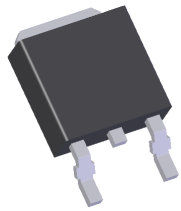
N0438N

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 mΩ max. (V_{GS} = 10 V, I_D = 26 A)
- Low Ciss : Ciss = 1900 pF typ. (V_{DS} = 25 V)
- High current : $I_{D(DC)}$ = ±52 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°C)

Item	Symbol	Ratings	Unit
Drain to Source Voltage (V_{GS} = 0 V)	V_{DSS}	40	V
Gate to Source Voltage (V_{DS} = 0 V)	V_{GSS}	± 20	V
Drain Current (DC) (T_C = 25 °C)	$I_{D(DC)}$	± 52	A
Drain Current (pulse) Note2	$I_{D(pulse)}$	± 104	A
Total Power Dissipation (T_C = 25 °C)	P_{T1}	50.2	W
Total Power Dissipation (T_A = 25 °C)	P_{T2}	1.0	W
Channel Temperature	T_{ch}	150	°C
Storage Temperature	T_{stg}	-55 to 150	°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 ≤ 10 μs, Duty Cycle ≤ 1%
3. Starting Tch = 25°C, VDD = 20 V, RG = 25 Ω, VGS = 20 → 0 V, L = 100 μH

Thermal Resistance

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

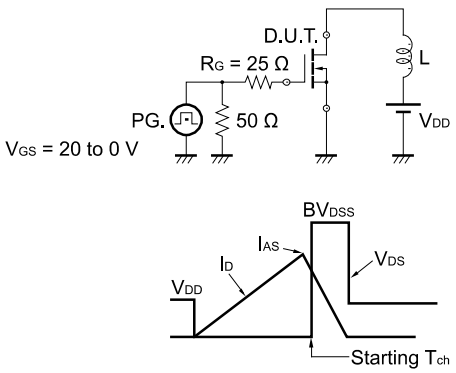
Notes: 4. This data is the designed target maximum value on Renesas's measurement condition. (Not tested)

Electrical Characteristics (T_A = 25°C)

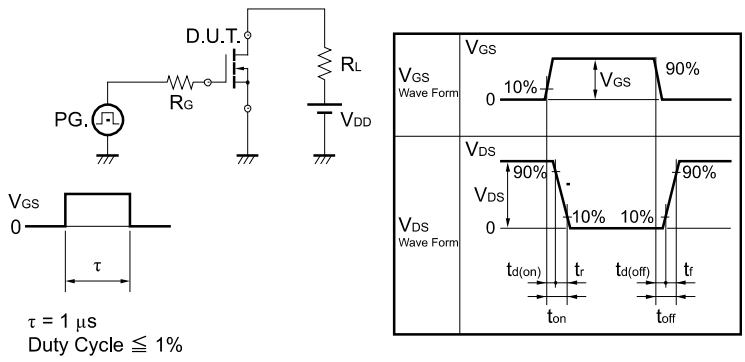
Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Zero Gate Voltage Drain Current	I_{DSS}			1	μA	V_{DS} = 40 V, V_{GS} = 0 V
Gate Leakage Current	I_{GSS}			±100	nA	V_{GS} = ± 20 V, V_{DS} = 0 V
Gate to Source Cut-off Voltage	$V_{GS(off)}$	2.0		4.0	V	V_{DS} = 10 V, I_D = 1 mA
Forward Transfer Admittance Note5	$\lvert y_{fs} \rvert$		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

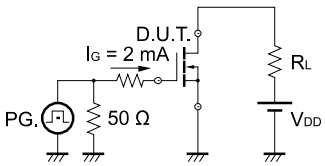
TEST CIRCUIT 1 AVALANCHE CAPABILITY



TEST CIRCUIT 2 SWITCHING TIME

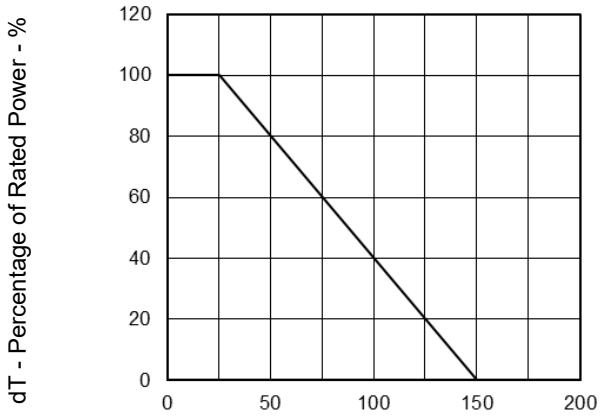


TEST CIRCUIT 3 GATE CHARGE

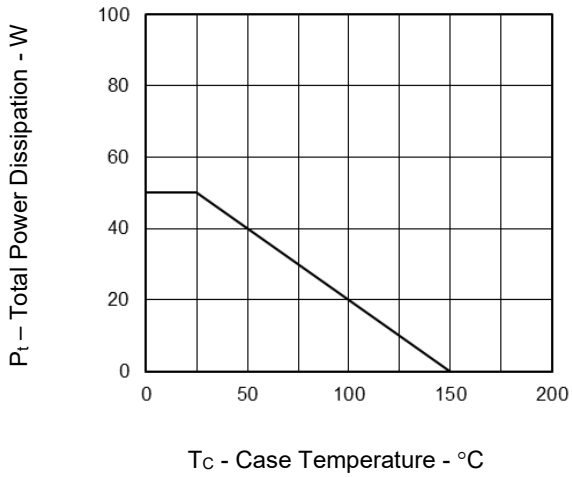


Typical Characteristics Note6

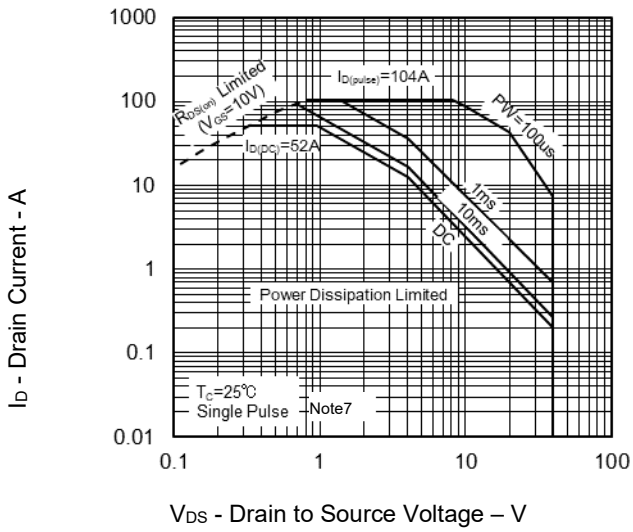
DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA



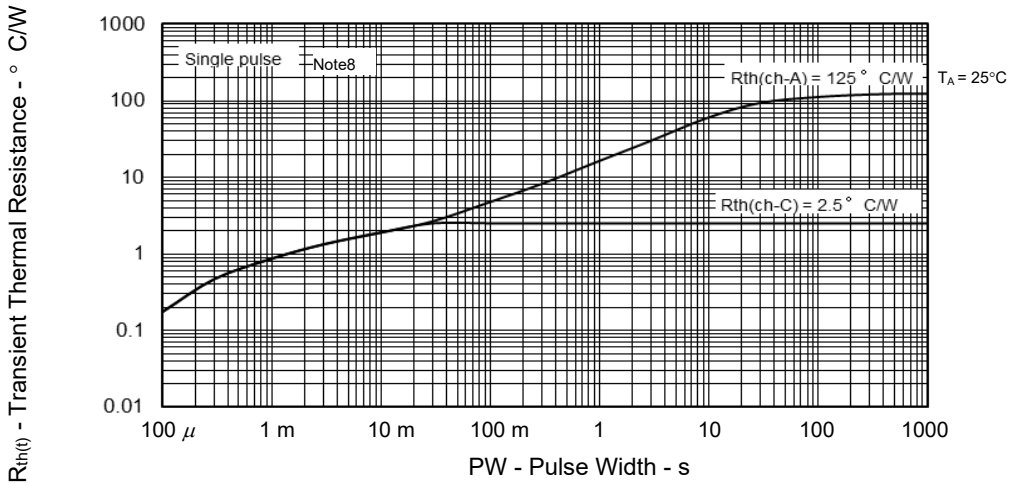
TOTAL POWER DISSIPATION vs. CASE TEMPERATURE



FORWARD BIAS SAFE OPERATING AREA

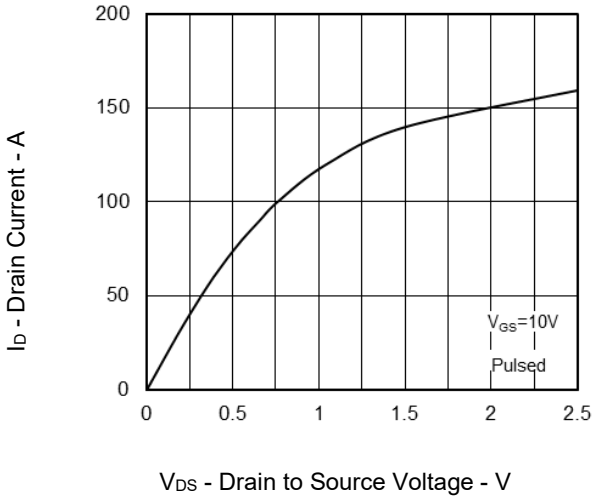


TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH

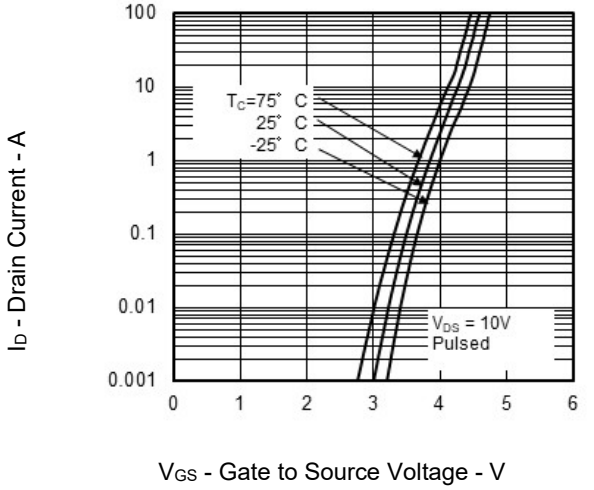


Notes: 6. Designed target value on Renesas measurement condition. (T_C = 25°C, unless otherwise specified)
7. This data is the designed value on Renesas's measurement condition. Renesas recommends that operating conditions are designed according to a document "Power MOSFET/IGBT Attention of Handling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

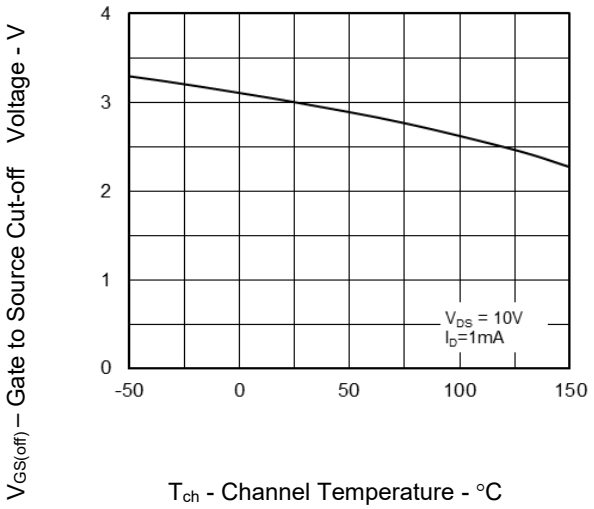
DRAIN CURRENT vs.
DRAIN TO SOURCE VOLTAGE



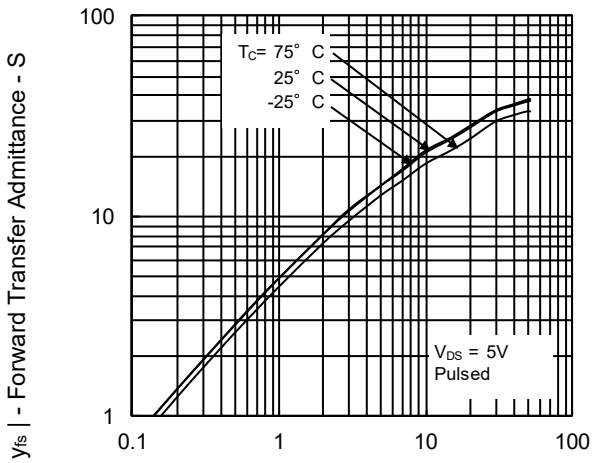
FORWARD TRANSFER CHARACTERISTICS



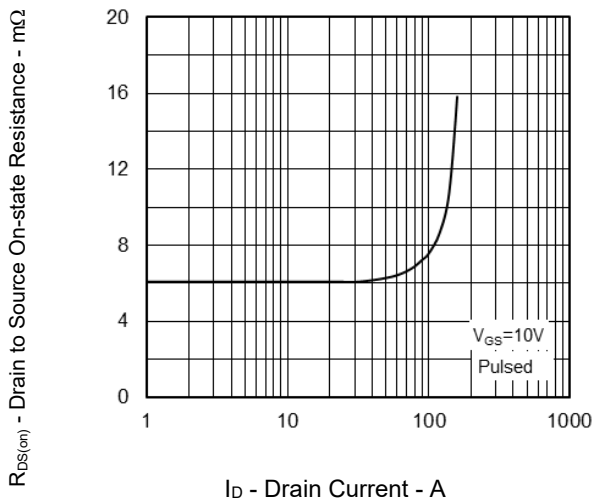
GATE TO SOURCE THRESHOLD VOLTAGE
vs. CHANNEL TEMPERATURE



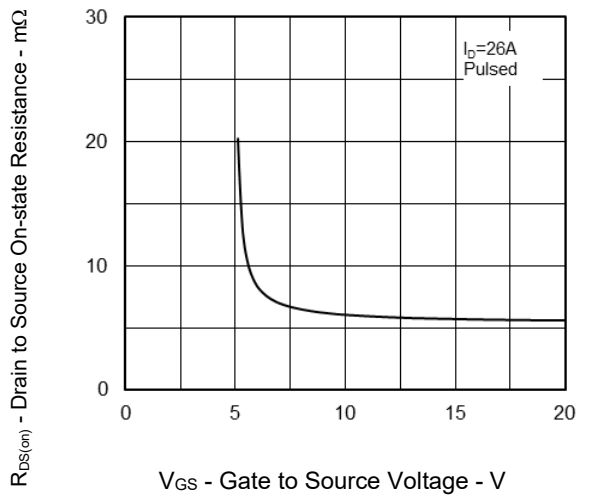
FORWARD TRANSFER ADMITTANCE vs.
DRAIN CURRENT



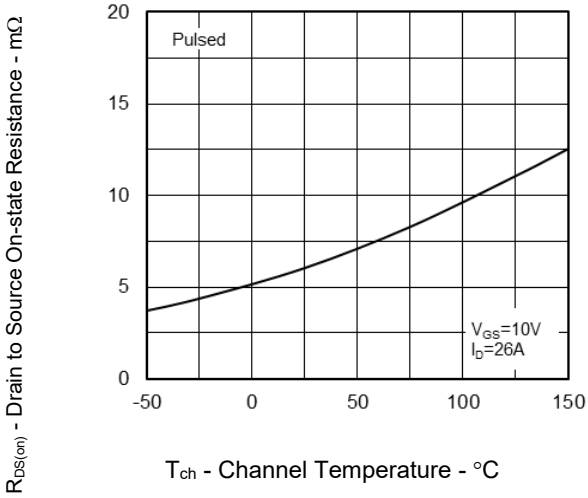
DRAIN TO SOURCE ON-STATE
RESISTANCE vs. DRAIN CURRENT



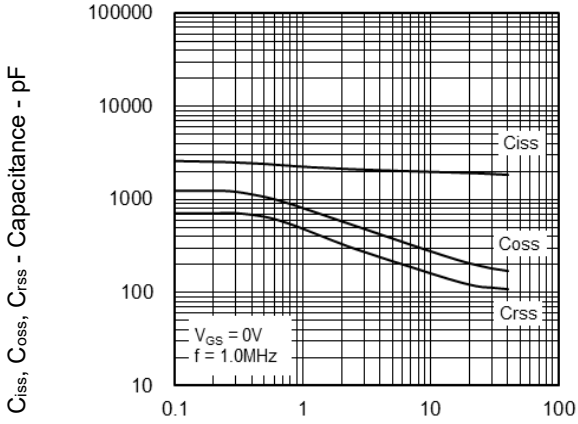
DRAIN TO SOURCE ON-STATE RESISTANCE
vs. GATE TO SOURCE VOLTAGE



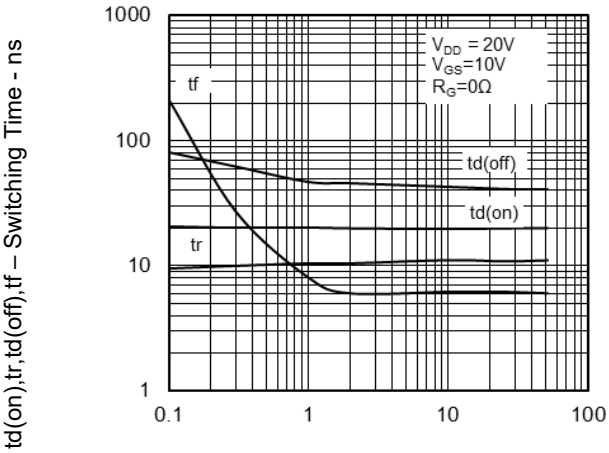
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



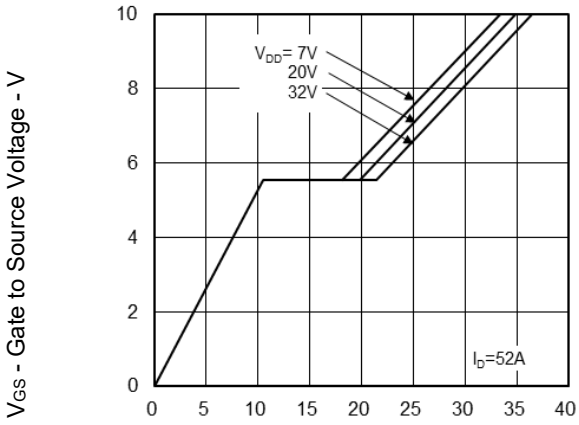
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



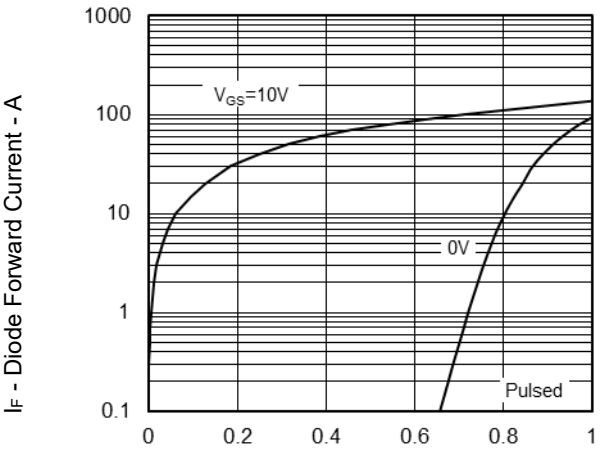
SWITCHING CHARACTERISTICS



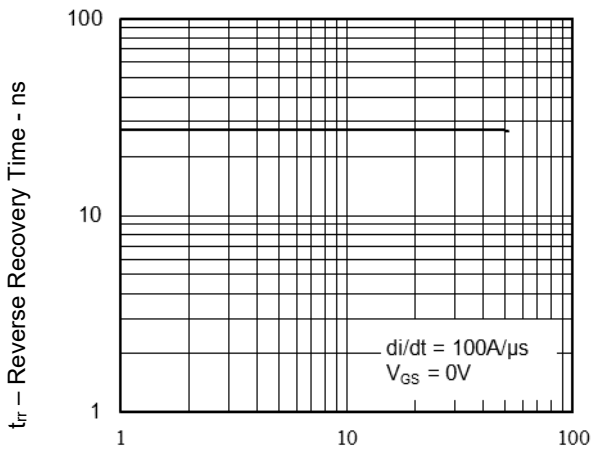
DYNAMIC INPUT CHARACTERISTICS



SOURCE TO DRAIN DIODE FORWARD VOLTAGE



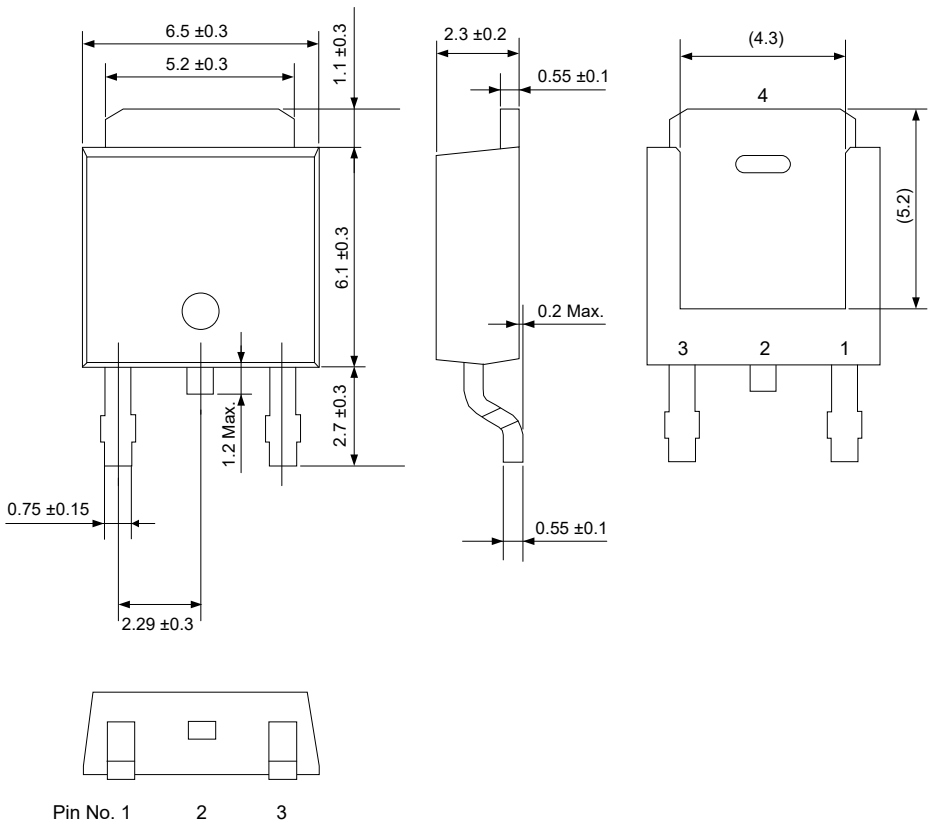
REVERSE RECOVERY TIME vs. DRAIN CURRENT



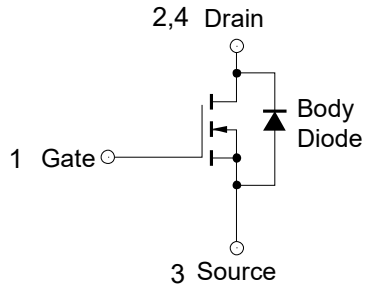
Package Drawings (Unit: mm)

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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9. 不可将瑞萨电子产品和技术用于或者嵌入日本国内或海外相应的法律法规所禁止生产、使用及销售的任何产品或系统中。也不可将瑞萨电子产品或技术用于(1)与大规模杀伤性武器（例如核武器、化学武器、生物武器或运送此等武器的导弹，包括无人机(UAV)）的开发、设计、制造、使用、存储等相关的任何目的；(2)与常规武器的开发、设计、制造或使用相关的任何目的；(3)扰乱国际和平与安全的任何其他目的，并且不可向任何第三方销售、出口、租赁、转让、或让与瑞萨电子产品或技术，无论直接或间接知悉或者有理由知悉该第三方或任何其他方将从事上述活动。用户必须遵守对各方或交易行使司法管辖权的任意国家/地区政府所公布和管理的任何适用出口管制法律法规。
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