

Switchgear Camera System for Power Grids






Minimizing risk to human operators is key

Our specialized rugged cameras for safe monitoring provide visual assurance of positions and thus contribute to minimizing risks to personnel. With the field-proven camera systems for all substation viewports, medium- and high-voltage, in gas- and air-insulated, Kappa is your most experienced partner.



Switchgear Camera System for Power Grids

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Business Cases

Stationary – Power grids solutions



Gas insulated
switchgear MV GIS

Gas insulated
switchgear HV GIS

Hybrid switchgear

Generator circuit
breaker (GCB)

Generators

Switchgear Camera System for Power Grids

Minimizing risk to personnel is most important



Safe & Field-Proven

- Safety for the staff on site
- Safe installation
- Full visualization of the isolation gap
- Housing is adapted to viewports
- Live-view of switch movement



Rugged High-End

- CMOS
- GigE Vision
- Glare- and reflection-free
- shock and EMC resistant design
- High temperature resistant



Easy to use

- Proven QA procedures
- Complete system set-up is thoroughly tested ex works
- Easy operation – no room for user errors












Complete system is scalable

- network, local and mobile solutions (with switches, patch panels, injector, laptop/PC or displays)
- Client-defined mechanical interfaces



Switchgear Camera System for Power Grids

Universal Digital Switchgear Camera

-  IP Camera design - IP host configuration
 -  with universal connections in all levels
 -  with commercial of the shelf infrastructure components
-  IP Camera design - Webserver
 -  Accessible with all brother
 -  DHCP Server
-  Power over Ethernet as a standard, USB + Ethernet as an option
-  Highly isolation plastic adapter (PEEK) for integration into almost all application
-  Integrated illumination



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Universal Digital Switchgear Camera System easy installation

- κ Networked architecture:
 - κ with universal connections in all levels
 - κ with commercial of the shelf infrastructure components
- κ 19" cabinets can be used for the Ethernet switches
- κ Flexible Ethernet network scaling
- κ Cat.7 installation cable can be laid before camera installation
- κ Camera is easy to change due to receptacle on camera backend
- κ IP 65 with Neutrik Ethercon cable carrier









Cable carrier (left) and RJ45 receptacle (right)

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Universal Switchgear Camera design - Illumination

Adjustable illumination beam profile and adjustable brightness

-  Eight high power white Light Emitting Diodes
-  One big waveguide
-  Individual adjustment of each single LED
-  Reduced glare and reflections
-  Factory preset for each equipment type
-  Adjustable by software

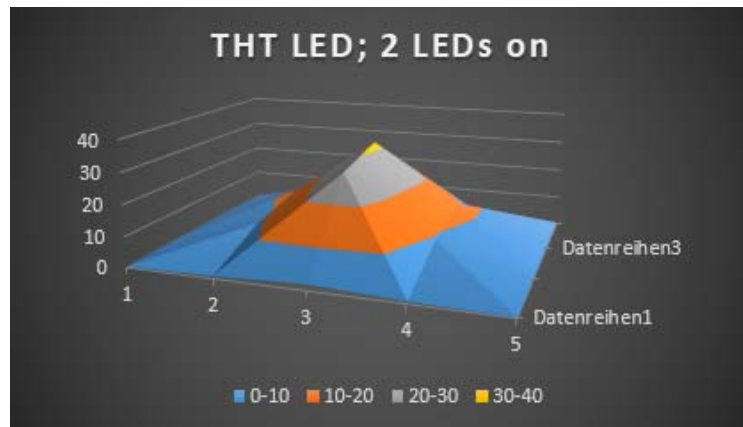


Kappa Switchgear Camera with waveguide

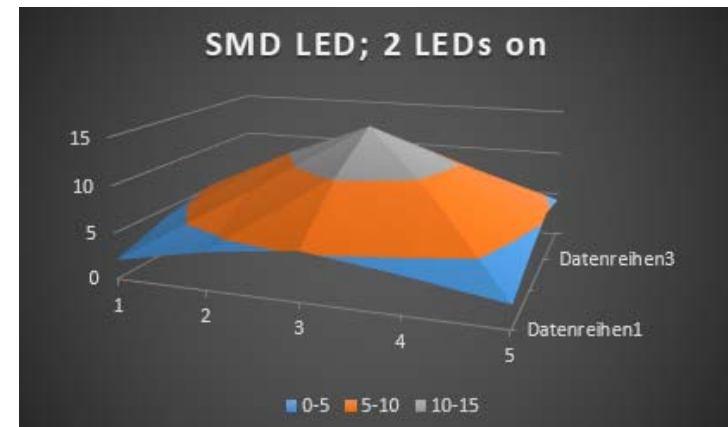
Switchgear Camera System for Power Grids

Universal Switchgear Camera design - Illumination

Adjustable illumination beam profile and adjustable brightness














Through Hole Technology (THT) LED
— no beam profile adjustment



Surface Mounted Device (SMD)
LED with optical waveguide

Switchgear Camera System for Power Grids

Universal Digital Switchgear Camera - Specification

-  Superior low-light performance
-  Electronic rolling shutter and GRR
-  Optical format 1/2.7-inch (6.6 mm)
-  Pixel size 3.0 μm x 3.0 μm
-  High Dynamic range Up to 96 dB
-  Full HD support at up to 1080P 30 fps for superior video performance
-  Color and gamma correction
-  Auto exposure, auto white balance, 50/60 Hz auto flicker detection and avoidance
-  Fail-safe IO
-  Color and gamma correction
-  H.264 encoding (8 and 10 bit intra-frame)







High reliability due to the use of technology from the automotive industry



Kappa Switchgear Camera

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Computer Systems and Operating System

-  Office desktop PC
-  Rugged industrial PC
-  Panel PC, 15" , 18" and 21"
-  Windows IoT 10 as base → ready to go for next generation Windows OS
-  Guaranteed software upgrade with new windows version
-  Daily automatic restart of operating system for reliable operation



Switchgear Camera System for Power Grids








Switchgear Monitoring Application

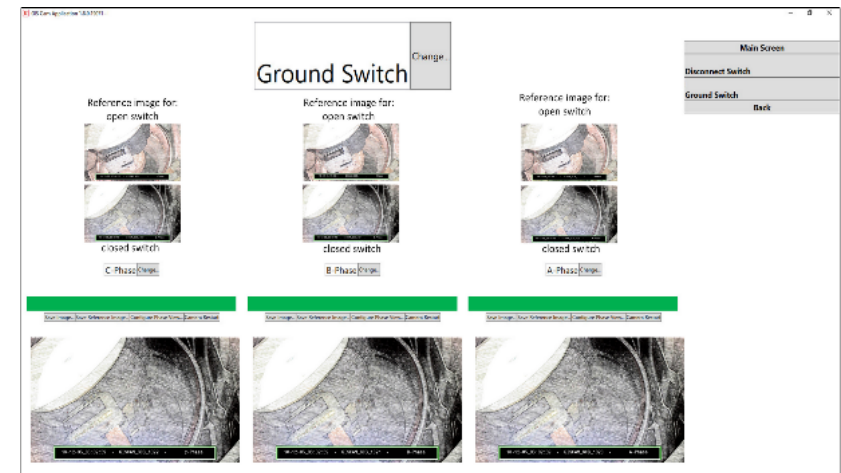
-  Ready to go – PC starts with the application
-  Modern user interface – easy navigation
-  Customer Specific Software Interface
-  Flexible configuration by customer
 -  Change circuit drawings (bmp)
 -  Change buttons (labels)
 -  System modification (changes or extensions)
-  Shell application (no Windows access)
-  Touch ready – for Panel PC integration



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Switchgear Monitoring Application - Advantages

-  Gapless frozen image detection
-  Preventive maintenance analysis and reporting
-  Easy change of configuration in the event of changes or extensions
-  System change report function
-  Scalable software for high number of cameras
-  User-friendly Interface
-  Known look and feel



Switchgear Camera System for Power Grids





Service

-  QA approved set up of new systems at Kappa
-  assignment of hardware to switchgears – SN based!!!
-  allocation of hardware identifiers
-  labelling of all hardware items
-  configuration of database
-  full system operation
-  Same service to be provided on-site (optional)
-  Kappa local service resource is available









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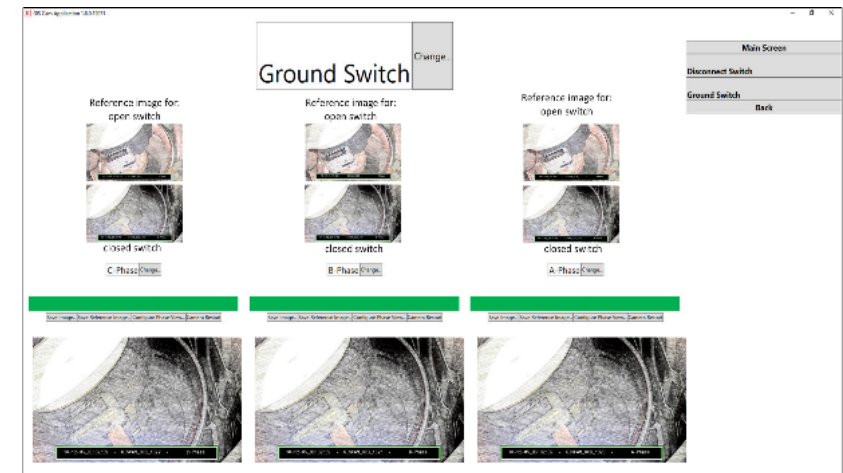
Live tracking of the switch movement

-  The camera system is able to remain operating while the switch device is moving
-  For the operator, this means an additional level of trust
-  For the manufacturer this means and an additional visual inspection of the switching process under load conditions
-  The data can be stored in the database for later analysis

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Preventive maintenance

-  cyclic self-test of the hardware components
 -  cameras are checked to ensure that they are accessible and that they streaming a valid image
 -  full system operating check
-  Reporting to the service engineer in case of an identified issue
-  Changelog
-  Kappa local service








Switchgear Camera System for Power Grids

Why we focus on visible light - Boundary conditions

- κ Standard viewport glasses transmit visible light
- κ The recognizable defects depend on the camera resolution - and thus also on the quality of the lens
 - κ With several switches in a cavity, the depth of focus becomes more relevant
 - κ homogeneous light becomes relevant
 - κ higher resolution = better visibility
- κ Standard viewport glasses does NOT transmit IR-light
- κ Thermal radiation spreads over the surface of the switches and is not sharply demarcated
- κ It is not necessary to use "arbitrarily" high-resolution cameras

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Detection of changes on the switches - Why we focus on visible light

-  No manufacturer is going to invest uneconomical effort, which is in no relation to the benefit
-  IR-technology is comparatively expensive and requires a structural modification of the equipment
-  Existing camera system technology can add value by software upgrades
-  No changes at the power grid equipment is needed
-  Retrofit of existing equipment is possible

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Dr. rer. nat. Claus Romano

Physicist

Senior Presales Engineer (Teamlead) and Product Manager SGC

Kappa optronics GmbH

Kleines Feld 6
37130 Gleichen
Germany

c.romano@kappa-optronics.com

www.kappa-optronics.com

