



fiber-optics for
ratings + measurement

Unlock your grid's full potential

with fiber-optic-based temperature
and wind measurements



100%
fiber optic DLR

Feel safe



It's as simple as it looks

FORM (Fiber Optics for Ratings and Measurement) combines fiber-optic measurements of temperature and wind with an advanced software and networking tool to help you get the most out of your transmission infrastructure.

Safely and seamlessly.

More bang for your buck.

By allowing you to safely operate your transmission network at its true thermal limit, FORM helps you to unlock the full potential of your transmission assets in a rapid and cost-effective manner.

What we're all about.

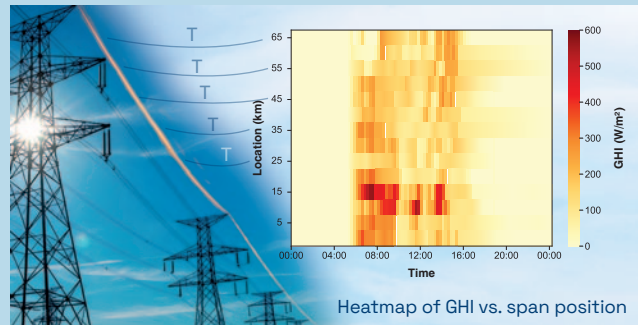
Practical experience has shown that FORM can increase the transmission capacity of an overhead line by up to 50% under favorable weather conditions. FORM combines various fiber optic technologies

that capture the ambient weather parameters for each section of a transmission line, thus providing unprecedented accuracy and transparency in determining the maximum power that can be safely transmitted. By exclusively using the line's existing fiber optic infrastructure (OPGW) for data communication, FORM is easy to configure, protected against cyber-attacks, and immune to electromagnetic interference. No more line-mounted sensors or weather stations along the transmission route!

Maximum performance at minimum OpEx

Distributed Temperature Sensing (DTS)

- High-resolution measurement of optical ground wire (OPGW) temperature
- Global horizontal irradiance (GHI) is calculated for every span in real time from OPGW temperature
- All measurements communicated exclusively with fiber-optics via OPGW
- All active monitoring equipment (DTS Interrogator) housed in substation



Glasfaser-Anemometer (FOA)

- Real-time measurement of wind speed
- No energy supply or communication hardware needed
- All measurements communicated exclusively with fiber-optics via OPGW
- All active monitoring equipment (RM-Wind Interrogator) housed in substation



Unified Monitoring System (UMS)

Centralized software platform for

- DLR calculations (real-time and forecast)
- Device management
- Data visualization





Maximum Quality, Zero AI

A trend among many DLR products is to use machine learning (ML), artificial intelligence (AI), and other “black box” principles to process input data and calculate line ratings.

At LANCIER Monitoring, we’re all about providing solutions for critical infrastructure that are compliant with technical standards and fully transparent to the end-user.

For these reasons, FORM exclusively uses real-world measurements in combination with physics-based equations from trusted industry standards to empower our customers with reliable high-quality data. Whether you’re facing a ratings audit (e.g., NERC FAC-008-5) or documenting standards compliance, we can give you peace of mind with FORM.

Direct
Measurements

+

AI-free, physics-
based equations

=

Transparency.
Compliability.
Peace of mind.



System Features

- > Ambient weather conditions measured solely by fiber optic sensors communicating via OPGW
 - > Each span has unique rating and temperature values for identifying the most critical span
 - > All data transfer over secure and reliable fiber optic networks
 - > Accuracy of measurements resilient to changes in line and OPGW properties (e.g., line creep, fiber attenuation)
 - > Robust fallback methods used to ensure 100 % reliability
 - > Calculations based on IEEE 738/CIGRE 601 methodologies
 - > Compatible with any voltage or current level, DC or AC, conductor diameter, no. of bundles, etc.
 - > No line-mounted sensors or mobile weather stations
 - > Minimal service and maintenance costs
 - > Three unique rating methodologies offered:
 - **FORM Basic package:**
Ambient Adjusted Rating (AAR)
All AAR calculations based on forecasts from external weather service providers
 - **FORM Smart package:**
Ambient Adjusted Rating + solar heating (AAR+)
All AAR+ calculations based on updated values of solar irradiance (GHI) and air temperature
 - **FORM Plus package:**
Dynamic Line Rating (DLR)
All DLR calculations based on updated values of solar irradiance (GHI), air temperature, wind speed, and wind direction
 - > Every rating type available:
 - Real-time: steady-state ratings and conductor temperature in 5-minute intervals
 - Forecasts: steady-state ratings calculations from the next 15min up to the next 72hr
 - Transient ratings for intervals between 15 and 60 minutes
- Both transient and steady-state ratings can be provided at any desired time interval

Data & Software Features

- > Early warning critical span detection with GIS support, enhanced system reliability
- > No wireless communication, therefore protected against cyberattacks and immune to electromagnetic interference (EMI)
- > Supports seamless integration into internal IT platforms with dedicated redundant server configuration (Linux and SQL based)
- > Connects to SCADA/EMS/DMS for supervisory control and fault management
- > Easy installation even during operation.
- > Supports IEC-60870-104, Rest API, MQTT and other networking protocols

Using real-time data to account for relevant weather conditions that change every few minutes within each span – such as solar radiation, ambient temperature, and wind speed – distinguishes FORM from other line rating technologies without sacrificing simplicity, safety, or cost-efficiency.

FORM minimizes upfront costs and simplifies cybersecurity integration

by transmitting all measurement data over the line's existing fiber-optic infrastructure (e.g., OPGW).

FORM determines and forecasts the conductor temperature of each span within a circuit and hence minimizes risks when operating a line above its static rating limit. Critical sections (i.e., the spans within a line that are the hottest or sag the most) may be hard to predict because they change over time, but FORM's high-resolution temperature measurements along the entire line allow for fast and accurate detection.

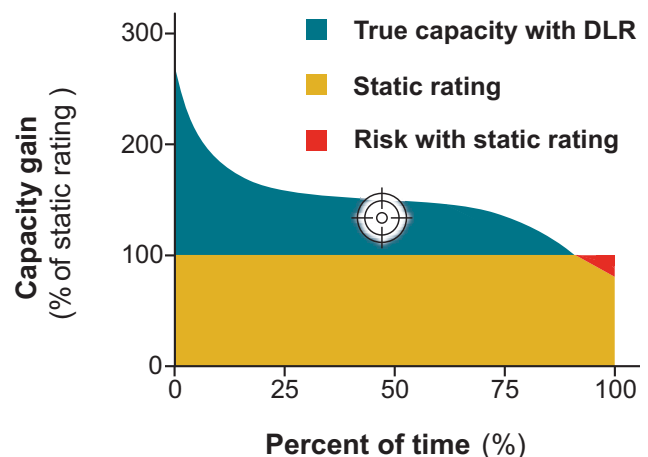


50 % more capacity for half the price

Good for the bottom line.

FORM from LANCIER Monitoring can help you reduce congestion costs and minimize re-dispatching while boosting renewables integration on your grid.

FORM increases capacity and avoids risks.



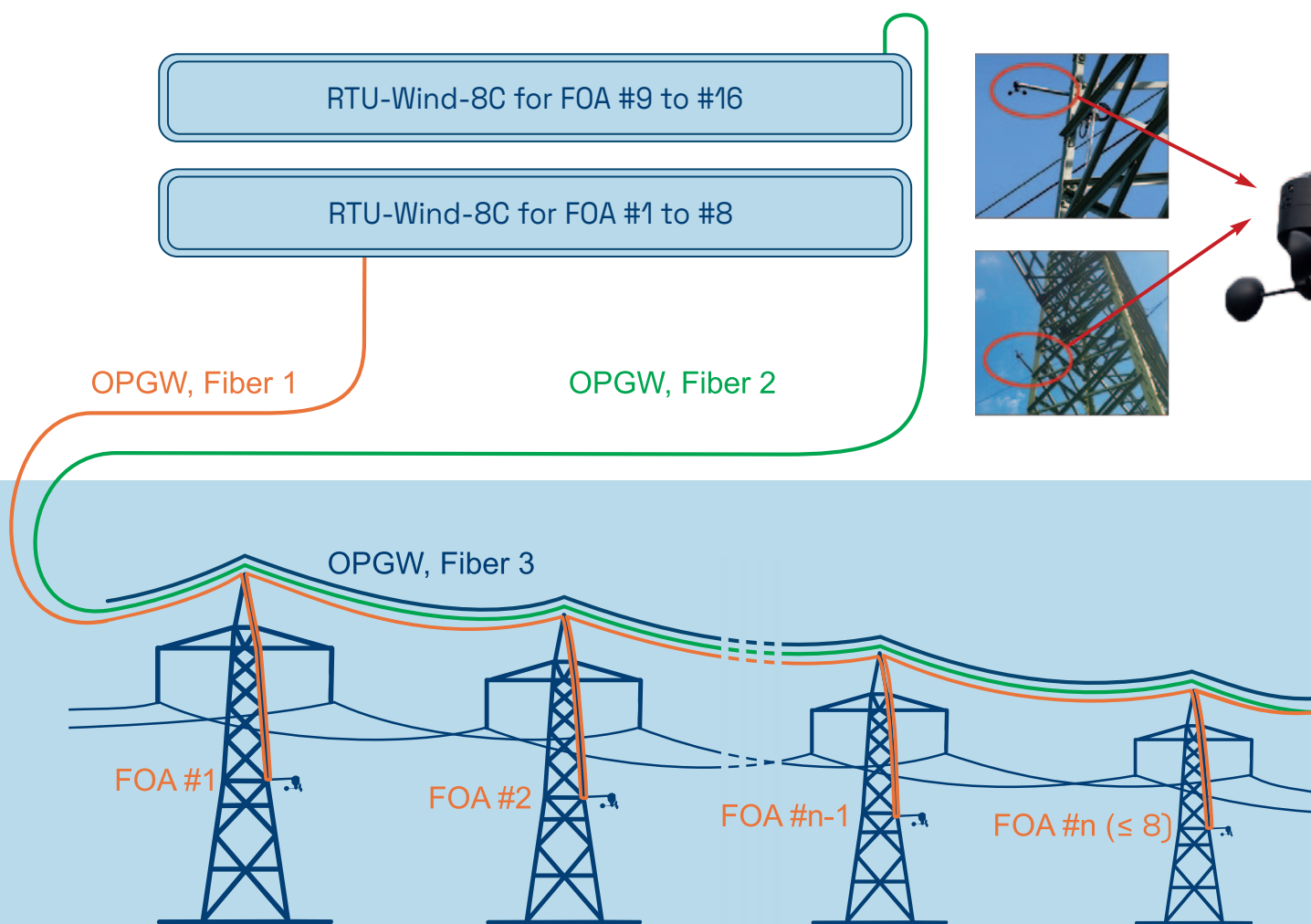
System Integration and Data Management

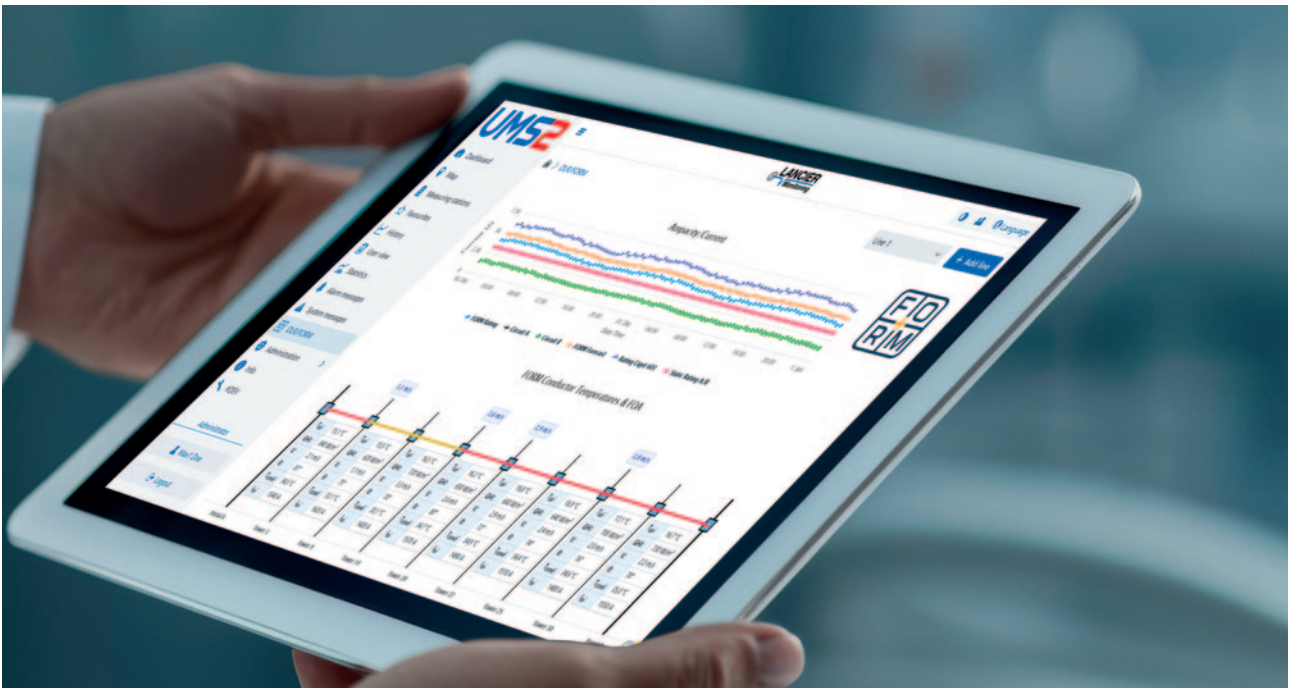
The FORM Application runs on our integrated software and networking platform UMS2. It can be located on a virtual machine in the TSO's data center or directly on the TSO's property as a hardware server, either on-site in any substation or in the corporate server center. No off-premises hosting is used. The standard version of the FORM/UMS2 application runs on Ubuntu, Red Hat Enterprise Linux (RHEL) or Windows Server with PostgreSQL as database management. However, we support other configurations such as running the application with an MS-SQL database.

The FORM application interrogates the DTS and RTU-Wind measuring devices from one or several OHLs leveraging existing fiber optic technologies (e.g. OPGW) and transmission networks.

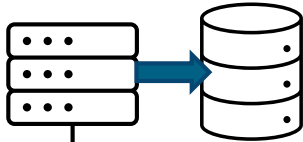
While the DTS measures the temperature inside the fiber in the OPGW, which is ultimately used to determine the solar irradiance, other fibers within the OPGW connect the FOAs to the RTU-Wind in the substation.

Rating results, forecast values, and status messages are transferred to the Operations Control Center by any standard communications protocol (e.g., IEC104).

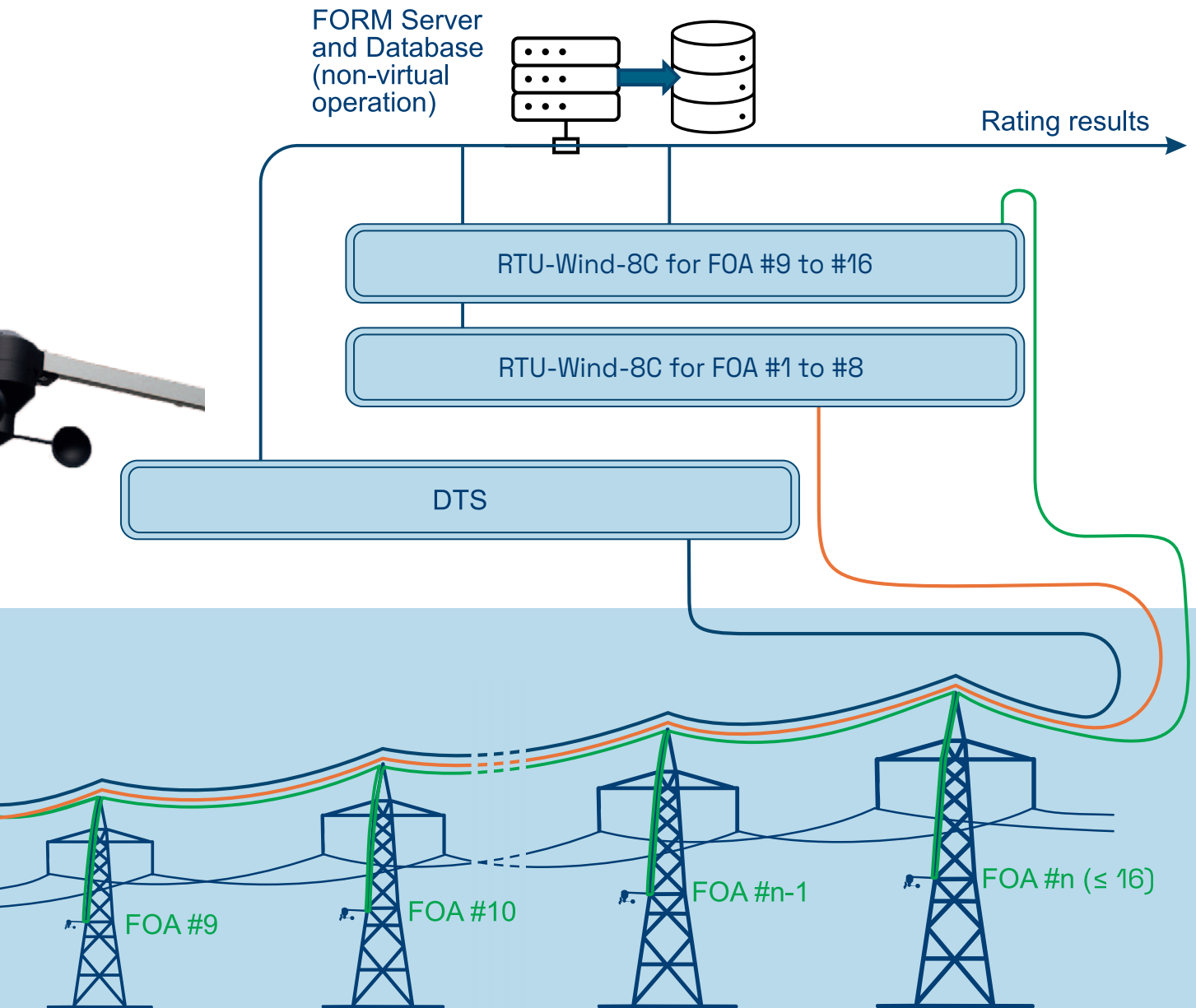




FORM Server and Database (non-virtual operation)



Rating results



Line Rating Options with FORM

We offer three different line rating methodologies to meet you where you want to be. Each have differing levels of conservatism that enable the TSO to

choose the right balance between capacity gains – which range anywhere from 5% to 50% – and discrepancies in forecasted and real-time ratings.

FORM Basic package: Ambient Adjusted Rating (AAR)

Our AAR calculations are based on air temperature forecasts provided by a third-party weather service. Conservative values are used for the solar irradiance and wind. AAR forecasts can be provided up to 72 hour in advance.

Capacity gains of 5% relative to static ratings are to be expected.

FORM Smart package: Ambient Adjusted Rating + using Solar forecast (AAR+)

If uncertainties in wind forecasts are a challenge for your optimal dispatch planning, then AAR+ is the perfect line rating methodology for you. AAR+ is an elegant solution based on updated values of air temperature and solar irradiance with conservative static values assigned for the wind. Because predicting if

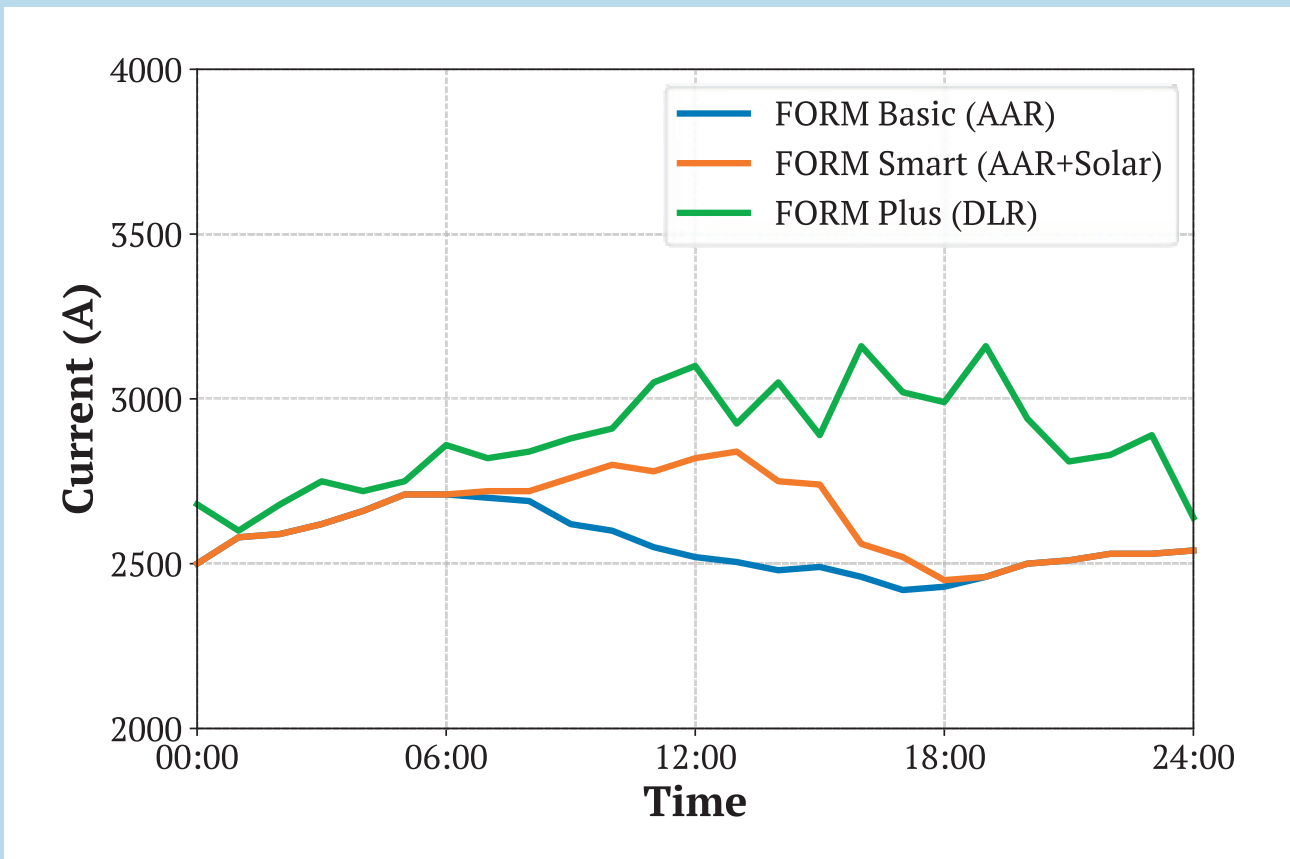
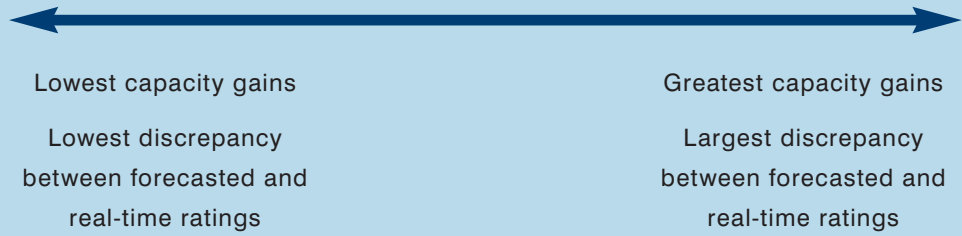
the sun will be shining is easier than pinpointing wind speed and direction, AAR+ reduces unwanted discrepancies between forecasted and real-time ratings relative to DLR. You can expect capacity gains of up to 10% relative to AAR.

FORM Plus package: Dynamic Line Rating (DLR)

DLR with FORM provides the most ultimate capacity gains. We use updated values of air temperature, solar irradiance, wind speed, and wind direction to calculate the true thermal capacity of every span

within the transmission line. Our experience has shown capacity gains of up to 50% relative to AAR are possible.

	FORM Basic	FORM Smart	FORM Plus
Air temperature	Forecast	Forecast & Measured	Forecast & Measured
Wind speed	Fixed: 0.6 m/s acc. to VDE-AR-N 4210-5	Fixed: 0.6 m/s acc. to VDE-AR-N 4210-5	Forecast & Measured
Wind direction	Fixed: 90° acc. to VDE-AR-N 4210-5	Fixed: 90° acc. to VDE-AR-N 4210-5	Forecast
GHI	Fixed: greatest possible	Forecast & Measured	Forecast & Measured



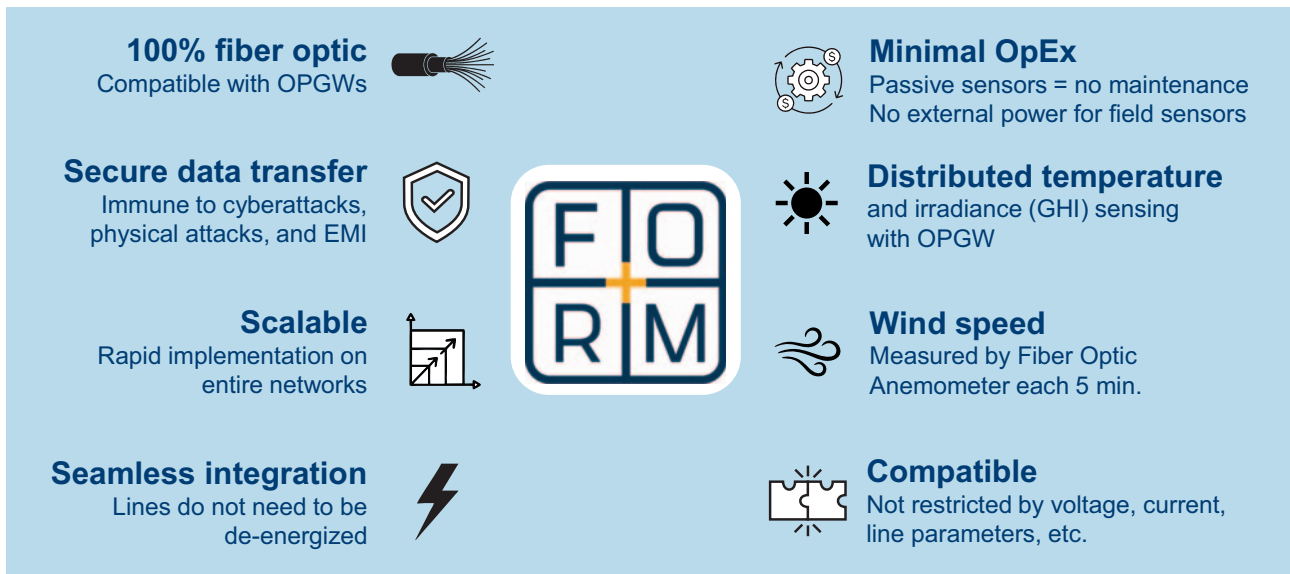
System specifications

Line length served	Up to 120 km (standard) Beyond 120 km upon request
Max. no of circuits per line	Not limited
Voltage range	Not limited
Voltage type (AC or DC)	Compatible with AC and DC
Minimum line current requirement	No minimum requirement
Communications	Fiber optics (via OPGW)
Line outage time required	No outage required
Hardware installation time	Less than a day
Solar irradiance (GHI) measurement resolution	Span level
Solar irradiance (GHI) measurement accuracy	±40 W/m ²
Wind measurement accuracy	±0.2 m/s
Cut-in wind speed	0.2 m/s

Rulemakings	Standards
FERC Order 881 (US)	IEEE 738-2023
NERC FAC-008-5 (US and Canada)	CIGRE 601
§49b EnWG (Germany)	CIGRE 324
VDE-AR-N 4210-5 (Germany)	DIN EN 50341-2-4

Supported networking protocols	IEC-60870-104, Modbus, OPC UA, REST-API, MQTT, CSV-export, SNMP, Email, HTTPS, electrical relays, others on request
Manufacturing information	All components of FORM are assembled and produced in the EU in ISO 9001 certified environments.
IT Security	Our software is developed in accordance with ISO 27001 standards.
Warranty	Full hardware maintenance and warranty for life of contract

Characteristics of FORM



The infographic features a central logo for FORM, which consists of the letters 'F', 'O', 'R', and 'M' arranged in a 2x2 grid within a square border. A yellow cross is positioned at the center of the grid. Surrounding the logo are eight characteristic descriptions, each with a corresponding icon:

- 100% fiber optic**: Compatible with OPGWs. Icon: Fiber optic cable.
- Secure data transfer**: Immune to cyberattacks, physical attacks, and EMI. Icon: Shield with a checkmark.
- Scalable**: Rapid implementation on entire networks. Icon: Line graph with an upward arrow.
- Seamless integration**: Lines do not need to be de-energized. Icon: Lightning bolt.
- Minimal OpEx**: Passive sensors = no maintenance. No external power for field sensors. Icon: Gear with a dollar sign.
- Distributed temperature and irradiance (GHI) sensing**: with OPGW. Icon: Sun.
- Wind speed**: Measured by Fiber Optic Anemometer each 5 min. Icon: Wind gusts.
- Compatible**: Not restricted by voltage, current, line parameters, etc. Icon: Interlocking puzzle pieces.

This sophisticated solution for dynamic line rating – named FORM - and its forecast packages are flexible, scalable, and can be tailored to the end user’s needs.

Feel free to contact us.



We develop solutions together:
innovative, reliable, future-proof

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