13.5. OPTIONAL INPUT-OUTPUT REACTORS

13.5.1. INPUT REACTOR

We suggest that a three-phase inductance, or a DCBUS DC inductance be installed on the supply line to obtain the following benefits:
- limit input current peaks on the input circuit of the inverter and value di/dt due to the input rectifier and to the capacitive load of the capacitors set;
- reducing supply harmonic current;
- increasing power factor, thus reducing line current;
- increasing the duration of line capacitors inside the inverter.

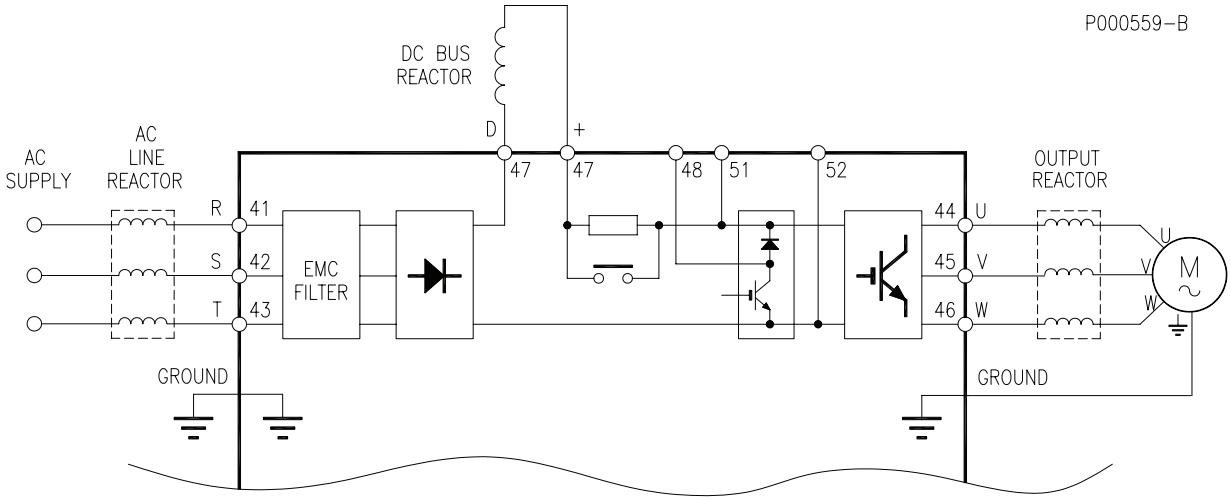
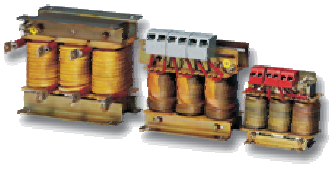


Fig. 56: Wiring diagram for optional inductance

Harmonic current



The shapes of the different waves (current or voltage) may be expressed as the sum of the basic frequency (50 or 60Hz) and its multiples. In balanced, three-phase systems, only odd harmonic current exists, as even current is neutralized by symmetrical considerations.
Harmonic current is generated by non linear loads absorbing non-sinusoidal current. Typical sources of this type are bridge rectifiers (power electronics), switched mode power supply and fluorescent lamps. Three-phase rectifiers absorb line current with a harmonic content n=6K±1 with K=1,2,3,... (e.g. 5th,7th,11th,13th,17th,19th, etc.). Harmonic current amplitude decreases when frequency increases. Harmonic current carries no active power; it is additional current carried by electrical cables. Typical effects are: conductor overload, power factor decrease and measurement systems instability. Voltage generated by current flowing in the transformer reactance may also damage other appliances or interfere with mains-synchronized switching equipment.

Solving the problem

Harmonic current amplitude decreases when frequency increases; as a result, reducing high-amplitude components determines the filtering of low-frequency components. The better way is to increase low-frequency impedance by installing an inductance. Power drive systems with no mains-side inductance generate larger harmonic currents than power drives which do have an inductance. Unlike DC inductance, AC inductance suppresses most harmonic currents and protects the rectifier from supply voltage peaks.
For >500kW drives, a *12-pulse* inductance is normally used. This suppresses the lowest harmonic current in the supply line. In a 12-pulse inductance, the lowest harmonics are the 11th and the 13th, followed by the 23rd, the 25th and so on, with their relevant low levels. The supply current shape is very similar to a sinusoid. A different solution to suppress this problem consists in powering the inverter with DC voltage supply using a regenerative inverter: current absorbed by the mains is perfectly sinusoidal, and the regenerative inverter recovers energy to the mains when the motor is regenerating.

NOTE DC-side inductance can be connected only to inverters sizes from S15 on (to be stated when ordering the equipment).

NOTE When a DC-side inductance is used, it is sometimes possible that no braking resistor or external braking unit can be connected to the inverter.

Harmonic currents

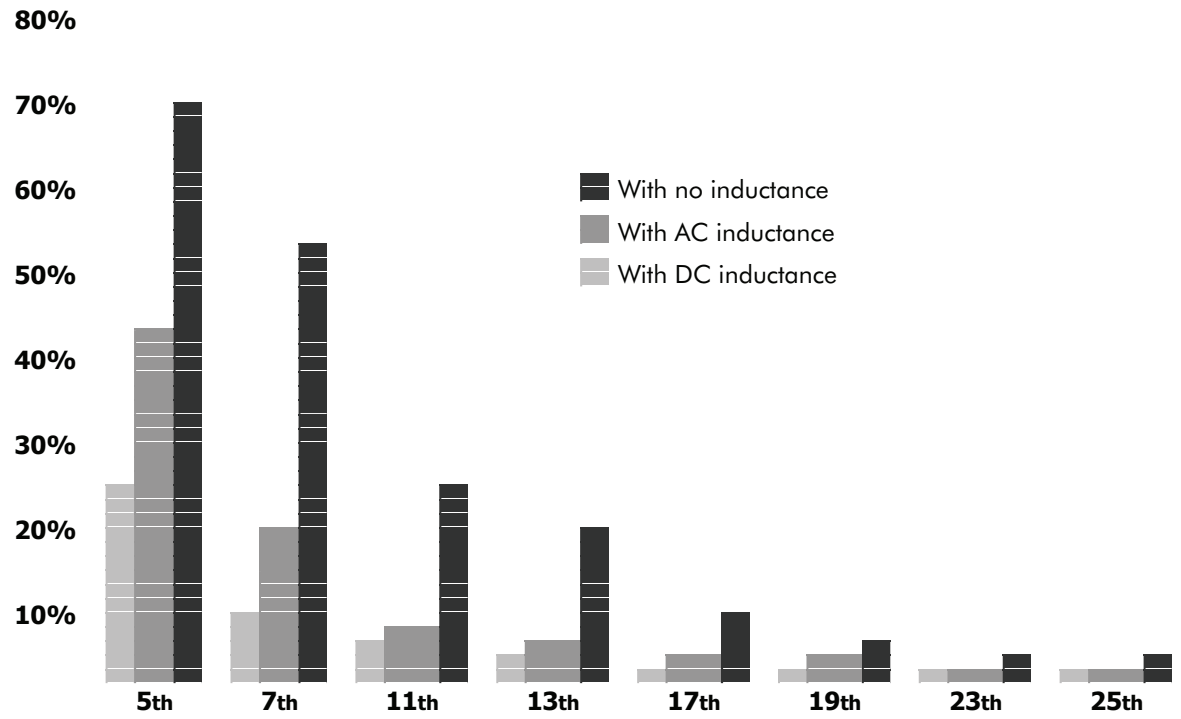


Fig. 57: Harmonic currents:

NOTE

The amplitude of harmonic currents and their distortion of the mains voltage is strongly affected by the features of the mains where the equipment is installed. The ratings stated in this manual fit most applications. For special applications, please contact Elettronica Santerno's After-sales service.

CAUTION

For inverter sizes lower than S40 included, always use an input inductance under the following circumstances: mains instability; converters installed for DC motors; loads generating strong voltage variations at startup; power factor correction systems; mains rated power exceeding 500 KVA.
Always activate a line inductance for inverter sizes higher than S50, unless the inverter is powered via a dedicated transformer.

The ratings of optional inductance recommended based on the inverter size are detailed in section 13.5.4.

13.5.2. 12-PHASE CONNECTION

For >500kW drives, a *12-pulse* rectifier is normally used. This suppresses the lowest harmonic current in the supply line.
A 12-pulse inductance suppresses 5th and 7th harmonics; harmonics left are the 11th and the 13th, followed by the 23th, the 25th and so on, with their relevant low levels. The supply current shape is very similar to a sinusoid.

In that case, a dedicated transformer is needed, along with a specific interphase inductance for current balance and an additional diode bridge installed outside the inverter (two supply modules are needed for modular inverters)

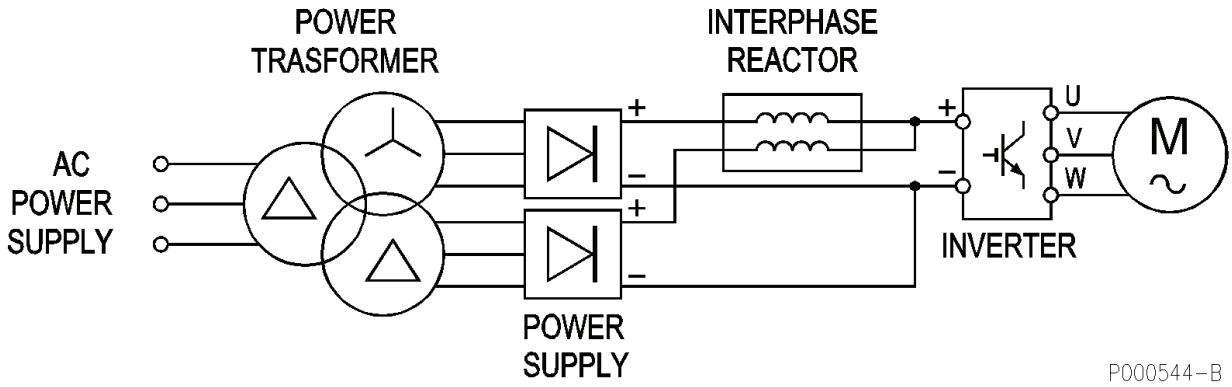


Fig. 58: Layout of a 12-phase connection

13.5.3. OUTPUT REACTOR

Installations requiring a longer distance between the inverter and the motor may cause overcurrent protections to frequently trip. This is due to the wire parasite capacity generating current pulses at the inverter output. This current peak may be limited by an inductance installed on the inverter output. Screened cables even have a higher capacity and may have problems with a shorter length. The recommended output inductance is the same that can be installed at the inverter input (see previous section). The max. distance between the motor and the inverter is given as an example, as parasite capacity is also affected by the type of wiring path and wiring system. For instance, when several inverters and their connected motors are networked, segregating the inverter wires from the motor wires will avoid capacitive couplings between the wiring of each motor. In that case, a reactance should be installed at the output of each inverter.

Motor wiring with unscreened cables

2-4-6-pole MOTORS

Size							
Up toS10							
Up toS30							
Up toS40							
FromS40							
Cable Length	30	60	90	120	150	> 150	**mt.**

8-10 pole MOTORS

Size						
Up toS10						
Up toS30						
Up toS40						
FromS40						
Cable Length	30	60	90	120	>120	**mt.**

Output inductance is not required
Output inductance is required

CAUTION

Inductance stated in the tables above may be used when the inverter output frequency does not exceed 60 Hz. For a higher output frequency a special inductance for the max. allowable operating frequency must be used; please contact Elettronica Santerno S.p.A.

NOTE

When using > 10 - pole motors an output inductance is always required.

NOTE

When using parallel-connected motors, always consider the total length of the cables being used (sum of the cable length of each motor).

Motor wiring with screened cables

2-4-6-pole MOTORS

Size					
Up toS10					
Up toS30					
Up toS40					
FromS40					
Cable Length	20	40	80	>80	**mt.**

8-10 pole MOTORS

Size						
Up toS10						
Up toS30						
Up toS40						
FromS40						
Cable Length	20	40	60	80	> 80	**mt.**

Output inductance is not required
Output inductance is required

CAUTION Inductance stated in the tables above may be used when the inverter output frequency does not exceed 60 Hz. For a higher output frequency a special inductance for the max. allowable operating frequency must be used; please contact Elettronica Santerno S.p.A.

NOTE When using > 10 - pole motors an output inductance is always required.

NOTE When using parallel-connected motors, always consider the total length of the cables being used (sum of the cable length of each motor).

Always use an output inductance for >= 10-pole motors or parallel-connected motors controlled by a single inverter

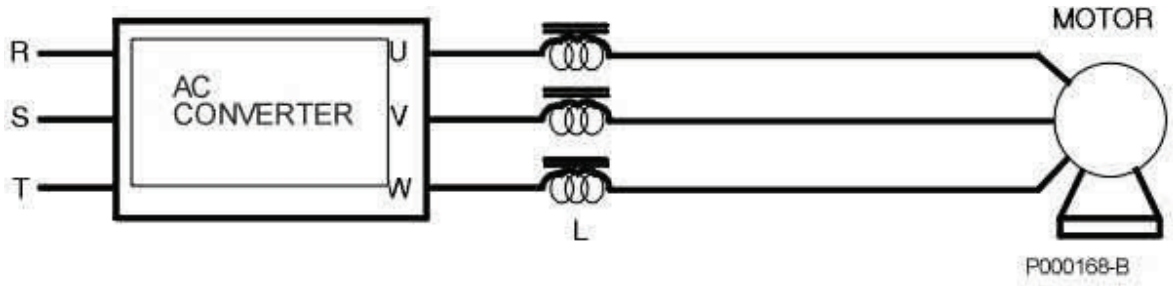


Fig. 59: Connection of an Output Inductance

13.5.4. REACTORS RATINGS TYPE "L2"

CLASS 2T - 4T

SIZE INVERTER	INVERTER MODEL	INPUT 3-PHASE AC INDUCTANCE MODEL	SINGLE-PHASE DC INDUCTANCE MODEL	OUTPUT INDUCTANCE MODEL
S05	0005	IM0126004 2.0 mH – 11 A	Not applicable	IM0126004 2.0 mH – 11 A (AC 3-PHASE)
	0007	IM0126044 1.27 mH – 17 A	Not applicable	IM0126044 1.27 mH – 17 A (AC 3-PHASE)
	0009			
	0011			
	0014			
S10	0016	IM0126084 0.7 mH – 32 A	Not applicable	IM0126084 0.7 mH – 32 A (AC 3-PHASE)
	0017			
	0020			
	0025	IM0126124 0.51 mH – 43 A	Not applicable	IM0126124 0.51 mH – 43 A (AC 3-PHASE)
	0030			
	0035			
S15	0038	IM0126164 0.24 mH – 92 A	Not applicable	IM0126164 0.24 mH – 92 A (AC 3-PHASE)
	0040			
	0049			
S20	0060		IM0140304 0.64 mH – 175 A	
	0067	IM0126204 0.16 mH – 142 A		IM0126204 0.16 mH – 142 A (AC 3-PHASE)
	0074			
	0086			
S30	0113	IM0126244 0.09 mH – 252 A	IM0140404 0.36 mH – 305 A	IM0126244 0.09 mH – 252 A (AC 3-PHASE)
	0129			
	0150			
	0162			
S40	0179	IM0126284 0.061 mH – 362 A	IM0140504 0.30 mH – 440 A	IM0126284 0.061 mH – 362 A (AC 3-PHASE)
	0200			
	0216	IM0126324 0.054 mH – 410 A	IM0140554 0.216 mH – 470 A	IM0126324 0.054 mH – 410 A (AC 3-PHASE))
	0250			
S50	0312	IM0126364 0.033 mH – 662 A	IM0140654 0.132 mH – 775 A	IM0126364 0.033 mH – 662 A (AC 3-PHASE)
	0366			
	0399			
S60	0457	IM0126404 0.023 mH – 945 A	IM0140754 0.092 mH – 980 A	IM0126404 0.023 mH – 945 A (AC 3-PHASE)
	0525			
S65	0598	IM0126444 0.018 mH – 1260 A	IM0140854 0.072 mH – 1550 A	IM0126444 0.018 mH – 1260 A (AC 3-PHASE)
	0748			
	0831			

See page below for inductance drawing.

CAUTION

When installing S40 size inverters or smaller, use L2 inductance under the following circumstances: mains instability; thyristor converters, loads generating strong voltage variations at startup; power factor correction systems; mains power exceeding 500 KVA.
When installing S50 size inverters or bigger, always install line inductance, unless they are powered through a dedicated transformer.
Always activate a line inductance for inverter sizes greater than S50, unless the inverter is powered via a dedicated transformer.

13.5.4.1. CLASS 2T-4T, INTERPHASE INDUCTANCE

SIZE	INVERTER MODEL	INTERPHASE INDUCTANCE MODEL	
S65	0598	1100A	IM0143504
	0748	1400A	IM0143604
	0831		

NOTE

Inductance designed for 12-phase connection.
Carefully follow the application diagram.

13.5.5. INDUCTANCE RATINGS

13.5.5.1. VOLTAGE CLASS 2T – 4T

INDUCTANCE MODEL	TYPE	INDUCTANCE RATINGS		DIMENSIONS							HOLE	WEIGHT	LEAKAGE
		mH	A	TYPE	L	H	D	M	E	G	mm	Kg	W
IM0126004	AC 3-PHASE	2.0	11	A	120	125	75	25	67	55	5	2.9	29
IM0126044	AC 3-PHASE	1.27	17	A	120	125	75	25	67	55	5	3	48
IM0126084	AC 3-PHASE	0.70	32	A	170	175	105	40	125	71	7x14	5.5	70
IM0126124	AC 3-PHASE	0.51	43	A	170	175	105	40	125	71	7x14	6	96
IM0126164	AC 3-PHASE	0.24	92	B	180	160	150	60	150	82	7x14	9.5	183
IM0126204	AC 3-PHASE	0.16	142	B	240	210	175	80	200	107	7x14	17	272
IM0126244	AC 3-PHASE	0.09	252	B	240	210	220	80	200	122	7x14	25	342
IM0126284	AC 3-PHASE	0.061	362	C	300	260	185	100	250	116	9x24	36	407
IM0126324	AC 3-PHASE	0.054	410	C	300	260	205	100	250	116	9x24	39.5	423
IM0126364	AC 3-PHASE	0.033	662	C	300	290	235	100	250	143	9x24	53	500
IM0126404	AC 3-PHASE	0.023	945	C	300	320	240	100	250	143	9x24	67	752
IM0126444	AC 3-PHASE	0.018	1260	C	360	375	280	100	250	200	12	82	1070

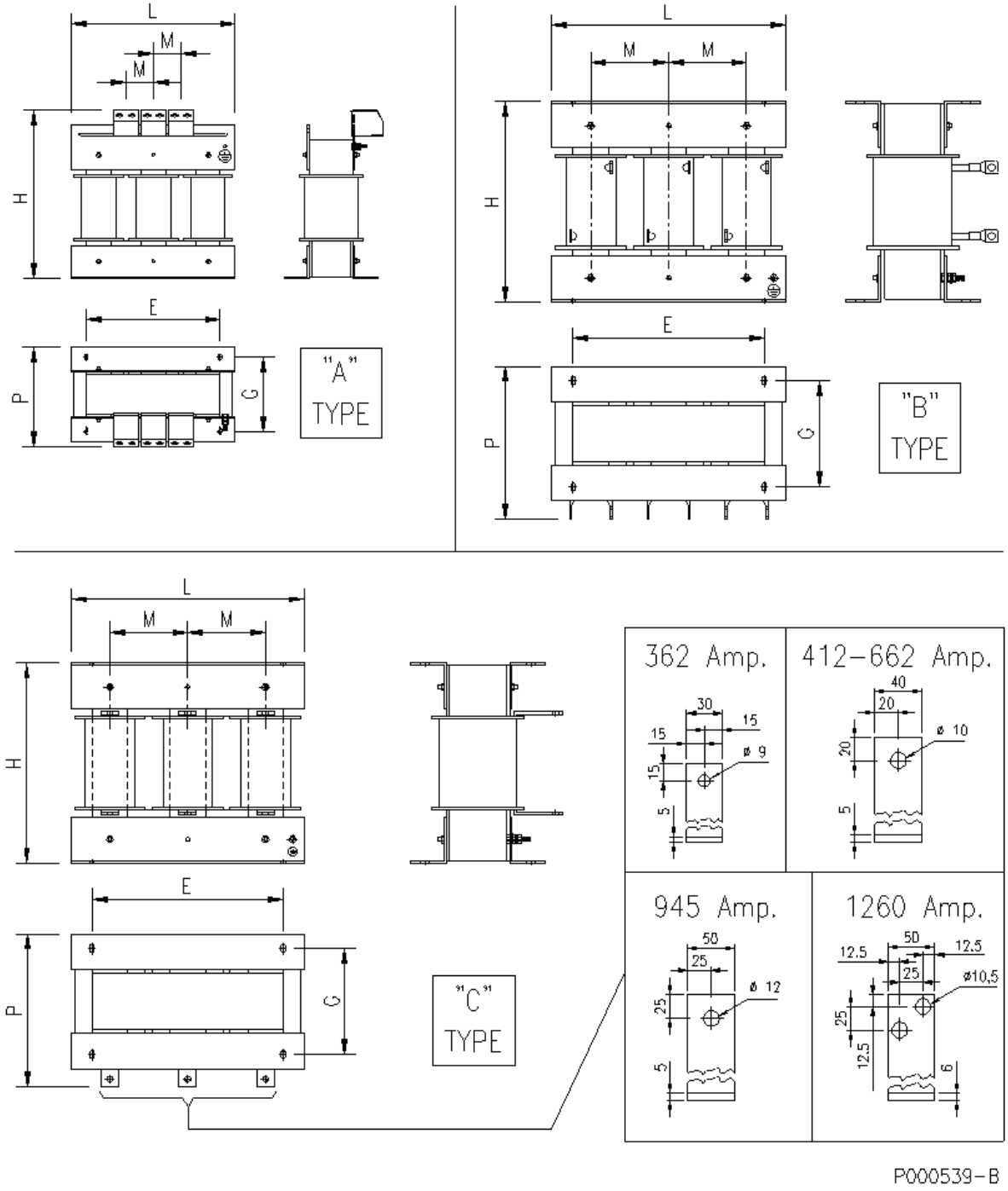


Fig. 60: Mechanical features of a 3-phase AC inductance

13.5.6. 3-PHASE AC INDUCTANCE, CLASS 2T AND 4T IN CABINET IP54

SIZE INVERTER	INVERTER MODEL	INDUCTANCE MODEL	TYPE	MECHANICAL DIMENSIONS (see figure below)	WEIGHT	LEAKAGE
				TYPE	Kg	W
S05	0005	ZZ0112010	AC 3-PHASE	A	6.5	29
	0007	ZZ0112020	AC 3-PHASE	A	7	48
	0009					
	0011					
	0014					
S10	0016	ZZ0112030	AC 3-PHASE	A	9.5	70
	0017					
	0020					
	0025	ZZ0112040	AC 3-PHASE	A	10	96
	0030					
	0035					
S15	0038	ZZ0112050	AC 3-PHASE	B	14.5	183
	0040					
	0049					
S20	0060	ZZ0112060	AC 3-PHASE	C	26	272
	0067					
	0074					
	0086					
S30	0113	ZZ0112070	AC 3-PHASE	C	32.5	342
	0129					
	0150					
	0162					

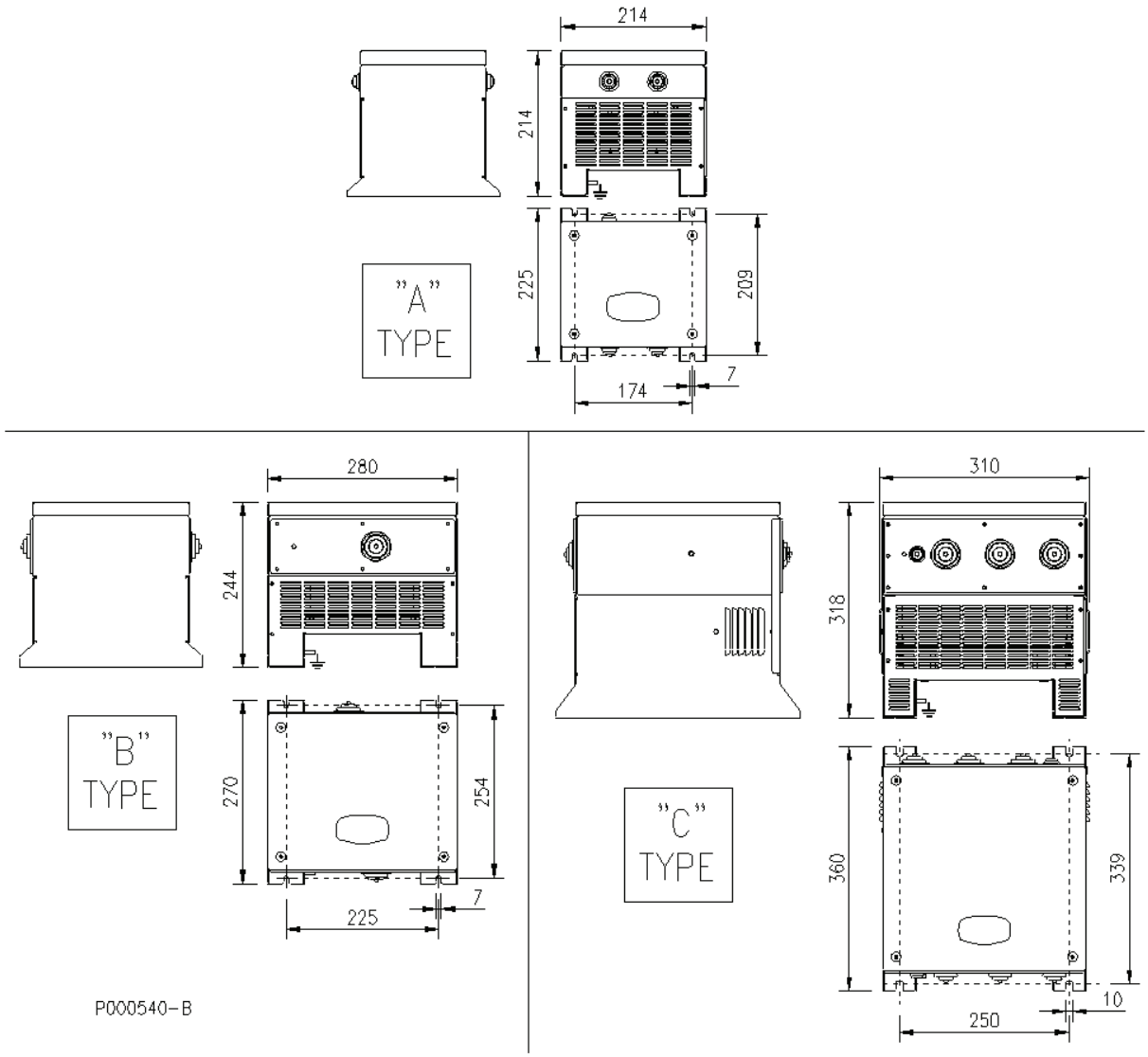


Fig. 61: Mechanical features of a 3-phase AC inductance, Class 2T-4T in cabinet IP54