



Lunch & Learn

Application Specific Standard Battery Workshop

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Application Specific Standard Battery Workshop



Agenda:

Find the right "fit" for your battery-powered project:

- ▶ Which battery options are available?
- ▶ Which certifications are needed?
- ▶ What off-the-shelf solutions are available?
- ▶ How to find the right battery partner.

Presenter: Dan Friel, National Business Development Manager, VARTA

Linked-In: Dan Friel: <https://www.linkedin.com/in/dan-friel-2004>



VARTA AG

MICROBATTERIES & SOLUTIONS

HOUSEHOLD BATTERIES



Largest Manufacturer of Hearing Aid Cells (1B/yr)
www.VARTA-Microbattery.com

Standard & Custom Battery Packs and Energy Storage
www.VARTA-Storage.com

Consumer Coin & Cylindrical Cells; Home Energy Storage
www.VARTA-Consumer.com

Application Specific Standard Battery Workshop



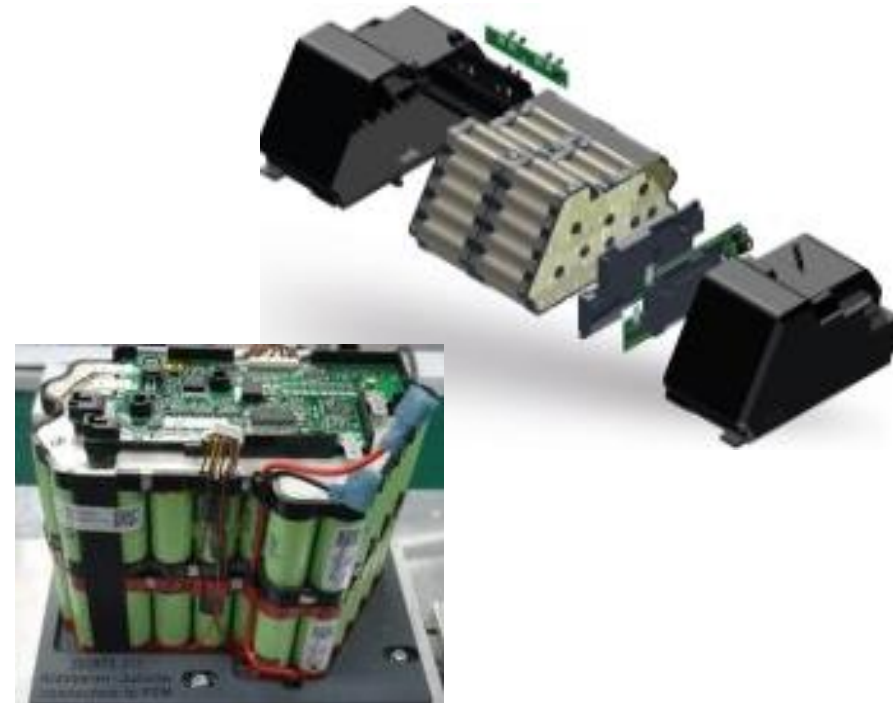
Application Specific Standard Batteries

- ▶ Traditional sizes and shapes (boxy)
- ▶ “Nominal” operating ranges for charge & discharge, temperatures, etc.



Custom Designed Batteries

- ▶ Unique sizes & shapes
- ▶ Non-typical operational & environmental characteristics



Application Specific Standard Battery Workshop



| Custom Design | Product Requirements | Application Specific Standard |
|----------------------------------|---------------------------|--|
| Product Family | Product Line | <u>One Time Design</u> |
| Extreme | Environment | <u>Typical</u> |
| 5+ Years | Product Life Cycle | <u>Few Years</u> |
| FDA, IS, other | Regulatory Certifications | <u>UN, UL, IEC</u> |
| Power or Energy | Power or Energy Device | <u>Energy</u> |
| Expandable | Capacity | <u>Fixed</u> |
| Unique Shape and/or Non-Embedded | Size & Shape | <u>Rectangle or Square, Embedded Battery</u> |
| Proprietary | Interface | <u>Industry Standard Protocols</u> |
| Fast, Regen | Charging | <u>Slow, After Usage</u> |
| On-board or Wireless | Charging Methods | <u>Traditional</u> |
| NRE | Design Costs | <u>Low</u> |
| Unit \$ x EAU > \$3M | Production Volumes | <u>Unit \$ x EAU < \$1M</u> |
| 2 to 6 months | Timing | <u>Immediate</u> |

Application Specific Standard Battery Workshop



How can a battery be 'Application Specific' and 'Standard' at the same time?

▶ Application Specific Standard

- ▶ Designed around a set of usage requirements for a family of devices
- ▶ Ex: Traditional alkaline batteries: The 9V was developed for smoke detectors
- ▶ Ex: Specialty batteries – “lantern battery”
- ▶ Ex: Photo lithium (back when we had film cameras!)



VARTA Storage – VARTA Microbattery

Our brands;

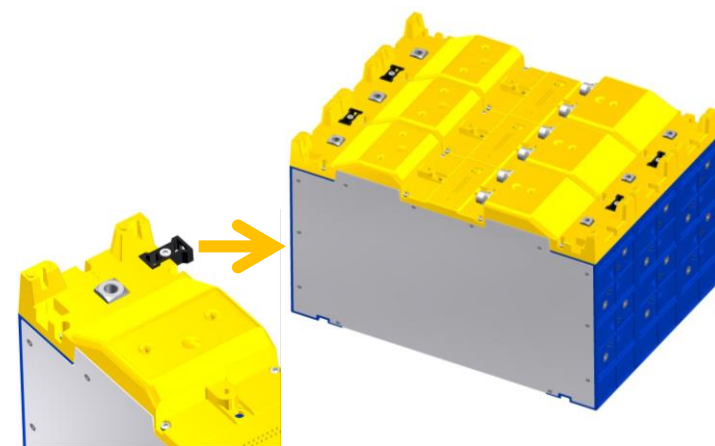


Application Specific Standard Battery Workshop



How can a battery be 'Application Specific' and 'Standard' at the same time?

- ▶ Application Specific Standard – Rechargeable Li-Ion Batteries
 - ▶ Designed around a set of usage requirements: High Energy for long run-times, Standard Interface, Easy to Use, Expandable Capacities, Special Features
 - ▶ Ex: Mobile Robotics, Industrial Material Handling, Low-speed Electric Vehicles



Application Specific Standard Battery Workshop



Cell Options - Coin

- ▶ Li-Ion: 3.6V, 16 to 120mAh
- ▶ Lithium: 3V, 27 to 620 mAh
- ▶ Silver: 1.55V, 6 to 160mAh
- ▶ Alkaline: 1.5V, 155mAh
- ▶ Zinc Air: 1.45V, 95 to 620mAh

Cell Options - Cylindrical

- ▶ NiMH: 1.2V, various
- ▶ Lithium: 3V, 850 to 2400mAh
- ▶ Alkaline: 1.5V, AAA, 1200mAh
- ▶ Alkaline: 1.5V, AA, 2600mAh
- ▶ Alkaline: 1.5V, C, 7800mAh
- ▶ Alkaline: 1.5V, D, 16500mAh
- ▶ Alkaline: 9V, 550mAh
- ▶ Alkaline: 12V, 50mAh



Application Specific Standard Battery Workshop

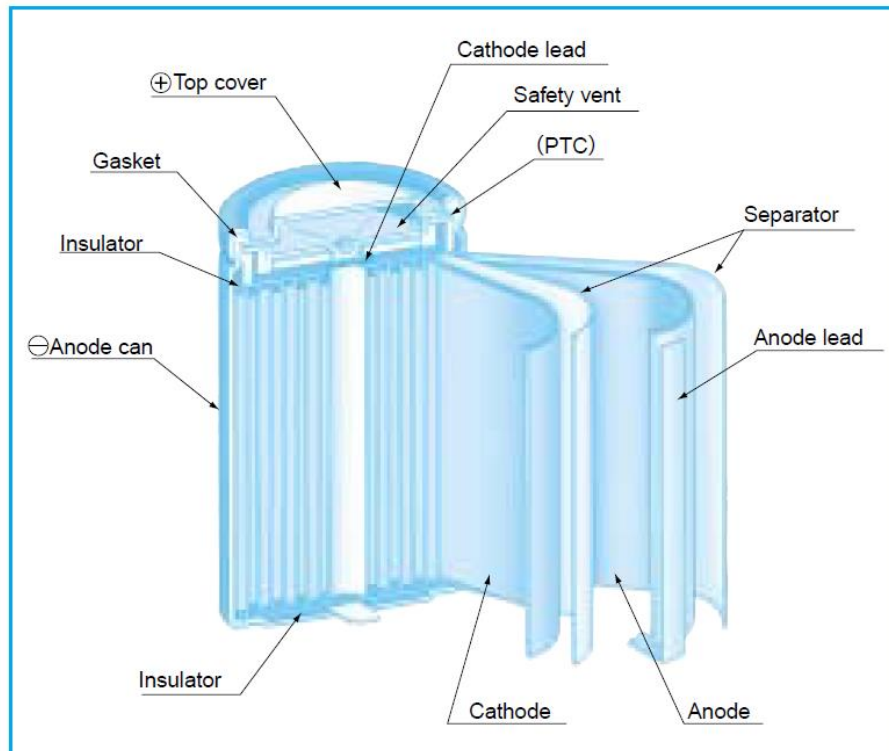


Cell Types:

- ▶ Cylindrical: 18650, 21700 (also 26650)
 - ▶ Lowest Cost & Highest Energy Density
 - ▶ Best Rate Capability: Fast Charge & Discharge



Cylindrical



Good for a **Technician Replaceable Battery**

Useful for devices that can last a whole day with the same Battery, then charge overnight.

Courtesy Sony (now Murata)

Application Specific Standard Battery Workshop

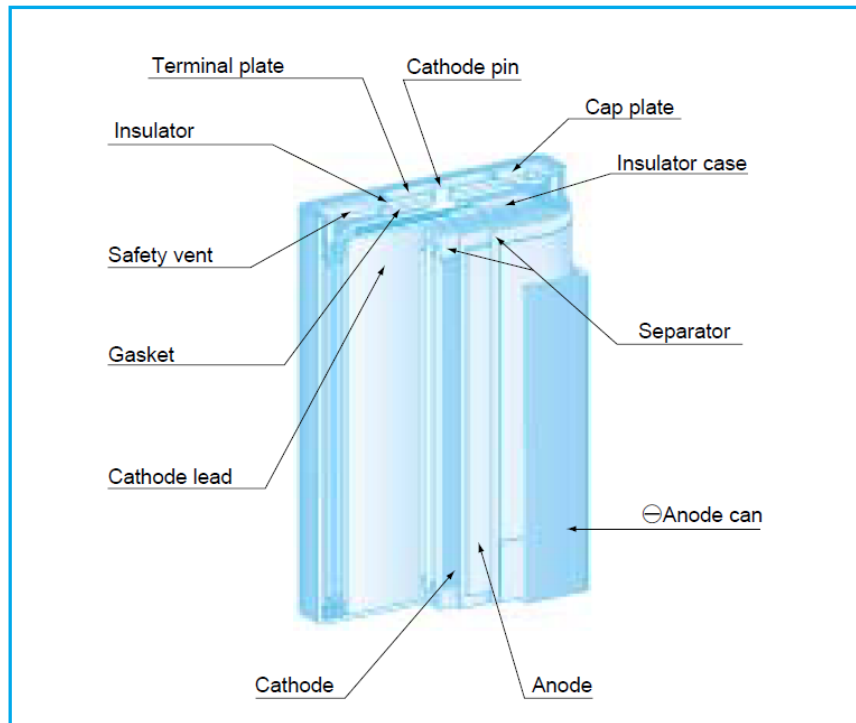


Cell Types:

- ▶ Prismatic: 103450 = 10 x 34 x 50 mm
 - ▶ Good Energy Density
 - ▶ Limited Sizes (z x 34 x 50mm most common & available)
 - ▶ Good Charge & Discharge Capability



Prismatic



Good for a **User-Replaceable Battery**

Useful for devices that use multiple batteries per day or shift and need easy replacement.

Courtesy Sony (now Murata) & Moli Energy

Application Specific Standard Battery Workshop

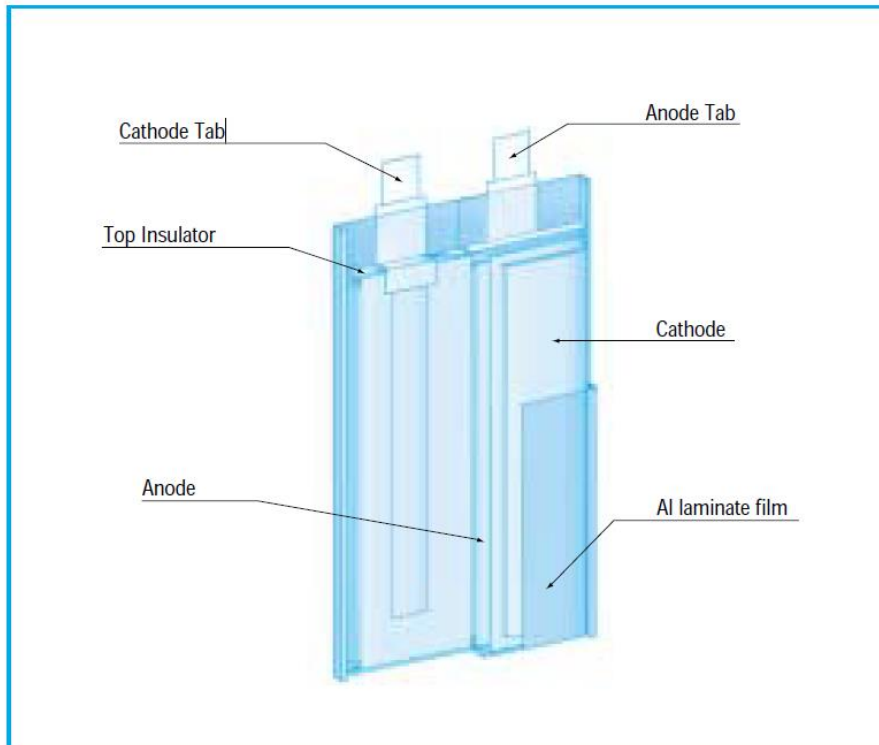


Cell Types:

- ▶ Pouch/Polymer: Various sizes – Usually thinner than 10mm
 - ▶ Lower Energy Density (due to thin size)
 - ▶ Thinnest options available; but more X-Y-Z size options
 - ▶ Reasonable Charge & Discharge Capability



Pouch



Good for a **Non-Replaceable Battery**

Useful for very thin devices that do not require a replaceable battery.

Courtesy Sony (now Murata) & VARTA

Application Specific Standard Battery Workshop



Cell Types:

- ▶ Cylindrical: 18650, 21700 (also 26650)
 - ▶ Lowest Cost & Highest Energy Density
 - ▶ Best Rate Capability: Fast Charge & Discharge
- ▶ Prismatic: 103450 = 10 x 34 x 50 mm
 - ▶ Good Energy Density
 - ▶ Limited Sizes (z x 34 x 50mm most common)
 - ▶ Good Charge & Discharge Capability
- ▶ Pouch/Polymer: Various sizes – Usually thinner than 10mm
 - ▶ Lower Energy Density (due to thin size)
 - ▶ Thinnest options available; but must consider swelling
 - ▶ Okay Charge & Discharge Capability



Application Specific Standard Battery Workshop



Which certifications are needed?

- ▶ Transportation: United Nations 38.3 – This is required to ship a battery (6th edition)
- ▶ UL – Underwriters Laboratories – Various standards based on usage (US-centric)
- ▶ IEC – International Electrotechnical Commission – World-wide standards
 - ▶ IEC 62133 useful world-wide
- ▶ CE Mark – Required for EU (can be self certified)
- ▶ Specific for applications: UL, IEC, FDA, etc.
 - ▶ Examples: UL2272 for Hover-boards; IEC-60601 for Medical
- ▶ Country / region specific considerations



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Multiple
Product
Options

Cells



Easy Block/Blade/Pro



CellPac LITE



EasyPack



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Cylindrical Battery Options

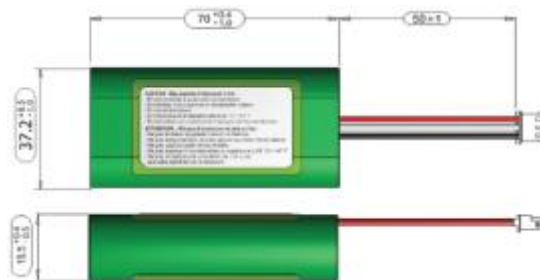
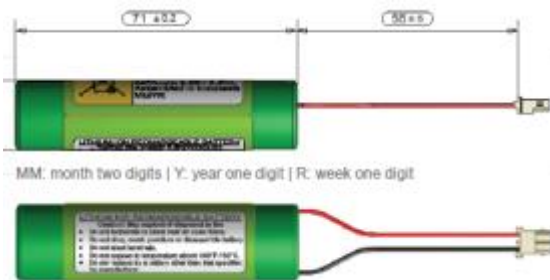
18650 Cells :

- ▶ 3.6V to 7.2V
- ▶ 9.5 to 19 Whr
- ▶ 2600 to 5200 mAh
- ▶ Molex connectors

21700 Cells:

- ▶ 3.6V to 7.2V
- ▶ 14.6 to 29.2 Whr
- ▶ 4000 to 8000 mAh

21700 Cylindrical Cells



Application Specific Standard Battery Workshop



Cylindrical Battery Options

18650 Cells :

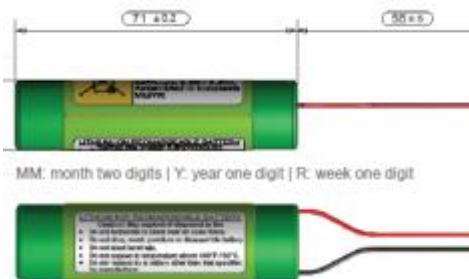
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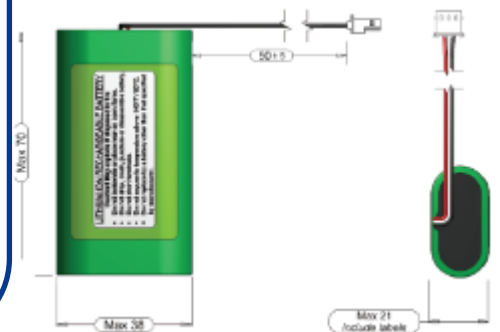


21700 Cylindrical Cells



Best for Technician Replaceable Battery

Useful for devices that can last a whole day on battery, then be charged overnight. (Battery can be replaced after 3 to 5 years of usage.)

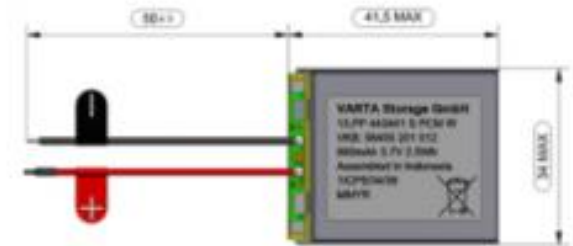
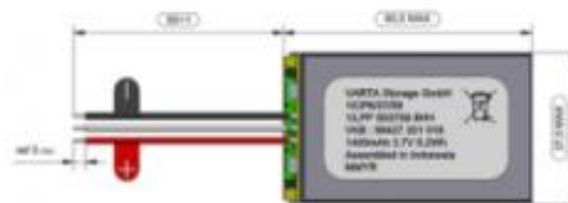
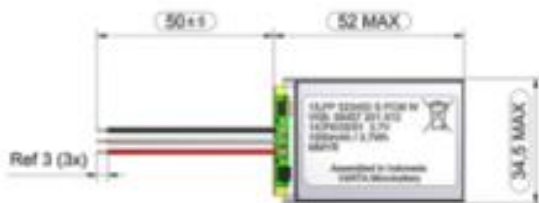
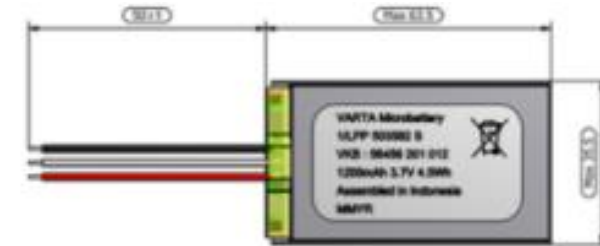
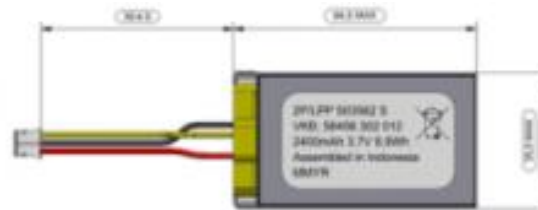
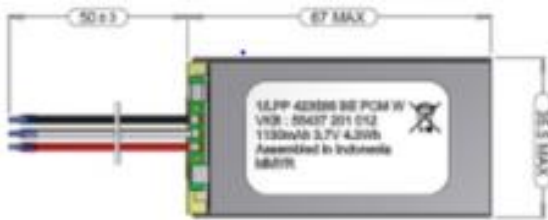


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Pouch/Prismatic Cell Options

- ▶ 3.6V to 7.2V
- ▶ 2.5 to 8.9 Whr
- ▶ 660 to 2400 mAh
- ▶ Bare wire or Molex connectors

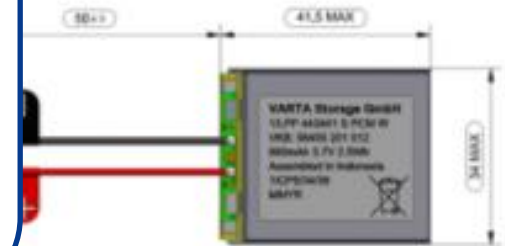
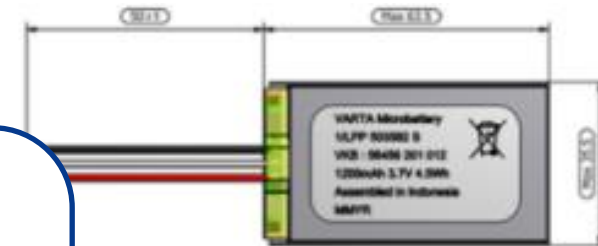
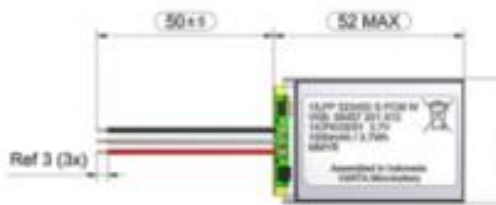
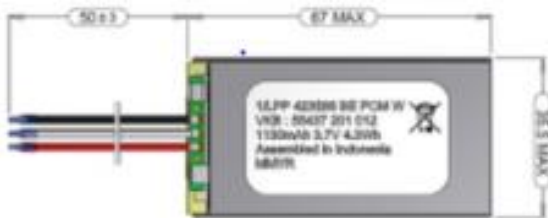


Application Specific Standard Battery Workshop



Pouch/Prismatic Cell Options

- ▶ 3.6V to 7.4V
- ▶ 2.5 to 8.9 Whr
- ▶ 660 to 2400 mAh
- ▶ Bare wire or Molex connectors



Best for **Non-Replaceable Battery**

Useful for thinner devices that can last a whole day on battery, then be charged overnight.

Application Specific Standard Battery Workshop



Encapsulated Pack Options

- ▶ 3.6V
- ▶ 2.4 to 19 Whr
- ▶ 660 to 5200 mAh
- ▶ Dual embedded connectors

EASYPACK CHARGER



EASYPACK PLUS



EASYPACK S



EASYPACK L



EASYPACK XL

Application Specific Standard Battery Workshop



Encapsulated Pack Options

- ▶ 3.6V
- ▶ 2.4 to 19 Whr
- ▶ 660 to 5200 mAh
- ▶ Dual embedded connectors



EASYPACK CHARGER



EASYPACK PLUS



Best for User-Replaceable Battery

Useful for devices that need multiple battery replacements per day. Fully enclosed battery is safe and easy for the end-customer to replace in the device.



EASYPACK S

EASYPACK L

EASYPACK XL

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MODULAR



STANDALONE



| | Easy Block | Easy Blade | Easy Stack | Easy Slice |
|------|------------|------------|------------|------------|
| 12 V | - | - | 161 Ah | 80.5 Ah |
| 24 V | 22.8 Ah | 64 Ah | 80 Ah | 40 Ah |
| 36 V | - | - | 47 Ah | 23.5 Ah |
| 48 V | 11.4 Ah | 32 Ah | 40 Ah | 20 Ah |

**Connect up to 25 in Parallel
No Master BMS Needed**

For more information: www.varta-storage.com/asb

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MODULAR



STANDALONE



Best for **Mobile Robotics, Material Handling, Floor Cleaning, Low Speed Electric Vehicles**

Useful for larger devices that need higher voltages, high capacity, but lower weight alternatives to Lead-Acid batteries.

| |
|------|
| 12 V |
| 24 V |
| 36 V |
| 48 V |

Easy
2
11

Easy Slice

| |
|---------|
| 80.5 Ah |
| 40 Ah |
| 23.5 Ah |
| 20 Ah |

**Connect up to 25 in Parallel
No Master BMS Needed**

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Application Specific Standard Battery Workshop



Final questions to consider ...

- ▶ Is this a one-time design or will the Battery be the first in a line of products?
- ▶ How critical is the Battery to the operation of the device?
- ▶ What is the operating Environment – typical or extreme?
- ▶ Expected Product Life-Cycle: Few years to 10+ years?
- ▶ Special Regulatory Certifications: FDA, IS, etc.
- ▶ Other “unique” requirements?

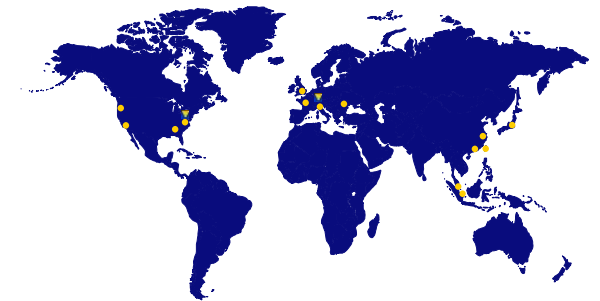


Application Specific Standard Battery Workshop



Finding the Right Battery Partner:

- ▶ Technology Leader
- ▶ Well known in the Industry
- ▶ Standard line of products in a variety of sizes
- ▶ Previous Custom designs with well known customers
- ▶ History and Industry Experience in Battery systems
- ▶ High-volume Manufacturing Expertise (not just a Design House)
- ▶ Worldwide Reach & Support
 - ▶ Multiple Manufacturing & Design locations
- ▶ Reputable firm – ideally a public company
- ▶ Financially Stable & Reliable



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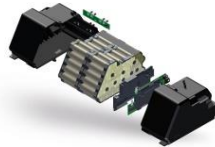
More than 130 years of innovation



**VARTA
Primary Lithium
Cell assembly**
+
Wire connector



**VARTA
PowerPack
Solutions**
+
Mechanical and
Electrical Design



**VARTA Storage
Residential Energy
Solutions**
+
Cell and charge balancing,
Power interface



**VARTA Storage
Commercial Storage
Solution**
+
Adressing multiple
energy management
functionalites



Production
+
Massive Investments in
production in lithium ion
cells in Ellwangen and
Noerdlingen

VARTA has a long history in research, development, and mass production of a variety of electro-chemistry and battery systems.

**VARTA
Lithium Cells**



**VARTA
Customized Lithium-
Polymer Pouch**
+
Safety Electronic



**VW VARTA
Joint Venture**
+
New material
technologies



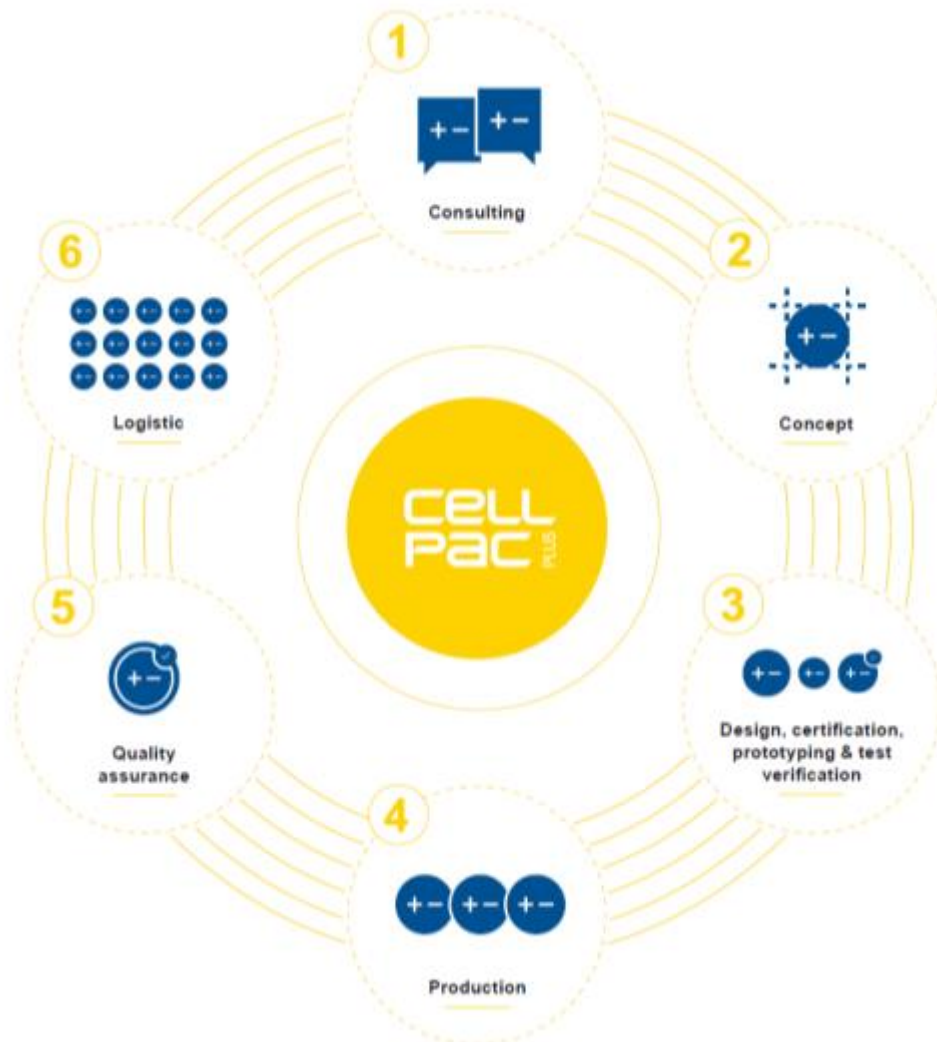
**VARTA
CoinPower Series**
+
Innovative
Cell-Design for highest
Performance & Safety



**New VARTA
CoinPower types**
+
form factors



VARTA Methodology Custom Designs



Complete Customer Focus:

To Your Schedule, Not Ours

- ▶ VARTA provides comprehensive service and consultation through the whole development process.
- ▶ Success-determining factors for the development of individual battery pack solutions:
 - ▶ Selection of the right Cells
 - ▶ Mechanical and Electrical design
 - ▶ Certification and Tests



Application Specific Standard Battery Workshop



VARTA's Family of Application Specific Standard Batteries:

- ▶ Voltages 3.6V to 48V
- ▶ Capacities 660mAh to >1500Ah
- ▶ Individual & Expandable
- ▶ Cylindrical Sizes
- ▶ Pouch/Prismatic Sizes
- ▶ Embedded Battery Packs
- ▶ Consumer Removable Packs
- ▶ Industrial, Mobile Robotics units

www.varta-storage.com/en/products/power/asb

www.varta-storage.com/en/products/power/cellpac-lite

Cells



Easy Block/Blade/Pro



CellPac LITE



EasyPack





Thanks for
joining us!

Lunch & Learn

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