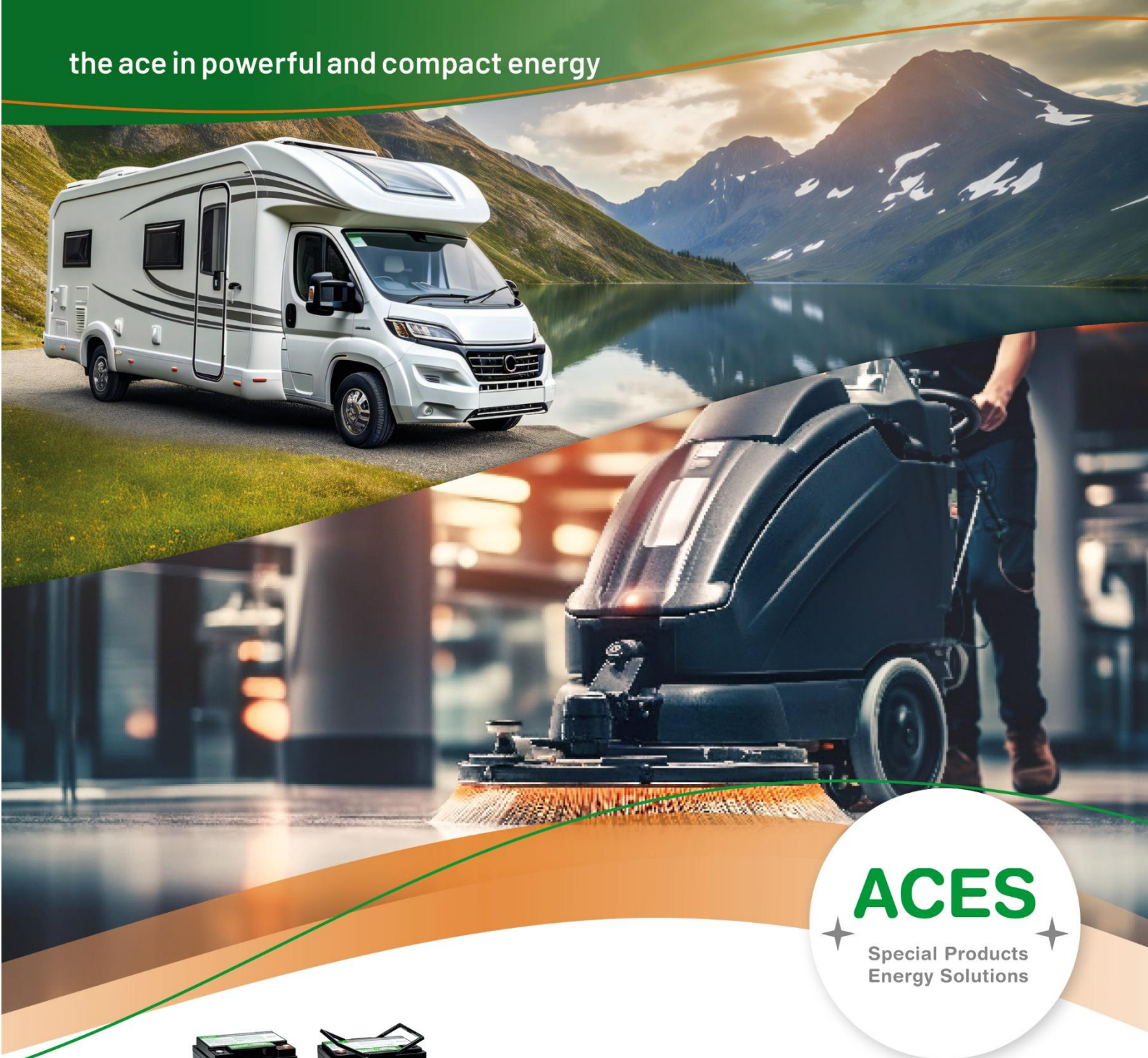
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ACES

Special Products
Energy Solutions




# USER MANUAL

12V 24V 48V 60V 72V HFA Series
LiFePO4 Batteries

# Table of Contents


1. Product description 3

1.1 Introduction HFA series Batteries 3
1.4 Technical specifications 12V <100AH 4
1.5 Technical specifications 12V HFA series batteries (>= 100Ah) 5
1.6 Technical specifications 24V HFA series batteries 7
1.7 Technical specifications 24, 36 & 48V HFA series batteries 9
1.8 Technical specifications 48V HFA series batteries (<=100AH) 10
1.9 Technical specifications 60V and 72V HFA series batteries 11
1.10 Battery Management System (BMS) 12
1.11 ACES APP installation and connection 12
1.12 ACES Android and iOS App example screens 13
1.13 ACES Lithium in comparison with Lead-acid battery for 24V 14

2. Safety guidelines 15

2.1 General rules for safety 15
2.3 Transport guidelines 15
2.4 End of Life and disposal 15

3. Installation 16

3.1 Mounting and connection instructions 16
3.2 Parallel connection of the batteries 16
3.3 Practical CAN Guide 17

4. Use of the battery 19

4.1 Charge 19
4.4 Four guidelines to prolong LiFePO4 20

5. Technical support 21

6. Warranty and liability 22

6.1 Scope 22
6.2 Identification 22
6.3 Period of warranty for ACES products 22
6.4 Warranty 22
6.5 Warranty management and return conditions 22
6.6 No warranty charges 23
6.7 Transport 23
6.8 Return address 23

7. Glossary of Abbreviations 23

8. CE declaration 24

# 1. Product description

## 1.1 Introduction HFA series Batteries

Read this manual before using the ACES LiFePO4 battery.
Our goal is for you to have a long-lasting battery, and following the instructions in this manual will help achieve that. Depending on the application, this type of battery can have a typical lifetime of 10-20 years. Improper use of lithium batteries can result in unsafe situations or permanent damage to the batteries. This manual provides clear instructions on the correct usage of ACES lithium batteries.

## 1.2 General

ACES Lithium batteries are designed in the Netherlands and are built with LiFePo4 or LFP cells. These cells have a nominal voltage of 3.2V.
In contrast with Lithium NMC, LMO and LCO cells these LiFePo4 cells are inherently safe, since NMC, LMO and LCO cells become unstable at high temperatures. LFP cells do not contain Cobalt and Manganese and do not catch spontaneously fire or explode. NMC, LMO and LCO cells are however still used in for example (some) electric cars, phones, tables, bicycles, tools, toys and RC-models. The reason for this is that these cells often have a relatively high maximum discharge rate and energy density.

Due to their stability and safety, HFA batteries are the best replacement for lead acid batteries. Compared to lead-acid batteries, ACES LiFePo4 batteries offer much longer life. Next to this they can accept relatively high charge currents, which is a big advantage for use with solar panels. Charging is also possible at any State of Charge (SOC). HFA batteries have a smaller volume and up to 4 times lower weight. Where a lead acid battery has about 60% capacity left at 1C discharge, the ACES lithium battery has still 97%. ACES lithium batteries are expected to have a lifespan of 10-20 years and more than 4000 cycles before the capacity reaches 80%. Whereas AGM lead-acid batteries have 2-5 years and about 300-500 cycles to 70%. The Built-in Battery Management System protects the battery against fault conditions.

## 1.3 Product features

- Bluetooth functionality for easy connectivity using the ACES Li Power app
- Monitor battery status and performance with the Bluetooth APP on both iOS and Android devices
- Utilizes LFP (LiFePo4) chemistry with high power density cells
- Features the safest Lithium Technology available
- Connect up to 4 batteries in parallel for increased power capacity
- Includes integrated BMS (Battery Management System) for optimal performance
- Equipped with electronic short circuit protection and integrated fuse for safety
- Offers overload protection to prevent damage
- Supports high charge currents for faster charging
- Fast charging capability, fully charging in approximately 1 hour
- Can be charged at any charge level without impacting battery life
- Durable ABS case with convenient handgrips for portability
- Compatible with a wide range of ACES chargers for easy recharging options

## 1.4 Technical specifications 12V <100AH

| |  |  |  |  |
|---|---|---|---|---|
| Description | 12.8V 24AH | 12.8V 45AH | 12.8V 60AH | 12.8V 80AH |
| Model name | AL12V24HFA | AL12V45HFA-BT | AL12V60HFA-BT | AL12V80HFA-BT |
| EAN / GTIN | 4738474176742 | 4738470384141 | 4738479938789 | 4738476325483 |
| Rated Capacity | 24Ah / 307WH | 45Ah / 576WH | 60Ah / 768WH | 80Ah / 1024WH |
| Discharge current | 24A | 45A | 60A | 80A |
| Peak discharge current | 100A | 125A | 200A | 300A |
| Maximum charge current | 24A | 45A | 60A | 80A |
| Recommended charge current | 3 - 12A | 4 - 23A | 6 - 30A | 8 - 40A |
| Internal heating available (charge below zero ˚C) | None | | | |
| Connection | M5 | M8 | | |
| Weight | 2.8 kg | 4 kg | 7.2 kg | 9.3 kg |
| Dimensions (L x W x H) mm | 181 x 76 x 167 | 165 x 126 x 175 | 197 x 166 x 173 | 260 x 168 x 209 |
| Nominal Voltage | 12.8V | | | |
| Operational Voltage range | 11.0 – 14.6V | | | |
| BMS cutoff Voltage | 10V | | | |
| Cycle Life 0.2C 80% DOD | >4000 | | | |
| Charge end voltage range | 14.2 - 14.6V (13.5V float Voltage) | | | |
| Charge characteristic | CC / CV | | | |
| Battery Management System | Integrated | | | |
| Serial connection | Not allowed | | | |
| Parallel connection | Up to 4 batteries (higher number on request) | | | |
| Bluetooth monitoring | None | Integrated - app available in Google Play and App Store | | |
| IP protection rating | IP65 | | | |
| Temperature range discharge | -20˚C – +60 ˚C | | | |
| Temperature range charge | 0˚C – +50 ˚C | | | |
| Temperature storage <1 month | -20˚C – +50 ˚C | | | |
| Temperature storage >1 month | 5 ˚C – +30 ˚C | | | |
| Warranty | 5 years | | | |

## 1.5 Technical specifications 12V HFA series batteries (>= 100Ah)

| |  |  |  |  |  |
|---|---|---|---|---|---|
| Description | 12.8V 100AH | 12.8V 100AH | 12.8V 120AH | 12.8V 150AH | 12.8V 150AH |
| Model name | AL12V100HFA-BT | AL12V100HFAS-BT | AL12V120HFA-BT | AL12V150HFA-BT | AL12V150HFAS-BTH |
| EAN / GTIN | 4738475950945 | 4738477545552 | 4738476073223 | 4738479950491 | 4738475083575 |
| Rated Capacity | 100Ah / 1280WH | 100Ah / 1280WH | 120Ah / 1536WH | 150Ah / 1920WH | 150Ah/1920WH |
| Discharge current | 100A | 150A | 100A | 150A | 150A |
| Peak discharge current | 300A | 300A | 350A | 360A | 360A |
| Maximum charge current | 100A | 100A | 100A | 150A | 150A |
| Recommended charge current | 10 - 50A | 10 - 50A | 10 - 60A | 15 - 75A | 15 - 75A |
| Internal heating (charge below zero ˚C) | None | | | | Yes |
| Connection | M8 | Din 17(-) / 19(+)mm | M8 | | Din 17(-) / 19(+)mm |
| Weight | 12.8 kg | 12 kg | 14 kg | 15 kg | 17 kg |
| Dimensions (L x W x H) mm | 306 x 168 x 211 | 317 x 175 × 188 | 260 x 168 x 209 | 260 x 168 x 209 | 355 x 175 x 188 |
| Nominal Voltage | 12.8V | | | | |
| Operational Voltage range | 11.0 - 13.5V | | | | |
| BMS cutoff Voltage | 10V | | | | |
| Cycle Life 0.2C 80% DOD | >4000 | | | | |
| Charge end voltage range | 14.2 - 14.6V (13.5V float Voltage) | | | | |
| Charge characteristic | CC / CV | | | | |
| Battery Management System | Integrated | | | | |
| Serial connection | Not allowed | | | | |
| Parallel connection | Up to 4 batteries (higher number on request) | | | | |
| Bluetooth monitoring | Integrated - app available in Google Play and App Store | | | | |
| IP protection rating | IP65 | | | | |
| Temperature range discharge | -20˚C – +60 ˚C | | | | |
| Temperature range charge | 0˚C – +45 ˚C | | | | -20˚C – +45 ˚C |
| Temp. storage <1 month | -20˚C – +50 ˚C | | | | |
| Temp. storage >1 month | 5 ˚C – +30 ˚C | | | | |
| Warranty | 5 years | | | | |

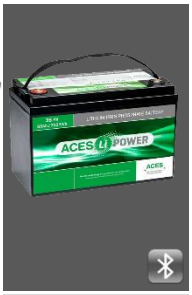
| |  |  |  |  |
|---|---|---|---|---|
| Description | 12.8V 200AH | 12.8V 280AH | 12.8V 340AH | 12.8V 460AH |
| Model name | AL12V200HFA-BTH | AL12V280HFA-BTH | AL12V400HFA-BCH | AL12V460HFA-BCH |
| EAN / GTIN | 4738479427757 | 4738475061597 | 4738478763764 | 4738479244828 |
| Rated Capacity | 200Ah/2560WH | 280Ah/3584WH | 340AH/4352Wh | 460AH/5888Wh |
| CAN-bus integrated | None | | Yes | |
| Discharge current | 200A | 200A | 300A | 300A |
| Peak discharge current | 400A | 400A | 500A | 500A |
| Max. charge current | 150A | 150A | 300A | 300A |
| Recommended charge current | 20 - 100A | 20 - 100A | 40 - 100A | 40 - 100A |
| Internal heating (charge below zero ˚C) | Yes | | | |
| Connection | M8 | | | |
| Weight | 22 kg | 24 kg | 34 kg | 42 kg |
| Dimensions (L x W x H) mm | 522 x 239 x 218 | 345 x 190 x 245 | 520 x 269 x 220 | 520 x 269 x 220 |
| Nominal Voltage | 12.8V | | | |
| Operational Voltage range | 11.0 - 13.5V | | | |
| BMS cutoff Voltage | 10V | | | |
| Cycle Life 0.2C 80% DOD | >4000 | | | |
| Charge end voltage range | 14.2 - 14.6V (13.5V float Voltage) | | | |
| Charge characteristic | CC / CV | | | |
| Battery Management System | Integrated | | | |
| Serial connection | Not allowed | | | |
| Parallel connection | Up to 4 batteries (higher number on request) | | | |
| Bluetooth monitoring | Integrated - app available in Google Play and App Store | | | |
| IP protection rating | IP65 | | | |
| Temp. discharge | -20˚C – +60 ˚C | | | |
| Temp. charge | -20˚C – +45 ˚C | | | |
| Temp. storage <1 month | -20˚C – +50 ˚C | | | |
| Temp. storage >1 month | 5 ˚C – +30 ˚C | | | |
| Warranty | 5 Years | | | |

## 1.6 Technical specifications 24V HFA series batteries

| |  |  |  |  |  |
|---|---|---|---|---|---|
| Description | 25.6V 12AH | 25.6V 30AH | 25.6V 50AH | 25.6V 60AH | 25.6V 75AH |
| Model name | AL24V12HFA | AL24V30HFA-BT | AL24V50HFA-BT | AL24V60HFA-BT | AL24V75HFA-BT |
| EAN / GTIN | 4738474993882 | 4738470670572 | 4738475996288 | 4738473635950 | 4738477281177 |
| Rated Capacity | 12Ah / 307WH | 30Ah / 768WH | 50Ah / 1280WH | 60Ah / 1536WH | 75Ah / 1920WH |
| Discharge current | 12A | 30A | 50A | 50A | 60A |
| Peak discharge current | 80A | 140A | 220A | 180A | 220A |
| Maximum charge current | 12A | 30A | 50A | 50A | 60A |
| Recommended charge current | 1 - 6A | 3 - 15A | 5 - 25A | 6 - 30A | 8 - 38A |
| Internal heating available (charge below zero ˚C) | None | | BTH model | None | BTH model |
| Connection | M5 | M8 | | | |
| Weight | 3 kg | 7.2 kg | 12.8 kg | 12 kg | 12.8 kg |
| Dimensions (L x W x H) mm | 181 x 76 x 167 | 197 x 166 x 173 | 306 x 168 x 211 | 260 x 168 x 209 | 306 x 168 x 211 |
| Nominal Voltage | 25.6V | | | | |
| Operational Voltage range | 22 - 27V | | | | |
| BMS cutoff Voltage | 20V | | | | |
| Cycle Life 0.2C 80% DOD | >4000 | | | | |
| Charge end voltage range | 28.4 - 29.2V (27V float Voltage) | | | | |
| Charge characteristic | CC / CV | | | | |
| Battery Management System | Integrated | | | | |
| Serial connection | Not allowed | | | | |
| Parallel connection | Up to 4 batteries (higher number on request) | | | | |
| Bluetooth monitoring | None | Integrated - app available in Google Play and App Store | | | |
| IP protection rating | IP65 | | | | |
| Temp. range discharge | -20˚C – +60 ˚C | | | | |
| Temp. range charge | 0˚C – +45 ˚C | | | | |
| Temp. storage <1 month | -20˚C – +50 ˚C | | | | |
| Temp. storage >1 month | 5 ˚C – +30 ˚C | | | | |
| Warranty | 5 years | | | | |

| |  |  |  |  |  |
|---|---|---|---|---|---|
| Description | 25.6V 84AH | 25.6V 100AH | 25.6V 160AH | 25.6V 200AH | 25.6V 230AH |
| Model name | AL24V84HFA-BT | AL24V100HFA-BTH | AL24V160HFA-BT | AL24V200HFA-BTC | AL24V230HFA-BCH |
| EAN / GTIN | 4738478485765 | 4738474010183 | 4738475180120 | 4738476426326 | 4738478438822 |
| Rated Capacity | 84Ah / 2150 WH | 100Ah / 2560WH | 160Ah / 4096WH | 200Ah / 5120WH | 230Ah / 5888WH |
| CAN-bus Integrated | No | | | Yes | |
| Discharge current | 84A | 100A | 150A | 150A | 200A |
| Peak discharge current | 220A | 350A | 400A | 400A | 400A |
| Maximum charge current | 84A | 100A | 150A | 100A | 150A |
| Recommended charge current | 8 – 42A | 10 - 50A | 15 - 80A | 20 - 100A | 20 - 100A |
| Internal heating (charge below zero ˚C) | no | yes | no | | Yes |
| Connection | M8 | | | | |
| Weight | 19 kg | 22 kg | 32 kg | 39 kg | 41 kg |
| Dimensions (L x W x H) mm | 483 x 170 x 211 | 522 x 239 x 218 | 520 x 269 x 220 | 520 x 269 x 220 | 520 x 269 x 220 |
| Nominal Voltage | 25.6V | | | | |
| Operational Voltage range | 22 - 27V | | | | |
| BMS cutoff Voltage | 20V | | | | |
| Cycle Life 0.2C 80% DOD | >4000 | | | | |
| Charge end voltage range | 28.4 - 29.2V (27V float Voltage) | | | | |
| Charge characteristic | CC / CV | | | | |
| Battery Management System | Integrated | | | | |
| Serial connection | Not allowed | | | | |
| Parallel connection | Up to 4 batteries (higher number on request) | | | | |
| Bluetooth monitoring | Integrated - app available in Google Play and App Store | | | | |
| IP protection rating | IP65 | | | | |
| Temp range discharge | -20˚C – +60 ˚C | | | | |
| Temp. range charge | 0˚C – +45 ˚C | -20˚C – +45 ˚C | 0˚C – +45 ˚C | -20˚C – +45 ˚C | 0˚C – +45 ˚C |
| Temp. storage <1 month | -20˚C – +50 ˚C | | | | |
| Temp. storage >1 month | 5 ˚C – +30 ˚C | | | | |
| Warranty | 5 years | | | | |

## 1.7 Technical specifications 24, 36 & 48V HFA series batteries

| |  |  |  |  |  |
|---|---|---|---|---|---|
| Description | 25.6V 300AH | 38.4V 60AH | 38.4V 100AH | 51.2V 12AH | 51.2V 18AH |
| Model name | AL24V300HFA-BTC | AL36V60HFA-BT | AL36V100HFA-BT | AL48V12HFA-BT | AL48V18HFA-BT |
| EAN / GTIN | 4738476704332 | 4738476110485 | 4738473635950 | 4738470107085 | 4738478548255 |
| Rated Capacity | 300Ah / 7680WH | 60Ah / 2304WH | 100Ah / 3840WH | 12AH / 614WH | 18AH / 921WH |
| CAN-bus integrated | Yes | No | | | |
| Discharge current | 200A | 60A | 100A | 12A | 18A |
| Peak discharge current | 400A | 220A | 200A | 60A | 80A |
| Maximum charge current | 150A | 60A | 100A | 12A | 18A |
| Recommended charge current | 20 – 100A | 6 – 30A | 10 – 50A | 2 – 6A | 3 – 9A |
| Internal heating available (charge below zero ˚C) | No | | | | |
| Connection | M8 | | | | |
| Weight | 51 kg | 17 kg | 26 kg | 6 kg | 8 kg |
| Dimensions (L x W x H) in mm | 640 x 245 x 220 | 330 x 172 x 215 | 520 x 269 x 220 | 197 x 166 x 173 | 260 x 168 x 209 |
| Nominal Voltage | 25.6V | 38.4V | | 51.2V | |
| Operational Voltage range | 22 – 27V | 30 – 43.2V | | 44 – 57.6V | |
| BMS cutoff Voltage | 20V | 30V | | 40V | |
| Cycle Life 0.2C 80% DOD | >4000 | | | | |
| Charge end voltage range | 28.4 - 29.2V (27V float Voltage) | 43.2 – 43.8V (40.2 – 40.8V float voltage) | | 57.6 – 58.4V (54V float Voltage) | |
| Charge characteristic | CC / CV | | | | |
| Battery Management System | Integrated | | | | |
| Serial connection | Not allowed | | | | |
| Parallel connection | Up to 4 batteries (higher number on request) | | | | |
| Bluetooth monitoring | Integrated - app available in Google Play and App Store | | | | |
| IP protection rating | IP65 | | | | |
| Temperature range discharge | -20˚C – +60 ˚C | | | | |
| Temperature range charge | 0˚C – +45 ˚C | | | | |
| Temperature storage <1 month | -20˚C – +50 ˚C | | | | |
| Temperature storage >1 month | 5 ˚C – +30 ˚C | | | | |
| Warranty | 5 years | | | | |

## 1.8 Technical specifications 48V HFA series batteries (<=100AH)

| |  |  |  |  |  |
|---|---|---|---|---|---|
| Description | 51.2V 30AH | 51.2V 60AH | 51.2V 80AH | 51.2V 100AH | 51.2V 150AH |
| Model name | AL48V30HFA-BT | AL48V60HFA-BT | AL48V80HFA-BT | AL48V100HFA-BCH | AL48V150HFA-BTC |
| EAN / GTIN | 4738478298242 | 4738476073223 | 4738470112966 | 4738470089312 | 4738479776329 |
| Rated Capacity | 30AH / 1536WH | 60AH / 3072WH | 80AH / 4096WH | 100AH / 5120WH | 150AH / 7680WH |
| CAN-bus integrated | No | | | Yes | |
| Discharge current | 30A | 60A | 80A | 100A | 150A |
| Peak discharge current | 100A | 180A | 220A | 220A | 300A |
| Maximum charge current | 30A | 60A | 80A | 80 / 100A | 100A |
| Recommended charge current | 3 – 15A | 8 – 30A | 8 – 40A | 10 – 50A | 10 – 75A |
| Internal heating available (charge below zero ˚C) | No | | | Optional | No |
| Connection | M8 | | | | |
| Weight | 13.5 kg | 20 kg | 32 kg | 39 kg | 51 kg |
| Dimensions (L x W x H) in mm | 330 x 172 x 215 | 483 x 170 x 240 | 520 x 269 x 220 | 520 x 269 x 220 | 640 x 245 x 220 |
| Nominal Voltage | 51.2V | | | | |
| Operational Voltage range | 44 – 57.6V | | | | |
| BMS cutoff Voltage | 40V | | | | |
| Cycle Life 0.2C 80% DOD | >4000 | | | | |
| Charge end voltage range | 57.6 – 58.4V (54V float Voltage) | | | | |
| Charge characteristic | CC / CV | | | | |
| Battery Management System | Integrated | | | | |
| Serial connection | Not allowed | | | | |
| Parallel connection | Up to 4 batteries (higher number on request) | | | | |
| Bluetooth monitoring | Integrated - app available in Google Play and App Store | | | | |
| IP protection rating | IP65 | | | | |
| Temperature range discharge | -20˚C – +60 ˚C | | | | |
| Temperature range charge | 0˚C – +45 ˚C | | | | |
| Temperature storage <1 month | -20˚C – +50 ˚C | | | | |
| Temperature storage >1 month | 5 ˚C – +30 ˚C | | | | |
| Warranty | 5 years | | | | |

## 1.9 Technical specifications 60V and 72V HFA series batteries

| |  |  |  |  |
|---|---|---|---|---|
| Description | 60.8V 30 AH | 60.8V 75AH | 73.6V 30AH | 73.6V 60AH |
| Model name | AL60V30HFA-BT | AL60V75HFA-BT | AL72V30HFA-BT | AL72V60HFA-BT |
| EAN / GTIN | 4738477281177 | 4738477140511 | 4738475685267 | 4738475648910 |
| Rated Capacity | 30AH / 1824WH | 75AH / 4560WH | 30AH / 2208WH | 60AH / 4416WH |
| CAN-bus Integrated | None | | | |
| Discharge current | 30A | 75A | 30A | 60A |
| Peak discharge current | 100A | 200A | 120A | 200A |
| Maximum charge current | 30 | 60A | 30A | 60A |
| Recommended charge current | 3 - 15 | 8–38A | 3–15A | 6–30A |
| Nominal Voltage | 51.2V | 60.8V | 73.6V | 73.6V |
| Operational Voltage range | 40–57.6V | 48–68.4V | 63.0–77.6V | 63.0–77.6V |
| Internal heating available (charge below zero ˚C) | None | | | |
| Connection | M8 | | | |
| Weight | 14 kg | 35 kg | 17 kg | 34 kg |
| Dimensions (L x W x H) in mm | 307 x 169 x 208 | 520 x 269 x 220 | 483 x 170 x 240 | 520 x 269 x 220 |
| BMS cutoff Voltage | 48V | 48V | 63V | 63V |
| Cycle Life 0.2C 80% DOD | >4000 | | | |
| Charge end voltage range | 68.4 – 69.3V (64V float voltage) | | 82.8 – 83.9V (78 – 79.3V float voltage) | |
| Charge characteristic | CC / CV | | | |
| Battery Management System | Integrated | | | |
| Serial connection | Not allowed | | | |
| Parallel connection | Up to 4 batteries (higher number on request) | | | |
| Bluetooth monitoring | Integrated - app available in Google Play and App Store | | | |
| IP protection rating | IP65 | | | |
| Temperature range discharge | -20˚C – +60 ˚C | | | |
| Temperature range charge | 0˚C – +45 ˚C | | | |
| Temperature storage <1 month | -20˚C – +50 ˚C | | | |
| Temperature storage >1 month | 5 ˚C – +30 ˚C | | | |
| Warranty | 5 years | | | |

## 1.10 Battery Management System (BMS)

The BMS will protect the battery against faults, which guarantees the best safety and best functionality of the battery. See the table below or a listing of BMS protections. It should be noted that these protections can, and often are activated during regular use. For example: during charging the overvoltage protection can activate. This should however be seen as proper operation of the battery and not as an error.
The BMS balances the cells to ensure that the battery retains its maximum capacitance during life.

Protection functions of the BMS:

| Protection code | Protection description |
|---|---|
| OVP | Over Voltage Pack protection |
| OCP | Overvoltage Cell Protection |
| UVP | Under Voltage Pack protection |
| UCP | Undervoltage Cell Protection |
| SCP | Short Circuit Protection active |
| OCC | Over Current Charge protection |
| OCD | Over Current Discharge protection |
| OTD | Over Temperature Discharge protection |
| OTC | Over Temperature Charge protection |
| UTC | Under Temperature Charge protection (below zero) |
| UTD | Under Temperature Discharge protection |

## 1.11 ACES APP installation and connection

**Step 1.** Install the ACES App ACES LI POWER via Google Play or
Apple store on your Smart phone or you scan the QR code via our website

**Step 2.** Make sure the Bluetooth on your smartphone is activated
Open the App on your smartphone

**Step 3.** You will see a list now with one or more Bluetooth connections.
Choose the model and serial number of your battery and you will be connected to the battery.

| Functions on the main screen | Description |
|---|---|
| Current | Actual battery current (range -999–999A) |
| Voltage | Actual battery Voltage (V) |
| SOC | State Of Charge; % of capacity left in the battery |
| Temp | Temperature of the Battery cells |
| Rated capacity | Battery Capacity in Ah on label |
| Remaining | Battery remaining Capacity in Ah |
| Cell high | Highest Cell Voltage |
| Cell high | Highest Cell Voltage |
| Discharge / Charge | Discharge and or Charge switch ON or OFF |
| Protection | Shows the code for the active protection |
| Power | Shows the actual Power in Watts |
| Cycles | Shows the number of charge cycles |

## 1.12 ACES Android and iOS App example screens

ANDROID APP ON Google play

Download on the App Store



### 1.13 ACES Lithium in comparison with Lead-acid battery for 24V

| Characteristic | ACES LiFePO4 lithium 24V-84AH  | 2xVMF140AH 12V-140AH  | 2 x 4PZS110 12V-155AH  | Benefits or drawbacks of ACES LiFePO4 |
|---|---|---|---|---|
| Weight | 18 kg | 83kg | 81kg | < 20% of the weight |
| Life Cycles@80% DOD | 4000 | 450 | n.a. | Much longer cycle life<br>> 20 times |
| Life Cycles@50% DOD | 10000 | 800 | 800 | Much longer cycle life<br>> 10 times |
| Capacity @ 0˚C | 85% | 76% | 70% | Best cold temp performance |
| Capacity @ C20<br>Capacity @ C5<br>Capacity @ C1 | 84AH<br>84AH<br>84AH | 140AH<br>114AH<br>80AH | 170AH<br>118AH<br>82AH | Almost 100% energy and power at any discharge rate |
| Max discharge level<br>Useable capacity C5 | 100%<br>84Ah | 80%<br>91Ah | 80%<br>94Ah | Fully useable discharge range |
| Maintenance | None | Low | High | No maintenance |
| Charge at all SOC levels possible | yes | no | no | Can be charged at all SOC without lifetime impact |
| Fast charging time | 1 hour | 6 hours | 6 hours | Can be charged 6 times faster. Charge in between |
| Lifetime | 10–20 years | 3–4 years | 3–4 years | Much longer life |
| Cost price*<br>**Prices only for reference* | € 1150 | € 506 | €418 | Higher initial cost |
| Cost/cycle@50% DOD and C5 discharge | € 0,1150 | € 0,58 | € 0,47 | Lowest cost per cycle |

The table above shows the comparison for a typical Pipe Rail trolley application.

## 2. Safety guidelines

### 2.1 General rules for safety

These batteries shall only be serviced by authorized personnel. Batteries opened by non-authorized personnel can have potential hazards and ACES cannot grant warranty on the product anymore.
The lithium batteries can provide extremely high currents, therefore one should be careful not to place any metal parts on the battery. Be careful when wearing metallic watches or armbands.

### 2.2 Explanation of the symbols on the battery

| | |
|---|---|
|   | Operational ambient temperature range -20˚C – 45˚C |
| IP<br>65 | Ingress protection rating IP65 |
|  | The battery should be kept far away from fire hazards |
|  | Service and opening the battery is not allowed by unqualified persons |
|   | The battery shall be disposed according local regulations |
|  | This battery or parts of it can be recycled |
|  | Conformity Declaration sign to EU legislation |

### 2.3 Transport guidelines

The battery must be transported in original packing.
Lithium batteries are classified as dangerous goods, should be treated according category UN3480, class 9 and should be packed according to the UN-handbook.
For land and sea transport the batteries must be packed according packing description P903.
For air-transport (IATA) the batteries must be packed according P965.
The original packing is according these rules.

### 2.4 End of Life and disposal

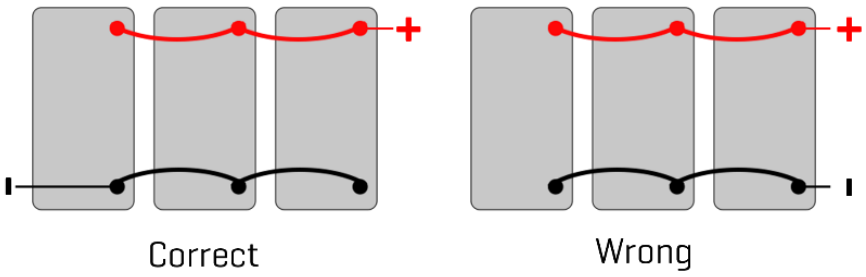
ACES LiFePO4 batteries are considered EOL (End Of Life) when the usable capacity drops below 70% of the initial capacity. EOL or defect lithium batteries are not allowed to put in private or industrial waste.
Therefor lithium batteries need to be disposed separately according EU standard 2002/96/CE to official Recycling places. Lithium batteries, or parts of it, can be recycled.

# 3. Installation

## 3.1 Mounting and connection instructions

Check the battery for damages before installation. If battery has damages contact your reseller.
A maximum of 4 batteries can be connected in Parallel. Series connection is not allowed.
The battery shall be mounted using special straps or clamps.
The battery shall be connected by using M8 screws and cable lugs (torque of about 8-10 nm).
The battery shall be mounted on rubber foam or rubber blocks.
Fixing of the battery shall be strong and suitable for the application
The cable cross section shall be suitable for the maximum continuous current.
Finally the cable connection shall be isolated by a suitable cable-boot, red for + and black for -.
The batteries are splash waterproof, but it is not allowed to use them under water.

## 3.2 Parallel connection of the batteries




Before parallel connection follow the instructions below:

- Make sure all the batteries are fully charged and have the (roughly) the same voltage
- Use only batteries with the same capacity
- The best is to use new batteries (to ensure that both batteries have the same wear level, namely no wear)
- Use only short cables suitable for the amount of current
- Disconnect the CAN power supply (CAN system needs to reboot to ensure proper master-slave configuration)

If N batteries are connected in parallel, ensure that N-1 batteries can handle the maximum allowed current. For example, with N batteries in parallel, the maximum current (ImaxN) is calculated as: ImaxN = Imax × (N - 1).

For batteries connected via CAN-bus with Victron or ACES, the formula changes to: ImaxN = 0.9 × Imax × N. In this case, the master battery determines the maximum current based on the connected slaves and their settings.

For the NMEA protocol, the formula is: ImaxN = Imax × (N - 1).

## 3.3 Practical CAN Guide

**Connecting ACES batteries to a CAN system**
ACES batteries use a CAN cable for two purposes:

1. Supplying 12V power
2. Enabling data transfer

When connecting more than 1 battery in parallel on the CAN bus network, the ACES batteries will automatically be recognized and will set their own master/slave for sending out the data. The send out data by the master is a recalculated package of data from the master and slaves.

To enable communication via the CAN bus, the battery requires an external 12V power source. This 12V supply "wakes up" the battery, allowing it to communicate and provide power. It's important to note:

- **The 12V supply must be turned off when the battery is not in use.** This allows the battery to enter sleep mode, reducing energy loss.
- **Master-slave configuration is determined during "wake up" of the battery.** So it is important that all ACES batteries connected to the CAN-network receive the 12V supply simultaneously for a correct master-slave configuration.
    - Without correct configuration, the batteries will interfere with each other and you will therefore not be able to obtain (correct) information from the batteries
    - If the master-slave determination went wrong, the system can be rebooted by removing the 12V supply for at least 10 seconds.
- The 12V supply should be fused to protect the system against possible short-circuits
    - Preferred fuse size is 3A

For providing this 12V supply, you have two main options:

1. **Combination of a DC-DC converter and a 12V lead-acid battery:**
    - This setup ensures that even if the battery shuts down due to a protection event, you can still access CAN bus information to diagnose the issue. The lead-acid battery maintains the 12V supply, allowing you to see what type of protection triggered the shutdown.
    - This is the recommended configuration for ensuring continuous visibility of CAN bus data, especially in scenarios where the main battery might shut down temporarily.
2. **Using only a DC-DC converter:**
    - This option works well under normal operating conditions but has a significant limitation: if the main battery shuts down due to a protection event, the DC-DC converter will also lose power, cutting off the 12V supply. As a result, you won't be able to access the CAN bus or view diagnostics, such as on a CAN bus display, since the power source is gone.
    - Additionally, the battery will only turn back on if the protection condition is resolved or if a charger is applied, particularly when the battery was empty. Until one of these conditions is met, the battery will remain off, and no diagnostics will be possible.

**Advice:** To ensure continuous monitoring and diagnostic capability, it is highly recommended to use the combination of a DC-DC converter and a 12V lead-acid battery. Always use a fused connection to protect the system from potential short circuits.

**Termination Resistors**
Termination resistors are essential for a stable CAN bus connection. They prevent signal reflections by being placed at **both ends** of the bus.

**Connection Setup:**

- **Middle of the CAN bus:** Only CAN bus cables should be connected to the battery. The termination resistor should not be connected.
- **At the ends of the bus:** One CAN bus cable and one termination resistor should be connected to the battery to properly terminate the bus.
    - When using splitters this means that some ports may need to be left unpopulated

**ACES Battery Tips**

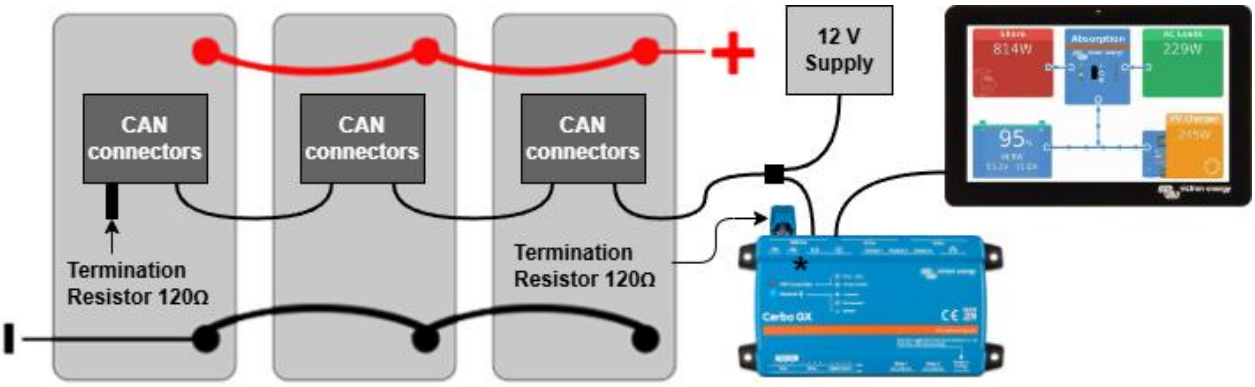
- Both CAN connectors on ACES batteries are identical, so either one can be used for connection or termination.
- **At the ends of the bus**, connect a CAN bus cable and termination resistor.
- **In the middle**, only connect the CAN bus cables, without the termination resistor.
- Ensure that there are **Only 2 resistors in a complete CAN network**

This ensures a stable and efficient CAN bus network.

**Example: Connecting to a Victron Cerbo GX**
In setups like the Victron Cerbo GX, the (separately sold) cable is split into:

- Separate wires for the 12V power supply.
- An **RJ45 connector** for data transfer.

The ACES batteries will be automatically recognized by the Cerbo GX.




**3.3 Short circuit prevention**

The battery is electronically protected for short-circuit. Additionally the battery contains a fuse that will not trip in normal use. The fuse only can trip at short-circuit when the electronic protection fails.

**3.4 Maintenance**

No regular maintenance is required for the battery.
Check the connection to the battery poles regularly if the screw is fixed strongly.
Clean the battery poles when heavy corrosion is noticed.

## 4. Use of the battery

### 4.1 Charge

1. Use only appropriate CC/CV chargers with charge end-voltage, float voltage, and charge current within according battery specification. For longest cycle life use the recommended charge current.
2. After finishing the charge to 100% the charger shall switch-off or fall back to floating voltage. If the maximum charging voltage is kept for a long time battery lifetime will be shortened.
3. The battery can be charged at every SOC level without impact on lifetime
4. The battery will not accept charge current below 0˚C
5. The battery can accept fast charging up to 1C. It is not recommended to do this always, because it will reduce cycle-life substantially.
6. Switch on/off the charger first before connect/disconnect to the battery.
7. Always charge the battery to 100%. When the charger is ready it is recommended to keep the charger connected for at least 3 hours. During this time the battery will finish the internal cell balance process. When the cells are fully balanced each time, there will be no loss of capacity over long time due to balance mismatch. Charging to 100% is also required to synchronize the SOC value.

### 4.2 Discharge

1. Care should be taken that the battery is not discharged with currents exceeding the specification.
2. If the battery is discharged with maximum currents at high ambient temperatures it is possible BMS thermal protection will switch off the battery.
3. It is recommended to set the undervoltage protection level in the connected equipment to a level higher than the BMS UVP level. Advised for 12V battery 11V, 24V battery 22V, for 48V battery 44V.
4. If during discharge the BMS undervoltage protection level is exceeded, the battery will switch itself off. The battery will switch on again when a charger is connected.

### 4.3 Deep discharge

Deep discharge means that the battery is fully depleted after switched off by the BMS UVP.
This is an unwanted situation, because after longer period in UVP protection the cells can be completely deep discharged due to internal self-discharge and BMS sleep current. Completely deep discharged cells means the battery is permanently defect and cannot be repaired.
Warranty is not granted when batteries are used like this.

Deep discharge with permeant damage can have following reasons:
1. During long time storage, connected equipment to the battery have still current draw and finally the battery goes in UVP protection mode. Too long time in this protection mode can cause deep discharge.
2. The battery is not charged before a long, e.g. a winterstop, period.
3. The battery poles are not disconnected before a long period of no usage.

Solution: charge the battery to 100% full before long period of not use and disconnect the poles.
Check by the APP the SOC condition of the battery regularly.

**Important!! The battery shall be fully charged at least every 3 months to prevent deep discharge!!**

## 4.4 Four guidelines to prolong LiFePO4

1. Avoid discharge below 20% SOC

In general, for daily use, no more than 80% of the total battery capacity should be used. This means that, ideally, the battery should not be discharged below 20% SOC, unless in an emergency. While 20% is the guideline, 10% should be considered the absolute minimum. This also ensures that some battery capacity remains in the event of a blackout. Another issue is that deeply discharging an LFP battery causes the voltage to drop significantly, which can cause the controller to shut down, especially under high or surging loads. A minimum SOC level or minimum voltage should therefore be set in the controller.

2. Avoid extreme temperatures

Prolonged high temperatures above 45℃ accelerate degradation and possible thermal expansion, while cold temperatures below 0℃ (zero) reduce performance and charge rates. Battery systems should be protected from temperature extremes, and charging should be carefully regulated if operated outside the recommended temperature range. While cold temperatures can damage the battery if it is (force) charged too quickly. Prolonged high temperatures above 45℃ will cause accelerated degradation, no matter the charge or discharge rate.

3. Fully charge the battery regularly

LFP batteries should be fully charged roughly every week to top balance the cells and ensure all battery modules are at a similar SOC. Fully charging the battery also ensures that the SOC calculation is correctly calibrated. However, if the battery is not used regularly, such as in an off-grid vacation home, the battery should not be held at 100% SOC for a prolonged period of time. In this instance, battery SOC should be reduced to 50% to 60% for LFP batteries.

4. Manage charge rates

Charging too quickly adds internal stress and heats the cells, increasing degradation. Generally, the BMS will manage the charge rates to avoid these issues, but the controller should also be configured correctly so as not to overcharge the battery. Ensure the battery charge rate settings match ACES specifications (maximum C rate). To reduce thermal stress, LFP batteries should be charged at a rate of 0.5C or below. In basic terms, this means it should take approximately two hours to charge a low battery. For example, this AL48V195HFPS battery should be charged at a maximum rate of 5kW for 2 hours.

## 5. Technical support

When the battery seems to be faulty first check protection condition CODE on APP and check the monitoring values.

**Following situations can apply:**

| Fault description | Possible cause | Solution |
|---|---|---|
| 0V output voltage on poles | Internal fuse and BMS defect | Repair by ACES service center |
| Too low voltage on poles 1 | BMS in protection UVP | Charge the battery |
| Too low voltage on poles 2 | BMS in protection OTP | Wait until battery cools down |
| Too low voltage on poles 3 | BMS in protection UTP | Use battery above -10 ˚C |
| Too low voltage on poles 4 | BMS in protection OCD | Will recover within 1 minute after load disconnect |
| Too low voltage on poles 5 | BMS in protection SCP | Will recover within 1 minute after remove short circuit |
| Battery does not charge 1 | BMS in protection UTC * | Use battery above zero ˚C* |
| Battery does not charge 2 | BMS in protection OTC | Wait until battery cools down |
| Battery has too low AH 1 | Cells unbalanced | Keep charger connected for longer time until cells balanced |
| Battery has too low AH 2 | Defect in BMS or cells | Repair by ACES service center |

*Not for batteries with built-in heater, these can be charged below zero.

If the suggested solution doesn't help it is recommended to send the battery to ACES service Center.

**Contact details ACES service Center:**

**ACES Energy**
Ambachtstraat 36
7622AP Borne
The Netherlands
Email: service@aces-energy.nl
Tel: +31 (0) 74-7857701

# 6. Warranty and liability

ACES ENERGY GENERAL TERMS AND CONDITIONS OF WARRANTY ON PRODUCTS

## 6.1 Scope

ACES Energy BV or ACES Energy SP BV, hereafter stated as ACES, offers manufacturer's guarantee as described in this document.
The prerequisite for a warranty claim is a defect or a malfunction that affects the intended use of the battery is no longer possible or is disproportionately restricted.
The guarantee period is not extended due to the granting of Services under this guarantee, in particular not for replacement or repair. In this case, the guarantee period does not start again.
This warranty does not limit legal provisions of the customer and are valid for all ACES lithium batteries with a purchase date from 01/01/2018. Accessories, consumables and other accessories are excluded.
The geographical scope of guarantee protection is Europe-wide and place of jurisdiction is the Netherlands.

## 6.2 Identification

All batteries and chargers delivered are uniquely identified with a serial number printed on a label attached to the product.
If the label is not clearly readable or removed it causes loss of warranty on the product.

## 6.3 Period of warranty for ACES products

- The period of warranty for HP and HFA Series is 60 months starting from the moment it is invoiced.
- The period of warranty for HFP Series is 60 months starting from the moment it is invoiced.
- All other ACES products have 24 months of warranty starting from the moment it is invoiced.
- At the end of the above mentioned period, the warranty will automatically expire without any notice
- The eventual repair or substitution does not extend the period of warranty.
- For distributors and OEM customers the warranty is extended for 3 months from the date of the invoice.

## 6.4 Warranty

Only manufacturing faults are covered by the warranty.
The warranty is limited to the original paid purchase price.
ACES liability under this guarantee is limited to the exchange, repair, reimbursement of the product.
The guarantor is solely responsible for the choice of an exchange, repair or reimbursement of costs.
Is this defective product no longer in the delivery program, so the guarantor reserves the right to replace it with a technically equivalent one from the current range.
Not covered by the warranty are listed below:
Damages, defects or malfunctions caused by force majeure, like lightning, overvoltage, severe weather, flood, fire.
Procedures described in the installation manual are not followed.
- Using the batteries or products outside the specifications and safety precautions as stated in the manual.
- Incorrect installation or commissioning, malfunction of other devices
- Failures caused by HW or SW design of parts that are designed not under responsibility of ACES
- Changes to and/or dismantling of the battery or product

## 6.5 Warranty management and return conditions

- As soon as a problem is noticed, ACES ENERGY must be informed within 7 days.
  Provide information about the exact model of the product, the quantity, the serial number, the supplier, the date of purchase and a copy of the original invoice.
- The warranty may be not applicable if it is not possible to define the condition of usage of the battery.
- Customers shall arrange the return of the products at their own expenses.

- Batteries will be checked in less than 10 labor days from their arrival at ACES.
- After analysis, repair or replacement they will be shipped back to the customer.
- Defective batteries or products arriving within the warranty period and excepted for warranty, will be repaired or replaced, and shipped back to the client under warranty.

### 6.6 No warranty charges

In case of batteries or products returned are not defective or out of warranty, investigation and repair cost will be offered to the customer before repair.
If products have damage, are modified or opened by non-qualified persons no warranty can be granted.
The Analysis cost of 100 Euros is always invoiced to the customer.
If repair is not possible the total cost is limited to the analysis cost.

### 6.7 Transport

The sender will be liable for the quality of the packaging.
ACES, will not be liable for damages on products during the shipping, following the shipment conditions at the expenses of the sender.
Transport damages at receival at ACES of returned products will be reported by ACES to the sender within 24 hours.
The carriage of lithium batteries is subject to special restrictions. For defective batteries special rules apply.
At delivery of the returned product by ACES , the customer shall immediately check on damages and make sure to make a written note to the transporter in case of damages.
All damages at delivery must be reported to ACES ENERGY within 24 hours after delivery.
ACES ENERGY is not liable for eventual direct or indirect damages to people or things by the damage of the product or caused by the improper use or transport of the product itself.

### 6.8 Return address

**ACES ENERGY B.V.**
Ambachtstraat 36
7622 AP Borne
The Netherlands
Tel. +31 (0) 74-7857701

## 7. Glossary of Abbreviations

| Abbreviation | Explanation |
|---|---|
| BMS | Battery Management System for battery protection and monitoring |
| CC/CV | Constant Current / Constant Voltage charge |
| Cycle | 1 Cycle is use of the battery after discharge and charge |
| EOL | End Of Life |
| LiFePo4 | Lithium Iron Phosphate chemistry; in short LFP |
| NMC | Nickel Manganese Cobalt chemistry |
| LCO | Lithium Cobalt Oxide chemistry |
| LMO | Lithium Manganese Oxide chemistry |
| SOC | State Of Charge, means AH-used/AH-rated |
| OVP | Over Voltage protection |
| UVP | Under Voltage protection |

## 8. CE declaration

# DECLARATION OF CONFORMITY

**COMPANY** : ACES Energy Special products B.V.

**ADRESS** : Ambachtstraat 36
7622 AP Borne
The Netherlands

Declares that the following products:

**PRODUCT** : Lithium Ion LiFePO4 Battery – ABS Casing

**BRAND** **:** Brand name ACES Li POWER

**MODEL NAME:**

- AL12V24HFA / AL12V45HFA-BT / AL12V60HFA-BT / AL12V80HFA-BT / AL12V100HFA-BT / AL12V100HFAS-BT / AL12V120HFA-BT / AL12V150HFA-BT/AL12V150HFAS-BT / AL12V150HFAS-BTH / AL12V200HFA-BT / AL12V200HFA-BTH / AL12V280HFA-BT / AL12V280HFA-BTH / AL12V340HFA-BCH / AL12V460HFA-BCH
- AL24V12HFA / AL24V30HFA-BT / AL24V50HFA-BT / AL24V50HFA-BTH / AL24V60HFA-BT / AL24V75HFA-BT / AL24V75HFA-BTH / AL24V84HFA-BT / AL24V100HFA-BT / AL24V100HFA-BTH / AL24V160HFA-BT/AL24V200HFA-BT/AL24V200HFA-BTC/AL24V230HFA-BCH/AL24V300HFA-BTC
- AL36V100HFA-BT
- AL48V12HFA-BT / AL48V18HFA-BT / AL48V30HFA-BT / AL48V30HFA-BTH / AL48V60HFA-BT / AL48V80HFA-BT /AL48V100HFA-BT /AL48V100HFA-BTC /AL48V100HFA-HTR / AL48V100HFA-BCH AL48V150HFA-BTC
- AL60V75HFA-BT / AL72V30HFA-BT / AL72V60HFA-BT

Are in conformity with the requirements of the following Directives of the European Union:
**Directive 2014/30/EU with the following harmonized standards:**

EN 61000-6-3:2007/A1:2011/AC:2012
EN 61000-6-2:2005/AC:2005

**Directive (RED) 2014/53/EU with the following harmonized standards:**
EN 300 328 V2.2.2

CE MARK DATE : 11-07-2024

Signed : W. Buikema



Authority : Director