• 15W0132B104 •

SINUS S

USER MANUAL

- Accessories -

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R.01

English

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ENERTRONICA SANTERNO USER MANUALS MENTIONED IN THIS USER MANUAL

The following Enertronica Santerno User Manuals are mentioned throughout this User Manual:

User Manual	Part Number
Mounting Instructions	**15P0132B100** SINUS S POWER UNIT – Mounting and switch-on instructions
Programming Manual	**15R0132B100** SINUS S – Programming Manual
Guide to the Regenerative Application	**15Q0102B00** SINUS PENTA – Guide to the Regenerative Application

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1. OVERVIEW

This manual covers the specifications and installation instructions for the external accessories available for the Sinus S frequency inverters manufactured by Enertronica Santerno:

- Braking Resistors
- Mains Chokes
- RFI Filters
- Sine Filters

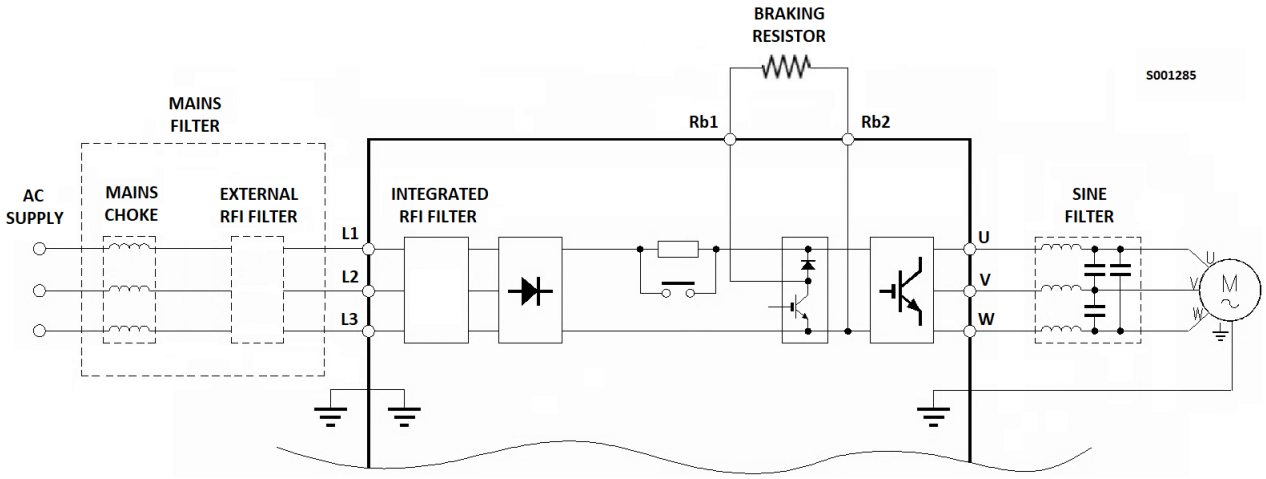

Figure 1: Wiring diagram for external accessories

2. BRAKING RESISTORS

When a large braking torque is required or the load connected to the motor is pulled (as for instance in lifting applications), the power regenerated by the motor is to be dissipated. This can be obtained in two ways:

- by dissipating energy to braking resistors or
- by powering the inverter via the DC-bus using a system able to deliver energy to the mains.

Both solutions are available:

- the first solution is described below;
- for the second solution a Sinus Penta Regenerative inverter is needed; please refer to the **Guide to the Regenerative Application**.

The braking resistor is to be connected outside the inverter to terminals Rb1 and Rb2 (see X105 in the **Mounting Instructions**); the parameters relating to the inverter braking shall be properly set (see the product's **Programming Manual**).

When choosing the braking resistor, consider the following:

- the supply voltage;
- the ohmic value of the braking resistor;
- the rated power of the braking resistor;
- the thermal capacity (absorbed energy) @ 250 °C ΔT of the braking resistor.

In particular:

- the supply voltage and the ohmic value determine the instant power dissipated in the braking resistor and are relating to the motor power;
- the rated power determines the mean power to be dissipated in the braking resistor and is relating to the duty cycle of the equipment [*]
- the thermal capacity determines the duration of the motor braking time [**].

V_{DC} [V]	Switching threshold for brake chopper
R_N [Ω]	Rated ohmic value of the braking resistor
P_{max} [W]	Maximum occurring braking power
P_N [W]	Rated power of the braking resistor
η_e	Electrical efficiency
η_m	Mechanical efficiency
t_1 [s]	Braking time
t_z [s]	Cycle time = time between two successive braking processes (t_1 + dead time)

$R_N \geq V_{DC} / (P_{max} \times \eta_e \times \eta_m)$
$P_N \geq P_{max} \times \eta_e \times \eta_m \times t_1 / t_z$
$C_{th} \geq P_{max} \times \eta_e \times \eta_m \times t_1$

NOTE

The braking energy required to reduce the speed of a rotating body is proportional to the total moment of inertia of the rotating mass, to the speed variation, to the absolute speed and is inversely proportional to the deceleration time required.

NOTE [*]

The duty cycle of the equipment is the resistor activation time in respect to the duty cycle full time (the duty cycle of the resistor is equal to the motor braking time divided by the equipment duty cycle): t_1 / t_z.

NOTE [**]

Energy [kJ] = Power [kW] x time [s].
If the thermal capacity shown in the tables is reached, the surface temperature will increase by 250 °C.

NOTE

The thermal capacity shown in the tables is valid for a braking time $t_1 \geq 10$ seconds.
For shorter times a smaller capacity shall be considered (adiabatic energy).

2.1. Assignment of Braking Resistors to the inverter

Enertronica Santerno provides selection tables for easy and quick selection of a braking resistor.

NOTE The assignment via the mains voltage and the rated power of the inverter is a non-binding recommendation.

A distinction is made between 4 application classes:

Application class	Meaning	Examples
Dynamic load	Compensation of low, sporadic voltage peaks	Overshoot due to backlash-affected mechanics at the end of the acceleration phase Transfer of conveyed material to downstream conveyor line
Emergency stop	Compensation of regenerative energy during emergency stop	Braking after pressing the emergency stop button
Passive load	Compensation of regenerative energy during horizontal movement	Braking of slides on machine tools or rotary tables Braking gantries and trolleys
Active load	Compensation of regenerative energy during vertical movement	Braking hoists

NOTE

Observe the operating conditions:

- Mean value of regenerative power < permanent power of the braking resistor
- Regenerative power during braking time < thermal capacity of the braking resistor

At any time, the following must apply:

- Cumulative braking times within the cycle time < maximum braking time

NOTE Braking resistors recommended for Emergency stop can be used for Dynamic Load too.

2.2. Applying the Braking Resistors to the Inverters

	**HOT SURFACE**	The braking resistor case may reach 250 °C based on the operating cycle.
	**CAUTION**	The cables of the braking resistors shall have insulation features and heat-resistance features suitable for the application. The minimum rated voltage of the cables must be 0.6/1 kV.
	**CAUTION**	The power dissipated by the braking resistors may be the same as the rated power of the connected motor multiplied by the braking duty-cycle; use a proper air-cooling system. Do not install braking resistors near heat-sensitive equipment or objects.
	**CAUTION**	Do not connect to the inverter any braking resistor with an ohmic value lower than the value given in the tables.

2.2.1. Light Duty – 400 Vac / 50 Hz – 480 Vac / 60 Hz – Emergency stop

Inverter			Braking resistor							
			CE Marked				UR Marked			
model	[kW]	[HP]	P/N	[Ω]	[W]	[kJ]	P/N	[Ω]	[W]	[kJ]
0006	4	5	RE2644100	100	350	24	RE2473820	82	150	22.5
0007	5.5	7.5	RE2643560	56	350	24	RE2463470	47	135	6.3
0011	7.5	10	RE2643560	56	350	24	RE2483470	47	200	30
0014	11	15	RE2643270	27	350	24	RE2483270	27	200	30
0017	15	20	RE3063270	27	550	75	RE2523270	27	600	90
0020	18.5	25	RE3063180	18	550	75	RE2493180	18	300	45
0025	22	30	RE3083150	15	1000	278	RE2863150	15	800	120
0030	30	40	RE3083150	15	1000	278	RE2863150	15	800	120
0034	37	50	RE3113100	10	2200	1360	RE3183750	7.5	1900	285

2.2.2. Heavy Duty – 400 Vac / 50 Hz – 480 Vac / 60 Hz – Emergency stop

Inverter			Braking resistor							
			CE Marked				UR Marked			
model	[kW]	[HP]	P/N	[Ω]	[W]	[kJ]	P/N	[Ω]	[W]	[kJ]
0001	0.37	0.5	RE2644470	470	350	24	RE1864470	470	20	3
0002	0.75	1	RE2644400	400	350	24	RE2264390	390	100	15
0003	1.5	2	RE2644200	200	350	24	RE2484180	180	200	30
0005	2.2	3	RE2644200	200	350	24	RE2484180	180	200	30
0006	3	4	RE2644100	100	350	24	RE2473820	82	150	22.5
0007	4	5	RE2643560	56	350	24	RE2463470	47	135	6.3
0011	5.5	7.5	RE2643560	56	350	24	RE2483470	47	200	30
0014	7.5	10	RE2643270	27	350	24	RE2483270	27	200	30
0017	11	15	RE3063270	27	550	75	RE2523270	27	600	90
0020	15	20	RE3063180	18	550	75	RE2493180	18	300	45
0025	18.5	25	RE3083150	15	1000	278	RE2863150	15	800	120
0030	22	30	RE3083150	15	1000	278	RE2863150	15	800	120
0034	30	40	RE3113100	10	2200	1360	RE3183750	7.5	1900	285

2.2.3. Light Duty – 400 Vac / 50 Hz – 480 Vac / 60 Hz – Passive load

Inverter			Braking resistor							
			CE Marked				UR Marked			
model	[kW]	[HP]	P/N	[Ω]	[W]	[kJ]	P/N	[Ω]	[W]	[kJ]
0006	4	5	RE2644100	100	350	24	RE2483820	82	200	30
0007	5.5	7.5	RE3063500	50	550	75	RE2513470	47	400	60
0011	7.5	10	RE3063500	50	550	75	RE2513470	47	400	60
0014	11	15	RE3063270	27	550	75	RE2523270	27	600	90
0017	15	20	RE3093270	27	1500	470	RE3163270	27	1200	180
0020	18.5	25	RE3093180	18	1500	470	RE3173180	18	1400	210
0025	22	30	RE3113150	15	2200	1360	RE3563150	15	2400	360
0030	30	40	RE3113150	15	2200	1360	RE3563150	15	2400	360
0034	37	50	RE3483100	10	4000	5000	n.a.			

2.2.4. Heavy Duty – 400 Vac / 50 Hz – 480 Vac / 60 Hz – Passive load

Inverter			Braking resistor							
			CE Marked				UR Marked			
model	[kW]	[HP]	P/N	[Ω]	[W]	[kJ]	P/N	[Ω]	[W]	[kJ]
0001	0.37	0.5	RE2644400	400	350	24	RE2264390	390	100	15
0002	0.75	1	RE2644400	400	350	24	RE2264390	390	100	15
0003	1.5	2	RE2644200	200	350	24	RE2484180	180	200	30
0005	2.2	3	RE2644200	200	350	24	RE2494180	180	300	45
0006	3	4	RE2644100	100	350	24	RE2483820	82	200	30
0007	4	5	RE3063500	50	550	75	RE2513470	47	400	60
0011	5.5	7.5	RE3063500	50	550	75	RE2513470	47	400	60
0014	7.5	10	RE3063270	27	550	75	RE2523270	27	600	90
0017	11	15	RE3093270	27	1500	470	RE3163270	27	1200	180
0020	15	20	RE3093180	18	1500	470	RE3173180	18	1400	210
0025	18.5	25	RE3113150	15	2200	1360	RE3563150	15	2400	360
0030	22	30	RE3113150	15	2200	1360	RE3563150	15	2400	360
0034	30	40	RE3483100	10	4000	5000	n.a.			

2.2.5. Light Duty – 400 Vac / 50 Hz – 480 Vac / 60 Hz – Active load

Inverter			Braking resistor							
			CE Marked				UR Marked			
model	[kW]	[HP]	P/N	[Ω]	[W]	[kJ]	P/N	[Ω]	[W]	[kJ]
0006	4	5	RE3083820	82	1000	278	RE2863820	82	780	117
0007	5.5	7.5	RE3083500	50	1000	278	RE2863470	47	800	120
0011	7.5	10	RE3083500	50	1000	278	RE2863470	47	800	120
0014	11	15	RE3093270	27	1500	470	RE3173270	27	1400	210
0017	15	20	RE3093270	27	1500	470	RE3173270	27	1400	210
0020	18.5	25	RE3483200	20	4000	5000	RE3573180	18	4300	645
0025	22	30	RE3763150	15	8000	10000	RE3663150	15	6200	930
0030	30	40	RE3763150	15	8000	10000	RE3663150	15	6200	930
0034	37	50	RE4023100	10	12000	15000	n.a.			

2.2.6. Heavy Duty – 400 Vac / 50 Hz – 480 Vac / 60 Hz – Active load

Inverter			Braking resistor							
			CE Marked				UR Marked			
model	[kW]	[HP]	P/N	[Ω]	[W]	[kJ]	P/N	[Ω]	[W]	[kJ]
0001	0.37	0.5	RE2644400	400	350	24	RE2264390	390	100	15
0002	0.75	1	RE2644400	400	350	24	RE2264390	390	100	15
0003	1.5	2	RE3064200	200	550	75	RE2504180	180	350	53
0005	2.2	3	RE3064200	200	550	75	RE2504180	180	350	53
0006	3	4	RE3083820	82	1000	278	RE2863820	82	780	117
0007	4	5	RE3083500	50	1000	278	RE2863470	47	800	120
0011	5.5	7.5	RE3083500	50	1000	278	RE2863470	47	800	120
0014	7.5	10	RE3093270	27	1500	470	RE3173270	27	1400	210
0017	11	15	RE3093270	27	1500	470	RE3173270	27	1400	210
0020	15	20	RE3483200	20	4000	5000	RE3573180	18	4300	645
0025	18.5	25	RE3763150	15	8000	10000	RE3663150	15	6200	930
0030	22	30	RE3763150	15	8000	10000	RE3663150	15	6200	930
0034	30	40	RE4023100	10	12000	15000	n.a.			

2.3. Available Braking Resistors

	**HOT SURFACE**	Braking resistors may reach temperatures higher than 250 °C.
	**CAUTION**	Use a proper air-cooling system. Do not install braking resistors near heat-sensitive equipment or objects.

2.3.1. 350 W Models (IP55) – CE Marked

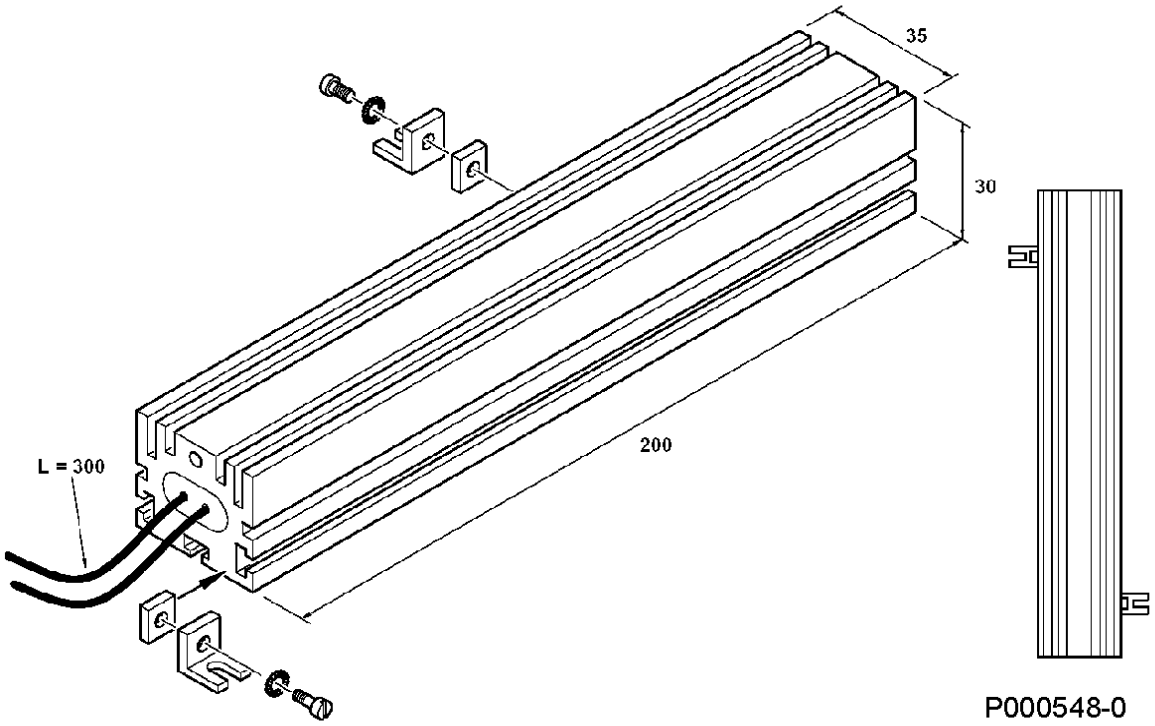

Figure 2: Overall dimensions, 350 W braking resistor

P/N	Ohmic value [Ω]	Rated Power [W]	Thermal Capacity @ 250 °C ΔT [kJ]	Weight [g]
RE2643270	27	350	24	400
RE2643560	56			
RE2644100	100			
RE2644200	200			
RE2644400	400			

2.3.2. 550 W Models (IP33) – CE Marked

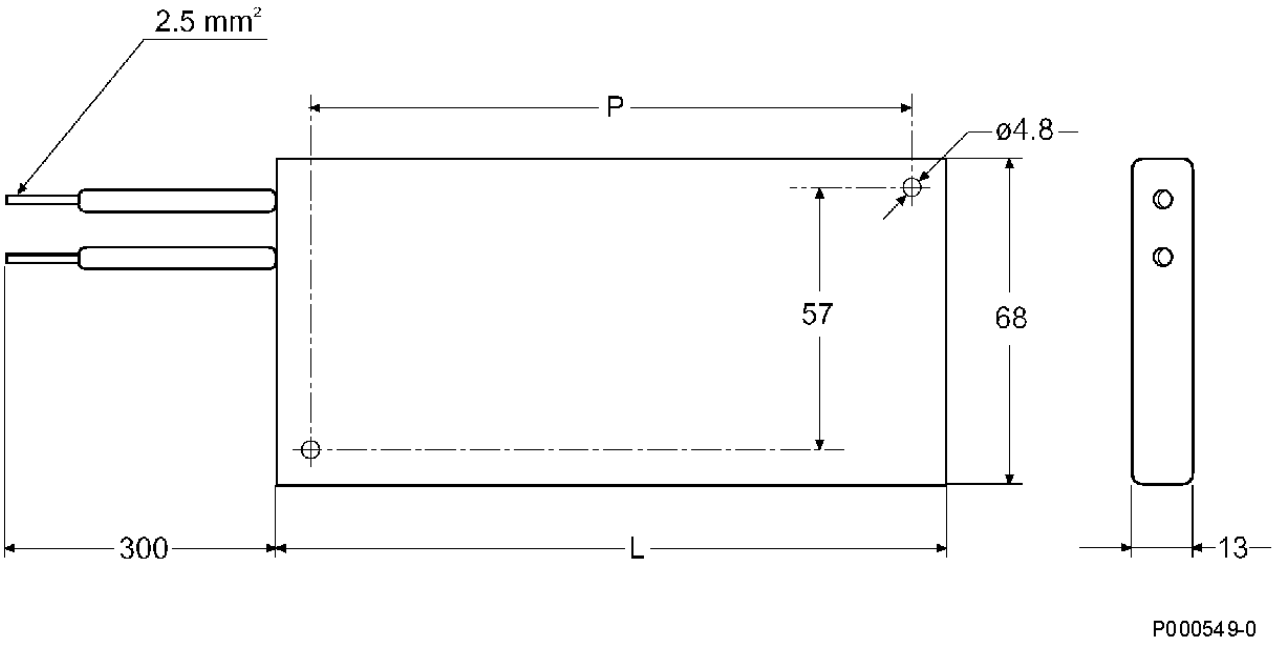

Figure 3: Overall dimensions, 550 W braking resistor

P/N	Ohmic value [Ω]	Rated Power [W]	Thermal Capacity @ 250 °C ΔT [kJ]	L (mm)	D (mm)	Weight [g]
RE3063180	18	550	75	195	174	500
RE3063270	27					
RE3063500	50					
RE3064200	200					

2.3.3. 1100 W to 2200 W models (IP54) – CE Marked

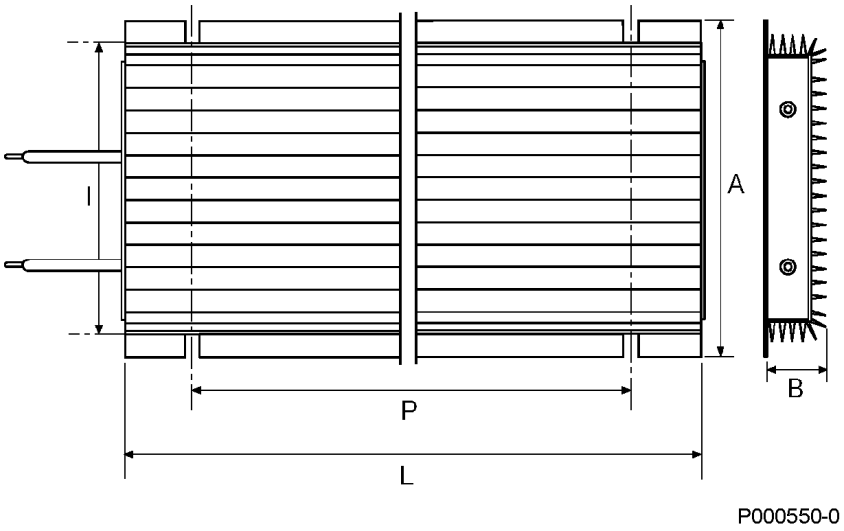

Figure 4: Overall dimensions, 1100 W, 1500 W and 2200 W braking resistors

P/N	Ohmic value [Ω]	Rated Power [W]	Thermal Capacity @ 250 °C ΔT [kJ]	A [mm]	B [mm]	L [mm]	I [mm]	P [mm]	Weight [g]
RE3083150	15	1000	278	95	30	320	80-84	240	1250
RE3083500	50								
RE3083820	82								
RE3093180	18	1500	470	120	40	320	107-112	240	2750
RE3093270	27								
RE3113100	10	2200	1360	190	67	380	177-182	300	7000
RE3113150	15								

2.3.4. 4 kW, 8 kW and 12 kW models (IP20) – CE Marked

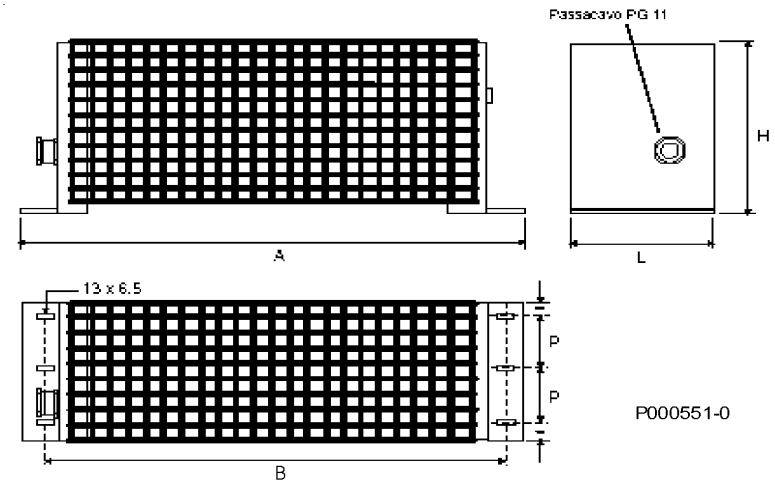

Figure 5: Overall dimensions, 4 kW, 8 kW and 12 kW braking resistors

P/N	Ohmic value [Ω]	Rated Power (W)	Thermal Capacity @ 250 °C ΔT [kJ]	A [mm]	B [mm]	L [mm]	H [mm]	P [mm]	Weight [g]
RE3483100	10	4000	5000	620	600	100	250	40	5.5
RE3483200	20								
RE3763150	15	8000	10000	620	600	160	250	60	10.6
RE4023100	10	12000	15000	620	600	200	250	80	13.7

2.3.5. 20 W to 150 W models (IP20 – NEMA 1; IP54 – NEMA 12) – UR Marked

P/N	Ohmic value [Ω]	Rated Power [W]	Thermal Capacity @ 250 °C ΔT [kJ]	H [mm]	W [mm]	D [mm]	IP	Weight [g]
RE1864470	470	20	3	160	40	36	20	0.34
RE2463470	47	135	6.3	216	80	28	20	0.67
RE2473820	82	150	22.5	238	80	59	20	0.70
RE2264390	390	100	15	235	20.6	40	54	0.37

2.3.6. 200 W and 300 W models (IP20 – NEMA 1) – UR Marked

P/N	Ohmic value [Ω]	Rated Power [W]	Thermal Capacity @ 250 °C ΔT [kJ]	H [mm]	W [mm]	D [mm]	Weight [g]
RE2483270	27	200	30	240	42	122	1.0
RE2483470	47						
RE2483820	82						
RE2484180	180						
RE2493180	18	300	45	320	42	122	1.4
RE2494180	180						

2.3.7. 350 W to 2400 W models (IP20 – NEMA 1) – UR Marked

P/N	Ohmic value [Ω]	Rated Power [W]	Thermal Capacity @ 250 °C ΔT [kJ]	H [mm]	W [mm]	D [mm]	Weight [g]
RE2504180	180	350	53	382	124	122	2.1
RE2513470	47	400	60	400	114	105	2.3
RE2523270	27	600	90	550	114	105	3.1
RE2863820	82	780	117	666	124	122	3.6
RE2863150	15	800	120	710	114	105	4.0
RE2863470	47						
RE3163270	27	1200	180	1020	114	105	5.6
RE3173180	18	1400	210	1110	114	105	6.3
RE3173270	27						
RE3563150	15	2400	360	1020	204	105	10

2.3.8. 1900 W to 6200 W models (IP20 – NEMA 1) – UR Marked

P/N	Ohmic value [Ω]	Rated Power [W]	Thermal Capacity @ 250 °C ΔT [kJ]	H [mm]	W [mm]	D [mm]	Weight [g]
RE3183750	7.5	1900	285	302	486	236	9.5
RE3573180	18	4300	645	302	486	426	13.5
RE3663150	15	6200	930	302	486	526	17.0

3. MAINS CHOKES

A three-phase mains choke shall be installed on the supply line to obtain the following benefits:

- It limits 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;
- It reduces supply harmonic current;
- It increases power factor, thus reducing line current;
- It increases 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 power supply units 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 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 a mains choke.

Power drive systems with no mains choke generate larger harmonic currents than power drives which do have a choke.

Harmonic currents in the inverter power supply

The amplitude of harmonic currents and their incidence on the mains voltage is strongly affected by the features of the mains where the equipment is installed. The ratings given in this manual fit most applications. For special requirements, please contact Enertronica Santerno's Customer service.

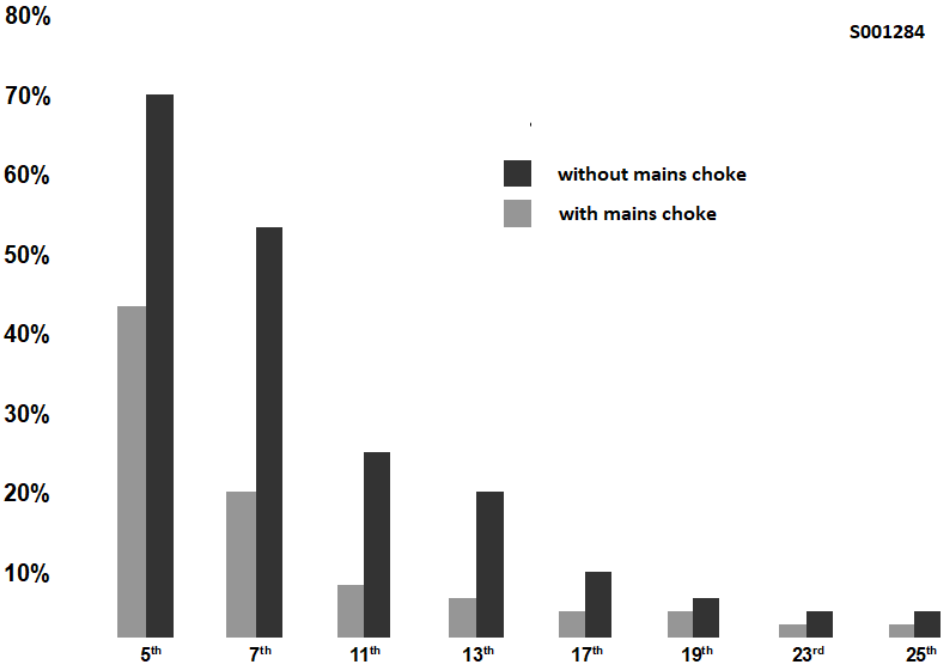

Figure 6: **Amplitude of harmonic currents (approximate values)**

The ratings of mains chokes recommended based on the inverter model are detailed in the section below.

NOTE For some inverter models the mains chokes are mandatory.
These models are highlighted in red in the following tables.

3.1. Applying the Mains Choke to the Inverter

3.1.1. Light Duty – 400 Vac / 50 Hz

Inverter		Choke					
		CE marked			UR Marked		
model	[kW]	P/N	[A]	[mH]	P/N	[A]	[mH]
0006	4	IM0126004	11	2.00	IM5101005	10	2.94
0007	5.5	IM0126044	17	1.27	IM5101006	16	1.84
0011	7.5	IM0126044	17	1.27	IM5101006	16	1.84
0014	11	IM0126084	32	0.70	IM5101007	25	1.18
0017	15	IM0126084	32	0.70	IM5101008	30	0.98
0020	18.5	IM0126124	45	0.51	IM5101009	40	0.74
0025	22	IM0126124	45	0.51	IM5101010	45	0.65
0030	30	IM0126144	68	0.30	IM5101012	63	0.47
0034	37	IM0126164	92	0.24	IM5101013	80	0.37

Red: mandatory

3.1.2. Heavy Duty – 400 Vac / 50 Hz

Inverter		Choke					
		CE marked			UR Marked		
model	[kW]	P/N	[A]	[mH]	P/N	[A]	[mH]
0001	0.37	IM0126000	5.25	4.20	IM5101000	1.5	19.6
0002	0.75	IM0126000	5.25	4.20	IM5101002	4	7.35
0003	1.5	IM0126000	5.25	4.20	IM5101002	4	7.35
0005	2.2	IM0126002	8.4	2.63	IM5101003	6	4.90
0006	3	IM0126002	8.4	2.63	IM5101004	8	3.68
0007	4	IM0126004	11	2.00	IM5101005	10	2.94
0011	5.5	IM0126044	17	1.27	IM5101006	16	1.84
0014	7,5	IM0126044	17	1.27	IM5101006	16	1.84
0017	11	IM0126084	32	0.70	IM5101007	25	1.18
0020	15	IM0126084	32	0.70	IM5101008	30	0.98
0025	18.5	IM0126124	45	0.51	IM5101009	40	0.74
0030	22	IM0126124	45	0.51	IM5101010	45	0.65
0034	30	IM0126144	68	0.30	IM5101012	63	0.47

Red: mandatory

3.1.3. Light Duty – 480 Vac / 60 Hz

Inverter		Choke					
		CE marked			UR Marked		
model	[HP]	P/N	[A]	[mH]	P/N	[A]	[mH]
0006	5	IM0126002	8.4	2.63	IM5101004	8	3.68
0007	7.5	IM0126004	11	2.00	IM5101005	10	2.94
0011	10	IM0126044	17	1.27	IM5101006	16	1.84
0014	15	IM0126084	32	0.70	IM5101016	20	1.47
0017	20	IM0126084	32	0.70	IM5101007	25	1.18
0020	25	IM0126084	32	0.70	IM5101008	30	0.98
0025	30	IM0126124	45	0.51	IM5101009	40	0.74
0030	40	IM0126144	68	0.30	IM5101011	50	0.59
0034	50	IM0126144	68	0.30	IM5101012	63	0.47

Red: mandatory

3.1.4. Heavy Duty – 480 Vac / 60 Hz

Inverter		Choke					
		CE marked			UR Marked		
model	[HP]	P/N	[A]	[mH]	P/N	[A]	[mH]
0001	0.5	IM0126000	5.25	4.20	IM5101000	1.5	19.6
0002	1	IM0126000	5.25	4.20	IM5101002	4	7.35
0003	2	IM0126000	5.25	4.20	IM5101002	4	7.35
0005	3	IM0126002	8.4	2.63	IM5101003	6	4.90
0006	4	IM0126002	8.4	2.63	IM5101003	6	4.90
0007	5	IM0126002	8.4	2.63	IM5101004	8	3.68
0011	7.5	IM0126044	17	1.27	IM5101006	16	1.84
0014	10	IM0126044	17	1.27	IM5101006	16	1.84
0017	15	IM0126084	32	0.70	IM5101016	20	1.47
0020	20	IM0126084	32	0.70	IM5101007	25	1.18
0025	25	IM0126084	32	0.70	IM5101008	30	0.98
0030	30	IM0126124	45	0.51	IM5101009	40	0.74
0034	40	IM0126144	68	0.30	IM5101011	50	0.59

Red: mandatory

3.2. Mains Choke Ratings

3.2.1. CE Marked Mains Chokes

P/N	RATINGS		DIMENSIONS							FIXING HOLES	WGT	LOSSES
	mH	A	TYPE	L	H	P	M	E	G	mm	kg	W
IM0126000	4.20	5.25	A	120	125	75	25	67	55	Ø5	2.6	19
IM0126002	2.63	8.4	A	120	125	75	25	67	55	Ø5	2.7	26
IM0126004	2.00	11	A	120	125	75	25	67	55	Ø5	2.9	29
IM0126044	1.27	17	A	120	125	75	25	67	55	Ø5	2.9	48
IM0126084	0.70	32	B	150	130	115	50	125	75	7x14	5	70
IM0126124	0.51	45	B	150	130	115	50	125	75	7x14	6	105
IM0126144	0.30	68	B	180	160	150	60	150	82	7x14	9	150

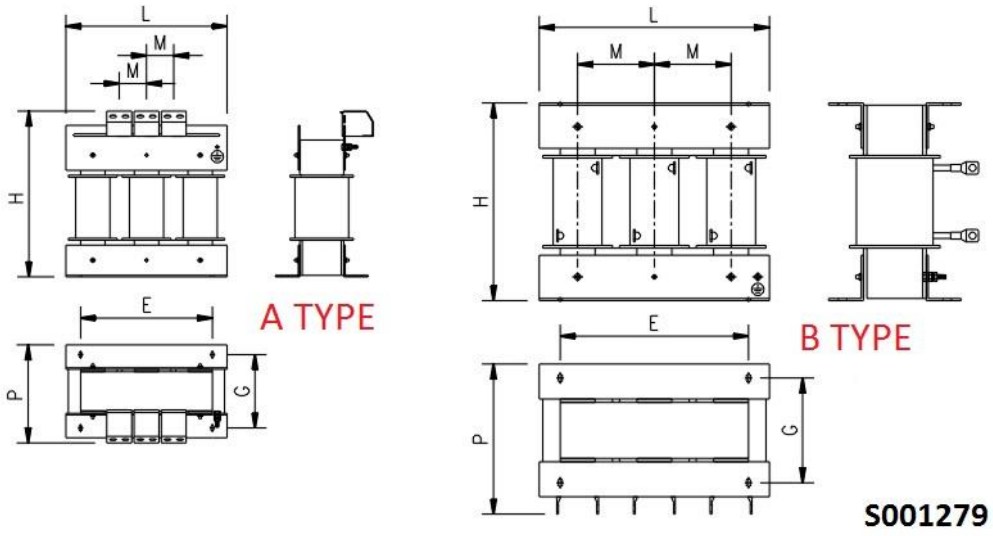

Figure 7: Mechanical features of CE Mains Chokes

3.2.2. UR Marked Mains Chokes

P/N	RATINGS		DIMENSIONS										WGT	LOSSES
	mH	A	TYPE	b	h	t	c	d	g2xg3	Ø	i1, i2	j1, j2	kg	W
IM5101000	19.6	1.5	A	77	56	100	-	42.5	4.8x9	9.5	30	50	0.52	3.8
IM5101001	14.7	2	A	77	56	100	-	42.5	4.8x9	9.5	30	50	0.53	5.8
IM5101002	7.35	4	A	95	60	115	-	49.3	4.8x9	9.5	30	50	1.31	11.5
IM5101003	4.90	6	A	95	69	120	-	58.5	4.8x9	9.5	30	50	1.45	17.3
IM5101004	3.68	8	B	120	85	140	105	70	4.9x9	9.5	30	50	1.9	23.1
IM5101005	2.94	10	B	120	85	140	105	70	4.9x9	9.5	30	50	2	28.9
IM5101006	1.84	16	B	120	95	140	105	80	4.9x9	9.5	30	50	2.7	46.1
IM5101016	1.47	20	B	155	95	165	135	80	5.8x11	10.5	30	50	3.8	57.6
IM5101007	1.18	25	C	155	110	170	135	95	5.8x11	10.5	30	50	5.8	72.0
IM5101008	0.98	30	C	155	110	170	135	95	5.8x11	10.5	30	50	5.85	86.4
IM5101009	0.74	40	C	185	102	200	170	57	8x12	13	30	50	6.8	116
IM5101010	0.65	45	C	185	112	200	170	67	8x12	13	30	50	8.25	130
IM5101011	0.59	50	D	185	112	210	90	93	8x12	13	30	75	8.35	144
IM5101012	0.47	63	D	185	122	210	90	103	8x12	13	30	75	9.65	181
IM5101013	0.37	80	D	210	125	240	105	106	8x12	13	30	75	12.5	230

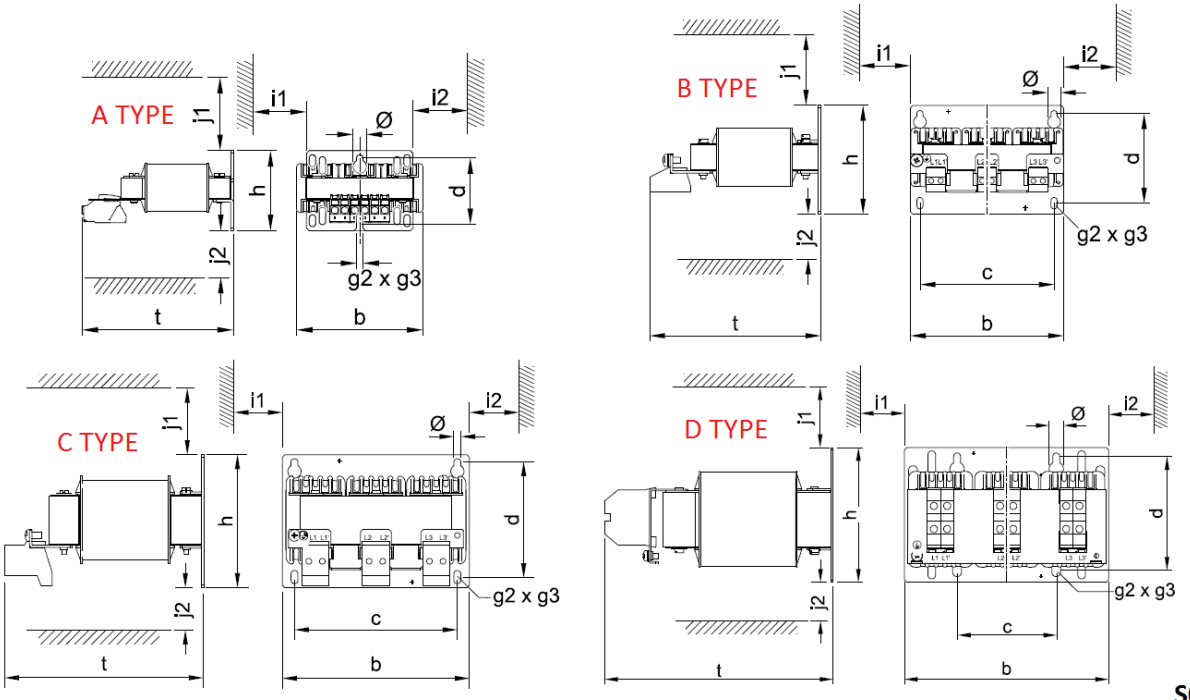

Figure 8: Mechanical features of UL Mains Chokes

4. RFI FILTERS

RFI and mains filters are used to ensure compliance with the EMC requirements of European Standard EN 61800-3. This standard defines the EMC requirements for electrical drive systems in various categories.

- RFI filters are capacitive accessory components. RFI filters reduce conducted noise emissions. RFI filters are also called EMC filters.
- Mains filters are a combination of mains chokes and RFI filters. Mains filters reduce the conducted noise emission.

Definition of the environments
(EN 61800−3)
First environment
The first environment comprises residential buildings or locations that are directly connected to a low-voltage system for supplying residential areas.
Second environment
The second environment comprises facilities or locations that are not directly connected to a low-voltage system for supplying residential areas.

Category C1
Category C1 defines the requirements for drive systems that are intended for the use in the first environment at a rated voltage lower than 1000 V.
The limit values of the EN 61800−3 comply with EN 55011 class B.
Category C2
Category C2 defines the requirements for permanently installed fixed drive systems that are intended for the use in the first environment at a rated voltage lower than 1000 V. Installation and commissioning may only be carried out by specialist personnel with EMC knowledge.
The limit values of the EN 61800−3 comply with EN 55011 class A group 1.
Category C3
Category C3 defines the requirements for drive systems that are exclusively intended for the use in the second environment at a rated voltage lower than 1000 V.
The limit values of the EN 61800−3 comply with EN 55011 class A group 2.

When working with stricter line-bound noise emission requirements which cannot be met using the radio interference suppression measures integrated in the inverter, external filters can be used. The filters can be installed below or next to the inverter.

If necessary, the internal filters have to be deactivated when external filters are used. For this purpose, remove the IT screws of the inverters.

RFI Filters	**Filter types**		
	Internal	**External**	
		Short Distance	**Long Distance**
Use	In standard applications	With short cable length	At switching frequencies 4 kHz and 8 kHz
Optimization	Easy use	For low leakage current	For long motor cable
Reduces noise emissions	Cable-guided and radiated	Cable-guided	Cable-guided

4.1. Maximum motor cable lengths and RFI operation

Inverter			Sinus S 0001	Sinus S 0002	Sinus S 0003 Sinus S 0005 Sinus S 0006 Sinus S 0007
Without RFI filter					
Without EMC category Thermal limitation	Max. Shielded motor cable length	m	15	50	50
	Max. Unshielded motor cable length	m	30	100	200
With integrated RFI filter					
Category C1	Max. Shielded motor cable length	m	3	3	-
Category C2		m	15	20	20
	Earth-leakage circuit breaker	mA	30	30	30
RFI filter Short Distance					
Category C1	Max. Shielded motor cable length	m	15	25	25
Category C2		m	15	50	50
	Earth-leakage circuit breaker	mA	30	30	30
RFI filter Long Distance					
Category C1	Max. Shielded motor cable length	m	15	50	50
Category C2		m	15	50	50
	Earth-leakage circuit breaker	mA	300	300	300

Inverter			Sinus S 0011 Sinus S 0014 Sinus S 0017	Sinus S 0020 Sinus S 0025 Sinus S 0030	Sinus S 0034
Without RFI filter					
Without EMC category Thermal limitation	Max. Shielded motor cable length	m	100	100	100
	Max. Unshielded motor cable length	m	200	200	200
With integrated RFI filter					
Category C1	Max. Shielded motor cable length	m	-	-	-
Category C2		m	20	20	20
	Earth-leakage circuit breaker	mA	300	300	300
RFI filter Short Distance					
Category C1	Max. Shielded motor cable length	m	25	-	-
Category C2		m	50	-	-
	Earth-leakage circuit breaker	mA	30	-	-
RFI filter Long Distance				*from Sinus S 0030: mains filter [*]*	
Category C1	Max. Shielded motor cable length	m	50	50	50
Category C2		m	100	100	100
	Earth-leakage circuit breaker	mA	300	300	300

NOTE [*] From Sinus S 0030, mains filters are used.
Mains filters are a combination of mains chokes and RFI filter.

4.1.1. Short distance: Light Duty – 400 Vac / 50 Hz – 480 Vac / 60 Hz

Inverter			Filter	Output current	h	w	d	Weight
model	[kW]	[HP]	P/N	[A]	[mm]	[mm]	[mm]	[kg]
0006	4	5	AC1717004	18.3	346	90	60	2.1
0007	5.5	7.5	AC1717004	18.3	346	90	60	2.1
0011	7.5	10	AC1717004	18.3	346	90	60	2.1
0014	11	15	AC1717005	29	371	120	60	2.4
0017	15	20	AC1717005	29	371	120	60	2.4
0020	18.5	25	n.a.					
0025	22	30	n.a.					
0030	30	40	n.a.					
0034	37	50	n.a.					

NOTE For models 0020 and above use Long Distance RFI filters.

4.1.2. Short distance: Heavy Duty – 400 Vac / 50 Hz – 480 Vac / 60 Hz

Inverter			Filter	Output current	h	w	d	Weight
model	[kW]	[HP]	P/N	[A]	[mm]	[mm]	[mm]	[kg]
0001	0.37	0.5	AC1717001	3.3	276	60	50	0.9
0002	0.75	1	AC1717001	3.3	276	60	50	0.9
0003	1.5	2	AC1717002	7.8	346	60	50	1.1
0005	2.2	3	AC1717002	7.8	346	60	50	1.1
0006	3	4	AC1717004	18.3	346	90	60	2.1
0007	4	5	AC1717004	18.3	346	90	60	2.1
0011	5.5	7.5	AC1717004	18.3	346	90	60	2.1
0014	7,5	10	AC1717005	29	371	120	60	2.4
0017	11	15	AC1717005	29	371	120	60	2.4
0020	15	20	n.a.					
0025	18.5	25	n.a.					
0030	22	30	n.a.					
0034	30	40	n.a.					

NOTE For models 0020 and above use Long Distance RFI filters.

4.1.3. Long distance: Light Duty – 400 Vac / 50 Hz – 480 Vac / 60 Hz

Inverter			Filter	Output current	h	w	d	Weight
model	[kW]	[HP]	P/N	[A]	[mm]	[mm]	[mm]	[kg]
0006	4	5	AC1717013	12.5	346	60	50	1.35
0007	5.5	7.5	AC1717014	18.3	346	90	60	1.7
0011	7.5	10	AC1717014	18.3	346	90	60	1.7
0014	11	15	AC1717015	29	371	120	60	2.1
0017	15	20	AC1717015	29	371	120	60	2.1
0020	18.5	25	AC1717016	50.4	436	205	90	7.1
0025	22	30	AC1717017	43	436	205	90	18.5
0030	30	40	AC1717017	55	436	205	90	18.5
0034	37	50	AC1717019	69	590	250	105	25

4.1.4. Long distance: Heavy Duty – 400 Vac / 50 Hz – 480 Vac / 60 Hz

Inverter			Filter	Output current	h	w	d	Weight
model	[kW]	[HP]	P/N	[A]	[mm]	[mm]	[mm]	[kg]
0001	0.37	0.5	AC1717011	3.3	276	60	50	0.9
0002	0.75	1	AC1717011	3.3	276	60	50	0.9
0003	1.5	2	AC1717012	7.8	346	60	50	1.1
0005	2.2	3	AC1717012	7.8	346	60	50	1.1
0006	3	4	AC1717013	12.5	346	60	50	1.35
0007	4	5	AC1717013	12.5	346	60	50	1.35
0011	5.5	7.5	AC1717014	18.3	346	90	60	1.7
0014	7,5	10	AC1717015	29	371	120	60	2.1
0017	11	15	AC1717015	29	371	120	60	2.1
0020	15	20	AC1717016	50.4	436	205	90	7.1
0025	18.5	25	AC1717016	50.4	436	205	90	7.1
0030	22	30	AC1717017	43	436	205	90	18.5
0034	30	40	AC1717018	55	590	250	105	23

5. SINE FILTERS

A sine filter in the motor cable limits the rate of voltage rise and the capacitive charge/discharge currents between the conductors that occur during inverter operation.

- Only use a sine filter with standard asynchronous motors.
- Operation only with V/f or square-law V/f characteristic control.
- Set the switching frequency permanently to the specified value.
- Limit the output frequency of the inverter to the **Max. output frequency** value given in the tables below.

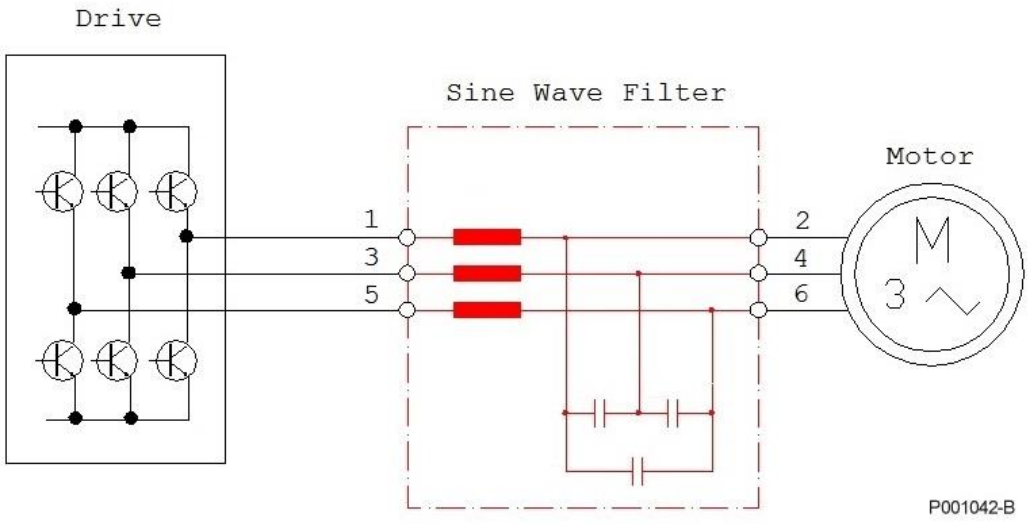

Figure 9: Sine filters

5.1.1. Light Duty – 400 Vac / 50 Hz

Inverter		Sine Filter	Rated inductance	Max. output frequency	Switching frequency
model	[kW]	P/N	[mH]	[Hz]	[kHz]
				150	4-8
0006	4	AC1845002	5.10		
0007	5.5	AC1845003	3.07		
0011	7.5	AC1845003	3.07		
0014	11	AC1845004	2.50		
0017	15	AC1845005	2.00		
0020	18.5	AC1845007	1.20		
0025	22	AC1845007	1.20		
0030	30	AC1845008	1.00		
0034	37	AC1845009	0.80		

5.1.2. Heavy Duty – 400 Vac / 50 Hz

Inverter		Sine Filter	Rated inductance	Max. output frequency	Switching frequency
model	[kW]	P/N	[mH]	[Hz]	[kHz]
0001	0.37	AC1845001	11.0	150	4-8
0002	0.75	AC1845001	11.0		
0003	1.5	AC1845002	5.10		
0005	2.2	AC1845002	5.10		
0006	3	AC1845002	5.10		
0007	4	AC1845003	3.07		
0011	5.5	AC1845003	3.07		
0014	7,5	AC1845004	2.50		
0017	11	AC1845005	2.00		
0020	15	AC1845007	1.20		
0025	18.5	AC1845007	1.20		
0030	22	AC1845008	1.00		
0034	30	AC1845009	0.80		

NOTE Sine filters are not available for 480 Vac / 60 Hz application.