Continuous Thermal Monitoring (IEC)

Reduce Risk of Electrical Fires Due to Faulty Connections in Critical Electrical Equipment

EcoStruxure Power Digital Application

ESXP2GE007EN-05
11/2023

EcoStruxure™ Power

Schneider Electric™

Legal Information

The information provided in this document contains general descriptions, technical characteristics and/or recommendations related to products/solutions.

This document is not intended as a substitute for a detailed study or operational and site-specific development or schematic plan. It is not to be used for determining suitability or reliability of the products/solutions for specific user applications. It is the duty of any such user to perform or have any professional expert of its choice (integrator, specifier or the like) perform the appropriate and comprehensive risk analysis, evaluation and testing of the products/solutions with respect to the relevant specific application or use thereof.

The Schneider Electric brand and any trademarks of Schneider Electric SE and its subsidiaries referred to in this document are the property of Schneider Electric SE or its subsidiaries. All other brands may be trademarks of their respective owner.

Schneider Electric does not grant any right or license for commercial use of the document or its content, except for a non-exclusive and personal license to consult it on an "as is" basis.

Schneider Electric reserves the right to make changes or updates with respect to or in the content of this document or the format thereof, at any time without notice.

To the extent permitted by applicable law, no responsibility or liability is assumed by Schneider Electric and its subsidiaries for any errors or omissions in the informational content of this document, as well as any non-intended use or misuse of the content thereof.

Table of Contents

Overview

Context of Application

One of the leading causes of electrical fires in low and medium voltage installations is faulty power connections of cables, busbars, and withdrawable circuit breakers, in particular when the connections are made on site.

A faulty power connection can lead to an increase in electrical contact resistance, inducing a thermal runaway that can lead, in the worst case, to destruction of switchgear and severe injury to the operator..

An increase in contact resistance can be caused by:

- Loose connections due to improper installation or maintenance (improper tightening torque or loosening of a connection due to vibrations or thermal cycling)
- Damaged surface (due to corrosion, excessive pressure, or excessive friction)

Infrared inspections are a common solution to detect faulty power connections, but these must be performed manually, are tedious, and only identify issues on a periodic basis.

Problem to Solve

The facility manager needs to:

- Detect thermal runaways before they lead to electrical fires.
- Take action to resolve any faulty connections.
- Reduce the costs of infrared inspections.
- Monitor connections that may not be visible during inspections.

Purpose of Application

Early detection of faulty connections

- Monitor the temperature of busbar, cable, transformer, and withdrawable circuit breaker connections.
- Detect temperature deviations from normal operating conditions before they result in equipment downtime.
- For some switchboards, with a higher density of smaller conductors, overheating can be detected using gas analysis with Insulation Decomposition Detection (IDD) technology.

Provide temperature alarming and reporting for fast response

- Send pre-alarms and alarms in case of abnormal temperature rise.
- Enable easy reporting of the thermal status of the electrical installation.

Complement/replace infrared inspections

- Continuously monitor critical connection points to replace or augment periodic infrared surveys.

Connection Temperature Monitoring

Connection Temperature Monitoring

Gas Analysis with Insulation Decomposition Detection (IDD) Technology

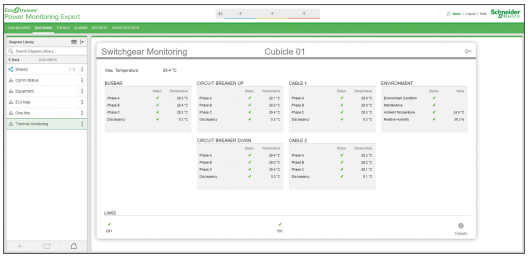
Application Outcomes

A properly designed Continuous Thermal Monitoring application provides the following outputs.

Live Data Display

For each electrical connection:

- Connection point absolute temperature
- Maximum phase-to-phase temperature discrepancy
- Status indication with respect to alarm thresholds (green/yellow/red)



Live Data Display

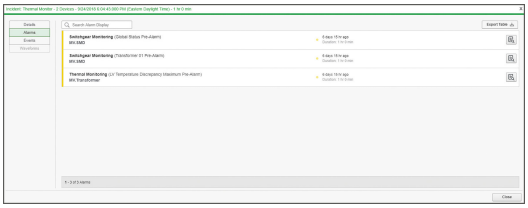
Events and Alarms

Alarms and pre-alarms can be defined for the following cases:

- When the absolute temperature threshold (defined by the user) is exceeded
- When an excessive discrepancy is detected between phase temperatures
- When the predictive threshold (which takes into account the conducted current) is exceeded
- When gas is detected due to overheating of the conductor insulation for some switchboards with a high density of smaller conductors

Pre-alarms and alarms help with early detection of faulty connections.

NOTE: Pre-alarm thresholds can be defined (for example, 80% of absolute threshold) to detect a temperature deviation as soon as possible.



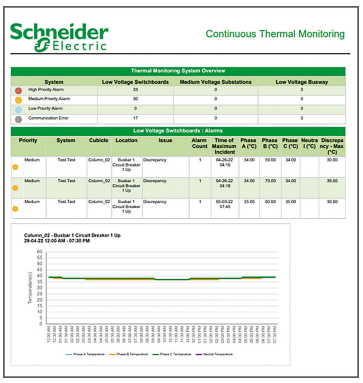
Thermal Monitoring Alarms

Trends

The Continuous Thermal Monitoring application provides trends to analyze long-term temperature evolution.

Reports

Thermal status of the electrical installation and historical trending can be included in dedicated reports.



Continuous Thermal Monitoring Report

Notifications

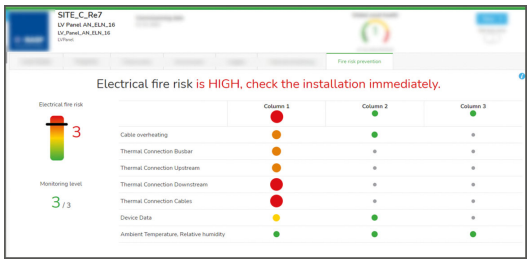
SMS and/or email notifications are sent for each pre-alarm and alarm condition to enable fast action.

Cloud-Based Analytics and Services

The EcoStruxure Service Plan powered by EcoStruxure Asset Advisor provides remote monitoring, asset management consulting, and on-site maintenance activities with recommendations from our Schneider Electric service experts.

Cloud-based analytics and services include:

- Continuous thermal monitoring
- Computation of an Electrical Fire Risk index
- Actionable recommendations 24/7 based on the live data and the value of this index



Electrical Fire Risk Prevention Indexes Computed in EcoStruxure Asset Advisor

Electrical Architecture

Introduction

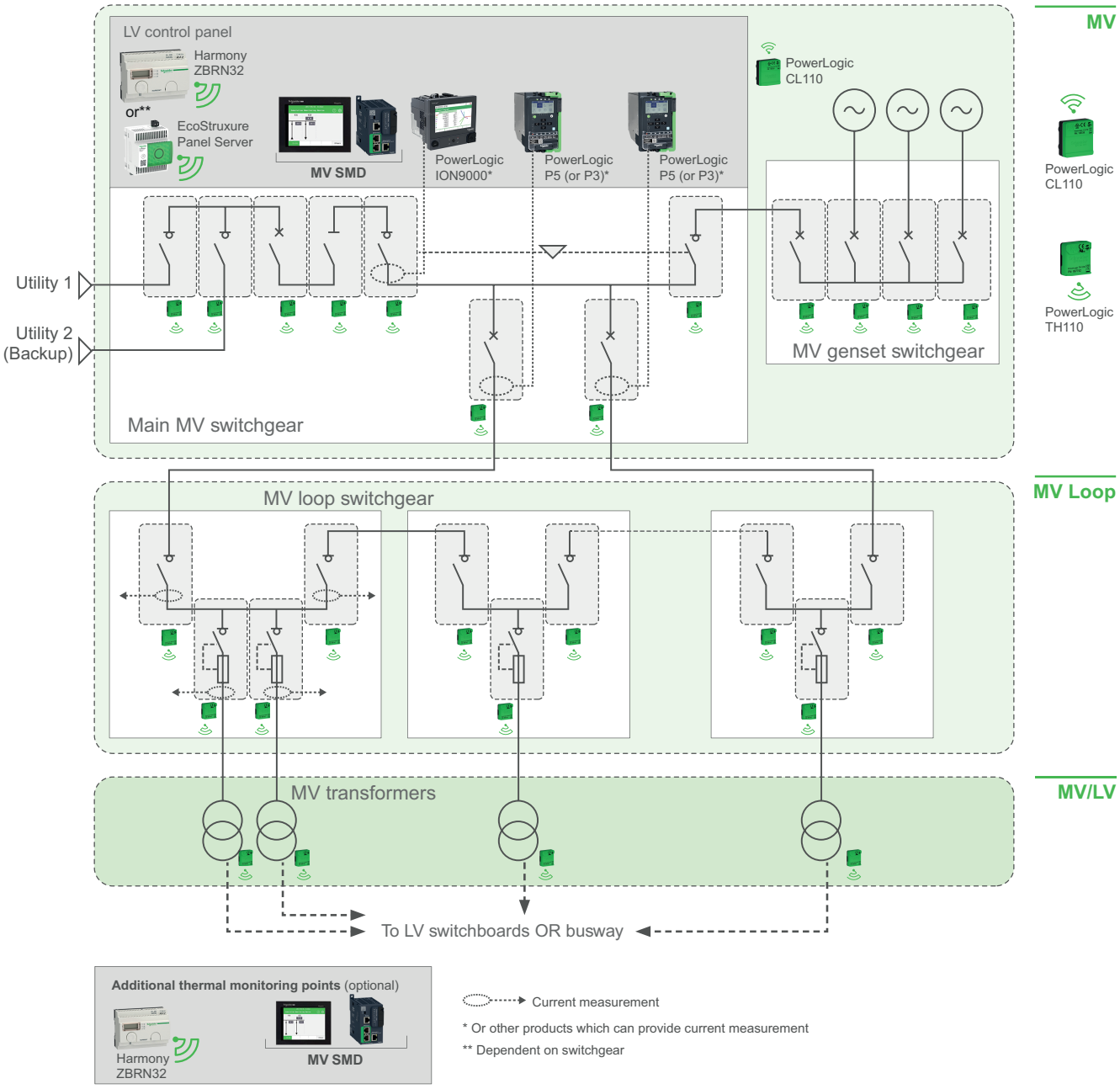
The following diagrams detail the areas of the architecture where the connected products should be installed in order to implement the Continuous Thermal Monitoring application:

Implementation for MV Switchgear and Transformers

Depending on the switchgear configuration and transformers to monitor, the number of connected products [PowerLogic TH110 sensor, Harmony ZBRN32 concentrator or EcoStruxure Panel Server, current measurement device, and Substation Monitoring Device (SMD)] has to be adapted.[1]

All devices except the PowerLogic TH110/CL110 sensors are installed in LV control panels of the switchgear.

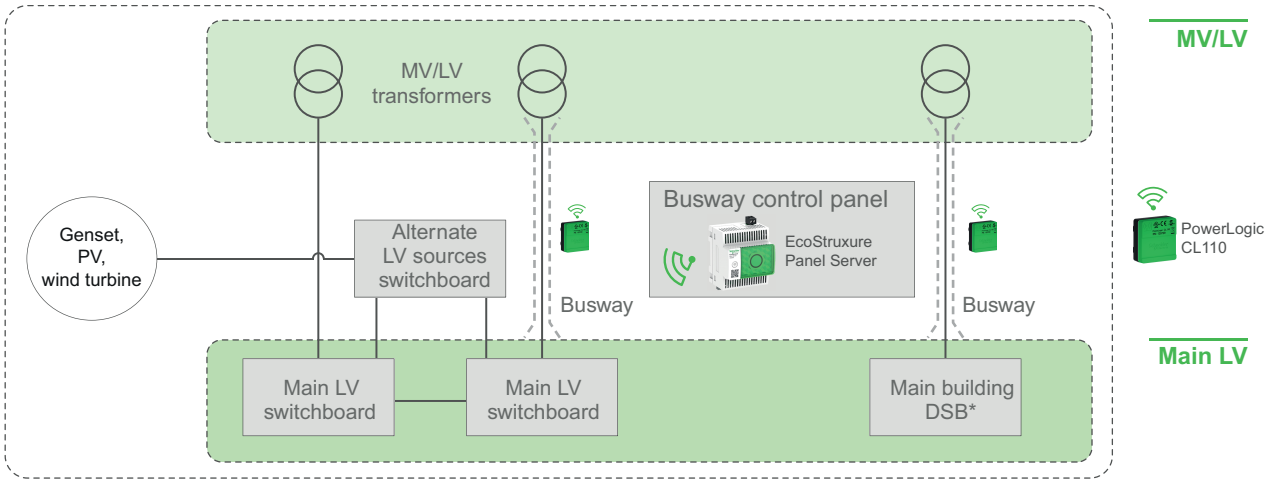
NOTE: Each MV switchgear is associated with an LV control panel. For legibility reasons, in the following diagram, the LV control panel has only been illustrated for the main MV switchgear. An additional Thermal Monitoring Panel may be needed, depending on distance constraints and user needs.



1. In new MV switchgear, the sensors are factory installed. For retrofit, the sensors must be installed by qualified Schneider Electric Services personnel.

Implementation for Busway

For each busway joint or junction, such as tap-off points, corners, elbows, or joint packs, a single PowerLogic CL110 is installed[2]. Per-phase sensors are not required. Continuous Thermal Monitoring for busway only uses the EcoStruxure Panel Server to wirelessly collect data from PowerLogic CL110 Environment Tag. A Substation Monitoring Device (SMD) is not required.



* DSB = Distribution Switchboard

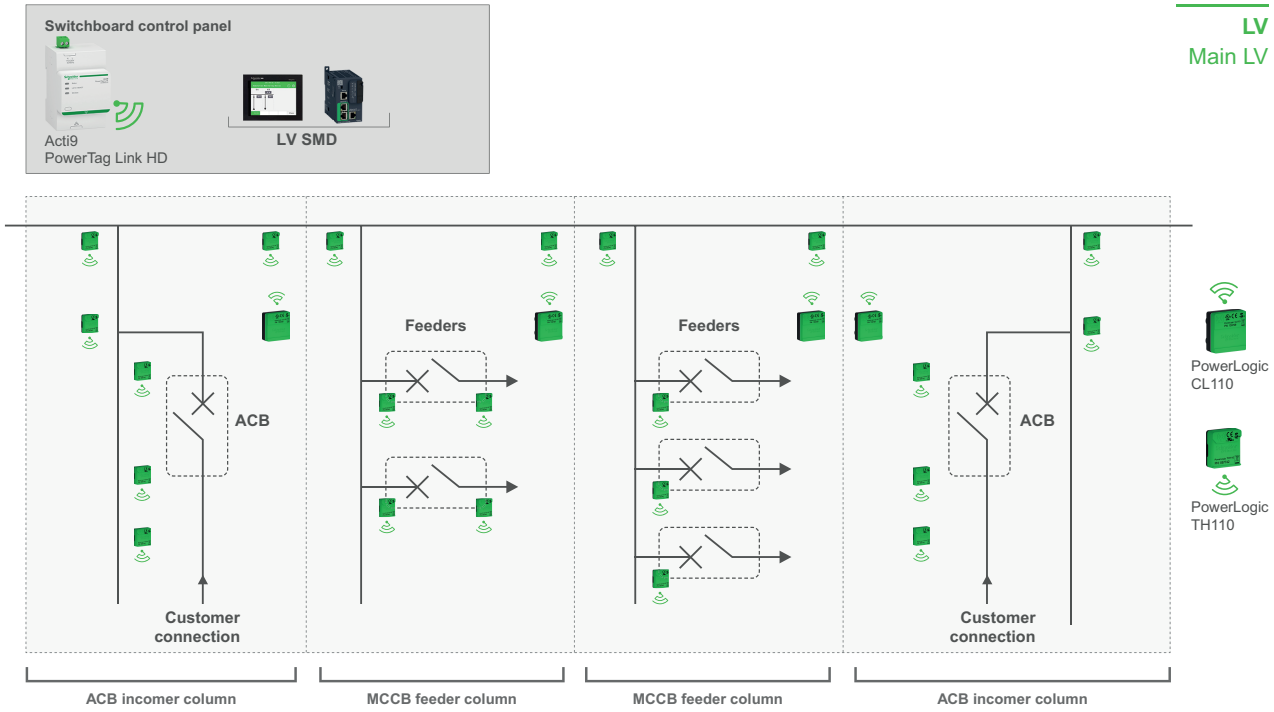
2. The sensors in the busway must be installed by qualified Schneider Electric field services personnel.

Implementation for LV Switchboards

Implementation of the Continuous Thermal Monitoring application depends on the type of switchboard:

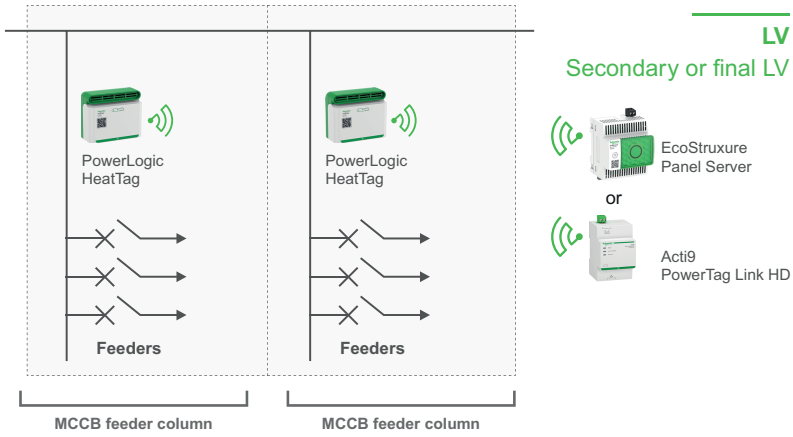
- **For LV Switchboards (Except PrismaSeT)**

  PowerLogic TH110 temperature sensors are installed on each phase of horizontal-vertical busbar junctions, as well as on ACB upstream/downstream connections. As an option, one PowerLogic CL110 per column can be added for ambient temperature measurement.



- **For PrismaSeT LV Switchboards**

  One PowerLogic HeatTag Insulation Decomposition Detector is installed at the top of each column.



Digital Architecture

Introduction

To define the digital architecture of the Continuous Thermal Monitoring application, you have to define the user's needs:

- What data is needed?
- Where should they be available (local, on premise, cloud, and/or remote)?
- Is there a need for notifications?
- Is there a need for advanced diagnostic services?

In the following pages, several architectures are described in response to different feature choices.

In addition to the Continuous Thermal Monitoring solutions, a basic solution is available to replace/complement the yearly infrared inspection campaigns.

This tablet thermal scan solution consists only of the wireless sensors without wireless data concentrator. The operator will have to go to each and every area where sensors are installed (switchboards, transformers, busway). Data will be collected with a direct connection to the tablet equipped with a wireless dongle.

This solution only offers access to instantaneous sensor data.

NOTE: Wireless sensors cannot be paired simultaneously with several wireless receivers. This tablet-based solution cannot be used simultaneously with advanced thermal monitoring solutions.

Digital architecture feature comparison table

The features of each architecture are detailed in the following table:

Feature	Tablet	Local HMI (1)	EcoStruxure Power Monitoring Expert	EcoStruxure Power Operation (2)	EcoStrux-ure Asset Advisor	EcoStruxure Power Monitoring Expert + Asset Advisor	EcoStruxure Power Operation + Asset Advisor
Tablet thermal scan							
Live data	●						
Local monitoring							
Live data		●					
Events and alarms		●					
Edge Control monitoring							
Live data			●	●		●	●
Events and alarms			●	●		●	●
Trends			●	●		●	●
Predesigned graphics for thermal monitoring			○	○		○	○
Reports			●	●		●	●
Remote notifications		○	●	●		●	●
Remote monitoring and services							
Events and alarms					●	●	●
Trends					●	●	●
Reports					●	●	●
Electrical fire risk index					●	●	●
Expert maintenance recommentations recommendations (3)					●	●	●

● Embedded

○ Available for all applications except LV busway

○ Available only for MV applications and if optional GSM modem is installed

● Available if Events Notification Module is installed

(1) Except for LV busway, local monitoring is available with the Substation Monitoring Device (SMD) optional HMI.

(2) Except for LV busway.

(3) Available with EcoStruxure Service Plan.

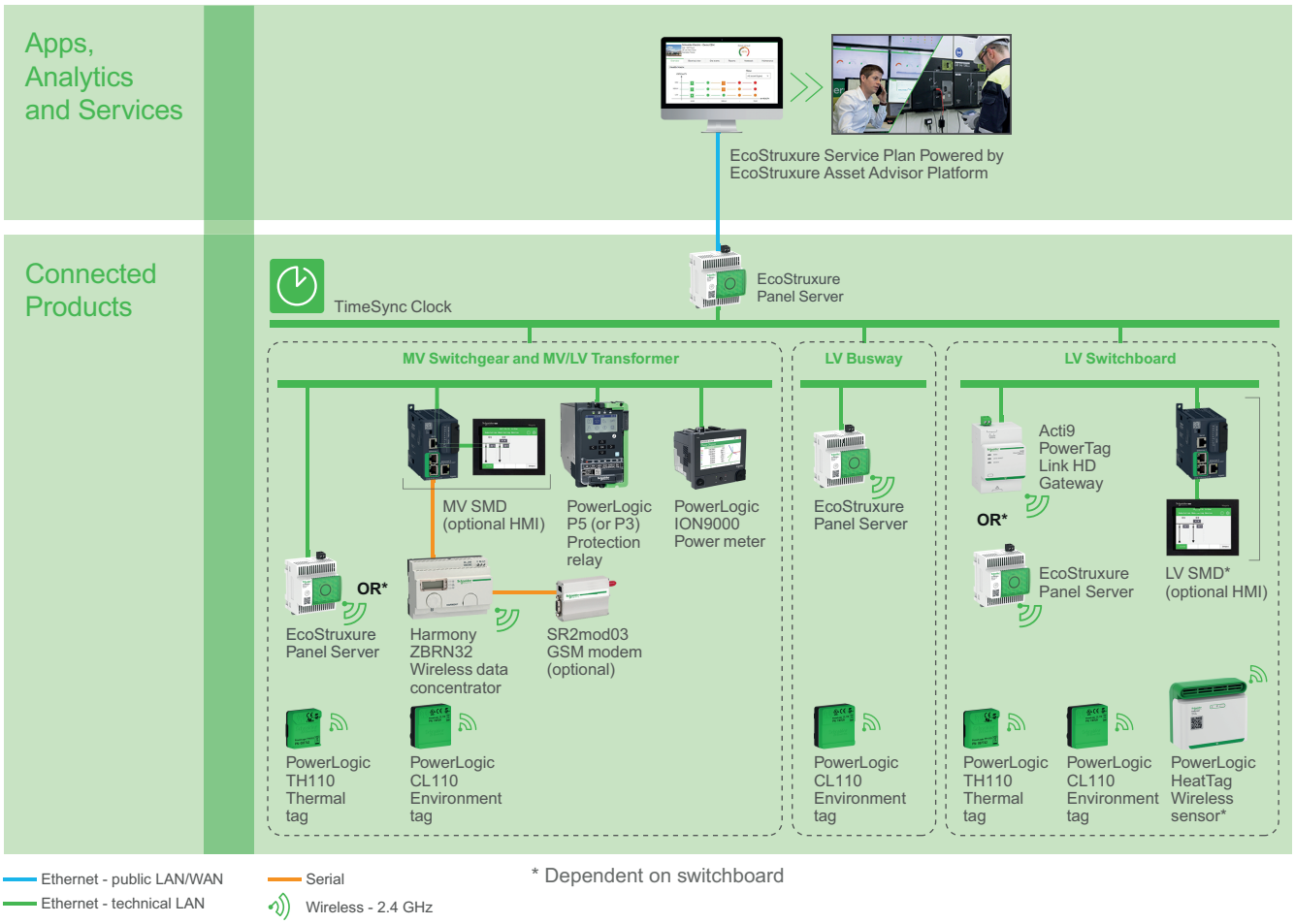
With Connected Products and Remote Services

In this architecture, data is collected from the wireless thermal sensors (PowerLogic CL110/TH110) and insulation decomposition detectors (PowerLogic HeatTag) using the EcoStruxure Panel Server, the Harmony ZBRN32 data concentrator or the Acti9 PowerTag Link HD gateway, depending on the switchgear.

In MV equipment, MV/LV transformer, and LV equipment applications, the data can then be passed on to the MV or LV Substation Monitoring Device (SMD) for local processing and display.

Data is then recorded using a cloud gateway (EcoStruxure Panel Server), passed on to the EcoStruxure Asset Advisor platform, and interpreted by experts as a part of EcoStruxure Service Plan.

Below is the recommended digital architecture for this solution:



How do you receive remote notifications?

Based on data collected in the EcoStruxure Asset Advisor platform, the Schneider Electric service experts proactively notify the user of critical anomalies.

Specifically for MV applications, remote notifications on alarms can be sent directly from MV Switchgear with an SR2mod03 modem connected to the MV Substation Monitoring Device (SMD).

With Connected Products, Edge Control Software, and Optional Remote Services

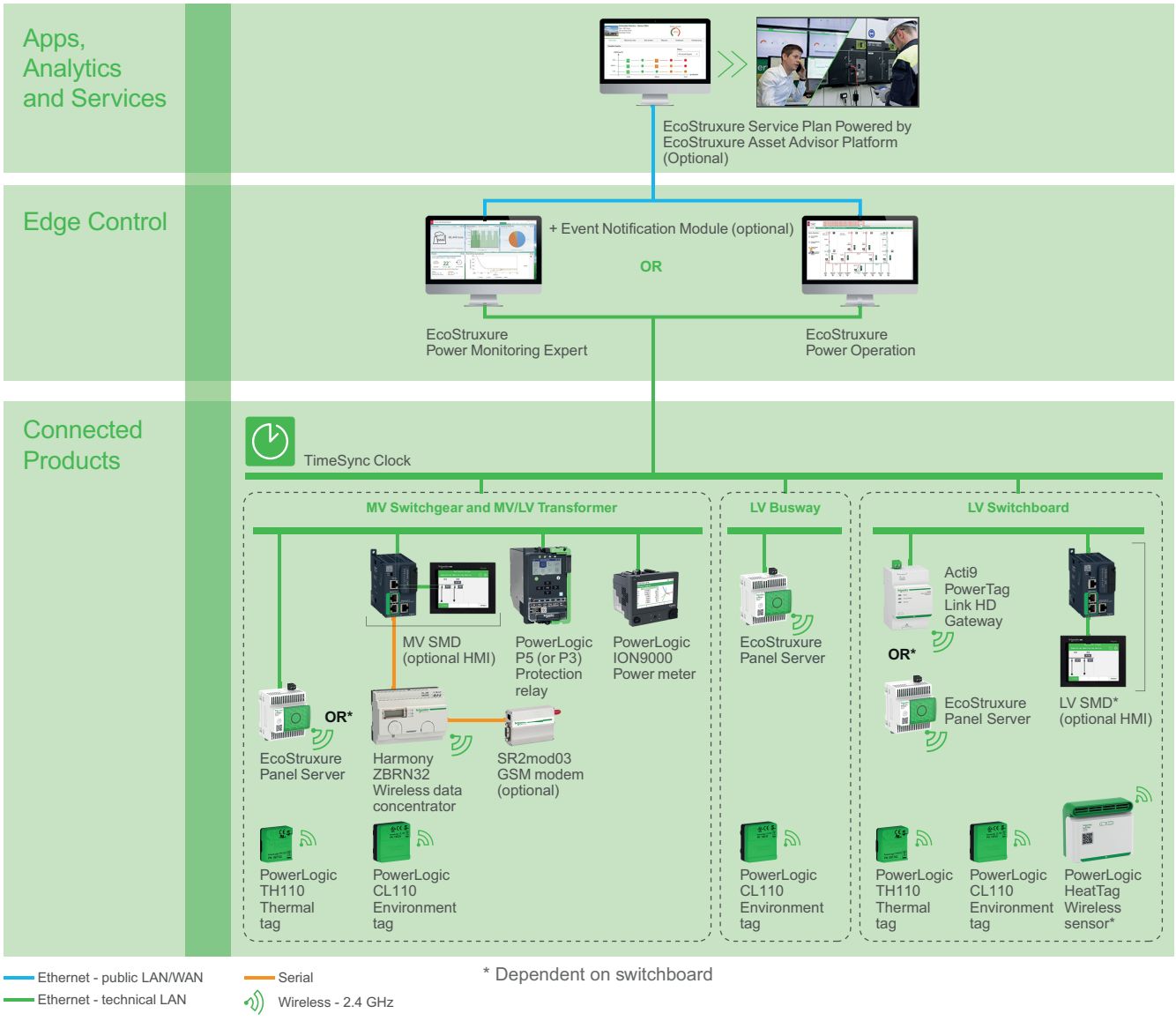
In this architecture, data is collected from the wireless thermal sensors (PowerLogic CL110/TH110) and insulation decomposition detectors (PowerLogic HeatTag) using the EcoStruxure Panel Server, the Harmony ZBRN32 data concentrator, or the Acti9 PowerTag Link HD gateway, depending on the switchgear.

In MV equipment, MV/LV transformer, and LV equipment applications, the data can then be passed on to the MV or LV Substation Monitoring Device (SMD) for local processing and display.

Data is then processed, recorded, and displayed to the user by the Edge Control software (EcoStruxure Power Monitoring Expert or Power Operation).

As an option, data from EcoStruxure Power Monitoring Expert or Power Operation can be passed on to the EcoStruxure Asset Advisor platform and interpreted by experts as a part of EcoStruxure Service Plan.

Below is the recommended digital architecture for this solution:



How do you receive remote notifications?

For both Edge Control solutions, remote notifications on alarms can be sent with the optional Event Notification Module of EcoStruxure Power Monitoring Expert and Power Operation.

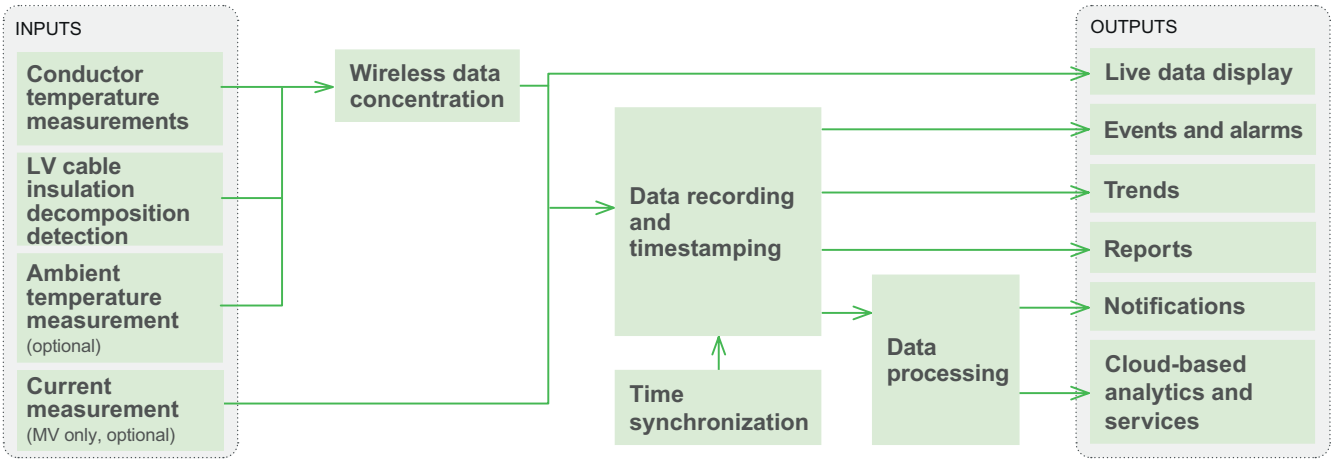
Based on data collected in the optional EcoStruxure Asset Advisor platform, the Schneider Electric service experts can proactively notify the user of critical anomalies.

Specifically for MV applications, remote notifications on alarms can be sent directly from MV Switchgear with an SR2mod03 modem connected to the MV Substation Monitoring Device (SMD).

System Description

Data Flow

The Continuous Thermal Monitoring application can be broken down as follows:



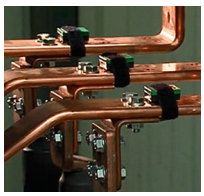
Inputs

The following data is required to enable the Continuous Thermal Monitoring application.

Conductor Temperature Measurements

For MV switchgear, MV/LV transformers, and certain LV switchboards, measurements are performed by factory-installed PowerLogic TH110 temperature sensors. They are installed on each phase in the critical areas of the gear, particularly at cable, busbar, transformer, and withdrawable circuit breaker connections to measure corresponding temperatures.

PowerLogic TH110



Set of PowerLogic TH110 Sensors Fixed on the Three Phases of an Electrical Connection

For the LV Busway Thermal Monitoring application, temperature measurement is performed by PowerLogic CL110 sensors mounted near busway junctions or connection points.

PowerLogic CL110

LV Cable Insulation Decomposition Detection

For some switchboards with a high density of smaller conductors, overheating can be detected using one PowerLogic HeatTag per column with gas analysis Insulation Decomposition Detection (IDD) technology.

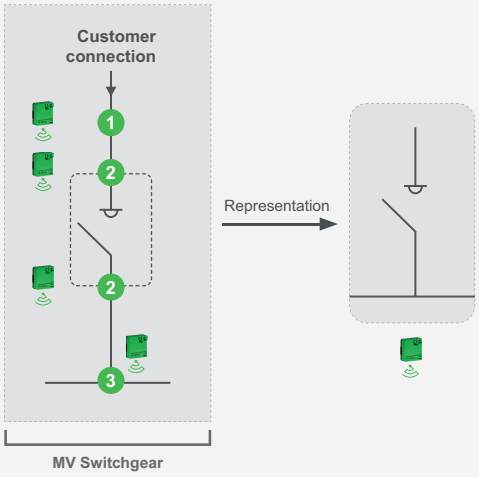
PowerLogic HeatTag

Illustration of Conductor Temperature Measurements and LV Insulation Decomposition Detection

MV Switchgear

In MV switchgear*, up to 15 sensors can be installed in each cubicle at the following locations:

1. Customer connections
2. Fixed parts of plug-in contacts upstream and downstream of switches and circuit breakers
3. Busbar junctions

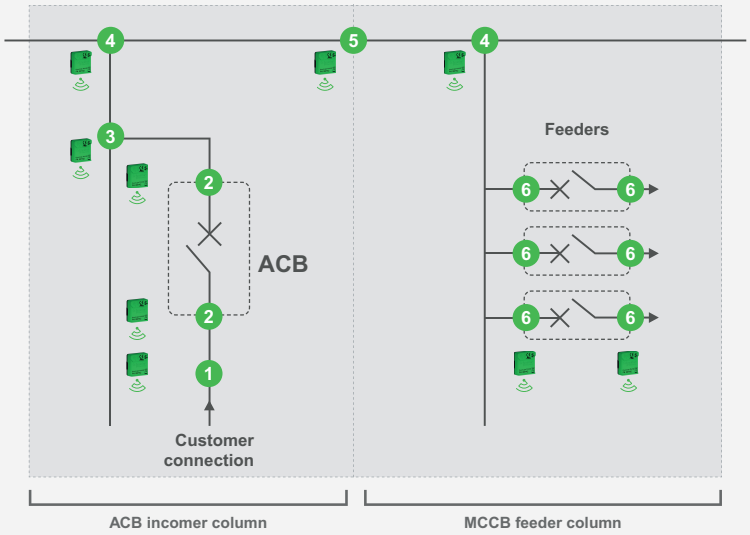


* Dependent on the switchboard

LV Switchboards (Except Prisma)

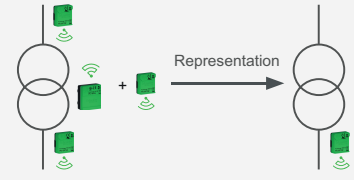
In LV switchboards (except Prisma), up to 100 PowerLogic TH110 temperature sensors per data concentrator can typically be installed to monitor each phase at the following locations:

1. Incoming customer connections of air circuit breakers (ACBs)
2. Fixed parts of plug-in contacts upstream and downstream of ACBs
3. Junctions between vertical busbars and ACB downstream bars
4. Junctions between horizontal busbars and vertical busbars
5. Splice bar junctions between sections of horizontal busbars
6. Upstream and downstream connections of large feeders



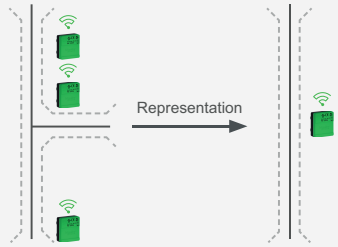
MV/LV Transformers

For dry transformer applications, PowerLogic TH110 sensors are installed on each phase connection, with a CL110 on the outside of the transformer enclosure.



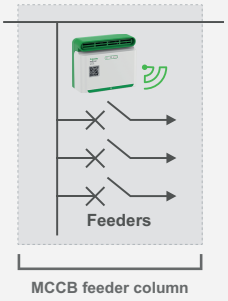
LV Busway

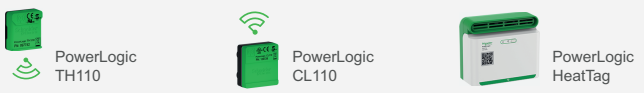
In busway applications, PowerLogic CL110 sensors should be deployed on each busway joint or connection.



LV Switchboards – Prisma

In Prisma switchboards, one PowerLogic HeatTag Insulation Decomposition Detector is installed at the top of each column.





Ambient Temperature Measurement (Optional)

PowerLogic CL110 ambient temperature sensors provide the internal ambient temperature of MV and LV equipment. In MV applications, ambient temperature measurement is used to dynamically adapt the temperature threshold.

PowerLogic CL110

Current Measurements (MV Only, Optional)

Current measurement of monitored connection points is used to dynamically adapt temperature thresholds.

This is performed by a protection relay (for example, PowerLogic P5/P3) or a power meter (for example, PowerLogic ION9000 or PM8000).

PowerLogic P5

PowerLogic P3

PowerLogic ION9000

PowerLogic PM8000

Wireless Data Concentration

In the Continuous Thermal Monitoring application, the wireless signals from the temperature sensors are collected by a wireless data concentrator:

- **For MV switchgear and MV/LV transformers,** depending on the offer, the Harmony ZBRN32 or the EcoStruxure Panel Server is used as the data concentrator. Up to 60 sensors can be connected per ZBRN32 or 85 per Panel Server.
- **For LV busway,** the EcoStruxure Panel Server is used as the data concentrator. Up to 65 sensors can be connected per Panel Server.
- **For LV switchboards,** depending on the offer, the Acti9 PowerTag Link HD or the EcoStruxure Panel Server is used as the data concentrator. Up to 100 sensors can be connected per Acti9 PowerTag Link HD or 85 sensors for EcoStruxure Panel Server.

Harmony ZBRN32

EcoStruxure Panel Server

Acti9 PowerTag Link HD

Data Recording and Timestamping

For the Continuous Thermal Monitoring application, considering the time constant of the physical phenomena observed (temperature rise of electrical conductors), time accuracy in the range of a minute is acceptable.

Measured and processed data is recorded with a timestamp for future analysis and reporting.

- Analog values are recorded for future trending analysis
- Status changes are recorded as events or alarms

Data recording is performed by EcoStruxure Power Monitoring Expert, Power Operation, or, optionally, by a local EcoStruxure Panel Server data logger when directly associated with EcoStruxure Asset Advisor.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

EcoStruxure
Panel Server

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

Time Synchronization

When data recording is performed by a PC (as is the case for EcoStruxure Power Monitoring Expert or Power Operation), time synchronization is typically taken care of by the operating system of the PC.

For the EcoStruxure Panel Server cloud gateway, time synchronization can be performed via NTP/SNTP.

TimeSync Clock

Data Processing

For MV switchgear, MV/LV transformers, and LV switchboards, data processing is performed by a local Substation Monitoring Device (SMD). The SMD consists of data concentration, data processing, and Human Machine Interface (HMI).

Substation Monitoring Device (SMD)

For busway applications, data processing is performed directly by EcoStruxure Power Monitoring Expert, Power Operation, or Asset Advisor.

EcoStruxure
Power Monitoring Expert

EcoStruxure
Power Operation

EcoStruxure
Asset Advisor

Current and temperature measurements are processed to provide the following outputs:

Analog value outputs

- Temperature discrepancy between phases (not applicable for LV busway)

Status

- Status indication of each measured point relative to the set thresholds
- Status indication of temperature discrepancies between phases (not applicable for LV busway)

Outputs

Display of the following outputs is performed locally on the optional Substation Monitoring Device (SMD) Human Machine Interface (HMI) (except trends) and/or remotely by EcoStruxure Power Monitoring Expert, Power Operation, or via the Asset Advisor web platform.

Substation Monitoring Device (SMD)

EcoStruxure
Power Monitoring Expert

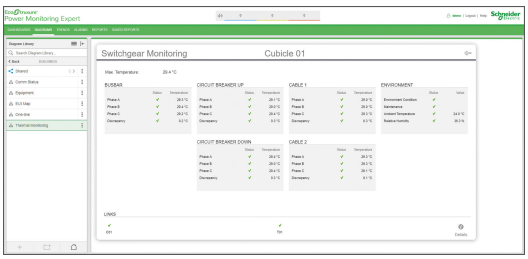
EcoStruxure
Power Operation

EcoStruxure
Asset Advisor

Live Data Display

The following live data is displayed:

- The value of each measured point (temperature and current)
- The temperature discrepancy between phases (not applicable for LV busway)
- The correlation between current and respective temperatures (in MV applications only)
- The status of each measured temperature relative to a set point or calculated threshold (with color code)
- The overheating status of conductors based on insulation deterioration gas analysis (with color code for some LV switchboards with a high density of smaller conductors)



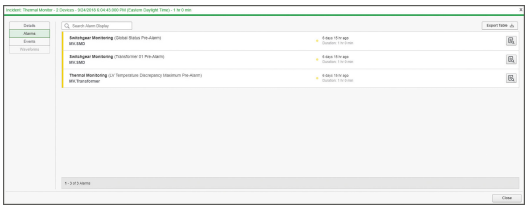
Live Data Display

Events and Alarms

Pre-alarms and alarms are generated when the following measurements exceed predefined set point or calculated thresholds:

- Individual phase temperature measurement
- Temperature discrepancy between phases (not applicable for LV busway)
- The overheating status of conductors based on insulation deterioration gas analysis (for some LV switchboards with a high density of smaller conductors)

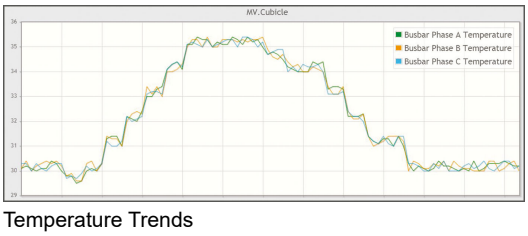
Additionally, sensor diagnostic information is available.



Thermal Monitoring Alarms

Trends

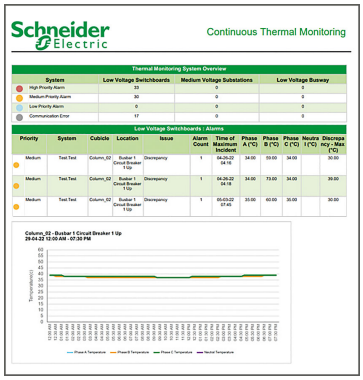
The Continuous Thermal Monitoring application provides the evolution of each measured value over time.



Temperature Trends

Reports

When EcoStruxure Power Monitoring Expert or Power Operation is installed, customized reports based on measured and processed data can be generated and sent automatically with email subscription.



Continuous Thermal Monitoring Report

Notifications

Notifications can be sent:

- By the Substation Monitoring Device (SMD) connected to an SR2mod03 GSM modem (alarms only through SMS)

SR2mod03

- By EcoStruxure Power Monitoring Expert or Power Operation with the Event Notification Module (events and alarms via email and/or SMS)
- By EcoStruxure Asset Advisor

Cloud-Based Analytics and Services

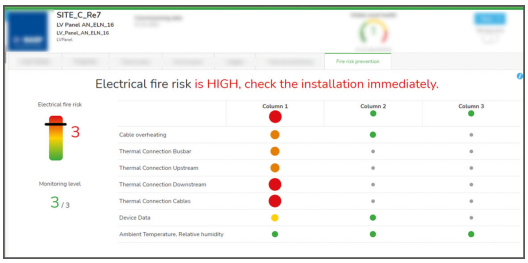
The EcoStruxure Service Plan powered by EcoStruxure Asset Advisor provides remote monitoring, asset management consulting, and on-site maintenance activities with recommendations from our Schneider Electric service experts.

EcoStruxure Service Plan Powered by EcoStruxure Asset Advisor Platform

Cloud-based analytics and services include:

- Continuous thermal monitoring
- Computation of an electrical fire risk index

- Actionable recommendations 24/7 based on the live data and the value of this index



Electrical Fire Risk Prevention Indexes Computed in EcoStruxure Asset Advisor

Schneider Electric
35 rue Joseph Monier
92500 Rueil Malmaison
France

+ 33 (0) 1 41 29 70 00

www.se.com

ESXP2GE007EN-05