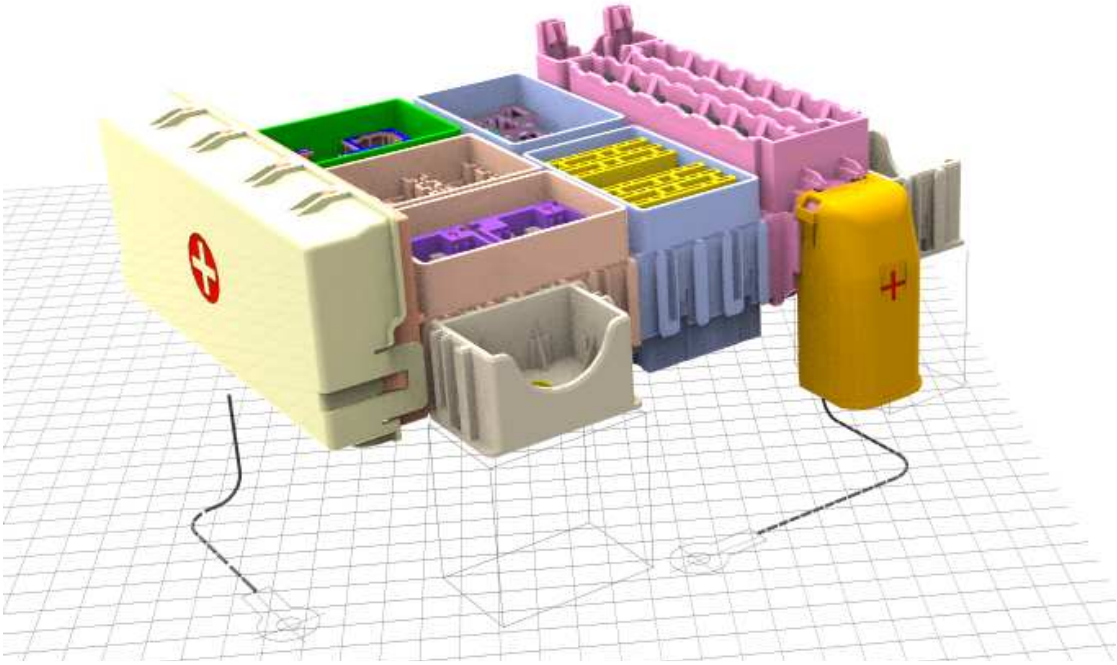
DESIGN OBJECTIVE

Modular Hard Wired Box
Fuse and Relay Modules



Design Targets and Performance Definition

*Trademark
| Indicates change

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1 SCOPE

This specification defines the general characteristics, the mechanical and electrical performances of the fuse and really modules.
With this specification fuses and relays are not automatically eligible. A failure at a component fuse or relay will be not automatically fail the whole test.

The needed performance for the application must be calculated by user and classified with the attention of the de-ratings of contacts, relays, fuses and type of wire. The design and arrangement is in responsibility of the user.
Attention, it is absolutely mandatory that the distributed load reflects a realistic scenario for testing!
During the tests fuses from the company Littlefuse and relays from TE Connectivity were used. The use of other components will be come to different performances.

2 STANDARD AND SPECIFICATIONS

ISO 8820 (2002)
ISO 16750 (2006)
IEC 60512 (2003)
DIN IEC 60068 (2009)
ISO 8092-1 (1996)
ISO 7588 (1998)
ISO 20653 (2006)
UL94

2.1 Spec's for Modules

- 114 – 94092 Overview Drawing
- 114 – 94090 Application specification for Modules

2.1.1 TE Contacts

TE - PN	Name / Customer	Product Spec	Application Spec	Used on Module PN
1355849	9,5mm MCP / TE	108-18630	114-18269	2141026-1
881572	Fuse Contact Busbar / TE	108-37011	114-37000	2141028-1
880397	Fuse Contact Single / TE	108-37011	114-37000	2141028-1
880398	Fuse Contact Single / TE	108-37011	114-37000	2141028-1
880399	Fuse Contact Single / TE	108-37011	114-37000	2141028-1
1355844	Fuse Contact Busbar / TE	108-18513	114-18148	2141029-1
1355877	Fuse Contact Single / TE	108-18513	114-18148	2141029-1
1355833	Fuse Contact Single / TE	108-18513	114-18148	2141029-1
1355880	Fuse Contact Single / TE	108-18513	114-18148	2141029-1
1670225	6,3mm Busbar Tab / TE	-	-	2141040-2
963754	6,3mm Tab / TE	-	-	2141040-1 / -2
963755	6,3mm Tab / TE	-	-	2141040-1 / -2
1534968	M5 Square Head Screw / TE	-	-	2141034-1

Table 1

2.1.2 Additional Contacts

TE - PN	Name / Customer	Customer - PN	Product Spec	Appl. Spec	Used on Module PN
2208343-1	6,3mm / LEAR	361330-YF200	-	-	2141026-1 2141024-1
2208343-2	6,3mm / LEAR	361430-YF200	-	-	2141022-1
2208343-3	6,3mm / LEAR	361030-YF200	-	-	2141024-1
2208342-2	4,8mm / Molex	33113-0003	-	-	2141022-1
2208342-1	4,8mm / Molex	33113-0005			2141022-1

Table 2

Please note!
The last drawing and specification of the above listed contacts has prior before this specification.

3 COMPONENT OVERVIEW & DIMENSIONS

		TE Part Number	Name of Module	Length / mm	Width / mm	Height / mm
3.1	Modules for Relays	2141026-1	Maxi / 2pos.	69,3	47	59
		2141022-1	Micro / 4pos.	69,3	47	40,75
		2141024-1	Mini / 2pos.	69,3	47	42,5
3.2	Modules for Fuses	2141029-1	Miniature 16pos. (Mini*)	69,3	47	49
		2141028-1	Medium 12pos. (ATO*)	69,3	47	43
		2141040-2	Type A 14pos. (J-Case*)	144,55	47	57,3
3.3	Modules for Pre-Fuses	2141040-1	Type A 14pos. (J-Case*)	155,55	47	57,3
		2141034-1	SF30 8pos. (Midi*)	137	70	24,1
3.4	Cover	2141039-1	B+ Cover for Type A Fuse	60	33,4	26
		2141033-1	Cover for Type SF30 Fuse	140,4	62	28,5
3.5	Bracket	2141031-1	Bracket 180°	47	31,5	26,5
		2141031-2	Bracket 90°	47	31,5	26,5

Table 3

*Trademark by Littlefuse

3.6 Box Layout

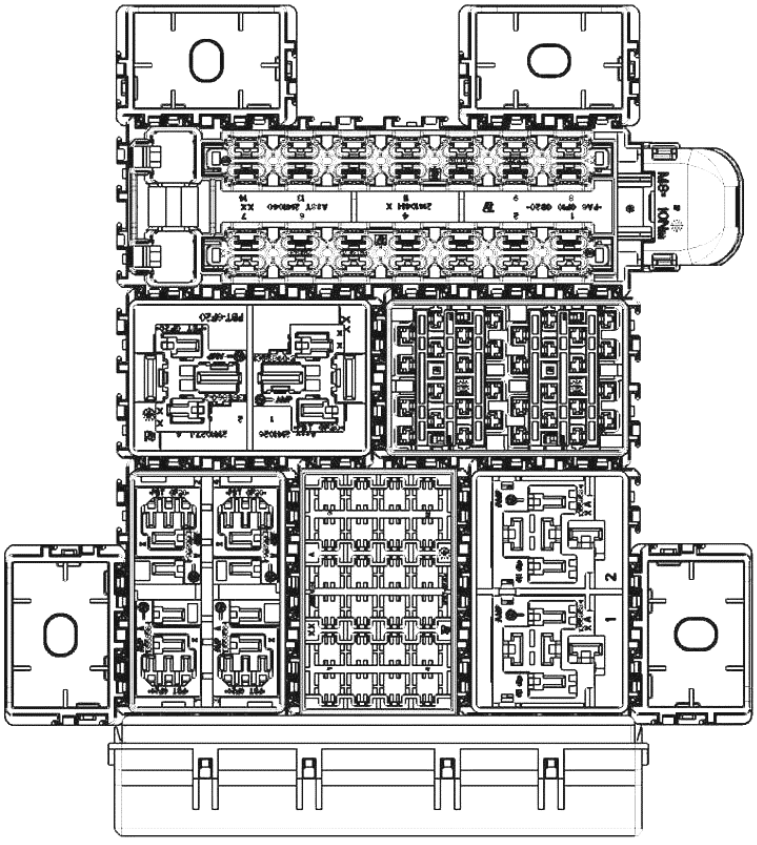


Fig. 1 Box layout for test group 1, 2, 3, 6 & 8

4 TECHNICAL DATA

All following specified data refer to ambient temperature 23℃ (if not differently indicated). In and output examinations before and after the tests are likewise accomplished at ambient temperature.

CODE ISO 16750 A EA G C A/B IP2X
(except module PN 2141040 & 2141028 IP1X if they are not fully loaded)

4.1 Operating Temperatures

The permitted operating temperature range of the DUT (device under test) is:

–40℃ and +85℃

The max. permitted storage temperature is:

-40℃ / +100℃.

4.2 Operating Voltage

The operating voltage range is acc ISO 16750 - 2:

(DC) 6V to 16V; nominal voltage 13,2V (battery voltage) (or 24V system possible but not tested).

All test are performed with this voltage ranges. Other operating voltage ranges are out of this specification and should be tested by user.

4.3 Operating Current

All at table 4 listed data are only for orientation or calculation. Modules are fully loaded expect part 2141034-1 & 2141040-1. The maximum permitted operating current is also dependent on contacts system, wire size and the characteristic of the used relays and fuses. All tests listed at page 14 were performed by using power supply matrix. It is important that the arrangement of the components doesn't create hot spots during operation. Therefore thermal images can help to localize such hot spots.

See de-rating curves at the appendix and example for load matrix at test plan page 14!

Type	PN	Used setting	Max. Current at	
			23℃	85℃
Modules for Relays	2141026-1 (Maxi)	2x Iso Relay	2x 54A (2x 70A**)	2x 36A (2x 50A**)
	2141024-1 (Mini)	2x Iso Relay	2x 38A NC / 2x 35A NO (2x 60A**)	2x 25A NC / 2x 23A NO (2x 45A**)
	2141022-1 (Micro)	4x Iso Relay	4x 26A NC / 4x 14A NO	4x 16A NC / 4x 9A NO
Modules for Fuses	2141029-1 (Mini*)	16x 30A Fuse	16x 13A	16x 8,5A
	2141028-1 (ATO*)	12x 30A Fuse	12x 9A	12x 4A
	2141040-2 (J-Case*)	-	tbd	tbd
Modules for Pre Fuses (with Busbar)	2141040-1 (J-Case*)	6x 60A Fuse B+wire 35mm²	6x 24A	6x 16A
	2141034-1 (Midi)	3x 60A Fuse B+wire 35mm²	3x 50A	3x 32A

Table 4 **according to relay datasheet

4.4 Operating Vibration

The operating vibration range is:
Class 1, on body or chassis
(Code EA acc. ISO 16750-3)

4.5 Sealing Class

The classification of the products is
UNSEALED (Class 0) IP 2X

4.6 UL94 Classification

UL 94 = HB

5 MECHANICAL CHARACTERISTICS

All mechanical push pull test shall perform with a rate of 50 ±10 mm/min. Record of the peak force is required.

5.1 Terminal Insertion

Terminal System ≤ 6,3mm shall be fully seated by force ≤ 14N
Terminal System 9,5mm shall be fully seated by force ≤ 30N

The forward stop must withstand a push-through force of min. 50N.

5.2 Terminal Extraction

The forces shown in table 4 are the minimum extraction force of a terminal from its cavity.
All cavities of the module must be tested twice.

Terminal Size in mm	Primary Lock Only in N (only for modules without spacer)	Primary and Secondary Lock in N	Primary and Secondary Lock after Test 6.3 in N
2,8	60	80	50
>2,8	60	90	50

Table 4

5.3 Insertion & Removal of Components

The maximum mating force and the minimum removal force of components must fulfil the following conditions:

	Mating	/	Removal
Maxi Relais 4pol.	max. 150N	/	min 60N
Mini Relais 5pol.	max. 180N	/	min 60N
Micro Relais 5pol.	max. 130N	/	min 60N
Medium (ATO*) Fuse	max. 70N	/	min. 7N
Miniature (Mini*) Fuse	max. 50N	/	min. 5N
Type (J-Case*) Fuse	max. 53N	/	min. 9N

5.4 Mounting Module to Module

The maximum force to mount each module to the other or onto a complex box can be calculated with the below data. Every module have different amount of slots*. Count how many slots are used for the assemble process and add the forces.

The maximum forces of each slot in mounting direction are:

Mounting with two Slots*	max. 60N
Mounting with three Slots*	max. 75N
Mounting with six Slots*	max. 120N

Please note it is not allowed to use only one slot for mounting modules.

*A Slot is one segment of the mounting features around every module (see Fig1). Each slot consists two guide ways with one latch and one stop. To reduce the mounting force it is simpler to press in turn on different corner than with a higher force in the centre of the module.

Maximum load before separate or break:

2 Slot	min. 200N
3 Slot	min. 300N
6 Slot	min. 500N

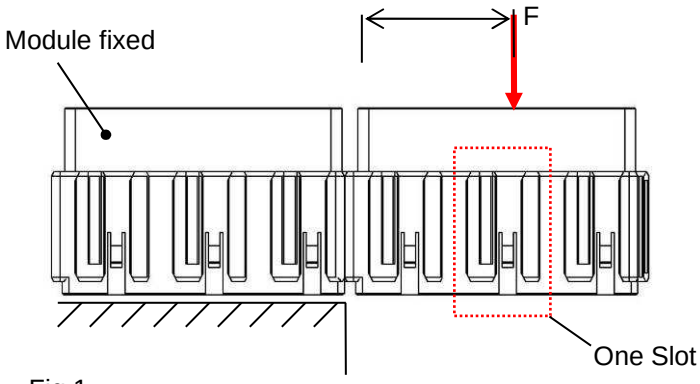


Fig.1

Test procedure: Use for the assembly the amount of slot they have to be tested. One module has to be fixed and the other module is free in space as shown in Fig.1. Use the same kind of module for this test and compare the different surface each other to reduce the test sequences.
Apply the force with a distance of 30mm with a minimum surface of 10x10mm or diameter of 10mm onto the free module.

5.5 Cover Pull Test

The cover must resist a force of 110N minimum against separation from the module.
The force has to be applied in opposite direction of the latches.

5.6 Tightening torque

8mm bolt (M8): 10Nm +/-1Nm;
6mm bolt (M6): 7Nm +/- 1Nm
5mm bolt (M5): 4Nm +/-0,5Nm

The 8mm bolt shall withstand 17Nm torque with no damages or distortions to the plastic housing.

The data of the 6mm bolt is the torque for the fixation of the brackets.

The 5mm bolt shall withstand 7 Nm torque with no damages or distortions to the plastic housing.
The test has to be performing with all feature, nut and washer.

6 ENVIRONMENTAL CONDITIONS

6.1 Thermal Shock

The Module will pass a test acc. IEC 60068-2-14 Na the following conditions:

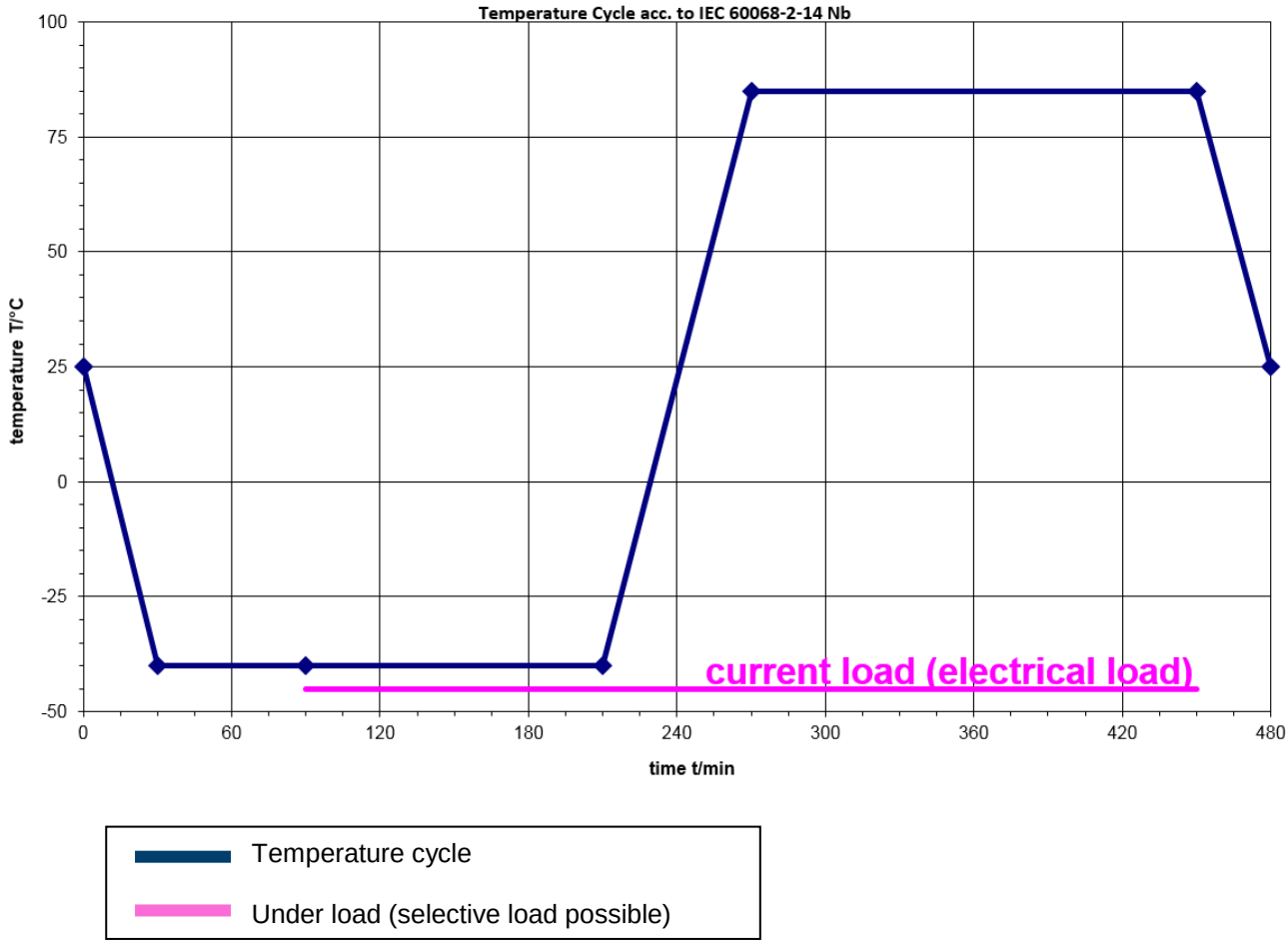
$\vartheta_{min.}$:	-40℃
$\vartheta_{max.}$:	+85℃
Duration of Temperature change:	20s max.
Number of cycles:	200
Duration @ $\vartheta_{min.}$/ $\vartheta_{max.}$:	à 1,5h (one cycle 3h)

Storage sample is not connected.

6.2 Temperature Cycle

The Module will pass a test acc. IEC 60068-2-14 Nb with the following conditions:

$\vartheta_{min.}$:	-40℃
$\vartheta_{max.}$:	+85℃
ΔT:	*1,6K/min*
Soak Time	*1,5h*
Number of cycles:	200
Duration @ $\vartheta_{min.}$/ $\vartheta_{max.}$:	8h
Load profile:	80% of the maximum rating of 4.3 (see load matrix)



6.3 Temperature Humidity Cyclic

Test acc. to DIN IEC 60068-2-38 ZAD

Number of cycles:	10
Duration of cycle:	24h
Tmin:	-10℃
Tmax:	+65℃
Humidity:	~93% RH

Testing with standby voltage and without power.

6.4 Humid Heat Constant

Test acc. to DIN IEC 60068-2-78 Cb

Duration:	7 days
Tmax:	+65℃
Humidity:	~95% RH

Testing with standby voltage and without power.

6.5 Protection against Ingress

6.5.1 Dust Test:

(Perform acc. DIN 40050T9) (See table 4 page 5)

Talcum Dust

Duration:	8h
Cycle:	15min

Voltage drop before and after test (continuity test and function test for relays).

6.5.2 Water Test:

IPx1 (Perform acc. DIN 40050T9)

Insulation Resistance:	Up= 500V DC, tp=1min
Requirement Riso ≥	10 MOhm
Dielectric Test:	Up= 400V AC, f=50Hz, tp=2min
Requirement:	no dielectric break down

6.6 Chemical Resistance

Acc. ISO 16750 Part 5 (not tested please check data sheet of base material)

6.7 Vibration

The Module will pass a test acc. to with following conditions:

ISO 16750, Part 3, 4.1.3.1.5 Test IV – Equipment mounted on spring masses (Vehicle Body Table 7).

RMS value:	rms 27,8m/s²
Test duration:	8h each axis
Temperature:	-40℃ / +85℃

The vibration examination takes place under electrical operation.

6.8 Mechanical Shock

The Module will pass a test acc. to the following conditions:

ISO 16750, Part 3, 4.2.2 for components on rigid points on body or frame (Table 19).

Acceleration:	500m/s²
Nominal shock duration:	6ms
Nominal shock shape:	half sine
Number of shocks per axis (positive und negative):	10x

The DUT shall function normally and there shall be no mechanical damage after testing.

6.9 Drop Test

Examination acc. ISO 16750 -3 with following conditions:

Fall height:	0,8 m
Number of samples:	3
Falls per DUT:	2
Surface:	Concrete or Steel Plate
Temperature:	Rt 23℃

(This test is not performed with single modules. If needed this test should be performed with harness and equipment)

7 ELECTRICAL TESTS

7.1 Fuse Load Test

Apply 135% current load (SF30 Fuse 200%) to every fuse until failure
Temperature: Rt 23℃
Test each circuit in turn

7.2 Maximum Current Rating

Acc. EN 60512 Part 5-2

Maximum temperature is dependent of the contact material, in general 130℃ for all modules.
Except medium (ATO*) fuse module for 100℃ dependin g on contact material.

7.3 Dielectric Test

The Module will pass a test acc. to the following conditions:

EN :

400V AC 60 or 50Hz
for two minutes

Requirment: The leakage current shall not exceed 1mA

7.4 Isolation Resistance

The Module will pass a test acc. to the following conditions:

EN 60512 Part 3-1:

500V DC
15s (60s)

Requirment: 10 MOhm

7.5 Dry Circuit Resistance

The Module will pass a test acc. to the following conditions:

EN 60512 Part 2-1:

20 mV
100mA

Requirment: Shall not increase above 150% of the initial values.

8 VISUAL EXAMINATION & FUNCTIONAL TEST

The visual and functional test for Fuse and Relay Modules must be carried out before and after each test sequence.
Full functionality of the Module shall be achieved.

8.1 Visual Examination

All parts used for testing shall be without damages and obvious defects.

8.2 Functional Test

100% Continuity
Electrically test of Each and every circuit shall be tested sequentially.
Every Relay shall be tested for both open and closed operating states.

Mechanical Functions

All mechanical functions such as rest positions and rest hooks must being examined on modules and covers at there presence and function before and in special after the test sequences.

9 TESTPLAN

Test	Test Group / Test Sequence							
Test Group	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Samples each test	3	3	3	3	3	3	3	3
8.1 Visual Examination	X	X	X	X	X	X	X	X
8.2 Functional Test	X	X	X	X	X	X		X
6.1 Thermal Shock	X					X		
6.2 Temperature Cycle Test	X							
6.3 Temp. Humidity Cyclic Test		X						
6.4 Humidity Heat Constant Test			X					
7.1 Fuse Load Test					X			
7.2 Maximum Current Rating				X				
5.2 Mechanical forces test		X					X	
6.7 Vibration						X		
6.8 Mechanical Shock						X		
6.5.1 Dust Test								X
6.5.2 Water								X
Test Report Nr.	14-AUT-DE 0130	13-AUT-DE-0384	13-AUT-DE-0336	12-AUT-DE-1436	12-AUT-DE-1739	13-AUT-DE-1205	**	15-AUT-DE-0584*

* Not performed with all modules
**11-AUT-1613, 1614, 1615, 1430, 1431, 1433, 1391 & 12-AUT-0272, 1885

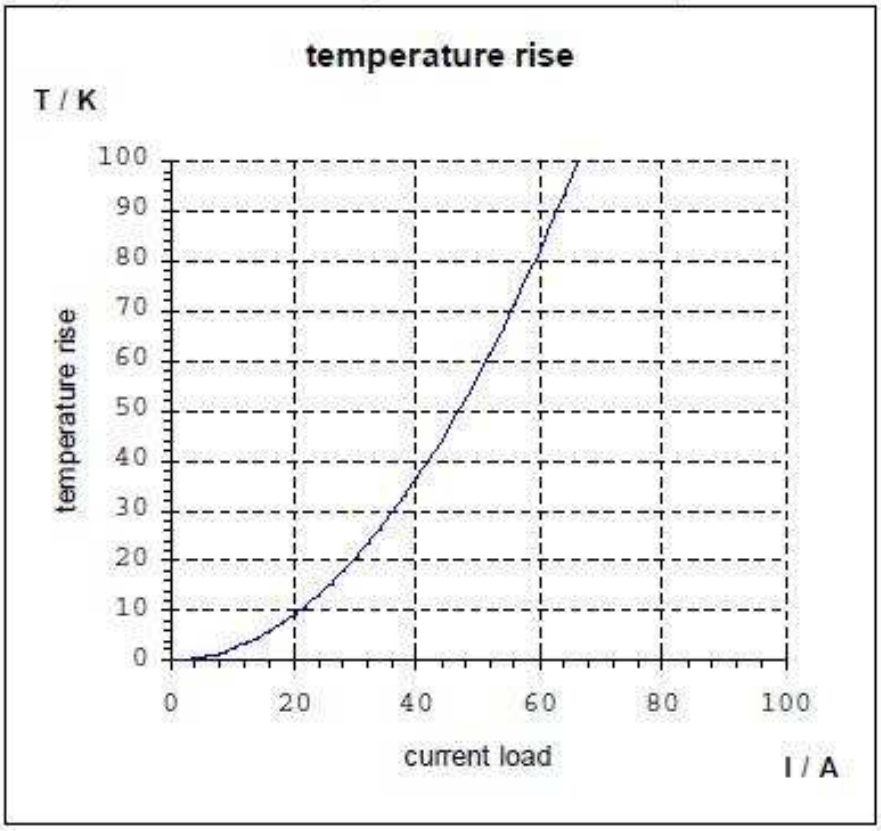
Overview of the used currents/cluster (load matrix) during test sequences (e.g. 6.2 & 6.7):

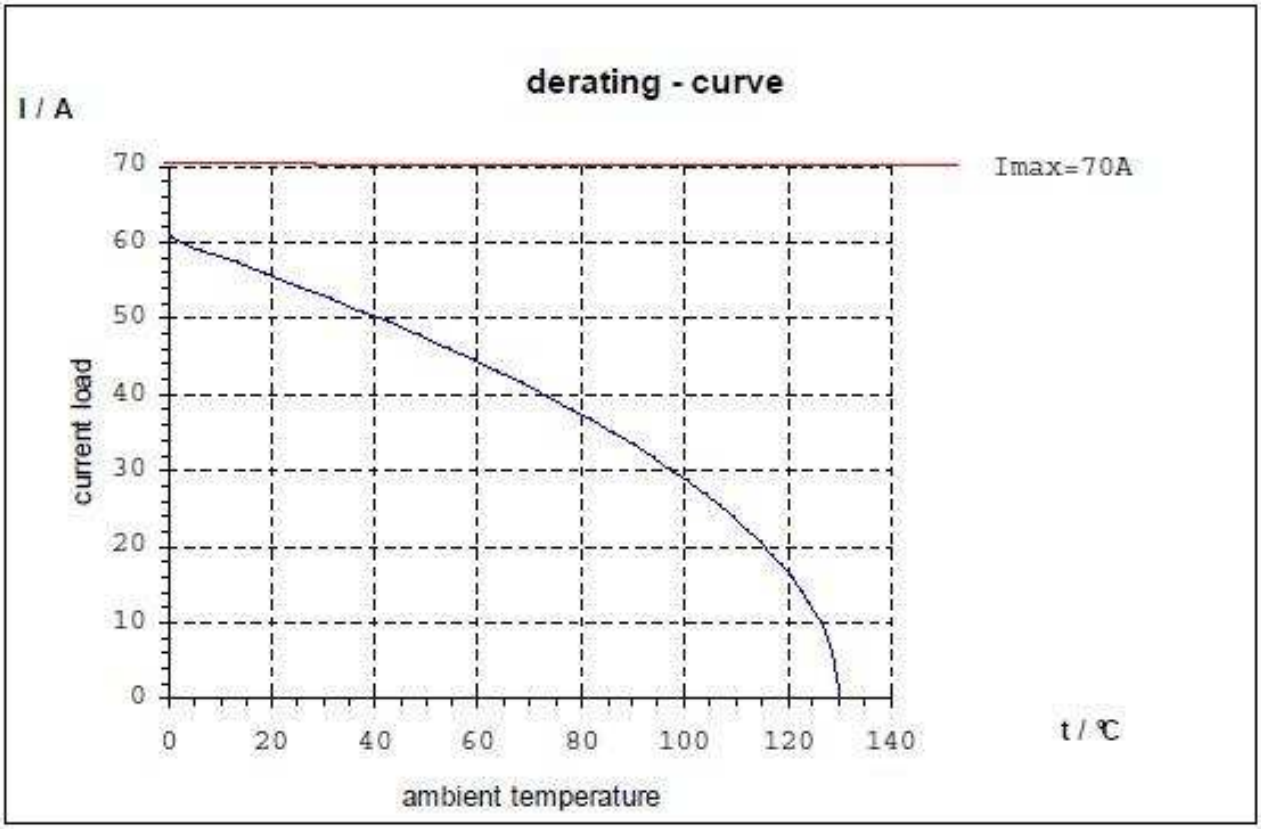
Component	Nominal value [A]	Test value [A]
ATO-Fuse	30	4
Mini-Fuse	30	8,5
J-Case-Fuse	40	15,5
Midi-Fuse	60	32
Maxi-Relay	70	36
Mini-Relay	60	23
Micro-Relay	30	9

		number of parts	current /typ [A]	current / cluster [A]
Cluster 1	Mini-Fuse	16	136	159
	Mini-Relay	2	23	
Cluster 2	Midi-Fuse	3	96	144
	Ato-Fuse	12	48	
Cluster 3	J-Case	6	96	141
	Maxi-Relay	2	36	
	Micro-Relay	4	9	

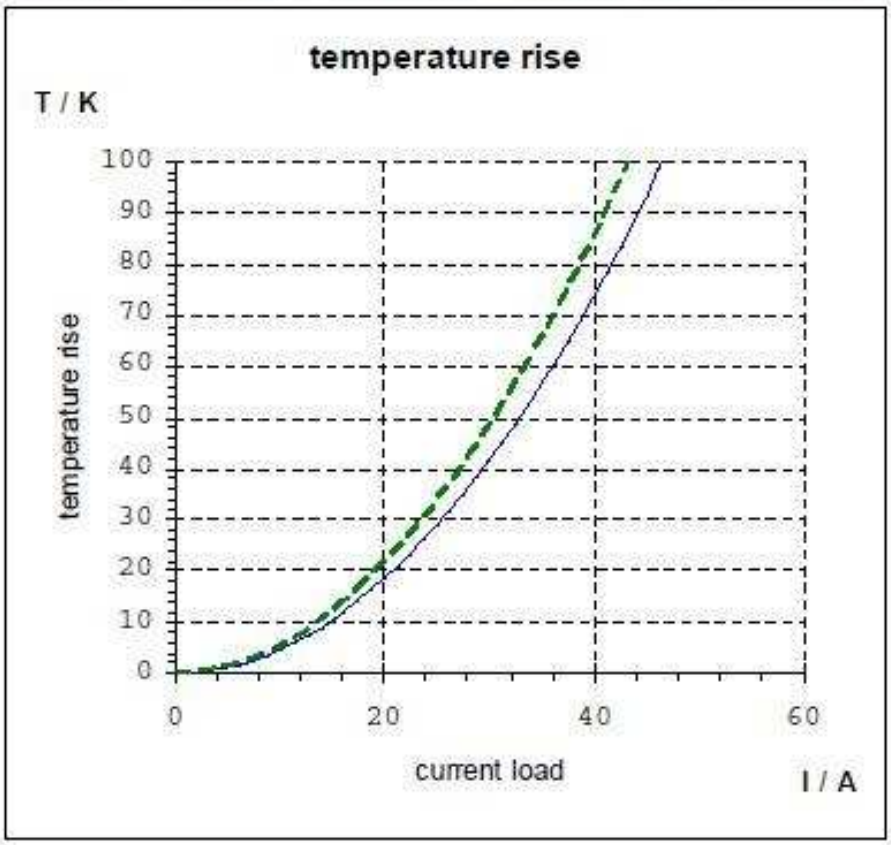
10 APPENDIX

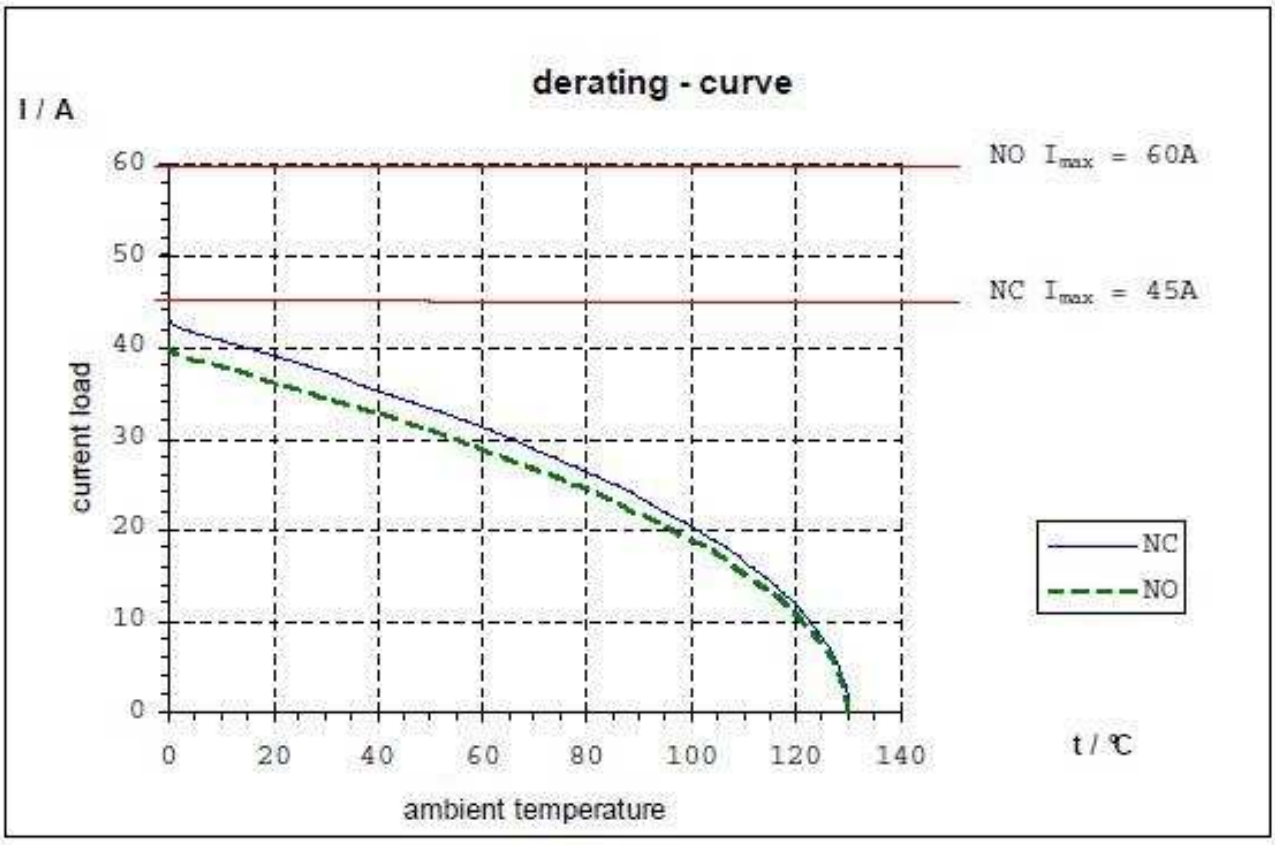
Maxi Relay Module, Part-No: 214 1026-1
(temperature rise and derating curve of the max. temperature, derating for each single plugin place)





Mini Relay Module, Part-No: 214 1024-1
This relay has two positions: **N**ormally Open and **N**ormally Close
(temperature rise and derating curve of the max. temperature, derating for each single plugin place)

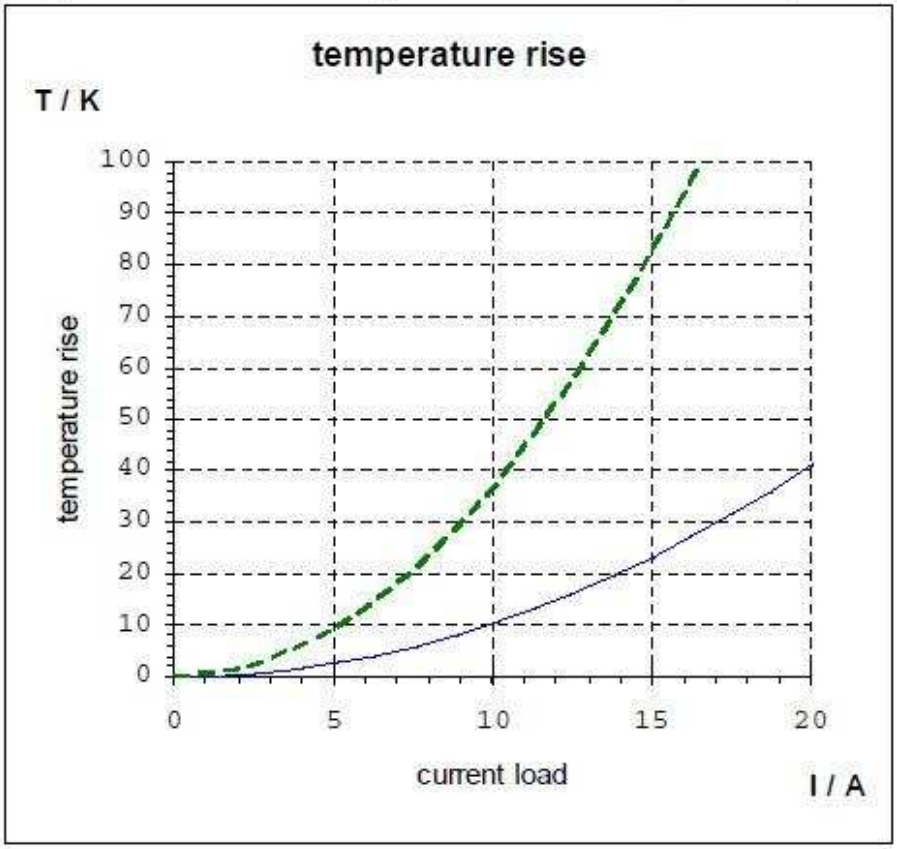


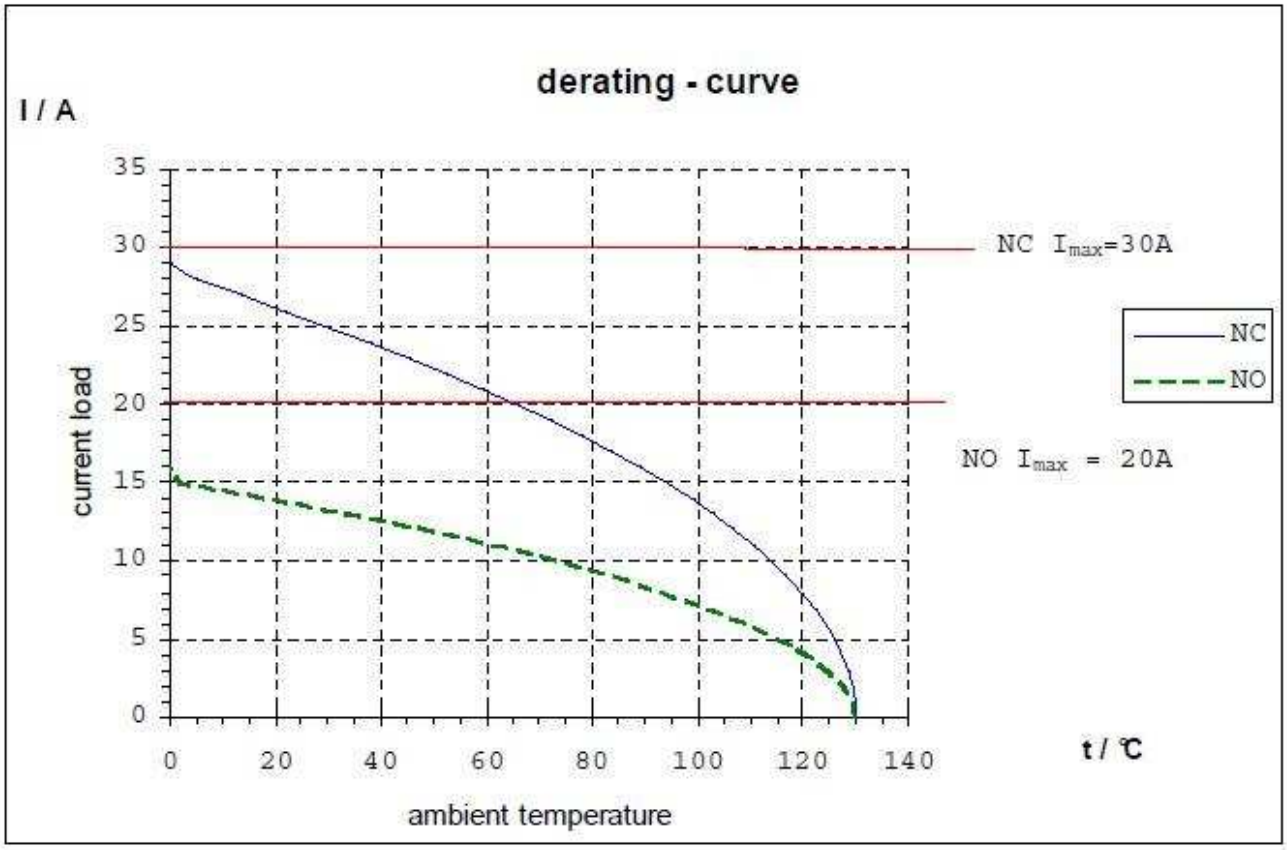


Micro Relay Module, Part-No: 214 1022-1

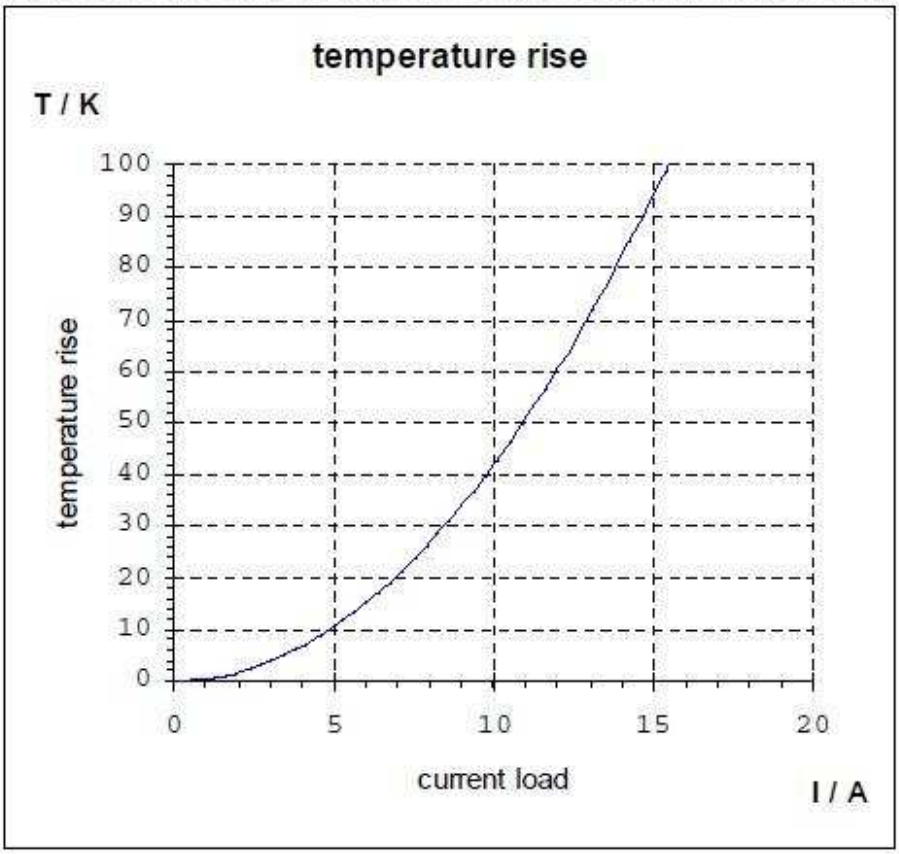
This relay has two positions: **N**ormally **O**pen and **N**ormally **C**lose

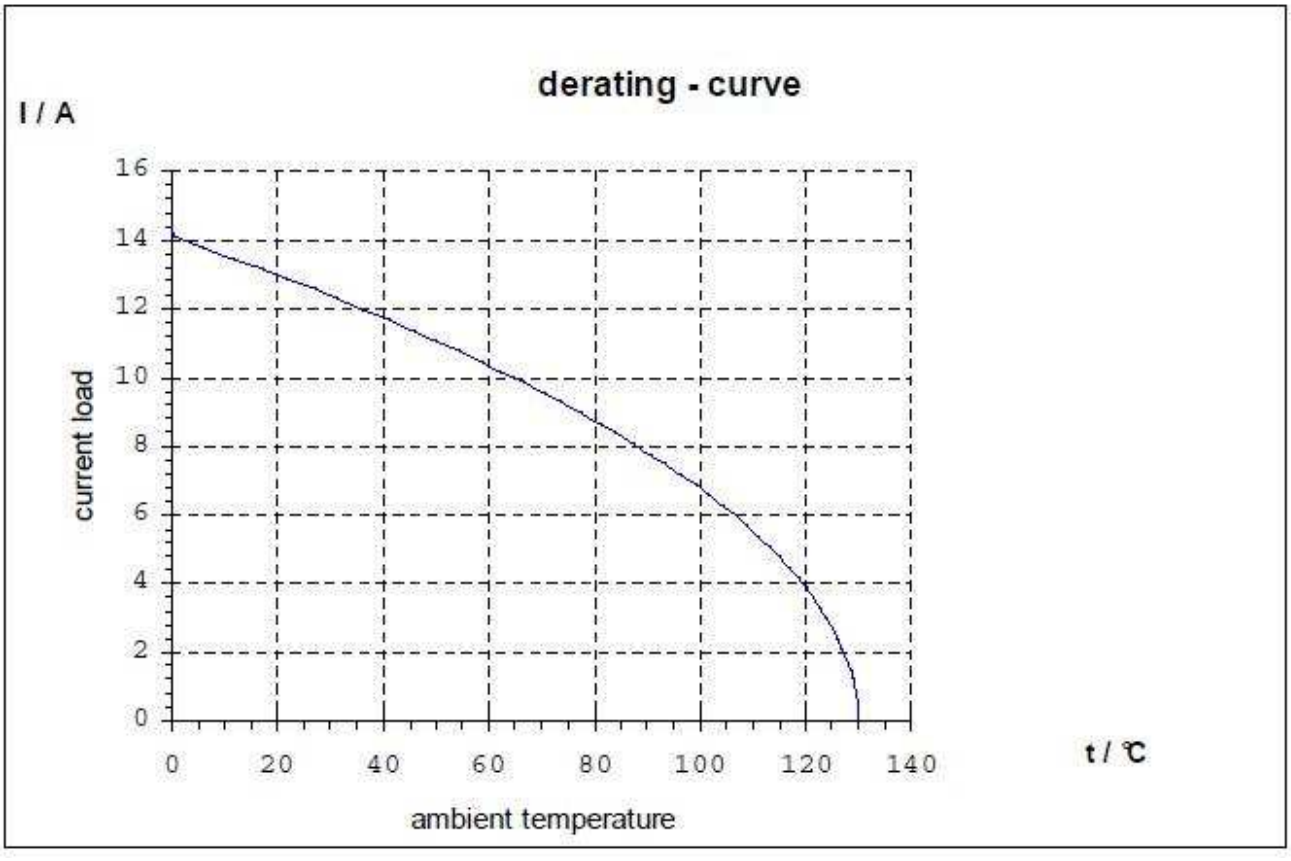
(temperature rise and derating curve of the max. temperature, derating for each single plugin place)



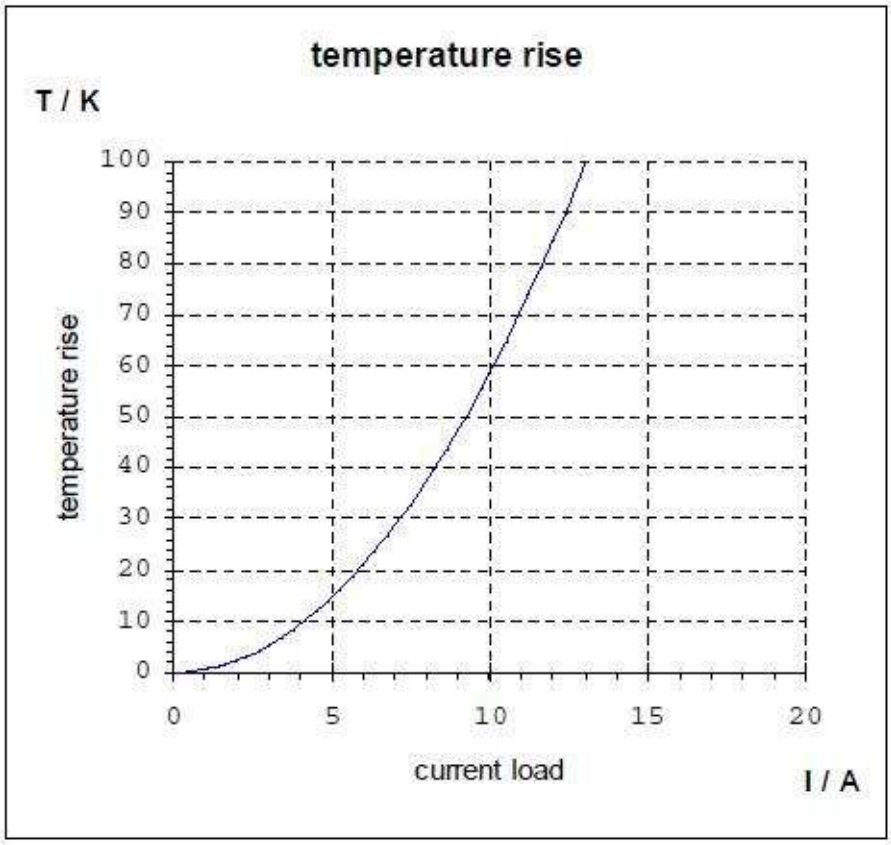


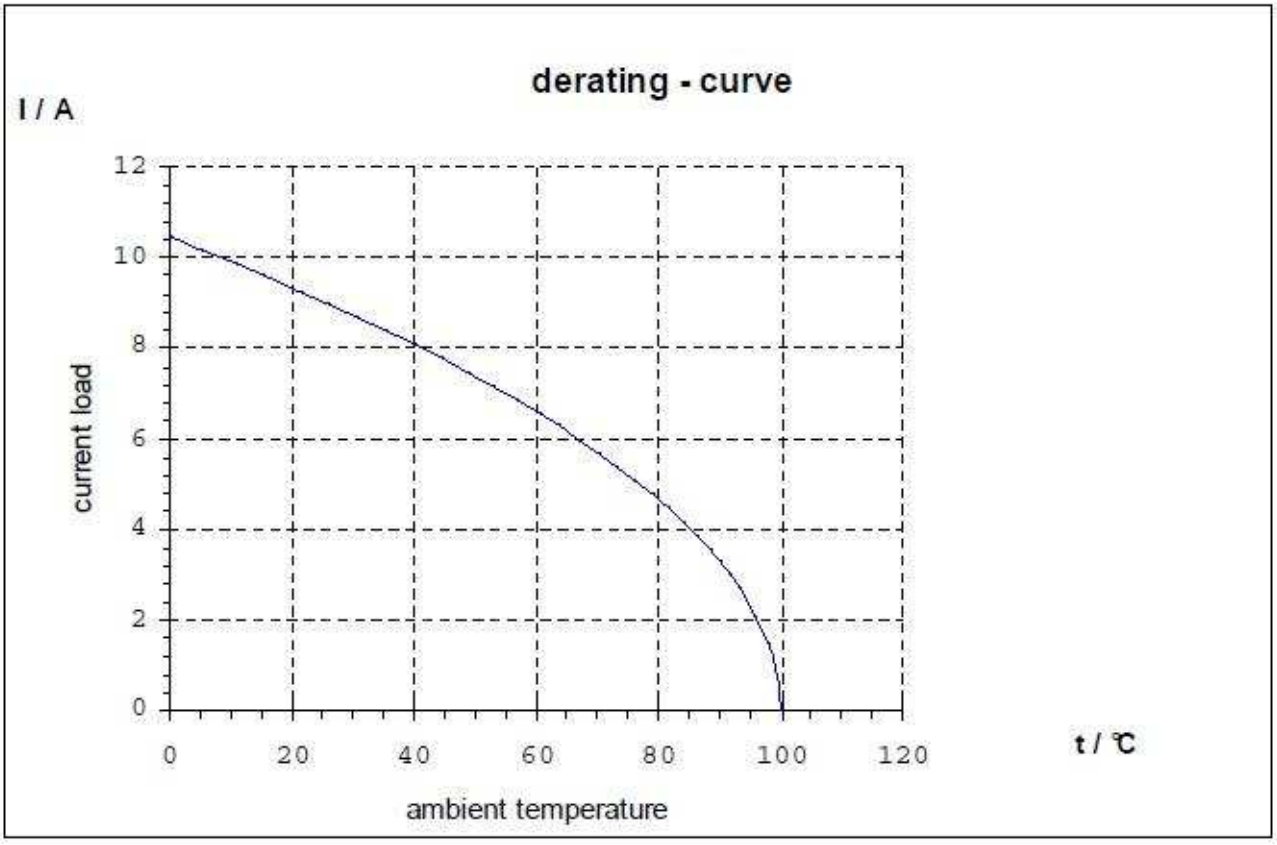
Miniature Fuse Module, Part-No: 214 1029-1, Mini-Fuse, 30A
(temperature rise and derating curve of the max. temperature, derating for each single plugin place)



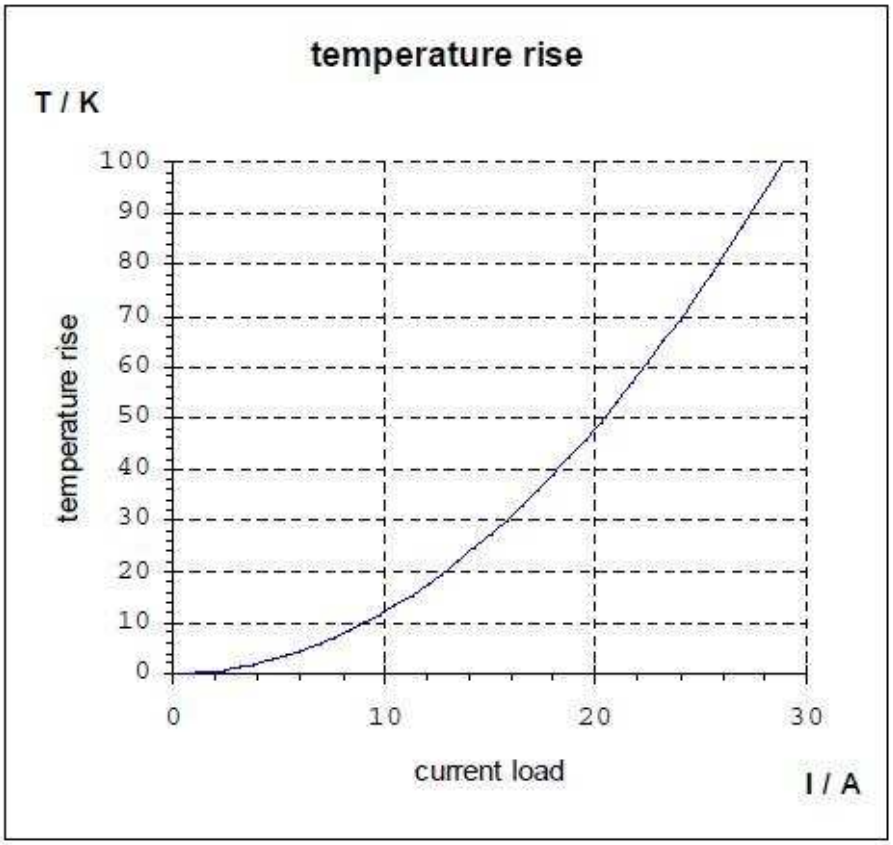


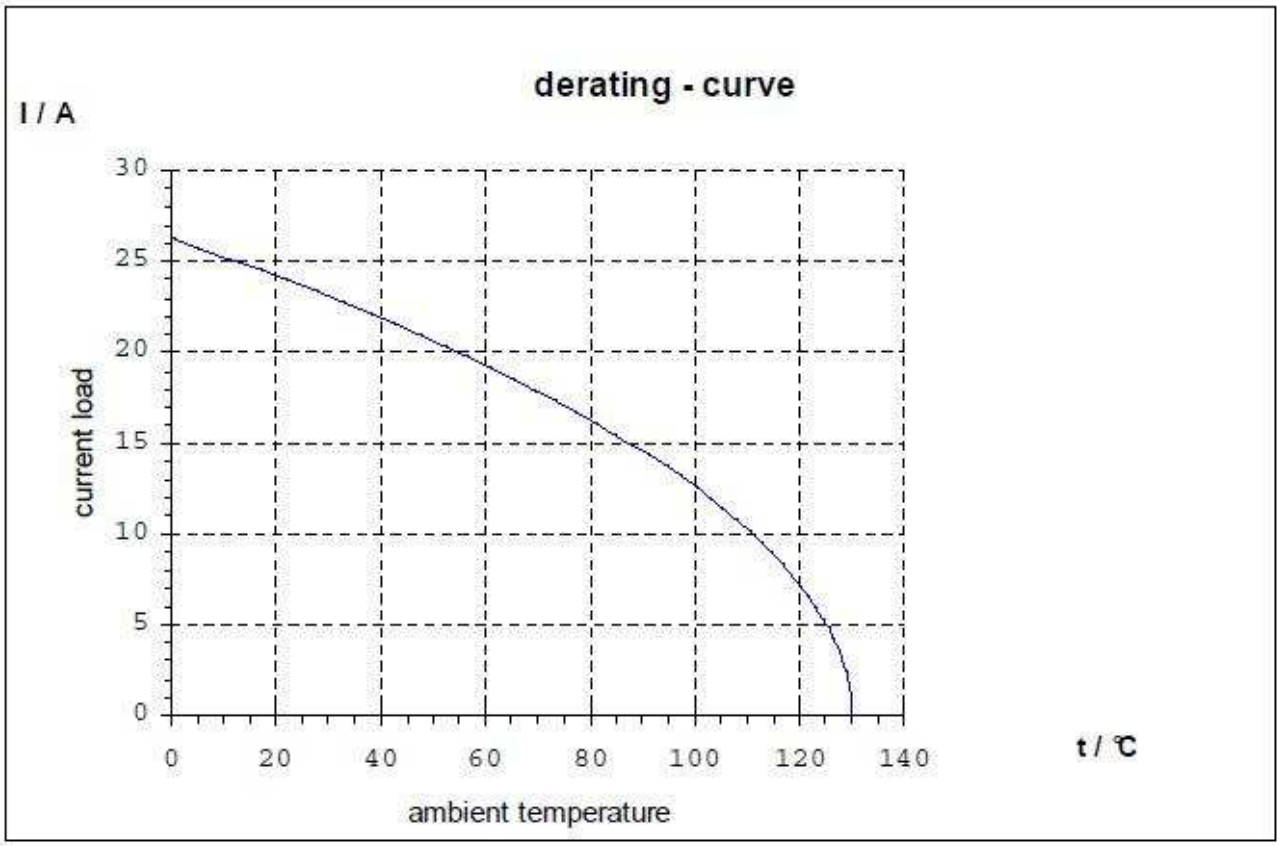
Medium Fuse Module, Part-No: 214 1028-1, ATO-Fuse, 30A
(temperature rise and derating curve of the max. temperature, derating for each single plugin place)





Fuse Module, Busbar Version, Part-No: 214 1040-1, J-Case, 40A
(temperature rise and derating curve of the max. temperature, derating for each single plugin place)





FUSE BOX ASSY,HARD WIRED,PRE, Part-No: 2141034-1, Midi-Fuse, 60A
(temperature rise and derating curve of the max. temperature, derating for each single plugin place)