

Products Tde Macno

Installation
AFE (Active Front End)



Cod. MP00100E00 V_1.8



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1 AFE: CONNECTIONS DIAGRAM

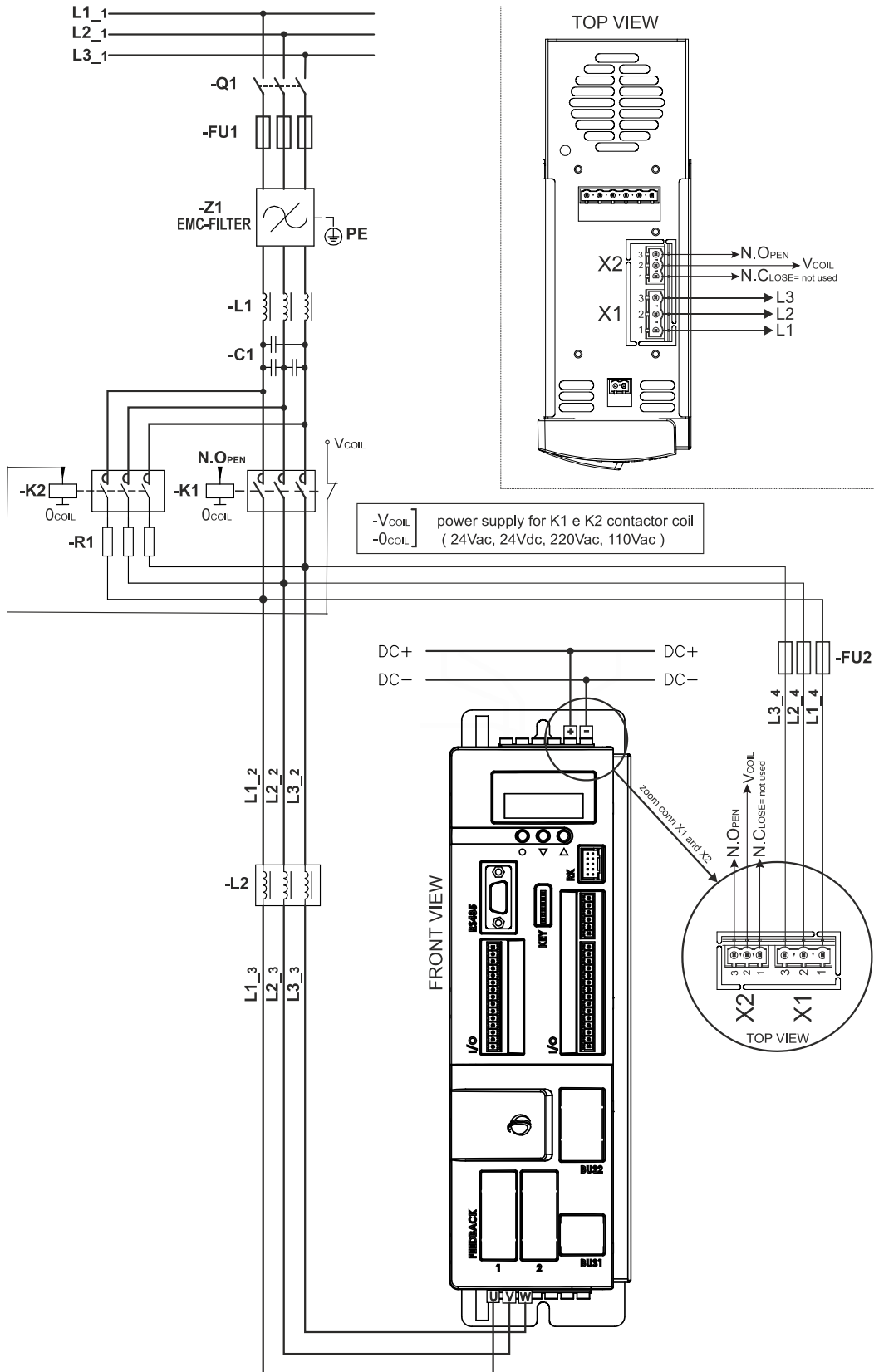


Figure 1A: AFE connections diagram OPDE 03A ÷ 07A

Note: 4S0016.2 feedback board for grid synchronisms should be inserted into the slot 1

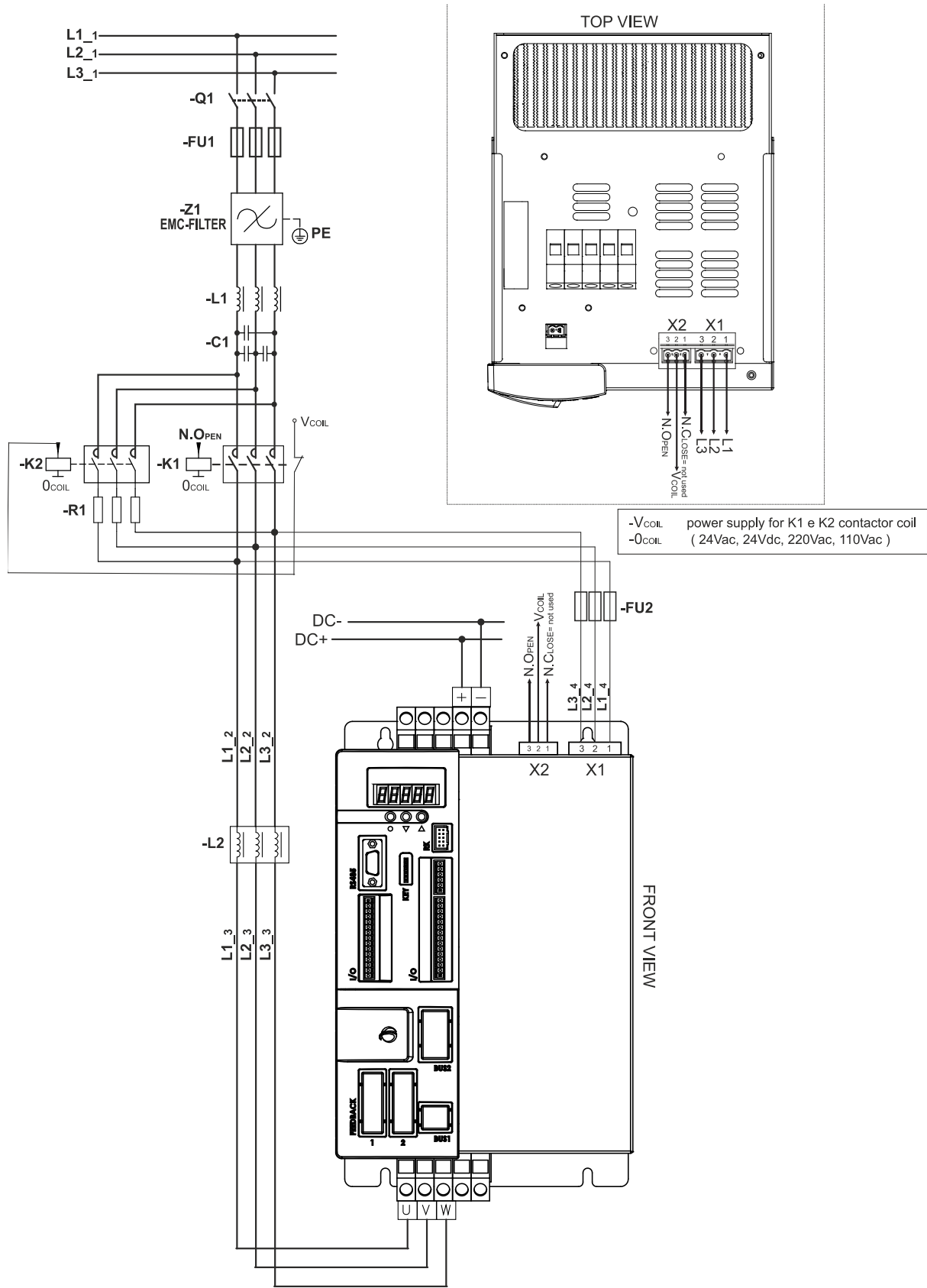


Figure 1B: AFE connections diagram OPDE 40A-60A

Note: 4S0016.2 feedback board for grid synchronisms should be inserted into the slot 1

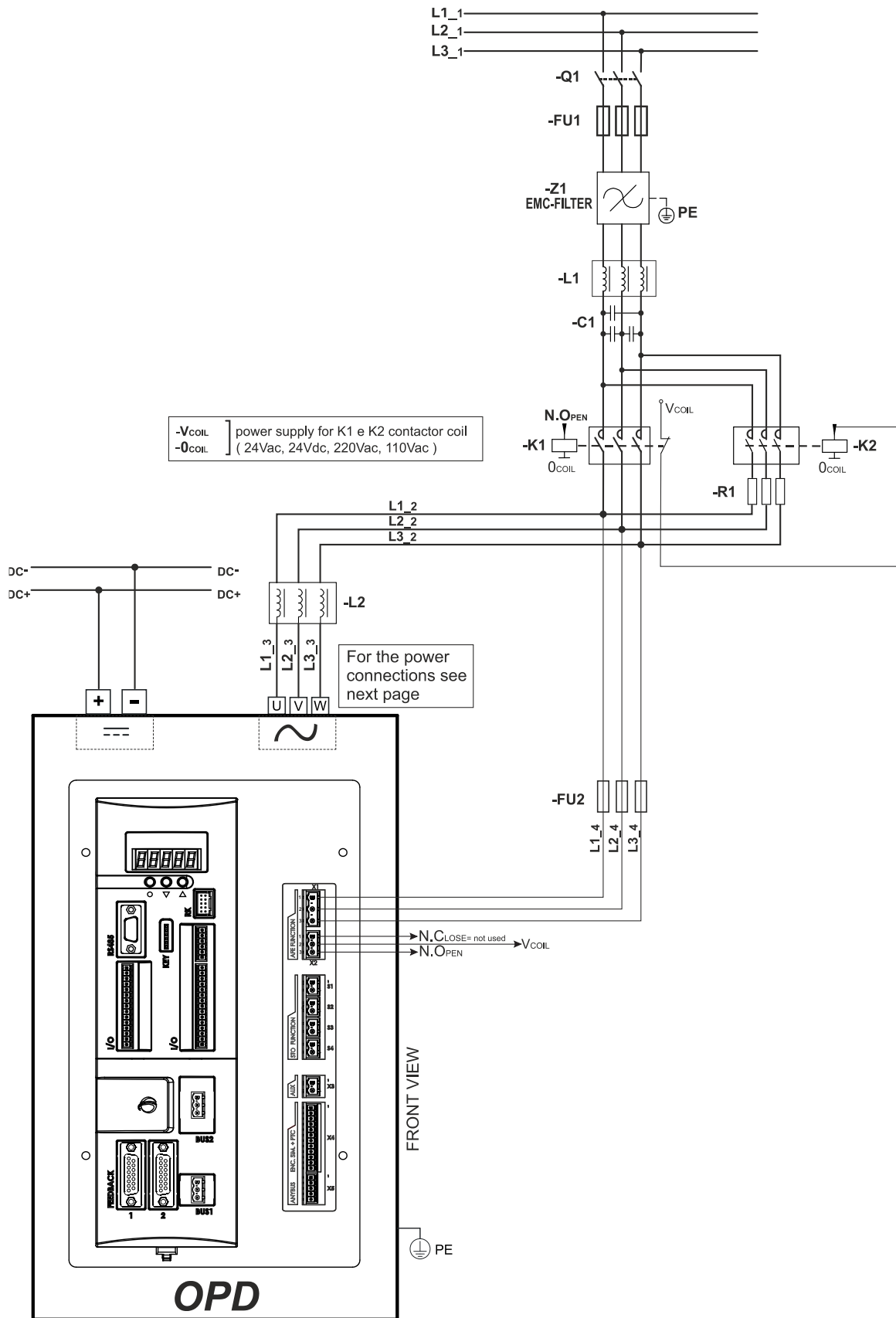
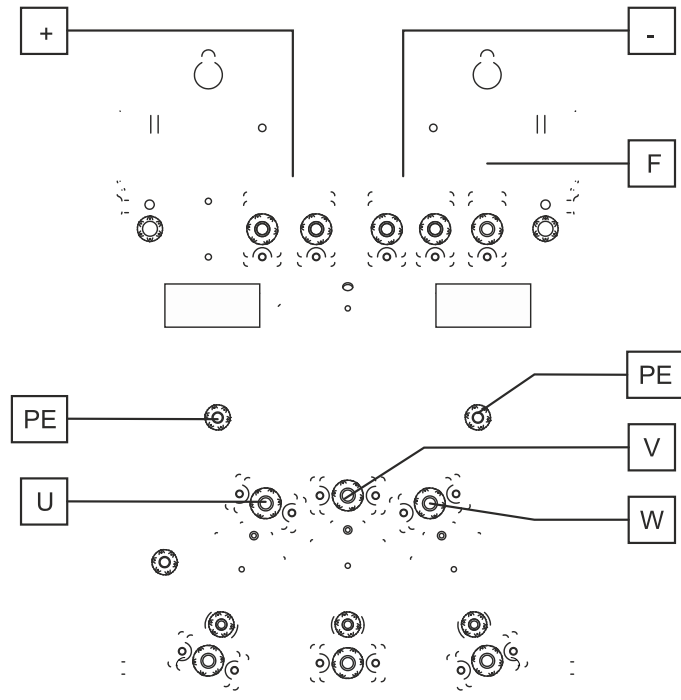


Figure 1C: AFE connections diagram OPDE 70A-460A

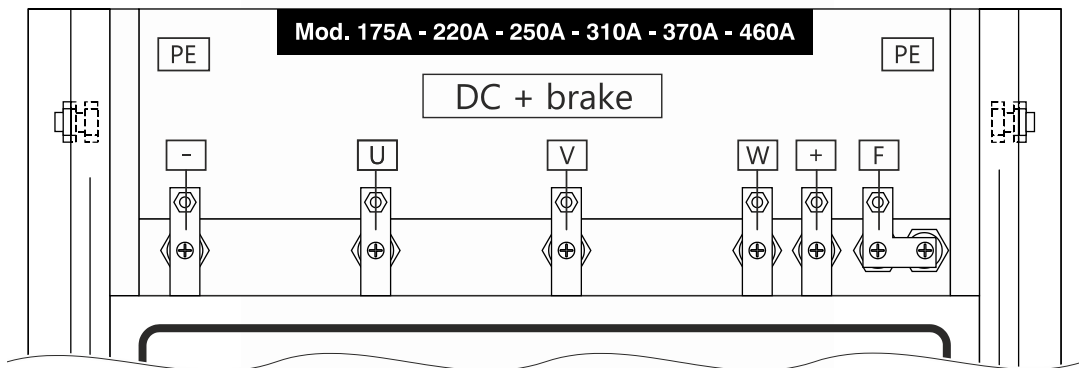
Note: 4S0016.2 feedback board for grid synchronisms should be inserted into the slot 1

Mod. 70A - 90A - 110A - 150A



Mod. 175A - 220A - 250A - 310A - 370A - 460A

DC + brake



Mod. 175A - 220A - 250A - 310A - 370A - 460A

DC brakeless

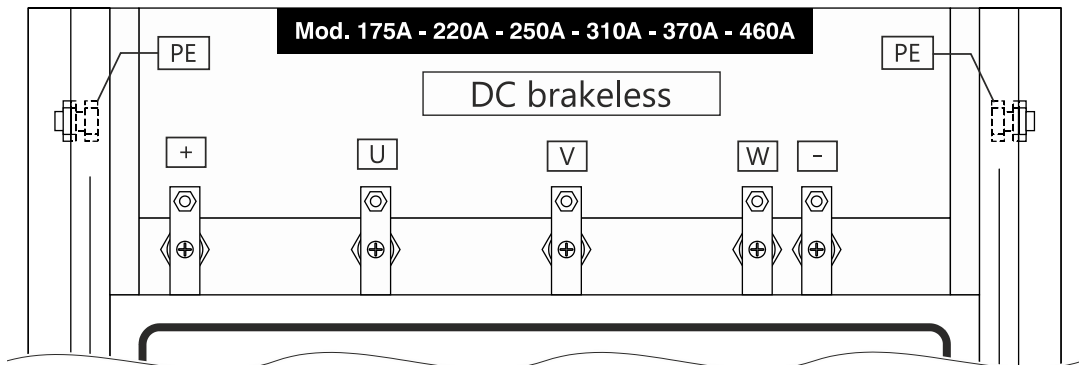


Figure 1D: AFE available power bars mod. 70A:460A

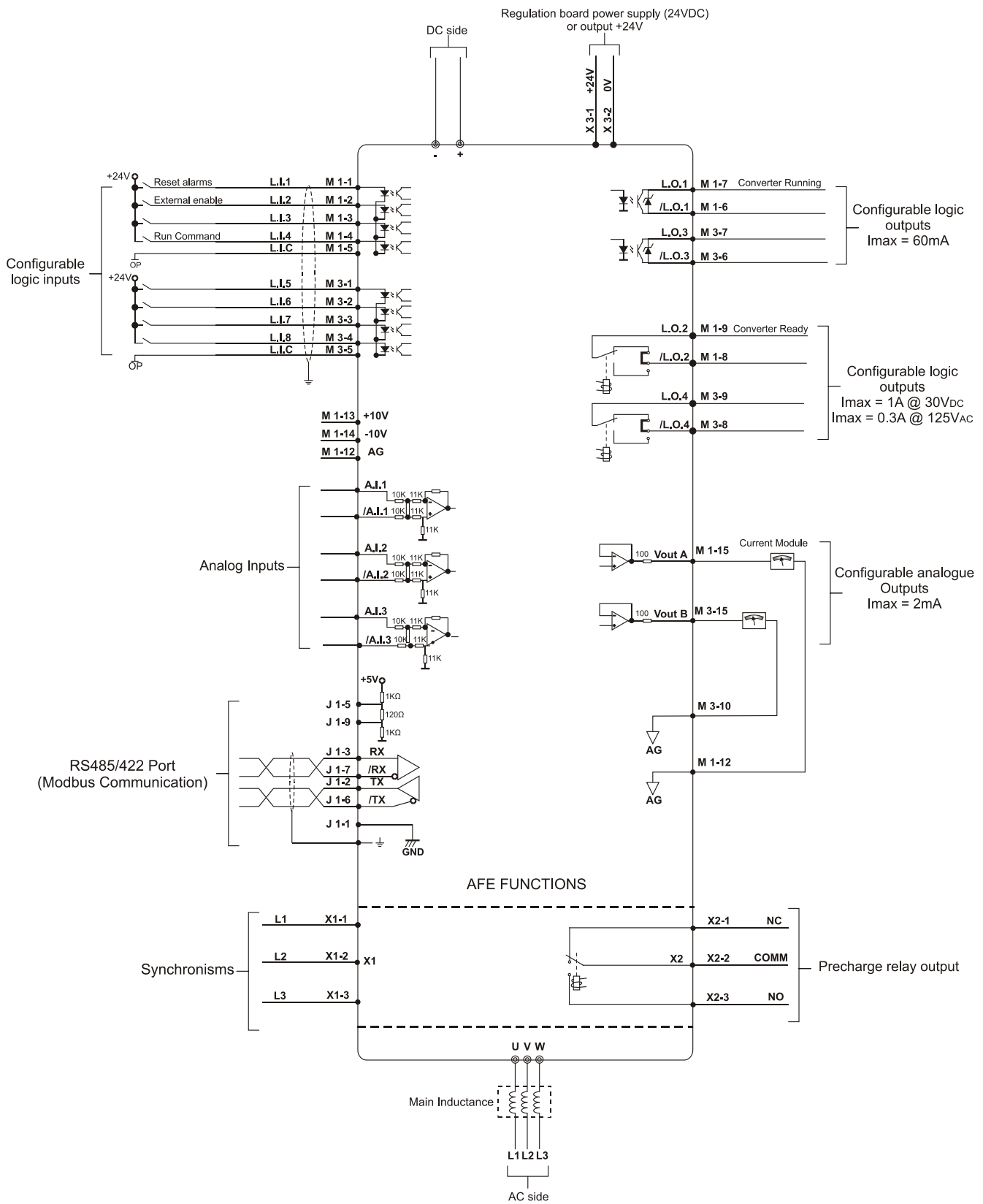



Figure 2: Electrical connections

FU1	Line fuses
FU2	Synchronisms fuses (2A gL-gG)
Z1	EMC filter group (if forecast)
L1	Optional line choke (foresee if the line drop is lower than 3%). (Table 6)
C1	Optional group of capacitors per Filter (500Hz/700Hz) (Table 7).
K1	Main contactor. It is normally open and it is closed only at the end of the soft-start (i.e. when the DC BUS is charged) and it can be commanded by the OPD output X2. Sizing (Table 2)
K2	Secondary contactor. It is normally closed and can open only once the soft-start of the DC BUS has been achieved. It can be controlled by the command outcoming from the X2 connector, only if the K1 contactor is closed. K2 is a contactor type AC-3, size up according to table 3.
R1	Resistors group for the soft-start of the DC BUS, size up according to table 4
L2	Main choke AFE (obligatory). Sizing according to Table

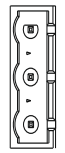
Table 2: Main components indicated in the AFE connections scheme

2 SYNCHRONISMS AND SOFT-START MANAGEMENT

2.1 X1 SYNCHRONISMS CONNECTOR DESCRIPTION

X1	PIN	FUNCTION	DESCRIPTION
	1	L1	Synchronism- U phase voltage
	2	L2	Synchronism- V phase voltage
	3	L3	Synchronism- W phase voltage

2.2 X2 MANAGEMENT SOFT-START CONNECTOR DESCRIPTION

X2	PIN	FUNCTION	DESCRIPTION
	1	N.C.	Close normally contact of end soft-start output relay. 4A/230V
	2	COMM.	Common normally contact of end soft-start output relay. 4A/230V
	3	N.O.	Open normally contact of end soft-start output relay . 4A/230V

The relay contact (N.O) at end of soft-start opens if:

- A.3.H alarm presence or;
- Vbus<P39 (min voltage DC for end soft-start) or;
- Vbus<P97 (minimum voltage level for forced grid off) or;
- Vgrid (mains)<P50 (minimum Vgrid)

3 CONTACTORS (K1,K2)

The choice of the main contactors (K1) must be made on the rated current of the AFE according to the instructions of the following table.

AFE size		Main Contactor (K1)	
		kW (400V) Rated power, three-phase motor at 50Hz	Rated Current In category of use AC-3
OPDE 03	1,5kW	< 4	< 9
OPDE 07	3kW	4	9
OPDE 12	5,5kW	5,5	12
OPDE 15	7,5kW	7,5	17
OPDE 22	11kW	11	25
OPDE 32	15kW	15	32
OPDE 40	18,5kW	18,5	40
OPDE 48	22kW	22	50
OPDE 60	30kW	30	65
OPDE 70	37kW	37	80
OPDE 90	45kW	45	95
OPDE 110	55kW	55	115
OPDE 150	75kW	75	150
OPDE 175	90kW	90	185
OPDE 220	110kW	110	225
OPDE 250	132kW	132	265
OPDE 310	160kW	160/200	300/400
OPDE 370	200kW	200	400
OPDE 460	250kW	250	500

Table 2: main contactor (K1)

The secondary contactor (K2) must be sized according to the following table (the currents involved are those of the capacitors soft-start in the DC Bus). In the right column the Ohmic value of the soft-start resistors is indicated (minimum values) .

AFE size		Secondary Contactor (K2)		
		kW (400V) Rated Power, three- phase motor at 50Hz	Rated current In category of use AC-3	Main Resistor [Ω] (minimum value)
OPDE 03	1,5kW	<4	<9	110
OPDE 07	3kW	<4	<9	110
OPDE 12	5,5kW	<4	<9	63
OPDE 15	7,5kW	<4	<9	63
OPDE 22	11kW	<4	<9	38
OPDE 32	15kW	<4	<9	29
OPDE 40	18,5kW	4	9	25
OPDE 48	22kW	4	9	23
OPDE 60	30kW	4	9	23
OPDE 70	37kW	4	9	23
OPDE 90	45kW	5.5	12	15
OPDE 110	55kW	5.5	12	11
OPDE 150	75kW	5.5	12	8
OPDE 175	90kW	7.5	17	5
OPDE 220	110kW	7.5	17	5
OPDE 250	132kW	11	25	4
OPDE 310	160kW	11	25	4
OPDE 370	200kW	11	25	4
OPDE 460	250kW	15	32	3

Table 3: secondary contactor (K2)

4 SOFT-START RESISTORS (GROUP R1)

The function of the soft-start resistors of the DC BUS is to limit the currents when the AFE is connected to the mains. In the following table the resistors calculated, supposing an AFE unit coupled with an inverter of the same power (concurrent factor = 1).

Each resistor must dissipate the energy indicated in the table in an adiabatic way , the value in Watts is only indicative.

AFE size	ENERGY [Joule]	WATT (indicative)		R [Ω] Minimum value	Commercial resistor (I.R.E. RFH)	TDE Macno Code
OPDE 03	1,5kW	3 X 180	3 X 10	110	RFH75 120 Ohm 150W	02M5N1200
OPDE 07	3kW	3 X 180	3 X 10	110	RFH75 120 Ohm 150W	02M5N1200
OPDE 12	5,5kW	3 X 310	3 X 20	63	RFH75 82 Ohm 150W	02M5N0820
OPDE 15	7,5kW	3 X 310	3 X 20	63	RFH75 82 Ohm 150W	02M5N0820
OPDE 22	11kW	3 X 520	3 X 30	38	RFH75 47 Ohm 150W	02M5N0470
OPDE 32	15kW	3 X 880	3 X 50	29	RFH75 47 Ohm 150W	02M5N0470
OPDE 40	18,5kW	3 X 1100	3 X 50	25	RFH75 47 Ohm 150W	02M5N0470
OPDE 48	22kW	3 X 1600	3 X 60	23	RFH75 47 Ohm 150W	02M5N0470
OPDE 60	30kW	3 X 1800	3 X 80	23	RFH75 47 Ohm 150W	02M5N0470
OPDE 70	37kW	3 X 1800	3 X 80	23	RFH75 47 Ohm 150W	02M5N0470
OPDE 90	45kW	3 X 1800	3 X 80	15	RFH100 15 Ohm 200W	02M6N0151
OPDE 110	55kW	3 X 2500	3 X 100	11	RFH100 15 Ohm 200W	02M6N0151
OPDE 150	75kW	3 X 3500	3 X 150	8	RFH100 15 Ohm 200W	02M6N0151
OPDE 175	90kW	3 X 5000	3 X 200	5	RFH100 5 Ohm 200W	02M6N9500
OPDE 220	110kW	3 X 5000	3 X 200	5	RFH100 5 Ohm 200W	02M6N9500
OPDE 250	132kW	3 X 7100	3 X 300	4	RFH220 4 Ohm 400W	02M7N9400
OPDE 310	160kW	3 X 7100	3 X 300	4	RFH220 4 Ohm 400W	02M7N9400
OPDE 370	200kW	3 X 7300	3 X 300	4	RFH220 4 Ohm 400W	02M7N9400
OPDE 460	250kW	3 X 10000	3 X 400	3	RFH220 3 Ohm 400W	02M8N9300

Table 4: soft-start resistors

5 L2 MAIN CHOKE (MANDATORY)

The table shows the main chokes for AFE.

AFE size		Fpwm [kHz]	In [A]	Choke 3-phase [mH]*	RMS thermal current [A]	RMS overload current [A]	THD (leff. thermal %) [%]	TDE Code	
OPDE 03	1,5kW	5	3,2	32,161	3,4	5,0	3,57	054R44007	RET44007
OPDE 07	3kW	5	7,4	13,907	7,8	11,7	3,57	054R44008	RET44008
OPDE 12	5,5kW	5	12,6	8,168	13,2	19,8	3,57	054R44009	RET44009
OPDE 15	7,5kW	5	15,8	6,514	16,6	24,9	3,57	054R44010	RET44010
OPDE 22	11kW	5	23,2	4,436	24,4	36,5	3,57	054R44011	RET44011
OPDE 32	15kW	5	33,7	3,054	35,4	53,1	3,57	054R44012	RET44012
OPDE 40	18,5kW	5	42,2	2,439	44,3	66,5	3,57	054R44013	RET44013
OPDE 48	22kW	5	48,5	2,122	50,9	76,4	3,57	054R44014	RET44014
OPDE 60	30kW	5	60,6	1,698	63,6	95,4	3,57	054R44015	RET44015
OPDE 70	37kW	5	70,6	1,458	74,1	111,2	3,57	054R44016	RET44016
OPDE 90	45kW	5	91,7	1,122	96,3	144,4	3,57	054R44017	RET44017
OPDE 110	55kW	5	105,4	0,976	110,7	166,0	3,57	054R44018	RET44018
OPDE 150	75kW	4	147,6	0,697	155,0	232,5	4,46	054R44019	RET44019
OPDE 175	90kW	5	173,9	0,592	182,6	273,9	3,57	054R44020	RET44020
OPDE 220	110kW	5	221,3	0,465	232,4	348,5	3,57	054R44021	RET44021
OPDE 250	132kW	5	250,9	0,410	263,4	395,2	3,57	054R44022	RET44022
OPDE 310	160kW	5	310	0,332	325,4	488,1	3,57	054R44023	RET44023
OPDE 370	200kW	5	370	0,279	387,3	581,0	3,57	054R44024	RET44024
OPDE 460	250kW	3	455	0,221	488,0	732,1	5,95	054R44025	RET44025

Table 5: main choke

*choke value to 14%

6 SECONDARY CHOKE L1 (OPTIONAL FOR 500HZ/700HZ FILTER)

AFE size		In [A]	Choke 3-phase [mH]*	RMS thermal current [A]	RMS overload current [A]	TDE code	
OPDE 03	1,5kW	3,2	6,891	3,4	5,0	054R44026	RET44026
OPDE 07	3kW	7,4	2,980	7,8	11,7	054R44027	RET44027
OPDE 12	5,5kW	12,6	1,750	13,2	19,8	054R44028	RET44028
OPDE 15	7,5kW	15,8	1,395	16,6	24,9	054R44029	RET44029
OPDE 22	11kW	23,2	0,950	24,4	36,5	054R44030	RET44030
OPDE 32	15kW	33,7	0,654	35,4	53,1	054R44031	RET44031
OPDE 40	18,5kW	42,2	0,522	44,3	66,5	054R44032	RET44032
OPDE 48	22kW	48,5	0,454	50,9	76,4	054R44033	RET44033
OPDE 60	30kW	60,6	0,363	63,6	95,4	054R44034	RET44034
OPDE 70	37kW	70,6	0,312	74,1	111,2	054R44035	RET44035
OPDE 90	45kW	91,7	0,240	96,3	144,4	054R44036	RET44036
OPDE 110	55kW	105,4	0,209	110,7	166,0	054R44037	RET44037
OPDE 150	75kW	147,6	0,149	155,0	232,5	054R44038	RET44038
OPDE 175	90kW	173,9	0,126	182,6	273,9	054R44039	RET44039
OPDE 220	110kW	221,3	0,099	232,4	348,5	054R44040	RET44040
OPDE 250	132kW	250,9	0,087	263,4	395,2	054R44041	RET44041
OPDE 310	160kW	310	0,071	325,4	488,1	054R44042	RET44042
OPDE 370	200kW	370	0,059	387,3	581,0	054R44043	RET44043
OPDE 460	250kW	455	0,047	488,0	732,1	054R44044	RET44044

Table 6: secondary choke (L1)

*choke value to 3%

7 FILTER CAPACITORS (C1) 500HZ/700HZ

AFE size		L2 [uH]	C1 (500Hz) [uF]	C1 (700Hz) [uF]	TDE Code	
OPDE 03	1,5kW	6891	1,1	0,5	C44APFP4100ZA0J	
OPDE 07	3kW	2980	2,4	1,2	C44APFP4150ZA0J	06EPA2150 (1,5µF)
OPDE 12	5,5kW	1750	4,1	2,1	C44APFP4300ZB0J	06EJA2300 (3µF)
OPDE 15	7,5kW	1395	5,2	2,6	C44APFP4300ZB0J	06EJA2300 (3µF)
OPDE 22	11kW	950	7,6	3,9	C44AJFP4500ZA0J	06EJA2500 (5µF)
OPDE 32	15kW	654	11,1	5,6	C44AJFP5100ZA0J	06EJA3100 (10µF)
OPDE 40	18,5kW	522	13,8	7,1	C44AJFP5100ZA0J	06EJA3100 (10µF)
OPDE 48	22kW	454	15,9	8,1	C44AJFP5100ZA0J	06EJA3100 (10µF)
OPDE 60	30kW	363	19,9	10,1	C44AJFP5100ZA0J	06EJA3100 (10µF)
OPDE 70	37kW	312	23,2	11,8	C44AJFP5100ZA0J	06EJA3100 (10µF)
OPDE 90	45kW	240	30,1	15,4	C44AJGP5250ZA0J	06EJA3250 (25µF)
OPDE 110	55kW	209	34,6	17,6	C44AJGP5250ZA0J	06EJA3250 (25µF)
OPDE 150	75kW	149	48,4	24,7	C44AJGP5250ZA0J	06EJA3250 (25µF)
OPDE 175	90kW	126	57,1	29,1	C44AJGP5500ZA0J	06EJA3500 (50µF)
					SRWT750153C1000	06F0400005 (50µF)
OPDE 220	110kW	99	72,6	37,1	C44AJGP5500ZA0J	06EJA3500 (50µF)
					SRWT750153C1000	06F0400005 (50µF)
OPDE 250	132kW	87	82,3	42,0	C44AJGP5500ZA0J	06EJA3500 (50µF)
					SRWT750153C1000	06F0400005 (50µF)
OPDE 310	160kW	71	101,7	51,9	C44AJGR5750ZA0J	06EJA3750 (75µF)
					SRWT750153C1000	06F0400005 (50µF)
OPDE 370	200kW	59	121,1	61,8	C44AJGR5750ZA0J	06EJA3750 (75µF)
					SRWT150253C2000	06F0400003 (100µF)
OPDE 460	250kW	47	238,3 ⁽²⁾	152,5 ⁽³⁾	2 x C44AJGR5750ZA0J ⁽¹⁾	2 x 06EJA3750 (75µF) ⁽¹⁾
					SRWT225253C3000	06F0400004 (150µF)

Table 7: filter capacitors (C1) 500 / 700Hz

- (1) Two parallel capacitors
- (2) 400Hz
- (3) 500Hz

Phase-Phase filter capacitors (C1) must be selected with values between C1(500Hz) and C1(700Hz) (Table 7). Choose AC filter Application capacitors (ex. ARCOTRONICS series MKP 700V-50Hz).

8 AFE FUSES

AFE size		FUSES [A] ⁽¹⁾	VOLTAGE [AC]	Maximum I ² T [A ² s] for AC input
OPDE 03	1,5kW	5-16	480	120
OPDE 07	3kW	10-16	480	120
OPDE 12	5,5kW	16-25	480	1200
OPDE 15	7,5kW	20-32	480	1200
OPDE 22	11kW	25-40	480	1200
OPDE 32	15kW	40-63	480	1200
OPDE 40	18,5kW	50-63	480	2750
OPDE 48	22kW	50-80	480	3900
OPDE 60	30kW	80-100	480	3900
OPDE 70	37kW	80-125*	480	7500
OPDE 90	45kW	100-140*	480	9000
OPDE 110	55kW	125-160*	480	40000
OPDE 150	75kW	160-200	480	62500
OPDE 175	90kW	200-250	480	62500
OPDE 220	110kW	250-315	480	160000
OPDE 250	132kW	315-350	480	160000
OPDE 310	160kW	350-400	480	562500
OPDE 370	200kW	400-450	480	562500
OPDE 460	250kW	500	480	562500
(*) The fuse rated current must be greater than grid rated current (¹) All fuses for AC grid input must be fast				

Table 8: AFE fuses

ATTENTION: The minimum values of the fuses are calculated for the converter that delivers the rated power

NOTE: The fuses are calculated for a minimum short-circuit current of the 10 times the rated current. The maximum short-circuit current must not be greater than 20 times the rated current.

9 SECTIONS AFE POWER CABLES

Sections of power cables are calculated according EN60204-1, class B1 installation, operating temperature of 40° and at rated power of the drive.

AFE size		POWER CABLES AC side [mm ²]	POWER CABLES DC side [mm ²]	PE protection cables [mm ²]
OPDE 03	1,5kW	1,5	1,5	1,5 (1,5)
OPDE 07	3kW	1,5	1,5	1,5 (1,5)
OPDE 12	5,5kW	2,5	2,5	2,5 (2,5)
OPDE 15	7,5kW	4	4	4 (4)
OPDE 22	11kW	6	6	6 (6)
OPDE 32	15kW	10	10	10 (10)
OPDE 40	18,5kW	10	10	10 (10)
OPDE 48	22kW	16	16	16 (16)
OPDE 60	30kW	16 / 25	25	16 / 25 (16)
OPDE 70	37kW	35	35	25 / 35 (25)
OPDE 90	45kW	35	35	25 / 35 (25/35)
OPDE 110	55kW	35 / 50	50	25 / 35 (35)
OPD 150	75kW	70	70	50 (50)
OPDE 175	90kW	90	90	50 (50)
OPDE 220	110kW	120	120	70 (70)
OPDE 250	132kW	150	150	70 (70)
OPDE 310	160kW	180 / 2x90	180 / 2x90	90 (90)
OPDE 370	200kW	240 / 2x120	240 / 2x120	120 (90)
OPDE 460	250kW	2x150	2x150	150 (150)

Table 9: AFE power cables

()DC side

10 APPENDIX A: FFE (C.00=1)

The term **FFE** (*Fundamental Front End*) refers to a bidirectional AC-DC converter in which DC Voltage is not controlled. It functions as a diode Bridge but with the recovery of energy to the grid. It only works on the fundamental component (50-60Hz) with no PWM modulation.

The hardware of the converter is the same of the AFE converter (the FFE function can be enabled by setting and saving c.00=1). RUN command is needed to enable the IGBTs, with no RUN command enabled the converter acts as a diode bridge with no regeneration.

The advantage is the reduction of the losses (no switching losses), with an improvement of current available, furthermore, the fact of not having PWM modulation allows to have a smaller inductance line side and no LC filter required.

No bus regulation and no sinusoidal currents (THD similar to diode bridge) are the limits of the converter.

In comparison to the AFE, the installation diagram for FFE is simplified because the inductance is reduced and the LC filter is no longer needed. The precharge circuit and the connections of the synchronism are quite similar to those of the AFE.

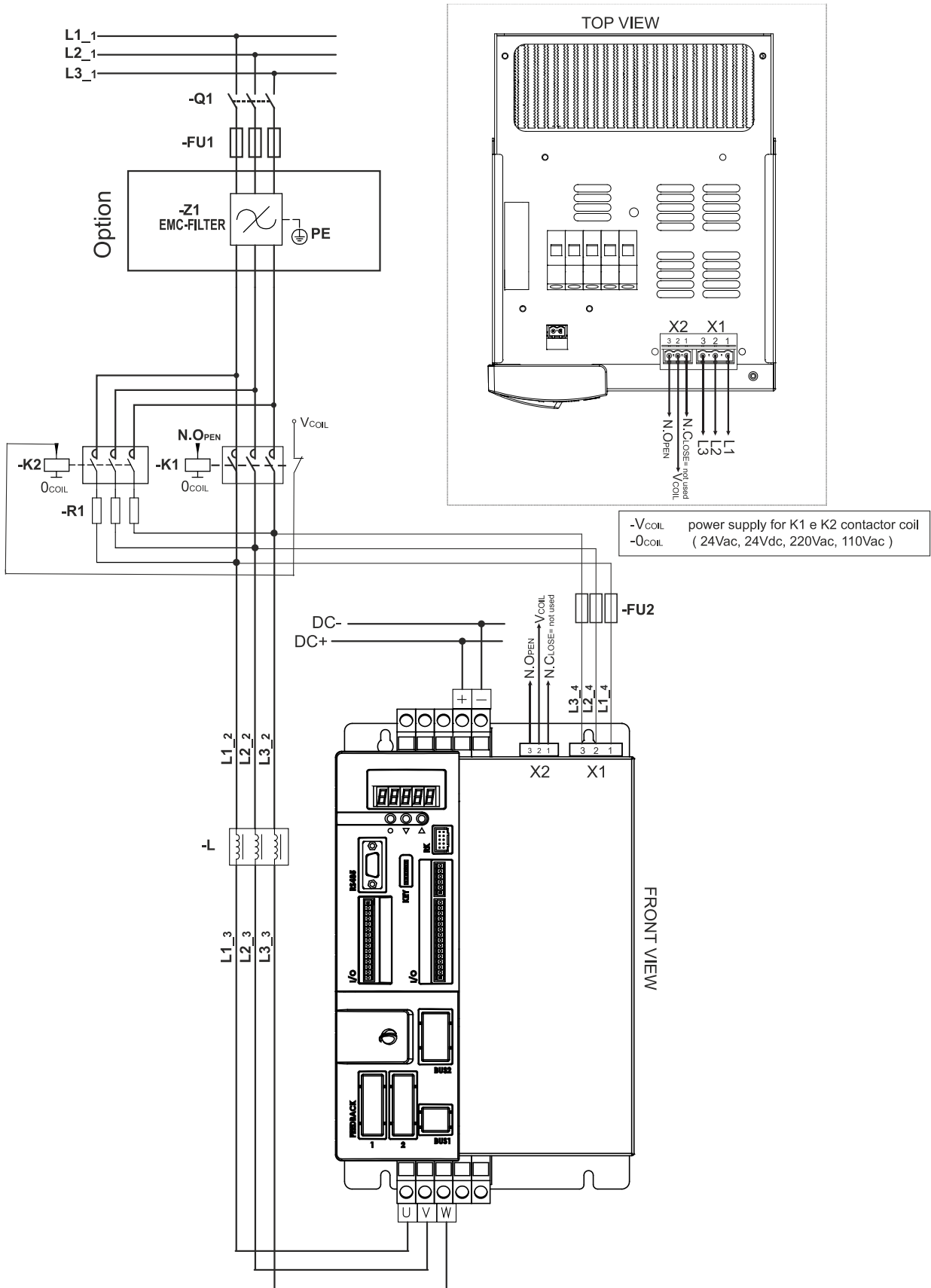


Figure 3: FFE connections diagram ODPE 60A

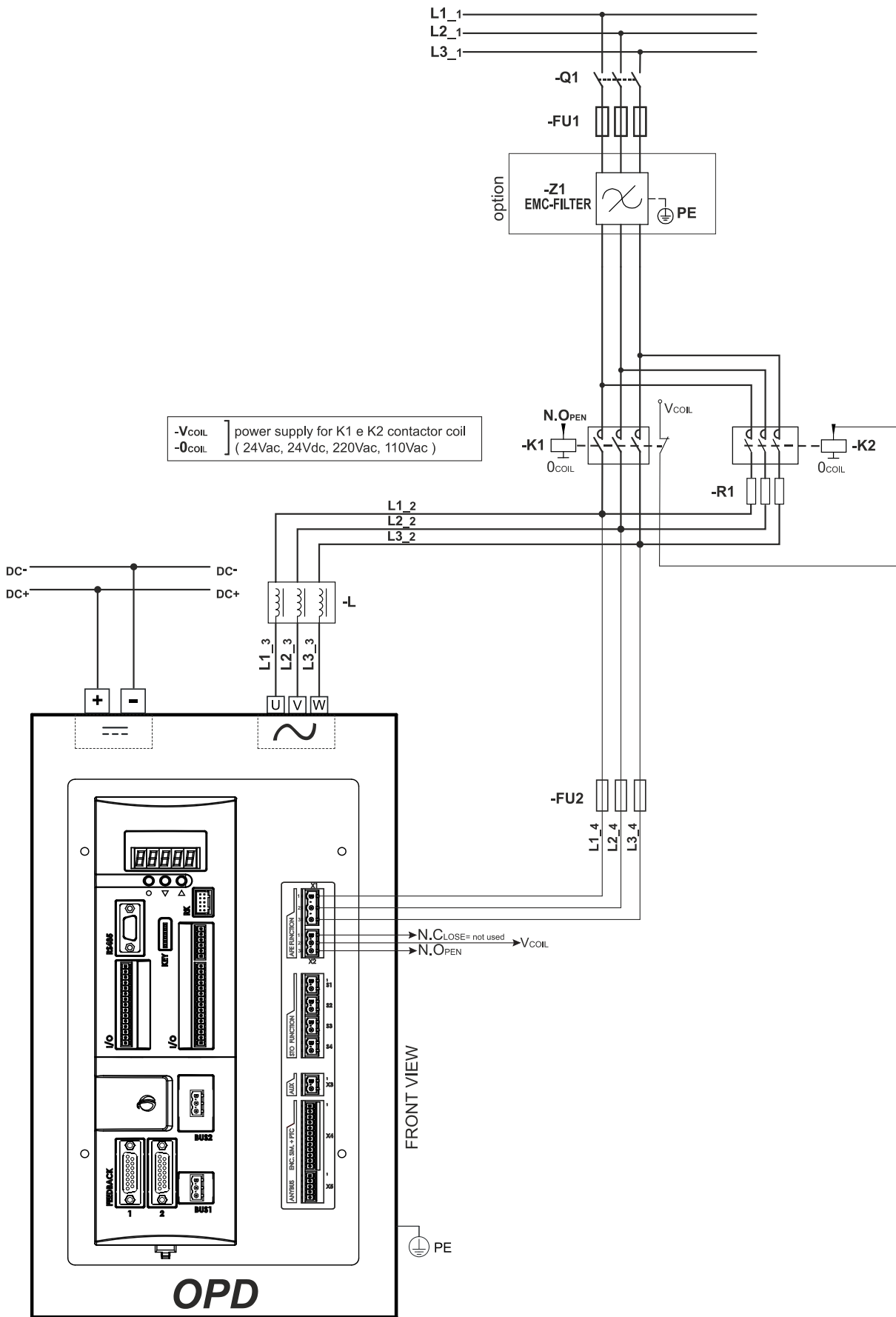


Figure 4: FFE connections diagram ODPE 70A:460A

10.1 FFE INPUT CHOKE -L

The table shows the input chokes for FFE

FFE size	Power (120%)	In [A]	L required [mH]	Choke 3-phase [mH]	Nominal Current thermal [A]	Saturation RMS current [A]	TDE Macno code	
OPDE 60	47kW	68,1	0,324	0,299	81,2	216,3	054RH037T	RET97037
OPDE 90	71,4kW	103,0	0,214	0,217	111,5	297,0	054RH040T	RET97040
OPDE 110	81,8kW	118,4	0,186	0,176	137,7	276,0	054R39027	RET39027
OPDE 175	135kW	195,4	0,113	0,123	197,1	524,9	054RH043T	RET97043
OPDE 250	194kW	281,8	0,078	0,085	286,3	762,3	054RH045T	RET97045
OPDE 310	241kW	348,1	0,063	0,068	357,6	952,2	054RH046T	RET97046
OPDE 460	361kW	522,0	0,042	0,045	535,8	1426,9	054RH048T	RET97048



ECS
TDE MACNO

Via dell'Oreficeria, 41
36100 Vicenza - Italy
Tel +39 0444 343555
Fax +39 0444 343509
www.bdfdigital.com