Increased Safety for Switchgear Cabinets

CI and ACI arresters:
Dimensioning switchgear assemblies without a backup fuse

Content

Benefits / advantages

Arrester with integrated fuse

Surge protective devices with integrated backup fuses – such as CI or ACI arresters – rule out dimensioning errors since the integrated fuse is optimally adapted to the protective device and its protective effect. CI or ACI arresters thus make a significant contribution to system availability.

Surge arresters (SPDs) ensure the availability of the electrical installation in case of surges and direct lightning strikes. The aim is optimal voltage limitation according to the rated voltage and/or insulation coordination of the switchgear assembly.

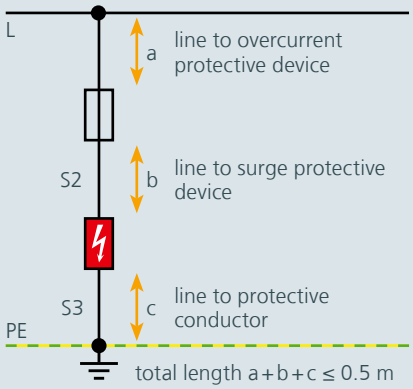
However, even in case of a fault, the surge protective devices must not lead to the unintentional disconnection of a system. This is achieved, on the one hand, using innovative spark gap technologies, but also by DEHN arresters with integrated fuses (CI technology) or with alternative technologies without backup fuses (ACI technology). The use of innovative spark gap technologies reduces mains follow currents to a minimum and thus avoids high loads on fuses, circuit breakers and other system components.

CI and ACI arresters: Your benefit for practical implementation

- Optimal impulse current carrying capability
- Reduction of connection lengths
- Optimal voltage protection level in the switchgear assembly
- Maximum system availability
- Reduced space and component requirements
- Monitoring of the surge arrester and backup fuse
- Fast installation
- Reduced cross-sectional areas (in case of ACI technology)
- Short cable lengths, making it easier to comply with the required maximum connection cable length of 0.5 m

Keeping the max. cable length

According to IEC 60364 Part 5-53, Clause 534, it must be ensured that the total length of all cables between the connection points of the SPD assembly **does not exceed** 0.5 m. This requirement applies to the cable length including the backup fuse and its practical implementation requires considerable effort.



Necessity of backup fuses

Since nominal currents in industrial or commercial environments exceed the operating current ranges of conventional surge arresters, a separate backup fuse is usually required to ensure trouble-free operation.

The following parameters influence the dimensioning criteria for these arrester backup fuses.

Requirements on backup fuses

Fuses should be

Small enough to pass the short-circuit rating test according to IEC 61643-11

Large enough to carry the impulse current specified by the manufacturer

These conflicting requirements and a lack of knowledge of the consequences mean that backup fuses – e.g. for surge arresters – are often insufficiently dimensioned and thus represent a safety risk.

Planners and users should also consider the following aspects for correct fuse dimensioning:

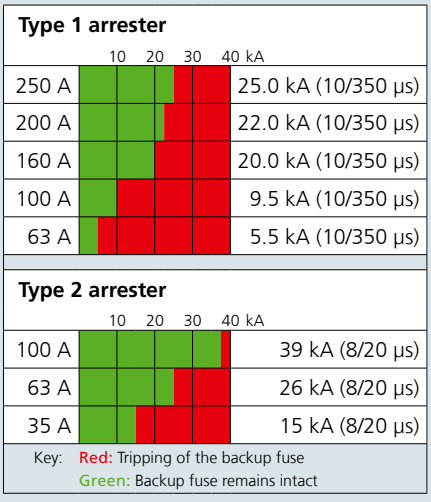
- Additional space requirements
- Additional costs
- Greater wiring effort
- Longer cable lengths
- Dimensioning of the backup fuse
- Selectivity
- Circuit breakers with equivalent time / current characteristics

Preventing dimensioning errors

Surge protective devices with integrated backup fuses or alternative technologies without backup fuses – such as CI or ACI arresters – rule out dimensioning errors since the integrated fuse is optimally adapted to the protective device and its protective effect. CI or ACI arresters thus make a significant contribution to the availability of the system and the surge arrester itself.

One aspect that is often neglected when selecting backup fuses is the inadequate impulse current carrying capacity of the fuse elements used and the need to monitor them. Incorrect dimensioning of the upstream fuses jeopardises the availability of the entire system, e.g.

- An insufficiently dimensioned system backup fuse may trigger too early in case of a fault and thus lead to the standstill of all downstream consumers and even to the failure of the entire system.
- If the device fuse of the surge arrester is too small, the protective effect of the arrester is reduced. The fuse may trigger too early and disconnect the arrester from the grid without it being visually apparent or reported via the remote signalling contact. The surge arrester is then inactive and the system defenceless against the next surge event.



DEHN protects – Safety from the expert

110 years of experience

Back in 1923, Hans Dehn began producing external lightning protection and earthing components to optimise the safety of buildings and systems. Thanks to technical foresight, DEHN launched the world's first generation of surge protective devices as early as 1954 – a milestone whose continuous further development has, to this day, ensured the safe operation and constant availability of electrical and electronic systems.

History – Type 1 combined arresters

1983: DEHNventil	2001: DEHNventil	2006: DEHNventil modular	2013: DEHNvenCI
			
Type VGA 280 4	Type DV ...	Type DV M ...	Type DVCI 1 255 (FM)

History –Type 2 surge arresters
Further development in safety

1954: J250	1986: VM 280	1993: DEHNguard 275	2009: DEHNguard CI	2018: DEHNguard ACI
				
Varistor • Surge protection	Varistor with thermal disconnector • Surge protection • Thermal disconnector	Varistor with Thermo Dynamic Control • Surge protection • Thermal disconnector • Dynamic disconnector	**CI:** Varistor with Thermo Dynamic Control and integrated fuse • Surge protection • Thermal disconnector • Dynamic disconnector • Integrated backup fuse	**ACI:** Advanced Circuit Interruption with switch / spark gap combination • Surge protection • Thermal disconnector • Dynamic disconnector • Integrated switch / spark gap combination to replace the backup fuse • Safe dimensioning

Wave breaker function

In case of spark gap-based type 1 arresters, the entire current flows through the type 1 arrester during the discharge process. Similar to a wave breaker, the energy is reduced to a level low enough to considerably relieve downstream SPDs All spark-gap-based type 1 arresters of the Red/Line family feature this WAVE BREAKER FUNCTION.

CI technology

Integrated backup fuse: Reduced space requirement, lower installation costs, faster wiring times and shorter connection cable lengths are clear advantages of the CI technology (Circuit Interruption) integrated in the DEHNvenCI, DEHNbloc Maxi S, DEHNguard ... CI and V(A) NH product families.

DEHNvenCI:
Type 1 combined arrester

The DEHNvenCI combined arrester with integrated backup fuse and RADAX flow spark gap technology ensures maximum system availability and protection of terminal devices. DEHNvenCI stands out for its space-saving design and user-friendliness. The remote signalling version of DEHNvenCI features a floating remote signalling contact.

Benefits:

- Spark-gap-based combined arrester (RADAX-Flow) with integrated backup fuse
- Energy coordinated within the Red/Line product series
- Low voltage protection level UP ≤ 1.5 kV (incl. backup fuse)
- Optionally with remote signalling contact
- Extinction of mains follow currents up to 100 kA_{rms}
- High lightning current discharge capacity up to 25 kA (10/350 µs)
- Safe protection of terminal devices
- Green-red operating state/fault indication in the inspection window for the arrester and backup fuse

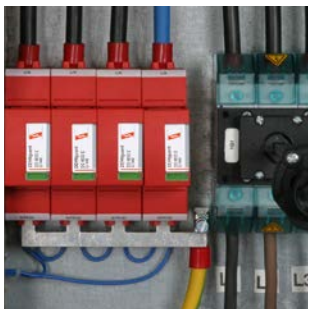
DEHNbloc Maxi 1 CI 440 and 760:
Type 1 lightning current arrester

This leakage-current-free arrester based on RADAX Flow spark gap technology provides maximum discharge capacity in the smallest possible space. Due to its high TOV withstand capability, DEHNbloc Maxi CI 440/760 is also suitable for protecting IT systems. DEHNbloc Maxi CI 440/760 is a DIN rail mounted device that can also be mounted directly on mounting plates using the mounting brackets included in the scope of delivery.

Benefits:

- Spark-gap-based lightning current arrester (RADAXFlow) with integrated backup fuse
- Energy coordinated within the Red/Line product series
- Low voltage protection level (incl. backup fuse)
- Extremely high lightning current discharge capacity of 35 kA (10/350 µs)
- High follow current extinguishing capability and follow current limitation
- With remote signalling contact for the monitoring device
- Green-red operating state/fault indication in the inspection window for the arrester and backup fuse

DEHNguard SE CI ... 440 FM:
Type 2 surge arrester



Surge protection is integrated in the module of the modular DEHNguard CI surge arresters with a width of only one standard DIN module. DEHNguard CI sets new standards in terms of saving space, user-friendliness and safety. The remote signalling version of DEHNguard CI features a floating remote signalling contact.

Benefits:

- Integrated and monitored backup fuse
- System availability ensured in the event of a fault
- Fast diagnosis of functionality
- Module replacement without tools
- Module locking mechanism
- Suitable for all system configurations
- Maximum performance due to a fuse which is ideally adapted to the SPD

Type 1 combined lightning current and surge arresters		Type	Part No.
	**DEHNvenCI with integrated backup fuse** Combined arrester with integrated lightning current carrying backup fuse. Discharge capacity (10/350 µs): 25 kA Voltage protection level: ≤ 1.5 kV	**DVCI 1 255** **DVCI 1 255 FM** [1]	**961 200** **961 205**
Coordinated type 1 lightning current arresters		**Type**	**Part No.**
	**DEHNbloc Maxi 1 CI 440 with integrated backup fuse** Coordinated single-pole lightning current arrester with integrated backup fuse, for industrial feeders 400 / 690 V, chemical plants, wind turbines and photovoltaic systems. Discharge capacity (10/350 µs): 35 kA Voltage protection level: ≤ 2.5 kV	**DBM 1 CI 440 FM** [1]	**961 146**
	**DEHNbloc Maxi 1 CI 760 mit integrierter Vorsicherung** Coordinated single-pole lightning current arrester with integrated backup fuse, for industrial feeders 690 V, chemical plants, wind turbines, photo-voltaic and IT systems. Discharge capacity (10/350 µs): 35 kA Voltage protection level: ≤ 4 kV	**DBM 1 CI 760 FM** [1]	**961 176**
Type 2 surge arresters		**Type**	**Part No.**
	**DEHNguard SE CI 440 FM mit integrierter Vorsicherung** Pluggable single-pole surge arrester consisting of a base part and plug-in protection module, with integrated backup fuse Voltage protection level: ≤ 2 kV	**DG SE CI 440 FM** [1]	**952 920**
	**DEHNguard SE CI WE 440 FM mit integrierter Vorsicherung** Pluggable single-pole surge arrester with a varistor rated voltage U_{mov} = 750 V AC, with integrated backup fuse, for industrial feeders 400 / 690 V (highperformance machines), chemical plants, wind turbines, photovoltaic and IT systems. Ideally suited for inverters with voltage peaks due to high rating of the varistor. Voltage protection level: ≤ 3 kV	**DG SE CI WE 440 FM** [1]	**952 923**

[1] FM = floating remote signalling contact

ACI technology

ACI – **A**dvanced **C**ircuit **I**nterruption – stands for the highest level of device safety and system availability. The integrated switch / spark gap combination makes a device backup fuse superfluous.

Benefits:

With ACI arresters you avoid those configuration errors made when selecting and dimensioning a backup fuse. The TOV withstand and the absence of leakage current increase the service life and a smaller connection cross-section facilitates installation.

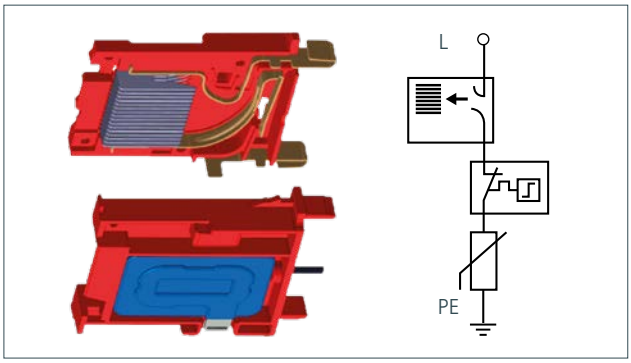
Mastering new challenges

The fuse elements typically used for surge arresters often only offer suboptimal backup protection, because they are essentially designed to protect cables and lines. In future, the optimally adapted backup protection of surge arresters will have to fulfil requirements such as, e.g.:

- Changing short-circuiting conditions due to decentralised system configurations
- High availability systems in computer centres or hospitals
- Use of frequency converters, respectively continuous operation of surge arresters or
- High demands on the TOV withstand capability

Surge protection with ACI technology

The new ACI technology stands for the highest level of device safety and system availability. With the newly integrated switch / spark gap combination, surge protection with ACI technology can master current and future requirements. This ensures that surge protective devices function reliably. Sensitive systems and devices remain available at all times. An upstream fuse is no longer required. This allows easy dimensioning and safe operation of the surge protective device.



ACI technology: Safety at the highest level

Safe dimensioning makes the new DEHNguard with ACI technology a no-worries package for the user who saves space, time and costs. ACI technology presents a technical solution to dimensioning issues which eliminates the need to select the right backup fuse or conductor cross-section. Constant availability of electrical systems is a must.

Power cuts and system failure are out of the question. Now is the time to consider the ongoing transition in the global power supply. Renewable power generation is creating new grid parameters: Isolated grids and storage systems are changing the short-circuiting conditions. One aspect which the new ACI technology already has well under control.

For highest system availability: DEHNguard ACI	Standard solution	CI technology	ACI technology	
Safe dimensioning	—	—	✓	ACI = Highest system availability
Small connection cross-section of 6 mm² (Cu) always sufficient [1)]	—	—	✓	
Longer service life due to TOV withstand and zero leakage current	—	—	✓	
Monitoring overcurrent protection SPD	—	✓	✓	
More space in the switchgear cabinet	—	✓	✓	
No external backup fuse needed	—	✓	✓	
Thermo Dynamic Control	✓	✓	✓	
Protective effect of a type 2 arrester	✓	✓	✓	

Safety well thought through

When the ACI surge arrester reaches the end of its service life, any fault current flowing through the varistor is safely interrupted by the new technology so that even small system fuses do not trip. The arrester is thus safely disconnected from the grid. This means much greater availability and operational safety for the system in comparison with standard type 2 arresters with external fuses.

Your benefits with DEHNguard ACI:

Safe dimensioning: Eliminate mistakes
With ACI arresters you avoid those configuration errors made when selecting and dimensioning a suitable backup fuse. This increases the availability of your system. The new switch / spark gap combination is integrated directly in and ideally adjusted to the arrester. No time and effort need be spent on selecting the right fuse size and tripping characteristics.

TOV withstand: Increase system availability
Temporary overvoltages (e.g., caused by loss of neutral) can destroy conventional surge protective devices. The new ACI arresters have a much better TOV withstand. This increases the availability of your system and avoids wasting time and money on repairs.

Zero leakage current: Increase the service lifetime of arresters
The technology in an ACI arrester makes sure that there are no leakage currents. This prevents premature ageing and saves the time and expense of replacing arresters ahead of schedule. ACI arresters also prevent the accidental tripping of the insulation monitoring.

Cross-sectional area of only 6 mm²: Easier to install [1)]
A conductor cross-section of just 6 mm² Cu is always enough. You save the valuable time you would, in the past, have spent dimensioning the cross-sections. Installation is also easier because 6 mm² Cu means smaller radiuses and shorter wiring.

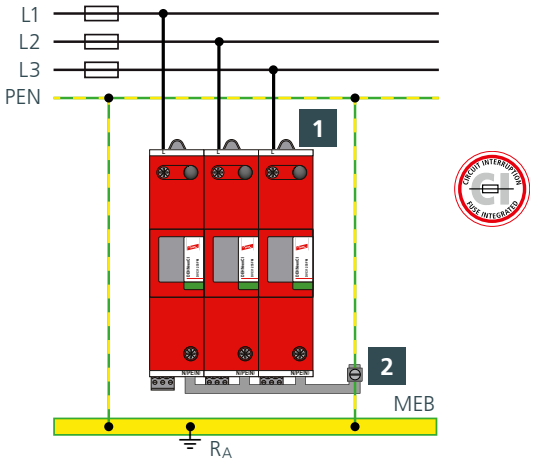
[1)] All live conductors should be wired so that they are inherently short-circuit and earth-fault-proof.

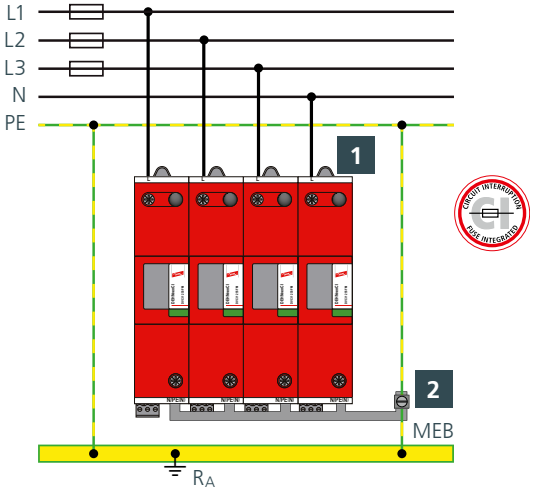
Transition in the energy sector: Fulfil future requirements
The global power supply is in a period of transition. Renewable power generation is creating new grid parameters. Isolated grids and storage systems are changing the short-circuit conditions. With ACI technology you are well equipped for these future requirements.

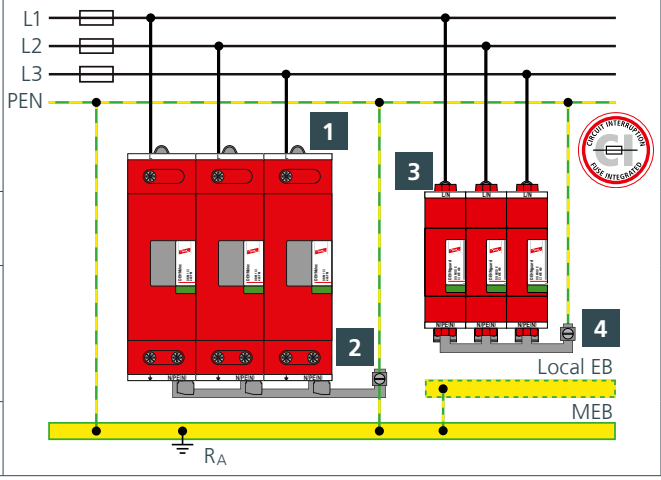
Type 2 surge arrester		Type	Part No.
	**DEHNguard M TT ACI ... FM** Modular surge arrester with Advanced Circuit Interruption (ACI) for TT and TN-S systems (3+1 configuration). Voltage protection level: ≤ 1.5 kV	**DG M TT ACI 275 FM** [1)] **DG M TT ACI 385 FM** [1)]	**952 341** **952 342**
	**DEHNguard M TNS ACI 275 FM** Modular surge arrester with Advanced Circuit Interruption (ACI) for TN-S systems. Voltage protection level: ≤ 1.5 kV	**DG M TNS ACI 275 FM** [1)]	**952 440**
	**DEHNguard M TNC ACI 275 FM** Modular surge arrester with Advanced Circuit Interruption (ACI) for TN-C systems. Voltage protection level: ≤ 1.5 kV	**DG M TNC ACI 275 FM** [1)]	**952 330**
	**DEHNguard M TT 2P ACI ... FM** Modular surge arrester with Advanced Circuit Interruption (ACI) for single-phase 230 V TT and TN systems (1+1 configuration). Voltage protection level: ≤ 1.5 kV	**DG M TT 2P ACI 275 FM** [1)] **DG M TT 2P ACI 385 FM** [1)]	**952 121** **952 122**
	**DEHNguard M TN ACI 275 FM** Modular surge arrester with Advanced Circuit Interruption (ACI) for single-phase 230 V TN systems. Voltage protection level: ≤ 1.5 kV	**DG M TN ACI 275 FM** [1)]	**952 220**
	**DEHNguard S ACI ... FM** Pluggable single-pole surge arrester with Advanced Circuit Interruption (ACI) consisting of a base part and plug-in protection module. Voltage protection level: ≤ 1.5 kV	**DG S ACI 275 FM** [1)] **DG S ACI 385 FM** [1)]	**952 100** **952 113**

[1)] FM = floating remote signalling contact

Sample installations

TN-C system – 3+0 configuration			Type	Part No.
1			**Combined arrester DVCI 1 255** (3x)	**961 200**
			or **Combined arrester DVCI 1 255 FM** [1] (3x)	**961 205**
2			**Earthing clip EB DG 1000 1 3** (1x)	**900 411**

TN-S system – 4+0 configuration			Product / Type	Part No.
1			**Combined arrester DVCI 1 255** (4x)	**961 200**
			or **Combined arrester DVCI 1 255 FM** [1] (4x)	**961 205**
2			**Earthing clip EB 1 4 9** (1x)	**900 417**

IT system 230 / 400 V – 3+0 configuration			Type	Part No.
1			**Coordinated lightning current arrester DBM 1 CI 440 FM** [1] (3x)	**961 146**
2			**Earthing clip EB 1 3 10** (1x)	**900 461**
3			**Surge arrester DG SE CI 440 FM** [1] (3x)	**952 920**
4			**Earthing clip EB 1 3 1.5** (1x)	**900 418**

[1] FM = floating remote signalling contact

Services and further information

Whether you need support with planning or answers to your questions – take advantage of our DEHN services.

More information at:
www.dehn-international.com

Online product database

Further information, data sheets and planning documents concerning CI or ACI arresters can be found in our online product database.

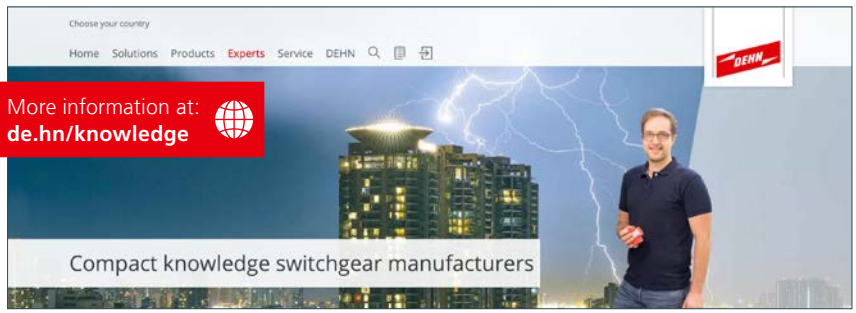
Simply enter the Part No. or description in the search field.

More information at:
de.hn/expert-pe

Expert pages

Have you already seen our expert pages?

Simply click to find an up-to-date and compact collection of all the information relevant for you.



More information at:
de.hn/knowledge

Answering questions

If you have commercial or specific technical questions, please contact our commercial customer services or our experts for lightning protection, earthing, surge protection, safety equipment and arc fault protection:

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