

# TYPE APPROVAL CERTIFICATE

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**This is to certify:****That the Li-Ion Battery System**with type designation(s)  
**AKASystem 15 OEM 37Ah PRC**

Issued to

**AKASOL AG**  
**Darmstadt, Hessen, Germany**is found to comply with  
**DNV GL rules for classification – Ships, offshore units, and high speed and light craft****Application :****Product(s) approved by this certificate is/are accepted for installation on all vessels classed by DNV GL.**Issued at **Hamburg** on **2020-03-24**This Certificate is valid until **2025-03-23**.DNV GL local station: **Augsburg**for **DNV GL**Approval Engineer: **Andreas Andrecht**

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**Arne Schaarmann**  
**Head of Section**

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid. The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.



## Product description

The AKASystem 15 OEM 37Ah PRC is a liquid-cooled, high-energy, lithium-ion battery solution for safe and reliable use in battery-powered vessels and hybrid solutions. Twelve cells are mounted to one module with build in cell supervising circuit module (CSC). Fifteen of these modules are combined to one battery system with included central control unit, Battery Management Unit (BMU).

The BMU is the main electronic control system that manages the battery. Main functions are protecting the battery from operating outside its safe operating area, monitoring its state and calculating secondary data like State of Charge (SOC) and State of Health (SOH). The BMU is a hardware combination of the individual components Battery Management Master (BMM) and Safety Control Unit (SCU). The BMM is the main monitoring and controlling unit for example for state of charge, state of health, balancing and many more. The SCU is a redundant controller to provide functional safety of the battery system. The SCU monitors the results of measurements, which are taken from the HV sensors (voltages / current) or sent by the CSC. The CSC measures the voltages and temperatures of the cells and provides also the resistors for passive balancing for each cell. The measured values are sent to BMM and SCU via a proprietary CAN.

### Identification

Battery System Part Nr.: 3000079304 (production location Langen) or  
1M000984 (production location Darmstadt)

BMU SW Version: 18 50 03.07.012 04-00059  
CSC SW Version: 18 27 05.00.000 04-00053

### Cell Specification

| Li-ion NMC Cell 37Ah  |            | Value      | Unit |
|-----------------------|------------|------------|------|
| Nominal Voltage       |            | 3,67       | V    |
| Max. Voltage          |            | 4,20       | V    |
| Min. Voltage          |            | 2,1        | V    |
| Rated Capacity @ 1 C  |            | 37         | Ah   |
| Operating Temperature | Min.       | -30        | °C   |
|                       | Max.       | 60         | °C   |
| Charge Current        | Cont.      | 55 (1.5C)  | A    |
|                       | Peak (10s) | 111 (3C)   | A    |
| Discharge Current     | Cont.      | 55 (1.5C)  | A    |
|                       | Peak (10s) | 166 (4.5C) | A    |

### Module Specification

| Module                        |            | Value      | Unit |
|-------------------------------|------------|------------|------|
| Nominal Voltage               |            | 44,4       | V    |
| Max. Voltage                  |            | 50,4       | V    |
| Min. Voltage                  |            | 36         | V    |
| Configuration                 |            | 12s1p      |      |
| Rated Capacity @ 1 C          |            | 37         | Ah   |
| Operating Temperature         | Min.       | -30        | °C   |
|                               | Max.       | 60         | °C   |
| Storage Temperature           | Min.       | -40        | °C   |
|                               | Max.       | 70         | °C   |
| Charge Current                | Cont.      | 55 (1.5C)  | A    |
|                               | Peak (10s) | 111 (3C)   | A    |
| Discharge Current             | Cont.      | 55 (1.5C)  | A    |
|                               | Peak (10s) | 166 (4.5C) | A    |
| Energy                        |            | 1,62       | kWh  |
| Number of voltage sensors     |            | 13         |      |
| Number of temperature sensors |            | 9          |      |

### Battery System Specification

| AKASystem 15 OEM 37Ah PRC (liquid-cooled) |        | Value | Unit |
|-------------------------------------------|--------|-------|------|
| Number of serial modules per tray         |        | 15    |      |
| Number of serial cells per module         |        | 12    |      |
| Number of parallel cells per module       |        | 1     |      |
| Rated Capacity of Cell technology         |        | 37    | Ah   |
| Nominal Voltage                           |        | 661   | V    |
| Max. Voltage                              |        | 756   | V    |
| Min. Voltage                              |        | 540   | V    |
| Rated Capacity                            |        | 37    | Ah   |
| Peak Discharge Power (10s)                |        | 110   | kW   |
| Peak Charge Power (10s)                   |        | 73    | kW   |
| Continuous power (RMS)                    |        | 36    | kW   |
| Peak Discharge Current (10s)              |        | 166   | A    |
| Peak Charge Current (10s)                 |        | 111   | A    |
| Continuous power (RMS)                    |        | 55    | A    |
| Energy                                    |        | 24,5  | kWh  |
| Operating Temperature range               | Min.   | -25   | °C   |
|                                           | Max.   | 58    | °C   |
| Dimensions                                | Height | 150   | mm   |
|                                           | Width  | 700   | mm   |
|                                           | Length | 1680  | mm   |
| Weight                                    |        | 238   | kg   |
| Ingress Rating                            |        | IP 67 |      |

### Location Classes

Temperature Class A  
Humidity Class B  
Vibration Class A  
EMC Class A  
Enclosure Class C (IP67)

### Application/Limitation

#### Gas detector

Gas detectors must be installed in the battery space as described in the safety description.

#### External Controller

The type approval covers the use of AKASystem 15 OEM 37Ah PRC as one tray system. For the operation of the system with more than one battery tray an external controller is needed. The DNVGL type approval is mandatory required for the external controller but excluded from this certificate.

## Approval conditions

For each delivery to DNV GL class the following documentation of the battery system is to be submitted for approval:

### Battery system:

- Reference to this type approval certificate
- Copy of the safety description (document 3030312TEN0015 version 1.3 dated 2020-02-18)
- I130 Project-specific Battery System Block Diagram
- E120 Technical specification of the battery system that is subject for product certification
- E170 Electric schematic diagram of the battery system showing internal arrangement of battery modules, battery strings, switch unit, emergency stop and independent safety system
- Z060 Functional description, including
  - Project-specific overall description of the battery management system
    - Software and hardware versions of BMU and CSC
    - capacity calculations for the gas extract ventilation fan
    - other relevant information not covered by the safety description.
- Z252 Test program for product certification, including routine tests specified in applicable rules
- Z265 Calculation report, documentation of the SOC and SOH calculation.

The Type Approval covers hardware and software listed under Product description.

When the type approved software is revised (affecting all future deliveries) DNV GL is to be informed by forwarding updated software version documentation. If the changes are judged to affect functionality for which rule requirements apply a new functional type test may be required and the certificate may have to be renewed to identify the new software version.

### Product certificate

Each delivery of the application system is to be certified according to Pt.6, Ch.2, Sec. 1. The certification test is to be performed at the manufacturer of the application system before the system is shipped to the yard. After certification, the clause for application software control will be put into force. The independent temperature disconnection is integrated in the system and is not required to be tested during certification. See DNVGL-RU-SHIP Pt.6 Ch.2 Sec.1, Table 7 Tests of battery systems, item 10.

### Application software control

All changes in software are to be recorded as long as the system is in use on board. Documentation of major changes is to be forwarded to DNV GL for evaluation and approval before implemented on board

## Type Approval documentation

### Tests carried out

Type tests according to applicable DNV GL rules and standards as listed below have been carried out. DNVGL-RU-SHIP Pt.6 Ch.2 Sec.1, DNVGL-RU-SHIP Pt.4 Ch.8, DNVGL-RU-SHIP Pt.4 Ch.9, DNVGL-CG-0339, DNVGL-CP-0418

Propagation testing acc. DNVGL-RU-SHIP Pt.6 Ch.2 Sec.1 [4.2.2] (with design option 2: No propagation between modules)

Safety Function and Sensor Failure Test acc. DNVGL-RU-SHIP Pt.6 Ch.2 Sec.1 [4.1.5.2]

### Marking of product

The products to be marked with:

- manufacturer name
- model name
- serial number
- power supply ratings

Job Id: **262.1-028749-1**  
Certificate No: **TAE00003XW**

## **Periodical assessment**

The scope of the periodical assessment is to verify that the conditions stipulated for the Type approval are complied with and that no alterations are made to the product design or choice of materials.

The main elements of the assessment are:

- Inspection on factory samples, selected at random from the production line (where practicable)
- Results from Routine Tests (RT) checked (if not available tests according to RT to be carried out)
- Review of type approval documentation
- Review of possible change in design, materials and performance
- Ensuring traceability between manufacturer's product type marking and Type Approval Certificate.

Periodical assessment is to be performed after 2 years and after 3.5 years. A renewal assessment will be performed at renewal of the certificate.

END OF CERTIFICATE