

EMS And BMS Introduction



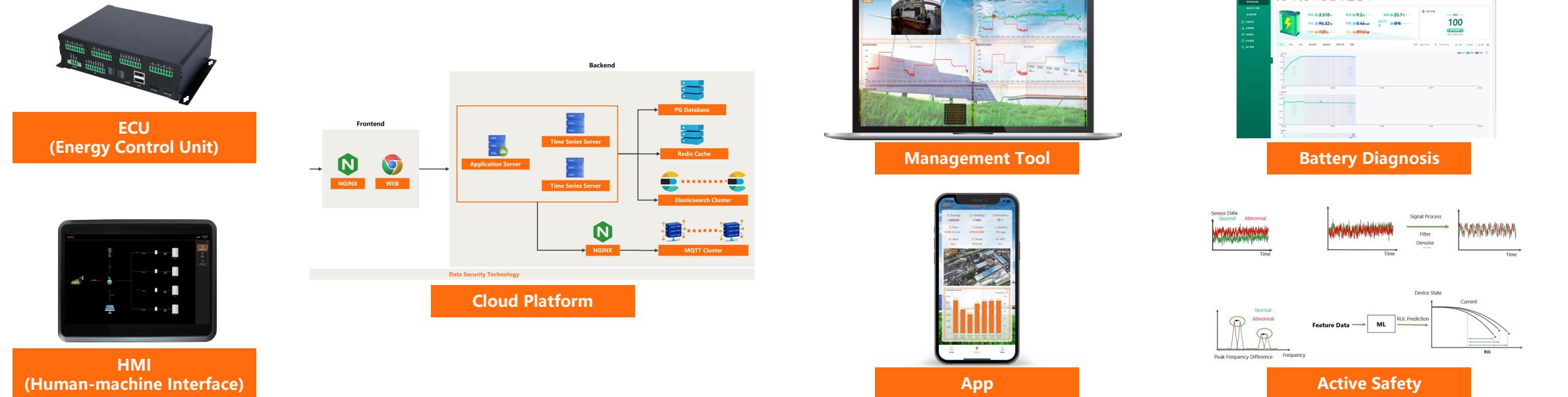
- 1. Professional C&I BESS EMS**
- 2. Automotive Level BMS**
- 3. Cutting-edge Battery Diagnosis Technology**

Professional C&I BESS EMS (Energy Management System)



Features	Applications	
	Time Of Use	Charge low and discharge high to save money
	Self-consumption Optimisation	Use more energy from renewable sources and minimise feed-in
	Off-grid	Create your own power grid independently of energy suppliers
	Peak Shaving	Shave consumption demand peaks to cut demand rate costs
	Charging Station Control	Avoid expensive grid connection expansion, save money by time of use
	Back-up Power	Storage system immediately takes over the power supply in the event of a power outage
	Ancillary Services	Including FFR and FCR-D services, to get benefit for participating in the up/down frequency regulations
	PV-diesel-hybrid Optimisation	Decreasing fuel requirements, wear and maintenance costs
	Micro-grid	Cover consumers' electricity demand when the existing grid connection is inadequate
	Zero Feed-in	Allow consumers in areas with a weak grid infrastructure to meet their high demand from their own electricity supply
	Direct Marketer Interface	Enables the facility operator to offer their electricity through a marketer

EMS Products Family

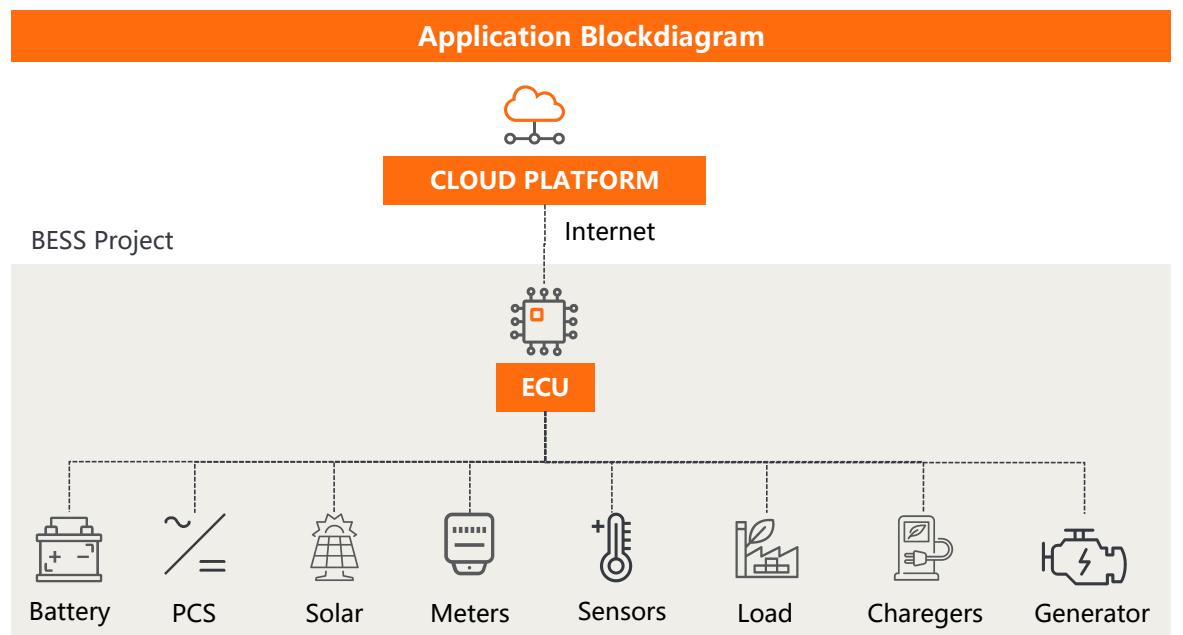


EMS Framework								
APPLICATION LAYER	BATTERY DIAGNOSIS	ACTIVE SAFETY	CELLPHONE APP	WEB BASED MGMT. TOOL	DATA VISUALIZATION			
	Fading Prediction Balance Strategy Maintenance Decision	Risk Identification Health Status Assessment Prediction Maintenance	Real-time Data Monitoring Remote Control Service Call	User/Project/Device/Data Mgmt. Data Center Report Center	Fantastic Case Show Screen Resolution Adapt			
	 ALGORITHM LIBRARY							
ALGORITHM LAYER	Data Process			Modeling		Data Twin		
	Filter And Denoise Time-frequency Transformation	Outlier Detection Data Classification	Feature Extraction Data Compression	Battery Cell/Pack Model ESS/Project Model	Economic Model Control Model	Machine Learning Load Forecasting	Conf And Control Optimization Prediction Maintenance	
	 CLOUD PLATFORM							
DATA LAYER	Device Access			Data Storage		Data Security		
	Authentication Mgmt. Encrypted Transmission	Proxy And VPN Message Queue		Data Cache Data Backup	High Availability Cluster Mass Data Storage	Encryption Algorithm Firewall	Blockchain Authority Mgmt.	
	 HMI  ECU							
DEVICE LAYER	 Battery	 PCS	 Solar	 Meters	 Sensors	 Load	 Chargers	 Generator

Features
<ul style="list-style-type: none"> • Small Size • Industrial Computer • Wealthy Peripherals • Excellent Performance

Functions
<ul style="list-style-type: none"> • BESS project devices communication, control and configuration • Energy management strategy execution • Protection strategy execution • Data and commands transfer with cloud • Communication with 3rd party EMS

ECU-100	Specifications
	CPU i.MX 6ULL, ARM Cortex A7, 792MHz
	RAM DDR3 512MB
	Memory eMMC 4GB
	Operating Temperature Range -40°C ~ 60°C
	Operating Humidity Range 5% ~ 95%RH
	Operating Altitude <2000m
	Weight ≈942g
	Peripherals Ethernet×2, CAN×2, RS485×4, TF Card×1, Console UART×1, DI×10, DO×6, Programmable LED×4
	Watch Dog Onboard Hardware Watchdog
	Software RT-Linux/Ubuntu OS All Hardware Drivers



ECU-200	Specifications
	CPU Multi-core Cortex-A53, 1.1GHz
	RAM DDR3 2GB
	Memory eMMC 8GB
	Operating Temperature Range -40°C ~ 60°C
	Operating Humidity Range 5% ~ 95%RH
	Operating Altitude <2000m
	Weight ≈972g
	Peripherals Ethernet×4, CAN×3, RS485×8, RS232×2, TF Card×1, LVDS×1, M.2×1, miniPCIe×1, Console UART×1, DI×18, DO×8, Programmable LED×4
	Watch Dog Onboard Hardware Watchdog
	Software RT-Linux/Ubuntu OS All Hardware Drivers

Certifications



Hardware Test



EMC Test



Low And High Temperature Test



Sinusoidal Vibration Test



Free-drop Examination

Software Framework

Peak Shaving

Power Expanding

Demand Response

Backup Power

Terminal Applications

Safe Operating Area
Safety Guards
Device Operating Range
Event record
I/O Requests

Database
Device data
System log
Event record
I/O Requests
Config

Self-diagnostics
Power-on Self-test
System Monitor
Watchdog
Error Handling
Integrity Check
Device Feedback

File System
SQLite
EEPROM

Web Socket
MQTT
VPN
FTP/SSH

Terminal Engine

PCS Control

BMS Control

Thermal Control

Aux Device Control

Battery Energy Storage System Control

Modbus - TCP/RTU

CAN

4G

RS485

DLT645

Ethernet

WIFI

RS232

Interface Drivers

Real-time Operating System

CPU(ARM Cortex A8)

Soft Test

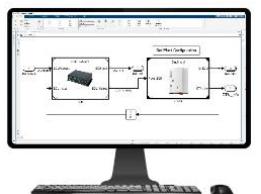
HIL Test System



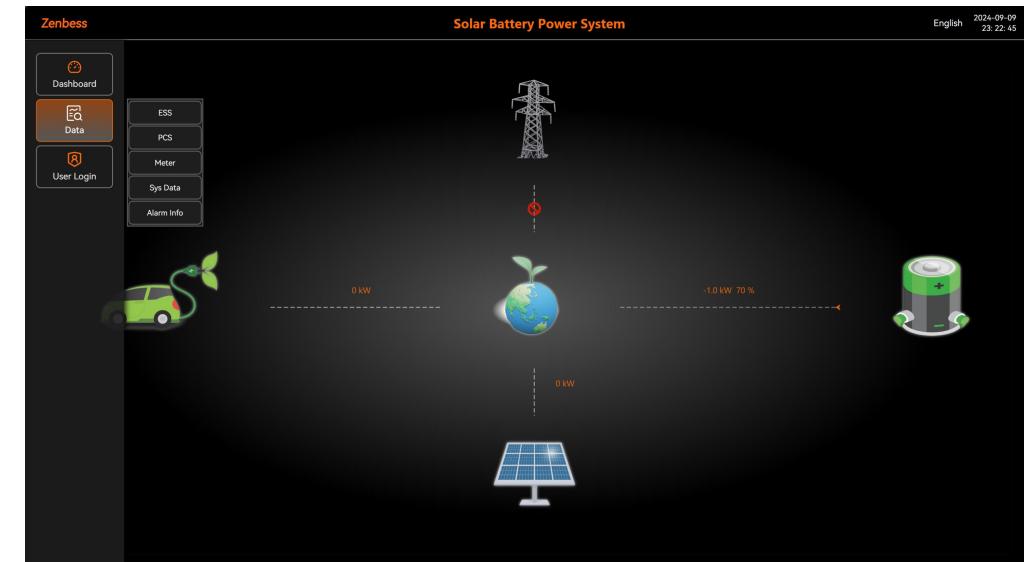
ECU Under Test



Real-Time Battery Simulator
Signal Conditioning
Data Acquisition
Digital Twin

speedgoat

Host Computer
Plant Design
Simulation
Test Automation

Certifications**Install Demonstration****UI Demonstration****HMI-7****Specifications**

CPU	Samsung S5P4418, ARM Cortex-A9, 1.4GHz
RAM	DDR3 1GB
Memory	eMMC 8GB
Display	Resolution 1024*600, IPS
Touch	High sensitivity and high transmittance resistive touch screen
Operating Temperature Range	-10°C ~ 50°C
Operating Humidity Range	20% ~ 90%RH
Dimension	224mm×160mm×45.5mm(L×W×H)
Weight	≈600g
Peripherals	Ethernet×1 RS485×4, RS232×1 USB Host×4 TF Card×1, Console UART×1 Beep×1

HMI-10**ECU-200 Specifications**

CPU	Samsung S5P4418, ARM Cortex-A9, 1.4GHz
RAM	DDR3 1GB
Memory	eMMC 8GB
Display	Resolution 1280*800, IPS
Touch	High sensitivity and high transmittance resistive touch screen
Operating Temperature Range	-10°C ~ 50°C
Operating Humidity Range	20% ~ 90%RH
Dimension	265mm×184mm×45.5mm(L×W×H)
Weight	≈1800g
Peripherals	Ethernet×1 RS485×4, RS232×1 USB Host×4 TF Card×1, Console UART×1 Beep×1

Features

**Strong Connectivity**

Support more than 1 million connections

**Flexible Deploy**

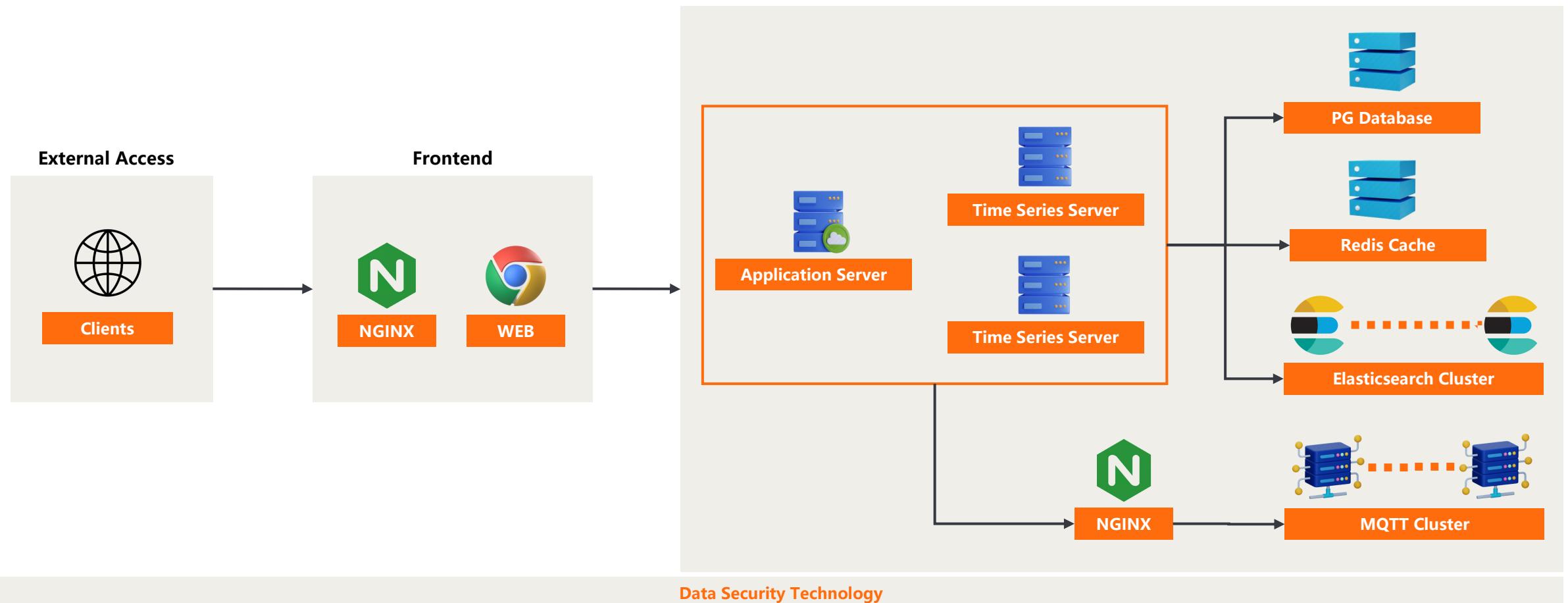
Support private deploy, public cloud deploy, hybrid deploy

**Scalable Configuration**

Easily configured to support kWh to MWh projects

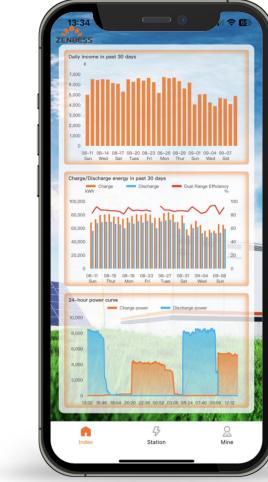
Framework

Backend



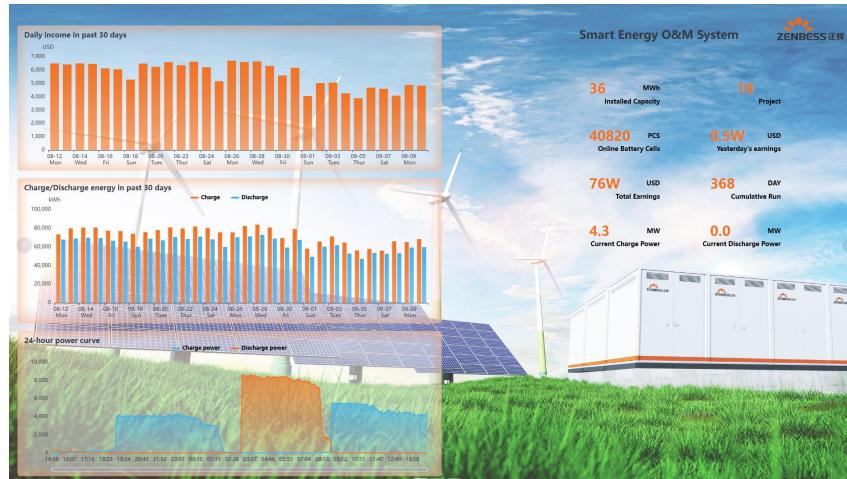
App

- ✓ Real-time Data Monitoring
- ✓ Remote Control
- ✓ Service Call
- ✓ Support iPhone and android



Mgmt. TOOL

- ✓ User/Project/Device/Data Mgmt.
- ✓ Data Center
- ✓ Report Tools




Smart Energy O&M System

Operational Project List

Project Name*	Income(CNY)*	Yest. Income(CNY)*	Yest. Consumption Rate *	Installed Capacity(kWh)*	Status*	Real-time Power(kW)*	SOC(%)*	SOH(%)*
Zhenghai Charging sta...	13419	146	9%	466	Run	1	81.0	100
Yuxing CO.,LTD Tongzhi...	30118	2392	96	2330	Run	5	98.0	100
Yuxing CO.,LTD	84570	3196	92	3728	Run	208	71.0	100
Xi'atong	81592	2531	101	2300	Run	5	98.0	100
Xinjiang	22341	948	94	912	Run	136	72.0	100
Tianjin	107295	380	73	466	Run	1	60.0	100
Tiekuang	145397	447	92	466	Run	103	96	100
SHH Feixiang Industry 2	71857	537	97	466	Run	152	4.0	100
SHH Feixiang Industry 1	10040	513	96	466	Run	163	1.0	100
Chongqing Special Bearing...	21628	473	93	466	Run	1	96.0	100
Longtai Charging Station	27405	102	45	213	Run	-35	63.0	100
HLL Optic-electro	172435	435	89	466	Run	103	89.0	100
Duolepiao	20471	215	69	213	Run	51	92.0	100
Changping Evaporator	67187	2660	61	302	Run	324	46.0	100
Changwei NBR	3279	7392	91	1328	Run	4	100.0	100
Changhe 2	1922038	9804	96	14032	Run	2254	61.0	100
Changhe 3	764051	6142	97	6998	Run	1132	81.0	100
Changzhou Huayu	405036	6001	41	2138	Run	5	62.0	100

Overview Of The Project



Mgmt. Tool : Case Show Of One Project



History Data



Real-time Camera



Project Report

The Project Report interface provides a comprehensive overview of the project's financial performance and daily operations:

- Financial Summary:** A table titled "常宝股份 2024年08月收益报表" shows monthly electricity prices, generation volumes, and revenue for different time periods (Low Peak, High Peak, etc.). Total monthly revenue is listed as 463982.66 元.
- Daily Performance:** A table titled "常宝股份 2024年09月收益报表" shows daily electricity generation and consumption data for specific hours (00:00-01:00, 02:00-03:00, etc.) across various categories like Residential, Commercial, and Industrial.

Each Unit Monitoring

The Each Unit Monitoring interface displays detailed performance metrics for individual battery cells across multiple units. The table includes columns for Serial Number, Status, Power (kW), SOC (%), and various voltage and temperature parameters. The background features a graphic of wind turbines and solar panels.

Config Params												
Serial Number *	Status *	Power(kW) *	SOC(%) *	cellMaxV(V) *	cellAveV(V) *	cellMinV(V) *	cellVDiff(mV) *	cellMaxT(°C) *	cellAveT(°C) *	cellMinT(°C) *	cellTDiff(°C) *	Operation
ZHES233240025	Run	0	97	3.351	3.348	3.344	6	29	25	24	5	Terminal Detail
ZHES233240009	Run	0	96	3.349	3.346	3.344	5	29	25	24	5	Terminal Detail
ZHES233240003	Run	0	97	3.349	3.346	3.343	4	28	25	24	4	Terminal Detail
ZHES233240012	Run	0	97	3.350	3.347	3.343	7	28	25	24	4	Terminal Detail
ZHES233240010	Run	0	97	3.350	3.347	3.342	8	28	25	24	4	Terminal Detail
ZHES233240031	Run	0	97	3.350	3.347	3.345	5	28	25	24	4	Terminal Detail
ZHES233240004	Run	0	97	3.350	3.347	3.345	5	28	25	24	4	Terminal Detail
ZHES233240024	Run	0	97	3.350	3.347	3.344	6	28	25	24	4	Terminal Detail
ZHES233240005	Run	0	97	3.351	3.348	3.346	5	28	25	24	4	Terminal Detail
ZHES233240036	Run	0	96	3.349	3.346	3.344	5	28	25	24	4	Terminal Detail
ZHES233240030	Run	0	96	3.350	3.347	3.344	5	28	25	24	4	Terminal Detail
ZHES233240022	Run	0	97	3.351	3.347	3.344	6	28	25	24	4	Terminal Detail
ZHES233240011	Run	0	96	3.348	3.346	3.348	4	28	25	24	4	Terminal Detail
ZHES233240029	Run	0	97	3.351	3.348	3.344	8	28	25	25	3	Terminal Detail
ZHES233240034	Run	0	97	3.350	3.347	3.342	9	28	25	25	3	Terminal Detail
ZHES233240037	Run	0	97	3.350	3.348	3.345	5	28	25	25	3	Terminal Detail
ZHES233240080	Run	0	98	3.346	3.343	3.342	4	27	25	24	3	Terminal Detail
ZHES233240078	Run	0	95	3.345	3.343	3.342	2	27	25	24	3	Terminal Detail
ZHES233240084	Run	0	98	3.345	3.343	3.342	3	27	25	24	3	Terminal Detail
ZHES233240079	Run	0	98	3.345	3.343	3.343	3	27	25	24	3	Terminal Detail

Mgmt. Tool : Case Show Of One Project



Voltage And Temperature Of Each Cell



Remote Access To Any Unit In A Project



Easy To Configure



Protection Settings

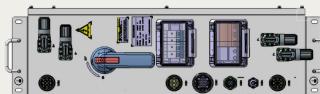


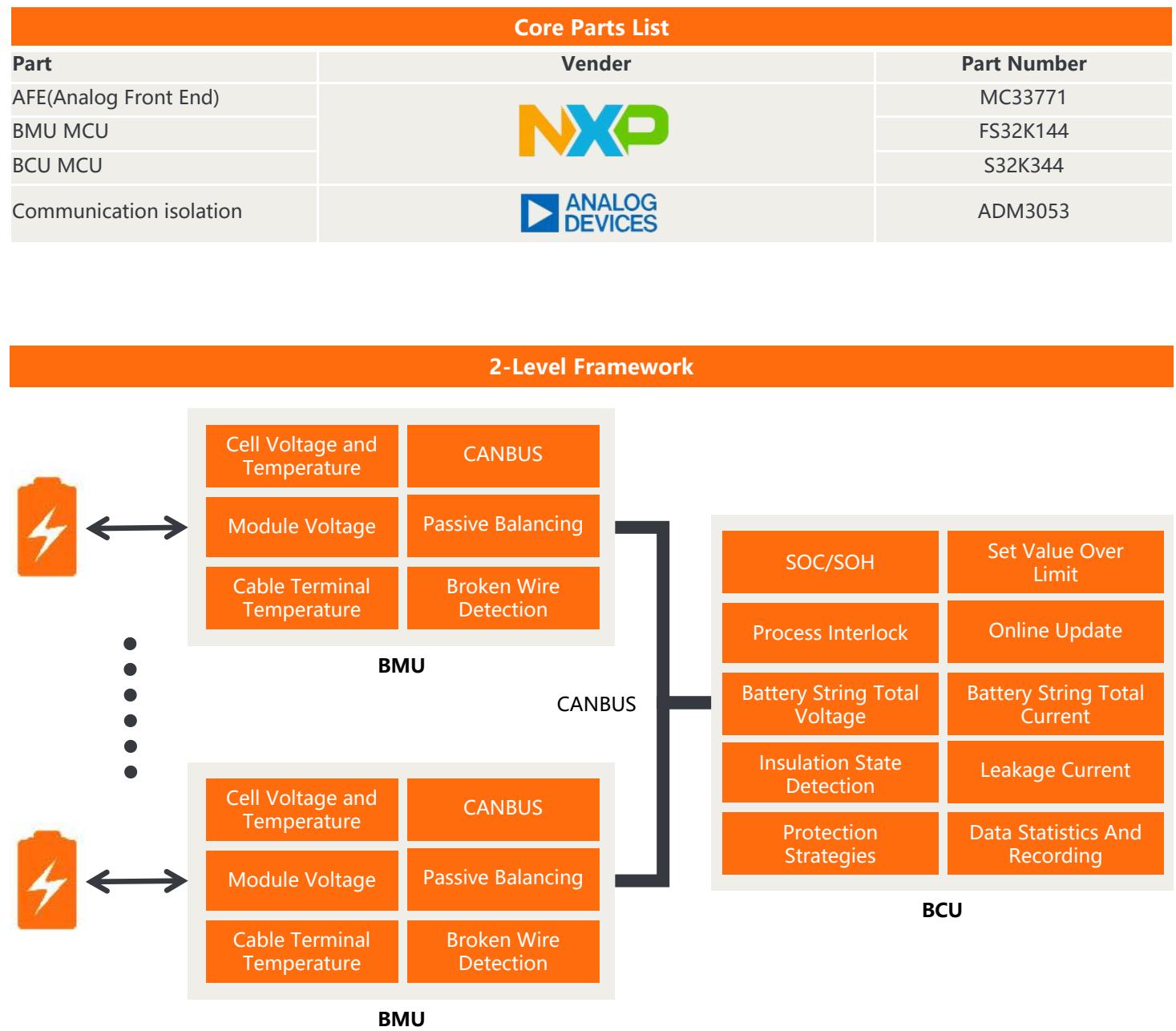
Automotive Level BMS (Battery Management System)



Features
<ul style="list-style-type: none">Measurement Error : $\pm 0.8 \text{ mV}$ ($V_{\text{cell}} = 3.3\text{V}$ $T_a = 25^\circ\text{C}$)
<ul style="list-style-type: none">Functional safety up to ASIL D
<ul style="list-style-type: none">CANFD technology, fully measure in 50ms, fastest protection



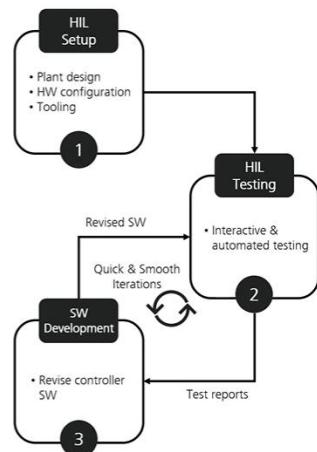
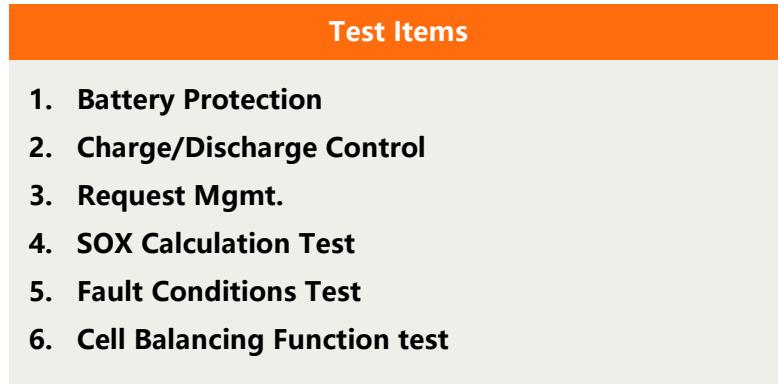
Products
 BMU
 BCU
 HV Box



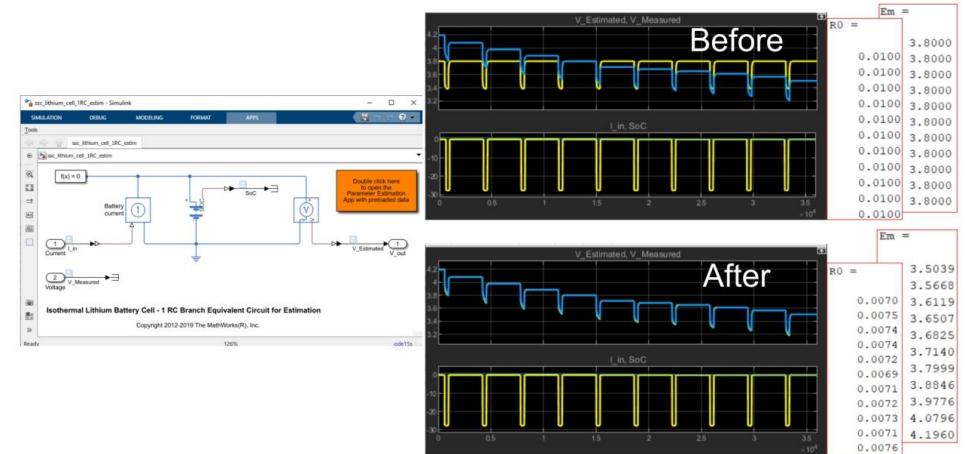
High Precision And Full Test BMS Hardware Test System



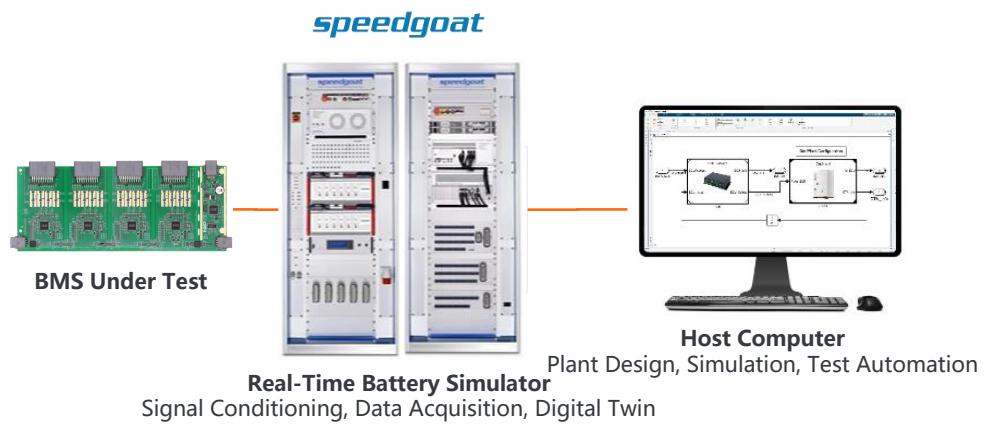
Test Items	System Block Diagram
<ol style="list-style-type: none">1. Battery cell voltage2. Total Voltage3. Total Current4. Temperature5. Insulation resistance6. Digital I/O signal7. SOC simulation8. Fault simulation9. Cell balancing function test	<p>All devices communicate via Ethernet.</p> <p>Switch</p> <p>Industrial PC</p> <p>NXI chassis</p> <p>IO signal/Insulation resistance simulation</p> <p>Multi-channel temperature simulation</p> <p>N8358-15-05 battery simulator</p> <p>BMU</p> <p>BCU</p> <p>Total current simulation</p> <p>N3330-60 programmable DC power supply</p> <p>N6915-120-600 DC electronic load</p> <p>Multi-channel battery cell simulation</p>

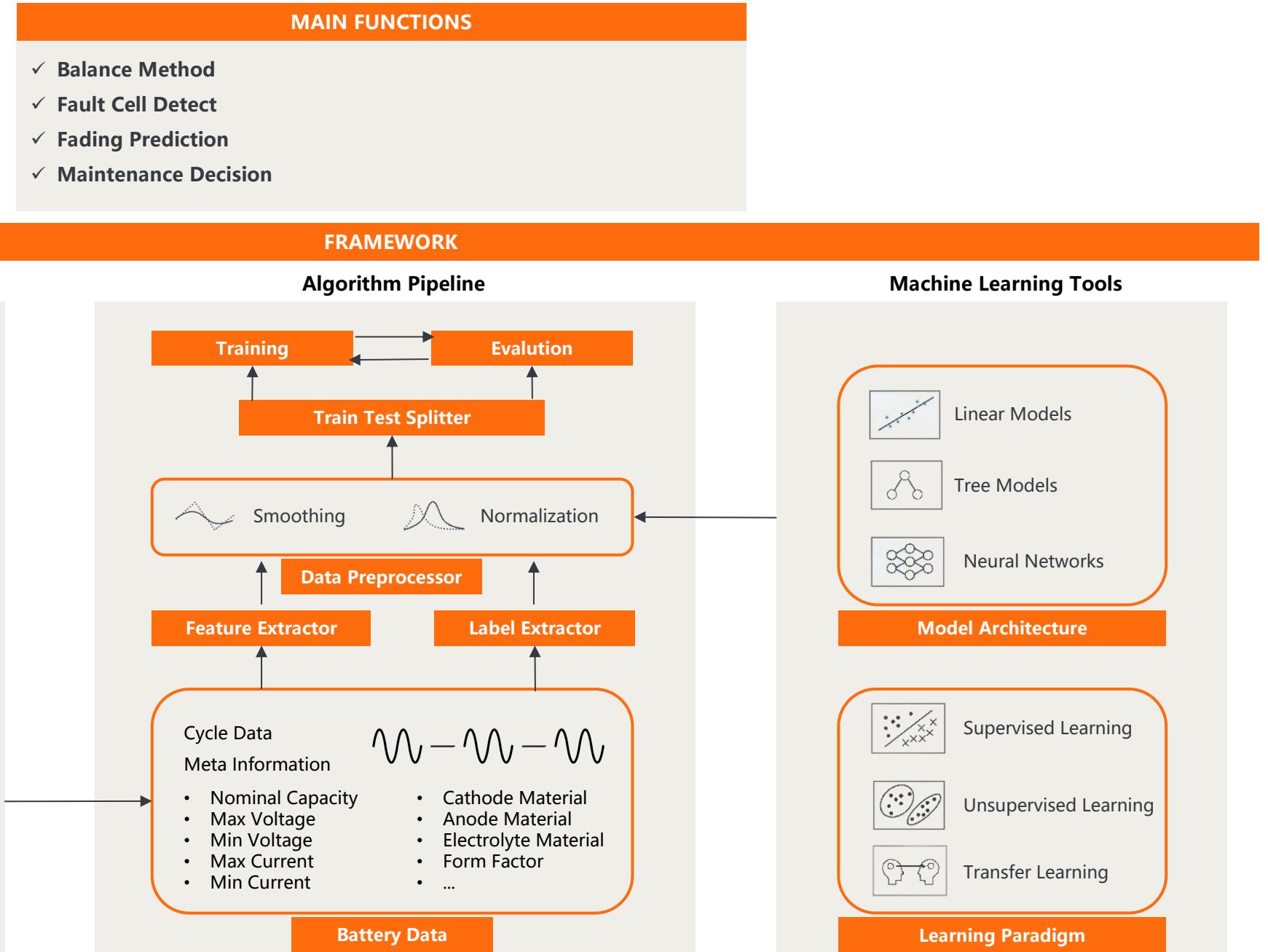


Battery Cell And Pack Modeling



HIL(Hardware In The Loop) Test





High-accuracy Detection of the ISC

ISC : Internal Short Circuit



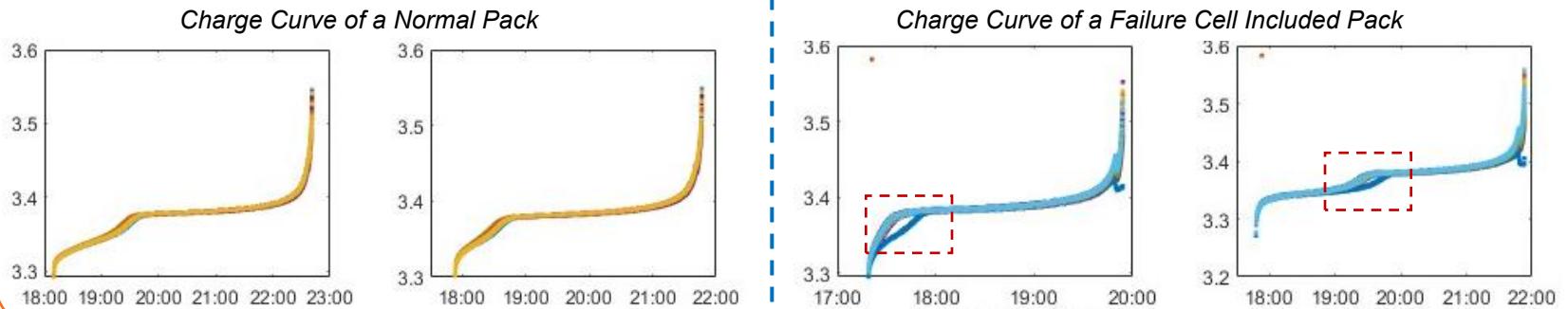
1

ISC is long thought to play a big role in LIB failure. For the detection and prevention of ISC, a **fault case base** has been built based on the failure cells, which are discovered by the related data from cloud platform firstly, and then diagnosed after disassembled.

Device ID	CellNum	Failure Cause
HJZ1CA2E0N1000443	19	electrode plate piercing separator
HJZ1CA2E6N1000222	17	electrode plate piercing separator
HJZ1BA1E9N1000753	71	dust piercing separator
HT71CA2F2N1000427	8	dust piercing separator

2

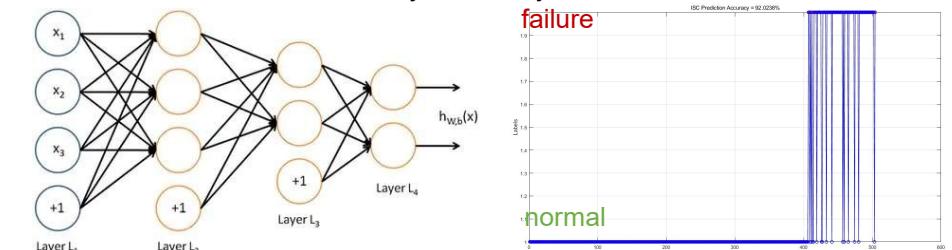
Long-term characteristic data of the fault cases in base has been traced back, from which a **feature curve that unique to fault cases** is discovered, shown in the 3.3 - 3.4 V range of the charge curve. As shown below, the voltage trend of a failure cell is different from a normal one within a specific interval(3.3 - 3.4 V).



3

A neural network model has been trained and applied to the prediction of ISC, based on the feature curve mentioned above. At present, a **92% accuracy** of ISC prediction can be made, and **6 months earlier** than that of the regular BMS detection, which improves the security of the system.

A Prediction Accuracy of 92% by Neural Network



Cell Balance Strategy : Flexible Charging/Discharging Ability to A Specific Cell

The retention rate of system capacity determines the service life of a BESS(Battery Energy Storage System), and directly affect the profit.

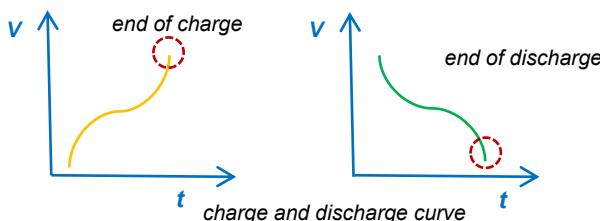
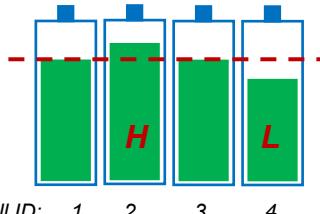
System capacity is influenced by several factors and one of the most significant one is considered as cell imbalance, which we have developed latest algorithm to overcome.

1. Screen Out “Outstanding Cells”

It's always two kinds of cells that determine the system capacity:

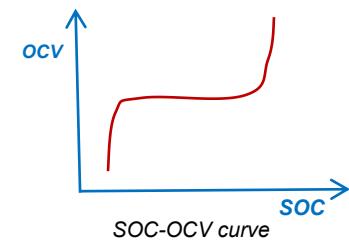
kind H: The one first to reach end-of-charge voltage

kind L : The one first to reach end-of-discharge voltage



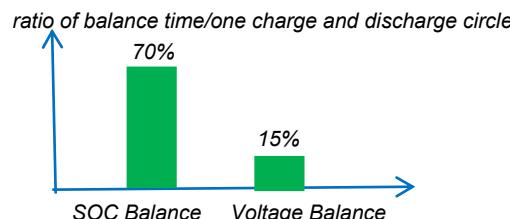
Real-time data is monitored based on cloud platform, which will record the ID of the cell diagnosed as *kind H* at the end of charge , and *kind L* at the end of discharge each circle.

Accurate SOC values of each cell will be mapped based on the SOC-OCV curve under some specific conditions, to calculate Δ SOC between the *kind H* and mean value, as well as the *kind L*.

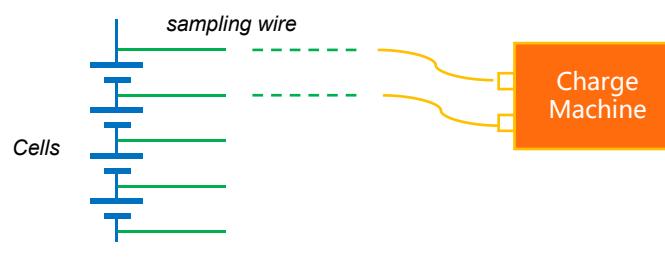


2. Equalizing “Outstanding Cells”

With the Δ SOC value given above, How much battery energy need to be released or supplied will be computed, then converted to a balance time value under a specific balance current.



1.Commands to open the balance circuits of the outstanding cells will be given off from BMS under the balance time above, improving the balance efficiency dramatically, compared with a normal voltage balance algorithm.



2. We also developed such a device to assist BMS balance when necessary, named charge machine, which can be connected to a specific cell by its sampling wire, and make it easy and efficient to balance the cell during a maintenance.