



wattkan

TEPLORE
Tensorpack

Commercial & Industrial Energy Storage System



High Performance



Long Lifespan



Maximum Safety



Advanced Control



Flexible Deployment

Introduction



Teplore's vision is to accelerate the world's transition to sustainable energy, based on this vision, Teplore focuses on developing innovative and sustainable distributed energy storage products and services, offering safe and efficient distributed energy storage systems to market, and providing energy storage-based solutions for commercial and industrial scenarios.



8th EIGHT ROADS[™]



“Technology Explore”

Wattkan was established to handle storage and renewable energy related projects from pre-sales phase until operation. Built on the years-long experience of an energy auditor having written a PhD on the topic of energy system optimization, Wattkan's explicit strategy is to deal with energy related topics holistically, assessing every aspect of the customer's site in order to deliver the very best solution and best value for money.



“Renewables, Batteries, Energy efficiency and more”



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Storage System

Functionality



Time of Use

Reduce costs by leveraging the price difference between peak and off-peak tariffs.



Peak Shaving

Control the maximum load power and reduce the demand charges.



Capacity Expansion

Increase electrical generation capacity without changing the transformer.



Renewable

Use more energy from renewable sources and minimise feed-in.



Microgrid

Create a small utility grid with or without a connection to a public utility grid.



Market Participation

Provide energy support to the grid in response to system operator alerts.

Application

Factory

Factories suffer from high electrical bills, Tensorpack with multi-use capabilities that can run several storage applications in parallel for time of use, peak shaving, renewable self-consumption and microgrid applications, where high storage capacity with many guaranteed cycles ensure sustainable and economic power delivery.



Charging Station

The grid power connection easily reaches its limits when constructing large EV chargers. Deploying Tensorpack can avoid transformer expansion costs since Tensorpack regulates the load peaks to protect against overload and reduce electrical bills.



Microgrid

Distributed energy storage combined with photovoltaic, diesel generators and other power sources to provide a stable power system in remote areas or areas with unstable power grids.



Ancillary Services

Connect Tensorpack to the flexibility market and regulate the frequency to the national grid, including FFR and FCR-D services, to get benefit for participating in the up/down frequency regulations.



Features

High Performance

Tensorpack's rack batteries are connected in series to avoid circulating current and ensure that PCS operates at the highest efficiency range. The thermal management system automatically adjusts the cooling strategy to maintain the best operating conditions of batteries.

Tensorpack T

Maximum round-trip efficiency **91%**



High Safety

Tensorpack cooperates with all front-line suppliers, including CATL, Schneider, Phoenix Contact, Starcharge, Sinexcel and Delta, to guarantee the best quality, security, and performance.

Thermal runaway warning algorithm combined with multi-level electrical protection devices and fire protection systems together ensure safety. Battery early warning technology accurately predicts the battery SOC and SOH, diagnoses and monitors the internal short circuit risks in advance.



Long Lifespan

The thermal management system ensures all batteries running in best temperature range with temperature difference of 5°C, combining with the DoD control algorithm, it greatly improves the lifespan of the battery system.

Entire life cycle exceeds **10.000/8.000** cycles

System service life exceeds **20** years

Flexible Deployment

► Pre-integrated System:

All pre-installation and debugging are completed before delivery, ensuring transportation of the entire cabinet.

► Low Construction Cost:

The system is ready for immediate connection and use upon arrival at the site, eliminating the need for extensive on-site wiring and debugging associated with traditional energy storage equipment.

► Low Maintenance Cost:

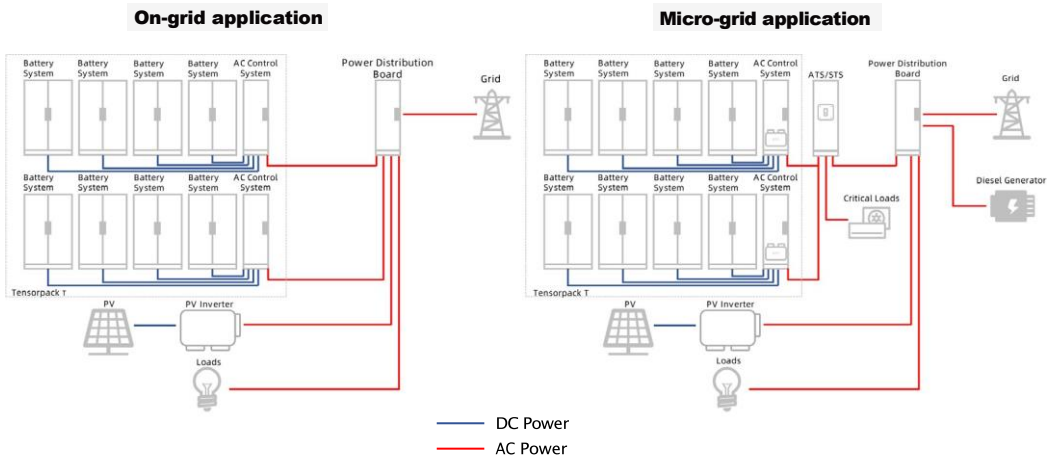
The system requires no manual on-site maintenance, reducing costs by more than 40%.

► Flexible Expansion:

Each unit occupies less than 2m² of space and supports parallel operation of up to 200 devices.

➔ **Maximum Cascaded System Size: ~ 50 MWh**

Electrical Block-Diagram



Product Specification

Depending on customer preference, three cell types are currently available. 280 Ah cells provide highest C, while 306 Ah cells enable 10.000 cycles. The standard system sizes are listed in the table below.

Customer specific configuration (i.e. lower/higher performance to energy ratio) is possible.

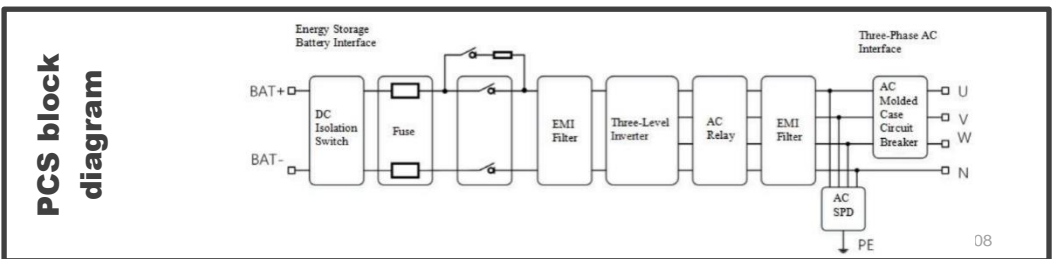
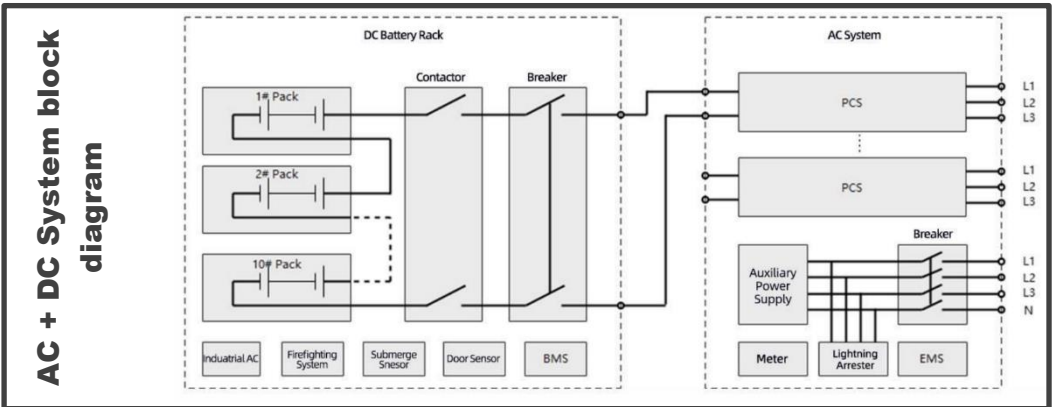
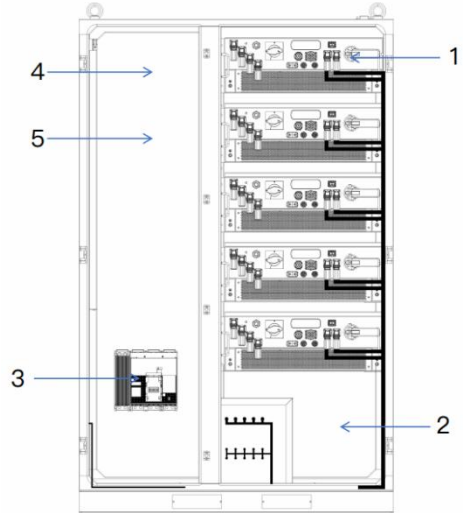
		Tensorpack T 215	Tensorpack T 241	Tensorpack T 265	Tensorpack T 235	Tensorpack T 258
AC parameters	Rated Power (kW)	100				
	Maximum Power (kVA)	110				
	Grid type	3P + N + PE				
	Rated Grid Voltage (V)	400				
	Grid Voltage Range (Vac)	352-440				
	Maximum current (A)	167				
	Grid Frequency (Hz)	50/60				
	Power factor	-1-1				
DC parameters	Battery Cell Type	LFP 280 Ah CATL	LFP 314 Ah CATL		LFP 306 Ah CATL	
	Rated Capacity (kWh)	215	241	265	235	258
	Voltage Range (V)	672-864	672 - 864	739,2-950,4	672-864	739,2-950,4
	Cycles expected 100% DoD 70% EoL 25°C +/-5°C 0,5C/0,5C	8000			10000	
System Parameters	Highest Round-trip Efficiency	91%				
	Operating Temperature (°C)	-30-55				
	Relative Humidity (%)	0-100, no condensation				
	Operating Altitude (m)	<3000	<2000			
	Communication Interface	LAN/RS 485/CAN	Ethernet / RS485			
	Communication Protocol	ModBus TCP/ModBus RTU/IEC104/CAN	ModBus TCP/Modbus TRU/MQTT/IEC104		ModBus TCP/ModBus RTU/IEC104	
	Ingress Protection	IP55				
	Thermal Management	forced air cooling				
	Noise Rating (dB)	<65	<70			
	Battery System Dimension (WDH)(mm)	1600x1250x2200	1500x1300x2200			
	PCS System Dimension (WDH)(mm)	800x1100x2200	800x1300x2200			
Weight (kg)	~ 2600			2975	3145	

AC Subsystem

PCS Cabinet

Teplora's PCS solution is an integrated cabinet with up to 5 inverters, integrated optional ATS and the local controller. Its design enables quick installation and modularity.

S/N	Item	Remarks
1	PCS Module	1-5 Modules
2	Busbar	
3	AC Breaker	
4	Local Controller	LC Integration Area
5	ATS	ATS Integration Area



Product Specification

Power Conversion System	
DC Connection	
Full Power DC Voltage Range	650 to 950V
Rated Input/Output Power	100kW
Maximum DC Operating Current	158 A
AC Connection	
AC Output Power	100 kVA
Maximum AC Operating Current	145 A
Nominal AC Voltage	400 Vac (3W+PE+N)
Nominal AC Frequency	50Hz/60Hz (Configurable)
THDi	<3% (Rated Output Power)
Power Factor	-1 to 1
Mechanical	
Dimension (WxHxD)	700 x 266 x 820 mm
Approximate Weight	85kg
Cooling	Intelligent Forced Air Cooling
Enclosure Rating	IP66
General Data	
Operating Temperature Range	-25 °C to +60 °C, Derating above 45 °C
Relative Humidity	0 to 95% RH, Non-Condensing
Altitude	3000 m
Compliance	
Safety/EMC	CE, IEC 62477, IEC 61000-6-2/-4
Grid Connection	EN50548-1, EN50549-2, VDE-AR-N4105, G99

Applied inverters are certified and authorized in Hungary to enable quick project flow. Small to medium systems are equipped with **StarCharge's** M100-E-IEC (SI105TENT04), while medium to large systems are equipped with a corresponding **Sinexcel** inverter.



Snapshot from StarCharge Product Data Sheet



Star Charge

Product name	M100-E-IEC
Model	SI105TENT04
BATTERY PORT	
Operating voltage range	650 - 950 V
Rated input/ output power	100 kW
Max. charging and discharging power	110 kW
Max. operating current	158 A
AC PORT (ON-GRID MODE)	
Max. output power	100 kVA
Rated current	145 A
Rated grid voltage	400 V a.c.; 3W+PE, +N(optional)
Frequency	50 Hz/60 Hz
Power factor range	1.0 (lagging) ~1.0 (leading)
THDi	<3% (rated power)
AC PORT (OFF-GRID MODE)	
Output voltage ¹⁾	400 V a.c.; 3W+N+PE
Max. output power	100 kVA
Max. alternating current	145 A (linear load) / 90 A (nonlinear load)
Max. unbalance load	17.5 kVA
Frequency	50 Hz/60 Hz
Max. allowable crest factor	2.5
THDv	<3% (rated conditions, resistively balanced load)
MECHANICAL	
Dimension (W x H x D)	700 x 266 x 820 mm
Weight	85 kg
Cooling	Intelligent forced air cooling
Enclosure material	Aluminum alloy
Installation type	Rack-mounted
Protection grade	IP65
Salt-mist protection	C5
PROTECTION	
Protect functions	<ul style="list-style-type: none"> Anti-reverse connection protection DC overvoltage and undervoltage protection Anti-AC phase sequence error protection AC overcurrent protection Overtemperature protection Anti-islanding protection AC surge protection
GENERAL DATA	
Topology	Transformer-less
Peak efficiency	98.1%
Operating temperature range	-25°C to 60 °C , derating above 45°C
Humidity	0% ~ 95%
Operating altitude	3000m
Audible noise	<75 dBA @ 1 m
Parallel connection	Up to 6 in parallel connections
INTERFACE	
Display	LED
Communication mode	RS485 / CAN
Firmware Update Mode	Remote update supported
STANDARDS	
Safety	IEC 62477-1
Grid connection standards(pending)	EN 50549-1, CEI0-21, RENblad 342, G99, Vde-AR-N4105k
EMC	IEC61000-6-2/-4

1) Additional transformers are required to support single-phase loads.

V09-202402

The above specifications are subject to change without prior notice for product improvement.

Kiserőművekben alkalmazható inverterek listája

Érvényes 2024.04.04-től

Gyártó	Típus	Névleges teljesítmény ¹	Fázisszám ²	Maximális teljesítmény ³
Wanbang Digital Energy Co., Ltd.	SI105TENT04	100 kVA	3F	100 kVA
	PWS1-500KTL-EX-1M1 (*)	62.5 kVA	3F	68.7 kVA
	PWS1-500KTL-EX-2M1 (*)	125 kVA	3F	137,5 kVA
	PWS1-500KTL-EX-3M1 (*)	187.5 kVA	3F	206.25 kVA
	PWS1-500KTL-EX-4M1 (*)	250 kVA	3F	275 kVA
	PWS1-500KTL-EX-5M1 (*)	312.5 kVA	3F	343,75 kVA
	PWS1-500KTL-EX-6M1 (*)	375 kVA	3F	412,5 kVA
	PWS1-500KTL-EX-7M1 (*)	437,5 kVA	3F	481,25 kVA
	PWS1-500KTL-EX-8M1 (*)	500 kVA	3F	550 kVA
	PWS1-500KTL-EX-1M8 (*)	62.5 kVA	3F	68.7 kVA
	PWS1-500KTL-EX-2M8 (*)	125 kVA	3F	137,5 kVA
	PWS1-500KTL-EX-3M8 (*)	187.5 kVA	3F	206.25 kVA
	PWS1-500KTL-EX-4M8 (*)	250 kVA	3F	275 kVA
	PWS1-500KTL-EX-5M8 (*)	312.5 kVA	3F	343,75 kVA
	PWS1-500KTL-EX-6M8 (*)	375 kVA	3F	412,5 kVA
	PWS1-500KTL-EX-7M8 (*)	437,5 kVA	3F	481,25 kVA
	PWS1-500KTL-EX-8M8 (*)	500 kVA	3F	550 kVA
	PWS1-500KTL-EX-2M4 (*)	125 kVA	3F	137,5 kVA
	PWS1-500KTL-EX-4M4 (*)	250 kVA	3F	275 kVA
	PWS1-500KTL-EX-6M4 (*)	375 kVA	3F	412,5 kVA
	PWS1-500KTL-EX-8M4 (*)	500 kVA	3F	550 kVA
Sinexcel (Shenzhen Sinexcel Electric Co., Ltd.)	PWS1-1725KTL-H-EX-8M1 (*)	1725 kVA	3F	1897 kVA
	PWS1-1725KTL-H-EX-7M1 (*)	1509 kVA	3F	1660 kVA
	PWS1-1725KTL-H-EX-6M1 (*)	1293 kVA	3F	1423 kVA

Wanbang Digital Energy Co., a leading provider of innovative energy solutions, offers the StarCharge inverter series.. StarCharge is a premium provider of comprehensive EV energy supply and storage solutions, with a global footprint spanning over 60 countries across six continents. With a commitment to a greener future, StarCharge has delivered 2 million EV chargers worldwide, leading the industry in sales volume over the past decade. In terms of manufacturing scale, StarCharge is producing close to 100,000 inverters per year.

Sinexcel is a leading provider of innovative energy solutions, offering a range of products that cater to the growing demand for clean and efficient energy. Their comprehensive energy solutions include solar photovoltaic (PV) systems, energy storage systems, and electric vehicle (EV) charging stations. Sinexcel produces a significant volume of inverters annually, with over 100,000 units manufactured each year.

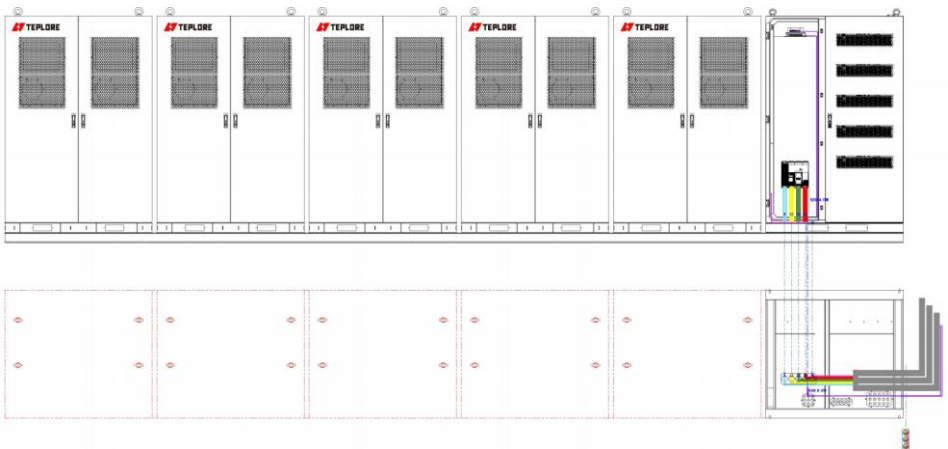
Installation

Teplora can provide a Skid Mounted Solution, with a single skid capable of up to 500kW/1MWh+. The system's electrical capacity depends on the battery system model chosen. The system installation guide in this chapter provides instructions for both external wiring and internal wiring. All the internal wiring is pre-installed in the factory, customer only need to connect the external wirings.

0.5 MW/1MWh + Installation Reference (Internal Wiring)



0.5 MW/1MWh + Installation Reference (External Wiring)



EMS and UI

Teplore's battery system is equipped with state-of-the-art BMS and EMS system and an accompanying visual user interface. Generally, Teplore's own EMS is capable to handle every on-site control logic and use-case requirement. In addition, country-specific requirements and advanced optimization logic-based strategies can be applied by using 3rd party EMS, with which Teplore provides full compatibility and support.

EMS Solution Compatibility

Type	Category	Compatibility				
Teplore Turnkey Solution	Teplore Local Controller	Time of Use/Load Shifting	DCM/Peak Shaving (Demand Charge Management)	PV Consumption/Zero Feed In		
		Constant Pricing Hour			Spot Market*	
		Capacity Expansion	FCR/aFRR/nFRR	Back-Up		
	Third Party's EMS*	Time of Use/Load Shifting	Constant Pricing Hour	Spot Market*	DCM/Peak Shaving (Demand Charge Management)	PV Consumption/Zero Feed In

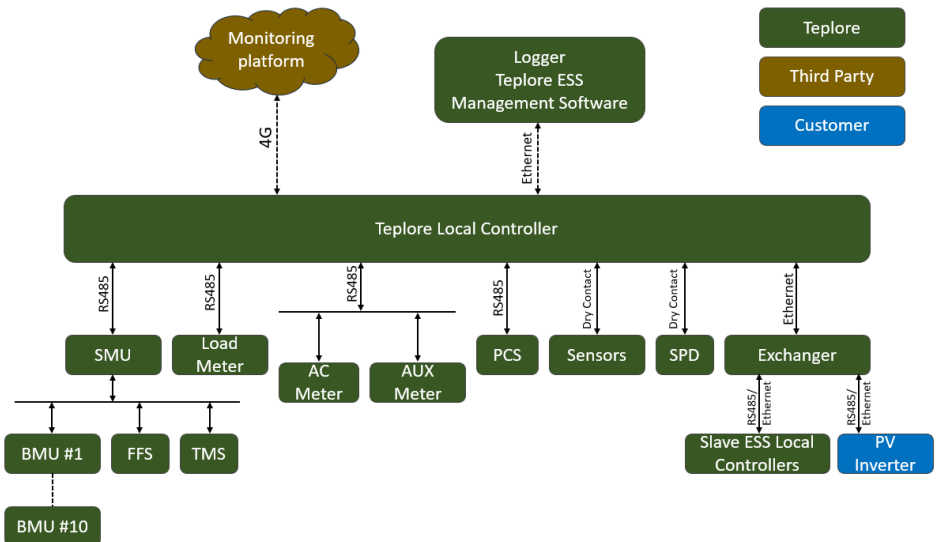
* Consult with Teplore for compatible third party EMS

■ Compatible Application

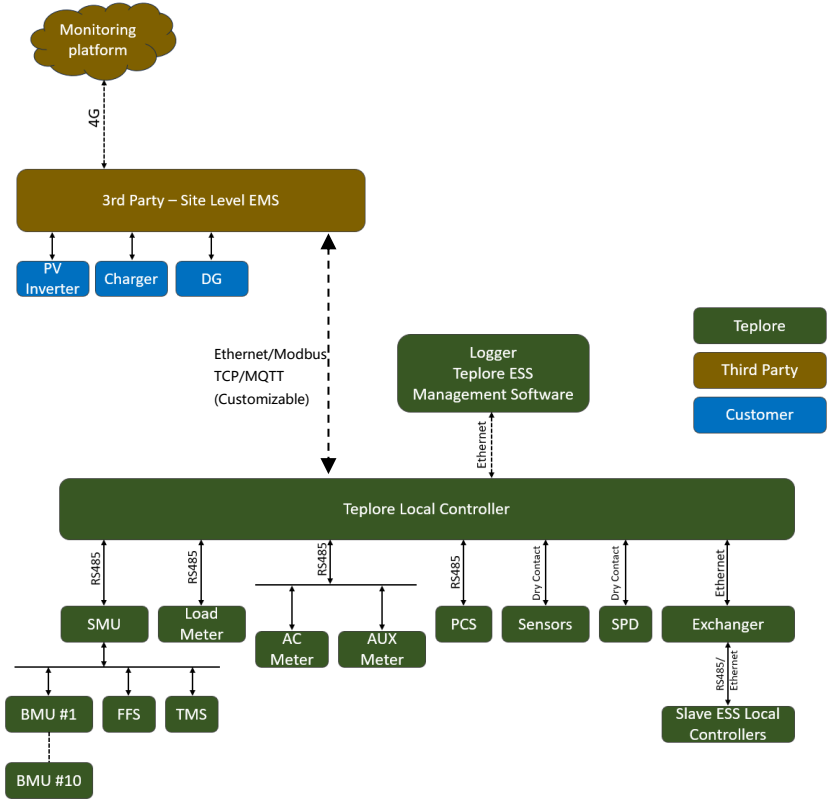
■ Uncompatible Application

EMS Topologies:

1. Local Controller Topology



2. 3rd Party's EMS Topology



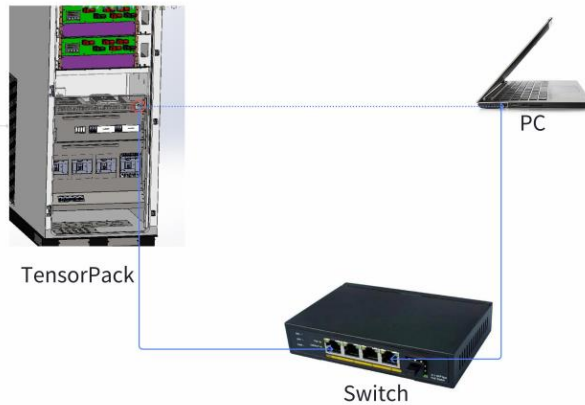
Local Controller Parameters

System	
Processor	Intel® Celeron® J6412 quad-core, 2.0 GHz (max. turbo 2.6 GHz)
Memory	Built-in 8 GB DDR4, 3200MHz, supports up to 32 GB (1 slot)
Hardware Security	TPM2.0
BIOS	AMI UEFI (64 Mbit)
OS Support	Microsoft® Windows 10, Windows 11, Advantech Linux (Ubuntu 20.04 Desktop/ Server)
External I/O	
Serial Ports	4 x RS-232/422/485, DB9, 50 ~ 115.2kbps
LAN	2 x RJ45, 10/100/1000 Mbps IEEE 802.3u 1000BASE-T Fast Ethernet
USB	3 x USB 3.2 GEN2, 1 x USB2.0
Displays	1 x HDMI 1.4 (3840 x 2160 @30 Hz) 1 x DP 1.4 (4096 x 2160 @60 Hz)
GPIO	24 Channel Isolated Digital I/O
Certification	
Certification	CE, FCC, UL, CCC, BSMI



Logger (UI)

Logger is a local management system primarily used for strategy management, information management, historical data querying & exporting, and system management in Tensorpack Energy Storage Stations. It is suitable for energy storage power station operators and qualified electrical technicians to manage local energy storage power stations.

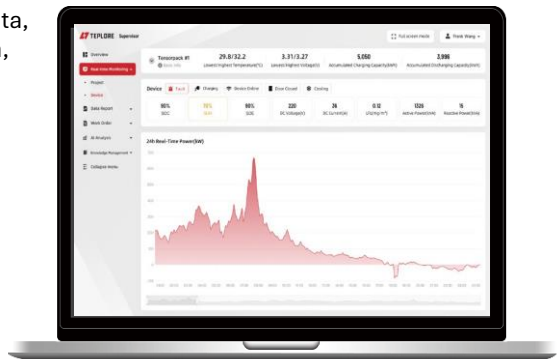


Tensorpack and PC can be networked either by direct connection or by connecting both Tensorpack and PC to the same switch.

Logger Interface

The logger UI is an on-site platform to store data, to reach, monitor and visualize operation data, and manipulate control strategy. Functions include:

- Project information
- Real-time alarms
- Operational data
- Control mode (local or remote)
- Transformer capacity
- Operational strategy
- Historical data
- Historical alarm



Economic evaluation

The economically proper way to evaluate a battery hardware suppliers offer is to calculate the corresponding LCOS (Levelized Cost of Storage). LCOS includes every cash-flows occurring during the lifetime of the project and with that defines the €/kWh cost of the storage, i.e. how much it costs to store 1 kWh of electricity. This can be used to define control strategies (trading strategies), but in the first – preparation – phase of the project, it is useful to compare the different hardware suppliers. In some cases not every information is available for this complete calculation, so we developed a simplified LCOS, we call LCOSX to enable efficient comparison of hardware suppliers and to be able to show our superiority compared to alternatives.

Intended use:

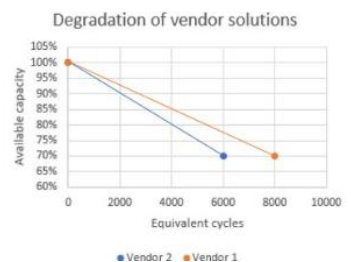
1. conduct feasibility study including simulation and evaluation of system component sizes
--> decision to proceed with battery and approximate battery size
2. collect quotations with detailed data sheets containing the following information:
 - I. guaranteed number of cycles, end of life capacity (EoL) and depth of discharge (DoD) (these are typically in one row)
 - II. round trip efficiency (RTE)
3. calculate this KPI to compare vendor solutions:

$$LCOSX = \frac{\text{Total investment cost [€]}}{\text{Lifetime stored energy [kWh]}(LTSE)}$$

$$LTSE = \frac{\text{Capacity [kWh]} + \text{EoL Capacity [kWh]}}{2} * \text{cycles}[\#] * \text{DoD}[\%] * \text{RTE}[\%]$$

LTSE is a simplified representation of energy being able to be stored in the battery. The first part of the LTSE equation is essentially the area below the colored curves, i.e. the area of a trapeze (capacity, EoL capacity, cycles). This must be adjusted by the depth of discharge and essentially the round-trip efficiency.

- depth of discharge is more or less similar because it is defined by the underlying technology, but different vendors define the capacity of the battery in various ways. Teplore defines the Tensorpack's capacity based on "utilizable" energy and not installed nominal capacity of cells. That is why the DoD of Teplore Tensorpack is 100%.
- round-trip efficiency defines the total loss of a stored amount of energy, because of charging and discharging and flowing through the inverters, cables and internal losses. It is not equivalent of AC efficiency of an inverter, which typically falls into the range of 97-99%.



LCOSX of Teplore Tensorpack falls in the range of 4,5 – 6,2 eurocent/kWh (depending of project size), being 20-150% ahead of competition.

Selected references

Actual official reference list of Teplora can be reached through www.teplora.com. Some, relevant, representative examples are listed below:



Panasonic

Application: Load Shifting, PV Consumption
Project Scale: 1.8MW / 3.87MWh

Teplora **1.8MW/3.87MWh** energy storage system commissioned to Panasonic factory. The project consists of 18 Tensorpack T 100kW/215kWh distributed energy storage systems that connected to 6 different 400V transformers. By coordinating with photovoltaics, the factory increases renewable energy consumption and reduces carbon dioxide emissions.



vanke

Application: PV Consumption
Project Scale: 200kW / 400kWh



ARTESYN

Application: Load Shifting
Project Scale: 1MW / 2MWh



GREEN ENERGY

Application: Load Shifting
Project Scale: 600kW / 1.2MWh



联想U谷

Application: Peak Shaving
Project Scale: 200kW / 430kWh



TOSHIBA

Application: PV Consumption
Project Scale: 500kW / 1.06MWh



Shenglong Group

Application: Ancillary Services
Project Scale: 600kW / 1.29MWh



Tianyuan Textile

Application: Load Shifting
Project Scale: 1.5MW / 3.225MWh



sanieng

Application: Peak Shaving
Project Scale: 500kW / 1.075MWh



Location: Kansas, USA
Application: Capacity Expansion
Project Scale: 500kW / 558kWh



Location: Sichuan, China
Application: PV Consumption
Project Scale: 400kW / 800kWh



Location: Shenzhen, China
Application: Capacity Expansion
Project Scale: 300kW / 600kWh



Location: Hangzhou, China
Application: Capacity Expansion
Project Scale: 100kW / 215kWh



Location: Melbourne, Australia
Application: Capacity Expansion
Project Scale: 100kW / 215kWh



Location: Shenzhen, China
Application: PV Consumption
Project Scale: 200kW / 400kWh



Technology **E**xplore

To accelerate the world's transition to sustainable energy

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