■ Selection of frequency converter

Usually the size of frequency converter is chosen on the basis of the shaft output, as this may be the only value known. However, if the data are known for both the application, the motor and the frequency converter, it is recommended to make a more accurate sizing.

The values must be based on the rated motor speed.

VLT 2000 only operates according to the CT (constant torque) characteristic

■ Sizing when you know the motor current

Exercise

Conveyor plant with a 1.1 kW, 3 × 380 V motor. At continuous operation the motor current is 2.5 A (3 × 415 V).

Solution

From the table on the next page you can see that a VLT type 2025 can yield 2.8 A at continuous operation. The right solution is therefore VLT 2025.

■ Sizing on the basis of the apparent power S_M [kVA] consumed by the motor

Exercise

A motor must yield constant torque at continous operation. Usually the necessary values will appear from the motor plate or from the motor catalogue.

Solution

From the table on the next page you can see that VLT type 2025 can yield 2.0 kVA (415 V) at continuous operation. The solution is therefore VLT type 2025.

Read values

Motor current = 2.5 A (3 × 415 V)

$$s_M = \frac{U \times I \times \sqrt{3}}{1000} \text{ [kVA]}$$

$$= \frac{415 \times 2.5 \times \sqrt{3}}{1000} \text{ [kVA]}$$

$$= 1.8 \text{ kVA}$$

■ Sizing on the basis of the power requirement P_{VLT} [kW] of the motor

Exercise

A machine tool is driven by a 3 kW motor. The power requirement is indicated to be 2.4 kW. The motor efficiency η is 0.80, cos φ = 0.81 and the motor voltage is 3 x 415 V.
η and cos φ are measured at 3 kW output. We estimate η and cos φ to be approximately the same at 80 % load.

Solution

From the table on the next page you can see that VLT type 2040 can yield 4.0 kVA (415 V) at continuous operation. The right solution is therefore VLT type 2040.

$$S_{VLT} = \frac{P_m}{\eta \times \cos \varphi}$$

$$= \frac{2.4 \text{ kW}}{0.80 \times 0.81}$$

$$= 3.7 \text{ kVA}$$

■ Which one to choose?

Mains: 1 × 220/230/240 V, 3 × 208/220/230/240 V

VLT type	Typical shaft output [kW]	Constant output current $I_{VLT,N}$ [A]	Constant output power at 230 V [kVA]
2010	0.37	2.2	0.9
2015	0.55	3.1	1.3
2020	0.75	4.0	1.6
2030	1.5	7.5	3.1
2040 *)	2.2	10.6	4.4
2050 *)	3.0	16.7	6.9

*) VLT types 2040 and 2050: only three-phase mains supply.

*Mains: 3 × 380/400/415/440/460 V *)*

VLT type	Typical shaft output [kW]	Constant output current $I_{VLT,N}$ [A]	Constant output power at 415 V [kVA]
2020	0.75	2.4	1.7
2025	1.1	2.8	2.0
2030	1.5	4.0	2.9
2040	2.2	5.6	4.0
2050	3.0	7.6	5.5
2060 *)	4.0	9.7	7.0

*) VLT type 2060: 3 × 380/400/415 V

■ Product range

The VLT 2000 Series is available in a single-phase/three-phase version (1 x 220-240 V or 3 x 208-240V) in the power range 0.37-1.5 kW and a three-phase version (3 x 208-240 V) in the power range 2.2-3.0 kW. A three-phase version (3 x 380-460 V) in the power range 0.75-4.0 kW is also available.

All units are delivered in an IP 20 enclosure.

■ How to find the right code number

When you have found the right VLT size you can find the code number to be ordered in the table below.

Example:

VLT type 2020 (3 x 380-460 V) three-phase without display with brake has the code number 195H3400.

As appears from the table a VLT 2000 single/three phase can be delivered with various options and modules such as brake function, RFI filter and motor coils.

VLT 2000 Series, single-phase/three-phase (1 × 220-240 V / 3 × 208-240 V) (3 x 208-240 V)

	VLT 2010	VLT 2015	VLT 2020	VLT 2030	VLT 2040	VLT 2050
Without display	195H3100	195H3102	195H3104	195H3106	195H3108	195H3110
With display	195H3101	195H3103	195H3105	195H3107	195H3109	195H3111
Without display with brake	195H3200	195H3202	195H3204	195H3206	195H3208	195H3210
With display with brake	195H3201	195H3203	195H3205	195H3207	195H3209	195H3211
RFI and motor filter module IP 20 1-phase	195H6523	195H6524	195H6524	195H6525		
RFI and motor filter module IP 20 3-phase	195H6522	195H6522	195H6522	195H6522		
RFI-filtermodul IP 20 (VBG-4)*	-	-	-	-	195H6528	195H6528
Motor coil module IP 00	195H6510	195H6510	195H6510	195H6510		
Motor coil module IP 10 (VBG-4)	195H6521	195H6521	195H6521	195H6521		
LC and RFI filter module IP 20 3-phase	195H6527	195H6526	195H6526	195H6526		

* Schaffner RFI-filter type FN351 - 16/29

VLT 2000 Series, three-phase (3 × 380/460 V). Note: VLT 2060: 380/415 V

	VLT 2020	VLT 2025	VLT 2030	VLT 2040	VLT 2050	VLT 2060
Without display	195H3300	195H3302	195H3304	195H3306	195H3308	195H3310
With display	195H3301	195H3303	195H3305	195H3307	195H3309	195H3311
Without display with brake	195H3400	195H3402	195H3404	195H3406	195H3408	195H3410
With display with brake	195H3401	195H3403	195H3405	195H3407	195H3409	195H3411
RFI and motor filter module IP 20**	195H6522	195H6522	195H6522	195H6522	195H6522	195H6522
Motor coil module IP 10 (VBG-4)	195H6521	195H6521	195H6521	195H6521	195H6521	195H6521
LC and RFI filter module IP 20**	195H6527	195H6527	195H6527	195H6526	195H6526	195H6526

**Only 380/415 V

■ VLT 2000 Series built-in RFI filter EN 55011 1A:

VLT Series 2000, single-phase (1 x 220-240 V)

	VLT 2010	VLT 2015	VLT 2020	VLT 2030
Without display	195H3600	195H3602	195H3604	195H3606
With display	195H3601	195H3603	195H3605	195H3607
Without display / With brake	195H3700	195H3702	195H3704	195H3706
With display / with brake	195H3701	195H3703	195H3705	195H3707
Motor coils, IP20, three-phase	195H6529	195H6529	195H6529	195H6529

VLT Series 2000, three-phase (3 x 380-415 V)

	VLT 2020	VLT2025	VLT2030	VLT 2040	VLT 2050	VLT 2060
Without display	195H3800	195H3802	195H3804	195H3806	195H3808	195H3810
With display	195H3801	195H3803	195H3805	195H3807	195H3809	195H3811
Without display / With brake	195H3900	195H3902	195H3904	195H3906	195H3908	195H3910
With display / with brake	195H3901	195H3903	195H3905	195H3907	195H3909	195H3911
Motor coils, IP20, three-phase	195H6529	195H6529	195H6529	195H6529	195H6529	195H6529

The VLT® 2000 with built-in RFI filter in IP 20 enclosure, is designed to be built directly into control panels.

EMC demands are fulfiled without any extra component.

- RFI filter to reduce electromagnetic interference.
- The VLT® 2000 units meet all necessary EMC immunity standards as laid down in the IEC 1000-4.
- The VLT® 2000 units meet the EMC emission requirements as laid down in the EN 55011, Group 1 Class A. The EMC emission specifications are complied with by using up to 40 m unscreened cable, see page 88.

■ VLT 2000 Series built-in compact RFI filter

For technical data, see page 12.

VLT Series 2000, single-phase (1 x 220-240 V)

	VLT 2010	VLT 2015	VLT 2020
With display / without brake	195H3112	195H3113	195H3114

■ Accessories/options to the VLT Series 2000:

Remote control (option)	175H1788
PC program (VLS Dialog 2)(**Danish**)	175H2877
PC program (VLS Dialog 2)(**English**)	175H2850
PC program (VLS Dialog 2)(**German**)	175H2876

■ Brake function

All units can be delivered with built-in brake function (factory-mounted). The brake resistors for the brake function must be connected according to the connection diagram on page 42.

Specifications	VLT 2010-2030	VLT 2040-2050	VLT 2020-2050	VLT 2060
	208-240 V	208-240 V	380-460 V	380-415 V
Max. current	5.5 A	16 A	5.5 A	7.5 A
Min. brake voltage	372 V DC	372 V DC	747 V DC	646 V DC
Max. brake voltage	382 V DC	382 V DC	764 V DC	661 V DC
P-band	4 V	8 V	8 V	8 V
Overcurrent fuse	None	None	None	None
Min. brake resistance	70 Ohm	25 Ohm	140 Ohm	90 Ohm

■ Motor coils (module)

The IP 20 enclosure (also with mains filter) is available with integrated motor coils or as an IP 00/IP 10 module for external mounting.

Motor coils in IP 00 and IP 10 enclosure contain only one motor coil, making it possible to use long motor cables up to 300 m. These motor coils must be installed separately (not for co-building with the VLT frequency converter).

Technical data

	208-240 V/IP 20	208-240V/IP 00	380-415 V/IP 20	380-460 V/IP 10
Max. current	3 × 2.2/4.0/7.5 A	3 × 7.5 A	3 × 9.7 A	3 × 10 A
Max. cable length (unscreened)	150 m	300 m	150 m	300 m
Max. cable length to fullfill EN 55011, Group 1, Class A Unscreened	100 m	-	100 m	-
Max. cable length (screened)	75 m	150 m	75 m	150 m
Inductance 3×	75 µH	75 µH	120 µH	240 µH
Outside dimensions	100x110x180 mm	-	100x110x180 mm	-
Code no.	195H6523,6524,6525 195H6521		195H6510	195H6522

■ Additional litterature:

MI.20.CX.02 - Moter coil, IP 10
MI.20.BX.52 - Moter coil, IP 00
MD.65.BX.XX - Brake resistors

■ RFI and motor filter (module)

The RFI and motor filter module in IP 20 enclosure is designed to be built in with the VLT frequency converter itself. The filter contains the following:

- RFI filter to reduce electro-magnetic interference.
- Motor coils making it possible to use long motor cables.
- Motor filter (motor RFI filter) to reduce the electro-magnetic interference from the motor cable.

The VLT 2000 Series basic units meet EMC immunity requirements as laid down in the IEC 1000-4 standards, but do not meet any EMC emission requirements.

Equipped with the IP 20 RFI and motor filter (195H6522, 195H6523, 195H6524, 195H6525), the VLT 2000 Series meets the EN 55011, Group 1, Class A requirements of EMC emission.
The EMC emission specifications are complied with by using up to 100 m unscreened motor cable.

■ LC and RFI filter (module)

The LC and RFI filter module in IP 20 enclosure is designed to be built in with the VLT frequency converter itself. The filter contains the following:

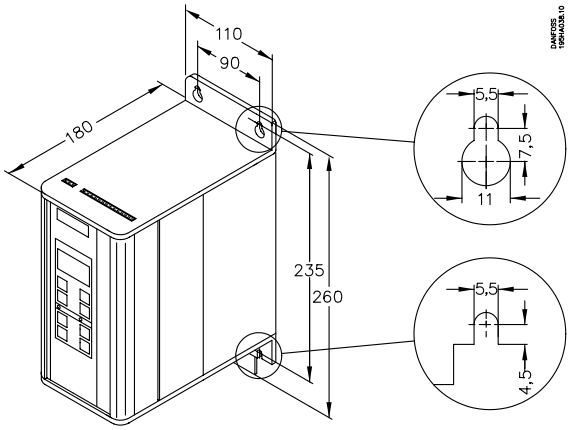
- RFI filter to reduce electro-magnetic interference
- LC filter to reduce the acoustic noise level from the motor and make it possible to use long motor cables up to 300 m.
- Motor filter (motor RFI filter) to reduce the electro-magnetic interference from the motor cable.

Equipped with the IP 20 LC and RFI filter (195H6526 and 195H6527), the VLT 2000 Series meets the EN 55011, Group 1, Class A requirements of EMC emission.
The EMC emission specifications are complied with by using up to 100 m unscreened motor cable.

Code nr.	195H6527	195H6526
VLT basic unit	VLT 2020, 2025, 2030	VLT 2040, 2050, 2060
Enclosure	IP 20	IP 20
Outside dimensions (H x W x D)	170 x 110 x 180 mm	170 x 110 x 180 mm
Built-in fan	Yes	No
Mains voltage	380 - 415 V	380 - 415 V
Current (max.)	4.0 A	9.7 A
Cut-out frequency	No limit	No limit
EMC immunity	IEC 801 Series	IEC 801 Series
EMC emission	EN 55011 Group 1, Class A	EN 55011 Group 1, Class A
Max. cable length to fullfill EN 55011, Group 1, Class A Unscreened	100 m	100 m
Max. temperature (full load)	40°C	40°C

■ Dimensions

VLT 2010-2030	single-phase, 220-240 V/three-phase, 208-240 V
VLT 2010-2020 built-in compact RFI filter	single-phase, 220-240 V



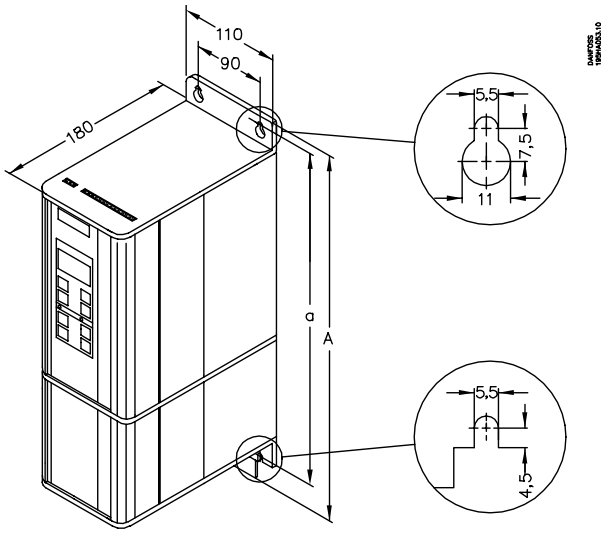
Min. space over and under frequency converters: 100 mm

Min. space to the left and the right of frequency converters: 0 mm (side-by-side mounting).

VLT 2010-2030 with module	single-phase, 220-240 V/three-phase, 208-240 V

With 100 mm module: A = 362 mm
a = 337 mm

With 170 mm module: A = 432 mm
a = 407 mm



Min. space over and under frequency converters: 100 mm.

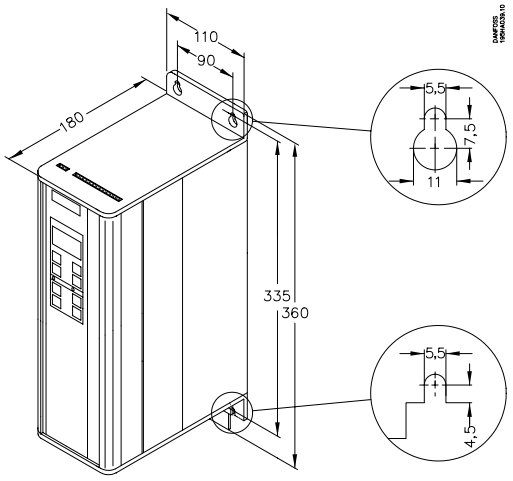
Min. space to the left and the right of frequency converters: 0 mm (side-by-side mounting).

■ Dimensions (cont'd)

VLT 2020-2060	three-phase, 380-415/460 V
VLT 2040-2050	three-phase, 208-240 V

Min. space over and under frequency converters: 100 mm.

Min. space to the left and the right of frequency converters: 0 mm (side-by-side mounting)



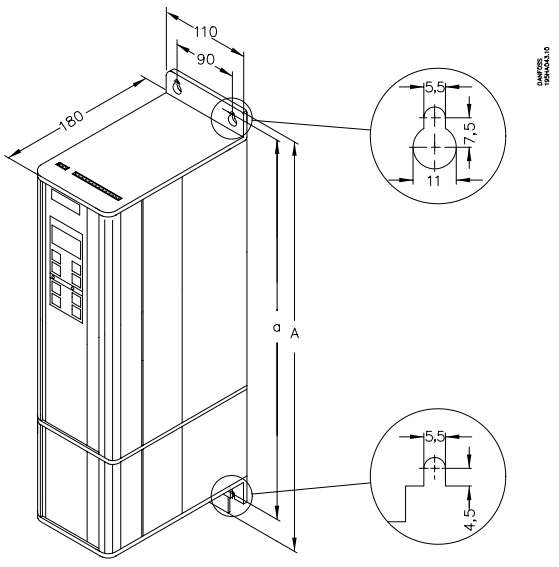
VLT 2020-2060 with module	three-phase, 380-415/460 V

with 100 mm module: A = 462 mm
a = 437 mm

With 170 mm module: A = 532 mm
a = 507 mm

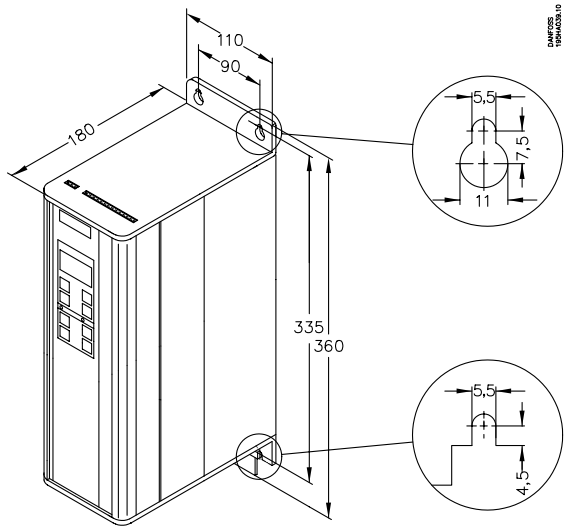
Min. space over and under frequency converters: 100 mm.

Min. space to the left and the right of frequency converters: 0 mm (side-by-side mounting)



■ **Dimensions (cont'd)**

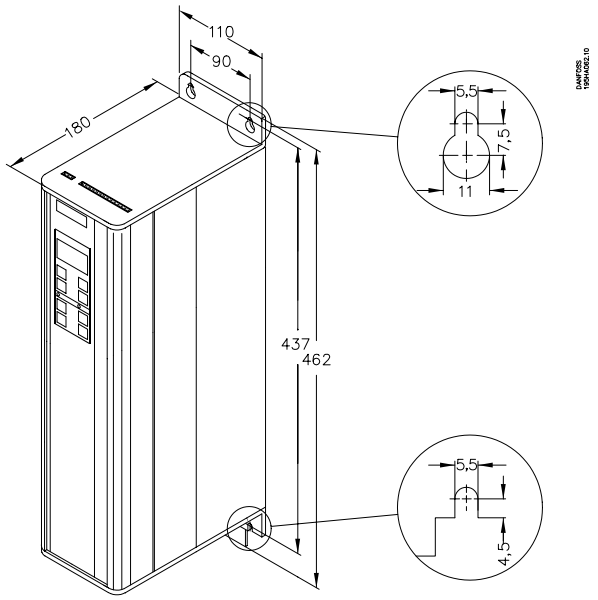
VLT 2010-2030 with built-in RFI filter, single-phase, 220-240 V



Min. space over and under frequency converters: 100 mm.

Min. space to the left and the right of frequency converters: 0 mm (side-by-side mounting)

■ VLT 2020-2060 with built-in RFI filter, three-phase, 380-415 V



Min. space over and under frequency converters: 100 mm.

Min. space to the left and the right of frequency converters: 0 mm (side-by-side mounting)

■ Technical data

Mains: 1 × 220/230/240 V, 3 × 208/220/230/240 V							3 x 208/220/230/240 V	
Meets the international standards, UL/ cUL [4]	VLT type	2010	2015	2020	2030	2040	2050
Constant load (CT):							
Output current	$I_{VLT.N}$ [A]	2.2	3.1	4.0	7.5	10.6	16.7
	$I_{VLT.MAX}$ [A] (60 s)	3.5	4.9	6.3	10.5	17.0	26.7
Output	$S_{VLT.N}$ [kVA]	0.9	1.3	1.6	3.1	4.4	6.9
	$S_{VLT.MAX}$ [kVA] (60 s)	1.4	2.1	2.6	4.3	7.0	11.0
Typical shaft output	$P_{VLT.N}$ [kW]	0.37	0.55	0.75	1.5	2.2	3.0
Max. cable cross section	[mm²]	4	4	4	4	4	4
Max. motor cable length	[m]	40 (with motor coils IP 10: unscreened cables 300 m, screened cables 150 m)					
Output voltage	U_M [%]	0-100% of mains voltage					
Output frequency	f_M [Hz]	0-120 or 0-500; programmable					
Rated motor voltage	$U_{M,N}$ [V]	200/208/220/230/240					
Rated motor frequency	$f_{M,N}$ [Hz]	50/60/87/100					
Thermal motor protection during operation		Built-in thermal motor protection (electronic)					
Switching on the output		Unlimited (frequent switching may cause cut-out)					
Ramp times	[s]	0.1-800					
	VLT type	2010	2015	2020	2030	2040	2050
Max. input current	$I_{L,N}$ [A]	(5.3/3.5)	(8.5/5.6)	(10.6/7.1)	(18/12)	(-/10)	(-/16)
Max. cable cross section	[mm²]	4	4	4	4	4	4
Max. prefuses	[A]	10	16	20	20	20	25
Bussmann Fuse type KTN-R 250 V AC [5]	[A]	10	15	20	20	20	25
Mains supply voltage	[V]	1 x 220/230/240 ±10 % 3 × 208/220/230/240 ±10 %				3 x 208/220/ 230/240±10 %	
Mains supply frequency	[Hz]	50/60					
Power factor/cos. φ_1		Without mains filter:0.50/0.87 With mains filter:0.65/1.0				0.90/1.0	0.90/1.0
Efficiency		>0.94 at rated load					
Switching on the input	times/min.	5					
	VLT type	2010	2015	2020	2030	2040	2050
Weight [kg]	IP 20	2.0	2.0	2.1	2.1	4.6	4.6
Weight [kg] with built-in RFI filter	IP 20	3.7	3.7	3.8	3.8		
Power loss at max. load	CT [W]	39	53	69	126	136	236
Enclosure		IP 20	IP 20	IP 20	IP 20	IP 20	IP 20
Vibration test	[g]	0.7					
Relative humidity	[%]	Max. 95 IEC 721 (according to VDE 0160)					
Ambient temperature	[°C]	0 → +40 at full-load operation [2]					
(according to VDE 0160)	[°C]	–25 → +70, storage/transport					
Frequency converter protection		Grounding and short-circuit proof [3]					
EMC applied standards (see page 90)	Emission	EN 55011, Group 1, Class A, CISPR 11 (with RFI and motor filter)					
	Immunity	IEC 1000-4					
UL file-number		E134261					

[2] In the range -10 - 0 °C the unit can start and run, but the display indications and certain operating characteristics will not meet the specifications.

[3] Brake option without protection

[4] Units with built-in RFI filter are not UL-approved.

[5] For the North American market

■ Technical data (continued)

Mains: 3 × 380-460 V (VLT type 2060: 3 × 380-415 V)

Meets the international standards, UL/cUL [4]		VLT type	2020	2025	2030	2040	2050	2060 [1]
	Constant load (CT):							
	Output current	$I_{VLT,N}$ [A]	2.4	2.8	4.0	5.6	7.6	9.7
		$I_{VLT,MAX}$ [A] (60 s)	3.8	4.5	6.4	9.0	12.2	15.5
	Output	$S_{VLT,N}$ [kVA]	1.91	2.23	3.19	4.46	6.05	6.97
		$S_{VLT,MAX}$ [kVA] (60 s)	3.06	3.57	5.10	7.14	9.69	11.2
	Typical shaft output	$P_{VLT,N}$ [kW]	0.75	1.1	1.5	2.2	3.0	4.0
	Max. cable cross section	[mm²]	4	4	4	4	4	4
	Max. motor cable length	[m]	40 (with motor coils IP 10: unscreened cables: 300 m, screened cables: 150 m)					
	Output voltage	U_M [%]	0-100 in % of mains voltage					
	Output frequency	f_M [Hz]	0-120 or 0-500; programmable					
	Rated motor voltage	$U_{M,N}$ [V]	380/400/415/440/460					
	Rated motor frequency	$f_{M,N}$ [Hz]	50/60/87/100					
	Thermal motor protection during operation		Built-in thermal motor protection (electronic)					
	Switching on the output		Unlimited (frequent switching may cause cut-out)					
	Ramp times	[s]	0.1-800					
		VLT type	2020	2025	2030	2040	2050	2060 [1]
	Max. input current	$I_{L,N}$ [A]	2.3	2.7	3.8	5.3	7.2	9.1
	Max. cable cross section	[mm²]	4	4	4	4	4	4
	Max. prefuses	[A]	16	16	16	16	16	20
	Bussmann Fuse type KTN-R 250 V AC [5]	[A]	15	15	15	15	15	
	Mains supply voltage	[V]	3 × 380-460 V ±10% 2060: 3 × 380-415 V ±10%					
	Mains supply frequency	[Hz]	50/60					
	Power factor/cos. φ_1		> 0.90/1.0 at rated load					
	Efficiency		> 0.97 at rated load					
	Switching on the input	times/min.	5					
		VLT type	2020	2025	2030	2040	2050	2060 [1]
	Weight [kg]	IP 20	4.0	4.0	4.0	4.2	4.2	4.2
	Weight [kg] with built-in RFI filter	IP 20	4.6	4.6	4.6	4.8	4.8	4.8
	Power loss at max. load	CT [W]	58	64	78	114	153	196
	Enclosure		IP 20	IP 20	IP 20	IP 20	IP 20	IP 20
	Vibration test	[g]	0.7					
	Relative humidity	[%]	Max. 95 IEC 721 (according to VDE 0160)					
	Ambient temperature	[°C]	0 → +40, at full load operation [2]					
	(according to VDE 0160)	[°C]	–25 → +70, storage/transport					
	Frequency converter protection		Grounding and short-circuit proof [3]					
	EMC applied standards (see page 90)	Emission	EN 55011, Group 1, Class A CISPR 11 (with RFI and motor filter)					
		Immunity	IEC 1000-4					
	UL file no.		E 134261					

1) VLT 2060 has not been UL approved.
2) In the range -10 - 0 °C the unit can start and run, but the display indications and certain operating characteristics will not meet the specifications.
3) Brake option without protection
4) Units with built-in RFI filter are not UL-approved.
5) For the North American market