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Generic specifications

Rating of creepage and clearance distances

The creepage and clearance distances of the RIA terminal blocks and headers are rated according to IEC 664-1.

Rated voltage, overvoltage category and pollution degree applicable in practice can be determined only after soldering the terminal block or header onto the printed circuit board. Important factors for the rating are the minimum distance of the circuit paths, the relatively low resistance against creepage current of the printed circuit board and the absence of separating ribs.

Since we are unable to influence these factors the insulation data given for all RIA terminal blocks and RIA headers relate to their independent condition.

Explanatory notes regarding the determination of Clearance and creepage distances

The standard IEC 664-1 uses the overvoltage category and the pollution degree to determine the Clearance and creepage distances.

The overvoltage category is divided into four sub-categories and determines the strength of the rated transient voltage in conjunction with the mains voltage.

The rated transient voltage basically determines the minimum clearance.

Minimum clearances apply to use on location up to a height of 2000 m above sea level.

The pollution degree is divided into four degrees and determines, in combination with insulating material and the shape of the separating ribs, the creepage distance.

Overvoltage category according to IEC 664-1

Equipment energized directly from the low-voltage mains

Technical data shall specify the overvoltage category as based on the following general explanation of overvoltage categories (see also IEC 364-4-443):

Equipment of overvoltage category I

is equipment for connection to circuits in which measures are taken to limit transient overvoltages to an appropriately low level. Examples are protected electronic circuits.

Equipment of overvoltage category II

is energy-consuming equipment to be supplied from the fixed installation. Examples of such equipment are appliances, portable tools and other household and similar loads.

Equipment of overvoltage category III

is equipment in fixed installations and for cases where the reliability and the availability of the equipment are subject to special requirements. Examples of such equipment are switches in the fixed installation and equipment for industrial use with permanent connection to the fixed installation.

Equipment of overvoltage category IV

is for use at the origin of the installation. Examples of such equipment are electricity meters and primary over-current protection equipment.

Degrees of pollution in the micro-environment according to IEC 664-1

The following four degrees of pollution in the micro-environment are established for the purpose of evaluating creepage distances and clearances:

Pollution degree 1

No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.

Pollution degree 2

Only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation is to be expected.

Pollution degree 3

Conductive pollution occurs or dry non-conductive pollution occurs which becomes conductive due to condensation which can be expected.

Pollution degree 4

The pollution generates continuous conductivity caused by conductive dust or by rain or snow.

Usage temperature

The usage temperature defines the temperature for the permanent operation of a component without destruction. This temperature is the addition of ambient temperature and the self-warming of the component during operation.

The ambient temperature is the temperature affecting permanently the component without regard to the self-warming of the component.

Temperature limits for product series RIACON, IDCON PLUGCON and SPRINGCON products without lever or push button (i.e. AST06) and accessories:
max. temperature limit +221 °F (+105 °C)
min. temperature limit -22 °F (-30 °C)

Temperature limits for SPRINGCON products with lever or push button:

max. temperature limit +212 °F (+100 °C)
min. temperature limit -22°F (-30 °C)

Example for rating work sheets (based on case A) (basic insulation at permanent voltage for equipment up to 2000 m above sea level) according to IEC/TR3 664-2-1.

Circuits directly connected to the low voltage mains

influence quantity	selection based on	reference to IEC 664-1	value
clearance			
impulse withstand voltage	overvoltage category of the equipment	table 1	table 2
creepage distance			
voltage	Rated voltage [V] or rated insulation voltage	table 3a, 3b	table 4
pollution (influence of humidity)	pollution degree (micro-environment)	section 2.5.1	table 4
insulation material	comparative tracking index	section 2.7.1.3	table 4

- step 1 - selection of the overvoltage category
 step 2 - selection of the impulse voltage, according to table 1
 step 3 - determination of the minimum clearance (cl), according to table 2
 step 4 - selection of the Rated voltage for creepage distances according to tables 3a and 3b
 step 5 - determination of the pollution degree and the comparative tracking index (CTI)
 step 6 - determination of the minimum creepage distance (cr), according to table 4
 step 7 - if $cr < cl$:
 - for pollution degree 3 or 4 the distance on the insulation material is as large as the clearance (cl), according to table 4;
 - for pollution degree 1 or 2 the distance on the insulation material is allowed to be as large as the creepage distance (cr), if this distance withstands the test impulse voltage used to establish the clearance.

Rated impulse voltage for equipment energized directly from the low-voltage mains Extract of table 1 IEC 664-1

nominal Voltage of the power supply system ¹⁾ in Vr		Tension cable to neutral cable separated from the nominal alternative or nominal direct current until ... inclusive V	Rated test voltage V			
three phase	single phase		Overvoltage category			
			I	II	III	IV
	120 - 240	50	330	500	800	1500
		100	500	800	1500	2500
		150	800	1500	2500	4000
230/400 277/480		300	1500	2500	4000	6000
400/690		600	2500	4000	6000	8000
1000		1000	4000	6000	8000	12000

note: cf. details IEC 664-1

Generic specifications

Minimum clearances for insulation coordination Extract of table IEC 664-1

Rated impulse withstand- voltage	Minimum clearances up to 2000 m above sea level		
	Case A in homogeneous field conditions		
	Pollution degree		
kV	1 mm	2 mm	3 mm
0,33	0,01		
0,40	0,02		
0,50	0,04		
0,60	0,06	0,20	0,80
0,80	0,10		
1,00	0,15		
1,20	0,25	0,25	
1,50	0,50	0,50	
2,00	1,00	1,00	1,00
2,50	1,50	1,50	1,50
3,00	2,00	2,00	2,00
4,00	3,00	3,00	3,00
5,00	4,00	4,00	4,00
6,00	5,50	5,50	5,50
8,00	8,00	8,00	8,00
10,00	11,00	11,00	11,00
12,00	14,00	14,00	14,00
15,00	18,00	18,00	18,00
20,00	25,00	25,00	25,00
25,00	33,00	33,00	33,00
30,00	40,00	40,00	40,00
40,00	60,00	60,00	60,00
50,00	75,00	75,00	75,00
60,00	90,00	90,00	90,00
80,00	130,00	130,00	130,00
100,00	170,00	170,00	170,00

note: cf. details IEC 664-1

**Extract from table 3a: single phase three- or two-wire a.c. or d.c. systems
IEC 664-1**

Nominal voltage of the supply system*	Voltages rationalized for table 4	
	for insulation line-to-line ¹⁾	for insulation line-to-earth ¹⁾
	all systems	three-wire systems mid-point earthed
V	V	V
12.5	12.5	
24 25	25	
30	32	
42 48 50**	50	
60	63	
30-60	63	32
100**	100	
110 120	125	
150**	160	
220	250	
110-220 120-240	250	125
300**	320	
220-440	500	250
600**	630	
480-960	1000	500
1000**	1000	

1) Line-to-earth insulation level for unearthed or impedance-earthed systems equals that for line-to-line because the operating voltage to earth of any line can, in practice, approach full line-to-line voltage. This is because the actual voltage to earth is determined by the insulation resistance and capacitive reactance of each line to earth; thus, low (but acceptable) insulation resistance of one line can in effect earth it and raise the other two to full line-to-line voltage to earth.

* For relationship to Rated voltage see 2.2.1.(+)

** These values correspond to the values given in table 1 (Rated impulse voltage for equipment energized directly from the low-voltage mains).

Generic specifications

**Extract of table 3b: three-phase four- or three-wire a.c. systems
IEC 664-1**

Nominal voltage of the supply system*	Voltages rationalized for table 4		
	for insulation line-to-line	for insulation line-to-earth	
	all systems	three-phase four-wire systems neutral-earthed ²⁾	three-phase three-wire systems unearthed ¹⁾ or corner-earthed
V	V	V	V
60	63	32	63
110 120 127	125	80	125
150**	160	--	160
208	200	125	200
220 230 230	250	160	250
300**	320	--	320
380 400 415	400	250	400
440	500	250	500
480 500	500	320	500
575	630	400	630
600**	630	--	630
660 690	630	400	630
720 830	800	500	800
960	1000	630	1000
1000**	1000	--	1000

1) Line-to-earth insulation level for unearthed or impedance-earthed systems equals that for line-to-line because the operating voltage to earth of any line can, in practice, approach full line-to-line voltage. This is because the actual voltage to earth is determined by the insulation resistance and capacitive reactance of each line to earth; thus, low (but acceptable) insulation resistance of one line can in effect earth it and raise the other two to full line-to-line voltage to earth.

2) For equipment for use on both three-phase four-wire and three-phase three-wire supplies, earthed and unearthed, use the values for three-wire systems only.

* For relationship to Rated voltage see 2.2.1.^(*)

** These values correspond to the values given in table 1 (Rated impulse voltage for equipment energized directly from the low-voltage mains).

Minimum creepage distances for equipment subject to long-term stresses Extract of table IEC 664-1

voltage r.m.s. ¹⁾	Creepage distances in millimetres											
	printed wiring material		pollution degree									
	pollution degree		1	2			3			4		
	1	2		insulation material group			insulation material group			insulation material group		
2)	3)	2)	I	II	III	I	II	III ⁴⁾	I	II	III ⁴⁾	
V	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
10	0.025	0.040	0.080	0.400	0.400	0.400	1.000	1.000	1.000	1.600	1.600	1.600
12.5	0.025	0.040	0.090	0.420	0.420	0.420	1.050	1.050	1.050	1.600	1.600	1.600
16	0.025	0.040	0.100	0.450	0.450	0.450	1.100	1.100	1.100	1.600	1.600	1.600
20	0.025	0.040	0.110	0.480	0.480	0.480	1.200	1.200	1.200	1.600	1.600	1.600
25	0.025	0.040	0.125	0.500	0.500	0.500	1.250	1.250	1.250	1.700	1.700	1.700
32	0.025	0.040	0.140	0.530	0.530	0.530	1.300	1.300	1.300	1.800	1.800	1.800
40	0.025	0.040	0.160	0.560	0.800	1.100	1.400	1.600	1.800	1.900	2.400	3.000
50	0.025	0.040	0.180	0.600	0.850	1.200	1.500	1.700	1.900	2.000	2.500	3.200
63	0.040	0.063	0.200	0.630	0.900	1.250	1.600	1.800	2.000	2.100	2.600	3.400
80	0.063	0.100	0.220	0.670	0.950	1.300	1.700	1.900	2.100	2.200	2.800	3.600
100	0.100	0.160	0.250	0.710	1.000	1.400	1.800	2.000	2.200	2.400	3.000	3.800
125	0.160	0.250	0.280	0.750	1.050	1.500	1.900	2.100	2.400	2.500	3.200	4.000
160	0.250	0.400	0.320	0.800	1.100	1.600	2.000	2.200	2.500	3.200	4.000	5.000
200	0.400	0.630	0.420	1.000	1.400	2.000	2.500	2.800	3.200	4.000	5.000	6.300
250	0.560	1.000	0.560	1.250	1.800	2.500	3.200	3.600	4.000	5.000	6.300	8.000
320	0.750	1.600	0.750	1.600	2.200	3.200	4.000	4.500	5.000	6.300	8.000	10.000
400	1.000	2.000	1.000	2.000	2.800	4.000	5.000	5.600	6.300	8.000	10.000	12.500
500	1.300	2.500	1.300	2.500	3.600	5.000	6.300	7.100	8.000	10.000	12.500	16.000
630	1.800	3.200	1.800	3.200	4.500	6.300	8.000	9.000	10.000	12.500	16.000	20.000
800	2.400	4.000	2.400	4.000	5.600	8.000	10.000	11.000	12.500	16.000	20.000	25.000
1000	3.200	5.000	3.200	5.000	7.100	10.000	12.500	14.000	16.000	20.000	25.000	32.000

1) This voltage is

- for functional isolation: the working voltage;
- for basic and supplementary insulation of the circuit energized directly from the low-voltage mains: the voltage rationalized through table 3a or table 3b, based on the Rated voltage [V] of the equipment, or the rated insulation voltage;
- for basic or supplementary insulation of systems, equipment and internal circuits not energized directly from the low-voltage mains: the highest r.m.s. voltage which can occur in the system, equipment or internal circuit when supplied at Rated voltage, and under the most onerous combination of conditions of operating within equipment rating.

2) insulation material groups I, II, IIIa and IIIb.

3) insulation material groups I, II and IIIa.

4) insulation material group IIIb is not recommended for pollution degree 3 above 630 V and in pollution degree 4.

Generic specifications

Current carrying capacity

The maximum current carrying capacity (rated current) is indicated in the technical data of each terminal block. It considers the heating limit indicated in IEC 998-1. According to this standard the self-heating of current carrying parts of the termination point shall not exceed 45 K. In case of insulated conductors, the heating of a conductor has to be measured as near as possible to the termination point in the terminal block.

Termination has to be done with rigid or flexible conductors of the biggest cross section that the wire entry is designed for. The connecting material is charged with alternate current according to table 2 during the whole test.

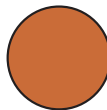
rated wire cross section	test current
mm ²	A
0.5	6
0.75	9
1	13.5
1.5	17.5
2.5	24
4	32
6	41
10	57
16	76
25	101
35	125

The current carrying capacity also depends on the use of the terminal block or connector. It is also necessary to consider the respective directives for appliances such as IEC 335-1, IEC 598-1, IEC 664 etc.

Copper conductors according to IEC 60228

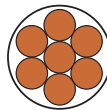
Single wire

Wire diameter = 1.78 mm
 Number of wires = 1
 Conductor dia. max. = 1.9 mm
 Nominal cross section = 2.5 mm²



Multi-wire

Wire diameter = 0.67 mm
 Number of wires = 7
 Conductor dia. max. = 2.2 mm
 Nominal cross section = 2.5 mm²



Rated current

is the value of current that a plug-in connector or coupler can carry continuously (not intermittently) and simultaneously through all contacts without exceeding the upper temperature limit.

The determination of the rated current value according to DIN VDE / IEC is different than according to UL.

Rated voltage

is the value of voltage according to which plug-in connectors and couplers are rated and to which certain operation characteristics are referred.

Wire cross section

The wire cross section for printed circuit board connectors and couplers as well as the admissible wire size range is defined according to IEC 939-1 and given in the technical data of each series.

The contacts of RIA printed circuit board connectors and couplers are designed to allow termination of copper wires without special preparation. The use of wire ferrules is not necessary, but can prevent wire strands from separating.

Note

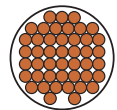
Conductors with soldered single wires are not allowed for connection to screw type terminal blocks, due to the cold flow of tin.

RIACON / SPRINGCON pluggable terminal blocks

No current should be applied when terminal blocks are plugged or wired. Empirical values are available on demand if small currents are necessary for operational reasons.

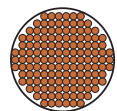
Fine stranded

Wire diameter = 0.26 mm
 Number of wires = 45
 Conductor dia. max. = 2.3 mm
 Nominal cross section = 2.5 mm²



Ultra-fine stranded

Wire diameter = 0.16 mm
 Number of wires = 120
 Conductor dia. max. = 2.3 mm
 Nominal cross section = 2.5 mm²



Structure and dimensions of conductors

according to IEC 228						American Wire Gauge (AWG)						
nominal cross section mm ²	single wire	multi-wire		fine and ultra-fine stranded		solid wire			stranded wire			
	max. dia. mm	max. dia. mm	min. no. of wires	max. dia. mm	min. no. of wires	AWG no.	dia. mm	circ. mil	mm ²	dia. mm	circ. mil	mm ²
0.5	0.9	1.1	7	1.1	15	20	0.81	1020	0.52	0.97	1111	0.56
0.75	1.0	1.2	7	1.3	22	18	1.02	1620	0.82	1.16	1600	0.82
1	1.2	1.4	7	1.5	29	(17)	1.15	2050	1.04			
-	-	-	-	-	-	16	1.29	2580	1.31	1.50	2580	1.32
1.5	1.5	1.7	7	1.8	29	(15)	1.45	3260	1.65			
-	-	-	-	-	-	14	1.63	4110	2.08	1.85	4100	2.09
2.5	1.9	2.2	7	2.3	47	(13)	1.83	5180	2.63			
-	-	-	-	-	-	12	2.05	6530	3.31	2.41	6500	3.32
4	2.4	2.7	7	2.9	53	(11)	2.3	8230	4.17			
-	-	-	-	-	-	10	2.59	10400	5.26	2.95	10530	5.37
6	2.9	3.3	7	3.9	80	(9)	2.91	13100	6.63			
-	-	-	-	-	-	8	3.26	16500	8.37	3.37	16625	8.48

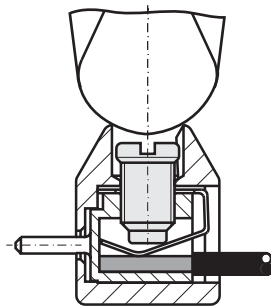
Protection against manual contact

The design of the insulating moulds provides that voltage carrying parts are contained inside the mould after termination of a wire with nominal cross section. This ensures adequate protection against accidental contact by the test finger according to IEC 529.

Exceptions are terminal blocks type 001, 009, 055, 057, 063, 086 and single terminal blocks.

It is required that live components are protected against accidental contact by fingers within a protection area with a 30 mm radius. This means that hazardous parts of an electric device cannot be touched by the straight test finger according to IEC 529.

Test finger arrangement



Testing is done with a terminated conductor of nominal cross section.

Insulation moulds

The insulation moulds are made of Polyamide. This material is self-extinguishing according to UL 94V-0, flexible and unbreakable up to -40 °F (-40 °C). Its stability under continuous temperature is rated up to 257 °F (125 °C), and up to 365 °F (185 °C) for short periods. The melting point is situated between 419 °F (215 °C) and 563 °F (295 °C) depending on the material type (PA 4.6, 6, 6.6).

It is highly weatherproof due to special ultra-violet stabilisation and highly resistant to micro-organisms, bacteria, fungi, enzymes and termites. Both features provide good stability under tropical conditions.

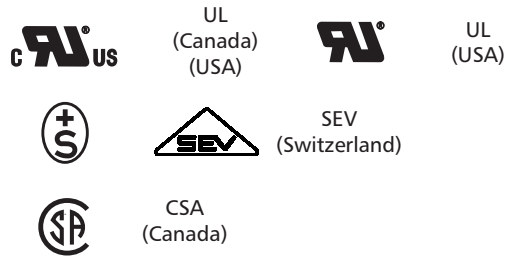
The material is not resistant to strong acids with concentrations over 90 % such as formic acid or to phenol or superheated steam.

Generic specifications

Approvals

Our current approvals are shown in the product summary, the type and approval index and for each product throughout the catalog.

Please note that the UL and CSA approvals apply only to products with wire protector.



Note to technical data

Values according to UL (USA)

V / A / AWG 300 / 20 / 22 - 12



Values according to CSA (Canada)

V / A / AWG 300 / 20 / 22 - 12



Voltage V

Current A

American wire range AWG

Values according to SEV (Switzerland) / IEC 998

0.08 - 2.5 mm² 250 V / 4 kV / 3 / 16 A



Rated cross section in mm²

Rated voltage in V

Rated test voltage in kV

Overtoltage category

Rated current in A

Our termination products are approved by SEV and controlled according to the CCA-NTR procedure.

SEV means: Schweizer Elektrotechnischer Verein (Electrotechnical Association of Switzerland) it is now called Electrosuisse

CCA means: CENELEC Certification Agreement (including factory inspections / process and product inspection)

NTR means: National Test Report

CENELEC means: European committee for electrotechnical standardization

Applied test standards:

- IEC 998-2-1
particular requirements for connecting devices as separate entities with screw-type clamping units (our RIACON / PLUGCON series)
- IEC 998-2-2
particular requirements for connecting devices as separate entities with screwless-type clamping units (our SPRINGCON / PLUGCON series)
- IEC 998-2-3
particular requirements for connecting devices as separate entities with insulation piercing clamping units (our IDCON series)
- IEC 999-1
connecting devices - electrical copper conductors - safety requirements for screw-type and screwless-type clamping units

European guidelines and CE mark

MC TECHNOLOGY GmbH as manufacturer of products falling under the scope of certain EU guidelines such as low voltage guideline 72/23/EWG, EMC guideline 89/336/EWG and its modifications and/or machinery guideline 89/392/EWG is setting the CE mark on the products and/or their packing units.

The CE mark confirms that the products comply with the EU guidelines and guarantees the free merchandise traffic within Europe.

The low voltage guideline 73/23/EWG defines products as electrical equipment if they are used with a nominal voltage between 50 V and 1000 V alternating voltage and between 75 V and 1500 V direct voltage.

This guideline applies to products such as linking or pc board connectors, single and multi-pole terminal blocks etc. meeting the requirements of the harmonized European standards and their special parts as for example IEC 998 for linking connectors.

The CE mark is attached to the smallest packing unit.



European agencies for testing and approvals

The following table gives a summary of the European agencies for testing and approvals that have joined one or several of the programs for mutual acceptance of test results and approvals.

	Agency	Acceptance of test results	
		NCB	CB
		IEC standards	IEC standards harmonisation documents
European Union			
Belgium	CEBEC	X	X
Germany	- VDE-PZI	X	X
	- TÜV-Rheinland	X	
	- TÜV-PS	X	
Denmark	DEMKO	X	X
Finland	FIMKO	X	X
France	LCIE	X	X
Greece	ELOT	X	X
Great Britain	- ASTA	X	X
	- BEAB	X	X
	- BASEC	X	X
	- BSI	X	X
Ireland	NSAI	X	X
Italy	IMQ	X	X
Luxemburg	SEE		X
Netherlands	KEMA	X	X
Austria	ÖVE	X	X
Portugal	IPQ		X
Sweden	SEMKO	X	X
Spain	AENOR	X	X

	Agency	Acceptance of test results	
		NCB	CB
		IEC standards	IEC standards harmonisation documents
EFTA countries			
Iceland	RER		X
Norway	SEMKO	X	X
Switzerland	SEV	X	X
other countries			
Poland	PCBC	X	
Slovakia	EVPU	X	X
Slovenia	SIQ	X	X
Czechia	EZU	X	X
Russia	GOST-R	X	
Ukraine	Der Standart	X	

Explanations:

IEC: International Electrotechnical Commission

NCB: National Certification Body - IEC - accredited national test and approval agency

CB: participation in the CB procedure: acceptance of test results based on IEC standards

CCA: participation in the CCA procedure: acceptance of test results based on European Standards (IEC) and documents for harmonisation (HD)