

**FIMER**



FIMER solar

# **Medium Voltage**

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# **Compact Skid**

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**Hardware manual**



# **Medium Voltage Compact Skid** **Hardware manual**

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# Safety instruction

## Contents of this chapter

This chapter presents the use of warnings in the manual and gives instructions for safe installation, start-up, use and maintenance of the Medium Voltage Compact Skid "MVCS".

## Use of warnings

Warnings caution you about conditions which can result in serious injury or death and/or damage to the equipment and advise on how to avoid the danger. The following warning symbols are used in this manual:



### WARNING!

Electricity warns of hazards from electricity which can cause physical injury and/or damage to the equipment.



### WARNING!

General warning warns about conditions, other than those caused by electricity, which can result in physical injury and/or damage to the equipment.



### WARNING!

General warning warns about weather conditions, prohibited maintenance operations during a typhoon, thunderstorm, snow, rain, and electrical storm. Maintenance in such conditions can result in physical injury and/or damage to the equipment.



### WARNING!

General warning warns about maintenance work on the roof which should always be done from the outer perimeter, considering the local safety regulations.

## Allowed usage

- The Medium Voltage Compact Skid "MVCS", is designed to group the energy generated by a group of string inverters and adapt it to the power grid. Use the MVCS only at its permissible input/output ratings and ambient conditions. Make sure this compliance is satisfied before commissioning.
- The operation and maintenance of the MVCS must be carried out by certified technicians that fulfill all local skill set and safety requirements. Any unqualified personnel must maintain a safe distance from the MVCS. All activities must be in accordance with the criteria described in the FIMER technical documents and local regulations.
- Make modifications to the MVCS only with authorization of FIMER. Any alterations done outside FIMER approval will invalidate the warranty for the product. FIMER is not liable for any damages caused by these changes.
- The MVCS is a non-walk-in type station, designed to be operated from the outside. Make sure the side doors are closed at all times during operation and that no personnel is inside or in the near vicinity of the MVCS.

## Safe installation, start-up and maintenance

This section contains the safety instructions which you must follow when installing, commissioning, and maintaining the MVCS. If ignored, physical injury or death may follow, or damage may occur to the equipment.

- Only authorized electricians/personnel are allowed to install, start-up and doing maintenance on the MVCS. Working methods, tools, components etc. must follow the IEC regulations.
- Obey all local safety regulations concerning electrical sub-stations.
- The MVCS should be energized and de-energized only by an authorized person who has the task-specific instructions for the operation of an MV substation and permission from the on-site foreperson in charge of electrical work.
- If other people must be in the vicinity while the door is open, warn them, and if required, provide supervision and guidance.

## General safety instructions



### WARNING!

Before you perform any work in the MVCS, obey the following safety precautions.

1. Obtain a work permit.
2. Clearly identify the work location.
3. Read the safety instructions of the working area and the component you are working on.
4. Make sure that there is no voltage presence in the working area you are going to work on, see Safety instructions for MV switchgear and MV transformer area and Safety instructions for the auxiliary services board.
5. Secure against reconnection.
6. Use a voltage tester to ensure that there is no voltage in working area.
7. Make sure that the MVCS is properly grounded.
8. Secure against reconnection.
9. Use protection against any live parts.
10. Take special precautions when you work close to exposed conductors.

## MVCS working area safety

The MVCS has three main working areas:

- AC Cabinet Area
- MV Transformer Area
- MV Switchgear Area

Each working area has separate safety instructions.

## Personal Protective Equipment (PPE)

- Perform any operation on the equipment with suitable work clothes and instruments.
- When choosing a personnel protective equipment, consider environmental conditions such as humidity, noise, etc. and local regulations.
- The minimum required safety equipment is as follows:
  - Safety shoes
  - Safety gloves
  - Safety glasses
  - Head protection
  - Hearing protection
  - Work clothes

## Safety instructions for MV switchgear and MV transformer area



### WARNING!

Perform the below instructions before you start working inside the MV switchgear and/or MV transformer area. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Obtain a work permit.
2. Identify the MV switchgear and read its safety instructions.
3. Check the operation of the capacitive voltage indicators in all MV switchgear bays (all phase LEDs are switched on when a voltage is connected). Capacitive voltage indicators:



4. Disconnect the MV switchgear from the grid and all possible power supplies (external, auxiliary, and inverters as well as any parallel connection stations), secure by locking and tagging.
  - a. Stop the string inverters outside the MVCS. Open the DC disconnecting switches in each inverter unit and add warning notices. If applicable, open the AC disconnecting switches in each inverter unit, lock and add warning notices.
  - b. Open all auxiliary breakers, switches and fuses in the auxiliary service board, lock and add warning notices.
  - c. Open main low voltage circuit breaker (if present), and all fuse base switches of the inverter inputs (AC Cabinet), lock and add warning notices.
  - d. Turn the vacuum circuit breaker of the MV switchgear (V/L module) to open position. Lock and add warning notice.
  - e. Turn the disconnecting switch of the MV switchgear (V/P module) to open position. Lock and add warning notice.
  - f. Turn the earthing switch of the MV switchgear (V/P module) to earthed position. Lock and add a warning notice.
  - g. Turn the disconnecting switch of the MV switchgear (C/L modules) to open position. Lock and add a warning notice.
  - h. Turn the earthing switch of the MV switchgear (C/L modules) to earthed position. Lock and add a warning notice.
  - i. With above operation the MV Switchgear, and so the MVCS, should be disconnected. See "Switchgear", "MVCS Interconnection Cables and Electrical Layout" and the general scheme of the PV plant to assure that no external supply is connected to the MV Switchgear.
5. Check that all shrouds/screens are in place.
6. Check that you are not near to any live parts while working. All live circuits must be protected with shrouds/screens.
7. Make sure that the MV switchgear is dead.
  - Check the status of voltage indicators in all MV switchgear bays. Also note that all phase LEDs which were switched on AC cabinet before step 3 are now switched off).



8. Check that the MV transformer is dead (high voltage terminals, low voltage terminals, any auxiliary power, and instrumentation). Use an appropriate high voltage tester only for the high voltage side, and a voltage detector with suitable testing heads for the low voltage side.

## Safety instructions for the auxiliary services board

1. If there is no main low voltage circuit breaker installed in the power section, then follow Safety instructions for MV switchgear and MV transformer area
  - a. Check that there is no voltage presence, with a voltage tester, neither in the power section nor in the auxiliary services board.
2. If main low voltage circuit breaker is installed, then follow:
  - a. Obtain a work permit.
  - b. Open the main circuit breaker or main switch upstream auxiliary service transformer, secure by locking and tagging.
  - c. Open the circuit breaker downstream auxiliary service transformer, secure by locking and tagging.
  - d. Open all switches, breakers, and connectors of the auxiliary service board, and secure by locking and tagging.
  - e. Make sure you are not near to any live parts while working. Disconnect the live circuits or protect them with shrouds/screens.
  - f. Check the status of the voltage indicators in the auxiliary service board.
  - g. Check that the auxiliary service board is dead.



## Safe operation

This section contains the safety instructions which you must follow when operating the MVCS. If ignored, physical injury or death, or damage may occur.



### **WARNING!**

Obey these instructions to prevent injury, death, or damage to the equipment.



### **WARNING!**

Keep all doors locked while the MVCS is operating. Allow access to only authorized personnel.

1. Keep all doors of the MVCS closed during operation. Give the keys only to authorized personnel.
2. Before you start a group of inverters, check the connections of each inverter input, and the recommendations in the specific inverter manual.
3. Do not open the AC base fuse switches when the MVCS is operating.
4. Before you adjust the group of inverters and set them into service, make sure that all of them are suitable for operation.
5. Do not use the inverters in a manner not specified in the manual.

#### **Notes:**

Spend as little time as possible near the inverters or the MVCS.

# Introduction to this manual

## Contents of this chapter

This chapter provides information about the manual such as applicability, target audience and contents. It also lists the related documents.

## Applicability

This manual is applicable to Medium Voltage Compact Skid "MVCS".

## Target audience

This manual is intended for personnel who transport, store, plan the installation, install, commission, and maintain the MVCS.

Read this manual before working on the MVCS. You are expected to know the fundamentals of electricity, wiring, electrical components, and electrical schematic symbols.

## Related documents

### Inverter manuals and guides

PVS-175-TL Product Manual	FIMER_PVS-175-TL A.1 Version_Product manual_EN_RevC.pdf
PVS-175-TL Quick installation guide	PVS-175-TL-Quick Installation Guide EN-REVA CC.pdf
PVS-175-TL data sheet	FIMER_PVS-175-TL_EN_RevB.pdf
PVS-100/120-TL Product Manual	FIMER-PVS-100_120-TL-B version-Product manual EN-Rev A
PVS-100/120-TL Quick installation guide	PVS-100_120-TL - Quick Installation Guide EN - RevB
PVS-100/120-TL data sheet	FIMER_PVS-100-120-TL-6MPPT-2MPPT_EN_RevA

### List of documents

See List of documents.

Note: The drawings are delivered with the unit only on request

## Terms and abbreviations

Term/ Abbreviation	Description
AC	Alternating current
CV/CCV	Construction of MV switchgear (L+P/ 2L+P)
DC	Direct current
HC	High cube container
LV	Low voltage (50...1000 V AC)
MV	Medium voltage
MVCS	Medium voltage compact skid
LVMCB	Low Voltage Main Circuit Breaker
PPE	Personal protective equipment
SF6	Sulfur hexafluoride (this gas type is used in MV switchgear).
SWG	Switchgear
THD	Total harmonic distortion

## IEEE device no. references

IEEE	Protection function
27	Undervoltage
50	Instantaneous Overcurrent
50N	Neutral Instantaneous Overcurrent
51	AC time overcurrent
51N	Neutral Time Overcurrent
59	Overvoltage
68	Transformer inrush detector
81	Medium voltage

# Hardware description

## Contents of this chapter

This chapter provides an overview of the Medium Voltage Compact Skid “MVCS”. It also includes layout, general data sheet of the main components, type designation label and ordering information.

## Product overview

The medium voltage compact skid connects a group of inverters to a medium voltage power grid. This solution is constructed around a skid house that contains:

- **MV switchgear**—connects to the power grid. It is also the main protecting, switching, breaking and disconnecting equipment of the medium-voltage side of the solar power plant.
- **MV transformer**—transforms low voltage from inverters to medium voltage for the power grid.
- **AC cabinet**—contains all parallel connections to the inverter inputs and the auxiliary service boards (required for the autonomous function of the MVCS). Note that the AC cabinet also includes an additional space for customer use (e.g. communication board, etc).

## Mechanical characteristics

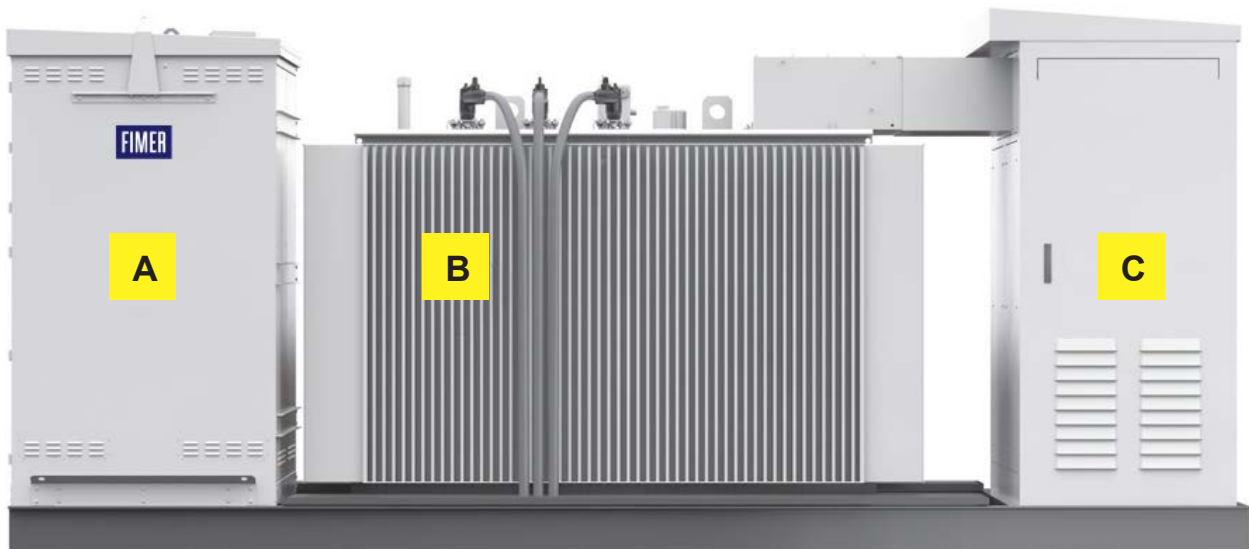
The MVCS is constructed over a skid, with the appropriate dimensions to be suitable to transport inside 20 ft or 40 ft HC container.

- External dimension (length, width, height) = 5700 x 2150 x 2580 mm.
- Total weight = 9-18 ton (may vary depending on MVCS final configuration).

## Layout drawing

This section describes the working areas and main components of the MVCS. For additional information, request to your local FIMER sales contact:

- “MVCS Structural Layout”.
- “MVCS Footprint”.




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A MV switchgear area. For more information, see section MV Switchgear

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B MV transformer area. For more information, see section MV Transformer

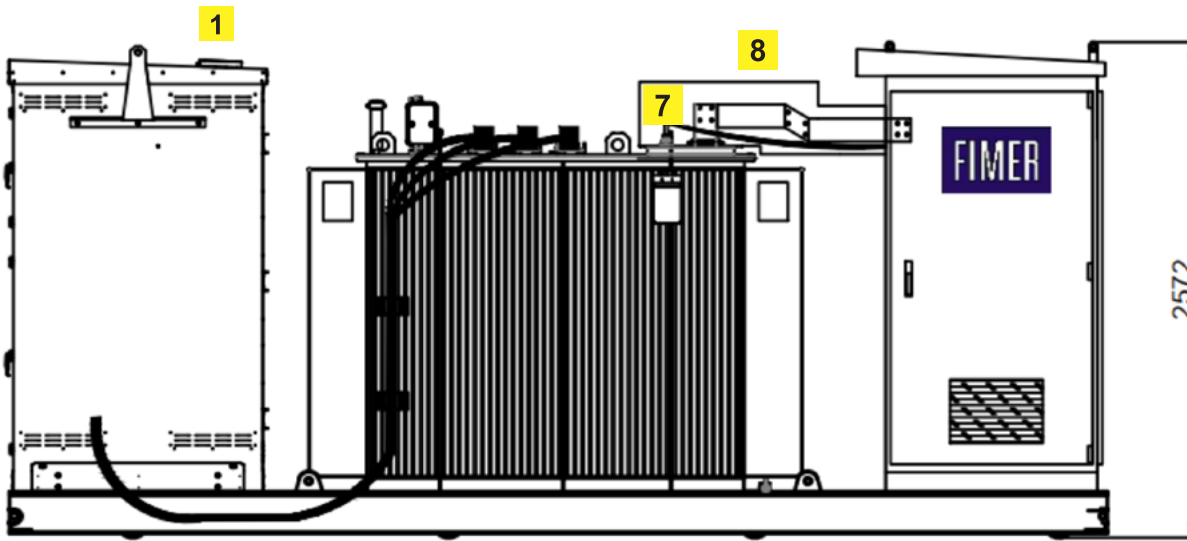
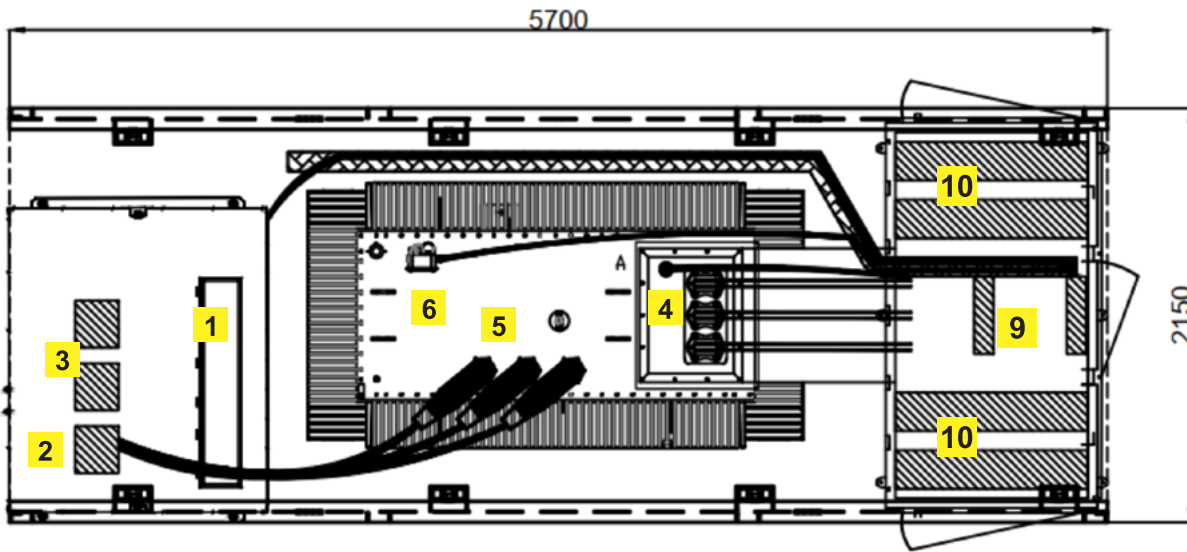
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C AC cabinet area. For more information, see section AC Cabinet

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# Working areas and main components

## Main Components Overview



	1	SF6 Outlet
A	2	MV Input from transformer (V module)
	3	MV Output (C module)
	4	LV Connection Box
B	5	MV Bushings
	6	Transformer Protection Device
	7	Neutral Bushing
C	8	Busduct/Busbars
	9	Auxiliary Section input
	10	String Inverter cables access

## MV Switchgear

Medium voltage switchgears protect MV transformers and the MVCS in general, its also allow the MVCS to be connected to the Grid and to other MVCS in parallel.

### Technical Datasheet Environmental

Minimum Ambient Temperature	-25 °C
Maximum Ambient Temperature (No derating)	60°C (40 °C)
Max Altitude	<1500 m asl
Relative humidity max. 24 hour mean	95%

Classification (IEC62271-200)	LSC2A IAC AFL 16/20/25 kA x 1s → Indoor solution LSC2A IAC AFLR 16/20/25 kA x 1s → Outdoor solution
SF6 Ventilation	Backwards (exhaust channel) → Indoor solution Downwards (cable trench) → Outdoor solution
Degree of Protection (IEC60529):	IP3X (cable compartment) – IP2X (front cover) IP54 for MV enclosure
Corrosivity protection	Standard: C4 Upgrade: C5M
Rated Voltages	24 / 50 / 125 kV 36 / 70 / 170 kV
Frequency	50/60 Hz
Operating Voltage	Up to 36 kV
Rated Current	630 A (@40°C) 500 A (@60°C)
Rated Short Circuit Current	20 kA – 1s
Internal Arc Fault withstand	Standard (24kV/36kV): 16 kA - 1s/ 20kA – 1s Upgrade (24kV/36kV): 20 kA - 1s/ 25kA – 1s
Configuration	Standard: 1 Line Switches + 1 Trafo Feeders Upgrade: 2 Line Switches + 1 Trafo Feeders
Electrical and mechanical class	M1

### MV Unit Composition

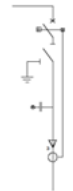
Line Switch 630A (C module), equipped as follow:

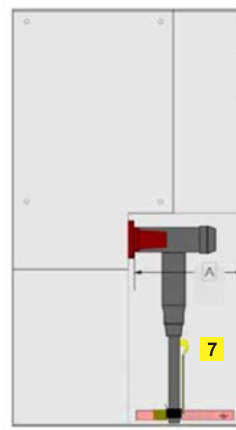
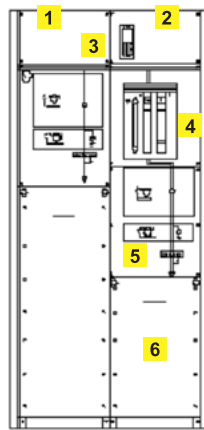
- Nr. 3 capacitive voltage indicators
- Manual line switch with earth position for the incoming MV cables
- Key lock with key free for earth switch closed
- Simple incoming MV cable (one cable per phase)



Trafo Feeder 630A (V module), equipped as follow:

- Nr. 3 voltage indicators
- Manual line switch with earth position for the MV cables
- Key lock with key free for earth switch closed
- Circuit Breaker (motorized as optional)
- Standard: Nr. 1 electronic protection relay (50/51-50N/51N)
- Optional: Relay with additional protections (59-27-81..) and measurement + comm functions as optional
- Nr. 3 CT





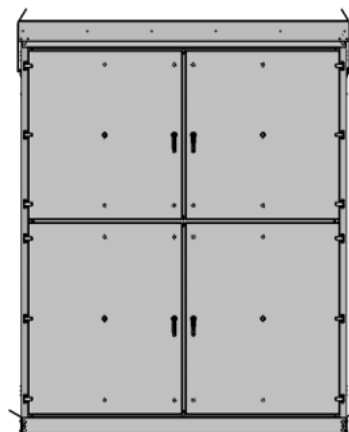
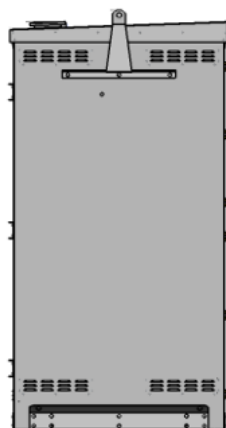
1	C module (L)
2	V module (P)
3	Protection Relay
4	Circuit Breaker
5	Interlocking
6	Cable compartment protection panel
7	Cable compartment

### MV Outdoor Enclosure

This enclosure is included when indoor switchgear is installed.

#### Technical Datasheet

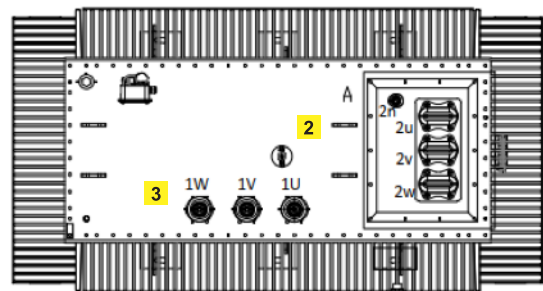
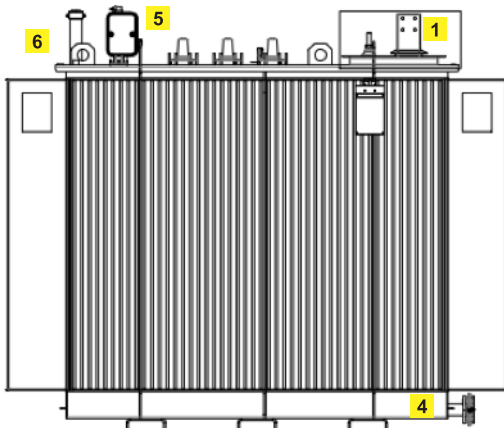
Minimum Ambient Temperature	-25 °C
Maximum Ambient Temperature	60 °C
Classification	AFLR
Degree of Protection (IEC60529):	IP54
Degree of Protection (IEC62262)	<b>IK9/10</b>
Corrosion class	Standard: C4 Upgrade: C5M
Paint colour	RAL7035
Cooling	Natural
SF6 Ventilation	Upper exhaust
Dimensions (WxLxH)	1676 x 1300 x 2238 mm



## MV Transformer

### Technical Datasheet

Minimum Ambient Temperature	-25 °C
Maximum Ambient Temperature (No derating)	60°C
Max Altitude	<1000 m asl
Reference Standard	IEC60076-1
Cooling type	ONAN
Power @30°C	Up to 6,66 MVA
Primary voltage	Up to 36 kV
Secondary Voltage	0,8/0,48/0,4 kV
Voltage regulation range	+/- 2x2,5%
Vectorial group	Dyn11
Primary insulation class	24 / 50 / 125 kV 36 / 70 / 170 kV
Secondary insulation class (ph)	3,6/10/40
Secondary insulation class (N)	1,1/10/20
Losses	Standard: EU 548/2014 Optional: EU 2019/1783 <sup>1</sup>
Short Circuit Impedance	5...8%
Frequency	50/60 Hz
Max Dimensions (LxWxH)	2650x1700x2200
Corrosion class	Standard: C4 Upgrade: C5M
Painting	RAL 7035
Load Power derating	According n° of inverters and environmental conditions
Safety protection device	RIS2/DGPT2 or similar



\*This layout may vary depending on final MVCS configuration

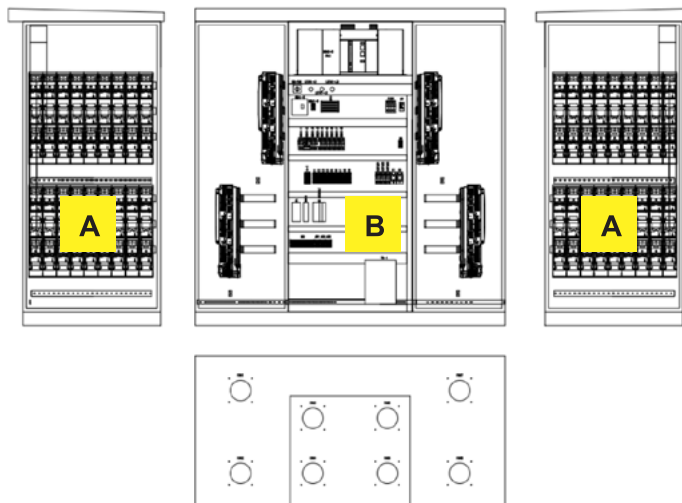
1	LV Bushings + Neutral terminal
2	Off-Load Tap changer
3	MV Connectors
4	Earthing terminal and Oil Drain Valve
5	RIS2/DGPT2 (protection device)
6	Oil filling plug

1) Included as standard if destination country is in EU

## AC Cabinet

### Technical Datasheet

Minimum Ambient Temperature	-25 °C
Maximum Ambient Temperature	50 °C
Max Altitude	<2000 masl
Reference standard	61439-1 & 2
Max Dimensions (WxLxH)	2080x1200x2295 mm
Max Weight	< 3000 kg
Ventilation	Forced + Natural (> 3000 m3/h)
IP	54 (20 with doors open)
Corrosion class	Standard: C4 Upgrade: C5M
Paint colour	RAL 7035
Doors → Cubicles (n°)	-Front → Aux services + MCB (2) -Lat. Left → Power Section 1 (1) -Lat. Right → Power Section 2 (1)
N° of Inputs (Power)	Up to 36 (Up to 6,7 MVA)
Input protection	Fuse gS NH1
Rated Voltage	800/480/400 V
Frequency	50/60 Hz
Conductor	Copper Busbars
Surge Arrester Protection	Type I+II
Aux Trafo Power	Standard: 10 kVA Upgrade: 20/30 kVA
Secondary Voltage	400-230 V
Spare Lines	2x16/10 A (1 ph)
Communication	MVCS signal concentration: -2x Remote I/O module, Digital signals, Input, 8-channel, 2-conductor connection -1x Remote I/O fieldbus coupler, Modbus/TCP -1x Network switch, unmanaged, Fast Ethernet, Number of ports
Main Circuit Breaker	Optional
UPS	Optional
Energy Measurement	Optional

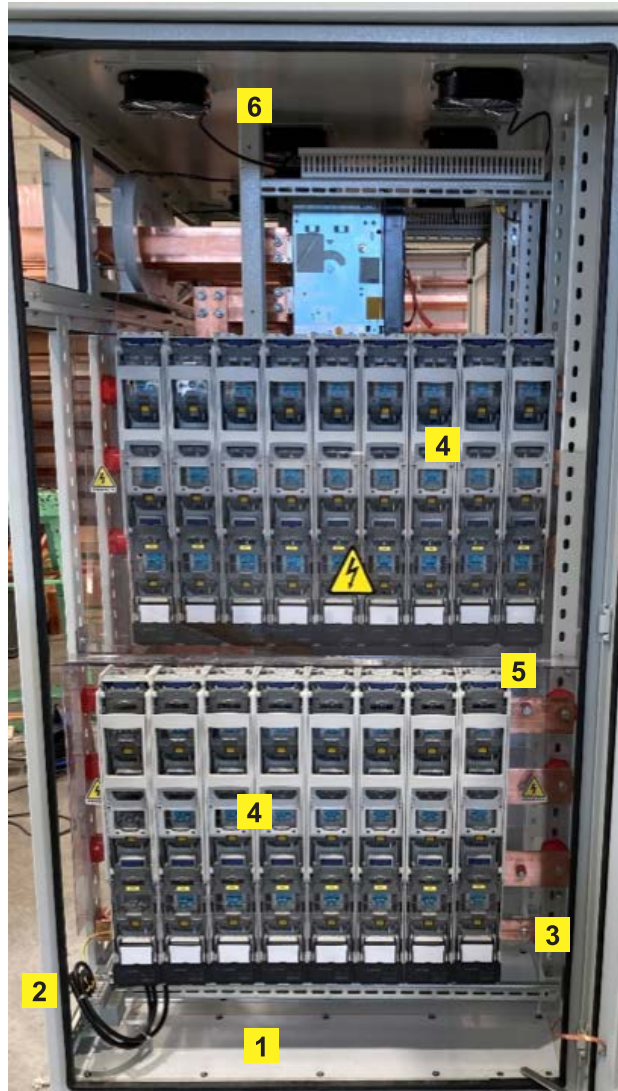


\*This layout may vary depending on final MVCS configuration

A	Inverter inputs. For more information, see section Inverter inputs (A)
B	Auxiliary service board. For more information, see section Auxiliary service board (B)



**Inverter inputs (A)**



\*This layout may vary depending on final MVCS configuration

1	Cover for incoming cables
2	Surge arrester protection
3	Grounding Busbar
4	Fuse holders + fuses for inputs protection
5	PVC protection cover
6	Ventilation system

### Auxiliary service board (B)

The figure below shows the disposition of the main components of a standard auxiliary service board.



\*This layout may vary depending on final MVCS configuration

1	Auxiliary service transformer
2	Surge arrester protection for the auxiliary service board
3	Upstream on-load fuse switch for auxiliary service transformer protection
4	Downstream circuit breaker for auxiliary service transformer protection
5	Auxiliary service board circuit breakers and differential protections
6	Grounding busbar
7	Terminals block
8	Voltage presence indication LEDs
9	Communication board (if present)
10	Cover for incoming cables
11	Main Circuit Breaker (if present)
12	Ventilation system

# List of signals

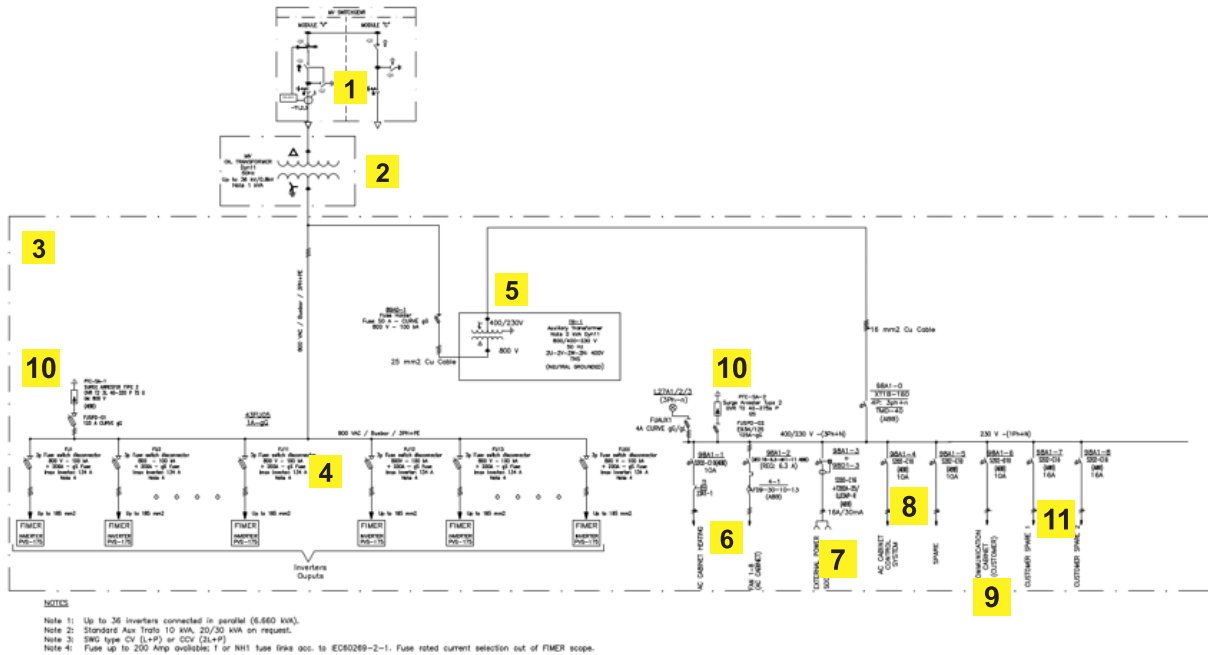
Signals from the different devices described above are concentrated in the auxiliary service board (7 & 9). These digital signals are connected to a Modbus TCP fieldbus coupler + industrial ethernet switch, so it can be integrated with an external SCADA. The list of most common signals:

Component	Signal	Signal type
A01 MV Cabinet type "C"	Disconnecter Status	DI
	Earth Switch Status	
	Gas Pressure Level	
A02 MV Cabinet type "C"	Disconnecter Status	
	Earth Switch Status	
	Disconnecter open indication	
A03 MV Cabinet type "V"	Earth Switch open indication	
	Circuit Breaker Status	
	Temperature stop T2	
Oil Transformer (DGPT2/RIS2)	Temperature stop T1	
	Internal Pressure alarm	
	Gas	
	Aux Transformer secondary breaker status	
Auxiliary Services Cabinet	Ventilation Status	

\*A02 MV Cabinet type "C" only for MVSWG CCV (2L+P) type

# Main circuit diagram

The general single-line diagram depends on the configuration and options of the unit as well as the configuration of the inverter group. The table below describes the baseline configuration.



\*Optionals, such as main circuit breaker, UPS, LV energy measurement; are not shown in this SLD

1	MV Switchgear
2	MV Transformer
3	AC Cabinet
4	Inverter Inputs
<b>Auxiliary Service Board</b>	
5	Auxiliary Service Transformer
6	AC cabinet own loads (fans & heating)
7	Sockets (1PH)
8	Control
9	Communication
10	SPD
11	Spares

## Type designation label

The figure below shows an example of the type designation label. The label contains the basic data of the unit. It is located inside the AC cabinet, specifically in auxiliary service board section.



1	Product description: MVCS + string inverter name
2	General designation: string inverter name + MVCS rated power
3	S/N
4	Manufacturing Year
5	CE marking

## MVCS Configuration

To define a MVCS the following inputs are needed:

Input	Value
String Inverter	
Number of inverters connected	
Medium Voltage level	

Eg:

- String Inverter: PVS-175
- Number of inverters connected to the MVCS: 20
- Medium Voltage Level: 15 kV

With the definition of the inputs above, then a standard MVCS will be configured:

- Skid: C4;
- SWG: 24kV;16kA;CV; 50/51-50N/51N-68 Relay;
- MV Transformer: 15/0,8 Dyn11; 3.700 kVA @30°C; Losses according EU 548/2014 Regulation
- AC Cabinet: 20 inputs;10kVA Auxtrafo (0,8/0,4-0,23 kV)

If additional features are needed, then the appropriate optional codes from the following section must be selected:

## MVCS optional codes

Code	Name	Description
<b>Standards</b>		
N.A.	MVCS Local Standards	Local requirements such as: - Non IEC Cable colour - LV Protection system (eg VDE-AR-N 4110) - Dedicated Labeling - Others on request These requirements should be submitted for FIMER evaluation and quotation.
<b>MV transformer</b>		
+TRTIER2	Oil Transformer losses	EU 548/2014 oil transformer is replaced with EU 2019/1783 losses oil transformer
<b>Auxiliary services</b>		
+ATR20	Auxiliary transformer power rating	Standard 10 KVA auxiliary service transformer is upgraded to a 20 KVA 400/230 V auxiliary service transformer
+ATR30	Auxiliary transformer power rating	Standard 10 KVA auxiliary service transformer is upgraded to a 30 KVA 400/230 V auxiliary service transformer
+ATR3	Additional 1-ph auxiliary transformer power rating	An additional auxiliary monophas service transformer of 3kVA is installed to provide customer with specified voltage level
+MCB	Main Circuit Breaker	Addition of a Main Circuit Breaker in accordance with MVCS specification
+UPS3	UPS 3kVA	Addition of UPS: 5,5 min (3kVA)/ 9 min (2,25kVA)/ 14 min (1,5kVA)/ 29,5 min (0,75 kVA)
+LVEM	LV Energy Meter	Addition of LV energy meter (current transformers and voltage transformers included)
<b>MV Switchgear</b>		
+SWGCCV	SWG CCV module	Standard 24k/36V CV switchgear is replaced with CCV switchgear
+M2420	SWG Short Circuit	Standard 24kV 16kA is replaced with 24kV 20 kA Only for SWG 24 kV
+M3625	SWG Short Circuit	Standard 36kV 20kA is replaced with 36kV 25kA Only for SWG 36 kV
+MMOTO	Motorized V module	Manual V module is replaced with Motorized V module
+MREFS	Feeder protection and control relay MV metering	Standard Self-powered protection relay ( 50/51-50N/51N-68) is replaced with upgraded protection relay 50/51-50N/51N-68- 59-27-81) including voltage and energy measurement
<b>Station (skid)</b>		
+TRFENCE	Transformer fence	Supply of a transformer fence around the transformer perimeter
+C5M	C5-M corrosion protection degree for enclosure	Enclosures and MV transformer standard C4 corrosion degree is upgraded to C5M corrosion degree. This optional is mandatory for C5-I or C5-M environments (ISO 12944)
<b>Warranty</b>		
+EW-60/64	Extended warranty 60/64 months	The warranty is extended to 60 months from commissioning or 64 months from delivery (whichever happens first)

# Storing, lifting and transporting

## Contents of this chapter

This chapter provides instructions for storing, lifting, and transporting the Medium Voltage Compact Skid "MVCS".



### WARNING!

Carefully inspect the container before performing any activity. Verify that the MVCS has no protuberance, lack of rings, or any general poor condition



### WARNING!

Ignoring the following instructions can cause physical injury or death, or damage to the equipment:

- Use only authorized lifting equipment and personnel.
- Prevent anybody getting under the load.
- Do not stand on the roof while fastening the lifting slings or while lifting.
- Do not throw slings or hooks onto the roof.



### WARNING!

Install silica gel bags for storage

## Storing

- Always store the MVCS in upright position.
- Protect the MVCS from rainwater and dust. Use covers for air outlets. Avoid opening the doors unnecessarily and remove the transportation plates during storage and at the time of installation.
- If condensation is possible in the storage area, follow the below conditions:
- Supply power to the internal heaters to maintain the inside temperature of the unit more than the outside temperature.
  - If power supply is not available, add humidity desiccant bags inside the station.
  - If the MVCS is stored for more than two weeks without using electric heaters, use desiccant bags. See also "Conditions for using desiccant bags".
- Make sure the ground underneath the MVCS is solid, flat, dry and vegetation-free. The ground must support the station evenly from below and there should not be any twisting or stress. Do not place the MVCS directly onto the bare ground because this could damage the paint and cause corrosion.
- Place the MVCS on wooden support beams. Locate the beams under the four corners and the middle points.

### Conditions for using desiccant bags

- Hang the desiccant bags approximately 1 m from the floor.
- Use 500 grams of desiccant per week. For example, for four weeks of storage, use 2 kg of desiccant bags.
- Replace the bags with fresh bags every four weeks.
- Do not open the doors unnecessarily during the storage period.
- Examples of suitable container desiccants: Xdry desiccants "H model" or Clariant "Container Dri®II- Pole".



## Lifting



### WARNING!

Inspect the container before any activity. Make sure that the container has no protuberance, enough rings and is in good condition. Ignorance of this message can cause physical injury, death or damage to the equipment.

Before lifting the MVCS, follow these instructions.

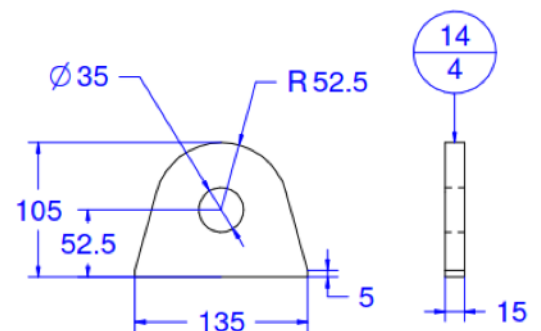
- Protect the corners of the MVCS against shock.
- The minimum rated loading capacity of each sling is five tons.
- The minimum length of each sling is three meters.
- Adjust the length of lifting slings so that the MVCS does not tilt during lifting.
- Do not allow the lifting slings to scratch the walls or roof. Damaged paint can lead to corrosion.
- Use a guide wire attached to a lower corner of the MVCS to prevent rotation.
- If there is a fence installed, remove it before lifting the MVCS.

### Tools used for lifting

- 20 tons bridge crane
- four slings
- minimum loading/unloading area = 20 x 3 meters

### Lifting instructions

1. Attach four slings to the fastening points (lifting lugs) located in the lateral beams of the skid. See the locations marked in below figure:



2. Connect the slings to the crane as shown in below picture.



## Transporting



### **WARNING!**

Keep the transportation height as low as possible. Make sure the total height of the transportation is not more than the maximum allowed height.



### **WARNING!**

Transport the MVCS on an open heavy-duty chassis. Do not use an enclosed trailer because the stations surface could easily be damaged.



### **WARNING!**

Do not throw the hooks over the roof. This can damage the paint and cause corrosion or operation problems.



#### 4 - Storing, lifting and transporting

Obey the following instructions:

- Protect the MVCS with wooden corners, plastic film, etc. The MVCS is delivered unpacked from the factory as standard.
- Protect the interior of the MVCS from rainwater by using temporary protection plates (anti-typhoon) on air intakes and outlets.
- The MVCS is built to fit inside:
  - 20 ft HC container → 1 MVCS
  - 40 ft HC container → up to 2 MVCS (consider the maximum permissible load of the container)
  - Truck with the proper dimensions and permissible load



#### Incoming inspection at arrival

- Visually check for any potential transportation damage(s). If any damages found, mark and record them and immediately inform your local FIMER representative or your FIMER sales contact.
- Repair any damaged paint. See section Maintenance of painted surfaces.
- Check that the MVCS corresponds to the delivery list and order. Record the deviations (if any) and immediately inform your local FIMER representative or FIMER sales contact.

## Unloading



### WARNING!

To prevent damage to the MVCS, keep the delivery packaging and protection canvas on until you install it.



### WARNING!

Inspect the MVCS carefully before performing any activity. Check that there is no protuberance or any general poor condition.

Before unloading, follow these instructions:

1. Protect the corners of the MVCS against shock.
2. Make sure that the terrain is level and sturdy. Consider that the MVCS has an approximate weight of 15 tons.
3. Unload the standard container carrying the MVCS inside. Follow local regulations and applicable standards.
4. Remove all stops, and transportation slings at both ends and laterals.

#### Tools used for unloading

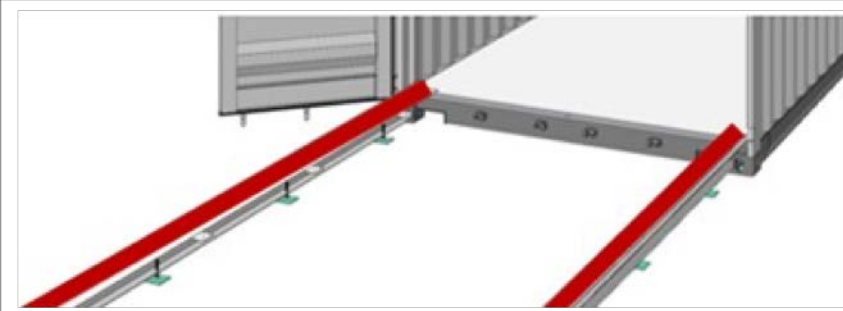
- Five tons forklift.
- Two guide platforms with length 5 m and width 400 mm.
- Two slings of eight tons. Minimum 5 m.

### Unloading Instructions (truck shipping)

1. Make sure that the terrain is in good condition for truck access.
2. Please follow the instructions described on Lifting.

### Unloading Instructions (container shipping)

1. Align the guide platforms to the wheels trajectory.
2. Make sure that the guide platforms are leveled to the container floor.



3. Connect the belly chains to the fastening points in the skid profile.



4. Connect the slings to the belly chains and to the forklift.
5. Slowly and carefully pull the MVCS out of the container using the forklift. The forklift must be perfectly aligned to the MVCS, so that the station does not touch the container walls.



**Note:**  
Pull the MVCS until connection with spreader and crane is possible. Then follow the lifting procedure to place the MVCS. The function of the wheels is to pull the MVCS out of the container, the wheels are not intended for move the MVCS around the PV plant.

# Mechanical installation

## Contents of this chapter

This chapter describes the mechanical installation of the Medium Voltage Compact Skid "MVCS" and gives instructions on how to select the location and guidelines to build the foundation for the MVCS. Always obey the local regulations.

## Safety

See Safety instructions.

Before you move the MVCS, see instructions in chapter Storing, lifting and transporting.

## Tools

Use the following tools to move the MVCS, to fasten the MVCS foundation, and to tighten the connections:

- Crane, forklift, or pallet truck (with sufficient load capacity)
- Pozidriv and Torx (2.5 to 6 mm) screwdrivers with short and long heads or bits
- Torque wrench
- Set of wrenches and sockets.

## Foundation guidelines

For information on the MVCS dimensions and footprint, see drawing "MVCS Footprint".

Always follow the local rules and laws when designing and constructing the foundation. Pay attention to the proper planning and constructing of the foundation. For example, an improper foundation can cause settling of the MVCS or difficulty opening the door.

Follow the below guidelines:

- To prevent any risk of corrosion, install the MVCS higher than its surroundings so that surface water will not collect around its perimeter.
- Tilt the surface of the surrounding ground at least 50 mm per meter (two inches per 40 in). This ensures that surface water flows away from the MVCS.
- Consider local conditions, such as soil type, frost protection, rain amounts, etc. There needs to be at least 300 + 200 mm gravel under the foundation.
- Consider the required cable bending radius and installation room.
- The built-on site user platform around the MVCS must be at least one meter (40 in) wide. If it is narrower, service work can be difficult.
- FIMER recommends that the entire perimeter of the MVCS must rest on the foundation.
- Check the load carrying capacity of the ground and potential local special requirements (for example, earthquake or typhoon anchoring) of the construction area. Use materials suitable for the local conditions and requirements.

## Placing the MVCS on the foundation

### WARNING!

Before lifting the MVCS onto the foundation, make sure the foundation is aligned well, hardened and stable.

1. Measure the level of the foundation and the tilting of the surface of the surrounding ground around the foundation. Obey Foundation guidelines.
2. Make sure the foundation below the MVCS is leveled. Inclination up to 0.1 degrees is permitted.
3. Lift the MVCS onto the foundation. Obey the instructions in section Foundation guidelines. Make sure that the foundation does not move. Also make sure that the station is stable and in direct contact with the foundation.
4. When the MVCS is placed on the foundation, measure the height and inclination of the MVCS. Check the slope of the surface of the surrounding ground around the MVCS.

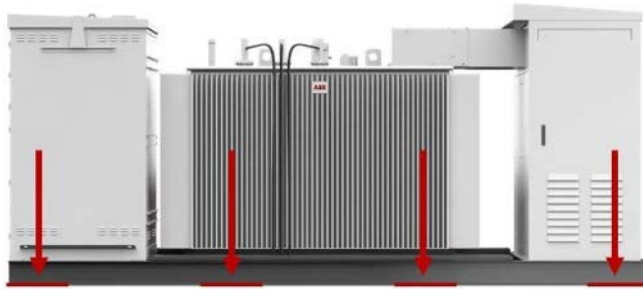


### Fastening the MVCS

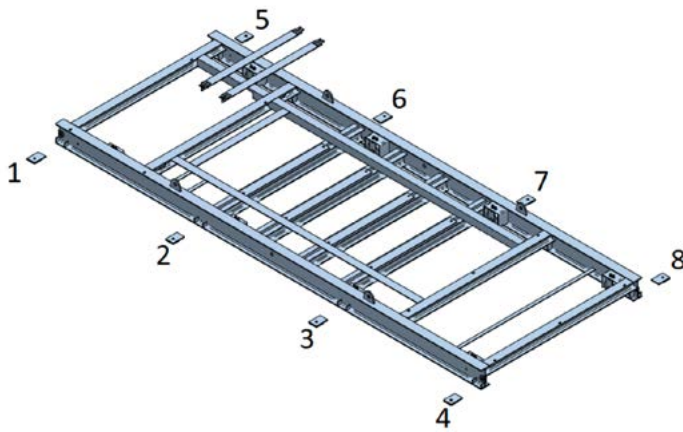
## WARNING!

Do not fasten the MVCS by electric welding, the welding circuit can damage electronic circuits and integrity of the station. FIMER does not assume any liability for damages caused by electric welding.

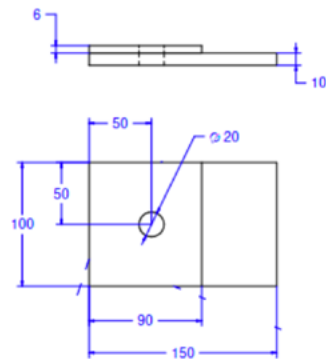
To fasten the MVCS to the foundation, bolt the cabinet through the holes on the base of the inverter or use the supplied attachment brackets (see figure below). Use bolts and washers in each connection point. For these anchoring points FIMER recommends "FH II 24/50 Nylon S" high performance anchoring.



Fastening points



Fastening points



Fixing plate detail

Follow the local regulations and applicable standard to calculate the mechanical connections and structural properties. Always consider the site conditions and terrain characteristics.

## Constructing earthing electrode and earthing

Construct an earthing electrode for the MVCS according to the local regulations. Connect the earthing electrode to the general earthing bar of the MVCS using the right cross section. For more information, see drawing "MVCS Grounding Layout".

## Filling the pit and finalizing the surroundings

1. If required for local frost conditions, add insulation around the column foundation.
2. To minimize the growth of grass, use geotextile below the foundation and below the service platform around the MVCS. Put the geotextile 20 cm (8 in) below and about 100 cm (40 in) around the foundation.
3. The MVCS is a not walking station, it is designed to be operated from the outside. Provide a permanent or portable platform for comfortable operation of the MVCS switching devices as the foundation of the foundation can be higher than the surrounding ground. For platform design and construction, follow the local rules and standards.
4. Do not plant trees near the MVCS. If bushes are planted, make sure that the planting compost base is at least one meter (40 in) away from the station housing and that the fully-grown bushes do not prevent maintenance access to the MVCS. Make sure that anything planted near the inverter does not discharge dust or seeds that can affect the cooling air flow

# Electrical installation

## Contents of this chapter

This chapter contains general instructions for earthing and cabling the medium voltage compact skid (MVCS). Obey all instructions contained in the applicable documentation (such as other hardware manuals) and the local regulations.



### WARNING!

Only an authorized electrician is allowed to install the cabling to the MVCS. Obey the Safety instructions and the local safety regulations. If ignored, physical injury or death may follow, or damage to the equipment may occur.



### WARNING!

Do not do any electrical installation work during a thunderstorm.



### WARNING!

Make sure that all external cable entries are fully sealed to prevent entry of foreign elements, such as animals, insects, and dust.

## Routing the cables

When you route the cables:

- Install the AC power cables and the control cables on separate routes.
- Use metallic screen cables for control cables.
- Do not put extra cables through the MVCS without permission. For more information, see drawing “MVCS Interconnection cables and electrical Layout”.

## LV busbar interconnection

Before energizing the MVCS, check the tightening torque of the mentioned bolts (M12). Final tightening torque = 60 Nm.

To access to the busbars, it is needed to remove the upper cover of the interconnection enclosure.



When it is finished, reinstall the upper cover and tighten correctly all the bolts (M6 – 16,8 Nm).



## Earthing

An external earthing electrode is required for the MVCS, for the construction of this electrode please follow local regulations as well as the following minimum requirements:

- Minimum cross-sectional: depends on MVCS configuration, please consult FIMER.
- Installation depth: follow local standards
- Installation route around the MVCS = one mm from the outer wall
- Connect the MVCS earthing busbar to the earthing electrode. It is recommended to use joint lubricant to protect the connection point against corrosion.

For more information, see grounding drawing "MVCS Grounding Layout".

## Protective earthing (grounding) inside the MVCS

The protective earth (PE) terminals or frames and metallic surfaces of the MVCS are connected to the main grounding busbar, please see "MVCS Grounding Layout".

At the installation site:

- Measure the continuity of all internal PE connections by measuring the conductivity between each protective earth terminal and the main PE busbar.
- Earth the shields, armors, and protective conductors of all incoming cables to the appropriate earthing terminals of the station.

## Measuring the insulation resistance of the cabling

Make sure that the insulation resistance of the external power cables is measured according to manufacturer recommendations and local regulations.

## Connecting the inverter inputs

To connect inverter cables to MVCS inputs (fuse holders), please check ac cables cross section, maximum cross section allowed in MVCS is 3001 mm<sup>2</sup> (defined by the fuse holders).

To connect the inverter inputs, follow the instructions below:

1. Make sure that all cables have the maximum cable size = 300 mm<sup>2</sup>.
2. Note that AC busbars are made in tinned copper, and so, if cables from the inverters are made in aluminum, then bi-metallic terminals or washers are needed.
3. Considering the AC cable sizes and that the cables must be aligned with the fuse bases, mark the LV AC lead through holes in the cable cover:



4. Remove the cable entry covers.
5. Drill holes of appropriate sizes in the AC cabinet cover and install cable glands to ensure that the IP degree of protection is maintained.

1) If bigger cross section is needed, please consult FIMER



Single-core



Multicore

6. Route the cables inside the AC cabinet.

7. Connect the cables to the correct fuse base terminals in the AC cabinet, make sure that the proper electrical sequence is maintained. Tighten the connections.



8. Connect the grounding cables coming from the inverters to the grounding busbar (below fuse holders).

**Note:**

AC cables can be connected to the fuse holders without terminals.





## Auxiliary and Communication Interconnection

See the following drawings:

- General MVCS Single Line diagram LV/MV-AC – “xxxxxxx\_011\_DW\_name”
- MVCS interconnection cables and electrical Layout – “xxxxxxx\_021\_DW\_name”
- SSAA Cabinet – “xxxxxxx\_141\_DW\_name”

To connect the cabling for auxiliary cabinet:

1. Remove the cable entry covers in Auxiliary service board (B) .
2. Considering the auxiliary cable sizes and their alignment, drill holes of appropriate sizes in the cable covers.
3. Install cable glands to ensure that IP protection is established.
4. Lead the cables into the station.
5. Connect the cables to the correct terminal blocks. Tighten the connections.
6. Fill the cable trenches and seal the cable entries. See Finalizing the installation.

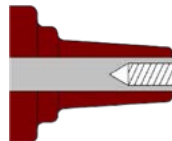
## MV Side (Grid) Interconnection

See the following documentation:

- General MVCS Single Line diagram LV/MV-AC – “xxxxxxx\_011\_DW\_name”
- MVCS interconnection cables and electrical Layout – “xxxxxxx\_021\_DW\_name”
- MVCS Footprint – “xxxxxxx\_302\_DW\_name”
- Switchgear – “xxxxxxx\_131\_SP\_name”

To connect MV cables:

1. Remove the cable entry covers.
2. Lead the cables into the MVCS and seal the cable entries.
3. Terminate the cables according to the cable manufacturer instructions. Connect the cables to the MV switchgear. The standard cable termination (see figure below) installed in MV switchgear is interface type C (400 series with M16 bolted contact) 630 A.



4. Fill the cable trenches and seal the cable entries. For more information, see chapter Finalizing the installation.
5. Connect the cables to correct terminals. Maximum MV cable sizes depend on the connector dimensions. See "switchgear" - xxxxxx\_131\_SP\_name"
6. Connect the shields to the earthing bar of the MV SWG



# Finalizing the installation

## Contents of this chapter

This chapter describes how to finalize and check the installation of the medium voltage compact skid (MVCS). Obey all local regulations.



### **WARNING!**

Only an authorized electrician is permitted to install the cabling to the MVCS. Obey the Safety instructions, and the local safety regulations. If ignored, physical injury or death may occur, or cause damage to the equipment.



### **WARNING!**

Do not do any electrical installation work during a thunderstorm.



### **WARNING!**

Make sure that all external cable entries are fully sealed to prevent entry of foreign elements, such as animals, insects, and dust.

## Finalizing the installation

- Clean the MVCS of all dirt.
- Repair any damages to the paint surface. See section Maintenance of painted surfaces
- If not yet done, seal the cable entries, cover the cable entries with sand and sprinkle a handful of cement over the sand. The cement hardens in a few days and it forms a barrier against small animals and plant growth.

## Checking the installation of MVCS

As part of the pre-commissioning inspection of a MVCS, it is needed to check the following points listed on Commissioning Pre-Conditions & Pre-Commissioning Checklist.

To complete this inspection process, we suggest printing the following charts. If any incidence is detected, it should be reported to FIMER before the commissioning.

### **Commissioning Pre-Conditions**

The following activities described, are the gross activities required before commissioning. This guide summarizes the activities described in Mechanical installation & Electrical installation, for a complete description of the activities, please refer to those chapters.

## 7 - Finalizing the installation

Activity	Status	Comments
<b>Mechanical Installation</b>		
Constructing the foundation	<input type="checkbox"/>	
Constructing the earthing electrode and earthing	<input type="checkbox"/>	
Placing and fixing the MVCS on the foundation	<input type="checkbox"/>	
<b>Electrical Installation</b>		
Install the AC cables coming for from the string inverters to the AC cabinet inputs. Metallic plates (not cable glands) are included in the lead through holes of the AC cabinet.	<input type="checkbox"/>	
Connect incoming and outgoing MV cables to the RMU C modules (plate included)	<input type="checkbox"/>	
Tighten the busbars of the interconnection between AC Cabinet and MV transformer. See LV busbar interconnection		
Connect additional communication, auxiliary, control etc., cables.	<input type="checkbox"/>	
Connect the earthing electrode to the terminal located at the base of the station.	<input type="checkbox"/>	
Check the electrical bond and continuity of all cabling.	<input type="checkbox"/>	
Check that all protective grounding inside the MV compact skid has continuity.	<input type="checkbox"/>	
Checking the installation. Refer to Finalizing the installation	<input type="checkbox"/>	
Make sure that the parameters of the MV/HV grid on which the PV plant is going to be connected match with the MV parameters of the MVCS (MV level, Isc..)	<input type="checkbox"/>	
Make sure that there is permission from grid operator to connect the PV plant	<input type="checkbox"/>	

## Pre-Commissioning Checklist

The following inspection activities should be checked when the installation process has been completed.

Activity	Status	Comments
<b>General Building</b>		
Check the external conditions of the buildings (no scratches, bumps, etc.)	<input type="checkbox"/>	
Check that there are no signs of rust (internal/external)	<input type="checkbox"/>	
Check that the MVCS has been placed in a concrete foundation.	<input type="checkbox"/>	
Check that the covers, filters and all components of the ventilation system are in good conditions.	<input type="checkbox"/>	
Labels and stickers in the building are in good condition, with no damages or scratches during transport.	<input type="checkbox"/>	
Check that all installation accessories are inside.	<input type="checkbox"/>	
Check that the building has been anchored to the foundation adequately	<input type="checkbox"/>	
Check that all doors opened and close smoothly.	<input type="checkbox"/>	
Check that the station is correctly levelled.	<input type="checkbox"/>	
Check that all cable entries are correctly sealed	<input type="checkbox"/>	

Check that the interlocking system of station and RMU work properly	<input type="checkbox"/>
Check that there is no condensation inside the station	<input type="checkbox"/>
<b>MV Switchgear &amp; MV Enclosure</b>	
Check visually that the switchgear is in general good conditions, and that there are no hits, bumps or any visible damages caused by transportation	<input type="checkbox"/>
Check visually that the MV switchgear enclosure (if present) is in general good conditions and that there are no hits, bumps or any visible damages caused by transportation	<input type="checkbox"/>
Check that the grounding connections of the switchgear is correctly connected to the grounding system of the MVCS	<input type="checkbox"/>
Verify that the switchgear is still correctly fixed to the station	<input type="checkbox"/>
Check that the MV cables coming from the ring are correctly connected with the specified torque.	<input type="checkbox"/>
Check that the MV cables coming for the ring are properly supported to the switchgear with clamps.	<input type="checkbox"/>
Check that the MV cables coming from the transformer are correctly connected with the specified torque.	<input type="checkbox"/>
Check that the MV cables coming from the transformer are properly supported to the switchgear with clamps.	<input type="checkbox"/>
Check the insulation resistance of the MV cables coming from the ring.	<input type="checkbox"/>
Check the correct point to point connection for the MV cables coming from the ring.	<input type="checkbox"/>
Check that the electrical sequence is correct for the MV cables coming from the MV ring.	<input type="checkbox"/>
Verify the correct function of the interlocking system	<input type="checkbox"/>
Check that the settings of the protection relay are suitable for MVCS and grid characteristics	
<b>MV Transformer</b>	
General visual inspection	<input type="checkbox"/>
Check carefully "Transformer Specification"	<input type="checkbox"/>
Check tightness for LV busbar bolts connection.	<input type="checkbox"/>
See LV busbar interconnection	<input type="checkbox"/>
Check that the oil level is within the limits	<input type="checkbox"/>
Check that there is no oil leakage	<input type="checkbox"/>
Check that HV cables are properly connected	<input type="checkbox"/>
Check RIS2/DGPT2 (protection device) is according to transformer technical specification "Transformer Specification"	<input type="checkbox"/>
Check that the tap charger position is correct to grid voltage	<input type="checkbox"/>
<b>AC Cabinet</b>	
Check visually that the Ac Cabinet is in general good conditions and that there are no hits, bumps or any visible damages caused by transportation	<input type="checkbox"/>
Check that the AC Cabinet is correctly fixed to the skid/baseframe	<input type="checkbox"/>
Check that all cables are firmly connected	<input type="checkbox"/>
Check the torque of the connection point of all the breakers in the panel	<input type="checkbox"/>

7 - Finalizing the installation

Check visually that AASS transformer, main circuit breaker (if present) and UPS (if present) are in general good conditions and that there are no hits, bumps or any visible damages caused by transportation	<input type="checkbox"/>
Check that AASS transformer, main circuit breaker (if present) and UPS (if present) are properly fixed to the cabinet	<input type="checkbox"/>
Check visually that all the devices, such as circuit breakers, relays, terminal strip, etc.. of the auxiliary board, are properly fixed and in general good conditions	<input type="checkbox"/>
Check that all the cables of the auxiliary board are firmly connected to their terminals.	<input type="checkbox"/>
Check the correct connection to the grounding grid	<input type="checkbox"/>
Verify that the value set in the thermostat of the Auxiliary Services Compartment are in accordance with the specifications. Standard Value 35°C	<input type="checkbox"/>
Check that all fuse holders (inverter string and LV device protection) include fuses and ensure electrical continuity	<input type="checkbox"/>
Check that all the string input fuses bases are properly connected and closed.	<input type="checkbox"/>
Check the phase sequence of every incoming line from inverter is correct	<input type="checkbox"/>

# Start-up and operation

## Contents of this chapter

This chapter describes the start-up procedure of the medium voltage compact skid (MVCS) and the general operation criteria.



### WARNING!

Only an authorized electrician is permitted to install the cabling to the MVCS. Obey the Safety instructions and the local safety regulations. If ignored, physical injury or death, or damage to the equipment may occur.



### WARNING!

Do not do any electrical installation work during a thunderstorm.

### Tools needed

- Voltage detector
- Insulation resistance meter. For more information, see section Measuring the insulation resistance of the cabling
- Personal protective equipment

## Start-up procedure

This section describes the procedure to startup the medium voltage compact skid (MVCS).



### WARNING!

Only an authorized electrician is permitted to install and perform the start-up procedure. Obey the Safety instructions and the local safety regulations. If ignored, physical injury or death, or damage to the equipment may occur.



### WARNING!

Read the manuals and start-up procedures of all other components (inverters, UPS, etc.). Note that the guidelines specified in this section does not replace the instructions given by the product manuals of each component.

## 8 - Start-up and operation

Task	Additional information	
<b>General Building</b>		
Make sure that Commissioning Pre-Conditions & Pre-Commissioning Checklist have been successfully completed		<input type="checkbox"/>
Make sure that the installation of the inverters has been properly done	See inverter product manual and commissioning manual	<input type="checkbox"/>
Make sure that the main switch of the Auxiliary service transformer is opened.		<input type="checkbox"/>
Make sure that the low voltage main circuit breaker "MCB" (if present), is open.	In general, make sure that the connection is going to be done in "no load" conditions.	<input type="checkbox"/>
Make sure that the fuse holders in which the inverters are connected are opened, and the inverters are disconnected		<input type="checkbox"/>
Make sure that all the local regulations, applicable laws, and standard are met.	Contact local grid operator and competent authorities	<input type="checkbox"/>
Turn the earthing switch on the grid side of the MV switchgear to the "not earthed" position.	Applicable for C (L) module(s) MV switchgear See MV switchgear documentation "Switchgear"	<input type="checkbox"/>
Ask permission to MV grid operator for connect the station to the power grid. Wait until the station is connected to the power grid before proceeding.		<input type="checkbox"/>
Turn the disconnecting switch on the grid side of the MV switchgear to "closed" position.	Applicable for C (L) module(s) MV switchgear See MV switchgear documentation "Switchgear"	<input type="checkbox"/>
Turn the earthing switch on the MV Transformer side of the MV switchgear to the "not earthed" position.		<input type="checkbox"/>
Turn the disconnecting switch on the MV transformer side of the MV switchgear to the closed position.	Applicable for V (P) module MV switchgear See MV switchgear documentation "Switchgear"	<input type="checkbox"/>
Close the main breaker of the MV transformer.		<input type="checkbox"/>
Make sure that the voltage level on the low voltage side of the MV transformer is correct.	PVS-175: 800V PVS-120: 480V PVS-100: 400V	<input type="checkbox"/>
Run the MV transformer with no load for several hours.	See MV transformer documentation "Transformer Specification"	<input type="checkbox"/>
Check the MV transformer for any malfunctions. Observe the temperature, listen to audible changes, etc.	See MV transformer documentation "Transformer Specification"	<input type="checkbox"/>
Close the low voltage main circuit breaker "MCB" (if present)		<input type="checkbox"/>
Close the Auxiliary service transformer primary breaker.		<input type="checkbox"/>
Check that the Auxiliary service transformer secondary winding voltage level is 230/400 V.	Must be 230/400 V $\pm$ 10%	<input type="checkbox"/>
Close the Auxiliary service transformer secondary breaker.		<input type="checkbox"/>
Close the auxiliary breakers one by one. After closing each breaker, check the voltage values.	Maintain "Closed" condition for the auxiliary service lines with load. Only open switches/breakers with loads	<input type="checkbox"/>
Close the fuse base switches of the inverter inputs one by one. Check each fuse base for voltage values directly in the inverter input, before closing the next fuse base.	Inverters must be de-energized. See inverter manual.	<input type="checkbox"/>
Connect (turn on) the inverters one by one following inverter commissioning procedure.	See inverter manual.	<input type="checkbox"/>

# Maintenance

## Contents of this chapter

This chapter contains the preventive maintenance instructions for the medium voltage compact skid (MVCS). The instructions are intended for certified personnel to perform maintenance tasks. Depowering of the units must be carried out by a certified electrician as per applicable local regulation. Maintenance of de powered unit can be carried out by a certified maintenance technician by Fimer



### **WARNING!**

Only an authorized electrician is permitted to do maintenance work on the MVCS. Obey the Safety instructions and follow the local safety regulations. If ignored, physical injury or death, or damage to the equipment may occur.



### **WARNING!**

Do not do any electrical installation work during a thunderstorm.

### **Tools needed**

- Torx drivers
- Philips screwdrivers (PoziDriv)
- Torque wrench
- Set of wrenches and sockets
- Cable and wire strippers
- Crimping tool and cable lugs
- Voltage detector
- Personal protective equipment

### **Tightening torque**

Use the torque values given in the table, unless otherwise specified.



### Electrical connections

Thread	Plug (mm)	Torque (N.m, ±10%)		
		Stainless steel A2-A4	Brass/copper	
		1.Flag 2.Busbar	Connection between nut and locknut (2 wrenches needed)	
			Terminal blocks	
M3	0,6x3,5	-	-	1
M6	10	-	-	-
M8	13	-	-	20
M10	17	25	-	-
M12	19	40	12	-
M14	22	-	-	-
M16	24	90	-	-
M20	30	-	20	-
M22	34	-	-	-
M24	36	-	-	-
M27	41	-	-	-
M30x2	46	-	30	-
M42x3	65	-	55	-
M48x3	75	-	60	-
M55x3	85	-	75	-
M64x3	95	-	110	-
M75x3	-	-	115	-
M90x4	-	-	115	-

### Mechanical connections

Thread	Plug (mm)	Torque (N.m, ±10%)			
		Stainless steel A2-A4	Stainless steel A2-A4		Stainless steel A2-A4
		1.Between steel parts	1. Cover-tank bolts 2. Drain valve		1. DGPT2, RIS2, DMCR 2. Thermometer pocket 3. HV insulator blocks 4. Pressure valve
			With gasket		With gasket
			Cork	NBR	NBR
M3	0,6x3,5	-	-	-	
M6	10	6	12	6	
M8	13	15	27	13	
M10	17	35	65	27	
M12	19	50	100	46	
M14	22	80	150	74	
M16	24	120	250	114	
M20	30	170	-	-	
M22	34	260	-	-	
M24	36	410	-	-	
M27	41	620	-	-	
M30x2	46	840	-	-	
M42x3	65	-	55	-	
M48x3	75	-	60	-	
M55x3	85	-	75	-	
M64x3	95	-	110	-	
M75x3	-	-	115	-	
M90x4	-	-	115	-	

## Maintenance intervals

The maintenance and component replacement intervals are based on the specified operational and environmental conditions. FIMER establishes the following as a minimum maintenance schedule. The MVCS final maintenance schedule must be adapted and defined by the maintenance responsible of the plant according to the site conditions, operations and others.

Action	Description
I	Visually inspect and perform maintenance if it is necessary.
P	On-site/off-site performance work (commissioning, tests, measurements, etc.)
R	Replace the component.

For more information on maintenance, contact your local FIMER service representative.

### Annual maintenance

Perform the following inspections at least once in every twelve months.

Action	Task
I	Check the operating environment, surroundings and conditions.
I	Check the availability of spare parts.
I	Check for any dust, corrosion, etc. inside and outside the MVCS.
I	Check and clean the inlet and outlet grills & filters.
I	Check the sealing of all cable entries to ensure that the IP protection level is maintained.
I	Clean the filters of the air inlet and outlet.
I	Examine the tightness and cleanliness of the main circuit terminals and earth connections.
I	Inspect the general conditions of the MVCS (door sealing, cooling fan operation, etc.)
I	Inspect the operation of locks, hinges, and gaskets.
I	Check that all labels are readable and in proper conditions.
I	Examine the condition of the foundation.

## Maintenance intervals

Component	Years from start-up or interval	
	10	20
Cooling fans	R	R
Air filters	R (every six months)	
Transformer	Follow manufacturer instructions. See "Transformer Specification"	
UPS (if present)	Follow manufacturer instructions. See "UPS"	

## Cleaning procedure



### WARNING!

Obey the Safety instructions and the local safety regulations. If ignored, physical injury or death, or damage to the equipment may occur.



### WARNING!

Read the manuals of other components (inverters, UPS, etc.). The guideline specified in this section does not replace the instructions given by the product manuals of each component.

## 9 - Maintenance

Task	Additional information	
Pre-check that there are safe conditions before starting any cleaning procedure.		<input type="checkbox"/>
<b>Cleaning the MVCS</b>		<input type="checkbox"/>
Use pressurized air to clean the external enclosure, floors, and gutters.		<input type="checkbox"/>
Use pressurized air to clean all air inlets and out-lets including grills.		<input type="checkbox"/>
<b>Cleaning the AC Cabinet</b>		<input type="checkbox"/>
Use a vacuum cleaner to clean the floor, doors and interior beams.	If necessary, use a duster or pressurized air to clean locations you cannot reach with the vacuum cleaner.	<input type="checkbox"/>
Remove dust from the air inlets and outlets.		<input type="checkbox"/>
Use pressurized air to clean locations with excessive dust, including busbar connections.		<input type="checkbox"/>
<b>Cleaning the inverters</b>		<input type="checkbox"/>
Follow the instructions in the inverters manual.		<input type="checkbox"/>
<b>Cleaning the MV transformer area</b>		<input type="checkbox"/>
Use a pressurized air to clean the general dust in the MV transformer surface and locations with excessive dust.	See MV transformer manual.	<input type="checkbox"/>
<b>Cleaning the air filters</b>		<input type="checkbox"/>
Clean the air filters by blowing compressed air from the inside to the outside through the filter until the dust comes off.		<input type="checkbox"/>
Loosen and remove the screws on the filter frame.		<input type="checkbox"/>
Clean the grill interior with a vacuum cleaner.		<input type="checkbox"/>

Task	Additional information	
Install the filter support frames and tighten the screws.		<input type="checkbox"/>
<b>Cleaning the fans</b>		<input type="checkbox"/>
Please see Safety instructions for the auxiliary services board		<input type="checkbox"/>
Turn OFF/OPEN the circuit breaker for fan.	Prevent the circuit breaker from turning on accidentally.	<input type="checkbox"/>
Use compressed air to clean the fans.		<input type="checkbox"/>
<b>Cleaning the MV switchgear area</b>		<input type="checkbox"/>
Use a vacuum cleaner to clean the floor, doors and interior metal beams.	If necessary, use a duster or pressurized air to clean locations you cannot reach with the vacuum cleaner.	<input type="checkbox"/>

## Maintenance of painted surfaces



### WARNING!

Obey the Safety instructions (page 9) and the local safety regulations. If ignored, physical injury or death, or damage to the equipment may occur.



### WARNING!

Obey the Safety instructions (page 9), requirements and specifications of the primer and paint manufacture.

### Repainting the scratched areas

Tools and materials

Use the following tools and materials. If the listed tools are not available in your local market, you can use products with similar characteristics approved by a qualified technician, and get approval from FIMER.

Tool	Specification	Make
Flap Disc	1 ud	Silver P80 Triton
Grinding machine	1 ud	Bosch
Flexible abrasive sponges	10 ud	Ehs
Degreasing sprays	250 ml	-
Body shop putties	1 ud	Finissage, Impa
Rags or blower	200 gr	-
Disposable gloves	10 ud	-
Safety glasses	1 ud	Uvex Astrospec
Masks	2 ud	-
Brushes	2 ud	-
Epoxy primer	500 gr	Maper
Aliphatic polyurethane	500 gr	Maper

### Painting the damaged surface (no visible rust)

If there is damage(s) to the paint surface, but no damages to the metal surface (i.e. no visible rust), then follow these instructions:

1. Clean the damaged area first with a suitable detergent and clean water.
2. Let the surface dry completely and keep it clean.
3. Apply the first layer of paint to the damaged area. Let it dry thoroughly for at least 12 hours.
4. Apply the second layer of paint to the damaged area.

### Painting the damaged surface (visible rust)

If the damage extends to the metal surface or there is visible rust:

1. Remove the rust with sandpaper/polishing disk.
2. Clean the damaged area and its surroundings using a cloth or blower.
3. If necessary, apply putty to even out the surface.
4. Coat the damaged area with an epoxy primer. Let it dry thoroughly (for at least 24 hours).
5. Apply first layer of paint to the damaged area. Let it dry thoroughly (for at least 12 hours).
6. Apply second layer of paint to the damaged area.
7. Apply final layer (e.g. Aliphatic Polyurethane coating).

### Maintenance of Zinc coated surfaces

Pay attention to doors and lower parts of the walls. These areas have potentially corrosive elements such as dust and humidity.

If there is damage to the zinc-coating:

1. Carefully remove any rust with sandpaper.
2. Clean the damaged area and its surroundings.
3. Coat the damaged area with the zinc coating. FIMER recommends to use Würth Zinc 300 due to the thicker coat. On large areas, you can use Würth Zinc Spray Perfect to ease the work and to get an even surface.

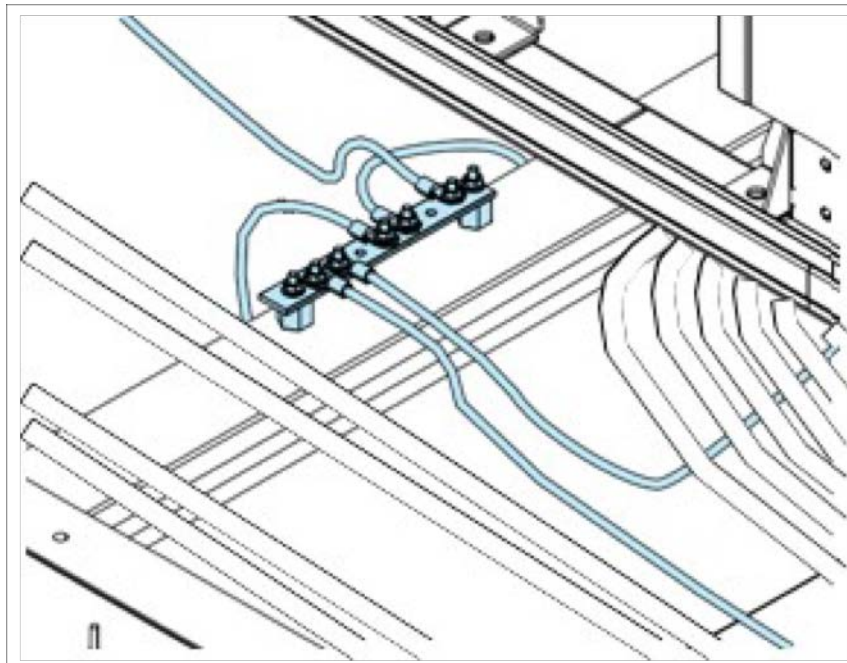
# Maintenance of grounding bars and points

## Tools

- Steel wool
- Ensto SR1 joint compound or equivalent
- 42839 Würth protective wax or equivalent

## Procedure

1. Examine the condition of the grounding bar and grounding cables in the MV switchgear area. If there is any visible corrosion, remove the cables and remove the corrosion with steel wool. Apply joint compound between the grounding bar and the joint surfaces of the cable terminal.



2. Change the spring lock washers. Tighten the cables to the nominal torque values.
3. If corrosion is more, apply protective wax spray on the grounding bar and the cable terminals.

# Technical data

## Contents of this chapter

This chapter contains the technical data of the medium voltage compact skid (MVCS).

## Technical data and types: MVCS

Power Range								
Number of inverters in parallel	6'	8'	10'	12	14	16	18	20
Maximum rating in kVA with PVS-100	600	800	1.000	1.200	1.400	1.600	1.800	2.000
Maximum rating in kVA with PVS-120	720	960	1.200	1.440	1.680	1.920	2.160	2.400
Maximum rating in kVA with PVS-175	1.110	1.480	1.850	2.220	2.590	2.960	3.330	3.700
Number of inverters in parallel	22	24	26	28	30	32	34	36
Maximum rating in kVA with PVS-100	2.200	2.400	2.600	2.800	3.000	3.200	-	-
Maximum rating in kVA with PVS-120	2.640	2.880	3.120	3.360	3.600	3.840	-	-
Maximum rating in kVA with PVS-175	4.070	4.440	4.810	5.180	5.550	5.920	6.290	6.660
General								
Length, Width, Height (L x W x H)	5.700 x 2.150 x 2.590 mm							
Weight approx.	7 – 18 ton							
Operating temperature range	Depending on power rating							
Operating altitude range	-25 C ... +60°C (with derating above 30°C)							
Relative humidity	≤ 1.000 m							
Environmental protection	≤ 95%							
Environmental protection rating	IP 54							
Painting corrosion protection	C4 (C5M optional)							
Painting colour	RAL7035							
MV switchgear								
Switchgear type	SF <sub>6</sub> -insulated <sup>2</sup>							
Rated current	630 A							
Configuration	CV (L+P) standard; CCV (2L+P) optional							
Protection (up to 24 kV / up to 36 kV)	Circuit breaker (16 kA standard 20 kA optional / 20 kA standard 25 kA optional)							
Protection relay type	Standard: 50/51; 50N/51N ;68 Optional: 50/51-50N/51N-68- 59-27-81 + comm & energy measurement							
Motorized optional	Yes							

<b>MV transformer</b>	
Transformer type	Outdoor Oil immersed (ONAN)
Power derating characteristic	According number of inverters connected in parallel and its power derating characteristic
Low voltage level	800 V → PVS175 480 V → PVS120 400 V → PVS100
Medium voltage level range	≤ 36 kV
Rated frequency	50/60 Hz
Oil type	Mineral
Tap changer	± 2 x 2.5%
Winding material (primary / secondary)	Al/ Al
Losses	Standard: EU 548/2014 Optional: EU 2019/1783 <sup>2</sup>
Protection Device	RIS2, DGPT2 or similar
<b>AC Cabinet</b>	
<b>Inverter input section</b>	
Number of fuse protected inputs	Up to 36
Fuse rating of feeders	160/200/315 A Depending on inverter selection
Over voltage protection - SPD	Type I+II
<b>Auxiliary service board</b>	
Auxiliary transformer power	10 kVA (20 kVA/30 kVA optional)
Auxiliary transformer voltage	800 / 400-230 V <sup>3</sup>
Comm	-2x Remote I/O module, Digital signals, Input, 8-channel, 2-conductor connection -1x Remote I/O fieldbus coupler, Modbus/TCP -1x Network switch, unmanaged, Fast Ethernet, Number of ports
LV Main Circuit Breaker	Optional
UPS	Optional
LV Energy Measurement	Optional
<b>Product compliance</b>	
Conformity	IEC 62271-212, IEC 62271-200, IEC 60076, IEC 61439-1

1) For 6/8/10 inputs MVSS can be selected.

2) Outdoor or indoor selection at FIMER's discretion.

4) Included as standard if destination country is in EU

5) 3 kVA aux trafo with required secondary voltages (eg 110 V) can be selected as optional

# Documents

## Contents of this chapter

This chapter contains the standard list of documents delivered together with a medium voltage compact skid (MVCS).

### List of documents

The list includes two types of documents:

- Product Series—Standard product series drawings that can be consulted prior to the purchase of the unit.
- Project Specific—Drawings specific to a project that are delivered with the unit, only on request.

Drawing code	Description	Type
xxxxxx_001_TZ_yyyy	Documents list	Product Series
xxxxxx_002_BQ_yyyy	Equipment list	Product Series
xxxxxx_011_DW_yyyy	General MVCS Single Line diagram LV/MV-AC	Project Specific
xxxxxx_021_DW_yyyy	MVCS interconnection cables and electrical layout	Project Specific
xxxxxx_022_DW_yyyy	MVCS grounding layout	Project Specific
xxxxxx_101_FT_yyyy	MVCS FAT Report	Product Series
xxxxxx_102_LB_yyyy	Labelling	Product Series
xxxxxx_141_DW_yyyy	AC Cabinet (Electrical & Dimensional)	Project Specific
xxxxxx_301_DW_yyyy	MVCS Structural Layout	Product Series
xxxxxx_302_DW_yyyy	MVCS Footprint	Product Series

1) Internal project code

2) Project name







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