Driving efficiency and sustainability

Medium Voltage Frequency Inverter

MVW01

User Manual



User Manual

MVW01

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SUMMARY OF REVISIONS

The information below describes the reviews made in this manual.

Version	Revision	Description
-	R01	First edition
-	R02	Addition of the functions: - Vector control with encoder - Sensorless vector control - Ride-Through for vector control - Redundant ventilation - Multivariable read-only parameter - WEG protocol at 192000 bps and 38400 bps - Communication protocol for DeviceNet Drive Profile Board New parameters, new faults and alarms regarding the 4000 HP parallel “Frame C” General revision
-	R03	Update for the MVW01 G2 line, firmware version 3.3X Inclusion of the graphic HMI Inclusion of the MVW01C (compact) Inclusion of the 5 level MVW01 Inclusion of inverter parallelism Inclusion of the synchronous motor line Description of special functions General revision
-	R04	Inclusion of the MVW01 WC General revision
-	R05	General revision
-	R06	General revision

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1 SAFETY INSTRUCTIONS

This manual contains the necessary information for the correct use of the MVW01 frequency inverter.

It was written to be used by people with proper technical training or qualification to operate this kind of equipment.

This manual presents all the functions and parameters of the MVW01, but it is not intended to explain every possible application of the MVW01. WEG will not take any liabilities for applications not described in this manual.

This product is neither intended for applications whose purpose is to ensure physical integrity and/or life of people, nor for any other application in which a fault of the MVW01 may create a situation of risk to the physical integrity and/or life of people. The designer who applies the MVW01 must provide ways to ensure the safety of the installation even in case of a failure of the inverter.

1.1 SAFETY WARNINGS IN THE MANUAL

The following safety notices are used in this manual:



DANGER!
Not following the procedures recommended in this warning can lead to death, serious injuries and considerable material damages.



ATTENTION!
Not following the procedures recommended in this warning can lead to material damages.



NOTE!
The text aims at providing important information for the complete understanding and proper operation of the product.

1.2 SAFETY WARNINGS ON THE PRODUCT

The following symbols are attached to the product as safety warnings:



High voltages are present.



Components sensitive to electrostatic discharge. Do not touch them.



Mandatory connection to the protective earth (PE).



Connection of the shield to the ground.

1.3 IDENTIFICATION LABEL OF THE MVW01

The identification label of the MVW01 is located inside the product Control Panel. The label contains important information on the inverter.

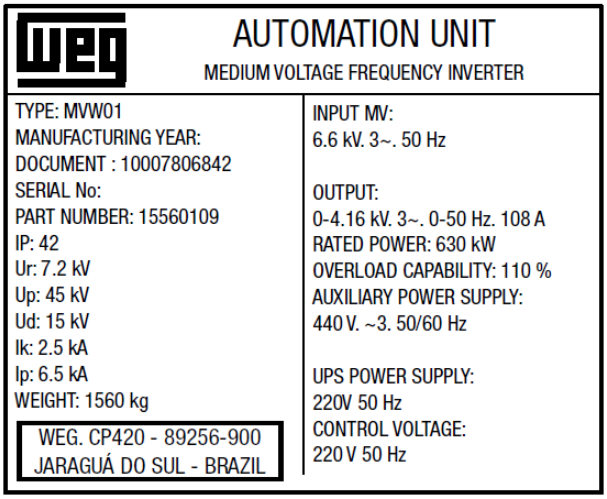


Figure 1.1: MVW01 identification label (example)

1.4 PRELIMINARY RECOMMENDATIONS

DANGER!
Only qualified personnel, familiar with the MVW01 inverter and related equipment must plan or perform the installation, commissioning, operation and maintenance of this equipment.
Such personnel must follow the safety instructions described in this manual and/or defined by local standards.
Failure to comply with the safety instructions may cause risk of death and/or equipment damage.

NOTE!
For the purposes of this manual, qualified personnel are those trained in order to be able to:
1. Install, ground, power up and operate the MVW01 in accordance with this manual and the safety legal procedures in force.
2. Wear/use protective equipment according to the standards in force.
3. Give first aid.

DANGER!
Always turn off the main power supply before touching any electrical component associated to the inverter.
Many components may remain charged with high voltages and/or moving parts (fans) even after the AC power supply input is disconnected or turned off.
Wait for at least ten minutes in order to guarantee the full discharge of the capacitors.
Always connect the equipment frame to the protective earth (PE) at the proper terminal.

ATTENTION!
Electronic boards have components sensitive to electrostatic discharges. Do not touch directly the component parts or connectors. If necessary, first touch the grounded metallic frame or use a proper grounding strap.

Do not execute any applied potential test on the inverter!
If necessary, contact WEG.

NOTE!
Frequency inverters may interfere with other electronic equipment. Follow the recommended procedures to minimize those effects.

NOTE!
Read the user manual completely before installing or operating this inverter.

ATTENTION!
When in operation, electric energy systems – such as transformers, converters, motors and cables – generate electromagnetic fields (EMF), posing a risk to people with pacemakers or implants who stay in close proximity to them. Therefore, those people must stay at least 2 meters away from such equipment.

2 GENERAL INFORMATION

This chapter defines the contents and the purpose of this manual and describes the main characteristics of the MVW01 frequency inverter and how to identify its components. It provides also additional information on the receiving and storage of the product.

2.1 ABOUT THE MANUAL

This manual has chapters with a logical sequence for the user receives, installs, programs and operates the the MVW01:

Chapter 1 SAFETY INSTRUCTIONS on page 1-1.

Chapter 2 GENERAL INFORMATION on page 2-1.

Chapter 3 MVW01 WITH 3 LEVELS (3L) on page 3-1.

Chapter 4 MVW01 WITH 5 LEVELS (5L) on page 4-1.

Chapter 5 MVW01C (COMPACT) on page 5-1.

Chapter 6 MVW01 WC (WATER COOLED) on page 6-1.

Chapter 7 OUTPUT FILTERS on page 7-1.

Chapter 8 INVERTER PARALLELISM on page 8-1.

Chapter 9 SUPPORTED MOTORS on page 9-1.

Chapter 10 INSTALLATION, CONNECTION AND ENERGIZATION on page 10-1.

Chapter 11 OPTIONAL ACCESSORIES AND BOARDS on page 11-1.

Chapter 12 SPECIAL FUNCTIONS on page 12-1.

Chapter 13 DIAGNOSTICS AND TROUBLESHOOTING on page 13-1.

This user manual contains information about WEG/MVW01 Medium Voltage Inverter. This document is arranged in dedicated and specific chapters to explain the proper handling, installation, parameterization, care, troubleshooting, adaption to applications and functionalities of the equipment.

The characteristics and recommendations contained in this manual were based on models of the standard MVW01. It is worth of notice that, in addition to supplying standard products, WEG technical team composed of distinct departments (Technical Sales, Contract Management, Engineering, Technical Assistance, among others) is qualified to develop and provide customized solutions according to the needs of its customers and specific applications.

The MVW01 may be engineered to meet the needs and technical specifications of our customers. Sizes, technical recommendations, performance data and optional items can be changed in relation to the information contained in this document.

Besides the user manual, the Supply Project is part of the documentation delivered to the customer. This project contains all the electrical, mechanical and parameterization information, as well as instructions for the interface/ installation with other equipment regarding the MVW01 supplied.

The MVW01, as well as other WEG products, is in constant evolution in relation to both internal parts (hardware) and programming (software/firmware). Any further explanation about the equipment and its documentation can be obtained by means of WEG communication channels.

WEG is not liable for the improper use of the information contained in this manual.

2.2 SOFTWARE VERSION

It is important to note the software version installed in the MVW01 since it defines the functions and the programming parameters of the inverter. This manual refers to the software version as indicated on the back cover. For instance, the version 3.5X means from 3.50 to 3.59, where “X” are evolutions in the firmware that do not affect the contents of this manual.

2.3 HOW TO SPECIFY THE MVW01 MODEL

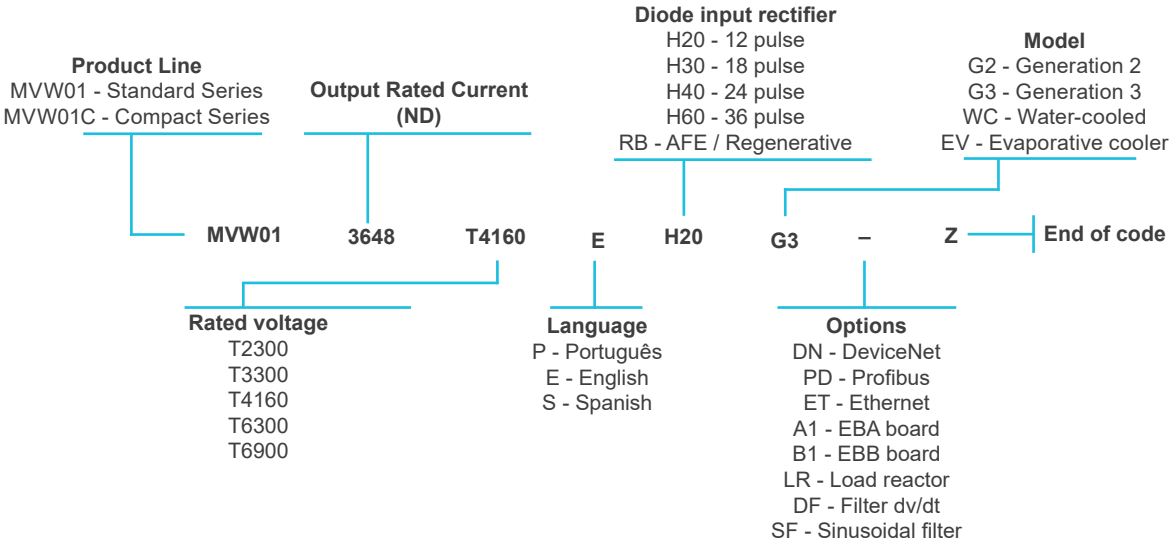


Figure 2.1: Product code

(1) For all available models check from Table 2.1 on page 2-6 to Table 2.6 on page 2-11.

Power Supply	Voltage	■ 2300, 3300, 4160, 4600 or 6900 V
	Frequency	■ 48.5 to 61.8 Hz
	Voltage imbalance between phases	■ < 3 %
	Cos φ	■ > 0.97
Auxiliary Supply	Voltage	■ 220, 380, 400, 415, 440, 460, 480, 525, 550, 575 or 690 V
	Frequency	■ 48.5 to 61.8 Hz
	Voltage imbalance between phases	■ < 3 %
Protection Degree	Standard	■ IP21
	Optional	■ IP41 and IP42
Dimension	Width / Height / Depth (mm)	■ 15 distinct frame sizes. Consult Section 3.1 MECHANICAL DATA on page 3-3, Section 4.1 MECHANICAL DATA on page 4-2, Section 5.1 PANEL CONSTRUCTIVE DETAILS on page 5-6, Section 6.6 MECHANICAL DATA on page 6-8
Environmental Conditions	Temperature	■ 0 to 40 °C (up to 50 °C with 2.5 % reduction in the output current/ °C)
	Humidity	■ 5 to 90 % without condensation
	Altitude	■ 0 to 1000 m (up to 4000 m with 10 % reduction in the output current / 1000 m)
	Pollution degree	■ 2
Finishing	Color	■ Gray ultra dull (Doors)
		■ Gray RAL 7035 (Base, Roof, Shutters)

Control	Microprocessor	■ 32 bits
	Control method	■ Sinusoidal PWM with Space Vector Modulation (SVM)
		■ Sinusoidal PWM with Optimized Pulse Patterns (OPP) Digital
	Control types	■ Scalar (Imposed Voltage - V/F)
		■ Vector (encoder and sensorless)
	Switching	■ High voltage IGBT transistor IGBT (HV - IGBT)
	Frequency range	■ 0 to 120 Hz
	Allowed overload	■ 150 % during 60 seconds, every 10 minutes (1.5 x Inom. - HD)
		■ 115 % during 60 seconds, every 10 minutes (1.15 x Inom. - ND)
	Efficiency	■ Higher 98.5 %
Performance	Speed control	■ V/F Regulation: 1 % of the nominal speed with slip compensation. Resolution: 1 rpm (keypad reference)
		■ Sensorless Regulation: 0.5 % of the nominal speed Speed variation range: 1:100
		■ With Encoder (using EBA or EBB board) Regulation: ±0.01 % of the nominal speed with a 14-bit analog input (EBA). ±0.01 % of the nominal speed with digital reference (keypad, Serial, Fieldbus, Electronic Potentiometer, Multispeed) ±0.1 % of nominal speed with 10-bit analog input (CC9)
Inputs Outputs	Analogical	■ 2 programmable differential inputs (10 bits): 0 to 10 V, 0 to 20 mA or 4 to 20 mA
		■ 1 programmable bipolar input (14 bits): -10 to +10 V, 0 to 20 mA or 4 to 20 mA
		■ 1 programmable isolated input (10 bits): 0 to 10 V, 0 to 20 mA or 4 to 20 mA
		■ 2 programmable outputs (11 bits): 0 to 10 V
		■ 2 bipolar programmable outputs (14 bits): (-10 to +10) V
		■ 2 programmable isolated outputs (11 bits): 0 to 20 mA or 4 to 20 mA
	Digital Analog Relay Transistor	■ 8 programmable isolated inputs: 24 Vdc
		■ 1 programmable isolated input: 24 Vdc
		■ 1 programmable isolated input: 24 Vdc (for motor PTC thermistor)
		■ 5 programmable outputs, contacts NO/NC: 240 Vac, 1 A
		■ 2 programmable isolated open collector outputs: 24 Vdc, 50 mA
Communication	Serial Interface Fieldbus Networks	■ RS-232 (point to point)
		■ RS-485, isolated, via EBA or EBB board (multipoint up to 30 inverters)
		■ Modbus RTU (incorporated software) via RS-485 serial interface
		■ Profibus DP or DeviceNet via additional KFB kits
		■ Ethernet or Profinet IO via additional KFB

Safety	Protections (memory of the last 100 faults / alarms with date and time)	■ DC Link overvoltage
		■ DC Link undervoltage
		■ Overtemperature at the inverter and at the motor
		■ Overcurrent at the output
		■ Motor overload (I x t)
		■ Braking resistor overload
		■ CPU (watchdog)/EEPROM fault
		■ Incremental encoder fault
		■ Short-circuit at the output
		■ Phase-ground short-circuit at the output
		■ External fault
		■ Auto-diagnosis fault and programming error
		■ Serial communication fault
		■ Phase loss at the input
		■ HMI-MVW01 interface connection fault
Applicable Standards	Electromagnetic compatibility	■ EMC directive 89 / 336 / EEC – industrial environment
		■ EN 61800-3 (EMC - Emission and Immunity) standard
	CEI - IEC 61800	■ Adjustable Speed Electrical Power Drive System
		■ Part 4 - General Requirements
		■ Part 5 - Safety Requirements
Humain-Machine Interface	Command	■ Start/Stop, Parameterization (Programming of general functions)
		■ Increase/decrease the speed
		■ JOG, Forward/Reverse selection, Local/Remote selection
	Supervision (Reading)	■ Speed reference (rpm)
		■ Motor speed (rpm)
		■ Value proportional to the speed (e.g.: m/min)
		■ Motor frequency (Hz)
		■ DC Link voltage (V)
		■ Motor torque %
		■ Output power (kW)
		■ Energized time (h)
		■ Operation time (h)
		■ Motor current (A)
		■ Motor voltage (V)
		■ Inverter status
		■ Digital input status
		■ Digital output (transistor) status
		■ Relay output status
		■ Analog input values
		■ 100 last erros in the memory with date and time
		■ Fault/alarm messages
Available Resources /Functions	Options	■ Fieldbus network communication kits (internal inverter installation) - Profibus DP - DeviceNet
		■ Ethernet Kit
		■ Profinet Kit IO
		■ Modbus kit TCP
		■ I/O expansion kit

2.3.1 Available Models

Nowadays, the MVW01 medium voltage inverter line can be divided in 2 distinct generations, G2 and G3. The third generation (G3) is based in the use of semiconductor devices with higher current capacity and efficiency, besides an improvement in the inverter cooling system. These combined features resulted in the increase of the power density of the inverters, now named MVW01 G3.

The power arms are not interchangeable between generations, that is, arms of different generations cannot operate on the same product.

In the third generation (G3) uses new electronic cards and a new user interface with HMI touch.

The next tables present the available models for both generations, and in the same generation the models are subdivided by their topology of 3 levels (3L) or 5 levels (5L).

Table 2.1: G2 - 3 level models

Rated Current (1)			Models	Motor Rated Power (2)				Dissipated Power (3)		Frame Size
ND	MX	HD		ND		HD		ND	HD	
[A]				[HP]	[KW]	[HP]	[KW]	[KW]		
3300 V										
96	98	85	MVW01 C096 T 3300	620	460	540	410	4.96	4.38	A0
113	116	99	MVW01 C113 T 3300	720	540	630	470	5.61	4.99	
131	134	115	MVW01 C131 T 3300	840	630	740	550	6.44	5.70	
152	155	134	MVW01 C152 T 3300	970	730	860	640	7.45	6.58	
176	180	155	MVW01 C176 T 3300	1130	840	990	740	8.65	7.60	
204	214	180	MVW01 0204 T 3300	1310	970	1150	860	8.05	7.23	A
237	249	208	MVW01 0237 T 3300	1520	1130	1330	990	9.23	8.19	
276	290	242	MVW01 0276 T 3300	1770	1320	1550	1160	10.69	9.41	
322	338	280	MVW01 0322 T 3300	2060	1540	1790	1340	12.51	10.85	
376	395	325	MVW01 0376 T 3300	2410	1790	2080	1550	14.77	12.63	
440	463	382	MVW01 0440 T 3300	2820	2100	2450	1820	18.67	16.64	C
460	480	410	MVW01 0460 T 3300	2950	2200	2630	1960	18.07	15.93	B
517	544	448	MVW01 0517 T 3300	3310	2470	2870	2140	21.49	18.96	C
607	639	526	MVW01 0607 T 3300	3890	2900	3370	2510	24.96	21.83	
713	751	618	MVW01 0713 T 3300	4570	3400	3960	2950	29.30	25.40	
816	859	707	MVW01 0816 T 3300	5230	3900	4530	3370	34.43	30.18	D
874	912	779	MVW01 0874 T 3300	5600	4170	4990	3720	35.91	32.01	C
934	984	809	MVW01 0934 T 3300	5980	4460	5180	3860	39.26	34.14	D
1069	1126	926	MVW01 1069 T 3300	6850	5100	5930	4420	45.11	38.93	
1234	1300	1070	MVW01 1234 T 3300	7910	5890	6860	5110	50.79	44.34	E
1311	1368	1169	MVW01 1311 T 3300	8400	6260	7490	5580	55.32	49.14	D
1425	1501	1235	MVW01 1425 T 3300	9130	6800	7910	5900	58.55	50.76	E
1632	1718	1414	MVW01 1632 T 3300	10460	7790	9060	6750	68.85	60.36	2xD
1748	1824	1558	MVW01 1748 T 3300	11200	8340	9980	7440	71.82	64.03	E
2138	2252	1852	MVW01 2138 T 3300	13700	10210	11870	8840	90.22	77.86	2xD
2622	2736	2338	MVW01 2622 T 3300	16800	12520	14980	11160	110.64	98.29	
2850	3002	2470	MVW01 2850 T 3300	18260	13600	15830	11790	117.11	101.52	2xE
3496	3648	3116	MVW01 3496 T 3300	22400	16690	19970	14870	143.65	128.07	
4160 V										
78	85	70	MVW01 C078 T 4160	630	470	570	420	4.97	4.60	A0
92	101	83	MVW01 C092 T 4160	740	550	670	500	5.63	5.20	
108	118	98	MVW01 C108 T 4160	870	650	790	590	6.41	5.92	
128	140	115	MVW01 C128 T 4160	1030	770	930	690	7.42	6.76	
151	165	135	MVW01 C151 T 4160	1220	910	1090	810	8.63	7.78	
181	195	162	MVW01 0181 T 4160	1460	1090	1310	970	9.67	8.78	A
216	233	195	MVW01 0216 T 4160	1740	1300	1580	1170	11.34	10.33	
260	280	235	MVW01 0260 T 4160	2100	1560	1900	1410	13.53	12.28	
294	312	265	MVW01 0294 T 4160	2370	1770	2140	1590	15.39	13.98	
330	350	300	MVW01 0330 T 4160	2670	1990	2420	1810	17.18	15.69	
405	436	365	MVW01 0405 T 4160	3270	2440	2950	2200	22.81	20.91	C
494	532	447	MVW01 0494 T 4160	3990	2970	3610	2690	27.19	24.85	
561	595	506	MVW01 0561 T 4160	4530	3380	4090	3040	30.90	28.26	
627	665	570	MVW01 0627 T 4160	5060	3770	4600	3430	34.14	31.33	
741	798	670	MVW01 0741 T 4160	5990	4460	5410	4030	41.31	37.67	D
835	885	757	MVW01 0835 T 4160	6740	5020	6110	4560	46.72	42.84	
941	998	855	MVW01 0941 T 4160	7600	5660	6910	5150	52.13	47.73	
1087	1153	988	MVW01 1087 T 4160	8780	6540	7980	5950	60.10	55.37	E
1254	1330	1140	MVW01 1254 T 4160	10130	7550	9210	6860	68.28	62.67	
1482	1596	1340	MVW01 1482 T 4160	11970	8920	10820	8060	82.62	75.35	2xD
1881	1995	1710	MVW01 1881 T 4160	15190	11320	13810	10290	104.27	95.46	
2508	2660	2280	MVW01 2508 T 4160	20260	15090	18420	13720	136.57	125.34	2xE

(1) Overload capacity:
HD: Heavy Duty: 150 % overload during 60 seconds every 10 minutes.
ND: Normal Duty: 115 % overload during 60 seconds every 10 minutes.
MX: Maximum Current: overload is not allowed.
(2) The motor rated power takes into account the operation with 0.87 power factor and 96 % efficiency at full load.
(3) Dissipated Power in the power arms and 12-pulse rectifier.

Table 2.2: G2 - 5 level models

Rated Current (1)			Models	Motor Rated Power (2)				Dissipated Power (3)		Frame Size
ND	MX	HD		ND		HD		ND	HD	
[A]				[HP]	[KW]	[HP]	[KW]	[KW]		
6000 - 6300 V										
58	62	55	MVW01 0058 T 6300	710	530	670	500	9.43	9.19	C1
73	78	69	MVW01 0073 T 6300	890	670	840	630	10.60	10.28	
91	97	86	MVW01 0091 T 6300	1110	830	1050	780	12.07	11.65	
114	122	108	MVW01 0114 T 6300	1390	1040	1320	980	14.01	13.49	
144	154	136	MVW01 0144 T 6300	1760	1310	1660	1240	16.68	15.95	
180	181	170	MVW01 0180 T 6300	2200	1640	2080	1550	20.07	19.11	
212	228	198	MVW01 0212 T 6300	2590	1930	2420	1800	20.64	16.63	C2
251	269	230	MVW01 0251 T 6300	3070	2290	2810	2100	23.54	21.97	
295	317	267	MVW01 0295 T 6300	3610	2690	3270	2430	26.96	24.77	
348	373	310	MVW01 0348 T 6300	4260	3170	3790	2830	31.27	28.16	
410	440	360	MVW01 0410 T 6300	5020	3740	4400	3280	36.59	32.28	
480	500	430	MVW01 0480 T 6300	5870	4370	5260	3920	42.84	38.55	
481	516	423	MVW01 0481 T 6300	5880	4380	5170	3850	43.96	38.45	C3
565	606	496	MVW01 0565 T 6300	6910	5150	6070	4520	52.45	45.43	
664	713	583	MVW01 0664 T 6300	8120	6050	7130	5310	63.23	54.35	
779	836	684	MVW01 0779 T 6300	9530	7100	8370	6230	76.79	65.51	
912	950	817	MVW01 0912 T 6300	11160	8310	9990	7450	89.90	78.60	
6600 - 6900 V										
54	58	50	MVW01 0054 T 6900	720	540	670	500	9.85	9.52	C1
67	72	63	MVW01 0067 T 6900	900	670	840	630	10.93	10.60	
86	92	81	MVW01 0086 T 6900	1150	860	1090	810	12.57	12.13	
109	117	102	MVW01 0109 T 6900	1460	1090	1370	1020	14.63	13.99	
139	149	130	MVW01 0139 T 6900	1860	1390	1740	1300	17.44	16.58	
177	178	165	MVW01 0177 T 6900	2370	1770	2210	1650	21.23	20.01	
205	221	192	MVW01 0205 T 6900	2750	2050	2570	1920	21.11	20.14	C2
241	260	223	MVW01 0241 T 6900	3230	2410	2990	2230	23.84	22.46	
283	305	259	MVW01 0283 T 6900	3790	2820	3470	2590	27.15	25.24	
332	358	301	MVW01 0332 T 6900	4450	3310	4030	3000	31.20	28.62	
390	420	350	MVW01 0390 T 6900	5230	3890	4690	3490	36.22	32.73	
458	494	411	MVW01 0458 T 6900	6140	4570	5510	4100	43.26	38.77	C3
460	480	404	MVW01 0460 T 6900	6160	4590	5410	4030	42.72	37.78	C2
538	580	482	MVW01 0538 T 6900	7210	5370	6460	4810	51.35	45.63	C3
631	680	566	MVW01 0631 T 6900	8450	6300	7580	5650	61.44	54.31	
740	798	665	MVW01 0740 T 6900	9910	7390	8910	6640	74.20	65.31	
874	912	767	MVW01 0874 T 6900	11710	8720	10280	7660	87.63	75.32	

(1) Overload capacity:
HD: Heavy Duty: 150 % overload during 60 seconds every 10 minutes.
ND: Normal Duty: 115 % overload during 60 seconds every 10 minutes.
MX: Maximum Current: overload is not allowed.
(2) The motor rated power takes into account the operation with 0.87 power factor and 96 % efficiency at full load.
(3) Dissipated Power in the power arms and 3x12-pulse rectifier.

Table 2.3: G3 - 3 level models

Rated Current (1)			Models	Motor Rated Power (2)				Dissipated Power (3)		Frame Size
ND	MX	HD		ND		HD		ND	HD	
[A]				[HP]	[KW]	[HP]	[KW]	[KW]		
3300 V										
96	98	85	MVW01 C096 T 3300	620	460	540	410	4.96	4.38	A0
113	116	99	MVW01 C113 T 3300	720	540	630	470	5.61	4.99	
131	134	115	MVW01 C131 T 3300	840	630	740	550	6.44	5.70	
152	155	134	MVW01 C152 T 3300	970	730	860	640	7.45	6.58	
176	180	155	MVW01 C176 T 3300	1130	840	990	740	8.65	7.60	
204	214	180	MVW01 0204 T 3300	1310	970	1150	860	8.05	7.23	A
237	249	208	MVW01 0237 T 3300	1520	1130	1330	990	9.23	8.19	
276	290	242	MVW01 0276 T 3300	1770	1320	1550	1160	10.69	9.41	
322	338	280	MVW01 0322 T 3300	2060	1540	1790	1340	12.51	10.85	
376	395	325	MVW01 0376 T 3300	2410	1790	2080	1550	14.77	12.63	
450	460	390	MVW01 0450 T 3300	2880	2150	2500	1860	17.24	14.71	B
560	590	490	MVW01 0560 T 3300	3590	2670	3140	2340	21.97	19.25	
607	639	526	MVW01 0607 T 3300	3890	2900	3370	2510	24.96	21.83	C
713	751	618	MVW01 0713 T 3300	4570	3400	3960	2950	29.30	25.40	
855	874	741	MVW01 0855 T 3300	5480	4080	4750	3540	33.68	28.71	
1064	1121	931	MVW01 1064 T 3300	6820	5080	5970	4440	43.49	37.99	
1170	1195	1013	MVW01 1170 T 3300	7500	5590	6490	4840	44.84	38.42	D
1283	1311	1111	MVW01 1283 T 3300	8220	6120	7120	5300	49.69	42.39	
1596	1681	1396	MVW01 1596 T 3300	10230	7620	8950	6660	63.93	55.96	
1710	1748	1482	MVW01 1710 T 3300	10960	8160	9500	7070	67.36	57.40	E
2128	2242	1862	MVW01 2128 T 3300	13640	10160	11930	8890	86.99	75.99	
2565	2622	2222	MVW01 2565 T 3300	16440	12240	14240	10610	89.68	76.84	2xD
3192	3362	2792	MVW01 3192 T 3300	20450	15240	17890	13330	127.86	111.92	
3420	3496	2964	MVW01 3420 T 3300	21910	16330	18990	14150	134.72	114.80	2xE
4256	4484	3724	MVW01 4256 T 3300	27270	20320	23860	17780	173.98	151.98	
4160 V										
78	85	70	MVW01 C078 T 4160	630	470	570	420	4.97	4.60	A0
92	101	83	MVW01 C092 T 4160	740	550	670	500	5.63	5.20	
108	118	98	MVW01 C108 T 4160	870	650	790	590	6.41	5.92	
128	140	115	MVW01 C128 T 4160	1030	770	930	690	7.42	6.76	
151	165	135	MVW01 C151 T 4160	1220	910	1090	810	8.63	7.78	
181	195	162	MVW01 0181 T 4160	1460	1090	1310	970	9.67	8.78	A
216	233	195	MVW01 0216 T 4160	1740	1300	1580	1170	11.34	10.33	
260	280	235	MVW01 0260 T 4160	2100	1560	1900	1410	13.53	12.28	
294	312	265	MVW01 0294 T 4160	2370	1770	2140	1590	15.39	13.98	
330	350	290	MVW01 0330 T 4160	2670	1990	2340	1750	17.18	15.69	
400	430	360	MVW01 0400 T 4160	3230	2410	2910	2170	20.12	18.14	B
500	530	480	MVW01 0500 T 4160	4040	3010	3880	2890	25.62	24.66	
627	665	551	MVW01 0627 T 4160	5060	3770	4450	3320	27.19	24.85	C
760	817	684	MVW01 0760 T 4160	6140	4570	5520	4120	38.26	34.54	
950	1007	912	MVW01 0950 T 4160	7670	5720	7370	5490	48.85	47.03	
1140	1225	1026	MVW01 1140 T 4160	9210	6860	8290	6170	58.06	52.36	D
1425	1510	1368	MVW01 1425 T 4160	11510	8580	11050	8230	74.31	71.52	
1520	1634	1368	MVW01 1520 T 4160	12280	9150	11050	8230	78.31	70.54	E
1900	2014	1824	MVW01 1900 T 4160	15350	11430	14730	10980	100.48	96.65	
2280	2450	2052	MVW01 2280 T 4160	18420	13720	16570	12350	116.12	104.72	2xD
2850	3020	2736	MVW01 2850 T 4160	23020	17150	22100	16460	148.62	143.04	
3040	3268	2736	MVW01 3040 T 4160	24560	18290	22100	16460	156.62	141.08	2xE
3800	4028	3648	MVW01 3800 T 4160	30690	22870	29470	21950	200.96	193.30	

(1) Overload capacity:
HD: Heavy Duty: 150 % overload during 60 seconds every 10 minutes.
ND: Normal Duty: 115 % overload during 60 seconds every 10 minutes.
MX: Maximum Current: overload is not allowed.
(2) The motor rated power takes into account the operation with 0.87 power factor and 96 % efficiency at full load.
(3) Dissipated Power in the power arms and 12-pulse rectifier.

Table 2.4: G3 - 5 level models

Rated Current (1)			Models	Motor Rated Power (2)				Dissipated Power (3)		Frame Size
ND	MX	HD		ND		HD		ND	HD	
[A]				[HP]	[KW]	[HP]	[KW]	[KW]		
6000 - 6300 V										
58	62	55	MVW01 0058 T 6300	710	530	670	500	9.43	9.19	C1
73	78	69	MVW01 0073 T 6300	890	670	840	630	10.60	10.28	
91	97	86	MVW01 0091 T 6300	1110	830	1050	780	12.07	11.65	
114	122	108	MVW01 0114 T 6300	1390	1040	1320	980	14.01	13.49	
144	154	136	MVW01 0144 T 6300	1760	1310	1660	1240	16.68	15.95	
180	181	170	MVW01 0180 T 6300	2200	1640	2080	1550	20.07	19.11	
212	228	198	MVW01 0212 T 6300	2590	1930	2420	1800	20.64	16.63	C2
251	269	230	MVW01 0251 T 6300	3070	2290	2810	2100	23.54	21.97	
295	317	267	MVW01 0295 T 6300	3610	2690	3270	2430	26.96	24.77	
348	373	310	MVW01 0348 T 6300	4260	3170	3790	2830	31.27	28.16	
410	440	360	MVW01 0410 T 6300	5020	3740	4400	3280	36.59	32.28	
480	500	430	MVW01 0480 T 6300	5870	4370	5260	3920	43.79	39.74	
481	516	423	MVW01 0481 T 6300	5880	4380	5170	3850	43.96	38.45	C3
565	606	496	MVW01 0565 T 6300	6910	5150	6070	4520	52.45	45.43	
664	713	583	MVW01 0664 T 6300	8120	6050	7130	5310	63.23	54.35	
779	836	684	MVW01 0779 T 6300	9530	7100	8370	6230	76.79	65.51	
912	950	817	MVW01 0912 T 6300	11160	8310	9990	7450	83.86	74.70	
1130	1212	992	MVW01 1130 T 6300	13820	10300	12130	9040	104.9	90.86	2xC3
1328	1426	1166	MVW01 1328 T 6300	16250	12100	14260	10630	126.46	108.7	
1558	1672	1368	MVW01 1558 T 6300	19060	14200	16730	12470	153.58	131.02	
1824	1900	1634	MVW01 1824 T 6300	22310	16620	19990	14890	167.728	149.402	
6600 - 6900 V										
54	58	50	MVW01 0054 T 6900	720	540	670	500	9.85	9.52	C1
67	72	63	MVW01 0067 T 6900	900	670	840	630	10.93	10.60	
86	92	81	MVW01 0086 T 6900	1150	860	1090	810	12.57	12.13	
109	117	102	MVW01 0109 T 6900	1460	1090	1370	1020	14.63	13.99	
139	149	130	MVW01 0139 T 6900	1860	1390	1740	1300	17.44	16.58	
177	178	165	MVW01 0177 T 6900	2370	1770	2210	1650	21.23	20.01	
205	221	192	MVW01 0205 T 6900	2750	2050	2570	1920	21.11	20.14	C2
241	260	223	MVW01 0241 T 6900	3230	2410	2990	2230	23.84	22.46	
283	305	259	MVW01 0283 T 6900	3790	2820	3470	2590	27.15	25.24	
332	358	301	MVW01 0332 T 6900	4450	3310	4030	3000	31.20	28.62	
390	420	350	MVW01 0390 T 6900	5230	3890	4690	3490	36.22	32.73	
458	494	411	MVW01 0458 T 6900	6140	4570	5510	4100	43.26	38.77	C3
460	480	404	MVW01 0460 T 6900	6160	4590	5410	4030	44.37	39.73	C2
538	580	482	MVW01 0538 T 6900	7210	5370	6460	4810	51.35	45.63	C3
631	680	566	MVW01 0631 T 6900	8450	6300	7580	5650	61.44	54.31	
740	798	665	MVW01 0740 T 6900	9910	7390	8910	6640	74.20	65.31	
874	912	767	MVW01 0874 T 6900	11710	8720	10280	7660	80.15	70.00	
1076	1160	964	MVW01 1076 T 6900	14420	10740	12920	9620	102.7	91.26	2xC3
1262	1360	1132	MVW01 1262 T 6900	16910	12600	15170	11300	122.88	108.62	
1480	1596	1330	MVW01 1480 T 6900	19830	14770	17820	13280	148.4	130.62	
1748	1824	1534	MVW01 1748 T 6900	23420	17450	20550	15310	160.292	140.008	

(1) Overload capacity:
HD: Heavy Duty: 150 % overload during 60 seconds every 10 minutes.
ND: Normal Duty: 115 % overload during 60 seconds every 10 minutes.
MX: Maximum Current: overload is not allowed.
(2) The motor rated power takes into account the operation with 0.87 power factor and 96 % efficiency at full load.
(3) Dissipated Power in the power arms and 3x12-pulse rectifier.

Table 2.5: Water Cooled Models - 3 level

Rated Current (1)		Models	Motor Rated Power (2)				Dissipated Power (3)		Frame Size
ND	HD		ND		HD		ND	HD	
[A]			[HP]	[KW]	[HP]	[KW]	[KW]		
3300 V									
265	234	MVW01 0265 T 3300	1700	1270	1500	1120	10.281	9.154	AW
308	270	MVW01 0308 T 3300	1970	1470	1730	1290	11.91	10.467	
359	315	MVW01 0359 T 3300	2300	1710	2020	1500	13.94	12.18	
419	364	MVW01 0419 T 3300	2680	2000	2330	1740	16.463	14.144	
460	423	MVW01 0460 T 3300	2950	2200	2710	2020	18.273	16.637	
598	533	MVW01 0598 T 3300	3830	2850	3420	2540	24.259	21.602	
672	582	MVW01 0672 T 3300	4310	3210	3730	2780	26.695	23.019	CW
789	684	MVW01 0789 T 3300	5060	3770	4380	3270	31.758	27.2	
874	803	MVW01 0874 T 3300	5600	4170	5150	3830	35.638	32.386	
1136	1013	MVW01 1136 T 3300	7280	5420	6490	4840	47.969	42.617	
1214	1052	MVW01 1214 T 3300	7780	5800	6740	5020	50.472	43.002	DW
1311	1204	MVW01 1311 T 3300	8400	6260	7710	5750	55.166	49.997	
1704	1520	MVW01 1704 T 3300	10920	8130	9740	7260	74.840	66.244	
1748	1606	MVW01 1748 T 3300	11200	8340	10290	7670	75.678	68.618	EW
1853	1704	MVW01 1853 T 3300	11870	8850	10920	8130	83.066	76.157	
2272	2025	MVW01 2272 T 3300	14560	10850	12980	9670	103.64	91.307	
2622	2408	MVW01 2622 T 3300	16800	12520	15430	11490	110.332	99.99	2xDW
3409	3039	MVW01 3409 T 3300	21840	16270	19470	14510	149.680	132.488	
3496	3211	MVW01 3496 T 3300	22400	16690	20570	15330	151.356	137.236	2xEW
4545	4051	MVW01 4545 T 3300	29120	21700	25960	19340	207.280	182.614	
4160 V									
235	211	MVW01 0235 T 4160	1900	1410	1700	1270	12.315	11.15	AW
281	254	MVW01 0281 T 4160	2270	1690	2050	1530	14.62	13.26	
312	285	MVW01 0312 T 4160	2520	1880	2300	1720	16.23	14.82	
338	306	MVW01 0338 T 4160	2730	2030	2470	1840	17.526	15.96	
382	345	MVW01 0382 T 4160	3090	2300	2790	2080	19.732	17.873	
392	360	MVW01 0392 T 4160	3170	2360	2910	2170	20.424	18.622	
429	390	MVW01 0429 T 4160	3470	2580	3150	2350	21.8	19.99	
527	475	MVW01 0527 T 4160	4260	3170	3840	2860	26.518	23.983	
550	495	MVW01 0550 T 4160	4440	3310	4000	2980	27.661	24.950	
642	581	MVW01 0642 T 4160	5190	3860	4690	3500	33.995	30.093	CW
729	658	MVW01 0729 T 4160	5890	4390	5310	3960	38.488	34.811	
815	741	MVW01 0815 T 4160	6580	4900	5990	4460	42.582	39.015	
963	871	MVW01 0963 T 4160	7780	5800	7040	5240	49.976	45.339	
1045	945	MVW01 1045 T 4160	8440	6290	7630	5690	54.221	49.058	
1086	984	MVW01 1086 T 4160	8770	6540	7950	5920	58.511	53.025	DW
1223	1112	MVW01 1223 T 4160	9880	7360	8980	6690	65.385	59.776	
1413	1284	MVW01 1413 T 4160	11410	8500	10370	7730	75.344	68.533	
1568	1424	MVW01 1568 T 4160	12670	9440	11500	8570	83.802	75.934	
1630	1482	MVW01 1630 T 4160	13170	9810	11970	8920	89.128	81.306	EW
1927	1742	MVW01 1927 T 4160	15570	11600	14070	10480	105.540	95.205	
2090	1899	MVW01 2090 T 4160	16880	12580	15340	11430	114.96	103.95	
2200	1988	MVW01 2200 T 4160	17770	13240	16060	11960	117.022	106.05	2xDW
2445	2223	MVW01 2445 T 4160	19750	14710	17960	13380	130.770	119.552	
3136	2851	MVW01 3136 T 4160	25330	18870	23030	17160	167.604	151.868	
3260	2964	MVW01 3260 T 4160	26330	19620	23940	17840	178.256	162.612	2xEW
4180	3800	MVW01 4180 T 4160	33760	25150	30690	22870	211.08	190.41	

(1) Overload capacity:
HD: Heavy Duty: 150 % overload during 60 seconds every 10 minutes.
ND: Normal Duty: 115 % overload during 60 seconds every 10 minutes.
(2) The motor rated power takes into account the operation with 0.87 power factor and 96 % efficiency at full load.
(3) Dissipated Power in the power arms and 12-pulse rectifier.

Table 2.6: Water Cooled Models - 5 level

Rated Current (1)		Models	Motor Rated Power (2)				Dissipated Power (3)		Frame Size
ND	HD		ND		HD		ND	HD	
[A]			[HP]	[KW]	[HP]	[KW]	[KW]		
6000 - 6300 V									
276	257	MVW01 0276 T 6300	3380	2520	3140	2340	21.83	20.57	C2W
326	299	MVW01 0326 T 6300	3990	2970	3660	2720	25.31	23.4	
384	347	MVW01 0384 T 6300	4700	3500	4240	3160	29.61	26.83	
452	403	MVW01 0452 T 6300	5530	4120	4930	3670	35.03	31.08	
480	433	MVW01 0480 T 6300	5870	4370	5300	3950	37.49	33.27	
533	468	MVW01 0533 T 6300	6520	4860	5720	4270	42.01	37.46	
624	559	MVW01 0624 T 6300	7630	5690	6840	5090	45.77	40.91	
735	645	MVW01 0735 T 6300	8990	6700	7890	5880	47.78	43.00	C3W
863	758	MVW01 0863 T 6300	10560	7860	9270	6910	65.95	57.15	
912	823	MVW01 0912 T 6300	11160	8310	10070	7500	69.69	62.04	
1013	889	MVW01 1013 T 6300	12390	9230	10870	8100	74.20	65.08	
1186	1062	MVW01 1186 T 6300	14510	10810	12990	9680	86.87	77.74	
1288	1149	MVW01 1288 T 6300	15760	11740	14060	10470	99.74	87.78	3xC2W
1368	1234	MVW01 1368 T 6300	16730	12470	15100	11250	105.93	94.27	
1519	1334	MVW01 1519 T 6300	18580	13840	16320	12160	116.81	102.12	
1778	1593	MVW01 1778 T 6300	21750	16200	19490	14520	136.73	121.94	
1824	1646	MVW01 1824 T 6300	22310	16620	20140	15000	139.39	124.09	2xC3W
2026	1778	MVW01 2026 T 6300	24780	18460	21750	16200	148.40	130.15	
2372	2124	MVW01 2372 T 6300	29020	21620	25980	19360	173.74	155.48	
2589	2274	MVW01 2589 T 6300	31670	23590	27820	20720	197.85	171.44	3xC3W
2736	2469	MVW01 2736 T 6300	33470	24930	30200	22500	209.08	186.14	
3039	2667	MVW01 3039 T 6300	37180	27700	32620	24310	222.60	195.23	
3558	3186	MVW01 3558 T 6300	43520	32430	38970	29040	260.61	233.22	
6600 - 6900 V									
267	250	MVW01 0267 T 6900	3580	2670	3350	2500	22.09	20.94	C2W
313	290	MVW01 0313 T 6900	4190	3120	3890	2890	25.32	23.68	
368	337	MVW01 0368 T 6900	4930	3670	4520	3360	29.42	27.08	
432	391	MVW01 0432 T 6900	5790	4310	5240	3900	34.54	31.22	
460	423	MVW01 0460 T 6900	6160	4590	5670	4220	37.19	33.82	
507	455	MVW01 0507 T 6900	6790	5060	6100	4540	42.99	39.47	
598	525	MVW01 0598 T 6900	8010	5970	7030	5240	48.30	42.28	
699	627	MVW01 0699 T 6900	9370	6980	8400	6260	55.70	50.12	C3W
820	736	MVW01 0820 T 6900	10990	8180	9860	7350	66.08	58.96	
874	803	MVW01 0874 T 6900	11710	8720	10760	8010	69.30	63.14	
962	865	MVW01 0962 T 6900	12890	9600	11590	8630	82.82	73.52	
1140	1000	MVW01 1140 T 6900	15270	11380	13400	9980	90.70	79.50	
1231	1114	MVW01 1231 T 6900	16490	12290	14930	11120	97.21	87.24	3xC2W
1311	1205	MVW01 1311 T 6900	17560	13090	16140	12030	103.53	94.40	
1445	1297	MVW01 1445 T 6900	19360	14420	17380	12950	114.60	102.84	
1704	1496	MVW01 1704 T 6900	22830	17010	20040	14930	135.14	118.62	
1748	1606	MVW01 1748 T 6900	23420	17450	21520	16030	138.59	126.30	2xC3W
1924	1730	MVW01 1924 T 6900	25780	19200	23180	17270	165.61	147.04	
2280	1994	MVW01 2280 T 6900	30550	22760	26720	19900	181.40	159.01	
2460	2208	MVW01 2460 T 6900	32960	24550	29580	22040	195.04	173.63	3xC3W
2622	2409	MVW01 2622 T 6900	35130	26170	32280	24040	207.88	189.43	
2886	2595	MVW01 2886 T 6900	38670	28810	34770	25900	229.62	206.32	
3420	3000	MVW01 3420 T 6900	45820	34140	40190	29940	272.11	238.52	

(1) Overload capacity:
HD: Heavy Duty: 150 % overload during 60 seconds every 10 minutes.
ND: Normal Duty: 115 % overload during 60 seconds every 10 minutes.
(2) The motor rated power takes into account the operation with 0.87 power factor and 96 % efficiency at full load.
(3) Dissipated Power in the power arms and 3x12-pulse rectifier.

NOTE!
The motor rated powers are only orientations, and the correct inverter selection must be done as a function of the rated current of the motor to be used, as well as the overloads related to the application.

2.3.2 MVW01 Main Components

Table 2.7: MVW01 main components

Suggested Tag	Function	Location (column)
A1	Input rectifier	Rectifier
V1	Pre-charge rectifier	
T2A and T2B	Pre-charge transformer (210 V - 4.3 kV)	
T3	PS1 Power supply transformer (220 V - 22 V)	
F1	Medium voltage fuse for +UD (pre-charge)	
A9.1	ISOC.01: signal feedback board and rectifier heatsink temperature	
A9.2	ISOC.00: link P and N - medium point to ground voltage	
A9.3	ISOY.00: rectifier heatsink temperature	
A2	Isolated power supply PS1/PS1S: input: 22 Vac or 220 Vac single-phase; output: 15 Vdc	
A15	Medium voltage resistors, for the Medium Point to ground voltage measurement	
BIU	U phase inverter arm	Inverter
BIV	V phase inverter arm	
BIW	W phase inverter arm	
HCTU	U phase Hall effect CT	
HCTV	V phase Hall effect CT	
HCTW	W phase Hall effect CT	
Q1	Main circuit breaker (control) – auxiliary supply for T1	Control
T1	Auxiliary supply transformer. Input: 220 V to 480 V (customer). Output: 220 V PS1S	
Q3	Circuit breaker for T3	
Q2	Circuit breaker for T2	
Q7	Electronics power supply PS24 circuit breaker	
Q4	Rectifier column exhausting fan circuit breaker	
Q5	Inverter column exhausting fans circuit breaker	
AR1	Pre-charge resistors	
A8	Control rack	
A10	MVC3 - main control board	
A11	Electronics power supply PS24: input: 220 Vac three-phase; output: 24 Vdc	
PIC	Power supply and internal I/O board	
A12	MVC4 control board (User interface)	
A13	EBX.XX - Optional function expansion board	
A14	Optional fieldbus board	
HMI	Human Machine Interface	
HMV	DC buss voltage modification board	

Note: Some parts of the inverter may be different for the MVW01 G2 and G3 lines.

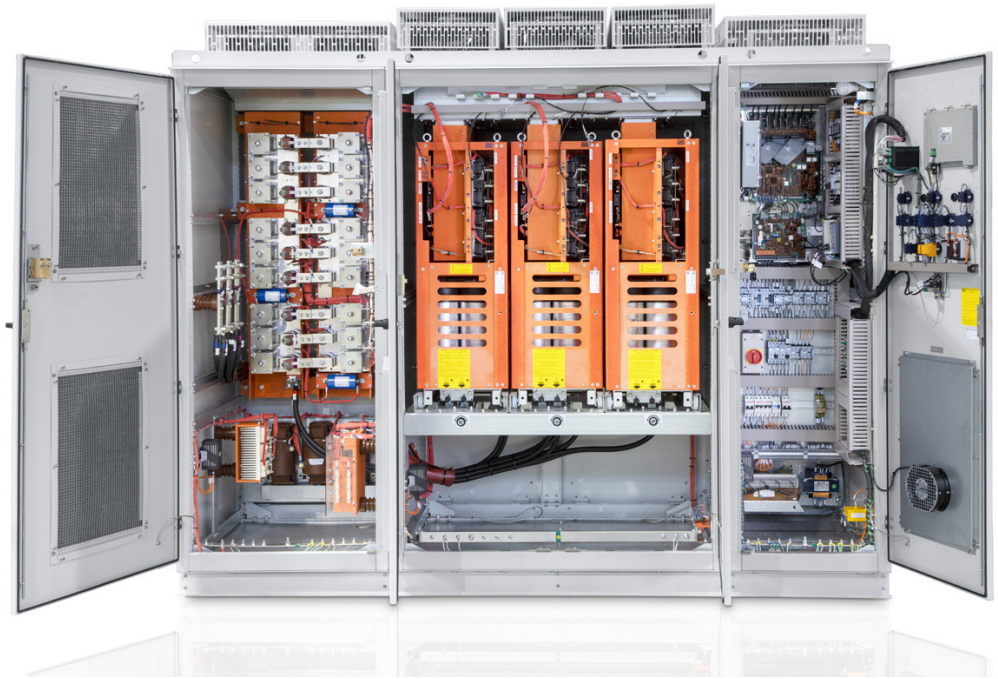
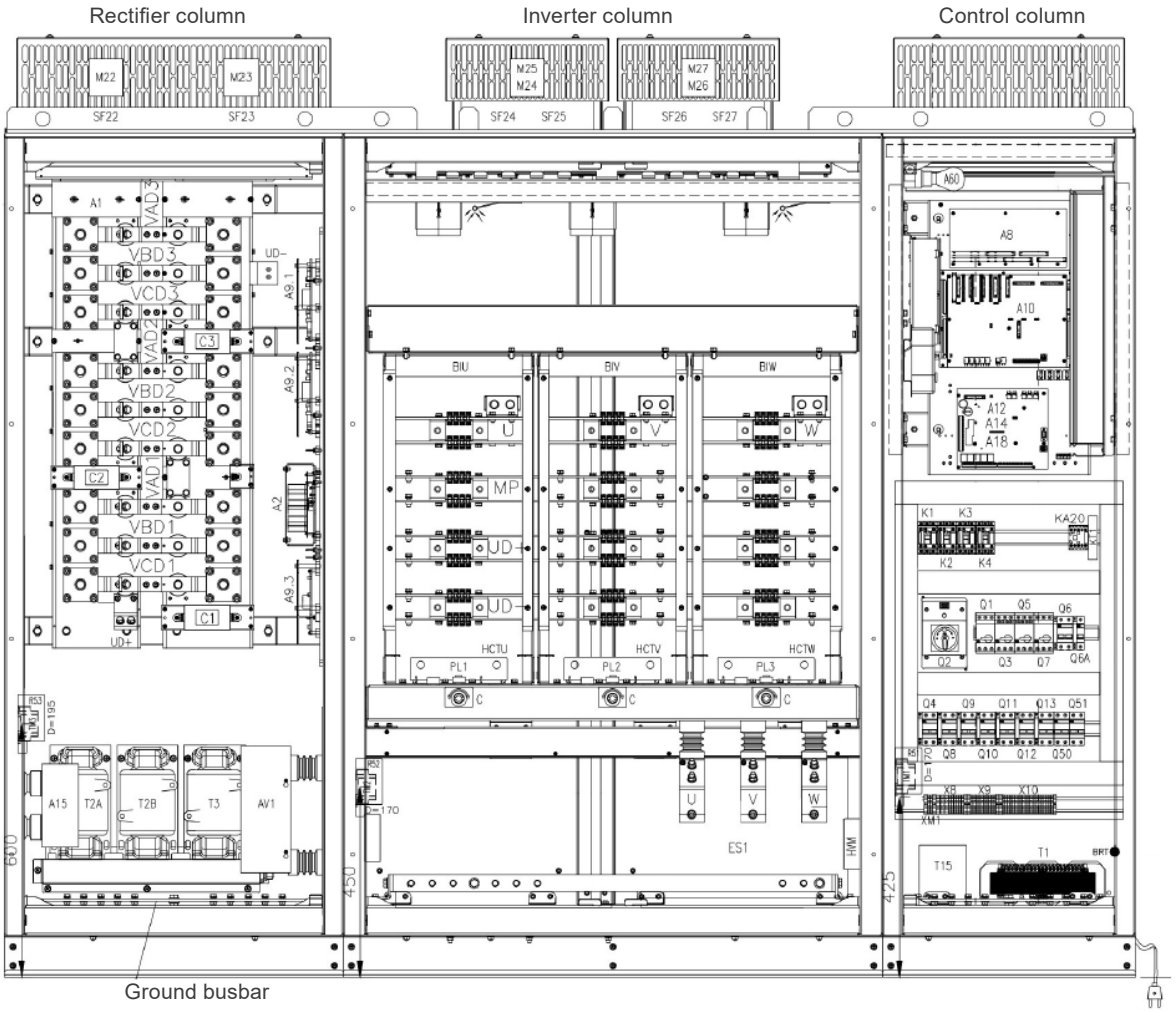


Figure 2.2: MVW01 G3 Panel general view



Rectifier Column	Inverter Column	Control Column
The rectifier column receives the cables from the transformer through the bottom of the cabinet. Besides the power rectifier, this column also contains electronic boards destined to measurements and power supply, medium voltage pre-charge circuit, and medium voltage transformers to supply these circuits. The cabinet has a grounding bar and its door remains closed during the operation. The measured signals are sent to the control column via optical fibers	The inverter column contains the inverter extractible arms (BIR, BIS and BIT). Connection bars for the motor medium voltage cables are available, and are accessed via the cabinet bottom. The arm semiconductors are controlled and monitored through fiber optic cables coming from the control column. This column also contains the medium voltage Hall effect current transformers, voltaic arc detection sensors and differential pressure sensor probe used to monitor exhausting fan faults. The cabinet also has a grounding bar and its door remains closed during the operation	The control column contains the electronic rack composed by the control, fiber optics interface, power supply, I/O, optional (function expansion and communication network) boards, as well as the command and protection circuits destined to the system operation (circuit breaker + transformer + inverter + motor), command transformer, low voltage pre-charge circuit, Human Machine Interface and terminal strips

Figure 2.3: MVW01 G3 internal component arrangement (Frame size A)

NOTE!
For the Rectifier Panel, optionally the cables can entered through the top of the panel.

2.3.3 MVW01 Electronic Boards

Table 2.8: MVW01 electronic boards

Name	Function	Panel / Module
MVC3	Main Control	Control/ A10
PIC2	Power supplies for the electronics, internal use digital inputs and output relays	
MVC4	User interface control	Control/ A12
FOI 3, 4	It converts electrical signals into optical signals and vice versa	Control/ A8
EBA, EBB, EBC	Optional function expansion boards	Control/ A13
Fieldbus	Optional network communication boards	Control/ A14
ISOY/ISOZ	Signal feedback boards, they measure medium voltages or temperatures and send the information via optical signals (1 channel)	Rectifier/ A9.3
ISOX	Signal feedback boards, they measure medium voltages or temperatures and send the information via optical signals (2 channels)	Rectifier/ A9.1 A9.2
PS24	Electronics power supply: - input: 220 Vac 3 ~ or 220 Vac 1 ~ - output: 24 Vdc	Rectifier/ A11
PS1/PS1S	Isolated power supply: - input: 22 Vac 1 ~ (PS1)/220 Vac 1 ~ (PS1S)	Control/ A2
HVM	It indicates that the DC Link is energized (Neon lamps)	Inverter (visible in the control)
1SD210F2 1SP0335	Gate Drivers	Inverter/ BIU, BIV, BIW
PLC2	PLC expansion board - optional	Control/ Rack A8
RSSI	Absolute encoder interface - optional	Control
HMI Cables		

2.3.4 PLC2 Expansion Board

The PLC2 board presents the following hardware features:

Table 2.9: PLC2

Communication	Serial Interface	■ CANopen Master/Slave and DeviceNet Slave networks ■ Optional for Profibus DP Slave network ■ Optional for rede DeviceNet Slave
Input	Analog	■ 1 differential analog input (-10 to +10) Vdc or (-20 to +20) mA, 14 bits
	Incremental Encoder	■ isolated encoder inputs, with external supply of 5 Vdc or (8 to 24) Vdc
	Digital	■ 9 isolated digital inputs, bidirectional, 24 Vdc ■ 1 motor PTC input
Output	Analog	■ 2 analog outputs (-10 to +10) Vdc or (0 to 20) mA, 12 bits
	Serial Interface	■ 1 serial communication interface - RS-232C (Standard protocol: MODBUS-RTU)
	Digital	■ 3 relay outputs: 250 V x 3 A ■ 3 optocoupled digital outputs, bidirectional, 24 Vdc x 500 mA

2.4 RECEIVING AND STORAGE

The MVW01 is supplied with the power arms separated from the cabinet and packed individually. The packing is made of an OSB frame and polystyrene foam wedges. There is an identification label outside this package, which is identical to the one attached to the arms. Confront the content of this label with the purchase order. In order to open the arm packages, refer to the procedure described in the Item 10.1.5 Unpacking on page 10-3.

If the MVW01 arms are not installed soon in the cabinet, store them in a clean and dry environment (temperature between -20 °C and 50 °C (-4 and 122 °F) and moisture below 80 %) covered up in order to avoid dust accumulation or water splashing. It is recommended to replace the silica gel every three months.

The MVW01 has a dehumidifier module, which must remain turned on in case of storage for over thirty days.

The MVW01 panel is supplied in a package composed of cardboard and wood. The guidance for handling, transportation, mechanical and electric installation is presented in the Chapter 10 INSTALLATION, CONNECTION AND ENERGIZATION on page 10-1 and in Item 10.1.5 Unpacking on page 10-3.



ATTENTION!
It is very important to check that the inverter software version is the same as indicated on the first page of this manual.

3 MVW01 WITH 3 LEVELS (3L)

The 3 level MVW01 is a variable frequency inverter destined to control medium voltage motors with nominal voltages of 2300 V, 3300 V, 4160 V and 4600 V and with a power range from 540 HP to 30690 HP. In its standard version it uses non-controlled semiconductors (diodes) at the input rectifier stage and controlled semiconductors (HV-IGBTs) to generate the three output phases at the inverter stage, in order to control the medium voltage motor speed and torque.

The MVW01 presents protections against overload, short-circuit, phase loss, undervoltage, overvoltage, overtemperature, and ground fault, it also has an independent fault monitoring for each HV-IGBT. The control type can be selected by the user, between scalar control (constant V/f ratio) and vector control (with sensorless or encoder feedback).

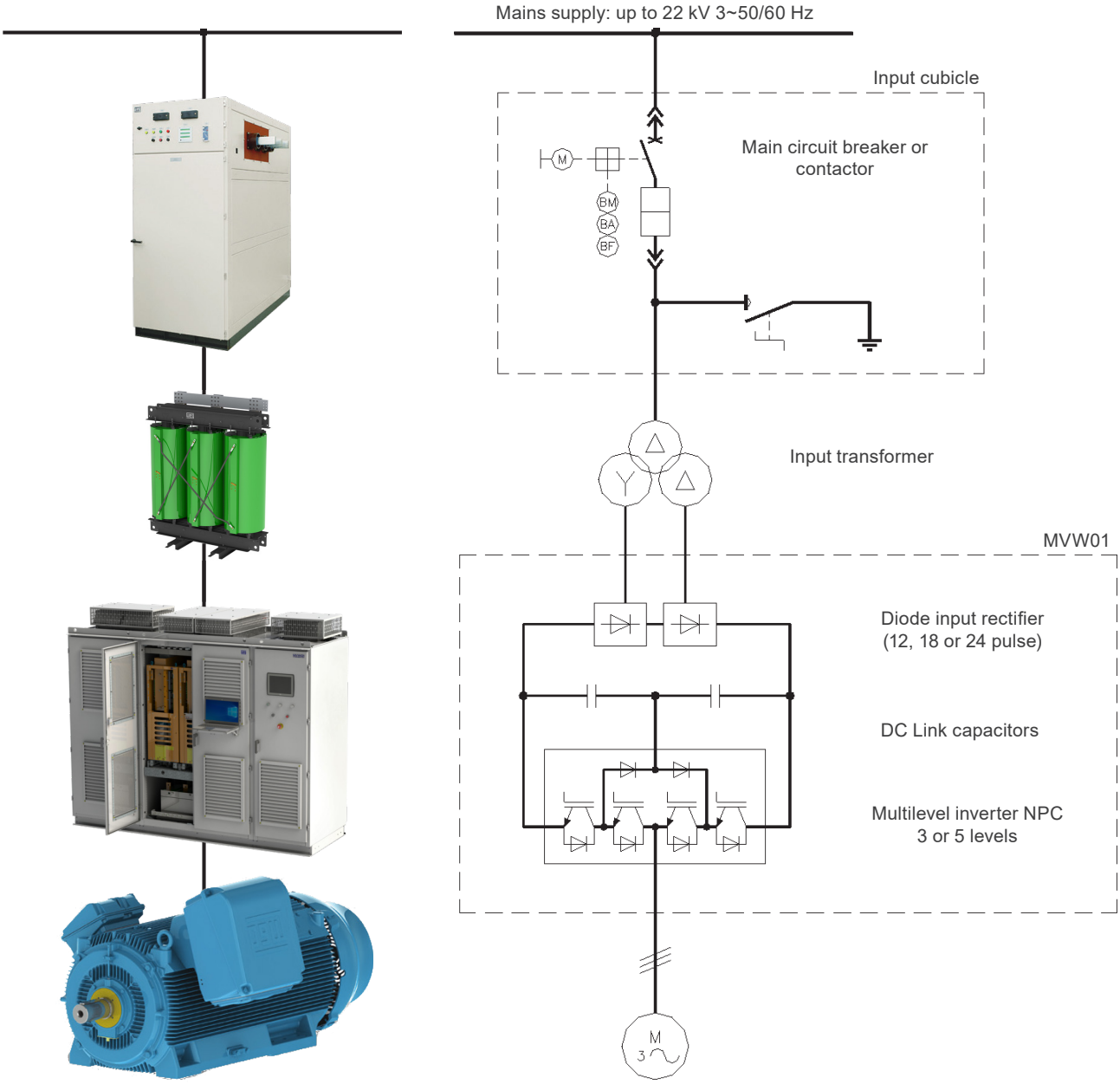


Figure 3.1: General block diagram

The input stage rectifier is a 12-pulse diode bridge (it can be supplied optionally for 18 or 24 pulses). This bridge feeds the inverter DC Link. An isolation transformer is required to feed it in addition to a medium-voltage circuit breaker. Both the transformer and the circuit breaker may be within the scope of the MVW01 supply. The minimum specifications of the input transformer are:

- Nominal power according to the inverter power rating considering the input current harmonics.
- Minimum impedance of 6 %.
- Shield between primary and secondary windings.
- Primary voltage according to the available line voltage.
- Secondary voltages according to the motor nominal voltage and 3.6 kV/7.2 kV voltage insulation class.

The DC Link is composed by high reliable dry plastic film capacitors with long useful live used for filtering. The capacitor bank is distributed through the power arms and split into two parts by a series connection that creates a medium point dividing the DC Link into two voltages, VP and VN.

The medium point is necessary to implement the inverter. The inverter is built in a three-level topology (NPC - “neutral point clamped”) using 4 HV-IGBTs (3.3 kV, 4.5 kV or 6.5 kV) and 2 clamping diodes per phase.

The complete inverter is assembled inside metallic cabinets with IP21 protection degree (IP41, IP42 optional).



Figure 3.2: MVW01 panel (Frame size A)

3.1 MECHANICAL DATA

3.1.1 Panel Constructive Aspects

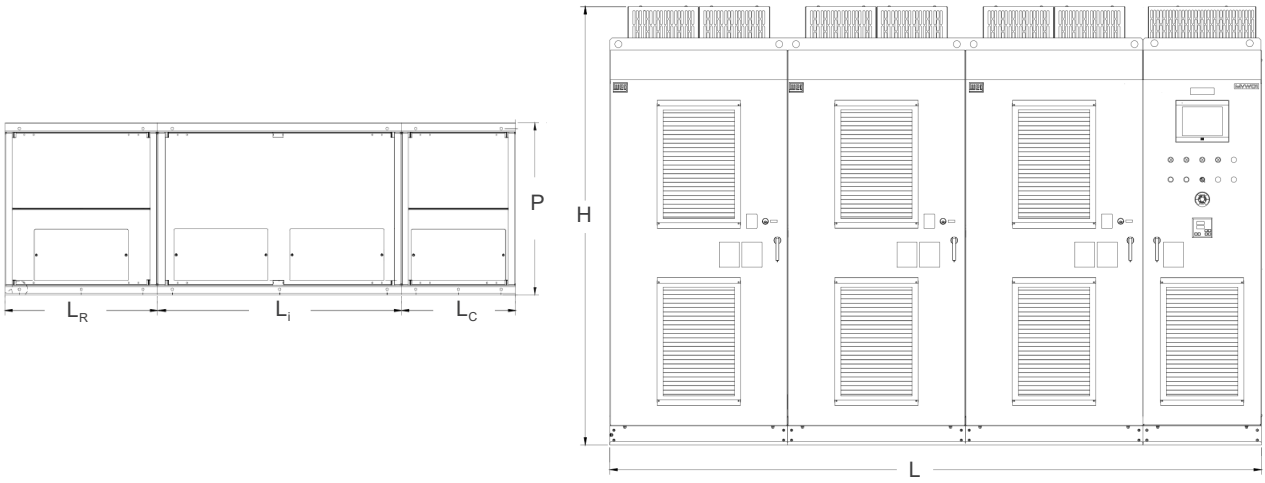


Figure 3.3: Panel constructive aspects

The MVW01 line is assembled in panels with the dimensions shown in Table 3.1 on page 3-3:

Table 3.1: Mechanical data (dimensions in mm)

Frame Size	L_R (mm)	L_I (mm)	L_C (mm)	L (mm)	H (mm)	P (mm)	Weight (kg)
A0	-	-	-	1000	2316	1000	900
A	600/800(1)	1280	600	2480/2680	2226	980	1560
B	800/1280(2)	1280	600	2680/3160			1700
C	800/1280(2)	2 x 1280	800	4160/4640			2700
D(5)	1280/2x1280(3)	3 x 1280	800	5920/7200		1000	4500
E(5)	1280/2x1280(4)	4 x 1280	800	7200/8480			5000
2 x D(5)	1280/2x1280(3)	3 x 1280	800	5920/7200		2 x 1000	9000
2 x E(5)	1280/2x1280(4)	4 x 1280	800	7200/8480			10000

Tolerance for all dimensions ± 10 mm.
(1) 800 mm: With 24 pulse rectifier.
(2) 1280 mm: With 24 pulse rectifier.
(3) 2x1280 mm: With 18 pulse rectifier (above 1420 A) or with 24 pulse rectifier.
(4) 2x1280 mm: With 18 or 24 pulse rectifier.
(5) Mechanics D and E with 18 or 24 pulse rectifier, consider + 800 mm for additional column of input and output cables.

NOTE!
The values shown in Table 3.1 on page 3-3 are standard values, however, they may change due to the special characteristics of the product:

- Input switchgear.
- Columns for dynamic braking.
- Exciter column (for synchronous machines).
- Output filters.
- Input filters (AFE).
- Additional inverter column (AFE).
- Additional column for cables connection (input and output).
- Special grounding and safety systems.
- Special cooling system.

The panel cooling is achieved by means of forced ventilation. The cold air enters through the grids located at the front doors, passes through the power section heatsinks, and the hot air is exhausted at the panel tops where the fans are installed.

The MVW01 has been designed to comply with the CEI – IEC 61800 (part 4 and 5) standard.

The MVW01 is appropriate for operation in industrial environments, with resistance to chemical agents and to corrosion.

The cabinet is built with painted steel plates that are processed (cutting, drilling, bending, chemical treatment, painting and finishing) at WEG, assuring the cabinet quality. The inverter parts that are not painted are zinc plated or have another suitable treatment in order to assure their resistance against corrosion.

The internal frame is composed by gauge #12 sheet steel (2.65 mm (0.10 in)) whereas the doors and closures are composed by gauge #14 sheet steel (1.9 mm (0.07 in)). The protection degree is IP21, for indoors environment.

The cooling air enters the panel through front openings protected by grids (one internal and another external) with air filters.

Filter cleaning or replacement can be done by removing the external grid with no need to open the doors and to interrupt the inverter operation. The internal grid with openings smaller than 10 mm prevents the access to the medium voltage compartment.

The hot air exhaustion occurs at the panel top where the exhausting fans are located, making service possible without opening the medium voltage compartment doors.

The medium voltage compartments (input rectifier and inverter) are mechanically and electrically interlocked in order to prevent the access to all the components that are able to present electric shock danger. Only after closing the rectifier and the inverter stage doors it becomes possible to lock them by means of a mechanical interlocking device located at the control stage. This device has an electric switch that, once closed, enables the MVW01 medium voltage energization. The door opening while the inverter is energized is not allowed.

In the event of door unlocking, the inverter disables the operation and switches off the input circuit breaker. The control stage is fed by an auxiliary power supply (220 V - 690 V) and can be locked in order to prevent access.

3.2 INPUT RECTIFIER

There are electronic boards in the rectifier column destined to attenuate, measure, convert into frequency and send the following signals, via fiber optic cables, to the control column:

- 2 input transformer secondary line voltages.
- 2 temperature of rectifiers heatsink.
- 2 DC Link voltages (+UD and -UD) referenced to the medium point (MP).
- The voltage between medium point and ground.

These boards as well as the boards and DC/DC converters present in the inverter arm are fed with 15 Vdc by the PS1/PS1S, and this power supply being fed by the secondary of the high insulation transformer T3.

The medium voltage cables for the input rectifier (A1) supply come from the input transformer secondary windings. The transformer configuration and the number of cables depend on the rectifier number of pulses:

- 12 pulses 6 cables.
- 18 pulses 9 cables.
- 24 pulses 12 cables.
- 36 pulses 18 cables.

Considering the standard rectifier version (12 pulses) the secondary winding voltage depends on the motor nominal voltage, being 2.2 kV for motors with 4160 V rated voltage, and 1.75 kV for motors with 3300 V rated

voltage. The 6 cables enter the rectifier cabinet at the top or at the bottom and are connected directly to terminals mounted on the rectifier module (A1) copper bars.

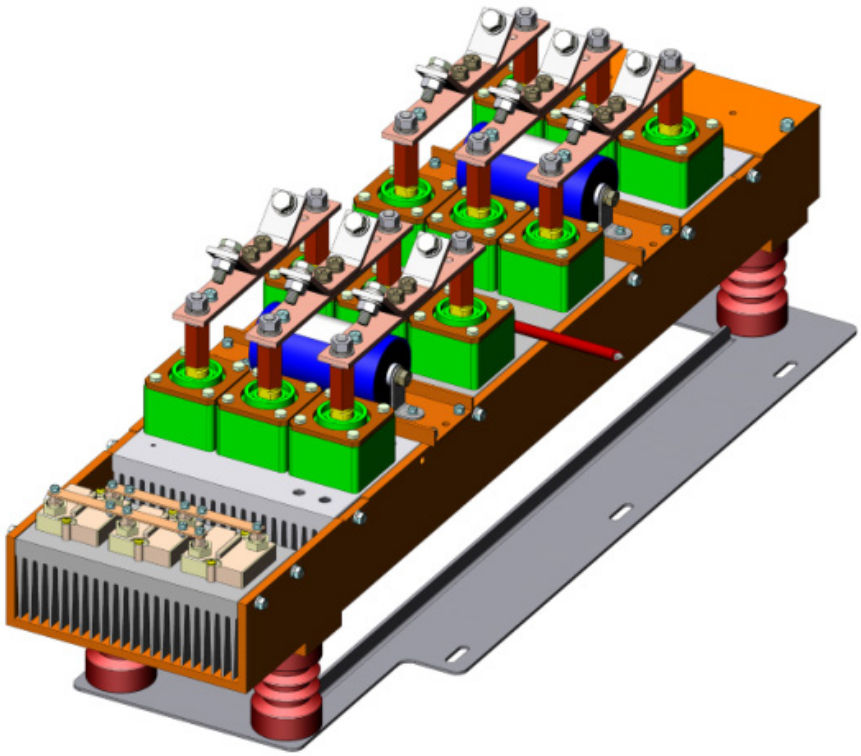


Figure 3.4: MVW01 12-pulse rectifier

The rectifier is connected to the DC Link located at the rear part of the MVW01 panel. The DC bus supplies the voltage for the three inverter power arms.

3.3 INVERTER ARMS

The inverter arms are identical and contain:

- 4 or 6 filtering capacitors (of dry plastic film).
- 4 medium voltage IGBT modules.
- 1 medium voltage diode module.
- 1 power heatsink.
- 4 gate driver boards (one for each IGBT).
- 4 isolated DC/DC converters (gate driver boards power supply).
- 1 heatsink temperature sensor (NTC resistor).
- 1 NPC resistor.
- 1 ISOC.02 Signal feedback board.
- 2 resistors for balancing the DC Bus.

The arm has a mechanical structure formed by bulk molding compound (BMC) (polyester resin and fiberglass).

The singers/pinchers located at the back of the inverter cabinet make the electrical connection of the arms to the busbars Describes the arm transportation and installation procedures Chapter 10 INSTALLATION, CONNECTION AND ENERGIZATION on page 10-1.

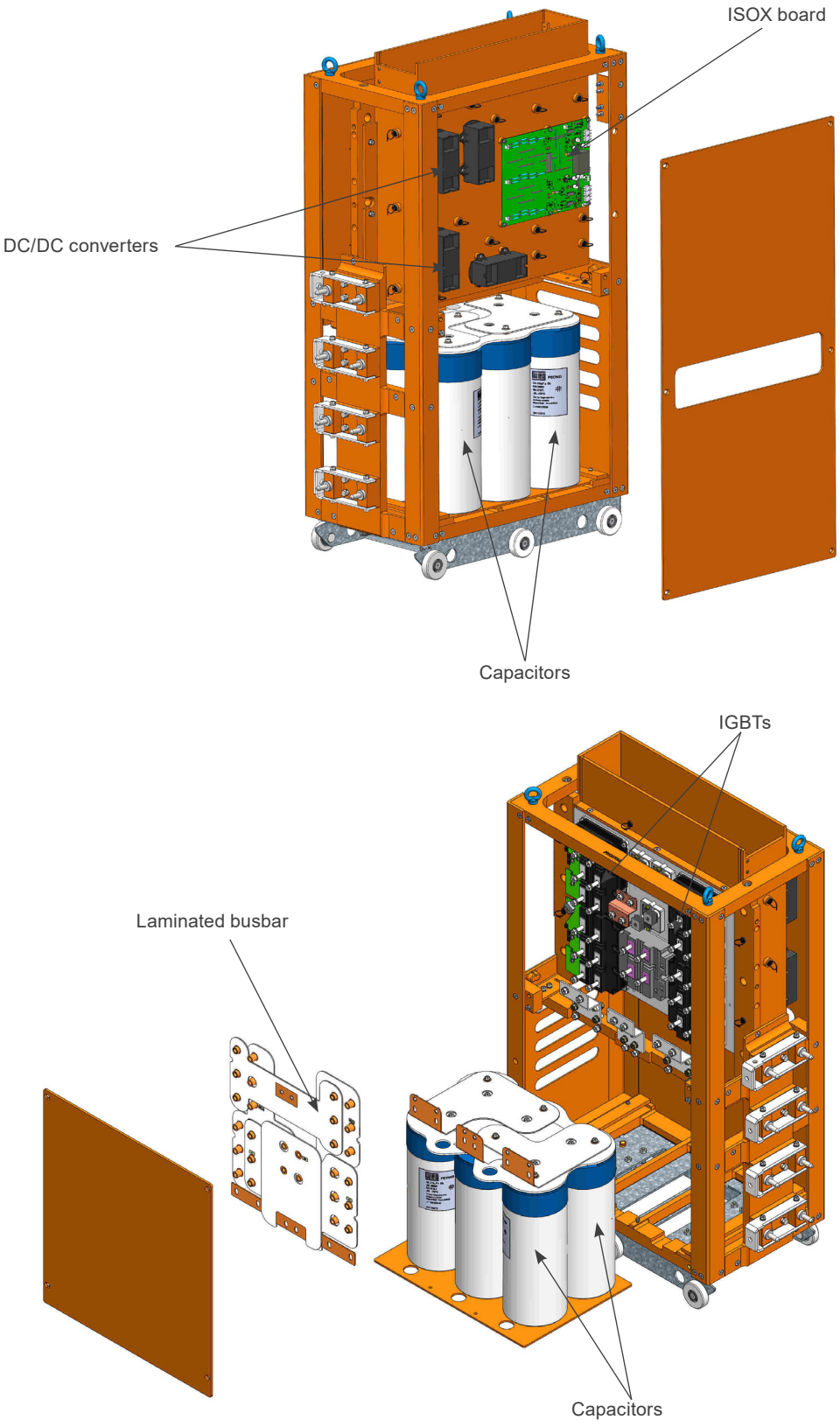


Figure 3.5: MVW01 Power arm

3.4 CONTROL RACK

Inverter operation:

The inverter uses PWM (Pulsed Width Modulation) modulation technique, in order to produce AC voltage with variable frequency and amplitude, from the DC Link voltage, and make it available to the motor at the output terminals. The connection of the medium voltage cables to the motor is available via terminals (copper bars). The cable exit is located on the lower front of the inverter panel.

The output current (motor current) is measured using Hall effect CTs in all the three phases, and the current signals are sent to the control board. The inverter uses the measurements to indicate the current and to perform the control and protection functions of the INVERTER + MOTOR system.

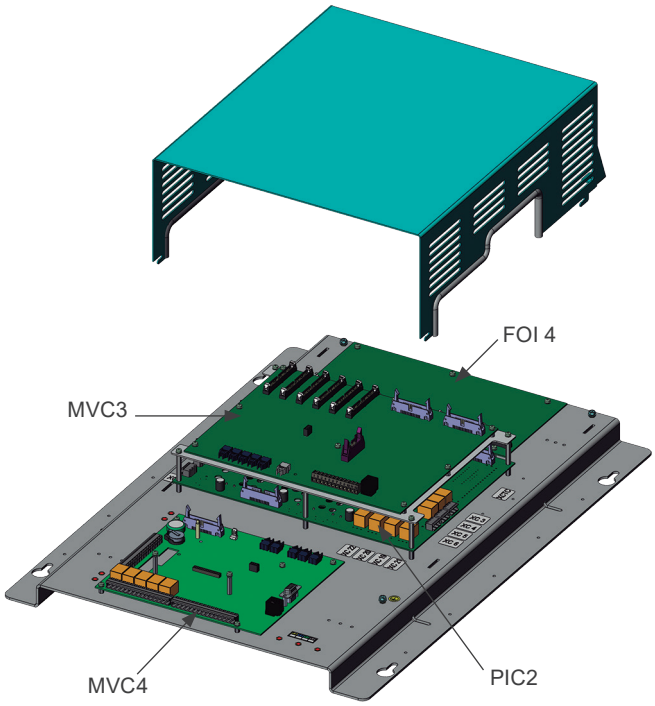


Figure 3.6: MVW01 standard control rack

Pre-charge:

During the power-up, due to the high inrush current that is necessary to load the DC Link, a pre-charge in the DC Link becomes necessary, and it is carried out by the rectifier (V1) and the high insulation transformer T2. The pre-charge circuit energizes the primary of this transformer with 220 V. The pre-charge resistors AR1 are also connected to the primary winding of this transformer, but they are installed in the control cabinet. Only after the pre-charge procedure it becomes possible to close the main circuit breaker.

Auxiliary power supply:

The auxiliary power supply (220 V - 690 V) must be connected to the specific terminal strip located in the control cabinet. The T1 transformer has taps for different primary voltages and supplies 220 V at the secondary in order to feed the low voltage circuits and the exhausting fans present in the product.

The control rack A8 is fed with 24 Vdc supplied by the PS24 (A11) power supply, whose input is of 220 Vca 1~or 3~. The control rack is composed by the Power Supply and Interface Board (PIC2); and by 02 control boards: MVC3 and MVC4. The MVC3 board is responsible for the motor and inverter control, and the MVC4 board performs the user interface tasks. Both boards are fed by low voltages coming from the PIC2 board, which also contains optoisolated digital inputs and relay outputs (220 Vac) for internal MVW01 use.

Optional Fieldbus communication and function expansion boards (EBA, EBB or EBC) can be connected to the MVC4 control board. The connections between the MVC3 board and the power stages are made with fiberoptic cables through the FOI interface boards.

NOTE!
For more information on the boards, refer to the Item 2.3.3 MVW01 Electronic Boards on page 2-14.

3.5 AVAILABLE MODELS

Refer to the Item 2.3.1 Available Models on page 2-5.

4 MVW01 WITH 5 LEVELS (5L)

The MVW01 5L line intends to meet the demand at lines with higher voltages and, thus, a specific topology and modulation are used. It uses with the power section structure of H-type bridges connected in star, allowing the inverter operation in 5 levels.

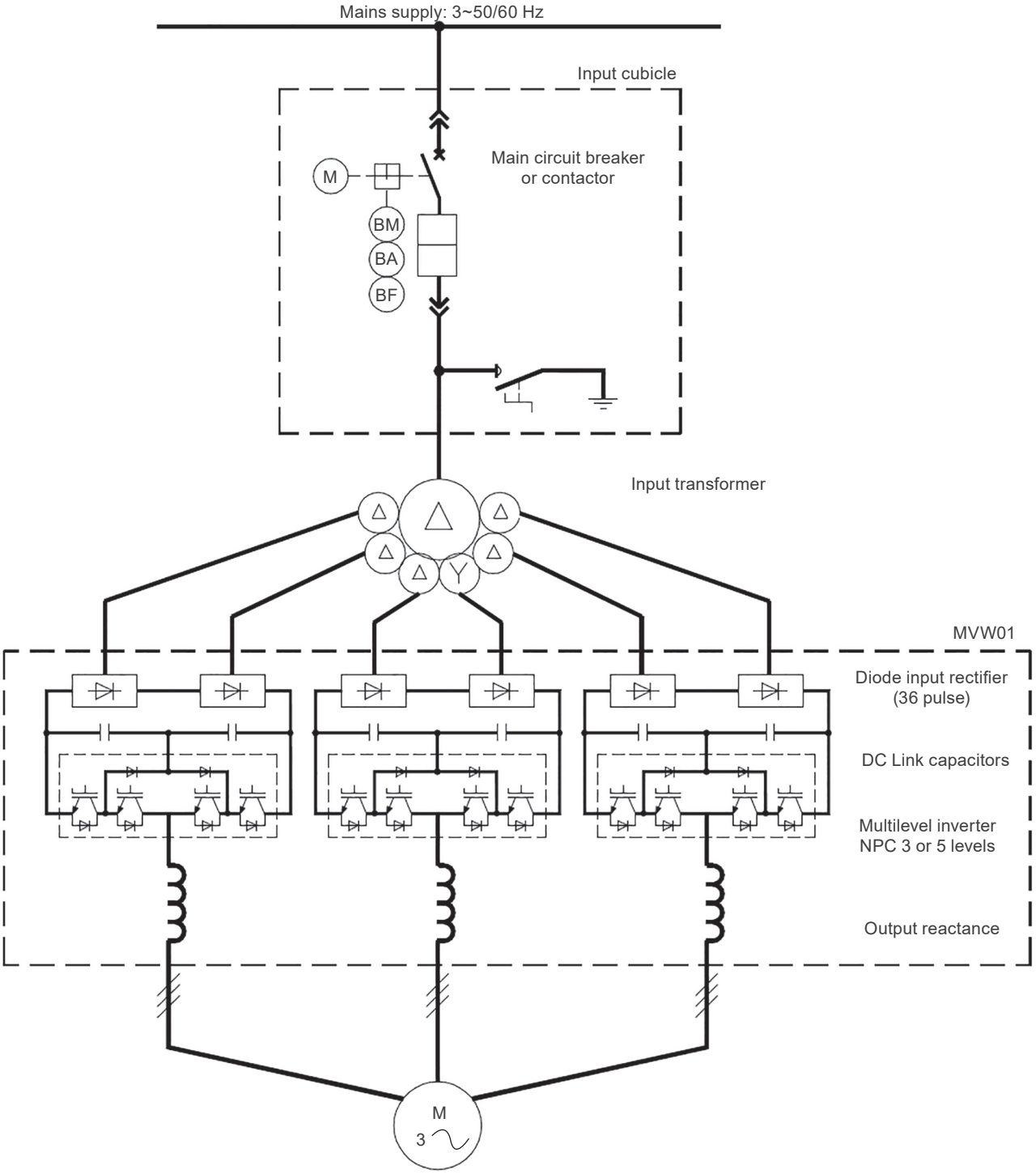


Figure 4.1: Power section structure of the 6.9 kV line

Considering that 3 isolated DC Links are necessary in this topology, new parameters for the voltage readings of these busses were added, together with the new parameters for the temperature reading of the rectifiers, added to feed these new DC Links.

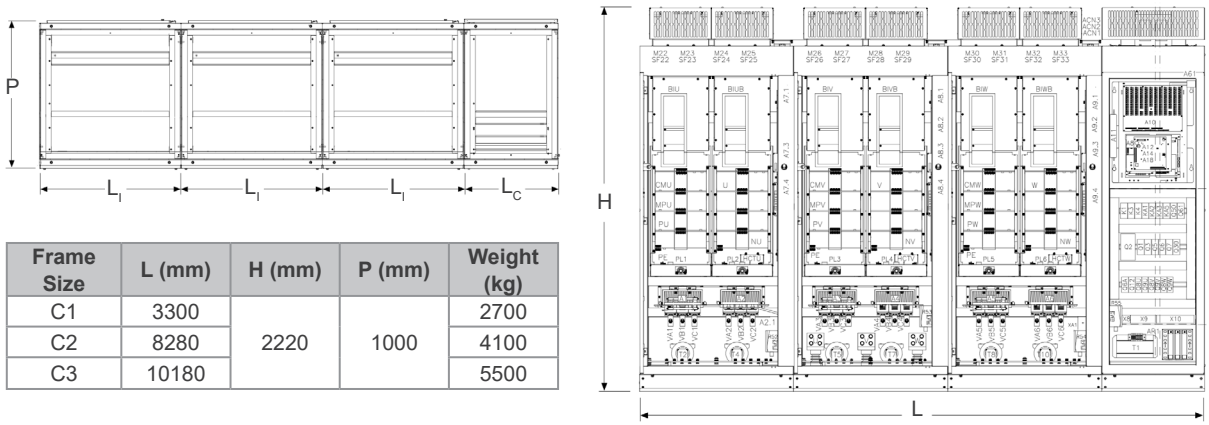
Table 4.1: Nomenclature regarding the rectifier parameters used for each H bridge

H Bridge Reference Phase	Nomenclature	Parameter
U	TEMP R1	P0059
V	TEMP R2	P0088
W	TEMP R3	P0089

Table 4.2: Nomenclature regarding the rectifier and DC bus parameters used for each H bridge

H Bridge Reference Phase	Nomenclature	Parameter
U	Vdc (+) U	P0053
	Vdc (-) U	P0052
V	Vdc (+) V	P0093
	Vdc (-) V	P0092
W	Vdc (+) W	P0095
	Vdc (-) W	P0094

4.1 MECHANICAL DATA



Frame Size	L (mm)	H (mm)	P (mm)	Weight (kg)
C1	3300	2220	1000	2700
C2	8280			4100
C3	10180			5500

Figure 4.2: Dimensions of the complete panel

NOTE!
The values shown in Figure 4.2 on page 4-2 are standard values, however, they may change due to the special characteristics of the product:

- Input Switchgear.
- Columns for dynamic braking.
- Exciter column (for synchronous machines).
- Output filters.
- Input filters (AFE).
- Additional inverter column (AFE).
- Additional column for cables connection (input and output).
- Special grounding and safety systems.
- Special cooling system (air/water).

4.2 AVAILABLE MODELS

See Item 2.3.1 Available Models on page 2-5.

5 MVW01C (COMPACT)

The line MVW01C is a variable frequency inverter destined to control medium voltage induction motors with nominal voltages of 2300 V, 3300 V, 4160 V, 6300 V and 6900 V, with a power range from 500 to 2250 HP. It uses non-controlled semiconductors (diodes) at the input rectifier stage and controlled semiconductors (HV-IGBTs) to generate the three output phases at the inverter stage, in order to control the motor speed and torque.

The MVW01C inverter line uses the same topology as the MVW01 line and has as the main feature compact dimensions. In order to achieve such dimensional reduction, all the inverter components are scaled to the power range of this product line. Another feature of this line is that in its standard version the inverter uses an 18 pulse rectifier bridge, which demands a special transformer with 3 secondary windings and 20° phase shift among them.

The MVW01C presents protections against overload, short-circuit, phase loss, undervoltage, overvoltage, overtemperature, and ground fault, it also has an independent fault monitoring for each HV-IGBT, has pressure sensors for ventilation efficiency monitoring. The control type can be selected by the user, between scalar control (constant V/f ratio) and vector control (with sensorless or encoder feedback).

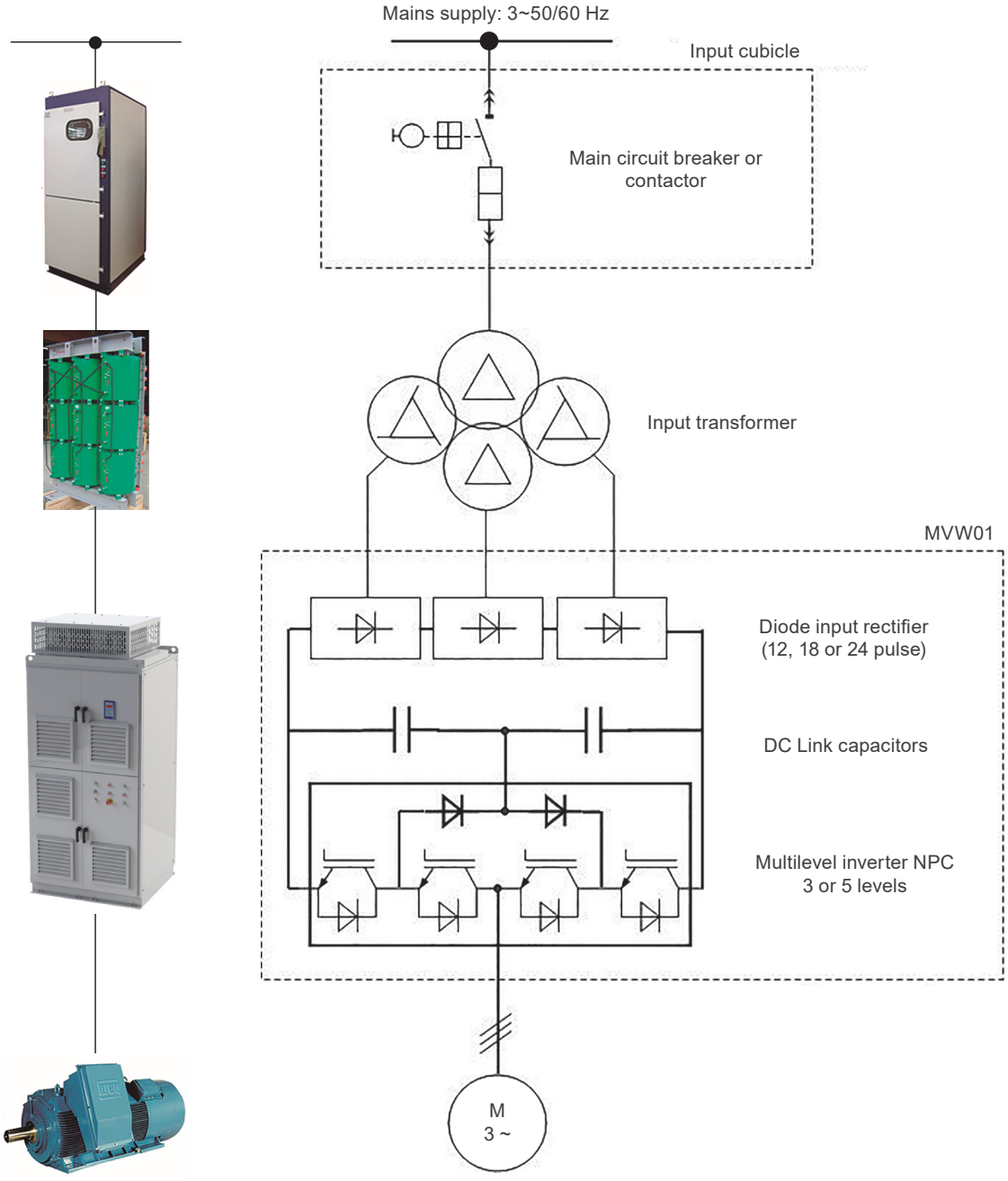


Figure 5.1: General block diagram

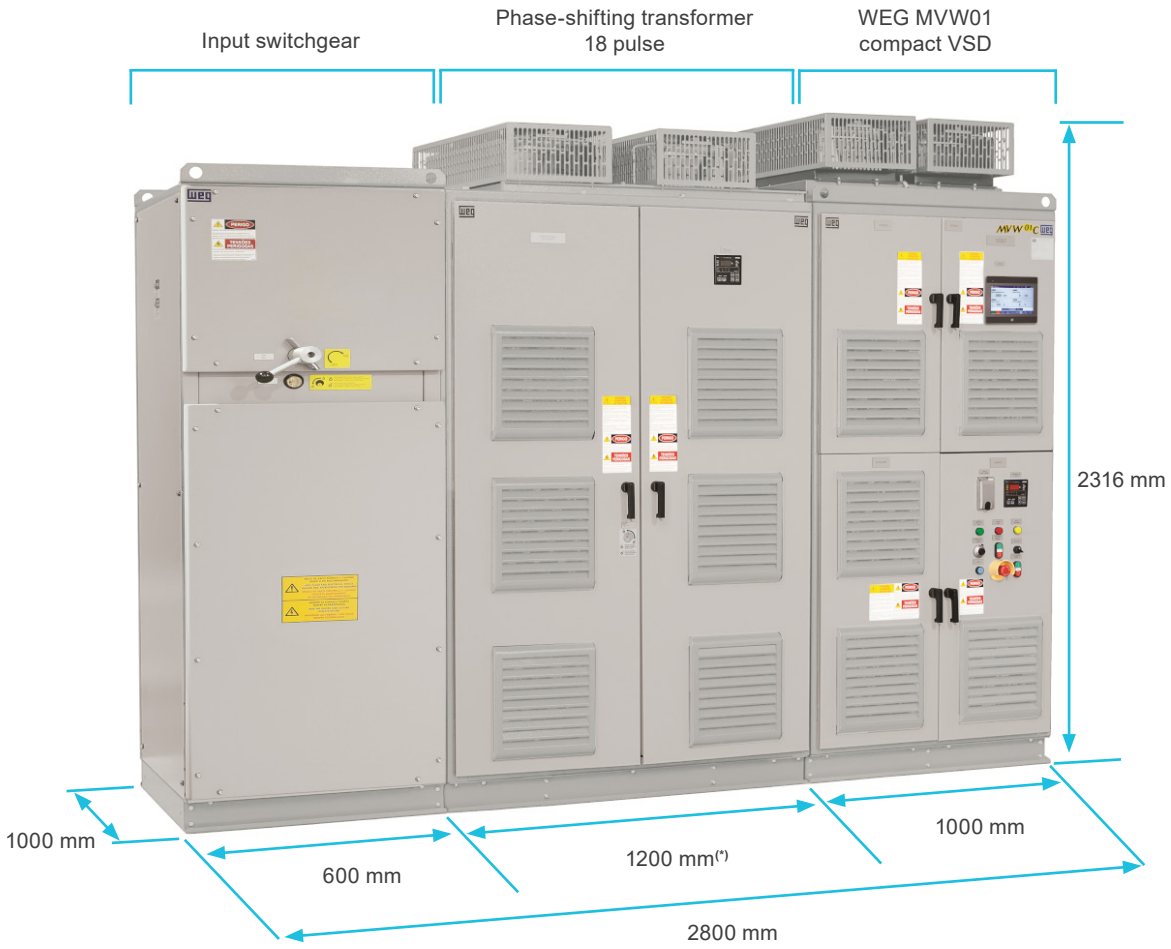


Figure 5.2: MVW01C panel

Table 5.1: Mechanical data (dimensions in mm)

Frame size	L_S (mm)	L_T (mm)	L_C (mm)	L (mm)	H (mm)	P (mm)	Weight (kg)
A0	600	1200 (*)	1000	2800	2316	980	900

(*) Tolerance for all dimensions ± 10 mm.

NOTE!
The values shown in Table 5.1 on page 5-2 are standard values, however, they may change due to the special characteristics of the product:

- Transformer configurations.
- Input switchgear.
- Compartment for dynamic braking.
- Exciter compartment (for synchronous machines).
- Output filters.
- Input filters (AFE).
- Additional inverter compartment (AFE).
- Special grounding and safety systems.
- Special cooling system.

Transformer

An isolating transformer is required to provide the number of secondary windings necessary to the rectifier bridge and the appropriate voltage level. The minimum specifications of the input transformer are:

- Nominal power according to the inverter power rating considering the input current harmonics.
- Minimum impedance of 6 %.
- Shield between primary and secondary windings.
- Primary voltage according to the available line voltage.
- Secondary voltages according to the motor nominal voltage and 7.2 kV voltage insulation class.

Input rectifier

The medium voltage cables for the input rectifier (A1) supply come from the input transformer secondary windings. The transformer configuration and the number of cables depend on the rectifier number of pulses:

- 6 cables for the 12 pulse configuration.
- 9 cables for the 18 pulse configuration.
- 12 cables for the 24 pulse configuration.

Considering the standard rectifier version (18 pulses) the secondary winding voltage depends on the motor nominal voltage, being 1.5 kV for motors with 4160 V rated voltage and 1.2 kV for motors with 3300 V rated voltage. The 9 cables may be inserted through the bottom part of the rectifier cabinet or through the top of the inverter cabinet, being connected directly to terminations in copper bars mounted on the module (A1).

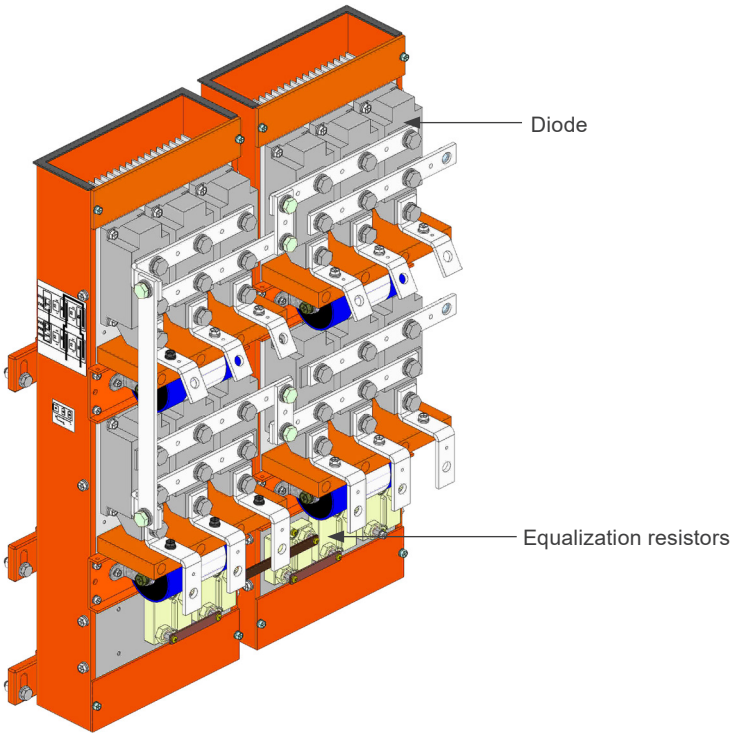


Figure 5.3: MVW01C 18-pulse rectifier

The rectifier is connected to the DC Link located at the rear part of the MVW01C panel, at the inverter compartment. The resistors for the DC bus voltage balancing are mounted together with the rectifier. The DC bus supplies the voltage for the three inverter power arms.

DC Link

The MVW01 DC Link consists of 4 dry plastic film capacitors of high reliability and long service life, designed for the filtering. The capacitor bank is mounted independent from the inverter arms and is divided in 2 parts by means of a series/parallel connection of the capacitors, creating a medium point (MP), necessary for the inverter implementation, which divides the DC Link voltage in two (VP and VN). There are three connections available at the capacitor bank, +UD, -UD and MP.

The connection between inverter arms and the DC Link capacitor bank is done by finger contacts and the connection between the DC Link and the rectifier is done using cables.

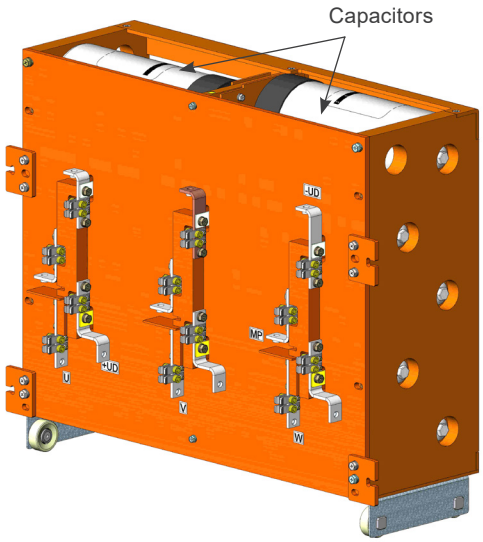


Figure 5.4: MVW01C DC Link

Inverter arms

The inverter arms are identical and contain:

- 04 medium voltage IGBT modules.
- 01 medium voltage diode module.
- 01 power heatsink.
- 01 Flat busbar.
- 04 gate driver boards (one for each IGBT).
- 04 gate driver adapter boards.
- 04 isolated DC/DC converters (gate driver board power supply).
- 01 heatsink temperature sensor (NTC resistor).
- 01 ISOX.02 Signal Feedback Board.
- 01 NPC resistor.

The arm has mechanical structure formed by bulk molding compound (BMC) (polyester resin and fiberglass) and steel plates, chemically treated to ensure resistance to corrosion.

The electric connection of the arms to the power busbars of the DC Link is done by means of finger contacts located at the front of the capacitor bank.

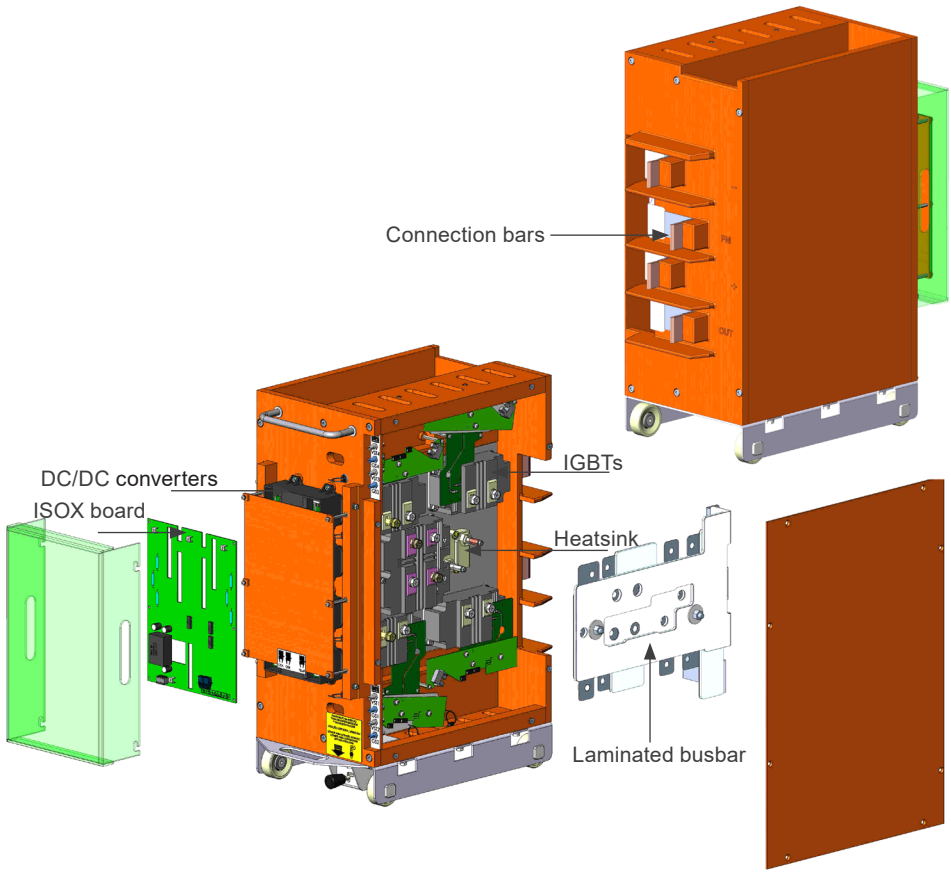


Figure 5.5: MVW01C power arm

Control rack

The control rack used in the MVW01C inverter line has the same functions and uses the same boards of the rack used in the MVW01 3L line. Refer to the Section 3.4 CONTROL RACK on page 3-7.

It is observed only a change in the arrangement of the boards because of the need for compaction of the MVW01C line.

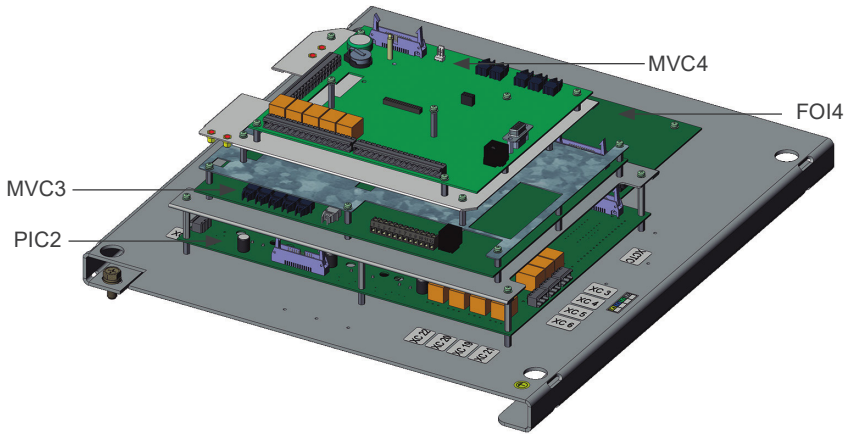


Figure 5.6: MVW01C control rack

5.1 PANEL CONSTRUCTIVE DETAILS

The MVW01C is supplied in form of a panel with the dimensions: 1000 mm x 2312 mm x 980 mm (width x height x depth). The complete panel can be defined, according to the components mounted in each panel division and to their functions, as the union of three compartments:

- Rectifier Compartment.
- Inverter Compartment.
- Control Compartment.

The Figure 5.7 on page 5-6 shows the complete panel drawing. The inverter arms are supplied separately inproper packages.

Arm dimensions: 260 mm x 607 mm x 522 mm (width x height x depth).

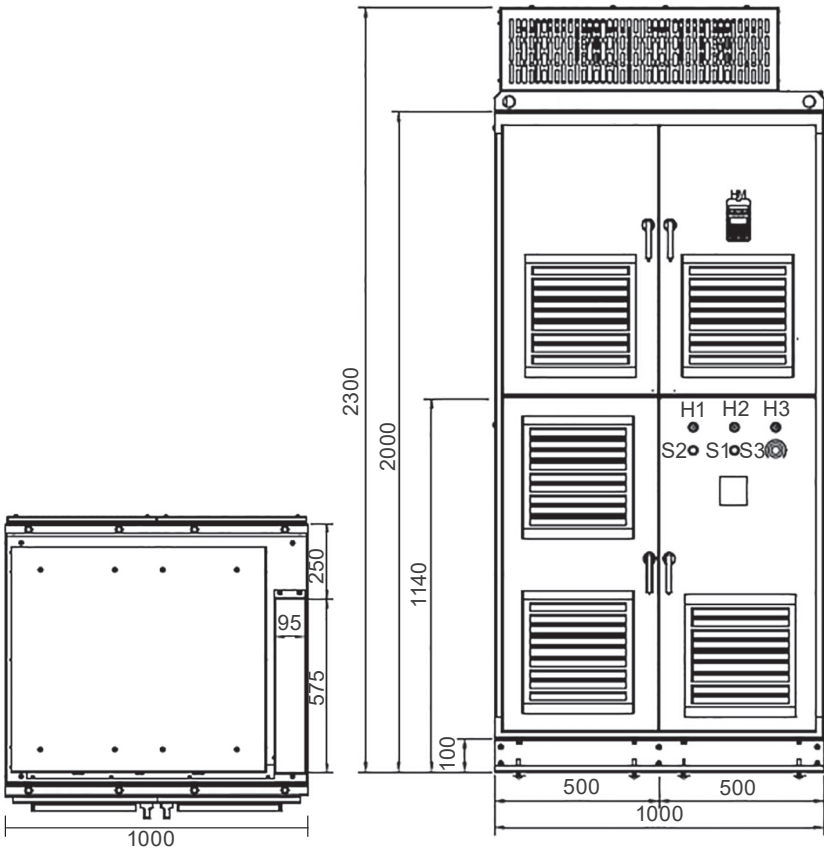


Figure 5.7: Dimensions of the MVW01C panel

The internal component distribution is presented in the Figure 5.8 on page 5-7.

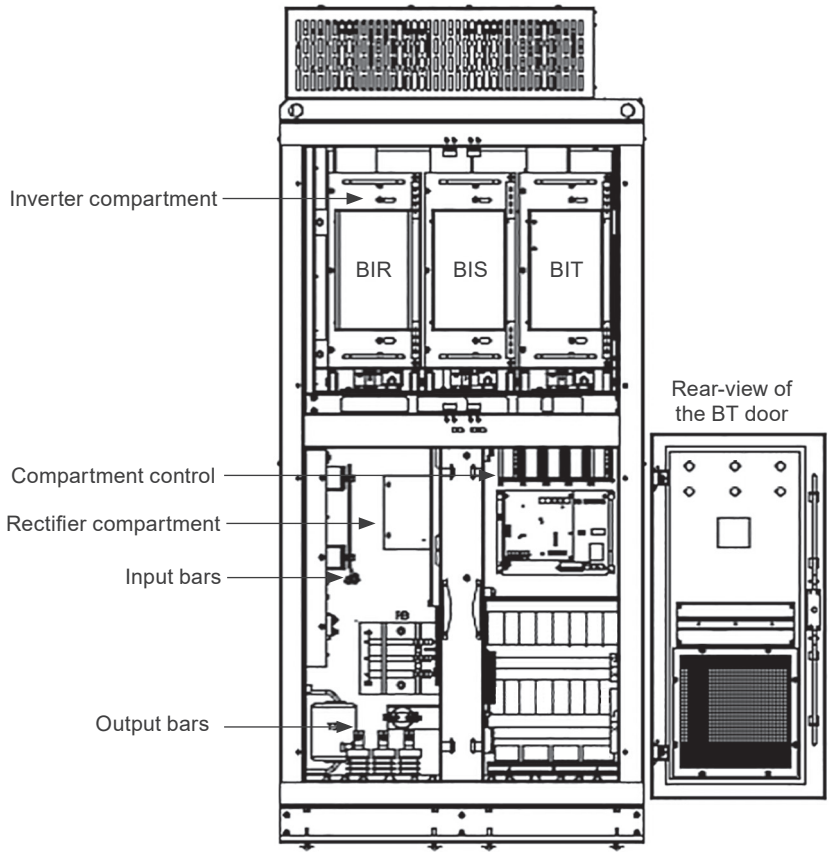


Figure 5.8: MVW01C internal component arrangement

5.2 AVAILABLE MODELS

See Item 2.3.1 Available Models on page 2-5.

6 MVW01 WC (WATER COOLED)

The line MVW01 water cooled is a variable frequency inverter destined to control medium voltage motors with nominal voltages of 3300 V, 4160 V, 6300 V and 6900 V, with a power range from 1500 to 33760 HP. It uses non-controlled semiconductors (diodes) at the input rectifier stage and controlled semiconductors (HV-IGBTs) to generate the three output phases at the inverter stage, in order to control the medium voltage motor speed and torque.

The MVW01 WC inverter line uses the same topology as the MVW01. The water cooled MVW01 version is perfect for high demanding and high power applications, such as environments with adverse conditions. It is also the ideal solution for applications where the hot air can not be dissipated and an air conditioner is not a commercially viable solution.

The line MVW01 WC is equiped with the WEG refrigeration system (RSW) of high efficiency which uses two independent water circuits, based on the principle of thermal exchange between liquids. The primary circuit carries the heat generated by the MVW01 to the heat exchanger. The secondary circuit carries the heat from the heat exchanger to an external refrigeration system.

The water circuits are reliable and provided with quick couplers with retenction, that prevents water from falling inside the panel, even during maintenance. The water cooling system is equiped with redundant pumps to guarantee continuous operation.

The MVW01 WC presents protections against overload, short-circuit, phase loss, output current limitation, undervoltage, overvoltage, overtemperature, ground fault, underpressure, overpressure, liquid leak detection, and independent fault monitoring for each HV-IGBT. The control type can be selected by the user, between scalar control (constant V/f ratio) and vector control (with sensorless or encoder feedback).



Figure 6.1: MVW01 WC Panel (IP54)

The internal component distribution is presented in the Figure 5.8 on page 5-7.

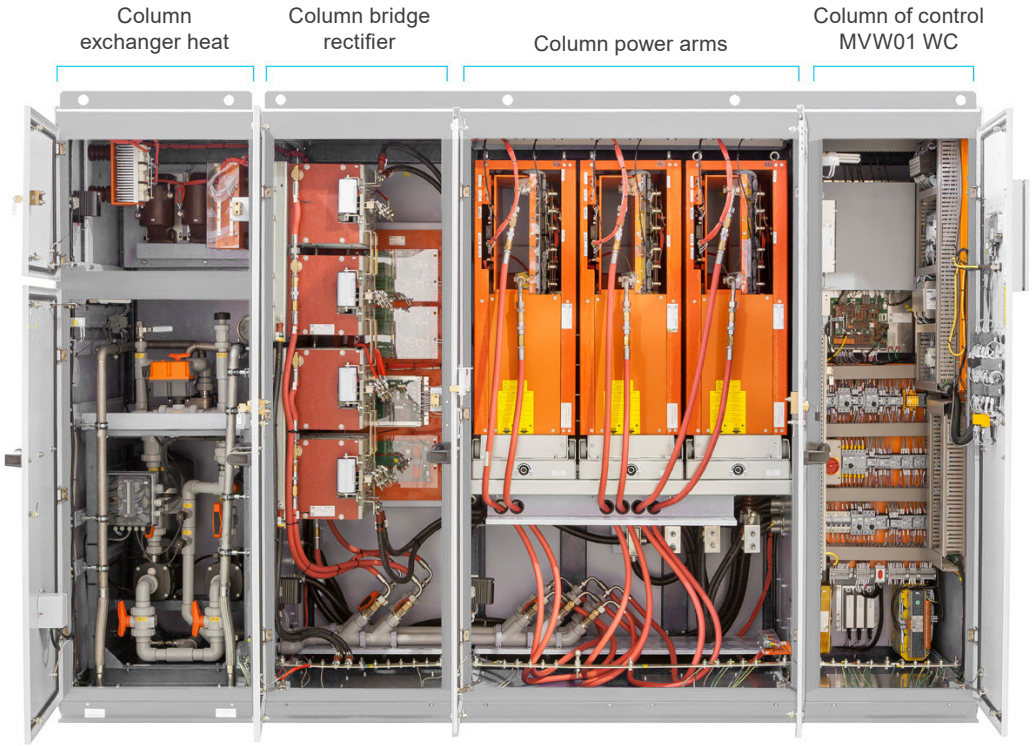


Figure 6.2: MVW01 WC panel general view

6.1 WATER COOLED BRIDGE RECTIFIER

The medium voltage cables for the input rectifier supply come from the input transformer secondary windings. The transformer configuration and the number of cables depend on the rectifier number of pulses:

- 12 pulses 6 cables.
- 18 pulses 9 cables.
- 24 pulses 12 cables.
- 36 pulses 18 cables.

Considering the standard rectifier version (18 pulses) the secondary winding voltage depends on the motor nominal voltage, being 1.5 kV for motors of 4160 V rated voltage and 1.2 kV for motors of 3300 V rated voltage. The 9 cables enter the rectifier cabinet at the top or at the bottom and are connected directly to terminals mounted on the rectifier module copper bars.



Figure 6.3: Water cooled rectifier 12 pulse (example)

The rectifier is connected to the DC Link located at the rear part of the MVW01 panel, in the inverter column. The DC bus supplies the voltage for the inverter power arms.

6.2 MVW01 WC POWER ARMS

The inverter power arms contain:

- 04 medium voltage IGBT modules.
- 01 medium voltage diode module.
- 01 water cooled power heatsink.
- 01 flat busbar.
- 04 gate driver boards (one for each IGBT).
- 04 isolated DC/DC converters (gate driver board power supply).
- 01 heatsink temperature sensor (NTC thermistor).
- 01 ISOX.02 Signal Feedback Board.
- 01 NPC resistor.

The arm has mechanical structure formed by bulk molding compound (BMC) (polyester resin and fiberglass) and steel plates, chemically treated to ensure resistance to corrosion.

The electric connection of the arms to the power busbars of the DC Link is done by means of finger contacts located at the front of the capacitor bank.

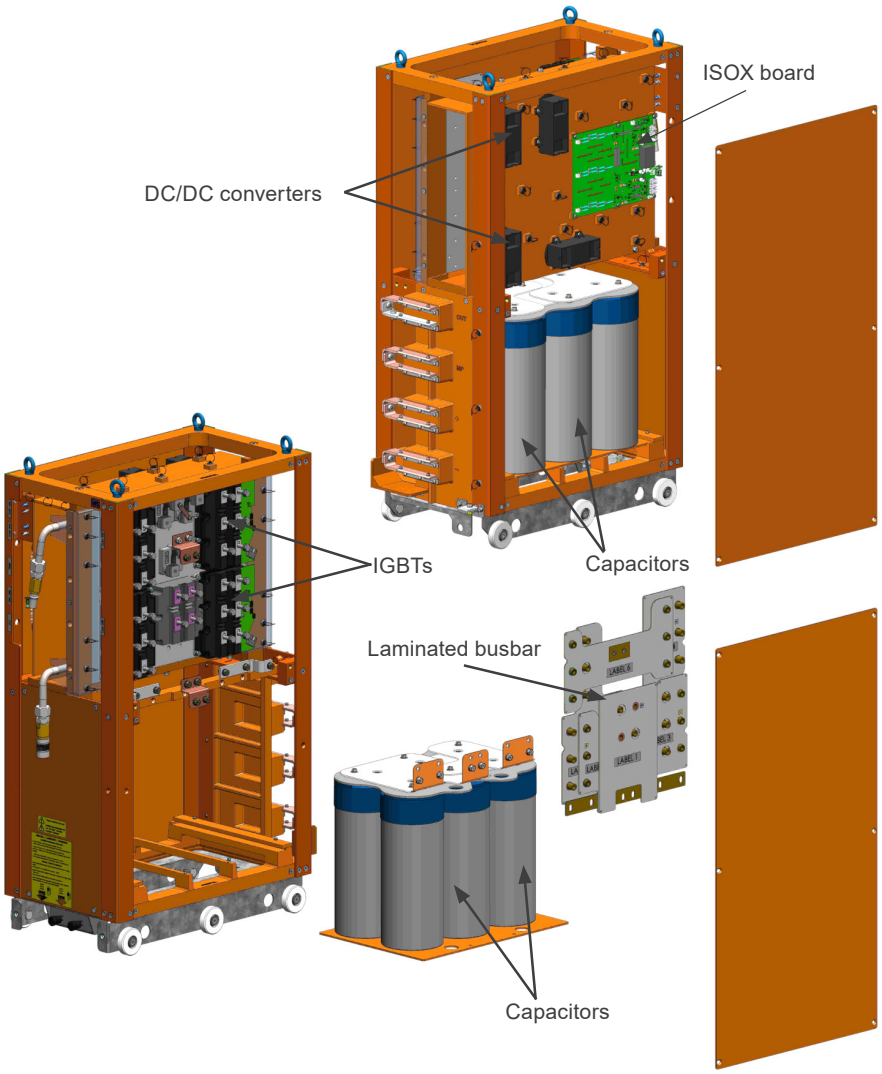


Figure 6.4: Water cooled power arm MVW01

6.3 CONTROL RACK

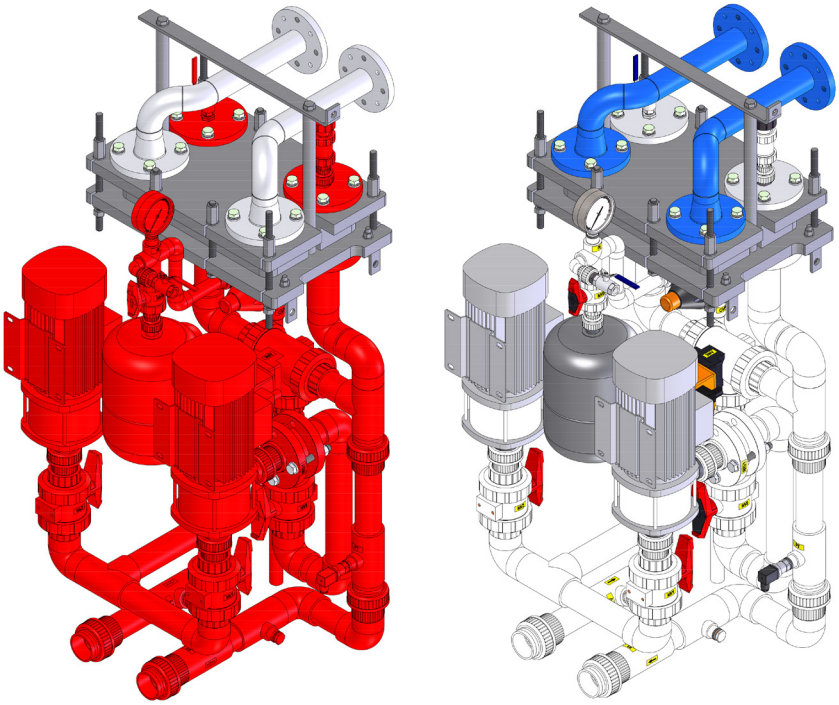
The control rack used in the MVW01 WC inverter line has the same functions and uses the same boards of the rack used in the MVW01 3L and 5L lines. Consult Section 3.4 CONTROL RACK on page 3-7.

6.4 WEG COOLING SYSTEM RSW

The operation of the RSW is based on the heat exchange principles among liquids, formed by primary and secondary circuits.

Primary circuit: It is a closed circuit composed of two pumps, a heat exchanger, an expansion tank, flow indicators, flow, temperature, and pressure sensors, besides that, there are valves for diferente purposes. The pumps are installed in a parallel configuration, and they operate alternatively pumping the coolant fluid through the circuit. The fluid remove the heat from the inverters and components being cooled and then transports to the heat exchanger where it transfers it to the secondary circuit. The RSW is controlled by the PLC circuit board of the frequency inverter (PLC300). The system parameters are collected by sensors and send them to the PLC for controlling the process. The inverter controls the three-way valve by monitoring the temperature and humidity in order to avoid a large difference in temperature in the coolant fluid as compared to the environmental temperature that causes condensation. Alarms are also triggered in cases of abnormalities that result in temperatures exceeding the specified range in the project. The control system commands the alarm and operation of the equipment by monitoring the flow. As it is a closed system, it is necessary to use an expansion tank (ET) to keep the pressure constant during operation. If abnormal pressures are detected by the pressure sensor, the control system commands the alarms and the operation of the equipment. The presence of the over pressure valve avoids that the pressure exceeds 6 bar. The system is also equipped with a leakage sensor.

Secondary circuit: This circuit is responsible for transferring the heat from the primary circuit to the customer's system using the heat exchanger. The RSW does not control the parameters of the secondary circuit, as these are the customer's and/or end user's responsibility.



(a) Primary (red) ***(b) Secondary (blue)***

Figure 6.5: (a) and (b) - RSW80: Primary Hydraulic Circuit (red) and Secondary (blue)

6.4.1 Heat Exchanger

Both models of the RSWs use 2 different exchangers, the RSW40 uses the brazed model and the RSW80 the plate model.

The plates, in the heat exchangers, are widely known for their effectiveness, low cost, great flexibility, and easy maintenance. The secret of this model of heat exchanger is its corrugated plates, which provoke a turbulent flow making the heat exchange extremely efficient and reduces incrustation. The plates are designed to provide turbulence throughout the entire heat exchange area.

The heat exchanger plates consist of a series of thin corrugated plates sealed to prevent leakage and mixing the fluids from different circuits. The plates are pressed between two pressure plates and are guided by two bars to keep them aligned between the plates. The fluid from the two circuits flows interspersed through the plates and counter-current, thereby providing a large area for heat exchange between the circuits.

The brazed exchanger is also made from thin corrugated plates, but the plates are brazed making it impossible to disassemble and perform maintenance (cleaning). The fluids from the two circuits flow interspersed between the plates and counter-current, providing a large area for heat exchange between the circuits.

6.4.2 Flow Sensor

This component monitors the speed of the flow of liquids and gases, it can be adjusted according to the need and it supplies a signal to identify if the flow is below or above the setting. The indication can also be seen on the display of the respective gauge.

6.4.3 Pressure Transmitter

The pressure transmitter model MBS 1700 monitors the internal pressure in a range between 0 to 10 bar and it sends a signal from 4 to 20 mA used for controlling the system.

6.4.4 Temperature Transmitter

The temperature transmitter model MBT 3560 monitors the internal temperature of the system between -50 ºC (-58 ºF) to 200 ºC (392 ºF) and sends a signal from 4 to 20 mA used for controlling the system.

6.4.5 Three-Way Valve

The 3-way valve is located in the primary circuit and it is used for controlling the temperature of the coolant fluid and avoiding condensation inside the panel, according to the combination of parameters measured by the system (fluid, environmental, and moisture temperatures) the valve is controlled in such a way as to keep a small difference in temperature measured to avoid condensation.

6.4.6 Centrifugal Pump

The centrifugal pump is responsible for supplying a continual flow of coolant fluid in the primary circuit. It supplies enough mechanical energy so that the flow complies with the required parameters of the project.

6.4.7 Over Pressure Valve

The over pressure valve is activated when, due to a system fault, the system pressure exceeds the adjusted value. In these cases, it lets the fluid drain outside the primary circuit, thus preventing the pressure from increasing and damaging any component. The adjustment range is from 0.5 to 10 bar. In the MVW01, it is adjusted to 6 bar.

6.4.8 Automatic Degasser Valve

The automatic degasser valve allows the release of the existing air from the primary circuit. Its working priciple is based on a sphere that is less dense than the refrigerant fluid and denser than the air, whereas, the presence of a significant amount of air makes the sphere move down by gravity, allowing the air to flow and thus discharging it from the circuit. When only coolant fluid is present, the valve remains closed. It is an automatic valve, installed vertically at the highest place in the circuit.

6.4.9 Expansion Tank

The membrane in the expansion tank prevents severe pressure variations while the equipment is operating, to prevent possible damages to the components. The expansion tank is composed of two sections, separated by a membrane, whereas one of the sides is filled by compressed air pre-loaded at 2 bar, and the other side is filled with coolant fluid from the primary circuit. If there is an increase in the pressure in the circuit, as the coolant fluid is incompressible, it will occupy a larger volume than the expansion tank and the air (compressible) in the other section, so it will be reduced in volume. Therefore, the undesirable high pressure will be mitigated by the expansion tank.

6.4.10 Leakage Sensor

Located on the lowest part of the RSW, it is a sensor that, on the presence of liquid, triggers a signal for alarm and changes the LED color from green to red.

6.5 INSTALLATION SPECIFICATIONS

6.5.1 Coolant Fluid

The quality specifications of the coolant fluid in the primary circuit must comply with the properties in Table 6.1 on page 6-7. The fluid must not contain any organic sediments or active chemical agents. The fluid must contain a corrosion inhibitor appropriate for PVCC pipes and EPDM sealants.

A filter must be used while filling the primary circuit tubes, in order to prevent the entrance of particles larger than 0.3 mm.

The temperature of the coolant fluid must never be under the environmental temperature of the panel and components, in order to avoid any risks of the fluid condensation. Up to 20 % of glycol ethylene can be added to the fluid in order to lower the fusion point of the fluid and avoid the fluid freezing. This percentage reduces the specific heat of the fluid and the capacity for heat exchange in the system.

Fluid: Demineralized water with a corrosion inhibitor and Glycol ethylene.

Table 6.1: Coolant fluid specifications primary circuit

Coolant Fluid Properties	Unit	Value
pH		6-8
Hardness	°dH	< 10
Conductivity	µS/cm	< 10
Chlorine	mg/l	< 10
Iron	mg/l	< 0.1
Maximum particle size	µm	< 300

For avoiding corrosion, we recommend using CorteC VpCI-649 anticorrosive. See the proportions in Table 6.2 on page 6-7.

Table 6.2: Recommended proportions of products in the coolant fluid

Product	Temperature above 10 °C	Temperature below 10 °C
Demineralized water (WEG PN: 10562331)	90 %	80 %
Glycol Ethylene (WEG PN: 12014320)	9 %	19 %
CorteC VpCI-649 (WEG PN: 12014546)	1 %	1 %

NOTE!
Always wear safety gloves and glasses when handling refrigerant fluid.

The quality demand in the coolant fluid in the secondary circuit is not as high as in the primary circuit, but good quality fluid will extend the maintenance period requirement or replacement of the heat exchanger. Organic sediments must be avoided, as they cause incrustation on the plates in the heat exchanger, reducing the thermal efficiency, and increasing the pressure drop.

The installation of a filter is recommended at the entrance to the secondary circuit, in order to prevent the entrance of particles larger than 0.5 mm. It is necessary to install a flow meter and temperature sensor on the secondary circuit to control the project parameters. The fluid in the secondary circuit must not contain chemical residues, which may corrode the materials used in the heat exchanger in the RSW.

NOTE!
If the coolant fluid does not comply with specifications and procedures, it can cause the loss of the product warranty. The heat exchanger is not prepared to operate using salt water.

6.5.2 Hydraulic Connections of the Secondary Circuit (Customer)

Secondary Circuit: It is responsible for transferring the heat from the RSW to the customer's circuit and it is connected by stainless steel flanged connections model DIN 2576. These connections (pipings) have a flexible part to allow easy adjustment of the assembly.

A filter must be provided by the customer and/or final consumer to prevent the entrance of particles larger than 0.5 mm. This measure seeks to increase the average periods between maintenance on the heat exchanger. The customer and/or final consumer must also provide the installation of a temperature sensor at the intake to the heat exchanger for monitoring and assuring the required parameters for correct operation of the system. If these components are not installed, then it may imply losing the warranty.

Table 6.3: Necessary requirements for the secondary circuit

Model	Maximum Temperature of the Coolant at the Inlet	Minimum Flow
RSW40	38 °C (100.4 °F)	145 l/min
RSW80	38 °C (100.4 °F)	260 l/min

NOTE!
The pressure in the secondary circuit cannot exceed 10 bar. Pressures over that can damage the heat exchanger.

6.5.3 Hydraulic Connections of the Primary Circuit (Inverter)

Primary Circuit: It is a closed circuit composed of two pumps, a heat exchanger, an expansion tank, flow indicators, flow, temperature, and pressure sensors, besides that, there are valves for diferente purposes. With the regulation valves present in the pipeline, it is possible to adjust the water flow in each power arm, rectifier and reactor heat exchanger.

Table 6.4: Flow for the primary circuit

Componet	Flow
Inverter arm	20 l/min
Rectifier (6 pulse)	20 l/min
Reactor heat exchanger	15 l/min

The fluid remove the heat from the inverters and components being cooled and then transports to the heat exchanger where it transfers it to the secondary circuit.

NOTE!
The nominal pressure in the primary circuit is 4 bar (3.5 bar minimum). The pressure cannot exceed 10 bar, pressures over that can damage the inverter components.

6.6 MECHANICAL DATA

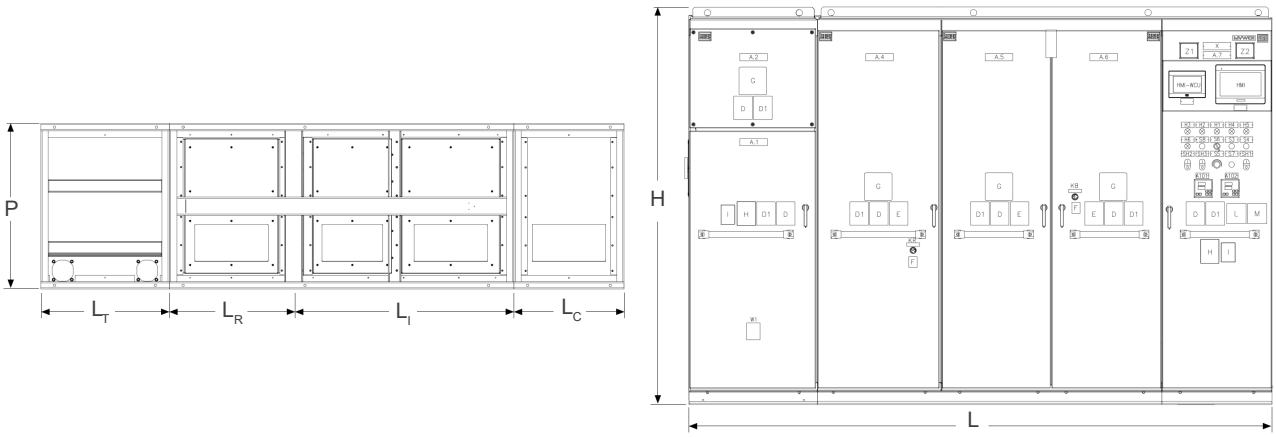


Figure 6.6: Panel constructive aspects

The MVW01 WC line is assembled in panels with the dimensions shown in Table 6.5 on page 6-9 and Table 6.6 on page 6-9:

Table 6.5: Mechanical data 3L (dimensions in mm)

Frame Size	L_R (mm)	L_L (mm)	L_I (mm)	L_C (mm)	L_T (mm)	L (mm)	H (mm)	P (mm)	Weight (kg)
AW	700	0	1200	600	700	3200	2200	1020	2500
CW	1200	2 x 600	2 x 1200	600	800	5700			4000
DW	1200	3 x 600	3 x 1200	600	1000	8000			5700
EW	1200	4 x 600	4 x 1200	600	1000	9800			6800
2 x DW	2 x 1200	6 x 600	6 x 1200	2 x 600	2 x 1000	2 x 8000			2 x 5700
2 x EW	2 x 1200	8 x 600	8 x 1200	2 x 600	2 x 1000	2 x 9800			2 x 6800
3 x DW	3 x 1200	9 x 600	9 x 1200	3 x 600	3 x 1000	3 x 8000			3 x 5700
3 x EW	3 x 1200	12 x 600	12 x 1200	3 x 600	3 x 1000	3 x 9800			3 x 6800

Table 6.6: Mechanical data 5L (dimensions in mm)

Frame Size	L_R (mm)	L_L (mm)	L_I (mm)	L_C (mm)	L_T (mm)	L (mm)	H (mm)	P (mm)	Weight (kg)
C2W	1280	3 x 900	800	1280	6060	3200	2200	1020	4800
C3W	1280	6 x 900	800	1280	8760	5700			5200
3 x C2W	3 x 1280	9 x 900	3 x 800	3 x 1280	3 x 6060	8000			3 x 4800
2 x C3W	2 x 1280	12 x 900	2 x 800	2 x 1280	2 x 8760	9800			2 x 5200
3 x C3W	3 x 1280	18 x 900	3 x 800	3 x 1280	3 x 8760	2 x 8000			3 x 5200

L_R: Rectifier column. L_L:Parallelism inductor column. L_I: Inverter column. L_T: Heat exchanger column. L_C: Control column. H: Height. L: Width. P: Depth.

Notes: Mechanical DW and EW with 18-pulse rectifier, consider + 800 mm of additional column for connections cable. For mechanics with sinusoidal filter consult WEG. Tolerance for all dimensions ± 10 mm.

NOTE!
The values shown in Table 6.5 on page 6-9 and Table 6.6 on page 6-9 are standard values, however, they may change due to the special characteristics of the product:

- Input Switchgear.
- Columns for dynamic braking.
- Exciter column (for synchronous machines).
- Output filters.
- Input filters (AFE).
- Additional inverter column (AFE).
- Additional column for cables connection (input and output).
- Special grounding and safety systems.
- Special cooling system (air/water).

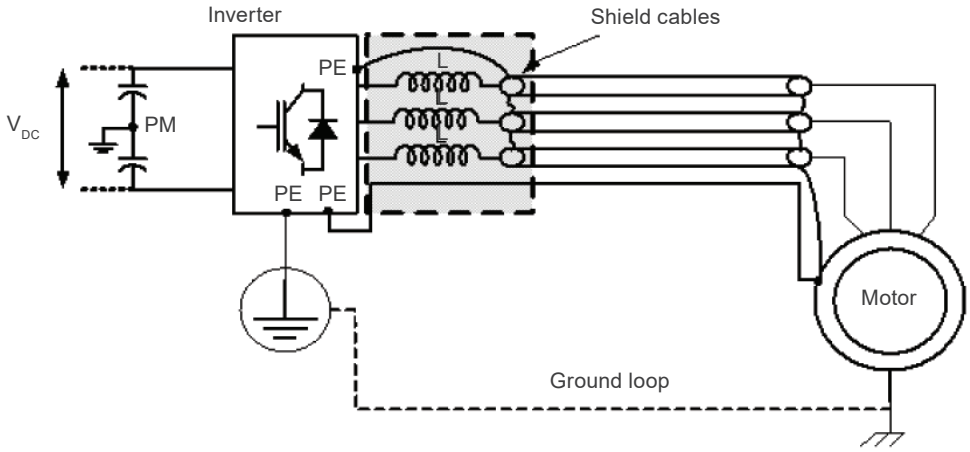
6.7 AVAILABLE MODELS

See Item 2.3.1 Available Models on page 2-5.

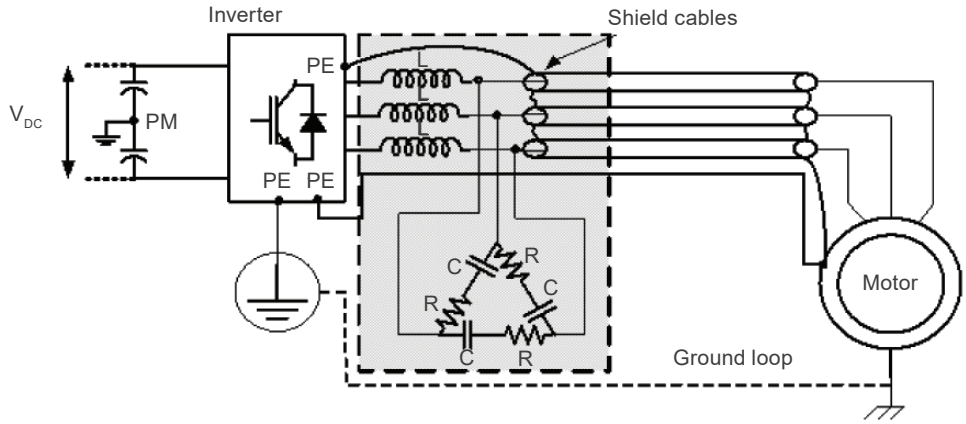
7 OUTPUT FILTERS

Depending on the installation conditions, the addition of an output dv/dt filter may be necessary, recommended for drive systems with cable length between 100 (328.08 ft) and 500 m (1640.41 ft), which are designed for application with new WEG motors. For drive systems with cable length greater than 500 m (1640.41 ft), or for driving already existent motors (retrofit applications (motor not prepared for operation with inverter)) the use of sinusoidal filters (by consulting WEG) is recommended.

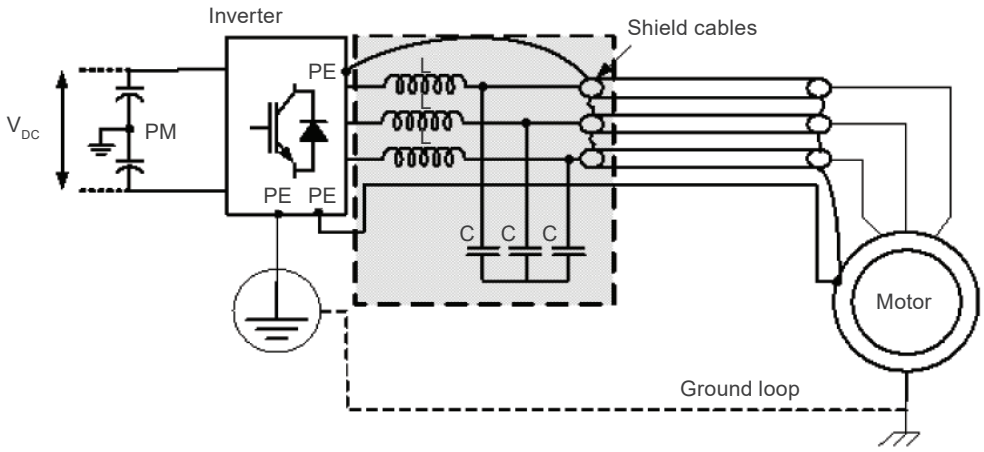
Table 7.1 on page 7-2 presents the line of dv/dt and sinusoidal filters for the MVW01 inverter, according to the description above.



(a) Output reactor - solution for cable length between 100 and 200 m (328.08 and 656.17 ft)



(b) RLC dv/dt filter - solution for cable length between 200 and 500 m (656.17 and 1640.41 ft)



(c) Sinusoidal filter - solution for cable length greater than 500 m (1640.41 ft), or for retrofit applications (motor not prepared for operation with inverter)

Figure 7.1: (a) to (c) Output filters for MVW01 inverters

Table 7.1: Output filters for MVW01 inverters

Motor Cables Length	Inverter Model: Nominal Current / Size	Output dv/dt Filter	Components
< 100 m	All models	It is not necessary	
100 m - 200 m	4160 V / A0 4160 V / A 3300 V / A0 3300 V / A 2300 V / A 2300 V / B	Output reactor with 2 % voltage drop	Reactor according to WEG specification
	4160 V / C D E 3300 V / C D E	It is not necessary	-
200 m - 500 m	4160 V / A 3300 V / A 2300 V / A 2300 V / B 4160 V / C 3300 V / C 4160 V / D 3300 V / D 4160 V / E 3300 V / E	RLC 02 dv/dt filter	Reactor according to WEG specification
> 500 m	All models	Sinusoidal filter	Under consultation to WEG

(*) Output filters for MVW01 inverters 6000-6900 V on request.

7.1 SINUSOIDAL OUTPUT FILTER

WEG sinusoidal filters have been developed with the purpose of reducing the voltage and current harmonic content at medium voltage motors power supply. They are compatible with new or already existent motors, and make it possible to drive motors without distance limitation between the MVW01 and the motor.

Besides the inductor and the capacitor, the sinusoidal filter is formed by a contactor in series with the capacitive branch. This contactor has the function of disconnecting the capacitors in case of an inverter failure, avoiding, thereby, resonances between the filter and the motor. The need to use the contactor must be evaluated for each application.

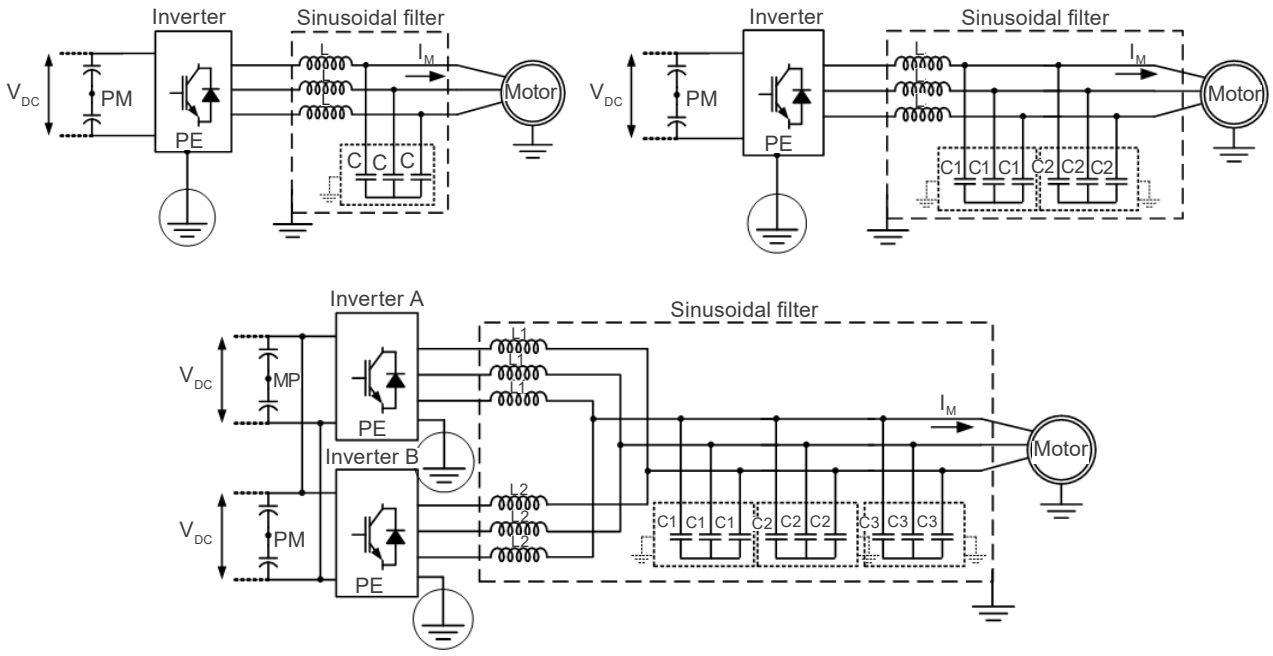


Figure 7.2: Possible configurations of sinusoidal filters

NOTE!
When the product features the option “sinusoidal output filter” the inverter comes from the factory enabled to operate with it. However, this function will be only available in the scalar control mode (P0202 = 0, 1 or 2) and when specified in the project requirements.

NOTE!
Inverter losses will be higher for operations with a sinusoidal filter.

Besides the creation of P0011, parameters P0003 and P0400 were changed in order to adapt the use of the MVW01 with sinusoidal output filter. The description of these parameters can be found in Programming Manual available at **www.weg.net**.

8 INVERTER PARALLELISM

The MVW01 frequency inverter has a wide range of currents that comprise parallel arrangements of conventional models with the use of reactors.

NOTE!
A 5 % derating is applied to each parallel unit in order to compensate the power drop caused by the use of the reactor.

8.1 STRUCTURE OF THE PARALLEL INVERTER

Up to four inverters can be connected in parallel, by means of reactors, in order to extend the power range of the MVW01 line. In this manual the standard inverter (not parallel) is identified as 3L, with two in parallel 3L2, with three in parallel 3L3, and with four in parallel 3L4.

The parameters and faults regarding the parallel inverter (3L2) suffered modifications in the arm nomenclature in order to adequate it to the new 6.9 kV inverter line and to the expansion of the existent 3300 V and 4160 V lines.

The figure below presents the power section structure of the inverter with the new HMI parameter correspondence.

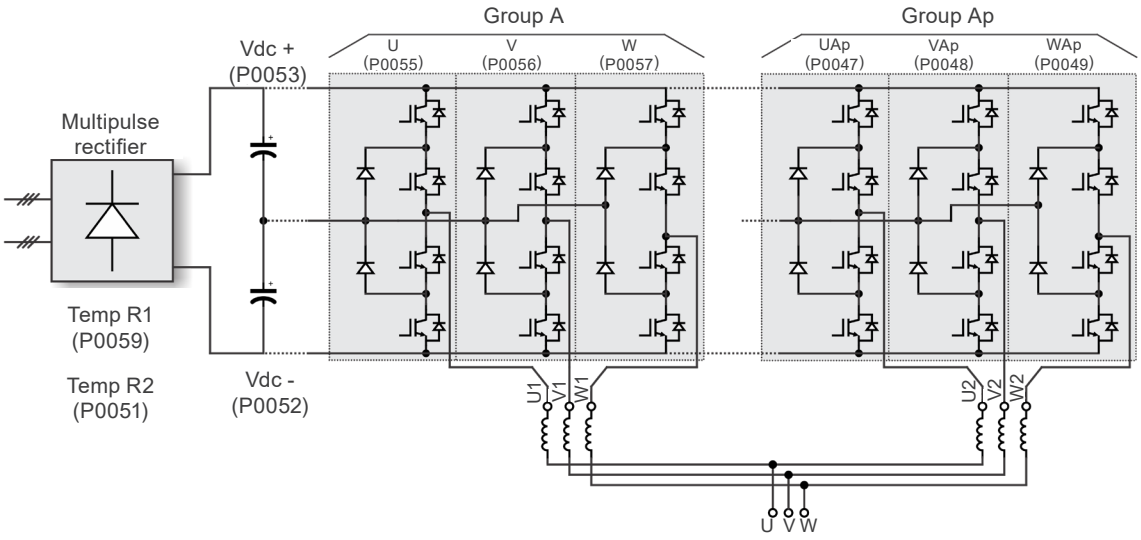


Figure 8.1: 3L2 line parameter correspondence

8.2 THREE LEVEL (3L) LINE WITH UP TO FOUR SET PARALLELISM (3L4)

For the present power section structure, up to 4 groups of power arms connected in parallel, by means of reactors, can be used. Table 8.1 on page 8-1 presents the nomenclature used to identify the several power arms.

Table 8.1: Correspondence of the 4160 V line parameters with the power arms

Group	Phase	Nomenclature	Temperature Read
A	U	U	P0055
	V	V	P0056
	W	W	P0057
Ap	U	UAp	P0047
	V	VAp	P0048
	W	WAp	P0049
B	U	UB	P0082
	V	VB	P0083
	W	WB	P0084
Bp	U	UBp	P0085
	V	VBp	P0086
	W	WBp	P0087

The structure of the power groups operating in parallel is presented next.

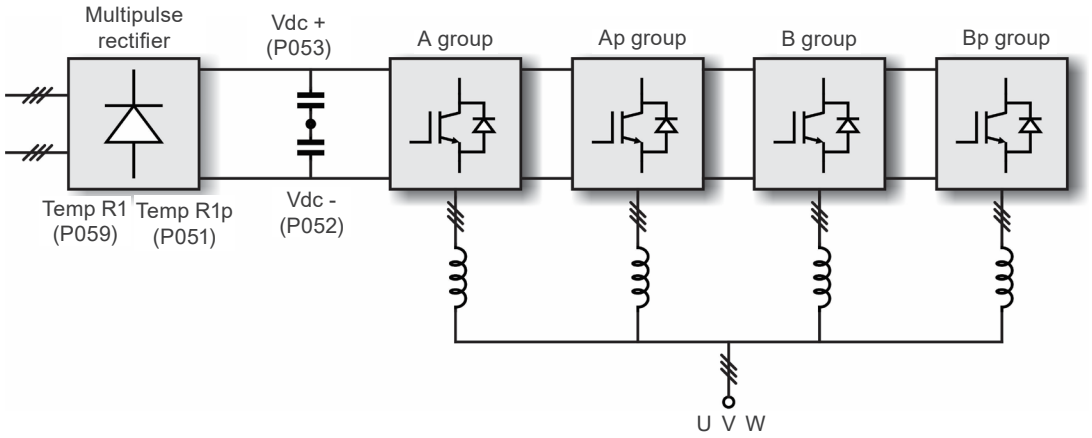


Figure 8.2: Power structure of the NPC 4160 V 3 levels up to 3L4

Table 8.2: Admissible power according to the number of groups used in parallel in the 3300 V and 4160 V line

Group	Frame Size	Maximum Power [HP]	Structure
A	A and B	4040	3L
A + Ap	C	7670	3L2
A + Ap + B	D	11510	3L3
A + Ap + B + Bp	E	15350	3L4

Configurations showed in the Table 8.1 on page 8-1 and power references of the Table 8.2 on page 8-2 are valid for the 3300 V and 4160 V lines. More information on the possible MVW01 voltage and power configurations can be found in the product catalog.

8.3 PARALLELISM OF 2 FRAME D OR 2 FRAME E

The MVW01 up to 30690 HP consists in the parallel association of two MVW01 inverter sets of frame size D or E. The power structures are associated normally through the use of reactors and differ basically because of the use of two separated DC Links fed by distinct secondary windings (or by using two completely independent transformers).

The main difference of this line compared to the other frame sizes that use parallelism is due to the use of two control sets of the size D or E, operating in parallel mode and a central control rack managing the combined and synchronized operation of the parallel inverters.

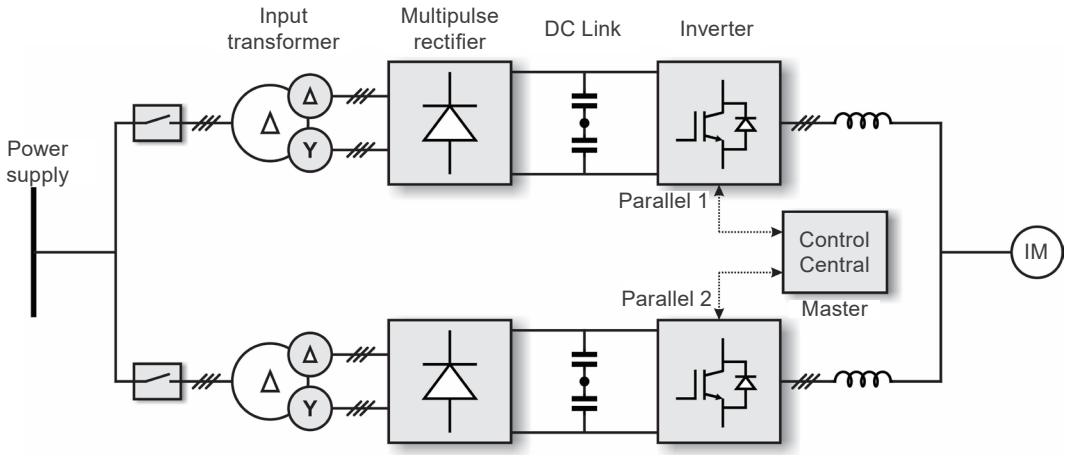


Figure 8.3: General diagram for the 2 x D and 2 x E models

This structure is necessary to increase the total number of inverter power arms, and in this system two inverters in parallel can be used, which, with the command of an auxiliary control rack equipped with specific software enables the operation of the system as a whole. The nomenclature regarding the power cell groups was maintained for parallel inverter, just like the parameters and the faults.

The control for the line up to 2 x E presents the need to use 3 HMIs, being one of them for the central rack whereas the two other present information regarding individual readings and faults of the parallel racks. Table 8.3 on page 8-3 lists the readings that are exhibited differently in the HMI of the control central.

Table 8.3: Admissible power according to the number of groups used in parallel inverter in the 3300 V and 4160 V line

Parameter	Parallel HMI (standard)	Central Control Rack HMI
P0003	Motor Current	Addition of the parallel inverter currents
P0004	DC Link Voltage	Highest voltage among the parallel DC Links

NOTE!
The faults and alarms are entirely described in the programming manual available for download on **www.weg.net**.

The connection between the Control Central/Parallels commands can be performed according to the diagrams of Figure 8.4 on page 8-3 or Figure 8.5 on page 8-3.

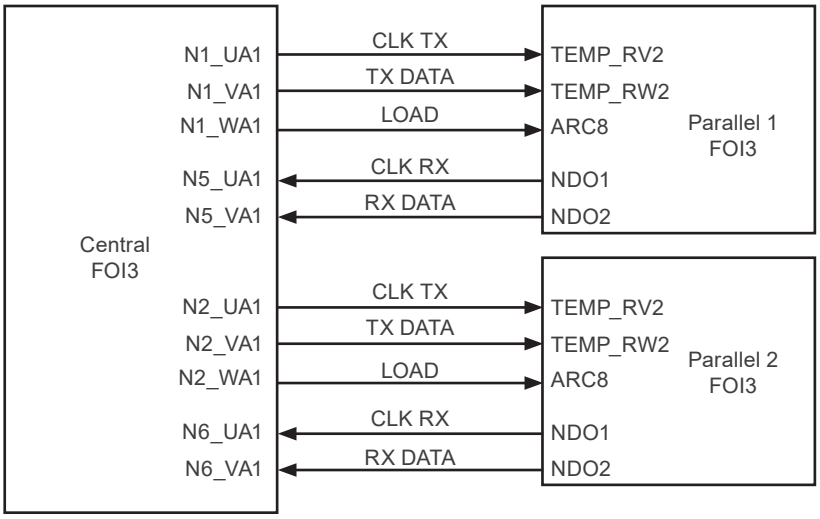


Figure 8.4: Communication between central and parallel racks using FOI3

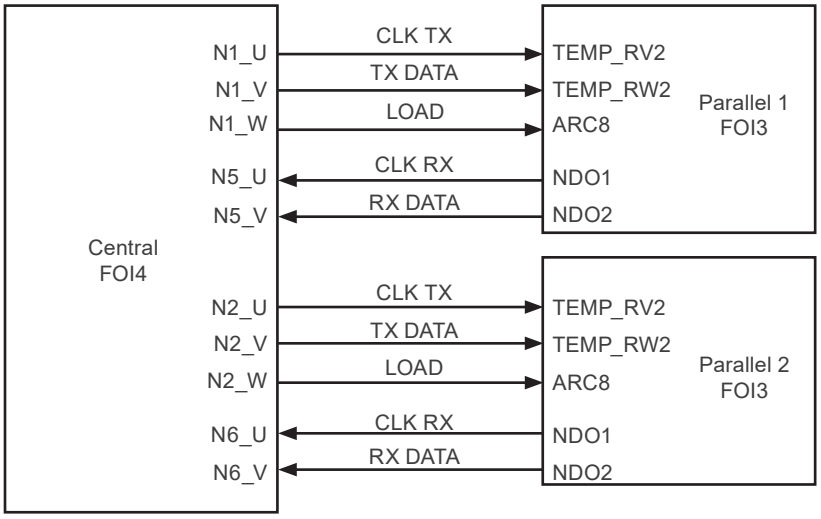


Figure 8.5: Communication between central and parallel racks using FOI4

NOTE!
The connections are made with fiber optic cables, with a length limit of 10 m. More information on panel connections and mechanical dimensions can be found in the inverter electrical project.

8.4 FIVE LEVEL PARALLELISM LINE

For the higher power inverters of the 6.9 kV line, it is necessary the use of parallel H bridges per phase and, in the same way as for the 4160 V, the parallelism occurs by the use of reactors. Figure 8.6 on page 8-4 shows the detailed description of the H bridge topology, as well as the related parameters.

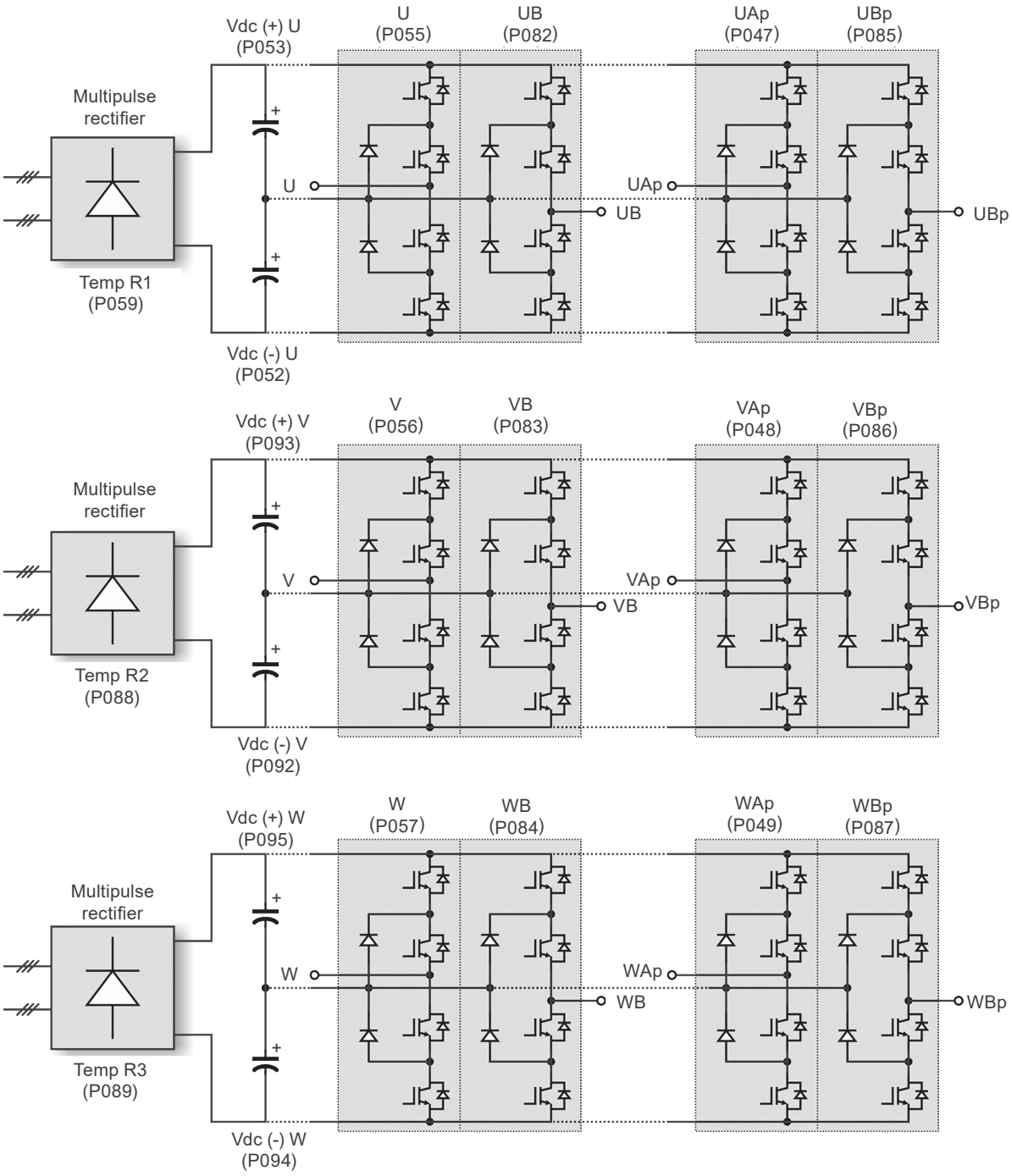


Figure 8.6: Topology of the 6.9 kV line 5 levels parallel

The parallelism reactors are magnetically coupled, as shown in the next figure.

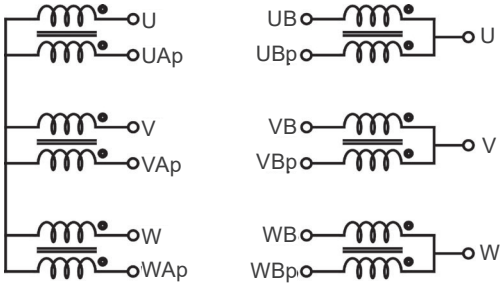


Figure 8.7: Parallelism reactors connectionof the 6.9 kV line

The other mechanical and power options of the 6.9 kV line can be found in the product catalog.

The parameters and faults correspondent to the power structure of this line are described in the programming manual available for download on **www.weg.net**.

9 SUPPORTED MOTORS

This chapter presents the types of motors compatible with the MVW01 and the respective control strategies.

9.1 INDUCTION MOTOR

The MVW01 is a high performance product designed for speed and torque control of three-phase induction motors. Motors of this type can be controlled by the following control strategies:

- Scalar control (V/f).
- Vector control (for details, see Section 11.3 INCREMENTAL ENCODER on page 11-14).
- Vector control without encoder (“sensorless”).

For more detailed information on the controls, refer to the Programming Manual available at **www.weg.net**.

9.2 SYNCHRONOUS MOTOR

In order to allow driving synchronous motors, the MVW01 introduces a number of software functions and new hardware elements for commanding and controlling these motors.

Figure 9.1 on page 9-1 presents the general diagram for driving the synchronous motor using the MVW01. For more details on the excitation control system and the direct connection of the motor to the line, refer to the electrical project of the inverter.

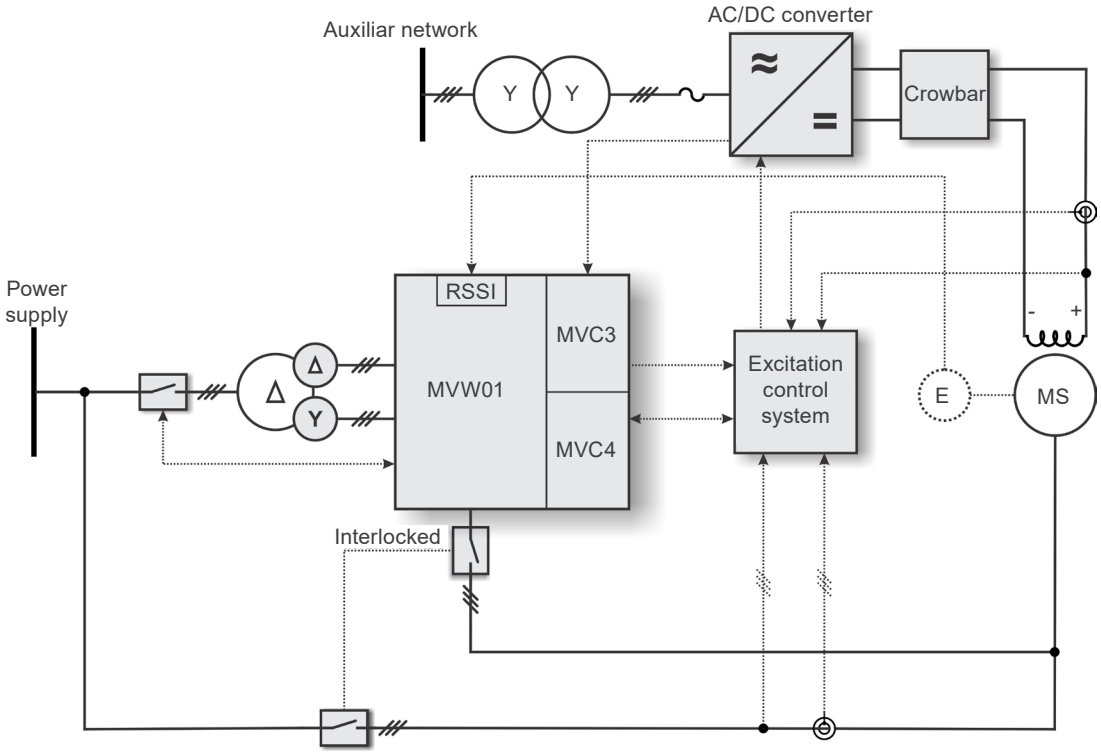


Figure 9.1: General diagram of the inverter for synchronous motor

9.2.1 Absolute Encoder with RSSI Board

In synchronous machine drive applications, it is necessary to use an absolute encoder so as to obtain the exact rotor position in relation to the stator, since the incremental encoder is not able to provide such information.

9.2.1.1 Absolute Encoder

The control of synchronous motors requires the use of an absolute encoder (available for the models shown in Table 9.1 on page 9-2 with 13 and 14 bits), which must observe the following specifications:

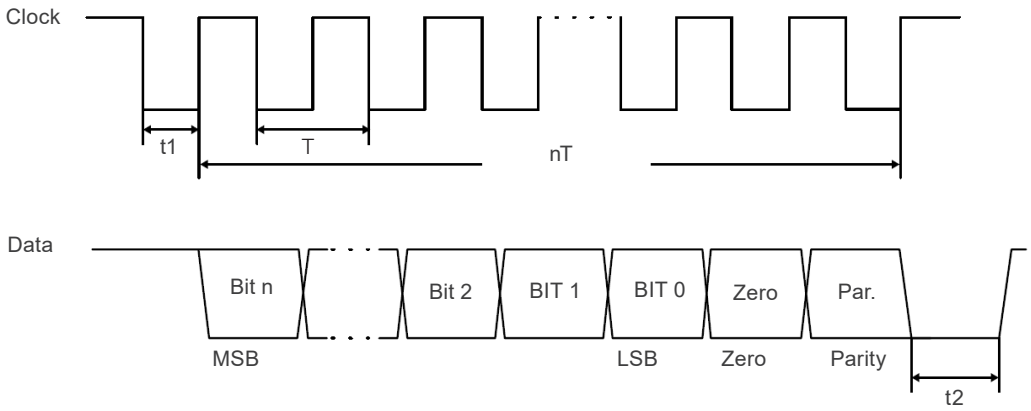


Figure 9.2: Example of Clock specification and data transfer to the absolute encoder

Table 9.1: Encoder recommendations for use in the MVW01

Manufacturer	Encoder Model	Quantity of Bits	Zero Bit	Parity Bit
Leine Linde	ISA647100150	13	Yes	No
Baumer	MHAP 400 B5 XXXXSB14EZ D	14	Yes	Yes

When mounting the encoder next to the motor, it is recommended:

- Coupling the encoder directly to the motor shaft (using a flexible coupling, however without torsional flexibility).
- Both the encoder metallic housing and shaft must be electrically isolated from the motor (minimum spacing: 3 mm).

NOTE!
The maximum encoder cable length is 200 m.
Refer to the motor project to define the type of encoder mounting.

Use good quality flexible couplings that avoid mechanical oscillations or backlash.

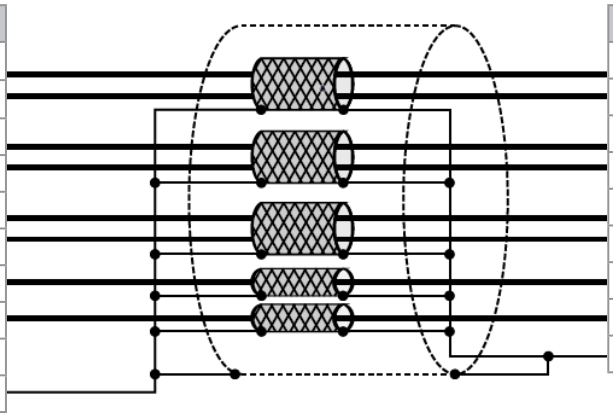
9.2.1.2 RSSI Board

The use of absolute encoder implies the need for an SSI data interface (Synchronous Serial Interface) between the encoder and the inverter. The RSSI board was developed for the encoder specification previously described. This board needs to be powered with 24 V in direct current, consumes up to 700 mA and has the following characteristics:

- RS485 communication channel for data transmission and clock according to SSI standard with absolute encoder.
- 2 fiber optic communication channels for use with up to two MVC3 control boards and fiber optic interface board.

For electrical connection, use shielded cables, keeping them at least 25 cm away from the other cables (power, control etc.). Preferably, inside a metallic conduit, as shown in Figure 9.3 on page 9-3.

Signal	Color
CLK +	Red
CLK +	Blue
	Yellow
	Green
DATA +	Gray
DATA -	Pink
Vdc	White
DGND	White
Shield	



XC9	Signal	Description
3	CLK +	Encoder signals
2	CLK +	
1		
9		
8	DATA +	
7	DATA -	
4	Vdc	Power supply
6	DGND	0 V reference
5		Ground

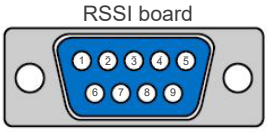


Figure 9.3: RSSI - Encoder connection cable

The connections to the encoder and to the MVC3 boards and fiber optic interface board, and components of the RSSI board are shown in Figure 9.4 on page 9-3 and Figure 9.5 on page 9-4, respectively.

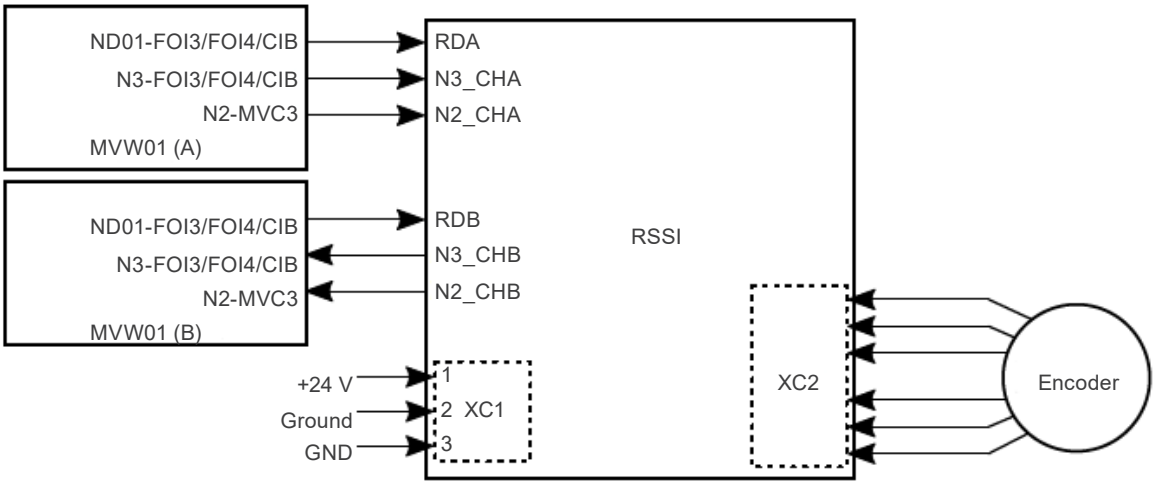


Figure 9.4: Connection diagram with the MVC3 and FOI3 boards

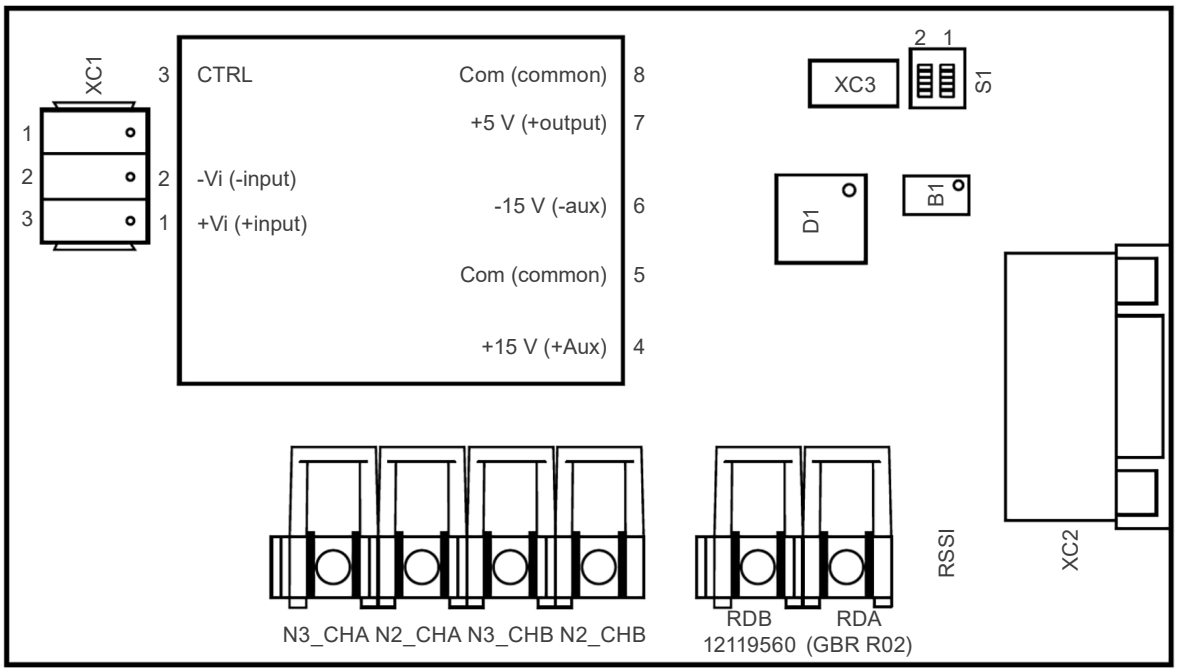


Figure 9.5: RSSI Board

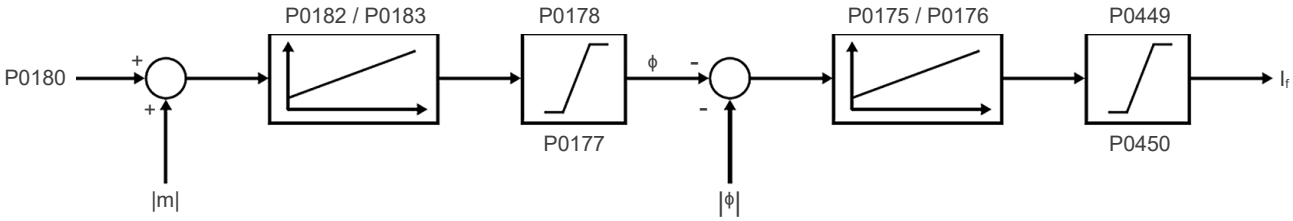
9.2.2 Field Set (DC with Brushes)

The field excitation of the synchronous motor can be done through an AC-DC converter that presents the possibility of being controlled by a control loop, and that has an input for current reference and presents an analogue output with the information of its output current (feedback for the MVW01).

Specifications:
Current reference input AC-DC: 0 to 10 V (AC-DC 5 V = 1 PU, observe P0462).
Feedback of the output current for the MVW01: 0 to 10 V (MVW01 5 V = 1 PU, observe P0462 and P0744).

NOTE!
The MVC3 board has only voltage signals, in order to use current signals an external current transducer must be used.

Example of configuration of the field current reference and paremeter setting of the inverter is presented in Figure 9.6 on page 9-4, the parameters presented are described in the Programming Manual available at **www.weg.net**.



|m| = Modulation index.
ϕ = Stator flux.
|ϕ|= Stator flux, module.
I_f= Field current reference.

Figure 9.6: Parameters used by the inverter in the calculation of the of the field current reference

NOTE!
Information presented in Chapter 9 SUPPORTED MOTORS on page 9-1 of this manual refers to the operation of synchronous machines with DC excitation and with brushes.
In order to drive synchronous machines with other types of excitation, consult WEG.

9.3 PERMANENT MAGNET SYNCHRO MOTORS (PMSM)

The MVW01 is a high-performance product designed also for controlling smooth-pole permanent magnet (PMSM) synchronous motors.

Application of smooth pole permanent magnet motors (PMSM) becomes attractive due to performance, high rotation, power density, and efficiency, is widely used in deep-sea oil extraction applications and motor applications at high speed.

The control method used by the MVW01 is voltage vector control without a position or speed sensor (sensorless). This robust control enables operation with a unity power factor and maximum utilization of the drive and motor. This control allows operation with maximum torque per ampere (MTPA) (motors with Lq = Ld).

10 INSTALLATION, CONNECTION AND ENERGIZATION

This chapter describes the electrical and mechanical installation procedures for the MVW01. The presented guidance and suggestions must be followed in order to assure the proper inverter operation.

ATTENTION!
The handling of the MVW01 and its mechanical and electrical installation must be carried out by persons trained and qualified by WEG.

ATTENTION!
STORAGE OF THE MVW01 PANEL AND ARMS:
- After receiving the equipment, remove the plastic film in order to prevent moisture condensation.
- Do not store exposed to sunshine and to temperatures above 40 °C (104 °F).
- Store the equipment in a clean, protected place with relative humidity not higher than 80 %.
- During all the storage period the conditions mentioned earlier must be satisfied, but when components are stored for more than one year, measures must be taken to dehumidify the storage location.
- When using equipment after a long storage period, verify whether the equipment is free of scratches, dirt, rust and other damages.
- The inverter performance and reliability can be impaired if the inverter or the power arms were stored in an environment out of the conditions listed previously.

DANGER!
- The procedures recommended in this warning have the purpose of protecting the user from death, severe personal injury and considerable property damage.
- Power supply isolating switches: equipment for isolating the inverter power and auxiliary supplies must be planed.
- They must cut off the inverter supplies (e.g., during installation maintenance tasks).
- This equipment cannot be used as emergency stop mechanism.
- Make sure that the power supply is disconnected before starting the wiring.
- The following information is intended to be a guide for a proper installation. Comply with applicable local regulations for electrical installations.

10.1 MECHANICAL INSTALLATION

10.1.1 Environmental Conditions

The inverter installation location is an important factor to assure good performance and high product reliability. The inverter must be installed in an environment free of:

- Direct exposure to sunlight, rain, high humidity, or sea-air.
- Inflammable or corrosive gases or liquids.
- Excessive vibration, dust or metallic particles and oil mist.

Allowed environmental conditions:

- Temperature: From 0 ºC to 40 °C (32 °F to 140 °F) - nominal conditions (no derating required).
- From 40 °C to 50 °C (140 °F to 122 °F): current reduction of 2.5 % for each Celsius degree above 40 °C (140 °F).
- Relative humidity: from 5 % to 90 % non-condensing.
- Altitude: up to 1000 m (3.300 ft) - nominal conditions (no derating required).

- From 1000 m to 4000 m (3,300 ft to 13.200 ft) - current derating of 1 % each 100 m (or 0.3 % each 100 ft) above 1000 m (3.300 ft) altitude.
- Pollution degree: 2 (according to IEC/UL standards) with non-conductive pollution.
- Condensation shall not originate conduction through the accumulated residues.

The medium voltage inverter MVW01 is supplied in form of a panel, whose dimensions are presented in Table 3.1 on page 3-3. According to the components mounted in each column and to their function, this complete panel results in in the inseparable union of three functions, rectifier, inverter and control.

The inverter power arms are supplied separately in their own packing.

Arm dimensions: 360 mm x 1040 mm x 680 mm (width x height x depth).

10.1.2 Handling Recommendations

The inverter package must be removed only at the installation site, where the panel will be operated.
Before hoisting or moving the panel, locate the hoisting eyes and fragile spots in the documentation that comes with the product. Follow the instructions that come with the panel.

10.1.3 Hoisting

Make sure that the lifting device used to hoist the panel and the arms is suitable for their weight and shape, refer to the Table 10.1 on page 10-2.

Table 10.1: Panel weight (approximately)

Frame Size	Weight (kg)
A0	900
A	1560
B	1700
C	2700
D	4500
E	5000
2 x D	2 x 4500
2 x E	2 x 5000

The inverter arms weigh approximately 140 kg (308.6 lb) each arms.

Observe the gravity center and ensure that the hoisting mechanism is adequate and safe. Use the configuration showed in the Figure 10.1 on page 10-3.

The cables or chains used for hoisting must be at a minimum angle of 45° regarding the horizontal plane.

Hoisting must be done in a slow and stable manner. Before starting make sure the entire pass is clear of obstacles. If any alteration or damage in the panel structure is noticed, then abort the hoisting and rearrange the cables or chains.

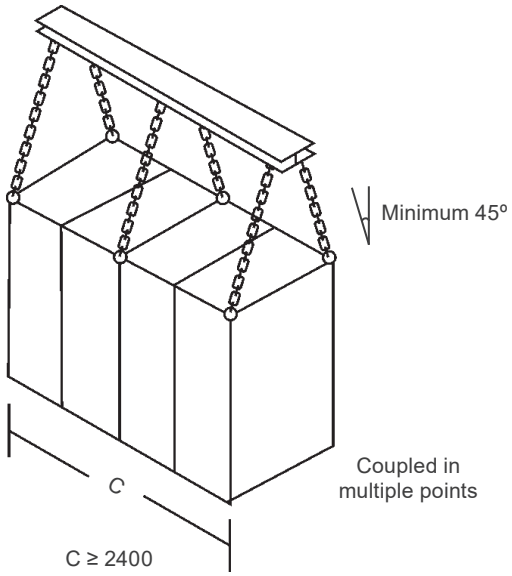


Figure 10.1: Recommended hoisting mechanism for the panel movement

10.1.4 Moving

When cranes or pulleys are used, make sure that the movements are slow and smooth, so that the panel and the arms do not suffer excessive swings and vibration.

When using movable hydraulic jacks, forklifts, rollers or other means, distribute the support points from one extreme through the other, avoiding pressure on fragile areas.

Make sure that all the panel doors be closed and locked, and that the door handles be in protected position.

10.1.5 Unpacking

Use proper tools to unpack the MVW01 panel and its arms. During this process, make sure that all the items listed in the documentation that comes with the product are present and in perfect conditions. Contact your local WEG representative in case of any irregularity.

Remove the arm packages carefully. The arms have hoisting eyes.

The inverter arms have fragile components (electronic boards, fiber optic connectors, busbars, wiring, etc.). Avoid touching these components! The arms must always be handled through their external metallic frame. While opening the package, inspect the arms for transportation damage. Do not install the arms if they are damaged or if you suspect of any damage.

Remove all packing material (plastic, wood, polystyrene foam, metal, nails, bolts, nuts, etc.) that might have remained inside the inverter panel or in the arms.

ATTENTION!
If any component presents problems (damages) it is recommended to:
- Stop the unpacking immediately.
- Contact the carrier and formally fill in a complaint with the problem found.
- Take pictures of the damaged parts.
- Contact your WEG representative or service.

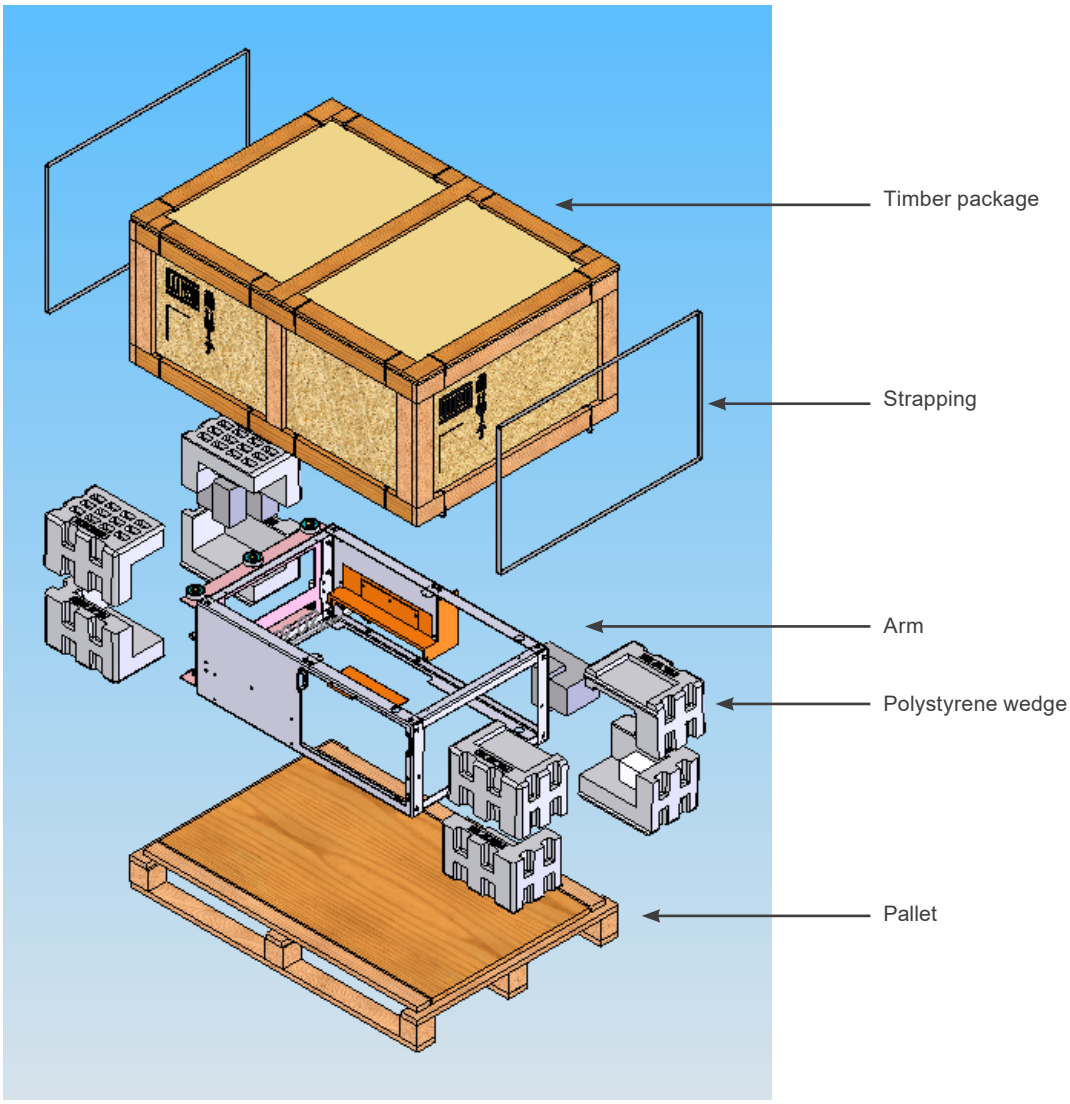


Figure 10.2: Standard power arm with package

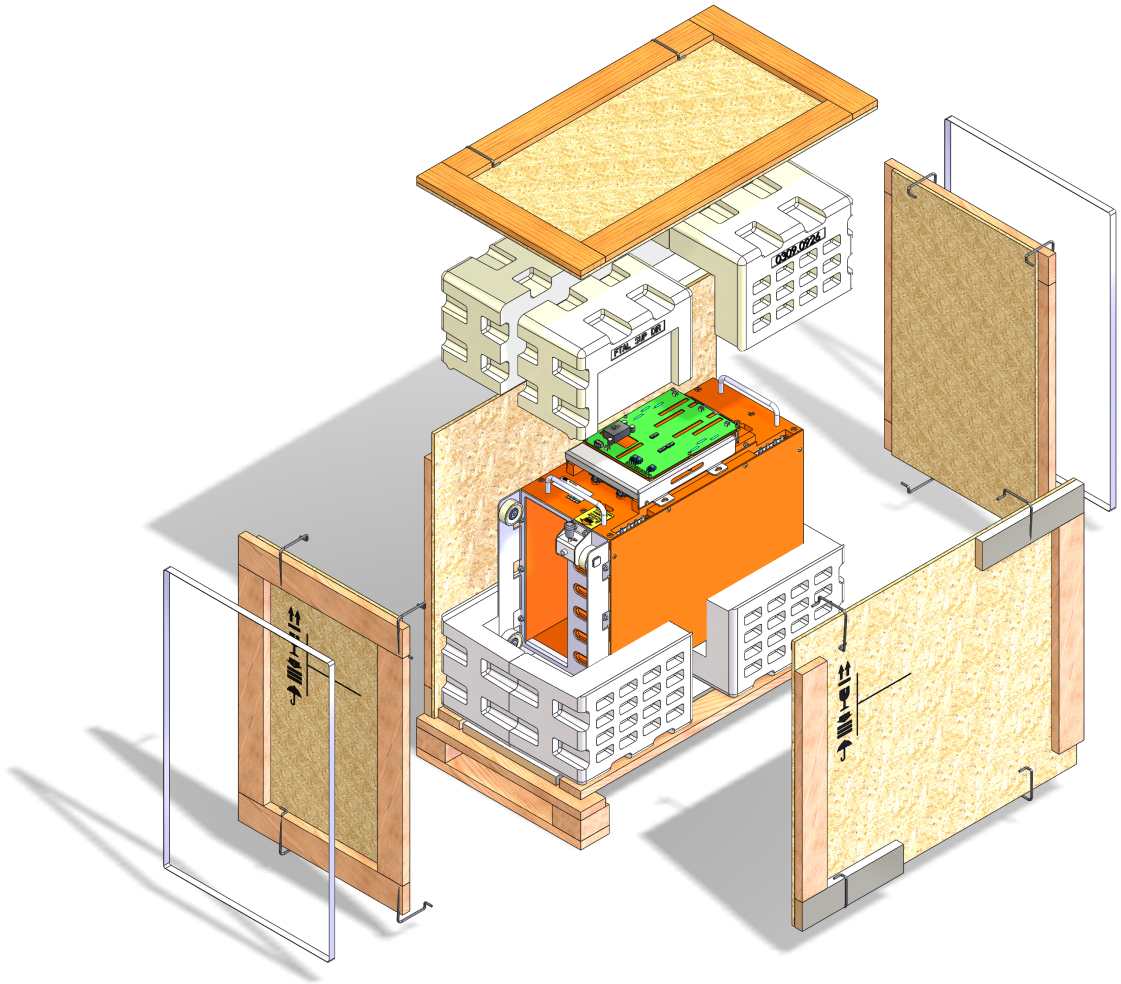


Figure 10.3: Compact power arm with package

10.1.6 Positioning/Mounting

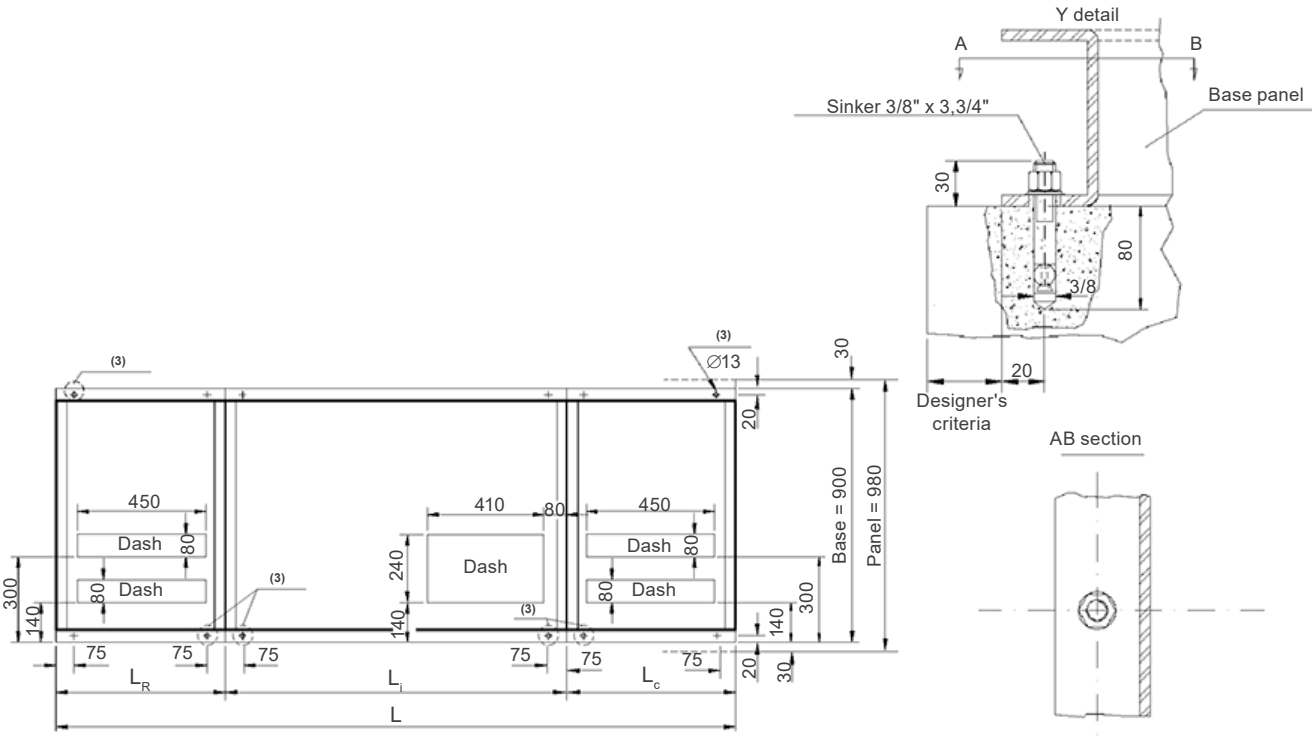
The MVW01 panel must be placed on a flat leveled surface, thus avoiding mechanical instability, door misalignment, among other problems.

ATTENTION!
Some MVW01 models are sectioned for transport purposes. The sectioned parts must be properly coupled during start-up.

The permanent operation position must allow heat radiation from all the surfaces and the necessary ventilation for its operation. The area in front of the panel must remain unobstructed, so that a total opening of the doors be possible, as well as the insertion and extraction of the arms and/or the power and control cables.

The Table 3.1 on page 3-3 shows the panel dimensions.

ATTENTION!
Make sure there is access for the electric connections: Input cables at the rectifier column and the output for the motor, main circuit breaker commands and status, transformer and motor protections, analog and digital inputs and outputs.
It is necessary to provide space behind the panel for rear access to internal components during the installation of the product.



(1) Standard TBG-269.
(2) Guiding instructions, consult specific project.
(3) Panel base ground fixation points.

Figure 10.4: Anchoring the MVW01 panel to the floor (mm)

NOTE!
Recommendations for anchoring the panel may vary for the several MVW01 models.
For more information refer to the specific project documentation.

10.1.7 Power Arm Insertion

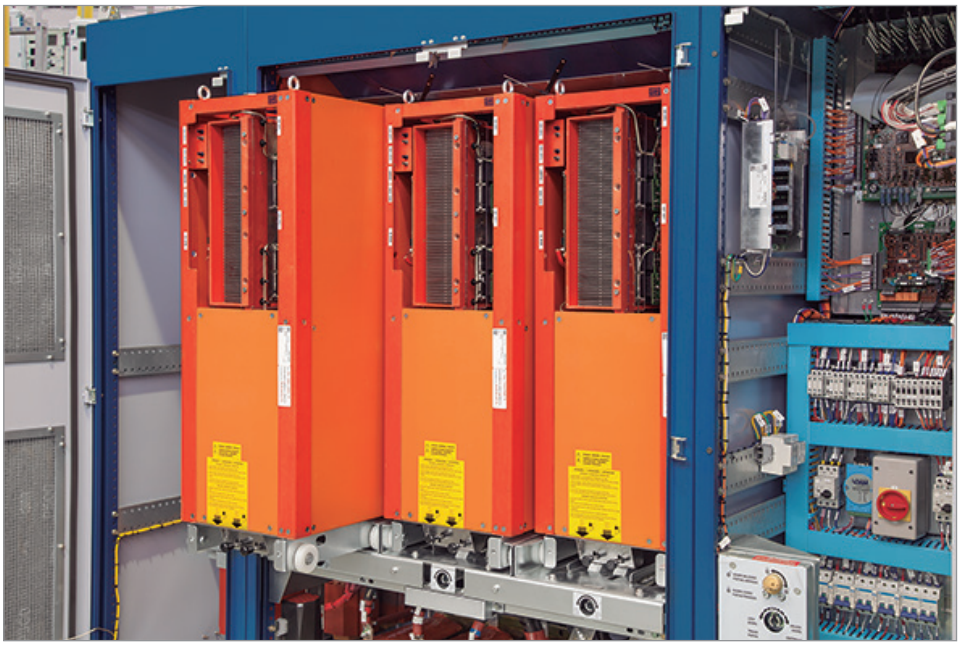


Figure 10.5: Power arm

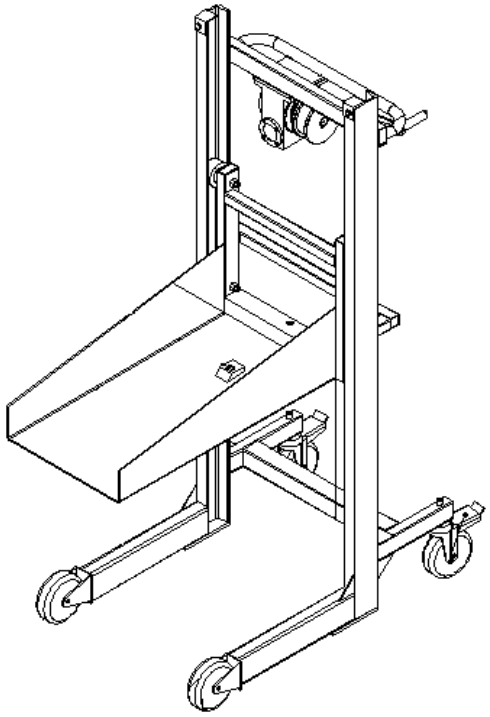


Figure 10.6: Power arm insertion/extraction/movement trolley

The power arm insertion must be performed with the help of the transport trolley (WEG part number 11136572), as shown in Figure 10.6 on page 10-7 and according to the following procedure.

NOTE!
During the power arm transport, they must have the locking mechanism active and be transported close to the floor (Figure 10.7 on page 10-8 - picture 1).

1. Rotate the crank handle until the trolley reaches the floor level.

2. Push the arm onto the trolley rails and activate the locking mechanism.

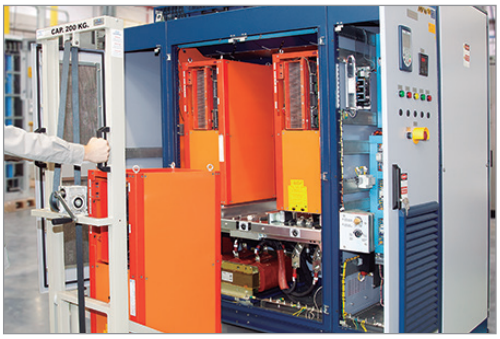
3. Move the transport trolley close to the panel, lifting the power arm to the required height and insert the trolley tabs at the position shown in (Figure 10.7 on page 10-8 - pictures 1, 2 and 3).

4. Lock the trolley wheels.

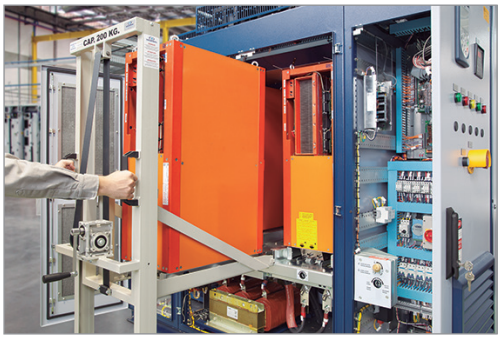
5. Release the lock that secures the arm to the trolley (Figure 10.7 on page 10-8 - picture 4) and push it observing the alignment of the wheels with the base in the panel.

6. The arm must be manually inserted until the locking system (locking pin) is activated (Figure 10.7 on page 10-8 - picture 5).

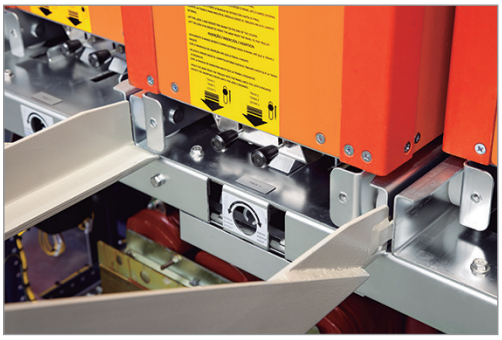
7. The final insertion stage is done using a crank handle, continuing the insertion to the point the second locking pin engages (Figure 10.7 on page 10-8 - pictures 5 and 6).



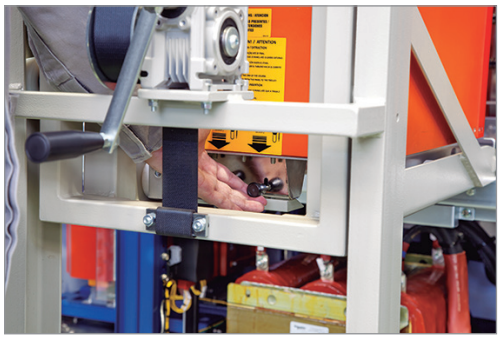
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2



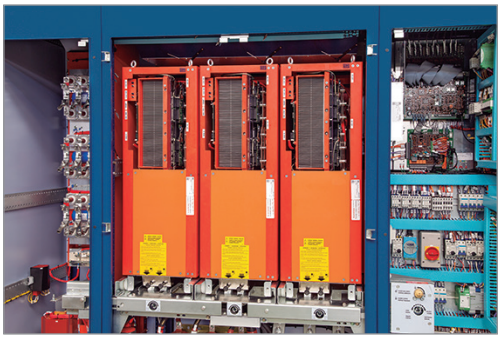
3



4



5



6

Figure 10.7: Details of the arm insertion stages

10.1.8 Power Arm Electric and Fiber Optic Connections

After inserting the power arms (U, V and W phases) connect the fiber optic cables and the supply cables according to the labels presented on the arms and on the cables.

The identifications of the cables are presented in the Table 10.2 on page 10-8 and Table 10.3 on page 10-9.

Table 10.2: Fiber optic cables identification

	Fiber Optic	Arm
1	GS1x-N1-FOI x	GS1
2	GS2x-N2-FOI x	GS2
3	GS3x-N3-FOI x	GS3
4	GS4x-N4-FOI x	GS4
5	VST1x-N5-FOI x	VST1
6	VST2x-N6-FOI x	VST2
7	VST3x-N7-FOI x	VST3
8	VST4x-N8-FOI x	VST4
9	TEMPx-N9-FOI x	TEMP
10	OSAx-N10-FOI x	OSA
11	OSBx-N11-FOI x	OSB

Table 10.3: Power arms supply cables identification

	Cable	Arm
1	BIX	XC1

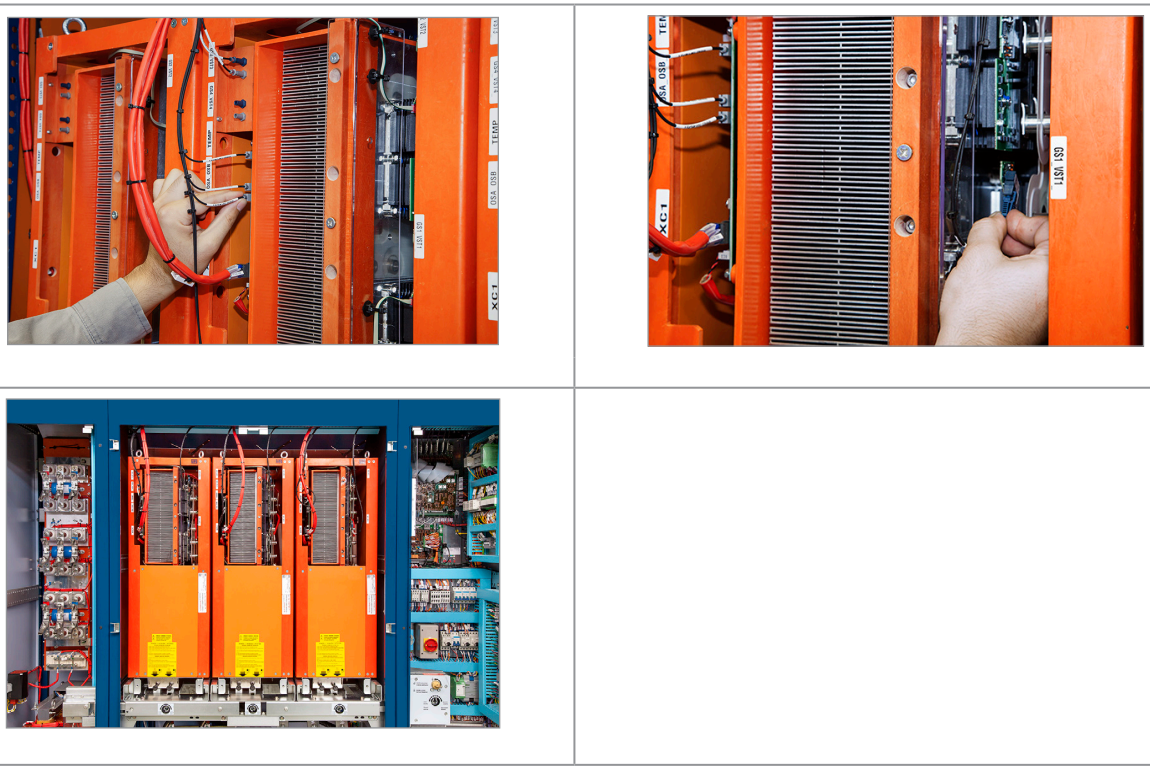


Figure 10.8: Details of the power arm supply and fiber optic cables installation stages

NOTE!
The fiber optic cables must be handled with caution, in order not to fold, bend, squeeze or cut them. Hold the cables only at their connectors when inserting or removing them, and never apply pressure or tensile force on the fiber.
In order to extract the power arms follow the procedures described in the previous sections in reverse order.

10.1.9 Insertion of the MVW01C Power Arms

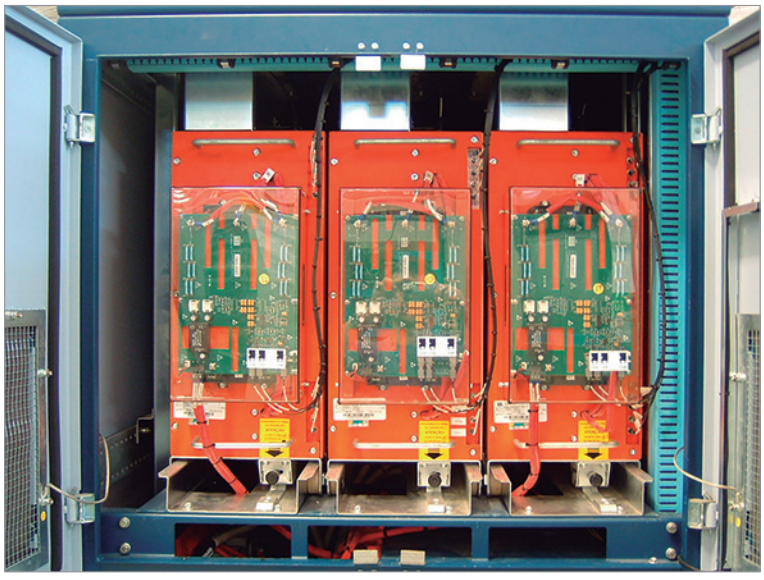
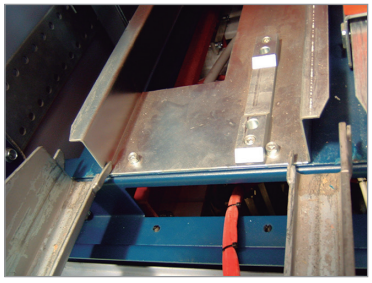


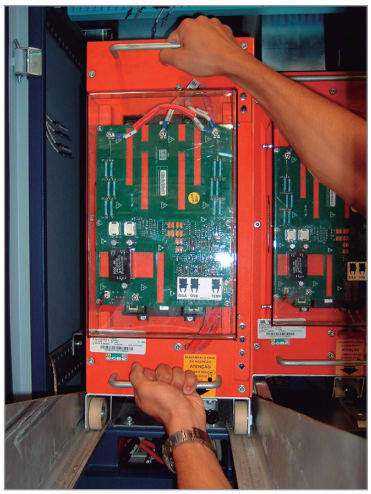
Figure 10.9: Power arms inserted in the MVW01C

The power arm insertion must be performed with the help of the transport trolley (WEG part number 11136572), and according to the following procedure.

NOTE!
During the power arm transport, they must have the locking mechanism engaged.

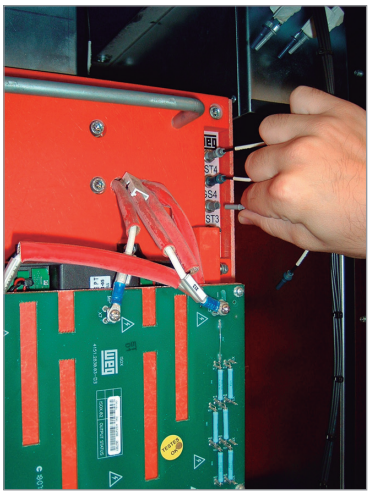
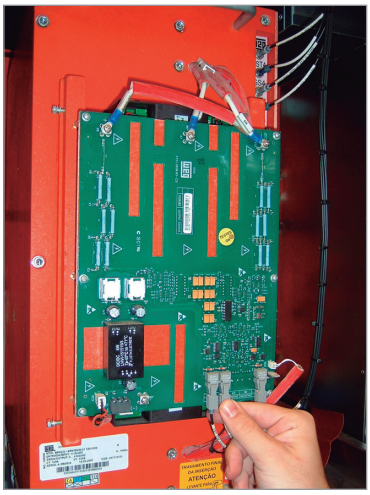
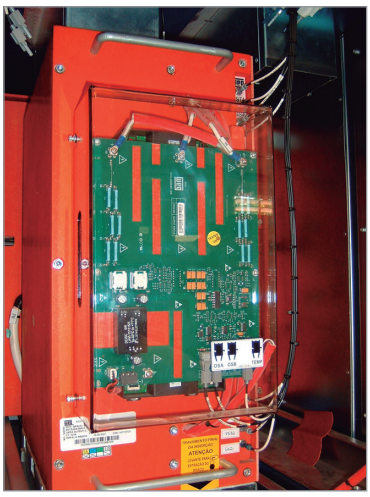
Table 10.4: Description of the power arm insertion procedure

	Picture	Insertion Procedure
1		1. Place the power arm on the transport trolley observing the proper locking with the locking pin 2. Lift the arm to the necessary height and bring the trolley close to the panel
2		3. Align the trolley guides with the inverter base according to the picture 2 4. Pay attention to the ISOX board supply cable, which cannot be on the insertion base in the panel at the moment of the arm insertion 5. Lock the trolley wheels
3		6. Release the lock that secures the arm to the trolley according to the picture 3

	Picture	Insertion Procedure
4		7. Holding on both power arm handles, push it observing the alignment of the wheels with the base in the panel
5		8. The arms must be inserted to the point that the locking pin engages. Observe the label about the insertion end, as shown in picture 5
6		9. The power arm insertion procedure is complete

NOTE!
In order to extract the power arms follow the procedures described in the previous sections in reverse order.

Table 10.5: Procedure for the installation of power supply and fiber optic cables on the power arms

	Picture	Connection Procedure
1		1. Connect the gate (GS1, GS2, GS3 and GS4) and status (VST1, VST2, VST3 and VST4) fiber optic cables according to the picture 1
2		2. In order to connect the ISOX fiber optic cables and the power supply cable, it is necessary to remove the protective acrylic cover 3. Connect the optic fibers OSA, OSB, and TEMP, and the power supply cable XC1, according to the picture 2
3		4. Reinstall the protective acrylic cover 5. The installation of the power supply cable and fiber optic cables is complete

10.2 ELECTRICAL INSTALLATION

10.2.1 Power Section

The power cables that connect the supply line to the main circuit breaker and the circuit breaker to the input transformer primary must be sized for the specified voltage and current. Refer to the cubicle (main circuit breaker) and transformer documentation, strictly following all the recommendations.

The power cables that connect the input, transformer secondary windings to the MVW01 rectifier column and those that connect the inverter column to the medium voltage motor (Figure 10.10 on page 10-14) must be specified for medium voltage application and sized for the nominal currents.

Table 10.6: Recommended power cables cross section (copper) [AWG]

	Power Cables [mm²]: U, V, W, VAS, VBS, VCS, VAD, VBD, VCD	Maximum Current [A]
Single Cable	10	71
	16	96
	25	126
	35	157
	50	189
	70	241
	95	292
	120	337
	150	384
	185	438
	240	514
Two Cables	2x50 (*)	302
	2x70 (*)	386
	2x95 (*)	467
	2x120 (*)	539
	2x150 (*)	614
	2x185 (*)	701
	2x240 (*)	822
Three Cables	3x95 (*)	613
	3x120 (*)	708
	3x150 (*)	806
	3x185 (*)	920
	3x240 (*)	1079
Four	4x120 (*)	876
	4x150 (*)	998
	4x185 (*)	1139
	4x240 (*)	1336
Five	5x185 (*)	1314
	5x240 (*)	1542

(*) It is recommended that the connection of parallel cables be made with auxiliary busbars.

Table 10.7: Recommended power cables cross section (copper)

Gauge of the Power Cables (S cross section) [mm²]	Minimun Gauge of the Grounding Cables (S cross section) (PE) [mm²]
S ≤ 16	S
16 < S ≤ 35	16
35 < S	S / 2

NOTE!
The cable cross sections/gauges presented in the Table 10.7 on page 10-13 are only orientative. In order to size the cables correctly the installation conditions, the applicable standards and regulations, and the maximum allowed voltage drop must be considered.

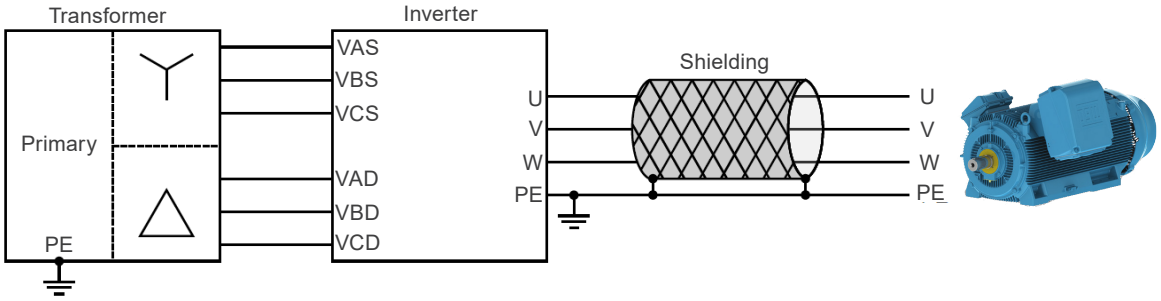


Figure 10.10: Power and ground connections for 12 pulses topology

NOTE!
If shielded cables are used between the transformer and the inverter, then connect the shield to the protective earth (PE) at both extremes of the cables.

- Minimum cable insulation voltage:

Table 10.8: Minimum insulation voltage of the power cables

Rated Voltage [V]	Minimum Insulation Voltage [V]
2300	3600 / 6000
3300	6000 / 10000
4160	6000 / 10000
6900	8700 / 15000

Commercial examples:

- Belden: 37540.
- Cofiban: Cofialt 7 kV (without shield).
- Pirelli: Eprotenax 6/10 kV.
- Ficap: Fibep or EPDry 6/10 kV.
- Use proper terminations for the power connections as well as for the shield connections to the ground bar. Tighten the connections with the appropriate torque.

Table 10.9: Power connections cable lugs and tightening torque

Identification	Column	Cable Lug	Torque [Nm] ±20 %
VAD	Rectifier	M10	30
VBD			
VCD			
VAS			
VBS			
VCS			
U	Inverter	M12	60
V			
W			
PE			
Shields	Rectifier and Inverter	M8	15

DANGER!

- It is mandatory to connect the inverter to a protection ground (PE). The grounding connection must follow the local regulations. Use at least conductors with the wire gauge indicated in the Table 10.7 on page 10-13. Connect the inverter to a specific grounding rod or to the general ground system (resistance ≤ 10 Ohms), the transformer frame ground for instance.
- Never connect the input transformer secondary windings to the ground.

10.2.2 Input Circuit Breaker

The MVW01 operates the input circuit breaker. This circuit breaker must have minimum voltage, closing and opening coils. The power supply for the circuit breaker circuits comes from the MVW01. The following signals, provided by the circuit breaker, are necessary for its operation: READY, ON, OFF and TRIP. These signals must be dry contacts (potential free).

The MVW01 also has inputs for the indications of input transformer alarm and fault.

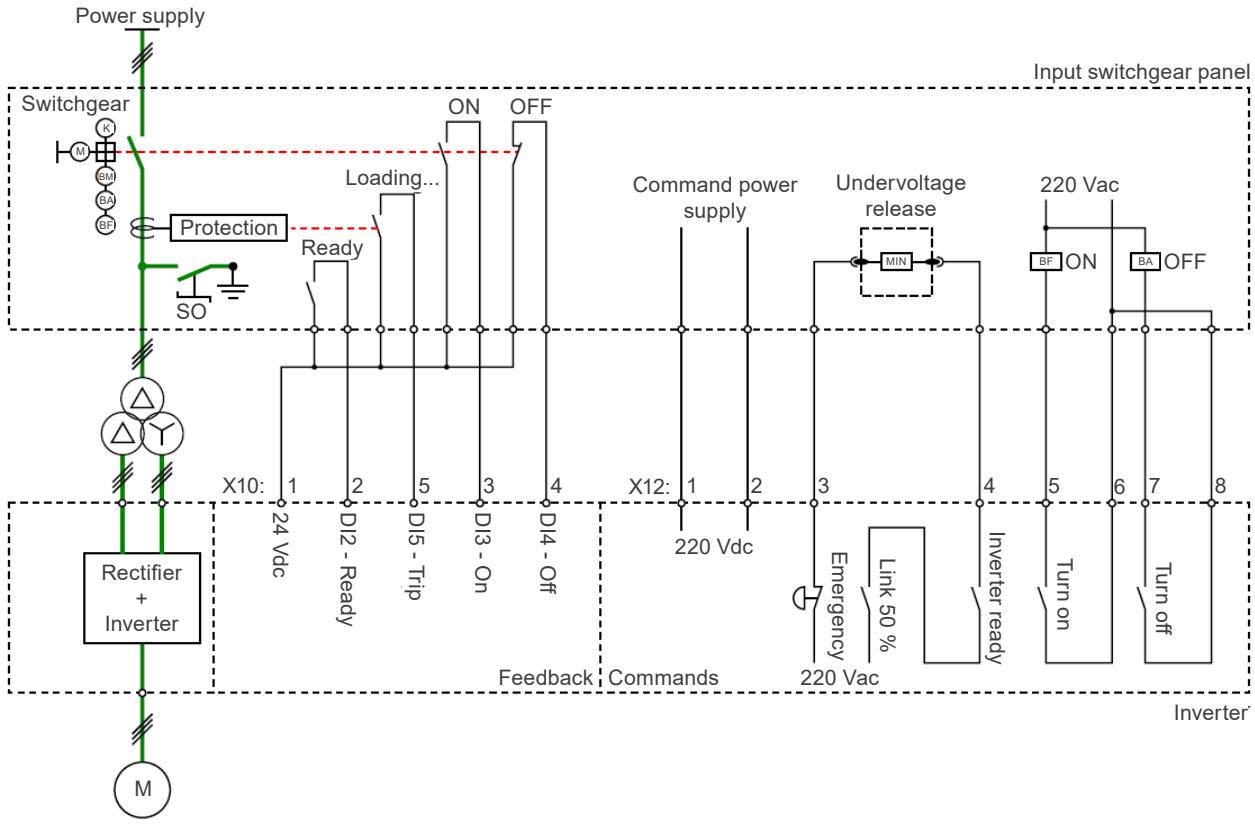


Figure 10.11: Connections between the input circuit breaker and the inverter

ATTENTION!

The input circuit breaker must only be closed by the inverter, otherwise the transformer and the inverter may be damaged.

DANGER!

Although the inverter commands the opening of the circuit breaker, there is no guarantee of its opening. In order to open the medium voltage cabinets for maintenance, follow all the procedures of safe de-energization (refer to the Item 10.3.5 Safe De-energization Instructions on page 10-19).

NOTE!
It is recommended that the MVW01 Kirk key is interlocked with the ring welded to the key of the input cubicle.

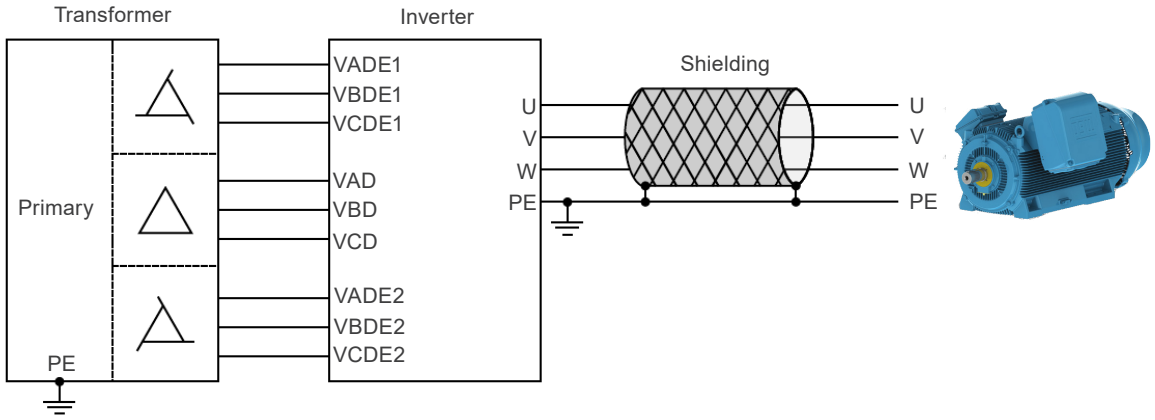


Figure 10.12: Power and ground connections for 18 pulses topology

NOTE!
If shielded cables are used between the transformer and the inverter, then connect the shield to the protective earth (PE) at both extremes of the cables.

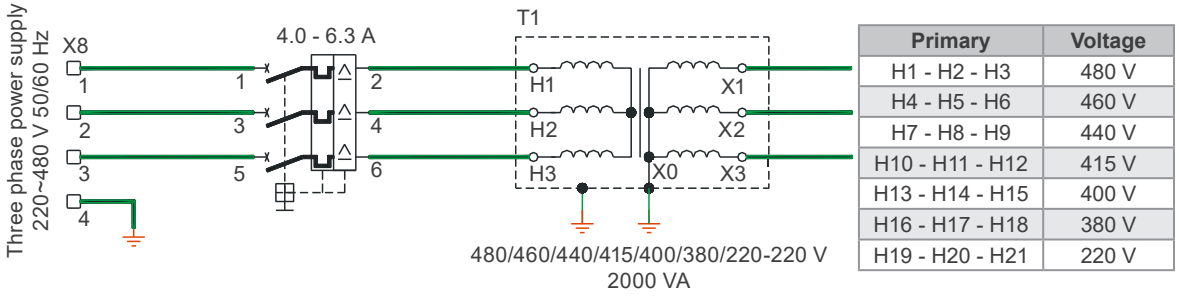
Table 10.10: Power connections cable lugs and tightening torque

Identification	Column	Cable Lug	Torque [Nm] ±20 %
VADE1, VBDE1 and VCDE1	Rectifier	M10	30
VAD, VBD and VCD			
VADE2, VBDE2 and VCDE2			
U		M12	60
V			
W			
PE			
Shields		M8	15

10.2.3 Low Voltage Auxiliary Supply

Control column power supply nominal voltage selection

An auxiliary voltage supply (220 V-480 V) should be available in the installation. This voltage must be wired to the terminal strip present in the control column. The command transformer (T1) taps must be selected according to the available auxiliary voltage. For more details, refer to the MVW01 electrical project.



Primary	Voltage
H1 - H2 - H3	480 V
H4 - H5 - H6	460 V
H7 - H8 - H9	440 V
H10 - H11 - H12	415 V
H13 - H14 - H15	400 V
H16 - H17 - H18	380 V
H19 - H20 - H21	220 V

Figure 10.13: Auxiliary power supply

10.3 ENERGIZATION, START-UP AND SAFE DE-ENERGIZATION

This chapter provides the following information:

- It is mandatory to connect the inverter to a protection ground (PE).
- How to check and prepare the inverter before powering-up.
- How to power-up and verify the energization success.
- How to operate the inverter when installed according to the standard project (refer to the Section 10.2 ELECTRICAL INSTALLATION on page 10-13 and the attached electric project).
- How to de-energize the inverter safely.

10.3.1 Pre-power Checks

The inverter must have already been installed according to the Chapter 10 INSTALLATION, CONNECTION AND ENERGIZATION on page 10-1. Even when the inverter electric project is different from the suggested one in the attachment, the following recommendations are applicable.



DANGER!
- Always disconnect all the power supplies before making any connections.
- Although the inverter commands the opening of the input circuit breaker, there is no guarantee of its opening and neither that no voltages are present.

In order to open the medium voltage cabinets, follow all the safe de-energization procedures.

1. Check if all the power, grounding and control connections are correct and tightened.

2. Clean the inverter internally, remove all packing material and installation residues from within the MVW01 cabinets.

3. Check all motor connections and verify whether its voltage, current and frequency match the inverter specifications.

4. If it is possible, decouple the motor mechanically from the load. If the motor cannot be decoupled, then make sure that rotation in any speed direction (Forward or reverse) is not hazardous to people or to the machine.

5. Close and lock the panel doors.

10.3.2 Initial Power-up (Parameter Settings)

After the pre-power checks the inverter can be powered up:

1. Verify the supply voltages.
   Verify whether the medium voltage line is available at the input cubicle.
   Measure the auxiliary low voltage power supply voltage that feeds the control column and make sure it is within the allowed limits of +10 %/-15 %).

2. Check the control column circuit breakers.
   Verify if the settings of the control circuit breakers are according to the electric project. Close the control column door.

3. Verify the emergency pushbutton.
   Make sure the emergency pushbutton is not actuated. In case it is actuated, use the safety key to unlock it.

4. Apply power to the control column.
   Close the control column auxiliary supply disconnector switch only after the power-up process be concluded.

5. Verify the first energization success.

The first time the panel is energized or when the factory settings are loaded with (P0204 = 5), the guided startup routine is initiated. This routine asks the user to program some parameters regarding the inverter and the motor.

10.3.3 Start-up

This section describes the inverter start-up with keypad operation. The considered control mode is V/F 60 Hz.

DANGER!
- High voltages may be present even after the power supply disconnection. The following sequence is valid for the standard MVW01 inverter.
- The inverter should have already been installed and programmed, according to Chapter 10 INSTALLATION, CONNECTION AND ENERGIZATION on page 10-1.

10.3.4 Start-up - HMI Operation - Control Mode: V/F 60 Hz

1. Apply power to the panel close the disconnector switch at the control column power supply input.

2. Once the control column has been energized, the MVC1 or MVC3 control board waits for its initialization, presenting the following message on the HMI: - After the control has finished its initialization (approximately 10 seconds), the message “Inverter in Undervoltage” is presented on the HMI.

   At this moment the inverter is in undervoltage state (DC Link is discharged) and the “Ready to Start” pilot light (H1) at the control column door is on, indicating that it is already possible to initiate the inverter pre-charge.

3. Initiate the pre-charge / power section energization.
   The MVW01 inverter pre-charge command must be given manually:

   - With the pilot light “READY TO START” on, press the “POWER-ON” pushbutton (S1).
   - Wait until the pre-charge is finished (approximately 10 seconds). During the pre-charge the “PRECHARGE” pilot light (H2) must remain on.
   - Once the pre-charge is successfully completed, the “PRE-CHARGE” pilot light goes off and the “INPUT ON” (H3) goes on, indicating that the input transformer circuit breaker was successfully closed.
   - The “Inverter Ready” message is displayed on the HMI.

NOTE!
The maximum number of pre-charge procedures that can be performed per hour must be established by the auxiliary transformer supplier.

ATTENTION!
If during the pre-charge any problem occurs, the inverter indicates an error related to it. The possible errors are:
- F0014 - Input circuit breaker closing failure.
- F0017 - Input circuit breaker not ready.
- F0020 - Pre-Charge Fault.

Refer to these error (alarm/fault) descriptions in the MVW01 Programming Manual.

NOTE!
The last speed reference value, set via the and keys and , is saved in the memory (P0120 = 1). If you want to change this value before enabling the inverter, change it through the parameter P0121 (HMI speed reference).

NOTES:

1. If the motor speed direction is inverted, switch off the inverter following the safe de-energization instructions and swap two of the motor cables.
   The HMI must indicate the same direction seen looking against the motor shaft end.

2. It the current is too high during the acceleration, especially at low speeds, it is necessary to reduce the acceleration ramp time (P0100 or P0102) or change P0136 Torque boost setting.
   Gradually increase and decrease the P0136 (Manual torque boost (I x R)) content until reaching an operation with approximately constant current throughout the entire speed range.
   Refer to the parameter description in the MVW01 Programming Manual.

3. If F0022 (DC Link Over Voltage) occurs during the deceleration, then increase its time via P0101 (Deceleration time) or P0103 (Deceleration time 2nd time) and check P0151 (DC Link voltage regulation level).

ATTENTION!
If the inverter receives a general enabling or a start command before the pre-charge has been finished (inverter still in undervoltage state), the command will be ignored and a warning message “Inverter Undervoltage” will be displayed on the HMI.

10.3.5 Safe De-energization Instructions

DANGER!
- Although the inverter commands the opening of the input circuit breaker, there is no guarantee of its opening and neither that no voltages are present, because the capacitors remain charged for a long time and they can also be charged through the auxiliary supply (pre-charge).
- In order to open the medium voltage cabinets, follow all the safe de-energization procedures described next.

1. Decelerate the motor to a complete stop.

2. Check the DC Link voltage at the parameter P0004 on the HMI.
   Open the control panel door and locate the neon lamps of the HVM (High Voltage Monitoring board), mounted on the cabinet left side (not available for all models).
   The four lamps must be on if the voltage showed via P0004 is above 200 V.

3. Press the “POWER OFF” pushbutton. The input transformer circuit breaker is switched off at this moment, and the “INPUT ON” pilot light going off indicates it.

ATTENTION!
If the input transformer circuit breaker does not open with the “POWER OFF” command, then open it manually.

4. Follow the DC Link voltage decrease through P0004 on the HMI and the HVM neon lamps.
   When the DC Link voltage crosses below 200 V the neon lamps start flashing with progressively lower frequency until going off completely.
   Wait until the DC Link voltage displayed at P0004 on the HMI gets below 25 V.

5. Press the emergency pushbutton located on the control column door and remove its key.

6. At the input transformer circuit breaker cubicle, extract the circuit breaker from its operation position and close the transformer primary winding grounding switch. Lock the cubicle with the key and/or put a warning sign “System in maintenance”.

7. Switch off the Q2 circuit breaker in the control column and lock it in the open position with a padlock and/or put a warning sign “System in maintenance”.

8. Switch off the Q1 circuit breaker in the control column. Remove the auxiliary power supply.

9. It is only after the sequence of procedures described here that medium voltage compartment doors can be opened.



DANGER!
If it were not possible to follow the discharge of the DC Link capacitors through the parameter P0004, as well as through the HVM board neon lamps, due to a malfunction or a previous de-energization, follow the instructions 5) through 8) and wait 10 minutes more.

11 OPTIONAL ACCESSORIES AND BOARDS

11.1 MVC4 SIGNAL AND CONTROL CONNECTIONS

The signal (analog inputs/outputs) and control (digital inputs/outputs and relay outputs) connections are made at the following terminal strips on the MVC4 control board (refer to the Figure 11.1 on page 11-1).
XC1A: digital signals.
XC1B: analog signals.
XC1C: relay outputs.

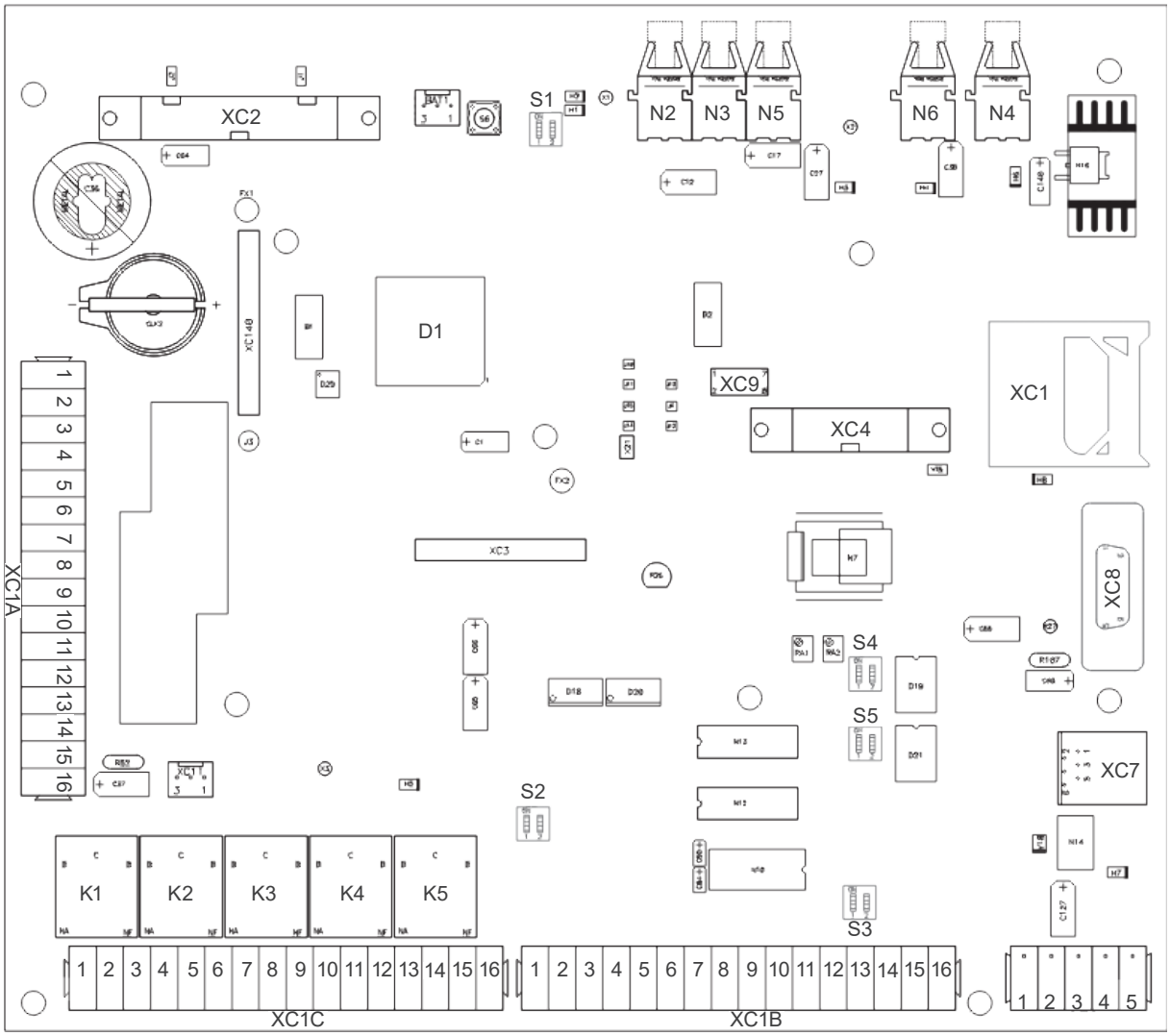


Figure 11.1: MVC4 - Customer connectors

11.1.1 Digital Inputs

Table 11.1: Description of the XC1A connector: digital inputs

Connector	Signal	Function (factory default)	Specification
1	24 Vdc	Power supply for digital inputs	24 Vdc ± 8 %, 90 mA
2	DI1	P0263 = Run/Stop	Isolated digital input
3	DI2	P0264 = FWD/REV	Isolated digital input
4	DI3	P0265 = Not used	Isolated digital input
5	DI4	P0266 = Not used	Isolated digital input
6	DI5	P0267 = JOG	Isolated digital input
7	DI6	P0268 = Ramp 2	Isolated digital input
8	24 Vdc	Power supply for digital inputs	24 Vdc ± 8 %, 90 mA
9	COM	Common point of the digital inputs	-
10	DGND*	0 V reference of the 24 Vdc power supply	Grounded
11	24 Vdc	Power supply for digital inputs	24 Vdc ± 8 %, 90 mA
12	DI9	P0271 = Not used	Isolated digital input
13	DI10	P0272 = Not used	Isolated digital input
14	24 Vdc	Power supply for digital inputs	24 Vdc ± 8 %, 90 mA
15	COM	Common point of the DI9 and DI10 digital inputs	-
16	DGND*	0 V reference of the 24 Vdc power supply	Grounded

Isolated digital inputs.
Minimum high level: 18 Vdc.
Maximum low level: 3 Vdc.
Maximum voltage: 30 Vdc.
Input current: 11 mA @ 24 Vdc.

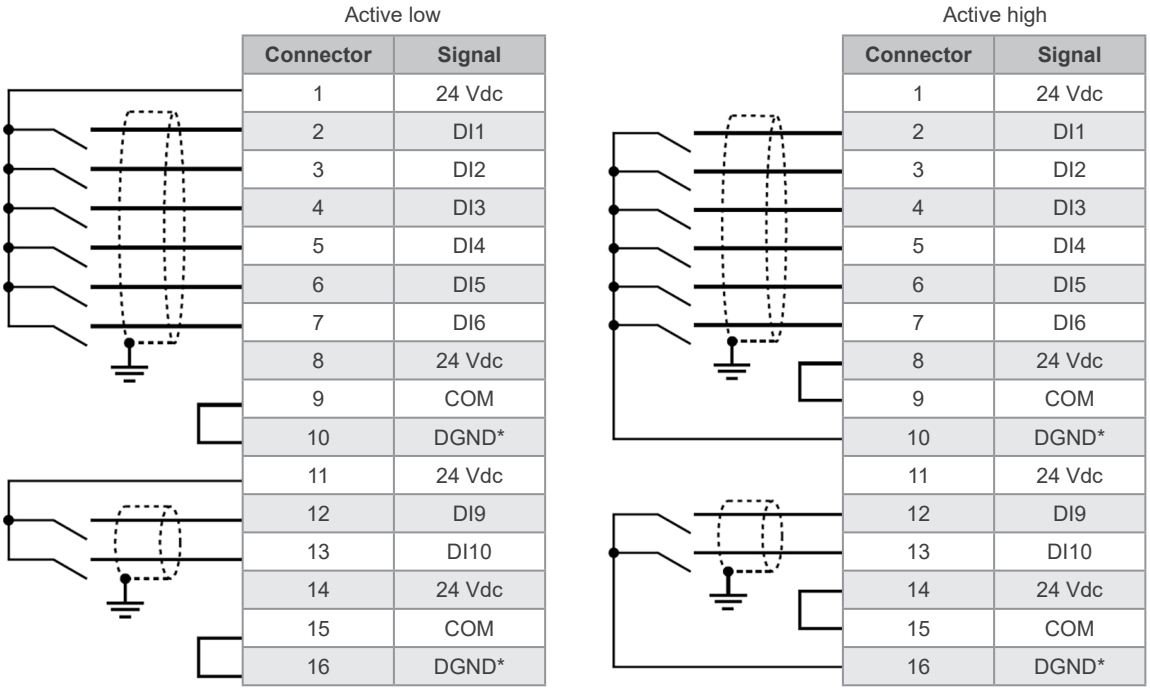
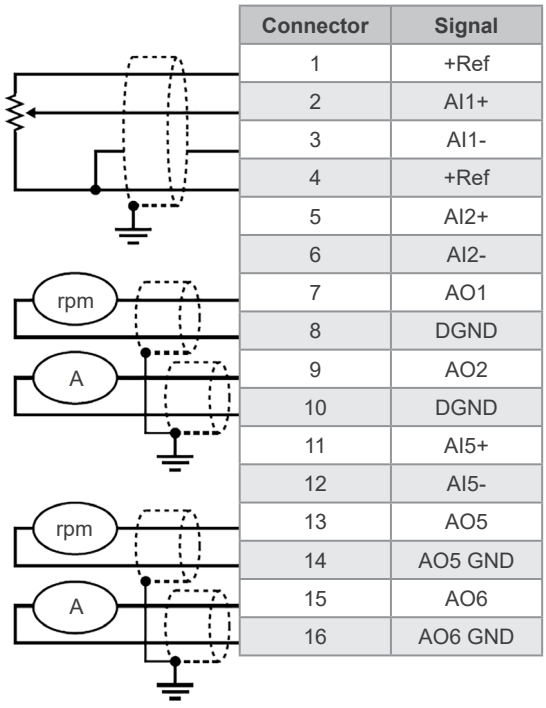


Figure 11.2: Description of the XC1A connector: digital inputs

11.1.2 Analog Inputs and Outputs

Table 11.2: Description of connector XC1B: analog inputs and outputs

Connector	Signal	Function (factory default)	Specification
1	+Ref	Positive reference for potentiometer	+ 5.4 V ± 5 %, 2 mA
2	AI1+	Speed reference (remote)	Resolution: 10 bits
3	AI1-		
4	-Ref	Negative reference for potentiometer	- 4.7 V ± 5 %, 2 mA
5	AI2+	P0237 = P0221/P0222	Resolution: 9 bits
6	AI2-		
7	AO1	P0251 = Real Speed	Resolution: 11 bits
8	DGND	0 V reference for analog output	Grounded
9	AO2	P0253 = Output Current	Resolution: 11 bits
10	DGND	0 V reference for analog output	Grounded
11	AI5+	P0721 = P0221/P0222	Resolution: 10 bits
12	AI5-		
13	AO5	P0259 = Real Speed	Resolution: 11 bits
14	AO5 GND	0 V reference for analog output 5	Grounded
15	AO6	P0261 = Output Current	Resolution: 11 bits
16	AO6 GND	0 V reference for analog output 6	Grounded



Connector	Signal
1	+Ref
2	AI1+
3	AI1-
4	+Ref
5	AI2+
6	AI2-
7	AO1
8	DGND
9	AO2
10	DGND
11	AI5+
12	AI5-
13	AO5
14	AO5 GND
15	AO6
16	AO6 GND

Figure 11.3: Description of connector XC1B: analog inputs and outputs

Table 11.3: Switch settings

Signal	Function (factory default)	Setting Element	Selection
AI1	Speed reference	S2.A	OFF - (0 to 10) V ON - (0 to 20) mA / (4 to 20) mA
AI2	P0237 = P0221/P0222	S2.B	OFF - (0 to 10) V ON - (0 to 20) mA / (4 to 20) mA
AI5	P0721 = P0221/P0222	S3.A	OFF - (0 to 10) V ON - (0 to 20) mA / (4 to 20) mA
AO5	P0259 = Real Speed	S4.A	OFF - (0 to 20) mA ON (4 to 20) mA
AO6	P0261 = Output Current	S5.A	OFF - (0 to 20) mA ON (4 to 20) mA

11.1.3 Relay Output

Table 11.4: XC1C terminal strip description: relay outputs

Connector	Relay		Function (factory default)	Specification
1	RL1	NO	P0277 = No Fault	240 Vca, 1 A
2		C		
3		NC		
4	RL2	NO	P0279 = N > Nx	240 Vca, 1 A
5		C		
6		NC		
7	RL3	NO	P0280 = N* > Nx	240 Vca, 1 A
8		C		
9		NC		
10	RL4	NO	P0281 = Not Used	240 Vca, 1 A
11		C		
12		NC		
13	RL5	NO	P0282 = Not Used	240 Vca, 1 A
14		C		
15		NC		
16	-	-	-	-

NC = normally closed contact.
NO = normally open contact.
C = common.

11.1.4 Wiring Installation

In the installation of signal and control wiring, the following care must be taken:

1. Cable gauges 0.5 mm² to 1.5 mm².

2. Maximum torque: 0.50 N.m (4.50 lbf.in).

3. Connections to XC1A, XC1B and XC1C must be made with shielded cable and separated from the other connections (power, control at 110/220 V, etc.). If those cables have to cross, such cross must be perpendicular, keeping a minimum separation distance of at least 5 cm at the crossing point;
   Screws located on the board and on the MVC4 board support plate, connect shield according to Figure 11.4 on page 11-4:

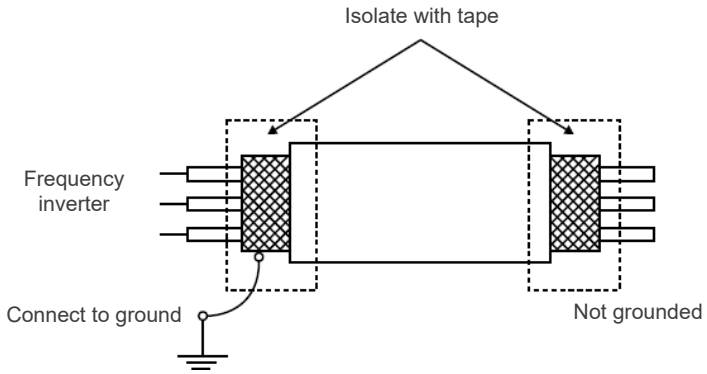


Figure 11.4: Shield connection

4. It is necessary to use galvanic isolators at the XC1B terminal strip signals for wiring distances longer than 50 m (150 ft).

5. Relays, contactors, solenoids or electromagnetic braking coils installed near inverters can generate interference in the control circuit; In order to eliminate this interference, connect RC suppressors in parallel with the coils of AC relays. Connect a free-wheeling diode in case of DC relays/coils.

6. When an external keypad (HMI) is used (for further information, refer to the programming manual available for download on **www.weg.net**), separate the cable that connects the keypad to the inverter from other cables of the installation, keeping a minimum distance of 10 cm (4 in) between them.

11.2 FUNCTION EXPANSION BOARDS

The function expansion boards increase the MVC4 control board functions. There are 3 expansion boards available and their selection depends on the application and the desired functions. The three boards cannot be used simultaneously. The difference between the EBA and EBB boards is in the analog inputs/outputs. The EBC1 board serves for the encoder connection; however, it does not have its own power supply as do the EBA/EBB boards. Next, the detailed description of those boards is presented.

11.2.1 EBA (Expansion Board A - I/O)

The EBA board can be supplied in different configurations, created from the combination of specific functions.

The available configurations are shown in the table below.

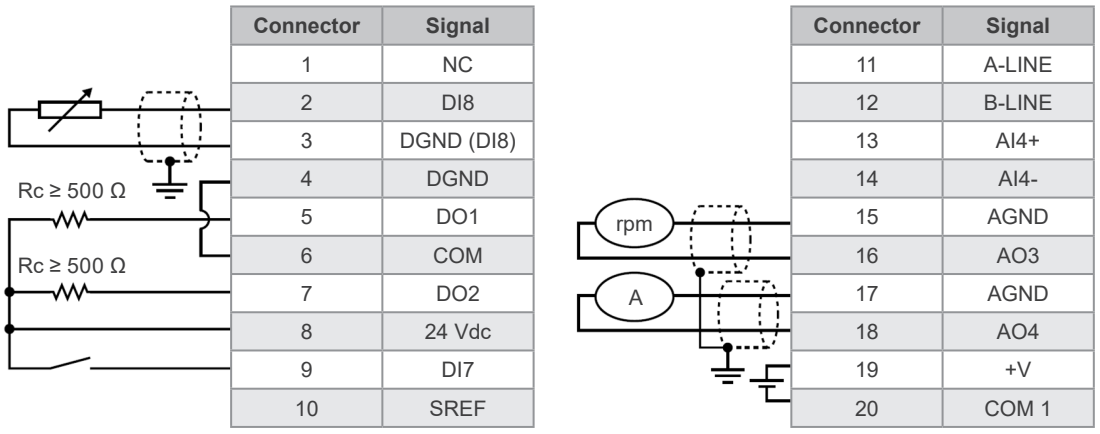
Table 11.5: EBA card versions and functions available

Functions	EBA.01-A1	EBA.02-A2	EBA.03-A3
Differential input for incremental encoder with 12 V / 200 mA, isolated internal power supply, feedback for speed regulator, digital speed measurement 14 bit resolution, (100 kHz maximum signal frequency)	Available	Not available	Not available
Buffered encoder output signals: isolated input signal repeater, differential output, available to external 5 V to 15 V power supply	Available	Not available	Not available
1 Differential analog input (AI4): 14 bits (0.006 % of the range [±10 V]), two-pole: -10 V to +10 V, (0 to 20) mA / (4 to 20) mA, programmable	Available	Not available	Available
2 Analog outputs (AO3/AO4): 14 bits (0.006 % of the range [±10 V]), two-pole: -10 V to +10 V, programmable	Available	Not available	Available
Isolated RS-485 serial port	Available	Available	Not available
Digital input (DI7): isolated, programmable, 24 V	Available	Available	Available
Digital input (DI8) with special function for motor thermistor (PTC): actuation 3.9 kΩ, release 1.6 kΩ	Available	Available	Available
2 isolated Open Collector transistor outputs (DO1/DO2): 24 V, 50 mA, programmable	Available	Available	Available

NOTE!
The use of the RS-485 serial interface does not allow the use of the standard RS-232 input of the MVC4 board. They cannot be used simultaneously.

Table 11.6: Description of the XC4 connector (full EBA board)

Connector	Signal	Function (factory default)	Specification
1	NC	-	-
2	DI8	Input 1 for the motor thermistor - PTC1 (See P0270)	Actuation: 3.9 kΩ Release:1.6 k Ω Minimum resistance: 100 Ω
3	DGND (DI8)	Input 2 for motor thermistor - PTC 2 (See P0270)	Referenced to DGND (DI8) through a 249 Ω resistor
4	DGND	0 V reference of the 24 Vdc power supply	Grounded via 249 Ω resistor
5	DO1	Transistor output 1: Not used	Isolated, open collector, 24 Vdc, max: 50 mA, required load (Rc) 500 Ω
6	COM	Common point DI7 digital input and DO1 and DO2 digital outputs	-
7	DO2	Transistor output 2: Not used	Isolated, open collector, 24 Vdc, max: 50 mA, required load (Rc) 500 Ω
8	24 Vdc	Power supply for digital inputs/outputs	24 Vdc ± 8 % Isolated, Capacity: 90 mA
9	DI7	Isolated digital input: Not used	Minimum high level: 18 Vdc Maximum low level: 3 Vdc Maximum voltage: 30 Vdc Input current: 11 mA @ 24 Vdc
10	SREF	Reference for RS-485	Isolated RS-485 serial
11	A-LINE	RS-485 A-LINE	
12	B-LINE	RS-485 B-LINE	
13	AI4 +	Analog input 4: Speed reference	Programmable differential (see P0243) Resolution: 14 bits (0.006 % of full scale) Impedance: 40 kΩ (-10 to +10) V 500 Ω [(0 to 20) mA/(4 to 20) mA]
14	AI4 -		
15	AGND	0 V reference for analog output (internally grounded)	Resolution: 14 bits (0.006 % of full scale) Required load (Rc) 2 kΩ
16	AO3	Analog output 3: Speed	
17	AGND	0 V reference for analog output (internally grounded)	
18	AO4	Analog output 4: Motor current	
19	+V	External power supply for encoder repeater output (XC8)	External power supply: 5 to 15 V Consumption: 100 mA @ 5 V, excluding the outputs
20	COM 1		



Connector	Signal
1	NC
2	DI8
3	DGND (DI8)
4	DGND
5	DO1
6	COM
7	DO2
8	24 Vdc
9	DI7
10	SREF

Connector	Signal
11	A-LINE
12	B-LINE
13	AI4+
14	AI4-
15	AGND
16	AO3
17	AGND
18	AO4
19	+V
20	COM 1

Figure 11.5: Description of the XC4 connector (full EBA board)

ENCODER CONNECTION: Refer to Section 11.3 INCREMENTAL ENCODER on page 11-14.

Installation

The EBA board is installed directly on the MVC4 control board, secured with spacers and connected via terminal blocks XC11 (24 V) and XC3.

Mounting instructions:

1. De-energize the control rack.

2. Configure the board via S2 and S3 DIP switches (refer to the Table 11.7 on page 11-8).

3. Carefully insert XC3 connector (EBA) into the female connector XC3 on the MVC4 control board. Make sure that all pins fit in the XC3 connector.

4. Press on the EBA board (near to XC3) and on the left top edge until the complete insertion of the connector and the plastic spacer.

5. Secure the board to the 2 metallic spacers with the 2 provided bolts.

6. Plug the XC11 connector of the EBA board to the XC11 connector on the MVC4 control board.

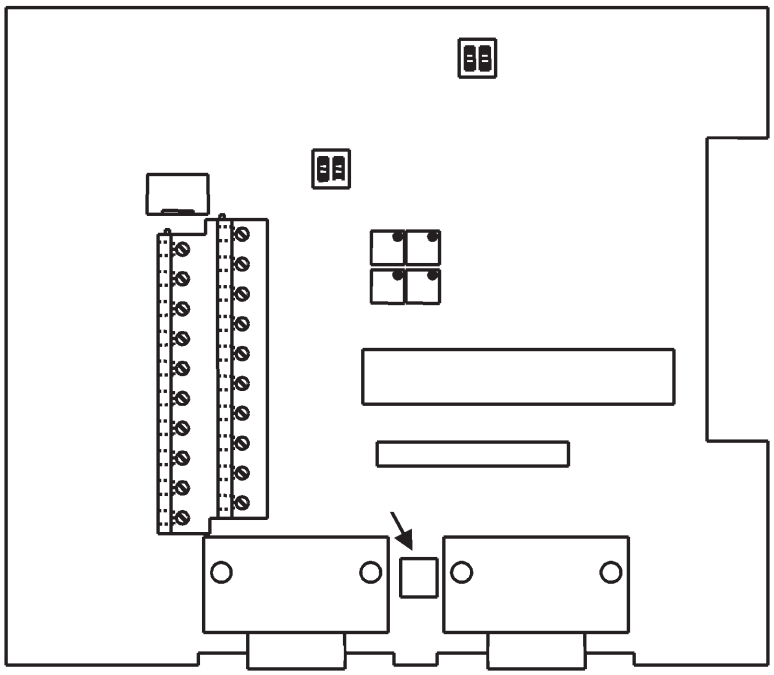


Figure 11.6: Position of the adjustment elements - EBA board

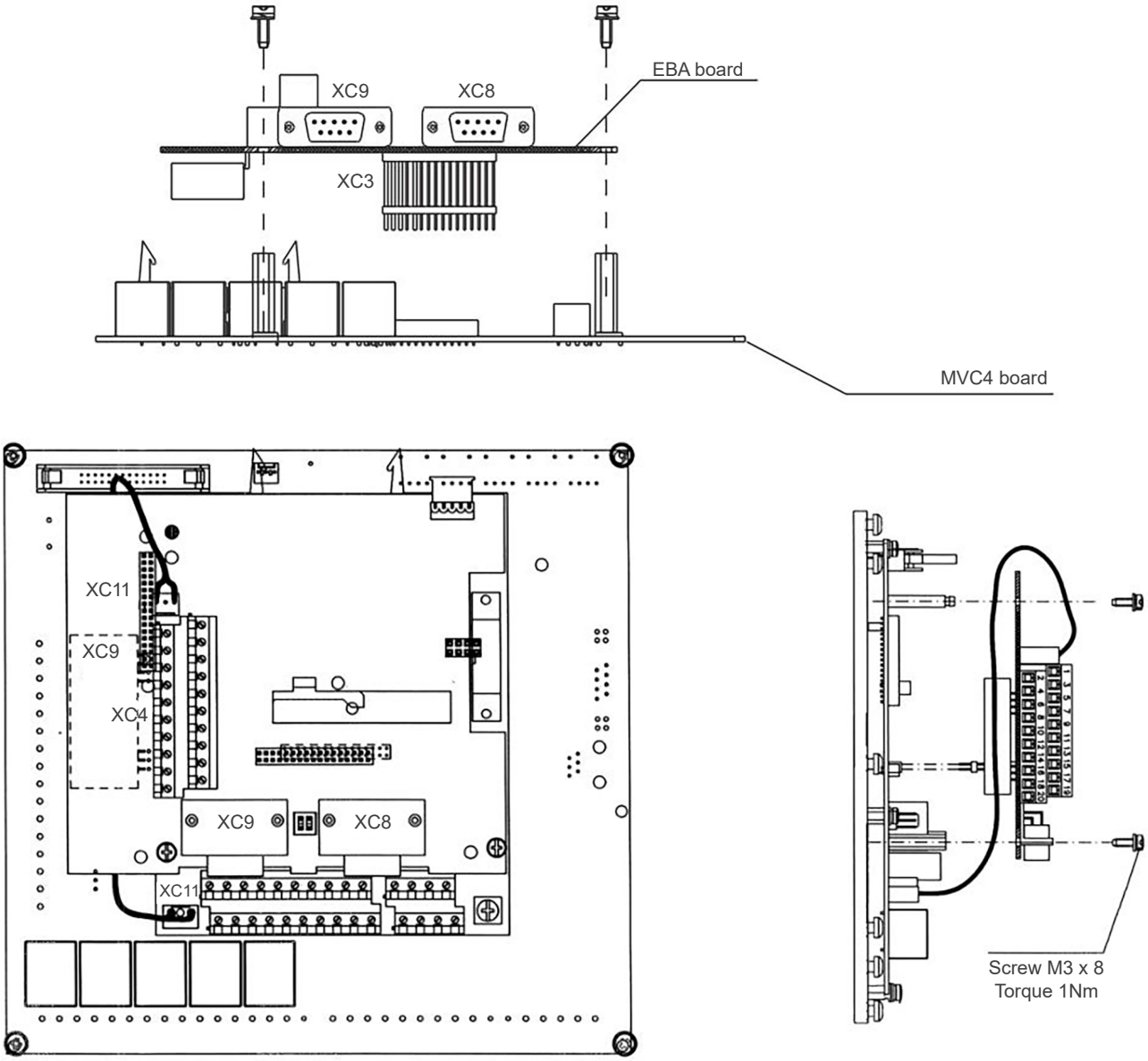


Figure 11.7: EBA board installation procedure

Table 11.7: EBA board configuration of setting elements

Switch	Signal – Factory Default	OFF (Factory Default)	ON
S2.1	AI4 - Speed reference	(0 to 10) V	(0 to 20) mA or (4 to 20) mA
S3.1	RS-485 B - LINE (+)	Without termination	With termination (120 Ω)
S3.2	RS-485 A - LINE (-)	Without termination	With termination (120 Ω)

Table 11.8: Trimpot settings - EBA card

Trimpot	Function	OFF (Factory Default)
RA1	AO3 - Offset	P0255 = Real Speed
RA2	AO3 - Gain	
RA3	AO4 - Offset	P0257 = Output Current
RA4	AO4 - Gain	

NOTE!
The external signal and control wiring must be connected to XC4 (EBA), following the same recommendations as for the wiring of the MVC4 control board (refer to the Section 11.1 MVC4 SIGNAL AND CONTROL CONNECTIONS on page 11-1).

11.2.2 EBB (Expansion Board B - I/O)

The EBB board can be supplied in different configurations, created from the combination of specific functions.

The available functions are presented in the Table 11.9 on page 11-9.

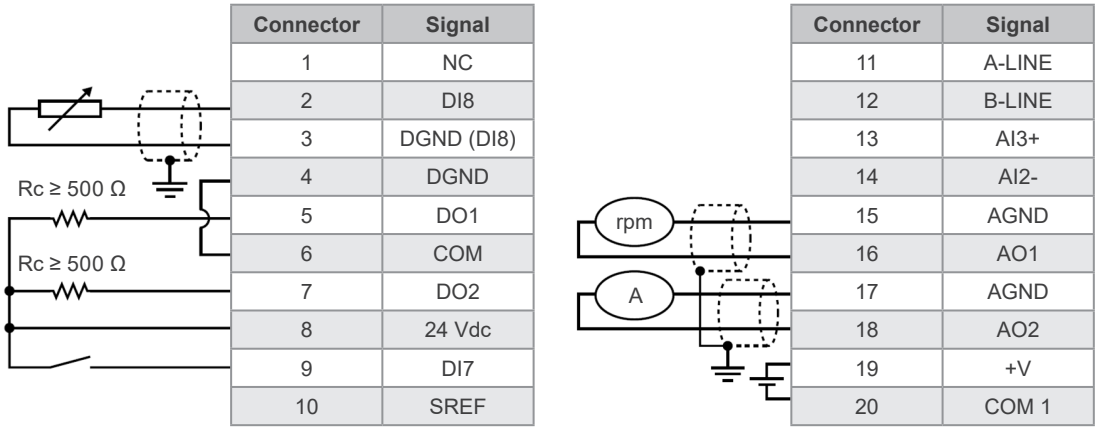
Table 11.9: EBB board versions and available features

Functions	EBB.01-B1	EBB.02-B2	EBB.03-B3	EBB.04-B4*	EBB.05-B5
Differential input for incremental encoder with 12 V / 200 mA, isolated internal power supply, feedback for speed regulator, digital speed measurement, 14 bits, resolution (100 kHz maximum signal frequency)	Available	Available	Not available	Available	Not available
Buffered encoder output signals: isolated input signal repeater, differential output, available to external 5 V to 15 V power supply	Available	Not available	Not available	Available	Not available
Analog differential input (AI3): 10 bits (0 to 10) V, (0 to 20) mA / (4 to 20) mA, programmable	Available	Not available	Available	Available	Not available
2 Analog outputs (AO1'/AO2'): 11 bits (0.05 % of the full scale range), (0 to 20) mA / (4 to 20) mA, programmable	Available	Not available	Available	Available	Available
Isolated RS-485 serial port	Available	Not available	Not available	Available	Not available
Digital input (DI7): isolated, programmable, 24 V	Available	Available	Available	Available	Not available
Digital input (DI8) with special function for motor thermistor (PTC): actuation 3.9 kΩ, release 1.6 kΩ	Available	Available	Available	Available	Not available
2 isolated Open Collector transistor outputs (DO1/DO2): 24 V, 50 mA, programmable	Available	Available	Available	Available	Not available

NOTE!
The use of the RS-485 serial interface does not allow the use of the standard RS-232 input of the MVC4 board. They cannot be used simultaneously.
AO1'/AO2' analog outputs are the same AO1/AO2 outputs on the MVC4 control board.

Table 11.10: Description of the XC5 connector (full EBB board)

Connector	Signal	Function (factory default)	Specification
1	NC	-	-
2	DI8	Input 1 for the motor thermistor - PTC1 (See P0270)	Actuation: 3.9 kΩ Release:1.6 kΩ Minimum resistance: 100 Ω
3	DGND (DI8)	Input 2 for motor thermistor - PTC 2 (See P0270)	Referenced to DGND (DI8) through a 249 Ω resistor
4	DGND	0 V reference of the 24 Vdc power supply	Grounded via 249 Ω resistor
5	DO1	Transistor output 1: Not used	Isolated, open collector, 24 Vdc, max: 50 mA, required load (Rc) 500 Ω
6	COM	Common point DI7 digital input and DO1 and DO2 digital outputs	-
7	DO2	Transistor output 2: Not used	Isolated, open collector, 24 Vdc, max: 50 mA, required load (Rc) 500 Ω
8	24 Vdc	Power supply for digital inputs/outputs	24 Vdc ± 8 % Isolated, Capacity: 90 mA
9	DI7	Isolated digital input: Not used	Minimum high level: 18 Vdc Maximum low level: 3 Vdc Maximum voltage: 30 Vdc Input current: 11 mA @ 24 Vdc
10	SREF	Reference for RS-485	Isolated RS-485 serial
11	A-LINE	RS-485 A-LINE	
12	B-LINE	RS-485 B-LINE	
13	AI3 +	Analog Input 3: Speed reference	Programmable differential (see P0243) Resolution: 10 bits (0.1 % of full scale) Impedance: 400 kΩ (0 to 10) V 500 Ω [(0 to 20) mA / (4 to 20) mA]
14	AI3 -		
15	AGND	0 V reference for analog output (internally grounded)	Resolution: 11 bits (0.5 % of full scale) Required load 600 Ω
16	AO1	Analog output 1: Speed	
17	AGND	0 V reference for analog output (internally grounded)	
18	AO2	Analog output 2: Motor current	
19	+V	External power supply for encoder repeater output (XC8)	External power supply: 5 to 15 V Consumption: 100 mA @ 5 V, excluding the outputs
20	COM 1		



Connector	Signal
1	NC
2	DI8
3	DGND (DI8)
4	DGND
5	DO1
6	COM
7	DO2
8	24 Vdc
9	DI7
10	SREF

Connector	Signal
11	A-LINE
12	B-LINE
13	AI3+
14	AI2-
15	AGND
16	AO1
17	AGND
18	AO2
19	+V
20	COM 1

Figure 11.8: Description of the XC5 connector (full EBB board)

ATTENTION!
The analog input AI3 and the analog outputs AO1' and AO2' isolation has the purpose of interrupting ground loops. Do not connect them to high potentials.

ENCODER CONNECTION: refer to Section 11.3 INCREMENTAL ENCODER on page 11-14.

Installation

The EBB board is installed directly on the MVC4 control board, secured with spacers and connected via terminal blocks XC11 (24 V) and XC3. Mounting instructions:

1. De-energize the control rack.

2. Configure the board as desired (switches S4, S5, S6 and S7, referring to Table 11.7 on page 11-8).

3. Carefully insert the XC3 pin bar connector (EBB) into the XC3 female connector on the MVC4 control board. Check the exact match of all the pins of the XC3 connector.

4. Press on the EBA board (near to XC3) and on the left top edge until the complete insertion of the connector and the plastic spacer.

5. Secure the board to the 2 metallic spacers with the 2 provided bolts.

6. Fit the XC11 connector on the EBB board to the XC11 connector on the control board (MVC4).

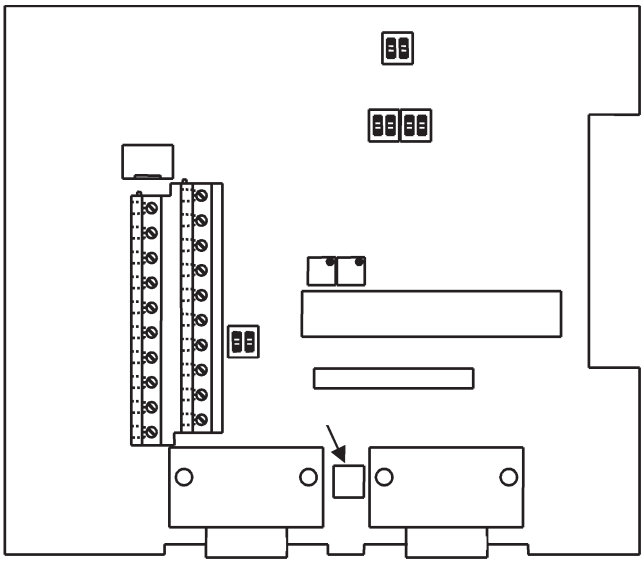


Figure 11.9: Position of the adjustment elements - EBB board

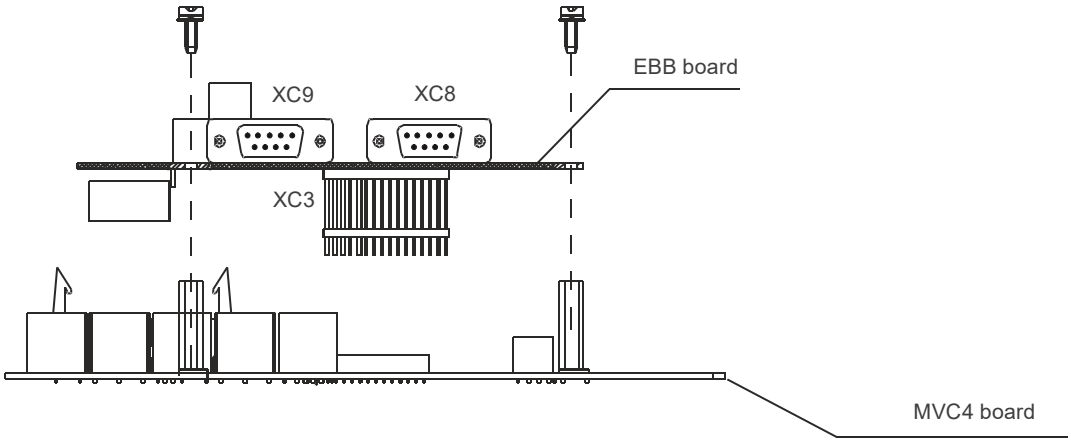


Figure 11.10: Procedure to install the EBB board

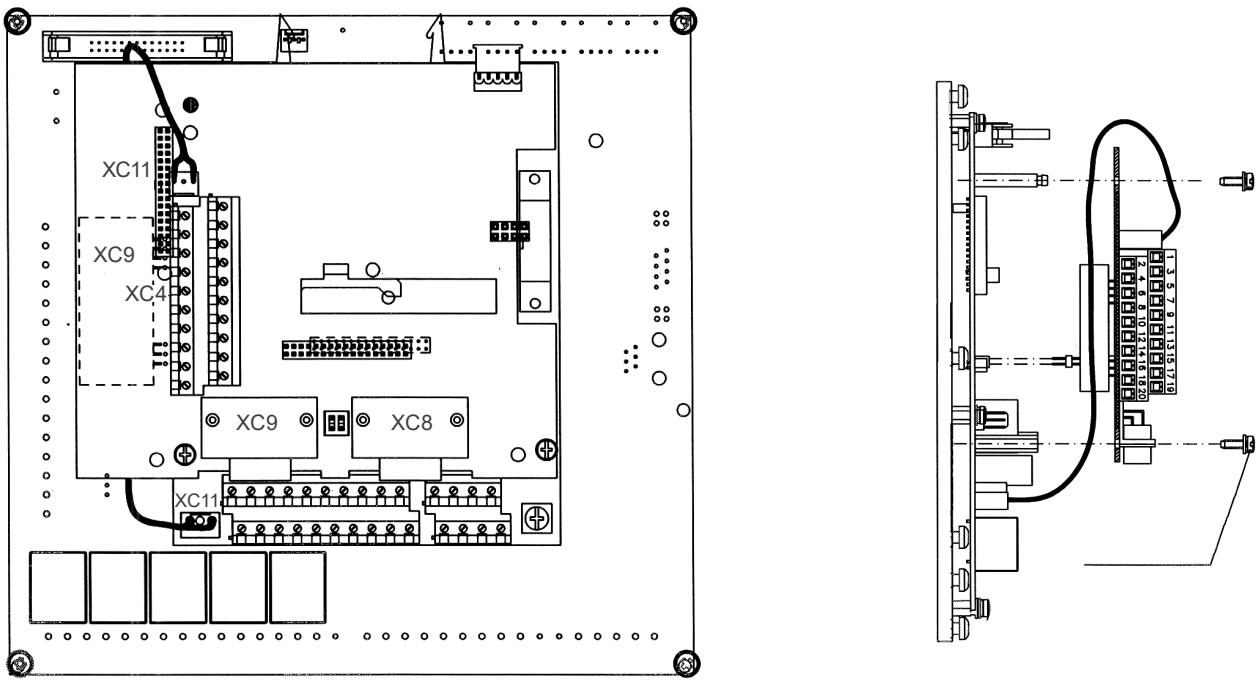


Figure 11.11: Procedure to install the EBB board

Table 11.11: Configurations of the setting elements - EBB board

Setting	Function (factory default)	OFF	ON
S4.1	AI3 - P0241 = P0221/P0222	(0 to 10) V	(0 to 20) mA or (4 to 20) mA
S5.1 and S5.2	AO1 - P0251 = Real Speed	(0 to 20) mA	(4 to 20) mA
S6.1 and S6.2	AO2 - P0253 = Output Cur		
S7.1 and S7.2	RS-485 B - LINE (+)	Without termination	With 120 Ω termination
	RS-485 A - LINE (-)		

Table 11.12: Configurations of the setting elements - EBB board

Trimpot	Function	Function (factory default)
RA5	AO1 - full scale	P0251 = Real Speed
RA6	AO2 - full scale	P0253 = Output Cur

NOTE!
The external signal and control connection must be fitted to XC5 (EBB) observing the same recommendations as those for the connection of the MVC4 control board (see Section 11.1 MVC4 SIGNAL AND CONTROL CONNECTIONS on page 11-1).

11.2.3 PLC2

NOTE!
For further information, see the specific manual for the PLC2 board.

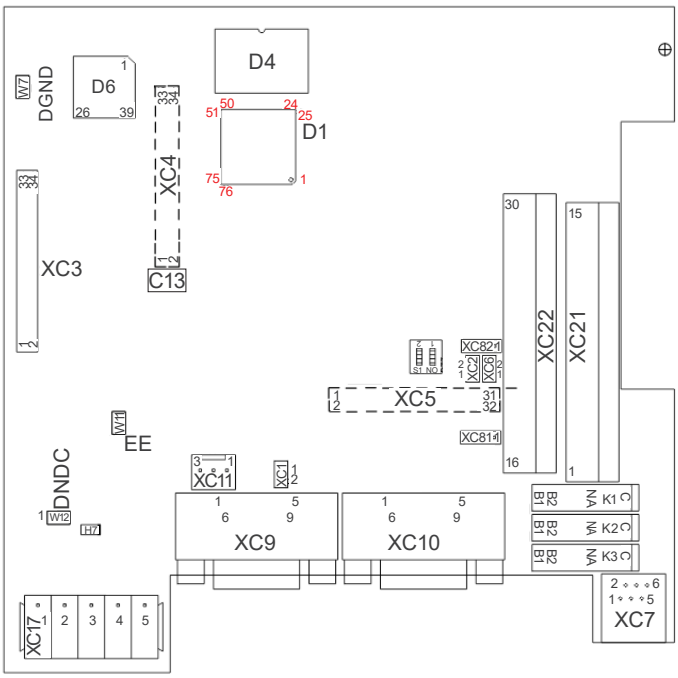


Figure 11.12: PLC2 board connectors

The connectors on the board and the function of their terminals are described below.

XC21 connector: Relay Outputs and Digital Inputs

Table 11.13: Description of the XC21 connector

Connector	Function		Description	Specification
1	C	DO1	Digital relay outputs	Contact capacity: 3 A 250 Vac
2	NO			
3	C	DO2		
4	NO			
5	C	DO3		
6	NA			
7	COM DO		Common of the DO4...DO6 digital outputs	-
8	DO4		Bidirectional opto-isolated digital outputs	48 Vdc, 500 mA
9	DO5			
10	DO6			
11	COM DI		Common of the DI1...DI9 inputs	-
12	DI9		Bidirectional isolated digital inputs	15-30 Vdc, 11 mA @ 24 Vdc
13	DI8			
14	DI7			
15	DI6			

Table 11.14: Description of the XC22 connector

Connector	Function		Description	Specifications
16	PTC1		Motor thermistor input	Actuation: 3900 Ω, Release: 1600 K Minimum Resistance: 100 Ω
17	PTC2		PTC	
18	GND ENC		Power supply reference for the encoder inputs	-
19	+ ENC		Power supply for the encoder inputs	5 Vdc regulator or (8 to 24) Vdc, 50 mA (**)
20	-	AO2	Analog output 2, 12 bits	(-10 to +10) Vdc or (0 to 20) mA
21	+			
22	-	AO1	Analog output 1, 12 bits	
23	+			
24	-	AI1	Differential analog input 1, 12 bits	
25	+			
26	DI1		Bidirectional isolated digital inputs	15-30 Vdc, 11 mA @ 24 Vdc
27	DI2			
28	DI3			
29	DI4			
30	DI5			

NO = normally open contact.
C = common.

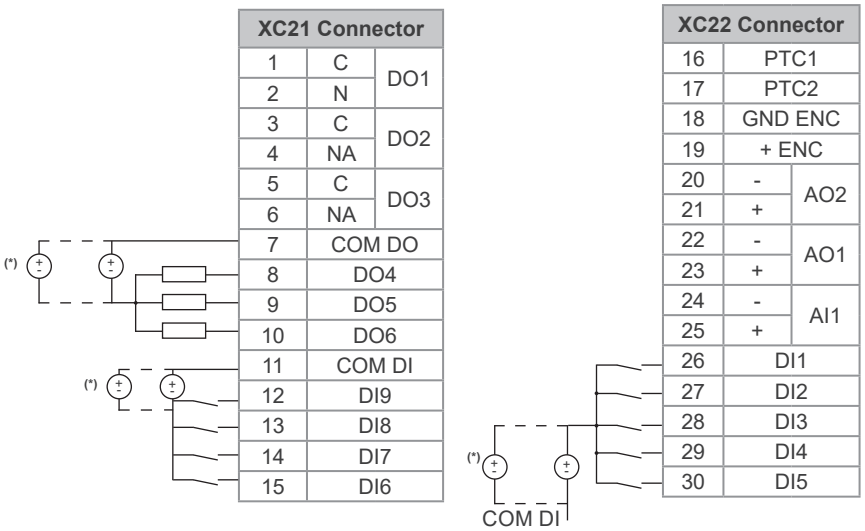


Figure 11.13: Description of the XC21 and XC22 connectors

ATTENTION!
(*) External power supply.
(**) For current, S1 switch must be ON.

11.3 INCREMENTAL ENCODER

Applications that require more speed or positioning accuracy, a speed feedback of the motor shaft by means of incremental encoder is required. The connection to the inverter is made through the XC9 connector (DB9) on the EBA function expansion board, or XC9 on EBB, or XC10 on EBC.

11.3.1 EBA/EBB Boards

When the EBA or EBB board is used, the selected encoder should have the following characteristics:

- Power supply voltage: 12 Vdc, less than 200 mA current consumption.

2 quadrature channels (90 º) + zero pulse with complementary outputs (differential):

- Signals A, /A, B, /B, Z and /Z.

- Linedriver or “Push-Pull” output circuit type (12 V level).
- Electronic circuit isolated from the encoder frame.
- Recommended number of pulses per revolution: 1024 ppr.

Follow the recommendations bellow when mounting the encoder on the motor:

- Coupling the encoder directly to the motor shaft (using a flexible coupling, however without torsional flexibility).
- Both the encoder metallic housing and the shaft must be electrically isolated from the motor (minimum spacing: 3 mm).
- Use good quality flexible couplings that prevent mechanical oscillations or “backlash”.

For electrical connection, use a shielded cable, keeping it as far as possible (> 25 cm) from other wiring (power, control etc.). Preferably, inside a metallic conduit.

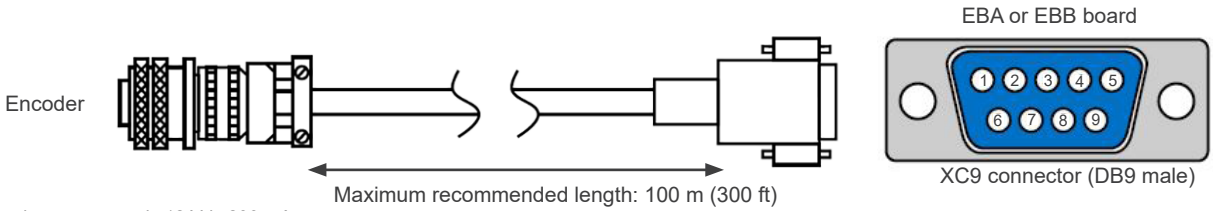
During start-up, it is necessary to program parameter P0202 (Control Type) = 4 (Encoder) to operate with speed feedback by incremental encoder.

For further details on vector control, see the programming manual available for download on **www.weg.net**.

The function expansion boards EBA and EBB have an encoder signal repeater, isolated and externally powered.

Encoder (3)	Signal	Color
A	A	Red
H	/A	Blue
B	B	Yellow
I	/B	Green
C	Z	Gray
J	/Z	Pink
D	+VE	White
F	COM	Brown
E	NC	
G	Ground	

XC9	Signal	Description
3	A	Signal encoder
2	A	
1	B	
9	B	
8	Z	
7	Z	
4	+VE	Source (1)
6	COM	Reference 0 V (2)
5	Ground	Ground



(1) Encoder power supply 12 Vdc 200 mA.
(2) Referenced to ground with 1 µF parallel to 1 kOhm.
(3) Valid pinout for encoder HS35B Dynapar.
For other models of the encoder verify the correct connection to comply with the necessary sequence.

Figure 11.14: EBA and EBB encoder input

NOTE!
The maximum allowed encoder signal frequency is 100 kHz.

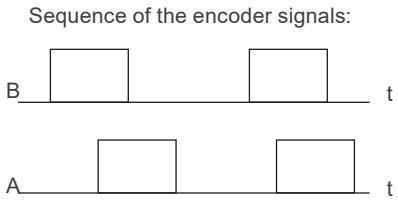


Figure 11.15: Encoder signals

Table 11.15: Encoder signal repeater output

Connector	Signal	Description
3	A	Encoder Signals
2	/A	
1	B	
9	/B	
8	Z	
7	/Z	
4	+V (*)	Power Supply
6	COM 1 (*)	Reference 0 V
5	Ground	Grounding

(*) For 5 V to 15 V external power supply, consumption 100 mA @ 5 V, excluding the outputs.

NOTE!
- Optionally, the external power supply may be connected via XC4:19 and XC4:20 (EBA) or XC5:19 and XC5:20 (EBB).
- Encoder Signals Line Driver differential (88C30). Average current value: 50 mA High level.

11.3.2 EBC1 Board

When the board EBC1 is used, the selected encoder should have the following characteristics:

- Power supply voltage: 5 V to 15 V.
- 2 quadrature channels (90 º) with complementary outputs (differential): Signals A, /A, B and /B.
- "Linedriver" or "Push-Pull" output circuit type (with identical level as the power supply voltage).
- Electronic circuit isolated from the encoder frame.
- Recommended number of pulses per revolution: 1024 ppr.

INSTALLATION OF THE EBC1 BOARD

The EBC board is installed directly on the MVC4 control board, secured by means of spacers and connected through the XC3 connector.

Mounting instructions:

1. De-energize the control rack.
2. Carefully insert the XC3 pin bar connector (EBC1) into the XC3 female connector on the MVC4 control board. Check the exact match of all the pins of the XC3 connector.
3. Press the center of the board (near XC3) until the connector is completely inserted.

4. Secure the board to the 2 metallic spacers with the 2 provided bolts.

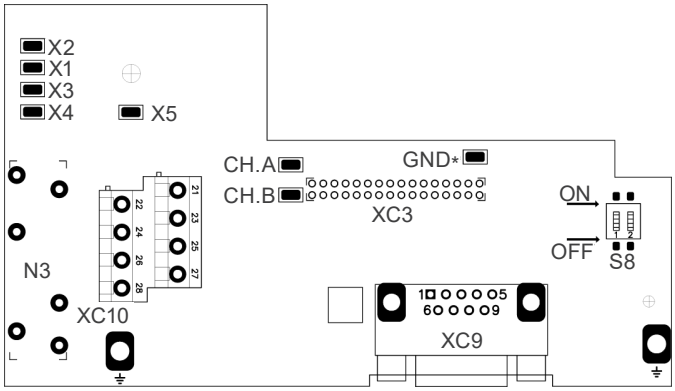


Figure 11.16: Position of the setting elements - EBC1 board

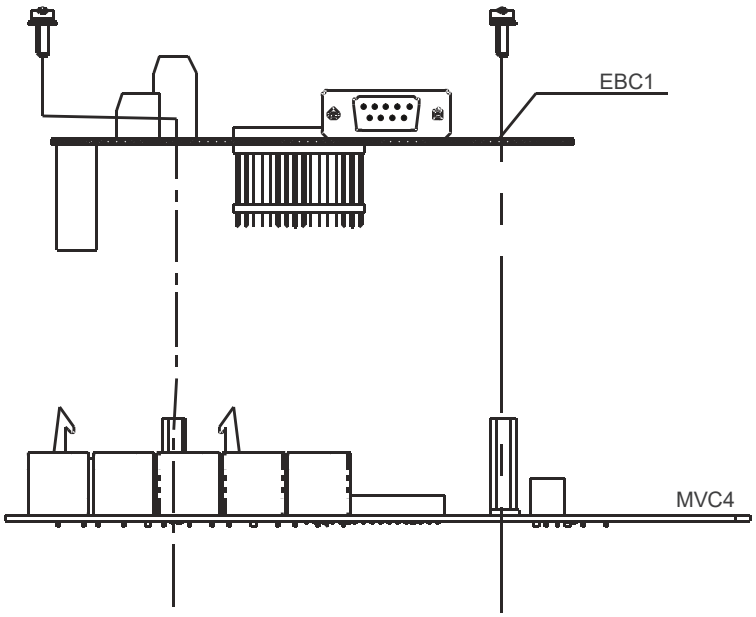


Figure 11.17: Procedure to install the EBC1 board

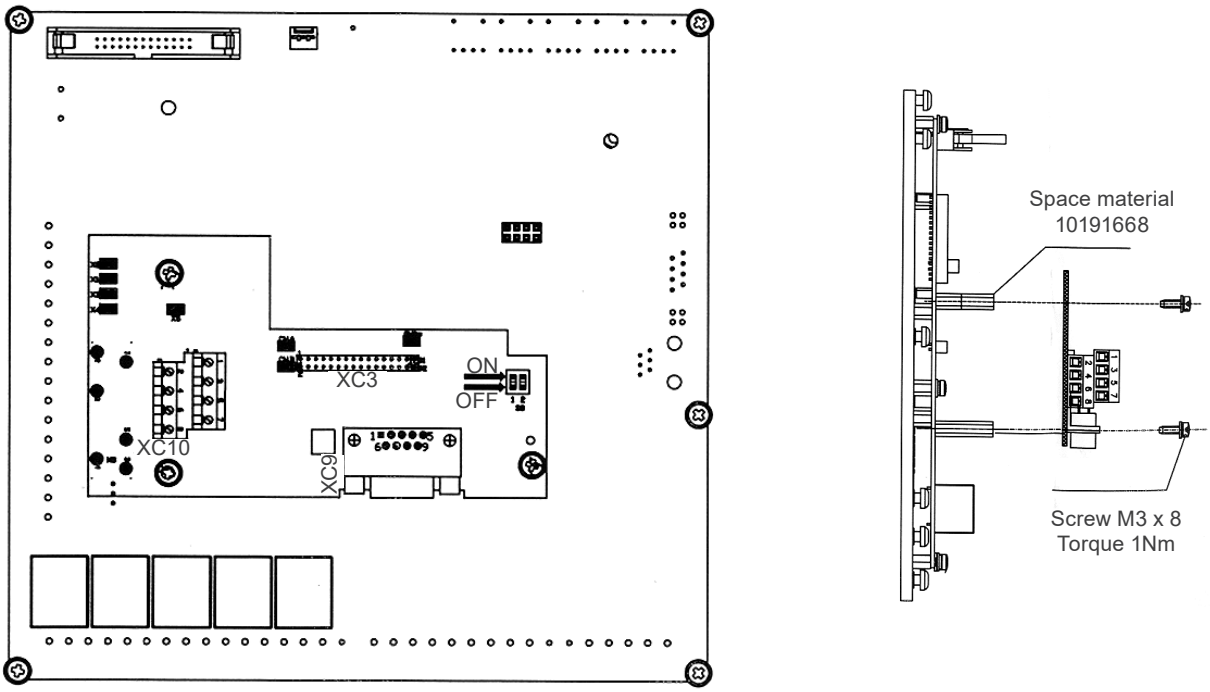


Figure 11.18: Procedure to install the EBC1 board

Configurations:

Table 11.16: Configurations of the setting elements - EBB board

Expansion Board	Power Supply	Encoder Voltage	Necessary Setting
EBC1.01	External 5 V	5 V	Switch S8 to ON, consult Figure 11.16 on page 11-17 for more details
	External 8 V to 15 V	8 V to 15 V	No action
EBC1.02	Internal 5 V	5 V	No action
EBC1.03	Internal 12 V	12 V	No action

NOTE!
The XC10:22 and XC10:23 terminals (see Figure 11.16 on page 11-17) should only be used to power the encoder if the connection to the DB9 connector is not used.

Encoder Mounting:

Follow the recommendations bellow when mounting the encoder on the motor:

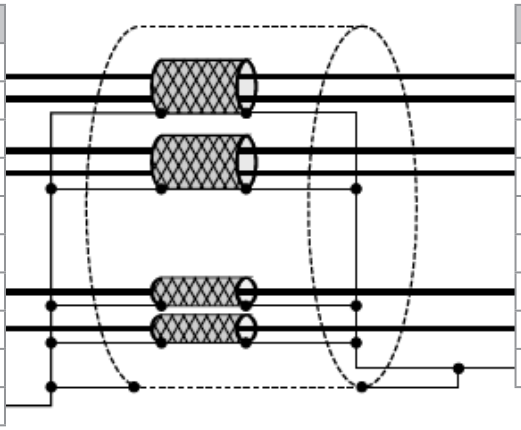
- Coupling the encoder directly to the motor shaft (using a flexible coupling, however without torsional flexibility).
- Both the shaft and the metallic frame of the encoder must be electrically isolated from the motor (minimum distance of 3 mm).
- Use good quality flexible couplings that prevent mechanical oscillations or “backlash”.

Use shielded cable for the electrical connection, keeping it as far as possible (> 25 cm) from the other wiring (power, control, etc.). Preferably, inside a metallic conduit.

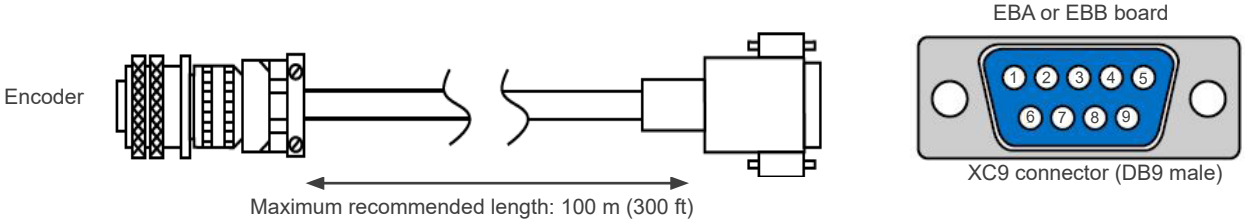
During start-up, it is necessary to program parameter P0202 (Control Type) = 4 (Encoder) to operate with speed feedback by incremental encoder.

For further details on vector control, see the programming manual available for download on **www.weg.net**.

Encoder(3)	Signal	Color
A	A	Red
H	/A	Blue
B	B	Yellow
I	/B	Green
C	Z	
J	/Z	
D	+VE	White
F	COM	Brown
E	NC	
G	Ground	



XC9	XC10	Signal	Description
3	26	A	Signal encoder
2	25	/A	
1	28	B	
9	27	/B	
8	-	Z	
7	-	/Z	
4	21,22	+VE	Source (1)
6	23,24	COM	Reference 0 V (2)
5	-	Ground	Ground



(1) Encoder power supply 5 to 15 Vdc 40 mA.
(2) Referenced to ground with 1 µF parallel to 1 kOhm.
(3) Valid pinout for encoder HS35B Dynapar.
For other models of the encoder verify the correct connection to comply with the necessary sequence.

Figure 11.19: EBC1 encoder input

NOTE!
The maximum allowed encoder signal frequency is 100 kHz.

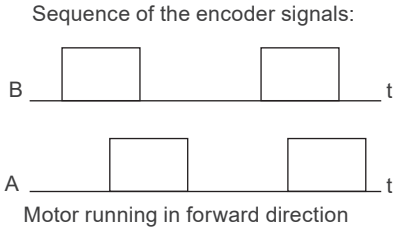


Figure 11.20: EBC1 encoder signals

11.4 SHORT UPS MODULE

The Short UPS module is an accessory that provides autonomy of approximately 500 ms in case of failure of the MVW01 inverter auxiliary power supply. After the occurrence of the auxiliary power supply failure, the inverter remains operational, without faults, during 500 ms.

The module is based on a low voltage frequency inverter, CFW10 and an external capacitor bank, which ensure the energy supply to the power supplies during the specified period. A filter is added to the inverter output, necessary because of the characteristic of the fed loads.

The Short UPS feeds the following loads:

- PS1S power supply: responsible for feeding the gate drivers.
- PS24 power supply: responsible for feeding the control.
- General command: input circuit breaker supply and its undervoltage release.

11.4.1 CFW10 Inverter Parameterization

For the correct operation of the Short UPS module, the CFW10 inverter must be parameterized as shown below:

- P100 = 1.0 (Acceleration time).
- P101 = 0.5 (Deceleration time).
- P121 = 57.4 (Output frequency).
- P206 = 3 (Auto-reset time).
- P222 = 0 (Remote speed reference).
- P263 = 0 (DI1 Digital input).
- P264 = 0 (DI2 Digital input).
- P265 = 4 (DI3 Digital input).
- P266 = 6 (DI4 Digital input).
- P297 = 10 kHz (Switching frequency).

11.5 MVC3 CONTROL BOARD CONNECTIONS

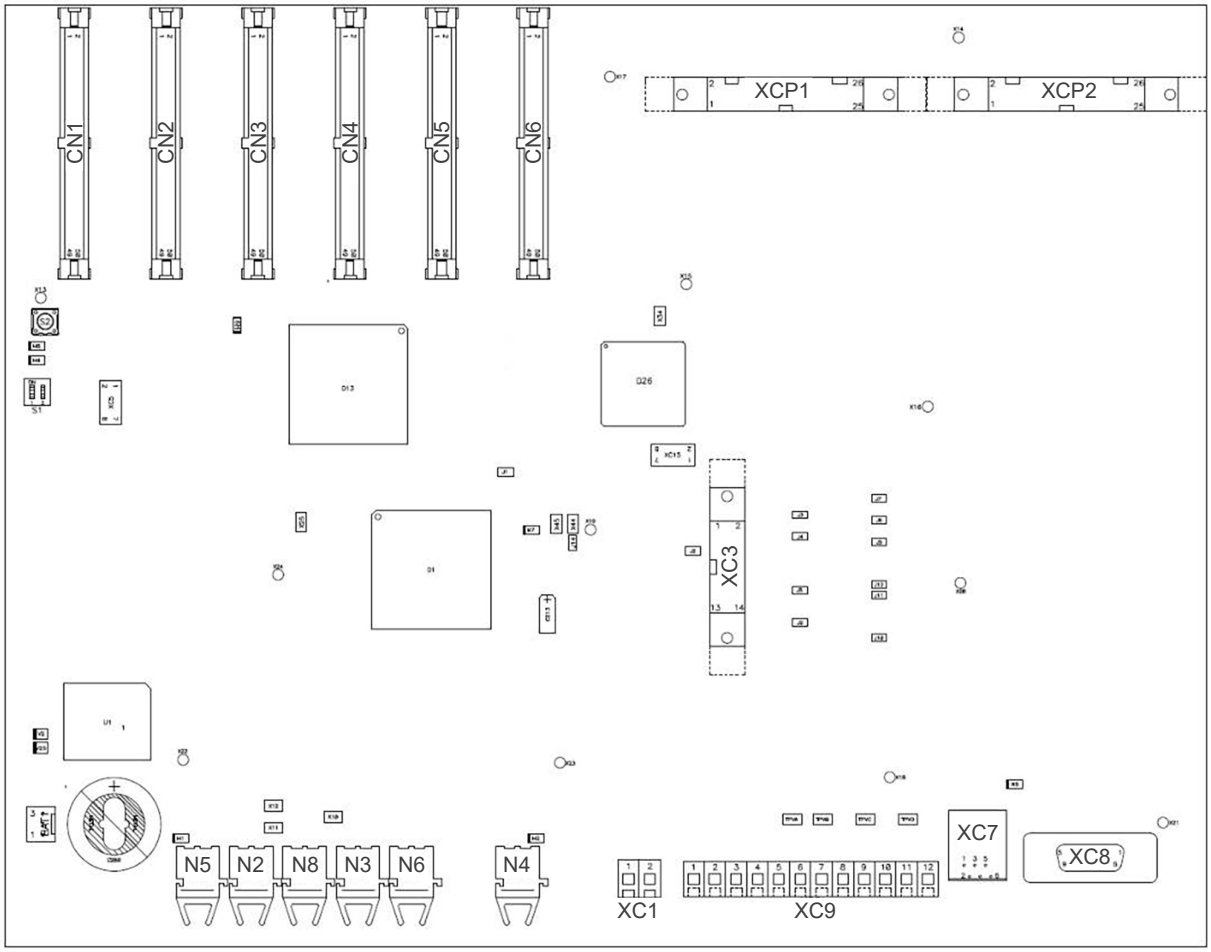


Figure 11.21: MVC3 board connections

Table 11.17: XC9 terminal strip connections

Connector	Signal	Function (Factory default)	Specification
1	+5.4 V	Positive reference for potentiometer	+5.4 V ±5 %, 2 mA
2	AI1-	P0740 (AI1 MVC3 Funct.): 0 (Not Used)	Differential, 11-bit resolution Impedance: 400 kΩ (-10 V to 10 V)
3	AI1+		
4	-4.7 V	Negative reference for potentiometer	-4.7 V ±5 %, 2 mA
5	AO1+	P0652 (MVC3 AO1 Funct.): 2 (Current Iu)	Differential, 11-bit resolution -10 V to 10 V, RL ≥ 10 kΩ (Maximum load)
6	AGND		
7	AO2+	P0654 (MVC3 AO2 Funct.): 5 (g_usM)	Differential, 11-bit resolution -10 V to 10 V, RL ≥ 10 kΩ (Maximum load)
8	AGND		
9	AO3+	P0656 (MVC3 AO3 Funct.): 2 (Current Iu)	Differential, 11-bit resolution -10 V to 10 V, RL ≥ 10 kΩ (Maximum load)
10	AGND		
11	AO4+	P0658 (MVC3 AO4 Funct.): 5 (g_usM)	Differential, 11-bit resolution -10 V to 10 V, RL ≥ 10 kΩ (Maximum load)
12	AGND		

Table 11.18: Description of the XC1 connector

Connector	Signal	Function (Factory default)	Specification
1	AI2-	P0744 (AI2 MVC3 Funct.): 0 (Not Used)	Differential, 11-bit resolution Impedance: 400 kΩ (-10 V to 10 V)
2	AI2+		

ATTENTION!
The I/Os described above are not isolated. Their utilization must be with galvanic isolators.

12 SPECIAL FUNCTIONS

12.1 LOAD SHARE FUNCTION “MAIN/AUXILIARY”

Conveyors belts and overhead cranes are classic examples of applications where the torque or position control is used to maintain the conveyor belt voltage within the limits during the operation, start and stop procedures or even in the transportation of materials in a rising of falling slope.

For motors connected to the same load, it is necessary to ensure a reliable load sharing. Such characteristic is best achieved with the use of multiple inverters operating in speed reference mode (Main) and torque limitation mode (Auxiliary (s)).

12.1.1 Implementation Modes

Three modes to implement the load sharing function will be presented: Torque Reference, Limitation of the Torque Current and Negative Slip.

Torque reference mode and current limiting mode are for high performance applications, it is mandatory that the inverters involved in the process be set to vector operating mode. Examples of high performance applications are: conveyor belts, mills (dual pinion, HPGR, SAG, BALL), overhead crane and lifting. For most applications, vector operating mode with speed or position sensor is recommended.

The negative slip operating mode is for scalar control and is used exceptionally in low dynamics/performance applications. In this operating mode, all inverters must receive the same speed reference signal, this type of load sharing is called “droop” or negative slip.

In order to implement the load sharing, the inverter assigned as main controls the load speed using all the other inverters of the process as actuators.

The three implementation methods and the main parameters used in each method are shown below.

12.1.2 Torque Reference - Operation in Vector Mode

One of the possible ways to implement the load sharing function is by parameterizing the salve inverter(s) to follow an external torque reference, which will be sent by the main inverter.

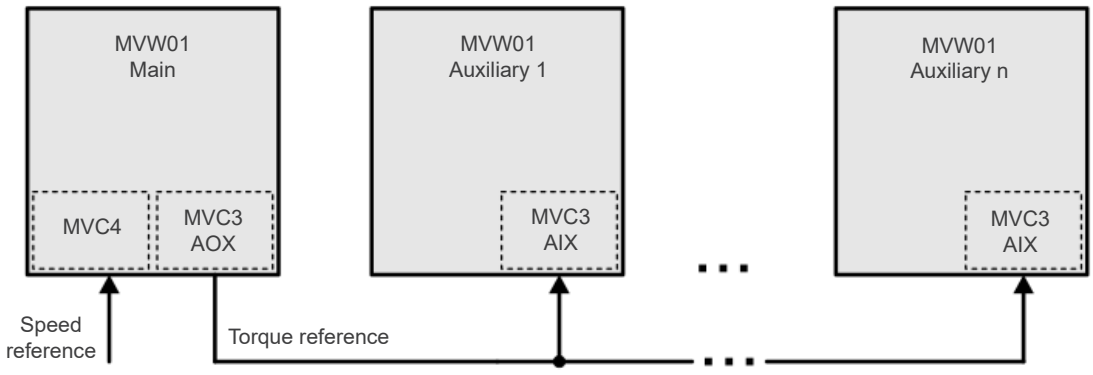


Figure 12.1: General operation scheme of the function

In order to do so, the inverters must be parameterized as follows:

Main inverter:

Parameterize one of the analog outputs of the MVC3 control board to send the torque reference to the auxiliary (s) inverter(s). In the example below, the analog output AO1 is parameterized.

P0652 (Analog Output 1 Function) = 188 (Inverter torque reference).

Auxiliary (s) inverter (s):

On the auxiliary inverter(s), it is necessary to parameterize an analog input of MVC3 board to receive the torque reference sent by the main inverter.

P0740 (Analog Input 1 Function) = 1 (Torque reference).

NOTE!
Pay attention to the polarity of the analog ones at the moment of the connection between the inverters.

12.1.3 Limitation of the Torque Current - Operation in Vector Mode

As in the previous mode, the main inverter operates in speed control mode, while the auxiliary inverter operates in torque current regulation mode. Besides the limit value of the torque current, the auxiliary inverter(s) receives the speed reference signal; therefore, in a potential situation of sudden load reduction, the speed reference is saturated, thereby avoiding a possible sudden acceleration of the motor.

The speed reference signal sent to the auxiliary inverter(s) must be set to a value slightly above the main inverter reference. It is recommended to apply an offset to the analog inputs of the auxiliary (s) greater than 5 % added to the reference sent by the main inverter; the ideal value may vary according to the application.

NOTE!
As the operation with negative torque reference is impossible, this method cannot be used for regenerative inverters or with dynamic braking.

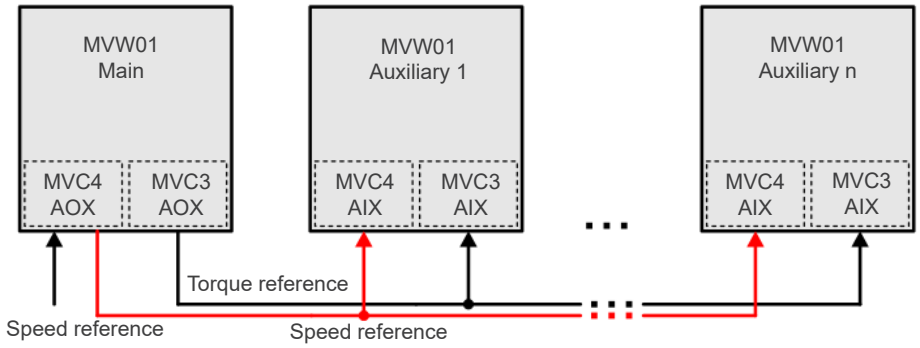


Figure 12.2: General operation scheme of the function

Therefore, the inverters must be parameterized as follows:

Main inverter:

Parameterize one of the analog outputs of the MVC3 board to send the torque current limit to the auxiliary inverter(s). The example below shows the parameterization of analog output AO1 of the MVC4 board to send the speed reference.

P0652 (Analog Output 1 Function – MVC3) = 188 (Inverter torque reference).

P0251 (Analog Output Function 1 – MVC4) = 0 (Speed reference).

Auxiliary inverter:

The auxiliary inverter(s) requires the parameterization of an analog input of the MVC3 board to receive the torque current limit sent by the main inverter. For the speed reference, use the analog input AI1 of the MVC4 board, whose standard function is the speed reference signal.

P0740 (Analog Input 1 Function - MVC3) = 2 (ICur. Lim.).

P0221 or P0222 (Speed Reference Selection Local/Remote Situation) = 1 (AI1 - MVC4). P0236 (Input AI1 Offset) = 5.0 %.

P0133 (Minimum Speed Reference) = set according to the application.

P0134 (Maximum Speed Reference) = set according to the application; it must be 5 % above the maximum limit of the main inverter.

12.1.4 Negative Slip – Operation in Scalar Mode

This method to implement the load sharing function is limited to applications of induction motor drive. It is based on the decrease of the frequency according to the increase of load on the motor; thus there is a natural distribution of the loads.

Regardless of the chosen speed reference source, it must be sent to all inverters. Due to the low accuracy of analog inputs, its use as speed reference source is not recommended.

This method to implement the load sharing must not be used for applications that require dynamic performance, and it can only be considered when the inverters drive motors with the same characteristic slip.

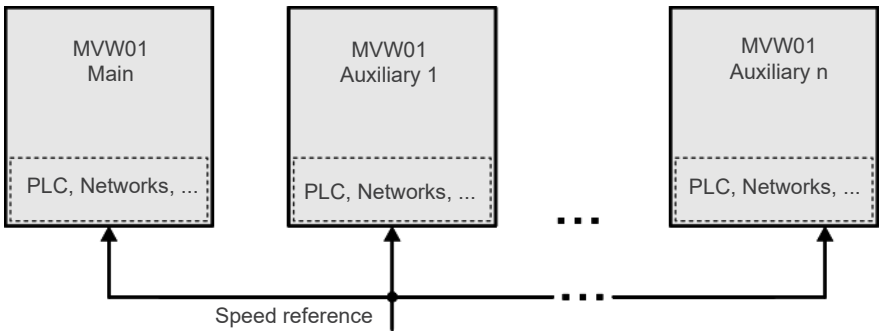


Figure 12.3: General operation scheme of the function

Therefore, the inverters must be parameterized as follows:

P0138 (Rated slip) = the motor slip is recommended (negative signal).

P0139 (Output current filter) = it is recommended to start with the standard value and gradually increment it if the system presents instability.

Besides the presented parameterization, the implementation of the load sharing function requires that all inverters involved in the process be enabled simultaneously; thus, the “General Enable” and “Run/Stop” signals must be sent to all inverters at the same time. There are several ways to meet this requirement and the most appropriate way will depend on each application.

The description given of the ways to implement the load sharing function intends neither to approach all possibilities of implementation, nor to detail all the aspects involved. The definition of the best implementation mode for a certain application, as well as the optimal adjustment of each mode must be defined by WEG engineering and application teams.

12.2 SYNCHRONOUS TRANSFER OR SYNCHRONOUS BYPASS FUNCTION

For applications where speed variation is not required during operation, the synchronous bypass function enables the motor to be accelerated through the inverter up to the rated operating frequency, and then the transfer to the supply line to occur. In this way, it is possible to eliminate the effects of the starting current related to a direct online start, and the frequency inverter is sized only for the motor starting condition.

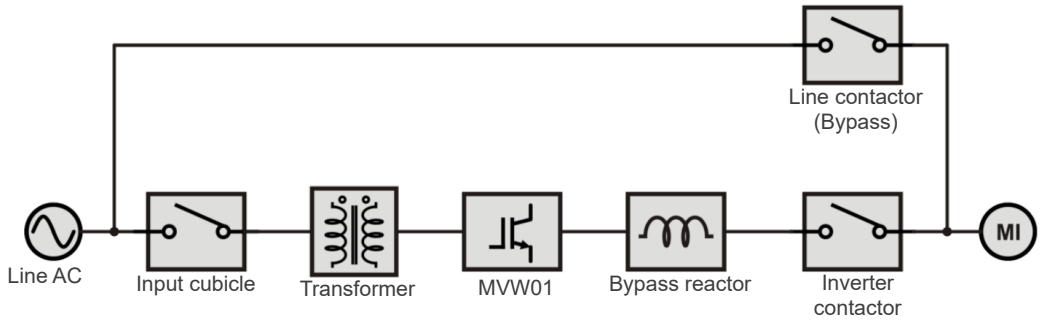


Figure 12.4: General scheme of synchronous transfer

12.2.1 Basic Settings

The synchronous transfer process involves accelerating the motor up to the rated speed, synchronizing the voltage imposed to the motor with the line voltage, and making the transfer to the line. For the transfer to occur properly and with minimal impact on the motor and on the inverter, a series of parameters must be carefully adjusted so as to ensure the phase synchronization, the minimum difference of the RMS value between the inverter and the line voltages and the timely occurrence of each step of the process.

Even with the correct setting of parameters related to the synchronous transfer process, it is necessary to use a reactor between the inverter and the motor in order to absorb differences between the inverter and the line voltage, thus protecting the inverter during the closing of the line contactor.

Therefore, after extract the bypass circuit breaker or contactor, making all the start-up procedure for inverter with operation in normal mode, it is necessary to:

- Configure the inverter in bypass mode (P0299 = 4).
- Choose one of the DIs available on the MVC4 board (DI3 to DI10) and configure it to start the synchronous transfer (P0265 to P0272 = 23 or 25).
- Configure the motor voltage (P0400 equal to the line voltage to which the motor will be transferred. In the operation with synchronous bypass, the inverter uses this value to calculate the RMS voltage that will be imposed to the motor when operating at rated frequency. E.g.: motor nameplate voltage of 4000 V and line of 4160 V. Configure P0400 = 4160 V.
- Start the motor at synchronous speed and close the digital input “Start Transf. Synchronous”.
- Adjust the search regulator of the synchronous transfer (P0634 and P0635) to obtain a faster searcher or mitigate any oscillation in angular error between the output voltage inverter and mains supply that prevents synchronization to happen.
- Decrease the speed reference below 95 % to exit the “Synchronism OK” state and repeat the procedure if necessary.
- When the inverter indicates “Synchronism OK”, measure with the oscilloscope and compare the voltage generated by the inverter (PWM) with the mains voltage (sinusoidal) for each of the phases. The inverter and grid voltages must be synchronized. The difference between the grid and inverter phases can be non-zero, as long as it is constant. If the difference between the grid and inverter phases is different from zero after synchronizing, adjust 0636.
- Stop the motor.
- Configure one DO (RL1 to RL5) to indicate that the synchronism with the line is “OK” (0277 to P0282 = 34). Start the motor at synchronous speed and close the digital input “Start Transf. Synchronous”.

- Set P0631 to compensate for the delay in closing the transfer breaker to the grid, so as to allow the inverter and grid to operate in parallel for a maximum of 2 ms after the circuit breaker/contactor closes. The effect of a very long time on P0631 generates an increase in the inverter current, which can reach the tripping value of the overcurrent fault F0070. In Sensorless mode, the inverter must be disabled before opening the inverter output contactor/breaker.

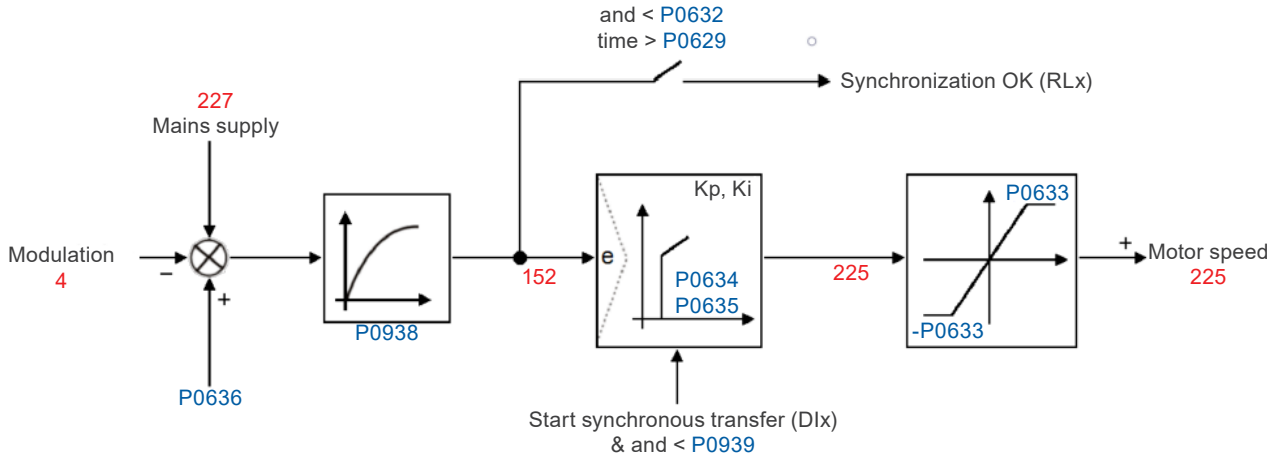


Figure 12.5: Operation diagram of the synchronous bypass function

12.2.2 Important Signals for Analog Outputs

- P0652, P0654, P0656, P0658 = 4 (modulation angle).
- P0652, P0654, P0656, P0658 = 152 (angular error filtered by P0938). P0652, P0654, P0656, P0658 = 225 (diagram frequency output).
- P0652, P0654, P0656, P0658 = 227 (power grid angle).

12.2.3 Possible Failures

A0008 – Timeout of synchronous transfer

- Rectifier phases at measuring point out of correct sequence (UWV).
- Wrong direction of rotation of the motor.
- P0630 – Time for synchronous transfer too short.
- P0633 – Search limit for synchronous transfer too low, causing small range of action in search of synchronism.
- P0634 and P0635 – Synchronous transfer searcher regulator causing oscillation in synchronism seek.
- P0101 and P0103 – Acceleration time too long, causing search delays.

Improper Indication for Synchronism Ok

- P0629 – Time for synchronization programmed to a minimum. In this case, the inverter will immediately signal synchronism OK when the angle error is within the value programmed in P0632.
- F0070 – Overcurrent (During Transfer).
- P0400 – Incorrect motor rated voltage, performing the bypass with wrong RMS voltage.
- P0636 – Incorrect output phase adjustment, causing the bypass to be out of phase.
- P0631 – Very long delay in the “Fast Disable” actuation, causing the inverter to remain in parallel with the grid for a very long period.

No Voltage on the Motor (During Transfer)

- P0631 – A very short delay in the “Fast Disable” actuation, causes the inverter to be disabled before the bypass circuit breaker has completed closing its contacts.

12.2.4 Operating Sequency

The Figure 12.6 on page 12-6 describes all the operating sequence of the signals involved in the synchronous transfer process.

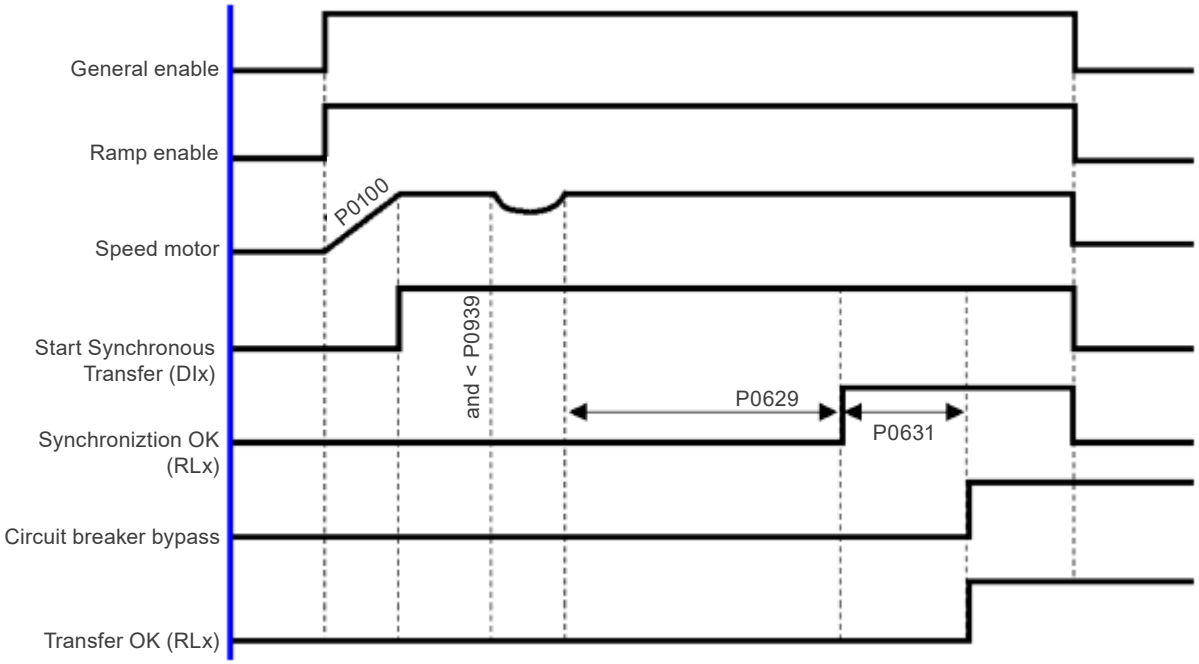


Figure 12.6: General operation scheme of the synchronous bypass function

12.3 SAFETY STOP FUNCTION

The Safety Stop function aims at providing the motor with a safe stop mode system through hardware, ensuring that the inverter will not spin the motor regardless of the software or auxiliary circuit.

12.3.1 Implementation Mode

As the MVW01 features an auxiliary power supply of the measuring boards and Gate Drivers, it will be necessary to use an exclusive transformer/supply set for the Gate Drivers, thus enabling to turn them off independently of the measuring boards.

By turning off this supply we are ensuring that under no circumstances will the system go into operation again. For this purpose, we will use a safety relay certified for the function, containing inside two independent relays in relation to the drive and contacts.

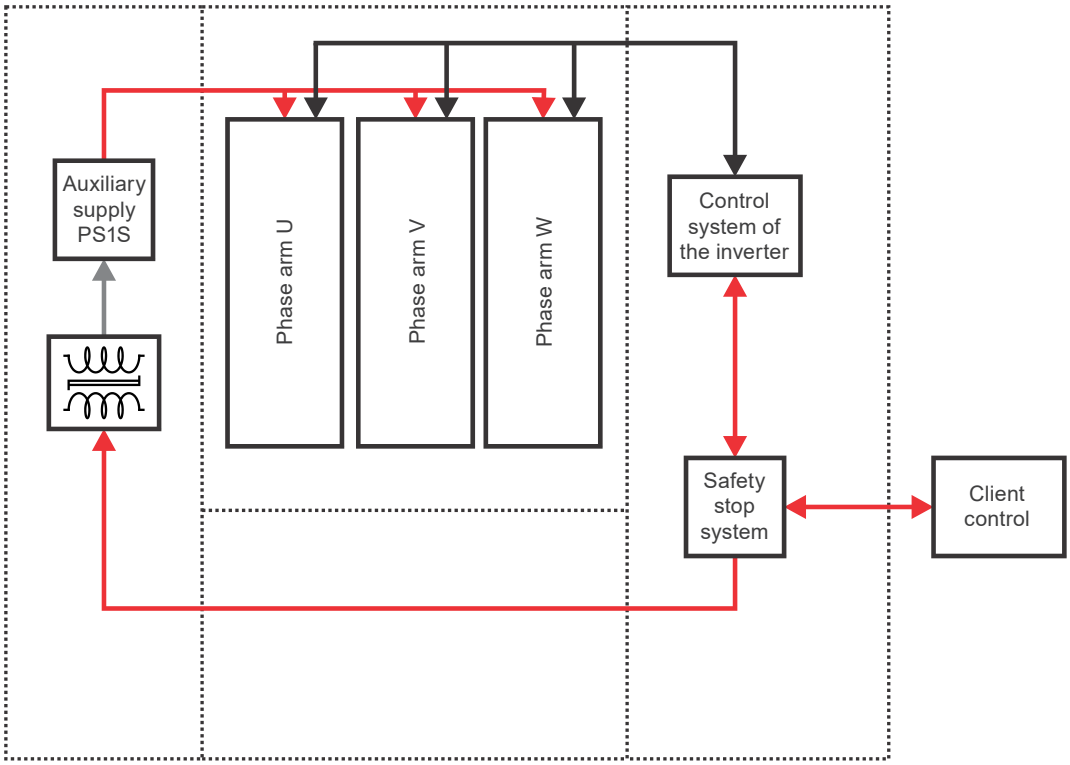


Figure 12.7: General operation scheme of the function

12.3.2 Hardware

To implement the system, a safety relay certified for this type of function will be used, according to the diagram in Figure 12.8 on page 12-8.

In order to enable the Safety stop function, it is necessary to command the safety relay directly by commanding any of the emergency buttons connected in series shown in Figure 12.8 on page 12-8. The relay, without influence of the inverter, will shut down the power of the Gate Drivers, inform the control about the change to the safe operating mode and send a feedback to the client.

On the inverter, the digital input DI15 of the MVC3 board (through the PIC board) is configured so that whenever it receives a signal of 24 V (high), the inverter, regardless of the routine it is running, immediately goes into the safe operating mode, inhibits the trigger signals of the switches and ignores all the IGBT, temperature of the arms and of the PS1 supply faults that may occur at this moment due to the power loss.

From the effective ingress of the inverter into the safe mode, the A165 alarm is signaled on the HMI, informing the inverter is locked for operation by the Safety Stop function.

On the MVC4 board, the relay outputs (RL1 to RL5) have the option 36 (Safety Stop). Such function provides the indication of the function in progress. The parameters for configuration of the relay outputs are: P0277, P0279, P0280, P0281 and P0282.

Since this is a safety function, the implementation is performed through a relay that presents actuation redundancy and simultaneity in the activation mode. Such redundancy is used both in the disconnection of the supply and in the information to the control and feedback to the client.

If a fault occurs in one of the internal relays, the system is locked likewise; however, due to its internal self-monitoring, it will not go back into operation, requiring a check of the cause for the lock. Therefore, the supply of the Gate Drivers is turned off, and the IGBT and/or temperature of the arms fault and/or PS1 supply fault is indicated, and consequently the entire system is shut down (the main circuit breaker opens) due to operation fault.

The image below presents the electrical diagram of the Safety Stop function.

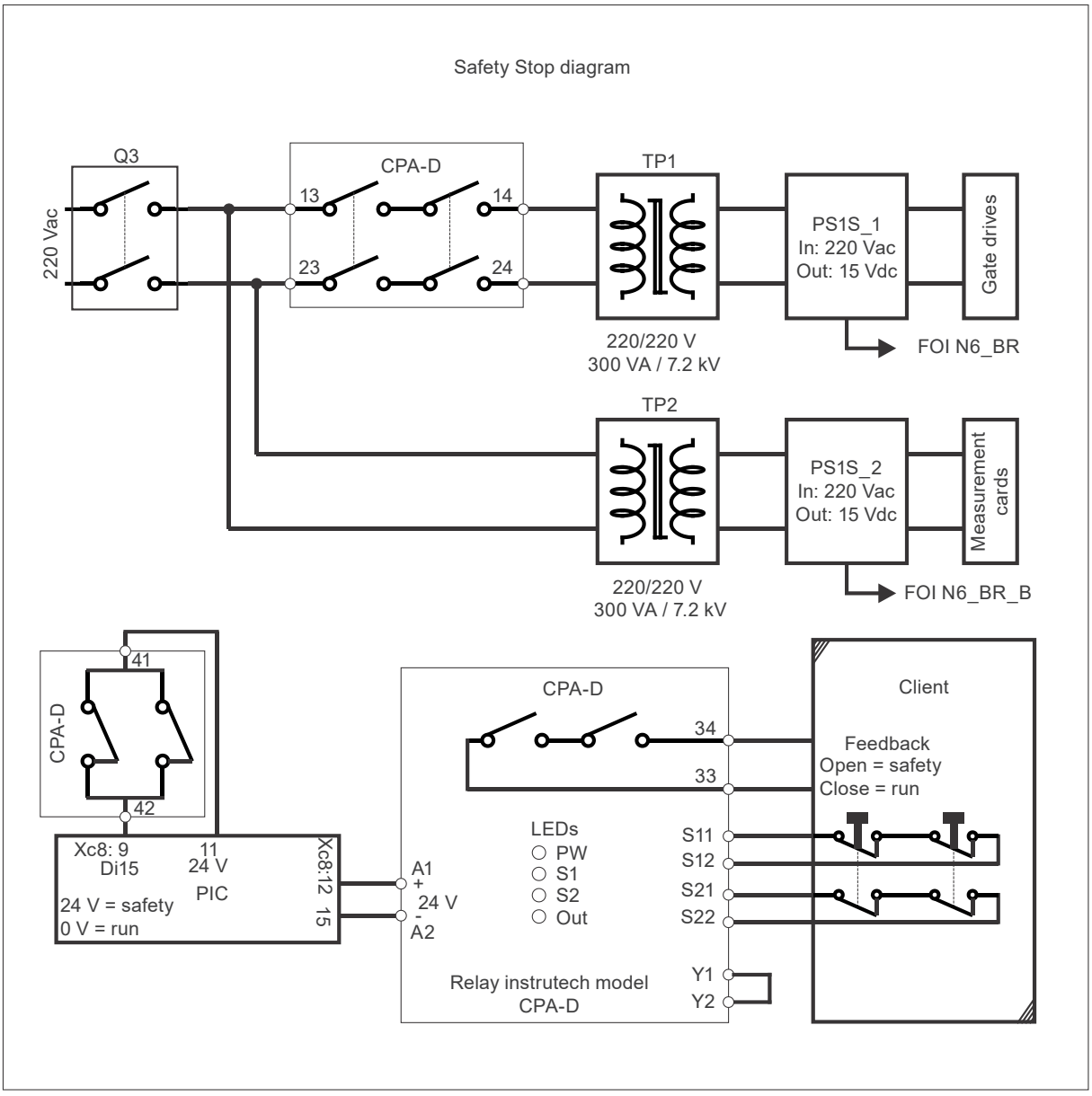


Figure 12.8: Electrical diagram of the Safety Stop function

The system leaves the safety stop function 100 ms after the signal of digital input DI15 is removed, and the inverter begins to monitor all the faults again, accept commands of enable PWM and reset of alarm A165.

13 DIAGNOSTICS AND TROUBLESHOOTING

13.1 INFORMATION FOR CONTACTING TECHNICAL SUPPORT

NOTE!
For technical support or servicing, it is important to have the following information at hand:
- Inverter model.
- Serial number, manufacturing date and hardware revision, which are available on the product identification label (refer to Section 1.3 IDENTIFICATION LABEL OF THE MVW01 on page 1-2).
- Software version (refer to Section 2.2 SOFTWARE VERSION on page 2-2).
- Application and programming data.

For explanations, training or services, please, contact WEG Technical Assistance.

13.2 PREVENTIVE MAINTENANCE

DANGER!
- Only people with properly qualified and familiar with the MVW01 Inverter and associated equipment must plan or service this equipment.
- Such personnel must follow the safety instructions described in this manual and/or defined by local standards.
- The noncompliance with the safety instructions may result in death risks and/or damages to the equipment.
- WEG Technical Assistance.

The MVW01 inverter has been designed and tested to have a long, failure-free, operation life. The preventive maintenance helps early identification of possible future failures, extending the useful life of the equipment, increasing the mean time between failures and reducing the equipment downtime. It also helps identifying whether the equipment is being used within its mechanical, electrical and environmental limits. The periodical cleaning during preventive maintenance assures an adequate operation when the inverter is used within its rated conditions.

In order to produce the best benefits, the preventive maintenance must be performed periodically by a qualified technician. The interval depends on factors like the duty cycle and the environmental conditions (ambient temperature, ventilation, the existence of dust, etc.). It is recommended to begin with the preventive maintenance frequently and increase the interval as the obtained results indicate the possibility of reducing that frequency. A detailed record of the preventive maintenance is also recommended. These records serve as proof of the maintenance fulfillment and help identify the cause of possible faults and alarms.

Two types of preventive maintenance are described next: during the inverter operation and with the inverter completely stopped/de-energized.

13.2.1 Preventive Maintenance During Operation

This type of maintenance is performed with the inverter energized and in operation. It is just necessary to access the control cabinet where only low voltage power supply (< 480 V) is present, but which is potentially dangerous.

DANGER!
- This equipment has high voltages that may cause electric shocks. Only people with properly qualified and familiar with the MVW01 Inverter and associated equipment must plan or service this equipment. In order to avoid the risk of shock, follow all the safety procedures required for servicing energized equipment.
- Do not touch any electrical circuit before ensuring it is de-energized.

Procedures:

1. Operation of the fans and exhausting fans:
   Verify the proper operation of the exhausting fans at the top of the rectifier cabinet and the inverter cabinet. The fans must be running in the same direction and their exhausting action must be perceptible. Verify the proper operation of the fan at the control cabinet: it must be running and blowing air into the cabinet.

2. Cleaning of the air inlet filters:
   Remove the protection grids from the air inlets at the doors of all the cabinets by unbolting them. Remove the filters and clean, wash or replace them. The amount of accumulated dirt on the filters helps defining the correct interval between preventing maintenances. Reinstall the filters and bolt the protection grids again.

3. Open the control cabinet and visually inspect the components inside it, verifying them to identify faults or the need of preventive maintenance with complete stop/de-energization for cleaning or replacement:

Components	Anomalies
Electronic boards	Excessive accumulation dust, oil, moisture, etc. Discolored or darker points due to excessive heat
Capacitors on electronic boards	Discoloration, smell, electrolyte leakage, case deformation
Resistors in general	Discoloration or smell
Control rack (A8), electronics power supply PS24 (A11)	Excessive heating of the aluminum base (more than 40 °C, 104 °F, above the ambient temperature)

4. Read and write down the following parameters from the HMI:

- P0003 - Motor Current
- P0004 - DC Link Voltage
- P0005 - Motor Frequency
- P0006 - VFD Status
- P0014 - Last Fault
- P0015 - Second Fault
- P0016 - Third Fault
- P0017 - Fourth Fault
- P0022 - Temperature on MVC3 Board
- P0042 - Time Powered Counter
- P0043 - Time Enabled Counter
- P0055 - Phase U Temperature
- P0056 - Phase V Temperature
- P0057 - Phase W Temperature
- P0058 - BR Phase Temperature
- P0059 - Rectifier Temperature
- P0067 - Error Register
- P0080 - Date (dd/mm/yy)
- P0081 - Hour (24hs)

Table 13.1 on page 13-3 shows the periodic preventive maintenance procedures under operation condition.

Table 13.1: Intervals and procedure of the preventive maintenance in operation

Interval	Items	Procedure
1 month after start-up	Monitoring parameters	■ Check if the inverter is operating within the project specifications: input transformer secondaries voltage and output current (P0003). Change the position of the main transformer taps if necessary
Every 3 months	Cleaning (or replacement) of the air filters (1)	■ Remove all filters from the panel and clean them with an air blower or with compressed air, or wash them with neutral detergent and dry them well, before installing them back into the panel ■ Replace all filters if cleaning is not efficient
Every 3 months	Visual inspection of the ventilation	■ Check if the flaps of the exhausters are open. Check the rotation direction of the exhausters in panels without flaps ■ Check the rotation direction of the control panel fan
Every 3 months	Upload of the Log of Faults and Alarms	■ Make a backup of the inverter complete programming. Follow the WPS© software instructions ■ Upload the Log of Faults and Alarms (P0067). Follow the WPS© software instructions
Every 3 months	Date and time setting	■ Adjust the current date and time, if necessary. Use the parameters P0080 (Date) and P0081 (Hour) by the Graph HMI V2 or the menu Settings by the Graph HMI V3 (touchscreen)
Every 3 months	Visual inspection of the control panel	■ Electronic boards: – Check for excessive dust accumulation or any accumulation of conductive particles or humidity – Check for heating spots (discolouration or blackening of components) – Check for leakage or deformation (expansion) of the body of electrolytic capacitors ■ Pre-charge resistors: check for heating spots (discolouration or blackening) ■ Flat cables and internal wiring: check for heating spots (deformation, discolouration or blackening) ■ Internal and signal lights: check the operation ■ Space heater cord: check the operation. If there is a thermostat, adjust the temperature to turn it off between 5 and 10 °C above the medium temperature of the electrical room
Every 3 months	Basic measurements on the control panel	■ Auxiliary power supplies: – Measure the voltages L1, L2 and L3 of the auxiliary power supply and check if it is within the +10/-15 % tolerance – Measure the auxiliary single phase supply for space heaters, sockets and lamps (if separate) and check if it is within the +10/-15 % tolerance ■ PSS24 power supply: – Measure the 220 VAC input voltages and check if they are within the +10/-15 % tolerance – Measure the 24 VDC output voltage and check if it is within the 0.2 V tolerance – Measure the temperature on the aluminium base and check if it is below Tamb + 20 °C (36 °F)

(1) The interval may be extended, according to the electrical room cleanliness, from 3 to 6 or 12 months.

13.2.2 Preventive Maintenance with Complete Stop/De-energization

DANGER!
- This equipment has high voltages that may cause electric shocks. Only people with properly qualified and familiar with the MVW01 Inverter and associated equipment must plan or service this equipment. In order to avoid the risk of shock, follow all the safety procedures required for servicing energized equipment.
- Do not touch any electrical circuit before ensuring it is de-energized.

This type of maintenance is also intended for the cleaning and visual inspection of the high voltage cabinets; therefore, it requires the complete de-energization of the inverter. In order to de-energize the inverter and clean the medium voltage panels, the instructions contained in Section 13.3 SAFE DE-ENERGIZATION INSTRUCTIONS on page 13-6 must be followed.

Its frequency can be lower than the preventive maintenance in operation.

Procedures:

1. Execute the procedures 1 and 4 of the Preventive Maintenance During Operation.

2. Follow the instructions in Section 13.3 SAFE DE-ENERGIZATION INSTRUCTIONS on page 13-6.

DANGER!
Although the inverter commands the opening of the input switchgear, there is no guarantee of its opening and neither that no voltages are present, because the capacitors remain charged for a long time, and they can also be charged through the auxiliary low voltage supply. Before opening and accessing the high voltage cabinets, follow all the safe de-energization procedures described next.

Table 13.2 on page 13-5 shows the periodic preventive maintenance procedures under stop and de-energization condition.

Table 13.2: Intervals and procedure of the preventive maintenance with stop and de-energization

Interval	Items	Procedure
Every 12 months	Internal panel cleanliness (1)	■ Electronic boards: use only an antistatic brush ■ Insulating materials, bars and air ducts: use an air blower and a flannel moistened with isopropyl alcohol. Avoid using compressed air, as it could contaminate the panels with oil or humidity ■ Power cables: use a dry flannel ■ Fins of the power cells heat sinks(2): use an air blower ■ Exhausters and fan: use air blower and a flannel moistened with isopropyl alcohol
Every 12 months	Maintenance of the input circuit breaker (1)(3)	■ Indicators ON/OFF ■ Operations counter ■ Abnormal smell and noise
Every 12 months	Visual inspection of the power panels (1)	■ Electronic boards: – Check for excessive dust accumulation or any accumulation of conductive particles or humidity – Check for heating spots (discolouration or blackening of components) – Check for leakage or deformation (expansion) of the body of electrolytic capacitors ■ Optical fibers and internal wiring: – Make sure the optical fibers are correctly inserted and that they do not bend with radius lower than 4 cm – Check for heating spots (deformation, discolouration or blackening) ■ Space heater cord: check the operation. If there is a thermostat, adjust the temperature to turn it off between 5 and 10 °C above the medium temperature of the electrical room
Every 12 months	Power and control connections	■ Check the tightening of all connections (control and power). Use the torques recommended by the user's guide
Every 2 years	Calibrations	■ Check the status of the offset calibrations. VMP-GND must be 0.0 % and within the 1.0 % tolerance
Every 2 years	Test of the protection relay (4)	■ Test of the selectivity adjustments ■ Trip test of the overcurrent output
Every 3 years	Maintenance of the input circuit breaker or contactor (3)	■ Insulation resistance ■ Lubrication ■ Cleanliness ■ Heating points etc.
Every 40000 h of operation (5)	Replacement of the exhausters	■ Replace the exhausters of the power columns and the fan of the control column
Every 5 years	Power cells clamps	■ Clean the contacts and clamps with a dry flannel and apply new conductive grease(6) to all clamps
Every 5000 energizations	Maintenance of the input circuit breaker or contactor (5)	■ Insulation resistance ■ Lubrication ■ Cleanliness ■ Heating points etc.

(1) The interval may be reduced or extended, according to the electrical room cleanliness, from 6 to 12 or 24 months.
(2) Remove the cells only in case of great dirt accumulation. Use an air blower and antistatic brush. Never use compressed air, as it could contaminate the cell with oil or humidity.
(3) Recommendation from most medium voltage circuit breakers and contactors manufacturers. Refer to the manufacturer's documentation.
(4) Recommendation from most protection relay manufacturers. Refer to the manufacturer's documentation.
(5) If the inverter is in operation 24/7, 40000 h are approximately 4.5 years.
(6) Conductive grease type PENETROX A, manufacturer BURNDY.

13.3 SAFE DE-ENERGIZATION INSTRUCTIONS

1. Decelerate the motor to a complete stop.

2. Check the DC Link voltage values of the installed power cells at parameters P1000 to P1035 da HMI.

3. Press the “POWER OFF” pushbutton. The input transformer switchgear should open at this moment, which is indicated by the “INPUT ON” pilot light going off.

ATTENTION!
If the input transformer switchgear does not open with the “POWER OFF” command, then open it manually.

4. Follow the DC Link voltage decrease through P0004 on the HMI and the HVM neon lamps. When the DC Link voltage crosses below 200 V the neon lamps start flashing with progressively lower frequency until going off completely.
   Wait until the DC Link voltage displayed at P0004 on the HMI gets below 25 V.

5. Press the emergency pushbutton located on the control column door and remove its key.

6. On the circuit breaker cabinet (switchgear) of the input transformer, switch off the switch disconnector and grounding of the inverter circuit. It is necessary to confirm visually the opening of the switch through the inspection window. Lock the cabinet and/or add warning sign indicating “System in maintenance”.

7. Switch off the Q2 circuit breaker in the control column and lock it in the open position with a padlock and/or put a warning sign indicating “System in maintenance”.

8. Switch off the Q1 circuit breaker in the control column. Remove the auxiliary power supply.

It is only after the sequence of procedures described above that high voltage compartment doors can be opened.

DANGER!
If it were not possible to follow the discharge of the DC Link capacitors through the parameter P0004, as well as through the HVM board neon lamps, due to a malfunction or a previous, de follow the instructions 5 through 8 and wait 10 minutes more.

9. Execute the procedures 2 and 3 of the Preventive Maintenance During Operation.

10. Clean the dust accumulated inside the control and high voltage cabinets as described next:

- Heatsink ventilation system (fans, rectifier and inverter arm heatsinks): remove the dust accumulated on the heatsink fins using compressed air.

- Electronic boards: remove the dust accumulated on the boards using an anti-static brush and / or low pressure ionized compressed air. If necessary, remove the boards from the inverter.

ATTENTION!
Electronic boards have components sensitive to electrostatic discharges. Do not touch the components or connectors directly. If necessary, first touch the grounded metallic frame or wear a proper grounded wrist strap.

- Cabinet inner part and other components: remove the accumulated dust using a vacuum cleaner with a nonmetallic nozzle. Perform this cleaning especially on the insulating materials that support energized parts to avoid leakage currents during operation.

11. Connection retightening: inspect all the electrical and mechanical connections and retighten them if necessary.

12. Reinstall all the removed components and connections in their respective places and follow the start-up procedures described in the Section 10.3 ENERGIZATION, START-UP AND SAFE DE-ENERGIZATION on page 10-17.

13.4 GENERAL WARRANTY CONDITIONS FOR MVW01 FREQUENCY INVERTERS MVW01

Weg Automação S.A, located at Av. Pref. Waldemar Grubba, 3000 in the city of Jaraguá do Sul – SC, provides warranty for defects in material and workmanship for WEG frequency inverters under the following conditions:

1. For the effectiveness of this warranty, it is essential that the buyer carefully inspects the purchased inverter immediately after its delivery, checking thoroughly its characteristics and installation, setting, operation and maintenance instructions. The inverter will be automatically considered as accepted and approved by the buyer when no written notice is given by the buyer within at most 5 days after the delivery date.

2. The total length of this warranty is of twelve months from the date of the supply by WEG or authorized dealer, proven through the purchase invoice of the equipment, and limited to twenty four months from the product manufacturing date, which is stated on the label attached to the product.

3. In case the inverter under warranty does not work properly or does not work at all, the warranty services may be performed during the business hours at WEG's sole discretion, at its headquarters in Jaraguá do Sul - SC, or at an Authorized Service Provider assigned by Weg Automation.

4. The defective product must be available to the supplier for the required period to detect the cause of the failure and to perform the corresponding repairs.

5. Weg Automação or an Authorized Service Provider will analyze the returned product, and, if any fault covered under the warranty is observed, they will repair, modify or replace the defective inverter at their own discretion, at not costs to the buyer, except as indicated in the Programming Manual available at **www.weg.net**.

6. The responsibility for this warranty is limited exclusively to the repair, modification or replacement of the inverter supplied. Weg takes no liabilities for personal injuries, damages to third parties, other equipment or installations, loss of profits, or any other incidental or consequential damages.

7. Other expenses, such as freights, packaging, disassembly/assembly and parameterization costs, will be paid exclusively by the buyer, including all working hours, transportation/accommodation and meal expenses for technical personnel, when service is needed and/or requested at the costumer's premises.

8. This warranty neither covers the normal wear of the product or equipment, nor damages resulting from incorrect or negligent operation, incorrect parameterization, improper maintenance or storage, abnormal operation in disagreement with the technical specifications, poor quality installations, or any influence of chemical, electrochemical, electrical, mechanical or atmospheric nature.

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