

Arc Flash Protection (IEC)

Help Protect Human Lives and Equipment from Arc Flash Damage

EcoStruxure Power Digital Application

ESXP2GE006EN-05

11/2023

EcoStruxure™ Power



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Overview

Context of Application

Arc flash incidents can occur as a result of maintenance activities, human error, or equipment failure. Often, this results in costly downtime, interruption of processes and equipment, and injury to persons. Most standard protective devices do not have the ability to respond quickly to arc flash incidents and to limit their effects on equipment and people.

NOTE: Arc flash is not to be confused with arc fault, which is another common cause of failure often related to human error or equipment/installations which are too old or damaged. This can also include loose terminals and crushed or damaged cables. Read the following article to learn more about the difference between arc flash and arc fault:

<https://blog.se.com/electrical-safety/2018/08/25/stopping-electrical-fires-using-arc-flash-and-arc-fault-protection/>

When not stopped or detected in time, these small arcs, at the final distribution level, can result in fires, putting lives and installations at risk. To learn more about Active Arc Fault Detection Devices, check out these links:

<https://www.se.com/ww/en/download/document/CA9SS100E/>

<https://www.se.com/ww/en/download/document/CA9SS099E/>

Problem to Solve

The facility manager needs to:

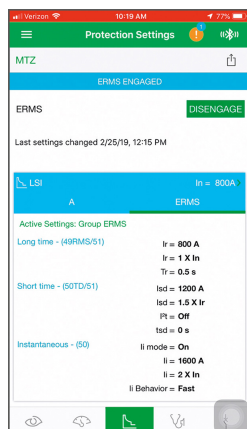
- Avoid personal injury due to arc flash events.
- Eliminate or minimize costs resulting from arc flash damage: downtime, repair time, and interruption of processes and equipment.
- Improve arc flash awareness, enabling fast response of maintenance teams.
- Provide post arc flash event analysis.

Purpose of the Application

Enhance passive arc flash mitigation solutions

- By minimizing equipment damage, downtime, and likelihood of personal injury or death through the detection of light and/or current resulting from arc flash events and ultra-fast operation (less than 40 ms) of associated protective devices.

- By reducing some of the risk during maintenance operation. Energy Reduction Maintenance Settings (ERMS) can be used to help protect staff, occupants, and equipment by temporarily changing circuit breakers to instantaneous trip mode.



ERMS Status Displayed on Power Device

Improve maintenance team awareness

By providing the appropriate information to help troubleshoot and identify the root cause of arc flash events. Arc flash incidents are displayed within easy-to-interpret single-line diagrams and graphical incident timelines.

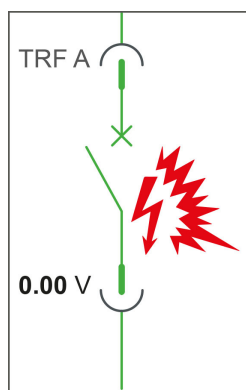
Enable arc flash post incident analysis

By leveraging relevant data. Reported events and alarms are collected from arc flash protective relays.

Application Outcomes

Live Data Display

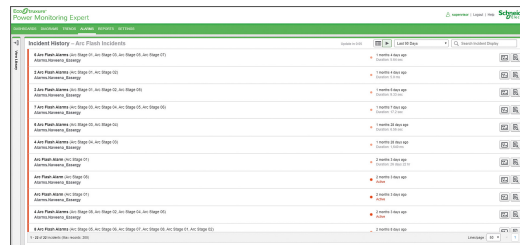
Arc flash incidents are displayed within easy-to-interpret graphical single-line diagrams that highlight which breaker operated as a result of an arc flash.



Display of Arc Flash Related Trips on Single-Line Diagram

Events and Alarms

- Circuit breaker operation statuses and alarms
- Arc flash protection device activation statuses and alarms
- Arc flash protection device diagnosis



Event ID	Event Name	Event Type	Event Status	Event Time	Event Location
1	Arc Flash Alarm - Arc Flash Incident	Arc Flash Alarm	Active	2023-10-27 10:00:00	10kV Busbar
2	Arc Flash Alarm - Arc Flash Incident	Arc Flash Alarm	Active	2023-10-27 10:00:00	10kV Busbar
3	Arc Flash Alarm - Arc Flash Incident	Arc Flash Alarm	Active	2023-10-27 10:00:00	10kV Busbar
4	Arc Flash Alarm - Arc Flash Incident	Arc Flash Alarm	Active	2023-10-27 10:00:00	10kV Busbar
5	Arc Flash Alarm - Arc Flash Incident	Arc Flash Alarm	Active	2023-10-27 10:00:00	10kV Busbar
6	Arc Flash Alarm - Arc Flash Incident	Arc Flash Alarm	Active	2023-10-27 10:00:00	10kV Busbar
7	Arc Flash Alarm - Arc Flash Incident	Arc Flash Alarm	Active	2023-10-27 10:00:00	10kV Busbar
8	Arc Flash Alarm - Arc Flash Incident	Arc Flash Alarm	Active	2023-10-27 10:00:00	10kV Busbar
9	Arc Flash Alarm - Arc Flash Incident	Arc Flash Alarm	Active	2023-10-27 10:00:00	10kV Busbar
10	Arc Flash Alarm - Arc Flash Incident	Arc Flash Alarm	Active	2023-10-27 10:00:00	10kV Busbar

Arc Flash Events and Alarms in Log Viewers of EcoStruxure Power Monitoring Expert and Power Operation

Trends

Long-term trends can be generated to determine if a slowly changing variable may have triggered an arc flash event.

Typically, observing temperature deviations can help you detect loose connections or insulation decomposition that could lead to an arc flash. For more information, refer to the [Continuous Thermal Monitoring](#) application.

Notifications

Immediate SMS and email notifications are sent to enable expedient response.

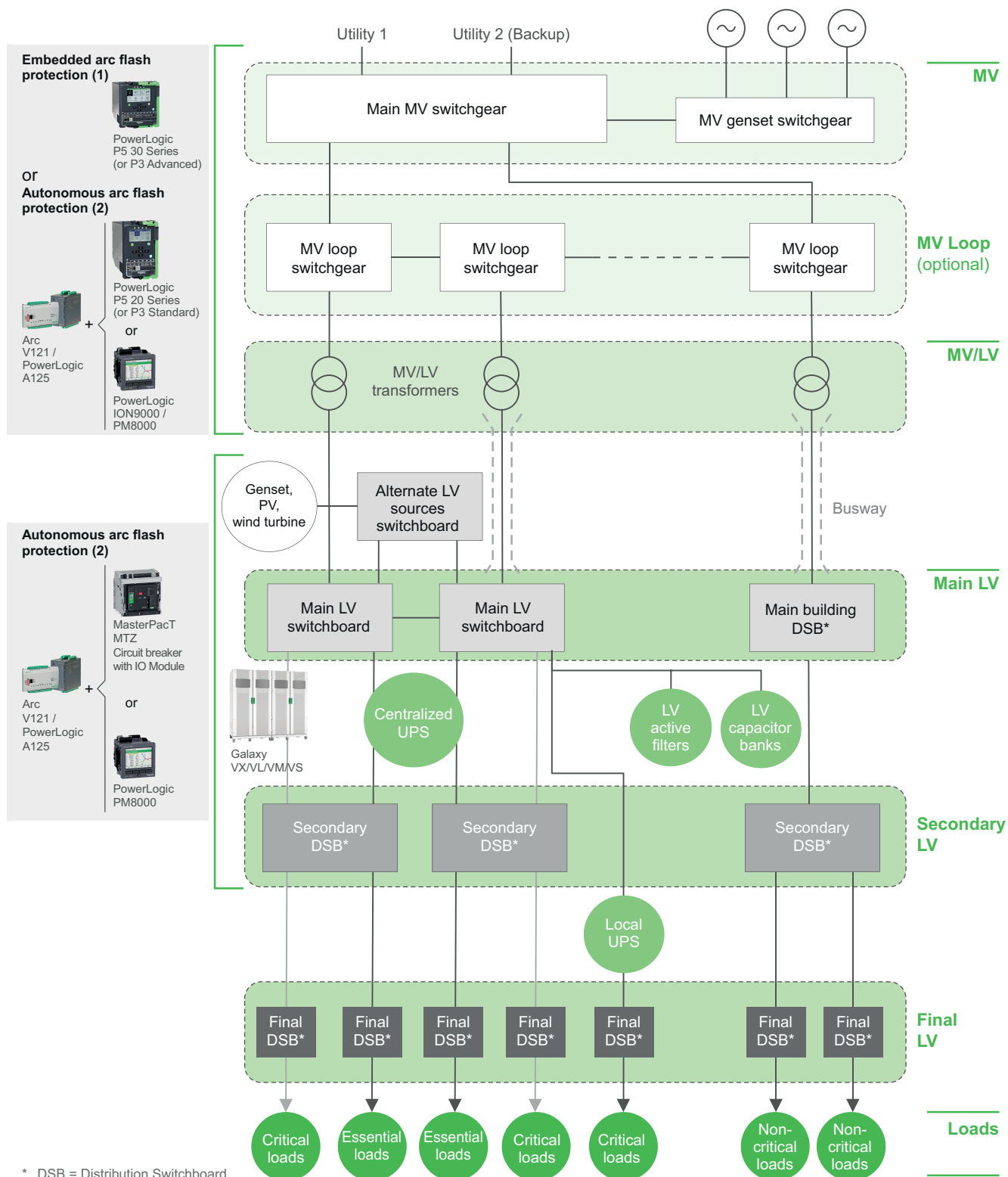
Analysis Tools

Display of arc flash incidents on the Power Event Analysis incident timeline (refer to the [Power Event Analysis](#) application).

Electrical current waveforms captured during an arc flash event can be displayed with a native waveform viewer in the Edge Control software.

Electrical Architecture

The following diagram details the areas of the architecture where the connected products should be installed in order to implement the Arc Flash Protection application:

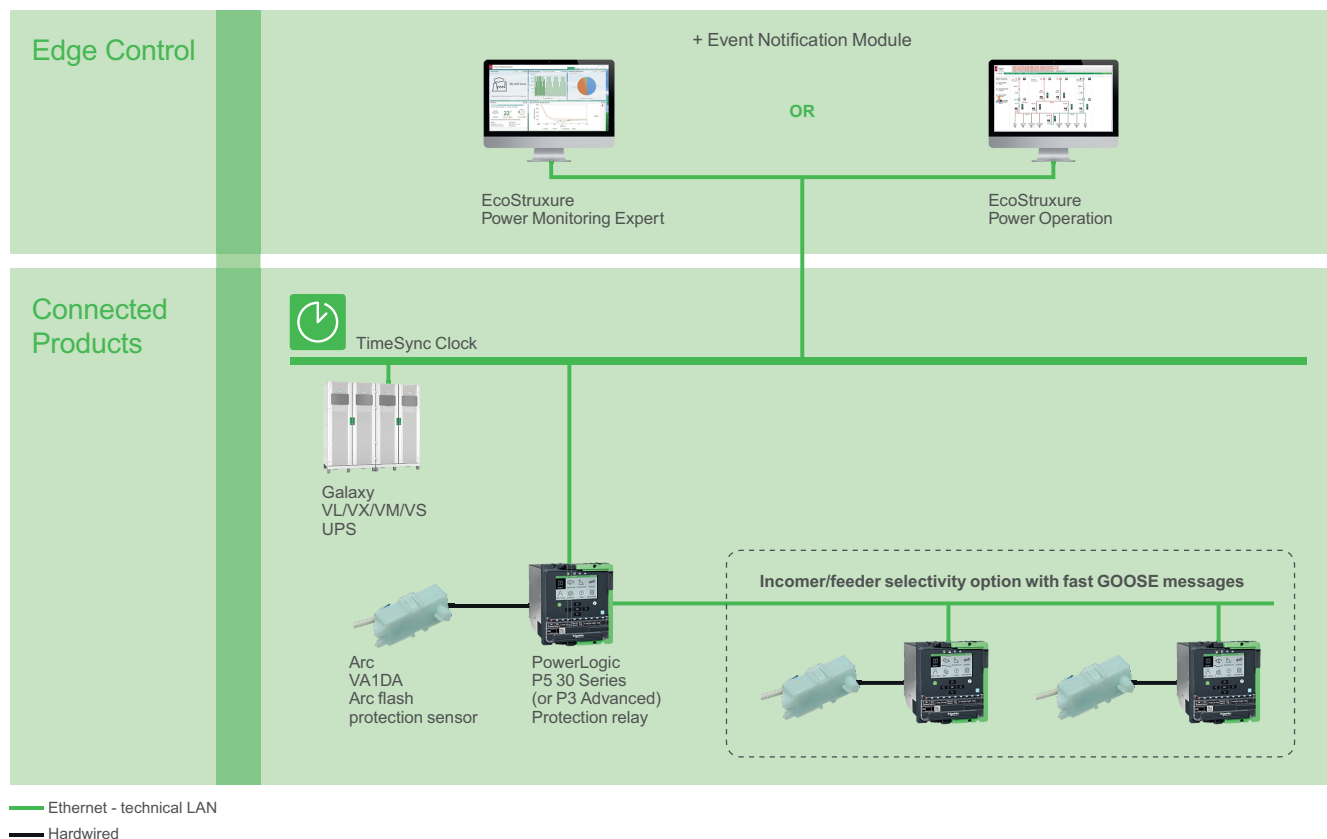


- (1) see digital architecture for arc flash protection embedded in protection relay
 (2) see digital architecture for arc flash protection as an autonomous feature

Digital Architecture

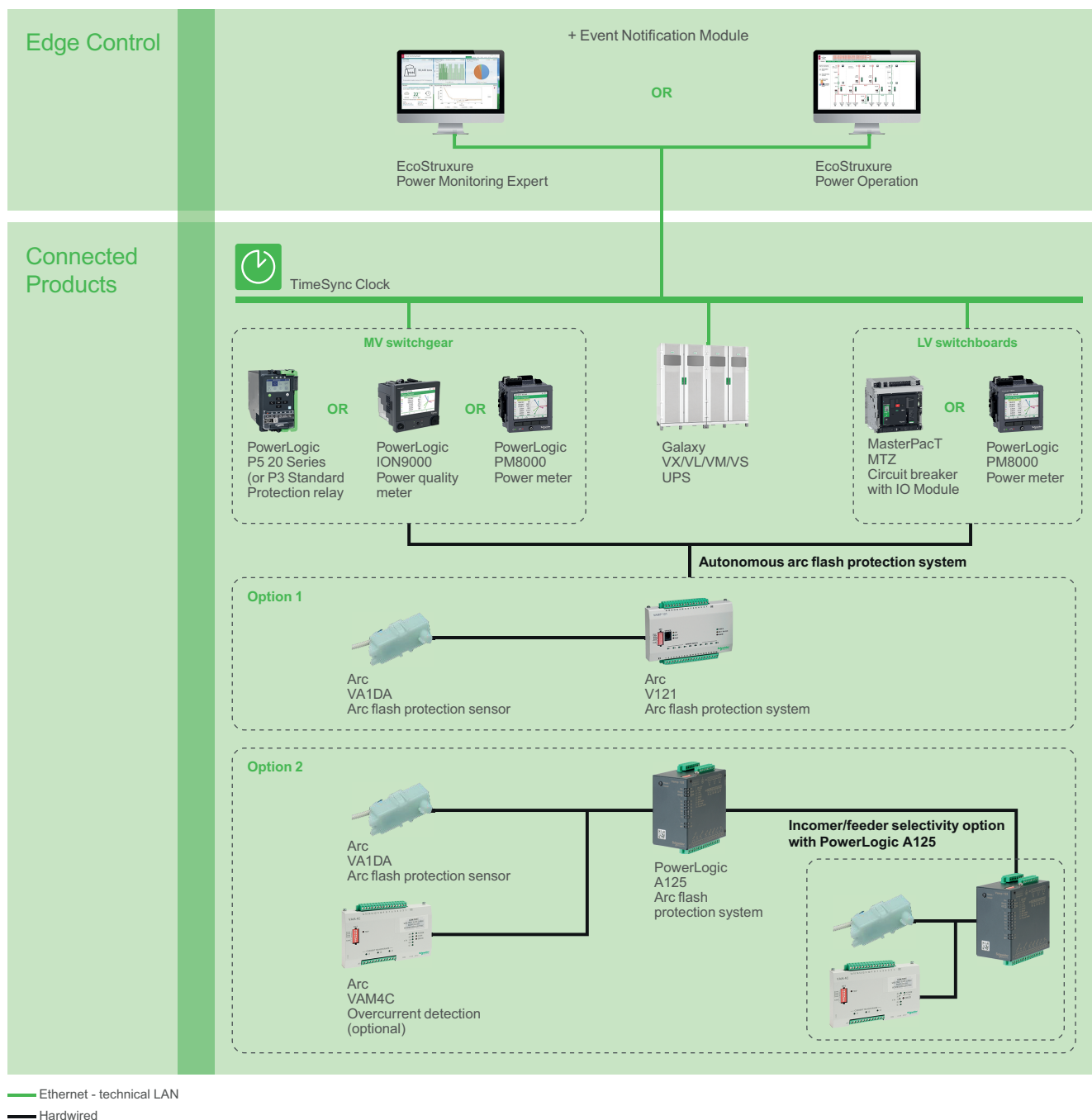
Architecture for Arc Flash Protection Embedded in Protection Relay

Below is the recommended digital architecture for the Arc Flash Protection application embedded in protection relay(s). This architecture is only applicable for MV switchgear:



Architectures for Arc Flash Protection as an Autonomous Feature

Below is the recommended digital architecture for the Arc Flash Protection application when PowerLogic A125 / Arc V121 performs arc fault protection autonomously from the electrical protection relay.

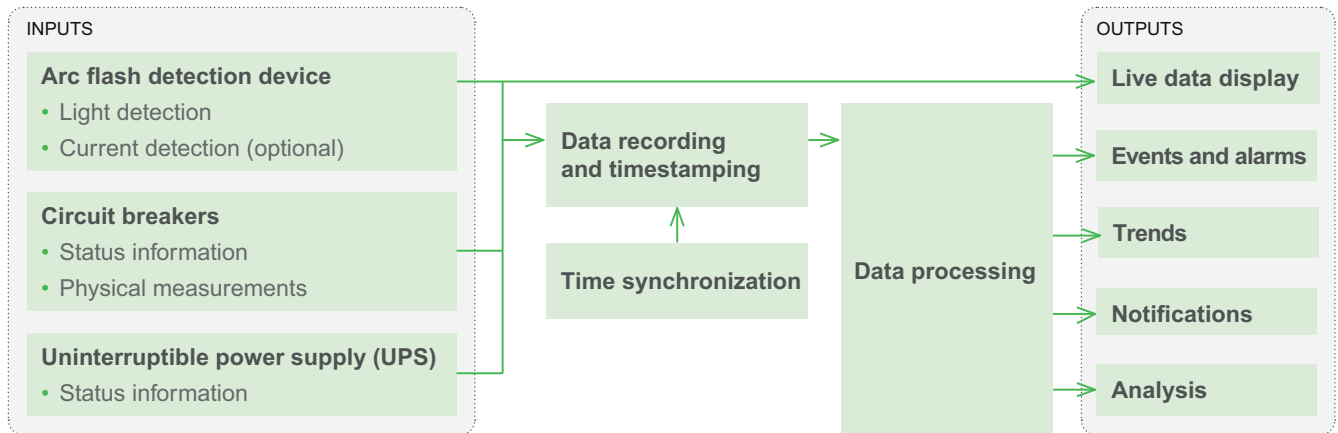


NOTE: For more information about options for Arc Flash Protection in LV switchboards, refer to Arc Flash Protection System in iPMCC by OKKEN Design guide (document number AFPDG0120EN).

System Description

Data Flow

The Arc Flash Protection application can be broken down as follows:



Inputs

Arc flash protection can either be embedded in an electrical protection relay (PowerLogic P5 30 series or P3 Advanced) or provided as an autonomous system when required (PowerLogic A125 / Arc V121).

NOTE: Embedded arc flash detection and protection capabilities are available in the PowerLogic P3 Advanced and P5 30 series. The PowerLogic P3 Standard and P5 20 series can also provide the arc flash protection capabilities when accompanied by standalone detection devices such as the PowerLogic A125 and Arc V121. The distinction between the embedded and standalone arc flash capabilities will be made throughout this application.

In all cases, the following data is required:

Arc Flash Detection Device

Light detection

To detect an arc flash, light sensors are installed in the critical areas of the switchboards. Arc VA1DA (or VA1EH) sensors offer a wide area arc flash detection with a typical detection time <1 ms.



Arc
VA1DA

These sensors can be connected to different arc flash protection devices like PowerLogic P5 30 series, P3 Advanced, PowerLogic A125, or Arc V121.

PowerLogic
P5 30 seriesPowerLogic
P3 AdvancedPowerLogic
P5 20 seriesPowerLogic
P3 StandardPowerLogic
A125Arc
V121

Current detection (optional)

In switchboards that could be exposed to unintentional light, the occurrence of an arc flash must be confirmed with the simultaneous detection of inrush current.

- Protection relays PowerLogic P5 30 series or P3 Advanced directly acquire these measurements through their standard current transformers.
- PowerLogic A125 requires an additional module (Arc VAM4C) with dedicated current transformers to detect high current values.
- Arc V121 cannot interface with a current metering system, it must only be used in switchboards that are not exposed to unintentional light sources.

Arc
VAM4C

Circuit Breakers

When an arc flash is detected, the main supply of the affected area must be disconnected to stop the effects of the arc. Due to high currents resulting from an arc flash, only a circuit breaker can perform this operation. For root cause analysis, circuit breakers must thus be monitored to get a comprehensive view of the arc flash event.

Status information

The arc flash protection system (embedded in protection relay or autonomous) must be able to control the circuit breaker. The following status information is monitored:

- Position (open, closed, racked-in, racked-out, etc.)
- Trip status, protection status
- Operating mode (local/remote when applicable)

Physical measurements

As the arc flash will generate high currents, the overcurrent protection of a protection relay is mandatory in parallel with the arc flash protection system. Therefore the circuit breaker must measure current values.

In addition, protection relays or trip units (PowerLogic P5/P3, MicroLogic X trip unit of MasterPacT MTZ with WFC Digital Module) will be able to capture current waveforms that can be leveraged to analyze the arc flash occurrence.

NOTE: In case the circuit breakers installed in the switchboard cannot communicate, the above information can be provided by a power meter equipped with digital inputs for status information and current measurements for waveform captures (PowerLogic ION9000, PM8000).

PowerLogic
P5 30 seriesPowerLogic
P3 AdvancedPowerLogic
P5 20 seriesPowerLogic
P3 StandardMasterPacT
MTZPowerLogic
ION9000PowerLogic
PM8000

Uninterruptible Power Supply (UPS)

Arc flash incidents can happen during the initial power up of the switchboards or during power restoration after maintenance activities.

To help ensure proper protection at switchboard power-up, the auxiliaries of all products involved in arc flash protection should be powered before the switchboard. To achieve this, auxiliaries should be powered from an external source through UPS, such as Galaxy VX/VL/VM/VS.

Therefore, it is recommended to monitor the status of any UPS used for that purpose throughout the electrical distribution network.

Galaxy
VX/VL/VM/VS

Data Recording and Timestamping

Depending on the solution selected for arc flash protection, data recording can occur at various levels.

Arc Flash Protection Embedded in Electrical Protection Relay

When the arc flash protection is embedded in the electrical protection relay (PowerLogic P5 30 series or P3 Advanced), analog and event data are recorded and timestamped onboard the protection relay itself.

PowerLogic
P5 30 seriesPowerLogic
P3 Advanced

Arc Flash Protection Installed as an Autonomous Feature

With PowerLogic A125 / Arc V121, data must be relayed through another communicating device of the switchboard.

- This device should preferably be a communicating protection relay involved in the arc flash protection. This device should offer digital inputs for connection with PowerLogic A125 / Arc V121. In this case, event data is recorded and timestamped onboard the communicating protection relay (PowerLogic P5 20 series, P3 Standard, or MasterPacT MTZ).

PowerLogic
P5 20 seriesPowerLogic
P3 StandardMasterPacT
MTZ

- In case the protection relays installed in the switchboard cannot communicate, a communicating power meter equipped with digital inputs can be used to relay information from PowerLogic A125 / Arc V121. In this case, event data is recorded and timestamped onboard the communicating power meter (PowerLogic ION9000 or PM8000).

PowerLogic
ION9000PowerLogic
PM8000

For the Arc Flash Protection application, time accuracy of ± 1 ms is recommended to be able to analyze the phenomena, in particular for highly critical applications.

For a comprehensive overview of device recording and timestamping capabilities, refer to Time Synchronization Capabilities of EcoStruxure Power Connected Products.

Time Synchronization

- For system-wide understanding of arc flash phenomena in highly critical applications, it is important to have consistent timestamping. The date and time should be accurately distributed to connected products and other systems. Time synchronization can be performed using various technologies (PTP, NTP, SNTP, etc.). An external master clock is required and can be connected to a GPS antenna to reach the expected time precision.
- For less critical applications, a simple time synchronization over Modbus can be sufficient.



TimeSync Clock

Data Processing

Arc Flash Protection

To help ensure fast reaction to arc flash, data processing of light and current sensors is performed locally by the arc flash protection system that will trigger the circuit breaker opening (PowerLogic P5 30 series, P3 Advanced, or PowerLogic A125 / Arc V121).

PowerLogic
P5 30 seriesPowerLogic
P3 AdvancedPowerLogic
A125Arc
V121

Smart Clustering

To obtain a contextualized capture of the arc flash incident, data processing in Edge Control software consists of:

- Consolidation of alarms, events, waveforms, status changes, and other corresponding data from all connected products in chronological views
- Smart grouping of related data to help identify the root cause of incidents

Smart clustering is performed by EcoStruxure Power Monitoring Expert or Power Operation.

EcoStruxure
Power Monitoring ExpertEcoStruxure
Power Operation

Outputs

Outputs are displayed via the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation).

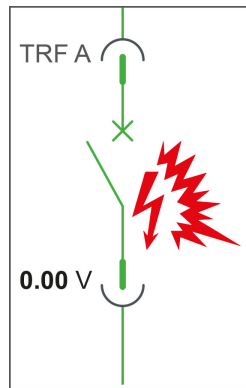
EcoStruxure
Power Monitoring ExpertEcoStruxure
Power Operation

Live Data Display

The live status of arc flash detection in the electrical distribution system can be represented in the Edge Control software in various forms such as:

Single-line diagrams

- Digital single-line diagrams, with real-time animation in case of arc flash detection



Display of Arc Flash Related Trips on Single-Line Diagram

Detailed diagrams

- Device diagrams, pre-configured along with native device drivers (PowerLogic P5 30 series or P3 Advanced) or customized to reflect PowerLogic A125 / Arc V121 (PowerLogic P5 20 series, P3 Standard, MasterPacT MTZ, PowerLogic ION9000, or PM8000)
- Real-time data in custom graphics (floor plans, elevation drawings)

Events and Alarms

Event log viewers

Events and alarms are uploaded from devices and visualized in native event and alarm viewers of the Edge Control software.

Chronological views include all events and alarms, acknowledged or unacknowledged alarms, summary alarms, or incidents related with arc flash:

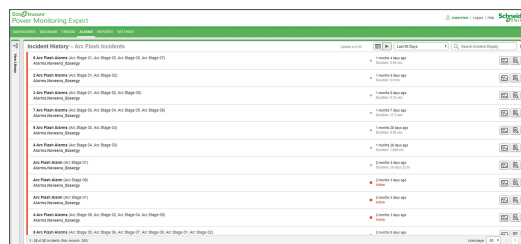
- Arc flash detection (light detection and optional current detection)
- Arc flash protection activation
- Circuit breaker status changes (opening, trip status, etc.)
- Arc flash protection system diagnostic status (UPS status, self-monitoring of sensors, self-diagnostics of connected products, and status of their interconnections).

High-speed and high-precision sequence of events helps locate the source of the fault.

In addition, user remote control actions during the repair phase are traced with operator name and timestamp.

Smart alarming

Arc flash events or alarms are intelligently grouped to be displayed as comprehensive arc flash incidents and to reduce the overall number of alarms in the viewer.



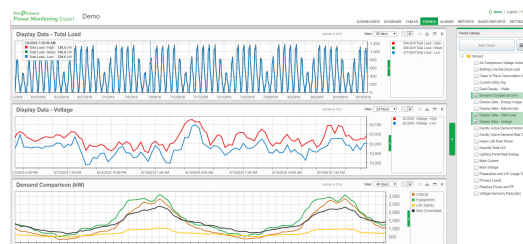
Incident Chronology with Arc Flash Events and Alarms

Notifications

- SMS and/or email notifications can be sent for fast analysis and action.
- Email notifications are also available to send reports and non-critical information.

Trends

In addition to high-resolution waveforms captured during the arc flash event, long-term trends can also be observed to understand if slow phenomena could trigger the arc flash.



Real-Time Trending in EcoStruxure Power Monitoring Expert

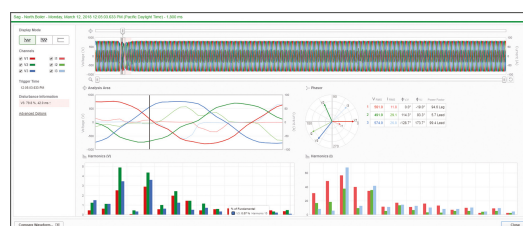
Analysis Tools

Power Event Analysis

The Power Event Analysis incident timeline provides advanced functions to enable further root cause investigation with detailed breakdown and sequence of alarms, waveforms, and power events involved in the incident (refer to the Power Event Analysis application).

Waveform viewer

To refine the understanding of an arc flash occurrence, electrical current waveforms captured by a protection relay, a trip unit, or a power meter can be displayed with a native waveform viewer in Edge Control software.



Waveform Viewer

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France

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www.se.com

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ESXP2GE006EN-05