

Lithium-ion batteries for ROTAX® Aircraft Engines

ATA System: 24-00-00 Electrical Power

1) Planning information

“PAC” Service Instruction Documents provide detailed information on non-certified ROTAX® Aircraft Engine Parts and Accessories. Referenced parts and accessories are provided without EASA certification or ASTM compliance. Certification / Compliance of referenced Parts and Accessories must be completed by the aircraft OEM.

To obtain satisfactory results, procedures specified in this publication must be accomplished with accepted methods in accordance with prevailing legal regulations.

BRP-Rotax GmbH & Co KG cannot accept any responsibility for the quality of work performed in accomplishing the requirements of this publication.

1.1) Applicability

All ROTAX® 4-stroke aircraft engines which are equipped with 12 V starter and fuse-box.

NOTICE

The battery is not a part of the Engine Type Design. Lithium-ion batteries part no. 966260 and 966265 have been tested and released by BRP-Rotax, but are not certified. The correct function in conjunction with the entire electrical system is the responsibility of the aircraft manufacturer. The certification of the battery is the responsibility of the aircraft manufacturer and must be carried out jointly with the aircraft.

1.2) Concurrent ASB/SB/SI and SL

In addition to this Service Instruction - PAC the following Service documents must be observed and complied with:

In general - all relevant Alert Service Bulletins (ASB), Service Bulletins (SB), Service Instructions (SI), Service Letters (SL), Service Instruction - Parts and Accessories (SI-PAC).

1.3) Reason

A battery is not included in the scope of delivery for ROTAX® aircraft engines. However, ROTAX® Lithium batteries with part no. 966260 and 966265 are available.

1.4) Subject

Installation and maintenance information for Genuine ROTAX® Lithium-ion batteries part no. 966260 and 966265 for ROTAX® 4-stroke Aircraft Engines.

1.5) Compliance

None - For Information Only.

1.6) Approval

None.

1.7) Labor time

Estimated labor hours - - - Labor time will depend on installation and therefore no estimate is available from the engine manufacturer.

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1.8) Mass data

966260 - ETX900 (16 Ah):

- Weight: 2.2 kg (4.9 lb)
- Dimensions: See Fig. 9.

966265 - ETX680C (12 Ah):

- Weight: 1.8 kg (3.9 lb)
- Dimensions: See Fig. 10.

1.9) Electrical load data

No change.

1.10) Software modifications

No change.

1.11) References

In addition to this technical information refer to current issue of

- in general Installation Manual (IM) and in particular:
Chapter 73-00-00 and Chapter 24-00-00
- In general, Illustrated Parts Catalog (IPC)
- In general, Maintenance Manual Line (MML) and in particular:
Chapter 05-20-00 and Chapter 12-20-00
- In general Maintenance Manual Heavy (MMH)
- Aircraft's Pilot Operating Handbook (POH)

NOTE: The status of the Manuals can be determined by checking the table of amendments. The 1st column of this table shows the revision status. Compare this number to the one listed on the ROTAX® website: www.flyrotax.com. Updates and current revisions can be downloaded for free.

1.12) Other Publications affected

None.

1.13) Interchangeability of parts

All parts are interchangeable.

2) Material Information

2.1) Material

Price and availability will be provided on request by ROTAX® Authorized Distributors or their independent Service Centers.

2.2) Company support information

Any possible support by BRP-Rotax will be provided on request by ROTAX® Authorized Distributors or their independent Service Centers.

2.3) Material requirement per engine

Parts requirement:

Fig. no.	Part no.	Qty/ engine	Description	Application
1-1	966260	1	Lithium-ion Battery ETX900 (16 Ah)	Electrical power
1-2	966265	1	Lithium-ion Battery ETX680C (12 Ah)	Electrical power



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Fig. 1

1. 966260 (16 Ah) 2. 966265 (12 Ah)

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2.4) Material requirement per spare part

None.

2.5) Rework of parts

None.

2.6) Special tooling/lubricants- /adhesives- /sealing compounds

None.

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3) Accomplishment/Instructions

ROTAX® reserves the right to make any amendments to existing documents, which might become necessary due to this standardization, at the time of next revision or issue.

NOTE: Before maintenance, review the entire documentation to make sure you have a complete understanding of the procedure and requirements.
All measures must be implemented and confirmed by at least one of the following persons or organizations:

- ROTAX® - Airworthiness representatives
- ROTAX® - Authorized Distributors or their independent Service Centers
- Persons approved by the respective Aviation Authorities
- Persons with approved qualifications for the corresponding engine types. Only authorized persons (iRMT, Level Heavy Maintenance) are entitled to carry out this work
- Persons with type-specific training

NOTE: All work has to be performed in accordance with the relevant Maintenance Manual.

WARNING

Failure to follow all application use, installation, charging, and storage instructions may result in battery damage and or fire!



All work must be performed in accordance with the relevant ROTAX® Instructions for Continued Airworthiness (ICA) of the respective engine type.

General

Further material on general inspection, maintenance and repair can also be found in relevant user's manual from the manufacturer.

Advisory Circular

The Advisory Circular (AC) contains maintenance methods, techniques and practices.

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3.1) Technical data

ROTAX® Lithium-ion Battery 966260 (ETX900)		
Voltage:	13.2 V	
Operating Temperature:	- 30 °C to + 60 °C (- 22 °F to 140 °F)	
Storage Temperature:	- 40 °C to + 70 °C (- 40 °F to 158 °F)	
Maximum Altitude:	50000 Ft	
Pulse Crank Amps:	840 A (3 sec @ 20 °C/68 °F, voltage >9 V)	
Cold Crank Amps:	400 A (modified SAE test, 3 sec@ - 17.8 °C/0 °F, voltage >7.2 V)	
Ah (1 hr discharge rate):	15.6 Ah (1C rate)	
Standard charge Voltage:	13.9 - 14.6 V	
Charge Amps:	Recommended	Maximum
	5-20 A	80 A

ROTAX® Lithium-ion Battery 966265 (ETX680C)		
Voltage:	13.2 V	
Operating Temperature:	- 30 °C to + 60 °C (- 22 °F to 140 °F)	
Storage Temperature:	- 40 °C to + 70 °C (- 40 °F to 158 °F)	
Maximum Altitude:	50000 Ft	
Pulse Crank Amps:	680 A (3 sec @ 20 °C/68 °F, voltage >9 V)	
Cold Crank Amps:	320 A (modified SAE test, 3 sec@ - 17.8 °C/0 °F, voltage >7.2 V)	
Ah (1 hr discharge rate):	12.4 Ah (1C rate)	
Standard charge Voltage:	13.9 - 14.6 V	
Charge Amps:	Recommended	Maximum
	5-15 A	60 A

NOTICE

ROTAX® Lithium-ion batteries use cells made of Lithium Iron Phosphate (LiFePO₄). This chemistry is one of the safest on the market today.

NOTICE

Lithium batteries have special requirements for shipping and must be declared as dangerous goods.

WARNING

Failure to follow all application use, installation, charging, and storage instructions may result in battery damage and or fire!

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3.2) Installation – related information



See current Installation Manual (IM) for the respective engine type.
Chapter 24-20-00

- Mount only upright or sideways
- Installation of the battery in the cockpit is not recommended unless the battery box is sealed and properly vented over-board.
- Be careful that the positive battery terminal does not or will not touch any metal parts of the aircraft.

1. Battery fault indicator LED
2. Battery fault monitoring wire

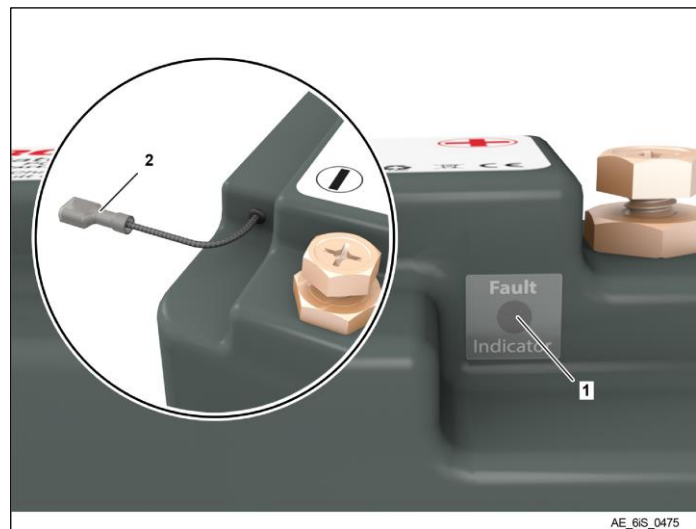


Fig. 2
Battery Fault Indication

3.2.1) Cockpit fault monitoring installation – LED

Step	Procedure
1	<p>The positive wire of the LED (anode, typically the red wire) should be connected to an electrical bus fuse / breaker downstream of the master switch.</p> <p>NOTE: It is recommended to use 20 - 22 AWG (0.33 - 0.52 mm²) wire and a fuse / breaker between 0.25 A to 3 A.</p> <p>NOTE: LED must have a built in 12 V current limiting resistor, or an appropriate resistor must be installed in series (see LED manufacturer's instructions).</p>
2	<p>The negative wire of the LED (cathode, typically the black wire) should be connected to the fault monitoring wire (2) of the battery.</p>

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NOTICE

An incandescent bulb can NOT be used.

1. Battery fault monitoring wire
2. LED
3. Fuse / breaker
4. Aircraft bus
5. Master switch

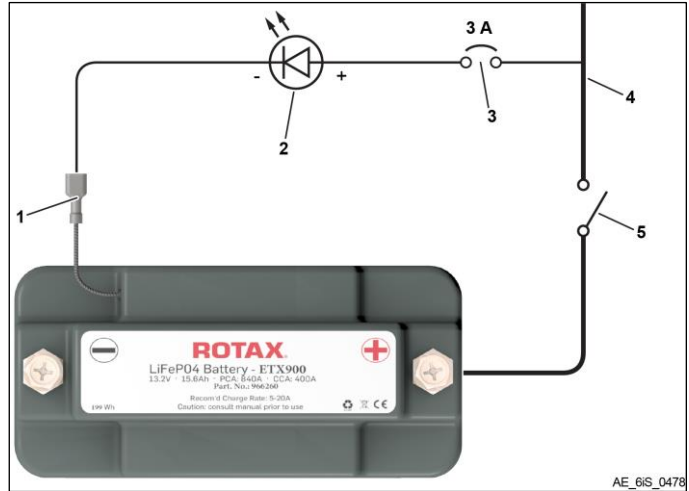


Fig. 3
Cockpit fault monitoring LED

3.2.2) Cockpit fault monitoring installation – Dynon Avionics EMS-D10, EMS-D120, Flight DEK-D180

Step	Procedure
1	Connect the fault monitoring wire (1) to EFIS contact input Pin 9 or Pin 10. NOTE: Ground (common) of EFIS must be referenced to battery negative.

1. Battery fault monitoring wire
2. EFIS connector

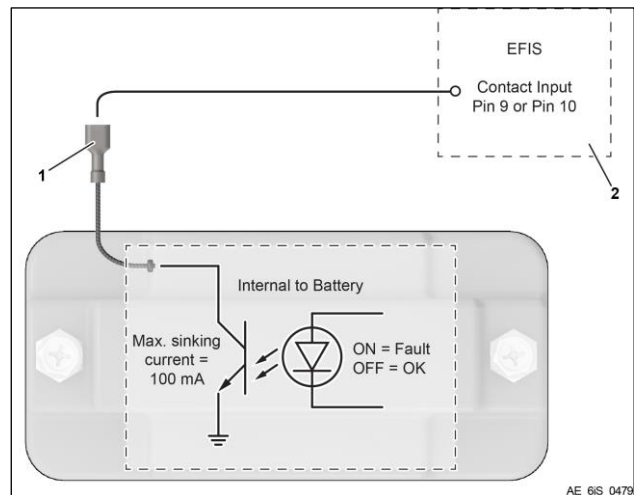


Fig. 4
Dynon Avionics EMS-D10, EMS-D120, Flight DEK-D180

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3.2.3) Cockpit fault monitoring installation – Dynon Avionics SkyView SV-EMS-220 / 221

Step	Procedure
1	<p>Connect the fault monitoring wire to a general-purpose input. (Any of Pins 4, 6, 7, 8, 9, 10, 11, 12, 20, 21, 22, 23, or 31)</p> <p>NOTE: Ground (common) of EFIS must be referenced to battery negative. See Dynon manual to configure a general-purpose input as a contact.</p> <p>NOTE: Configure the input as “active low”, “alarm” type. When Dynon power is off the LED inside battery may be dimly lit (less than 120 mA, too small to drain the battery).</p>

1. Battery fault monitoring wire
2. EFIS connector

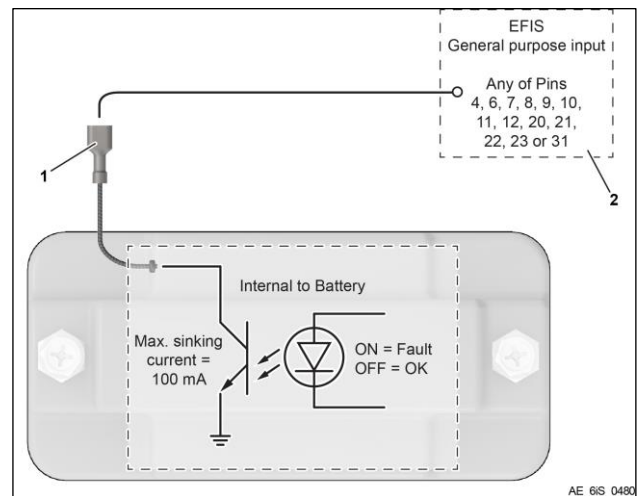


Fig. 5
Dynon Avionics SkyView SV-EMS-220 / 221

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3.2.4) Cockpit fault monitoring installation – Garmin EFIS (G3X)

Step	Procedure
1	<p>Connect the fault monitoring wire to a contact input.</p> <p>NOTE: Ground (common) of EFIS must be referenced to battery negative.</p> <p>NOTE: Configure the digital input 1-4 (pin 40-43) as “active low”, “user defined alert” type. See Garmin manual to configure contact input pin.</p>

1. Battery fault monitoring wire
2. EFIS connector

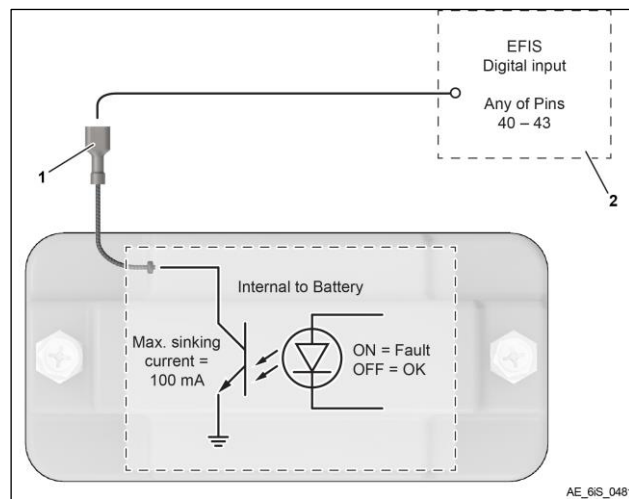


Fig. 6
Garmin EFIS (G3X)

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3.2.5) Cockpit fault monitoring installation – Grand Rapids Technologies EFIS

Step	Procedure
1	Connect directly to an analog input. NOTE: See Garmin manual for configuration instructions. Configure the input as "aux. voltage" with details found in the following table.

Grand Rapids Technologies EFIS - Analog 1	
Function:	Aux. (EIS compatible)
Internal pull-up:	On
Scale factor:	25
Offset:	0
Sensing:	Forward
Integer / Decimal:	Decimal
Aux. function:	Aux
Aux. name:	EXT flt

1. Battery fault monitoring wire
2. EFIS connector

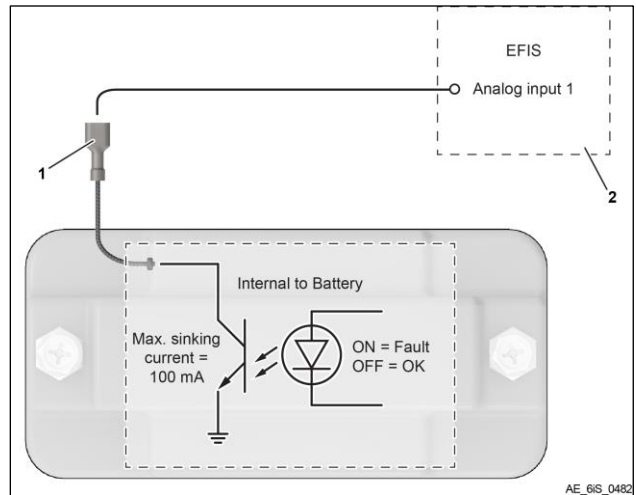


Fig. 7
Grand Rapids Technologies EFIS

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3.2.6) Voltage monitoring - recommended

The low charge level is very different from a lead acid battery, for a lithium battery is completely drained at approximately 11.5 V, and the normal resting voltage is 13.3 V. The table below shows the recommended user alerts based on voltages when in flight.

NOTE: This table pertains to existing voltage level warning equipment and is NOT associated with the Fault monitoring LED.

Voltage	User Alert
>15 V	High voltage warning
<13.5 V	Alternator off-line alert
<12.6 V	Low charge level warning

NOTE: Rotax does not supply a voltage monitoring system.

3.2.7) Charging

ROTAX® Lithium-ion batteries are shipped fully charged, it is recommended you check the voltage first, if it is above 13.3 V continue to install the battery according to the aircraft manufacturers manual and start the aircraft

ROTAX® Lithium-ion batteries are compatible with most "modern" lead-acid battery chargers or LiFePO4 battery chargers. This means a charger that automatically turns off when the battery is fully charged, a charger with a micro-processor, or a charger with multiple mode charging. The "full charge" voltage for the ETX Lithium battery is 13.3 V or higher. Some lead-acid battery trickle chargers maintenance mode voltage can be below 13.3 V, which is too low for a lithium battery.

Never use the de-sulfate setting on your charger. Be sure the charger's output voltage level does not exceed 15 V. If the charger does not display the voltage reading, then use a voltmeter to check the voltage while charging.

3.2.8) Storage



See current Operators Manual (OM) for the respective engine type, Section 8.1.

If the aircraft is to be put in storage for an extended period of time, disconnect the battery cable to eliminate drain from the aircraft's electrical system. A fully charged Lithium-ion battery can be put in storage for over a year without charging.

Battery can be stored at temperatures between – 40 °C to + 70 °C (- 40 °F to 158 °F). Lithium-ion batteries have no liquid inside and will not freeze.

3.3) Operation – related information



See current Operators Manual (OM) for the respective engine type, Section 3.4.

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NOTICE

For maximum battery and engine starting system life, do not crank an engine for more than 10 seconds within any 1-minute period.

ROTAX® Lithium-ion batteries incorporate an internal Battery Management System (BMS) which contains redundant circuits for over-charge, over-discharge, excessive cranking and short-circuit protection. If the BMS disconnects due to excessive cranking protection or short circuit protection, the BMS will automatically reconnect after a cooldown period (typically 1-3 minutes).

The battery's microcontroller monitors all failure modes, and reports failures with a built-in LED indicator. The table below shows the most common fault conditions and possible causes.

Indicator LED	Voltage	Possible cause	Recommended action
Slow Flashing (5 sec. on / 5 sec. off)	Less than 12.8 V	Battery over-discharged (due to faulty charging system)	Charge battery. Once charged, the light will stop flashing.
Slow Flashing (5 sec. on / 5 sec. off) (> 1 hour time period)	13.2 V - 14.6 V	Weak or failing cell	Discontinue use. If in flight, this is not an immediate issue unless it is in conjunction with a charging system failure.
Slow Flashing (5 sec. on / 5 sec. off)	Greater than 15.2 V	Over-charging (due to faulty charging system)	If in flight, shutoff charging system immediately. Aircraft over-voltage protection is strongly recommended (i.e., over voltage crowbar circuit)
Slow Flashing (5 sec. on / 5 sec. off) (< 30 min. time period)	13.2 V – 14.6 V	Cell to cell charge levels are not balanced	May come on briefly during periods of high current charging until the cells are automatically balanced. Try charging with a plugin charger, like an Optimate Lithium charger.
Solid Light	Any voltage	BMS electronic issue	Discontinue use. If in flight, this is not an immediate issue unless it is in conjunction with a charging system failure.
Solid Light that turns off after 3 min.	Any voltage	Short Circuit protection was activated	Nothing needs to be done.
Short flashing (2 sec. on / 2 sec. off)	Any voltage	High battery temperature (> 75 °C / 167 °F)	Let battery cool down prior to cranking or charging. If in flight, this is not an immediate issue, but if it continues subsequent flights, investigate and mitigate high temperature at battery location.

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NOTICE

A sustained fault can indicate a serious issue with the battery or aircraft charging system that requires immediate attention. Discontinue use until the issue is resolved and the battery no longer indicates a fault.

WARNING

Continued use of a faulty battery can result in a cell rupture, the release of flammable vapors, smoke and or a fire.

3.4) Maintenance (Line) – related information



See current Maintenance Manual Line (MML) for the respective engine type, Chapters 05-20-00 and 12-20-00.

3.4.1) Inspection

Points of inspection	Interval operating hrs.		Instructions
	25*	100	
* no periodic maintenance (requirement after the first 25 hours of operation) **no periodic maintenance for the first 24 months (thereafter every 100 hours)	25*	100	
Inspect the battery and its mounting for damage, wear and security of attachment.	X	X	See Maintenance Manual Line (MML) Chapter 12-20-00
Inspect battery terminal connections for secure attachment and corrosion.	X	X	Tightening torque 4 Nm (35 in-lbs)
**Test the fault indicator.		X	To test, touch the fault monitoring wire output of the battery to ground – the internal battery LED should come on as well as the cockpit indicator.
Capacity check.		X	Test that the battery is capable of supporting the aircraft's emergency load for the required time specified by the aircraft manufacturer.

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3.5) Maintenance (Heavy) – related information



See current Maintenance Manual Heavy (MMH) for the respective engine type.

3.6) Test run



Conduct test run. See current Maintenance Manual Line (MML) for the respective engine type chapter 12-20-00.

3.7) Summary

NOTE: Work on EASA certified parts might affect the EASA Form 1 and does require appropriate documentation by authorized persons. Repairs must be entered into the engine logbook and also do apply for the EASA Form 1.

A revision bar outside of the page margin indicates a change to text or graphic.

Translation into other languages might be performed in the course of language localization but does not lie within ROTAX® scope of responsibility.

3.8) Inquiries

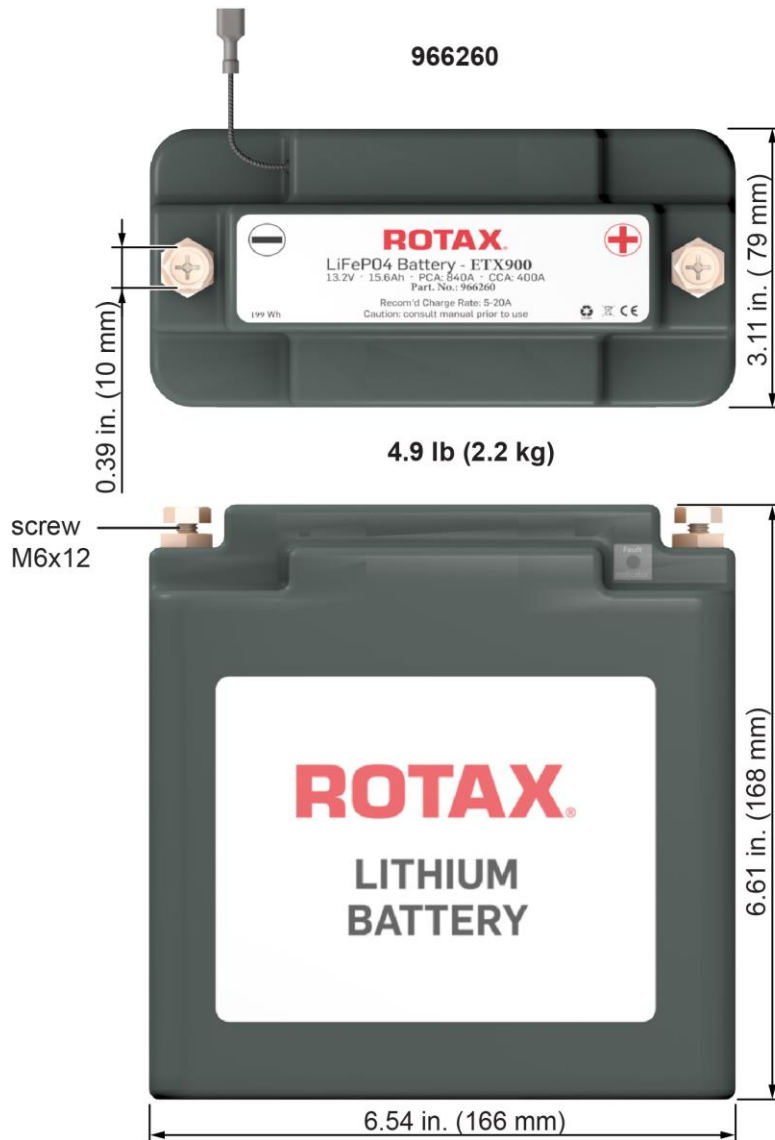
Inquiries regarding this Service Instruction - PAC should be sent to the ROTAX® authorized distributor of your area.

A list of all ROTAX® Authorized Distributors and their independent Service Centers is provided on www.flyrotax.com.

SERVICE INSTRUCTION - PAC

4) Appendix

The following drawings should convey additional information:



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Fig. 9

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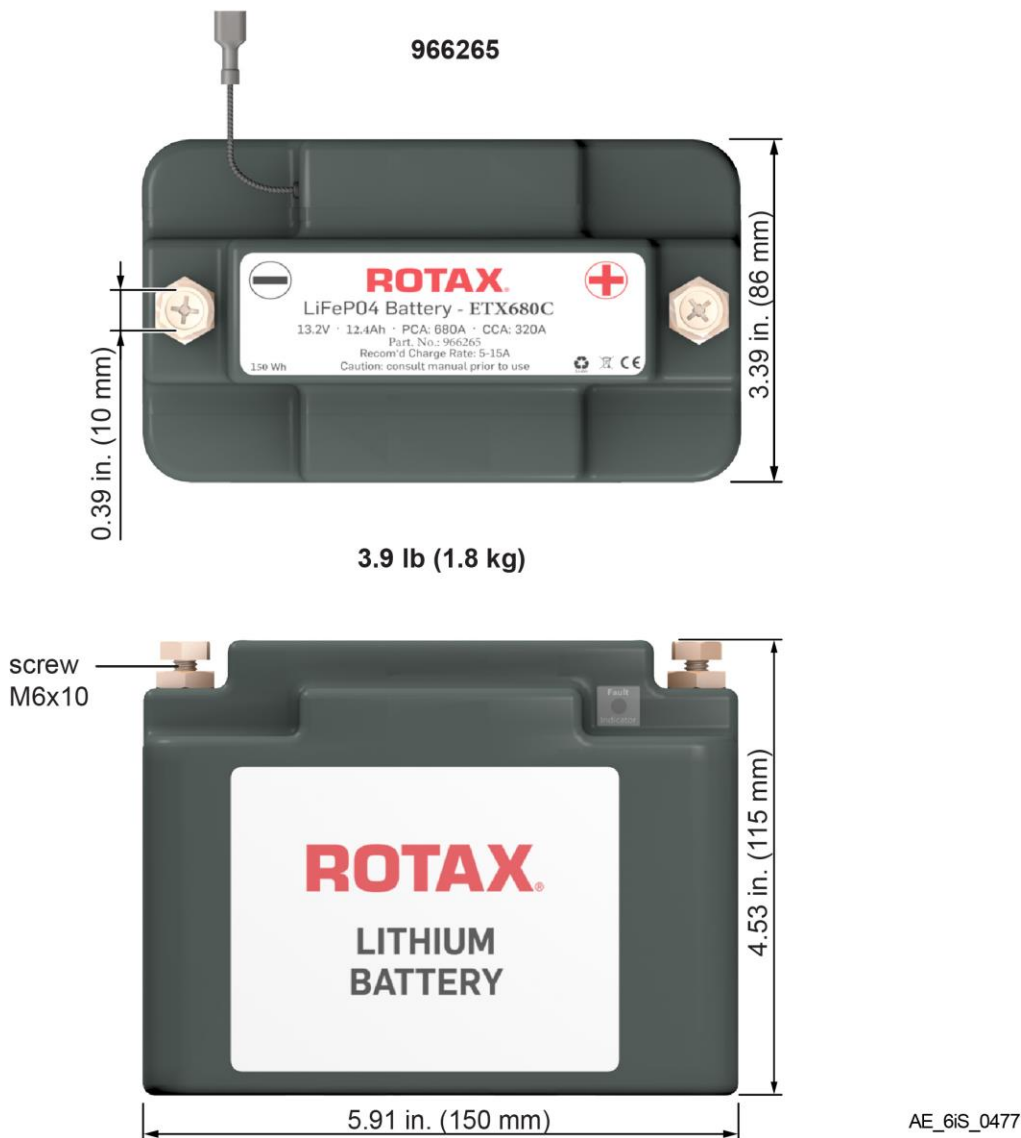


Fig.10

NOTE: The illustrations in this document show the typical construction. They may not represent full detail or the exact shape of the parts which have the same or similar function.

Exploded views are not technical drawings and are for reference only. For specific detail, refer to the current documents of the respective engine type.