

# UL 248 AND CSA C22.2 N°248 LOW VOLTAGE NORTH AMERICAN FUSES

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## 1. INTRODUCTION

UL 248 is a fuse standard and replaces the former UL 198. UL 512 is a fuse block standard

Above standards establish the dimensional and electrical characteristics of fuses as well as the acceptance criteria at overload and short circuit levels. There are as well requirements on the labelling of the fuses. Fuses have “rejection” to prevent installing the wrong voltage and ampere rating fuse when an older fuse range with same dimensions has a lower breaking capacity.

UL listed fuses are general purpose fuses and voltage ratings are maximum whereas the IEC 60269 requires the test voltage to be between 110 % and 115 % the rated voltage of the fuse. However the IEC-60269 has now introduced the gN and gD fuse types complying with the UL requirements. They are respectively identical to the fast fuses and the time delay fuses described in the UL 248.

**Amp-trap 2000® Fuses**  
For Type-2, “no damage” circuit protection - in all the configurations you need.

- Class J / AIT
- Class L / A4BQ
- Class RK1 / A2D & A6D
- Class CC / ADR
- Class CC / ACR

**Your problem:** You need maximum overcurrent protection to prevent costly damage to today's highly sensitive motor and electrical-system components. That way, plant shutdowns, replacement costs, and repair bills are kept to an absolute minimum.

**Our solution:** By opening in less than 1/4 cycle under short circuit conditions, Amp-trap 2000® fuses current limit enough to prevent undue downstream damage — and therefore comply with the extra-stringent IEC, Type-2 standard. In addition, their current-limiting ability ranks among the industry's highest, allowing for motor starting and transformer inrush current without nuisance opening.

As for other fuses the fuses complying with UL 248 have advantageous characteristics in the following points:

- **Safety**
- **Speed**
- **Breaking capacity**
- **Maintenance before a short-circuit**
- **Maintenance after a short-circuit**
- **Selectivity (or discrimination)**
- **Power quality**
- **Future system growth**
- **Universal**
- **Low power consumption**
- **Price**

## 2. INTRODUCTION TO THE UL 248 STANDARD

It was formerly the UL 198. Products meeting UL198 are “grand-fathered” into 248 without additional testing. This updating and rewriting was done by the industry in 1996. It is harmonized with CSA and all documents are the same.

### 2.1. The 16 parts of UL 248

TABLE 1

PART No.	FUSE CLASS	FERRAZ SHAWMUT RANGES	
		FAST ACTING	TIME DELAY
01	General Requirements	This Standard applies to low-voltage fuses rated 1000 V or less (2000 V or less for part 13), AC and/or DC, with interrupting ratings up to 200 kA. These fuses are intended to be used in accordance with the <i>Canadian Electrical Code, Part I</i> (CEC), and the <i>National Electrical Code, NFPA 70</i> (NEC).	
02	C	British standard dimensions. Mainly used in Canada for motor short circuit protection: FES, FESC & FESF	
03	CA	CN	
	CB	CNS	
04	CC	ATMR	ATDR & ATQR
05	G		AG (time delay above 5 A)
06	H non renewable	CRN (250 V) & CRS (600 V)	NRN (250 V) & NRS (600 V)
07	H renewable	RF (250 V) & RFS (600 V)	
08	J	A4J	AJT
09	K	K5: OT (250 V) & OTS (600 V) K5: OTN (250 V 15 to 60 A)	
10	L	A4BY	A4BQ & A4BT
11	Plug	G, GP & GW	GT, TD, GSL & GTL
12	R	RK1: A2K (250 V) & A6K (600 V)	RK1: A2D (250 V) & A6D (600 V)
			RK5: TR (250 V) & TRS (600 V)
13	Semiconductor Fuse gR and aR	Component recognized products 2000 V AC or less The DC voltage rating may be different from the AC rating	
14	Supplemental (60 A or less)	ATM, OTM, GGU, SBS, 6X32 & 5X20	ATQ, TRM, GFN, 6X32 & 5X20
15	T	A3T (300 V) & A6T (600 V)	
16	Test Limiters	Fuses designed to protect an equipment during testing	

Products meeting UL198 are “grand-fathered” into 248 without additional testing. Listed fuses must comply with all requirements of a UL standard. They are suitable for general use and are applied per NEC. They can be stamped with the UL logo



Recognized components are suitable for limited applications. They do not meet all requirements of a standard. But the UL describes the type of tests the fuses must perform. Semiconductor fuses are Recognized component and can be marked with the special logo.



## 2.2. Typical technical data

- Temperature rise: 100% ( $1.0 I_N$ )
- Current carry (conventional non-fusing current) : 110%, temperature stabilization (125% for IEC class gG)
- Fusing factor (conventional fusing current) :
  - 135% for ratings below 601 A, ( $1,60 I_N$  for IEC class gG)
  - 150 % for ratings above 600 A ( $1,60 I_N$  for IEC class gG)
  - 160 % for class C
- Time-delay (optional):
  - generally 500% at minimum time 10s
  - For class CC and supplemental fuses it becomes 200% at minimum time 12 s
- Short-circuit:  $I^2t$  &  $I_p$  (peak current) limits specified by class
- Interrupting rating: 200kA, optional 300Ka

According to the fuse class the fuse must comply with 1 or several of the 5 overload tests described in table 2

**TABLE 2: OVERLOAD TESTS**

CURRENT RATING $I_N$  ( A )	OVERLOAD MAXIMUM CLEARING TIME ( MINUTES )			TIME DELAY MINIMUM CLEARING TIME ( S )	
	TEST CURRENT IN MULTIPLE OF THE FUSE CURRENT RATING $I_N$				
	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5
	$1.35 I_N$	$1.50 I_N$	$2 I_N$	$2.0 I_N$	$5.0 I_N$
0 – 30	60	-	4 *	12	10
31 – 60	60	-	6 *	12	10
61 – 100	120	-	8	-	10
101 – 200	120	-	10	-	10
201 – 400	120	-	12	-	10
401 – 600	120	240	14	-	10
601 – 800	-	240	-	-	-
801 – 1200	-	240	-	-	-
1201 – 1600	-	240	-	-	-
1601 – 2000	-	240	-	-	-
2001 – 2500	-	240	-	-	-
2501 – 3000	-	240	-	-	-
3001 – 4000	-	240	-	-	-
4001 – 5000	-	240	-	-	-
5001 – 6000	-	240	-	-	-

\* Respectively 2 and 4 for supplemental fuses

### 2.3. Main characteristics of the main FERRAZ SHAWMUT fuse ranges

TABLE 3

CLASS	MAX VOLTAGE	CURRENT RATING	OVERLOAD TESTS	BREAKING CAPACITY	DESIGNATION
	(V)	(A)	test #	(KA)	
J	600	1 à 600	1 & 3	200KA	A4J
J	600	1 à 600	1 & 3 & 5	200KA	<b>AJT</b>
L	600	601 à 6000	2	200KA	A4BY
L	600	601 à 2000	2 & 5	200KA	A4BT
L	600	601 à 6000	2 & 5 I <sub>N</sub> / 4 s	200KA	<b>A4BQ</b>
RK1	250	1 / 10 à 600	1	200KA	A2K
	600		1		A6K
RK1	250	1 / 10 à 600	1 & 5	200KA	<b>A2D</b>
	600		1 & 5		<b>A6D</b>
RK5	250	1 / 10 à 600	1 & 5	200KA	TR
	600		1 & 5		TRS
CC	600	1/4 to 30	1	200KA	ATMR
CC	600	1/4 to 30	1 & 2	200KA	<b>ATDR</b>
G	480	1 to 60		100KA	AG
T	300	1 to 1200	1 (ratings: 0 to 600 A) 2 (ratings > 600 A) 3 (ratings: 0 to 600 A)	200KA	A3T
	600	1 to 800			A6T
K5	250	1 to 600	1 & 5	50KA or higher	OT
	600	1 to 600	1 & 5		OTS
Supplem.	500	1/10 to 30	1 & 4	10KA	ATQ
Supplem.	600	1/10 to 50	1 & 3	30A: 100KA 50A: 10KA	ATM

**AMP-TRAP 2000 FUSES (preferred solutions) are: AJT, A4BQ, A2D and A6D, ATDR**  
They are all Time Delay fuses

### 2.4. Advantages of Dual-Element construction (used in Time Delay fuses) vs. Single-Element

The dual element construction is used in many Time Delay fuses

- Thermal sensitivity - reduce equipment damage from heat
- Superior long-term cycling capabilities
- Performance characteristics remain unchanged over time
- Lower watts loss, therefore lower temperature
- Good coordination with downstream devices
- Ability to size closer to normal running current
- Greater short-term overload capacity

### 3. COMPARISON OF THE TIME CURRENT CURVES OF IEC AND UL FUSES

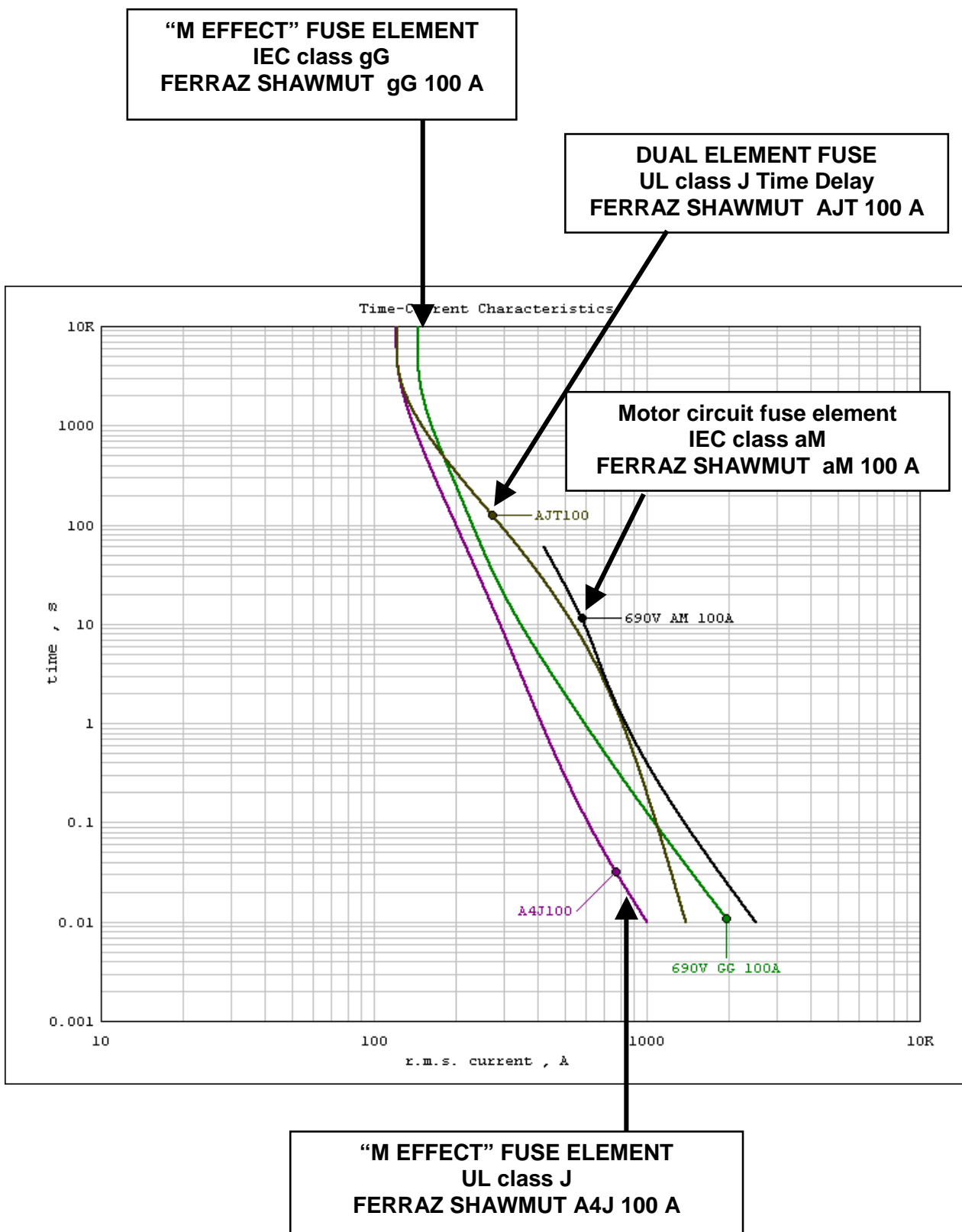


Figure 3 : comparison of IEC and UL fuses

## 4. PRESENTATION OF SELECTED FERRAZ SHAWMUT RANGES

### 4.1. Class J: FERRAZ SHAWMUT types AJT & A4J

- Two types are available:  
Time-delay AJT (preferred): melts at 500% @ 10 s  
Fast-acting A4J: melts between 200 % and 330 % @ 10 s
- Current limitation (similar to RK1)  
AJT 600 A cut off current = 55 KA at 200 KA fault  
A4J 600 A cut off current = 53 KA at 200 KA fault
- DC capability:  
AJT tested at 500 V dc 100 KA  
A4J tested at 300 V dc 20 KA
- Dimensions approximately same as European sizes
- Ampere range: 0 - 600A @ 600V
- Interrupting rating: 300kA for the AJT range  
200kA for the A4J range
- Main, feeder & branch circuit applications



### 4.2. Class L: FERRAZ SHAWMUT types A4BQ & A4BY

- Two types are available:  
time-delay A4BQ (preferred) melts at 500% & 4 sec  
fast-acting A4BY
- Current limitation  
A4BQ 6000 A cut off current = 240 KA at 200 KA fault  
A4BY 6000 A cut off current = 220 KA at 200 KA fault
- DC capability:  
A4BQ 601 to 3000 A tested at 500 V dc 100 KA  
A4BY 200 to 2500 3000 A tested at 300 V dc 100 KA
- Main or feeder fuse applications
- Seldom used by OEM's ... little European use
- Ampere range: 601 - 6000A @ 600V~
- Interrupting rating: 300kA for the A4BQ range  
200kA for the A4BY range
- **Note : Fusing factor 150%**



#### 4.3. Class RK1: FERRAZ SHAWMUT types A2D & A6D and types A2K & A6K

- Two types are available:

time-delay (preferred): A2D (250V)& A6D (600V)  
melt at 500% & 10 sec

fast-acting A2K (250V) & A6K(600V)

- Current limitation  
A6D 600 A cut off current = 62 KA at 200 KA fault  
A6K 600 A cut off current = 48 KA at 200 KA fault
- Ampere range: 0 - 600A @ 250V & 600V
- Interrupting rating:  
300 kA for A2D & A6D  
200 KA for A2K & A6K
- Main, feeder & branch circuit applications
- Seldom used by OEM's - replacement



#### 4.4. CLASS T: FERRAZ SHAWMUT types A3T & A6T

- Available types:  
fast-acting only.  
Two ranges rated 300 V and 600 V
- Current limitation:  
The 300 V range is better than class J  
The 600 V range produces the same peak  
current as the class J fuses
- Dimensions: Very compact
- Ampere range: 0 - 1200A @ 300Vac and 600Vac
- Above 600A unique fusing factor 150% (like L's)
- Interrupting rating: 200kA (optional 300kA)
- Applications: main, feeder & branch circuit applications





#### 4.5. North American Control Fuses (CA,CB,CC,G, Midget)

- **Class CC: FERRAZ SHAWMUT type ATDR & ATMR**

CC is a variant of NF 10x38mm fuses (French)

Two different types: Time Delay ATDR with 200% / 12 seconds  
Fast acting ATMR

Rejection feaure

Ratings: 600 V AC ¼ to 30 A  
Breaking capacity: 200 KA



- **Class G (4 sizes): FERRAZ SHAWMUT type AG**

4 sizes but always 10.3 mm diameter , only the length changes.  
Dimensions do not allow inter-changeability with other fuse classes

RATING (A)	LENGTH (mm)
½ to 15	33.3
20	35.8
25 to 30	41.2
35 to 60	57.2

Time Delay above 5 A  
Rated 480 V  
100 KA breaking capacity



- **Class C: FERRAZ SHAWMUT FES, FESC & FESF**

Equivalent to the BS 88 fuses.  
Motor protection in Canada

- **Class CA & CB: FERRAZ SHAWMUT CN & CNS**

Fast acting fuses for Canada only.

- **Supplemental (Midgets): FERRAZ SHAWMUT ATQ, A6Y-2B, ATM, TRM, OTM, GGU**

All have the same size: 10,3 mm x 38 mm  
Voltage ratings : 125 V , 250 V , 300 V , 500 v, 600 V according to fuse types and current ratings.

Fast acting fuses and Time Delay fuses  
GFN is a Time Delay with blown fuse indicator recmmanded for solenoid circuits and control circuits.



- **Supplemental (Miniatures)**



## 5. PROTECTION LEVEL

- Type 1: damage is allowed but contained in enclosure. Repair or parts replacement usually required.
- Type 2: minor damage is allowed, corrected by simple repair. The equipment can be made suitable for further use
- Type 3: little or no damage. The equipment is immediately re-usable.

## 6. STANDARD VOLTAGE SYSTEMS IN NORTH AMERICA (60HZ)

120 / 240 V, 1-phase (USA & Canada)  
120 / 208 V, 3-phase (USA & Canada)  
240 / 416 V, 3-phase (Canada)  
277 / 480 V, 3-phase (mainly USA)  
347 / 600 V, 3-phase (mainly Canada)

Higher industrial voltages 2400V, 4160V, 4800V and 7200v nominal

Distribution voltages ... 15kV, 25kV & 35kV

## 7. SELECTION OF THE FUSE VOLTAGE RATING $U_N$

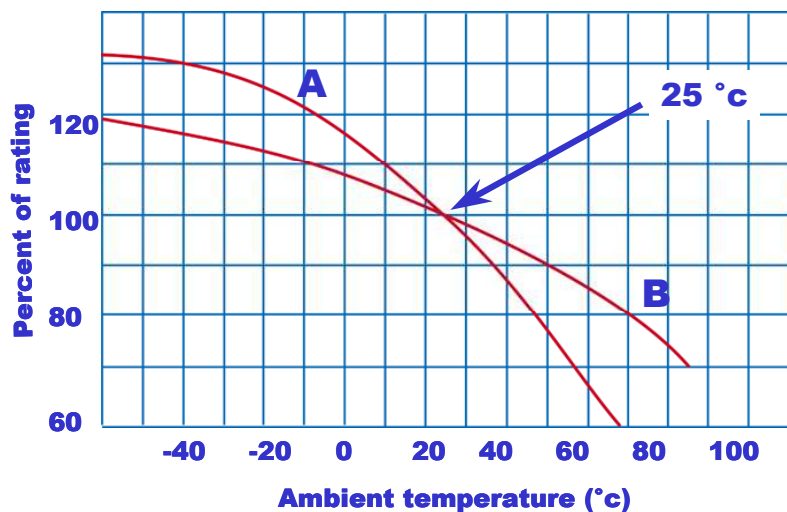
VOLTAGE RATINGS OF THE FUSES ARE **MAXIMUM**

Consequently the fuse voltage rating must be equal or higher than the **maximum value** of the voltage of the system

## 8. SELECTION OF THE FUSE CURRENT RATING $I_N$

GENERAL RULE: FUSES ARE NOT LOADED BEYOND 80% EXCEPT CLASS L & MEDIUM VOLTAGE

### Ambient Compensation Chart



**A : effect on blowing time B : Effect on current carry**

Figure 4

## 9. HOW TO SELECT FUSES QUICKLY AND EASILY

### 9.1. Two methods

- use tables in application information or individual tables for each fuse range (figure 5)



Figure 5



figure 6

- use software SAF : Select-A-Fuse (figure 6)

### 9.2. APPLICATION EXEMPLE : MOTOR CIRCUIT PROTECTION

MOTOR DATA:

**Voltage: 460 V**  
**Power: 250 HP**  
**Start time: 8s**

- Selection from tables in the Application Information

MOTOR HP	FULL LOAD AMPERES	RECOMMENDED FUSE AMPERE RATING								
		MOTOR ACCELERATION TIMES								
		MINIMUM 2 SECS.	TYPICAL 5 SECS.	HEAVY LOAD OVER 5 SECS.	MINIMUM 2 SECS.	TYPICAL 5 SECS.	HEAVY LOAD OVER 5 SECS.	MINIMUM 2 SECS.	TYPICAL 5 SECS.	HEAVY LOAD OVER 5 SECS.
<b>460V</b>		<b>RK5-TRS (Tri-onic®)/RK1-AGD</b>			<b>J-AJT</b>			<b>UL CLASS CC ATDR</b>		
1/2	1.1	1-4/10	1-6/10	2	1-1/2	1-6/10	2	3	3-1/2	4-1/2
3/4	1.6	2	2-1/4	2-8/10	2	2-1/4	2-8/10	3-1/2	5	6-1/4
1	2.1	2-1/2	3-2/10	4	2-1/2	3-2/10	4	5	6-1/4	9
1-1/2	3	3-1/2	4-1/2	5-6/10	3-1/2	4-1/2	5-6/10	6	9	12
2	3.4	4	5	6	4	5	6	8	10	15
3	4.8	5-6/10	7	9	6	8	9	12	15	17-1/2
5	7.6	10	12	15	10	12	15	15	25	30
7-1/2	11	15	17-1/2	20	15	17-1/2	20	25	30	-
10	14	17-1/2	20	25	17-1/2	20	25	30	-	-
15	21	25	30	40	25	30	40	-	-	-
20	27	35	40	50	35	40	50	-	-	-
25	34	40	50	60	40	50	60	-	-	-
30	40	50	60	70	50	60	70	-	-	-
40	52	70	80	100	70	80	100	-	-	-
50	65	80	100	125	80	100	125	-	-	-
60	77	100	125	150	100	125	150	-	-	-
75	96	125	150	175	125	150	175	-	-	-
100	124	175	200	225	175	200	225	-	-	-
125	156	200	225	300	200	225	300	-	-	-
150	180	225	250	350	225	250	350	-	-	-
200	240	300	350	450	300	350	450	-	-	-
250	302	400	450	600	400	450	600	-	-	-
300	361	450	600	-	450	600	-	-	-	-

Results from the table are:

**AJT600**  
**A6D600**  
**TRS600**

- Selection from the Select-A-Fuse software

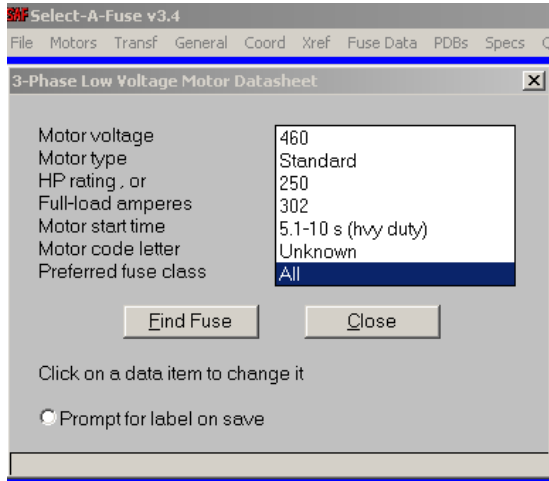


figure 7

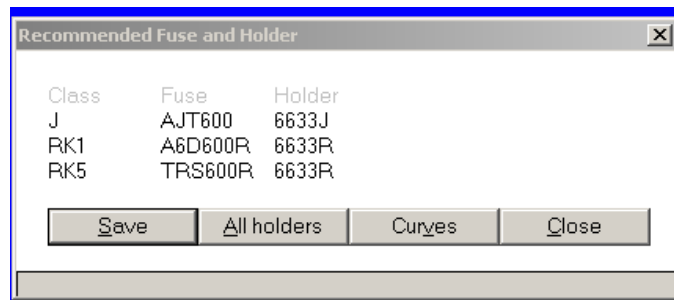


figure 8

### 9.3. Differences between the 3 solutions

	dimensions	Cut off under 100 KA fault	Melt current at 10 s	comment
AJT600	64x203	42 KA	3200 A	Most compact
A6D600R	66x264	50 KA	3000 A	
TRS600R	66x264	72 KA	3300 A	cheapest