



CITEL

Surge Protection for
Utility-Interactive
Solar Photovoltaic (PV) Systems

Surge Protection for Utility-Interactive Solar Photovoltaic (PV) Power Systems

Background and Protection Considerations

Utility-Interactive or Grid-Tie Solar Photovoltaic (PV) Systems are very demanding and cost intensive projects. They often require the Solar PV System to be operational for several decades before it can yield the desired return on investment.

Many manufacturers will guarantee a system life of greater than 20 years while the inverter is generally guaranteed for only 5-10 years. All costs and return on investments are calculated based on these time periods. However, many PV systems are not reaching maturity due to the exposed nature of these applications and its interconnection back to the AC utility grid. The solar PV arrays, with its metallic frame and mounted in the open or on roof tops, act as a very good lightning rod. For this reason, it is prudent to invest in surge protection to eliminate these potential threats and thus maximize the systems life expectancy. The cost for a comprehensive surge protection system is less than 1% of the total system expenditure.

To analyze the full threat level of the installation, we must make a risk assessment.

Geographic Risk – Areas with severe lightning and unstable utility power are more vulnerable.

Application Surface Area Risk – The greater the surface area of the solar PV array, the more exposure to direct and/or induced lightning surges.

Power Interconnection Risk – The AC utility grid is a likely source of switching transients and/or induced lightning surges.

Operational Downtime Risk – Consequences of system downtime are not only limited to equipment replacement. Additional losses can result from lost orders, idle workers, overtime, customer/management dissatisfaction, expedited freight charges and expedited shipping costs.

Best Practices

1) Earthing System

Surge Protectors shunt transients to the earth grounding system. A low impedance ground path, at the same potential, is critical for the surge protectors to function properly. All power systems, communication lines, grounded and ungrounded metallic objects need to be equipotentially bonded for the protection scheme to work efficiently.

2) Underground Connection from External PV Array to Electrical Control Equipment

If possible, the connection between the external Solar PV Array and the internal power control equipment should be underground or electrically shielded to limit the risk of direct lightning strikes and/or coupling.

3) Coordinated Protection Scheme

All available power and communication networks should be address with surge protection to eliminate PV system vulnerabilities. This would include the primary AC utility power supply, Inverter AC output, Inverter DC input, PV string combiner and other related data/signal lines such as RS-485, 4-20mA current loop, PT-100, RTD, and telephone modems.



Application of Surge Protection for a Large Commercial Utility-Interactive Solar PV System

A comprehensive approach to the application of lightning and surge protection will help to ensure the maximum life expectancy and efficiency for your solar PV power system. The following illustration details the application points for the surge protectors and the primary protection goal of each device.

1 AC Distribution Panel

Protects all loads connected to the facility's main distribution panel against transients originating from the AC utility grid or internal switching equipment, i.e. CNC machines, elevators, inductive motors.

2 Inverter AC Output

Local protection in front of the inverter to protect against threats from the AC utility and generated internally within the facility.

3 Data/Signal Lines

Protects inverter, communication equipment and PC workstations against lightning induced transients entering the system via exposed sensor and communication lines.

4 Inverter DC Input

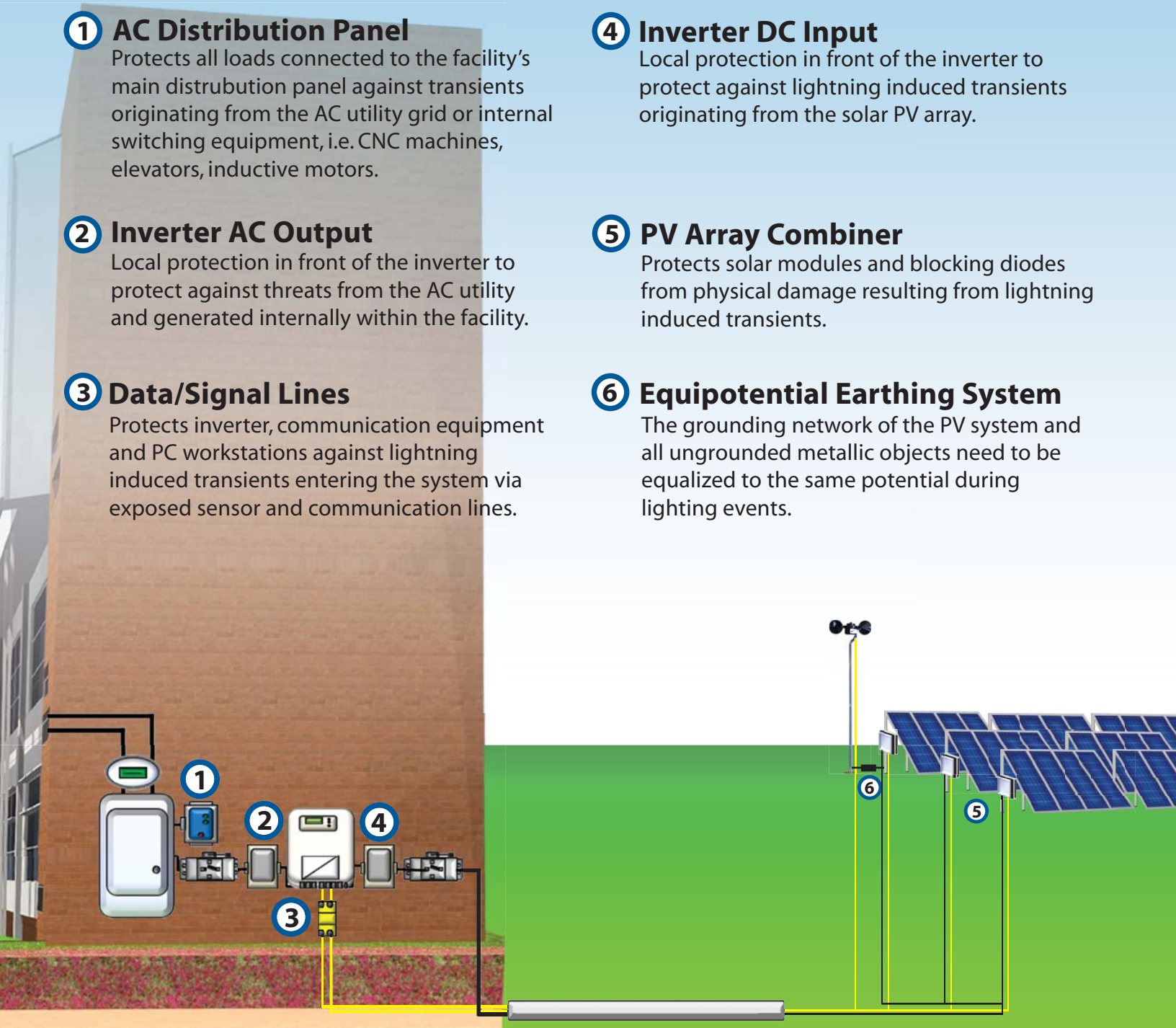
Local protection in front of the inverter to protect against lightning induced transients originating from the solar PV array.

5 PV Array Combiner

Protects solar modules and blocking diodes from physical damage resulting from lightning induced transients.

6 Equipotential Earthing System

The grounding network of the PV system and all ungrounded metallic objects need to be equalized to the same potential during lighting events.



Surge Protection Selection Guide

DS60PV

- Heavy Duty DC Surge Protector
- Inverter DC Input
- PV Combiner Box



| Technical Data | | DS60PV-500 | DS60PV-1000 |
|----------------------------------|------|------------|-------------|
| Max. line voltage (DC) | Uc | 550Vdc | 1000Vdc |
| Repetitive surges x 15 (8/20 μs) | In | 40kA | 40kA |
| Surge current (10/350 μs) | Iimp | 12.5kA | 12.5kA |

DS50PV

- General Duty DC Surge Protector
- Inverter DC Input
- PV Combiner Box



| Technical Data | | DS50PV-500 | DS50PV-1000 |
|----------------------------------|------------------|------------|-------------|
| Max. line voltage (DC) | Uc | 530Vdc | 1060Vdc |
| Repetitive surges x 15 (8/20 μs) | In | 20kA | 20kA |
| Surge current (8/20 μs) | I _{max} | 40kA | 40kA |

DS150E/G

- Heavy Duty AC Surge Protector
- Inverter AC Output



| Technical Data | | DS15xE-480/G | DS15xE-300/G | DS15xE-120/G |
|----------------------------------|------|--------------|--------------|--------------|
| Max. line voltage (AC) | Uc | 550Vac | 330Vac | 150Vac |
| Repetitive surges x 15 (8/20 μs) | In | 70kA | 70kA | 70kA |
| Surge current (10/350 μs) | Iimp | 15kA | 15kA | 15kA |

* x = Number of poles protected: 1,2,3,4

DS40S/G

- General Duty AC Surge Protector
- Inverter AC Output



| Technical Data | | DS4xS-480/G | DS4xS-400/G | DS4xS-120/G |
|----------------------------------|------------------|-------------|-------------|-------------|
| Max. line voltage (AC) | Uc | 550Vac | 400Vac | 150Vac |
| Repetitive surges x 15 (8/20 μs) | In | 20kA | 20kA | 20kA |
| Surge current (8/20 μs) | I _{max} | 40kA | 40kA | 40kA |

* x = Number of poles protected: 1,2,3,4

DLA

- Data/Signal Line Surge Protector
- RS-485 - PT100
- 4-20mA - Telco



| Technical Data | | DLA-48D3 | DLA-24D3 | DLA-6D3 |
|----------------------------------|------------------|----------|----------|---------|
| Max. line voltage (DC) | Uc | 53Vdc | 28Vdc | 8Vdc |
| Repetitive surges x 10 (8/20 μs) | In | 5 kA | 5 kA | 5 kA |
| Surge current (8/20 μs) | I _{max} | 20 kA | 20 kA | 20 kA |

* Max. current 300mA

M200

- AC Surge Protector
- Main Distribution Panel



| Technical Data | | M200-480D | M200-277Y | M200-120T |
|----------------------------------|------------------|-----------|-----------|-----------|
| Max. line voltage (AC) | Uc | 550Vac | 320Vac | 150Vac |
| Repetitive surges x 15 (8/20 μs) | In | 40kA | 40kA | 40kA |
| Surge current (8/20 μs) | I _{max} | 200kA | 200kA | 200kA |

DS210..DC

- DC Surge Protector
- Charge Controller



| Technical Data | | DS210-110DC | DS210-48DC | DS210-24DC |
|----------------------------------|------------------|-------------|------------|------------|
| Max. line voltage (DC) | Uc | 125 Vdc | 56 Vdc | 30 Vdc |
| Repetitive surges x 15 (8/20 μs) | In | 2kA | 1kA | 1kA |
| Surge current (8/20 μs) | I _{max} | 6kA | 2kA | 2kA |

P100S-350

- Isolating Spark Gap
- Ungrounded Metal Objects



| Technical Data | | P100S-350 |
|----------------------------------|------------------|-----------------|
| Max. line voltage (DC) | Uc | 350 Vdc +/- 20% |
| Repetitive surges x 15 (8/20 μs) | In | 70 kA |
| Surge current (8/20 μs) | I _{max} | 150kA |



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