Expert Knowledge

12.0

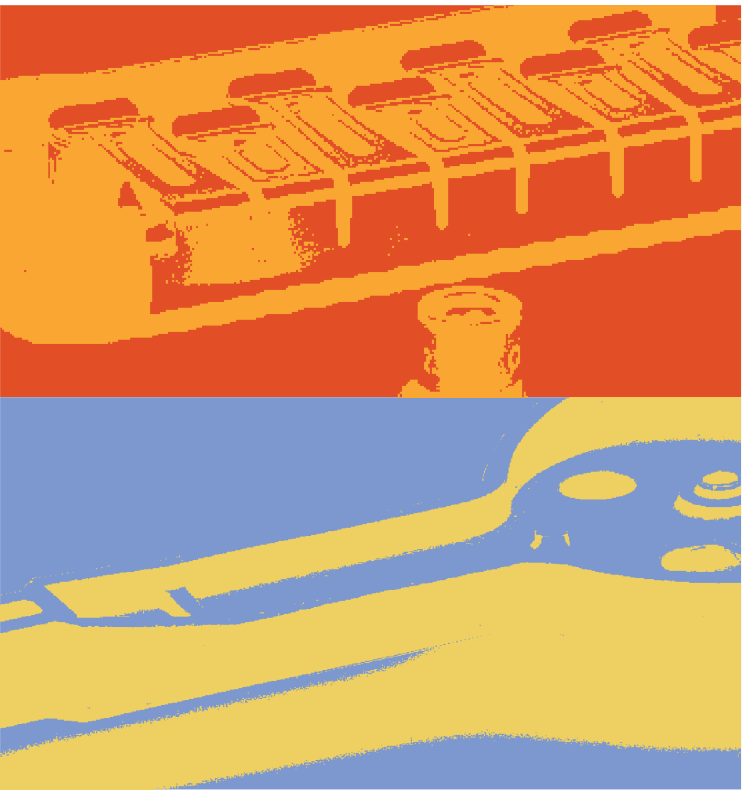
Protection Systems from KRONE

Overview

KRONE

12.0 Protection Systems from KRONE

Overview



The trend towards increasing investments at the workplace in technical equipment for data processing and other communication systems can result in substantial losses when this equipment is destroyed as a result of over-voltage.
Damaged or destroyed equipment, which is integrated into manufacturing or data storage processes, results not only in the direct damage but also high costs due to downtime. Furthermore, delays in production due to data loss, damaged process control computers or computerised warehouse and storage systems are by no means rare. These delays cost many times the amount of the direct damage.
According to the insurance industry, indirect influences are responsible for 95% of the damage as a result of atmospheric discharges (lightning). This also gives weight to the fact that networks located kilometres away from the site of impact can be damaged. The total annual damage caused by this phenomenon in Germany alone totals more than DM 500 million. Apart from the material loss, plant and network operators also face the danger to "life and limb". It is all too often that they suddenly realise that even small excess voltages have caused unforeseeable damage.
Too late - if no precautions have been taken.

Contents of this chapter

Protection Systems from KRONE

Brief description

Protection systems from KRONE

Protection systems in the communications network
The importance of over-voltage protection has increased considerably over the past years. On one hand, this is due to growing demands placed on modern communications which, apart from voice also consist to a substantial extent of data transmissions. On the other hand, the rapid development in the field of electronics has resulted in miniaturisation - with an increased integration density - and hence in reduced electrical strength.

Connection and distribution technologies from KRONE, which set a global standard, are supplemented by a powerful and flexible protection concept. Individual protection possibilities enable an optimum cost-to-benefit ratio and ensure maximum economic efficiency for the user.

Applications of over-voltage protection
Protection systems are used wherever communication lines are distributed and connected. Remember, communication is not just voice transmission, i.e. it goes clearly beyond pure telecommunication applications. Over-voltage protection fulfils various requirements, depending on the type of installation to be protected. In conventional switching equipment with relays and two-motion selectors, over-voltage protection is primarily used to protect people. In highly sensitive, electronic switching equipment, however, comprehensive protection measures are necessary in order to protect not just people, but also the valuable installation itself. Over-voltage is undoubtedly the number one cause of faults, i.e. interference caused by electrical energy disturbances in communication lines. The term “over-voltage” often calls to mind thunderstorms, releasing vast amounts of energy. However, even static discharges, which may appear to be harmless, can seriously affect signal transmission or even “paralyse” entire networks. Over-voltage in supply lines for centrally controlled process management and control systems can sometimes lead to immense damage, costing millions, or even to irrecoverable losses.

Different forms of over-voltage
Although the different forms of over-voltage have basically remained unchanged for many years, their causes and effects, however, are subject to a great deal of change. Over-voltage can be caused not only by reproducible interferences, but also by impulses which occur randomly. Reproduceable excess voltages, caused, for example, by capacitive or inductive switching, are often easy to localise and suppress. In order to achieve efficient protection against excess voltages caused by non-reproduceable interferences, a range of standards and recommendations can be adopted with a view to causes, duration and injection of such interferences into the system. Over-voltage in communication networks is usually the result of electromagnetic interference, equalising currents between different earth potentials or network short circuits. This is caused by switching operations on neighbouring lines, the indirect effect of lightning or natural forces, or by human error. The direct effect of lightning on distribution equipment is an exception, because this type of equipment is usually installed indoors or in enclosures. The massive amounts of energy involved in direct lightning require separate protection concepts and structural measures.

Apart from direct lightning strikes, however, interference by one of the following phenomena is more often than not the cause of damage to or destruction of communication systems:

- indirect lightning impact,
- electromagnetic interference,
- inductive or capacitive effects,
- electrostatic discharge and
- contact with live power lines.

These conditions often represent a high degree of danger to human life.

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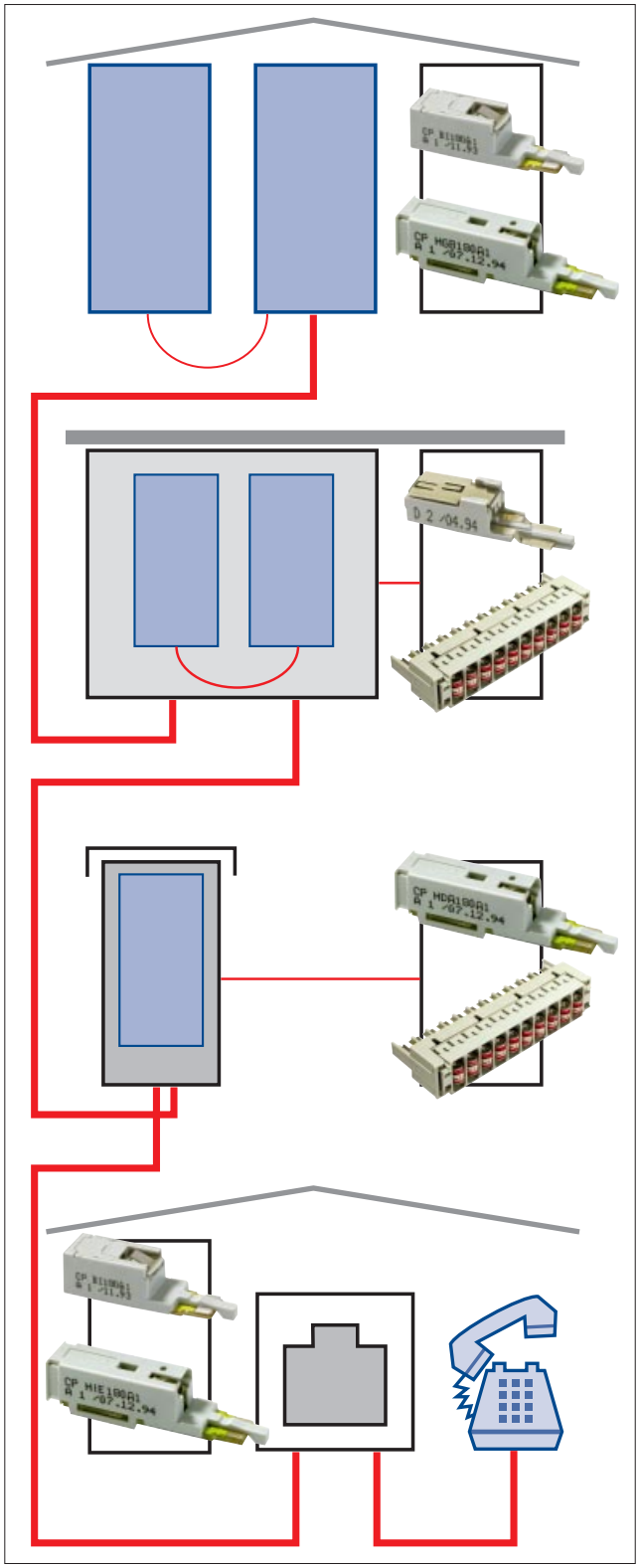
Protection Systems from KRONE

Brief description

Protection systems from KRONE



Recommendations for the application of protection measures

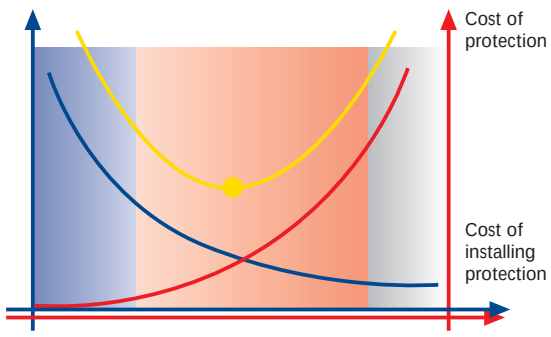
Over-voltage protection devices consist of components or protective circuits with the task of limiting interference to the permissible values. This is why it is so important to adapt over-voltage protection devices to regional and local requirements.
These requirements include operating conditions on the line and the protection requirements which result from the specific area of application.

Graded protective circuits with secondary protection elements should be used for the incoming circuits on the exchange side and for terminal equipment (telephone, fax, modem), because in addition to personnel safety, sensitive electronic systems must also be protected. High-voltage protection is usually sufficient for the line. In the event that active components are installed in the cross connection cabinet, graded protective circuits are also recommended here.

Costs and benefits for the user

When selecting a suitable over-voltage protection module, viewing the cost-to-benefit ratio is of enormous interest. The cost of installing protection modules is in direct contrast to the increased availability of the communication network and lower repair costs. An optimum selection on the part of the network operator results in minimum costs with maximum economic efficiency of the equipment. The extent of protection measures is based on the requirements and specifications from the network operator or the manufacturer of the equipment. In the idealised diagram, the cost minimum is the point where the two curves meet.

Cost relationships



The applicable standards and/or regulations for setting up and operating telecommunication networks must also be observed with a view to protecting personnel.

Protection Systems from KRONE

Operating conditions

Operating conditions

The range of products for protection systems is designed to meet the needs of copper-based connection and distribution systems from KRONE. From the point of view of application possibilities, the protection modules are electrically equivalent, however, not necessarily compatible with a view to contacting and protection behaviour.

The basic differences are:
- operating behaviour of the system to be protected,
- over-voltage protection requirements (electrical and mechanical)
  (For example, requirements facing the permissible impulse current or the permissible AC discharge current. The network operator's specifications must be observed when designing the protection modules).
- the LSA-PLUS/LSA PROFIL and/or MDF 71 connection system used,
- protection for 1 pair or for the entire module.

Furthermore, protection equipment and systems must be designed to meet the needs of the following network conditions:

Before the planning phase begins, the requirements for the protection system must be examined together with the operating conditions. Over-rated protection hardly ever leads to damage, however, it does have an impact on the economic efficiency of the equipment. Over-rated protection also means an increase in repair costs and poses a risk to life and limb.
Installation takes place after the distribution equipment has been set up. Retrofitting of existing equipment is in most cases not a problem if LSA-PLUS and LSA PROFIL systems are installed.

Network condition	Selection condition	Protection module
Operating voltage	<	Response voltage
Voltage resistance of the equipment to be protected	>	Impulse response voltage
Nominal current	<	Nominal current
Cut-off frequency (Transmission rates)	<	Cut-off frequency

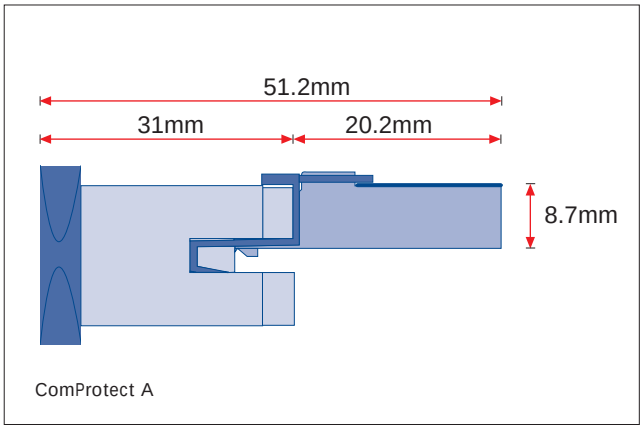
Apart from the electrical characteristics, the conditions of the interface with the distributor system, and, if necessary, also the housing dimensions must be taken into consideration at the earliest stage possible. The following protection modules are available for the LSA-PLUS series (series 2):

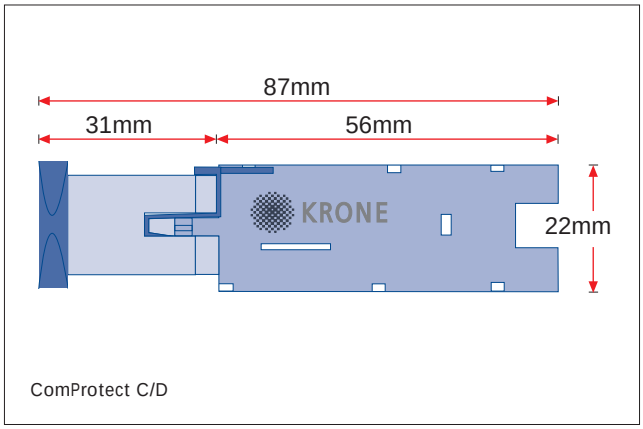
KRONE protection modules	LSA-PLUS distribution module	Jumpering with protection element in place
Magazines	Connection or disconnection module	no
1 pair ComProtect A	Connection or disconnection module	yes
1 pair ComProtect B	Disconnection or switching module	yes
1 pair ComProtect C	Disconnection or switching module	no
1 pair ComProtect D	Disconnection or switching module	no
1 pair ComProtect H	Disconnection or switching module	yes
10 pairs ComProtect ARD	Disconnection or switching module	no

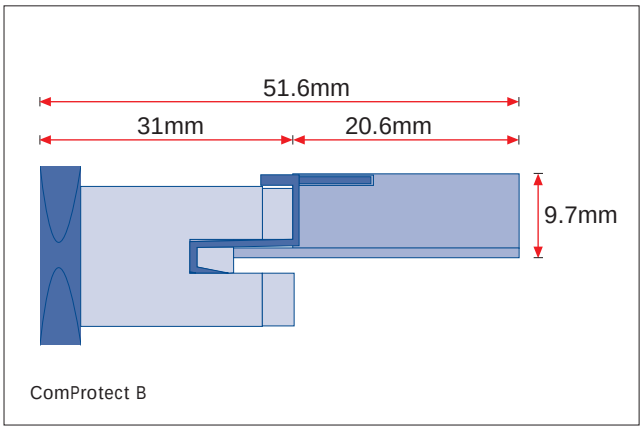
Operating conditions

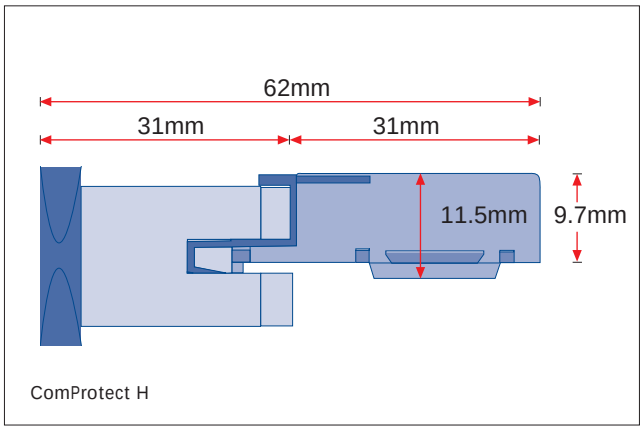
Operating conditions

Basically, distribution modules with disconnection, switching and connection contacts can be used. This provides fundamental specifications for the protection components: disconnection and switching modules permit the insertion of serial protection components into circuits. The connection modules only permit parallel contact access.









Dimensions of a ComProtect 1-pair protective plug (type A, B, C, D and H) installed in the LSA-PLUS distribution module

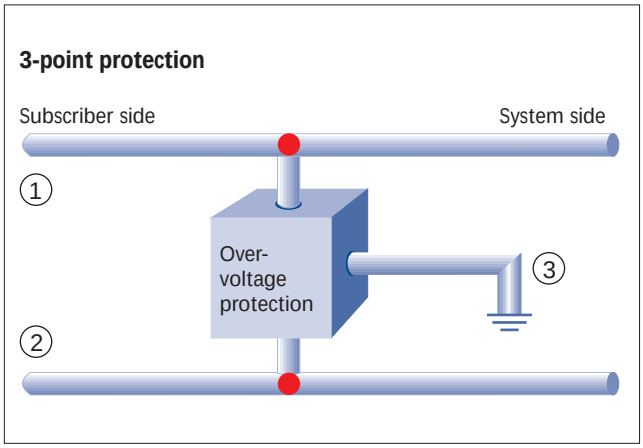
Operating conditions

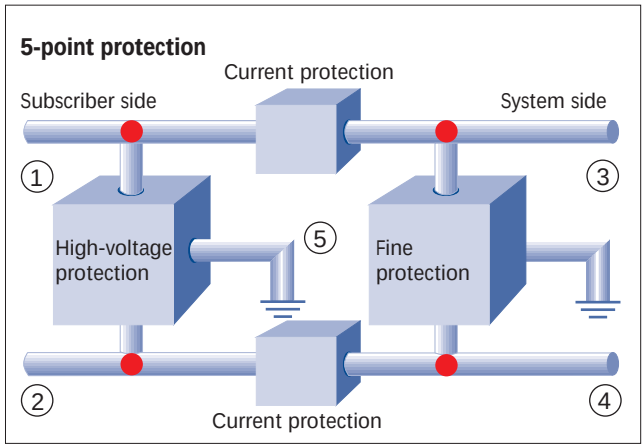
Operating conditions

	Operating voltage of the network	Operating current of the network	Cut-off frequency/ transmission rate	Preferred type *) recommended
Exchange system				
Analogue telecommunication line	160V	< 100mA	4KHz	CP BI 180 A1 CP HGB 180 A1 CP AA 180 A1
ISDN S_0 interface	42V	< 60mA	192kbit/s	CP BI 70 A1 CP HGB 180 A1
ISDN U_{k0} interface	70V 99V	< 60mA	2Mbit/s	CP BI 70 A1 CP BI 180 A1 CP HGB 180 A1
Pmux connection (primary multiplex connection)	60V	< 60mA	2Mbit/s	CP BI 70 A1 CP HGB 180 A1
PCM (without external supply)	5V	< 60mA	2Mbit/s	CP BI 12 A1 CP HGB 180 A1
PCM (with external supply of 100V)	100V	< 60mA	2Mbit/s	CP BI 180 A1 CP HGB 180 A1
Modem for telecommunication line	60V	< 60mA	64kbit/s	CP BI 70 A1
Modem for Datex P	12V	< 60mA	48kbit/s	CP BI 12 A1
Data transmission				
RS 232	12V	< 20mA	20kbit/s	CP HIE 12 A1 CP BI 12 A1
RS 485	12V	< 20mA	2Mbit/s	CP HIE 12 A1
Ethernet	5V	< 20mA	20Mbit/s	CP HIE 5 A1
Token ring	5V	< 20mA	16Mbit/s	CP HIE 5 A1
Measuring and control technology				
TTL level	5V	< 20mA	64kbit/s	CP BI 12 A1 CP CJ 12 A1
TTY level	24V	< 20mA	64kbit/s	CP BI 24 A1 CP CJ 24 A1

*) preferred types from the product range. Alternatives and solutions for other requirements can be found in the product catalogue.

Operating conditions





Selection
Irrespective of the series and circuit used, the over-voltage protection components are all based on the same working principle: any excessive voltages which may occur are discharged to earth, i.e. depending on the component, the energy consumption in the protection device is relatively small. One precondition for this is the low-resistance earthing of the protection components.

In line with signal potentials, a distinction is made between 3-point and 5-point protection. In the case of connection modules, only 3-point protection is possible. Switching modules are basically recommended for 5-point protection (components in the signal path) because - once the protective plug has been removed - the contact in the module is open, so that possible faults cannot make their way to the downstream network. 5-point protection can also be implemented using disconnection modules.

KRONE supplies various types of protective circuits:
- 3-point protection: pure over-voltage protection (high-voltage or secondary protection)
- 5-point protection: over-voltage protection combined with current protection
- 5-point protection: graded protection (high-voltage and secondary protection with current protection).

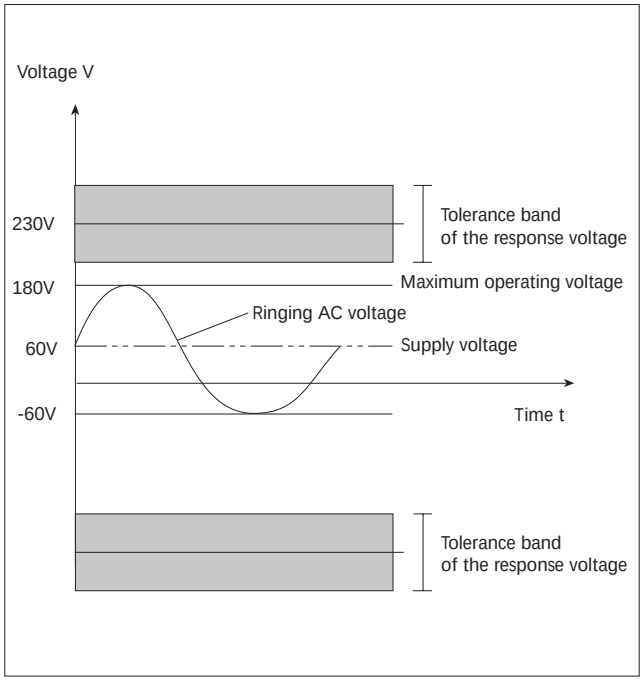
Components designed for single-pair protection provide a safe and reliable solution in LSA-PLUS and LSA PROFIL distribution systems when compared to multiple-pair protection magazines for 8-pair and/or 10-pair modules. When a 1-pair protection plug has to be removed, this does not mean that the entire module (8 or 10 pairs) is no longer protected. The possibility of partial or combined equipping is also provided. The most convenient protection plug variants (ComProtect 2/1 A, B and H), thanks to their small dimensions, also offer the option of switching and jumpering the modules with the protective components in place. All protection functions thus remain guaranteed at all times for both the communication equipment and maintenance personnel.

The advantages of protection components for 8 and 10 pairs are mainly based on the fast setting up of a protection panel (low installation costs). When necessary, magazines for LSA-PLUS/LSA PROFIL can be installed in the distributor in combination with ComProtect.

Operating conditions

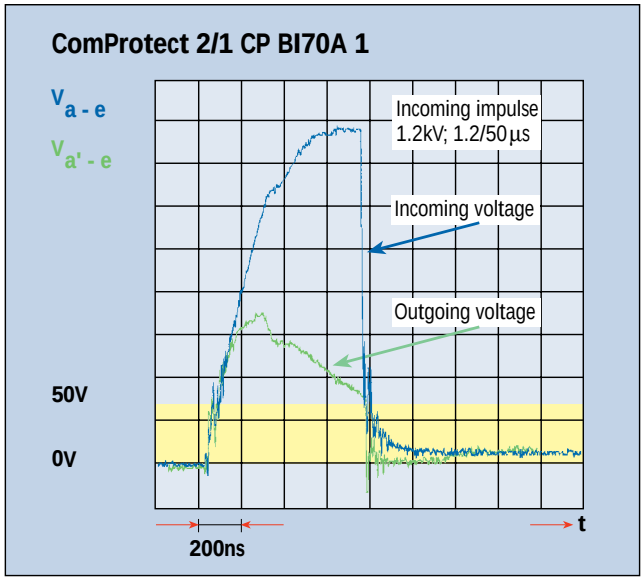
Operating voltage / technical data
The operating voltage of the system to be protected determines the voltage class of the protection plug. It must be ensured that the protection device is not triggered during normal operation, because this would not only destroy the protective circuit, it would also lead to an interruption in signal transmission. The highest possible voltage class should be selected for the protection plug - at least above the maximum voltage possible during operation (maximum operating voltage, including tolerance). The upper limit for selecting the voltage class of the protection plug is determined by the maximum protection level permitted, i.e. the maximum input voltage that would not damage the downstream components of the system should over-voltage occur. Other electrical parameters for protective circuits result from the selection of components and switching configurations.

Properly dimensioned over-voltage protection components have a serviceable life of several decades and require no additional maintenance. Based on the guidelines by Deutsche Telekom AG, it is recommended that the nominal DC response voltage of over-voltage arrestors be tested every 6 years. If the protective circuit has been subjected to impulse current, it is recommended the arrestors be replaced for safety reasons.



Operating voltage and protection level
Idealised presentation for a maximum operating voltage of 180V

Fail safe
Protective circuits with an integrated fail-safe feature are highly recommended. Components for over-voltage protection are usually designed only for pulse-shaped loads. Therefore, if permanent overloads are possible (e.g. mains contact), a safe short-circuit to earth must be ensured. Overloaded or overheated protection components would not only lose their protective function, they could cause fire or an explosion thereby leading to considerable damage.



System solutions from KRONE

ComProtect protection plug for LSA-PLUS/LSA PROFIL, 1-pair, 8-pair and 10-pair
In a number of applications, in particular, where valuable electronic equipment is used, simple 3-point protection with over-voltage arrestors is simply not sufficient. Although over-voltage arrestors are in many cases essential components, the systems to be protected may require additional secondary protection. This and other aspects demand a highly flexible and efficient protection concept which is implemented on the basis of the modular design of the ComProtect protection plugs.

- 3-point and 5-point protection.
- Flexible equipping of the module, thanks to the 1-pair, 8-pair or 10-pair design of ComProtect.
- Partial protection and retrofitting possible.
- High-voltage protection, secondary protection, current protection and graded protection can be selected to meet given requirements.
- Additional measuring and disconnection points of various protection plugs enable work on the line without interrupting protection functions.
- With size kept to a minimum, jumper work on the distributor is possible without removing the protection components.

ComProtect for LSA-PLUS/LSA PROFIL is installed after the necessary connection work has been completed. The earth rail, designed for 10 pairs (8 pairs), is fitted parallel to the cable wires of the LSA-PLUS or LSA PROFIL module where interference is anticipated. The lateral fork contacts of the earth rail provide a low-resistance connection to the back-mount frame (LSA-PLUS) and/or via earth contact clips to the round profile bars (LSA PROFIL). It should also be ensured here that the rack frame (round profile bars) is connected to earth potential. The earth rail has one tongue for each pair, so that the ComProtect protection plug can then be plugged into the module in such a way that its mating groove contacts this tongue. This patented technology from KRONE ensures optimum safety for functionality and contact. The conductive contact between the earth spring of the protection plug (earth contact of the protective circuit) and the 10-pair (8-pair) earth rail is ensured during installation. In the LSA PROFIL system, additional earth clips must be installed in order to ensure a conducting contact (earth contact) between earth rail and round profile bars.

Magazines for LSA-PLUS, LSA PROFIL and MDF71
The KRONE range of products includes various magazines for over-voltage protection. All the versions have one thing in common, i.e. they are adaptations of the protective components of the LSA-PLUS and/or LSA PROFIL distribution systems. MDF 71 and other related versions (dropwire and PCB modules) are also available. Various types of magazines are available for protection in the MDF 71 system. Typical 3-point protection is implemented in the magazines, i.e. the protective components to be installed are connected to a common central connection (earth potential when installed) in the magazine. Two-electrode arrestors serve as protective components - they offer high energy absorption and very low capacitance values. In special cases, magazines can also be fitted with polycrystalline over-voltage protection components. Magazines can be particularly improved by installing fail-safe contacts (fail-safe rings) in addition to the over-voltage arrestors.

In the case of magazines for over-voltage protection in the LSA-PLUS distribution system, fail-safe contacts (thermal protection springs) can be simply plugged in, hence connecting them parallel to the 2-electrode arrestors. If the arrestor overheats as a result of over-voltage, a solder material melts, triggering the fail-safe function to generate a short-circuit to earth parallel to the arrestors, hence discharging any subsequent currents. The same effect is achieved in 71/4 and 71/5 magazines by installing fail-safe rings which close when the arrestors overheats, melting a pre-stressed fail-safe contact.

Protection Systems from KRONE

System overview

System solutions from KRONE

3-electrode arrestors with optional fail safe contacts are available for LSA-PLUS and LSA PROFIL Magazines.

The installation of protection plugs in the MDF 71 with magazine protection means the implementation of an efficient 5-point protection system.

After the distribution equipment has been installed, all connection work is then carried out. Only when a low-resistance connection between rack frame and central earth bar and/or earth rod is established does the distribution frame provide an earth potential for the over-voltage protection components. The magazines are already equipped with earth contacts which, when installed, ensure a low-resistance path between rack frame and protection components. After the over-voltage arrestors and optional fail-safe contacts have been fitted, the magazines are inserted into the distributor module. Magazines 71/4 A(T) and 71/5 A(T) are inserted into the appropriate lateral contact insert (subscriber side) of the distributor element of the MDF 71.

Technical specifications

The following technical specifications and dimensions of the ComProtect A, B, C, D and H have been compiled for the standard programme of 1-pair protection components:

Transmission behavior	++	++	+(+)	o	o	++	o
Disconnection contacts				■	■		
Jumpering ability		■	■			■	
Line protection			■		■		
Reversible current protection			■	■		■	■
Irreversible current protection					■	■	
Partial/combined fitting		■	■	■	■	■	
Fail-safe	■	■	■	■	■	■	
Secondary protection			■	■	■	■	■
High-voltage protection	■	■	■	■	■	■	■
	Magazines 2/10 Magazines 71	ComProtect 2/1 CP A	ComProtect 2/1 CP B	ComProtect 2/1 CP C	ComProtect 2/1 CP D	ComProtect 2/1 CP H	2/10 ARD

o Adequate
++ Very good
+(+) Good or optional very good

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Technical specifications

ComProtect / types		Type B					
Technical specifications	2/1CP…	BI12A1	BI24A1	BI70A1	BI180A1	BOD180A1	Unit
Max. operating voltage (a–b, b–b[1])	V_{max}	12	24	70	180	180	V
Colour marking		none	none	none	none	none	
Nominal response DC voltage (over-voltage arrestors) *)	V_{ag}	90	90	90	230	500	V
Tolerance of the nominal response DC voltage		± 20	± 20	± 20	± 20	± 20	%
Max. nominal current at 20°C	I_N	90	90	90	120	90	mA
Max. output voltage at 1kV/µs	V_o	30	60	190	350	350	V
Nominal discharge impulse current (8/20µs), (a/b–e) *)	I_{sN}	5	5	5	5	5	kA
Nominal AC discharge current (a/b–e) *)	I_{wN}	–	–	5	5	5	A_{rms}
Nominal decoupling resistance at 20°C	R	25	25	25	10	20	Ω
Typical switching time for current protection (500mA/25°C)	t_t	≤ 3	≤ 3	≤ 3	≤ 10	≤ 3	s
Response time, Fail-safe @ 1A	t_f	≤ 10	≤ 10	≤ 10	≤ 10	≤ 10	s
Response time, Fail-safe @ 5A	t_f	< 5	< 5	< 5	< 5	≤ 5	s
Insulation resistance (without secondary protection) at 100V	R_{isol}	–	–	–	1000	1000	MΩ
Leakage current (secondary protection / with voltage	I_L	≤ 1	≤ 1	≤ 10	≤ 5	≤ 5	µA
Nominal capacity at 1MHz/1V_{rms} (a/b–e)	C	100	50	50	50	50	pF
Typical cut-off frequency (–3dB, Z_w = 600Ω)	f_g	8	8	8	8	8	MHz
Typical cut-off frequency (–3dB, Z_w = 150Ω)	f_g	30	30	30	30	30	MHz
Impulse voltage resistance (1,2/50µs), 3 x	U_{sp}	1.75	1.75	1.75	1.75	1.75	kV
AC voltage resistance (50Hz), 1 min	U_{sw}	1000	1000	1000	1000	1000	V_{rms}
Operating temperature:	–20°C … +60°C						
Storage temperature:	–40°C … +80°C						
Electrical testing:	*) According to ITU K. 12						
Mechanical loads:	Sinusoidal-shaped oscillations according to IEC 68-2-6						
Climatic conditions:	DIN IEC 68 part 2–2/3 (exposure to high temperatures) DIN IEC 68 part 2–1 (exposure to low temperatures)						

Technical specifications

ComProtect / types		Type H								
Technical specifications	2/1CP...	HEB180A1	HDA180A1	HGB180A1	HGB180A2	HIE05A1	HIE12A1	HSD5A1	HSD12A1	Unit
Max. operating voltage (a–b, b–b[1])	V_{max}	180				5	12	5	12	V
Colour marking		none				blue	brown	blue	brown	
Nominal response DC voltage (over-voltage arrestors) *)	V_{ag}	230			230	230		–		V
Tolerance of the nominal response DC voltage		± 20			± 20	± 20		–		%
Max. nominal current at 20°C	I_N	110	–	120		120		500		mA
Max. output voltage at 1kV/µs	V_0	< 700			< 500	18	35	18	35	V
Nominal discharge impulse current (8/20µs), (a/b–e) *)	I_{sN}	3			5	5		0,2		kA
Nominal AC discharge current (a/b–e) *)	I_{wN}	3			5	5		1		A_{rms}
Nominal decoupling resistance at 20°C	R	1	–	8		8		1		Ω
Typical switching time for current protection (500mA/25°C)	t_t	5	–	6		6				s
Response time, fail-safe @ 1A	t_f	< 25			< 15	≤ 10		–		s
Response time, fail-safe @ 5A	t_f	< 5				≤5		–		s
Insulation resistance (without secondary protection) at 100V	R_{isol}	> 1000				–				MΩ
Leakage current (secondary protection)/ with voltage	I_L	–				< 1 / 5	< 1 / 12			µA
Nominal capacity at 1MHz/1V_{rms} (a/b–e)	C	< 5				< 12				pF
Typical cut-off frequency (–3dB, Z_w = 600Ω)	f_g	> 65								MHz
Typical cut-off frequency (–3dB, Z_w = 150Ω)	f_g	> 100								MHz
Operating temperatue:		–20°C … +60°C								
Storage temperature:		–40°C … +80°C								
Electrical testing:		*) According to ITU K. 12								
Mechanical loads:		Sinusoidal-shaped oscillations according to IEC 68-2-6								
Climatic conditions:		DIN IEC 68 part 2–2/3 (exposure to high temperatures) DIN IEC 68 part 2–1 (exposure to low temperatures)								

Technical specifications

ComProtect types		Type A, C and D								
Technical specifications	2/1CP...	AA180A2	AA280A2	CH60A1	CJ12A1	CJ24A1	CJ60A1	DE180A1	DX180A1	Unit
Max. operating voltage (a–b, b–b[1])	V_{max}	180	280	60	12	24	60	180	180	V
Colour marking		green	red	yellow	brown	orange	yellow	green	green	
Nominal response DC voltage (over-voltage arrestors) *)	V_{ag}	230	350	230	230			230		V
Tolerance of the nominal response DC voltage		± 20		± 20	± 20			± 20		%
Max. nominal current at 20°C	I_N	–		90	370			100	500	mA
Max. output voltage at 1kV/µs	V_0	< 800	< 900	< 175	50	90	150	600		V
Nominal discharge impulse current (8/20µs), (a/b–e) *)	I_{sN}	5		5	5			5		kA
Nominal AC discharge current (a/b–e) *)	I_{wN}	5		5	–			5		A_{rms}
Nominal decoupling resistance at 20°C	R	–		35	1.7			25	–	Ω
Nominal inductance (a–a'), (b–b')	l	–		–	100			–	–	µH
Typical switching time for current protection (500mA/25°C)	t_t	–		3/0,5	–			–	< 100/10	s
Response time, fail-safe @ 1A	t_f	< 20		< 10	< 10			< 10		s
Response time, fail-safe @ 5A	t_f	< 5		< 5	< 5			< 5		s
Insulation resistance (without secondary protection) at 100V	R_{isol}	> 1000		> 1000	> 1000			> 1000		MΩ
Leakage current (secondary protection)/ with voltage	I_L	–		< 5/60	≤ 100/12	≤ 2/24	≤ 1/50	–		µA
Nominal capacity at 1MHz/1V_{rms} (a/b–e)	C	7.5		250	300	400	3000	7.5		pF
Typical cut-off frequency (–3dB, Z_w = 600Ω)	f_g	> 65		3	0.5			> 65		MHz
Typical cut-off frequency (–3dB, Z_w = 150Ω)	f_g	> 100		19	0.15			> 100		MHz
Impulse voltage resistance (1,2/50µs), 3 x	U_{sp}	1.75		1.75	1.75			1.75		kV
AC voltage resistance (50Hz), 1min	U_{sw}	1000		1000	1000			1000		V_{rms}
Operating temperature:	–20°C … +60°C									
Storage temperature:	–40°C … +80°C									
Electrical testing:	*) According to ITU K. 12									
Mechanical loads:	Sinusoidal-shaped oscillations according to IEC 68-2-6									
Climatic conditions:	DIN IEC 68 part 2–2/3 (exposure to high temperatures) DIN IEC 68 part 2–1 (exposure to low temperatures)									