

TWS Technology

POWERING UP YOUR MOBILITY

TWS
Technology with Spirit



TWS Technology

Email: info@tws.com

 @TWS Technology

 @TWS Technology

Website: www.tws.com

 @TWS-Technology

 @TWS Technology



Contents

Technology
with
Spirit



About TWS

About Us	01
Our Milestones	03
Core Values	05

Applications

ESS	08
Modules	09
Vacuum Cleaners	10
eMobility	11
Material Handling	12
eCall	13
Industrial Handhelds	14
Smartphones	15
Medical	16
Portable Power Station	17

Technical Competencies

Advanced Manufacturing

Global Footprint

23

About TWS

Dynamic Leadership in Innovative Rechargeable Lithium-ion Battery Solutions

TWS, a dynamic and global industry leader focused on providing innovative Lithium-based battery technology solutions, was founded in 1998. With over 25 years development, we have now grown to about 2,000 global employees to service the world-wide markets. TWS always follows the practice of customer-focused values and we're committed to providing innovative solutions in response to the rapid growth of new lithium-ion battery applications.

Founded in 1998	Tech Centers 6	Factories 4
Patents 80+	Active SKUs 500+	Batteries Sold 300,000,000+



A Better Life through Innovation



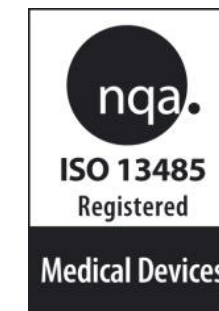
Vision

Create a better life for people



Mission

To be the industry leader in rechargeable energy solutions



Our Milestones



Core Values



Customer Oriented

We always think first about our customers during our decision-making process. We ensure that everyone in the company treats our clients' needs as our first priority. Based on these principles, we build mutually successful long-term partnerships with our clients.

Integrity

We value and hold high ethical standards and will never compromise our business ethics under any circumstances. We always deliver what we promise in our work by being honest, trustworthy, fair, accountable and respectful with our business partners.

Employee Engagement

The success of TWS is built on the contributions and perseverance of our employees. TWS has built an open platform nurturing employees' drive for excellence. United as one, every employee in TWS devotes their passion and effort into whatever work they do, and across all departments.

Teamwork

We work together cohesively and coherently, towards common goals. Creating a positive and productive working atmosphere, we support and depend on each other to blend individual strengths to enhance team performance while uplifting our TWS capabilities.

Pursuit of Excellence

At TWS, we always "Strive for Excellence". We don't just spout empty talk, we walk the talk. We continuously create value for our customers, and abide by the principle of "There is always a better solution" and therefore keep striving to outdo ourselves.



ESS



With over 80 patents and over 100 senior experts worldwide, TWS Technology had custom-designed billions of battery packs for customers across various industries.



ESS



Modules



Vacuum Cleaners



eMobility



Material Handling



eCall



Industrial Handhelds



Smartphones



Medical



Portable Power Station

Lithium-ion is the best-known storage technology today, TWS has been building integrated battery systems for over 20 years. The same degree of expertise, quality control and technological innovation is used in our process of developing high-performance ESS batteries for the residential and commercial use. State of the art battery system designed for efficiency and long life.

TWS ESS batteries build with cylindrical or prismatic can type cell with the selection of LFP and NMC technology. Our robust BMS technology supports both Master-Slave and Daisy Chain architecture.



Why TWS?

- 25 years cell chemistry experience and various cell selections ensures the best cost performance solutions
- Mature BMS and software solutions that shorten Time-to-Market
- Fully automated production processes for high reliability and safety
- Local aftersales engineering services globally

Solutions

◆ Technical type

- Liquid-cooling

◆ Product type

- Standard outdoor Commercial & Industrial ESS cabinets
 - TrackY series
 - ProeM series
- Customized container system based on customers' requirements



Application scenarios

- Power-side
- Grid-side
- User-side



Modules



Vacuum Cleaners



TWS provides modules solutions with both standard and customized module design for many years with significant volumes supplied to automotive customers. TWS offers battery modules with or without BMS and option for local assembly, and flexibility in battery pack design with cost advantages.



Electric Passenger Cars



Electric Buses and Trucks



Light Electric Vehicles



Electric Off-highway Vehicles



TWS modules fully conform with the German Association of Automotive Industry Standard. This ready-to-use solution provides multiple cell configuration options with on-demand design flexibility which would allow for condensed project timelines with minimal design development. The TWS modules are widely used in electric vehicles in part because of the superior quality.

Why TWS?

- Cost competitiveness with cell energy options
- Ultra-long cycle life
- Optimal mechanical light weight design against the risk of cell thermal runaway
- Options for local assembly with short lead times

Modern lifestyles created the huge demand in cordless vacuum cleaning and robotic cleaning machines. At TWS, our vision is to Create A Better Life For People and this translates into the design and manufacturing of the power source into the household appliances. TWS's technology team works to outpace the previous design versions in order to stay on top of new solutions; providing a variety of reference designs for customer adaptation that will reduce design cycle times, but yet still provide high quality.



Robotic Vacuum Cleaners



Upright Vacuum Cleaners



Stick Vacuum Cleaners



Handheld Vacuum Cleaners



Wet dry vacuum cleaner

Solutions



Hardware



MCU



Standalone AFE+MCU



AFE+MCU two-in-one



System solutions

TWS supports the vacuum cleaners and robotic cleaners with compact and powerful battery solutions, allowing high energy density, extra safety features with communication facilities at an effective cost.

Why TWS?

- Pioneering as supplier of power solutions for global OEMs
- Systematic Value Engineering resulting leadership in best cost performance design solutions
- Full range of battery solutions for hardware protection, AFE and MCU control
- In-house firmware engineering team who understand hardware at the component level created competitive advantages



eMobility



Material Handling

TWS provides best cost performance full battery solutions for eMobility to fulfill numerous applications including electric scooters, electric bicycles, pedelecs and electric motorcycles globally. Experienced in the joint development of BMS, hardware and software solutions.

Environmental sustainability has become the major consideration of logistics vehicles' operation on a global level, thus contributing to the positive impact on cost containment and improvement of human health. TWS provides standard or customized solutions with the merit of easy maintenance, long service hours, lower degradation and quick charge technology.



eBike



eMoped



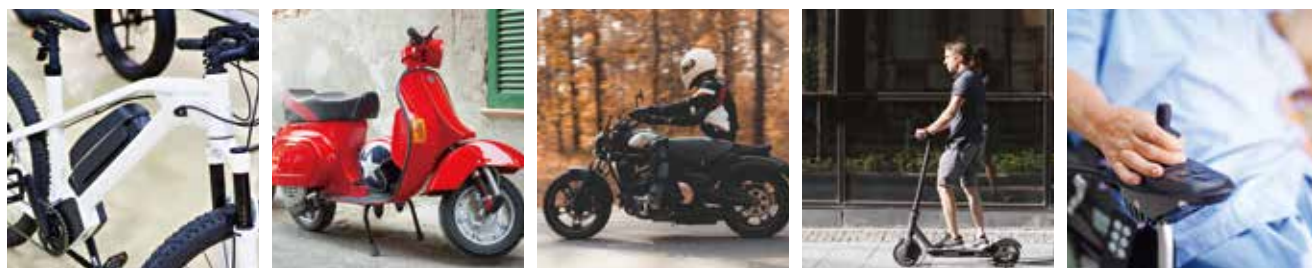
eMotorcycle



eScooter



eWheelchair



Backed by increasing government initiatives towards controlling rising air pollution levels, electric two-wheelers are ever-increasing and becoming popular among major urban transport systems in all cities of the globe. These vehicles are easily charged by AC power and often come with removable and replaceable batteries.

Why TWS?

- Ready-made platforms and BMS solutions to fulfill common applications
- TWS's round the clock design team shortens Time-to-Market
- Specialized End-to-End Integrated IP67 Product Development Capability
- Local aftersales engineering services globally

Standard solutions

- 36V standard solutions for eBike
- 48V standard solutions for eBike and eMoped
- 60V standard solutions for eMotorcycle
- 72V standard solutions for eMotorcycle

Why TWS?

- We offer optimized cell energy and modular assembly design, with our BMS options for a variety type of eForklift and autonomous mobile robots
- Continuous roadmap on standard solutions making the universal products compatible with 4x the number of SKUs required for simple plug and play applications.
- Best in class cell chemistry to achieve high energy level and long cycle life
- TWS's recycling program achieves environmentally friendly standards



eCall



TWS's ecall battery solutions with full range of cell selections. The robust design features and high-performance and high-stability solution is second to none.

Working with all OEMs and Tier 1 automotive customers, TWS provides wide range solutions with highly competitive propositions as well as performance driven.

Why TWS?

- High-performance and high-stability solutions
- Proven track records with global automotive OEMs and Tier 1 customers
- Global FAE engineering teams serve customer needs at their locations
- Built in quality and superior end-to-end quality assurance process achieve zero defects

Industrial Handhelds



TWS has reliable and ruggedly designed battery packs for harsh environment challenges, optional added-value features with Intrinsic Safe, Communications, NFC, e-Ink Display and Wireless Charging capabilities.



Mobile Computers



Portable Scanners



Portable Printers



Walkie Talkie



Point-of-Sale Terminals



Industrial handheld devices are expected to withstand extreme climatic and environmental conditions while being lightweight and having longevity in operation. Due to such advantages, these handheld electronic devices are used in multiple industries such as airline, automotive, retail, agriculture, construction, oil and gas, military and aerospace given performance at harsh environment and design function to communicate without interference. TWS designed battery supports over 10 years product life cycles.

Why TWS?

- 25 years professional experiences in complex TWS + OEM + JDM multiple parties' multi-locations concurrent engineering development programs
- Outstanding cell application competences supporting best selection for customers
- Beyond Li-ion solutions available with Super Capacitor Technology
- Experiences and knowhow of testing & verification processes for reliable and ruggedized battery designs

Smartphones



Safe, fast charge, compact and high energy density smartphone battery. Superior stable quality level by automated manufacturing process.

With 5G becoming a reality, smartphones become increasingly more indispensable to human life, and smartphones nowadays offer way beyond communication functions. The APPs, data communication, gaming and computing markets are continuously evolving, creating steady demand for safer, more powerful and rapid charging batteries. TWS's knowhow spans throughout the entire array of processes from the inception of a new battery solution, integrated seamlessly with the devices during its design, through careful selection of cell designs and chemistries, robust mechanical design solutions, and knowledgeable software integrations.

Why TWS?

- Pioneer in turnkey 2-cell high voltage fast charge battery solutions
- Experience in mechanical tolerance analysis (cell normal swelling) and knowhow to design compact battery packs
- Integrated SIOP business process (Sales, Inventory, Operations Planning) to meet dynamic demand fluctuations
- Large scale automated production lines for precise and miniature components in battery assembly

Medical



With an ISO 13485 certified manufacturing facility TWS's rigorous, in-house vertically integrated approach serves as the basis to meet these standards, ensuring that your medical products are reliable and safe.

TWS has a legacy of unrivaled quality and safety for 25 years in designing and manufacturing lithium-ion battery packs. TWS understands the unique and challenging aspects of the medical space and is prepared to meet all of the industry certification standards as well as the demanding qualification and testing criteria. With an ISO 13485 certified manufacturing facility, TWS's rigorous, in-house vertically integrated approach serves as the basis to meet these standards, ensuring that your medical products are reliable and safe. TWS's track record, resources, and approach places TWS at the forefront of medical battery integrators and will continue to successfully serve large-scale, top tier medical device manufactures.

Why TWS?

- In-house engineering R&D, NPI, and FAE resources will ensure a streamlined, controlled holistic approach from concept to design through mass production.
- Vertically integrated approach to manufacturing with full traceability of components results in the most rigorous quality control in battery pack industry.
- Proven Six Sigma quality control and improvement methodology
- Strong history of developing and patenting customized, innovative technologies.

Portable Power Station



Technical Competencies



The global attention on clean energy and the trend of outdoor lifestyle has driven the development of portable power station. TWS Technology has independently developed its portable power station with the features of triple protection, fast charge, high performance and convenient operation, which can provide power supply of outdoor activities and emergency rescue.

TWS T series portable station ptation and solar panel



Why TWS?

- 25 years of experience in lithium battery industry, with mature experience and research results in BMS field; owning a global sales and technical service network, and rich supply chain integration resources in lithium battery field.
- With mature and professional automatic production technology, ensuring product reliability and consistency
- Having a professional R&D team, focusing on the development and research of lithium battery packing /BMS (battery), power frequency conversion technology (discharge), solar power generation charging technology (charge), lithium cell, etc.
- With a complete and efficient operation system for the production and quality control of portable power station.

TWS owns extensive cell and battery expertise, comprehensive design capability, spirit of innovation and fully integrated end-to-end product development capability.

Battery Expertise

With over 20 years professional experiences in battery design and manufacture, and over 200 engineers globally located, TWS has extensive expertise from cells to battery pack systems and knowhow of various applications.

Comprehensive Design Capability

TWS has comprehensive design capability on Li-ion batteries, including well-engineered software and hardware platform powered BMS from simple to complex master-slave systems that cover many applications and communication protocols. The sophisticated simulation capabilities in both mechanics & thermal that ensure our robust design solves power challenges while keeping products safe, but bringing reliability with best performance to cost ratio, Design-to-Quality & Design-to-Cost.

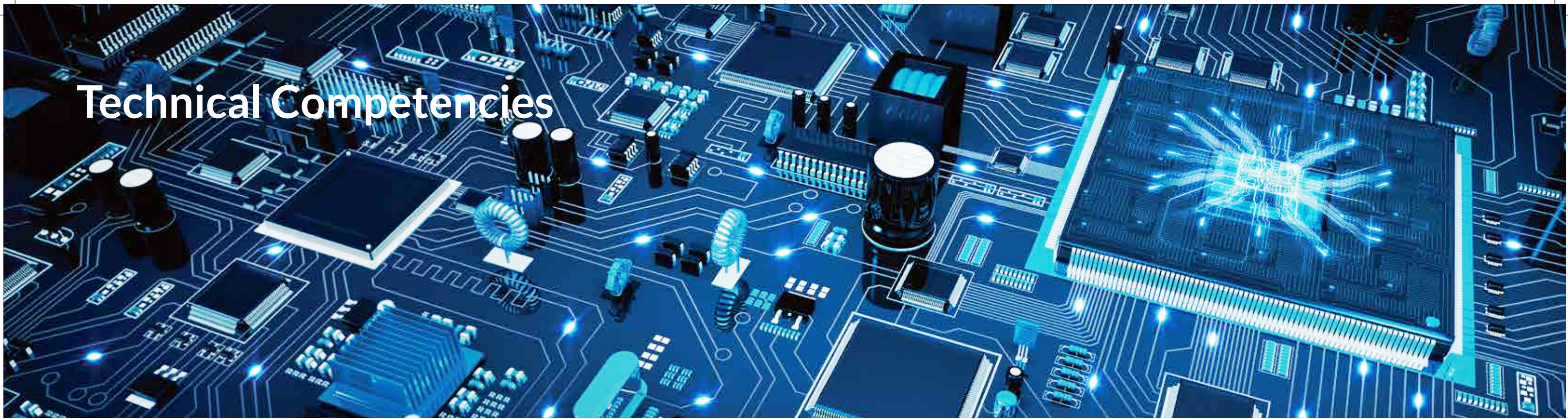
Teamwork

We work together cohesively and coherently, towards common goals. Creating a positive and productive working atmosphere, we support and depend on each other to blend individual strengths to enhance team performance while uplifting our TWS capabilities.

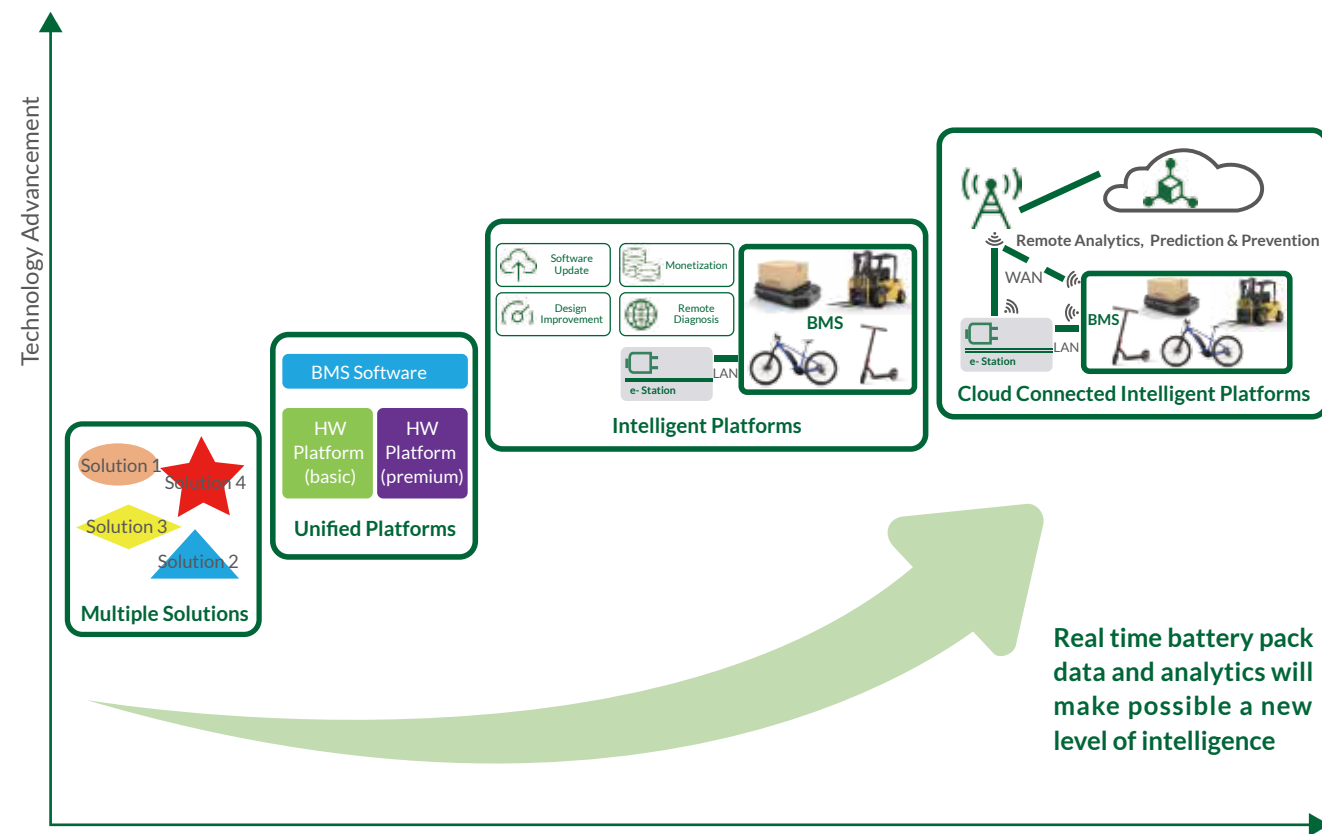
Pursuit of Excellence

At TWS, we always "Strive for Excellence". We don't just spout empty talk, we walk the talk. We continuously create value for our customers, and abide by the principle of "There is always a better solution" and therefore keep striving to outdo ourselves.

Technical Competencies



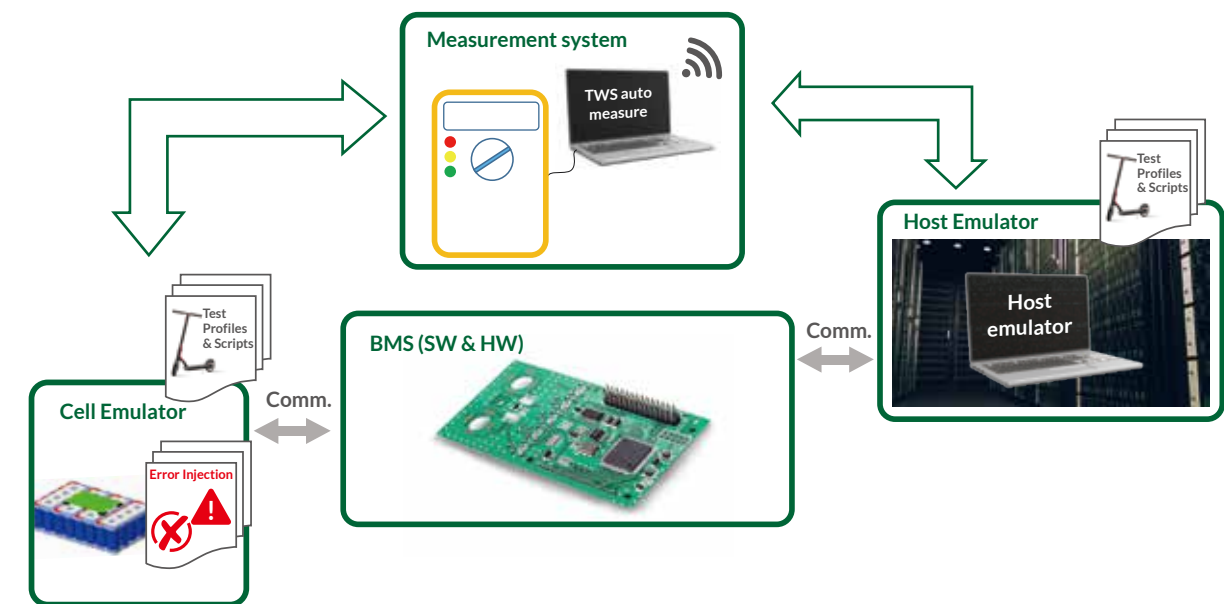
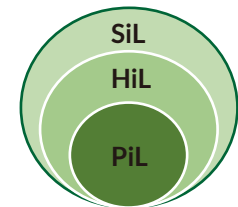
TWS BMS Roadmap



TWS Automated Test System (ATS)

System Functional Validation & Comprehensive Test

- Simulate & inject all possible fault conditions
- Test all designed BMS & system functions
- Validate battery pack behaviors to the host



Advanced Manufacturing



CE	CB	EAC	CCC	CCC	SAE
UL US	CCC	BC	IC	ANATEE	IATA LIN30.1
NOM	CCC	PCG	CCC	CCC	AEO
CCC	CCC	PSE	CCC	CCC	CTF Stage 1

TWS has multiple manufacturing facilities with operational excellence and agility. They are located strategically in Guangzhou, Xuyi, Huaibei and Jakarta. These manufacturing sites have highly differentiated advanced manufacturing capabilities to deliver the best quality, fastest delivery, and lowest cost to our customers through the adoption of the TWS Operating System to pursue premier performance at the world-class level. Our operational excellence is a simple philosophy rooted in customer-facing priorities: Quality, Delivery, Cost, and Innovation.

TWS's Operating System provides a standard framework of how we operate to achieve premier performance by driving continuous improvement culture and building world-class processes to engage employees, give our customers great service and win shareholders' confidence. The strategic initiatives of Lean Six Sigma are implemented to eradicate wastes in everything we do; ACE (Achieving Cost Excellence) to drive for cost competitiveness in the marketplace; SIOP (Sales, Inventory, and Operations Planning) to improve delivery and cash performance; Lean Product Launch to deliver speed and zero defects of new products to the market; and Winning Cultures to cultivate a highly engaged and performance based team.

Manufacturing Sites

Guangzhou

- > 1,400+ Employees
- > 150+ Engineers
- > Workshop area: 28,000 m²
Site area: 113,097 m²
- > Production capacity: 1.1 GWh
- > Flexible & automated battery pack assembly, SMT and injection molding production

Xuyi

- > 100+ Employees
- > 10+ Engineers
- > Workshop area: 8,820 m²
Site area: 32,000 m²
- > Production capacity: 1.5 GWh
- > Flexible & automated battery pack assembly

Huaibei

- > 200+ Employees
- > 40+ Engineers
- > Workshop area: 20,000 m²
Site area: 33,000 m²
- > Production capacity: 10 GWh
- > Fully automated EV and large format module & battery pack production

Jakarta

- > 150+ Employees
- > 10+ Engineers
- > Workshop area: 4,000 m²
- > Production capacity: 500 MWh
- > Fully automated battery pack production

Global Footprint

USA

- San Diego
- ▲ Chicago
- ▲ Sacramento
- ▲ Reno
- ▲ Atlanta
- ▲ Los Angeles

UK Germany

- ▲ London
- Frankfurt

China

- Guangzhou
- ◆ Huaibei
- Nanjing
- ◆ Xuyi
- ▲ Suzhou
- ▲ Hong Kong

Japan

- ▲ Tokyo

Korea

- Seoul

Indonesia

- ◆ Jakarta

- Headquarters
- Tech Center
- ◆ Manufacturing Site
- ▲ Sales office

North America

San Diego / USA

Address: 1201 Simpson Way, Escondido, CA 92029,
San Diego, USA

Europe

Frankfurt / Germany

Address: Ohmstraße 11, 63225 Langen, Germany

London / UK

Address: Unit 6, Wyvols Court Farm, Basingstoke Road
Reading, RG7 1WY

Asia

Jakarta / Indonesia

Address: Jalan Arya Kemuning No. 77 (Cadas Baru RT.002/
RW.007), Kelurahan Periuk, Kecamatan Periuk,
Kota Tangerang 15131, Provinsi Banten, Indonesia
Tel: +62-21-8082-099

Asia

Guangzhou / China

Address: 39 Nan Yun San Road, Science Park,
Guangzhou 510663 PRC

Nanjing/ China

Address: 1301, 1302, 1308, 13F Block B1, Jiulonghu
International Enterprise Headquarters Park,
Jiangning District, Nanjing, Jiangsu, 211100,
PRC

Suzhou/China

Address: 204, New Times, No. 2, Baodai West, Wuzhong
District, Suzhou, Jiangsu Province, 215128, PRC

Tokyo / Japan

Address: Nihonbashi Otomi Building 3F, 13-7,
Nihonbashiodenmachi, Chuoku, Tokyo
103-0011 Japan

Tel: +81-3-6403-3503 Fax: +81-3-6869-2934

Huaibei / China

Address: 89, Economic Development Zone, Huaibei,
235000, PRC

Xuyi / China

Address: No.66, Jinyuan Road, Economic Development
Zone, Xuyi County, Huaian City, Jiangsu
Province, 211700, PRC

Hong Kong / China

Address: 11/F, Tung Hip Commercial Building, 244-248 Des
Voeux Road Central, Sheung Wan, Hong Kong

Seoul / Korea

Address: 1014, Gangnam ACE Tower, 174-10, Jagok-ro,
Gangnam-gu, Seoul, Korea 06373