6.4. REACTANCE

6.4.1. INPUT INDUCTANCE

We suggest to install a three-phase inductance on the supply line. This allows 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.

Harmonic currents

The shapes of the different waves (current or voltage) may be expressed as the sum of the basic frequency (50 or 60 Hz) 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), switching supplies and fluorescent lamps. Three-phase rectifiers absorb line current with a harmonic content $n = 6 K \pm 1$ with $K = 1, 2, 3,\ldots$ (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.

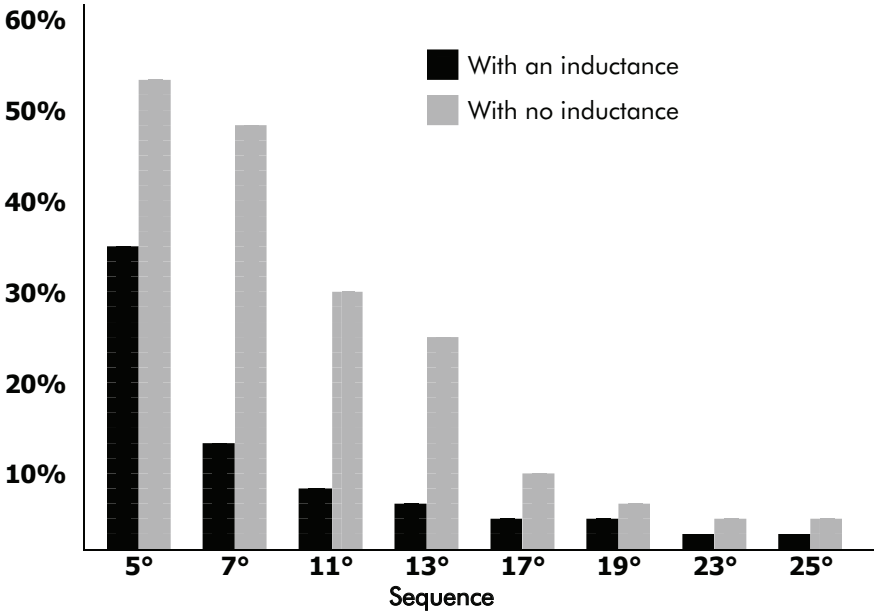
Solving the problem

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. Some inverters have an inductance connection located on the continuous bar, usely called DC inductance. The AC inductance presents the advantage of filtering, beyond the components at low frequency, also the components at high frequency with greater effectiveness.

0 1 2 3 4 5 6 7 8

For > 500 kW 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 23th, the 25th and so on, with their relevant low levels. The supply current shape is very similar to a sinusoid.

Harmonic currents



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 S40 size inverters or bigger, always install line inductance, unless they are powered through a dedicated transformer.

The ratings of optional inductance recommended based on the inverter size are detailed below.

6.4.2. INDUCTANCE RATINGS

6.4.2.1. CLASS 2T - 4T

SIZE	MODEL	CURRENT	INDUCTORS RATINGS		DIMENSIONS						HOLE	WEIGHT	DISSIPATED POWER
			mH	A	L	H	P	M	E	G	mm	Kg	W
S05	0005	10.5	2.0	11	120	135	80	40	67	55	5	2.8	29
	0007	12.5	1.27	17	120	135	90	40	67	55	5	3	48
	0009	16.5	1.27	17	120	135	90	40	67	55	5	3	48
	0011	16.5	1.27	17	120	135	90	40	67	55	5	3	48
	0014	16.5	1.27	17	120	135	90	40	67	55	5	3	48
S10	0016	26	0.7	32	150	175	105	50	125	71	7x14	5	70
	0017	30	0.7	32	150	175	105	50	125	71	7x14	5	70
	0020	30	0.7	32	150	175	105	50	125	71	7x14	5	70
	0025	41	0.51	43	150	175	125	50	125	71	7x14	6	96
	0030	41	0.51	43	150	175	125	50	125	71	7x14	6	96
	0035	41	0.51	43	150	175	125	50	125	71	7x14	6	96
S15	0038	65	0.24	92	180	160	155	60	150	82	7x14	10	183
	0040	72	0.24	92	180	160	155	60	150	82	7x14	10	183
	0049	80	0.24	92	180	160	155	60	150	82	7x14	10	183
S20	0060	88	0.24	92	180	160	155	60	150	82	7x14	10	183
	0067	103	0.16	142	240	210	170	80	200	122	7x14	24.5	342
	0074	120	0.16	142	240	210	170	80	200	122	7x14	24.5	342
	0086	135	0.16	142	240	210	170	80	200	122	7x14	24.5	342
S30	0113	180	0.09	252	240	210	220	80	200	122	7x14	24.5	342
	0129	195	0.09	252	240	210	220	80	200	122	7x14	24.5	342
	0150	215	0.09	252	240	210	220	80	200	122	7x14	24.5	342
	0162	240	0.09	252	240	210	220	80	200	122	7x14	24.5	342
S40	0179	300	0.061	362	300	260	220	100	250	116	9x24	37	407
	0200	345	0.061	362	300	260	220	100	250	116	9x24	37	407
	0216	375	0.054	410	300	290	230	100	250	126	9x24	53	500
	0250	390	0.054	410	300	290	230	100	250	126	9x24	53	500
S50	0312	480	0.033	662	300	290	230	100	250	126	9x24	53	500
	0366	550	0.033	662	300	290	230	100	250	126	9x24	53	500
	0399	630	0.033	662	300	290	230	100	250	126	9x24	53	500
S60	0457	720	0.023	945	300	320	260	100	250	138	9x24	67	752
	0525	800	0.023	945	300	320	260	100	250	138	9x24	67	752
S65	0598	900	0.018	945	300	320	260	100	250	138	9x24	67	752
	0748	1000	0.018	1260	360	390	280	120	250	200	12	82	1070
	0831	1200	0.018	1260	360	390	280	120	250	200	12	82	1070

See next page for the mechanical drawing of the inductance

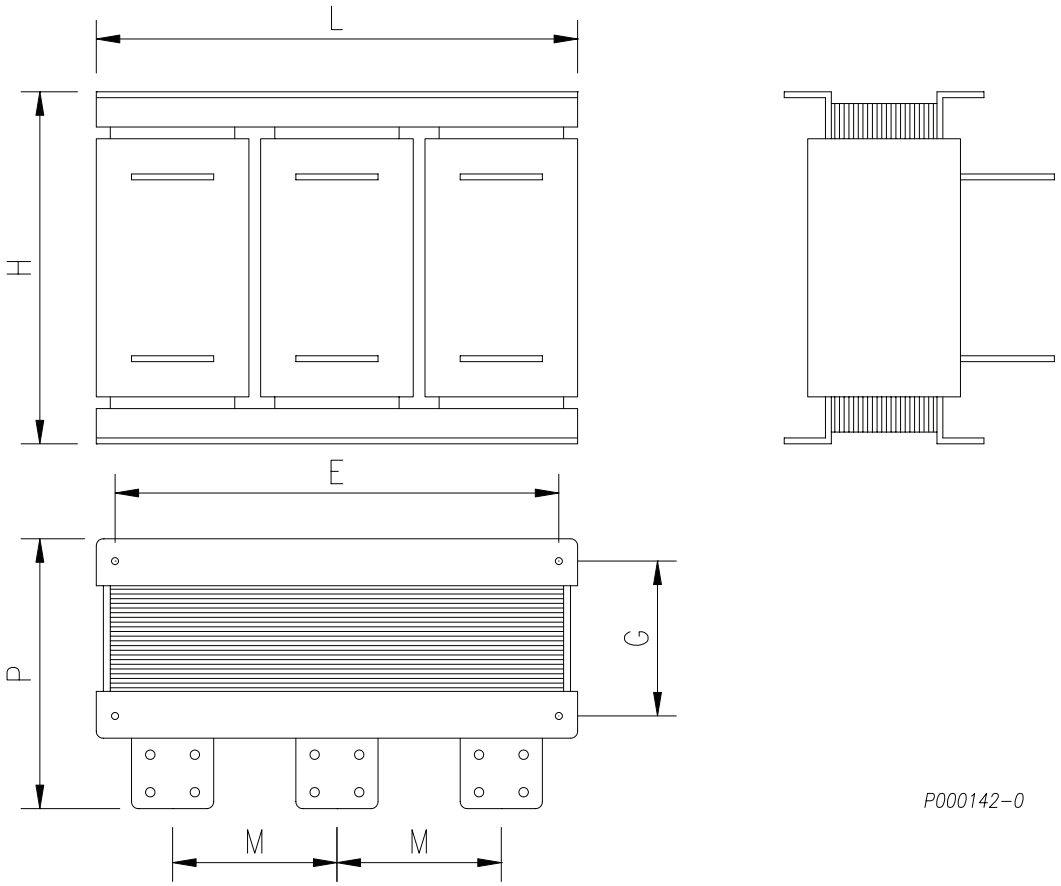
0 1 2 3 4 5 6 7 8

6.4.2.2. CLASS 5T - 6T

INVERTER SIZE	INVERTER MODEL	INVERTER CURRENT	INDUCTORS RATINGS		DIMENSIONS						HOLE	WEIGHT	DISSIPATED POWER
			mH	A	L	H	P	M	E	G	mm	Kg	W
S65	0250	390	0.093	410	300	290	220	100	250	133	9x24	52	581
	0312	480	0.058	662	360	310	250	120	325	166	9x24	79	746
	0366	550	0.058	662	360	310	250	120	325	166	9x24	79	746
	0399	630	0.058	662	360	310	250	120	325	166	9x24	79	746
	0457	720	0.040	945	360	390	270	120	250	200	12	88	1193
	0525	800	0.040	945	360	390	270	120	250	200	12	88	1193
	0598	900	0.040	945	360	390	270	120	250	200	12	88	1193
	0748	1000	0.030	1260	420	410	290	140	300	200	12	110	1438
S70	0831	1200	2*0.058	2*662	420	410	290	140	300	200	12	110	1438

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 S40 size inverters or bigger, always install line inductance, unless they are powered through a dedicated transformer.



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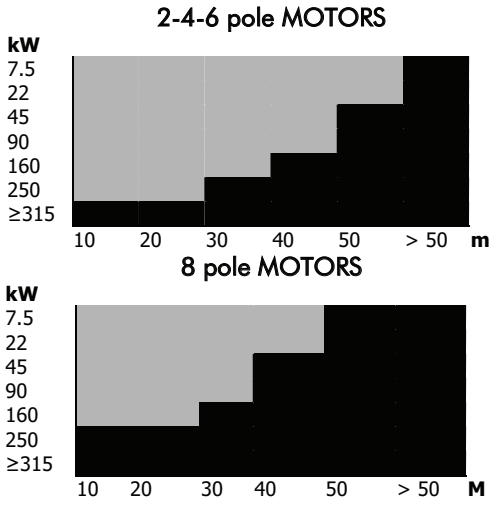
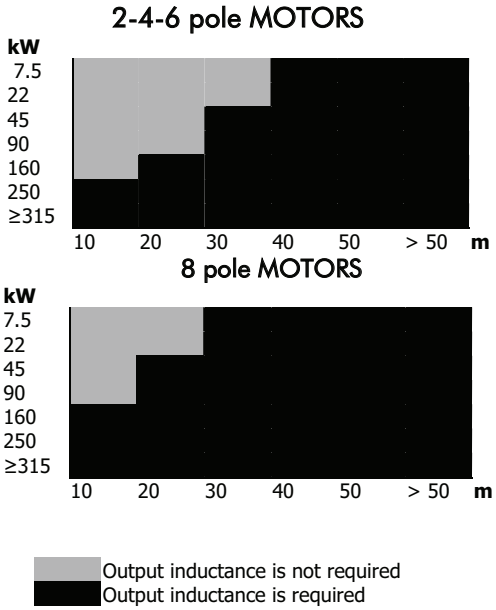
6.4.3. OUTPUT REACTANCE

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. (high request of di/dt from inverter). This current peaks 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



Motor wiring with screened cables



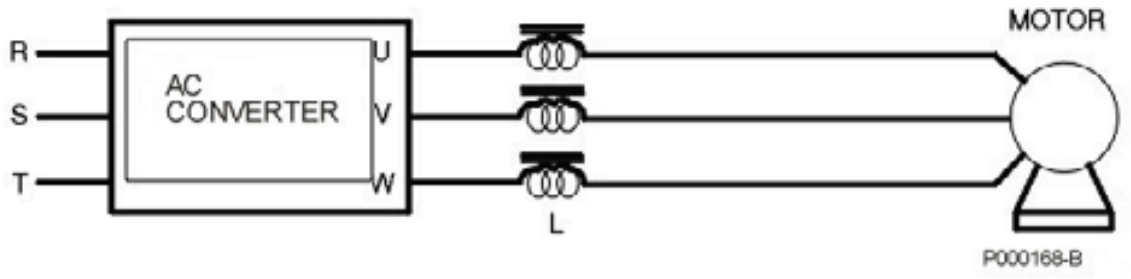


Fig.65: Output inductance wiring

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, > 10 - pole motors or parallel-connected motors controlled by a single inverter, an output inductance is always required.