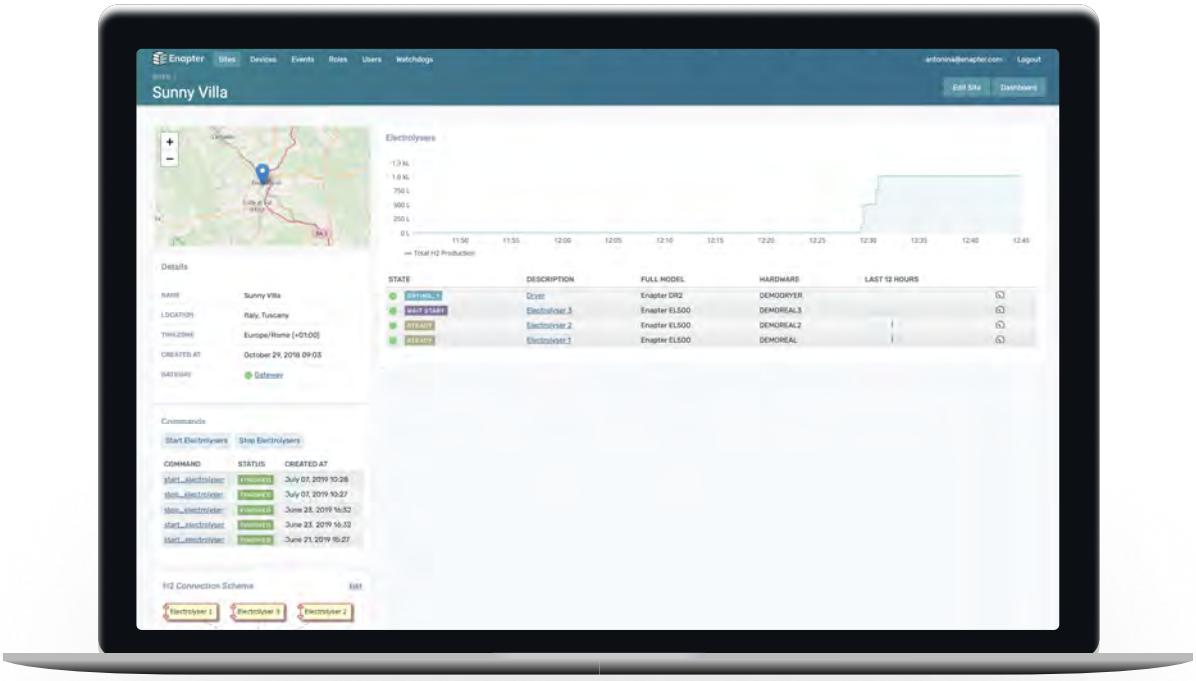
Enapter

Software Defined Energy Management System



Enapter

Winning awards and making waves

Forbes

"It's a paradigm change."

Start Up Energy Transition

Winner 2019
in the category Low-Carbon Energy Production

NEW ENERGY CHALLENGE

Runner-Up 2018

pv magazine HIGHLIGHT 2020 STORAGE GIGAWATT WINNER

Storage Highlights 2020
Gigawatt Winner

30 UNDER 30

Forbes 30 UNDER 30
Energy 2020

Welcome to the Digital Era of Energy

We have reached a turning point in our understanding of energy. Solar and wind are the cheapest ways to generate power. Variable renewables power the energy systems of the future, hydrogen and other options provide the energy storage needs of today and tomorrow.

Renewable energy sources highly depend on natural cycles and weather conditions. Tapping into digital integration allows green energy systems to become more autonomous, independent and resilient. Enapter aims to spur technological breakthrough in new energy hardware by developing ground-breaking software.

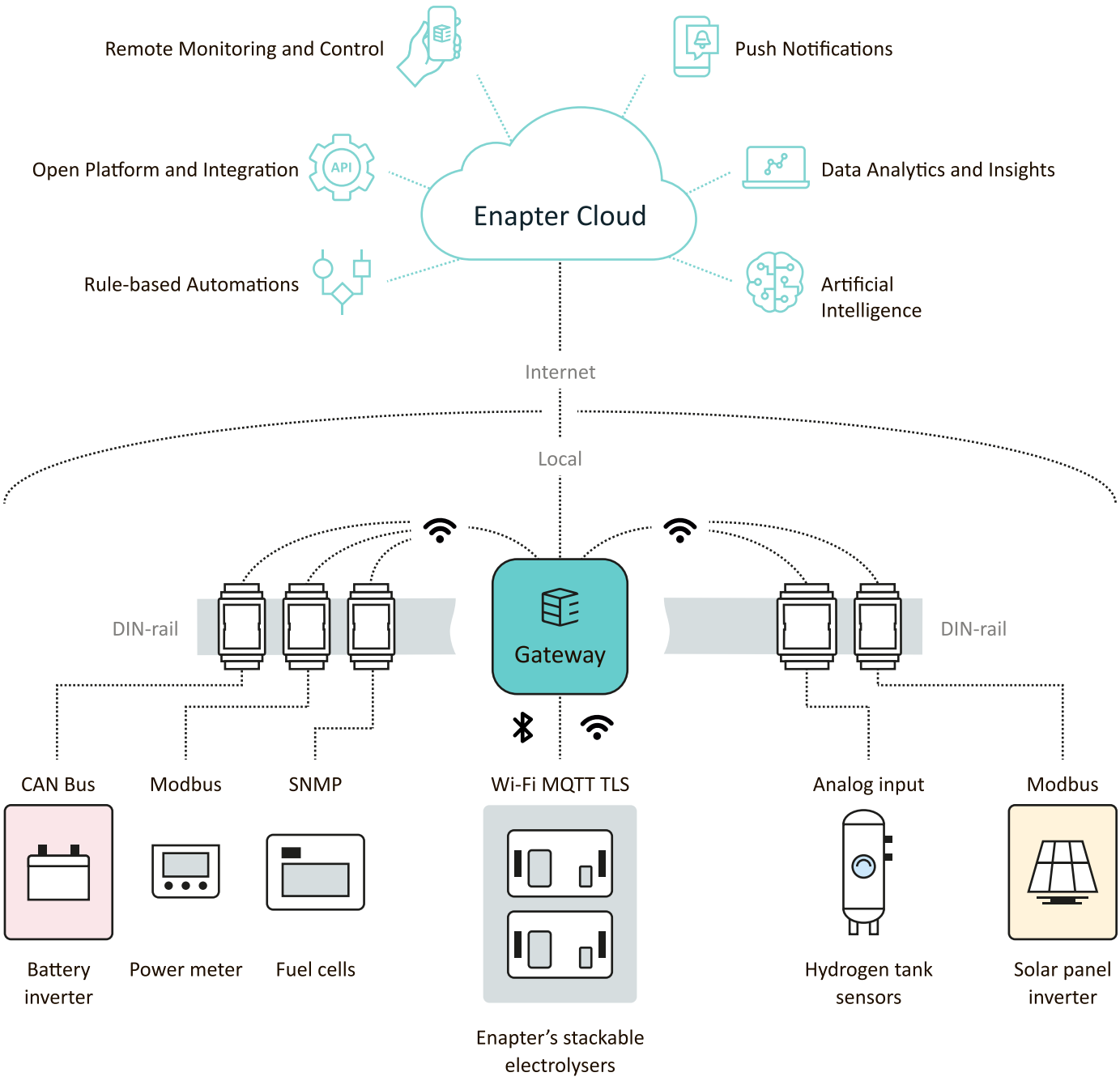
Collecting and analysing onsite data from solar panels, hydrogen storage tanks, batteries, digital and analog sensors with Enapter's Software Defined Energy Management System helps to make energy generation, storage and transmission much more predictable and balanced.

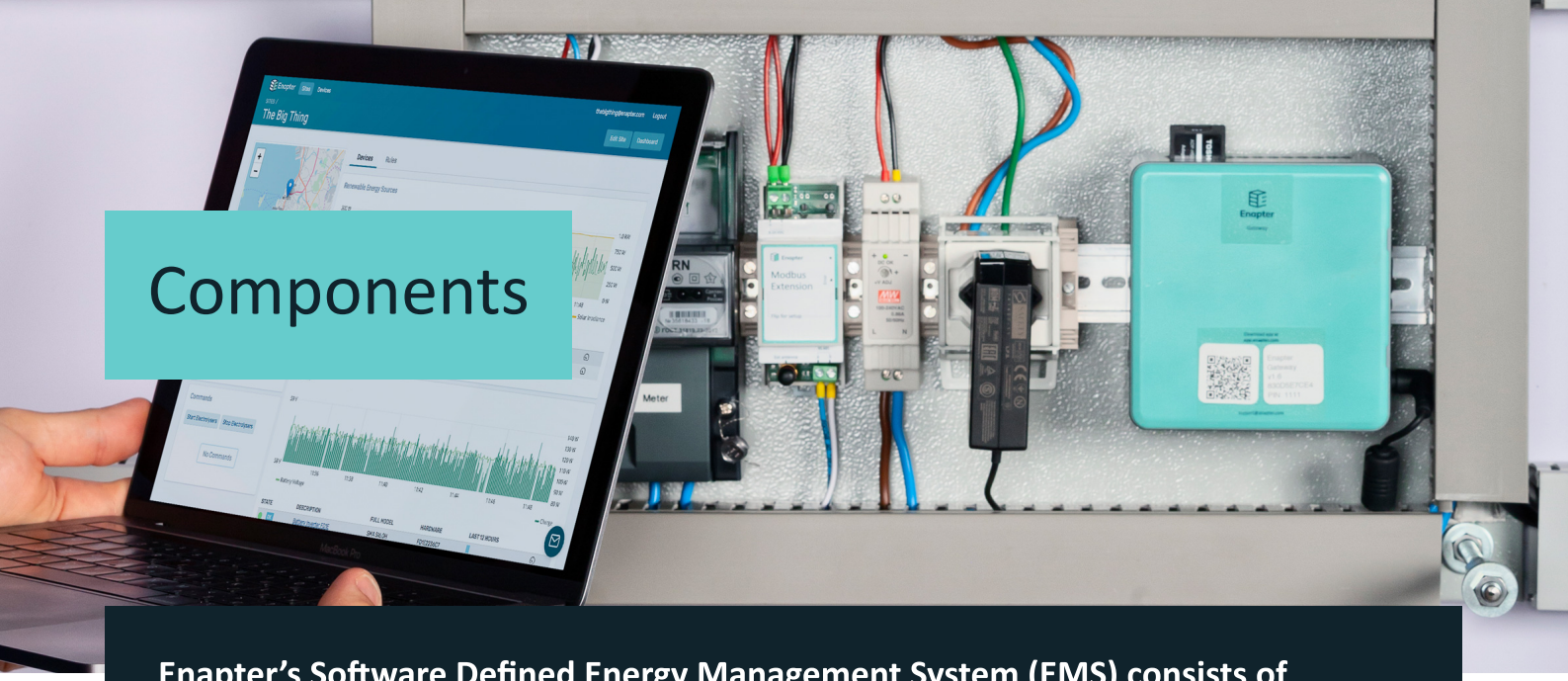
Enapter's digital technologies are not only making the global energy landscape connected, but also intelligent. They render energy systems more efficient, reliable and sustainable through advances in connectivity, data analytics and flow management using industry-grade security via the Enapter Cloud.

The digital transformation is a game changer in many ways. It drives cost down, predicts who and when energy is needed, and consolidates autonomous smart grids – it opens access to reliable and affordable sources of energy for everyone and everywhere in the world.

Architecture

The high-level architecture design of the Enapter Software Defined Energy Management System.





Components

Enapter's Software Defined Energy Management System (EMS) consists of several components and translates a wide range of communication protocols into a universal one connecting all devices into one unified energy network.

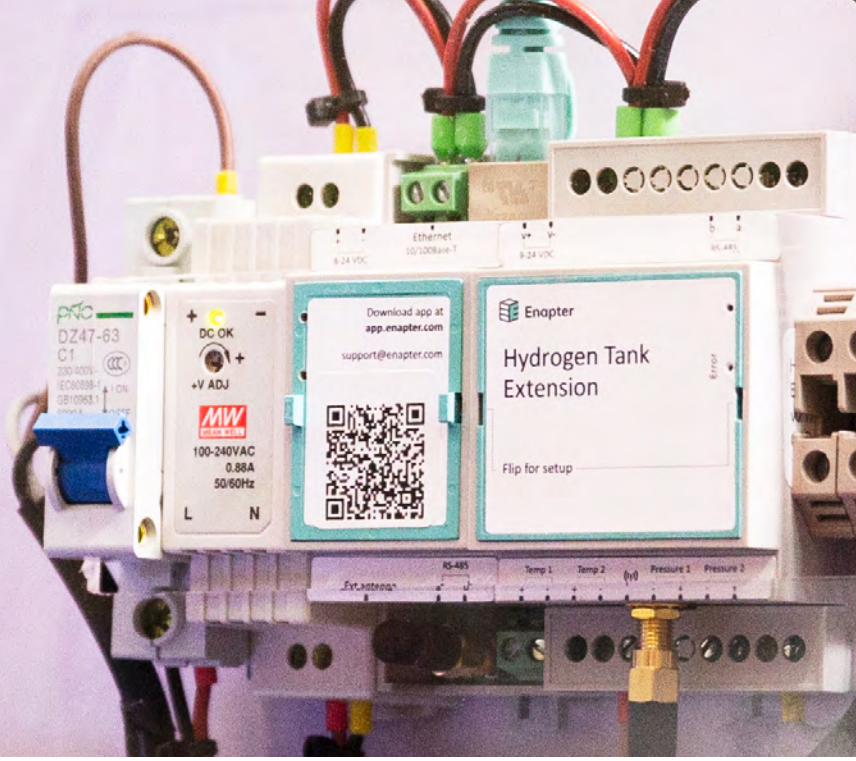
This is much needed as modern energy systems are modular and contain equipment from different vendors and a multitude of analog and digital sensors. While each device can operate in a stand-alone mode the energy system must be running as unified solution with defined logic.

The Enapter EMS is designed in a modular and customizable way, and adresses the integration of components in an efficient way.

The key components of the Enapter EMS:

- Universal Communication Modules
- Mobile Applications
- Enapter Gateway
- Enapter Cloud and Dashboards

Universal Communication Modules



Universal Communication Modules (UCM) serve to translate the protocols of individual connected energy devices into a unified one. This is achieved via extensions that deliver data to the Enapter Gateway and Cloud through a secure wireless connection.

All Enapter devices (Electrolysers, Dryer, etc.) come with preinstalled UCMs which provide the immediate ability to monitor and manage devices. To ensure that UCMs support the latest protocols and security fixes over-the-air updates are supported.

Modules

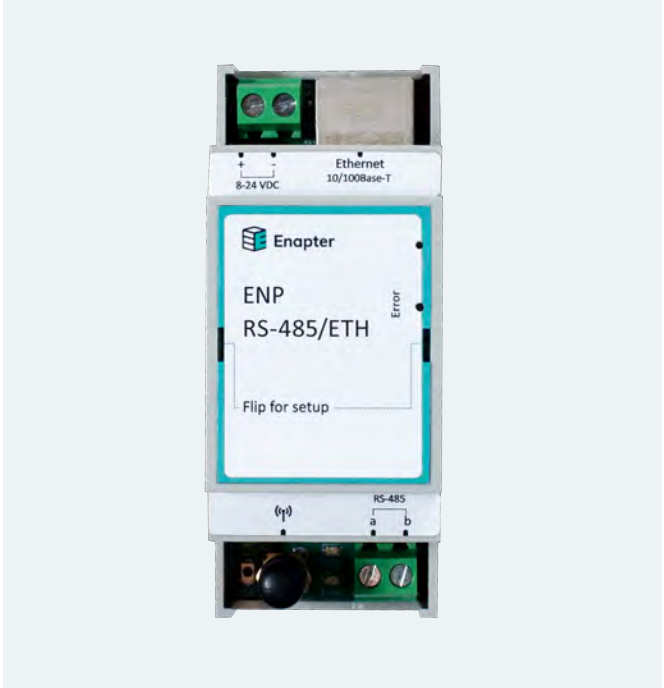
ENP-RS485

Modbus

Connect devices using RS-485 interface, working on the Modbus RTU, Profibus and others. Examples of connected devices are: irradiance sensors, ventilation systems, pumps, motors, solar charge controllers or battery inverters.

Wireless Wi-Fi 2.4 GHz
Wireless Bluetooth 4.0 LE
1 Modules DIN Rail Enclosure

Modbus RTU / RS485



ENP-RS485/ETH

Modbus **Ethernet**

Connect devices such as solar charge controllers, fuel cells, Internet services and others using RS-485 interface, working on the Modbus RTU or using it over TCP protocol via Ethernet interface.

Wireless Wi-Fi 2.4 GHz
Wireless Bluetooth 4.0 LE
2 Modules DIN Rail Enclosure

Modbus RTU / RS485
Modbus TCP / Ethernet
Ethernet IEEE 802.3/802.3u, 10/100 BASE-T

Automatic polarity detection and correction
Loop-back modes
Auto-negotiation

ENP-RS232

Modbus

Connect devices such as irradiance sensors, a ventilation systems, pumps, solar charge controllers or battery inverters using the RS-232 interface.

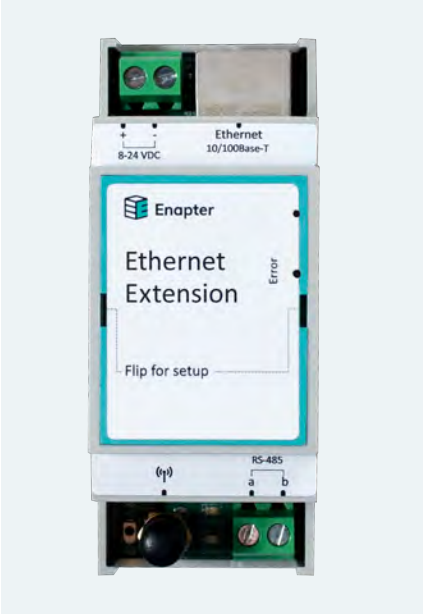
Wireless Wi-Fi 2.4 GHz
Wireless Bluetooth 4.0 LE
1 Modules DIN Rail Enclosure

ENP-CAN

CAN bus

Connect devices such us irradiance sensors, solar charge controllers or battery inverters using the CAN Bus interface.

Wireless Wi-Fi 2.4 GHz
Wireless Bluetooth 4.0 LE
1 Modules DIN Rail Enclosure



ENP-ETH

Ethernet

Connect devices such as battery inverters or fuel cells using the Modbus RTU over TCP protocol via Ethernet interface.

Wireless Wi-Fi 2.4 GHz
Wireless Bluetooth 4.0 LE
2 Modules DIN Rail Enclosure

Ethernet IEEE 802.3/802.3u, 10/100 BASE-T

Automatic polarity detection and correction

Loop-back modes
Auto-negotiation

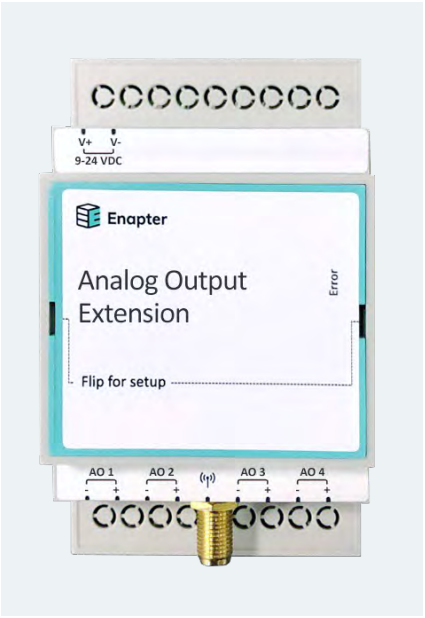
ENP-RL6

Relay module

Control of a low-power load without high inrush currents. For example a normal closed valve, a normal open valve, signal lamps or intermediate contactors.

Wireless Wi-Fi 2.4 GHz
Wireless Bluetooth 4.0 LE
3 Modules DIN Rail Enclosure

6 relay 7A 230V
7 Digital Inputs



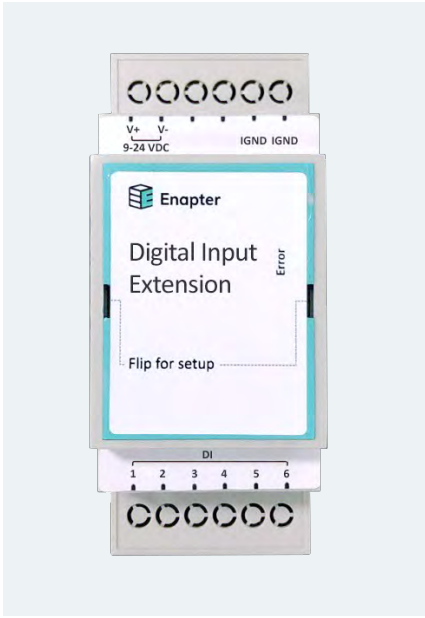
ENP-AO4

Analog Output

Connect analog devices and control them with a 0...10 V signal. For example a valve, a sensor or a dimmer.

Wireless Wi-Fi 2.4 GHz
Wireless Bluetooth 4.0 LE
3 Modules DIN Rail Enclosure

4 Analog Outputs 0-10V



ENP-DI4

Digital Input

Direct control of low-power loads without high inrush currents: signal lamps, intermediate contactors.

Wireless Wi-Fi 2.4 GHz
Wireless Bluetooth 4.0 LE
2 Modules DIN Rail Enclosure

ENP-HTE

Hydrogen Tank Module

Connect pressure and temperature sensors installed on hydrogen tank for example an analog pressure sensor with at least 0…40 bar pressure range and 0…10 V signal, a PT1000 class B temperature sensor.

Wireless Wi-Fi 2.4 GHz
Wireless Bluetooth 4.0 LE
3 Modules DIN Rail Enclosure

2x Analog Temperature Sensors (PT 1000)

2x Analog Pressure Sensors (0-10V)

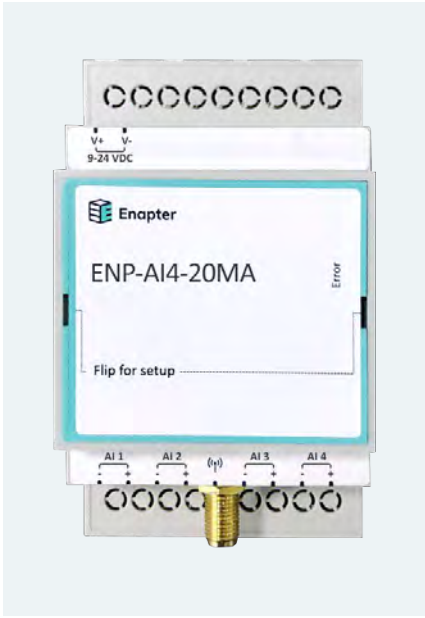
ENP-AI4-50V

Analog Input

Connect analog sensors with a signal of -50...+50 V for example a thermometer, a pressure sensor, measuring voltages on each battery cell and others.

Wireless Wi-Fi 2.4 GHz
Wireless Bluetooth 4.0 LE
3 Modules DIN Rail Enclosure

4 Analog Inputs -50 - +50V



ENP-AI4-20MA

Analog Input

Connect analog sensors with a 4...20 mA signal for example a thermometer, a pressure sensor, measuring voltages on each battery cell and others.

Wireless Wi-Fi 2.4 GHz
Wireless Bluetooth 4.0 LE
3 Modules DIN Rail Enclosure

4 Analog Inputs 4-20mA

Enapter Gateway

Rule-based Automations

The Enapter Gateway is the key energy site controller allowing to manage any energy system efficiently.

The purpose of the Gateway is to collect all data from energy devices connected via UCMs. It analyzes and processes data with suitable commands by the Enapter Rule Engine – the subsystem which executes rules in a simple if-then-else logic defined by the user.

This logic allows to send action commands to devices based on conditions driven by sensors or other device's data integrated in the energy system:

IF **solar irradiance is** **>600 WATT/SQM**

THEN **START** **Electrolyser.**

The logic is set using the convenient command line interface (CLI) and can extend to any level of branching and complexity. In cases when standard condition rules are not sufficient it is possible to extend functionality by contributing additional logic using Lua scripting language.

The gateway plays a significant role in securely and reliably operating microgrids. It can therefore be organized into a reliable Master-Slave cluster allowing uninterruptable operation and maintenance.

The Enapter Gateway software is based on the open source Linux and Yocto project. It runs on standard Intel-based hardware.

Remote Monitoring and Control

Enapter Cloud

The Enapter Cloud collects performance and error data from the Enapter Gateway and all connected UCMs. It stores it in a time series database and provides real-time or on-demand visualization of collected data on customizable dashboards.

Devices can easily be added by scanning QR code.

Dashboards can be used for monitoring purposes, demonstration, analysis and performance tuning.

Mobile app

Enapter's mobile application makes the installation of any energy system quick and easy. After the setup all devices can then be managed via the mobile or web dashboard. They can also be controlled by the logic of the Enapter Rule Engine. In case of any issue or misbehavior the mobile app will push notifications to the user. This functionality is available via Wi-Fi or 3G network, all over the world.

Download on the App Store

ANDROID APP ON Google play

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