Flex'ion®

Transportation, Storage, Installation and Operation Instructions

1. Introduction

Flex'ion® is a family of Li-ion battery systems that includes large format Li-ion cells and the necessary electronics for providing power backup for mission critical applications.

This quick start guide describes how to transport, store, install and operate the battery system. Within this document, the necessary tasks are noted with *Fx#* and they are arranged in the order that they should be executed.

Please consult the Flex'ion Installation & Commissioning and Operation & Maintenance Manuals for full instructions.

2. Safety

A battery system is an active electrical device that contains a specific quantity of energy. The Safety Rules below must be complied with to ensure correct handling and operation.

- Saft products are designed with safety considerations; however, batteries can be dangerous if used incorrectly.
- Failing to comply with the Safety Rules described below may cause the battery system to fail and may cause serious injury.
- Improper operation of the product may cause a cell to overheat or vent.

Safety Rules:

- Read these instructions fully before installing and operating the battery system.
- Batteries MUST be installed in a restricted access area only. Only authorized personnel Trained and Certified according to the local rules (for example per NFPA 70E in U.S.) to handle High Voltage Hazard should be allowed to enter the restricted area and work on the system.
- Batteries must be installed in a location that can be easily ventilated in case of misuse, such as described below.
- Never short-circuit the battery terminals.
- Do not reverse the polarity.
- Do not overcharge or over-discharge the battery.
- Adhere to factory voltage range specification given in this document.
- Do not open the battery module.
- Do not disassemble the unit.
- Do not use the battery without its electronic management system.
- Do not subject to excessive mechanical stress.
- Do not expose the unit to water or condensation.
- Install the batteries in an area compatible with pollution level 2 according to EN 60664-1 (typical of office or laboratory environments).
- Do not place the batteries on or near fires or other high-temperature locations (> 70°C). Doing so may cause the batteries to overheat or vent. Using the batteries in this manner may also result in the loss of performance and reduce product life expectancy.
- Immediately disconnect the batteries if, during operation, they emit an unusual smell, feel hot, change shape, or appear abnormal in any other way. Contact Saft immediately if any of these problems are observed.
- Connect to power systems/rectifiers with maximum rated output of Vmax only (refer to Table 1).
- Refer to the Battery Information Sheet (BIS) for emergency response procedures and personal protective equipment in case of an abnormal event.
- If smoke is emitted from the system, stay clear of the smoke and evacuate the area immediately.
- For normal handling and operation according to this installation and operation document, personal protective equipment (PPE) is required.

3. Tools

The necessary installation tools are described in Table 2. These tools are not provided with the battery system.

4. Receiving, Unpacking and Inspection

Flex'ion components are packaged in accordance with UN3480 Class 9A.

Fx1	Check that all items are received against the packing list.	Table 3

If items were not received or if anything was damaged, do not install the component. Please contact your local Saft representative.

Fx2	Study Flex'ion® features	Figure 3,4,5

The Flex'ion® battery system comprises one or more STRINGs (depending on the configuration), managed by a single Master Battery Management Module (MBMM, refer to Figure 3). One STRING comprises:

- Electrical cabinet
- Battery Management Module (BMM)
- A minimum of three battery modules connected in series (depending on the configuration)
- An Intelli-Connect™ module with MBMM + PLC device
- Communications and power cables
- Documentation set

Fx3	Check the condition before and during storage and prior to installation.	Table 4

Always keep the Flex'ion components together in their original packaging.

5. Storage

Store the battery system components in their original packaging under these conditions to optimize product lifetime:

- Recommended range +20°C (68°F) to +40°C (104°F)
- No direct sunlight, rain or flooding (IP20).
- ≤ 95% relative humidity (RH) maximum. (non-condensing).
- The BMM circuit breaker set to "OFF" position (open circuit).
- Modules are shipped at these SOC:
  1. Road and sea freight: 50% SOC
  2. Air freight: 30% SOC
- Due to self-discharge, the battery modules must be recharged as follows:
  1. Road and sea freight shipment – not later than 250 days from dispatch day from Saft
  2. Air freight shipment – not later than 130 days from dispatch day from Saft (second recharge must follow not later than 250 days under condition that the previous recharge was to 50% SOC)
- Saft recommends recharging to 50% SOC.
- For individual module charging, please contact Saft.
- The aforementioned durations are valid when maximum storage temperature is 25°C (ideal storage temperature 10°C).

Fx4	After 6 months, check the SOC once per month in storage.	Figure 6

NOTE:

Acceptable storage temperature range is from -20°C to +50°C (-4°F to 122°F). Depending on this range, a refreshing charge may be required more frequently.

6. Transportation and packing

Flex'ion systems are transported disassembled. The cabinet, BMM and battery modules have their own packaging for transportation.

The Li-ion battery modules are shipped from Saft in packaging compliant with UN Requirements for the Transport of Dangerous Goods (UN 3480) and applicable regulations such as IATA (Air), IMDG Code (Maritime), ADR (Road in Europe) and any other local regulations required.

Figure 2: Package marked as damaged/ defective lithium-ion batteries

Figure 1: Packaging of (potentially) damaged or defective battery module

The battery module package must display a class 9A hazard label in addition to markings identifying the applicable proper shipping name (Lithium-ion batteries) and UN number (3480).

When packing, avoid any risk of short-circuits between the terminals.

Ensure all packaged components are protected from damage during transportation.

Transport and storage of defective batteries

If the Li-ion battery module is identified as being damaged or defective (has leaked, sustained physical or mechanical damage or is defective for a safety reason) it shall be packed in accordance with packing instructions P908 or LP904 of IMDG Code (Maritime) / ADR (Road in Europe) regulations as applicable. According to IATA (Air) regulations, the lithium batteries identified by the manufacturer as being defective for safety reasons, or that have been damaged, and have the potential of producing a dangerous evolution of heat, fire or short circuit are forbidden for air transportation (e.g. those being returned to the manufacturer for safety reasons).

Packaging used shall conform to the packing group II performance level.

- Each (potentially) damaged or defective battery module shall be individually packed in an inner packaging. The purpose of the inner packaging (e.g. plastic bag) is to collect any potentially released electrolyte.
- Each (potentially) damaged or defective battery module in the inner packaging must be put into an interlayer. The interlayer comprises a sufficient amount of absorbing, non-combustible and electrically non-conductive thermal insulation material (e.g. vermiculite in an aluminum bag) to absorb any possible leak from the inner packaging and to protect against dangerous evolution of heat.
- Each (potentially) damaged or defective battery module in the inner packaging and interlayer must be put into an outer packaging. The outer packaging (box, drum) protects against any further damage and/or dangerous condition during carriage. Appropriate measures shall be taken to minimize the effects of vibration and shock and prevent movement within the package. Cushioning material that is non-combustible and electrically non-conductive may also be used.

Packages must be additionally marked "DAMAGED/ DEFECTIVE LITHIUM-ION BATTERIES".

Saft must be contacted when safety is a concern or in case of any doubt, to determine how to proceed in such instances and the appropriate shipping method.

7. Installation

Before installing, double check the condition of each battery module.

Fx5	Size the correct number of battery modules to connect to the DC bus.	Figure 3,4,5

Before installing, ensure the right number of battery modules are connected in series to support the DC bus.

Fx6	Check for maximum of 2V difference between battery modules operating on the same DC bus.	Figure 7

If battery modules have more than 2.0Vdc difference, then recharging is necessary. Consult Saft for full instructions.

Fx7	Connect the battery modules.	Figure 7,8,9

Before system integration, verify that all the components inside the cabinet are correctly attached to the rack and connected with relevant tightening couples.

Full system installation and commissioning may only be performed by an engineer certified by Saft. This is required to activate the system warranty:

- Connect power cables between BMM and Intelli-Connect.
- The power connections of the BMM with the first and last battery modules of each string are performed though the HV terminals "VIN-BAT" and "VIN+BAT" located on the BMM front face (refer to Figure 6).
- The power connections of each battery string, once assembled, are performed through the HV terminals "VOUT-DC" and "VOUT+DC" located on the BMM front face (refer to Figure 6).
- Connect Low Voltage cable (installed in Cabinet) to BMM.
- Connect CAN bus cable between battery modules and BMM.
- If the battery system comprises multiple parallel strings, connect BMM #01 communication port to BMM#02, etc. (refer to Figure 6).
- Connect the MBMM signals to the customer's application (when requested).
- Connect the electrical power cables between battery modules, BMM and Intelli-Connect using insulated tools.
- Connect the battery string to the dc bus of the application. The power connections of each battery module are performed via the high voltage (HV) "+" and "- "terminals located on the front face. Personal protective equipment is required.

Fx8	Power ON	Figure 9

- Reclose/reengage the circuit breaker on each BMM.
- According to the configuration, press the push ON/START button on the front door of the master cabinet (refer to Table 4).

IMPORTANT:

Never leave the Flex'ion® ON when it is not in use. The internal electronics will self-discharge the cells to a low voltage alarm level which may render the module un-usable.

8. Operation/Maintenance

Flex'ion provides uninterrupted standby power anytime the AC power supply is OFF. Continue trouble-free operation by complying with these instructions.

Battery modules do not require regular maintenance. Periodically checking the complete Flex'ion system during other site routines is recommended (more details are available in the Operating & Maintenance manual).

- LED state (refer to Table 4).
- Clean any excessive dirt build-up using a nonmetallic brush or a dry or damp cloth.
- Do not use any cleaning solvents or soaps.
- Do not immerse, bathe or hose off the Flex'ion system.

Charge and discharge of the Li-ion battery must be monitored and managed with respect to parameters such as current, cell voltages and module temperatures. This management is performed by the battery module at the cell level and BMM at string level.

Table 1: Voltage range depending on the modules in series

Modules in series	46PFe, 46MFe				23MFe			
	Vmin	Vnom	Vmax	#	Vmin	Vnom	Vmax	#
5	175	231	266	V	88	116	133	V
6	210	277	319	V	105	139	160	V
7	245	323	372	V	123	162	186	V
8	280	370	426	V	140	185	213	V
9	315	416	479	V	158	208	239	V
10	350	462	532	V	175	231	266	V
11	385	508	585	V	193	254	293	V
12	420	554	638	V	210	277	319	V
13	455	601	692	V	228	300	346	V
14	490	647	745	V	245	323	372	V

Table 2: Tools needed

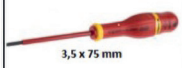
#	Tool		Use
A		Insulation tester and Multimeter	Voltage/resistance measurement
B		Torx 25	Removal cover
C		Torx 50, 40, 30	Power terminals, BMM, Intelli-Connect, Grounding screws
D		Wrench 8, 13, 19	Grounding point of BMM, Cabinet binding
E		Flat screwdriver	Communication cable BMM
F		Cross screwdriver	Cabinet binding
g		Hex key 5, 6	Cabinet binding
h			Personal safety equipment (gloves/shield/shoes/clothes)

Table 3: Battery string comprising 11 modules*

Item	Module	Description	Qty
A	EC	Electrical cabinet	1
B	BMM	Battery Management Abbreviation	1
C	##P/MFe	Battery modules	11
D	I-C	Intelli-Connect™ with Master BMM	1
E	CAB	Signal and power cables	1
F	DOC	Documentation set	1

* actual configuration is subject to design parameters

Table 4: LED push button operation

LED state		Description
	Steady	Nominal mode
	Fast blink	Charging
	Slow blink	Discharging
	Steady	Stand-by mode
		OFF

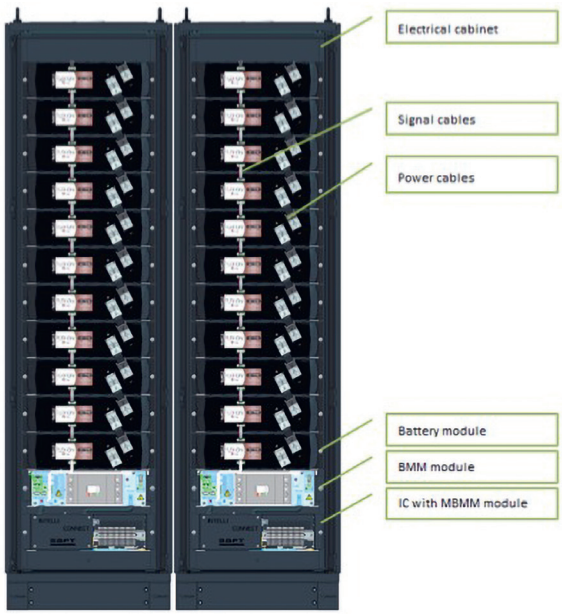


Figure 3: Configuration example of two cabinets in parallel, each comprising 11 modules in series to provide nominal 508 Vdc and 268 kW for 5 minutes.

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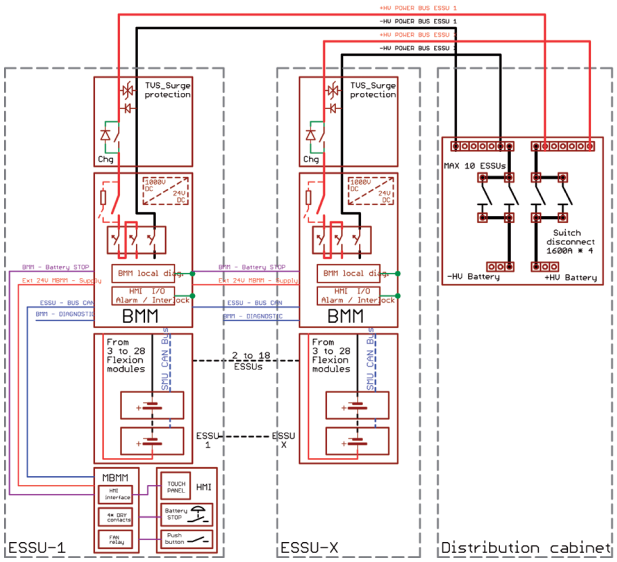

Figure 4: System overview of standard, 2-wire architecture of multi-string system

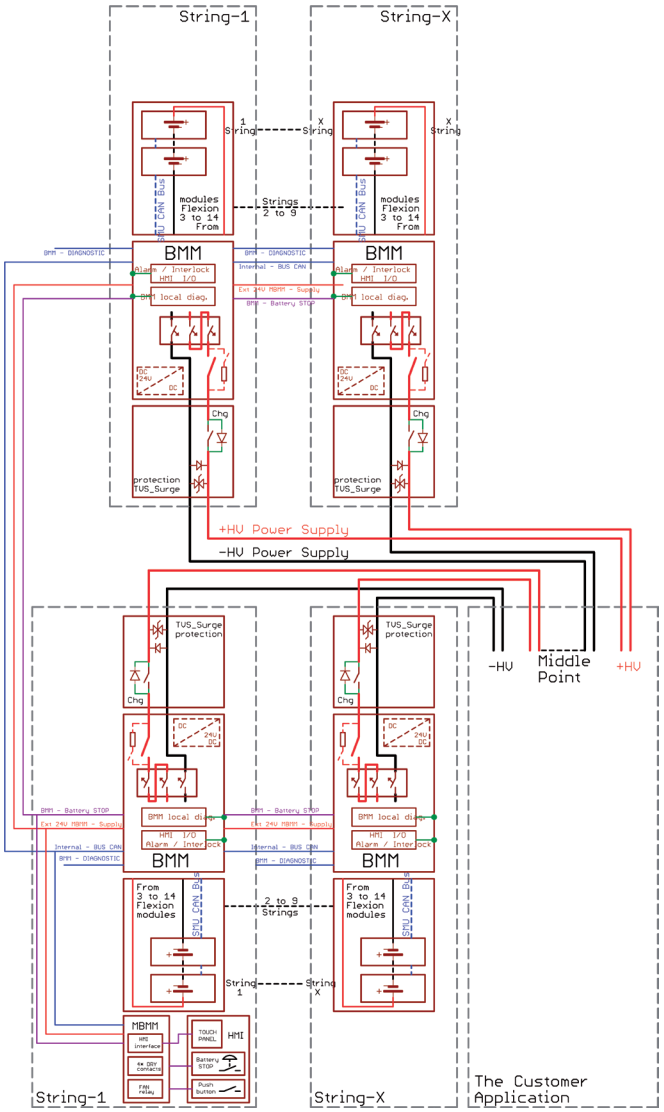

Figure 5: System overview of midpoint, 3-wire architecture of multi-string system

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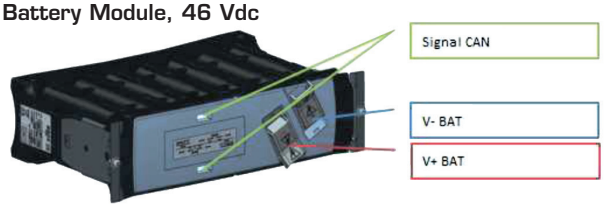
WARNING:

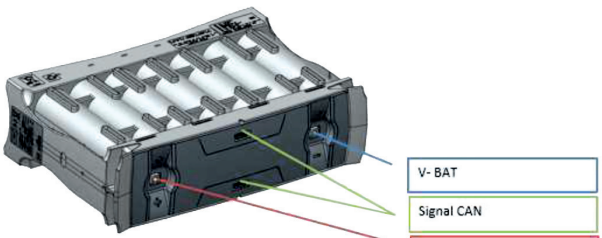
Always use insulated tools while working with Flex'ion® components and battery modules.

NOTE:

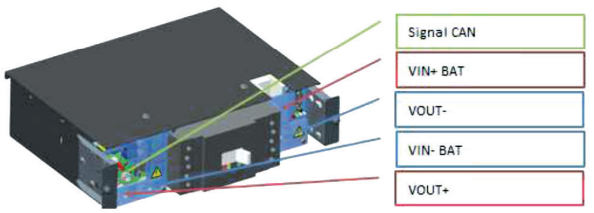
Always use personal safety equipment while working with Flex'ion® components and battery modules.

Battery Module, 46 Vdc

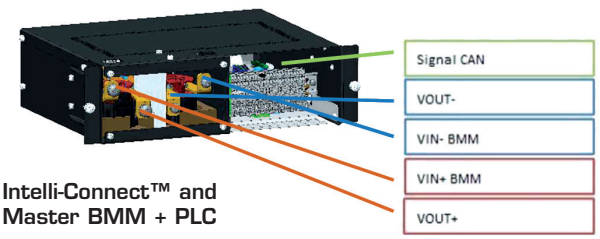




Battery Module, 23 Vdc



Battery Management Module (BMM)



Intelli-Connect™ and Master BMM + PLC

Figure 6: Power and Signal connectors

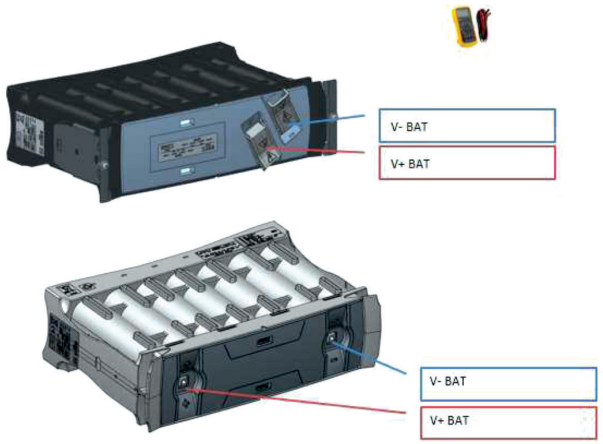


Figure 7: Check the maximum voltage of modules

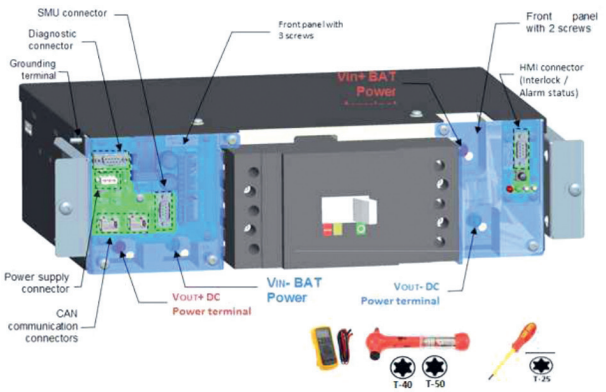


Figure 8: BMM overview

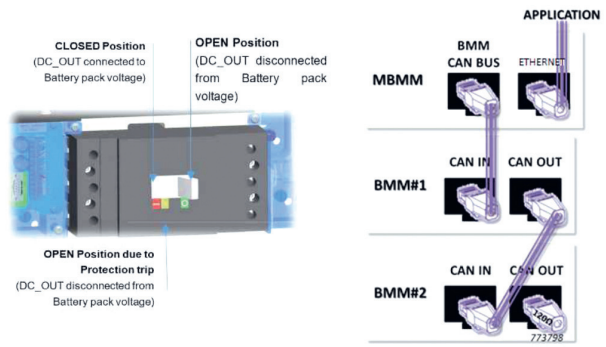


Figure 9: POWER ON main switch

IMPORTANT:

Full instructions are provided in the Flex'ion Installation & Commissioning (available to installation engineers certified by Saft) and Operating and Maintenance Manuals (available upon request).

NOTE:

Always use trained personnel when working with Flex'ion systems, components and battery modules.

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Doc. N° 22026-1019-2
Edition: October 2019

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