Type JAE

Type JAE micro fuse is designed for circuit protection against excessive current in portable electronic equipment, electric circuit around battery, etc. because the demand for high capacity batteries is increasing.
Wire material is adopted for fuse element, and the performance against rush current is increased in spite of compact design.
Also, the ecology design of Type JAE is environmentally friendly because of complete lead-free.

FEATURES

1. Our original construction design has excellent fusing and cutting characteristics.
2. Especially, performance against rush current is excellent since wire material is used for fuse element.
3. Surface temperature rise is 75°C or less when applying rated current for fusing. This gives less influence to the peripheral units.
4. Resistance to soldering heat : Reflow or flow soldering 10 seconds at 260°C
5. Our original terminal construction makes almost no occurrence of Tombstone phenomenon.
6. Small size of 3216 (3.2 × 1.6 × 1.4 mm)
7. Suitable for automatic mounting
8. Precise dimensions allows high-density mounting and symmetrical construction of terminals provide “Self-Alignment”.
9. Complete lead-free, bromine-free.

RATING

Item	Rating
Category Temperature Range	-40 ~+125℃
Rated Current	0.4-0.5-0.63-0.8-1.0-1.25-1.6-2.0-2.5-3.15A
Rated Voltage	24VDC
Voltage Drop	Refer to CATALOG NUMBERS AND RATING
Insulation Resistance (between terminals and case)	1000 MΩ or more
Fusing Characteristics	Fusing within 2 minute if the current is 250% of rated current.
Clearing Characteristics	Breaking voltage : 24 V
	Breaking current : 50 A

ORDERING INFORMATION

JAE 2402 252 NA 52 010 ＊

Type
JAE

Code	RV
2402	24V

Code	Rated current
401	0.4 A
501	0.5 A
631	0.63A
801	0.8 A
102	1.0 A

Code	Rated current
132	1.25A
162	1.6 A
202	2.0 A
252	2.5 A
322	3.15A

Code	Package type
NA	φ180 Reel

Code	Case size
52	3.2×1.6

＊ Bromine-free

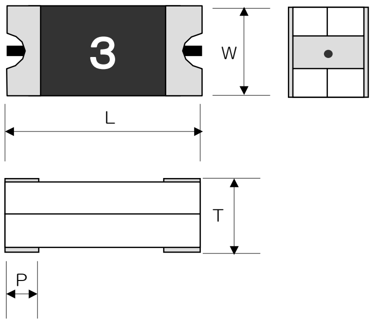
CATALOG NUMBERS AND RATING

August, 2015

Catalog number	Case size	Rated current A	Internal resistance mΩ (Typical)	Voltage drop mV (Max.)	Rated voltage VDC	Breaking current A
JAE 2402 401 □□52010	3.2×1.6	0.4	310	220	24	50
JAE 2402 501 □□52010	3.2×1.6	0.5	240	200		
JAE 2402 631 □□52010	3.2×1.6	0.63	190	150		
JAE 2402 801 □□52010	3.2×1.6	0.8	145	150		
JAE 2402 102 □□52010	3.2×1.6	1.0	118	150		
JAE 2402 132 □□52010	3.2×1.6	1.25	93	150		
JAE 2402 162 □□52010	3.2×1.6	1.6	70	150		
JAE 2402 202 □□52010	3.2×1.6	2.0	54	150		
JAE 2402 252 □□52010	3.2×1.6	2.5	43	150		
JAE 2402 322 □□52010	3.2×1.6	3.15	34	150		

For the taping type, the packing code “NA” will be entered in □□.
Catalog numbers are approved by UL and cUL. (File No.E170721)

DIMENSIONS



Main body : Glass epoxy
Terminal : Tin plating

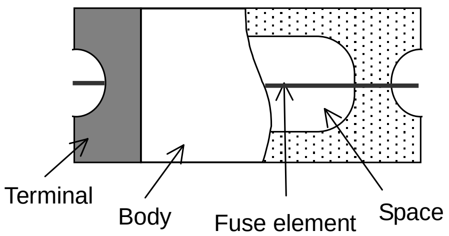
(mm)

Case size	Case code	L	W	T	P
3216	52	3.2 ± 0.2	1.6 ± 0.2	1.4 ± 0.2	0.6 ± 0.2

MARKING

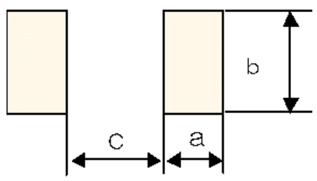
Code : Rated current	Code : Rated current
S : 0.40A	W : 1.25A
T : 0.50A	X : 1.60A
U : 0.63A	2 : 2.00A
V : 0.80A	Y : 2.50A
1 : 1.00A	3 : 3.15A

CONSTRUCTION



Name	Material, standard, and treatment
Fuse element	Lead-free alloy
Space	—
Terminal	Tin plating
Body	Glass epoxy

RECOMMENDED PAD DIMENSIONS

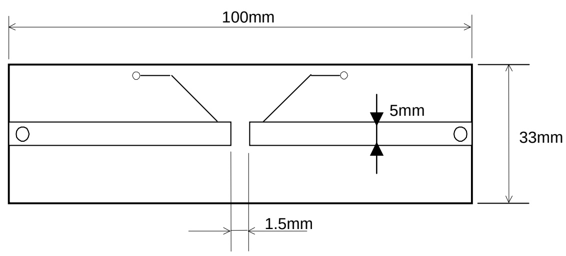


(mm)

	Size 3216
a	1.0
b	1.6
c	1.6

(Reflow)

STANDARD TEST BODY

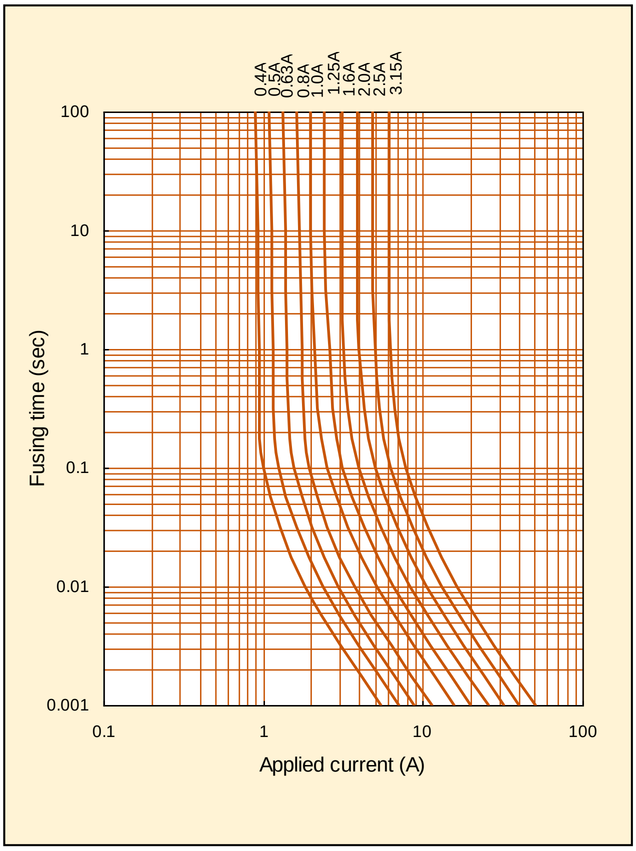


Glass epoxy body on one side
Board thickness : 1.6 mm
Copper layer :35μm

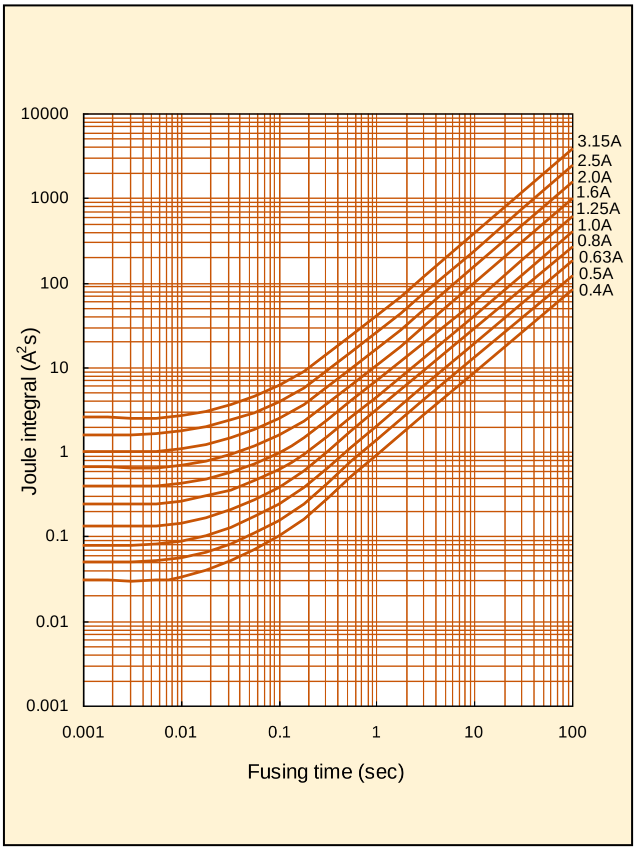
PERFORMANCE

No.	Item	Performance	Test method
1	Temperature rise	Temperature rise shall not exceed 75°C.	Apply rated current.
2	Current-carrying capacity	Shall not open within 1 hour.	Apply 100% of rated current.
3	Clearing characteristics	Arc shall not be continued. Marking shall be legible.	Breaking voltage : 24V Breaking current : 50 A
4	Voltage drop	Voltage drop is below the value specified in CATALOG NUMBERS AND RATING.	Apply rated current.
5	Fusing characteristics	Fusing within 2 min.	Apply 250% of rated current. (Ambient temperature : 10 ~ 30°C)
6	Insulation resistance	1000 MΩ or more	Insulation resistance between terminals and case
7	Electrode strength (Bending)	No mechanical damage. Resistance change after the test shall be within ± 20%.	Board supporting width : 90 mm Bending speed : Approx. 0.5 mm/sec. Duration : 5 sec. Bending : 3 mm
8	Shear test	No mechanical damage. Resistance change after the test shall be within ± 20%.	Applied force : 20 N (2.04 kgf) Duration : 10 sec. Tool : R0.5 Direction of the press : side face
9	Substrate bending test	No mechanical damage. Resistance change after the test shall be within ± 20%.	Supporting dimension : 1.6 mm Applied force : 20 N (2.04 kgf) Duration : 10 sec. Tool : R0.5 Direction of the press : thickness direction of product
10	Solderability (Solder Wetting time)	Solder Wetting time : within 3sec.	Solder : Sn–3Ag–0.5Cu Temperature : 245 ± 3°C meniscograph method Solder : JISZ3282 H60A, H60S, H63A Temperature : 230 ± 2°C meniscograph method
11	Solderability (new uniform coating of solder)	The dipping surface of the terminals shall be covered more than 95% with new solder.	Solder : Sn–3Ag–0.5Cu Temperature : 245 ± 3°C Dipping : 3 sec. Solder : JISZ3282 H60A, H60S, H63A Temperature : 230 ± 2°C Dipping : 3 sec.
12	Resistance to soldering heat	Marking shall be legible. No mechanical damage. Resistance change after the test shall be within ± 20%.	Dipping (1 cycle) Preconditioning : 100 ~ 150°C, 30±5 sec. Temperature : 260 ± 3°C, 5 $^{+1}_{-0}$ sec. Reflow soldering (2 cycles) Preconditioning : 150～180°C、90±30 sec. Peak : 250 $^{+5}_{-0}$ °C Holding : 230°C or higher, 30±10 sec. Cooling : 3 ~ 6°C/sec or faster Manual soldering Temperature : 350 ± 10°C Duration : 2 ~ 3 sec Measure after 1 hour left under room temperature and humidity.
13	Solvent resistance	Marking shall be legible. No mechanical damage. No significant irregularity in the appearance.	Dipping rinse Solvent : Isopropyl alcohol Duration : 90 sec.
14	Vibration	No mechanical damage. Resistance change after the test shall be within ± 20%.	Frequency range : 10 ~ 55 ~ 10 Hz/min Vibration amplitude : 1.5 mm Duration : 2 hours in each of XYZ directions (total : 6 hours)
15	Shock	No mechanical damage. Resistance change after the test shall be within ± 20%.	Peak value : 490 m/s^2(50G) Duration : 11 m sec. 6 aspects × 3 times (total : 18 times)
16	Thermal shock	No mechanical damage. Resistance change after the test shall be within ± 20%.	–55 ± 3°C : 30 min. Room temperature : 2 ~ 3 min or less 125 ± 2°C : 30 min. Room temperature : 2 ~ 3 min or less Repeat above step for 10 cycles
17	Moisture resistance	No mechanical damage. Resistance change after the test shall be within ± 20%.	Temperature : 85 ± 3°C Humidity : 85 ± 5% RH Duration : 1000 hours
18	Load life	No mechanical damage. Resistance change after the test shall be within ± 20%.	Temperature : 85 ± 2°C Applied current : Rated current × 100% Duration : 1000 hours
19	Moisture resistance load	No mechanical damage. Resistance change after the test shall be within ± 20%.	Temperature : 85 ± 2°C Humidity : 85 ± 5% RH Applied voltage : rated current × 100% Duration : 1000 h
20	Stability	No mechanical damage. Resistance change after the test shall be within ± 20%.	Temperature : 125 ± 2°C Duration : 1000 hours

FUSING CHARACTERISTICS

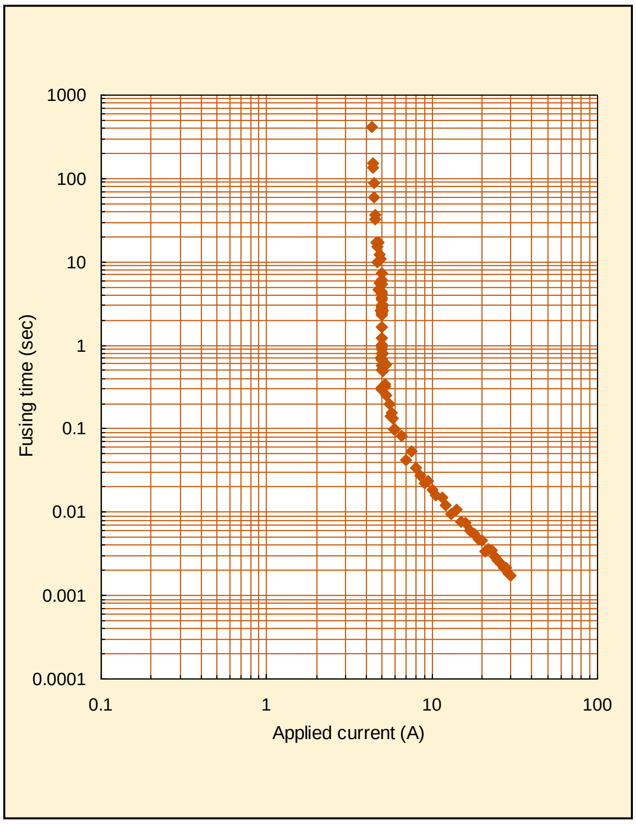


I^2T-T CHARACTERISTICS



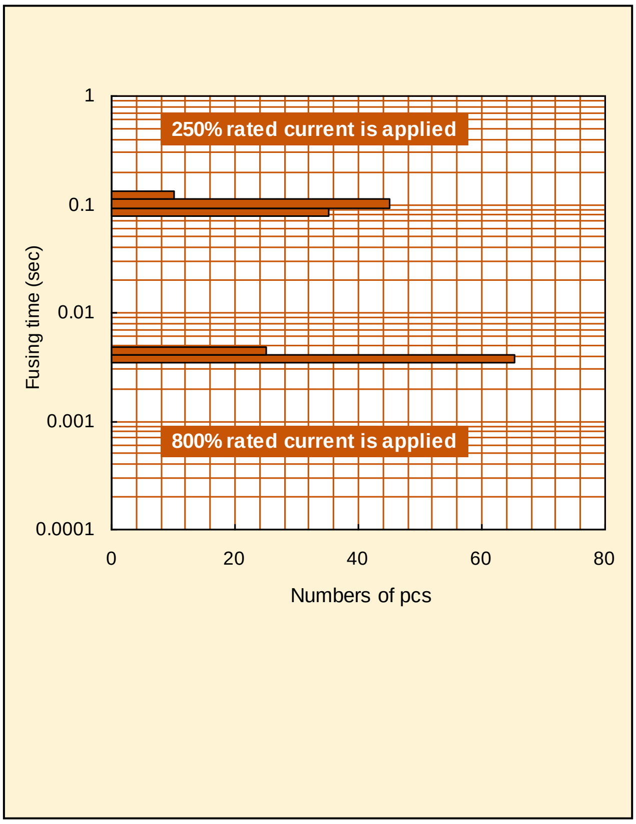
DISTRIBUTION OF FUSING CHARACTERISTICS

JAE 2402 252NA52010 n=100



DISTRIBUTION OF FUSING TIME

JAE 2402 252NA52010



DETERMINATION OF RATED VALUE AND SELECTION OF MICRO FUSE (TYPE JAE)

Determine the rated value of circuit protection element, and select the correct circuit protection element for your circuit. If you select the correct circuit protection element, safety of your circuit can be ensured.
How to determine the rated value of the circuit protection element is described below :

■Flow for fuse selection

1. Measurement of circuit values using actual device
   Measure the circuit values, such as operating current of the circuit.
2. Calculation from operating current
   From the obtained operating current and the category temperature, calculate the minimum rated value to determine the applicable fuse.
3. Calculation from overload current
   From the obtained overload current, calculate the maximum rated value to determine the applicable fuse.
4. Calculation from inrush current
   From the inrush current, calculate the minimum rated value to determine the applicable fuse.
5. Final determination of rated value
   From the calculation results of steps 2 through 4, determine the rated value.
6. Operation check using actual device
   After selecting the rating, confirm if the device works properly under the pre-determined conditions.

■ Fuse selection

1. Measurement of circuit values using actual device

Before determining the rated value of the fuse, preliminarily measure the following using the actual device.

1–1 Operating current
Using an oscilloscope or equivalents, measure the operating current of the circuit.

1–2 Overload current
Using an oscilloscope or equivalents, measure the overload current that needs to break the circuit.

1–3 Inrush current
Using an oscilloscope or equivalents, measure the inrush current of the circuit at power-on or power-off. In addition, determine the number of inrush current applied.

1–4 Category temperature
Measure the ambient temperature of the fuse circuit.

EXAMPLE TO SELECT RATINGS OF TYPE JAE
<Fuse selection>
Effective operating current : 1.2 A
Effective overload current : 6.0 A
Inrush current waveform : Fig. A
(Pulse width : 1 ms, Wave height : 6.0 A)
Numbers to withstand inrush current : 100,000 times
Category temperature : 85°C

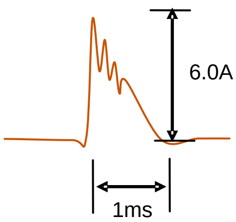


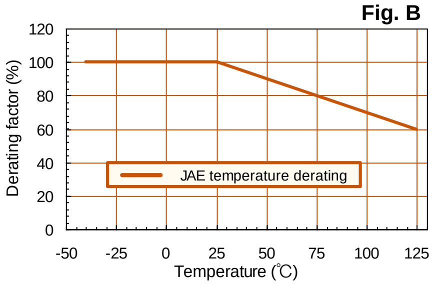
Fig. A : Inrush current waveform

2. Calculation from operating current

2–1 Measurement of operating current
Using an oscilloscope or equivalents, measure operating current (effective current) of the actual circuit.
Example : Effective operating current = 1.2 A

2–2 Derating
①Temperature derating factor
Using Fig. B, find the temperature derating factor correspond to the temperature.
②Rated derating factor
Rated derating factor = 1.0 (Constant irrespective of temperature)

Fig. B



Use Formula 1 to calculate the rated current of the fuse to be used for the circuit.
Rated current of fuse ≥ Operating current / (① × ②) ... Formula 1

Example: Category temperature = 85°C, Operating current = 1.2 A
①Temperature derating factor = 0.76 (Refer to Fig. B.)
②Rated derating factor = 1.0 (Constant irrespective of temperature)
Calculation using Formula 1 :
Rated current ≥ 1.2 / (0.76 × 1.0) = 1.58 A
The above calculation result shows that the fuse with rated current of 1.58 A or more should be selected for this circuit.

Type JAE, with rated current of 1.6 A or more can be selected.

3. Calculation from overload current

3–1 Measurement of overload current

Using oscilloscope or equivalents, measure the overload current that needs to break the circuit.
Example : Effective overload current = 6.0 A

3–2 Calculation from overload current

Determine the rated current so that the overload current can be 2.5 times larger than the rated current.
Use Formula 2 to calculate the rated current of the fuse.

Rated current of fuse ≤ Overload current / 2.5 ... Formula 2

Example : Overload current = 6.0 A
Use Formula 2 to calculate the rated current.
Rated current ≤ 6.0 / 2.5 = 2.4 A

The above calculation result shows that the fuse with rated current of 2.4 A or less should be selected for this circuit.

Type JAE, with rated current of 2.0 A or less can be selected.

4. Calculation from inrush current

4–1 Measurement of inrush current waveform

Using an oscilloscope or equivalent, measure the waveform of the inrush current of the actual circuit.

4–2 Creation of approximate waveform

Generally, the waveform of inrush current is complicated. For this reason, create the approximate waveform of inrush current as shown on Fig. C to simplify calculation.

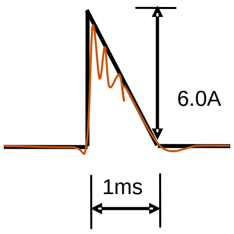


Fig. C : Inrush current waveform
Red line : Actual measurement waveform
Black line : Approximate waveform

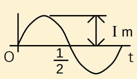
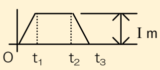
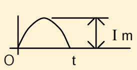
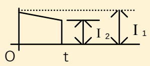
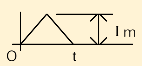
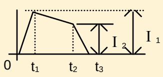
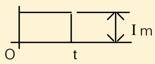
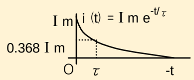
4–3 Calculation of I^2t of inrush current

Calculate I^2t (Joule integral) of the approximate waveform.
The formula for this calculation depends on the approximate waveform.
Refer to Table A.

Example : Pulse applied = 1 ms, Peak value = 6.0 A,
Approximate waveform = Triangular wave
Since the approximate waveform is a triangular wave, use the following formula for calculation.
I^2t of rush current = 1 / 3 × Im^2 × t ... Formula 3
(Im : Peak value, t : Pulse applying time)
Use Formula 3 to calculate I^2t of the rush current :
I^2t = 1 / 3 × 6 × 6 × 0.001 = 0.012 (A^2s)

JOULE-INTEGRAL VALUES FOR EACH WAVEFORM

Table A

Name	Waveform	I^2t	Name	Waveform	I^2t
Sine wave (1 cycle)		$\frac{1}{2} I_m^2 t$	Trapezoidal wave		$\frac{1}{3} I_m^2 t_1 + I_m^2 (t_2-t_1) + \frac{1}{3} I_m^2 (t_3-t_2)$
Sine wave (half cycle)		$\frac{1}{2} I_m^2 t$	Various wave 1		$I_1 I_2 t + \frac{1}{3} (I_1-I_2)^2 t$
Triangular wave		$\frac{1}{3} I_m^2 t$	Various wave 2		$\frac{1}{3} I_1^2 t_1 + \{I_1 I_2 + \frac{1}{3} (I_1-I_2)^2\} (t_2-t_1) + \frac{1}{3} I_2^2 (t_3-t_2)$
Rectangular wave		$I_m^2 t$	Charge/ discharge waveform		$\frac{1}{2} I_m^2 t$

∗Following formula is generally used for calculation of I^2t as i(t) equal to current.

$$I^2t = \int_0^t i^2(t)\, dt$$

4–4 Search of load ratio

①Set up the number of cycles to withstand. (generally 100,000 times)

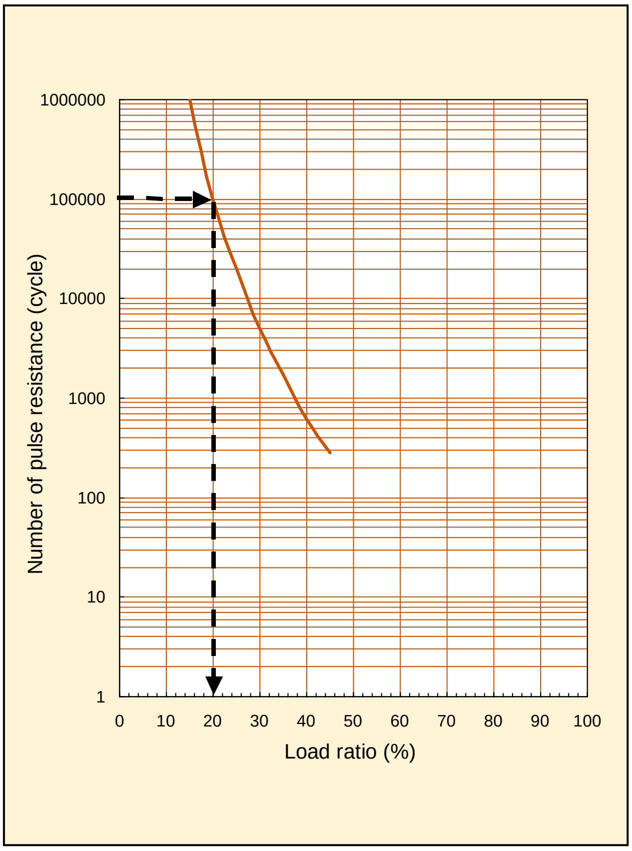
②Obtain the load ratio from Pulse resistance characteristics. (Fig. D)

Example : 100,000 times is required against inrush current applied.

The load ratio is 20% or less from Fig. D.

PULSE RESISTANCE CHARACTERISTICS

Fig. D



4–5 Calculation from Joule integral and load ratio

Use Formula 4 to calculate the standard I^2t for the fuse to be used.

Standard I^2t of fuse > (I^2t of inrush current / load ratio) ....Formula 4

Example : I^2t of pulse = 0.012 A^2s, Pulse applied = 1 ms, Required load ratio = 20%

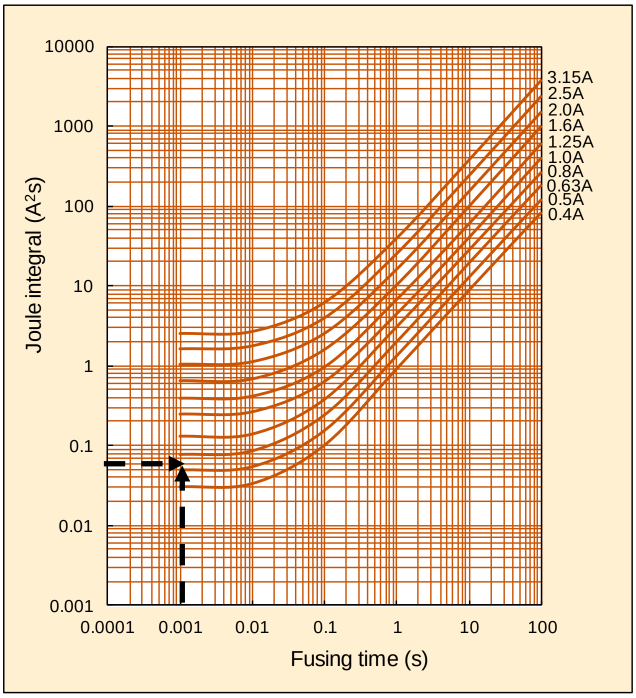
From Formula 4,
Standard I^2t of fuse > 0.012 / 0.2 = 0.06 (A^2s)
The standard I^2t of the fuse should be 0.06 (A^2s) or more.

Since the rush pulse applied is 1 ms, obtain the intersection of 1 ms (horizontal axis) and 0.06 A^2s (vertical axis) from Fig. E (refer to the arrow shown in Fig.E).

Select a fuse whose curve is above the intersection. Type JAE, with rated current of 0.63 A or more should be selected.

JOULE INTEGRAL VS. FUSING TIME

Fig. E



5. Final determination of rated value

Determine the rated current of the micro fuse. The rated current should meet all the calculation results.

Example : 1.6 A and 2.0 A meet the all requirement.

6. Operation check using actual device

After selecting the rating, confirm if the device works properly under the pre-determined conditions.