



NOVARIS

Application Note
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SURGE PROTECTION FOR CCTV SYSTEMS

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Introduction

Like all electrical and electronic equipment CCTV systems can be damaged by electrical disturbances. These are most commonly caused by direct and indirect lightning effects, but also other overvoltage disturbances caused by electrical switching operations, load switching and other grid related transients being coupled into the connecting cabling.

Correct selection and application of Surge Protection Devices (SPD) can reduce or even eliminate damage to your CCTV system components and this application note provides guidance on all aspects of this process.

Background and risks

CCTV systems are often distributed systems covering significant areas using copper cables for connections between the cameras and the controlling or recording equipment. The fact that often these systems are located outdoors and parts of the system are earthed (grounded) at different locations and they use large scale integrated electronics makes them particularly susceptible to electrical transients and disturbances.

Often systems for protection of high security installations such as military or prison facilities use sophisticated PTZ and infra-red cameras mounted on high poles that makes them highly exposed to lightning induced surges.

These types of cameras are extremely expensive and can be difficult to access for repair so installing best practice surge protection is a cost-effective method to minimise surge damage and resultant downtime.

Modes of damage

CCTV networks are susceptible to all three modes of surge induction, Earth Potential Rise (EPR) magnetic field and electric field induction.

EPR is probably the most damaging effect for systems with many outdoor cameras mounted on poles at different locations whereas electric and magnetic fields can act on the cabling systems even when they are inside a structure. All three effects can generate large voltage differences easily sufficient to damage the cameras and the controlling or recording equipment.

Protection against damage from these effects takes the form of correctly specified Surge Protection Devices (SPD) that can keep the system voltages well below the levels where equipment is damaged whilst passing the high surge current waveforms at the same time.

All electrical services require SPDs to be fitted if good protection is to be assured; signal/data cables, power cables and the main incoming power supply all require protection.

Application of SPD's

To select the correct SPD for any application there five basic steps to follow:

- What is the exposure level of the site? AS1768 provides good guidance in assessing this and determining a suitable surge rating for the SPDs
- What is the signal in the cable, maximum possible voltage, highest frequency?
- For series SPDs what is the maximum line current?
- Is the cable between equipment longer than 10m? If so an SPD is required at each end of the cable run
- What is the method of mounting for the SPD and what IP rating is required?

The answers to these points will allow suitable SPDs to be chosen using this application note as well as the individual product data sheets which can be obtained from the Novaris website, novaris.com.au

This application note details the surge protection devices available for most common CCTV protocols and applications. For other CCTV applications not covered in this note, please contact Novaris at info@novaris.com.au

IP cameras

These are the most common types of camera used with wired connections. They utilise standard LAN connections using the RJ45 type of connector. They come in a range of speeds with the more modern ones being classified as CAT6 or CAT6A and work with data rates of up to 1.0Gb/s.

Many applications use Power over Ethernet (PoE) where the power for the field device or camera is delivered via the same cable as the network connection.

For these applications Novaris has a full range of SPDs that are designed to protect the field equipment as well as the controlling equipment which usually takes the form of a network switch.

These RJ45 range of network protection products are designed with IP camera applications in mind. They support both CAT6, CAT6A, Gigabit and PoE applications utilising up to 160W of 2 pair power.

For applications where the field equipment needs to be isolated from ground under normal conditions -EC90 versions, such as the RJ45-1CAT6-EC90 are available.

RJ45-1CAT6

The RJ45 single units are designed for point to point applications including field equipment (camera) protection. They are a 2 stage protection device with 10kA of signal protection per pair on the line side and low impedance silicon based protection on the equipment side which faces the protected equipment. The PoE unit is designed to pass up to 1A of current at 80V DC per signal pair allowing it to be used for high current applications.



Figure 1. Single Port RJ45-1CAT6 PoE SPD

RJ45-8CAT6-1RU, RJ45-16CAT6-1RU, RJ45-24CAT6-1RU

This is a 1RU rackmount surge protected termination unit, available equipped with 8, 16 or 24 ports. Line cables terminate on RJ45 sockets at the rear of the unit and the front patches to the protected equipment. This is a compact unit that can replace standard rack mount termination products.

Each port is configured identically to the standard RJ45-1CAT6 with Gigabit performance and 160W PoE capability.



Figure 2. RJ45-24CAT6-1RU rack mounted unit

RJ45-8CAT6, RJ45-16CAT6, RJ45-24CAT6

This is a 2RU protected patch panel used in conjunction with an existing rackmount termination unit.

These units are available in 8, 16 and 24-port options to suit different configurations of network switch. The surge protection configuration in these units is identical to that utilised in the RJ45-1CAT6 SPD but in a convenient 19inch configuration for direct connection to a PoE switch.



Figure 3. RJ45-24CAT6 rack mounted unit

DIN Rail mounted RJ45 protection

These DIN rail compatible units are designed for industrial application where they can be installed in equipment rooms, outdoor cabinets or equipment enclosures. They clip onto a standard TS32 DIN rail and use the DIN rail as the primary means of earthing. In addition, a separate earth stud is provided. The earth should be connected to the local earth as well as the earth connection of the equipment it is protecting. 4mm² wire is suitable for this.

Two DIN mounted units are available, single circuit DRJ45-1CAT6 and 8 circuits, as shown below in figure 4. All units use the same modular circuits as the RJ45-1CAT6.



Figure 4. DRJ type RJ45 surge protector

Weatherproof RJ45 protection

For outdoor applications, a two-circuit protector is available. It comes in a weatherproof IP54 rated housing with a hinged access door and soft gaskets to seal the cable entries which are at the bottom. These units should always be installed with the cable entry ports facing downwards to prevent water entering the housing.

The unit is fitted with an earth connection at the top and this should be connected to the local earth as well as the earth connection of the equipment it is protecting. 4mm² wire is suitable for this.



Figure 5. ORJ45-2CAT6 weatherproof protector

IP67 rated outdoor RJ45 protection

For installation of RJ45 network protection outdoors where a suitably located enclosure is not available a single circuit IP67 rated SPD is available. This is the RJ45-1CAT6-IP67, it is available in standard and isolated ground EC90 versions.

The unit still connects using plug in RJ45 sockets but makes use of special cable glands to deliver a seal around the cables. Please refer to the installation instructions carefully to ensure the IP rating is maintained after installation is completed.



Figure 6. RJ45-1CAT6-IP67 protector

RJ45 Installation

Installation of the RJ45 network protection products is straightforward. They are simply plugged in line with the established network infrastructure ensuring the line side of the SPD faces the cable between the local and field equipment and the equipment side faces the equipment to be protected. The SPDs should be mounted as close to the equipment being protected as possible and the ground connection wire connected directly to the equipment ground terminal or chassis earth stud as shown in figure 6 below.

There is an earth stud on the rear of the rack mount unit and a flying earth lead on the single port units provided for this purpose.

The DRJ, ORJ and IP67 units achieve their earth path either by the DIN rail or by a using a grounding wire on the earth stud provided on the unit.

The earth connection wires should be cut and shortened as much as physically possible. Do not coil or loop these wires.

All RJ45 protection units have no series resistance and therefore do not affect the total cable lengths specified for the category of cable type used.

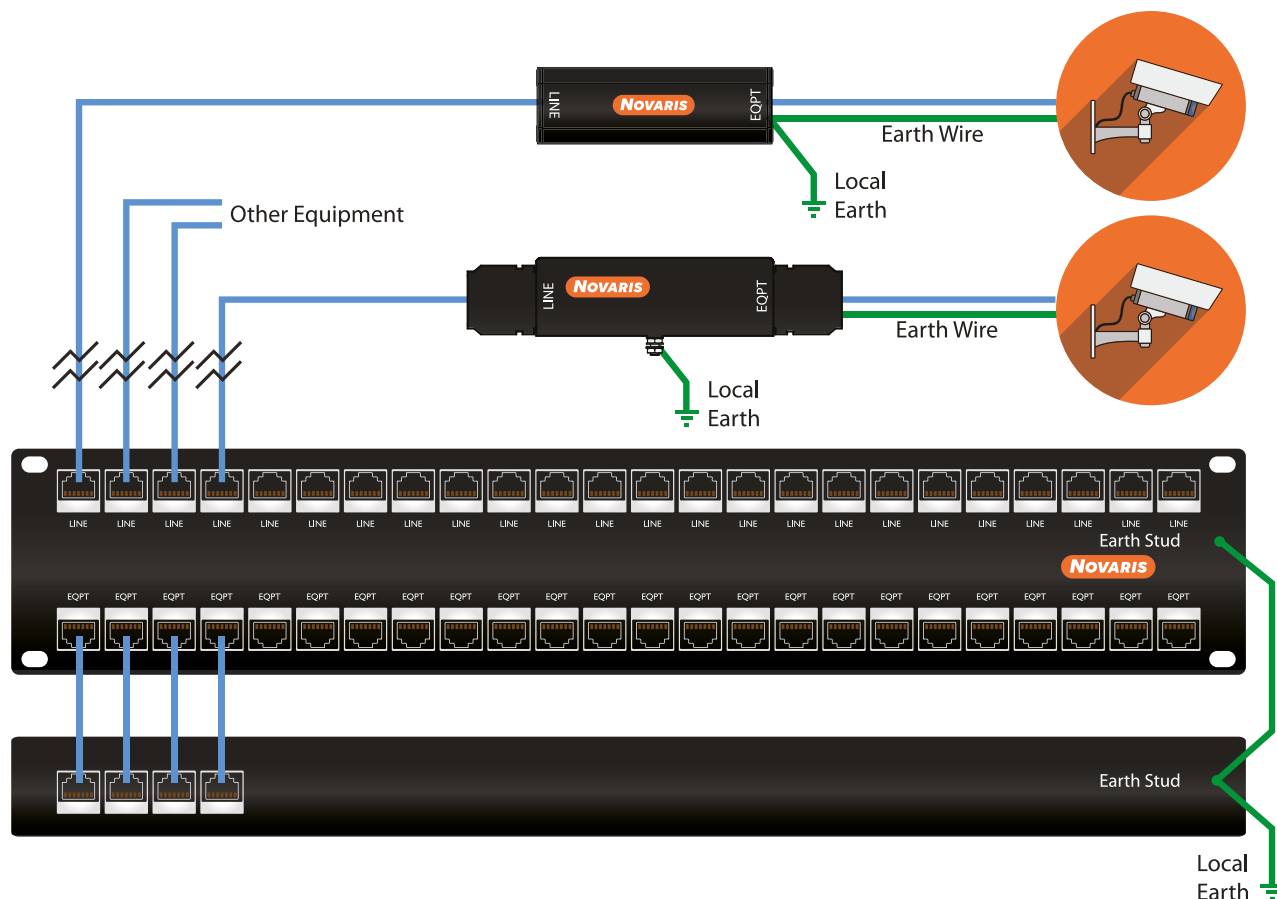


Figure 7. Wiring schematic for rack unit with remote field protection

Cable types and selection of correct field SPD's

The type of Ethernet cable used for external wiring has an impact on the type of SPD to use at the field side. The field equipment, CCTV cameras in this case, are usually earthed locally at the mounting pole, fence or to a building structure. This means that the earth potential at the camera location and that of the controlling equipment can be at very different voltages during surge events, potentially causing equipment damage. This is why both ends of the cables need protection as shown in figure 6 above.

The type of cable used for the field wiring can defeat this arrangement and cause system interference due to the inadvertent connections of the two separate earth systems via a cable screen.

If the field wiring is unscreened, Unscreened Twisted Pair (UTP) then the field SPD should be a direct earth type, such as the RJ45-1CAT6.

If the field wiring is screened, Screened Twisted Pair (STP) then the cable screen would directly connect both earthing systems together via the SPDs, potentially causing earth loops and interference. To break this loop an isolated ground SPD should be used at the field side, such as the RJ45-1CAT6-EC90. The EC90 option will remain floating from earth until a surge event occurs and after conducting the surge energy to earth will return to an isolated state.

Analogue camera protection

Novaris has a range of coaxial protection units suitable for the older styles of analogue cameras. There are number of different products designed to suit the application.

BNC coaxial signal protection

The CLB coaxial protection units are designed specifically for security and CCTV application. They have a 20kA protection first stage with secondary silicon based protection to provide a low let through voltage to the equipment side. They are enclosed in an extruded aluminium enclosure to protect the signal from external interference. The unit has an earth stud mount for earthing and can be ordered with a DIN rail mount option.



Figure 8. CLB-FF-10 coaxial protector

SFD-C combined power and signal protection

The SFD-C combined unit provides protection for both the power and signal lines of a coaxial based installation in a convenient 28mm wide DIN rail mount unit. The power supply to the camera is protected with a 3-stage surge protection system which incorporates a low pass LC filter to provide a very low let through voltage. These combined units have models designed for 30V and 230V AC power supply systems.

These units can be directly earthed via the DIN rail mounting or via the centre terminal of the power connectors. This should be connected to the local earth as well as the earth connection of the equipment it is protecting. 4mm² wire is suitable for this.



Figure 9. SFD1-6-3-30-C combined signal and power protector

The signal protection is the same as used in the CLB protection devices and is isolated from earth via a gas discharge tube to prevent any video interference due to ground/earth loops.

Balun converted coaxial transmission

A convenient way of achieving good cable management when installing a balun converted coaxial system over Cat5/6 cable is to pass the cable through a Krone mounting block. The Novaris range of Krone protection units are available in a range of voltages to suit most applications up to 350mA. They can also be used to protect PTZ control systems such as Pelco D using the KPx-06DC unit.

Figure 10 below shows an example of such a unit.



Figure 10. KP10 protector for Krone blocks

SDI coaxial protection

SDI CCTV systems operate at a much higher frequency than standard coaxial camera systems. The CB-MF-90-3 protection unit, as shown below in figure 11, can pass up to 3 GHz signals with less than 0.2% transmission loss through the device whilst providing 20kA of protection for the signal. These devices are available with multiple mounting options such as flying lead, DIN mount and an L bracket. The power for the SDI camera can be protected with a Novaris signal protector such as the SSP6A-26-G.



Figure 11. Typical BNC coaxial protector

Control signal protection low current

The Novaris Signal Line (SL) products are ideally suited for protecting PTZ control signals. The SL-485 is ideally suited for the underlying RS485 protocol of Pelco D. RS232 controlled cameras can use the Novaris SL-36 protectors.

The SL signal line protectors are a multi stage protection device with 10kA of protection on the line side and tertiary protection on the equipment side to deliver low let through voltages to the equipment.

They use DIN rail mounting bases and the surge protection module simply plugs in, they are suitable for line currents up to 250mA.

They are available to suit a wide range of protocols and signals, please refer to the product handbook or the Novaris website novaris.com.au for details.

As with the other signal units on cables over 10 meters in length, for optimum protection a device needs to be installed at both ends to provide a full current path in the case of a surge.

The base units are available in a direct grounding version, Type G, and an indirect grounding option, Type EC90. Typically the G version would be used at the controlling equipment and the EC90 base at the field equipment end, so that ground/earth loops are avoided.



Figure 12. Signal line protectors, low current

Control signal protection high current

The Novaris Signal Line (SL2) products are similar to the SL products but feature a greater load current and higher surge ratings for equipment in high exposure locations.

The SL2 signal line protectors are a multi stage protection device with 20kA of protection on the line side and tertiary protection on the equipment side to deliver low let through voltages to the equipment.

They use DIN rail mounting bases and the surge protection module simply plugs in, they are suitable for line currents up to 500mA.

They are available to suit a wide range of protocols and signals, please refer to the product handbook or the Novaris website novaris.com.au for details.

They also feature a mechanical alarm indicator on the front and a voltage free remote alarm contact to indicate if the device has been damaged by a surge above its ratings.

As with the other signal units on cables over 10 meters in length, for optimum protection a device needs to be installed at both ends to provide a full current path in the case of a surge.

The base units are available in a direct grounding version, Type G, and an indirect grounding option, Type EC90. Typically, the G version would be used at the controlling equipment and the EC90 base at the field equipment end, so that ground/earth loops are avoided.

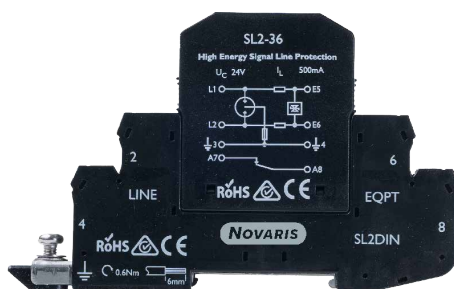


Figure 13. Typical SL2 protector

These units are also available in a two pair configuration, the SL4 range. Please refer to the product handbook or the Novaris website novaris.com.au for details.

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DVR and control equipment power protection

Protection of the AC power feeding the control or DVR equipment should not be forgotten.

The best protection is provided by filters which utilise 3 stages of protection including a low pass LC filter stage to help reduce the levels of high frequency noise which can have detrimental effects on sensitive electronics.

For full details of applying SPDs to power systems please refer to the Novaris application note 0015-D65.

Two filters that are particularly well suited to DVR application are the PP10 and the SFD series.

For wired installations, SFD surge filters are recommended. They provide a low 600V let through in a DIN rail format as shown in figure 14 below.



Figure 14. Typical SFD surge filter

For plugin or retrofit installations the PP10 filters provide the same low let through voltage and have general purpose mains outlets for total loads up to 10A. They simply plug into a standard wall outlet using in IEC lead and provide up to 8 filtered outlet sockets.



Figure 15. Typical PP10 plug-in surge filter

Versions are also available with UK, US, EU and universal sockets.

DC power protection

Where DC power is used for applications such as PTZ controls surge protection is also recommended. As with control signals if the cable is over 10 meters in length, for optimum protection a device needs to be installed at both ends to provide a full current path in the case of a surge.

Depending on the load current required there are two options for protecting these circuits.

For load currents less than 6 Amps use the SSP6A family and for load currents over 6 Amps but less than 10 Amps use the SSP10A family. Both of these product ranges are DIN rail mount and have removable top cassettes to allow for circuit disconnection without using additional terminals.

The SSP6A is the same form factor as the SL range of signal line protectors as shown in figure 11 while the SSP10A is in the SL2 type housing as shown below in figure 16.

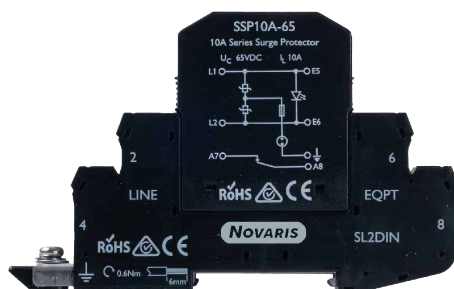


Figure 16. typical SSP10A DC power SPD

