Installation and Operating Manual

LITHIUM STORAGE SYSTEM

TS HV 70

TESVOLT

THE ENERGY STORAGE EXPERTS

CONTENTS

1 IMPORTANT INFORMATION ABOUT THIS MANUAL

1.1 SCOPE

This document applies to the TESVOLT TS HV 70 high-voltage storage system in conjunction with the SMA Sunny Tripower Storage 60 battery inverter (SMA STPS 60).

Read this manual thoroughly to ensure error-free installation, initial commissioning and maintenance of the TESVOLT TS HV 70. Installation, initial commissioning and maintenance must be carried out by qualified and authorised specialists. The Installation and Operating Manual should be kept close to the unit and must be accessible at all times to all individuals involved in installation or maintenance.

All information about the battery inverter SMA Sunny Tripower Storage 60 in this manual is non-binding. TESVOLT assumes no responsibility for the accuracy and currency of this information. Ensure that you follow the relevant product documentation, such as installation or operating manuals from the manufacturers, for the battery inverter and other, third-party products.

This Installation and Operating Manual applies to Germany only, without restriction. Ensure that you adhere to the applicable local legal regulations and standards.
The standards and legal regulations in other countries may contradict the specifications in this manual. In this case, please contact service@tesvolt.com or the TESVOLT Service Line +49 (0) 3491 8797 - 200.

1.2 MEANING OF SYMBOLS

Symbols in the manual

This manual contains the following types of warnings and information:

DANGER! This symbol indicates that electric shock may result if you fail to follow the instruction, even when the unit is disconnected from the utility grid, as a voltage-free state only occurs after a time delay.

DANGER! This symbol indicates that death or serious injury may result if you fail to follow the instruction.

CAUTION! This symbol indicates that injury may result if you fail to follow the instruction.

WARNING! This symbol indicates information that property damage may result if you fail to follow the instruction.

NOTE: This symbol indicates information relating to the use of the unit.

Symbols on the unit

The following types of warning, prohibition and mandatory symbols are also used on the unit:

CAUTION! RISK OF CHEMICAL BURNS
If the battery is damaged and a fault occurs, this may result in electrolyte escaping and the formation of hydrofluoric acid in small concentrations and quantities, among other effects. Contact with these liquids can lead to chemical burns.

- Do not subject the battery modules to violent impact.
- Do not open, disassemble or mechanically alter the battery modules.

- If there is contact with the electrolyte, rinse the affected area immediately with water and promptly seek medical attention.

CAUTION! RISK OF EXPLOSION
Improper handling or fire can cause lithium battery cells to ignite or explode and cause serious injuries.

- Do not install or operate the battery modules in potentially explosive areas or in areas with high humidity.
- Store the battery modules in a dry area and within the temperature ranges specified in the data sheet.
- Do not open, drill through or drop the battery cells or modules.
- Do not expose the battery cells or modules to high temperatures.
- Do not throw the battery cells or modules into a fire.
- In case of fire, use CO_2 fire extinguishers if the fire comes from the battery. In case of fire in the vicinity of the battery, use an ABC fire extinguisher.
- Do not use defective or damaged battery modules.

CAUTION! HOT SURFACE
In the event of malfunction, components can become very hot and cause serious injury if touched.

- Switch the storage system off immediately if it is defective.
- Take particular care when handling the unit if malfunctions or defects become apparent.

NO NAKED FLAMES!
Handling naked flames and sources of ignition in the immediate vicinity of the storage system is prohibited.

DO NOT INSERT OBJECTS INTO OPENINGS ON THE STORAGE SYSTEM'S CASING!
No objects, such as screwdrivers, may be inserted through openings in the casing of the storage system.

WEAR SAFETY GOGGLES!
Wear safety goggles when working on the unit.

FOLLOW THE MANUAL!
It is imperative that you follow the Installation and Operating Manual when working on and operating the unit.

1.3 GENERAL SAFETY INFORMATION

DANGER! Failure to observe the safety information can result in death.
Improper use can lead to fatal injuries. Any person tasked with working on the system must have read and understood this manual and, in particular, the section "2 Safety" on page 8 et seq. **All the safety instructions must be followed under all circumstances.**

Everyone who works on the TESVOLT TS HV 70 must follow the specifications in this manual.

This manual cannot describe every conceivable situation. For this reason, the applicable standards and corresponding occupational health and safety regulations always take priority.

In addition, installation may also involve residual hazards under the following circumstances:

- Installation is not carried out properly.
- Installation is carried out by personnel who have not received the relevant training or instruction.
- The safety information provided in this manual is not followed.

1.4 DISCLAIMER

TESVOLT GmbH assumes no liability for personal injury, damage to property, damage to the product and follow-on damage attributable to the following causes:

- Non-compliance with this manual,
- Improper use of the product,
- Repairs, opening the cabinet and other actions performed on or with the product by unauthorised and/or unqualified personnel,
- Use of non-approved spare parts.

Unauthorised modifications or technical changes to the product are forbidden.

1.5 APPROPRIATE USE

The TESVOLT TS HV 70 is a modular battery storage system based on lithium-ion technology. The components were built in accordance with the current state of the art in technology and product-specific standards.

The TESVOLT TS HV 70 has been designed for operation with the the SMA Sunny (SMA STPS 60) three-phase battery inverter. Any other use must be agreed with the manufacturer and, if necessary, with the local energy supply company.

It may only be operated in closed rooms. The TESVOLT TS HV 70 works in an ambient temperature range of -10°C to 50°C and at a maximum humidity of 85%. The battery cabinet may not be exposed to direct sunlight or placed directly beside sources of heat.

The battery cabinet may not be exposed to corrosive environments.

When installing the battery storage system, ensure that it is standing on a sufficiently dry, horizontal and flat surface with sufficient load-bearing capacity.

The altitude of the installation location may not be higher than 2,000 m above sea level without approval in writing from the manufacturer.

In regions subject to flooding, care must be taken to ensure that the battery cabinet is installed in a suitably elevated location and is protected against contact with water.

According to IEC 62619, the storage system must be installed in a fire-proof room. This room must be free from fire loads and must be equipped with an independent fire alarm unit in accordance with the locally applicable regulations and standards. The room must be separated by class T60 fire doors. Comparable fire protection requirements also apply to other openings in the room (e.g. windows).

Adherence to the specifications in this manual also forms part of appropriate use.

The TESVOLT TS HV 70 may not be used:

- for mobile use on land or in the air (it may only be used on water in agreement with, and with the written consent of, the manufacturer),
- for use with medical equipment,
- as a UPS system.

1.6 GUARANTEE

The current guarantee conditions can be downloaded from the internet by visiting **www.tesvolt.com**.

1.7 REQUIREMENTS FOR INSTALLERS

The locally applicable regulations and standards are to be adhered to for all work.

The installation of the battery storage system may only be carried out by qualified electricians who have the following qualifications:

- Training in dealing with hazards and risks associated with installing and operating electrical equipment, systems and batteries,
- Training in installing and commissioning electrical equipment,
- Knowledge of and compliance with the locally applicable technical connection requirements, standards, directives, regulations and laws,
- Knowledge of handling lithium-ion batteries (transport, storage, disposal, sources of danger),
- Knowledge of and compliance with this Installation and Operating Manual and other applicable documents,
- Successful participation in **TESVOLT HV 70 certification training** (information about the training courses can be found at www.tesvolt.com. For further information, please send an email to academy@tesvolt.com).

2 SAFETY

The TS HV 70 meets the requirements set out in IEC 61508 parts 1 to 7 and complies with safety integrity level (SIL) 1.

DANGER! Life-threatening electric shock from damaged components or short circuit

Bridging the battery terminals causes a short circuit that results in a flow of electrical current. A short circuit of this type should be avoided under all circumstances. For this reason, follow these instructions:

- Use insulated tools and insulated gloves.
- Do not place any tools or metal parts on the battery modules or the APU HV1000-S.
- Always remove watches, rings and other metal objects when working with the batteries.
- Do not install or operate the battery storage system in explosive areas or areas with high humidity.
- When working on the battery storage system, switch off all voltage supplies first to the charge controller, then to the battery, and ensure that they cannot be switched on again.

DANGER! Chemical burns and poisoning due to electrolyte or poisonous gases

During normal operation, no electrolyte can escape from the battery and no poisonous gases can form. Despite careful design, damage to the battery in the event of a fault can result in escaping electrolyte or small concentrations and quantities of toxic gases, organic solvent gases and hydrofluoric acid. For this reason, please follow these instructions:

- Do not subject the battery modules to violent impact.
- Do not open, disassemble or mechanically alter the battery modules.

If there is contact with the electrolyte, rinse the affected area immediately with water and promptly seek medical attention.

DANGER! Improper handling can result in life-threatening burns

Lithium battery cells can ignite if handled incorrectly. For this reason, ensure that you adhere to the following instructions for handling lithium battery cells:

- Do not install or operate the battery modules in potentially explosive areas or in areas with high humidity.
- Store the battery modules in a dry area and within the temperature ranges specified in the data sheet.
- Do not open, drill through or drop the battery cells or modules.
- Do not expose the battery cells or modules to high temperatures.
- Do not throw the battery cells or modules into a fire.
- In case of fire, use CO_2 fire extinguishers if the fire comes from the battery. In case of fire in the vicinity of the battery, use an ABC fire extinguisher.
- Do not use defective or damaged battery modules.

DANGER! Danger of death due to misuse

Any use of the battery storage system beyond the intended use or any other type of use can result in considerable hazards.

DANGER! Danger of death due to unqualified operators

Incorrect handling of the battery storage system can result in significant hazards for the operator. For this reason, any action that requires the battery cabinet to be opened may only be carried out by qualified specialists in accordance with the instructions in section “1.7 Requirements for installers” on page 8.

WARNING! Incorrect use can cause damage to the battery cells

- Do not expose battery cells or modules to rain and do not immerse them in liquids.
- Do not expose battery cells to corrosive environments (e.g. ammonia, salt).
- Do not use any other battery inverters apart from the SMA STPS 60.
- Commission the battery storage system within **six months** of delivery at the latest.

3 PREPARATION

3.1 TOOLS REQUIRED

TOOL	USE
5–30 Nm torque wrench with 10 and 13 mm sockets, long 8 mm hexagon socket screwdriver (recommended minimum length: 120 mm in total)	For tightening the grounding connections and the AC and DC connecting cables to the SMA STPS 60, for example
TX 25/30 Torx screwdriver	For fastening the baying connectors and removing the cover of the DC connection, for example
PH 3 cross-head screwdriver	Fastening the battery modules and APU HV1000-S in the battery cabinet
35 mm² to 50 mm² crimping tool	For crimping the wire-end ferrules for the DC connecting cable
Voltmeter (min. 1,000 V_{DC})	Measuring the power supply and battery voltages (up to 1,000 V_{DC}) and testing the battery modules' state of charge
19 mm spanner	Optional: lifting the cabinet cover, installing spacers

3.2 TRANSPORT TO THE END CUSTOMER

Transport regulations and safety information

All the requirements set out in the German Ordinance on the Transport of Dangerous Goods by Road, Rail and Inland Waterways (GGVSEB) and the European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR) must be adhered to.

- The battery modules may only be transported by the manufacturer or by a haulier engaged by the manufacturer. Should transport on public roads nevertheless be necessary, this may only be carried out by personnel who have received appropriate training and instruction. This instruction is to be documented and carried out periodically.
- Smoking is prohibited in the vehicle during the transport journey, and also in the immediate vicinity during loading and unloading.
- Two tested fire class D metal fire extinguishers (minimum capacity: 2 kg) and equipment for dangerous goods in accordance with the ADR are to be carried in the vehicle.
- The freight carrier is prohibited from opening the outer packaging of the battery module.

DANGER! Risk of injury due to improper transport in a vehicle
Improper transport and/or inadequate transport locks can cause the load to slide or topple over, leading to injuries. Position the cabinet vertically and in such a way that it cannot slide around in the vehicle, and use securing straps to prevent it from toppling over and sliding.

CAUTION! Risk of injury due to tilting battery cabinet
The cabinet weighs approx. 120 kg and may topple over if tilted, causing injuries or becoming damaged itself.

CAUTION! Risk of injury if safety shoes are not worn when the cabinet is being transported
Injuries such as crushing injuries can occur due to the components' heavy dead weight when the cabinet or battery modules is/are being transported. For this reason, all individuals involved must wear safety shoes with protective toe caps.

CAUTION!
Please also follow the safety information in section "3.3 Transport at the end customer's site" on page 11 below, especially when loading and unloading.

WARNING! Risk of damage to the unit during transport with installed battery modules
Transporting the cabinet with battery modules installed causes damage to the unit. The battery modules and cabinet must therefore always be transported separately from each other. Never move a cabinet once fitted with battery modules or, in particular, suspend it using a lifting device.

3.3 TRANSPORT AT THE END CUSTOMER'S SITE

CAUTION! Risk of injury due to improper transport of the battery modules
Battery modules are heavy (36 kg) and may cause injury if they topple over or slide around. Ensure that transport is carried out safely and that only suitable means of transport are used.

CAUTION! Risk of injury due to tilting battery cabinet during transport
The cabinet weighs approx. 120 kg and may topple over if tilted, causing injuries or material damage.

CAUTION! Risk of injury if safety shoes are not worn when the cabinet is being transported
Injuries such as crushing injuries can occur due to the components' heavy dead weight when the cabinet or battery modules are being transported. For this reason, all individuals involved must wear safety shoes with protective toe caps.

CAUTION! Risk of injury from sharp edges and metal panels when transporting the cabinet
When the unpacked cabinet is being transported or installed, there is an increased risk of injury, particularly from sharp-edged metal panels. For this reason, all individuals involved must wear safety gloves.

WARNING! Risk of damage to the unit during transport with installed battery modules
Transporting the cabinet with battery modules installed causes damage to the unit. The battery modules and cabinet must therefore always be transported separately from each other. Never move a cabinet once it is fitted with modules or, in particular, suspend it using a lifting device.

NOTE: Transport by at least two people.
We recommend using a hand truck. Caution: Do not damage the casing!

The individual components of the TS HV 70 can weigh up to 120 kg, and are therefore unsuitable for transport by one person. We recommend at least two people install the system. A dolly or hand truck is helpful during the installation process. Take care not to damage the casing.
No more than five battery modules may be stored on top of each other.

Figure 3.1 Permissible and impermissible storage positions of a packaged battery module

3.4 INSTALLATION LOCATION

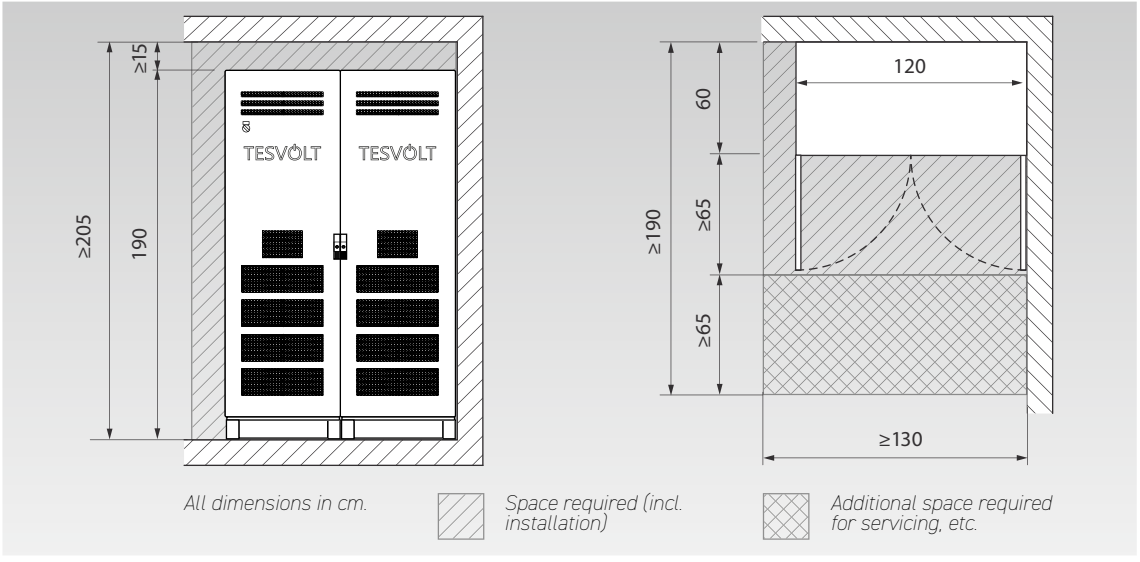
Necessary prerequisites

Section “1.5 Appropriate use” on page 7 lists all the necessary prerequisites and conditions for installing a TS HV 70.

When selecting the installation site, bear in mind transport routes and the necessary site clearance.

STOP **WARNING! Possible damage to the building due to static overload**
When fully installed, the battery storage system weighs up to 823 kg. Ensure that the installation location has sufficient load-bearing capacity. If in doubt, consult a structural engineer.

Dimensions



4 TECHNICAL DATA

4.1 SMA SUNNY TRIPOWER STORAGE 60 (SMA STPS 60)

The TESVOLT TS HV 70 has been optimised for use with the SMA STPS 60 three-phase battery inverter. The overall system is perfectly coordinated to the needs of trade and industry. The system can be used for an extremely wide range of applications thanks to the flexible energy management provided by the SMA Inverter Manager and the high C-rate of the TS HV 70 storage system. Projects up to the mega-watt range can be implemented with this unit.

TECHNICAL DATA SMA STPS 60	
Nominal charging power (AC)	60 kVA
Nominal discharging power (AC)	75 kVA
DC voltage range	575 to 1,000 V_{DC}
Dimensions (H x W x D)	740 x 570 x 306 mm
Max. efficiency	98.8 %
Self-consumption	< 3 W
Operating temperature	-25°C to 60°C
Weight	77 kg
Protection class	IP 65 | NEMA 3R
Communication	Modbus TCP/IP
Topology	Transformer-free

Figure 4.1 SMA Sunny Tripower Storage 60 with SMA Inverter Manager

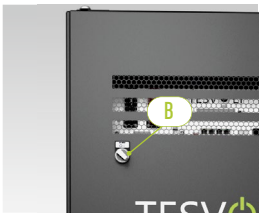
4.2 TESVOLT TS HV 70

TESVOLT TS HV 70 TECHNICAL DATA		
Energy (14 | 16 battery modules)		67 kWh | 76 kWh
C-rate		1C
Cell		Lithium NMC prismatic (Samsung SDI)
Max. charging/discharging current		94 A
Cell balancing		Active Battery Optimizer
Cycles expected at 100 % DoD | 70 % EoL | 23°C +/- 5°C 1 C/1 C		6,000
Cycles expected at 100 % DoD | 70 % EoL | 23°C +/- 5°C 0.5 C/0.5 C		8,000
Efficiency (battery)		Up to 98 %
Self-consumption (standby)		5 W
Operating voltage		666 to 930 V_{DC}
Operating temperature		-10 to 50 °C
Humidity		0 to 85% (non-condensing)
Max. altitude of the installation location		2,000 m above sea level
Total weight	14 | 16 battery modules	742 kg | 823 kg
	Weight per battery module	36 kg
	Weight per cabinet	120 kg
Dimensions (H x W x D)		1,900 x 1,200 x 600 mm
Certificates/standards	Cell	IEC 62619, UL 1642, UN 38.3
	Product	CE, UN 38.3, IEC 62619, IEC 61000-6-1/2/3/4, German Battery Act 2006/66/EC
Guarantee		10-year performance guarantee, 5-year system guarantee
Recycling		TESVOLT provides a free battery take-back scheme in Germany
Protection class		IP 20
Battery specification as per DIN EN 62620:2015		IMP47/175/127/[14S]E/-20+60/90

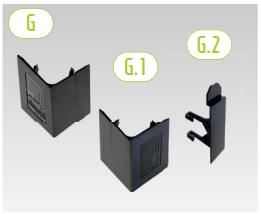
5 TS HV 70 BATTERY STORAGE SYSTEM

5.1 CABINET STRUCTURE AND COMPONENTS

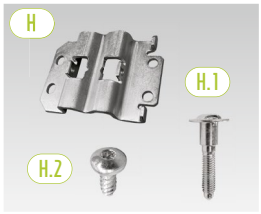
Cabinet halves



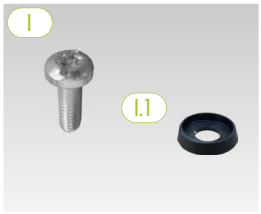
External switch



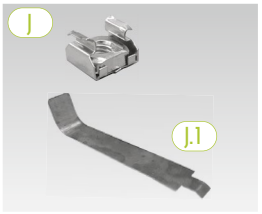
Base corner cover plate and connector



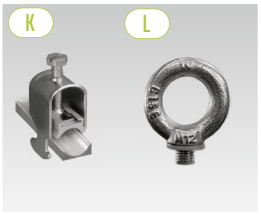
Baying connector with screws for fastening



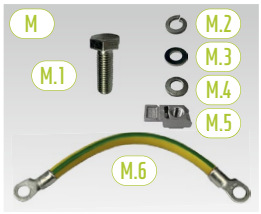
Pan head screw with plastic washer



Cage nut with installation aid

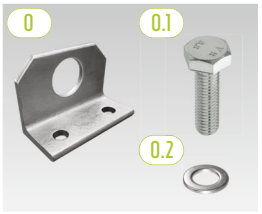


Cable support clip
Ring screw



Cabinet grounding connection

Spacer with accessories for lifting the roof



Optional: combination bracket with fastening materials

5.2 SCOPE OF DELIVERY OF THE TS HV 70 CABINET

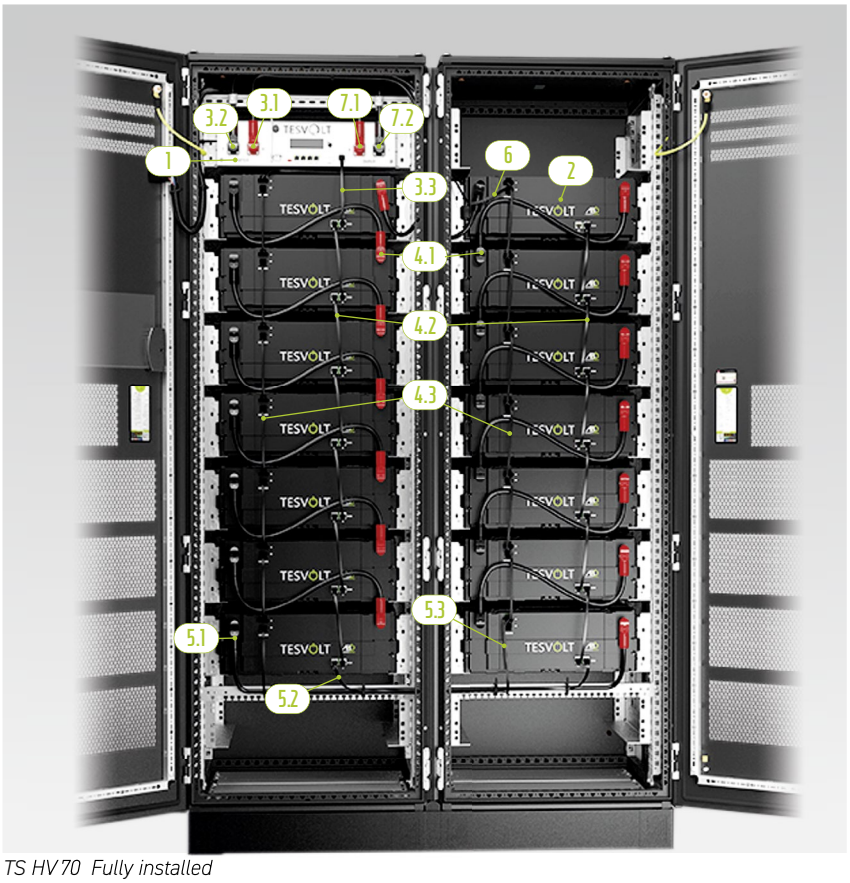
ITEM	NUMBER	DESCRIPTION
A	2	**Cabinet halves** (left/right)
B	1	**External switch** (pre-installed)
C	1	**Central grounding point** (pre-installed)
C.1	1	**Grounding point** (pre-installed)
D	1	**C-rail** (pre-installed)
E	1	**Connection cable for external switch** (pre-installed)
F	2	**Cable retention rail** (pre-installed, also referred to as "mounting rail")
G	4	**Base corner cover plates (right)**
G.1	4	└ **Base corner cover plates (left)**
G.2	2	└ **Connector for corner cover plates**
H	6	**Baying connector**
H.1	12	└ **M6 x 35 setscrew**
H.2	24	└ **5.5 x 13 mm pan head screw** (Torx TX25)
I	100	**M6 x 16 pan head screw** (cross-head)
I.1	100	**M6 plastic washer**
J	100	**M6 cage nut**
J.1	2	└ **Auxiliary tool for cage nuts**
K	2	**Cable retention clip** for C-rail (strain relief)
L	8	**Ring screw**
M	1	**Cabinet grounding connection kit**
M.1	2	└ **M8 x 30 screw**
M.2	2	└ **M8 spring washer**
M.3	2	└ **M8 washer**
M.4	2	└ **M8 contact washer**
M.5	2	└ **M8 speed nut**
M.6	1	└ **Grounding cable**
N	8	**20 mm spacer**
N.1	8	└ **M6 x 16 countersunk screw** (Torx TX30)
N.2	8	└ **Cover cap**
N.3	8	└ **Plastic washer**
O	2	**Combined bracket** (optional – only for transporting the installed cabinet casing by crane, not including battery modules)
O.1	4	└ **M12 screw**
O.2	4	└ **M12 washer**

5.3 SETUP AND COMPONENTS

APU HV1000-S

Battery module incl. Active Battery Optimizer (ABO)

APU connector kit HV1000



TS HV 70 Fully installed

Module connector kit HV1000

Cabinet connector kit HV1000

Rack balancing cable 0.75 m

BatBreaker DC connector kit BatBreaker for the battery inverter HV1000

Switch

Type plate

SMA Inverter Manager with power supply unit

Janitza power measurement

BatBreaker

DC connector kit Bat-Breaker/STPS

Installation manual

TESVOLT USB-Stick

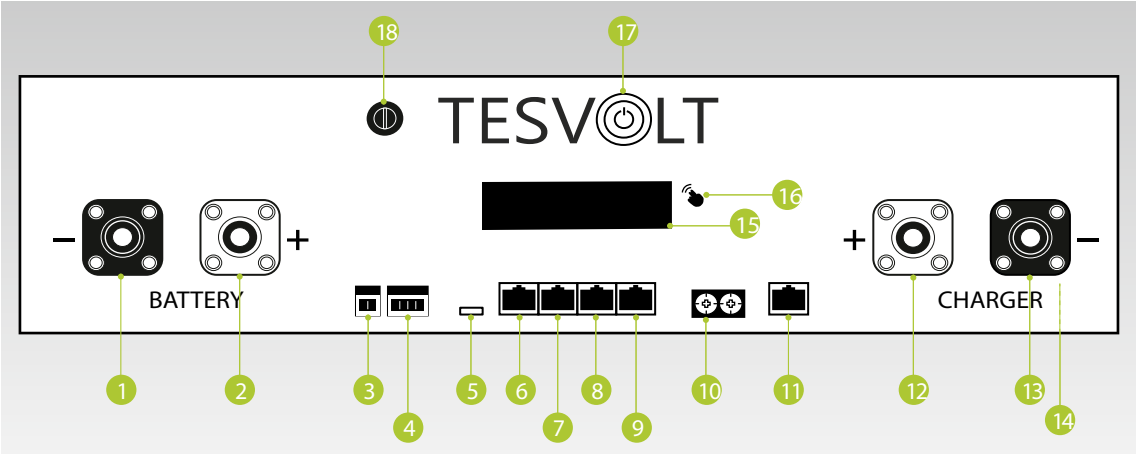
Battery room sticker

SMA Data Manager M set

5.4 SCOPE OF DELIVERY OF THE TS HV 70

ITEM	NUMBER	DESCRIPTION
1	1	**APU HV1000-S**
2	14 or 16	**Battery module 4.8-1C-HV1000** incl. Active Battery Optimizer (ABO)
3	1	**APU connector kit HV1000** from the APU to the first and 14th/16th battery module
3.1	1	└ **DC connecting cable, 0.95 m – 35 mm²** (RD to RD)
3.2	1	└ **DC connecting cable, 1.15 m – 35 mm²** (BK to BK)
3.3	1	└ **Patch cable CAT 6, 0.30 m**
3.4	1	└ **APU grounding cable, 0.70 m – 16 mm²** (GN-YW) M6 – M8
4	1	**Module connector kit HV1000** (extra pack with two extra cables each for 16 battery modules)
4.1	12	└ **DC connecting cable, 0.55 m – 35 mm²** (RD to BK)
4.2	12	└ **Patch cable CAT6, 0.30 m**
4.3	12	└ **Rack balancing cable, 0.24 m**
5	1	**Cabinet connector kit HV1000**
5.1	1	└ **DC connecting cable, 1.20 m – 35 mm²** (RD to BK)
5.2	1	└ **Patch cable CAT 6 > CAT 6 patch cable, 1.00 m**
5.3	1	└ **Rack balancing cable, 1.10 m**
6	1	**Rack balancing cable, 0.75 m**
7	1	**DC connector kit for APU to Bat INV/BatBreaker – HV1000**
7.1	1	└ **DC connecting cable, 5.00 m – 35 mm²** (red plug on one end)
7.2	1	└ **DC connecting cable, 5.00 m – 35 mm²** (plug black on one side)
7.3	2	└ **Insulated wire-end ferrule, 35 mm²**
7.4	1	└ **Patch cable CAT 6, 5.00 m**
7.5	1	└ **Grounding cable, 5.00 m – 16 mm²** (GN YW)
8	2	**Switch**
9	2	**Type plate TS HV 70**
10	1	**SMA Inverter Manager**
11	1	**24 V power supply**
12	1	**Janitza power measurement UMG 604E-Pro**
13	Optional	**BatBreaker 160-4X-HV1000** (optional, part of the scope of delivery for master/slave systems)
14	Optional	**BatBreaker DC connector kit BatBreaker for the battery inverter HV1000**
14.1	1	└ **DC connecting cable, 1.00 m – 35 mm²** (+ cable, red marking)
14.2	1	└ **DC connecting cable, 1.00 m – 35 mm²** (- cable, blue marking)
15	1	**TESVOLT TS HV 70 Installation and Operating Manual**
16	1	**TESVOLT USB-Stick**
17	1	**Battery room sticker**
18	Optional	**SMA Data Manager M set** incl. external 24 V power supply

5.5 CONNECTIONS AND SETUP OF THE APU HV1000-S



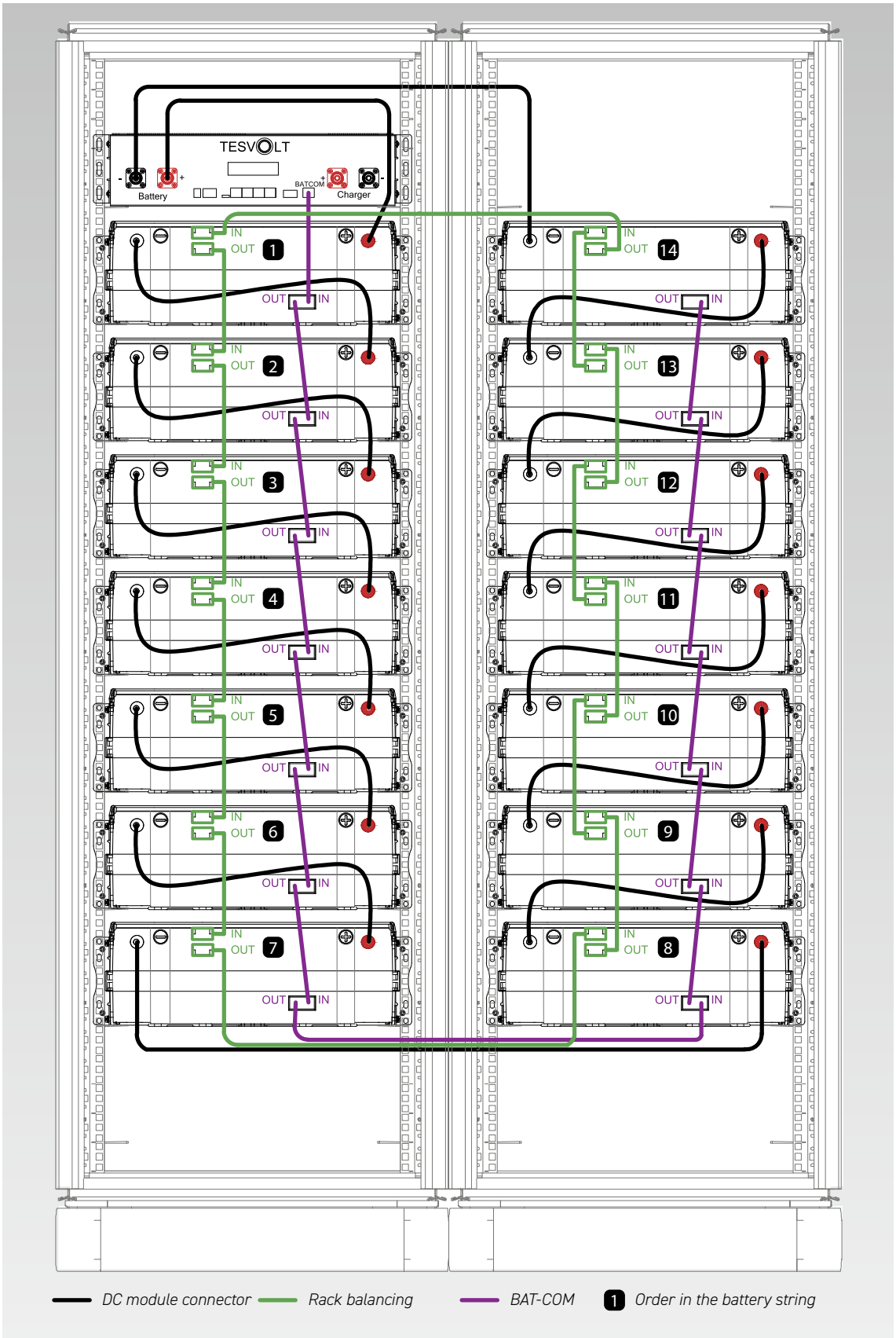
NO.	DESIGNATION	DESCRIPTION
1	BATTERY –	The battery's DC connection for the negative pole (black)
2	BATTERY +	The battery's DC connection for the positive pole (red)
3	EXT SWITCH	Connection of the external switch (B)
4	E-STOP	Four-pin plug for the optional connection of an emergency stop switch for quick shutdown (pre-installed with bridge on delivery)
5	TERM	CAN bus termination TERM must be activated (ON) for the first and last CAN bus subscribers.
6	CAN IN	APU HV1000-S master/slave communication (input)
7	CAN OUT	APU HV1000-S master/slave communication (output)
8	CAN SMA	Connection not used on the TS HV 70.
9	LAN	Modbus TCP/IP transmission for communication between battery and SMA Inverter Manager
10	ADDRESS	Further information can be found in the section "Overview of all addressing options" on page 44.
11	BAT-COM	Communication connection to the first battery module
12	CHARGER +	DC connection for the SMA STPS 60 or BatBreaker for the positive pole (red)
13	CHARGER –	DC connection for the SMA STPS 60 or BatBreaker for the negative pole (black)
14	GROUND	Grounding connection (M6 thread bolt on the rear of the unit)
15	DISPLAY	Display for information, warnings and errors
16	MARKING	Marking for activating and changing the display by tapping
17	SWITCH	On/off switch for the battery
18	APU fuse (F1)	Fuse to protect the APU HV1000-S (2 A miniature fuse, 5 x 20 mm, time lag (T) according to DIN 41571-2, type: ESKA 521.020, 250 V_{AC}) Operation is not possible with a defective fuse.

5.6 CONNECTIONS AND SETUP OF THE BATTERY MODULE

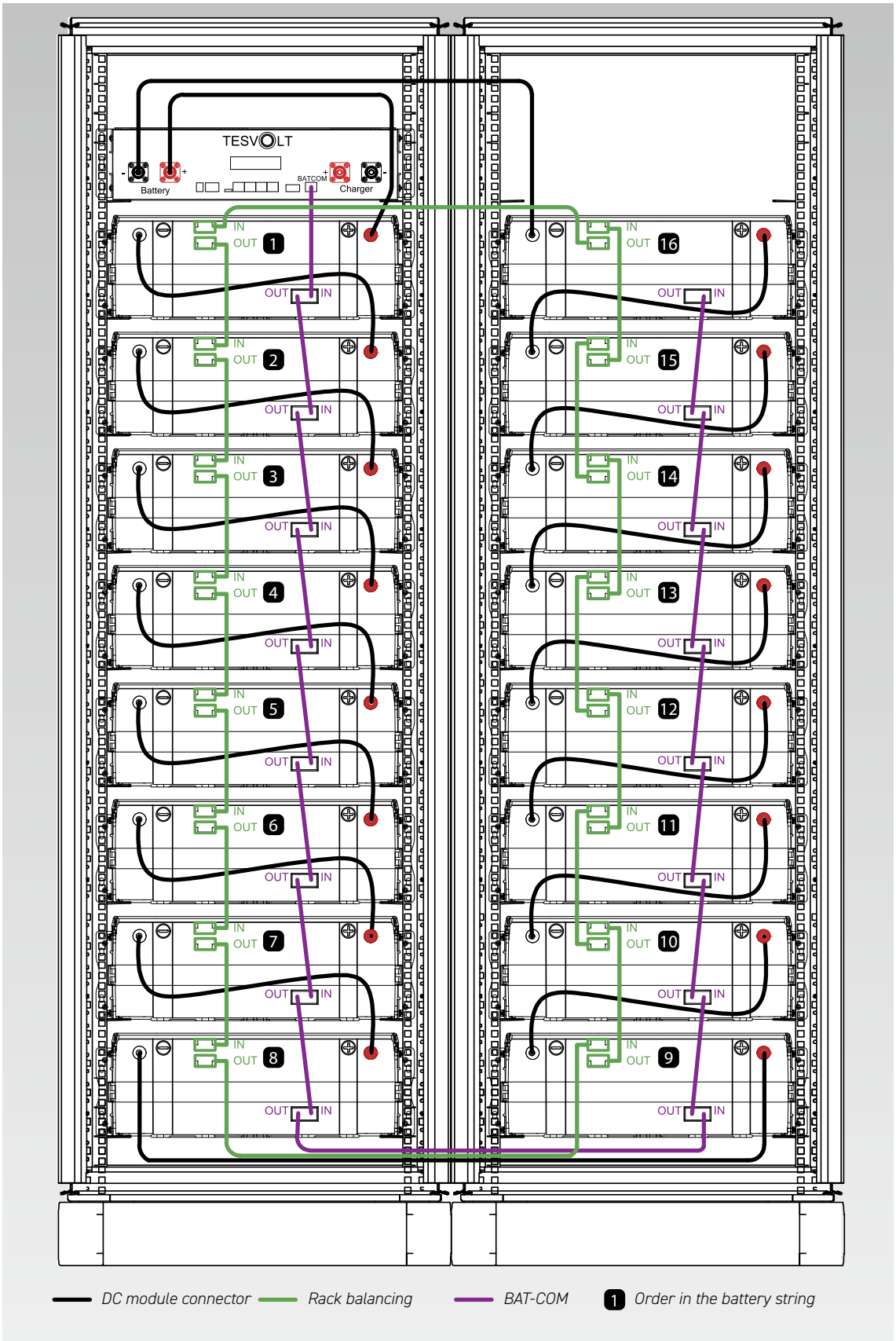
NO.	DESIGNATION	DESCRIPTION
19	– POLE	Battery negative pole (black)
20	+ POLE	Battery positive pole (red)
21	RACK BALANCING IN	Rack balancing (input)
22	RACK BALANCING OUT	Rack balancing (output)
23	BAT-COM OUT	Communication connection for battery module (output)
24	BAT-COM IN	Communication connection for battery module (input)

5.7 WIRING THE BATTERY MODULES

Wiring 14 battery modules



Wiring 16 battery modules

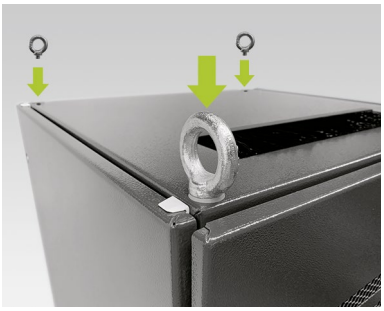


6 INSTALLATION

6.1 SETTING UP THE CABINET

Remove the packaging and transport locks from the cabinet. The cabinet consists of two halves that are joined together once at the installation location.

1

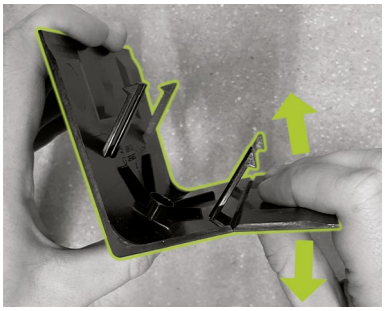


Optional: install the ring screws:
Install four ring screws at the four corners of the cabinet halves to transport the individual halves of the cabinet by crane. To do this, remove all the fastening screws from the cabinet covers and replace them with the ring screws (L).

2

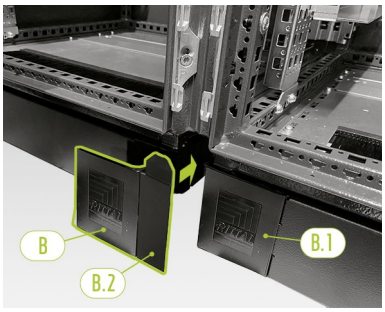
Transport the cabinet halves to the final installation location. While doing so, ensure that you follow the information and specifications in section "3.4 Installation location" on page 12.

3



Prepare a right base corner cover plate (G) (with the logo on the left leg) for fitting on the cabinet base. To do this, break the cover plate in half at the notch on the right leg. The narrow piece can be disposed of. Now use the two hooks of the connector for the base corner cover plate (G.2) to attach it to the shortened cover plate's short leg.

4



Now attach a left base corner cover plate (G.1) to the left corner at the front of the right half of the battery cabinet. Then you can attach the assembled cover plate to the right corner of the left half of the cabinet. Finally, fit the remaining base corner cover plates to the battery cabinet base's remaining corners.

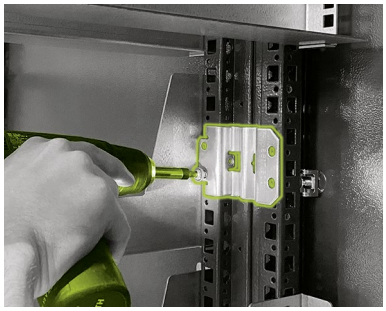
5

First of all, on the front of the cabinet attach three baying connectors (H) to the middle, vertical cabinet profiles inside the cabinet at the top, middle and bottom. The baying connectors are affixed to the frame profiles with two setscrews (H.1) on each side from the right and left.

6

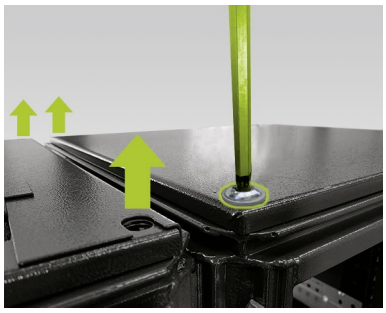
Now, fit the remaining three baying connectors (H) to the cabinet profiles at the rear of the cabinet at the same height as the front baying connectors already installed. When fitting the bottom baying connector, use the same process as for fitting on the front cabinet profiles. However, for the top and middle cabinet baying connectors, you must first remove the slide rail on one side in the fitting area.

7



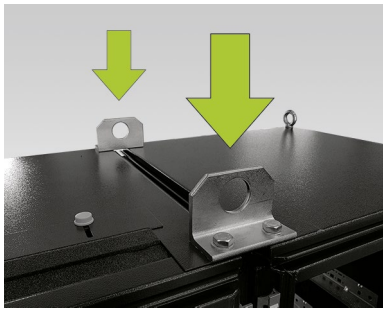
Then fasten the middle and the top cabinet baying connectors using the front holes and four screws (H.2). Then refit the relevant slide rail.

8



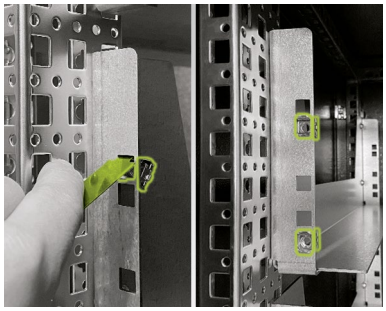
Optional: installing the combined brackets:
If you would like to transport the assembled cabinet (without the battery modules) by crane, two combined brackets (O) have to be fitted. To do this, remove the four fastening screws from the cabinet covers on the sides of the two halves of the cabinet that are connected to one another.

9



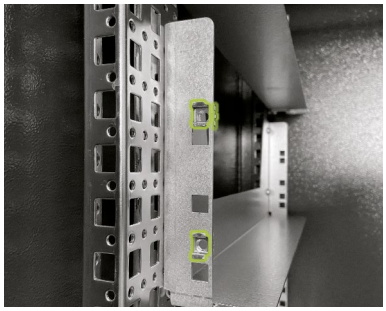
Optional: installing the combined brackets:
Install one combined bracket (O) each in place of the previously removed fastening screws in the cabinet covers. Fasten the combined brackets with two M12 x 40 screws (O.1) and washers (O.2) each.

10



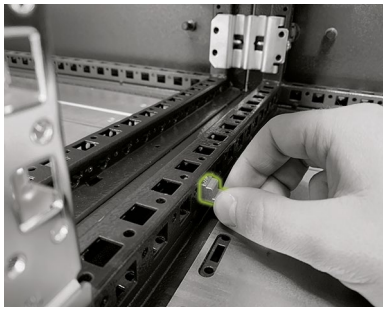
Fit the cage nuts (J) for affixing the APU HV1000-S (1) in the slide rails using the auxiliary tool (J1). The APU HV1000-S uses the top slide rails in the left half of the cabinet. Distribute the cage nuts from bottom to top. Start at the bottom edge of the slide rails of the APU HV1000-S. Use the first opening and fit the first two cage nuts on both sides. Now, fit the remaining two cage nuts in the second opening in both slide rails from the top.

11



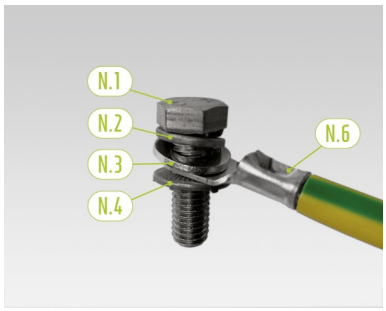
Now, fit the cage nuts (J) for fastening the battery modules (2) with the auxiliary tool (J1) (see "5.7 Wiring the battery modules" on page 19 et seq. for the positions of the battery modules). Distribute the cage nuts from bottom to top. Start at the bottom edge of the slide rail for the relevant battery module. Fit the first two cage nuts in the second opening on both sides from below, and fit the remaining two cage nuts in the top opening in the two slide rails.

12



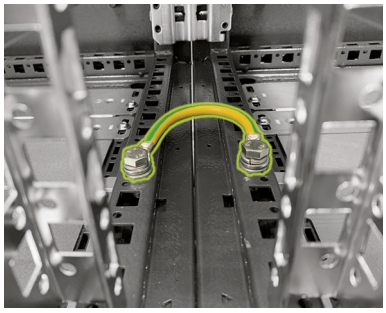
Fit the cabinet grounding connection set (K) to equalise the potential between the two halves of the cabinet. To do this, insert the speed nuts (K.5) from the side into the two middle cabinet profiles at the cabinet base. You are free to choose the position, but both speed nuts must be directly opposite each other.

13



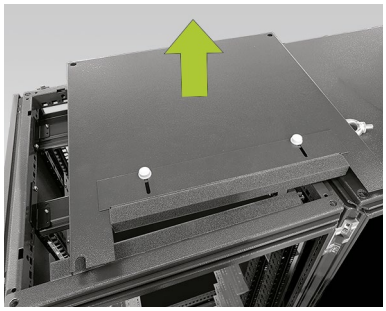
Now prepare the grounding cable (M.6) for installation. To do this, put an M8 spring washer (M.2), an M8 washer (M.3), the grounding cable's cable eyelet (M.6) and finally the M8 contact washer (M.4) onto the M8 screw (M.1). Ensure that the teeth of the M8 contact washer (M.4) are pointing downwards, towards the end of the screw.

14



Fit the prepared grounding cable (M.6) to the middle cabinet frame profiles using the pre-fitted speed nuts (M.5). Use a torque wrench with a tightening torque of 10 Nm.

15

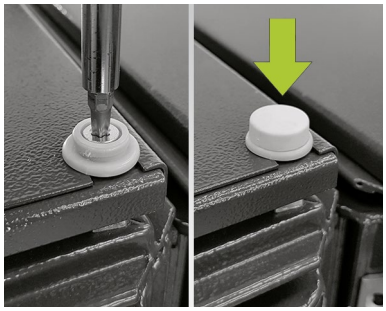


Optional: lifting the cabinet covers for additional ventilation:
First of all, remove all the fastening screws, ring screws or combined brackets and then the two top cabinet covers.

16

Optional: lifting the cabinet covers for additional ventilation:
Now screw four spacers (N) into the threaded holes for the ring screws on each half of the cabinet.

17



Optional: lifting the cabinet covers for additional ventilation:
Then place the top cabinet cover on the spacers and fasten it with four M6 x 16 countersunk screws (N.1) (TX30) including plastic washers (N.3).
Next fasten the cover caps (N.2) to the plastic washers.

18

Now attach the type plates (9) to the cabinet in the following positions: 1 x left-hand inside door and 1 x on the outside on a visible side panel.

6.2 INSTALLING THE COMPONENTS

DANGER! Life-threatening electric shock if grounding is insufficient or absent!
If a fault occurs on the unit, insufficient or absent grounding can cause damage to the unit. This poses the risk of a lethal electric shock.

NOTE: Before installing the APU HV1000-S (1), note its serial number in the document "CS-S.FB.003.E.ENG_Commissioning_Protocol_TSHV70", which can be found on the TESVOLT USB-Stick (16). The serial number can be found on a sticker on the underside of the APU HV1000-S. If the TESVOLT USB-Stick (16) is lost, contact the TESVOLT Service Line +49 (0) 3491 87 97 - 200 or write an email to service@tesvolt.com concerning the commissioning protocol.

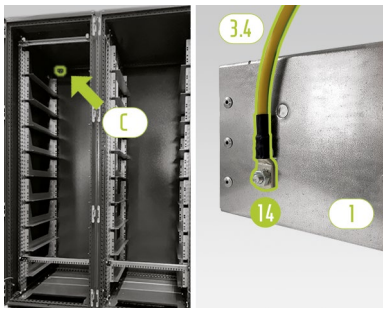
1

Ensure the battery cabinet is grounded. To do this, connect the grounding cable (7.5) to the central grounding point (C) or the grounding point (C.1). First fasten the nut only loosely.

2

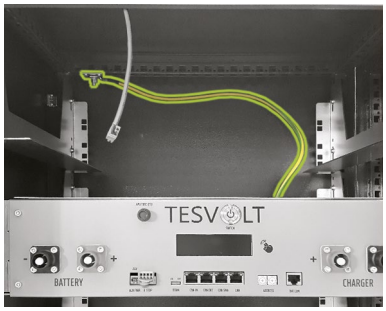
Before installing the APU HV1000-S (1) and the battery modules (2), note their serial numbers in the document "CS-S.FB.003.E.ENG_Commissioning_Protocol_TSHV" on the TESVOLT USB-Stick (16).

3



The APU HV1000-S must be grounded. Using the grounding cable (3.4), connect the APU HV1000-S to the central grounding point (C). To do this, place the grounding cable's M6 ring cable lug (3.4) onto the earthing bolt (14) (on the back of the APU HV1000-S) with a tightening torque of 6 Nm.

4



Attach the end to the central grounding point C with the M8 ring cable lug. Use a torque wrench with a tightening torque of 10 Nm. For easier installation, you can temporarily place the APU HV1000-S on the slide rails of the first battery module during installation.

5

Insert the APU HV1000-S in the left half of the cabinet on the topmost slide rails and use the enclosed M6 x 16 pan head screws I (cross-head) and plastic washers I.1 to fasten it to the pre-installed cage nuts J.

6

The four-pin plug for the e-stop connection on the APU HV1000-S must be plugged in for operation. The APU HV1000-S will remain inactive without this plug. Further information about the e-stop can be found in the section “6.3 E-stop contact” on page 30.

7

All battery modules 2 of a TESVOLT-TS-HV-70-battery storage system must have exactly the same state of charge. So be sure to check the voltage of the battery modules before installation. The correct voltage of a battery module at installation is 50.0 +/- 0.1 V_{DC}. If there are deviations, please contact the TESVOLT Service Line +49 (0)3491 8797-200 or email service@tesvolt.com.

8

Insert the first battery module into the slide rails below the APU HV1000-S. Affix it to the pre-fitted cage nuts using four M6 x 16 pan head screws I (cross-head) incl. plastic washers I.1. Now fit the remaining modules in the left half of the cabinet. If 16 battery modules are being used, the bottom position is occupied as well.

9

Once the left half of the cabinet has been filled, install the battery modules on the right side. Start at the level of the top left module (the position at a level with the APU HV1000-S remains unoccupied). Affix the module to the pre-fitted cage nuts J with four M6 x 16 pan head screws I incl. washers I.1. Then, place the next module below the one that has already been installed and fasten it as described. Continue until all the modules have been installed.

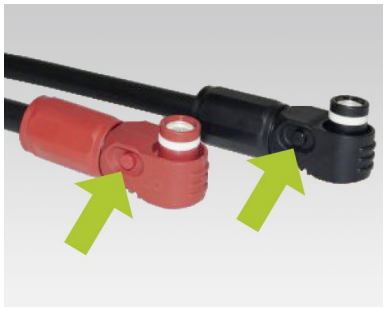
DANGER! Improper DC wiring can lead to life-threatening injuries
One or more of the battery modules will short circuit if the DC cables are connected incorrectly. This may cause components to become extremely hot and potentially ignite, which can lead to serious injuries.

- Ensure that wiring is carried out properly in accordance with section "5.7 Wiring the battery modules" on page 19 et seq.
- **Ensure that the DC cables' plugs audibly click into place when they are being fastened.**

DANGER! Risk of death due to electric shock even before grid connection
The battery modules have a voltage of 50.0 +/– 0.1 V_{DC} when installed. When the DC connectors are installed, the voltage of the battery modules increases as they are connected in series. If all the modules are connected, parts of the unit carry an operating voltage of up to 930 V_{DC} before connection to the grid/commissioning. Contact with the live components can lead to serious or even fatal injuries. For this reason, ensure that you follow the relevant occupational safety regulations.

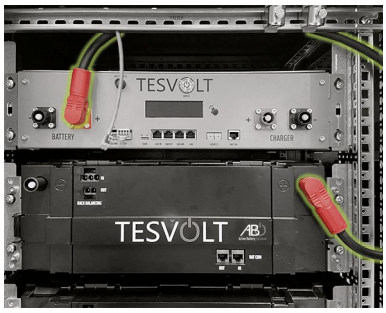
WARNING! Potential damage to the unit due to incorrect DC connection
If the DC wiring is not carried out correctly, this may cause a short circuit and the battery modules will need to be replaced. In addition, damage to the APU HV1000-S can occur.

10



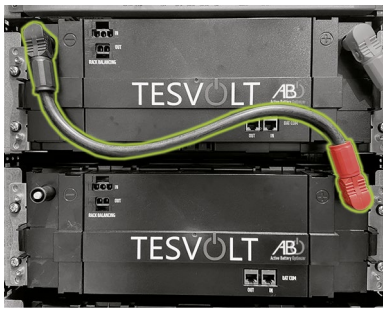
When installing the DC wiring, please note the following: **the plugs must audibly click into place.** The plugs can be unlocked by pressing the pushbutton on the side of the plug (see markings in the illustration).

11



The battery modules of the TS HV 70 are connected in series. The colours of the plugs must match the colours of the jacks on the battery module, i.e. red plug to red jack, for example. Start on the left side of the cabinet with the APU HV1000-S and the first battery module and the connecting cable (3.1).

12

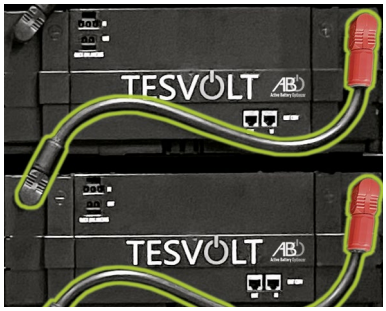


Then connect the remaining battery modules in this half of the cabinet with the DC connecting cables (4.1).

13

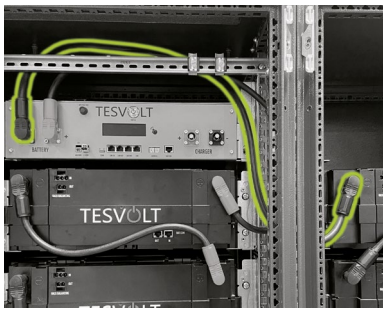
Connect the bottom two battery modules using the long DC connecting cable 5.1 from the cabinet connector set 5.

14



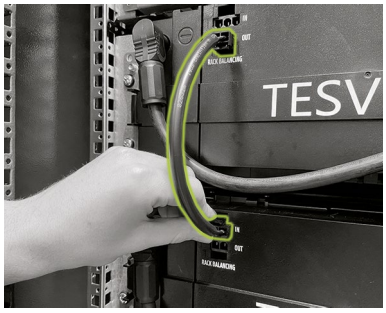
Install the remaining DC connecting cables 4.1 between the modules on the right side. Start with the bottom module.

15



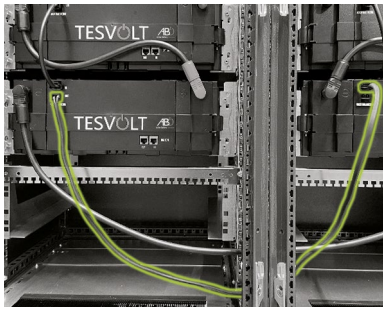
Connect the last module and the APU HV1000-S using the connecting cable 3.2. Make sure you follow the instructions in section “5.7 Wiring the battery modules” on page 19.

16



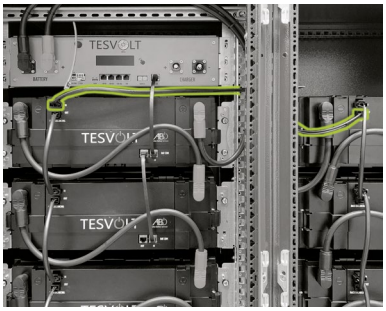
Connect the rack balancing “OUT” connection 22 of the first battery module below the APU HV1000-S to the rack balancing “IN” connection 21 of the next battery module down using a rack balancing module connector 4.3. Continue in this manner, connecting all the battery modules in the left half of the cabinet.

17



Use one of the 1.10 m long rack balancing connecting cables 5.3 to connect the bottom modules in the left and right halves of the cabinet.

18

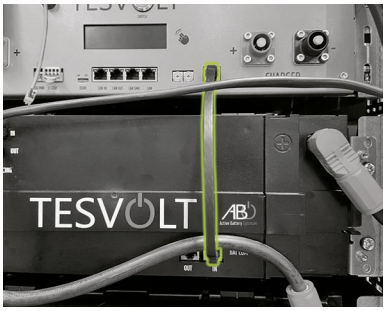


Now connect the remaining battery modules on the right side, starting from the bottom. Follow the specifications in section “5.7 Wiring the battery modules” on page 19 et seq.
Finally, using the 0.75 m rack balancing cable (6), connect the rack balancing “OUT” connection of the top module on the right half of the cabinet to the rack balancing “IN” - connection of the top module on the left side.

STOP

WARNING! Possible malfunction of the device due to faulty BAT-COM wiring
Incorrectly executed connection of the BAT-COM communication cable will lead to malfunctions in the operation of the battery. Ensure correct wiring in accordance with section “5.7 Wiring the battery modules” on page 19 et. seq.

19

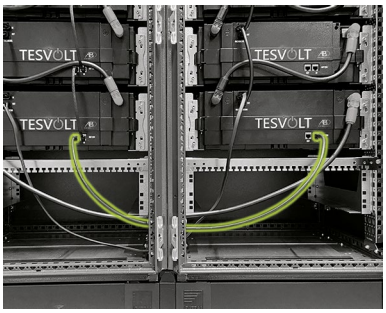


Connect the BAT-COM communication cable using the the supplied patch cables (3.3), (4.2) and (5.2). Connect the “BAT-COM” (11) connection of the APU HV1000-S and the BAT-COM “IN” connection on the battery module positioned below the APU HV1000-S using a patch cable (3.3). Then use a patch cable (4.2) to connect the same module’s BAT COM “OUT” connection to the next module’s BAT-COM “IN” connection.

20

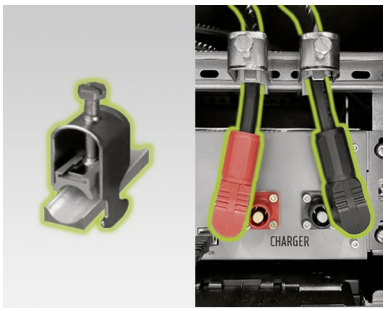
Connect the battery modules in the left half of the cabinet in the same way using the patch cables (4.2).

21



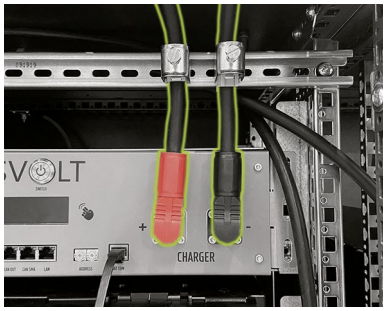
Establish the BAT-COM connection between the bottom battery modules using the longer patch cable (5.2).
Next, connect the remaining modules in the right half of the cabinet, starting at the bottom and using the patch cables (4.2). The last battery module’s BAT-COM “OUT” connection remains open.

22



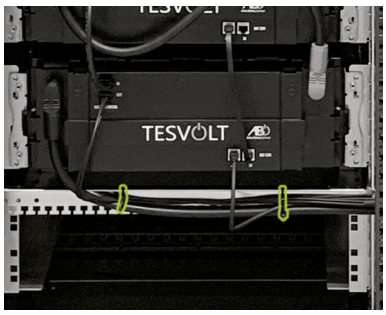
Now, lay the DC cables (7.1) / (7.2), starting from the APU HV1000-S “CHARGER” (12) (13) to the SMA STPS 60 or to the BatBreaker (13). The red plug is intended for connection to the positive pole and the black plug for connection to the negative pole. Please note that the cable can only be shortened on the SMA STPS 60/BatBreaker side. To relieve the strain on the DC cables, install the two cable retention clips (K) above the CHARGER connections (12) (13) of the APU HV1000-S (1) on the C-rail (D).

23



Only connect the DC cables 7.1 and 7.2 to the HV1000-S APU once the SMA STPS 60 is completely connected.
Please note that the plugs must audibly click into place.
Finally, fix the DC cables in the cable retention clips K.

24



Fasten the cabinet connector cables in the bottom part of the cabinet to the cable retention rails F using cable ties.
It is important to ensure while doing so that the cables are not crushed or damaged.

25

Establish the **LAN connection** 9 for the APU HV1000-S using the patch cable 7.4 with one of the two supplied TESVOLT switches 8 and with the jack labelled "LAN". This switch is connected to the "LAN 2" jack of the SMA Inverter Manager 10 and will be referred to as the "LAN 2 switch" from now on. The SMA STPS 60 is also connected to it (see section "7 Connection to the battery inverter" on page 32 et seq.).

26

Only master/slave systems: Run the CAN bus wiring between the CAN OUT 7 and CAN IN connections 5 on the APUs of the storage systems in the master/slave configuration according to the specifications in section "5.7 Wiring the battery modules" on page 19 et seq. Use the patch cable(s) 7.4 from the scope of delivery for the slave storage system.

27

Insert the plug of the connection cable E into the "EXT. SWITCH" connection 3 on the APU HV1000-S.

28

Finally, fill out the commissioning protocol. You will find a template for this on the TESVOLT USB-Stick 16. Also note down the serial numbers of the battery inverter and peripheral devices such as the SMA Inverter Manager. Send the completed commissioning protocol to service@tesvolt.com.

6.3 E-STOP CONTACT

The TS HV 70 has a quick shutdown (e-stop) function. The unit has a four-pin plug that is accessible from the outside for this purpose. This electrical connection can be connected to an external control system using the appropriate Wago 734-104 jack. If necessary, the external control system can switch off the unit as quickly as possible using a separate (i.e. completely independent) switching path. This shutdown is much faster than the normal shutdown process. The wiring connection may only be implemented using a dry contact.

WARNING! Possible damage to the unit due to use of the e-stop
The e-stop device is used to quickly shut down the system. As the battery storage system is not switched off properly when the e-stop is used, damage to the TS HV 70 can occur. For this reason, never use the e-stop to switch off the unit under normal circumstances.

WARNING! Possible damage to the APU HV1000-S or external components due to an unsuitable switching device
The e-stop contact is at a voltage of 24 V_{DC} relative to the potential of the casing. This voltage is created from the battery voltage by the power supply unit in the APU HV1000-S. Connecting a wet switching device can result in damage to the APU HV1000-S and/or external components.

E-stop states

1. Contacts 1 and 4 as well as 2 and 3 of the Wago plug are connected, e.g. by an external relay; the e-stop is inactive and the APU HV1000-S is thus switched on.
2. Contacts 2 and 3 on the Wago plug are open, e.g. after activation of the external switch; the e-stop is active (this is shown on the APU HV1000-S display); the DC connection between the TS HV 70 and the SMA STPS 60 is interrupted.

Request to the external control system

Since the e-stop uses an internal voltage of 24 V_{DC} within the unit, external (relay) switching by means of a dry contact must be used for correct functioning. This switching can be adapted to match the requirements of the external control system. The possible wirings are shown in the figures below.

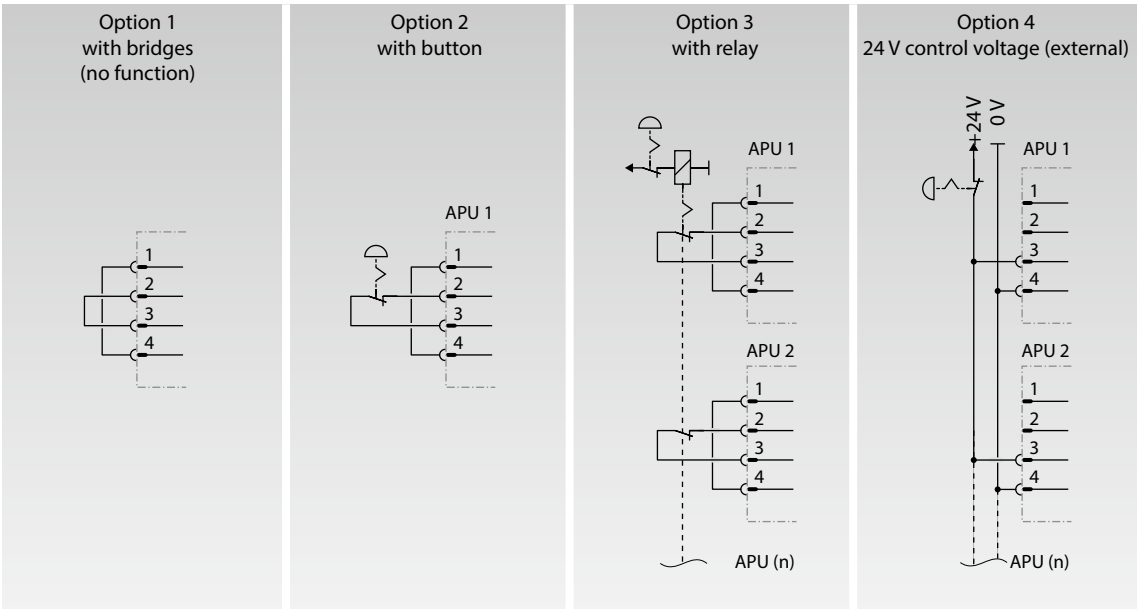


Figure 6.1 E-stop, options 3 and 4 are intended for use in systems with more than one APU HV1000-S.

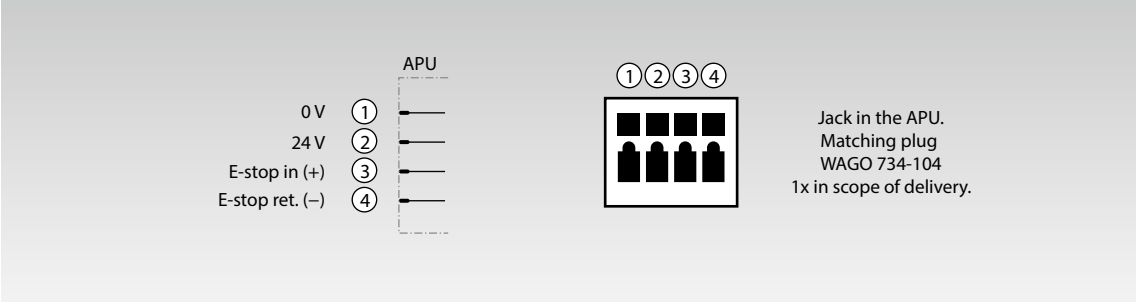


Figure 6.2 Assignment of the e-stop connection jack 4

NOTE: If you are not using the e-stop function, the bridged plug must be fitted to the e-stop connection 4, as the storage system will otherwise remain inactive!

E-stop connection 4 on the APU HV1000-S with Wago plug.

6.4 EXTERNAL 24 V POWER SUPPLY FOR THE APU HV1000-S

NOTE: If you want to operate the APU HV1000-S with an external 24 V power supply, please coordinate your intention beforehand with the TESVOLT Service Line +49 (0)3491 8797-200 or via service@tesvolt.com.

In the factory configuration, the APU HV1000-S is supplied with operating voltage by an internal power supply unit. If your planning requires an external 24 V supply, however, an adapted version of the APU HV1000-S can be supplied on request. Please coordinate your plans with TESVOLT Service in good time.

7 CONNECTION TO THE BATTERY INVERTER

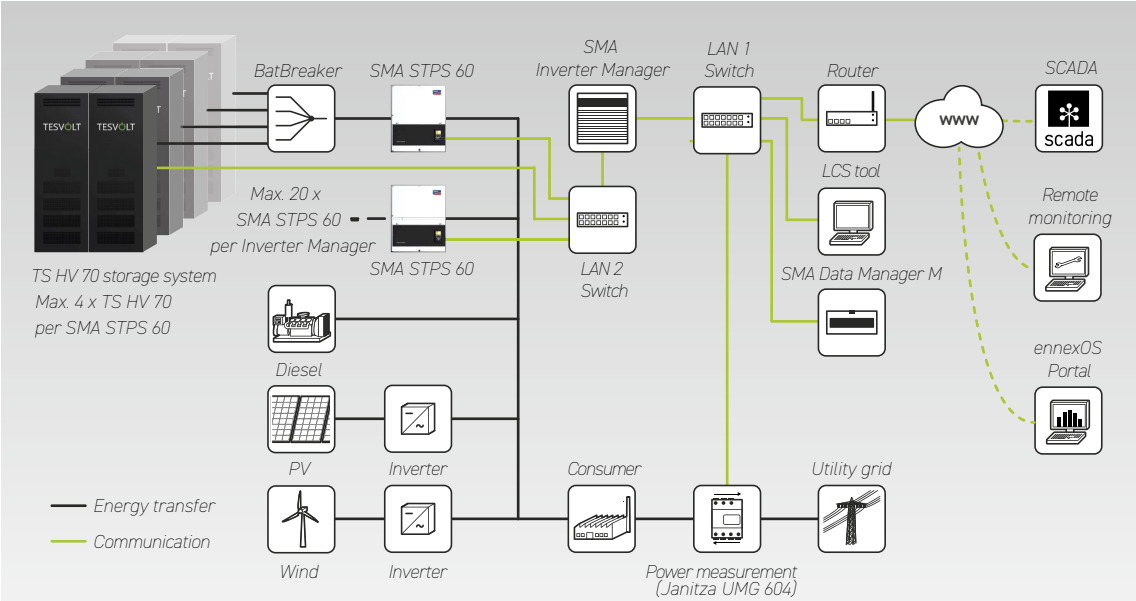
WARNING! Possible damage to the TS HV 70 and/or the SMA STPS 60 by additional consumers in the DC auxiliary circuit

Always follow the instructions for connecting the TS HV 70 and the SMA STPS 60. For example, there must be no additional consumers or components planned for the DC auxiliary circuit between the battery and inverter. If you would like to make changes to the system setup, you must always consult with TESVOLT Service regarding your plans.

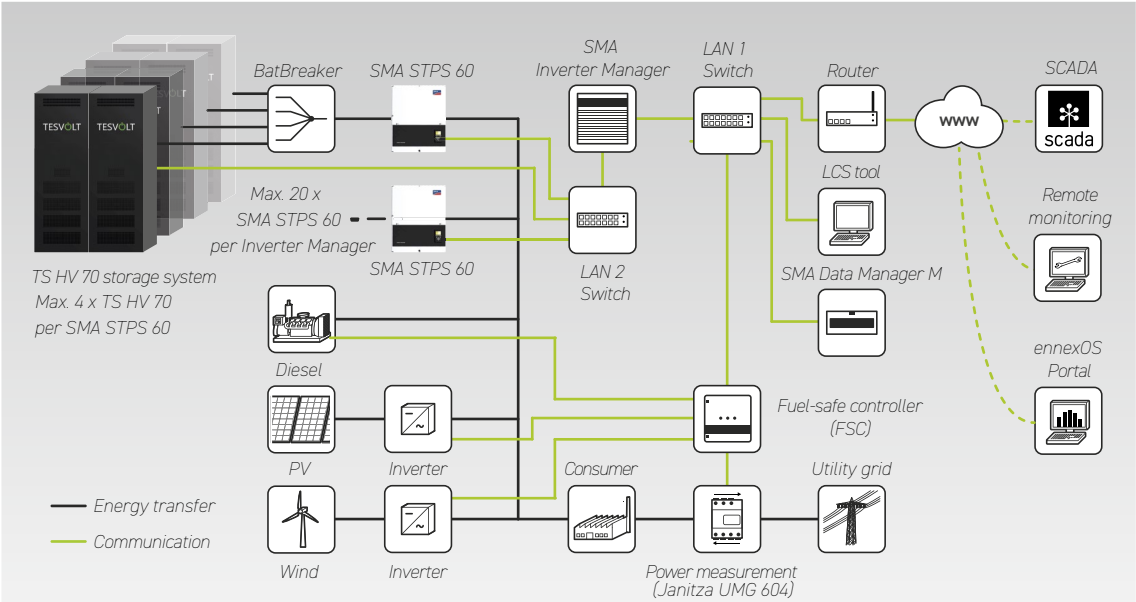
NOTE: Up to 20 SMA STPS 60 units can be operated in parallel on an SMA Inverter Manager.

7.1 SYSTEM SETUP

Standard system structure



System structure with Fuel Save Controller (FSC)



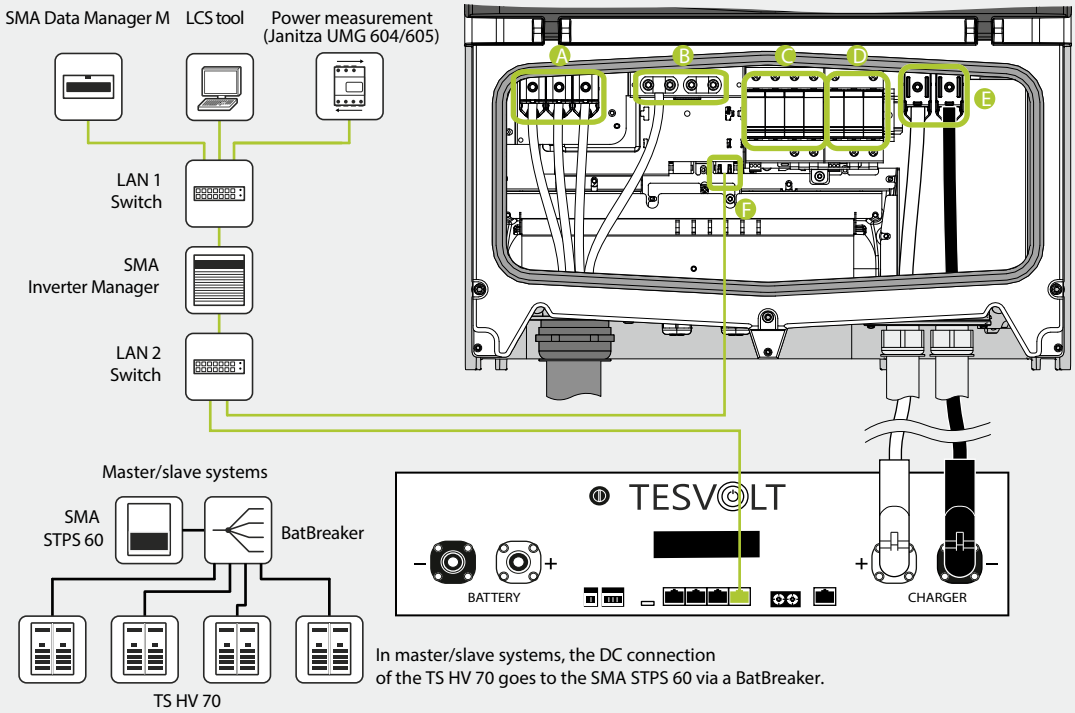
7.2 SMA STPS 60 CONNECTION DIAGRAM

DANGER! Lethal electric shock or damage to the unit due to incorrect connection
The valid installation manual for the SMA STPS 60 provides authoritative information about correctly connecting the SMA STPS 60. For this reason, the information provided in this manual is entirely non-binding.

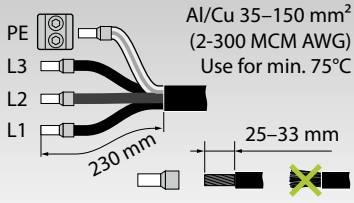
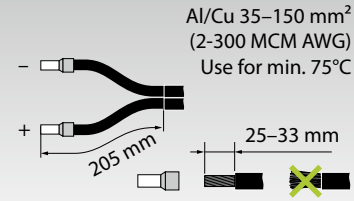
WARNING! Possible damage to the TS HV 70 if the installation requirements are not met
Before connecting the SMA STPS 60, the installation of the TS HV 70 must be completely finished.

WARNING! Potential malfunctions due to improper laying of cables
Communication, measuring and control cables must always be kept separate from AC/DC cables, as otherwise electromagnetic interference can cause disturbances in data transmission and, as a result, malfunctions.

NOTE: If a BatBreaker (13) is used in a master/slave system, use the DC connector set (14) to connect the BatBreaker to the SMA STPS 60.



In master/slave systems, the DC connection of the TS HV 70 goes to the SMA STPS 60 via a BatBreaker.

ITEM	DESIGNATION	DESCRIPTION	
A	AC connecting terminals	The tightening torque must be 20 Nm for a conductor cross-section of 35 to 95 mm², and 30 Nm for 96 to 150 mm². Note: If cables with fine- or extra fine-wired conductors are used, wire-end ferrules must be used for the connection.	 Al/Cu 35–150 mm² (2-300 MCM AWG) Use for min. 75°C
B	Unit grounding		
C	AC overvoltage protection	Surge protection device (SPD)	
D	DC overvoltage protection	Surge protection device (SPD)	
E	DC connecting terminals	Battery connection: The tightening torque is 20 Nm for a conductor cross-section of 35 to 50 mm². Note: If cables with fine- or extra fine-wired conductors are used, wire-end ferrules must be used for the connection.	 Al/Cu 35–150 mm² (2-300 MCM AWG) Use for min. 75°C
F	Two ethernet interfaces	Communication interface to the SMA Inverter Manager	

8 COMMISSIONING

8.1 COMMISSIONING A SINGLE UNIT

WARNING! Possible damage to the battery due to incorrect configuration
Incorrect configuration may damage the battery. The parameter settings influence the SMA STPS 60's charging behaviour. For this reason, it is important to make the correct settings during commissioning.

Prerequisites

The SMA STPS 60 has been installed in accordance with SMA's specifications (installation/connection).

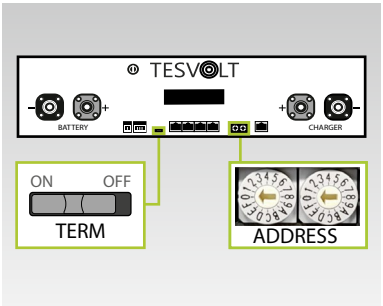
Procedure

1 Check the wiring of the SMA STPS 60 and TS HV 70 (also see the installation manual for the SMA STPS 60).

2 Check the wiring of the components in accordance with section "5.7 Wiring the battery modules" on page 19 et seq. If the wiring is correct, all live components will be protected against physical contact. Switch the DC power switch on the BatBreaker (if present) to "ON". Ensure that the SMA STPS 60's DC load-disconnecting switch is set to "ON".

WARNING! Possible damage to the APU HV1000-S due to undetected errors during installation
Carry out the check carefully in accordance with step 2, as damage to the APU HV1000-S can occur if there are deviations.

3 Now commission the SMA Inverter Manager 10.

4 

Check and, if necessary, correct the settings for termination and addressing the TS HV 70 ("TERM" 5 and "ADDRESS" 10) on the APU HV1000-S.
TERM is to be set to "ON" when operating a single TS HV 70, and ADDRESS is to be set to "0" and "0".

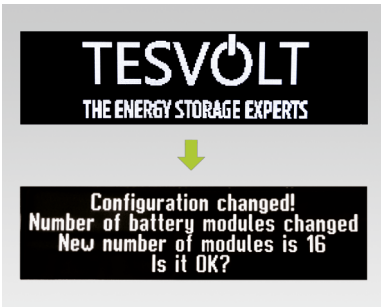
5 Switch on the external switch B on the outside of the cabinet door.

6 Press the On/off switch ("SWITCH") 17 on the APU HV1000-S.

WARNING! Possible damage to the APU HV1000-S due to improper operation
If you tap on the APU HV1000-S to activate it or confirm an action, you must note the following instructions to avoid damaging the APU HV1000-S:

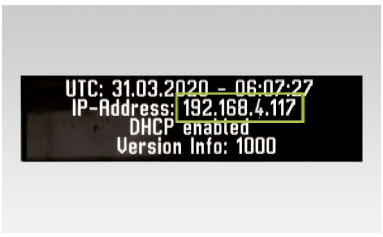
1. Do not use objects to tap the unit under any circumstances.
2. Tap gently with your fingers on the marking 16 to the right of the display on the casing. **Never tap on the display**.

7



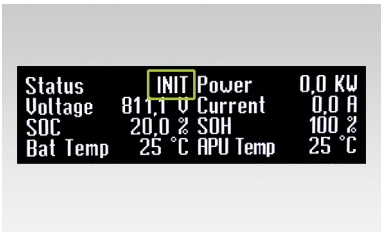
The number of battery modules detected (14 or 16) is shown on the display. Confirm the number is correct by tapping twice on the marking 16 beside the display. If the displayed number of modules differs from the number actually present, shut down the unit and check the BAT-COM wiring. If the fault continues to occur regardless, please contact the TESVOLT Service Line +49 (0) 3491 87 97 - 200 or email to service@tesvolt.com.

8



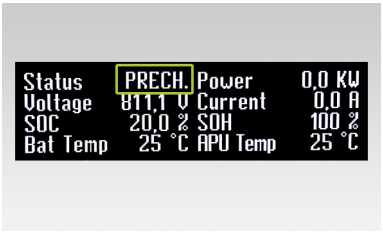
Tap beside the display again to access the next menu item. You will now be shown the assigned IP address. It must begin with 192.168.4. ....

9



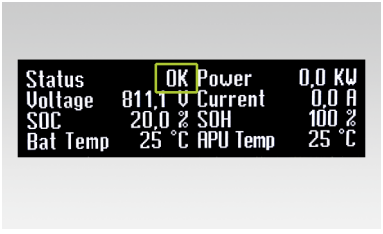
The TS HV 70 switches to "INIT" mode and the on/off "SWITCH" 17 starts to flash.

10



Start the commissioning process of the battery inverter with the SMA LCS Tool. The software and a manual can both be found on the TESVOLT USB-Stick 16. Once the commissioning process has been successfully completed, the battery storage system switches to pre-charge mode "PRECH".

11



After precharge mode, the on/off "SWITCH" 17 remains lit. "OK" appears as the status on the display of the APU HV1000-S. The TS HV 70 is now ready for operation.

NOTE: The display remains active for approximately two minutes and is then deactivated. It can be reactivated by tapping twice.

8.2 COMMISSIONING TS HV 70 SYSTEMS USING THE MASTER/SLAVE PRINCIPLE

STOP

WARNING! Possible damage to the battery due to incorrect configuration
Incorrect configuration may damage the battery. The parameter settings influence the SMA STPS 60's charging behaviour. For this reason, it is important to make the correct settings during commissioning.

Prerequisites

The SMA STPS 60 has been installed in accordance with SMA's specifications (installation/connection).

Procedure

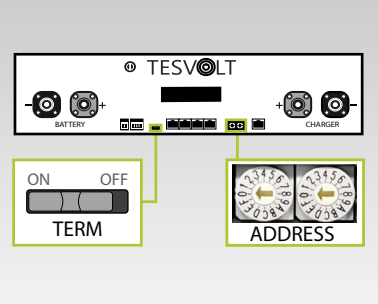
1 Check the wiring of the SMA STPS 60 and TS HV 70 (see the installation manual for the SMA STPS 60).

2 Check the wiring of the components in accordance with section "5.7 Wiring the battery modules" on page 19 et seq. If the wiring is correct, all live components will be protected against physical contact. Switch the DC power switch on the BatBreaker to "ON". Ensure that the SMA STPS 60's DC load-disconnecting switch is set to "ON".

STOP **WARNING! Possible damage to the APU HV1000-S due to undetected errors during installation**
Carry out the check carefully in accordance with step 2, as damage to the APU HV1000-S can occur if there are deviations.

3 Now commission the SMA Inverter Manager 10.

4



You can now make the settings for termination and addressing the TS HV 70 ("TERM" 5 and "ADDRESS" 10)in accordance with the section "Overview of all addressing options" on page 44 and the figures in section "10.2 Expanding capacity using additional TS HV 70 units" on page 41 et seq. In the case of master/slave systems, TERM 5 is to be set to "ON" for the APU HV1000-S of the master and the last storage system in the master/slave configuration. TERM 5 is to be set to "OFF" for all other slave APUs in the configuration.

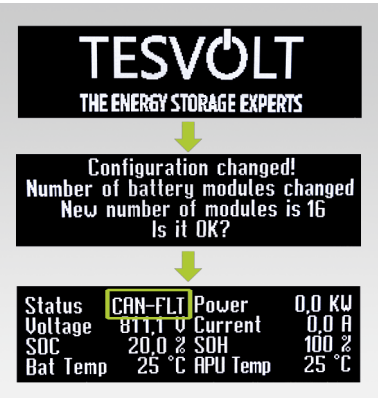
STOP **WARNING! Possible damage to the APU HV1000-S due to improper operation**
If you tap on the APU HV1000-S to activate it or confirm an action, you must note the following instructions to avoid damaging the APU HV1000-S:

1. Do not use objects to tap the unit under any circumstances.
2. Tap gently with your fingers on the marking to the right of the display on the casing. **Never tap on the display**.

NOTE: The display remains active for approximately two minutes and is then deactivated. It can be reactivated by tapping twice.

5 You can now commission all the slave storage systems. Proceed in reverse order according to their position in the master/slave configuration. Start with the last slave of the master/slave configuration and first switch on the external switch B on the outside of the cabinet door and then the on/off "SWITCH" 17 on the APU HV1000-S.

6



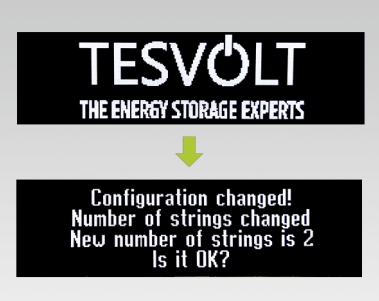
The number of battery modules detected (14 or 16) is shown on the slave storage system's display. Confirm the number is correct by tapping twice on the marking 16 next to the display. If the displayed number of modules differs from the number actually present, shut down the TS HV 70 and check the BAT-COM wiring.
If the fault continues to occur regardless, please contact service@tesvolt.com or the
TESVOLT Service Line +49 (0) 3491 87 97 - 200.
Once commissioning has been completed successfully, the status changes to "CAN-FLT".

7 Switch on the next slave storage system and proceed as described in steps 4 and 5, i.e. as for commissioning the first slave.

8 Once all of the slave storage systems have been commissioned, the master cabinet can be started. To do this, switch on the external switch B on the outside of the cabinet door.

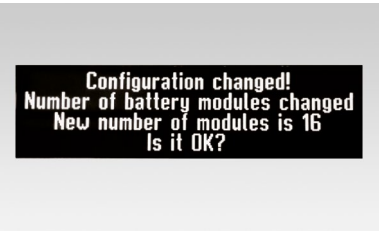
9 Now press the On/Off switch ("SWITCH") 17 on the corresponding APU HV1000-S.

10



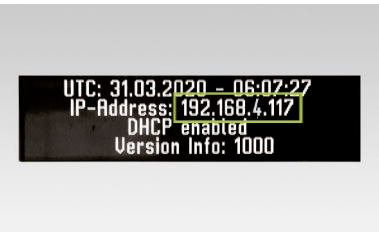
Unlike the slave APUs, the master initially requests the number of "strings". The number of strings corresponds to the number of storage systems in the master/slave configuration (e.g. master + slave 1 = 2 strings). Confirm the number is correct by tapping twice next to the display. If there are deviations, check the CAN OUT → CAN IN wiring, the termination and the addressing. If the fault continues to occur, contact the TESVOLT Service Line +49 (0) 3491 87 97 - 200 or service@tesvolt.com.

11



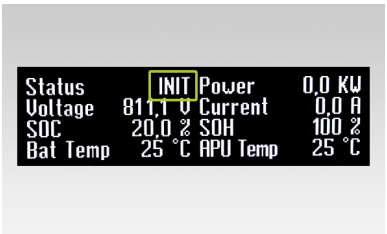
The display of the master APU HV1000-S now shows the number of detected battery modules (14 or 16). Confirm the number is correct by tapping twice. If there are deviations, shut down the TS HV 70 and check the BAT-COM wiring. If the fault continues to occur, contact service@tesvolt.com or the TESVOLT Service Line +49 (0) 3491 87 97 - 200.

12



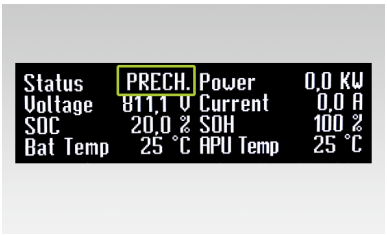
Tap beside the display again to access the next menu item. You will now be shown the assigned IP address. It must begin with 192.168.4. ....

13



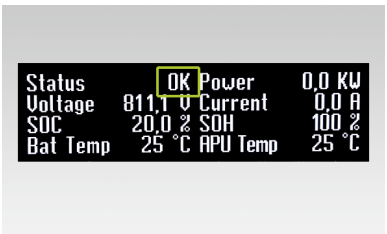
The TS HV 70 switches to "INIT" mode and the on/off "SWITCH" 17 starts to flash.

14



Start the commissioning process of the SMA STPS 60 with the SMA LCS Tool. The software and a manual can both be found on the TESVOLT USB-Stick 16. Once the commissioning process has been successfully completed, all the TS HV 70 units switch to precharge mode "PRECH".

15



Once the precharging has completed successfully, the on/off switches "SWITCH" 17 on all APU HV1000-Ss in the master/slave configuration are continuously illuminated. "OK" appears as the status on the display of the APU HV1000-S. All the TS HV 70 units are now ready for operation.

9 DECOMMISSIONING

DANGER! Danger of death due to electric shock after decommissioning
Large parts of the battery system are still under full voltage even after decommissioning, meaning there is a risk of a fatal electric shock if operators touch live parts of the storage system.

DANGER! Risk of injury due to electric shock after decommissioning

- Discharging of the inverter's capacitors can take several minutes even after switching off. For this reason, please wait 15 minutes until the system has largely discharged.
- The DC auxiliary circuit is not completely voltage-free after decommissioning; the voltage is merely low ($U_{DC} \leq 60\ V_{DC}$), meaning a fatal electric shock can no longer occur if operators touch live parts of the DC auxiliary circuit.

WARNING! Possible damage to the unit due to incorrect decommissioning
For standard decommissioning, the output must be 0 kW before the APU HV1000-Sis decommissioned using the on/off switch. Use the SMA LCS Tool to reduce the output to 0 kW.
The DC disconnecting switch on the underside of the STPS must remain in the "ON" position, and under no circumstances must it be set to "OFF".

1. Reduce the output of the SMA STPS 60 to 0 kW. To do this, open the SMA LCS Tool and access the Inverter Manager.
2. Press the "Plant Stop" button at the top right in the LCS tool. The Inverter Manager lowers the output of the STPS to 0 kW, opens the AC contactor of the STPS and gives the command to the APU HV1000-S to disconnect from the DC path. Wait until the audible opening of the contactors in the STPS and the APU HV1000-S is heard. Please refer to SMA's product documentation or the website www.sma.de for further information.

NOTE: The SMA LCS Tool is an SMA product. For this reason, TESVOLT cannot guarantee the accuracy of information provided about this and other products belonging to SMA. Binding information can only be found in SMA's valid product documentation for the relevant product.

3. Disconnect the SMA STPS 60's AC fuses.
4. Switch off the external switch (B) on the outside of the cabinet door.
5. 

Press the on/off switch ("SWITCH") (17) on the APU HV1000-S. The green LED must then go out.
For systems with multiple TS HV 70 units, each APU HV1000-S must be switched off.
6. On the APU HV1000-S, disconnect the DC cables (7.1)/(7.2) from the unit at the CHARGER connection (12) / (13).
7. Wait 15 minutes until the system is largely voltage-free as the capacitors in the inverter take several minutes to discharge.

10 EXPANDING THE STORAGE SYSTEM

The capacity and the charging/discharging power of TESVOLT battery systems can be expanded.

10.1 EXPANDING CAPACITY USING THE TS HV EXPANSION SET

Installing expansion modules

STOP **WARNING! Possible damage to the unit and/or battery inverter if the expansion and original battery modules have different states of charge**
If a battery module is installed in a TS HV 70 battery storage system and this module's state of charge differs from that of the battery modules already present, this can cause damage to the battery modules or the APU HV1000-S.

1 The new battery modules are supplied with a state of charge (SoC) of approx. 20%. Before you integrate a new battery module into an existing battery system, the existing system must be brought to the same voltage level. First check the state of charge of the new battery modules by carrying out a voltage measurement; this must be exactly 50.0 +/– 0.1 V_{DC}. If there are deviations, please contact the TESVOLT Service Line +49 (0) 3491 87 97 - 200 or service@tesvolt.com.

2 Adjust the voltage of the original battery modules of the TS HV 70 so that it matches the voltage of the new battery modules exactly. Use the SMA LCS Tool to do this. Further information about the procedure can be found in the section "Adjusting the battery voltage using the SMA LCS Tool" on page 40.

3 Decommission the battery cabinet in accordance with section "9 Decommissioning" on page 38.

4 Prepare the battery cabinet for installation of the battery modules. Remove the cables in the cabinet connector set (5) from the bottom two battery modules. Start with the DC cables (5.1). Continue with the patch cable (5.2) and the rack balancing cable (5.3).

5 Now remove the two cable retention rails (F) and reattach them below the bottom slide rails. Leave two holes free on the rack frame below the slide rails and fit the cable retention rails (F) on the third hole. Use the old cage nuts (J) for this. Please use the auxiliary tool (J1) to disassemble and install them.

STOP **WARNING! Possible damage to the unit due to incorrect wiring**
Incorrect connection of the DC or BAT-COM cables will cause battery management components and/or the battery modules of the TS HV 70 to become damaged, necessitating replacement. It is therefore essential to ensure correct wiring in accordance with section "5.7 Wiring the battery modules" on page 19 et. seq.

6 Now insert the new battery modules in the bottom position.

7 You can now connect the new modules to the old ones. Start on the left side of the cabinet with the DC cables (4.1) in the module connector set (4). Continue with the patch cable (4.2) and the rack balancing cable (4.3). Then connect the cables in the cabinet connector set (5) to the new modules. Start with the DC cables (5.1). Continue with the patch cable (5.2) and the rack balancing cable (5.3). After this, connect the new and old battery modules in the right half of the cabinet using the module connector set (4).

8 Finally, check that the wiring is correct in accordance with section "5.7 Wiring the battery modules" on page 19 et seq.

9 You can now recommission the storage system in accordance with section "8 Commissioning" on page 34.

10 In the event of a restart, the APU HV1000-S queries the number of modules now detected on the display. If the number is correct, confirm this by tapping twice on the marking to the right of the display.

11 After this, start recommissioning the system using the SMA LCS Tool (adjusting the new voltage limits). Sign into the SMA LCS Tool using your ***"Grid Guard" code***. After starting recommissioning, go through the commissioning procedure and select "Tesvolt 16 modules". During recommissioning, follow the documentation for the SMA LCS Tool.

Adjusting the battery voltage using the SMA LCS Tool

NOTE: The SMA LCS Tool is an SMA product. For this reason, TESVOLT cannot guarantee the accuracy of information provided about this and other products belonging to SMA. Binding information can only be found in SMA's valid product documentation for the relevant product.

1 Enter your ***SMA Grid Guard Code*** in the "Service" > "Grid Guard" tab. If you do not have a code, please contact the SMA Service Line.

2 Access the active power specification in the "Inverter Parameter" > "Support Settings" > "Immediate Controls" > ***"Active Power [P_Ref]"*** tab and set the active power to "**0**%" > Put the STPS on standby and save the settings ("Save").

3 Make the following settings under the "Power Management" tab:
Limited Export enabled "Off" | ***Peak Load Shaving "Off"*** | ***Time of Use "Off".***

4 Determine the ACTUAL DC voltage using the APU or STPS display or the SMA LCS Tool and compare this with the TARGET voltage of 700.0 V_{DC} (14 battery modules with 50.0 V_{DC} each).

Note: The stored energy must be prevented from being fed back into the utility grid. For this reason, the energy fed in from the battery storage system must not exceed the current consumption in the local utility grid.

5 If you have to reduce the voltage of the TS HV 70 (discharging), enter a value between 0 and 100 % [positive number] for ***"Active Power [P_Ref]"***.

6 If you have to increase the voltage of the TS HV 70 (charging), enter a value between 0 and -100 % [negative number] for ***"Active Power [P_Ref]"***.

7 Monitor charging or discharging to the target voltage of 700.0 V_{DC}.

When the target voltage is reached, slowly reduce the charging/discharging power to 0%.

8 Compare the voltage of one of the existing modules in the storage system with the module voltage of the expansion modules. Both values must be 50.0 +/-0.1 V_{DC}.

9 Adjust the voltage of the storage system until the new and original modules are at the same voltage.

10.2 EXPANDING CAPACITY USING ADDITIONAL TS HV 70 UNITS

WARNING! Possible damage to the unit and/or battery inverter if the unit is extended by different capacities

If you would like to use multiple TESVOLT TS HV 70 battery storage systems on one SMA STPS 60 inverter, it is essential that they all have the same capacity.

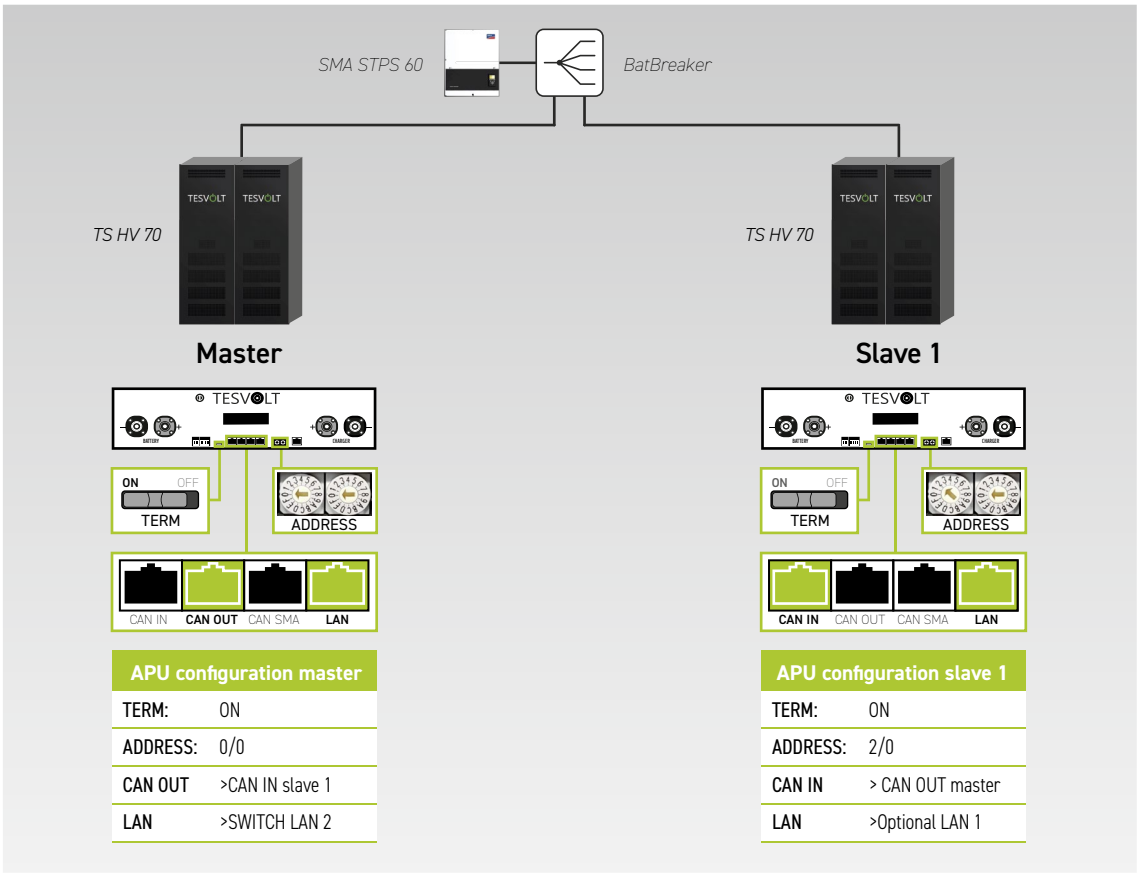
WARNING! Possible damage to the unit and/or battery inverter if the unit is extended by different capacities

When battery systems are connected in parallel, the APUs may not be operated as independent masters and must always be installed in master/slave systems.

NOTE: Up to four TS HV 70 units can be connected in parallel per SMA STPS 60 using the master/slave principle.

NOTE: When expanding a single storage system to include one or more slave storage systems, a BatBreaker (13) and a BatBreaker DC connector set (14) must be ordered and installed at the same time.

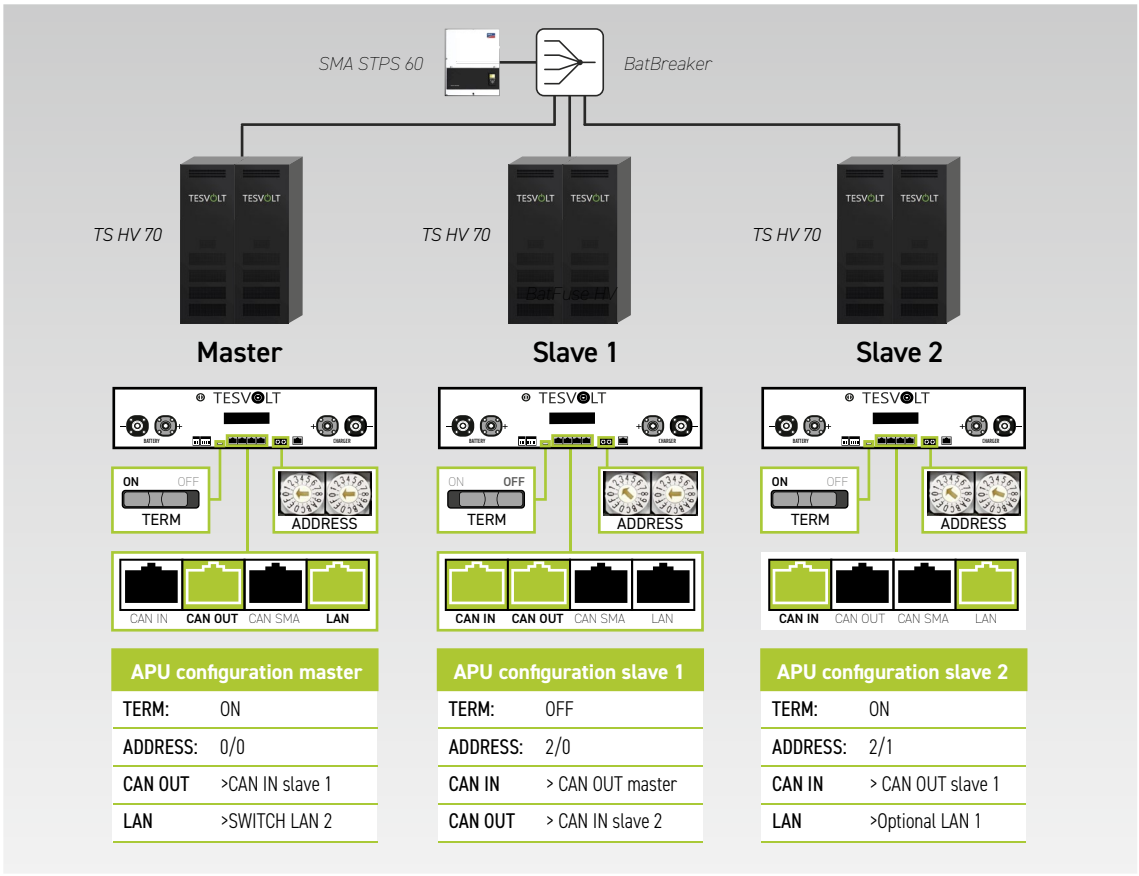
System with one master and one slave



APU configuration master	
TERM:	ON
ADDRESS:	0/0
CAN OUT	>CAN IN slave 1
LAN	>SWITCH LAN 2

APU configuration slave 1	
TERM:	ON
ADDRESS:	2/0
CAN IN	> CAN OUT master
LAN	>Optional LAN 1

System with one master and two slaves

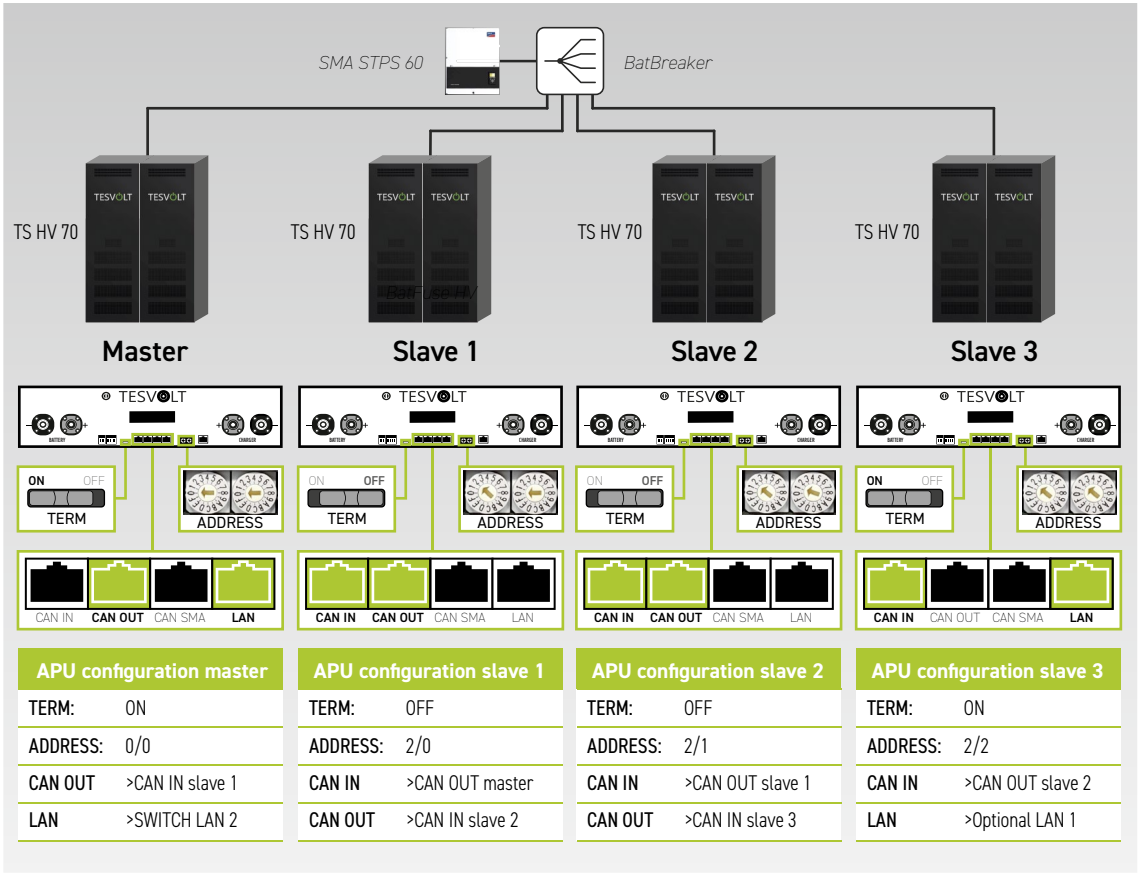


APU configuration master	
TERM:	ON
ADDRESS:	0/0
CAN OUT	>CAN IN slave 1
LAN	>SWITCH LAN 2

APU configuration slave 1	
TERM:	OFF
ADDRESS:	2/0
CAN IN	> CAN OUT master
CAN OUT	> CAN IN slave 2

APU configuration slave 2	
TERM:	ON
ADDRESS:	2/1
CAN IN	> CAN OUT slave 1
LAN	>Optional LAN 1

System with one master and three slaves



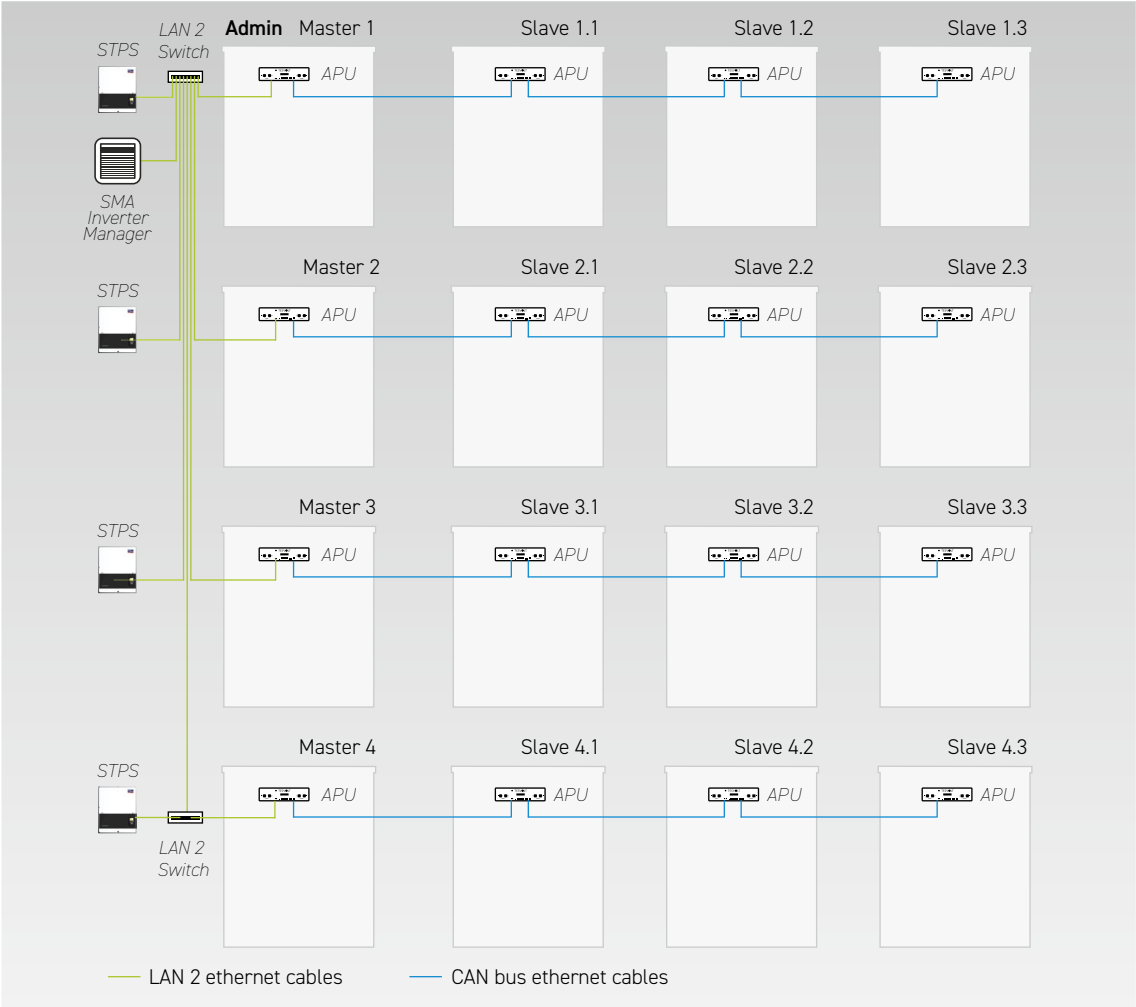
APU configuration master	
TERM:	ON
ADDRESS:	0/0
CAN OUT	>CAN IN slave 1
LAN	>SWITCH LAN 2

APU configuration slave 1	
TERM:	OFF
ADDRESS:	2/0
CAN IN	>CAN OUT master
CAN OUT	>CAN IN slave 2

APU configuration slave 2	
TERM:	OFF
ADDRESS:	2/1
CAN IN	>CAN OUT slave 1
CAN OUT	>CAN IN slave 3

APU configuration slave 3	
TERM:	ON
ADDRESS:	2/2
CAN IN	>CAN OUT slave 2
LAN	>Optional LAN 1

LAN2 wiring for systems with multiple master and slave storage systems



Port assignment of switches

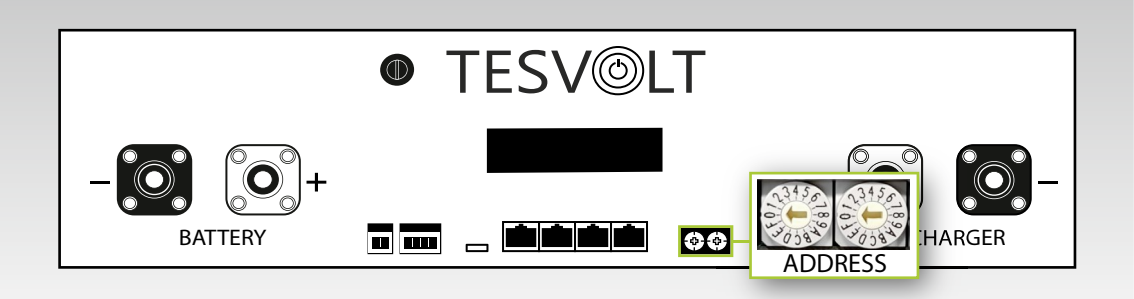
LAN 1 switch (8-port)

PORT	DESCRIPTION
1	SMA Inverter Manager (IVM) LAN 1
2	Janitza UMG 604
3	SMA Data Manager M
4	Router/internet
5	Service PC
6	Reserve/optional last slave in the configuration
7	Reserve
8	Reserve

LAN 2 switch (8-port)

PORT	DESCRIPTION
1	SMA Inverter Manager (IVM) LAN 2
2	SMA STPS 60 (master 1)
3	APU (master 1)
4	SMA STPS 60 (master 2)
5	APU (master 2)
6	SMA STPS 60 (master 3)
7	APU (master 3)
8	LAN 2 Switch (master 4) /service PC

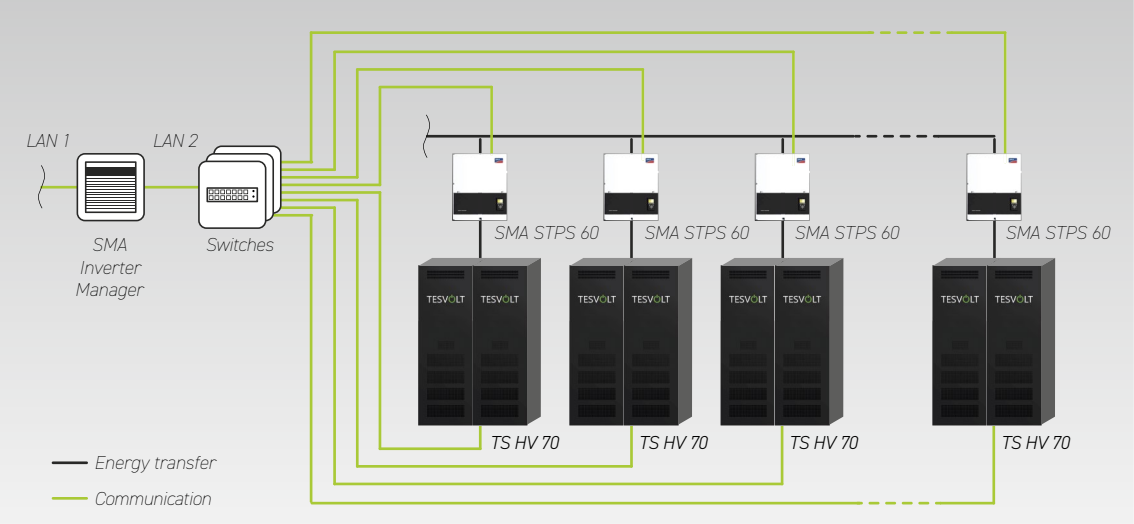
Overview of all addressing options



Set the address selector on the APU HV1000-S to match the configuration and data in the table below.

LEFT SELECTOR	RIGHT SELECTOR	DESIGNATION
0	0	Master 1
2	0	Slave 1 (of master 1)
2	1	Slave 2 (of master 1)
2	2	Slave 3 (of master 1)
0	0	Master 2
2	0	Slave 1 (of master 2)
2	1	Slave 2 (of master 2)
2	2	Slave 3 (of master 2)
0	0	Master 3
2	0	Slave 1 (of master 3)
2	1	Slave 2 (of master 3)
2	2	Slave 3 (of master 3)
0	0	Master 4
2	0	Slave 1 (of master 4)
2	1	Slave 2 (of master 4)
2	2	Slave 3 (of master 4)

10.3 EXPANDING THE POWER USING SMA STPS 60



The charging and discharging power can be increased by increasing the number of SMA STPS 60 units. Up to 20 SMA STPS 60 units can be operated on one SMA Inverter Manager.

11 TESVOLT BATTERY MONITORING SOFTWARE – BATMON

11.1 VIEWS AND FUNCTIONS

TESVOLT BatMon is a piece of software that can be used to analyse and visualise batteries right down to the cell level.

NOTE: The software can be found on the supplied TESVOLT USB-Stick (16) and must be installed in a writable directory on the "C:" drive, for start-up. The installation path suggested by the installation program must not be changed.

To obtain insights into the battery with the BatMon software, the service laptop's LAN connection must be connected to the LAN 2 switch (also see "7.1 System setup" on page 32).

After installation, launch the file "BatMon.exe". Tick all the boxes in the firewall query about full access to the network. The "System" menu item at the bottom of the BatMon interface includes a "Communication Port" button. The serial number and the IP address of the master APU HV1000-S must be selected here under "Select APU" (this information can be found on a sticker on the underside of the APU HV1000-S).

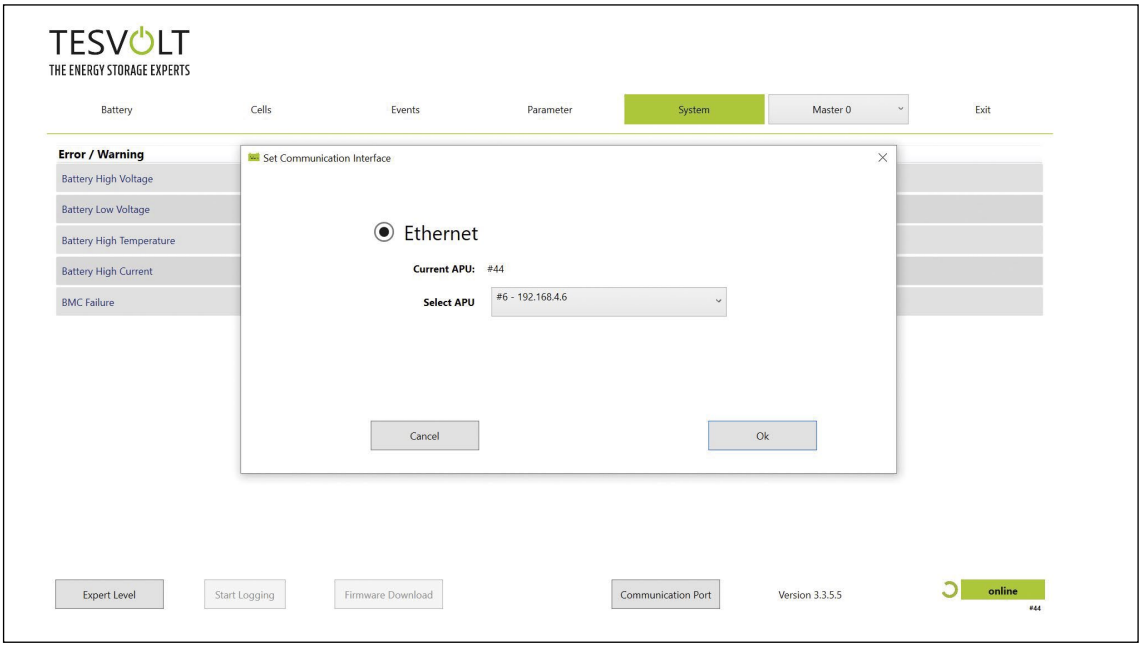


Figure 11.1 Screen for setting the network configuration

NOTE: If the configuration is correct and the battery is successfully connected, a continuous green circle and the "online" display area will appear in the bottom right-hand corner of the BatMon interface.

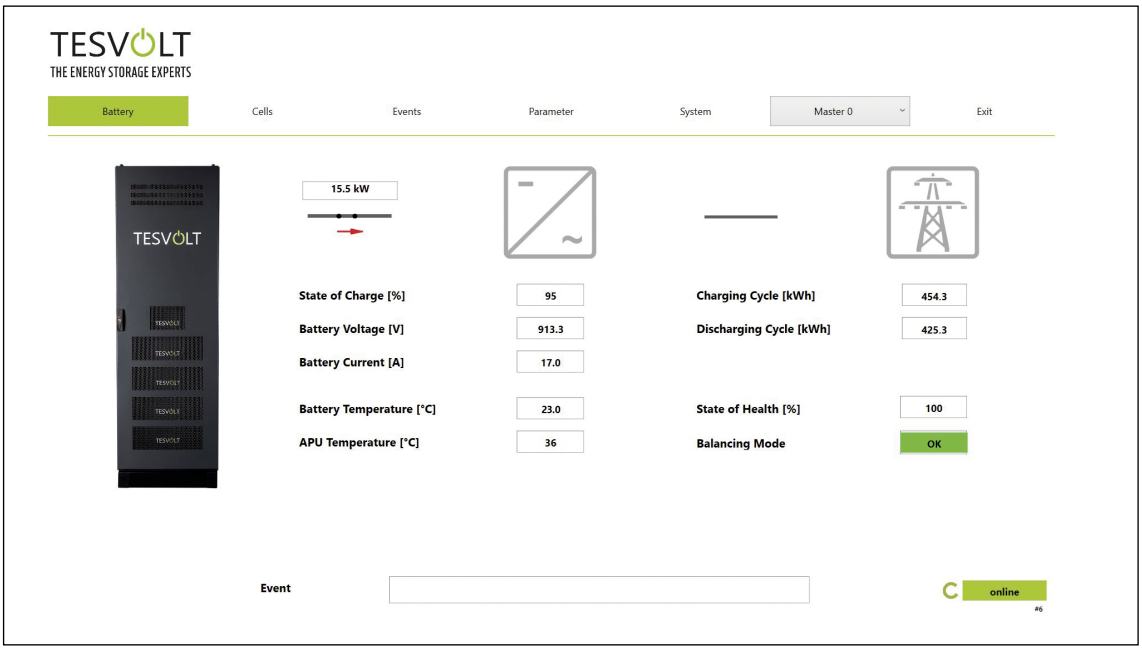


Figure 11.2 "Battery" screen

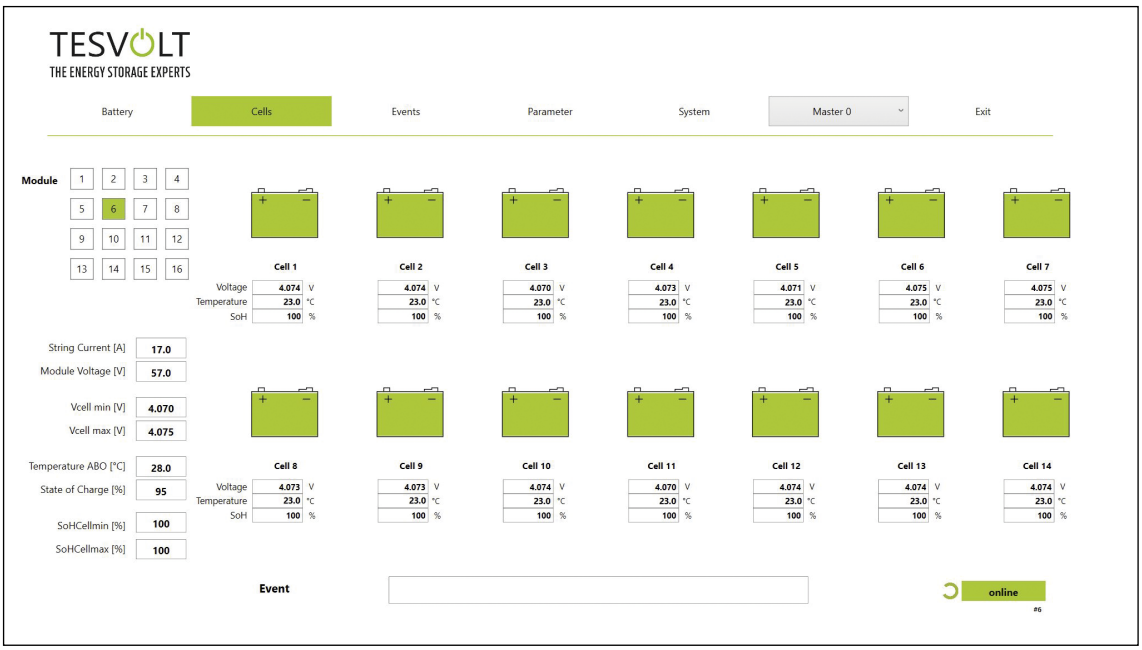


Figure 11.3 "Cells" screen

11.2 MENU STRUCTURE

The battery parameters highlighted in green in the table are password-protected. As these parameters directly affect the battery, only certified specialists are permitted to configure these parameters. You will receive the password directly from TESVOLT Service on request.

BATTERY	CELLS	EVENTS	PARAMETERS	SYSTEM	SELECTION
Charging/discharging power	Cell voltage	Event logbook	Battery parameters	Current errors	Master
Battery voltage	Cell temperature	Clear events	Load default	BatMon version	Slave
Charging/discharging current	SoC (cell)	Save events (as PDF)	Save default	Expert level	
Battery temperature	SoH (cell)		Reset APU	Start logging	
Balancing mode	Module voltage			Firmware download	
Charging cycle (kWh)	Charging/discharging power			Communication port	
Discharging cycle (kWh)	ABO temperature				
SoC (state of charge)					
SoH (state of health)					
Warning - time		Displayed	Expert settings	Functions	
APU temperature		data	Only with password		

11.3 THE MOST IMPORTANT CELL PARAMETERS

SoC – state of charge

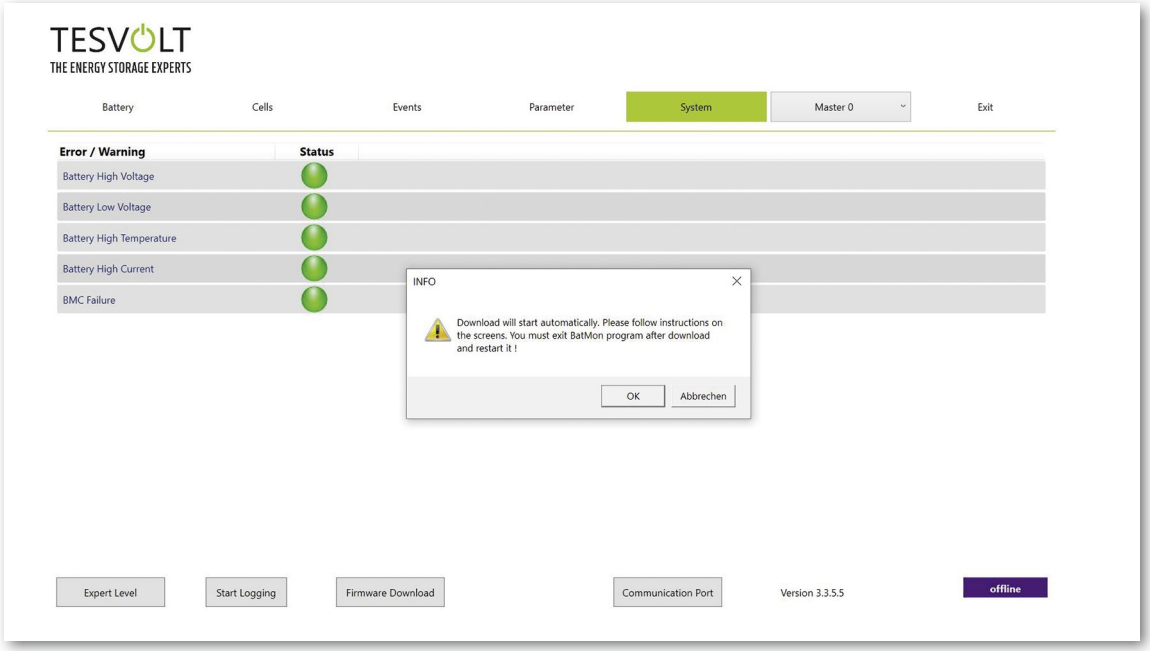
This value indicates the percentage to which the battery has been charged. 100% refers to a fully charged battery. The APU HV1000-S can use the parameters to determine the state of charge of a cell or battery module, and to stop the charging process if necessary. This prevents overcharging. The software also has the same function for the discharge process to prevent unnecessary strain on cells. Battery limit states define the points at which the system stops charging and discharging.

SoH – state of health

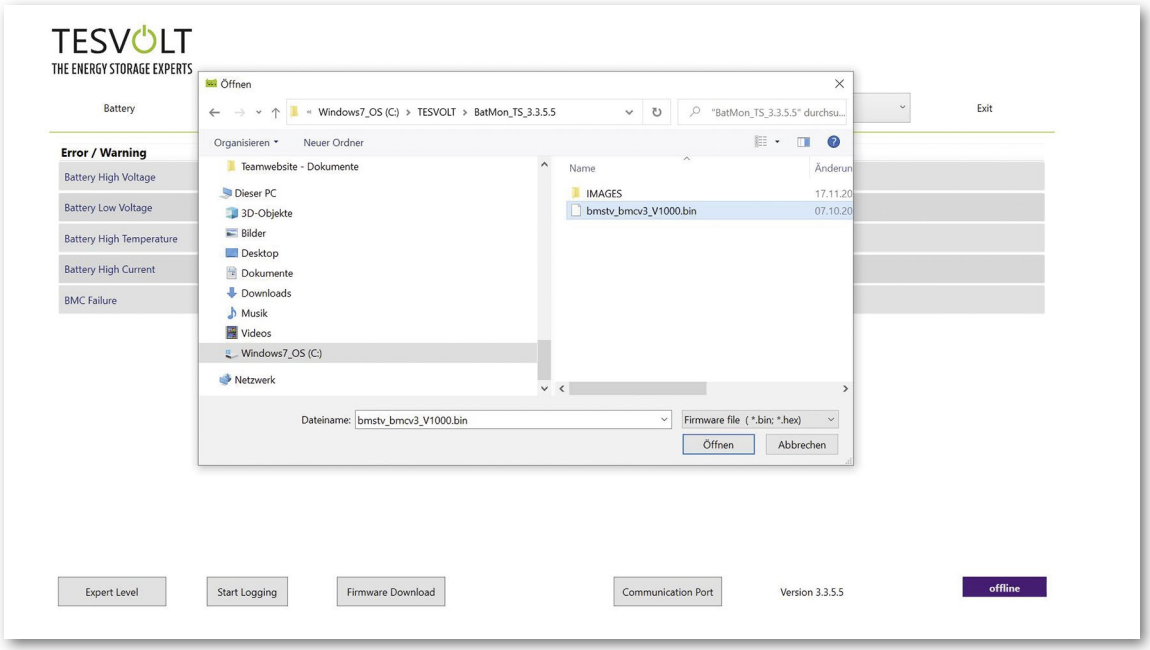
This value indicates a cell's health. Precise monitoring allows the system to detect performance differences between individual cells and thus detect damaged/defective cells. Depending on the seriousness of the fault, disconnection between the APU HV1000-S and STPS or shutdown of the storage system may occur.

12 FIRMWARE UPDATE

If required, the firmware update is installed via BatMon in coordination with TESVOLT Service. To do this, you have to enter the password in the Expert Level on the "System" page in BatMon. This can only be done in coordination with TESVOLT Service.

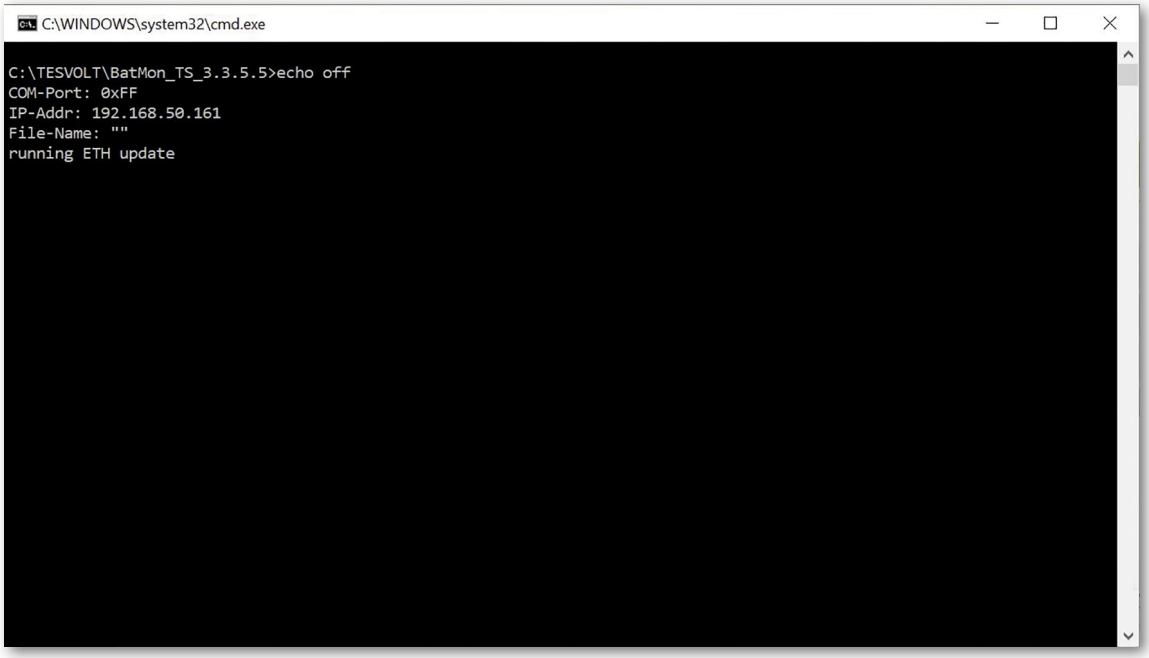


The latest firmware can then be downloaded with the "Firmware download" button on the "System" tab.



In the window that opens, select the firmware file (.bin) and confirm the selection by clicking on "Open".

Next, the update window opens. The update may take up to one minute. Afterwards, BatMon must be restarted.



13 FAULT AND WARNING MESSAGES ON THE TESVOLT TS HV 70

There are different types of messages as follows:

- Information (I): Status information, no error
- Warning (W): The system continues to run (possibly with limitations).
- Error (F): The system will shut down.

ID	TYPE	MESSAGE	DESCRIPTION	ERROR HANDLING
102	I	I102 Reset	Restart of the APU	After five unsuccessful restart attempts, the APU goes into "sleep mode". In this case: shut down the system. Contact TESVOLT Service.
104	F	F104 Current sensing error	Faulty current measurement	Shut down the system. Contact TESVOLT Service.
106	I	I106 E-stop	E-stop has been activated/deactivated.	If the e-stop signal is continuous: check e-stop wiring and correct if necessary. Shut down the system. Contact TESVOLT Service.
110	I	I110 Precharge	APU starts precharging the battery inverter.	–
121	F	F121 Parameter fault	A parameter value is outside the safe range.	Load default parameters. Perform a restart. Warning! Customer-specific parameters will be overwritten.
122	I	I122 Event buffer cleared	The message memory has been erased.	–
123	I	I123 Default parameters loaded	The default parameter values have been loaded.	To restore customer-specific parameter settings, contact TESVOLT Service.
201	F	F201 IsoSPI connection timeout	The communication between the APU and battery modules is interrupted.	Check the BAT-COM wiring. Shut down the system. Contact TESVOLT Service.
202	W	W202 Master/slave communication timeout	Communication between the APUs in the master/slave configuration is faulty.	Check the master/slave configuration (addressing, termination). Check communication connections between the APUs.
205	F	F205 No. modules master/slave not consistent	A slave shows a different number of modules than the master.	Check the BAT-COM wiring and the system configuration. After this, start the systems individually and check the displayed number of modules in each case.
206	F	F206 Balancing selftest (startup) failed	The ABO selftest failed.	Perform a restart. If the error occurs more than once: shut down the system. Contact TESVOLT Service.
207	F	F207 Module configuration fault	Different number of configured and communicating battery modules	Perform a restart. Perform reconfiguration. If the error continues to occur: shut down the system. Contact TESVOLT Service.
208	F	F208 I_String1 offset fault	An implausible current value has been measured.	Perform a restart. If the error continues to occur: shut down the system. Contact TESVOLT Service.
209	F	F209 Cell configuration fault	Voltage detected at an ABO measuring channel to which no battery cell should be connected	Perform a restart. If the error continues to occur: shut down the system. Contact TESVOLT Service.
211	F	F211 Difference V_String/V_ext too high	Difference between external and internal voltage measurement too high.	Perform a restart. Check module configuration and correct if necessary. If the error continues to occur: shut down the system. Contact TESVOLT Service.
212	F	F212 Reverse polarity detected V_ext	A negative voltage has been measured at the output.	Check power wiring for the system. If the error continues to occur: shut down the system. Contact TESVOLT Service.

ID	TYPE	MESSAGE	DESCRIPTION	ERROR HANDLING
213	F	F213 Contactor fault	Contactor is defective.	Contact TESVOLT Service immediately! Switch off the system. Disconnect the battery inverter from the utility grid. If possible, switch DC switch on battery inverter to O.
214	F	F214 Reference voltage fault	Hardware error detected	Shut down the system. Contact TESVOLT Service.
215	W	W215 High temperature difference (module) warning	An excessive temperature difference within a battery module was measured.	The system enables the regular power again as soon as the temperature difference is within the permissible range. In case of repeated, continuous occurrence, check for external sources of heat or cold.
216	W	W216 High temperature difference (string) warning	An excessive temperature difference within a battery string was measured.	The system enables the regular power again as soon as the temperature difference is within the permissible range. In case of repeated, continuous occurrence, check for external sources of heat or cold.
217	F	F217 Balancing selftest fault	ABO selftest failed	Perform a restart. If a hardware defect occurs, a corresponding error message is shown.
218	F	F218 Temperature NTC open wire	Contact error in the temperature line	Shut down the system. Contact TESVOLT Service.
219	F	F219 Temperature NTC short circuit	Contact error in the temperature line	Shut down the system. Contact TESVOLT Service.
220	F	F220 LTC Diagnostics: open wire	Contact error between ABO and battery cell	Shut down the system. Contact TESVOLT Service.
221	F	F221 LTC diagnostic fault: category 1	Internal ABO error	Perform a restart. If the error continues to occur: shut down the system. Contact TESVOLT Service.
222	F	F222 LTC diagnostic fault: category 2	Internal ABO error	Perform a restart. If the error continues to occur: shut down the system. Contact TESVOLT Service.
223	F	F223 LTC diagnostic fault: sum of cell fault	Internal ABO error	Perform a restart. If the error continues to occur: shut down the system. Contact TESVOLT Service.
301	F	F301 ABO board temperature max	The temperature of the ABO board is too high. The system will be disconnected and balancing switched off.	Let the system cool down and restart. If the error occurs frequently: shut down the system. Contact TESVOLT Service.
305	F	F305 Balancer temperature high	The temperature of the balancer of an ABO board is too high.	If the error occurs frequently: shut down the system. Contact TESVOLT Service.
310	W	W310 Contactor EOL warning	The lifespan of the contactors will soon be reached.	Maintenance/replacement of the contactors will soon be necessary. Contact TESVOLT Service.
311	W	W311 Contactor EOL OC warning	The end of the contactors' lifespan due to overcurrent shutdowns will soon be reached.	Maintenance/replacement of the contactors will soon be necessary. Contact TESVOLT Service.
360	F	F360 Contactor EOL reached	The end of the contactors' lifespan has been reached.	Maintenance/replacement of the contactors is required. Contact TESVOLT Service.
361	F	F361 Contactor EOL OC reached	The end of the contactors' lifespan due to overcurrent shutdowns has been reached.	Maintenance/replacement of the contactors is required. Contact TESVOLT Service.
701	I	I701 External heartbeat timeout	No heartbeat signal via the Modbus interface for more than 15 minutes.	Check the network connection and configuration.

ID	TYPE	MESSAGE	DESCRIPTION	ERROR HANDLING
911	F	F911 Permanent system lock	The system was operated outside of specifications and was shut down for safety reasons. SYS LOCK appears on the display.	This error cannot be acknowledged. An on-site inspection of the system by TESVOLT Service is required. Shut down the system. Contact TESVOLT Service.
921	F	F921 Cell max voltage	Overvoltage in a battery cell	Contact TESVOLT Service.
922	F	F922 Cell min voltage	Undervoltage in a battery cell	Contact TESVOLT Service.
923	F	F923 Battery max temperature	The upper temperature limit of a battery cell has been exceeded.	Shut down the system and let it cool down to at least 25 °C. Check the wiring of the battery modules and the ventilation of the battery storage system. Perform a restart.
924	F	F924 Battery min temperature	The temperature has fallen below the lower limit of a battery cell.	Shut down the system and increase the ambient temperature to at least 5 °C. Perform a restart.
927	F	F927 Battery high current (I_MAX)	Overcurrent shutdown. This error is automatically acknowledged three times.	If the error occurs frequently: shut down the system. Contact TESVOLT Service.
928	F	F928 Hardware safety block/HW high current	Hardware overcurrent shutdown. This error is automatically acknowledged three times.	If the error occurs frequently: shut down the system. Contact TESVOLT Service.
931	F	F931 Dynamic cell imbalance fault	Dynamic cell imbalance detected. This may indicate a defective battery cell.	Perform a restart. If the error continues to occur: shut down the system. Contact TESVOLT Service.
932	F	F932 Static cell imbalance fault	Static cell imbalance detected. This may indicate a defective battery cell.	Perform a restart. If the error continues to occur: shut down the system. Contact TESVOLT Service.
933	F	F933 APU temperature max	The temperature limit value of the APU has been reached.	Allow the system to cool down. The system will then reconnect automatically. If the error continues to occur: shut down the system. Contact TESVOLT Service.
934	F	F934 Precharge fault	Pre-charge error. This error is automatically acknowledged twice.	If the third attempt also fails: check power wiring for incorrect polarity. If no error is found: shut down the system. Contact TESVOLT Service.
935	F	F935 Battery EOL reached	The end of the lifespan of a module has been reached (end of life).	Shut down the system. Contact TESVOLT Service.
937	W	W937 Cell high voltage	Overvoltage in one battery cell in the battery module	If the error continues to occur: shut down the system. Contact TESVOLT Service.
938	W	W938 Cell low voltage	Undervoltage in one battery cell in the battery module	If the error continues to occur: shut down the system. Contact TESVOLT Service.
939	W	W939 Battery high temperature	Warning: The temperature of a battery cell is too high. The permissible charge and discharge current is limited.	If the error occurs frequently: check the wiring of the battery modules and the ventilation of the battery storage system.
940	W	W940 Battery low temperature	Warning: The temperature of a cell is too low. The permissible charge and discharge current is limited.	If possible, increase the ambient temperature to at least 5 °C.
943	F	F943 Battery high current (temperature derating)	Excessive current	Restart the system. If the error continues to occur: shut down the system. Contact TESVOLT Service.
947	W	W947 Dynamic cell imbalance warning	Dynamic cell imbalance. This may indicate defective battery cells.	If the warning occurs more frequently: shut down the system. Contact TESVOLT Service.
948	W	W948 Static cell imbalance warning	Static cell imbalance	If the warning continues to occur: shut down the system. Contact TESVOLT Service.

ID	TYPE	MESSAGE	DESCRIPTION	ERROR HANDLING
949	W	W949 APU temperature high	APU temperature too high. The system power will be limited to 50 %.	If the warning occurs more frequently: contact TESVOLT Service.
951	W	W951 Battery EOL warning	The end of the battery lifespan will soon be reached.	Contact TESVOLT Service.
972	F	F972 Isolation fault	Isolation fault in the DC line (excessive differential current measured)	Check the grounding of the battery cabinet and APU and also the wiring. If no error is detected: shut down the system. Contact TESVOLT Service.
973	F	F973 Isolation sensor selftest fault	The differential current sensor has a fault.	Shut down the system. Contact TESVOLT Service.
974	F	F974 Isolation sensor selftest fault (offset)	The differential current sensor has a fault.	Shut down the system. Contact TESVOLT Service.

NOTE: For further assistance or in the event of persistent faults, please contact the TESVOLT Service Line +49 (0) 3491 87 97 - 200 or service@tesvolt.com.

14 MAINTENANCE

WARNING! Possible damage to the unit and/or battery inverter if it is not decommissioned correctly

Before carrying out maintenance work, ensure that the TS HV 70 is decommissioned in accordance with the specifications in section "9 Decommissioning" on page 38.

NOTE: When cleaning and maintaining the SMA STPS 60, always follow the specifications and instructions in the technical documentation for the SMA STPS 60.

NOTE: The locally applicable regulations and standards are to be adhered to for all maintenance work.

The TESVOLT USB-Stick (16) contains the template of a maintenance log that you can use as an aid.

The lithium cells used by TESVOLT for the TS HV 70 are low-maintenance. However, to ensure safe operation, all plug connections must be inspected and, if necessary, pressed back into place by qualified specialists at least once a year.

The following checks or maintenance work must be carried out once a year:

- General visual inspection
- Check all screwed electrical connections: Check the tightening torque with the values specified in the following table. Loose connections must be retightened to the specified torque.

CONNECTION	TIGHTENING TORQUE
APU HV1000-S grounding	6 Nm
Central grounding point	10 Nm
Connections of the SMA STPS 60 – for conductor cross-section 35 to 95 mm²	20 Nm
Connections of the SMA STPS 60 – for conductor cross-section 96 to 150 mm²	30 Nm

- Check the SoC, SoH, cell voltages and temperatures of the battery modules for irregularities using the BatMon software.
- Switch the TS HV 70 off and on again once a year.

NOTE: Take a screenshot of the "Battery" and "Cell" pages of each battery module and archive them together with all events as a PDF.

If you would like to clean the battery cabinet, please use a dry cleaning cloth. Ensure that no moisture comes into contact with the battery connections. Do not use solvents of any kind.

15 STORAGE

To ensure a long battery life, the storage temperature should be kept in a range between –20°C and 50°C and the cells should be cycled at least every six months. To minimise self-discharge during longer storage periods, the DC connection cables should be removed from the "BATTERY" connections 1/2 of the APU HV1000-S. This interrupts the power supply of the 24 V power supply installed in the APU HV1000-S and prevents discharge of the battery.

16 DISPOSAL

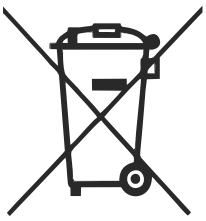
TESVOLT battery modules installed in Germany are integrated into the free GRS take-back system. For disposal, please contact the TESVOLT Service Line +49 (0) 3491 87 97 - 200 or email service@tesvolt.com. Further information can be found at http://www.en.grs-batterien.de/index/.

The batteries may only be disposed of in accordance with the disposal regulations for used batteries applicable at the time of disposal. Immediately decommission any damaged batteries and please contact your installer or sales partner first before disposal. Ensure that the battery is not subjected to moisture or direct sunlight. Ensure quick removal by your installer or TESVOLT.

1. Do not dispose of batteries and rechargeable batteries in household waste! Please note that you are legally obliged to return used batteries and rechargeable batteries.
2. Used batteries may contain pollutants that can damage the environment or harm your health if they are not stored or disposed of properly.
3. Batteries also contain important raw materials such as iron, zinc, manganese, copper, cobalt or nickel and can be recycled.

Further information can be found at https://www.tesvolt.com/en/products/recycling.html

Do not dispose of batteries in household waste!



17 LEGAL NOTICE

TESVOLT TS HV 70 Installation and Operating Manual

Last revised: 01/2021

Subject to technical changes.

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