

N0438N

N-channel MOSFET

40 V, 52 A, 7.5 mΩ

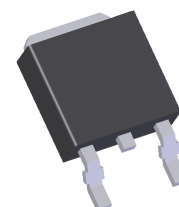
R07DS1416EJ0100

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) ($T_C = 25^\circ\text{C}$)	$I_{D(DC)}$	± 52	A
Drain Current (pulse) ^{Note2}	$I_{D(pulse)}$	± 104	A
Total Power Dissipation ($T_C = 25^\circ\text{C}$)	P_{T1}	50.2	W
Total Power Dissipation ($T_A = 25^\circ\text{C}$)	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. $PW \leq 10 \mu\text{s}$, Duty Cycle $\leq 1\%$

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

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	$^\circ\text{C/W}$

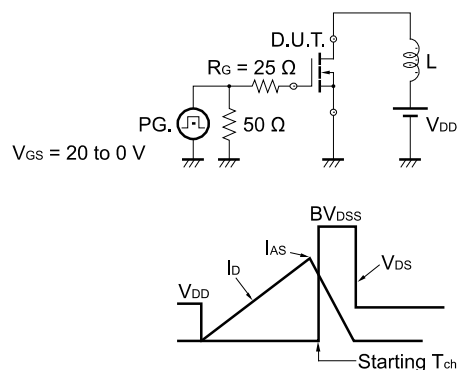
Notes: 4. This data is the designed target maximum value on Renesas's measurement condition. (Not tested)

Electrical Characteristics ($T_A = 25^\circ\text{C}$)

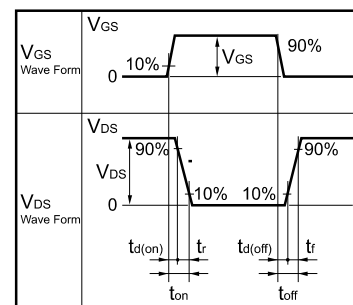
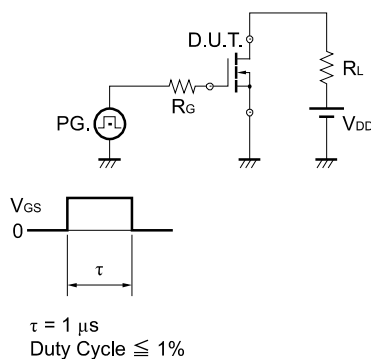
Item	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
Zero Gate Voltage Drain Current	I_{DSS}			1	μA	$V_{DS} = 40\text{ V}$, $V_{GS} = 0\text{ V}$
Gate Leakage Current	I_{GSS}			± 100	nA	$V_{GS} = \pm 20\text{ V}$, $V_{DS} = 0\text{ V}$
Gate to Source Cut-off Voltage	$V_{GS(off)}$	2.0		4.0	V	$V_{DS} = 10\text{ V}$, $I_D = 1\text{ mA}$
Forward Transfer Admittance ^{Note5}	$ y_{fs} $		32		S	$V_{DS} = 5\text{ V}$, $I_D = 26\text{ A}$
Drain to Source On-state Resistance ^{Note5}	$R_{DS(on)}$		6.1	7.5	m Ω	$V_{GS} = 10\text{ V}$, $I_D = 26\text{ A}$
Input Capacitance	C_{iss}		1900		pF	$V_{DS} = 25\text{ V}$
Output Capacitance	C_{oss}		200		pF	$V_{GS} = 0\text{ V}$
Reverse Transfer Capacitance	C_{rss}		110		pF	$f = 1\text{ MHz}$
Turn-on Delay Time	$t_{d(on)}$		20		ns	$V_{DD} = 20\text{ V}$, $I_D = 26\text{ A}$
Rise Time	t_r		11		ns	$V_{GS} = 10\text{ V}$
Turn-off Delay Time	$t_{d(off)}$		41		ns	$R_G = 0\text{ }\Omega$
Fall Time	t_f		6		ns	
Total Gate Charge	Q_G		36		nC	$V_{DD} = 32\text{ V}$
Gate to Source Charge	Q_{GS}		10		nC	$V_{GS} = 10\text{ V}$
Gate to Drain Charge	Q_{GD}		11		nC	$I_D = 52\text{ A}$
Body Diode Forward Voltage ^{Note5}	$V_{F(S-D)}$			1.5	V	$I_F = 52\text{ A}$, $V_{GS} = 0\text{ V}$
Reverse Recovery Time	t_{rr}		27		ns	$I_F = 52\text{ A}$, $V_{GS} = 0\text{ V}$
Reverse Recovery Charge	Q_{rr}		16		nC	$di/dt = 100\text{ A}/\mu\text{s}$

Notes: 5. Pulsed test

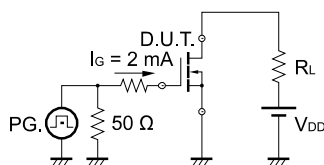
TEST CIRCUIT 1 AVALANCHE CAPABILITY



TEST CIRCUIT 2 SWITCHING TIME

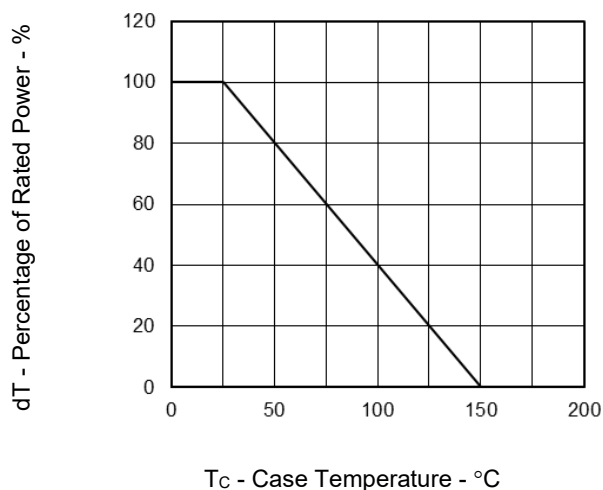
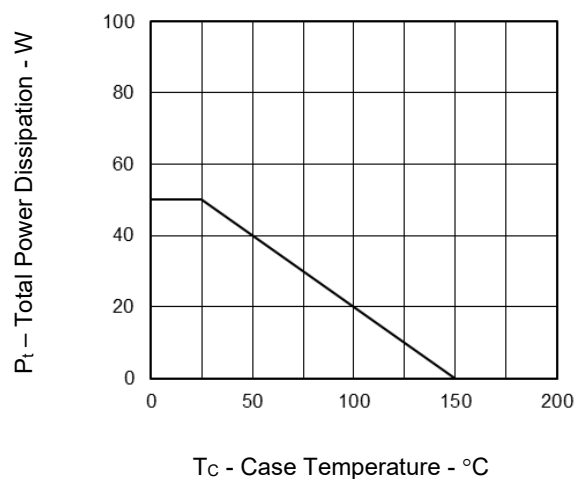


TEST CIRCUIT 3 GATE CHARGE

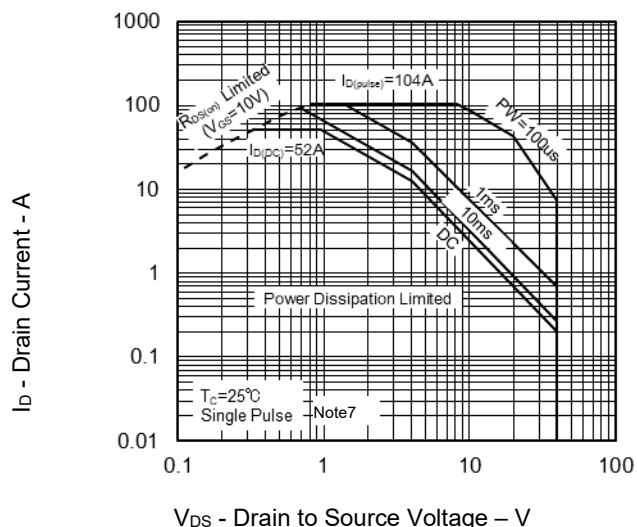


Typical Characteristics

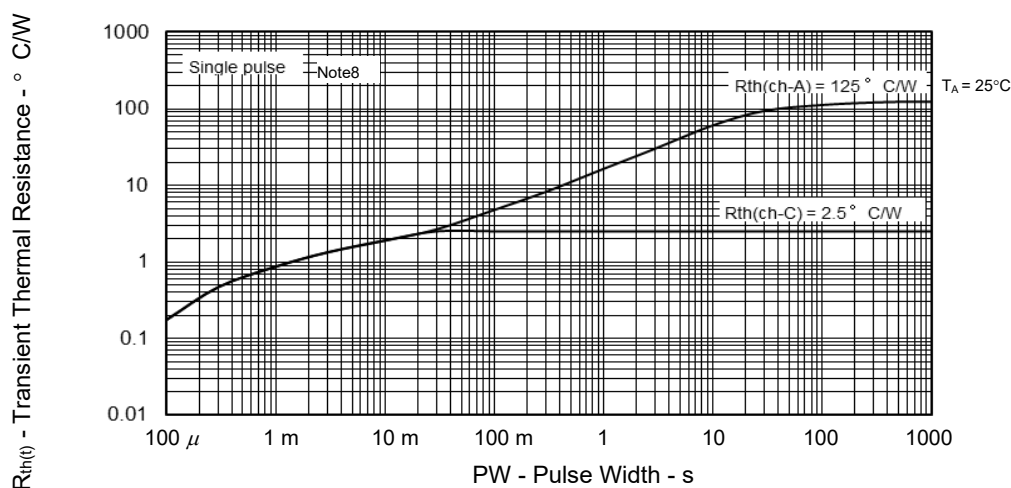
Note6

DERATING FACTOR OF FORWARD BIAS
SAFE OPERATING AREATOTAL POWER DISSIPATION vs.
CASE TEMPERATURE

FORWARD BIAS SAFE OPERATING AREA



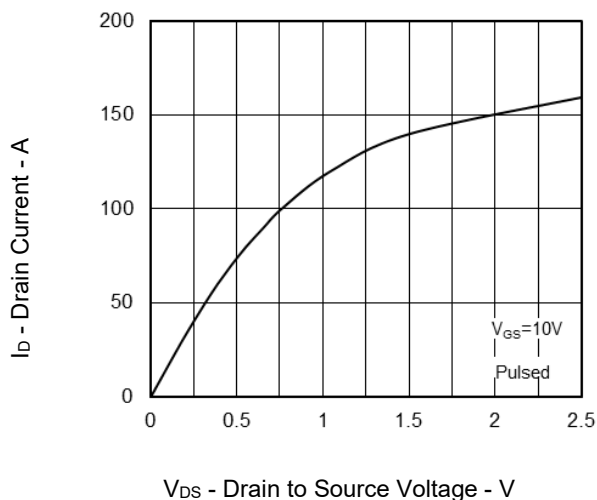
TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



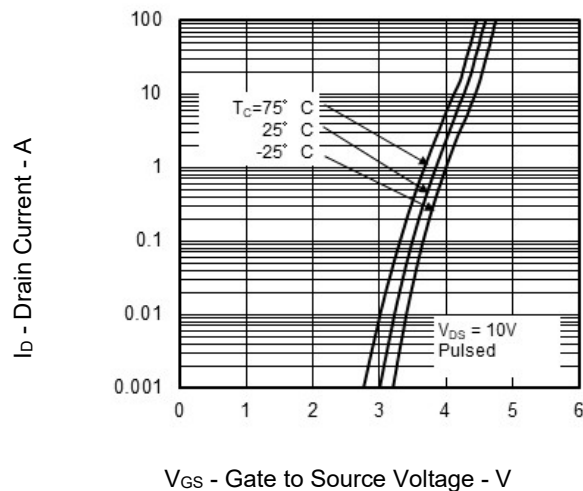
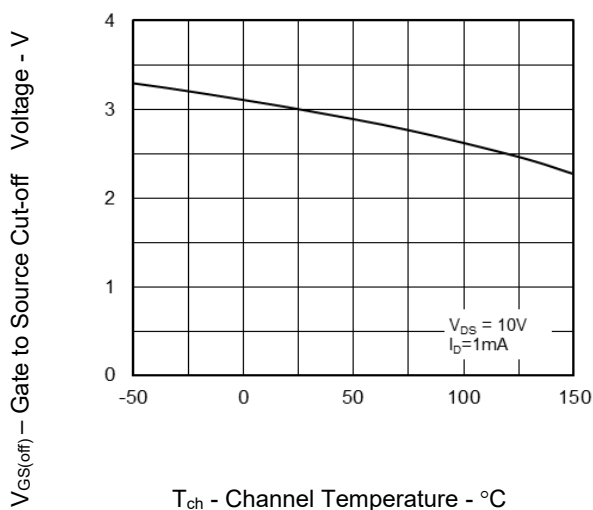
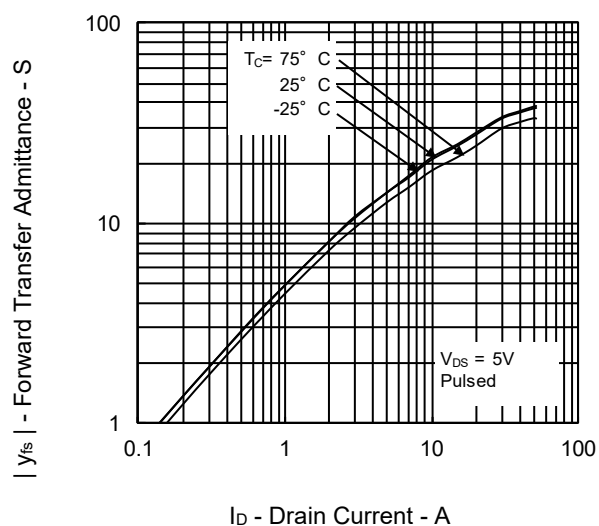
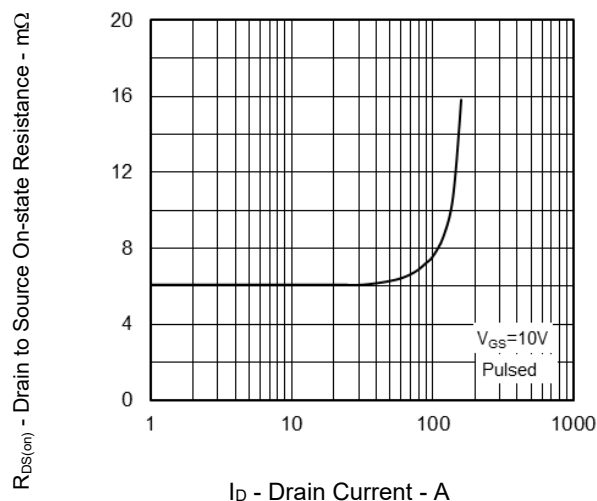
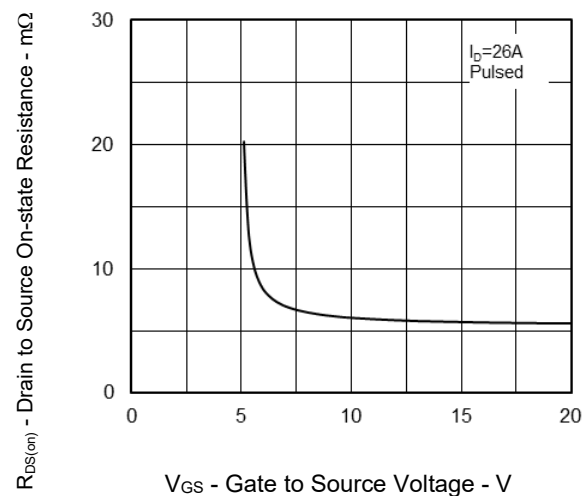
Notes: 6. Designed target value on Renesas measurement condition. ($T_C = 25^\circ C$, unless otherwise specified)

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)".

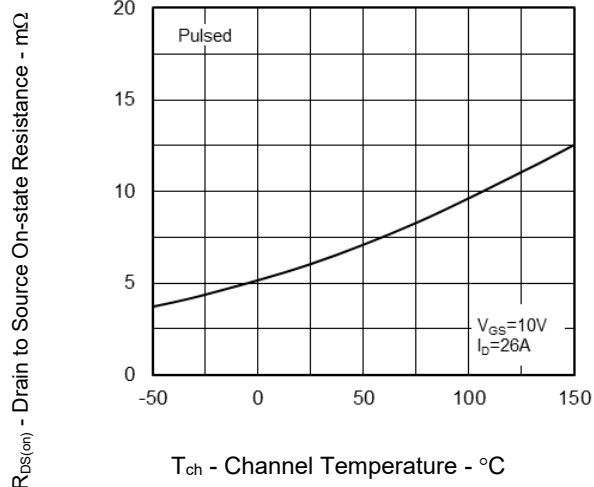
8. This data is the designed target maximum value on Renesas's measurement condition.

DRAIN CURRENT vs.
DRAIN TO SOURCE VOLTAGE

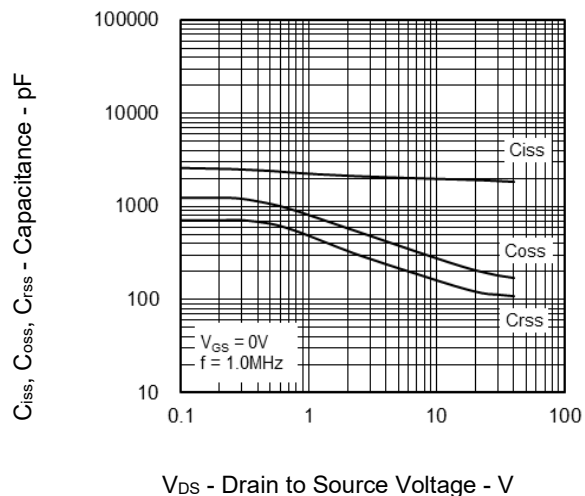
FORWARD TRANSFER CHARACTERISTICS

GATE TO SOURCE THRESHOLD VOLTAGE
vs. CHANNEL TEMPERATUREFORWARD TRANSFER ADMITTANCE vs.
DRAIN CURRENTDRAIN TO SOURCE ON-STATE
RESISTANCE vs. DRAIN CURRENTDRAIN TO SOURCE ON-STATE RESISTANCE
vs. GATE TO SOURCE VOLTAGE

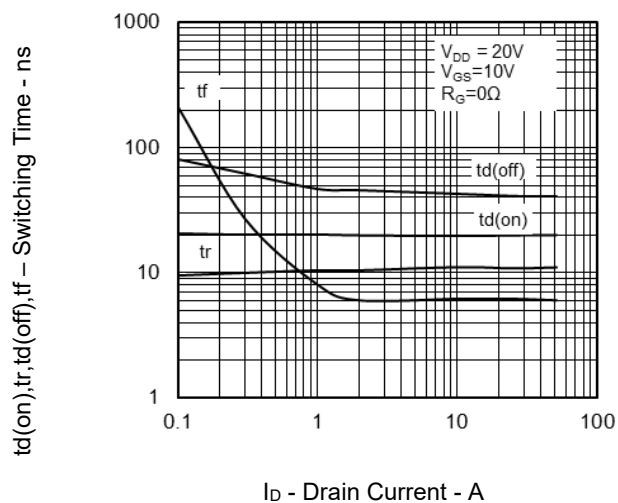
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



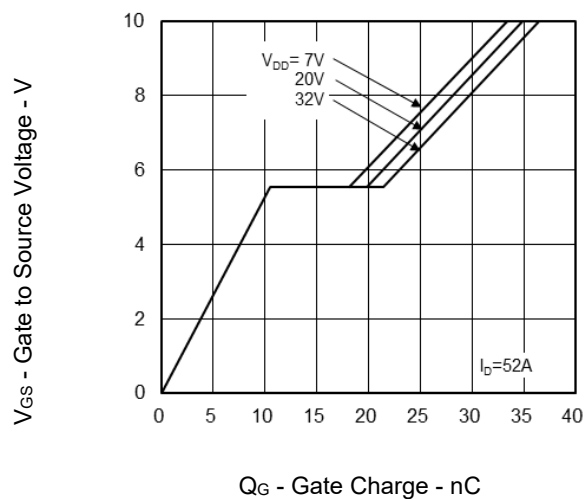
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



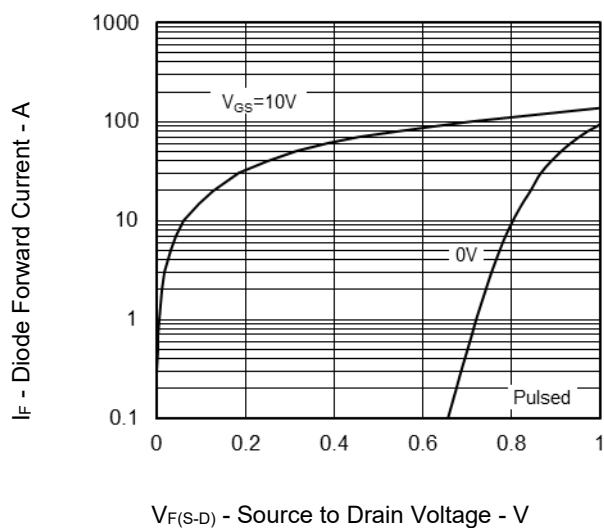
SWITCHING CHARACTERISTICS



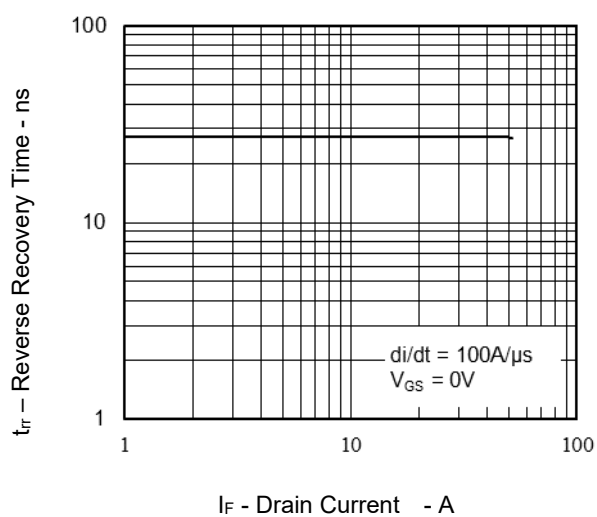
DYNAMIC INPUT CHARACTERISTICS



SOURCE TO DRAIN DIODE FORWARD VOLTAGE



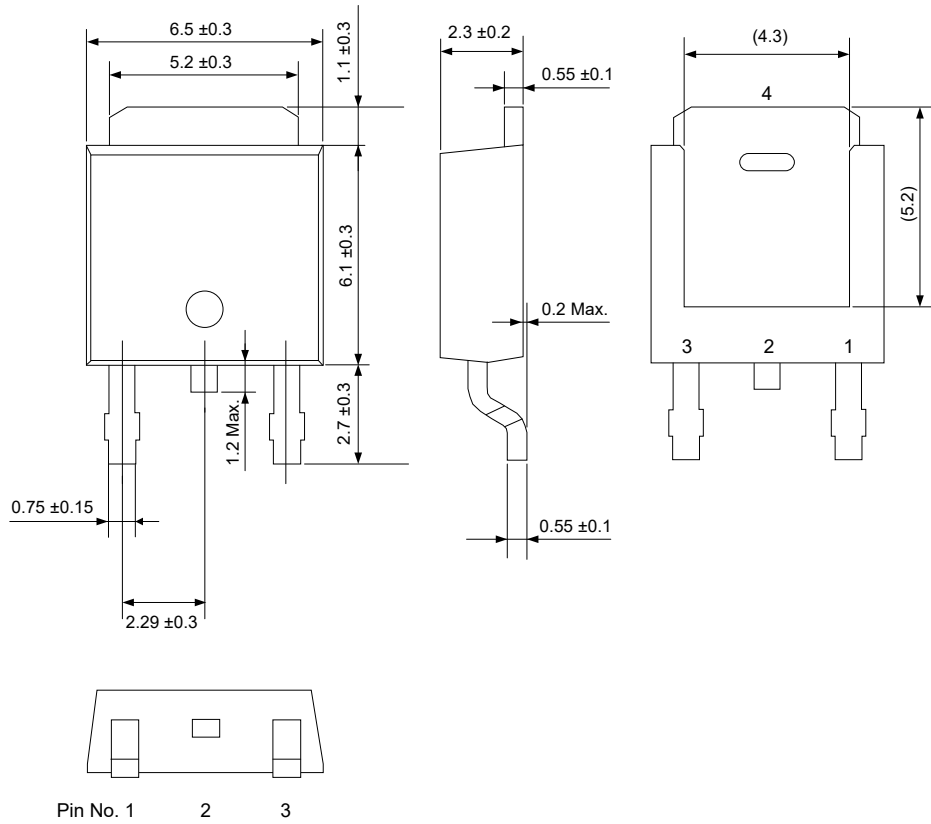
REVERSE RECOVERY TIME vs. DRAIN CURRENT



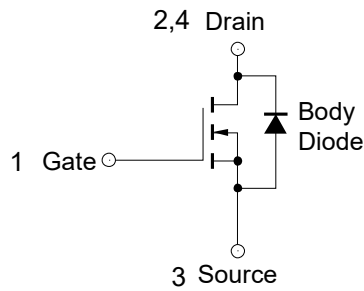
Package Drawings (Unit: mm)

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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