Abstract

This note provides information about VLT frequency converters, supplied with an externally DC supply from the company REEL.

The reason for using a external DC supply is that it give the possibility to use load sharing between 'Big' drives (VLT 5100 90 kW) and 'smaller' drives (VLT 5004 2.2 kW).

The REEL supply also gives you some other advantages, because the drive substance a brake chopper, a fast mains supply monitor with externally alarm outputs and when using the recommended RFI filter it keep Class A1.

It means that it is possible to save brake chopper and RFI filter at all the drives connected to the DC-link.

The benefits are:

- Simplified wiring: Only one power supply + RFI filter. All VLT 2800 and VLT 5000 can be connected to the same DC bus
- Load sharing only by using one AC chokes
- Common brake chopper for all drives is built into the power supply
- 160% braking with 100% duty cycle, also for 'Big' VLT 5000 drives
- Built-in mains failure detector with very short response time improves the kinetic back up function of VLT 5000.

■ Technical data and description

In short form the DC-supply consist of:

- Precharge control (soft charge)
- Switching circuit
- Brake chopper
- DC link measurement transducer (internal)
- Optional RFI filter
- Either a digital control card which can be controlled by a keypad/PC (but only for applications with other REEL drives) or a analog control card, which can be controlled by "jumpers" and the inputs on control card.

■ REEL Modules

D 00 01 00 ..... Rated power (380V): 60 kVA
D 00 02 00 ..... Rated power (380 V): 120 kVA
D 00 03 00 ..... Rated power (380 V): 160 kVA
D 00 04 00 ..... Rated power (380 V): 240 kVA
D 00 05 00 ..... Rated power (380 V): 480 kVA

All modules are delivered with braking module (D 00 01 00 with external braking module), fan and closing plate.

■ Technical data:

Rated supply voltage ..... 3 x 380-460 V +10% / -15%
Rated input frequency ..... 45 - 65 Hz
Output / DC link voltage at which the braking resistance is switched on are:
For mains supply 380 - 400 V ..... 660 Vdc
For mains supply 400 - 460 V ..... 780 Vdc
Overload ..... 150% for 1 minute every 10 minutes
200% for 10 seconds every 10 minutes
Galvanic isolation ..... Opto insulated digital input/output (PELV)
Working temperature ..... 0 - 40° C (derating from 40°C to max. 50° C)
Enclosure rating ..... IP 20
Cooling ..... Built-in fan
EMC standard applied ..... EN55011 Class A1 with RFI-filter.

■ Signal and control connections

PIN	Denomination	Technical features	Notes
01	+10	+ 10 Vdc/ 50 mA	Supply +10 V
02/03	SG	0 Vdc	Common for ±10 V
04	-10	-10 Vdc/ 50 mA	Supply -10 V
05	IG	0V input impedance 10 ohm	Input ground for serial input protection
06/07	+P	+ 25,5 Vdc/ 5,5 A	Supply +24 V
08/09	PG	Reference 0Vdc for "+P"	Common for + 24 V
10	-C	0 Vdc	Common for input/output
11	RST	OFF: < 3 Vdc ON: 15 - 28 Vdc	General reset
12	EN	OFF: < 3 Vdc ON: 15 - 28 Vdc	General enablement
13	+ C	5 - 30 Vdc MAX	DC input voltage to carry on static outputs "UAL" and "mSR"
14	mSR	Max current 50 mA	Output for „rotating motors" (Enabled output means 1 or more motors rotating)
15	UAL	Max current 50 mA	General output for run starting /Capacitor precharge done (Enabled output correspon to: no anomaly occurring)

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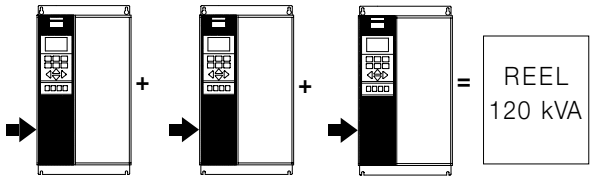
■ Dimensioning the size of DC- supply power to the VLT frequency converter.

According to the Technical data on the previous page the maximum output power in kVA for 380 V supply voltage is 120 kVA.
To this DC supply you can add the following VLT frequency converters:



VLT 5052 45 kVA + VLT 5052 45 kVA + VLT 5032 30 kVA = 120 kVA

Notice that the maximum load for the DC supply in this example is 1 minute 150% load for every 10 minutes and 10 seconds 200% load for every 10 minutes.
If one or more of the VLT frequency converters are permanently operating in regenerative mode the regenerative load can be subtracted form the total load of the DC supply.

See the kVA for VLT frequency converters in the Operating instructions.

■ Dimensioning of the ultra-quick break fuses for supply (type IEC 60 269)

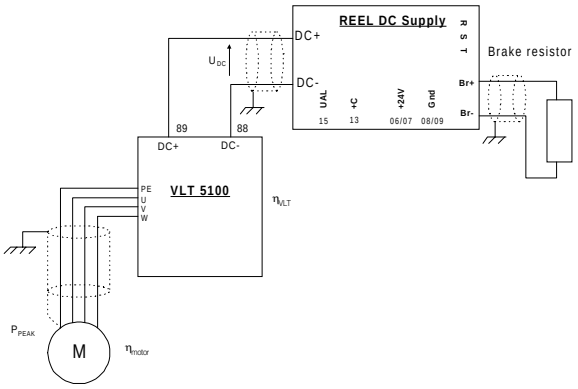
The fuses must be dimensioned according to the size of DC supply. The function of the fuses is to protect the inner rectifier bridge.

The value of the fuses is shown in a table in the manual.

Supply Type	Fuse Size	I²t
Size 01 (60kVA)	125A0	145 kA²/sec
Size 02 (120kVA)	300A / 350A	110 kA²/sec
Size 03 (160kVA)	350A / 400A	145 kA²/sec
Size 04 (240kVA)	500A / 630A	405 kA²/sec
Size 05 (480kVA)	800A / 900A	720 kA²/sec

We recommend to use Bussmann Typower Zilox Serie (aR).
Remember that I²t have to be smaller or equal with the size shown in the table above.

■ Calculation of brake resistor value



To keep the REEL DC-supply from cutting out for protection when the motor brakes, the resistor Value has to be calculated on the basis of the peak braking power and the intermediate circuit voltage:

$$Rbr = \frac{U_{DC}^2}{P_{PEAK}} \quad [\Omega]$$

As can be seen, the brake resistor depends on the intermediate circuit voltage (Udc).
With a REEL DC supply that has a mains voltage of 3 x 380-400 Volts, the brake is activated at 710 Volts (Udc); if the mains voltage is 3 x 440-460 Volts, the brake is activated at 780 Volts (Udc).
The formular can then be express as:

3 x 380-400V: $Rbr = \frac{504100}{P_{PEAK}} \quad [\Omega]$

3 x 440-460V: $Rbr = \frac{608400}{P_{PEAK}} \quad [\Omega]$

NB!
Remember to check whether your brake resistor is able to handle a voltage of 780 Volts.

For more information see Braking Instruction MI50D2xx.

■ Calculation of brake resistor value

P_{PEAK} can be caluculated by the following formular:

P_{PEAK} = Norm. brake power x $M_{BR(\%)}$ x η_{MOTOR} x η_{VLT} [kW]

where $M_{BR(\%)}$ is expressed as a percentage of the rated brake torque and η_{MOTOR} x η_{VLT} are the efficiency for the motor and VLT.
If max. brake torque is required set the value to 150%.
If a brake resistor with a higher ohmic value is choosen 150% braking torque cannot be obtained, and there is a risk that REEL DC-supply will cut out for protection.
But if only 80% braking torque is reqiured it is possible to install a brake resistor with a higher ohmic value.

The table below shows the minimum resistance values to be applied according to the supply module's size.

Size	Braking Power Ppeak	Min. Ohm value	Danfoss code number
Size 01 (40kVA)	0 - 40 kW	-*	
Size 02 (120kVA)	0 - 120 kW	15 Ω	175U852
Size 03 (160kVA)	0 - 160 kW	5 Ω	175U958
Size 04 (240kVA)	0 - 240 kW	3 Ω	175U961
Size 05 (480kVA)	0 - 480 kW	3 Ω	175U961

* Braking outside the module.

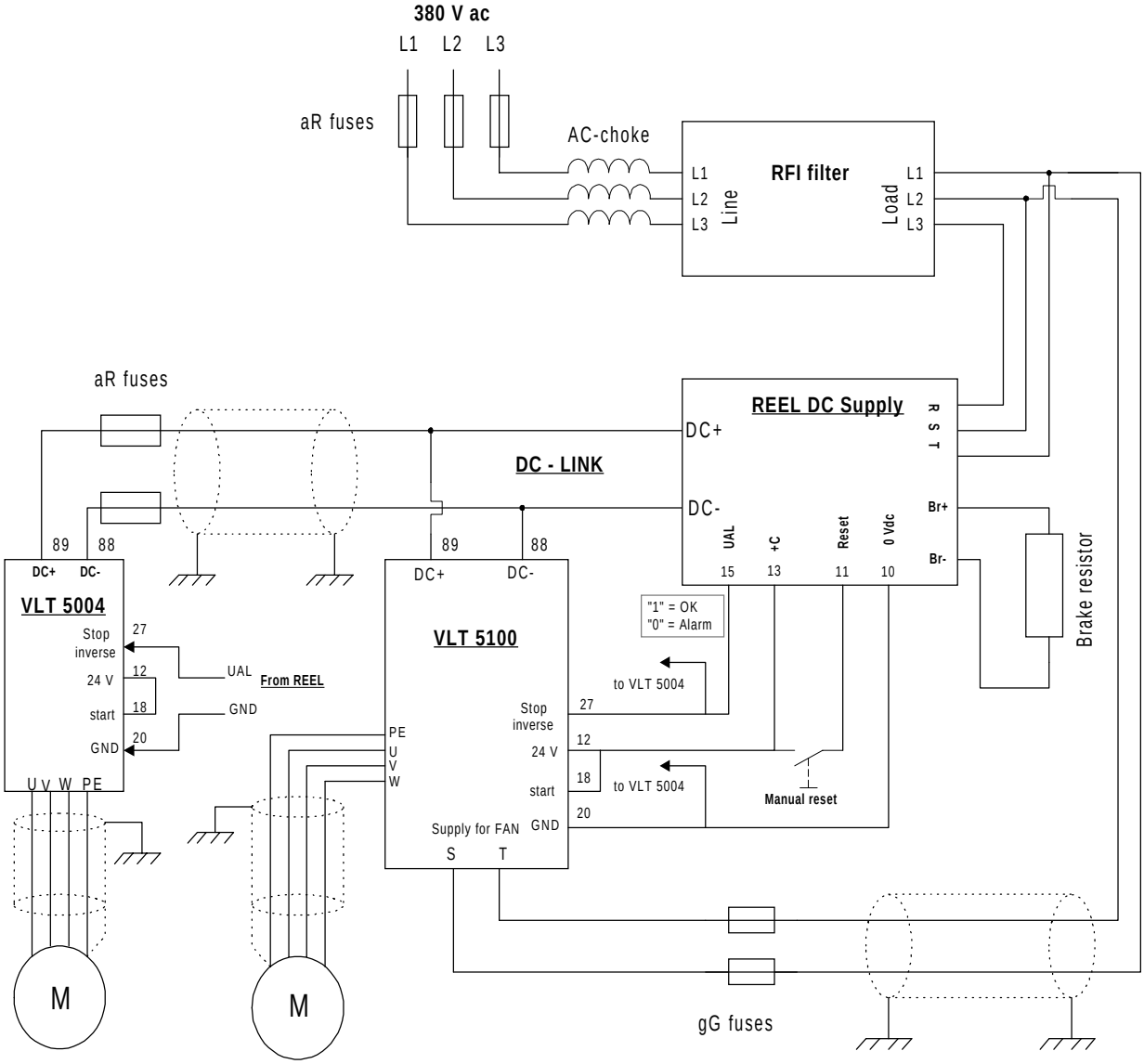
Installation

A few general rules have to be followed for connecting the VLT frequency converters EMC correct and for keeping EN55011 Class A1.

- Always keep power cables (especially the DC link) separated from the signal ones.
- The frequency converter, DC-supply and RFI-filter have to be mounted on metal plate, which is well connected to ground.
- Cable for DC-link, supply for Fan and motor cable have to be shielded.
- Screen has to be fixed with metal clamps on the nearest point to electrical connection.

NB!

Note that the internal fans by some VLT frequency converters are supply from the mains. To secure that the fans are running a external supply must be connected to the fans. See Operating Instructions or page 7 in this Instruction.



■ Load sharing with a 120 kVA DC supply, VLT 5100 and VLT 5004

The followed test results is measured for the test arrangement on the previous page.

	1)	2)	3)	4)
VLT 5100	Load (288 Nm)	Regen. (-174 Nm)	Load (288 Nm)	Regen. (-175 Nm)
VLT 5004	Load (7,5 Nm)	Load (7,5 Nm)	Regen. (-11 Nm)	Regen. (-11 Nm)
Power in VLT 5100 (kW)	44,7	-27,5	44,7	-27,6
Power in VLT 5004 (kW)	1,08	1,08	-1,8	-1,8
Power to brake resistor (kW)	0	22,11	0	24,6
Input supply to REEL (kW)	43	0	42	0
Udc (DC-link)	498 V	676 V	500 V	720 V

1) Both drives running with load, the REEL supply must therefore give power to the drives. The DC link is low and no power goes to the brake resistor.

2) The VLT 5100 is running regenerative and therefore is the DC-link relative high. The VLT 5004 are still loaded and could therefore use a little of the power from the VLT 5100. The rest goes to the brake resistor.

3) Here we have the opposite situation, but the VLT 5004 only gives a little power to the DC link and therefore it is necessary that the REEL DC-supply contribute with some power.

4) Both VLT frequency converters are running regenerative and the extra power goes to the brake resistor to keep the DC-link under the over voltage trip limit.

Notes:

The calculation of the power is made by means of the torque (Nm) and the speed of rotation.
Because of small inaccuracy in the equipment and reading inaccuracy, the result is not 100 % exacted. But it shows how the power split up, dependent on the conditions. By regenerative operation it necessary to use a brake resistor otherwise the DC-supply will give an alarm and stop the frequency converter, because of too high intermediate voltage. In this test we have used a brake resistor dimensioned for a regenerative load of 25 kW (58% braking load).

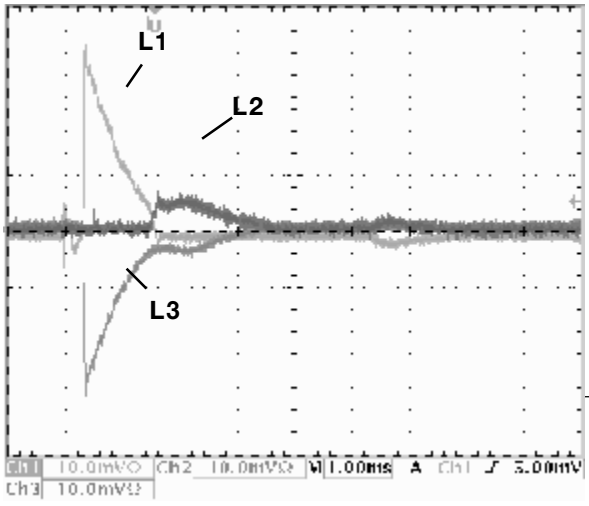
- Alarms don't reset it self, when over voltage is away.
- The alarm has to be reset on the control board or by digital input or by power off (autoreset level is about 180 Vdc)

■ Power "sag" at supply on the DC supply

The DC supply reacts immediately on a power sags with a alarm on output UAL. This signal can be used to coast the VLT frequency converter.
This kind of alarm reset itself when the power is back, because the auto reset level for power off is reached.

■ Inrush current on REEL DC supply

Measuring start current on DC-supply after discharging the capacitors on VLT 5100.
The maximal Inrush current only is ± 30 A and take about 3 mSec. (only for the combination shown on page 5)



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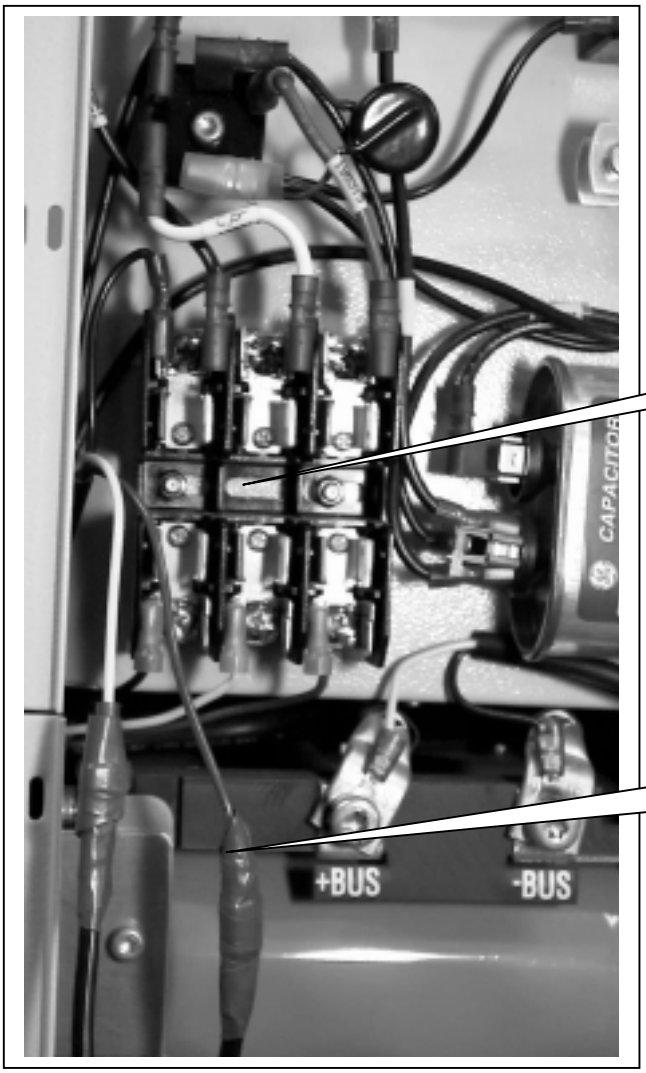
■ Fan installation for VLT 5060 - 5500 380 - 500 V

The fans for the VLT frequency in the above mention series is supply by the mains. By a installation with REEL DC supply the Fans must have a seperated A.C. supply to secure that they also will run.



Remove the Fan fuses.

Remove S and T (red and white wire) from the upper side of the fuse box and connect the two wires to 400 Vac.