to Source On-state Resistance ^{Note5}	R _{DS(on)}		6.1	7.5	mΩ	V _{GS} = 10 V, I _D = 26 A
Input Capacitance	C _{iss}		1900		pF	V _{DS} = 25 V
Output Capacitance	C _{oss}		200		pF	V _{GS} = 0 V
Reverse Transfer Capacitance	C _{rss}		110		pF	f = 1 MHz
Turn-on Delay Time	t _{d(on)}		20		ns	V _{DD} = 20 V, I _D = 26 A
Rise Time	t _r		11		ns	V _{GS} = 10 V
Turn-off Delay Time	t _{d(off)}		41		ns	R _G = 0 Ω
Fall Time	t _f		6		ns	
Total Gate Charge	Q _G		36		nC	V _{DD} = 32 V
Gate to Source Charge	Q _{GS}		10		nC	V _{GS} = 10 V
Gate to Drain Charge	Q _{GD}		11		nC	I _D = 52 A
Body Diode Forward Voltage ^{Note5}	V _{F(S-D)}			1.5	V	I _F = 52 A, V _{GS} = 0 V
Reverse Recovery Time	t _{rr}		27		ns	I _F = 52 A, V _{GS} = 0 V
Reverse Recovery Charge	Q _{rr}		16		nC	di/dt = 100 A/μs

Notes: 5. Pulsed test

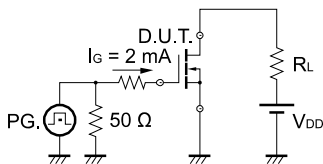
TEST CIRCUIT 1 AVALANCHE CAPABILITY



TEST CIRCUIT 2 SWITCHING TIME

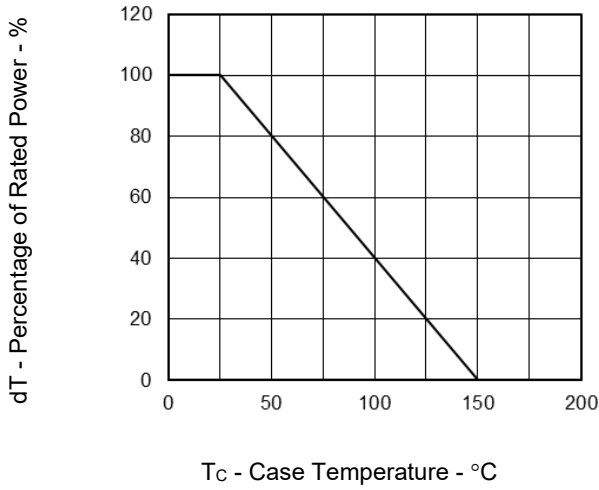


TEST CIRCUIT 3 GATE CHARGE

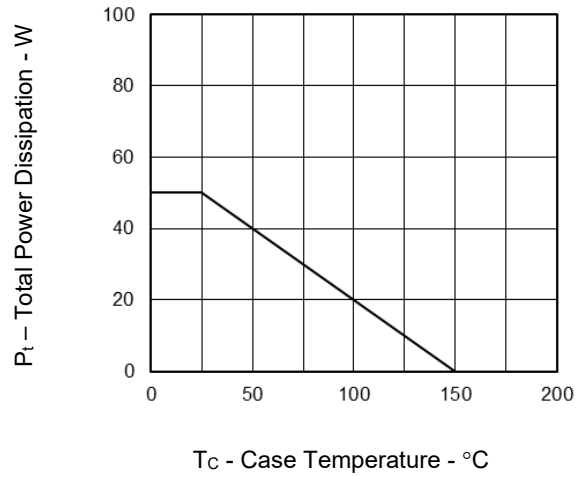


Typical Characteristics Note6

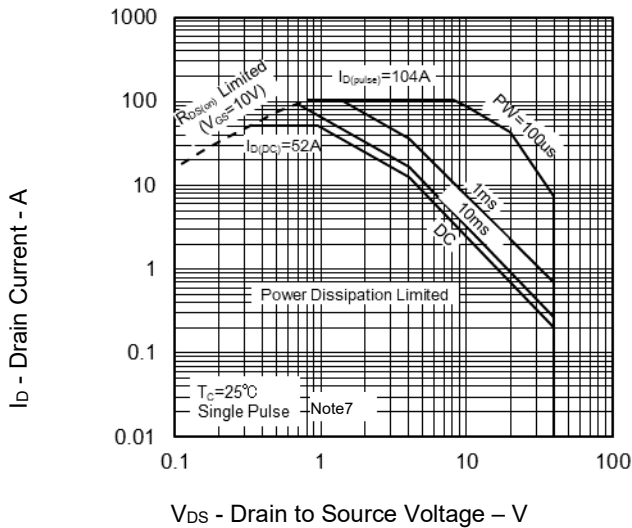
DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA



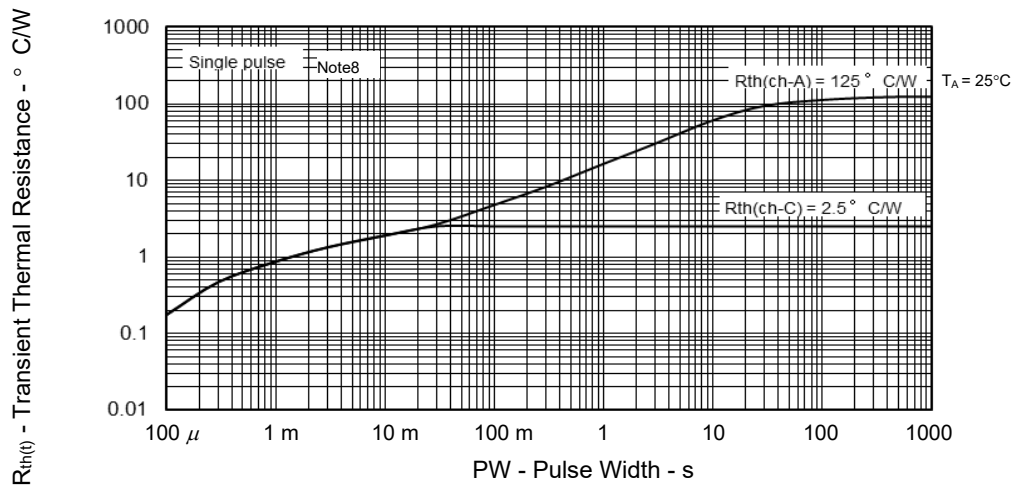
TOTAL POWER DISSIPATION vs. CASE TEMPERATURE



FORWARD BIAS SAFE OPERATING AREA

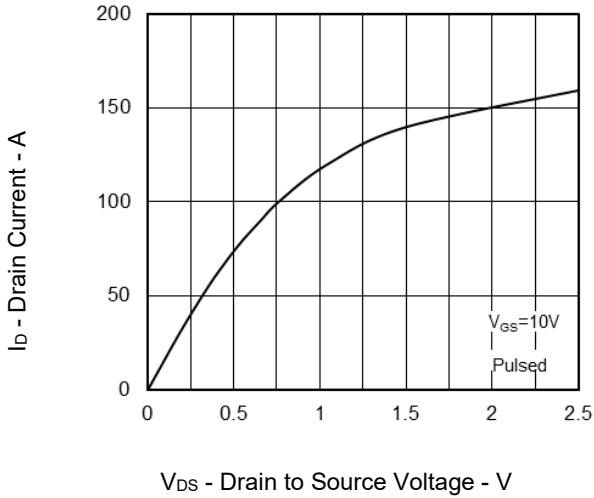


TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH

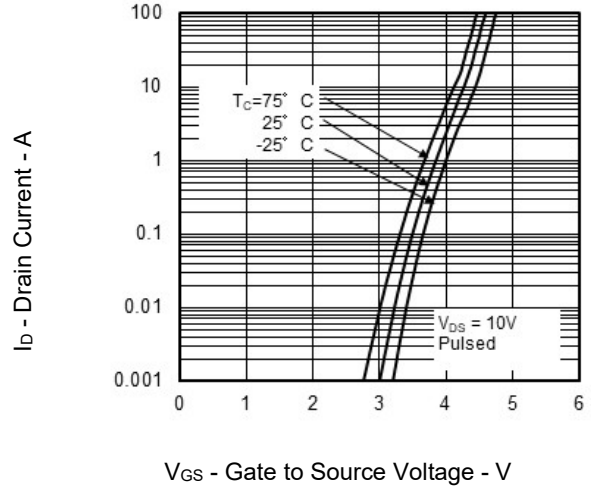


- Notes: 6. Designed target value on Renesas measurement condition. ($T_c = 25^\circ\text{C}$, unless otherwise specified)
 7. This data is the designed value on Renesas's measurement condition. Renesas recommends that operating conditions are designed according to a document "Power MOSFET/IGBT Attention of Handling Semiconductor Devices (R07ZZ0010)".
 8. This data is the designed target maximum value on Renesas's measurement condition.

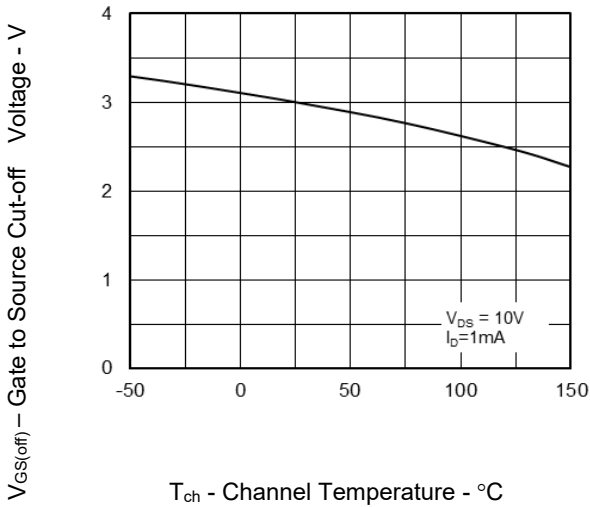
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



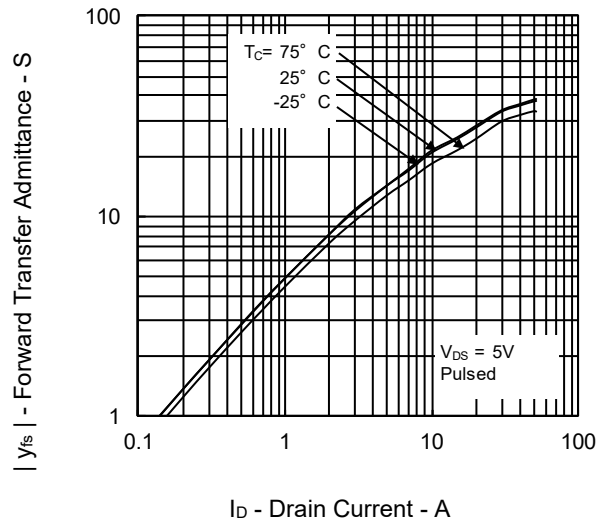
FORWARD TRANSFER CHARACTERISTICS



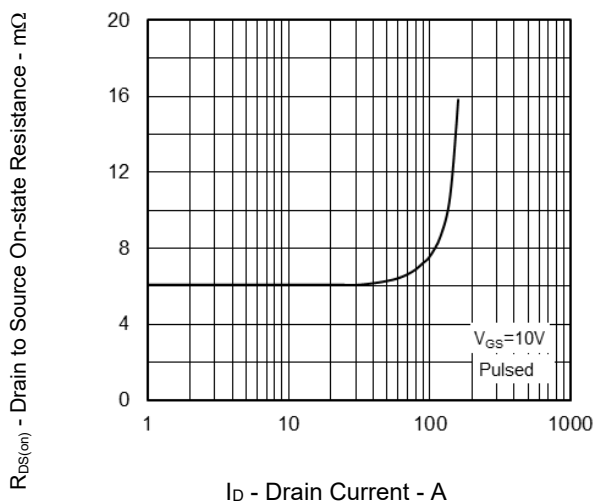
GATE TO SOURCE THRESHOLD VOLTAGE vs. CHANNEL TEMPERATURE



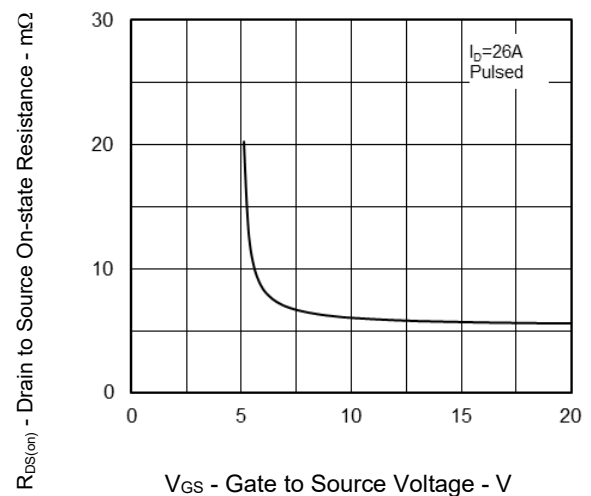
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



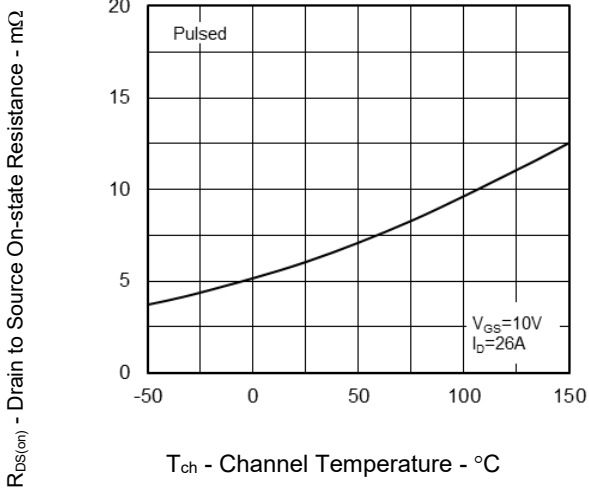
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



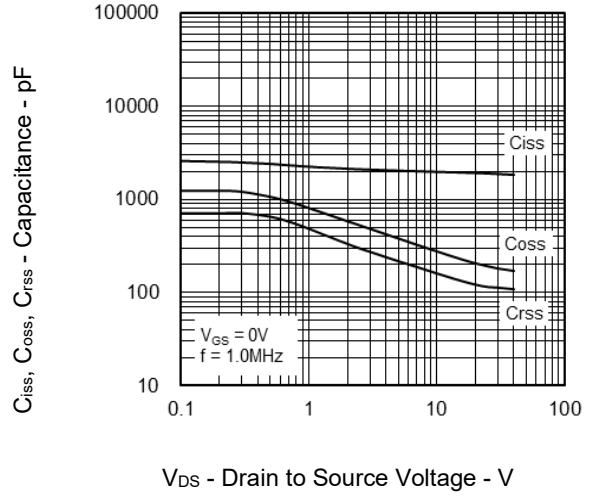
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



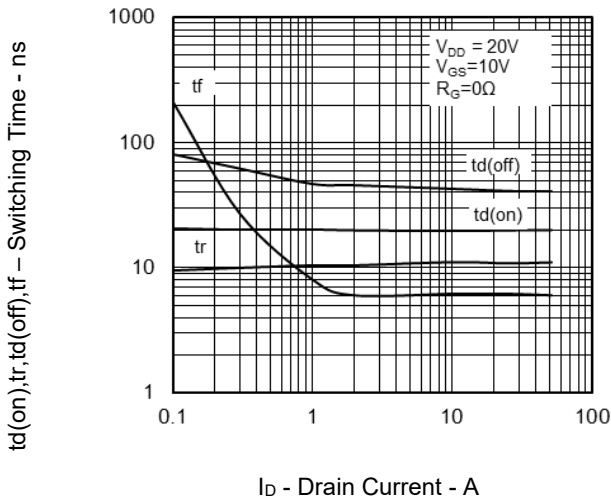
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



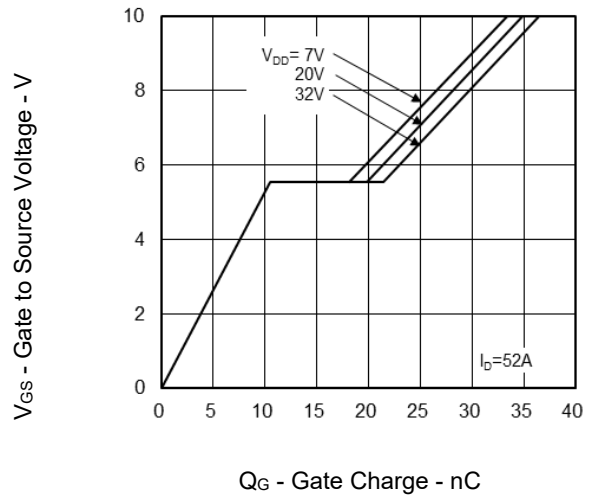
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



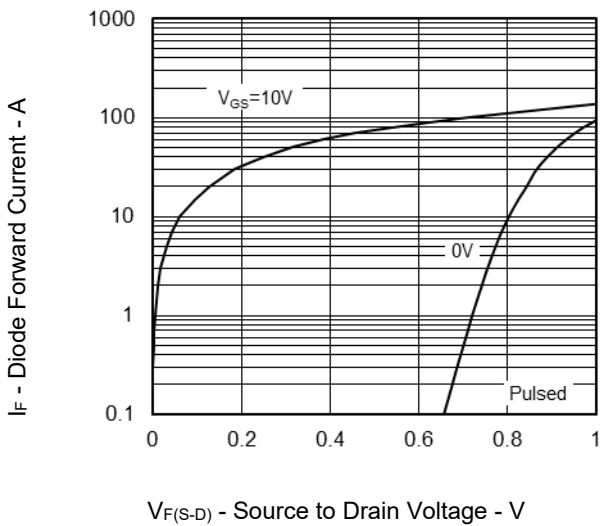
SWITCHING CHARACTERISTICS



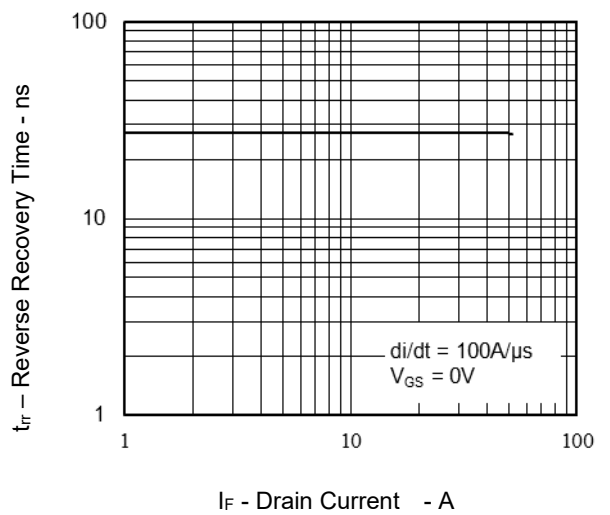
DYNAMIC INPUT CHARACTERISTICS



SOURCE TO DRAIN DIODE FORWARD VOLTAGE



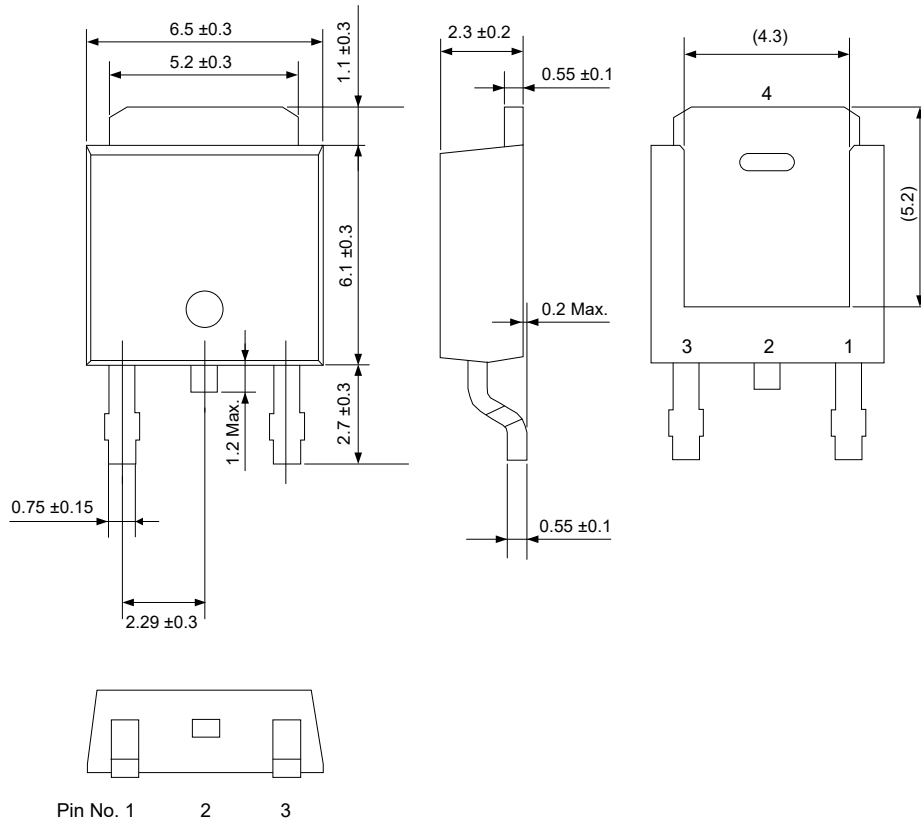
REVERSE RECOVERY TIME vs. DRAIN CURRENT



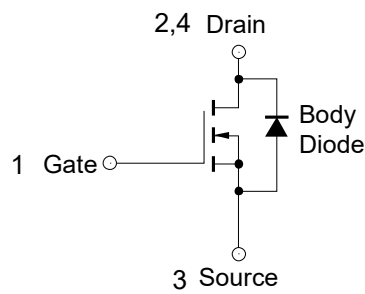
Package Drawings (Unit: mm)

Package Name	JEITA Package Code	JEDEC Code	RENESAS Code	Previous Code	MASS (Typ) [g]
TO-252	—	TO-252	PRSS0004ZK-A	TO-252A	0.32

Unit: mm



Equivalent Circuit



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Renesas Electronics Corporation
TOYOSU FORESIA, 3-2-24 Toyosu, Koto-ku, Tokyo 135-0061, Japan

Renesas Electronics America Inc.
1001 Murphy Ranch Road, Milpitas, CA 95035, U.S.A.
Tel: +1-408-432-8888, Fax: +1-408-434-5351

Renesas Electronics Canada Limited
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe GmbH
Arcadisstrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 101-101, Floor 1, Building 7, Yard No. 7, 8th Street, Shangdi, Haidian District, Beijing 100085, China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 Lango Road, Putuo District, Shanghai 200333, China
Tel: +86-21-2226-0695, Fax: +86-21-2226-0599

Renesas Electronics Hong Kong Limited
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852-2886-9022

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886-2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, Unit #03-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit No 3A-1 Level 3A Tower 8 UOA Business Park, No 1 Jalan Pengaturcara U1/51A, Seksyen U1, 40150 Shah Alam, Selangor, Malaysia
Tel: +60-3-5022-1298, Fax: +60-3-5022-1290

Renesas Electronics India Pvt. Ltd.
No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India
Tel: +91-80-67208700

Renesas Electronics Korea Co., Ltd.
17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea
Tel: +82-2-558-3737, Fax: +82-2-558-9338

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