Surge protection for closed-circuit television systems (CCTV)
Application, technical structure and application examples
Application

Camera systems are used to monitor rooms, buildings and outdoor spaces, in order to record unauthorised access or criminal activities. Thus, the high availability of these systems must be guaranteed. CCTV (closed-circuit television) describes such camera monitoring systems. The difference to general camera systems is that the recorded images are only determined for a limited number of receivers (closed circuit), in contrast to transmissions for public television, for example.

CCTV camera systems are frequently installed outside buildings or on objects. During a thunderstorm, the devices
• can be completely destroyed by a direct lightning strike,
• or, if there is a remote lightning strike, can be damaged by surge voltages induced in transmission cables during the release of electromagnetic waves.
Technical structure

Camera system structures have various differences. For video transmission, a coaxial cable with a BNC plug connection is frequently used as a cable medium, or a two-core/twisted pair cable is used. If the camera possesses a control unit to swivel and tilt the camera head, this transmission is usually controlled via a serial RS485 interface via a two-core/twisted pair cable. A three-pole cable is used as the power supply.

Depending on the version, the data and video interfaces are frequently run together, for example through an RJ45 network connection. Modern IP cameras possess a single RJ45 connection, which transmits both the data and video signal and also the power supply via Power over Ethernet (PoE).

To prevent a failure of cameras and display systems, the components must be protected against atmospheric discharges and surge voltages.

OBO Bettermann offers tailor-made surge protection solutions for these applications, in order to guarantee safe system operation.
Surge protection concept

To fulfill a comprehensive surge protection concept, all the parts of a terminal or any equipment that are able to carry current must be included in the equipotential bonding. In the case of camera systems, these are the different interfaces which the camera possesses. Depending on the version, the number varies from one to three.
Variants

The surge protective devices are available in the following variants:

<table>
<thead>
<tr>
<th>Variant</th>
<th>Description</th>
<th>Protection class:</th>
<th>Connections</th>
</tr>
</thead>
</table>
| PND-3in1-C-OS   | To protect the power, data and video cable in one device in the case of surge voltages and lightning currents. | Type 2+3/D1-C2     | Power: 3-pole (screw terminal)  
|                 |                                                                            |                    | Data: 4-pole (screw terminal)  
|                 |                                                                            |                    | Video: Coaxial BNC socket     |
| PND-2in1-C-OS   | To protect the power, data and video cable in one device in the case of surge voltages and lightning currents. | Type 2+3/D1-C1-C2  | Power: 3-pole (screw terminal)  
|                 |                                                                            |                    | Data + video: RJ45 socket      |
| ND-CAT6/E-B     | To protect the RJ45 Power-over-Ethernet interface in the case of surge voltages and lightning currents. | Type 1/D1          | Power + Data + video: RJ45 socket |
| ND-CAT6/E-F     | To protect the RJ45 Power-over-Ethernet interface in the case of surge voltages. | Type 2+3/C2-C1     | Power + Data + video: RJ45 socket |

In addition, OBO can offer the matching housing for every variant for installation in outdoor areas.
Application examples

The following application examples offer a schematic diagram of the structure and protection of the most common camera monitoring systems for surge voltages and lightning currents. A connection box can be used to house the surge protective devices, for example on the camera pole. The surge protective devices should be installed as close as possible to the device to be protected, allowing the protection level and the risk of coupling on the protected side to be kept low. In addition, the length of the connection from the surge protective device to the local equipotential bonding should be kept as short as possible.
Scenario 1:

Three-cable camera system with/without external lightning protection

The camera is integrated into the system via three separate cables (power, data, video). Each of the three cables must be separately equipped with surge protection, in order to protect all the interfaces. As the PND-3in1-C-OS is a type 2+3 combination arrester for the power supply and type 1+2 (D1/C2) for data cable protection, it can be used with camera systems with and without lightning protection and protects all the named interfaces with a single device. For monitoring if the device is functioning, the device also possesses a visual display. If it goes out, then the surge protection device should be replaced immediately.

The data and video transmission and the power supply are each carried out separately.

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PND-3in1-C-OS (item no.: 5081072)</td>
</tr>
<tr>
<td>2</td>
<td>230 V</td>
</tr>
<tr>
<td>3</td>
<td>Video cable (Coax/BNC)</td>
</tr>
<tr>
<td>4</td>
<td>Data cable (RS485)</td>
</tr>
<tr>
<td>5</td>
<td>Monitor</td>
</tr>
<tr>
<td>6</td>
<td>Camera control unit</td>
</tr>
<tr>
<td>7</td>
<td>Camera</td>
</tr>
<tr>
<td>8</td>
<td>Swivel and tilt head</td>
</tr>
<tr>
<td>9</td>
<td>External lightning protection with protection angle</td>
</tr>
</tbody>
</table>
Scenario 2:

**Two-cable camera system with/without external lightning protection**

The video signal is transmitted jointly with the data signal for the movement controller via a network connection (RJ45). The voltage to the camera is supplied separately. The PND-2in1-C-OS surge protection device offers the matching interfaces for such cases in a single device. Here too, the property of a combination arrester is given, meaning that it can also be used for camera systems with external lightning protection, providing reliable protection against surge voltages. In addition, as is the case with the PND-3in1-C-OS, the device possesses a visual display to monitor if the device is functioning.

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1. PND-2in1-C-OS (item no.: 5081070)
2. 230 V
3. Data and video cable (RJ45)
4. Monitor
5. Camera control unit
6. Camera
7. Swivel and tilt head
8. External lightning protection with protection angle
Scenario 3:

IP camera system

IP cameras only require one cable between the command centre and the camera. This cable transmits both the data and video signal and also the power supply via Power over Ethernet. The high amount of cabling work is not necessarily, as transmission via IP is versatile and can easily be integrated in existing systems. The ND-CAT6/E-B (type 1) can be used in lightning protection zones from 0 to 1. For lightning protection zones 1 to 3, ND-CAT6/E-F must be used.

ND-CAT6/E-B (item no.: 5081804) or
ND-CAT6/E-F (item no.: 5081802)
PC as command centre
LAN/PoE cable
Camera
External lightning protection with protection angle
Combined protection device 2in1 for CCTV camera systems

- Protection of power and data interface in a single device
- In aluminium housing
- Simple mounting with adapter plug
- Two-stage protection circuit
- Three-pole power connection for the power interface
- RJ45 connection for the data interface
- With LED operation display (OS)
- Incl. DIN rail fastening set

Application: Protection of CCTV, video signals, (IP) cameras and/or TV systems

<table>
<thead>
<tr>
<th>Type</th>
<th>Maximum continuous voltage (L-N) V</th>
<th>Maximum discharge current (8/20 µs) kA</th>
<th>Pack Piece</th>
<th>Weight kg/100 pc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PND-2in1-C-OS</td>
<td>255</td>
<td>10</td>
<td>1</td>
<td>27.000</td>
</tr>
<tr>
<td>Item no.</td>
<td>5081070</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Combination protection device for IP-based TV/camera systems

- In aluminium housing
- Simple mounting with adapter plug
- Two-stage protection circuit
- Three-pole power connection for the power interface
- RJ45 connection for the data interface
- With LED operation display (OS)
- Incl. DIN rail fastening set

Application: Protection of CCTV, video signals, (IP) cameras and/or TV systems

PND-2in1-C-OS

- Temperature range: -20°C to +80°C
- Installation type: Installation
- Protection rating: IP20
- Earthing via: Connection cable/DIN rail
- Lightning protection zone LPZ: 1-3
- SPD to IEC 61643-11: Class II+III
- SPD to EN 61643-11: Type 2+3
- Maximum continuous voltage (L-N): Uc = 255 V
- Rated current: Ic = 16 A
- Protection level: Uc < 1,3 kV
- Idle voltage: Uoc = 10 kV
- Nominal discharge current (8/20 µs): In/L = 5 kA
- Maximum discharge current (8/20 µs): Imax = 10 kA
- Network: Maximum continuous voltage AC: Uc = 5,65 V
- Maximum continuous voltage DC: Uc = 8 V
- Category: Type 1/2+3 / D1+C2+C1
- Impulse durability wire-wire: C1: 0,3 kV / 0,15 kA (8/20µs)
- Impulse durability wire-earth: C2: 3 kV / 1,5 kA (8/20µs)
- Protection level wire-wire: <40 V
- Protection level wire-earth: <450 V
- Frequency range: 0 - 100 MHz
- Shielding connection available: Yes
- Shield connection: Direct
- Testing standard: IEC 61643-21

Dimensions

Connection options
Combined protection device 3in1 for CCTV camera systems

<table>
<thead>
<tr>
<th>Type</th>
<th>Maximum continuous voltage (L-N)</th>
<th>Maximum discharge current (8/20 μs)</th>
<th>Pack</th>
<th>Weight</th>
<th>Item no.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PND-3in1-C-OS</td>
<td>255 V</td>
<td>10 kA</td>
<td>10</td>
<td>29.900</td>
<td>5081072</td>
</tr>
</tbody>
</table>

Combination protection device for coaxial TV/camera systems

- Protection of power and data interfaces in a single device
- In aluminium housing
- Simple mounting with adapter
- Two-stage protection circuit
- Three-pole power connection for the power interface
- With LED operation display (OS)
- Incl. DIN rail fastening set

Application: Protection of CCTV, video signals, cameras and/or TV systems

PND-3in1-C-OS

Lightning protection zone LPZ: 1–3
Earth ing via: Connection cable/DIN rail
Protection rating: IP20
Power
SPD to IEC 61643-11: Class II-III
SPD to EN 61643-11: Type 2-3
Maximum continuous voltage (L-N) $U_c$: 255 V
Rated current $I_c$: 16 A
Protection level $U_{imp}$: <1,3 kV
Nominal discharge current (8/20 μs) $I_{imp}/U_{imp}$: 5 kA
Maximum discharge current (8/20 μs) $I_{max}$: 10 kA
Data
Maximum continuous voltage AC $U_c$: 5.65 V
Maximum continuous voltage DC $U_c$: 8 V
SPD to IEC 61643-21: Class H II / D1+C2
Category: Type 1-2 / D1+C2
Impulse durability wire-wire $I_{imp}$: 1 kA
Impulse durability wire-earth $I_{imp}$: <450 V
Protection level wire-wire $I_{max}$: <65 V
Protection level wire-earth $I_{max}$: <90 V
Frequency range: 0-100 MHz
Video
Maximum continuous voltage AC $U_c$: 5.65 V
Maximum continuous voltage DC $U_c$: 8 V
SPD to IEC 61643-21: Class H II / D1+C2
Category: Type 1-2 / D1+C2
Impulse durability wire-wire $I_{imp}$: 5 kA (8/20μs)
Impulse durability wire-earth $I_{imp}$: 10 kA (8/20μs)
Impulse current (10/350) $I_{imp}$: 1 kA
Protection level wire-earth $I_{max}$: <90 V
Protection level wire-wire $I_{max}$: <150 V
Frequency range: 0-100 MHz
Screen connection: Yes
Screening: Direct
Temperature range: -20°C to +80°C
Surge protection for high-speed networks up to 1 GBit (Class ND-CAT6/E-F)

- Protection class: Fine protection
- High-quality RJ45 sockets
- Low protection level at high current load
- Earthing via DIN rail or connection cable
- Support of Power over Ethernet ++ (PoE++)/4PPoE) to 1 A in accordance with IEEE 802.3
- Tested transmission quality in networks up to 1 GBit/s (Class E) or CAT6
- Rapid installation through plug-in version
-incl. DIN rail fastening set and earthing cable

Application example: 1 GBit Ethernet, 10/100 MBit Ethernet, PoE applications, IP camera systems, ISDN S0 interfaces

ND-CAT6/E-F

- Maximum continuous voltage AC: U_{AC} = 41 V
- Maximum continuous voltage DC: U_{DC} = 58 V
- Category: Type 2+3 / C2+C1
- Lightning protection zone LPZ: 1 a 2
- Channel performance ISO/IEC: Class E
- Channel performance Ansi/EA: CAT 6
- Number of poles: 8
- Rated current: I_{R} = 1 A
- Impulse durability wire-wire: I_{C1}: 0,3 kV / 0,15 kA (8/20µs)
- Impulse durability wire-earth: I_{C2}: 3 kV / 1,5 kA (8/20µs)
- Total discharge current (8/20): 5 kA
- Protection level wire-wire: \textless 40 V
- Protection level wire-earth: \textless 900 V
- Frequency range: \textgreater 250 MHz
- Temperature range: 0 \textdegree C \textless \textless 80 \textdegree C
- Installation type: Connector/cable adapter
- Connection system: RJ45 8(8)
- Protection rating: IP10
- Shielding connection available: Yes
- Earthing via: Connection cable/DIN rail
- Testing standard: IEC 61643-21

Dimensions

Connection options

- Type: ND-CAT6/E-F
- Version: Fine protection, 8 wires + shield
- Connection system: RJ45 8(8)
- Pack: 1
- Piece: 1
- Weight: 16.380 kg
- Item no.: 5081802
Surge protection for high-speed networks up to 1 GBit (Class ND-CAT6/E-B)

Data cable protection device for high-speed networks
- Protection class: Basic protection
- High-quality RJ45 sockets
- Low protection level at high current load
- Earthing via DIN rail or connection cable
- Support of Power over Ethernet ++ (PoE++)/4PPoE) to 1 A in accordance with IEEE 802.3
- Tested transmission quality in networks up to 1 GBit/s (Class E) or CAT6
- Rapid installation through plug-in version
- Incl. DIN rail fastening set and earthing cable

Application example: 1 GBit Ethernet, 10/100 MBit Ethernet, PoE applications, IP camera systems, ISDN S0 interfaces

ND-CAT6/E-B

| Maximum continuous voltage AC \( U_{ac} \) | 46 V |
| Maximum continuous voltage DC \( U_{dc} \) | 65 V |
| Category | Type 1 / D1 |
| Lightning protection zone LPZ | 0/1 |
| Channel performance ISO/IEC | Class E |
| Channel performance ANSI/EA | CAT 6 |
| Number of poles | 8 |
| Rated current \( I \) | 1 A |
| Impulse durability wire-wire | C2: 3 kV / 1,5 kA (8/20µs) |
| Impulse durability wire-earth | C2: 3 kV / 1,5 kA (8/20µs) |
| Total discharge current (8/20) | 10 kA |
| Protection level wire-wire | <1100 V |
| Protection level wire-earth | <900 V |
| Frequency range | >250 MHz |
| Temperature range | -40 °C to +80 °C |
| Installation type | Connector/cable adapter |
| Connection system | RJ45 8(8) |
| Protection rating | IP10 |
| Shielding connection available | Yes |
| Shield connection | Direct |
| Earthing via | Connection cable/DIN rail |
| Testing standard | IEC 61643-21 |
Data cable protection device for high-speed networks

- Protection class: Fine protection
- High-quality RJ45 sockets
- Low protection level at high current load
- Earthing via DIN rail or connection cable
- Support of Power over Ethernet ++ (PoE++/4PPoE) to 1 A in accordance with IEEE 802.3
- Tested transmission quality in networks up to 10 GBit/s (Class EA) or CAT6
- Rapid installation through plug-in version
- Inc. DIN rail fastening set and earthing cable

Application example: 10 GBit Ethernet, 10/100 MBit Ethernet, PoE applications, IP camera systems, ISDN S0 interfaces

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**ND-CAT6A/EA**

- **Maximum continuous voltage AC** $U_{1L}$: 41 V
- **Maximum continuous voltage DC** $U_{1C}$: 58 V
- **Category** Type 2+3 / C2+C1
- **Lightning protection zone** LPZ 1-3
- **Channel performance ISO/IEC** Class EA
- **Channel performance ANSI/EA** CAT 6A
- **Number of poles** 8
- **Rated current** $I_{n}$: 1 A
- **Impulse durability wire-wire** $I_{p1}$: 0.3 kV / 0.15 kA (8/20µs)
- **Impulse durability wire-earth** $I_{p2}$: 2 kV / 1 kA (8/20µs)
- **Total discharge current (8/20)**: 7 kA
- **Protection level wire-wire** $I_{p1}$: <120 V
- **Protection level wire-earth** $I_{p2}$: <700 V
- **Frequency range** >500 MHz
- **Temperature range** $\theta$: -40 to +80 °C
- **Installation type** Connector/cable adapter
- **Connection system** RJ45 8(8)
- **Protection rating** IP10
- **Shielding connection available** Yes
- **Earthing via:** Connection cable/DIN rail
- **Testing standard** IEC 61643-21

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**Dimensions**

- Width: 25.5 mm
- Height: 48.7 mm
- Depth: 93.6 mm

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**Connection options**

- Fine protection, 8 wires + shield, RJ45 8(8)

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**Packaging information**

- **Pack** 1
- **Piece** 1
- **Weight** kg/100 pc.: 16.600
- **Item no.** 5081800