No. P-JHC-E006
DATE 2016-05

NCC

PRODUCTS DATA SHEET

MICRO FUSE

TYPE JHC

SIZE 7.3x5.8mm

UL. cUL approved
File No.E170721
30A, 40A, 50A, 60A

RoHS compliant
〈Complete lead-free〉

MATSUO ELECTRIC Co., LTD.

Type JHC

TYPE JHC High Current Micro Fuse is designed for the purpose of external short circuit protection of the lithium ion battery of medium sizes, such as a power tool and an electric assistant bicycle.
Though it was a surface mount type, it was small and realized high current rating, because a fuse element and a terminal adopt the structure of one.
Furthermore perfectly compliant to Lead-free makes environment friendly design.

FEATURES

1. High current rating was realized because a fuse element and a terminal adopt the structure of one.
2. Surface mount type and small size of 7358 (7.3 × 5.8 × 4.2mm).
3. Surface temperature rise is 75°C or less when applying rated current. This gives little influence to the peripheral units.
4. Alumina ceramics are adopted as a case, original structure is adopted as the inside of a case, and the safety at the time of fusing is improved. [Application classification by use ：4]
5. Suitable for automatic mounting
6. Complete lead-free

APPLICATION CLASSIFICATION BY USE

The application classification by use which divided the market and use into four is set up supposing our products being used for a broad use.
Please confirm the application classification by use of each product that you intend to use.
Moreover, please be sure to inform to our Sales Department in advance in examination of the use of those other than the indicated use.

Market	Application classification by use	Use		Recommendation Type
		Outline	Typical example of application	Circuit Protection Components
High reliability apparatus	1	- Apparatus in which advanced safety and reliability are demanded. - Whether failure of the Apparatus which cannot maintenance exchange products, and a product is direct for a human life, Apparatus which changes or may cause a fatal system fai	- Space development Apparatus relation (Satellite, Rocket, Artificial Satellite) - Aviation and a defensive system - Atomic power, fire power, and a water-power generation system	With no relevance
In-vehicle - Industrial apparatus	2	- Apparatus in which reliability is important. - The apparatus in which maintenance exchange of a product is very difficult, and failure of a product influence a human life, or the range of failure is wide range.	- Vehicles control of transport machines, such as a car, and a railroad, a vessel (Engine control, drive control, brake control) - The operation control system of the Shinkansen and a main artery	Type KAB N series Type JAG N series Type KVA N series
	3	-Apparatus which can maintenance exchange products, and apparatus in which the loss of the system failure is large although failure of a product does not influence a human life, and maintenance engineering is demanded	- Vehicle indoor loading parts, such as an air-conditioner and car navigation, and in-vehicle a communication facility - Security management system for home/buildings etc. - Control apparatus, such as Industrial use robots and a machine tool etc.	Type KAB M series Type JAG M series Type KVA M series
Apparatus in general	4	- The small size and the thin article which applies leading-edge technology positively - The product supposing being used widely in the market for the apparatus which can maintenance exchange products, and apparatus with a partial system fa	-Smart phone, Mobile phone, Mobile PC (tablet), Electronic dictionary - Desktop PC, Notebook PC, Home network - Amusement apparatus (Pachinko,Game machine)	Type KAB Type KAB T series Type KAH Type JAE, Type JAG Type JAH, Type JAH L series Type JHB, Type JHC Type KVA

RATING

Item	Rating
Category Temperature Range	-40 ～+125℃
Rated Current	30A、40A、50A、60A、80A、100A
Rated Voltage	35VDC, 60VDC
Voltage Drop	Refer to CATALOG NUMBERS AND RATING
Insulation Resistance (between terminals and case)	1000MΩ or more
Fusing Characteristics	Fusing within 1 minute if the current is 250% of rated current.
Clearing Characteristics	Breaking voltage：Rated Voltage
	Breaking Current：300A,600A

ORDERING INFORMATION

JHC 3502 503 R 44E

Type
JHC

Code	Voltag
3502	35V
6002	60V

Code	Rated current	Code	Rated current
303	30 A	603	60 A
403	40 A	803	80 A
503	50 A	104	100 A

Code	Package type
R	φ180 Reel
N	φ330 Reel

Code	Case size
44E	7.3X5.8

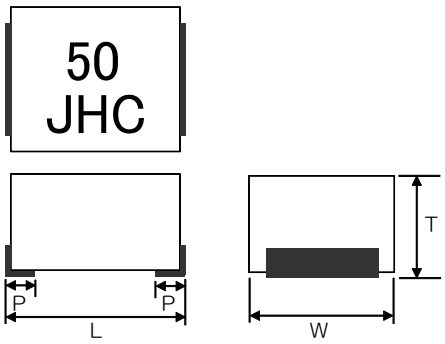
CATALOG NUMBERS AND RATING

May 2016

Catalog number	Case size	Rated current A	Internal resistance mΩ (Typical)	Voltage drop mV (Max.)	Rated voltage VDC	Breaking current A
JHC 3502 303 ☐ 44E	7.3×5.8	30	1.38	80	35	300
JHC 6002 303 ☐ 44E					60	
JHC 3502 403 ☐ 44E		40	1.08		35	
JHC 6002 403 ☐ 44E					60	
JHC 3502 503 ☐ 44E		50	0.85		35	
JHC 6002 503 ☐ 44E					60	
JHC 3502 603 ☐ 44E		60	0.74	90	35	600
JHC 6002 603 ☐ 44E					60	
JHC 3502 803 ☐ 44E		80	0.56		35	
JHC 6002 803 ☐ 44E					60	
JHC 3502 104 ☐ 44E		100	0.47	100	35	
JHC 6002 104 ☐ 44E					60	

・For the taping type, the packing code "R or N" will be entered in ☐.
・Catalog numbers are approved by UL. cUL.(File No.E170721)
・80A and 100A are to be approved by UL.cUL

DIMENSIONS

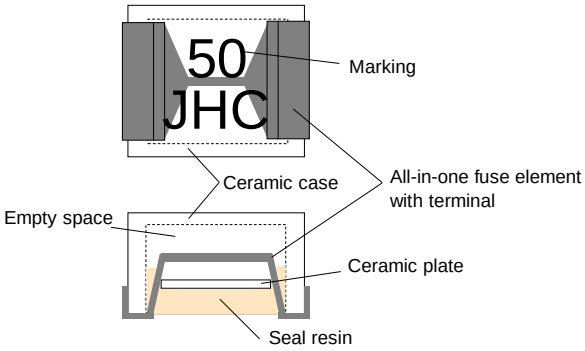


Main body：Ceramic case
Terminal：Tin plating

(mm)

Case size	Case code	L	W	T	P
7358	44E	7.3±0.3	5.8±0.2	4.2±0.2	1.2±0.3

CONSTRUCTION

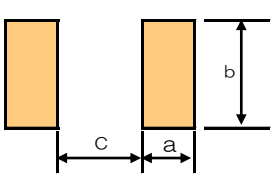


Name	Material, standard, and treatment
All-in-one fuse element with terminal	Copper Alloy（Tin plating terminal）
Ceramic case	Alumina ceramics
Ceramic plate	Alumina ceramics
Seal resin	Silicone resin
Marking	UV curable resin
Empty space	—

MARKING

Code ： Rated current	Code ： Rated current
30 ： 30A	60 ： 60A
40 ： 40A	80 ： 80A
50 ： 50A	100 ： 100A

RECOMMENDED PAD DIMENSION

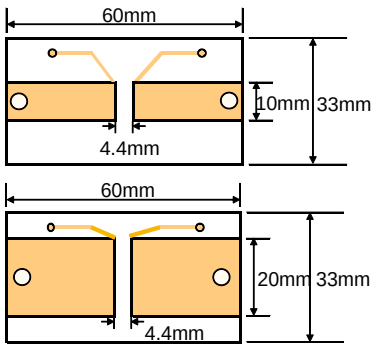


(mm)

	Size 7358
a	2.7
b	5.8
c	4.4

(Reflow)

STANDARD TEST BOARD



Glass epoxy body on one side
Board thickness : 1.6mm
Thickness of Copper layer : 400μm
Rated Current : 30~50A

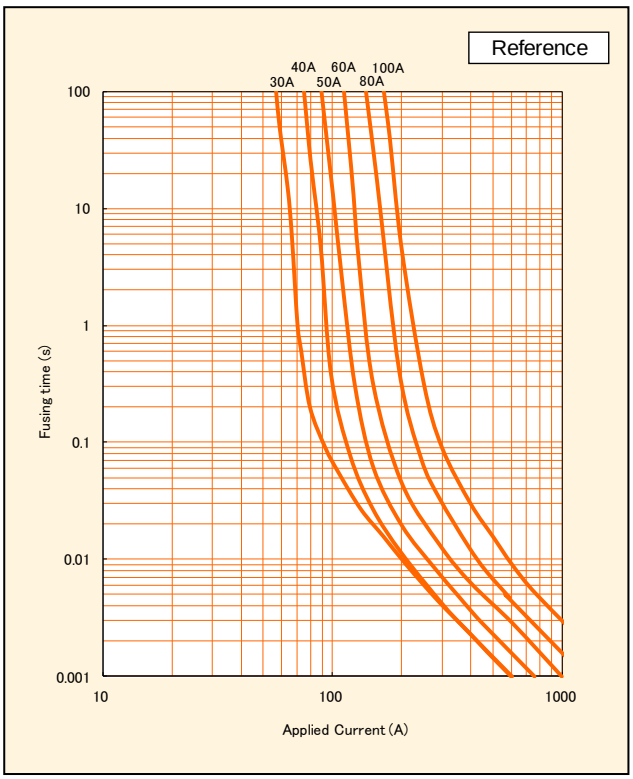
Glass epoxy body on one side
Board thickness : 1.6mm
Thickness of Copper layer : 500μm
Rated Current : 60~100A

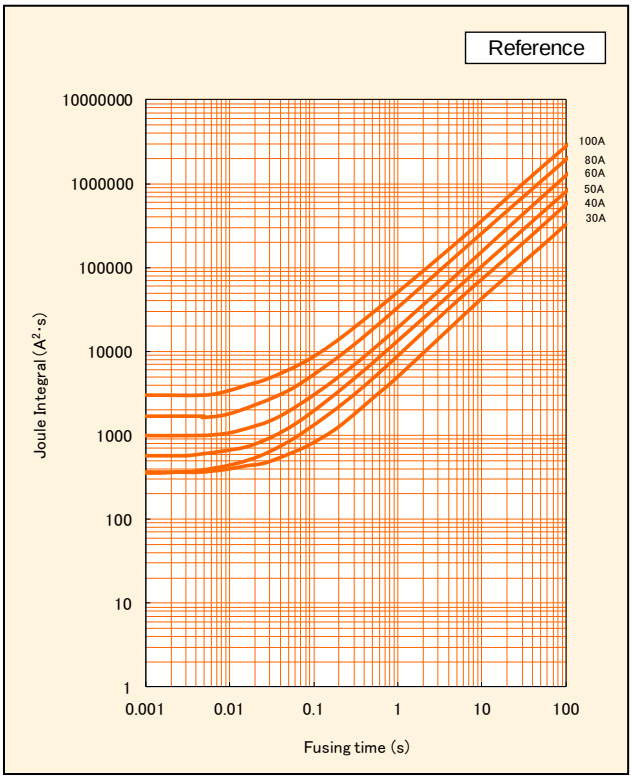
PERFORMANCE

No	Item	Performance	Test method
1	Temperature rise	Temperature rise shall not exceed 75℃	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. No ignition. Marking shall be legible No bursting of the fuse	Breaking voltage : Rated voltage Breaking current : 300A(30～50A)、600A(60～100A)
4	Voltage drop	Voltage drop is below the value specified in CATALOG NUMBERS AND RATING.	Apply rated current
5	Fusing characteristics	Fusing within I min.	Apply 250% of rated current (Ambient temperature: 10～30℃)
6	Insulation resistance	1000MΩ or more	Insulation resistance between terminals and case(ceramics)
7	Electrode strength (Bending)	No mechanical damage. Resistance change after the test shall be within ± 20%.	Board supporting width : 90mm Bending speed : Approx. 0.5mm/s Duration : 5 s Bending : 3mm
8	Shear test	No mechanical damage. Resistance change after the test shall be within ± 20%.	Applied force : 20N Duration : 10s Tool : R0.5 Direction of the press : side face
9	Core body strength	No mechanical damage. Resistance change after the test shall be within ± 20%.	Supporting dimension : 3.65mm Applied force : 20N Duration : 10s Tool : R0.5 Direction of the press : thickness direction of product
10	Solderability (Solder Wetting time)	Solder Wetting time : within 3s	Solder : Sn-3Ag-0.5Cu Temperature : 245±5℃ 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±5℃ Dippinng : 3s
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℃／60s Temperature : 265±3℃／6～7s Reflow（2 cycle） Preconditioning : Lower than 180℃ 1～2min Peak : 250±5℃ 5s Holding : 230～250℃ 30～40s Cooling : More than 2min Manual soldering Temperature : 350±10℃ Duration : 3～4s Measure after 1hour 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 : 90s
14	Vibration	No mechanical damage. Resistance change after the test shall be within ± 20%.	Frequency rage : 10～55～10Hz/min Vibration amplitude : 1.5mm 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 : 490m/s^2 Duration : 11ms 6 aspects × 3 times (total: 18 times)
16	Thermal shock	No mechanical damage. Resistance change after the test shall be within ± 20%.	-55±3℃ : 30min Room temperature : 2～3min or less 125±2℃ : 30min Room temperature : 2～3min 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℃ Humidity : 85±5%RH Duration : 1000h
18	Load life	No mechanical damage. Resistance change after the test shall be within ± 20%.	Temperature : 85±2℃ Applied current : Rated current×70% Duration : 1000h
19	Moisture resistance load	No mechanical damage. Resistance change after the test shall be within ± 20%.	Temperature : 85±3℃ Humidity : 85±5%RH Applied current : Rated current×70% Duration : 1000h
20	Stability	No mechanical damage. Resistance change after the test shall be within ± 20%.	Temperature : 125±2℃ Duration : 1000h

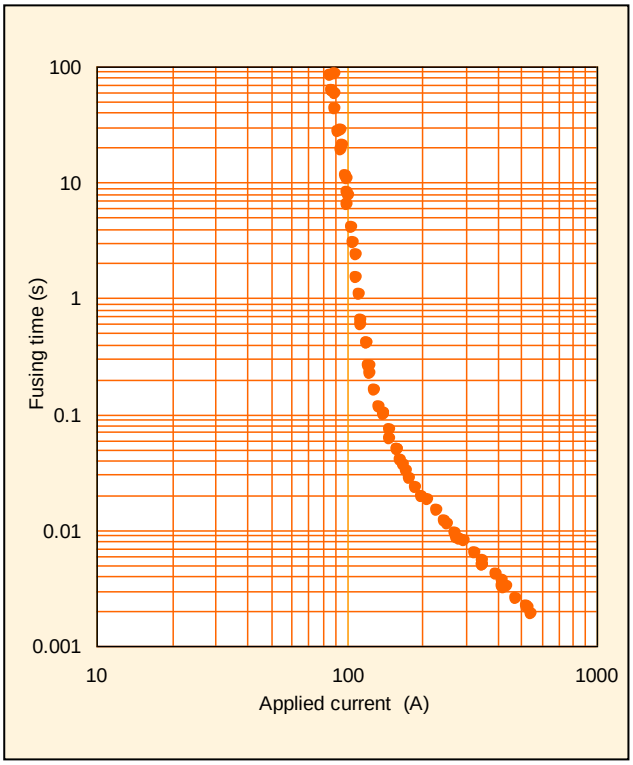
FUSING CHARACTERISTICS

I^{2}T - T CHARACTERISTICS

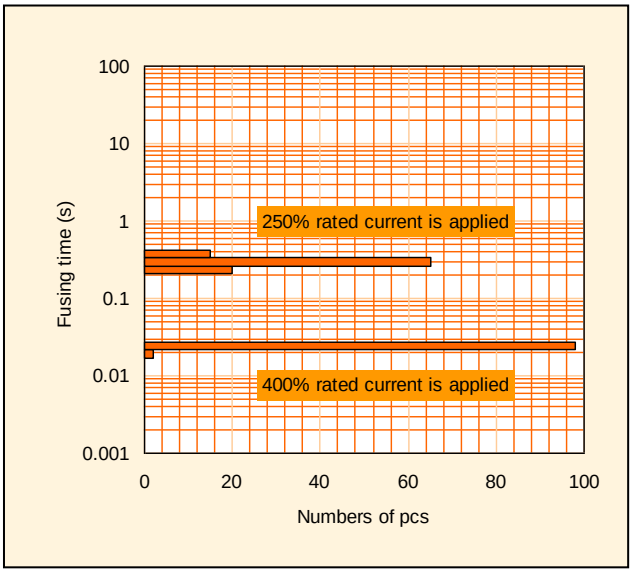




DISTRIBUTION OF FUSING CHARACTERISTICS



DISTRIBUTION OF FUSING TIME



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

Determine the rated value of the micro fuse, and select the micro fuse for your circuit. If you select the micro fuse , safety of your circuit can be ensured.
How to determine the rated value of the micro fuse 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 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 condition by using the actual device.

1-1. Operating current
   Using an oscilloscope or equivalents, measure 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 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.

<The notes to the design of substrate wiring>
   In a 25℃ environment under normal circumstances, please design substrate wiring so that the surface temperature of a fuse does not exceed 80℃.

EXAMPLE TO SELECT RATINGS OF TYPE JHC
<Fuse selection>
   Effective operating current : 30 A
   Effective overload current : 140 A
   Inrush current waveform : Fig. A
   (Pulse width : 2 ms, Wave height : 300 A)
   Numbers to withstand inrush current : 100,000 times
   Category temperature : 85°C
   Operating time : 4,000h

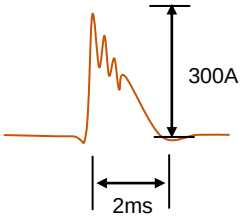


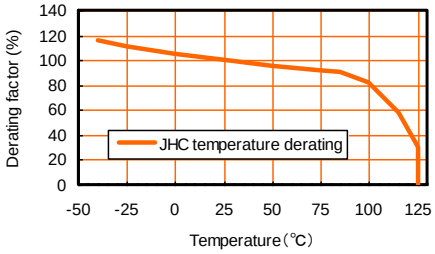
Fig. A : Inrush current waveform

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 = 30 A

Fig. B

2–2 Derating
   ①Temperature derating factor
      Using Fig. B, find the temperature derating factor correspond to the Temperature. However, in order to be allowed to check an operating condition in use to the apparatus used for a long time that the operating time exceeds 4,000 h, please ask our Sales Department.
   ②Rated derating factor
      Rated derating factor = 0.94 (Constant irrespective of temperature)



      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 =30 A
         ①Temperature derating factor = 0.90 (Refer to Fig. B.)
         ②Rated derating factor = 0.94 (Constant irrespective of temperature)

Calculation using Formula 1 :

Rated current ≥ 30/(0.90×0.94) = 35.5A

The above calculation result shows that the fuse with rated current of 35.5A or more should be selected for this circuit.

Type JHC, with rated current of 50 A and 40A can be selected.

3. Calculation from overload current

3–1 Measurement of overload current

Using oscilloscope or equivalents, measure overload current that needs to break circuit.

Example : Effective overload current = 140 A

3–2 Calculation from overload current

Determine rated current so that overload current can be 2.5 times larger than rated current.

Use Formula 2 to calculate rated current of fuse.

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

Example : Overload current = 140 A

Use Formula 2 to calculate the rated current.

Rated current ≤ 140/2.5 = 56 A

The above calculation result shows that the fuse with rated current of 56 A or less should be selected for this circuit.

Type JHC, with rated current of 50 A and 40A can be selected.

4. Calculation from inrush current

4–1 Measurement of inrush current waveform

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

4–2 Creation of approximate waveform

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

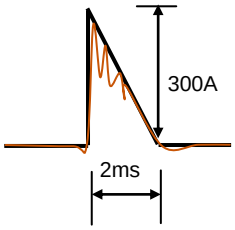


Fig. C：Inrush current waveform
Red line : Actual measurement waveform
Black line：Approximate waveform

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

Calculate I^2t (Joule integral) of approximate waveform.

The formula for this calculation depends on the approximate waveform.

Refer to Table A.

Example : Pulse applied = 2 ms, Peak value = 300 A

Approximate waveform = Triangular wave

Since the approximate waveform is a triangular wave, use the following formula for calculation.

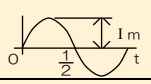
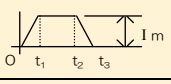
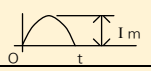
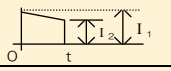
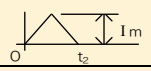
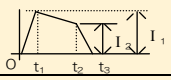
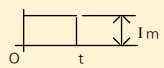
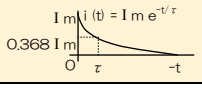
I^2t of rush current = $1/3 \times Im^2 \times t$ ... Formula 3 (Im : Peak value, t : Pulse applying time)

Use Formula 3 to calculate I2t of the inrush current:

$I^2t = 1/3 \times 300 \times 300 \times 0.002 = 60\ (A^2s)$

JOULE-INTEGRAL VALUES FOR EACH WAVEFORM

Table A

Name	Waveform	I^2t	Name	Waveform	I^2t
Sine wave (1cycle)		$\frac{1}{2} I_m^2 t$	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		$\frac{1}{2} I_m^2 \tau$

* 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 number of cycles to withstand.

PULSE RESISTANCE CHARACTERISTICS

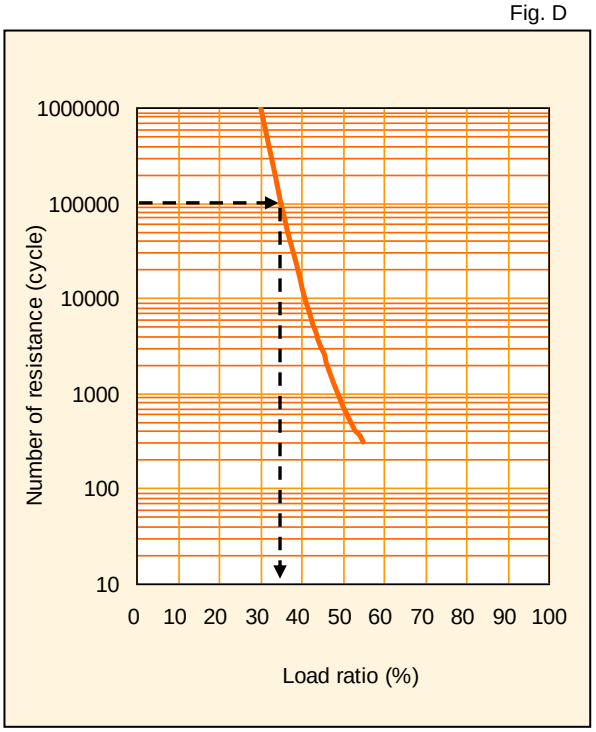
(generally 100,000 times)

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

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

The load ratio is 35% or less from Fig. D.

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 = 60 A2s,

Pulse applied = 2 ms, Required load ratio = 35%

From Formula 4,

Standard I^2t of fuse > 60/0.35 = 171.4 (A2s)

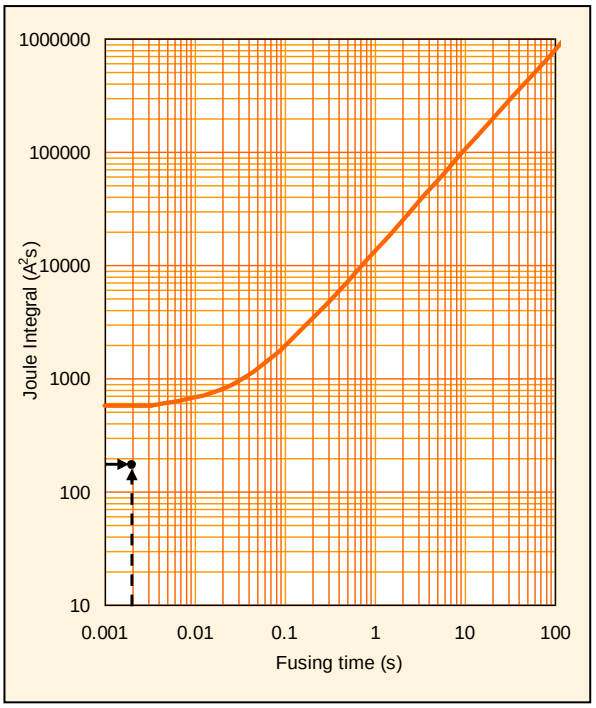
The standard I^2t of the fuse should be 171.4 (A2s) or more.

Since the rush pulse applied is 2 ms, obtain the intersection of 2 ms (horizontal axis) and 171.4 A2s (vertical axis) from Fig. E (refer to the arrow shown in Fig. E).

Select a fuse whose curve is above the intersection. Type JHC with rated current of 50 A and 40A should be selected.

JOULE INTEGRAL VS. FUSING TIME

Fig. E



5. Final determination of rated value

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

Example : Rated current of 50 A and 40A meets the all requirement.

6. Operation check using actual device

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

Application Notes for Micro Fuse

1. Circuit Design

HIGH CURRENT MICRO FUSE should be designated only after confirming operating conditions and Micro Fuse characteristics.

When determining the rated current, be sure to observe the following items :

(1) Type JHC should always be operated below the value considered in the rated derating rate and temperature derating rate for rated current.

(2) Type JHC should always be operated below the rated voltage.

(3) TYPE JHC should be selected with correct rated value to be fused at overload current.

(4) When TYPE JHC are used in inrush current applications, please confirm sufficiently inrush resistance of Micro Fuse.

(5) Please do not apply the current exceeding the breaking current to TYPE JHC. In addition, I would like confirmation beforehand not to have possibilities to cut if off normally when you uses it by a high inductance circunt.

(6) Use TYPE JHC under the condition of category temperature.

(7) TYPE JHC should not be used in the AC power source and primary power source.

(8) TYPE JHC should be selected by determining the operating conditions that will occur after final assembly, or estimating potential abnormalities through cycle testing.

(9) In a 25 ℃ environment under normal circumstances, please design substrate wiring so that the surface temperature of a fuse does not exceed 80 ℃.

And, please use after checking that turn on operating current and overload current by an actual substrate in advance, and it is satisfactory.

2. Assembly and Mounting

During the entire assembly process, observe Micro Fuse body temperature and the heating time specified in the performance table. In addition, observe the following items :

(1) Mounting and adjusting with soldering irons are not recommendable since temperature and time control is difficult.

(2) Once Micro Fuse mounted on the board, they should never be remounted on boards or substrates.

(3) During mounting, be careful not to apply any excessive mechanical stresses to TYPE JHC.

3. Solvents

For cleaning of Micro Fuse, immersion in isopropyl alcohol for 90 seconds (at 20 ~ 30°C liquid temp.) will not be damaged. If organic solvents (Pine Alpha™, Techno Care™, Clean Through™, etc.) will be applied to TYPE JHC, be sure to preliminarily check that the solvent will not damage TYPE JHC .

4. Ultrasonic Cleaning

Ultrasonic cleaning is not recommended for TYPE JHC. This may cause damage to TYPE JHC such as broken terminals which results in electrical characteristics effects, etc. depending on the conditions.

5. Caution During Usage

(1) TYPE JHC with electricity should never be touched. TYPE JHC with electricity may cause burning due to TYPE JHC high temperature.

Also, in case of touching TYPE JHC without electricity, please check the safety temperature of TYPE JHC.

(2) Protective eye glasses should always be worn when performing fusing tests.

However, there is a fear that TYPE JHC will explode during test. During fusing tests, please cover particles not to fly outward from the board or testing fixture.

Caution is necessary during usage at all times.

6. Environmental Conditions

(1) TYPE JHC should not be stored or operated in the presence of acids, or alkalis, or corrosive atomosphere.

(2) TYPE JHC should not be vibrated, shocked, or pressed excessively.

(3) TYPE JHC should not be operated in a flammable or explosive atmosphere.

(4) TYPE JHC should not be used under dew condensation environment.

7. Emergency

In case of fire, smoking, or offensive odor during operation, please cut off the power in the circuit or pull the plug out.

8. Storage

(1) TYPE JHC should be stored at room temperature (-10°C ～+40°C) without direct sunlight.

TYPE JHC should not be stored in corrosive atmosphere such as H_2S (hydrogen sulfide) or SO_2(sulfur dioxide) .

Direct sunlight may cause decolorization and deformation of the exterior and taping.

Also, there is a fear that solderability will be remarkably lower in high humidity.

(2) If the products are stored for an extended period of time, please contact Matsuo Sales Department for recommendation. The longer storage term causes packages and tapings to worsen. If the products are stored for longer term, please contact Matsuo Sales Department for advice.

(3) The products in taping, package, or box should not be given any kind of physical pressure. Deformation of taping or package may affect automatic mounting.

9. Disposal

When TYPE JHC are disposed of as waste or “scrap”, they should be treated as “industrial waste”.

10.Samples

TYPE JHC received as samples should not be used in production applications. A sample is provided for the special use (in such cases as the one for the form sample, the electriccharacteristic confirmation)

MATSUO ELECTRIC CO., LTD.

Please feel free to ask our sales department for more information on Micro Fuse.

Overseas Sales Dep : 5-3, 3-Chome, Sennari-cho, Toyonaka-shi, Osaka 561-8558, Japan Tel : 06-6332-0883 Fax : 06-6332-0920

Head Office : 5-3, 3-Chome, Sennari-cho, Toyonaka-shi, Osaka 561-8558, Japan Tel : 06-6332-0871 Fax : 06-6331-1386

URL : http://www.ncc-matsuo.co.jp/