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POWER MOSFET, P-CHANNEL, RADIATION HARDENED, HIGH RELIABILITY, SPACE USE, DETAIL SPECIFICATION FOR

JAXA R
2SJ1A01, 2SJ1A02, 2SJ1A03
2SJ1A04, 2SJ1A05, 2SJ1A06
2SJ1A07, 2SJ1A08, 2SJ1A09
2SJ1A10, 2SJ1A11, 2SJ1A12

Prepared and Established by Fuji Electric Co., Ltd.
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This document is the English version of JAXA QTS/ADS which was originally written and authorized in Japanese and carefully translated into English for international users. If any question arises as to the context or detailed description, it is strongly recommended to verify against the latest official Japanese version.

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1 GENERAL

This specification establishes the detailed requirements for space use, high reliability, P channel power MOSFET (100 and 200V for TO-254 types and SMD types) used for electronic equipment installed on spacecrafts. The details for the products specified in this specification are as follows.

1.1 Part Number

The part numbers for the products are provided in accordance with JAXA-QTS-2030 and shall be shown as the following example.

(Example)

ID number JAXA R 2SJ 1 A101

- A101: Serial number starting from A01
- 1: ID number assigned for qualified manufacturer: 1
- 2SJ: Constituent (as specifed in paragraph 1.4.2 of JAXA-QTS-2030)
- R: Radiation hardness assurance level 1000Gy(Si)
- JAXA: Common parts for space development

The part numbers for the products covered by this specification are assigned as follows:

JAXA R 2SJ1A01
JAXA R 2SJ1A02
JAXA R 2SJ1A03
JAXA R 2SJ1A04
JAXA R 2SJ1A05
JAXA R 2SJ1A06
JAXA R 2SJ1A07
JAXA R 2SJ1A08
JAXA R 2SJ1A09
JAXA R 2SJ1A10
JAXA R 2SJ1A11
JAXA R 2SJ1A12

1.2 Absolute Maximum Ratings

The absolute maximum ratings of the products specified in this specification are as follows. Unless otherwise specified, T_A is +25°C.

Part No.	V_{DS} (V)	I_D (A)	$I_{D(pulse)}$ (A)	V_{GS} (V)	P_D T_C=25°C (W)		P_D T_A=25°C (W)		T_{ch}(1) (°C)	T_{stg} (°C)	$R_{th(ch-c)}$ (°C /W)	$R_{th(ch-a)}$ (°C /W)	SOA
JAXA R 2SJ1A01	-100	-42	-168	±20	250	Fig.5	2.60	Fig.6	150	-55 to 150	0.5	48.0	Fig.7
JAXA R 2SJ1A02	-100	-25	-100		125	Fig.8	2.58	Fig.9			1.0	48.5	Fig.10
JAXA R 2SJ1A03	-100	-11	-44		62.5	Fig.11	2.55	Fig.12			2.0	49.0	Fig.13
JAXA R 2SJ1A04	-100	-42	-168		250	Fig.14	---	---			0.5	---	Fig.15
JAXA R 2SJ1A05	-100	-29	-116		150	Fig.16	---	---			0.83	---	Fig.17
JAXA R 2SJ1A06	-100	-13	-52		70	Fig.18	---	---			1.67	---	Fig.19
JAXA R 2SJ1A07	-200	-35	-140		250	Fig.20	2.60	Fig.21			0.5	48.0	Fig.22
JAXA R 2SJ1A08	-200	-16	-64		125	Fig.23	2.58	Fig.24			1.0	48.5	Fig.25
JAXA R 2SJ1A09	-200	-7.5	-30		62.5	Fig.26	2.55	Fig.27			2.0	49.0	Fig.28
JAXA R 2SJ1A10	-200	-37	-148		250	Fig.29	---	---			0.5	---	Fig.30
JAXA R 2SJ1A11	-200	-18	-72		150	Fig.31	---	---			0.83	---	Fig.32
JAXA R 2SJ1A12	-200	-8.5	-34		70	Fig.33	---	---			1.67	---	Fig.34

Note(1) The channel temperature T_{ch} is given by the following equations:

$T_{ch}=T_C + R_{th(ch-c)} \times P_D$

$T_{ch}=T_A + R_{th(ch-a)} \times P_D$

Where T_C: Case temperature (°C)

T_A: Ambient temperature (°C)

$R_{th(ch-c)}$: Thermal resistance between channel and case (°C/W)

$R_{th(ch-a)}$: Thermal resistance between channel and ambient (°C/W)

P_D: Power dissipation (W)

1.3 Primary Electrical Characteristics

The primary electrical characteristics of the products specified in this specification are as follows. Unless otherwise specified, T_A is +25°C.

Electrical Characteristics (1/3)

Part No.	$V_{(BR)DSS}$ (V)	I_{DSS} (μA)	I_{GSS} (nA)	$V_{GS(th)}$ (V)	$R_{DS(on)}$([1]) (mΩ)	gfs([1]) (S)	E_{AS} (mJ)
	I_D=-1mA V_{GS}=0V	V_{DS}=80% of rated V_{DS} V_{GS}=0V	V_{GS}=±20V V_{DS}=0V	I_D=-1mA V_{DS}=V_{GS}	I_D=50% of rated I_D V_{GS}=-12V	I_D=50% of rated I_D V_{DS}=-25V	Rated I_D V_{DD}=-48V, V_{GS}=-12V
	Min	Max	Max	Min-Max	Max	Min	Max
JAXA R 2SJ1A01	-100	-10	±100	-2.5 to -4.5	45	8	1091
JAXA R 2SJ1A02	-100				97	8	458
JAXA R 2SJ1A03	-100				226	4	260
JAXA R 2SJ1A04	-100				38	8	1426
JAXA R 2SJ1A05	-100				90	8	598
JAXA R 2SJ1A06	-100				219	4	391
JAXA R 2SJ1A07	-200				91	8	655
JAXA R 2SJ1A08	-200				210	8	358
JAXA R 2SJ1A09	-200				487	3.5	191
JAXA R 2SJ1A10	-200				84	8	809
JAXA R 2SJ1A11	-200				203	8	482
JAXA R 2SJ1A12	-200				480	3.5	299

Note([1]) Pulse test: Pulse width ≤ 1ms, Duty cycle ≤ 2%

Electrical Characteristics (2/3)

Part No.	Q_{GS} (nC)	Q_{GD} (nC)	Q_G (nC)	$t_{d(on)}$ (ns)	t_r (ns)	$t_{d(off)}$ (ns)	t_f (ns)
	V_{DS}=50% of rated V_{DS}, I_D= rated I_D, V_{GS}=-12V			V_{DD}=50% of rated V_{DS}, I_D= rated I_D, V_{GS}=-12V, R_G=10Ω			
	Max	Max	Max	Max	Max	Max	Max
JAXA R 2SJ1A01	75	50	230	70	60	225	150
JAXA R 2SJ1A02	30	20	95	50	25	115	45
JAXA R 2SJ1A03	15	10	40	25	20	75	25
JAXA R 2SJ1A04	75	50	230	70	60	225	150
JAXA R 2SJ1A05	30	20	95	50	25	115	45
JAXA R 2SJ1A06	15	10	40	25	20	75	25
JAXA R 2SJ1A07	75	50	230	70	60	225	150
JAXA R 2SJ1A08	30	20	95	50	25	115	45
JAXA R 2SJ1A09	15	10	40	25	20	75	25
JAXA R 2SJ1A10	75	50	230	70	60	225	150
JAXA R 2SJ1A11	30	20	95	50	25	115	45
JAXA R 2SJ1A12	15	10	40	25	20	75	25

Electrical Characteristics (3/3)

(Body Diode Characteristics)

Part No.	V_{SD}(1) (V)	t_{rr} (ns)	Q_{rr} (µC)
	I_F= rated I_D V_{GS}=0V	I_F= rated I_D, V_{GS}=0V, -di/dt=100A/µs, T_{ch}=25°C	
	Max	Typ	Typ
JAXA R 2SJ1A01	-2.0	260	2.0
JAXA R 2SJ1A02		255	2.0
JAXA R 2SJ1A03		215	1.5
JAXA R 2SJ1A04		260	2.0
JAXA R 2SJ1A05		255	2.0
JAXA R 2SJ1A06		215	1.5
JAXA R 2SJ1A07		375	4.5
JAXA R 2SJ1A08		315	3.0
JAXA R 2SJ1A09		280	2.5
JAXA R 2SJ1A10		375	4.5
JAXA R 2SJ1A11		315	3.0
JAXA R 2SJ1A12		280	2.5

Note(1) Pulse test: Pulse width ≤ 1ms, Duty cycle ≤ 2%

1.4 Radiation Hardness

The radiation hardness of the products specified in this specification is as follows.

Symbol	Radiation hardness assurance level
R	1000 Gy(Si) {1×10^5 rad(Si)} (Dose Rate 36Gy(Si)/ h to 360Gy(Si)/ h)

2 APPLICABLE DOCUMENTS

The latest issues of documents listed below at the time of contract award or application form a part of this specification the extent specified herein.

JAXA-QTS-2030	Semiconductor Devices, High Reliability, Space Use, General Specification for
MIL-STD-750	Test Methods Standard for Semiconductor Devices

3 REQUIREMENTS

3.1 Design and Construction

The design and construction of the products shall meet this paragraph and paragraph 3.3 of JAXA-QTS-2030.

3.1.1 Package Configuration and Terminal Connection

The package configuration and terminal connection shall meet the requirements specified in Figures 1-a, 1-b, 1-c and 1-d.

3.1.2 Terminal Materials and Finish

a) TO-254 Package

The leads shall be made of Fe-Ni (Ni-Au plating) covered OCF (Oxygen-Free Copper) and plated with gold as specified in paragraph 3.3.7 c) 2) 2.3) or with Pb-Sn solder immersion as specified in paragraph 3.3.7 c) 2) 2.1) of JAXA-QTS-2030. In the case of Pb-Sn solder immersion, unplated lead length shall be less than 2mm from the lead egress on the product's body.

b) SMD Package

The material of terminals shall be Cu-W alloy. The terminals shall be finished with gold plating. The purity of gold shall be a minimum of 99.7%. The thickness of the plating shall be a minimum of 1.27μm. This finish shall be plated with nickel as an underplating of a thickness between 1.27μm and 7.62μm.

3.1.3 Electrical Characteristics

The electrical characteristics shall meet the requirements specified in Tables 1-a and 1-b.

3.2 Marking

Marking shall be in accordance with the paragraph 3.4 of JAXA-QTS-2030 and Figures 2-a, 2-b, 2-c and 2-d.

3.3 Certification

Manufacturers who wish to supply the products specified herein shall be certified by JAXA as specified in paragraph 3.1 of JAXA-QTS-2030.

4 QUALITY ASSURANCE PROVISIONS

4.1 General Requirements

The general requirements shall be in accordance with the paragraph 4.1 of JAXA-QTS-2030.

4.2 Materials Control

The materials control shall be in accordance with the paragraph 4.2 of JAXA-QTS-2030.

4.3 Manufacturing Process Control

The manufacturing process control shall be in accordance with the paragraph 4.3 of JAXA-QTS-2030.

4.4 In-process Inspection

The in-process inspection shall be in accordance with the paragraph 4.5 of JAXA-QTS-2030.

4.5 Screening

The screening shall be in accordance with paragraph 4.7 of JAXA-QTS-2030. The electrical characteristics to be measured, test conditions and delta limits shall be as follows.

4.5.1 Electrical Characteristics to be Measured

The following parameters shall be measured during the interim and final electrical characteristics tests for screening.

(1) Interim electrical characteristic tests T_A=+25°C

Measuring item	$V_{(BR)DSS}$ (V)	I_{DSS} (μA)	I_{GSS} (nA)	$V_{GS(th)}$ (V)	$R_{DS(on)}$([1]) (mΩ)	G_{FS}([1]) (S)	V_{SD}([1]) (V)
MIL-STD-750 Test Method No.	3407	3413	3411	3404	3421	3475	---
Test conditions	Bias Condition C I_D=-1mA V_{GS}=0V	Bias Condition C V_{DS}=80% of rated V_{DS} V_{GS}=0V	Bias Condition C V_{GS}=±20V V_{DS}=0V	I_D=-1mA V_{DS}=V_{GS}	I_D=50% of rated I_D V_{GS}=-12V	I_D=50% of rated I_D V_{DS}=-25V	I_F= rated I_D V_{GS}=0V
	Min	Max	Max	Min-Max	Max	Min	Max
JAXA R 2SJ1A01	-100	-10	±100	-2.5 to -4.5	45	8	-2.0
JAXA R 2SJ1A02	-100				97	8	
JAXA R 2SJ1A03	-100				226	4	
JAXA R 2SJ1A04	-100				38	8	
JAXA R 2SJ1A05	-100				90	8	
JAXA R 2SJ1A06	-100				219	4	
JAXA R 2SJ1A07	-200				91	8	
JAXA R 2SJ1A08	-200				210	8	
JAXA R 2SJ1A09	-200				487	3.5	
JAXA R 2SJ1A10	-200				84	8	
JAXA R 2SJ1A11	-200				203	8	
JAXA R 2SJ1A12	-200				480	3.5	

Note([1]) Pulse test: Pulse width ≤ 1ms, Duty cycle ≤ 2%

(2) Final electrical characteristics test: As specified in the subgroups 1, 2 and 3 of Tables 1-a and 1-b.

4.5.2 Test Conditions

The conditions of gate stress test, avalanche energy test, temperature cycling test, reverse bias burn-in test and burn-in test for screening test shall be as follows.
(Gate stress test shall be performed as part of In-process inspection.)

Gate stress test: V_{GS}=-35V, t=1ms, T_A=25°C

Single pulse avalanche energy (E_{AS}) test: $I_{D(pulse)}$ = rated I_D, V_{DD}=-48V, V_{GS}=-12V

Initial $T_C = +25^{-5}_{+10}$ °C

$$L(mH) = \left[\frac{2E_{AS}}{(I_D)^2}\right]\left[\frac{BV_{DSS} - V_{DD}}{BV_{DSS}}\right] \quad \text{▪ ▪ Equation (1)}$$

Temperature cycling test: Condition G, 20 cycles

Reverse bias burn-in test (GS): T_A=150°C, V_{GS}=-16V
V_{DS}=0V, 48hr

Burn-in test (DS): T_A=150°C, V_{DS}=80% of rated V_{DS}
V_{GS}=0V, 240hr

4.5.3 Delta Limits

The delta limits for reverse bias burn-in test and burn-in test shall be as follows.

$\Delta I_{GSS} \leq |20nA|$

$\Delta I_{DSS} \leq |10\mu A|$

$\Delta R_{DS(on)} \leq |20\%|$

$\Delta V_{GS(th)} \leq |20\%|$

4.6 Qualification Test and Quality Conformance Inspection

The qualification test and the quality conformance inspection shall be in accordance with paragraphs 4.6 and 4.8 of JAXA-QTS-2030. External dimensions, electrical characteristics, test conditions and limits shall be as specified in Figures 1 and 3, and Tables 1, 2, 3, 4 and 5. Group C tests and Group D tests may be exempted when the qualification test or quality conformance inspection for the Groups C and D tests was performed and the device passed the test within a year. Detailed requirements are specified in Table 6. Group E tests may be exempted in spite of chip size, when the semiconductor devices manufactured from the die of the same wafer lot have passed the Group E tests in the qualification test or the quality conformance inspection.

4.6.1 Electrostatic Discharge Sensitivity Test

Electrostatic discharge sensitivity test in the qualification test shall be performed with the following lead combination:

Gate and Source

4.6.2 Radiation Hardness Test

Radiation test (TID: Total Dose Irradiation) level, electrical characteristics, test conditions and limits in the qualification tests and the quality conformance inspections shall be as specified in Table 5. The bias shall be maintained during the irradiation and post-irradiation electrical characteristics test. The post-irradiation electrical characteristics test shall be performed within 24 hours after the completion of irradiation.

4.7 Change of Tests and Inspections

No change has been made to any test or inspection specified in appendixes A, B or C of JAXA-QTS -2030.

4.8 Long-term Storage

Delivery of the products stored at the manufacturer's site for 24 months or longer shall be in accordance with paragraph 4.9.1 of JAXA-QTS-2030.

5 PREPARATION FOR DELIVERY

Preparation for delivery shall be in accordance with Section 5 of JAXA-QTS-2030.

6 NOTES

6.1 Terms and Definitions

The terms and definitions used herein shall be in accordance with paragraph 1.2 of JAXA-QTS-2030 and as follows.

(1) SEB (Single Event Burnout);

Burnout of the device caused by the incidence of a proton or a heavy ion, when the device is applied to an off-state voltage between drain and source.

(2) SEGR (Single Event Gate Rupture);

Breakdown of MOSFET Gate Oxide film caused by the incidence of a proton or a heavy ion, when the device is applied to a gate bias voltage between gate and source.

6.2 Notice for Acquisition Officers

The precautions to be taken by the purchaser shall be in accordance with paragraph 6.2 of JAXA-QTS-2030 and as follows.

6.2.1 Handling Instructions

The products specified in this specification contain thin oxide films and can be damaged due to electrostatic discharge (ESD). ESD protection measures shall be implemented to avoid ESD between the gate and source and between the gate and drain during transportation and other handling environments.

6.2.2 Beryllium Warning

The products specified in this specification contain beryllium. Disintegration or chemical processing of the products that may produce dusts or fumes shall be prohibited. Disposition of the products shall be performed in accordance with applicable regulations. (Beryllium is used in 2SJ1A01, 2SJ1A02, 2SJ1A03, 2SJ1A07, 2SJ1A08 and 2SJ1A09)

Table 1-a. Group A Test ([1])

Gr.No	Sub	MIL-STD-750 Test Item	Method	JAXA R	100V Class 2SJ 1A01	2SJ 1A02	2SJ 1A03	2SJ 1A04	2SJ 1A05	2SJ 1A06	200V Class 2SJ 1A07	2SJ 1A08	2SJ 1A09	2SJ 1A10	2SJ 1A11	2SJ 1A12
A -1		**Static Characteristics (T_A=25°C)**		Sample Size	LTPD 3											
	-1a	Breakdown Voltage Drain to Source V_{DSS}	3407	Conditions	Bias Condition C I_D=-1mA , V_{GS}=0V											
				Limits	min -100V DC						min -200V DC					
	-1b	Gate Current I_{GSS}	3411	Conditions	Bias Condition C V_{GS}=±20V , V_{DS}=0V											
				Limits	max ±100nA DC											
	-1c	Drain Current I_{DSS}	3413	Conditions	Bias Condition C V_{DS}=-80V , V_{GS}=0V						Bias Condition C V_{DS}=-160V , V_{GS}=0V					
				Limits	max -10μA DC											
	-1d	Gate to Source Voltage (Threshold) $V_{GS(th)}$	3404	Conditions	Bias Condition C V_{GS}=V_{DS} , I_D=-1mA											
				Limits	-2.5 to - 4.5V DC											
	-1e	Static Drain to Source On-State Resistance $R_{DS(on)}$	3421	Conditions	Pulse Test([2]) , V_{GS}=-12V											
					I_D						I_D					
					-21A	-12.5A	-5.5A	-21A	-14.5A	-6.5A	-17.5A	-8A	-3.75A	-18.5A	-9A	-4.25A
				Limits	max [mΩ]						max [mΩ]					
					45	97	226	38	90	219	91	210	487	84	203	480
	-1f	Forward Transconductance gfs	3475	Conditions	Pulse Test([2]) , V_{DS}=-25V											
					I_D						I_D					
					-21A	-12.5A	-5.5A	-21A	-14.5A	-6.5A	-17.5A	-8A	-3.75A	-18.5A	-9A	-4.25A
				Limits	min						min					
					8S	8S	4S	8S	8S	4S	8S	8S	3.5S	8S	8S	3.5S
	-1g	Forward Voltage V_{SD}	---	Conditions	Pulse Test([2]) , V_{GS}=0V											
					I_D						I_D					
					-42A	-25A	-11A	-42A	-29A	-13A	-35A	-16A	-7.5A	-37A	-18A	-8.5A
				Limits	max -2.0V DC											
A -2		**Static Characteristics (T_A=125°C)**		Sample Size	LTPD 5											
	-2a	Gate Current I_{GSS} (125°C)	3411	Conditions	Bias Condition C V_{GS}=±20V , V_{DS}=0V											
				Limits	max ±100nA DC											
	-2b	Drain Current II_{DSS} (125°C)	3413	Conditions	Bias Condition C V_{DS}=-80V , V_{GS}=0V						Bias Condition C V_{DS}=-160V , V_{GS}=0V					
				Limits	max -25μA DC											
	-2c	Gate to Source Voltage (Threshold) $V_{GS(th)}$ (125°C)	3404	Conditions	Bias Condition C V_{GS}=V_{DS} , I_D=-1mA											
				Limits	min -2.0V DC											
	-2d	Static Drain to Source On-State Resistance $R_{DS(on)}$ (125°C)	3421	Conditions	Pulse Test([2]) , V_{GS}=-12V											
					I_D						I_D					
					-21A	-12.5A	-5.5A	-21A	-14.5A	-6.5A	-17.5A	-8A	-3.75A	-18.5A	-9A	-4.25A
				Limits	max [mΩ]						max [mΩ]					
					78	168	392	66	156	380	183	422	979	169	408	965

Notes([1]) The same sample may be used for all subgroups.

([2]) Pulse test: Pulse width ≤ 1ms, Duty cycle ≤ 2%

Table 1-b. Group A Test ([1])

Gr.No	Sub	MIL-STD-750 Test Item	Method	JAXA R	100V Class 2SJ 1A01	2SJ 1A02	2SJ 1A03	2SJ 1A04	2SJ 1A05	2SJ 1A06	200V Class 2SJ 1A07	2SJ 1A08	2SJ 1A09	2SJ 1A10	2SJ 1A11	2SJ 1A12
A -3		**Static Characteristics (T_A=-55°C)**		Sample Size	LTPD 5											
	-3a	Gate to Source Voltage (Threshold) $V_{GS(th)}$ (-55°C)	3404	Conditions	Bias Condition C V_{GS}=V_{DS} , I_D=-1mA											
				Limits	max -5.0V DC											
	-3b	Forward Transconductance gfs (-55°C)	3475	Conditions	Pulse Test ([2]) , V_{DS}=-25V											
					I_D						I_D					
					-21A	-12.5A	-5.5A	-21A	-14.5A	-6.5A	-17.5A	-8A	-3.75A	-18.5A	-9A	-4.25A
				Limits	min						min					
					8.5S	8.5S	4.5S	8.5S	8.5S	4.5S	8.5S	8.5S	4.0S	8.5S	8.5S	4.0S
A -4		**Dynamic Characteristics (T_A=25°C)**		Sample Size	LTPD 3											
		Switching Time Test (1) Turn-on delay time: $t_{d(on)}$ Rise time: t_r (2) Turn-off delay time: $t_{d(off)}$ Fall time: t_f	3472	Conditions	V_{DD}=-50V V_{GS}=-12V, R_g=10Ω						V_{DD}=-100V V_{GS}=-12V, R_g=10Ω					
					I_D						I_D					
					-42A	-25A	-11A	-42A	-29A	-13A	-35A	-16A	-7.5A	-37A	-18A	-8.5A
				Limits	max						max					
				$t_{d(on)}$	70	50	25	70	50	25	70	50	25	70	50	25
				t_r	60	25	20	60	25	20	60	25	20	60	25	20
				$t_{d(off)}$	225	115	75	225	115	75	225	115	75	225	115	75
				t_f	150	45	25	150	45	25	150	45	25	150	45	25
A -6a		**Safe Operating Area Test([3])**		Sample Size	LTPD 5											
			3474	Conditions	---											
	-6b	**End-Point Electrical Measurements**	---		Same as Gr.A-1											
A -7		**Other Characteristics (T_A=25°C)** ([4])		Sample Size	LTPD 10											
	-7a	Gate Charge (1) Gate Charge: Q_g (2) Gate to Drain Charge: Q_{gd} (3) Gate to Source Charge: Q_{gs}	3471	Conditions	V_{GS}=-12V V_{DS}=-50V						V_{GS}=-12V V_{DS}=-100V					
					I_D						I_D					
					-42A	-25A	-11A	-42A	-29A	-13A	-35A	-16A	-7.5A	-37A	-18A	-8.5A
				Limits	max						max					
				Q_g	230nC	95nC	40nC	230nC	95nC	40nC	230nC	95nC	40nC	230nC	95nC	40nC
				Q_{gd}	50nC	20nC	10nC	50nC	20nC	10nC	50nC	20nC	10nC	50nC	20nC	10nC
				Q_{gs}	75nC	30nC	15nC	75nC	30nC	15nC	75nC	30nC	15nC	75nC	30nC	15nC
	-7b	Reverse Recovery Characteristics (1) T_{rr} (2) Q_{rr}	3473	Conditions	I_F= I_D						I_F= I_D					
					-42A	-25A	-11A	-42A	-29A	-13A	-35A	-16A	-7.5A	-37A	-18A	-8.5A
					V_{GS}=0V -di/dt=100A/μs											
				Limits	max						max					
				T_{rr}	260	255	215	260	255	215	375	315	280	375	315	280
				Q_{rr}	2.0	2.0	1.5	2.0	2.0	1.5	4.5	3.0	2.5	4.5	3.0	2.5

Notes([1]) The same sample may be used for all subgroups.

([2]) Pulse test: Pulse width ≤ 1ms, Duty cycle ≤ 2%

([3]) The samples used for subgroups A-1, A-2, and A-3 tests shall be used.

([4]) The samples used for subgroups A-6 tests shall be used.

Table 2-a. Group B Test

Gr.No	Sub	Test Item	MIL-STD-750 Method	JAXA R	100V Class 2SJ 1A01	2SJ 1A02	2SJ 1A03	2SJ 1A04	2SJ 1A05	2SJ 1A06	200V Class 2SJ 1A07	2SJ 1A08	2SJ 1A09	2SJ 1A10	2SJ 1A11	2SJ 1A12
B -1		**Dimensions**([1])		Sample Size	Level I ([2]) 3p Level II ([2]) 3p											
			2066	Conditions	See Fig. 1											
B -2		**Resistance to Solvents**([3]) ([4])		Sample Size	Level I 3p Level II 3p											
			1022	Conditions	Solvent a, b, c											
B -3b		**Temperature Cycling (Air to Air)**		Sample Size	Level I 6p Level II 6p											
			1051	Conditions	-55^{+0}_{-5}°C↔25^{+10}_{-5}°C↔150^{+5}_{-0}°C 100 cycles											
-3c		**Surge Test**	4066	Conditions												
		(1) Gate Shock			V_{GS}=-35V											
		(2) Avalanche	4066	Conditions	V_{DS}=-48V, L= See paragraph 4.5.2, Equation (1)											
					$I_{D(pulse)}$											
					-42A	-25A	-11A	-42A	-29A	-13A	-35A	-16A	-7.5A	-37A	-18A	-8.5A
-3d		**Hermetic Seal**	1071	Conditions												
		(1) Fine			Condition H											
				Limits	max 1×10^{-3}Pa-cm^3/s											
		(2) Gross	1071	Conditions	--- Condition C											
-3e		**End-Point Electrical Measurements**	---	Conditions	Same as Gr.A-1											
-3f		**Decap-Internal Visual**	2075 2071	Conditions	---											
-3g		**Bond Strength**	2037	Conditions	Condition A											
				Limits	Gate Wire >90gf											
					Source Wire											
					>300gf	>300gf	>90gf	>300gf	>300gf	>90gf	>300gf	>300gf	>90gf	>300gf	>300gf	>90gf
-3h		**SEM**([1])	2077	Conditions	---											
-3i		**Die Shear**		Sample Size	Level I 3p Level II 3p											
			2017	Conditions	---											
				Limits	min 2.5kgf											
B -4		**Solderability**([3]) ([4])		Sample Size	Level I 6 leads([5]) Level II 6 leads([5])											
			2026	Conditions	---											

Notes([1]) The test may be performed using the samples prior to inspection lot formation.

([2]) Level I and Level II shall be applicable to the qualification test and the quality conformance inspection, respectively. (See paragraphs C.3.2 and C.3.3 of JAXA-QTS-2030)

([3]) Electrically defective products from the same inspection lot may be used.

([4]) When electrically defective products are used, the samples shall be exposed to the same thermal environments as the certified samples experience in all thermal tests required as part of the screening test.

([5]) This test shall be performed for each 3 lead from 2 devices.

Table 2-b. Group B Test

Gr.No	MIL-STD-750			100V Class						200V Class					
Sub	Test Item	Method	JAXA R	2SJ 1A01	2SJ 1A02	2SJ 1A03	2SJ 1A04	2SJ 1A05	2SJ 1A06	2SJ 1A07	2SJ 1A08	2SJ 1A09	2SJ 1A10	2SJ 1A11	2SJ 1A12
B -5a	**Intermittent Operation Life**		Sample Size	Level I LTPD 10 Level II 12p											
		1042	Conditions	Condition D, 2000 cycles([1])											
-5b	**End-Point Electrical Measurements**	---	Conditions	Same as Gr.A-1											
B -6c	**Accelerated Steady-state Gate Stress (High Temp. GS)**		Sample Size	Level I LTPD 10 Level II 12p											
		1042	Conditions	V_{GS}=-20V, T_A =150°C, 48hr or V_{GS}=-20V, T_A =175°C, 24hr											
-6d	**End-Point Electrical Measurements**	---	Conditions	Same as Gr.A-1											
-6e	**Accelerated Steady-state Reverse Bias (DS)**	1042	Conditions	V_{DS}=100V						V_{DS}=200V					
				T_A =150°C, 240hr or T_A =175°C, 120hr											
-6f	**End-Point Electrical Measurements**	---	Conditions	Same as Gr.A-1											
-6g	**Bond Strength**		Sample Size	20 wires											
		2037	Conditions	Condition A											
			Limits	Gate Wire >90gf											
				Source Wire											
				>300gf	>300gf	>90gf	>300gf	>300gf	>90gf	>300gf	>300gf	>90gf	>300gf	>300gf	>90gf
B -7	**Thermal Impedance** $Z_{th(ch-c)}(\Delta V_{SD})$		Sample Size	Level I LTPD 10 Level II 8p											
		3161	Conditions	T_A =25°C											
			Limits	max (°C/W)						max (°C/W)					
				0.5	1.0	2.0	0.5	0.83	1.67	0.5	1.0	2.0	0.5	0.83	1.67

Note([1]) If the samples are also used for “Intermittent operating life test” of C1-1 in the Group C test, the test shall be performed up to 6000 cycles.

Table 3. Group C Test

Gr.No	Sub	Test Item	MIL-STD-750 Method	JAXA R	100V Class 2SJ 1A01	2SJ 1A02	2SJ 1A03	2SJ 1A04	2SJ 1A05	2SJ 1A06	200V Class 2SJ 1A07	2SJ 1A08	2SJ 1A09	2SJ 1A10	2SJ 1A11	2SJ 1A12
C	1-1a	**Intermittent Operation Life**		Sample Size	Level I LTPD 10 Level II LTPD 10											
			1042	Conditions	Condition D, 6000 cycles ([1])											
	1-1b	**End-Point Electrical Measurements**	---	Conditions	Same as Gr.A-1											
C	1-2a	**Steady-state Bias Life test (high temperature GS applied)** ([2])		Sample Size	Level I LTPD 5 Level II NA											
			1042	Conditions	V_{GS}=-16V T_A=150°C , 1000hr											
	1-2b	**End-Point Electrical Measurements**	---	Conditions	Same as Gr.A-1											
	1-2c	**Steady-state Bias Life test (high temperature DS applied)** ([2])([3])		Sample Size	Level I LTPD 5 Level II NA											
			1042	Conditions	V_{DS}=80V						V_{DS}=160V					
					T_A=150°C, 1000hr											
	1-2d	**End-Point Electrical Measurements**	---	Conditions	Same as Gr.A-1											
C	-2a	**Thermal Shock Temperature Cycling**		Sample Size	Level I 12p Level II NA											
			1051	Conditions	-55^{+0}_{-5}°C↔25^{+10}_{-5}°C↔150^{+5}_{-0}°C 100 cycles											
	-2b	**Hermetic Seal** (1) Fine	1071	Conditions	Condition H											
				Limits	max 1×10^{-3}Pa-cm^3/s											
		(2) Gross	1071	Conditions	Condition C											
	-2c	**End-Point Electrical Measurements** ([4])	---	Conditions	Same as Gr.A-1											
C	-3	**Thermal** Impedance ([5])([6])		Sample Size	Level I LTPD 10 Level II 8p											
		$Z_{th(ch-c)}(\Delta V_{SD})$	3161	Conditions	T_A =25°C											
				Limits	max (°C/W)						max (°C/W)					
					0.5	1.0	2.0	0.5	1.0	2.0	0.5	1.0	2.0	0.5	1.0	2.0
C	-4a	**Safe Operating Area Test**([7])		Sample Size	Level I LTPD 10 Level II LTPD 10											
			3474	Conditions	---											
	-4b	**End-Point Electrical Measurements** ([7])	---	Conditions	Same as Gr.A-1											
C	-6a	**Electric Discharge Sensitivity Classification**		Sample Size	Level I 3p Level II NA											
			1020	Conditions	V_{GS}											
					±2750V	±1000V	±500V	±2750V	±1000V	±500V	±2750V	±1000V	±500V	±2750V	±1000V	±500V
					V_{DS}=0V											
	-6b	**End-Point Electrical Measurements**	---	Conditions	Same as Gr.A-1											

Notes([1]) For the quality conformance inspection, the minimum cycles may be reduced to 2000 cycles.

([2]) The legibility of the marking shall not apply.

([3]) This test may be conducted using the samples other than the ones used for Group C1-2a.

([4])This test may be conducted prior to the hermetic seal.

([5])Thermal impedance curve shall be obtained during the qualification test.

([6])This test may be exempted if performed in the Group B test.

([7])This test may be exempted if performed in the Group A test.

Table 4-a. Group D Test

Gr.No	Sub	MIL-STD-750 Test Item	Method	JAXA R	100V Class 2SJ 1A01	2SJ 1A02	2SJ 1A03	2SJ 1A04	2SJ 1A05	2SJ 1A06	200V Class 2SJ 1A07	2SJ 1A08	2SJ 1A09	2SJ 1A10	2SJ 1A11	2SJ 1A12
D	-1a	**Thermal Shock (Glass Strain)**		Sample Size	Level I LTPD 15 Level II LTPD 15											
			1056	Conditions	Condition B, 15 cycles											
	-1b	**Thermal Shock (Temperature Cycling)**	1051	Conditions	-55^{+0}_{-5}°C↔25^{+10}_{-5}°C↔150^{+5}_{-0}°C 45 cycles											
	-1c	**Terminal Strength**	2036	Conditions	Condition A 1.5kg, 30s											
	-1d	**Moisture Resistance**	1021	Conditions	(MIL-STD-202, Method 106)											
	-1e	**Hermetic Seal** (1) Fine	1071	Conditions	Condition H											
				Limits	max 1×10^{-3}Pa-cm^3/s											
		(2) Gross	1071	Conditions	Condition C											
	-1f	**Visual Inspection**	1051 1021	Conditions	---											
	1g	**End-Point Electrical Measurements**	---	Conditions	Same as Gr.A-1											
D	-2a	**Shock**(1)		Sample Size	Level I LTPD 15 Level II LTPD 15											
			2016	Conditions	No Operating, 14700m/s^2 (1500G) 5 blows in each orientation, X_1, Y_1, Y_2 and Z_1											
	-2b	**Vibration, Variable Frequency**(1)	2056	Conditions	100 to 2000 Hz, 4min 196 m/s^2 (20G) 4 times each orientation, X, Y and Z											
	-2c	**Constant Acceleration**(1)	2006	Conditions	98100 m/s^2 (10000G) X_1, Y_1, Y_2 and Z_1 orientation											
	-2d	**Hermetic Seal**(1) (1) Fine	1071	Conditions	Condition H											
				Limits	max 1×10^{-3}Pa-cm^3/s											
		(2) Gross	1071	Conditions	Condition C											
	-2e	**End-Point Electrical Measurements**(1)	---	Conditions	Same as Gr.A-1											
D	-3a	**Salt Atmosphere**(2)		Sample Size	Level I LTPD 15 Level II LTPD 15											
			1041	Conditions	35°C, 24hr Rate of salt deposit=10 to 50g/m^2/24hr											

Notes(1) Samples used for subgroup 1 may be used.

(2) Electrically defective products from the same inspection lot may be used.

Table 4-b. Group D Test

Gr.No	Sub	MIL-STD-750 Test Item	Method	JAXA R	100V Class 2SJ 1A01	2SJ 1A02	2SJ 1A03	2SJ 1A04	2SJ 1A05	2SJ 1A06	200V Class 2SJ 1A07	2SJ 1A08	2SJ 1A09	2SJ 1A10	2SJ 1A11	2SJ 1A12
D	-5	**Internal Water Vapor** (1)		Sample Size	Level I 3p Level II 3p											
			1018	Conditions	---											
D	-6a	**Resistance to Soldering Heat**		Sample Size	Level I 3p Level II NA											
			2031	Conditions	250°C, 10s			240°C, 10s			250°C, 10s			240°C, 10s		
	-6b	**Visual Inspection**	---	Conditions	---											
	-6c	**Hermetic Seal** (1) Fine	1071	Conditions	Condition H											
				Limits	max 1×10^{-3}Pa-cm^3/s											
		(2) Gross	1071	Conditions	Condition C											
	-6d	**End-Point Electrical Measurements**	---	Conditions	Same as Gr.A-1											

Note(1) Electrically defective products from the same inspection lot may be used.

Table 5. Group E Test

Gr.No	Sub	Test Item	MIL-STD-750 Method	JAXA R	100V Class 2SJ 1A01	2SJ 1A02	2SJ 1A03	2SJ 1A04	2SJ 1A05	2SJ 1A06	200V Class 2SJ 1A07	2SJ 1A08	2SJ 1A09	2SJ 1A10	2SJ 1A11	2SJ 1A12
E	**-1a**	**Total Dose Irradiation (TID)**	1019	Sample Size	Level I 4p([1]) Level II 4p([1])											
				Conditions	Total Dose 1×10^3Gy(Si) Dose Rate 36Gy(Si)/h to 360Gy(Si)/h Bias Condition (during irradiation, after irradiation) (a) V_{DS}=0V , V_{GS}=-20V (b) V_{DS}=-80V, V_{GS}=0V						(b) V_{DS}=-160V, V_{GS}=0V					
	-1b	**End-Point Electrical Measurements**			Within 24hr after irradiation											
	(1)	Breakdown Voltage Drain to Source V_{DSS}	3407	Conditions	Bias Condition C I_D=-1mA , V_{GS}=0V											
				Limits	min -100V DC						min -200V DC					
	(2)	Gate Current I_{GSS}	3411	Conditions	Bias Condition C V_{GS}=±20V , V_{DS}=0V											
				Limits	max ±100nA DC											
	(3)	Drain Current I_{DSS}	3413	Conditions	Bias Condition C V_{DS}=-80V , V_{GS}=0V						Bias Condition C V_{DS}=-160V , V_{GS}=0V					
				Limits	max -10μA DC											
	(4)	Gate to Source Voltage (Threshold) $V_{GS(th)}$	3404	Conditions	Bias Condition C V_{GS}=V_{DS} , I_D=-1mA											
				Limits	-2.5 to -4.5V DC											
	(5)	Static Drain to Source On-State Resistance $R_{DS(on)}$	3421	Conditions	Pulse Test([2]) , V_{GS}=-12V											
					I_D						I_D					
					-21A	-12.5A	-5.5A	-21A	-14.5A	-6.5 A	-17.5A	-8A	-3.75A	-18.5A	-9A	-4.25A
				Limits	max [mΩ]						max [mΩ]					
					45	97	226	38	90	219	91	210	487	84	203	480

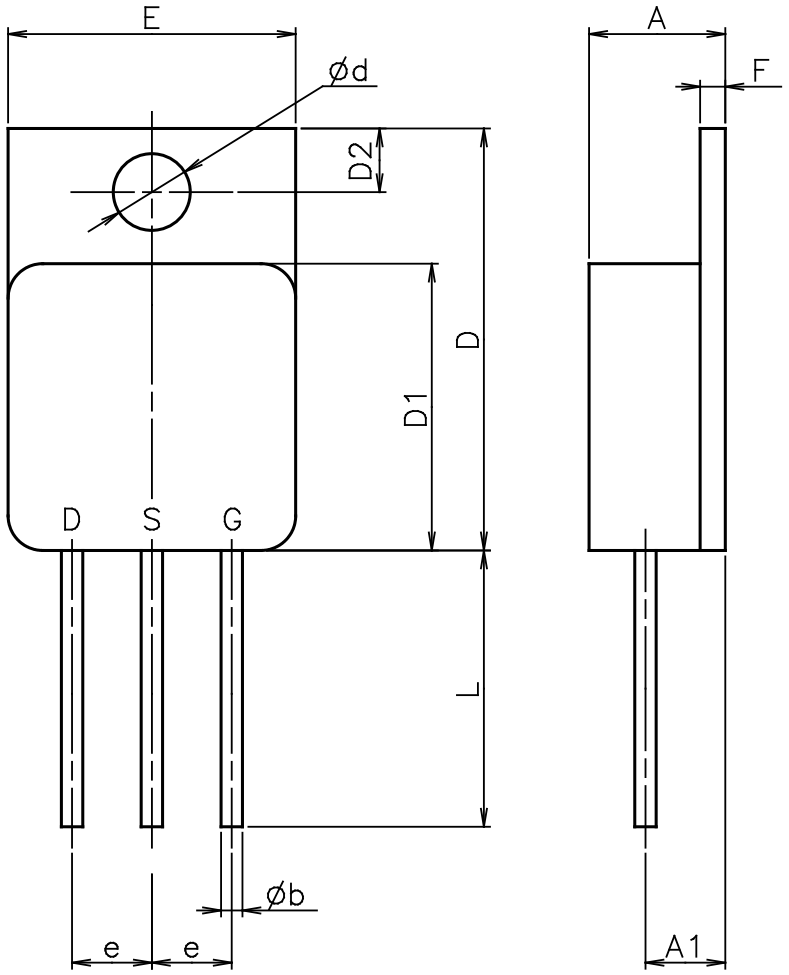
Notes([1]) This test shall be performed for each single wafer lot. When an inspection lot consists of multiple inspection sublots, one inspection sublot may be performed this test.

([2]) Pulse test: Pulse width ≤ 1ms, Duty cycle ≤ 2%

Table 6. Exemption of Quality Conformance Inspection

When the qualification test or the quality conformance inspection for products specified as following table was initiated within a year from the completion date of the screening test for the inspection lot, and the device passed the test or inspection, the corresponding tests may be exempted.

Gr.No	Sub	Package	TO−254						SMD−					
									2	1	0.5	2	1	0.5
			100V Class			200V Class			100V Class			200V Class		
		JAXA R	2SJ 1A01	2SJ 1A02	2SJ 1A03	2SJ 1A07	2SJ 1A08	2SJ 1A09	2SJ 1A04	2SJ 1A05	2SJ 1A06	2SJ 1A10	2SJ 1A11	2SJ 1A12
		JAXA-QTS-2030 Appendix C	Die Size						Die Size					
		Test Item	1/1	1/2	1/4	1/1	1/2	1/4	1/1	1/2	1/4	1/1	1/2	1/4
C	**1-1a**	Intermittent Operation Life	The tests may be exempted when: 1) the devices having the same or larger die size have passed the tests. 2) the test is performed with the same or larger V_{DS} specified in paragraph 1.2.						The tests may be exempted when: 1) the devices having the same or larger die size have passed the tests. 2) the test is performed with the same or larger V_{DS} specified in paragraph 1.2.					
	1-1b	End-Point Electrical Measurements												
	-2a	Thermal Shock (Temperature Cycling)												
	-2b	Hermetic Seal												
	-2c	End-Point Electrical Measurements												
	-3	Thermal Resistance	This test may be exempted when the device passed the Group B-7 test.											
	-4a	Safe Operating Area Test	This test may be exempted when the device passed the Group A-6 test.											
	-4b	End-Point Electrical Measurements												
D	**-1a**	Thermal Shock (Glass Strain)	This test may be exempted when any one of the products passed the Group D-1 test.						• The tests using the package types SMD-1 and SMD-0.5 may be exempted when SMD-2 has passed these tests. • The tests using the package type SMD-0.5 may be exempted when SMD-1 has passed these tests.					
	-1b	Thermal Shock (Temperature Cycling)												
	-1c	Terminal Strength												
	-1d	Moisture Resistance												
	-1e	Hermetic Seal												
	-1f	Visual Inspection												
	-1g	End-Point Electrical Measurements												
	-2a	Shock												
	-2b	Vibration, Variable Frequency												
	-2c	Constant Acceleration												
	-2d	Hermetic Seal												
	-2e	End-Point Electrical Measurements												
	-3a	Salt Atmosphere							This test may be exempted when any one of the products passed the Group D-1 test.					
	-5	Internal Water Vapor												

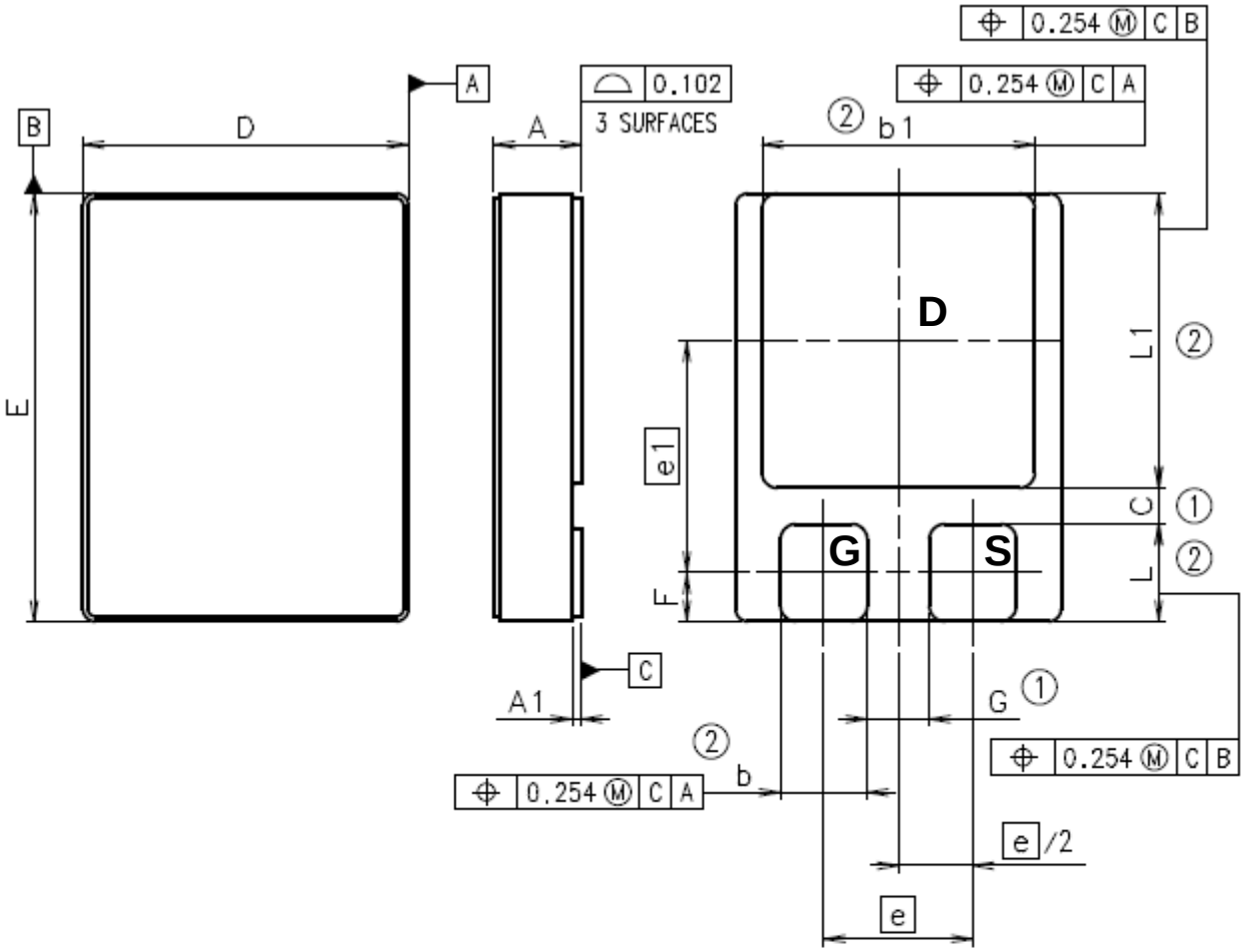


Symbol	Dimension (mm)	
	Min	Max
A	6.35	6.65
A1	3.61	4.01
øb	0.90	1.14
D	20.07	20.31
D1	13.59	13.85
D2	2.93	3.17

Symbol	Dimension (mm)	
	Min	Max
ød	3.56	3.80
E	13.60	13.84
e	3.51	4.11
F	1.10	1.30
L	12.84	13.60

Note: All leads are isolated from the case.

Figure 1-a. Package Configuration and Lead Connection of TO-254 Type Package
（JAXA R 2SJ1A01, 2SJ1A02, 2SJ1A03, 2SJ1A07, 2SJ1A08 and 2SJ1A09）



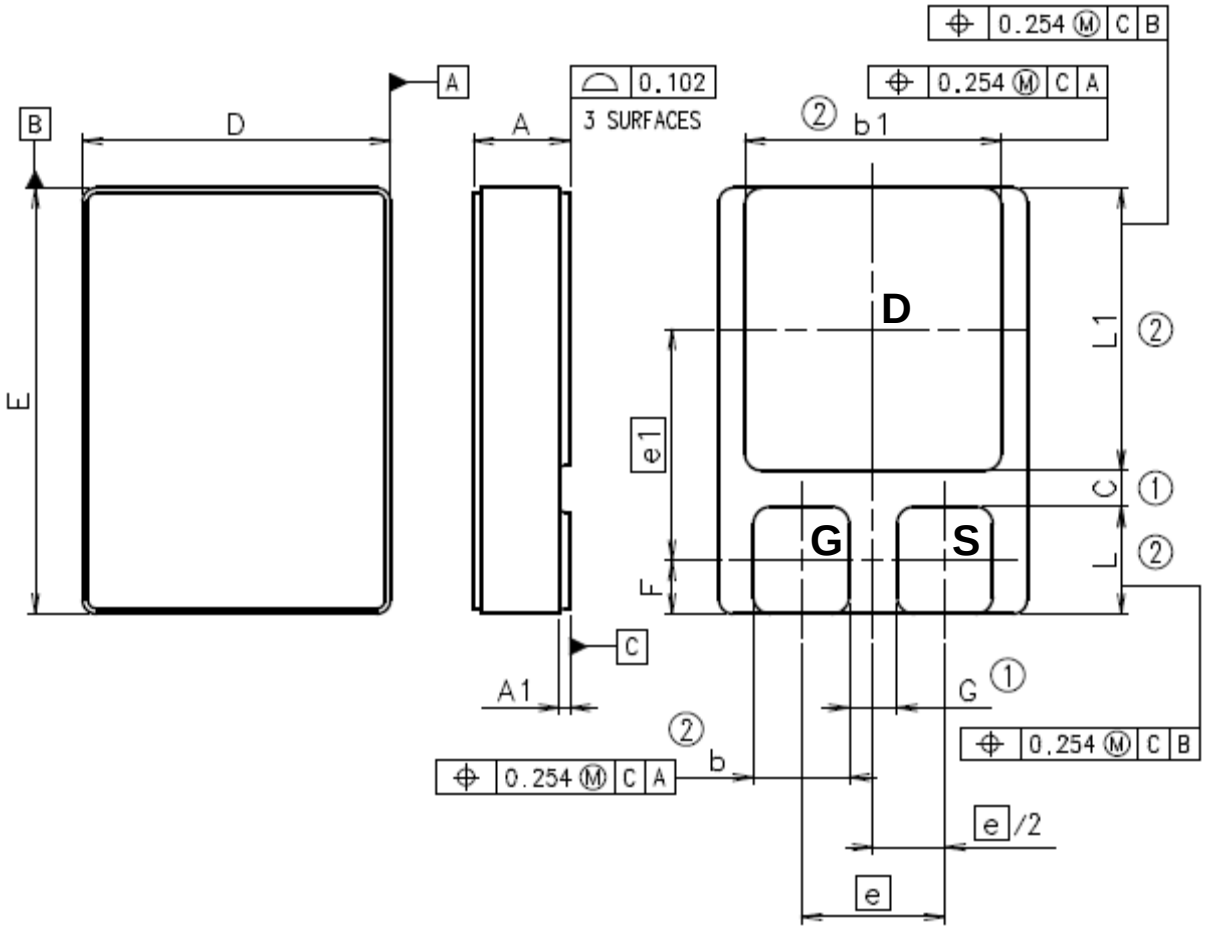
Symbol	Dimension (mm)		
	Min	Typ	Max
A	———	———	3.58
A1	0.254	0.381	0.508
b	3.43	3.555	3.68
b1	11.05	11.175	11.30
C	0.89	———	———
D	13.21	13.335	13.46
E	17.40	17.525	17.65

Symbol	Dimension (mm)		
	Min	Typ	Max
e/2	———	3.05	———
e	———	6.10	———
e1	———	9.50	———
F	———	1.99	———
G	1.27	———	———
L	3.87	3.99	4.11
L1	11.94	12.065	12.19

Notes: ① Dimension includes metallization flash.
② Dimension does not include metallization flash.

Note: All terminals are isolated from the case.

Figure 1-b. Package Configuration and Terminal Connection of SMD-2 Type Package
(JAXA R 2SJ1A04 and 2SJ1A10)



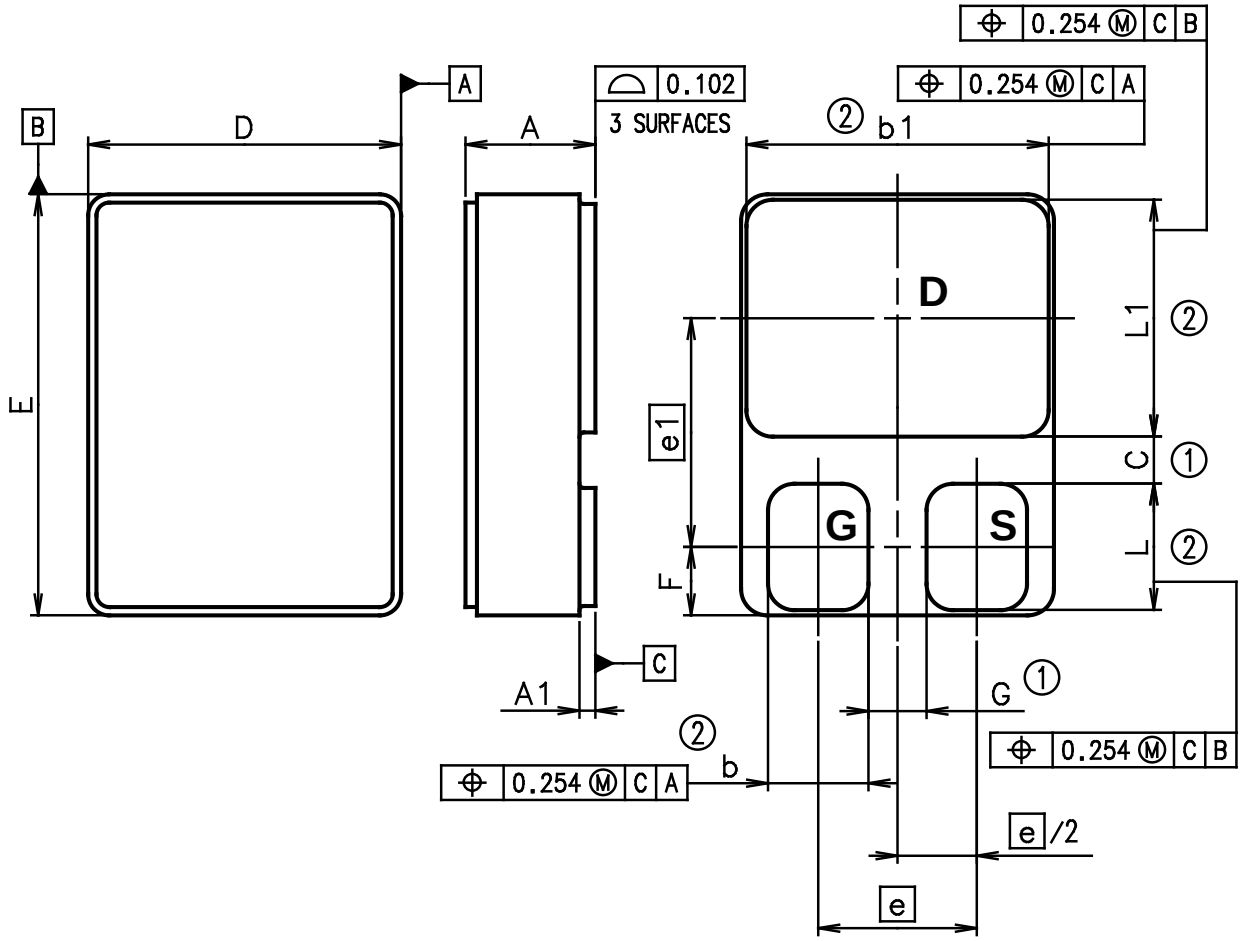
Symbol	Dimension (mm)		
	Min	Typ	Max
A	———	———	3.58
A1	0.254	0.381	0.508
b	3.43	3.555	3.68
b1	9.40	9.525	9.65
C	0.76	———	———
D	11.31	11.43	11.55
E	15.75	15.875	16.00

Symbol	Dimension (mm)		
	Min	Typ	Max
e/2	———	2.67	———
e	———	5.33	———
e1	———	8.61	———
F	———	1.99	———
G	0.89	———	———
L	3.87	3.99	4.11
L1	10.42	10.54	10.66

Notes: ① Dimension includes metallization flash.
② Dimension does not include metallization flash.

Note: All terminals are isolated from the case.

Figure 1-c Package Configuration and Terminal Connection of SMD-1 type package (JAXA R 2SJ1A05 and 2SJ1A11)



Symbol	Dimension (mm)		
	Min	Typ	Max
A	—	—	
A1	0.254	0.381	0.508
b	2.29	2.415	2.54
b1	7.14	7.265	7.39
C	0.76	—	—
D	7.40	7.52	7.64
E	10.04	10.16	10.28

Symbol	Dimension (mm)		
	Min	Typ	Max
e/2	—	1.905	—
e	—	3.81	—
e1	—	5.52	—
F	—	1.65	—
G	0.762	—	—
L	2.93	3.05	3.17
L1	5.59	5.715	5.84

Notes: ① Dimension includes metallization flash.
② Dimension does not include metallization flash.

Note: All terminals are isolated from the case.

Figure 1-d Package Configuration and Terminal Connection of SMD-0.5 type package (JAXA R 2SJ1A06 and 2SJ1A12)

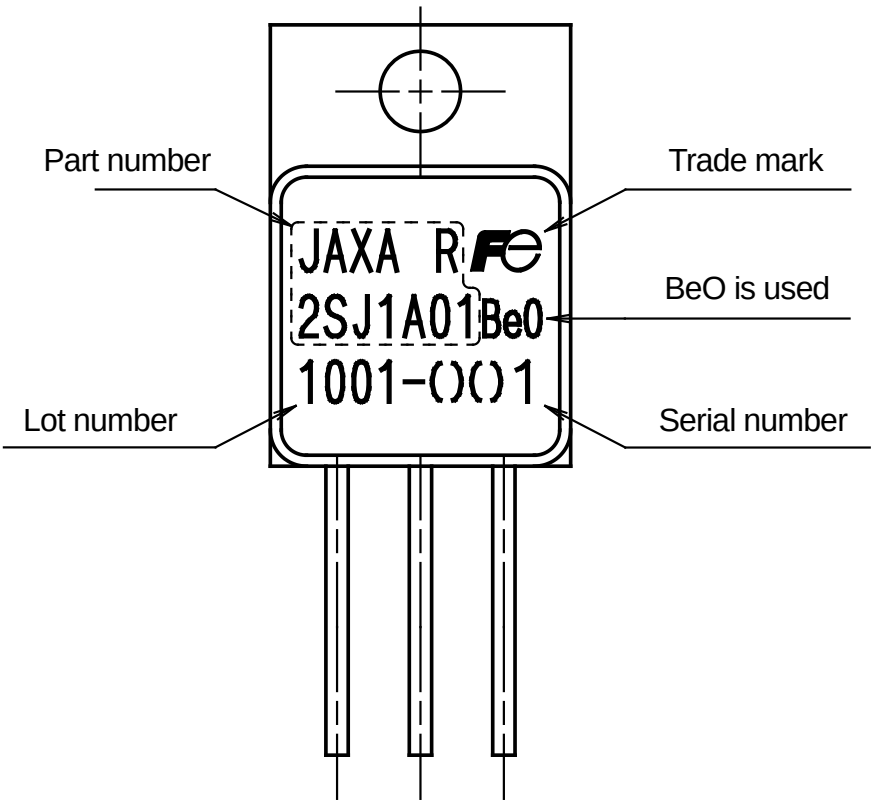


Figure 2-a Markings (TO-254)
（JAXA R 2SJ1A01, 2SJ1A02, 2SJ1A03, 2SJ1A07, 2SJ1A08 and 2SJ1A09）

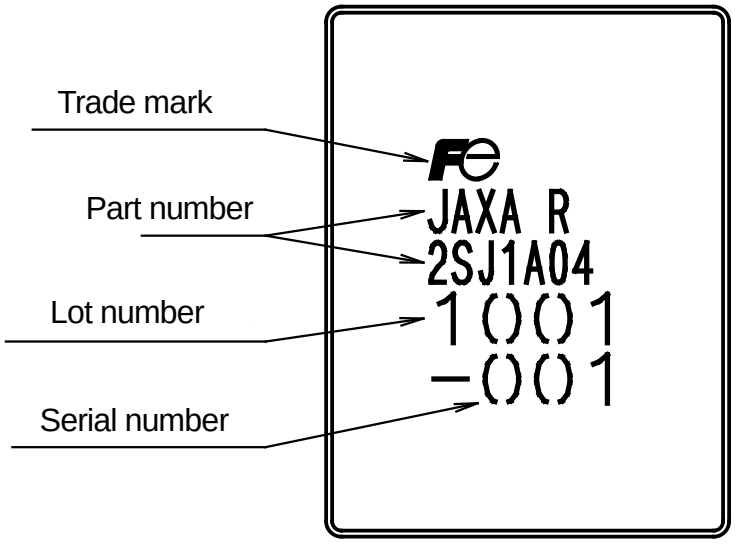


Figure 2-b. Markings (SMD-2)
（JAXA R 2SJ1A04 and 2SJ1A10）

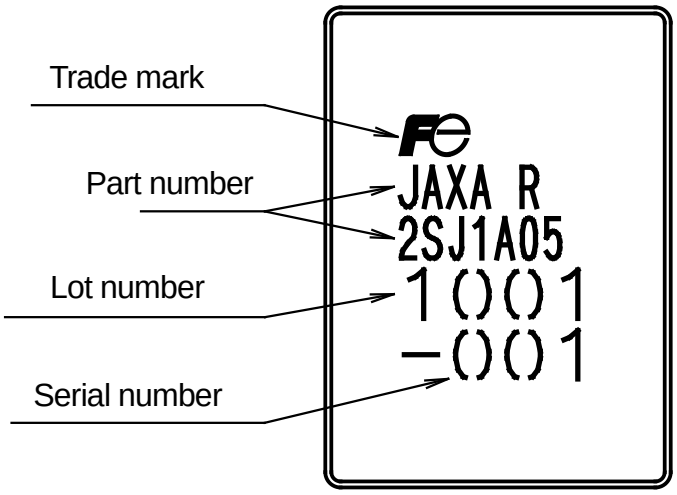


Figure 2-c. Markings (SMD-1)
（JAXA R 2SJ1A05 and 2SJ1A11）

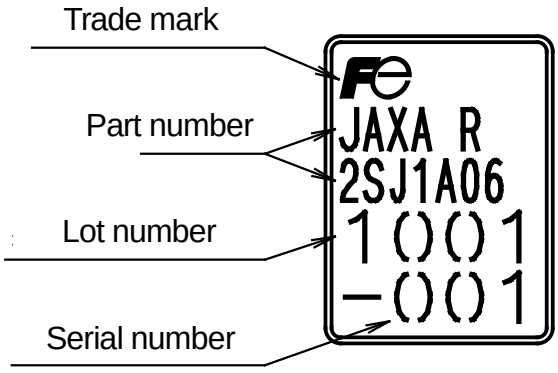


Figure 2-d. Markings (SMD-0.5)
（JAXA R 2SJ1A06 and 2SJ1A12）

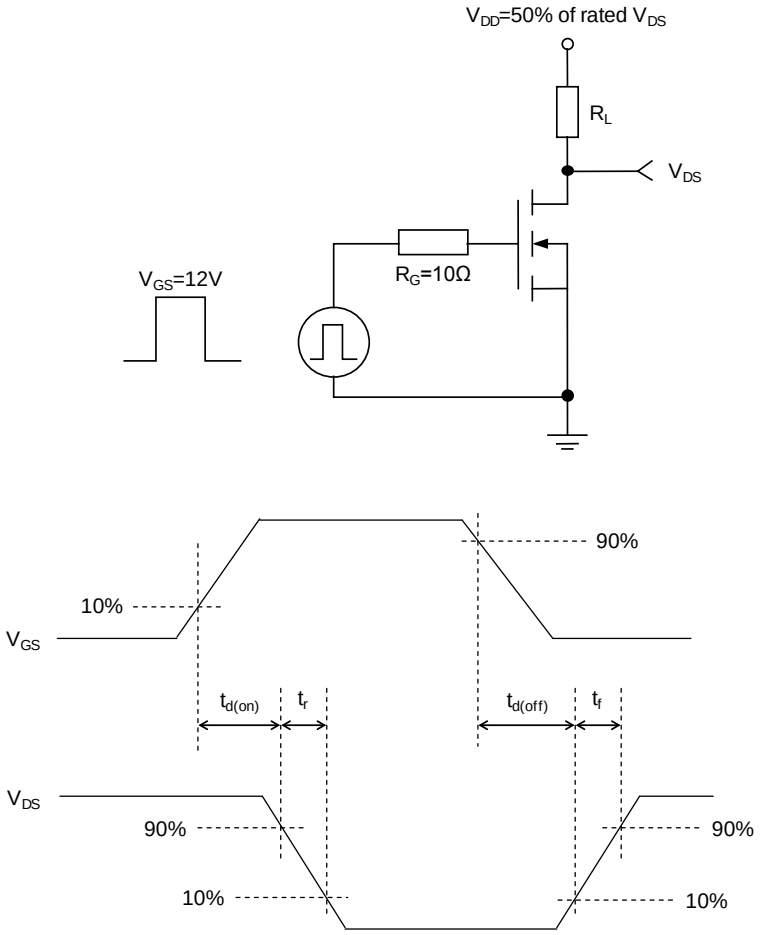


Figure 3. Switching Time Test Circuit and Waveforms

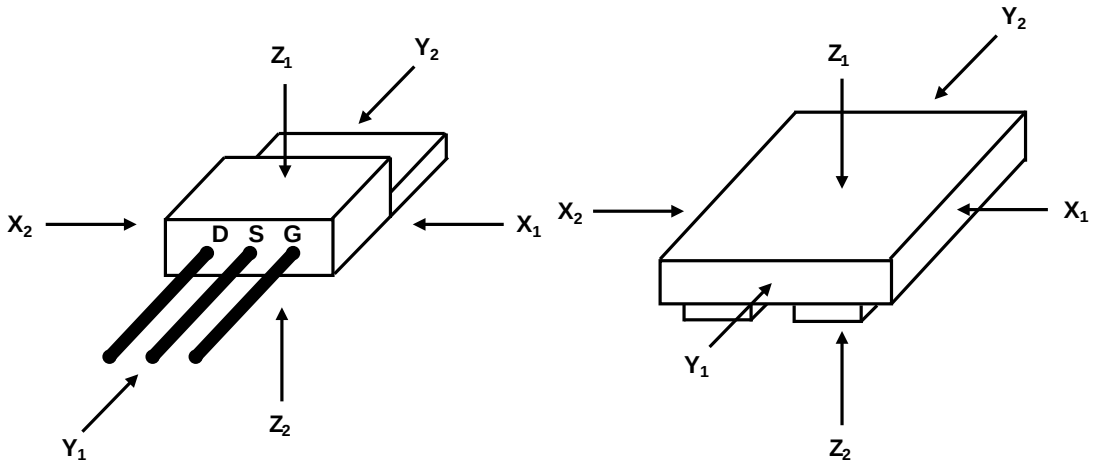


Figure 4. Orientation of the Device

JAXA R 2SJ1A01

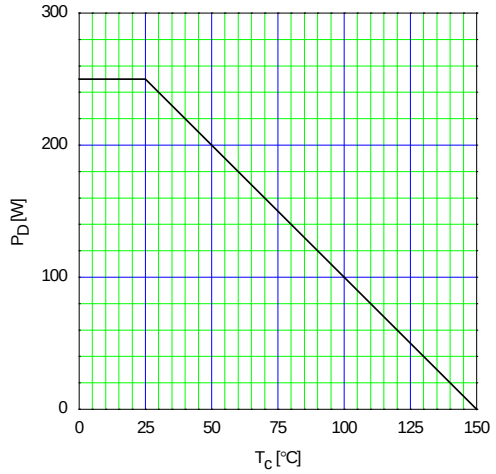


Fig. 5 Allowable Power Dissipation P_D – Case Surface Temperature T_C

JAXA R 2SJ1A01

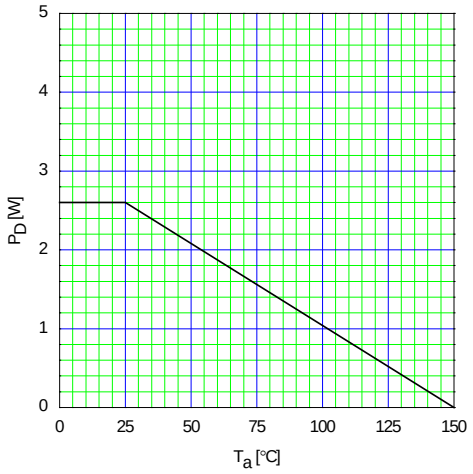


Fig. 6 Allowable Power Dissipation P_D – Ambient Temperature T_a

JAXA R 2SJ1A01

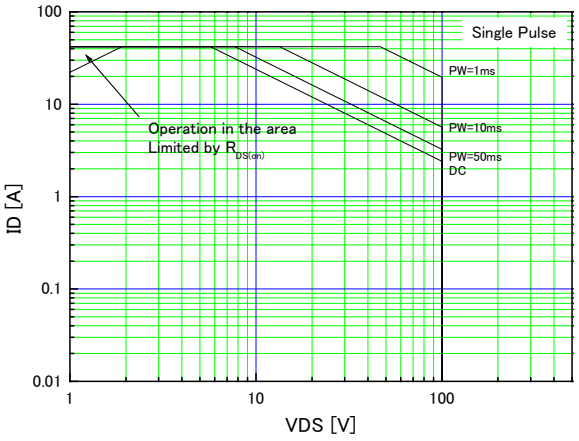


Fig. 7 Maximum Safe Operating Area

JAXA R 2SJ1A02

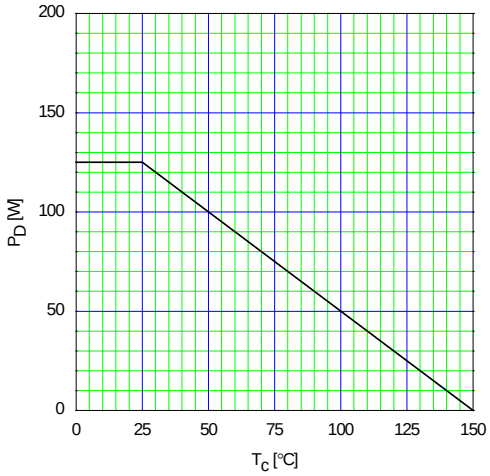


Fig. 8 Allowable Power Dissipation P_D – Case Surface Temperature T_C

JAXA R 2SJ1A02

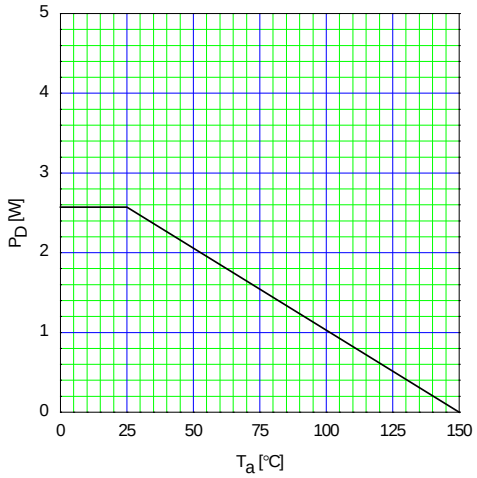


Fig. 9 Allowable Power Dissipation P_D – Ambient Temperature T_a

JAXA R 2SJ1A02

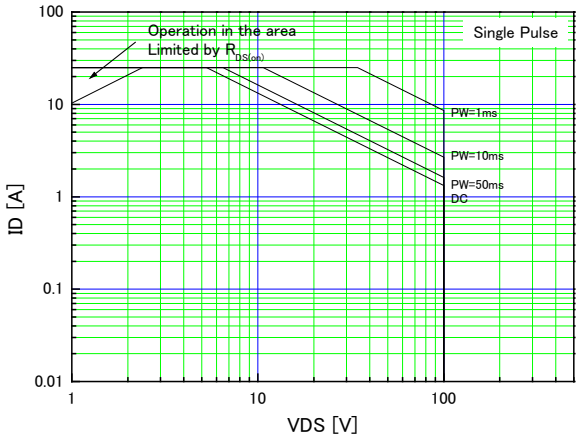


Fig. 10 Maximum Safe Operating Area

JAXA R 2SJ1A03

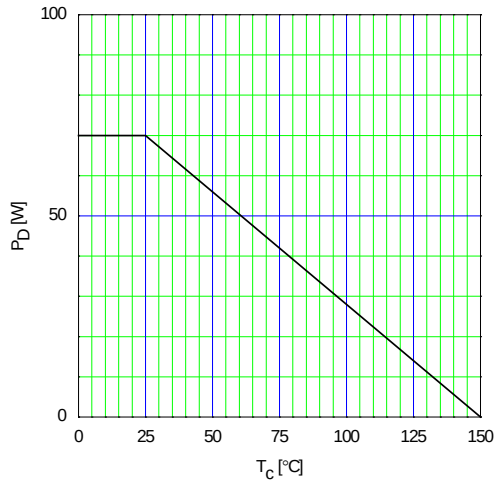


Fig. 11 Allowable Power Dissipation P_D – Case Surface Temperature T_C

JAXA R 2SJ1A03

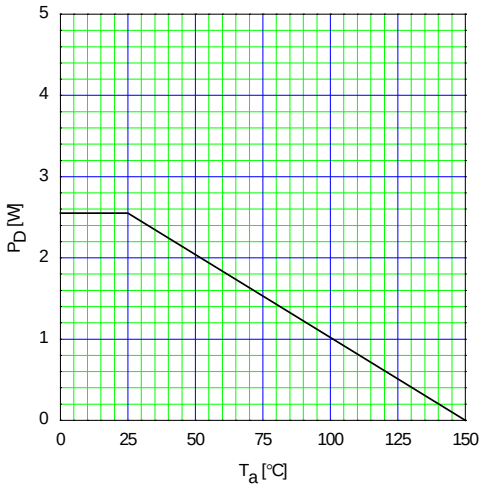


Fig. 12 Allowable Power Dissipation P_D – Ambient Temperature T_a

JAXA R 2SJ1A03

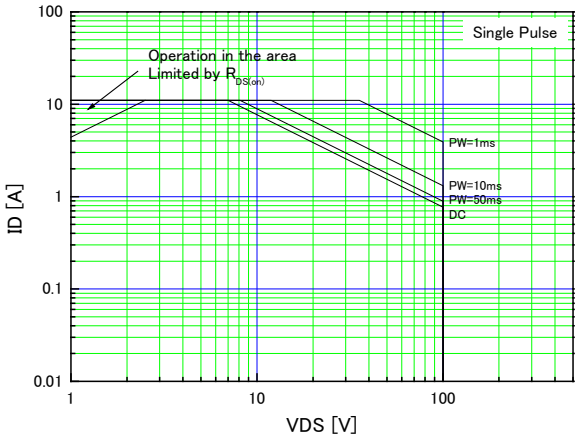


Fig. 13 Maximum Safe Operating Area

JAXA R 2SJ1A04

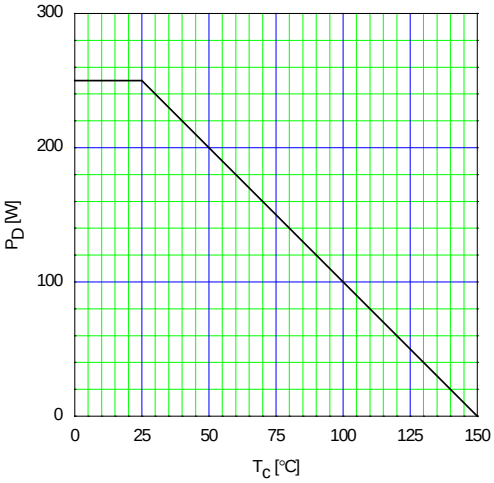


Fig. 14 Allowable Power Dissipation P_D – Case Surface Temperature T_C

JAXA R 2SJ1A04

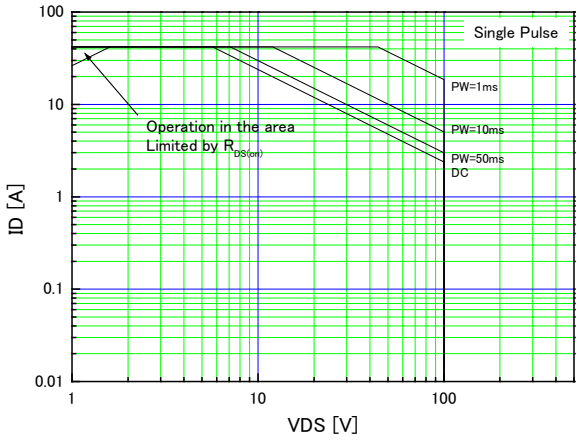


Fig. 15 Maximum Safe Operating Area

JAXA R 2SJ1A05

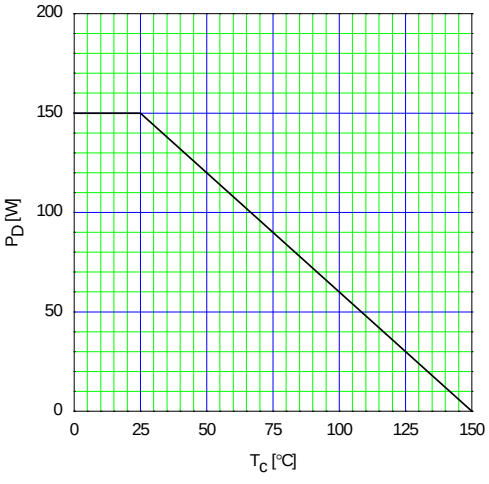


Fig. 16 Allowable Power Dissipation P_D – Case Surface Temperature T_C

JAXA R 2SJ1A05

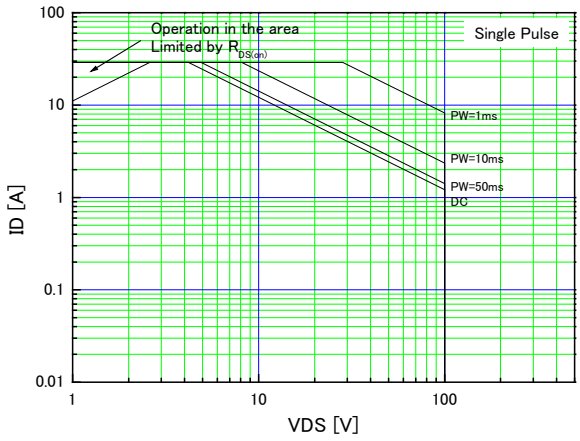


Fig. 17 Maximum Safe Operating Area

JAXA R 2SJ1A06

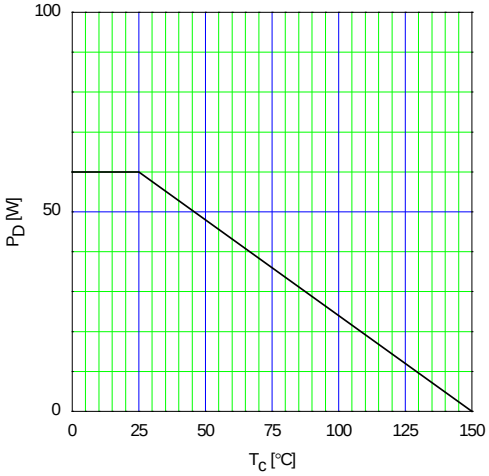


Fig. 18 Allowable Power Dissipation P_D – Case Surface Temperature T_C

JAXA R 2SJ1A06

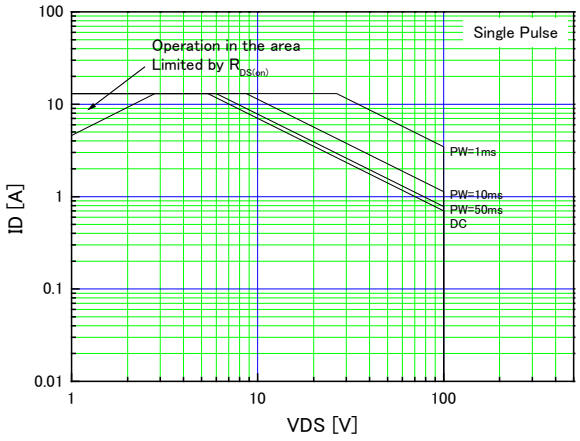


Fig. 19 Maximum Safe Operating Area

JAXA R 2SJ1A07

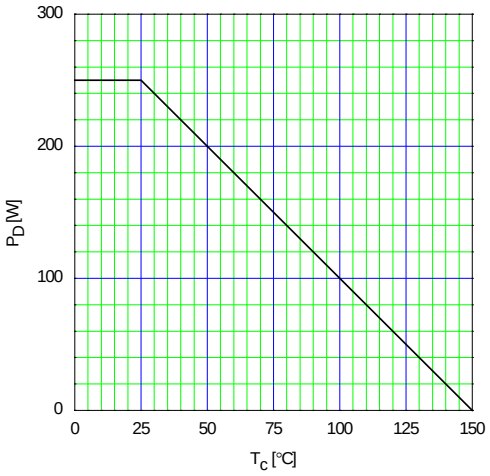


Fig. 20 Allowable Power Dissipation P_D – Case Surface Temperature T_C

JAXA R 2SJ1A07

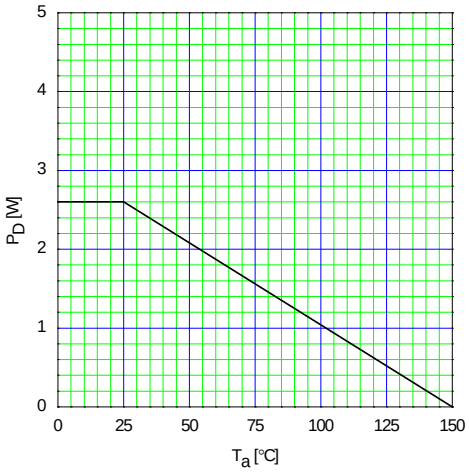


Fig. 21 Allowable Power Dissipation P_D – Ambient Temperature T_a

JAXA R 2SJ1A07

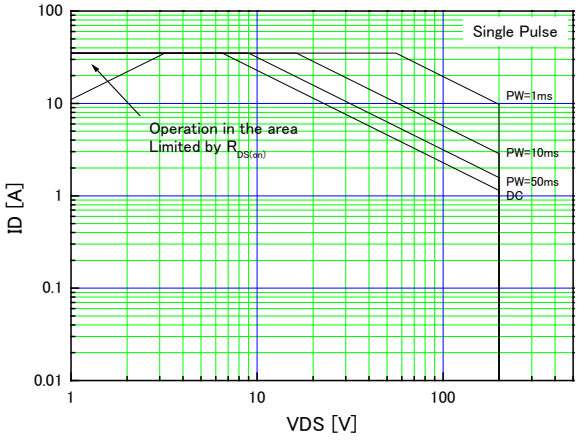


Fig. 22 Maximum Safe Operating Area

JAXA R 2SJ1A08

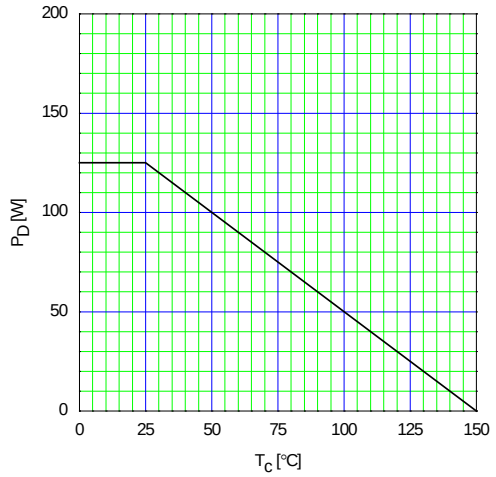


Fig. 23 Allowable Power Dissipation P_D – Case Surface Temperature T_C

JAXA R 2SJ1A08

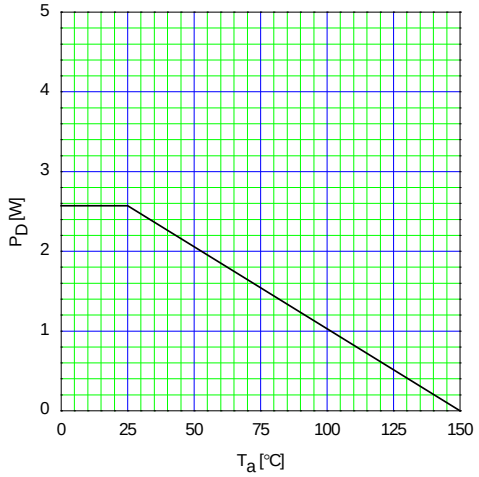


Fig. 24 Allowable Power Dissipation P_D – Ambient Temperature T_a

JAXA R 2SJ1A08

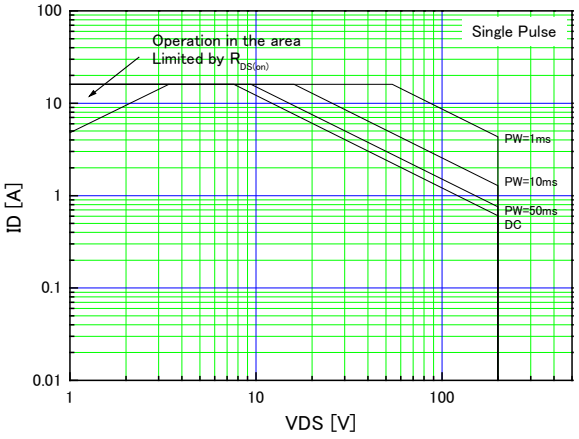


Fig. 25 Maximum Safe Operating Area

JAXA R 2SJ1A09

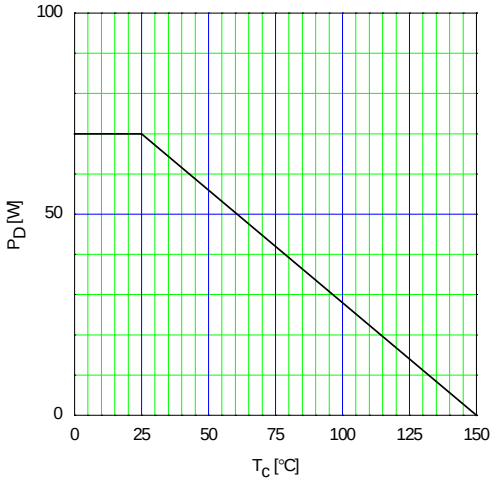


Fig. 26 Allowable Power Dissipation P_D – Case Surface Temperature T_C

JAXA R 2SJ1A09

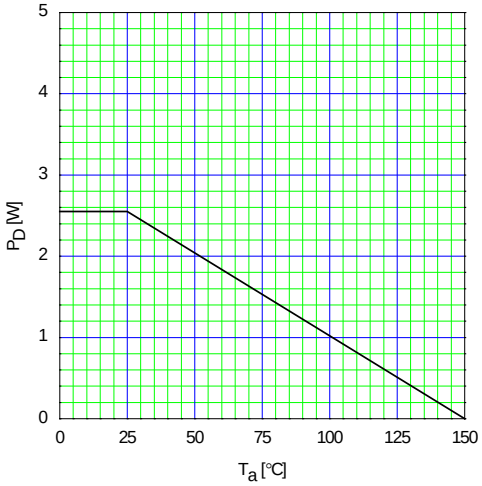


Fig. 27 Allowable Power Dissipation P_D – Ambient Temperature T_a

JAXA R 2SJ1A09

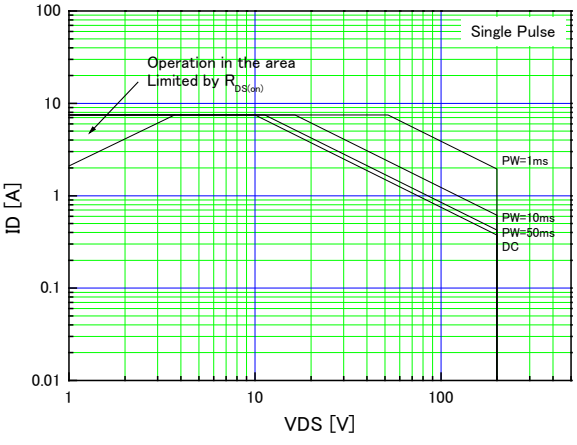


Fig. 28 Maximum Safe Operating Area

JAXA R 2SJ1A10

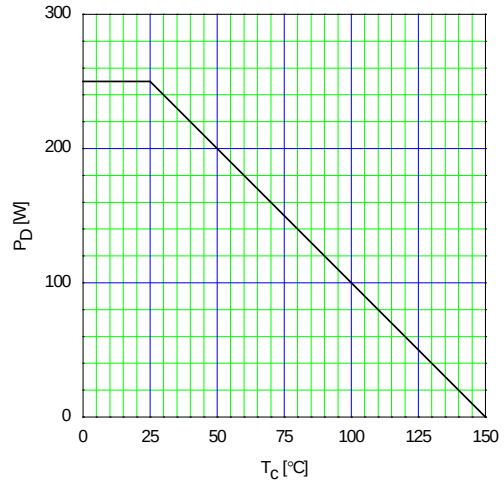


Fig. 29 Allowable Power Dissipation P_D – Case Surface Temperature T_C

JAXA R 2SJ1A10

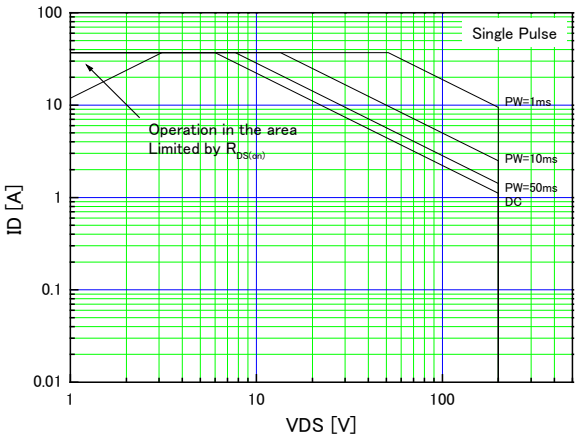


Fig. 30 Maximum Safe Operating Area

JAXA R 2SJ1A11

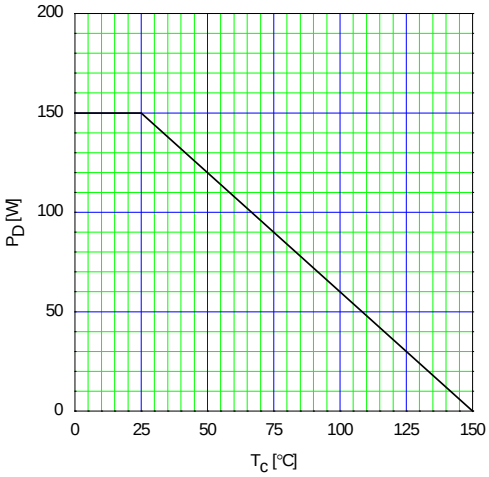


Fig. 31 Allowable Power Dissipation P_D – Case Surface Temperature T_C

JAXA R 2SJ1A11

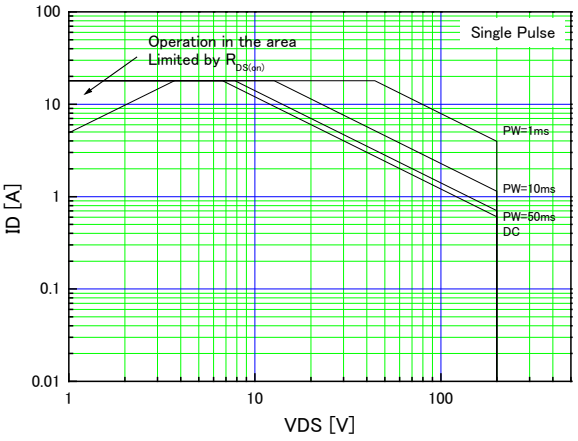


Fig. 32 Maximum Safe Operating Area

JAXA R 2SJ1A12

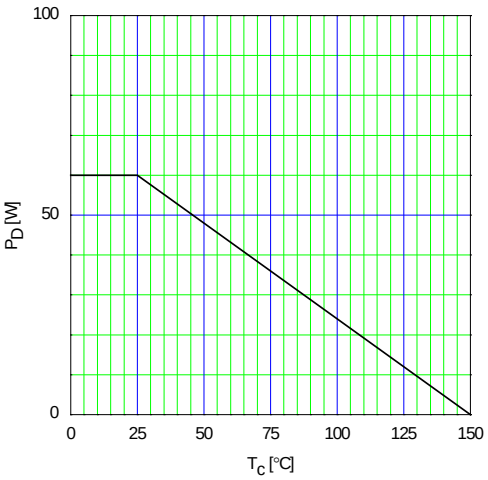


Fig. 33 Allowable Power Dissipation P_D – Case Surface Temperature T_C

JAXA R 2SJ1A12

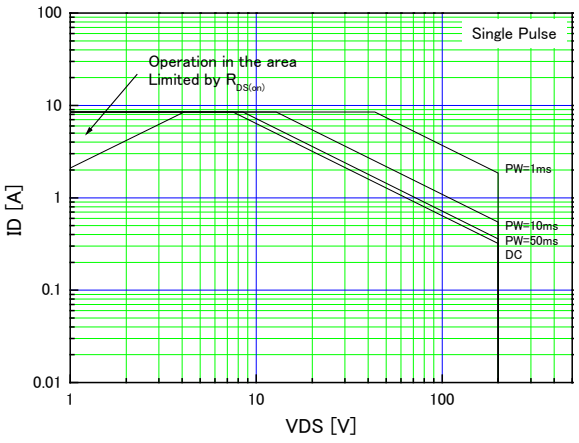


Fig. 34 Maximum Safe Operating Area