

1. GENERAL DESCRIPTION

Gate resistor installed Dual N-channel MOSFET
For lithium-ion secondary battery protection circuits

Gate resistor installed Dual N-channel MOSFET

2. FEATURES

- Source-source On-state resistance: RSS (on) typ. = 2.65 mΩ (VGS = 3.8 V)
- CSP (Chip Size Package)
- Halogen-free / RoHS compliant (EU RoHS / UL-94 V-0 / MSL: Level 1)

3. MARKING SYMBOL: WF

4. PACKAGING

Embossed type (Thermo-compression sealing): 8,000 pcs / reel (standard)

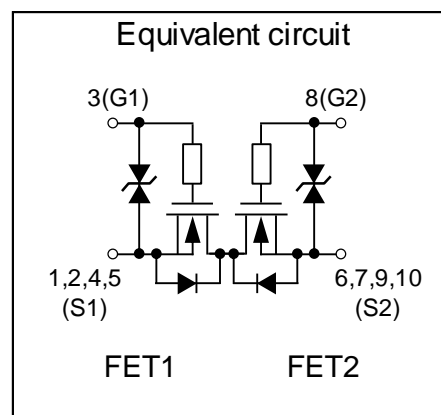
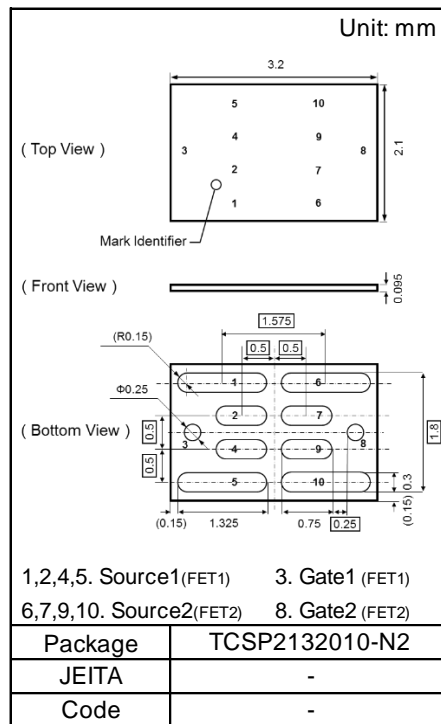
5. ABSOLUTE MAXIMUM RATINGS Ta = 25 °C

Parameter	Symbol	Rating	Unit
Source-source Voltage	VSS	23	V
Gate-source Voltage	VGS	±12	V
Source Current	DC	IS1 *1	13
		IS2 *2	23.4
		IS3 *3	31.8
	Pulsed *4	ISp	130
Total Power Dissipation	DC	PD1 *1	0.59
		PD2 *2	1.9
		PD3 *3	3.5
Channel Temperature	Tch	150	°C
Storage Temperature Range	Tstg	-55 to +150	°C

6. THERMAL CHARACTERISTICS Ta = 25 °C

Parameter	Symbol	Rating	Unit
Thermal Resistance (ch-a)	Rth *1	212	°C / W
	Rth *2	66	
	Rth *3	36	

- Note
- *1 Mounted on FR4 board (25.4 mm x 25.4 mm x t1.0 mm)
FR4 board partially covered with copper pad (42 mm² area, 36 μm thickness).
 - *2 Mounted on FR4 board (25.4 mm x 25.4 mm x t1.0 mm).
FR4 board fully covered with copper pad (605 mm² area, 36 μm thickness).
 - *3 Mounted on ceramic board (70 mm x 70 mm x t1.0 mm).
 - *4 t = 10 μs, Duty Cycle ≤ 1 %



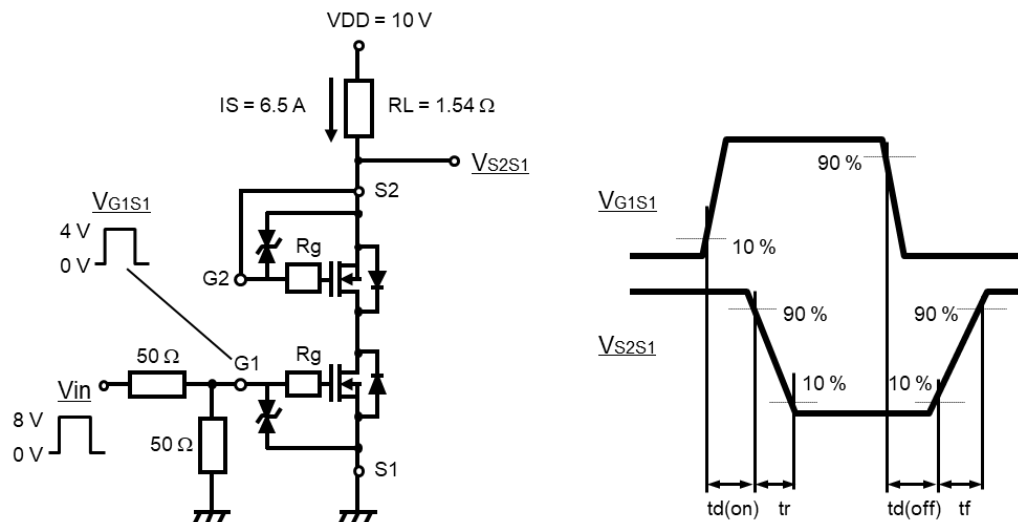
7. ELECTRICAL CHARACTERISTICS $T_a = 25\text{ }^\circ\text{C} \pm 3\text{ }^\circ\text{C}$

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Source-source Breakdown Voltage	VSSS	$I_S = 1\text{ mA}, V_{GS} = 0\text{ V}$	23			V
Zero Gate Voltage Source Current	ISSS	$V_{SS} = 23\text{ V}, V_{GS} = 0\text{ V}$			1.0	μA
Gate-source Leakage Current	IGSS1	$V_{GS} = \pm 8\text{ V}, V_{SS} = 0\text{ V}$			± 10	μA
	IGSS2	$V_{GS} = \pm 5\text{ V}, V_{SS} = 0\text{ V}$			± 1.0	
Gate-source Threshold Voltage	Vth	$I_S = 1.33\text{ mA}, V_{SS} = 6\text{ V}$	0.35	0.90	1.40	V
Source-source On-state Resistance	RSS(on)1	$I_S = 6.5\text{ A}, V_{GS} = 4.5\text{ V}$	1.80	2.45	3.20	m Ω
	RSS(on)2	$I_S = 6.5\text{ A}, V_{GS} = 3.8\text{ V}$	1.90	2.65	3.45	
	RSS(on)3	$I_S = 6.5\text{ A}, V_{GS} = 3.1\text{ V}$	2.05	3.00	4.50	
	RSS(on)4	$I_S = 6.5\text{ A}, V_{GS} = 2.5\text{ V}$	2.30	3.85	7.60	
Body Diode Forward Voltage	VF(s-s)	$I_F = 6.5\text{ A}, V_{GS} = 0\text{ V}$		0.6	1.0	V
Input Capacitance *1	Ciss	$V_{SS} = 10\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ kHz}$		4770		pF
Output Capacitance *1	Coss			460		
Reverse Transfer Capacitance *1	Crss			400		
Turn-on Delay Time *1,*2	td(on)	$V_{DD} = 10\text{ V}, V_{GS} = 0\text{ to }4\text{ V}$		1.4		μs
Rise Time *1,*2	tr	$I_S = 6.5\text{ A}$		2.8		
Turn-off Delay Time *1,*2	td(off)	$V_{DD} = 6\text{ V}, V_{GS} = 4\text{ to }0\text{ V}$		5.8		μs
Fall Time *1,*2	tf	$I_S = 6.5\text{ A}$		4.0		
Total Gate Charge *1	Qg	$V_{DD} = 6\text{ V}$		36		nC
Gate-source Charge *1	Qgs	$V_{GS} = 0\text{ to }4\text{ V}$		18		
Gate-drain Charge *1	Qgd	$I_S = 13\text{ A}$		12		
Gate Resistance *1	Rg	$f = 10\text{ kHz}$	400	700	1000	Ω

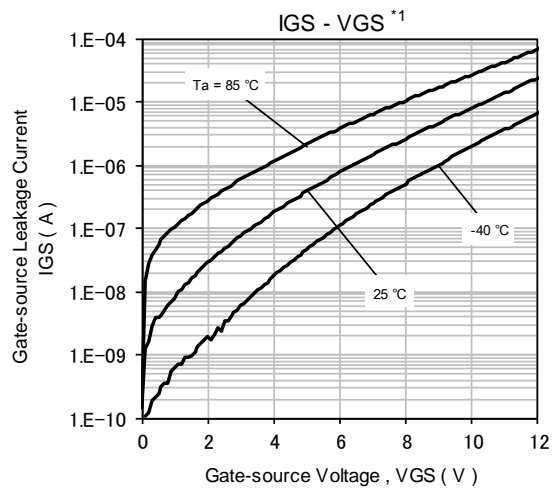
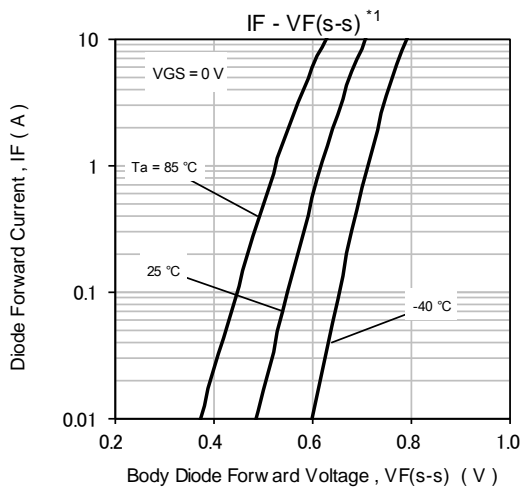
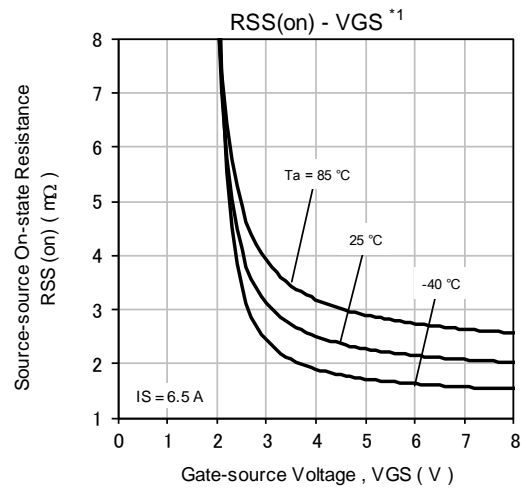
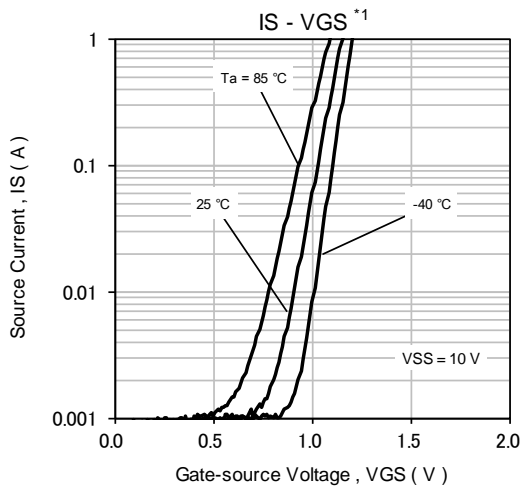
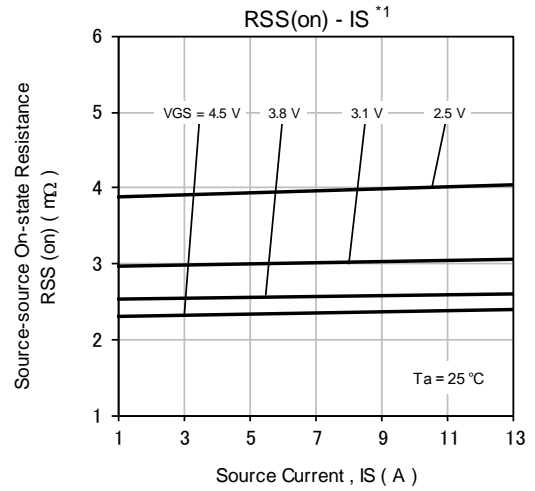
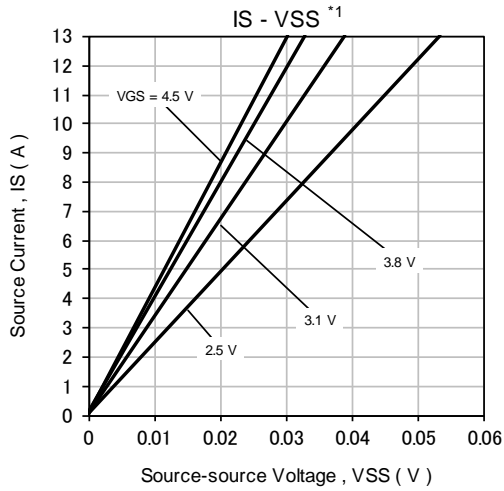
Note Measuring methods are based on JAPANESE INDUSTRIAL STANDARD JIS C 7030 Measuring methods for transistors.

*1 Guaranteed by design, not subject to production testing

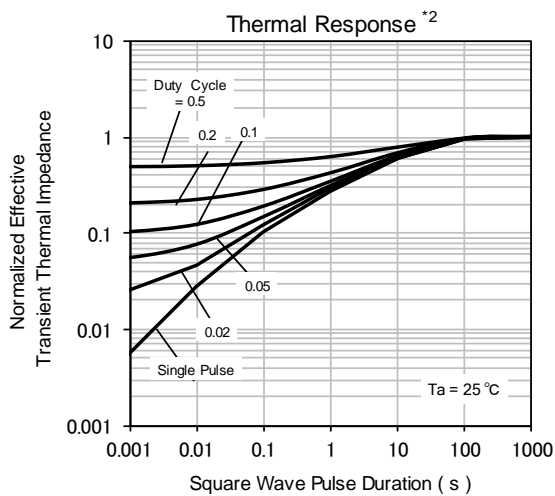
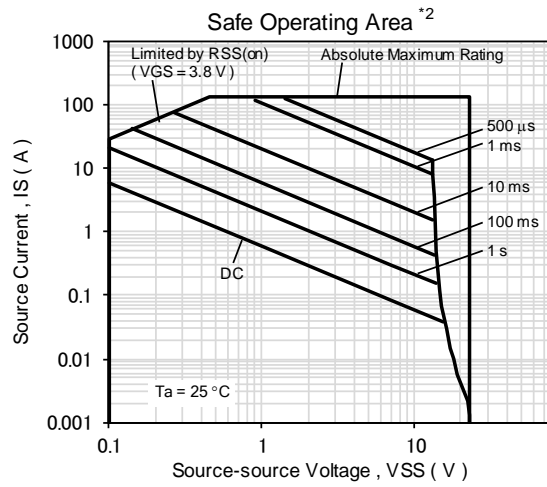
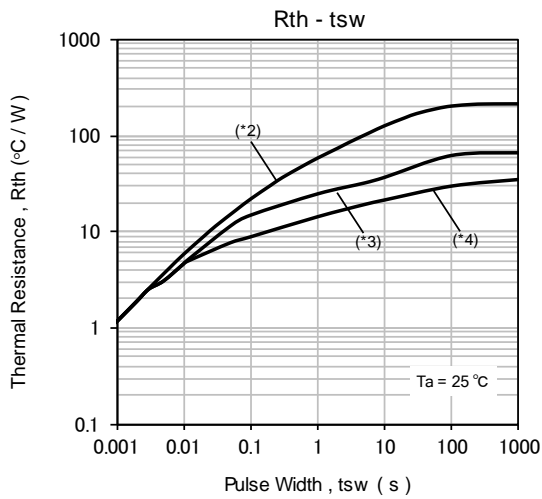
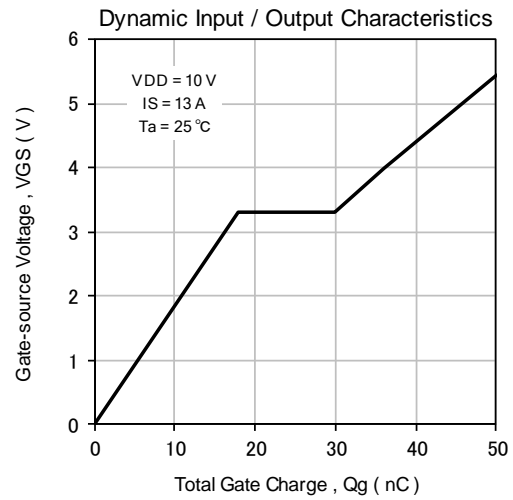
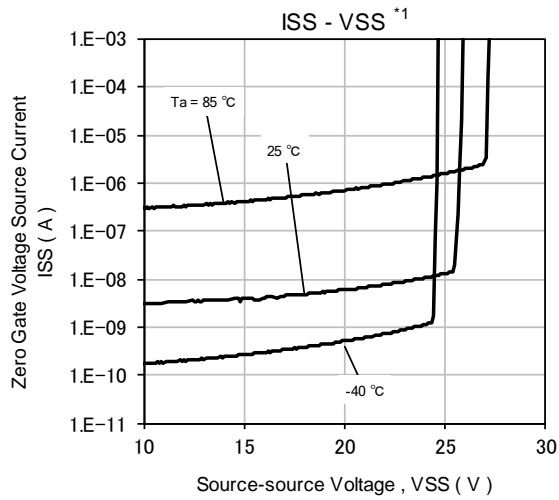
*2 Measurement circuit for Turn-on Delay Time / Rise Time / Turn-off Delay Time / Fall Time



8. TECHNICAL DATA (Reference)



TECHNICAL DATA (Reference)

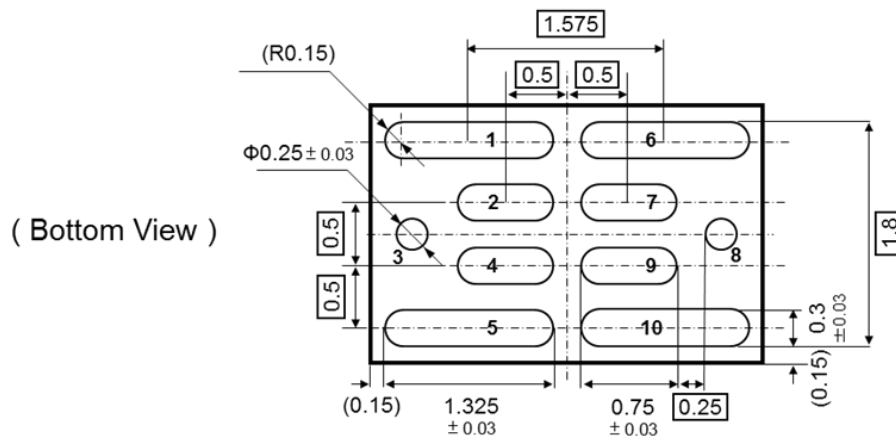
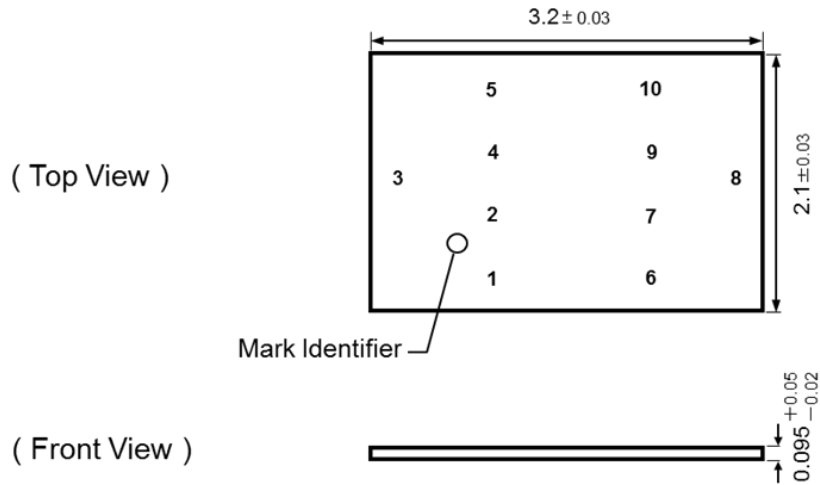


Note

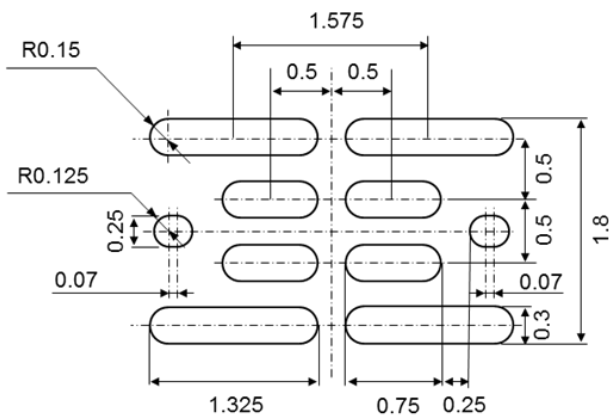
- *1 Pulse measurement.
- *2 Mounted on FR4 board (25.4 mm × 25.4 mm × t1.0 mm).
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- *4 Mounted on Ceramic board (70 mm × 70 mm × t1.0 mm).

9. OUTLINE

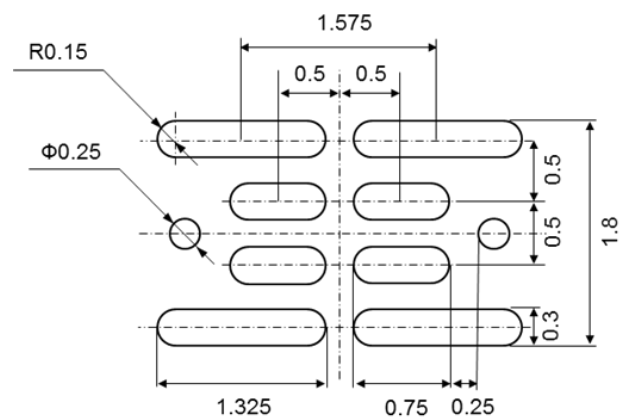
Unit : mm



10. LAND PATTERN (Reference) Unit: mm



11. STENCIL PATTERN (Reference) Unit: mm



12. REVISION HISTORY

Date	Revision	Description
2021.2.3	1.00	1. initially issued.