

# Protect, Automate and Digitalize the Power Grid

## PT GAE ADVAN ENERGI

PT GAE Advan Energi (GAE-ADV) was established in 2022 and is a spin off from PT Guna Elektro's Power Division. GAE-ADV is majority owned by PT Guna Elektro which has been in the electrical, mechanical and telecommunication field since 1962 and is an Authorized Distributor and Value-Added Reseller of various well-known partners around the world.

GAE-ADV provides design, engineering, installation, technical support and after sales services to major utility, industrial and commercial customers throughout Indonesia and helps to protect and optimize existing assets while improving substation electrical system performance, reliability, and safety.

Our integrated solutions:

- Digital Substation Solutions
- Protection & Control
- Advanced Automation Applications
- Utility & Industrial Communication
- Asset Monitoring & Diagnostic
- Advanced Industrial Network
- GNSS Time Synchronization
- Intelligence Thermal & Visual Substation Monitoring
- Electrical Equipment Testing & Analysis Solutions
- Power Quality Solutions
- Switchgear & Power Control Rooms

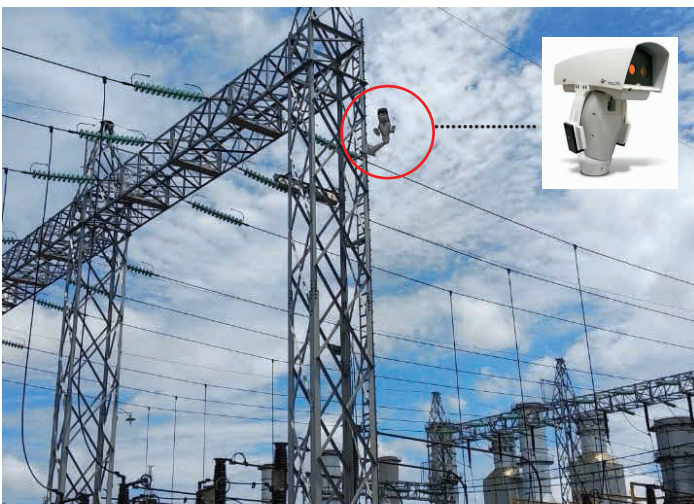
## Vision & Mission

We strive to become one of the leading participants in the national development with a strong focus in the telecommunication, electrical and mechanical infrastructure and to become a world class player. In developing our business we commit ourselves to professionally provide value added services to our stakeholders.

Our ultimate goal is to make quality industrial system & affordable equipment.



GAE has successfully installed and commissioned the first hybrid overhead/underground line protection system for 150 kV lines, by integrating several brands of IEC 61850-9-2LE sensors and IEDs, i.e. GE Micom Agile P645 CCP Relay, Artech Flexible Optical CT (SDO FCT) and Merging Units (SDO MU), synchronized using Tekron PTP GPS time server and connected using Hirschmann Ethernet Switch in Parallel Redundancy Protocol (PRP) network. This protection system will send signal to the existing line differential protection relay, to block auto-reclose function when fault occurred at the underground cable section.



The first installed comprehensive asset monitoring in a digital substation, GAE together with SWI (Systems With Intelligence) provides intelligent asset monitoring solutions for real time visualization of electric power applications. These systems are designed to protect and prolong the life of high value assets and increase the safety, reliability and uptime of operations. Coupling advanced thermal and visual imaging technology with analytic algorithms, SWI solutions automate the remote monitoring process with integrated connectivity to SCADA and asset management applications.



Eversince 2012, GAE has installed a number of digital substations.

The utilities have been benefitting this technology in many ways from faster installation, increased reliability and availability, reduced maintenance cost and optimized asset operation in situational awareness.

# Digital Substation

## Substation Bay Controllers

- Bay computer
- Control logics
- Event recorder
- Embedded control functions



## Protection IEDs

Without analog inputs, smaller form factor, hot-standby, hot-swap, flexible control



## Intelligence Substation Monitoring

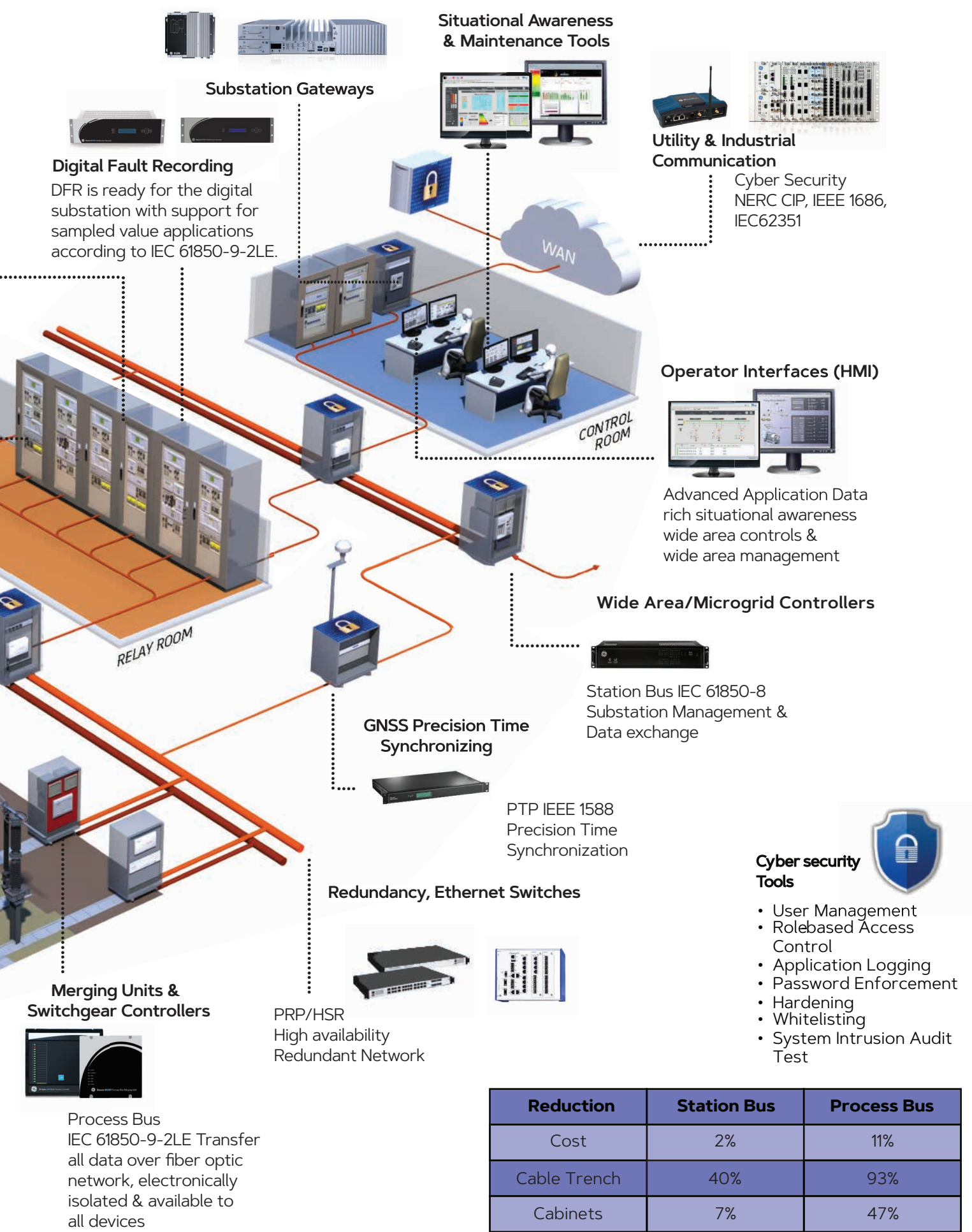


## Primary Asset Monitoring IEDs



Enabling a condition based asset replacement strategy and delivering improvements in system reliability and availability.

SWITCH YARD



**Situational Awareness & Maintenance Tools**

**Substation Gateways**

**Digital Fault Recording**  
 DFR is ready for the digital substation with support for sampled value applications according to IEC 61850-9-2LE.

**Utility & Industrial Communication**

Cyber Security  
 NERC CIP, IEEE 1686,  
 IEC62351

**Operator Interfaces (HMI)**

Advanced Application Data  
 rich situational awareness  
 wide area controls &  
 wide area management

**Wide Area/Microgrid Controllers**

Station Bus IEC 61850-8  
 Substation Management &  
 Data exchange

**GNSS Precision Time Synchronizing**

PTP IEEE 1588  
 Precision Time  
 Synchronization

**Redundancy, Ethernet Switches**

PRP/HSR  
 High availability  
 Redundant Network

**Merging Units & Switchgear Controllers**

Process Bus  
 IEC 61850-9-2LE Transfer  
 all data over fiber optic  
 network, electronically  
 isolated & available to  
 all devices

**Cyber security Tools**



- User Management
- Rolebased Access Control
- Application Logging
- Password Enforcement
- Hardening
- Whitelisting
- System Intrusion Audit Test

Reduction	Station Bus	Process Bus
Cost	2%	11%
Cable Trench	40%	93%
Cabinets	7%	47%

# Protection & Control

## Generator Protection

### Utilities

- Multilin G30
- Multilin G60
- Micom P34X

### Industrial

- Multilin 889



## Transformer Protection

### Utilities

- Multilin T35
- Multilin T60
- Micom P64X

### Industrial

- Multilin 845
- Multilin 345

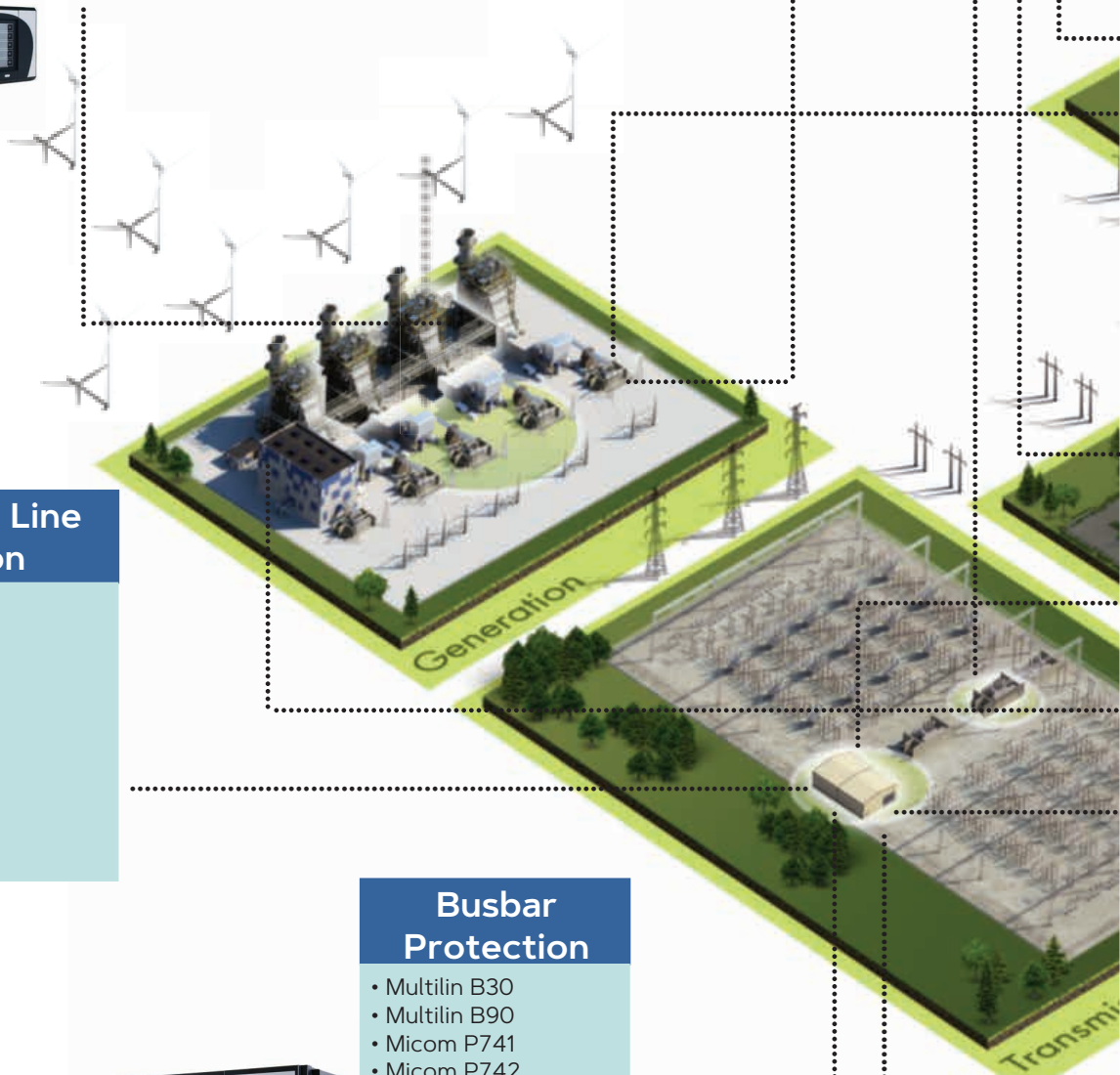


## Transmission Line Protection

- Multilin L30
- Multilin L60
- Multilin L90
- Multilin D30
- Multilin D60
- Micom P44X
- Micom P54X
- Micom P54A-B-C-E
- Micom P59X
- Micom P84X

## Busbar Protection

- Multilin B30
- Multilin B90
- Micom P741
- Micom P742
- Micom P743
- Micom P746
- Micom P747





### Feeder Protection

- Multilin F35
- Multilin F60
- Multilin F650
- Multilin 850
- Multilin 350
- Micom P14X
- Micom P14N
- Micom P14D
- Micom P94V
- Micom P153
- Micom P154



### Motor Protection

#### Utilities

- Multilin M60
- Micom P24X

#### Industrial

- Multilin 859
- Multilin 869
- Multilin 339
- Multilin MM200
- Multilin MM300



### Specialized Protection & Bay Controller

- Multilin C30
- Multilin C60
- Multilin C70
- Multilin C650
- Micom C264



### Metering

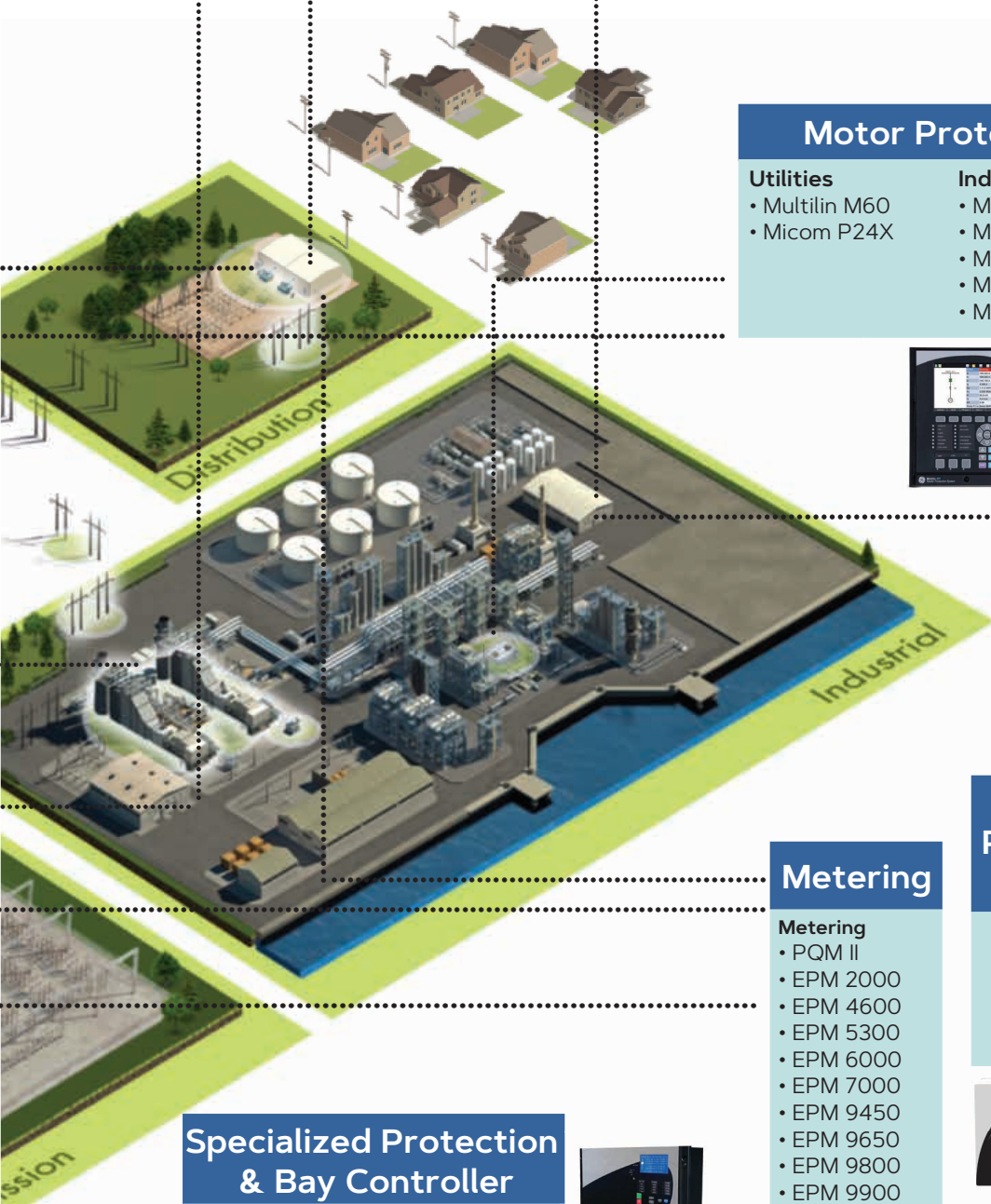
#### Metering

- PQM II
- EPM 2000
- EPM 4600
- EPM 5300
- EPM 6000
- EPM 7000
- EPM 9450
- EPM 9650
- EPM 9800
- EPM 9900
- EPM 9900P

### Fault Recording, PMU's & Travelling Wave Fault Locating (TWFL)

#### Fault Recording

- DR60
- RPV311
- N60
- Micom P847

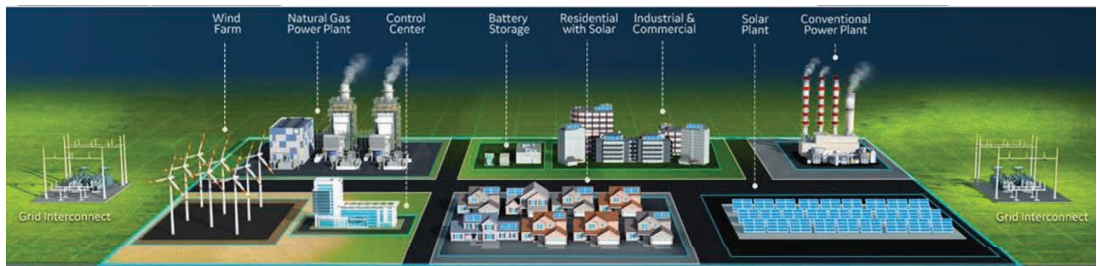




# Advanced Automation Applications

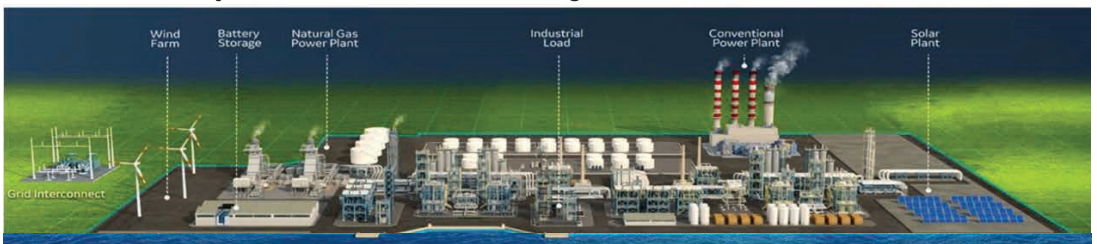
AAA offers an engine embedded in the GE Power Gateway (GPG) running in VxWorks as RTOS which with the Goose, C37.118 and IEC61850-9-2 stacks, a very powerful PLC engine and an embedded or external HMI with the latest features, making GPG as a very reliable, fast and deterministic solution to execute various kind of applications. Logics, algorithms and HMI are fully configurable.

Across the **utilities** AAA can execute the following functionalities, including Wide Area Monitoring & Protection Systems (WAMPS), and SIPS.



MONITOR		MANAGE			OPTIMIZE	PREDICT	ADVISE
Diagnostic	Interfacing	Protection	Control & Grid Stability	Network Operation	Optimal Energy Management	Forecasting	Flexibility (Disruptive)
Observability	HMI user interface	Protection System	Synch (POI Ctrl)	Local State Estimation	Unit Commitment	PV Short-term	Morphing
Power Quality Monitoring	Low-level Data Analytics Discriminate DER Ctrl Access	Dynamic Protection Groups	Voltage & Frequency CTRL Coordination Automated Load Shedding Automated RES Ctrl	Topology Processing Power Flow Black Start	Optical Dispatch Thermal Dispatch	Wind-Power Short-term Load Short-term Market Price Short-term	Multiple POI Support DER insertion market approach Financial tools Scada Interface

Across the **industry** AAA can execute the following functionalities

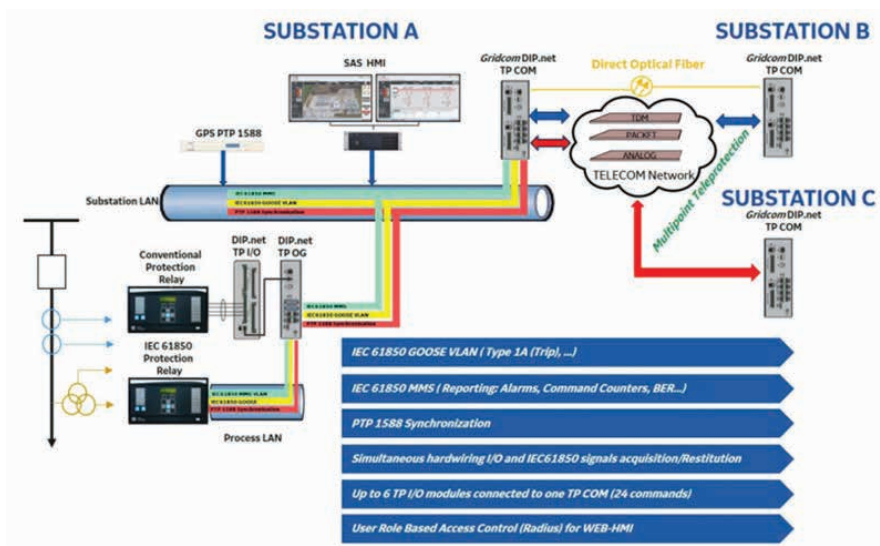


MONITOR		MANAGE			OPTIMIZE	PREDICT	ADVISE
Diagnostic	Interfacing	Protection	Control & Grid Stability	Network Operation	Optimal Energy Management	Forecasting	Flexibility (Disruptive)
Maintenance Scheduling : load/power management	HMI: metering concentration CB monitoring	Protection System	Synch (POI Ctrl)	Topology Processing Power Flow Black Start Peak Shaving Self healing and automatic restoration Islanding, Resynch, and Reconnection	Automatic Source Transfer Power Quality control	PV Short-term Load Short-term Market Price Short-term	Morphing Multiple POI Support Energy Cost Billing Process Interface
Power Quality Monitoring	Motor/MCC monitoring	Dynamic Protection Groups	Voltage & Frequency CTRL Coordination		RT Volt/Var Control and Optimization		
Local State Estimation	Energy Monitoring	Grid point of connection Protection	Automated Load Shedding		Synth Automatic Generation Control		
Motor Diagnostics			Automated RES Ctrl				





# Utility & Industrial Communication



## Key Features

- Flexible I/O cross-connect and multiple configuration capabilities
- Modular teleprotection to stick with your substation migration plan
- User oriented design for more efficient operations
- Comprehensive GUI to get the best of the product capabilities

Teleprotection channels have a decisive role in ensuring uninterrupted power supply, requiring them to be fast, dependable, and secure. Providing IEC 61850 teleprotection for transmission and distribution grids, Gridcom DIP.net is an efficient, modern, and reliable communication solution for transferring critical messages and commands for managing the grid to prevent failure and network damage.

Prompt, dependable and secure transmission of commands and control signals across the grid. GE's Gridcom DIP.net is a versatile interface between the electrical substation and telecom network, bringing benefits such as low cost of ownership, easy and secure remote access, as well as advanced monitoring functionality.



## Key Benefits

- Repurpose narrowband spectrum for more bandwidth-intensive IP applications using QAM modulation
- Provide backward compatibility with GE MDS SD Series or legacy GE MDS x710 radios to seamlessly expand or migrate networks
- Minimize network downtime with dual radio uplinks and other redundancy features
- Protect network and assets against intrusion with powerful cyber security capabilities
- Simplify operations, reduce learning curves and reduce cost by unifying the deployment of multiple wireless technologies on a single platform

The constant evolution of industrial SCADA applications coupled with the ever increasing scale of asset deployment cause significant challenges on underlying licensed narrowband networks. Such networks need to offer an always-on connectivity to maximize application availability. They must provide a comprehensive framework of security in order to guard against the intensified waves of cyber attacks. Finally, the wireless networks must enable advanced performance in order to scale and support modern TCP/IP applications.

The GE MDS Orbit is an industrial-strength wireless router platform that helps overcome the challenges of deploying modern industrial automation applications. In addition to enabling high performance communication over the licensed narrowband spectrum, the Orbit platform offers a diverse range of integrated secondary radio options including cellular, Unlicensed 900MHz ISM as well as Wi-Fi.

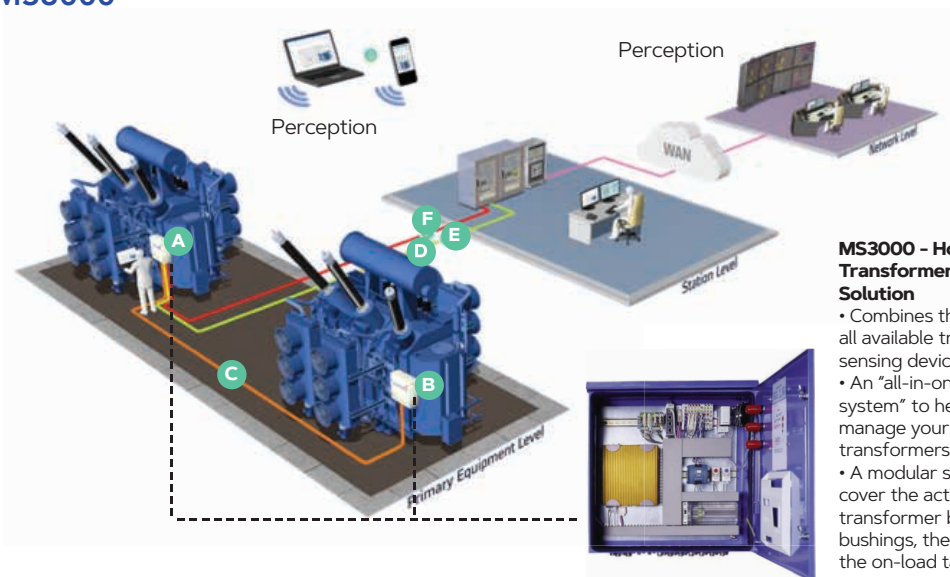


# Monitoring & Diagnostic

GE offers a wide range of solutions to monitor and manage critical assets on the electrical grid, detect and diagnose issues and provide expert information and services to customers.

GE's asset monitoring and diagnostics portfolio includes solutions for single- and multi-gas transformer DGA, enhanced transformer solutions and switchgear monitoring, as well as software and services.

## MS3000



- A-** MS 3000 IED Master Module incl. Webserver
- B-** MS 3000 Slave Module
- C-** Field Bus
- D-** Communication Protocols eg. IEC 61850, IEC 60870-5-101,-104,DNP3.0 or Modbus,etc
- E-** HTTP (TCP/IP via Ethernet)
- F-** Hardwired Signals
- G-** Wireless Access

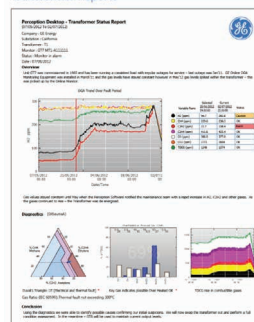
### MS3000 - Holistic Transformer Monitoring Solution

- Combines the outputs from all available transformer sensing devices
- An "all-in-one expert system" to help the customer manage your valuable transformers
- A modular system that can cover the active part of the transformer but also the bushings, the cooling system, the on-load tap-changer and detect transient over voltages and the presence of partial discharge

## SOFTWARE



### Transformer Reports

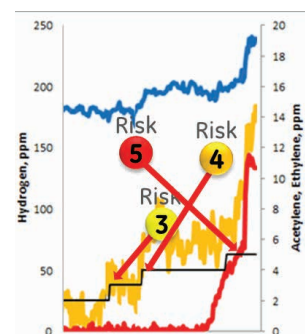


### GE Perception Fleet

- Transformer Fleet Risk Management Software System
- A Comprehensive DGA Diagnostic Tool
- With web browser interface provides customers comprehensive transformer fleet condition rankings, transformer risk information, and expert analysis on-demand.
- For Condition-Based Maintenance Program, provides the insight required to shift from costly time-based maintenance to cost effective and focused condition-based maintenance

- Dangerous defects that may cause faults
- Serious defects that may have serious consequences
- Defects that may affect future reliability
- Minor defects not affecting reliability
- Good condition

Asset Hierarchy	Ranking
GE_Trans_116A	Good condition
GE_Dis_13B	Minor defects not affecting reliability
GE_Trans_15A	Serious defects that may have serious consequences
GE_Trans_111B	Serious defects that may have serious consequences
GE_Dis_14B	Serious defects that may have serious consequences
GE_Trans_113A	Serious defects that may have serious consequences
GE_Dis_12B	Serious defects that may have serious consequences
GE_Dis_13A	Serious defects that may have serious consequences
GE_Trans_113B	Serious defects that may have serious consequences
GE_Trans_114A	Serious defects that may have serious consequences
GE_Trans_115B	Serious defects that may have serious consequences
GE_Trans_111A	Serious defects that may have serious consequences
GE_Dis_15C	Serious defects that may have serious consequences
GE_Trans_112B	Minor defects not affecting reliability





## Single Gas Transformer DGA



### Hydran 201Ti

- Continuous Monitoring of gas and moisture levels.
- Provide personnel with single reading ppm of value of various fault gases.

### Hydran M2-X

- Small online early warning transmitter
- Permanently mounted on the transformer
- Provide traditional Hydran composite gas (H<sub>2</sub>, CO, C<sub>2</sub>H<sub>2</sub>, C<sub>2</sub>H<sub>4</sub>) & moisture.

## Multiple Gas Transformer DGA & Enhanced Transformer Solutions



### Kelman DGA 900

- 9-gas online transformer DGA monitoring system.
- Measures all faulted gases (in ppm) by international standards as well as moisture in oil.



### Kelman DGA 900 PLUS

- Dedicated options for Transformer Thermal Models / Cooling Monitoring / OLTC and Bushing (C1, Tan Delta and PD monitoring)



### TRANSFIX DGA 500

- Measures five individual dissolved gases and moisture.
- The well known Duval's triangle DGA diagnostic described in Appendix B of IEC Standards 60599.



### Kelman DGA 900 MULTITRANS

- 9-gas online transformer DGA monitoring unit designed to monitor a bank of three single-phase.
- Measures all faulted gases (in ppm) by international standards as well as moisture in oil.



### Kelman DGA 900 TAPTRANS

- 9-gas online transformer DGA monitoring unit designed to monitor the transformer and OLTC (On-Load Tap-Changer)
- Measure the main, selector and diverter tanks.



### Kelman MINITRANS

- A low-cost online discrete multi-gas DGA transformer monitoring unit.
- Monitoring 3 key gases: Hydrogen, Acetylene, and Carbon Monoxide plus moisture in oil.



### Kelman TRANSPORT X2

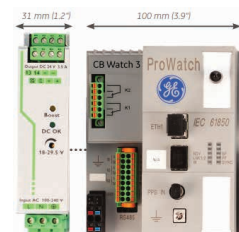
- Portable 'lab in a box' device.
- The ability to perform DGA in less than 30 minutes on the spot.
- Calibration and consumable gas free design for autonomous field operation.
- Robust design with IP67 rating.



### Intellix BMT 300

- Bushing Monitoring and Partial Discharge Detection for transformer.
- Online system that continuously monitor the condition of the bushings.

## CB WATCH 3



### CB Watch 3 - Compact and modular circuit breaker online monitoring solution for most type of high voltage circuit breaker

- Modular - only get the functionalities you want
- Compact modern online monitoring device for any brand of HV circuit breaker
- Measures and checks key parameters every time the CB operates.
- Continuously monitors other items in between operations
- Used to extend the life of ageing asset and extend maintenance intervals, while reducing the risk of "failure to operate"

#### Enables detection of following root causes:

- 1 - Control Circuit Integrity**
  - Open circuit in control circuit
  - Damaged trip/close coil
  - Lack or low DC voltage supply
- 2 - Operational Health**
  - Breaker responds to command and opens/closes
  - Time/speed to operate
- 3 - Arc extinction**
  - Excessive arcing time
  - Arcing contact wear
- 4 - Dielectric integrity**
  - SF<sub>6</sub> gas leaks
  - When gas replenishment is next due
- 5 - Stored interruption energy**
  - Spring rewinding time
  - Rewinding/pump motor current
  - Pump starts when no operation
- 6 - Environment**
  - Extreme cold conditions
  - Cabinet heater integrity

# Advanced Industrial Network Solutions



Unmanaged Industrial Ethernet Switches



Lite Managed Industrial Switches - GECKO



Industrial Wireless LAN



RED25 Fast Ethernet Entry-level Switches



Industrial Cellular Router



Compact Industrial Switches (Managed)



Robust DIN Rail Switches



Managed RSP Switches



19" Ruggedized Switches



Workgroup Switches



Parallel Redundancy Protocol (PRP)



Waterproof IP65/ IP67 Switches



Core Backbone Switches



Industrial Security System



Network Management Software



Backbone Switches



High-availability Seamless Redundancy (HSR)



Modular Industrial Switches



Serial to Ethernet Converters



Secure Remote Access Solution



Routers



Managed Rack Mount Switches



Power Over Ethernet (PoE)



Managed Switches



Unmanaged Switches



Industrial Media Converters



Serial Communications



Power over Ethernet (PoE)



Secured by Tofino



Clear Space® Wireless

# GNSS Time Synchronization

For nearly a hundred years, the electric power industry operated without an external time reference, except perhaps to ensure that the average frequency was correct so as to keep clocks with synchronous motors running on-time. The past decade has seen an explosion in the use of accurate time in the substation and generation plant, now that accurate timing signals are inexpensively available everywhere. The value of time synchronization is best seen by understanding that the power grid is a single, complex and interconnected system.

Navigation satellite technology has made accurate time available in the substation, generation plant, or indeed anywhere in the world with outstanding accuracy and low cost. To implement accurate timing in your

utility, you will need to choose a source of timing signals, an appropriate substation clock, and the distribution infrastructure to provide accurate time to your IEDs.

Tekron products are fully customizable satellite reference clock which references GPS & GLONASS networks. It meets the demanding precision and reliability requirements of the electric power industry. Tekron clocks are designed with GNSS spoofing mitigation in mind. All of product referenced NTP, SNTP and PTP (IEEE1588v2) Grand master or Boundary clock that provides secure, accurate and reliable time synchronization to enterprise networks. Each of the ports are independently addressable and logically isolated allowing multiple Networks to be connected to the same clock without compromising the network security.

				
<ul style="list-style-type: none"> <li>• TCG 01-G: GNSS Timing Generator</li> <li>• TCG 02-G: GNSS Timing Generator</li> </ul>	<p>IRIG-B Analyzer</p>	<ul style="list-style-type: none"> <li>• ITR: Isolated Timing Repeater</li> <li>• PTP Translator</li> </ul>	<ul style="list-style-type: none"> <li>• NTS 02-G: Multiport Network Time Server</li> <li>• NTS 03-G+: Multiport Network Time Server</li> </ul>	<p>TTM 01-G: Compact GNSS Clock</p>



# Transformer Buchholz Relay

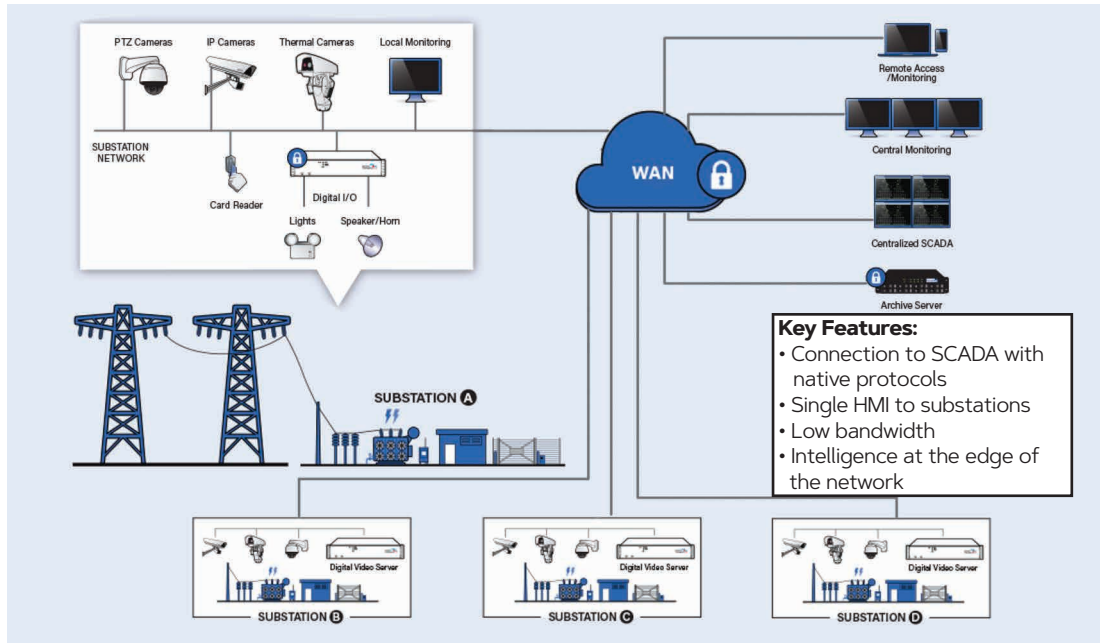
Elektromotoren und Gerätebau Barleben GmbH (EMB GmbH) was founded in 1863, specialised primarily in the manufacture of protection devices for liquid-cooled and liquid-insulated appliances. A decades-long experience in the development and manufacture of Buchholz relays in particular has enabled us to carve out a reputation as one of the leading companies in the sector.

				
<p>Buchholz Relay</p>	<p>Smart Buchholz Relay</p>	<p>Gas Relay for hermetically sealed transformers</p>	<p>Monitoring Relay for Tap Changer</p>	<p>Gas Sampling Device</p>

# Intelligence Thermal & Visual Substation Monitoring

Systems With Intelligence (SWI) solutions provide highly reliable operation in harsh environments intelligent video and asset monitoring solutions for the protection of critical infrastructure within the electric utility industry.

SWI Inc. designs, manufactures, and integrates various best in class components to offer a complete intelligent video monitoring solution tailored specifically for electric utility applications.



## Utility Camera Application



IPCAM2000S -  
Fix mount IP  
Camera



IPTZ1016 -2MP 38X  
IR Network  
Pan/Tilt/Zoom



TCAM2000 -  
Thermal  
Fix/Pan/Tilt mount



TCAM2500 -  
Dual Vision  
Pan/Tilt/Zoom mount

## Industrial /Oil & Gas Camera Application



IM500 - Industrial  
IoT Module  
Dual Thermal &  
Visual Camera 3G/  
LTE connection to  
IoT cloud



EXIPCAM1500 -  
Compact Explosion  
Proof HD Camera



EXIPTZ2000 -  
Explosion Proof  
PTZ Camera



EXTPTZ2000 -  
Explosion Proof  
Thermal & Visual  
PTZ



EXTCAM2000 -  
Explosion Proof  
Thermal Camera  
EXIPCAM2001 -  
Explosion Proof  
HD Camera

## Server & Software



DVS2500 -  
Substation  
Hardened Digital  
Video Server



DVS500 -  
Substation  
Hardened Digital  
Video Server



VMS2000 Server



VMS2000 Client



VMS2000 Analytics

# Electrical Equipment Testing & Analysis Solutions



## Circuit Breaker Analyzer

- **TM-1800** - Modular based design, up to 12 main contact channels.
- **TM-1700** - Various standard models, up to 6 main contact channels.
- **EGIL** - Suitable for testing one break per phase breaker, 3 main contact channels.



## Breaker Static Dynamic Resistance and Dual Ground Testing

- **DCM** - Dual ground testing method for faster and safer testing.
- **SDRM** - Static & Dynamic resistance measurement, accessories for CB Analyzer.



## Contact Resistance Test

- **Mjolner 200/600** - 200A & 600A micro-ohmmeter with dual ground safety and printer built-in.
- **DLRO 100/200/600** Famous Megger "Ducter" Low Contact resistance tester.
- **MOM2/200/600/690** - Simple and compact micro-ohmmeter wide range from 200-800A output.



## Primary Current Injection

- **ODEN AT** - Modular design, up to 20kA output.
- **INGVAR** - Most advanced primary current injection system up to 500A output.
- **SPI225** - Up to 2000A. Smart Primary injection system, equipped with breaker TCC curves database and software.



## VIDAR

- Test the integrity of vacuum interrupters quickly, safely and easily.
- Easy to operate. Follows ANSI/IEEE standardized DC test methods.
- Lightweight and portable.

## Circuit Breaker Test Systems



## TRAX Multifunction Transformer & Substation Test System

- Transformer winding, turn ratio, tap changer, short circuit impedance, demagnetization.
- 12 kV Tan delta testing.
- CT & VT testing.
- Circuit Breaker testing.
- Primary injection up to 2000A.



## Instrument Transformer testing

- **MCRT** - CT, VT, CVT and relay testing, 2KV output according to IEC standard.
- **MVCT** - CT and VT Analyzer with CT knee point up to 30kV.



## Transformer Resistance Testing

- **MTO 106-6A** - 2 channel entry level distribution transformer ohm-meter.
- **MTO 210/250** - 10/50A 2 channel transformer ohm-meter with integrated demagnetization feature.
- **MTO 300/330** - Automated 6 terminal - 6 winding transformer ohm-meter with auto-demag and OLTC testing.



## Turn-Ratio Testing

- **TTRU3** - True 3 phase turn ratio meter, can test phase shifting and zig-zag transformer.
- **TTR310E/330A** - Three phase turn ratio meter with highest ratio measurement (45,000 : 1).
- **TTR100-1** - Handheld TTR.



## MWA 300/330A

- Combine TTR & Winding Resistance Analyzer.
- Three phase TTR testing.
- Built-in demagnetization.
- 55% smaller, 40% higher than individual instrument.
- Faster and more efficient testing.

## Transformer Test Systems



## Power Factor/ Tan Delta Test Set

- **Delta 4110** - Fully automatic 12kV Insulation power factor/ tan delta test set. High Noise Suppression for use in high interference substation Individual Temperature Correction (ITC) for more accurate measurement.
- **Delta 4310** - Fully 12kV insulation power factor test with on-board computer display.



## Sweep Frequency Response Analyzer (SFRA)

- **FRAX101** - with wireless communication (Bluetooth) and battery operated.
- **FRAX99** - with optional battery operated.
- **FRAX150** - with built-in PC.



## Insulation Diagnostic Analyzer

- **IDAX 300/300S** - Frequency Domain Spectroscopy (FDS) technology for measurement of moisture/ water content in transformer insulation paper.
- **IDAX 350** - with on-board computer
- **VAX 020/220/230** High voltage amplifier for testing water content in bushing, CT and water treeing in XLPE cable.



## Transformer Insulator Oil Test

- **OTS 100/80/60AF** - Laboratory instrument for testing transformer oil breakdown voltage. 60-80-100 kV test range.
- **OTS 80/60PB** - Portable oil breakdown test set equipped with battery and charger.



## Transformer Oil Tan Delta & Moisture

- **OTD** - Oil tan delta tester measuring the Tan delta, Resistivity and Relative Permittivity of insulating liquids.
- **KF 875/KF LAB MkII** - Karl Fischer titrimetry for testing moisture in transformer oil.

For over a century, Megger has led the field in developing electrical test equipment. As early as 1903, Megger was addressing urgent requirements among electrical engineers by developing the world's first practical insulation tester. Ever since, Megger has continued to support its customers with tough, reliable products backed up by investment in high quality technical support.

**Relays and Protection Testing**



**Multi Phase Relay Tester**  
• SMRT 410/410D  
• SMRT 46/46D

High Current output up to 60A at 300 VA per phase.  
Flexible output design up to 4 voltage & 10 currents.  
Wide range of relays test plan database.  
End-to-end testing capability.  
IEC61850 Testing.



**Single Phase Relay Tester**  
• Sverker780/650/  
SMRT1

The engineer's tool box for all single phase relay testing.  
Up to 100A/300V output.  
Various relay testing application, include frequency and directional relay test.



**Relay and Substation Test System**  
• Sverker900

The test box for substation 3-phase testing. 3x35A and 4x300V output.  
Relay testing, CT/VT ratiotest, polarity, impedance & primary injection.



**Relay Testing & Management Software**  
• RTMS, AVTS & PowerDB Pro

Designed to manage all aspect of protective relay testing using Megger SMRT family testing unit. Manual & auto test screen, ramping, transient, impedance, comtrade playback, etc. Includes relay library with over 200 relays specific from 31 relay manufacturer. PowerDB stores all test results in single database, scaleable to Microsoft SQL server & comply to NERC standards.



**Protection Relay Tool**

• ERTS - Electronic Recloser Test Simulator  
• MGTR-II - GPS timing reference for end-to-end test using SMRT unit  
• PAM410/420 - Multifunction phase angle meter  
• TM200 - Digital Timer  
• STVI - Smart Touch View Interface handheld controller for SMRT unit.

**Resistance, Battery & Power Quality Testing**



**Battery Discharge Test System**  
• Torkel 900

Battery load/discharge testing unit (dummy load).  
Output up to 200A, 500A. Power upto 15kW.  
Expandable with TXL extra load unit.  
Can be equipped with BVM independent battery cell voltage monitoring unit.



**Battery Ground Fault Tracer/Simulator**  
• BGL/BGFT/BGFS

Easily located ground fault in ungrounded DC system.  
Operate in high electrical noise environment.  
BGFS for battery ground fault location training and simulation.



**Battery Impedance Test Equipment**  
• BITE2/BITE3

Determine health of lead acid and Ni-Cd battery cells up to 7000Ah.  
On-line testing with pass/warning/fail calculation.  
Measure impedance, interconnection resistance and cell voltage.



**Ground Testing Equipment**  
• DET14C/DET2/  
DET3/DET4

2,3,4 terminal earth resistance and soil resistivity tester.  
Bothstakeless or clamp-on testing option.  
Noise rejection up to 40V peak-to-peak.  
Ground resistance measurement up to 200kΩ.  
IP54 rated enclosure with battery operated and rechargeable for some models.



**Power Quality Analyzer**  
• MPQ1000/  
MPQ2000

Handheld (MPQ1000) or portable (MPQ2000) option.  
3 phase power quality analyzer with up to 5 current and 4 voltage channel.  
IEC61000-4-30 class A compliance.  
IP54 enclosure, rechargeable battery operated.  
External SD card data storage up to 32GB.  
Ethernet & wireless communication.



Megger has developed over the years by acquiring companies with complementary expertise, such as circuit breaker test expert Programma (Sweden) in 2007, the world leader in cable test technology SebaKMT (Germany) in 2012, Baker Instruments (electric motor testing operations) was concluded in late August 2018, and Power Diagnostix of Aachen, Germany, a leader in high voltage diagnostic equipment in 2019. This acquisition greatly enhances Megger's capabilities, particularly in the field of Partial Discharge (PD) testing.

**Cable Testing & Diagnostic**



**EZ Thump**  
Highly portable cable fault location system for LV/MV network. 15 kV, 3 kV, 4 kV, and 12 kV output versions with 500 joule surge generator. Battery and AC line operation. On board TDR with 7.6 km range.



**Surgeflex**  
• SFX5/8/12/16/25/32/40  
Portable cable test and fault location system on low and medium voltage power cables. Testing voltage from 5 kV up to 40 kV depend on models. Surge energy from 1000 joule up to 2000 joule depend on models. Embedded Teleflex for easy of controlling and testing procedure.



**Cable Test and Diagnostic System**  
• TDM45/TDS NT/  
PDS 62-SIN  
Cable testing, diagnostic and sheath testing in one device. High power VLF testing at 0.1 Hz with high capacity up to 5 microfarad. Internal cable tan delta measurement with automatic result interpretation. PD diagnostic using VLF sine wave, damped AC or 50/60 Hz slope technology voltages.



**Cable Fault Pin Pointer, Tracer, & Identification**  
• Digiphone+ - Acoustic and electro-magnetic fault pin pointing of underground cable.  
• ESG-NT - Earth Fault locator to pin pointing cable sheath fault, measures step voltage potential produced by test generation in the underground.  
• Faultsniffer - Cable fault pin pointing in low voltage cable.  
• Easyloc RxTx - Utility location system to detect and trace cable runs and pipe network.



**VLF Cable Insulation Testing**  
Sine wave & Cosine (CR) options. Wide range from 20-80 kV output. Frequency range from 0.01 Hz to 0.1 Hz. High testing capacity up to 10 microfarad. Option with embedded or add-on cable tan delta and partial discharge function.

**Insulation Testing & Partial Discharge Detection**



**AC & DC HV Insulation Testing**  
HPA series suitable for 50 Hz AC testing, from 35 kV up to 78kV rms output.  
HPG series can be both AC and DC testing up to 78 kVrms AC output or 110 kV DC output.  
Typical application area: Testing switchgear, CT/VT, cables and other MV systems.



**DC Diagnostic Insulation Testing**  
• MIT 515/525/  
1025/1525/2500  
Well known "Megger" insulation tester. Wide range output from 500 V up to 15 kV depend on model. Measurement up to 20 TΩ depend on models. Li-ion battery extended capacity, rapid charge. CAT IV-600V safety rating. Advance memory with time/date stamp.



**High Performance Diagnostic Insulation Testing**  
• S1-568/1068/  
1568  
Output range 5 kV, 10 kV and 15 kV depend on model. High noise rejection for use in noisy environment such as EHV substations. Resistance measurement up to 35 TΩ, depend on models. Li-ion battery with rapid charge features. CAT V-1000 V safety rating. Long memory up to 11 hours logging.



**PD Scan**  
• Online PD Handheld Scanner.  
• For fast verification of partial discharge activity in MV and HV plants.  
• For a quick assessment of the condition of the switchgear and cables.



**UHF PDD**  
• Handheld Online PD Substation Surveying System.  
• Non-invasive tool for online PD measurements in MV and HV substations  
• Large colour touch-screen for easy operation.

# Power Quality Solutions

**About** Merus Power is a global green technology company headquartered in the city of Nokia, Finland. Merus Power design, manufacture and markets a wide range of innovative electrical energy storages and power quality systems. Our solutions portfolio includes Active Harmonic Filters, STATCOM, SVC, HPQ and Energy Storage System. Our customers benefit from improved power quality which enables energy savings, increased productivity, guaranteed process reliability and grid code compliance.

## Application



**Heavy Industries**

- Steel and Metal Industries
- Mining, Mineral and Cement Industries
- Isolated Power Grids in Marine and Oil & Gas Industries



**Light Industries**

- Industries with Fast Fluctuating Loads
- Critical Process Industries
- Conventional Manufacturing Industries



**Commercial Buildings**

- Hospitals
- Data Centers and IT facilities
- Airports and Other Commercial Facilities



**Infrastructure and Utilities**

- Water and Waste Water Treatment Plants
- Heat, Ventilation and Air Conditioning (HVAC) & District Cooling Plants
- Transmission and Distribution Utilities



**Renewable Energy**

- Wind farms
- Solar farms

## Product



**Active Harmonic Filters**

- Active Harmonic Filters.
- Power factor correction.
- Voltage variation control and flicker mitigation.
- Load balancing in 3-phase system.
- Merus A2 series available from 200V up to 480V (auto sensing) with unlimited scalability sizing with 50A up to 200A rated of individual unit.
- Merus-M series available in 690V and 960V nominal voltage.



**Static Synchronous Capacitor (STATCOM)**

- Part of Merus FACTS Family based on IGBT power electric technology, provide extremely fast and reliable solution for power quality challenge.
- Designed to provide real time power compensation and active harmonic filter.
- Minimized voltage variations and mitigation flicker.
- Available in various voltage level up to 38.5kV.
- Can supply in complete turn-key solution include capacitors, reactor and transformer.



**Static Var Compensators (SVC)**

- Another part of Merus FACTS, built-on proven thyristor technology.
- Voltage stabilization and load balancing.
- Flicker mitigation and maintaining of power factor to desired levels.
- Harmonic Mitigation
- Available from 3.3kV up to 38.5kV.
- Power output from 4MVar up to 250MVar, can be connected parallel for higher total output.
- Can supply in complete turn-key solution.



**Hybrid Power Quality (HPQ)**

- HPQ combines two technologies, detuned capacitor bank + active harmonic filter, in an all-in-one solution.
- Provides better performance than traditional capacitor banks and is more economical than a standard active harmonic filter installation.
- Operates in two modes: Power Factor Correction (PFC) mode for most user application and Ultra-Fast (UF) mode for fast changing and switching speed (<20ms) application such as cranes or lifts.
- Provides stepless and fast power factor correction, harmonic current mitigation and imbalance correction.
- Available for voltage range 220 - 690 VAC, 10 - 200 kVar.

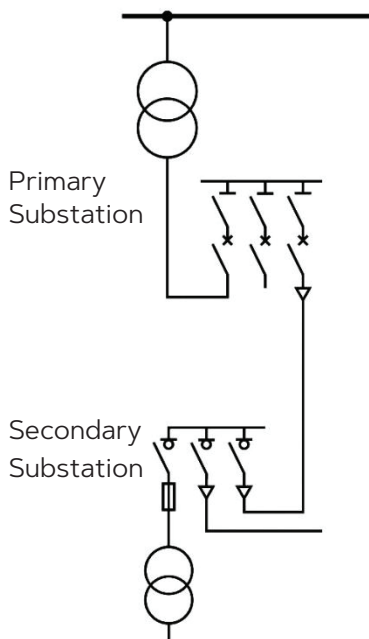


**Energy Storage System (ESS)**

- Can be placed at any level of an electrical system to increase operational performance and reliability, provide energy in real time when primary power source have been interrupted.
- Applicable for renewable energy, T&D, island operation, hybrid & microgrid.
- Various functionality such as peak shaving, ramp rate management, spinning reserve, frequency regulation, system stability improvement, black start functionality.
- Consist of several building blocks i.e: Energy storage (Li-ion battery), MCC Control, protection and monitors, power conversion system and utility connection.

# Switchgear Solutions

GAE provides a wide range of ratings and designs both in IEC and ANSI standard. The switchgears are fully type tested in compliance with international standard to ensure high level protection for people and equipment at all times.



### Air Insulated Metal Clad Switchgear up to 24kV

- GAEclad series are designed, assembled, and tested to comply with the latest IEC standards.
- Internal Arc Fault IAC AFLR tested as per IEC 62271-200.



### SF6 Fully Insulated Ring Main Unit up to 24kV

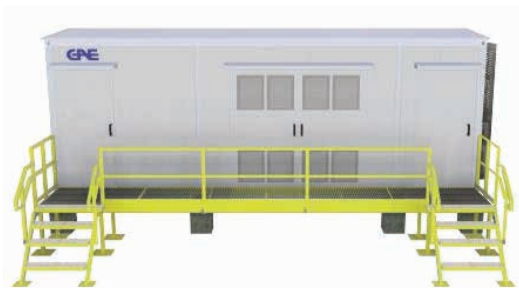
- GRM series RMU can be of free combination and full modularization.
- Extensible SF6 switchgear made of 3mm thick stainless steel.



### Air Insulated Metal Enclosed Switchgear up to 24kV

- Air Insulated modular switchboard for secondary distribution.
- SF6 Load Break and Disconnecting Switch
- SF6 or Vacuum Circuit Breaker.

# Electrical House (eHouse)



### Design:

- GAE eHouse is designed and built to withstand the most challenging environment and location.
- Flexible mousing design, can be pedestal, skid, or trailer.
- Building design for up to 2-hour fire rating
- Wall and roof structure can be fully welded or interlocking system
- Exterior panels are painted up to C-5 Category
- Experienced in Oil & Gas Company, Mining, Utility, Building & Structural



### Benefit:

- Customized to your needs
- Pre-assembled and pre-tested prior to shipment
- Any size, any place, any time, end-to-end responsibility
- Built on our site. shipped to your site

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