



camlin rail

Protecting Networks.  
Maximising Availability.

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Advanced analytics is going to make **condition-based maintenance** an attractive lever for increasing maintenance efficiency. With efficiency gains of 10 to 15% expected, it is estimated that the global maintenance market can save up to EUR 7.5 billion per year by moving towards condition-based maintenance.

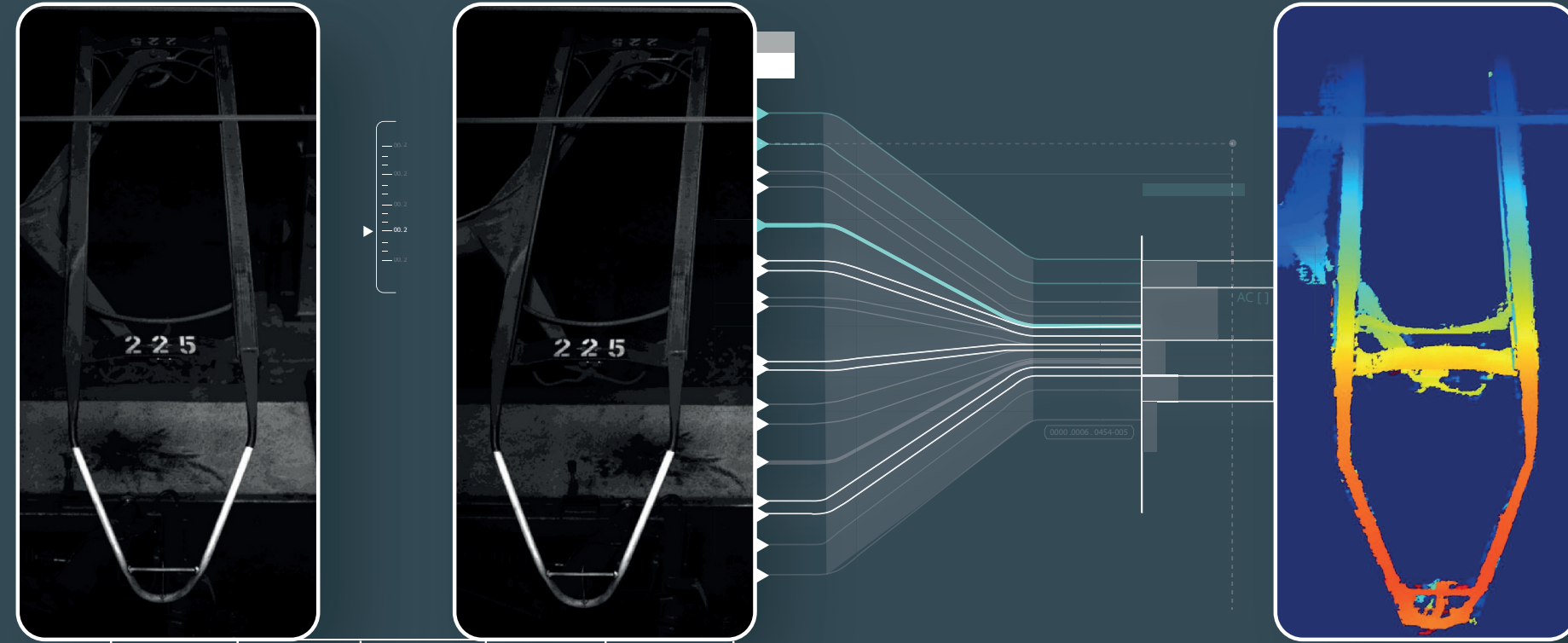
McKinsey Report '**The rail sectors changing maintenance game**'

Train passing at high speed through the Camlin Rail TrainVue System in The Netherlands.

Photography courtesy of Mr Arjan Vrieze, Nedtrain.







## » Redefining Pantograph Monitoring

## Introduction

Camlin Rail is part of the Camlin Group, with a worldwide presence and facilities in 21 cities across 17 countries. At Camlin, our goal is to optimize the critical infrastructures that people, cities and communities around the world depend on, all day and every day.

As these networks get bigger and more complex, they're becoming exponentially harder to manage. And that's why we're here - to make the world's energy and transport infrastructures run more efficiently, ultimately helping our customers keep the lights on and keep passengers moving.

At Camlin Rail, we're driving sustainable efficiencies and performance success for railway networks and operators. Our pantograph system keep trains running in peak condition while reducing operational costs.

Our train monitoring solutions – including the world's first intelligent 3D pantograph monitoring system, is helping rail operators optimise maintenance schedules and maximize fleet availability while

enabling staff to work and maintain rolling stock more safely. Our automated reconfigurable power systems maintain supply continuity during extreme fault conditions, enabling railways to keep trains running with less disruption to passenger journeys.

Our solutions are closely aligned with the objectives of the Digital Railway initiative that will bring dramatic enhancements in efficiency, capacity, safety and sustainability to tomorrow's digital railway network. Camlin Rail is proud to have a global track record, successfully deploying our systems across Europe, North America and Asia to help deliver a safer, more efficient and more sustainable railway of the future.



## Redefining Pantograph Monitoring

# PanVue

PanVue is an industry first in pantograph monitoring by adopting a fully automated machine vision system based on stereo vision. Railways are getting busier and as more demands are placed on the infrastructure, there is a need to deploy automated tools to help drive operational performance. The Camlin Rail PanVue provides the railway operator with a unique and cost-effective tool set combined with advanced analytics to improve operational decision making.

Our wayside pantograph monitoring system helps railway infrastructure owners, OEMs and train operators optimize maintenance schedules and maximize rolling stock fleet availability.

Successfully deployed by rail operators across Europe, North America and Asia, PanVue uses advanced imaging and machine learning to assess pantograph condition – safely, in real-time and without the need to withdraw trains from service.

We are proud to have ongoing partnerships with the worlds largest railways. PanVue can be flexibly deployed either in either wayside or overhead mounting frame (OMF) configuration – or a combination of the two – to suit railway operators' requirements.

## PanVue Benefits



### Safer working

Eliminates safety risks to maintenance staff, with no need to manually access top of carriage/power car.



### Reduced risk of line teardown

Protects service continuity, customer revenues and threats to operational reputation.



### Accurate, repeatable results

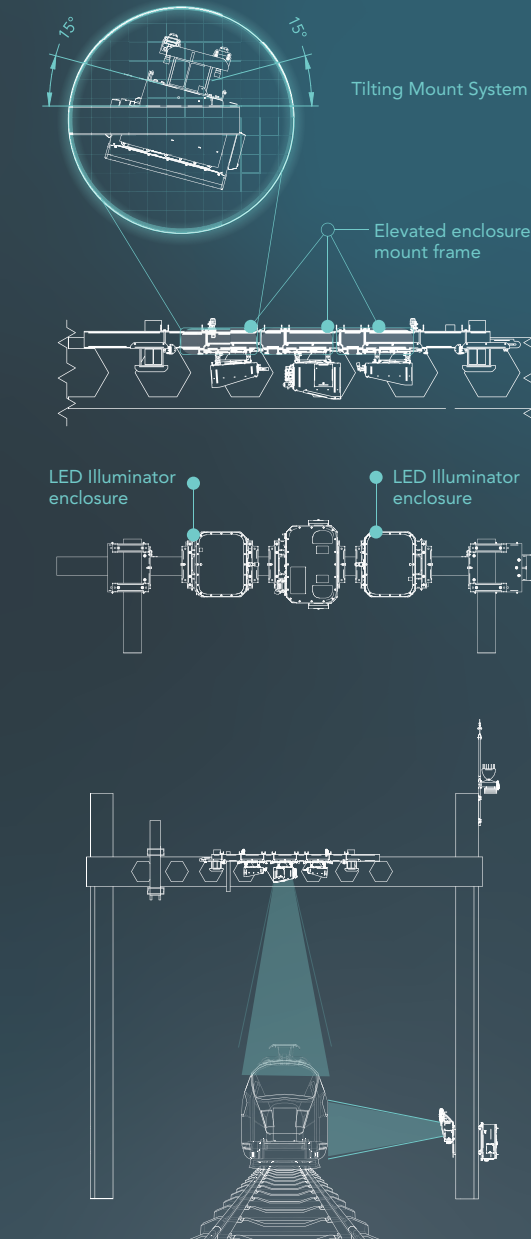
Fully automated pantograph inspection workflow provides consistent, highly precise monitoring data.



### Maximized fleet availability

Automated, real-time wayside inspection maximizes availability of rolling stock, with no need to take trains out of service.

## Overhead Mounting Frame

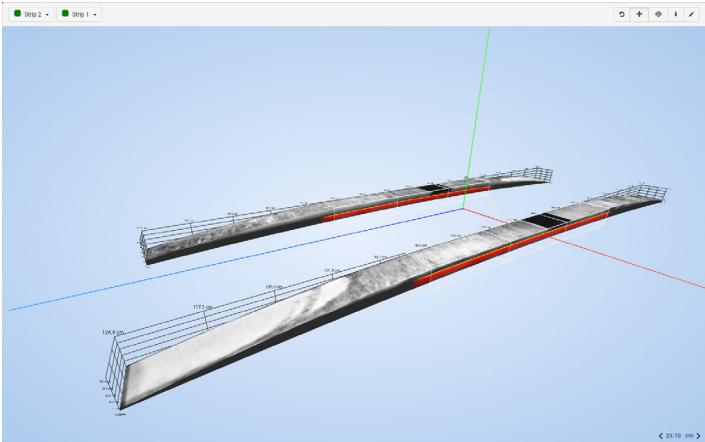


**Stereoscopic Image Capture**  
High-resolution stereoscopic camera acquires pantograph images at train speeds of up to 300 kmh.

**MVID**  
Automatic recognition of carriage ID linked with monitored pantograph



# PanVue Features



Real time three dimensional monitoring of two tracks in any direction up to 300km/h



Analyse the degree of wear and chipping of the contact strip



Automatic classification of (multiple) pantograph models



Automatic check if the structure of the pantograph is in correct contact with the catenary



Fully automated alerts (e-mail notification) for different pantograph models.



3D model re-construction of carbon strips



Automatic real time pantograph model recognition and multipara metric analysis



Analyse horn structure for defects (missing or damaged)



Measure the degree of uplift (no additional modules required)



# theia

## Enabling smarter, data-driven asset monitoring and fleet maintenance.

Theia is a web-based user interface which allows multiple users to access pantograph data from a smart device such as a tablet, smartphone, or desktop computer. Theia has been designed with the user in mind with its sleek and intuitive display, allowing the user to easily understand pantograph condition via high resolution images and supporting 3D analysis. Camlin appreciate that each user of Theia will have different objectives depending on their job function; whether it be infrastructure owner, the train operator, the OEM or a combination of all three, therefore, it is key that the pantograph data and statistical reports work for their business. Therefore, Camlin developed 'FleetView', an additional feature within Theia which is asset driven and enables the train operator and/or OEM to easily understand the condition of the pantographs across the fleet; understand dynamic carbon wear rates across different pantograph models and external conditions, such as weather. FleetView can support or eliminate the manual inspection of pantographs by creating a digital record of pantograph inspection with a further option to automatically create work orders (via end customer API) ahead of scheduled maintenance visits.

Statistical analysis of pantograph data helps identify trends, managing risk adds objectivity into the decision-making process. Theia enables the user to configure, run and share .pdf reports based on selected data points to help drive operational performance.

There are three main stakeholders that benefit from PanVue data either by connecting directly to Theia or via an approved API:

### Infrastructure Owner

**Aim:** Infrastructure protection, risk management and safety

**Outcome:** Theia enables the infrastructure owner to understand the condition of pantographs operating on the network - at any given time - and manage risk. The user can configure, run, and share .pdf reports based on statistical analysis to understand the performance of different pantographs, different train operators and different parts of the network depending on how many PanVue systems are in operation.

### Train Operator/OEM

**Aim:** Fleet availability, fleet performance and safety

**Outcome:** Our FleetView feature within Theia enables the train operator to understand pantograph condition across its entire fleet via intuitive dashboards and statistical analysis. The operator can configure, run, and share .pdf reports based on carbon wear degradation, carbon chipping and other parameters such as orientation, weather conditions and uplift. Theia can be integrated with an approved API to support the automatic generation of work orders should a damaged pantograph be detected.

### Insight and Analytics

- Simplify information flow via intuitive analytical tools and dashboards
- Drive data-based decisions with key stakeholders
- Improve time to insights with automated reports

### Seamless Integration

- Supports asset management workflow
  - Maintenance scheduling
  - Asset tracking
- Enables automatic creation of work orders
- Range of standard and configurable APIs

### Asset Management

- Understand true condition of train fleet and catenary
- State of good repair (review)
- Reduce risk with maintenance tracking
- Understand fleet condition with FleetView app



# PanVue

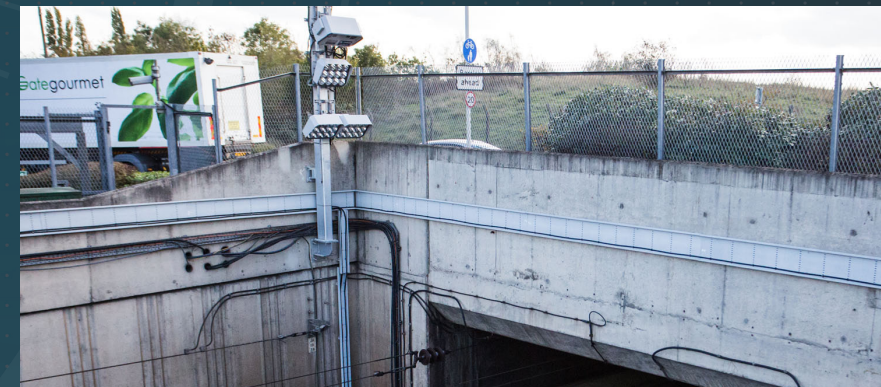
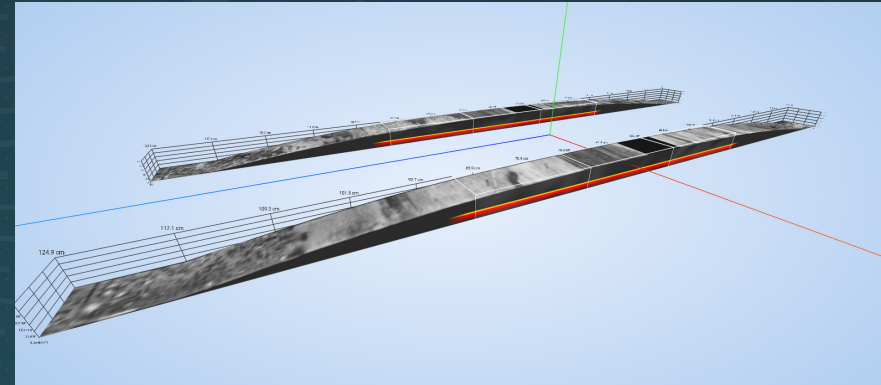
Heathrow Airport

2019

## Heathrow

### THE SPECIFICS

- ✓ PanVue installed on the main line connecting Heathrow Airport to London Paddington and the UK rail network
- ✓ Heathrow Airport selected PanVue because of its wayside, modular and lightweight design
- ✓ In January 2019 Camlin Rail and Heathrow Airport received a UK contractor excellence award for the successful delivery of this project



# PanVue

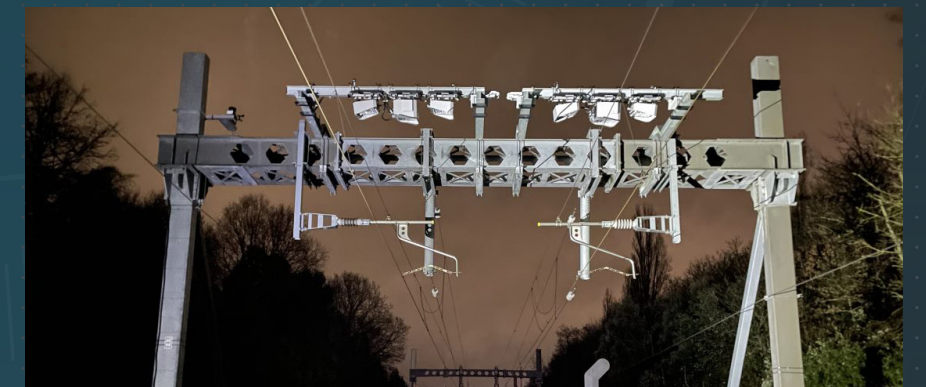
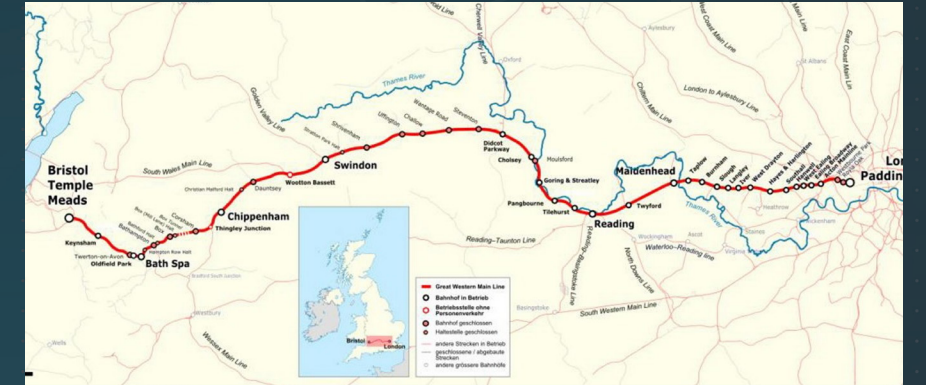
Great Western Line Network Rail

2020 – 2022

## Network Rail

### THE SPECIFICS

- ✓ The Great Western Line is the main arterial route connecting Western England and Wales to London Paddington
- ✓ 16 No, PanVue OMF systems, complete with weather stations installed over 6 locations
- ✓ PanVue deployed as a distributed system to sectionalise the network to reduce OLE inspection area





# PanVue

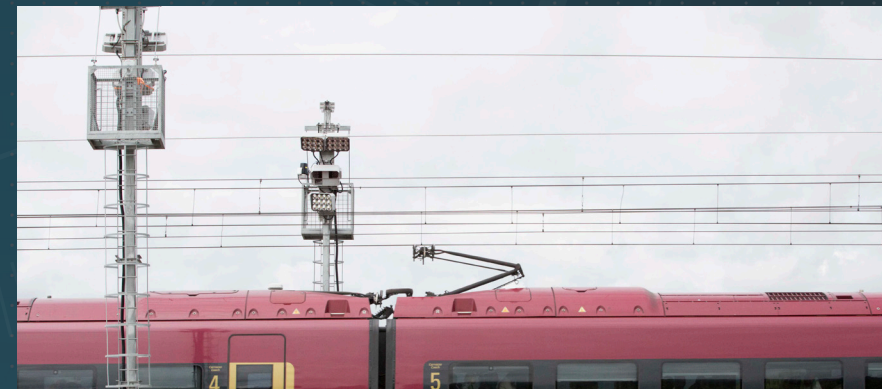
Italy RFI

2020 – 2025



## THE SPECIFICS

- ✓ RFI, the Italian railway owner and operator, awarded a pantograph monitoring tender to Camlin Rail in 2019
- ✓ A design and build contract to design, install and commission 38 No. PanVue Wayside Systems over the next five years
- ✓ The project will cover the Southern half of Italy and will monitor high speed and regional lines via the control centre in Rome





# » OCS Monitoring

## Overhead Contact System Monitoring

A failure to maintain the connection between train and power supply, the pantograph and the contact wire, can be operationally disastrous.

OCS Monitoring (Overhead Contact System Monitoring) integrates visual measurement algorithms with analytics platforms and precise positional certainty data, to prevent OCS incidents such as pan flips, contact force and out of tolerance stagger. By monitoring and evaluating train infrastructure in real-time, the OCS can alert issues as they occur and flag potential issues to enable timely preventative action.



### Performance

OCS failures cost infrastructure providers millions per year and cause countless passenger delay minutes. OCS monitoring can drastically reduce both through remote condition monitoring and early warning of degraded parts.



### Reliability

Risk based maintenance through data intelligence and trend analytics to reduce service affecting failures. OCS monitoring aligns with the benefit cases for intelligent infrastructure programmes worldwide.



### Safety

Opportunity to reduce workers activity time line-side, reducing outage time and transferring line-side activity to locations outside the operational boundary (on or near the line).



### Vision Analytics

OCS Monitoring checks the state of the OCS by processing visual measurement algorithms against video captured by pantograph cameras on a frame-by-frame basis. With each frame processed in real-time OCS allows continuous monitoring of the network at high speeds.



### Remote Condition Monitoring

Utilising passenger trains to survey the status, performance, and behaviour of the OCS results in a reduction of "boots on ballasts" and better visibility of all parties responsible for preventing downtime.



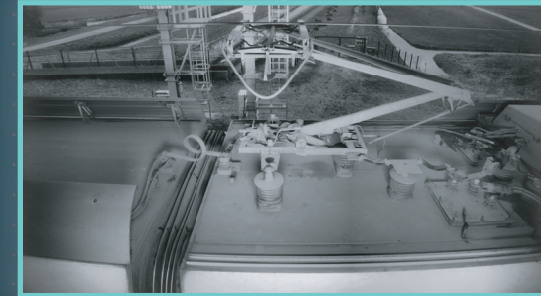
### Trend Analysis

Real-time analysis against historical metrics identifies failure or emerging threshold events. Resulting data is transmitted to cloud-based processing engines where immediate failure alerts are flagged to operational teams.



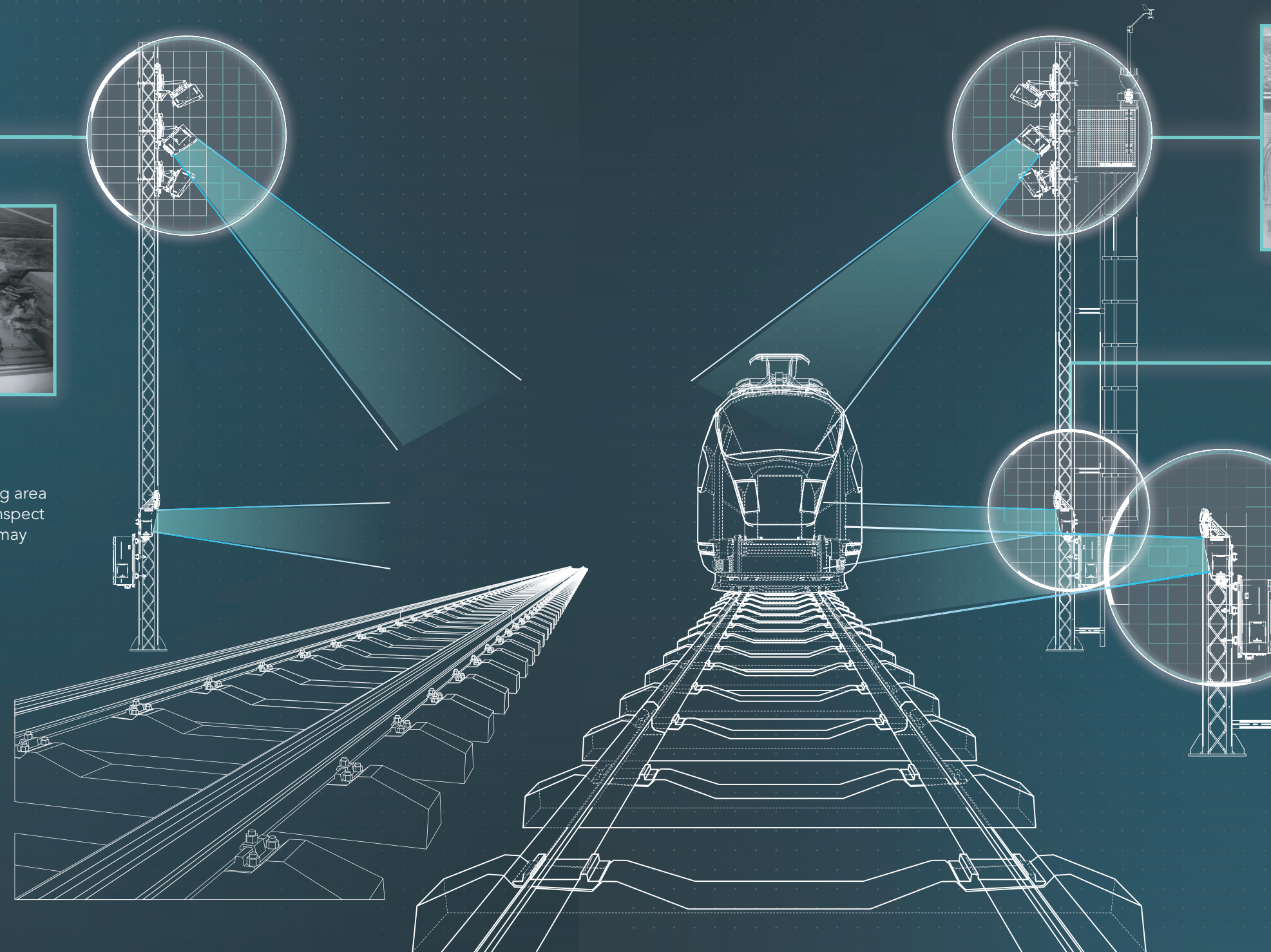
# TrainVue

One of the key challenges faced by train operators is the manual inspection of rolling stock to ensure it is of an acceptable condition to enter the operational railway. This procedure is a mandatory and regulatory requirement which needs to be completed daily. The manual checks are labour intensive and involve several challenges, namely, the inspections can typically only be carried out during the hours of darkness which impacts the safety of maintenance teams and the quality and consistency of the inspection and, the rolling stock being spread across multiple depots requiring extensive use of maintenance teams. TrainVue solves this problem by capturing and analysing images of the rolling stock - at full line speed - and presenting them to the maintenance teams via a secure, web-based user interface. The images are time stamped and correlated with the train (asset) which allows the railway to keep an extensive digital record of asset condition as well as track and trend the condition of components. This approach allows train operators to maximise the availability of their fleets.



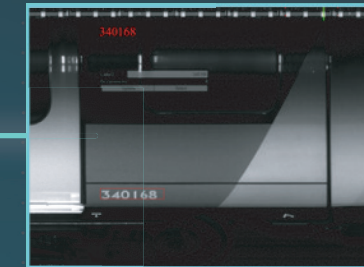
## RoofVue

High resolution images of the lower pantograph structure and its mounting area (panwell) allow the user to manually inspect for damage or foreign objects which may impact pantograph performance.



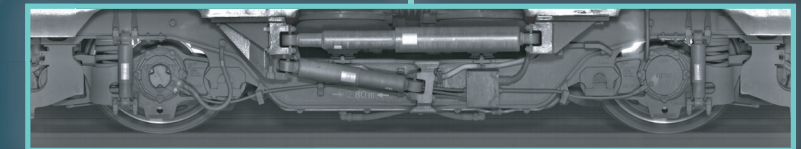
## PanVue

Stereo cameras capture high resolution images which are used to create a 3D digital twin of the pantograph head. The user is alerted automatically if a pantograph is out of specification.



## Train Identification

Camlin can provide two options to be able to correlate the train to the pantograph, panwell and bogie scan images. RFID would be the most common technique but, if the railway does not have the rolling stock fitted with RFID tags a machine vision solution is available. MVID (Machine Vision Identification) uses optical character recognition (OCR) to automatically read the train numbers and characters on the side of the train and correlate this information with the acquired images. Train Identification allows the user to track and trend train (asset) performance over time.



## CarVue (bogie)

High resolution images of the bogies are captured and automatically segmented at full line speed. The images are uploaded to the server for manual or automated analysis by the user.



# » Signet

Reconfigurable  
Signalling Power



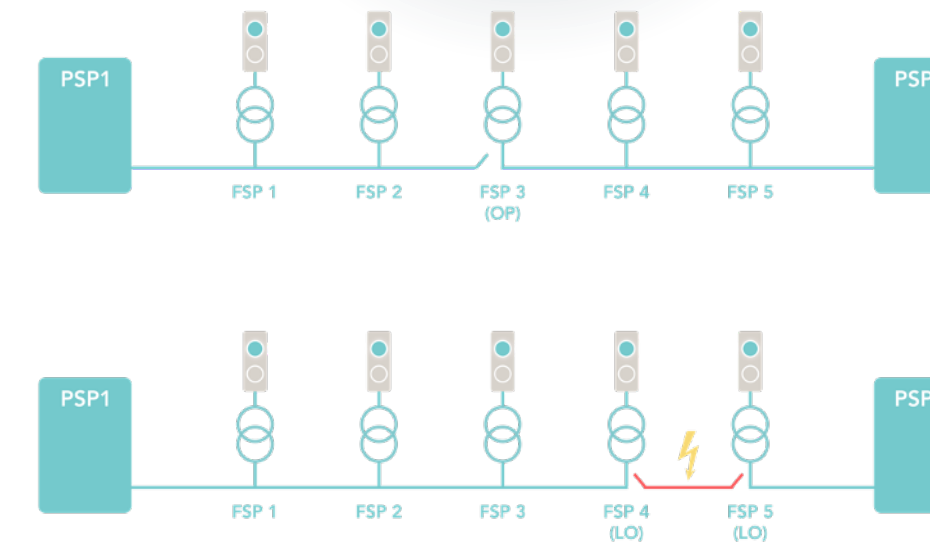
Signet is our advanced automated reconfigurable signalling power system that allows railways to maintain supply continuity during extreme fault conditions.

In the event of PSP supply failure, cable fault, or if a section of the power cable is stolen, Signet first switches the circuit open in order to protect the power system. It then rapidly reconfigures the network in order to isolate the faulted or missing section and ensure continuity of supply.

Once the fault has been repaired or the missing cable replaced, Signet allows power to be restored the network, and returns the network to its original configuration. Signet is available in 400V 3-phase or 650V single-phase versions to suit IT or TN systems.

*"On the West Coast Main line, Signet replaced the traditional LV power supply fuse protection systems to provide coordination and basic sectionalisation which was proving to be expensive and labour intensive and often resulted in long train delays and lost minutes. Signet solves this problem in a cost effective and controllable manner by automatically restoring power to affected signals and reconfiguring the system to isolate the fault."*

NETWORK RAIL, WEST COAST



Graphical example of fault between FSP4 and FSP5. SIGNET system has automatically isolated the fault and maintained supply to all FSPs.

## Signet Benefits



### Automatic reporting

Alarms generated by Signet are sent automatically to the network management system – such as Network Rail's Intelligent Infrastructure.



### Automated operation

Signet automatically isolates the section of network where cable faults or theft have occurred: supply is restored after fault is repaired.



### Fewer delays for passenger

Signet reduces the impact of signalling power faults on service continuity, minimising passenger dissatisfaction and potential penalties for operators.



### Operationally proven

Signet is approved by Network Rail, with over 2,500 units deployed on major UK rail projects including West Coast Main Line, Crossrail and Thameslink.



# Transformer Monitoring

## TOTUS Transformer Monitor

TOTUS monitors all key components on the transformer, giving a full picture of transformer health and is the ONLY unit to integrate DGA, Partial Discharge (PD), Bushing Monitoring (BM), Through Fault Currents (TFC) and Transformer Analytics into a single system.

TOTUS provides a comprehensive, granular picture of power transformer health that allows asset managers to optimise maintenance strategies resulting in significantly reduced risk of sudden transformer failure and associated costs, enhanced predictive maintenance to extend life of the transformer and uninterrupted power supply, reducing unplanned outages.



TOTUS can be equipped with:



Dissolved Gas Analysis (DGA)



Partial Discharge (PD)



Bushing Monitoring (PD)



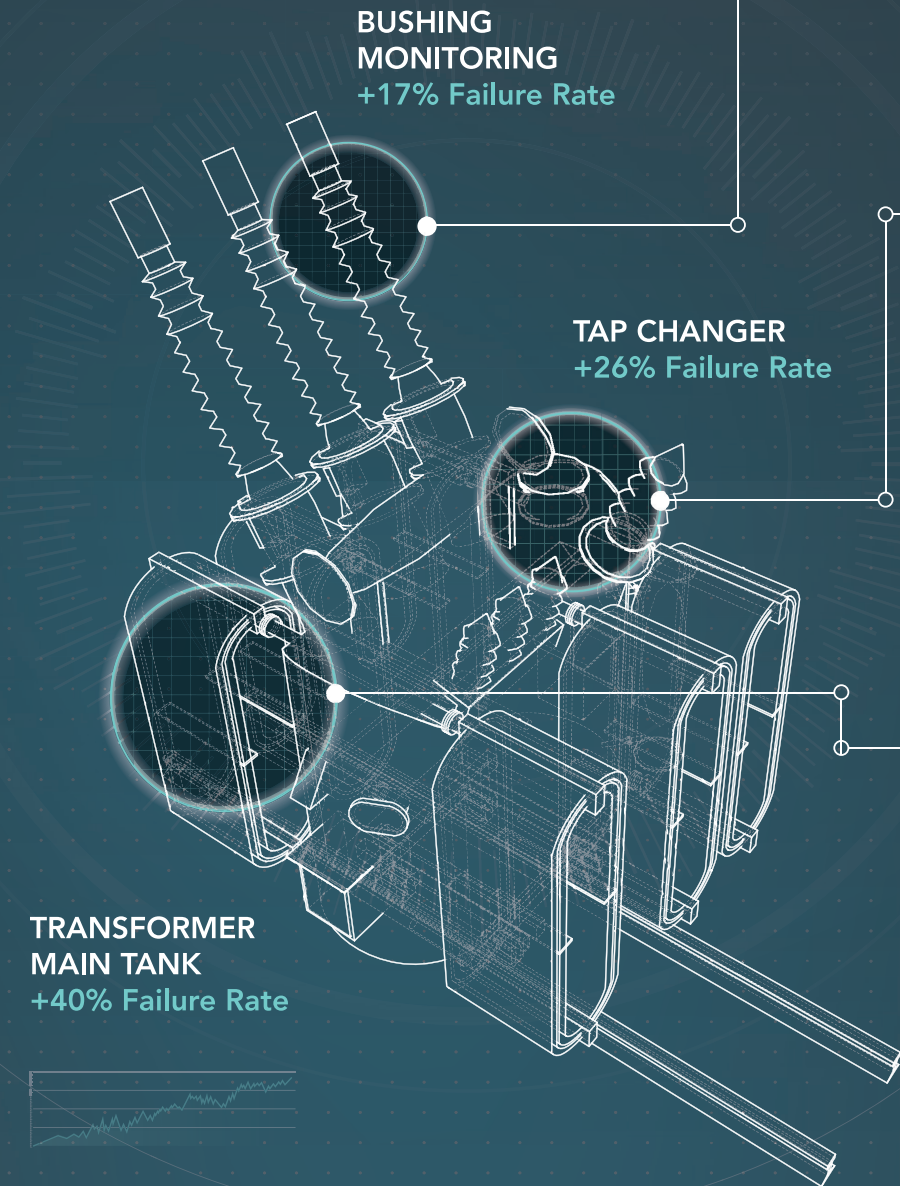
Through Fault Current (TFC)

Giving you a comprehensive picture of transformer health in a single system.

## TOTUS Monitoring Capabilities

80%+ of transformer failures are due to failures in the Bushings, Windings and OLTC

(CIGRE Working Group A2.37)



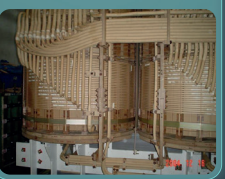
✓ Bushings



✓ Tap Changer



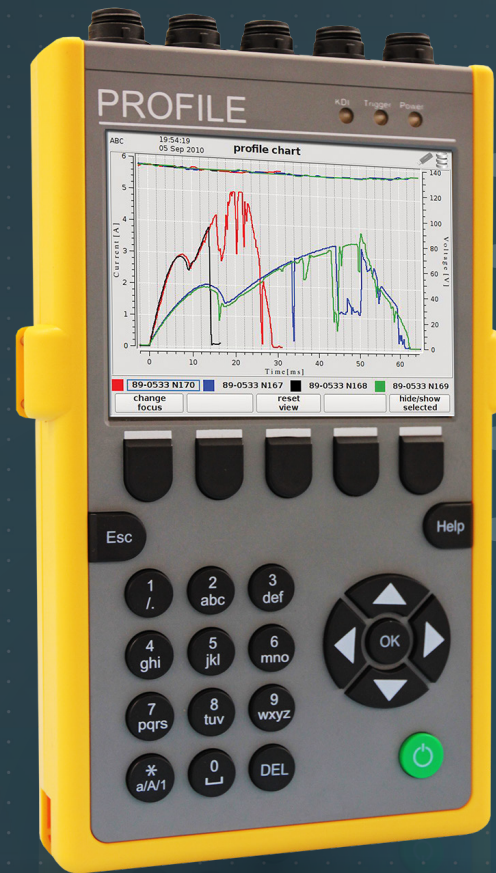
✓ Main Tank





# Profile P3

## Circuit Breaker Analyser



**PROFILE P3** provides a unique insight into the true condition of circuit breakers at all voltages. Capturing the vital 'first trip' shows how the breaker would perform in a real-life fault situation.

### Problem

A slow tripping circuit breaker can cause major disruptions on power networks resulting in:

- Widespread loss of supply
- Damage to plant
- Potential safety issues
- CI / CML financial penalties

Conventional testing requires a circuit breaker to be isolated. However this first trip operation can often temporarily clear any slow tripping problem. Therefore capturing the 'first trip' operation is essential to effective circuit breaker condition monitoring.

### Solution

The **PROFILE P3** offers a cost effective solution by enabling:

- Fast and simple online test
- Capture vital first trip operation
- Combined relay and circuit breaker test
- Onsite analysis of breaker defects
- Efficiently target critical resources

**PROFILE P3** is a powerful diagnostic tool for analysing:

- Main contact operating time
- Auxiliary contact operating time
- 'Health' of Close & Trip coils
- Condition of DC battery circuit
- Auxiliary contact condition
- The Total Trip Time

### Key Features

#### Powerful Onsite Analysis

The **PROFILE P3** can display and overlay up to four records in graphical form. This enables quick onsite analysis of potential defects by comparing a first trip or close profile to subsequent circuit breaker operations.

#### Combined Protection Relay and Circuit Breaker Online Test

An enhanced version of the software enables both the protection relay and circuit breaker trip times to be captured.

#### Multi-shot Mode

With this function the **PROFILE P3** is able to re-arm and capture multiple circuit breaker operations. This can be used for monitoring a circuit breaker during faults or SCADA initiated operations. Also it can be used to capture a sequence of trip/close operations during one test setup.

#### Automated Comparison Function

This provides a clear pass/fail (green/red) indication by determining if the key parameters – Buffer, Acon, Mcon are outside user set tolerances between the first, second and third trip operations.

# Reflekt

## Portable Fault Locator



The REFLEKT represents the next generation of fault location, adding intelligence and automation to create a powerful, simple to use device for the railway industry.

The railway distribution network, like that of the utility industry, can be disrupted by cable faults or theft. However, the railway power system cannot be easily re-configured in a short period of time so it is necessary to find faults quickly and effectively in order to minimise train delays.

It can take many years of training and experience before an engineer is confident of finding faults, while the pressures on the modern utility & personnel mean this expertise may not be readily available. To ease these problems, Camlin Rail has developed the REFLEKT, a unique automated cable fault locator based on well proven Time Domain Reflectometry (TDR) principles.

REFLEKT makes TDR fault location more effective, accessible and simple than ever before. REFLEKT offers industry-leading capability and flexibility for experienced staff, whilst providing simple and fast automated test capabilities for less experienced staff.

### Key Benefits

- REFLEKT designed specifically for railway applications with ranges up to 8km
- Automated fault location – no manual interpretation of complex TDR traces
- Manual 'Expert' mode available – access to full traces for expert verification
- Easily adaptable for a variety of cable types, networks and fault types
- Used on single phase, 2 phase or 3 phase networks & on both energised and de-energised cables
- Rugged IP65 rated case means unit is fit for use in the modern utility
- Simple user interface and display
- Simple connection to all available lines – no changing to compare pairs
- Confidence level in result displayed to assist decision making





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