



# Operating Instructions

## VLT<sup>®</sup> Lift Drive LD 302





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# 1 Introduction

## 1.1 Purpose of the Manual

This manual targets

- system designers
- installers
- service technicians

It provides detailed information for the installation and start-up of the frequency converter. *Chapter 3 Mechanical Installation* provides requirements for mechanical and electrical installation, including

- input
- motor
- control and serial communications wiring
- control terminal functions

*chapter 5 Commissioning* provides detailed procedures for

- start-up
- basic operational programming
- functional testing

The remaining chapters provide information about

- user interface
- programming
- applications
- start-up troubleshooting
- specifications

## 1.2 Additional Resources

Supplemental publications and manuals are available from Danfoss.

See [www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations/Technical+Documentation.htm](http://www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations/Technical+Documentation.htm) for listings.

## 1.3 Document and Software Version

This manual is regularly reviewed and updated. All suggestions for improvement are welcome. *Table 1.1* shows the document version and the corresponding software version.

Edition	Remarks	Software version
MG34X1	This is the first edition of this manual	6.72

Table 1.1 Document and Software Versions

## 1.4 Intended Use

The frequency converter is an electronic motor controller intended for

- regulation of motor speed in response to system feedback or to remote commands from external controllers. A power drive system consists of the frequency converter, the motor and equipment driven by the motor.
- system and motor status surveillance.

The frequency converter can also be used for motor protection.

Depending on configuration, the frequency converter can be used in standalone applications or form part of a larger appliance or installation.

The frequency converter is allowed for use in residential, industrial and commercial environments in accordance with local laws and standards.

### NOTICE

**In a residential environment this product can cause radio interference, in which case supplementary mitigation measures can be required.**

### Foreseeable misuse

Do not use the frequency converter in applications which are non-compliant with specified operating conditions and environments. Ensure compliance with the conditions specified in *chapter 12 Specifications*.

## 1.5 Certifications



## 1.6 Disposal Instruction

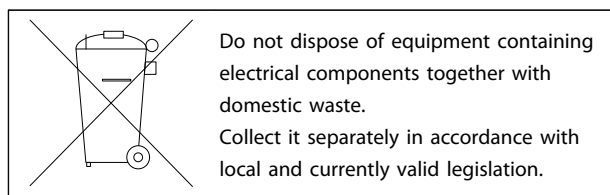


Table 1.2 Disposal Instruction

## 2 Safety

The following symbols are used in this document:

### **⚠ WARNING**

Indicates a potentially hazardous situation which could result in death or serious injury.

### **⚠ CAUTION**

Indicates a potentially hazardous situation which could result in minor or moderate injury. It may also be used to alert against unsafe practices.

### **NOTICE**

Indicates important information, including situations that may result in damage to equipment or property.

### 2.1 Qualified Personnel

Correct and reliable transport, storage, installation, operation and maintenance are required for the trouble-free and safe operation of the frequency converter. Only qualified personnel is allowed to install or operate this equipment.

Qualified personnel is defined as trained staff, who are authorised to install, commission, and maintain equipment, systems and circuits in accordance with pertinent laws and regulations. Additionally, the personnel must be familiar with the instructions and safety measures described in this document.

### 2.2 Safety Precautions

#### **⚠ WARNING**

##### **HIGH VOLTAGE**

Frequency converters contain high voltage when connected to AC mains input power. Qualified personnel only should perform installation, start up, and maintenance. Failure to perform installation, start up, and maintenance by qualified personnel could result in death or serious injury.

#### **⚠ WARNING**

##### **UNINTENDED START**

When the frequency converter is connected to AC mains, the motor may start at any time. The frequency converter, motor, and any driven equipment must be in operational readiness. Failure to be in operational readiness when the frequency converter is connected to AC mains could result in death, serious injury, equipment, or property damage.

#### **⚠ WARNING**

##### **DISCHARGE TIME**

Frequency converters contain DC-link capacitors that can remain charged even when the frequency converter is not powered. To avoid electrical hazards, disconnect AC mains, any permanent magnet type motors, and any remote DC-link power supplies, including battery back-ups, UPS, and DC-link connections to other frequency converters. Wait for the capacitors to fully discharge before performing any service or repair work. The amount of wait time is listed in the *Discharge Time* table. Failure to wait the specified time after power has been removed before doing service or repair could result in death or serious injury.

Voltage [V]	Minimum waiting time (minutes)	
	4	15
380-400	0.25-7.5 kW [0.34-10 hp]	11-75 kW [15-100 hp]
High voltage may be present even when the warning LEDs are off!		

Table 2.1 Discharge Time

## 3 Mechanical Installation

### 3

### 3.1 Equipment Pre-installation Check List

- Compare the model number of the unit on the nameplate to what was ordered to verify the proper equipment
- Ensure each of the following are rated for same voltage:
  - Mains (power)
  - Frequency converter
  - Motor
- Ensure that the frequency converter output current rating is equal to or greater than motor full load current for peak motor performance
  - Motor size and frequency converter power must match for proper overload protection
  - If frequency converter rating is less than motor, full motor output cannot be achieved

### 3.2 Unpacking

#### 3.2.1 Items Supplied

Items supplied may vary according to product configuration.

- Make sure the items supplied and the information on the nameplate correspond to the order confirmation.
- Check the packaging and the frequency converter visually for damage caused by inappropriate handling during shipment. File any claim for damage with the carrier. Retain damaged parts for clarification.

#### **NOTICE**

**Do not remove the nameplate from the frequency converter (loss of warranty).**

#### 3.2.2 Storage

Ensure that requirements for storage are fulfilled. Refer to *chapter 12.2 Ambient Conditions* for further details.

### 3.3 Installation Environment

#### 3.3.1 Installation Site Check List

- The frequency converter relies on the ambient air for cooling. Observe the limitations on ambient temperature for optimal operation.
- Before mounting the frequency converter, ensure that the installation location has sufficient support strength
- Keep the frequency converter interior free from dust and dirt. Ensure that the components stay as clean as possible. In construction areas, provide a protective covering. Optional IP54 (NEMA 12) or IP66 (NEMA 4) enclosures may be necessary.
- Keep the manual, drawings, and diagrams accessible for detailed installation and operating instructions. It is important that the manual is available for equipment operators.
- Locate equipment as near to the motor as possible. Keep motor cables as short as possible. Check the motor characteristics for actual tolerances. Do not exceed
  - 300 m [1,000 ft] for unshielded motor cables
  - 150 m [500 ft] for screened cable.
- Consider derating for temperatures between 40 °C [104 °F] and 50 °C [122 °F] and elevation 1,000 m [3,300 ft] above sea level. See the equipment *Design Guide* for detailed information.

### 3.4 Mounting

#### 3.4.1 Cooling

Ensure that top and bottom clearance for air cooling is provided. See *Illustration 3.1* for clearance requirements.



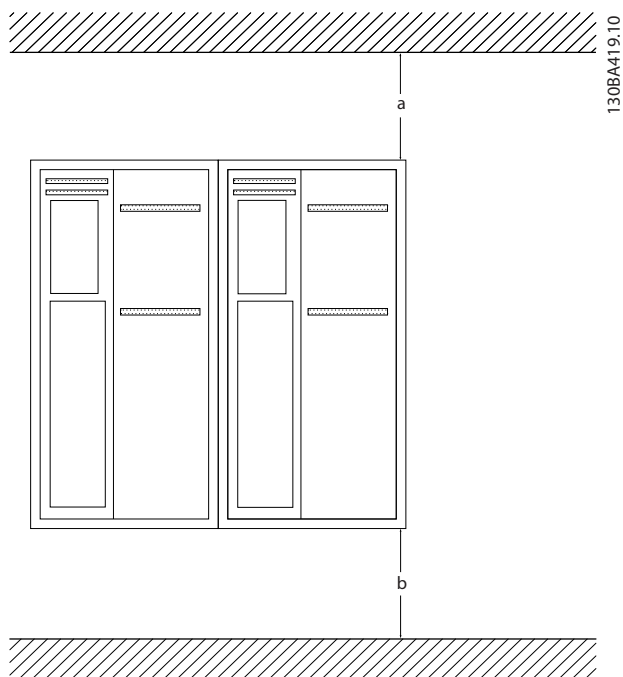


Illustration 3.1 Top and Bottom Cooling Clearance

Enclosure type	A1-A5	B1-B4	C1, C3	C2, C4
a/b [mm]	100	200	200	225

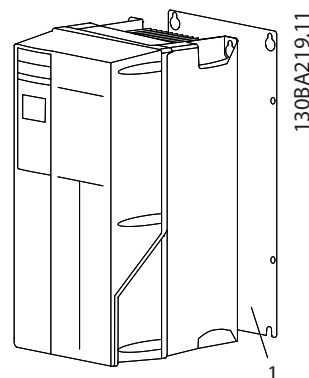
Table 3.1 Minimum Airflow Clearance Requirements

### 3.4.2 Lifting

- To determine a safe lifting method, check the weight of the unit
- Ensure that the lifting device is suitable for the task
- If necessary, plan for a hoist, crane, or forklift with the appropriate rating to move the unit
- For lifting, use hoist rings on the unit, when provided

### 3.4.3 Mounting

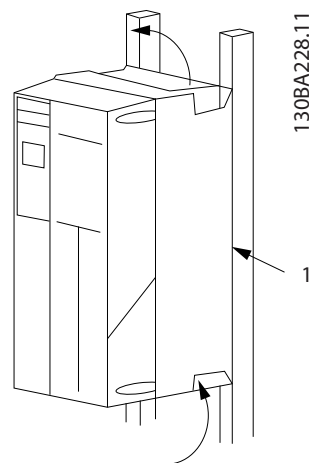
1. Ensure that the strength of the mounting location supports the unit weight. The frequency converter allows side-by-side installation.
2. Mount the unit vertically to a solid flat surface or to the optional back plate (see *Illustration 3.2* and *Illustration 3.3*).
3. Use the slotted mounting holes on the unit for wall mount, when provided.



Item	Description
1	Back plate

Illustration 3.2 Proper Mounting with Back Plate

Install the back plate properly for required airflow to cool the unit.



Item	Description
1	Back plate

Illustration 3.3 Proper Mounting with Railings

**NOTICE**

Back plate is needed when mounted on railings.

**NOTICE**

Improper mounting can result in overheating and reduced performance.

## 4 Electrical Installation

### 4.1 Safety instructions

#### 4.1.1 Requirements

#### **WARNING**

##### EQUIPMENT HAZARD!

Rotating shafts and electrical equipment can be hazardous. All electrical work must conform to national and local electrical codes. Only trained and qualified personnel should install, start up, and maintain the equipment. Failure to follow these guidelines could result in death or serious injury.

#### **NOTICE**

##### WIRING ISOLATION!

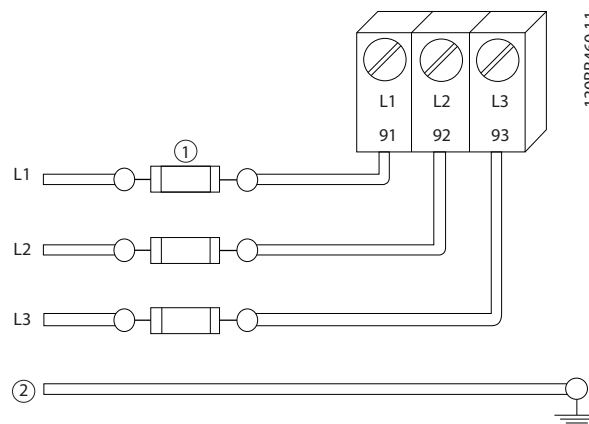
Run input power, motor wiring and control wiring in 3 separate metallic conduits or use separated screened cable for high frequency noise isolation. Failure to isolate power, motor and control wiring could result in less than optimum frequency converter and associated equipment performance.

For safety, comply with the following requirements.

- Electronic controls equipment is connected to hazardous mains voltage. Take extreme care to protect against electrical hazards when applying power to the unit.
- Run motor cables from multiple frequency converters separately. Induced voltage from output motor cables that are run together can charge equipment capacitors even with the equipment turned off and locked out.

##### Overload and equipment protection

- The frequency converter provides overload protection for the motor (Class 20 motor protection). See *chapter 10 Special Conditions* for details.
- All frequency converters must be provided with short circuit and overcurrent protection. Input fusing is required to provide this protection, see *Illustration 4.1*. If not factory supplied, the installer must provide fuses as part of installation.



Item	Description
1	Fuses
2	Ground

Illustration 4.1 Frequency Converter Fuses

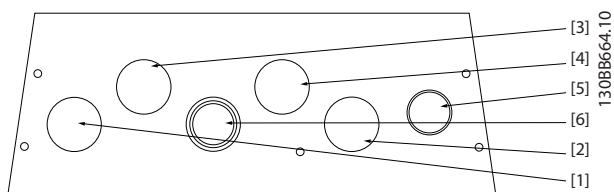
##### Wire Type and Ratings

- All wiring must comply with local and national regulations regarding cross section and ambient temperature requirements.
- Danfoss recommends that all power connections are made with a minimum 75 °C [167 °F] rated copper wire.
- See *chapter 12.3 Power Ratings, Weight and Dimensions* for recommended wire sizes.

#### 4.1.2 Cable Entries

#### **NOTICE**

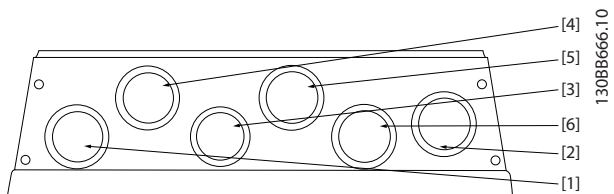
Other solutions are possible. Unused cable entries can be sealed with rubber grommets (for IP21).



Item	Recommended use	Dimensions <sup>1)</sup>		Nearest metric
		UL [in]	[mm]	
1	Mains	3/4	28.4	M25
2	Motor	3/4	28.4	M25
3	Brake/load sharing	3/4	28.4	M25
4	Control cable	3/4	28.4	M25
5	Control cable <sup>2)</sup>	3/4	28.4	M25
6	Control cable <sup>2)</sup>	3/4	28.4	M25

<sup>1)</sup> Tolerance ±0.2 mm  
<sup>2)</sup> Knockout hole

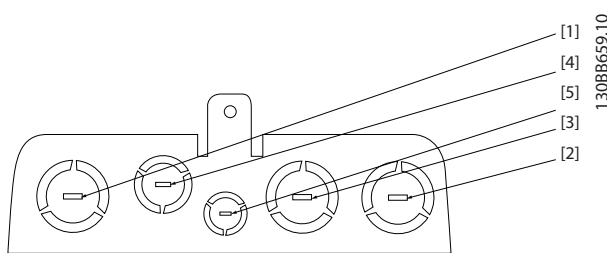
Illustration 4.2 A5 (IP55)



Item	Recommended use	Dimensions	
		UL [in]	[mm]
1	Mains		M25
2	Motor		M25
3	Brake/load sharing		28.4 mm <sup>1)</sup>
4	Control cable		M25
5	Control cable		M25
6	Control cable		M25

<sup>1)</sup> Knock-out hole

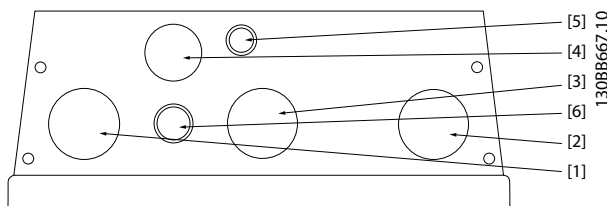
Illustration 4.3 A5 (IP55) Threaded Gland Holes



Item	Recommended use	Dimensions <sup>1)</sup>		Nearest metric
		UL [in]	[mm]	
1	Mains	1	34.7	M32
2	Motor	1	34.7	M32
3	Brake/load sharing	1	34.7	M32
4	Control cable	1	34.7	M32
5	Control cable	1/2	22.5	M20

<sup>1)</sup> Tolerance ±0.2 mm

Illustration 4.4 B1 (IP21)

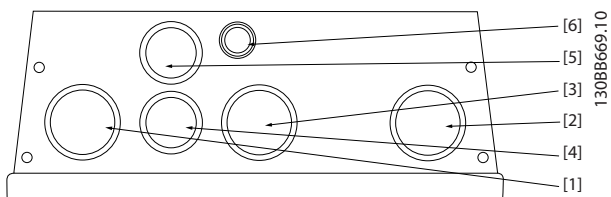


Item	Recommended use	Dimensions <sup>1)</sup>		Nearest metric
		UL [in]	[mm]	
1	Mains	1	34.7	M32
2	Motor	1	34.7	M32
3	Brake/load sharing	1	34.7	M32
4	Control cable	3/4	28.4	M25
5	Control cable	1/2	22.5	M20
6	Control cable <sup>2)</sup>	1/2	22.5	M20

<sup>1)</sup> Tolerance ±0.2 mm  
<sup>2)</sup> Knockout hole

Illustration 4.5 B1 (IP55)

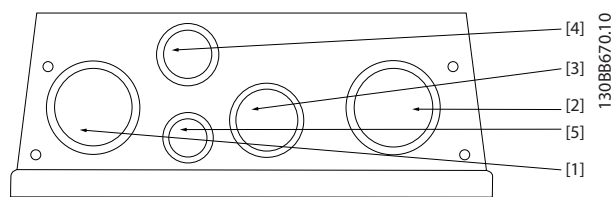
4



Item	Recommended use	Dimensions
1	Mains	M32
2	Motor	M32
3	Brake/load sharing	M32
4	Control cable	M25
5	Control cable	M25
6	Control cable	22.5 mm <sup>1)</sup>

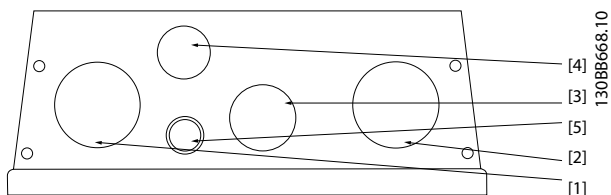
<sup>1)</sup> Knockout

Illustration 4.6 B1 (IP55) Threaded Gland Holes



Item	Recommended use	Dimensions
1	Mains	M40
2	Motor	M40
3	Brake/Load Sharing	M32
4	Control cable	M25
5	Control cable	M20

Illustration 4.8 B2 (IP55) Threaded Gland Holes



Item	Recommended use	Dimensions <sup>1)</sup>		Nearest metric
		UL [in]	[mm]	
1	Mains	1 1/4	44.2	M40
2	Motor	1 1/4	44.2	M40
3	Brake/load sharing	1	34.7	M32
4	Control cable	3/4	28.4	M25
5	Control cable <sup>2)</sup>	1/2	22.5	M20

<sup>1)</sup> Tolerance ±0.2 mm  
<sup>2)</sup> Knockout hole

Illustration 4.7 B2 (IP55)

## 4.2 EMC Compliant Installation

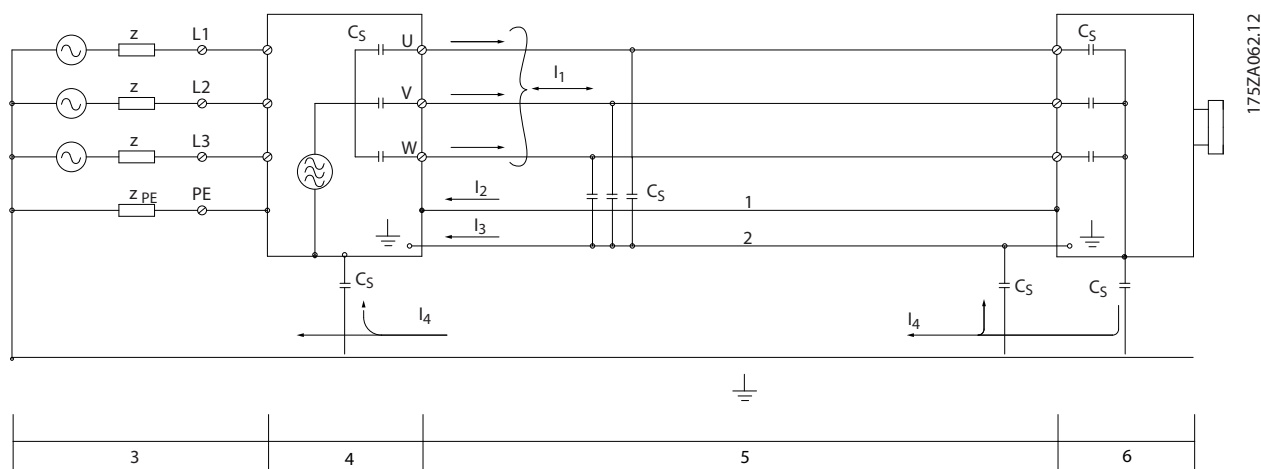
### 4.2.1 General Aspects of EMC Emissions

The frequency converter, motor cable and the motor generate airborne interference in the range 30 MHz to 1 GHz. Capacitive currents in the motor cable coupled with a high dU/dt from the motor voltage generate leakage currents.

Use screened motor cable to reduce radiated interference. Connect the motor cable screen to the frequency converter enclosure as well as to the motor enclosure. Use integrated screen clamps to avoid twisted screen ends (pigtailed).

To reduce the interference level from the entire system (unit + installation), make motor and brake cables as short as possible. Avoid placing cables with a sensitive signal level alongside motor and brake cables. Especially control electronics generate radio interference higher than 50 MHz (airborne).

4



1	Ground wire
2	Screen
3	AC mains supply
4	Frequency converter
5	Screened motor cable
6	Motor

Table 4.1

Illustration 4.9 Situation that Generates Leakage Currents

Ensure that screen currents can be conveyed back to the frequency converter. Also, ensure good electrical contact from the mounting plate through the mounting screws to the frequency converter chassis.

### **NOTICE**

When unscreened cables are used, some emission requirements are not complied with, although the immunity requirements are observed.

## 4.2.2 EMC Immunity

All Danfoss frequency converters comply with the requirements for the industrial environment as well as home and office environments.

Immunity tests were performed in accordance with the following standards:

- **EN 61000-4-2 (IEC 61000-4-2):** Electrostatic discharges (ESD): Simulation of electrostatic discharges from human beings.
- **EN 61000-4-3 (IEC 61000-4-3):** Incoming electromagnetic field radiation, amplitude modulated simulation of the effects of radar and radio communication equipment as well as mobile communications equipment.
- **EN 61000-4-4 (IEC 61000-4-4):** Burst transients: Simulation of interference brought about by switching a contactor, relay, or similar devices.
- **EN 61000-4-5 (IEC 61000-4-5):** Surge transients: Simulation of transients brought about for example, by lightning that strikes near installations.
- **EN 61000-4-6 (IEC 61000-4-6):** RF common mode: Simulation of the effect from radio-transmission equipment joined by connection cables.

Voltage range: 380-400 V					
Basic standard	Burst IEC 61000-4-4	Surge IEC 61000-4-5	ESD IEC 61000-4-2	Radiated electromagnetic field IEC 61000-4-3	RF common mode voltage IEC 61000-4-6
Acceptance criterion	B	B	B	A	A
Line	4 kV CM	2 kV/2 Ω DM 4 kV/12 Ω CM	—	—	10 V <sub>RMS</sub>
Motor	4 kV CM	4 kV/2 Ω <sup>1)</sup>	—	—	10 V <sub>RMS</sub>
Brake	4 kV CM	4 kV/2 Ω <sup>1)</sup>	—	—	10 V <sub>RMS</sub>
Load sharing	4 kV CM	4 kV/2 Ω <sup>1)</sup>	—	—	10 V <sub>RMS</sub>
Control wires	2 kV CM	2 kV/2 Ω <sup>1)</sup>	—	—	10 V <sub>RMS</sub>
Standard bus	2 kV CM	2 kV/2 Ω <sup>1)</sup>	—	—	10 V <sub>RMS</sub>
Relay wires	2 kV CM	2 kV/2 Ω <sup>1)</sup>	—	—	10 V <sub>RMS</sub>
Application and fieldbus options	2 kV CM	2 kV/2 Ω <sup>1)</sup>	—	—	10 V <sub>RMS</sub>
LCP cable	2 kV CM	2 kV/2 Ω <sup>1)</sup>	—	—	10 V <sub>RMS</sub>
External 24 V DC	2 V CM	0.5 kV/2 Ω DM 1 kV/12 Ω CM	—	—	10 V <sub>RMS</sub>
Enclosure	—	—	8 kV AD 6 kV CD	10 V/m	—

**Table 4.2 EMC Immunity**

1) Injection on cable screen

AD: Air discharge

CD: Contact discharge

CM: Common mode

DM: Differential mode

### EMC Test Results

The following test results have been obtained using a system with

- a frequency converter
- a screened cable
- a control box with potentiometer
- a motor

- a screened motor cable

RFI filter type	Conducted emission					Radiated emission	
Standards and requirements	EN 55011	Class B Housing, trades and light industries	Class A Group 1 Industrial environment	Class A Group 2 Industrial environment	Class B Housing, trades and light industries	Class A Group 1 Industrial environment	
	EN/IEC 61800-3	Category C1 First environment, home and office	Category C2 First environment, home and office	Category C3 Second environment, industrial	Category C1 First environment, home and office	Category C2 First environment, home and office	
<b>H1: RFI Class A1/B, Category 1/2</b>							
LD 302	0-75 kW [0-100 hp] 380-480 V	IP20	50 m [164 ft]	150 m [492 ft]	150 m [492 ft]	No	Yes
	0-7.5 kW [0-10 hp] 380-480 V	IP55	50 m [164 ft]	150 m [492 ft]	150 m [492 ft]	No	Yes
<b>H2: RFI Class A2, Category 3</b>							
LD 302	0-7.5 kW [0-10 hp] 380-480 V	IP20	No	No	5 m [16 ft]	No	No
	11-75 kW [15-100 hp] 380-480 V	IP20	No	No	25 m [82 ft]	No	No
	0-7.5 kW [0-10 hp] 380-480 V	IP55	No	No	5 m [16 ft]	No	No
<b>H3: RFI Class A1/B, Category 1/2</b>							
LD 302	11-55 kW [15-75 hp] 380-480 V	IP55	50 m [164 ft]	150 m [492 ft]	150 m [492 ft]	No	Yes

**Table 4.3 EMC Test Results (Emission, Immunity)**

H1, H2 or H3 is defined in the type code position 16-17 for EMC filters

H1 - Integrated EMC filter. Fulfils EN 55011 Class A1/B and EN/IEC 61800-3 Category 1/2

H2 - No additional EMC filter. Fulfils EN 55011 Class A2 and EN/IEC 61800-2 Category 3

H3 - Integrated EMC filter. Fulfils EN 55011 Class A1/B and EN/IEC 61800-3 Category 1/2.

### 4.3 Harmonics

#### 4.3.1 General Aspects of Harmonics Emission

A frequency converter takes up a non-sinusoidal current from mains, which increases the input current  $I_{RMS}$ . A non-sinusoidal current is transformed with a Fourier analysis and split into sine-wave currents with different frequencies, that is, different harmonic currents  $I_n$  with 50 Hz basic frequency:

	$I_1$	$I_5$	$I_7$
Hz	50	250	350

Table 4.4 Harmonic Currents

The harmonics do not affect the power consumption directly, but increase the heat losses in the installation (transformer, cables). So, in plants with a high percentage of rectifier load, maintain harmonic currents at a low level to avoid overload of the transformer and high temperature in the cables.

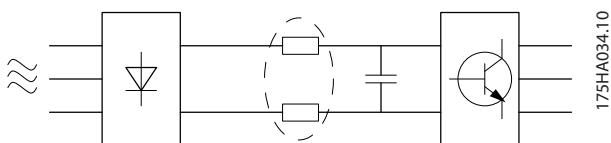


Illustration 4.10 Harmonic Currents

#### NOTICE

Some of the harmonic currents might disturb communication equipment connected to the same transformer or cause resonance with power-factor correction batteries.

To ensure low harmonic currents, the frequency converter is equipped with intermediate circuit coils as standard. This normally reduces the input current  $I_{RMS}$  by 40%.

The voltage distortion on the mains supply voltage depends on the size of the harmonic currents multiplied by the mains impedance for the frequency in question. The total voltage distortion THD is calculated based on the individual voltage harmonics using this formula:

$$THD\% = \sqrt{U_5^2 + U_7^2 + \dots + U_N^2}$$

(UN% of U)

### 4.3.2 Harmonics Emission Requirements

#### Equipment connected to the public supply network

Options	Definition
1	IEC/EN 61000-3-2 Class A for 3-phase balanced equipment (for professional equipment only up to 1 kW total power).
2	IEC/EN 61000-3-12 Equipment 16-75 A and professional equipment as from 1 kW up to 16 A phase current.

Table 4.5 Connected Equipment

### 4.3.3 Harmonics Test Results (Emission)

Power sizes up to PK75 in T2 and T4 comply with IEC/EN 61000-3-2 Class A. Power sizes from P1K1 and up to P18K in T2 and up to P90K in T4 comply with IEC/EN 61000-3-12, Table 4. Power sizes P110 - P450 in T4 also comply with IEC/EN 61000-3-12 even though not required because currents are above 75 A.

	Individual harmonic current $I_n/I_1$ (%)			
	$I_5$	$I_7$	$I_{11}$	$I_{13}$
Actual (typical)	40	20	10	8
Limit for $R_{scc} \geq 120$	40	25	15	10
	Harmonic current distortion factor (%)			
	THD		PWHD	
Actual (typical)	46		45	
Limit for $R_{scc} \geq 120$	48		46	

Table 4.6 Harmonics Test Results (Emission)

If the short-circuit power of the supply  $S_{sc}$  is greater than or equal to:

$$SSC = \sqrt{3} \times RSCE \times Umains \times Iequ = \sqrt{3} \times 120 \times 400 \times Iequ$$

at the interface point between the user's supply and the public system ( $R_{scc}$ ).

It is the responsibility of the installer or user of the equipment to ensure that the equipment is connected only to a supply with a short-circuit power  $S_{sc}$  greater than or equal to what is specified above. If necessary, consult the distribution network operator.

Other power sizes can be connected to the public supply network by consultation with the distribution network operator.

Compliance with various system level guidelines: The harmonic current data in Table 4.6 are given in accordance with IEC/EN61000-3-12 with reference to the



Power Drive Systems product standard. The data may be used to calculate the harmonic currents' influence on the power supply system and to document compliance with relevant regional guidelines: IEEE 519 -1992; G5/4.

## 4.4 Grounding

### 4.4.1 Grounding Requirements

#### **⚠ WARNING**

#### **GROUNDING HAZARD!**

Ground the frequency converter in accordance with national and local electrical codes as well as instructions contained within these instructions. Ground currents are higher than 3.5 mA. Failure to ground frequency converter properly could result in death or serious injury.

- To ground electrical equipment properly, follow all local and national electrical codes
- Proper protective earthing for equipment with ground currents higher than 3.5 mA must be established, see *chapter 4.4.1.1 Ground Leakage Current*
- A dedicated ground wire is required for input power, motor power and control wiring
- Use the clamps provided with the equipment for proper ground connections
- Do not ground one frequency converter to another in a "daisy chain" fashion
- Keep the ground wire connections as short as possible
- Use of high-strand wire to reduce electrical noise is recommended
- Follow motor manufacturer wiring requirements

#### 4.4.1.1 Ground Leakage Current

Follow national and local codes regarding protective earthing of equipment with a leakage current > 3.5 mA. Frequency converters generate a leakage current in the ground connection. A fault current in the frequency converter at the output power terminals might charge the filter capacitors and cause a transient ground current. The ground leakage current depends on various system configurations including RFI filtering, screened motor cables, and frequency converter power.

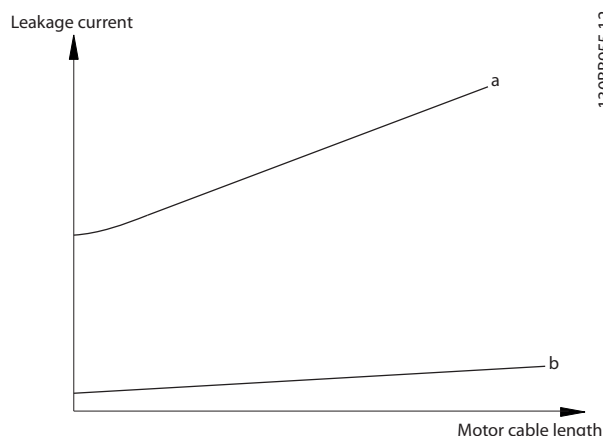


Illustration 4.11 Cable Length and Power Size Influence on Leakage Current. Pa > Pb.

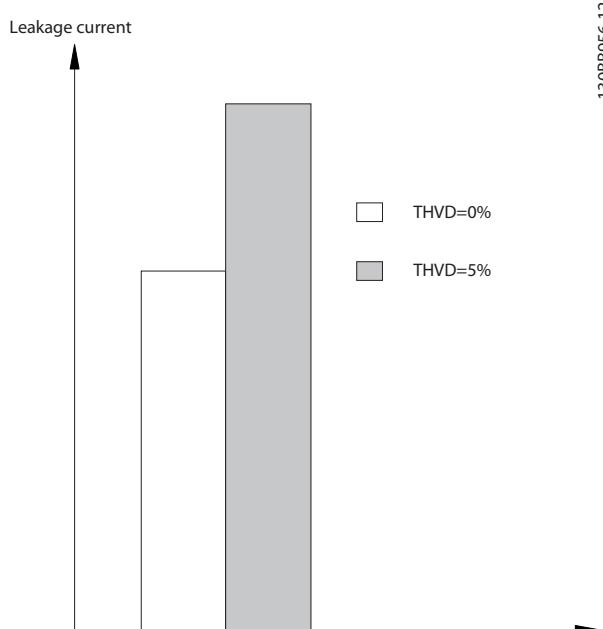


Illustration 4.12 Line Distortion Influences Leakage Current

According to EN/IEC 61800 5 1, ground wire must be reinforced, if the leakage current exceeds 3.5 mA:

- Ground wire (terminal 95) of at least 10 mm<sup>2</sup> [8 AWG]
- 2 separate ground wires both complying with the dimensioning rules

See EN/IEC61800-5-1 and EN50178 for further information.

**Using RCDs**

Where residual current devices (RCDs), also known as earth leakage circuit breakers (ELCBs), are used, comply with the following:

Only use RCDs of type B, capable of detecting AC and DC currents

To prevent faults due to transient ground currents, use RCDs with an inrush delay

Dimension RCDs according to the system configuration and environmental considerations

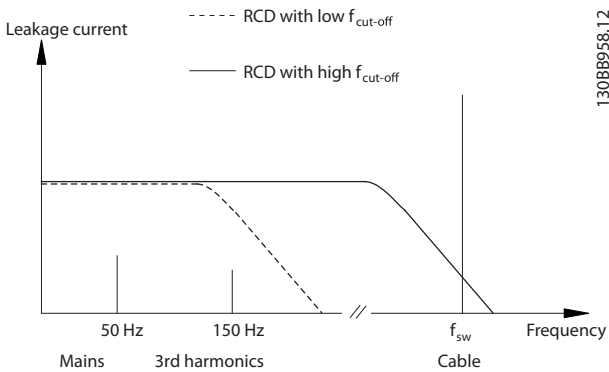


Illustration 4.13 Main Contributions to Leakage Current

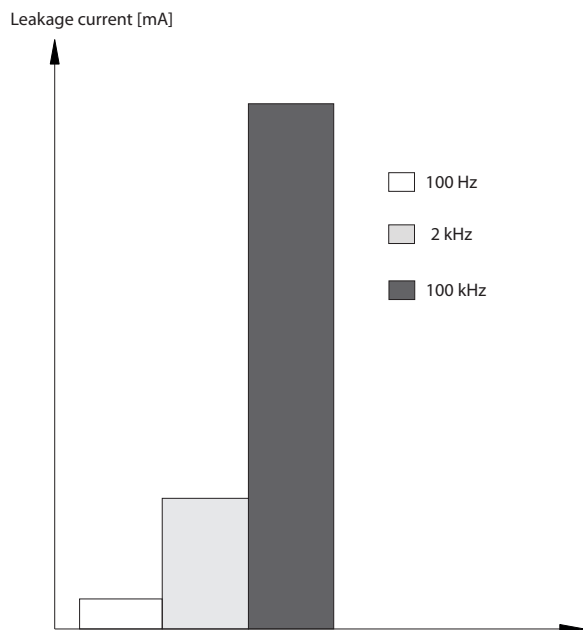


Illustration 4.14 Influence of the Cut-off Frequency of the RCD

**4.4.1.2 Grounding Using Screened Cable**

Grounding clamps are provided for motor wiring (see Illustration 4.15).

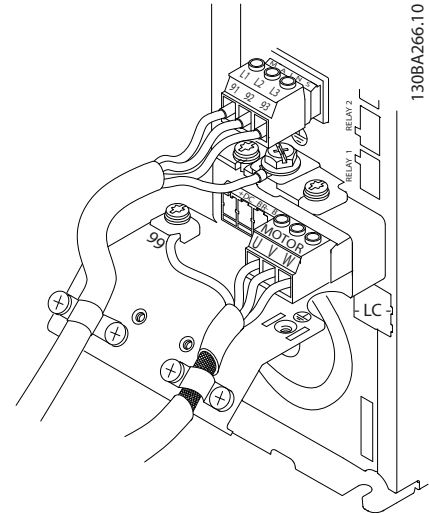


Illustration 4.15 Grounding with Screened Cable

**4.5 PELV - Protective Extra Low Voltage**

**WARNING**

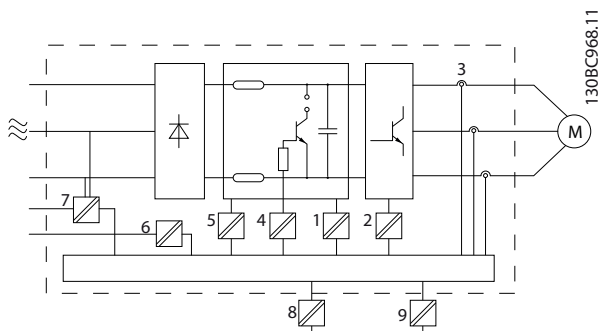
**ELECTRICAL SHOCK HAZARD!**

Protect against electrical shock by using electrical supply of the PELV type and the setting up the installation as described in local/national regulations on PELV supplies. Failure to protect against electrical shock can cause personal injury or death.

All control terminals and relay terminals 01-03/04-06 comply with PELV, except for grounded Delta leg above 400 V.

The electrical isolation complies with the requirements for higher isolation according to EN 61800-5-1.

To maintain PELV all connections made to the control terminals must be PELV, e.g. thermistor must be reinforced/double insulated.



Item	Description
1	Power supply (SMPS) incl. signal isolation of $U_{DC}$ , indicating the voltage of intermediate DC link circuit
2	Gate drive that runs the IGBTs (trigger transformers/opto-couplers)
3	Current transducers
4	Opto-coupler, brake module
5	Internal inrush, RFI, and temperature measurement circuits
6	Custom relays
7	Mechanical brake
8	Functional galvanic isolation for 24 V back-up option
9	Functional galvanic isolation for RS-485 standard bus interface

Illustration 4.16 Galvanic Isolation

**⚠ WARNING**

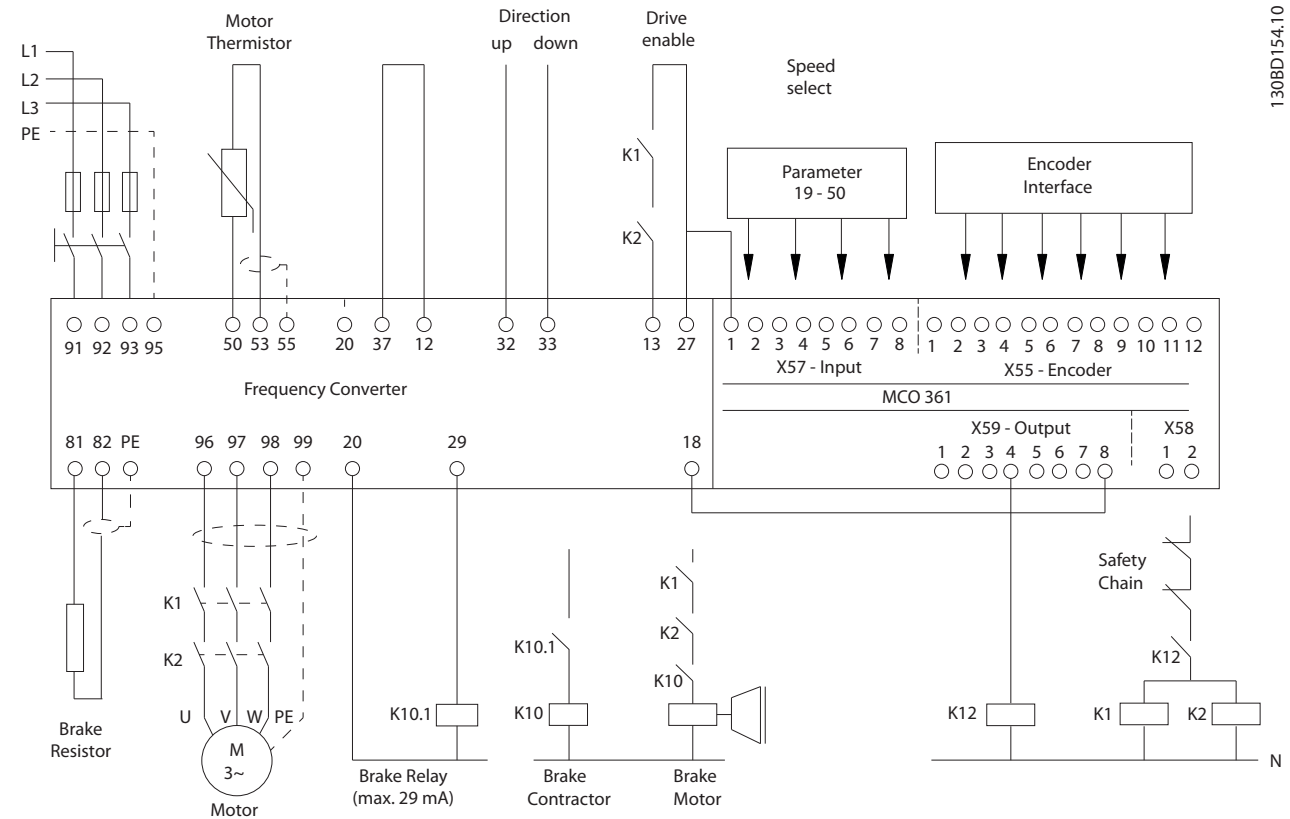
Installation at high altitude:  
 380-400 V, enclosure types A, B and C: At altitudes above 2,000 m [6,600 ft], contact Danfoss regarding PELV.

## 4.6 Wiring Schematic

### 4.6.1 Operation with Motor Contactors

Illustration 4.17 is valid when 19-86 Enable SC is set to [1] Simple control.

4

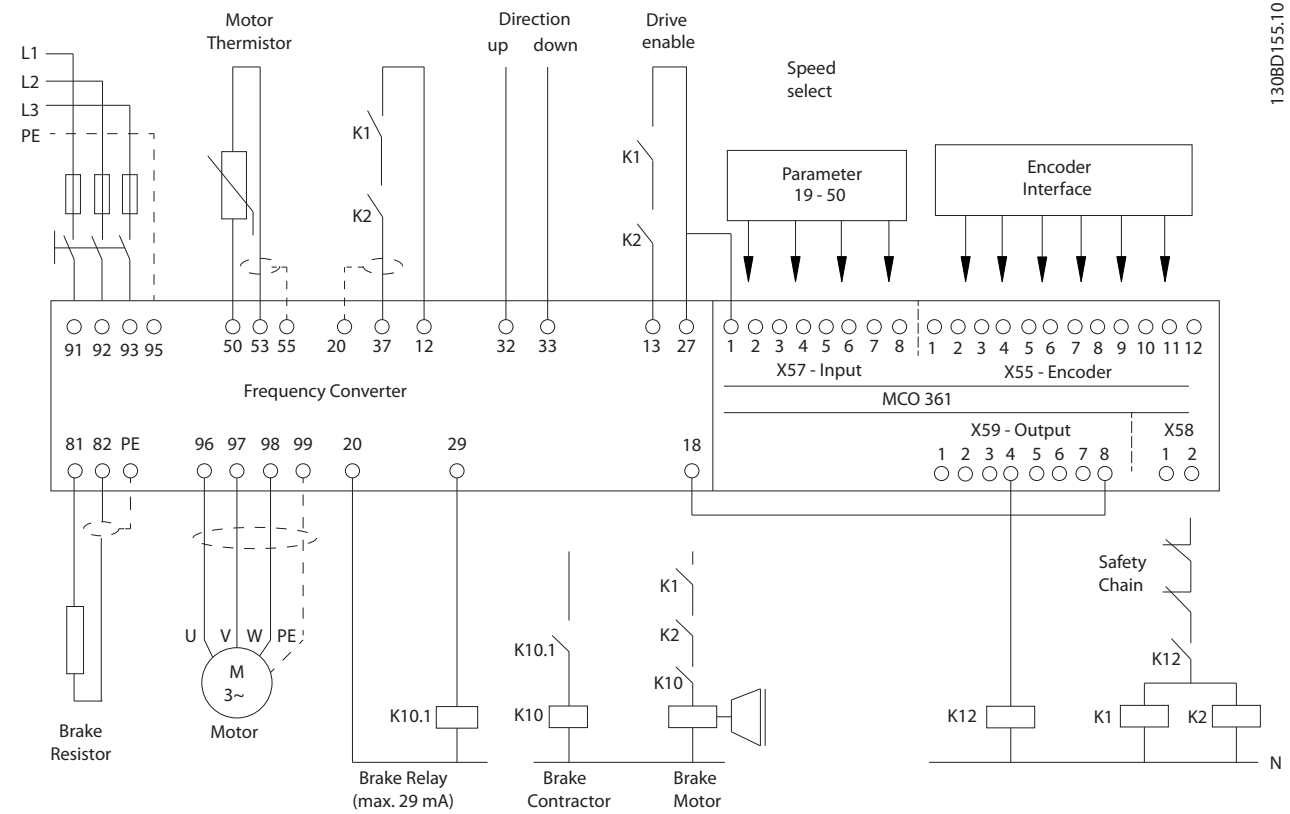


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Illustration 4.17 Wiring Schematic with Contactors

### 4.6.2 Operation without Motor Contactors

Illustration 4.18 is valid when 19-86 Enable SC is set to [1] Simple control.



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Illustration 4.18 Wiring Schematic without Contactors

## 4.7 Motor Connection

### **⚠ WARNING**

#### INDUCED VOLTAGE!

Run output motor cables from multiple frequency converters separately. Induced voltage from output motor cables that are run together can charge equipment capacitors even with the equipment turned off and locked out. Failure to run output motor cables separately could result in death or serious injury.

- For maximum cable sizes and length, see *chapter 12.3 Power Ratings, Weight and Dimensions*
  - Comply with local and national electrical codes for cable sizes
  - Do not install power factor correction capacitors between the frequency converter and the motor
  - Do not wire a starting or pole-changing device between the frequency converter and the motor
1. Connect the 3-phase motor wiring to terminals 96 (U), 97 (V), and 98 (W).
  2. Ground the cable in accordance with grounding instructions provided.
  3. Torque terminals in accordance with the information provided in *chapter 12.4 Connection Tightening Torques*.
  4. Follow motor manufacturer wiring requirements.

*Illustration 4.15* represents mains input, motor, and grounding for basic frequency converters. Actual configurations vary with unit types and optional equipment.

## 4.8 AC Mains Connection

- Size wiring based on the input current of the frequency converter. For maximum wire sizes, see *chapter 12.3 Power Ratings, Weight and Dimensions*.
- Comply with local and national electrical codes for cable sizes.
- Connect 3-phase AC input power wiring to terminals L1, L2, and L3 (see *Illustration 4.15*).
- Depending on the configuration of the equipment, input power is connected to the mains input terminals or the input disconnect.
- Ground the cable in accordance with grounding instructions provided in *chapter 4.4.1 Grounding Requirements*
- All frequency converters may be used with an isolated input source as well as with ground reference power lines. When supplied from an isolated mains source (IT mains or floating delta)

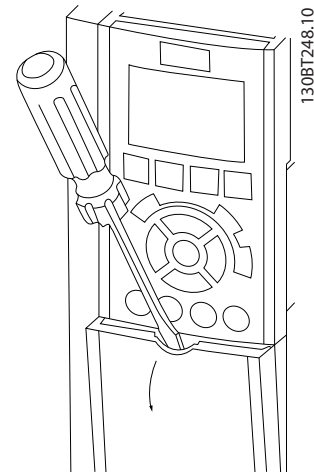
or TT/TN-S mains with a grounded leg (grounded delta), set *14-50 RFI Filter* to OFF. When off, the internal RFI filter capacitors between the chassis and the intermediate circuit are isolated. This isolation prevents damage to the intermediate circuit and reduces ground capacity currents in accordance with IEC 61800-3.

## 4.9 Control Wiring

- Isolate control wiring from high-power components in the frequency converter.
- If the frequency converter is connected to a thermistor, for PELV isolation, optional thermistor control wiring must be reinforced/double insulated. A 24 V DC supply voltage is recommended.

### 4.9.1.1 Removing the Cover

- Remove cover plate with a screw driver. See *Illustration 4.19*.
- Or remove front cover by loosening attaching screws. See *Illustration 4.20*.



**Illustration 4.19 Control Wiring Access for Enclosure Types A2, A3, B3, B4, C3 and C4**

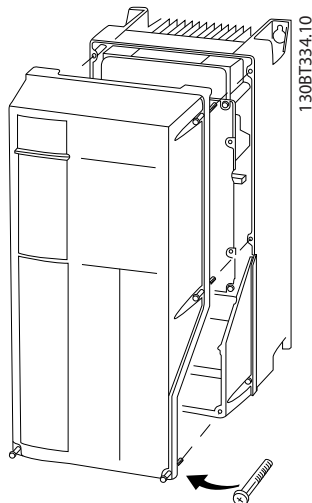


Illustration 4.20 Control Wiring Access for Enclosure Types A4, A5, B1, B2, C1 and C2

**Enclosure types A2 and A3**

Encoder and I/O terminal are located behind the C option terminal cover, see *Illustration 4.21*.

The lift controller bus terminals and debug terminals (RS-485) are on the top of the C-option cover. If these connections are used, cut out the plastic parts above the connectors and mount the cable relief.

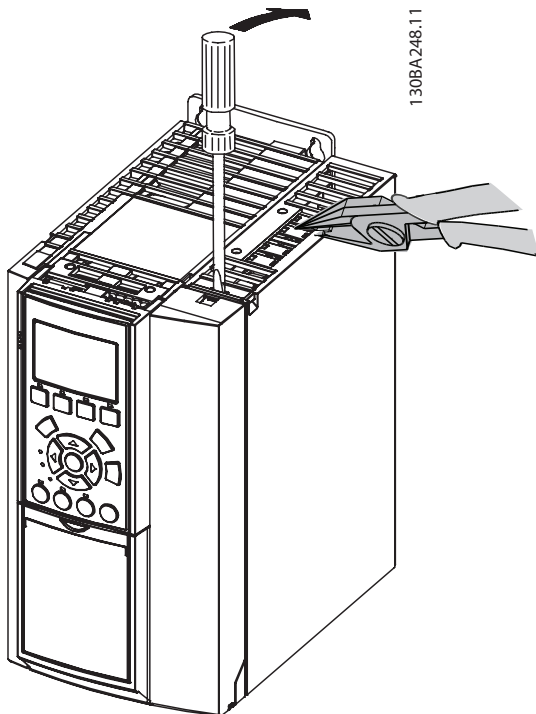


Illustration 4.21 Location of Encoder and I/O Terminals

**Enclosure types A5, B1 and B2**

All MCO 361 terminals are located next to the control card. To get access, remove the front cover, see *Illustration 4.20*.

See *Table 4.7* before tightening the covers.

Enclosure type	IP20	IP55
A4/A5	-	2/1.5
B1	-	2.2/1.6
B2	-	2.2/1.6
C1	-	2.2/1.6
C2	-	2.2/1.6
- Does not exist		

Table 4.7 Tightening Torques for Covers [Nm]/[lb-ft]

**4.9.1.2 Control Terminal Types**

*Illustration 4.22* shows the removable frequency converter connectors.

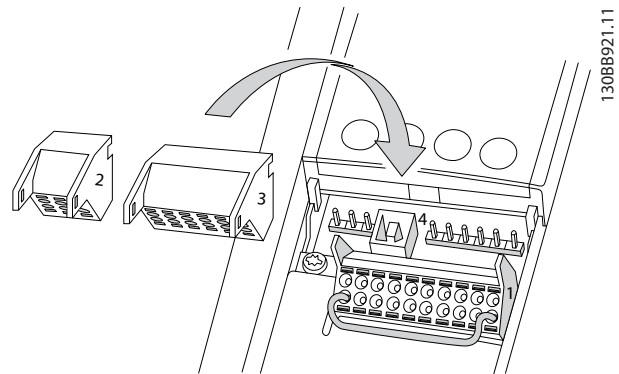


Illustration 4.22 Control Terminal Locations

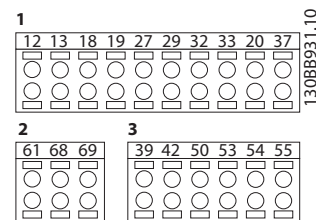


Illustration 4.23 Terminal Numbers

- **Connector 1**, terminals 12-37
- **Connector 2**, terminals 61, 68, 69
- **Connector 3**, terminals 39-55
- **Connector 4**, USB port for use with the MCT 10 Set-up Software
- Also provided are 2 Form C relay outputs. Location depends upon the frequency converter configuration and size.

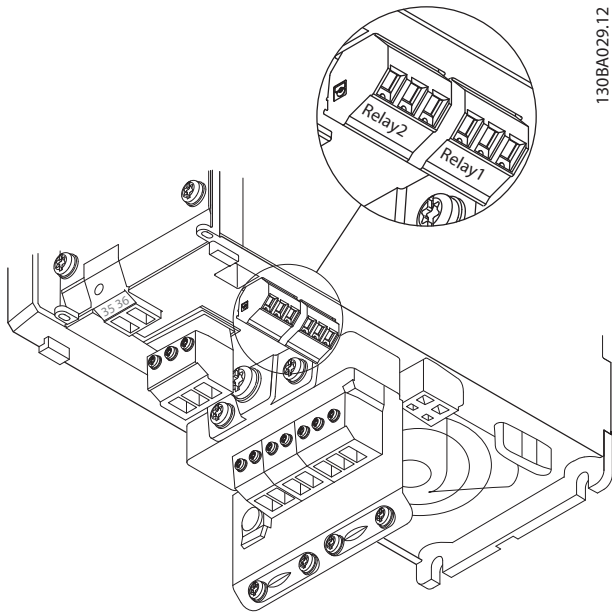
### 4.9.1.3 Relay Connection

To set relay output, see parameter group 5-4\* Relays.

No.	01-02	make (normally open)
	01-03	break (normally closed)
	04-05	make (normally open)
	04-06	break (normally closed)

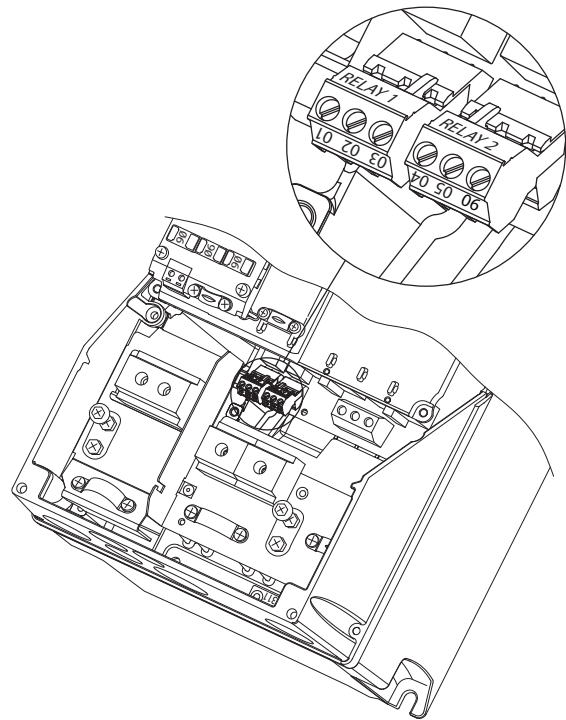
Table 4.8 Relay Connections

#### Location of relays



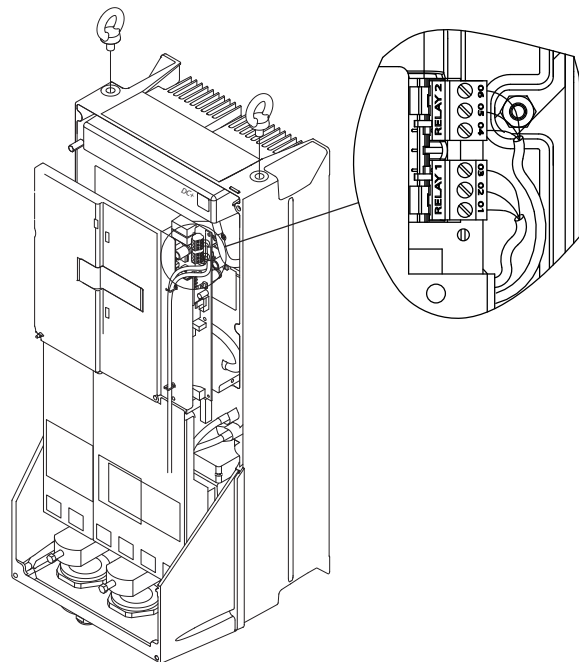
130BA029.12

Illustration 4.24 Terminals for Relay Connection (Enclosure Types A1, A2 and A3).



130BA215.10

Illustration 4.25 Terminals for Relay Connection (Enclosure Types A5, B1 and B2).



130BA391.12

Illustration 4.26 Terminals for Relay Connection (Enclosure Types C1 and C2).



### 4.9.1.4 Wiring to Control Terminals

Control terminal connectors can be unplugged from the frequency converter for ease of installation, as shown in *Illustration 4.22*.

1. Open the contact by inserting a small screwdriver into the slot above or below the contact, as shown in *Illustration 4.27*.
2. Insert the bared control wire into the contact.
3. To fasten the control wire into the contact, remove the screwdriver.
4. Ensure that the contact is not loose. Loose control wiring can cause equipment faults or less than optimal operation.

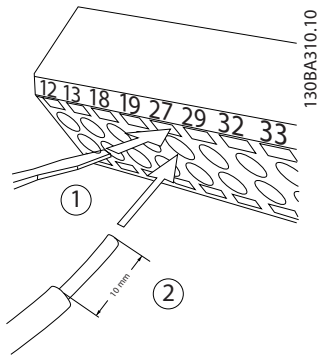


Illustration 4.27 Connecting Control Wiring

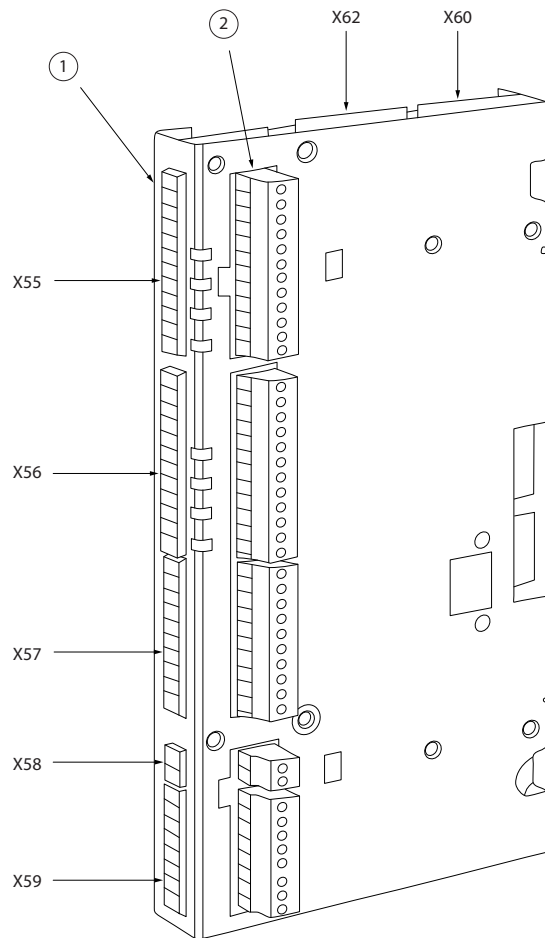
See *chapter 12.3 Power Ratings, Weight and Dimensions* for control terminal wiring sizes.

See *chapter 4.7 Motor Connection* for typical control wiring connections.

### 4.9.1.5 Lift Controller MCO 361 Control Terminals

MCO control terminals are plug connectors with screw terminals.

- X55 = Encoder
- X56 = Not used
- X57 = Digital inputs
- X58 = 24 V DC supply
- X59 = Digital outputs
- X62 = Not used
- X60 = DCP connector



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Item	Description	Item	Description
1	Terminal block 1	X58	24 V DC supply
2	Terminal block 2	X59	Digital outputs
X55	Encoder 2	X62	Not used
X56	Not used	X60	DCP connector
X57	Digital inputs		

Illustration 4.28 Location of Terminal Blocks on MCO 361

Terminal block 1 is used with bookstyle and terminal block 2 with compact enclosure types.

Terminal Block	No	Terminal description	Lift controller function		
			TTL	SinCos (1 Vpp)	SSI/Endat
X55	1	+24 V supply	-	-	-
	2	+8 V supply	-	-	-
	3	+5 V supply	5 V	5 V	5 V
	4	GND	0 V	0 V	0 V
	5	A	A	A	A
	6	A not	A not	A not	A not
	7	B	B	B	B
	8	B not	B not	B not	B not
	9	Z/Clock	H	N	Clock
	10	Z not/Clock not	H not	N not	Clock not
	11	DATA	-	-	DATA
	12	DATA not	-	-	DATA not
X56	1-12	Not used	No function		
X57	1	Digital Input	Drv. enable		
	2	Digital Input	Defined by 19-50 Run-in mode		
	3	Digital Input	Defined by 19-50 Run-in mode		
	4	Digital Input	Defined by 19-50 Run-in mode		
	5	Digital Input	Defined by 19-50 Run-in mode		
	6	Digital Input	Defined by 19-50 Run-in mode		
	7	Digital Input	Defined by 19-50 Run-in mode		
	8	Digital Input	Defined by 19-50 Run-in mode		
	9	Digital Input	not used		
	10	Digital Input	not used		
X58	1	+24 V supply	not used		
	2	GND	not used		
X59	1	Digital Output	Defined by 19-84 Function output 1		
	2	Digital Output	Speed level 1, < 0.8 m/s or depending on 19-71 Set-up counter		
	3	Digital Output	Speed level 2, < 0.3 m/s or depending on 19-71 Set-up counter		
	4	Digital Output	Output contactor K12		
	5	Digital Output	CTR - Ready/fault		
	6	Digital Output	Over temperature. Depends on 19-70 Temp. monitor		
	7	Digital Output	In position or Stand-still for setting 19-50 Run-in mode to 6 or 7.		
	8	Digital Output	Connected to terminal 18		

Terminal Block	No	Terminal description	Lift controller function		
			Can	DCP3	DCP4
X60	CS*	Control Select			
	1	RxD/TxD - P			
	2	RxD/TxD - N			
	3	0 V			
	4	5 V			
*CS is high when transmissions are active					
X62	1-5	Not used	N/A		

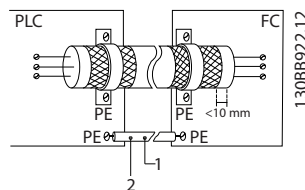
Table 4.9 Terminal Blocks

### 4.9.1.6 Using Screened Control Cables

#### Correct screening

Provide screening clamps at both ends of cable to ensure best possible cable contact.

If the ground potential between the frequency converter and the PLC differs, electric noise may occur. Solve this problem by fitting an equalising cable next to the control cable. Minimum cable cross section: 16 mm<sup>2</sup> [6 AWG].



Item	Description
1	Min. 16 mm <sup>2</sup> [6 AWG]
2	Equalising cable

Illustration 4.29 Correct Screening

#### Long control cables

With long control cables, ground loops may occur. To eliminate ground loops, connect one end of the screen-to-ground with a 100 nF capacitor (keep leads short).

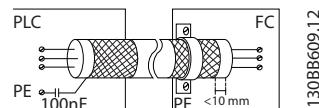


Illustration 4.30 Long Control Cables

**Avoid EMC noise on serial communication**

To reduce interference between conductors, use twisted-pair cables, see *Illustration 4.31*. Connect the terminal the ground via an internal RC-link. The recommended method is shown in *Illustration 4.31*.

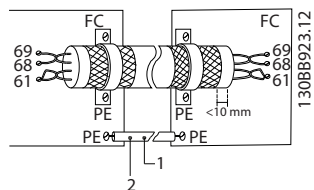


Illustration 4.31 Twisted-pair Cables

**4.9.1.7 Terminal 37, Safe Torque Off**

**Preparation**

Remove the bridge (jumper) between terminals 37 and 12 (24 V DC). Cutting or breaking the jumper is not sufficient.

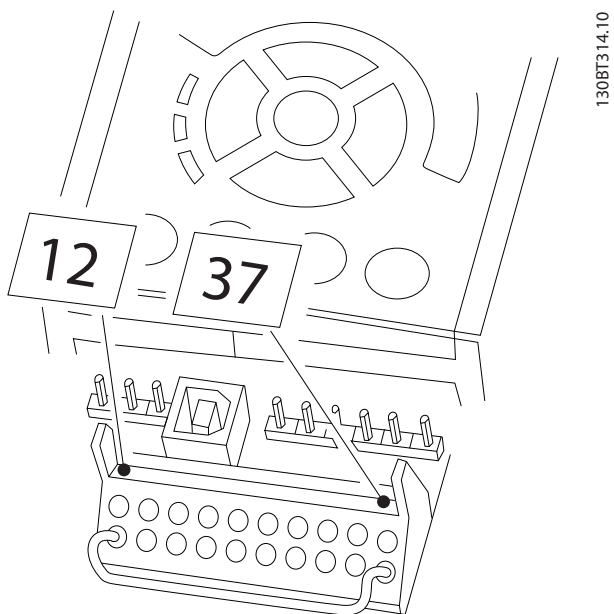
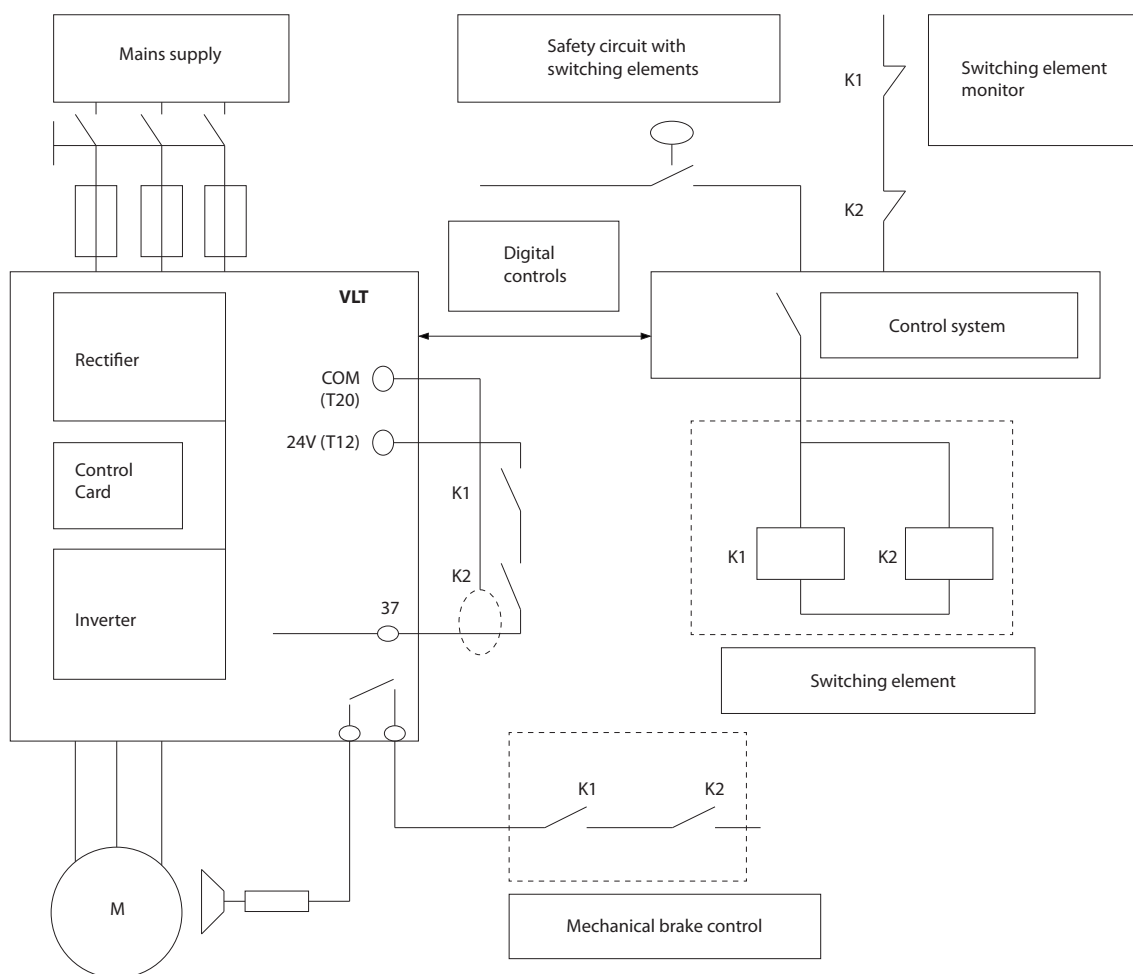


Illustration 4.32 Bridge Jumper Between Terminal 37 and Terminal 12, 24 V DC.



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Illustration 4.33 Wiring in Lift Applications

**System component requirements**

All components used with the Safe Torque Off function must comply with the general requirements of EN 81-1.

**Switching device requirements**

The monitoring of the switching device is as defined in EN81-1 § 12.7.1: "The supply at terminal 37 must be interrupted by 2 independent contacts (see block diagram). If one contactor does not open, prevent a new start at the latest with the next direction change".

Design of the switching elements:

According to EN81 § 13.2.1.2 b) category DC -13, § 13.2.1.3 (in forced contacts) and § 13.2.2.

§ 14.1.1 error consideration for electrical safety devices

Electrical requirement of the switching elements:

- Air and leakage paths
- Rated shock capability 4 kV
- IEC 60 664-1 over voltage category III
- Degree of contamination 3
- Rated insulation voltage 250 V AC

The wire between terminal 12 and the first contact element is identical to the wire from contact element 2 to terminal 37. This wire must be protected and the screen must be connected to terminal 20 (GND). The 2 switching elements must be installed next to each other. Electrical requirements of the cable must comply with the requirements of EN 81-1 § 13.5. The cables must be flexible and protected Rated voltage  $U_0/U$  300/500 V.

**NOTICE**

The function of the 2 independent switching elements can also be activated with an emergency stop relay in accordance with EN954-1 category 4 and EN81 appendix H. Perform a function test according to the elevator control system documentation.

**4.9.1.8 Lift Control without Motor Contactors**

The Safe Torque Off function can be used as replacement for the 2 independent contactors between frequency converter and motor.

### 4.10 Installation Check List

Before completing installation of the unit, inspect the entire installation as detailed in *Table 4.10*. Check and mark the items when completed.

Inspect for	Description	<input checked="" type="checkbox"/>
Auxiliary equipment	<ul style="list-style-type: none"> <li>Look for auxiliary equipment, switches, disconnects, or input fuses/circuit breakers that may reside on the input power side of the frequency converter or output side to the motor. Ensure that they are ready for full-speed operation</li> <li>Check function and installation of any sensors used for feedback to the frequency converter</li> <li>Remove any power factor correction caps on motor(s)</li> <li>Adjust any power factor correction caps on the mains side and ensure that they are dampened</li> </ul>	
Cable routing	<ul style="list-style-type: none"> <li>Ensure that motor wiring and control wiring are separated or screened or in 3 separate metallic conduits for high-frequency interference isolation</li> </ul>	
Control wiring	<ul style="list-style-type: none"> <li>Check for broken or damaged wires and loose connections</li> <li>Check that control wiring is isolated from power and motor wiring for noise immunity</li> <li>Check the voltage source of the signals, if necessary</li> <li>The use of screened cable or twisted pair is recommended. Ensure that the shield is terminated correctly</li> </ul>	
Cooling clearance	<ul style="list-style-type: none"> <li>Measure that top and bottom clearance is adequate to ensure proper air flow for cooling, see</li> </ul>	
Ambient conditions	<ul style="list-style-type: none"> <li>Check that requirements for ambient conditions are met</li> </ul>	
Fusing and circuit breakers	<ul style="list-style-type: none"> <li>Check for proper fusing or circuit breakers</li> <li>Check that all fuses are inserted firmly and are in operational condition and that all circuit breakers are in the open position</li> </ul>	
Grounding	<ul style="list-style-type: none"> <li>Check for sufficient ground connections that are tight and free of oxidation</li> <li>Grounding to conduit, or mounting the back panel to a metal surface, is not a suitable grounding</li> </ul>	
Input and output power wiring	<ul style="list-style-type: none"> <li>Check for loose connections</li> <li>Check that motor and mains are in separate conduit or separated screened cables</li> </ul>	
Panel interior	<ul style="list-style-type: none"> <li>Inspect that the unit interior is free of dirt, metal chips, moisture, and corrosion</li> <li>Check that the unit is mounted on an unpainted, metal surface</li> </ul>	
Switches	<ul style="list-style-type: none"> <li>Ensure that all switch and disconnect settings are in the proper positions</li> </ul>	
Vibration	<ul style="list-style-type: none"> <li>Check that the unit is mounted solidly, or that shock mounts are used, as necessary</li> <li>Check for an unusual amount of vibration</li> </ul>	

Table 4.10 Installation Check List

**CAUTION**

POTENTIAL HAZARD IN THE EVENT OF INTERNAL FAILURE

Risk of personal injury when the frequency converter is not properly closed.

- Before applying power, ensure all safety covers are in place and securely fastened.

## 5 Commissioning

### 5.1 Safety Instructions

#### 5.1.1 Safety Inspection

#### **CAUTION**

##### HIGH VOLTAGE!

If input and output connections have been connected improperly, there is potential for high voltage on these terminals. Power cables for multiple motors run improperly in same conduit cause a risk of leakage current charging capacitors within the frequency converter. The risk is also present even when the frequency converter is disconnected from mains input. For initial start-up, make no assumptions about power components. Follow pre-start procedures. Failure to follow pre-start procedures could result in personal injury or damage to equipment.

1. Input power to the unit must be OFF and locked out. Do not rely on the frequency converter disconnect switches for input power isolation.
2. Verify that there is no voltage on input terminals L1 (91), L2 (92), and L3 (93), phase-to-phase, and phase-to-ground,
3. Verify that there is no voltage on output terminals 96 (U), 97 (V), and 98 (W), phase-to-phase, and phase-to-ground.
4. Confirm continuity of the motor by measuring ohm values on U-V (96-97), V-W (97-98), and W-U (98-96).
5. Check for proper grounding of the frequency converter as well as the motor.
6. Inspect the frequency converter for loose connections on terminals.
7. Confirm that the supply voltage matches voltage of frequency converter and motor.

#### **NOTICE**

Before applying power to the unit, inspect the entire installation, see *chapter 4.10.1 Installation Check List*

### 5.2 Applying Power to the Frequency Converter

#### 5.2.1 Applying Power Procedure

#### **WARNING**

##### HIGH VOLTAGE!

Frequency converters contain high voltage when connected to the energised DC bus. Only qualified personnel should install, start up and maintain the frequency converters. Failure to let qualified personnel install, start up and maintain the frequency converters could result in death or serious injury.

#### **WARNING**

##### UNINTENDED START!

When the frequency converter is connected to the energised DC bus, the motor may start at any time. The frequency converter, motor, and any driven equipment must be in operational readiness. Failure to be in operational readiness when the frequency converter is connected to the energised DC bus could result in death, serious injury, equipment, or property damage.

1. Confirm that input voltage is balanced within 3%. If not, correct input voltage imbalance before proceeding. Repeat procedure after voltage correction.
2. Ensure optional equipment wiring, if present, matches installation application.
3. Ensure that all operator devices are in the OFF position. Panel doors closed, or a cover mounted.
4. Apply power to the unit. DO NOT start the frequency converter now. For units with a disconnect switch, turn to the ON position to apply power to the frequency converter.

#### **NOTICE**

If the status line in the LCP reads AUTO REMOTE COAST, it indicates that the unit is ready to operate, but is missing an input signal on terminal 27.

### 5.3 Local Control Panel

The local control panel (LCP) is the combined display and keypad on the front of the unit and has several user functions.

- Start, stop, and control speed when in local control
- Display operational data, status, warnings, and cautions
- Programming frequency converter functions
- Manually Reset the frequency converter after a fault when auto-reset is inactive

**NOTICE**

Adjust the display contrast by pressing [Status] and [▲]/[▼].

5.3.1 LCP Layout

The graphical LCP is divided into 4 functional groups (see *Illustration 5.1*).

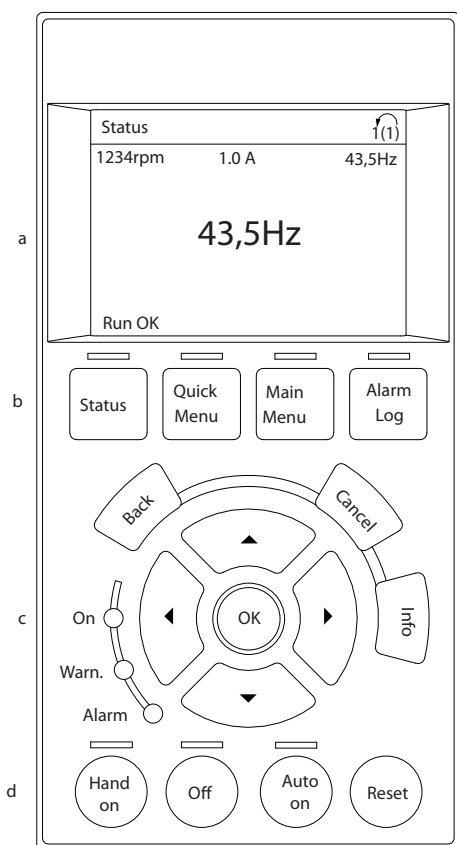


Illustration 5.1 LCP

- Display area.
- Display menu keys for changing the display to show status options, programming, or error message history.
- Navigation keys for programming functions, moving the display cursor, and speed control in

local operation. Also included are the status indicator lights.

- Operational keys and reset.

5.3.2 Setting LCP Display Values

The display area is activated when the frequency converter receives power from

- mains voltage
- a DC bus terminal
- a 24 V external supply

The information displayed on the LCP can be customised for user application.

- Each display readout has a parameter associated with it
- Options are selected in main menu 0-2\*
- The frequency converter status at the bottom line of the display is generated automatically and is not selectable. See *chapter 9 Application Examples* for definitions and details.

Display	Parameter number	Default setting
1.1	0-20	Speed [RPM]
1.2	0-21	Motor current
1.3	0-22	Power [kW]
2	0-23	Frequency
3	0-24	Reference [%]

Table 5.1 Parameter Numbers and Default Settings for Display Lines

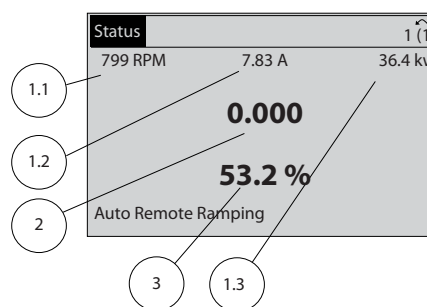


Illustration 5.2 Example Showing all Display Lines

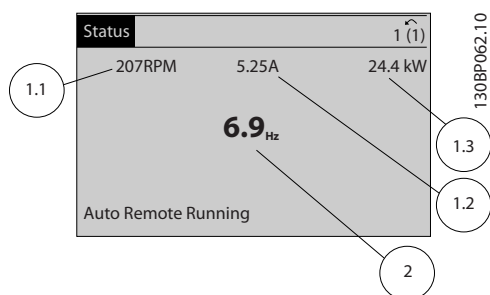


Illustration 5.3 Example Showing a Reduced Number of Display Lines

Key	Function
Alarm log	Displays a list of current warnings, the last 5 alarms, and the maintenance log. <ul style="list-style-type: none"> <li>For details about the frequency converter before it entered the alarm mode, select the alarm number using the navigation keys and press [OK].</li> </ul>

Table 5.2 Menu Key Functions

5

### 5.3.3 Display Menu Keys

Menu keys are used for menu access for parameter set-up, toggling through status display modes during normal operation, and viewing fault log data.



Illustration 5.4 Menu Keys

### 5.3.4 Navigation Keys

Navigation keys are used for programming functions and moving the display cursor. The navigation keys also provide speed control in local (hand) operation. 3 indicator lights are also located in this area.

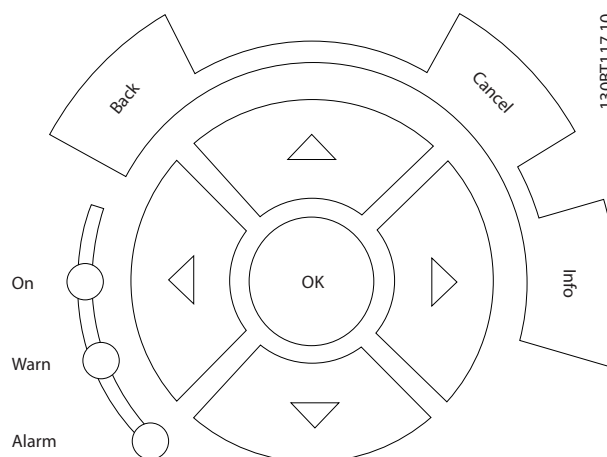


Illustration 5.5 Navigation Keys

Key	Function
Status	Press to show operational information. <ul style="list-style-type: none"> <li>In Auto mode, press and hold to toggle between status readout displays</li> <li>Press repeatedly to scroll through each status display</li> <li>Press and hold [Status] plus [▲] or [▼] to adjust the display brightness</li> <li>The symbol in the upper right corner of the display shows the motor rotation direction and the active set-up. This is not programmable.</li> </ul>
Quick Menu	Allows access to programming parameters for initial set-up instructions and many detailed application instructions. <ul style="list-style-type: none"> <li>Press to access Q2 Quick Set-up for sequenced instructions to program the basic frequency converter set-up</li> <li>Follow the sequence of parameters as presented for the function set-up</li> </ul>
Main Menu	Allows access to all programming parameters. <ul style="list-style-type: none"> <li>Press twice to access top-level index</li> <li>Press once to return to the last location accessed</li> <li>Press and hold to enter a parameter number for direct access to that parameter</li> </ul>

Key	Function
Back	Reverts to the previous step or list in the menu structure.
Cancel	Cancels the last change or command as long as the display mode has not changed.
Info	Press for a definition of the function being displayed.
Navigation keys	Use the 4 navigation keys to move between items in the menu.
OK	Use to access parameter groups or to enable an option.

Table 5.3 Navigation Key Functions



Indicator light	Indicator	Function
Green	On	The On indicator light activates when the frequency converter receives power from mains voltage, a DC bus terminal, or a 24 V external supply.
Yellow	Warn	When warning conditions are met, the yellow Warn indicator light comes on and text appears in the display area identifying the problem.
Red	Alarm	A fault condition causes the red alarm indicator light to flash and an alarm text is displayed.

Table 5.4 Indicator Light Functions

### 5.3.5 Operation Keys

Operation keys are found at the bottom of the LCP.

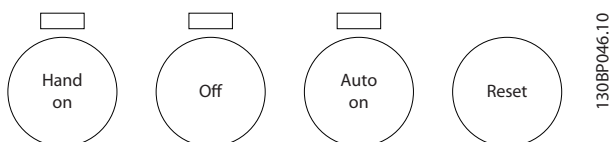


Illustration 5.6 Operation Keys

Key	Function
<b>Hand on</b>	Starts the frequency converter in local control. <ul style="list-style-type: none"> <li>To control frequency converter speed, use the navigation keys</li> <li>An external stop signal by control input or serial communication overrides the local hand on</li> </ul>
<b>Off</b>	Stops the motor but does not remove power to the frequency converter.
<b>Auto On</b>	Puts the system in remote operational mode. <ul style="list-style-type: none"> <li>Responds to an external start command by control terminals or serial communication</li> <li>Speed reference is from an external source</li> </ul>
<b>Reset</b>	Resets the frequency converter manually after a fault has been cleared.

Table 5.5 Operation Key Functions

### 5.3.6 Back-up and Copying Parameter Settings

Programming data is stored internally in the frequency converter.

- Data can be uploaded into the LCP memory as a storage back-up
- Once stored in the LCP, the data can be downloaded back into the frequency converter
- Data can also be downloaded into other frequency converters by connecting the LCP into those units and downloading the stored settings. (This procedure is a quick way to program multiple units with the same settings).
- Initialisation of the frequency converter to restore factory default settings does not change data stored in the LCP memory

## ⚠ WARNING

### UNINTENDED START!

When the frequency converter is connected to AC mains, the motor may start at any time. The frequency converter, motor, and any driven equipment must be in operational readiness. Failure to be in operational readiness when the frequency converter is connected to AC mains could result in death, serious injury, or equipment or property damage.

## CAUTION

Initialisation restores the unit to factory default settings. Any programming, motor data, localisation, and monitoring records are lost. Uploading data to the LCP provides a back-up before initialisation.

Restoring the frequency converter parameter settings back to default values is done by initialisation of the frequency converter. Initialisation can be carried out through 14-22 Operation Mode or manually.

- Initialisation using 14-22 Operation Mode does not change frequency converter data such as operating hours, serial communication selections, personal menu settings, fault log, alarm log, and other monitoring functions
- Using 14-22 Operation Mode is generally recommended
- Manual initialisation erases all motor, programming, localisation, and monitoring data and restores factory default settings

### 5.3.7 Recommended Initialisation

1. Press [Main Menu] twice to access parameters.
2. Scroll to 14-22 Operation Mode.
3. Press [OK].
4. Scroll to Initialisation.

5. Press [OK].
6. Remove power to the unit and wait for the display to turn off.
7. Apply power to the unit.

Default parameter settings are restored during start up. This may take slightly longer than normal.

8. Alarm 80 is displayed.
9. Press [Reset] to return to operation mode.

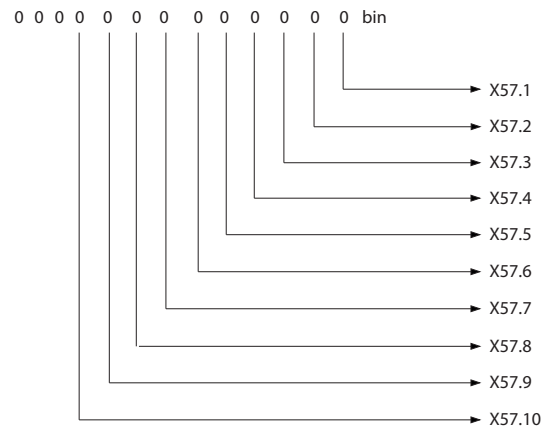
### 5.3.8 Manual Initialisation

1. Disconnect power to the unit and wait for the display to turn off.
2. Press and hold [Status], [Main Menu] and [OK] at the same time and apply power to the unit.

Factory default parameter settings are restored during start-up.

After powering-up the frequency converter, the LCP displays *Operation Mode*.

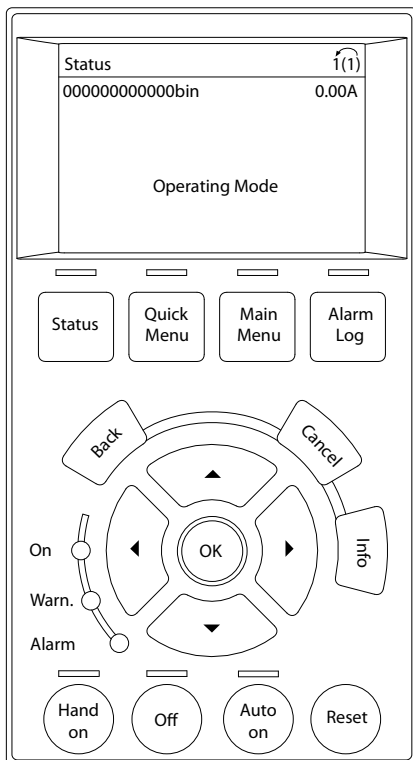
The LCP displays the input status terminal X.57 (0 bin=0 V DC, 1 bin=24 V DC) and the actual motor current in Ampere.



1308D352.10

Illustration 5.8 LCP Display, Status Terminal X.57

5



1308D644.10

Illustration 5.7 LCP Display

## 6 Programming

### 6.1 Basic Operational Programming

The frequency converter requires basic operational programming before running the best performance.

1. To enable motor operation, enter motor nameplate data.
2. Set up the parameters in parameter group 19-\*\* *Application Parameters* for the lift application.

### 6.2 Automatic Motor Adaptation

Automatic Motor Adaptation (AMA) is a procedure that measures the electrical characteristics of the motor to optimise compatibility between the frequency converter and the motor.

- The frequency converter builds a mathematical model of the motor for regulating output motor current. The procedure also tests the input phase balance of electrical power. It compares the motor characteristics with the data entered in parameters 1-20 *Motor Power [kW]* to 1-25 *Motor Nominal Speed*.
- It does not cause the motor to run and it does not harm the motor
- Some motors may be unable to run the complete version of the test. In that case, select *Enable reduced AMA*
- If an output filter is connected to the motor, select *Enable reduced AMA*
- If warnings or alarms occur, see *chapter 10 Special Conditions*
- Run this procedure on a cold motor for best results

#### To run AMA

1. Press [Main Menu] to access parameters.
2. Scroll to parameter group 19-\*\* *Application Parameters*.
3. Press [OK].
4. Scroll to 19-63 *Motor Adaptation (AMA)*.
5. Press [OK].
6. Select [1] *Enable complete AMA*.
7. Press [OK].
8. Follow on-screen instructions.
9. The AMA runs automatically and indicates when it is complete.
10. Press [OK] and [Cancel] to save measured values.

### 6.3 Programming the Lift Application

Press [Main Menu] or [Quick Menu] to set up the lift application parameters.

#### **NOTICE**

**Press [OK] and [Cancel] simultaneously to save changed parameter settings.**

The following procedures describe which parameters to set and in which order.

#### Setting motor data for asynchronous motors

1. 19-01 Motor number.
2. 1-10 Motor Construction.
3. 1-20 Motor Power [kW].
4. parameter 1-22 Motor Voltage.
5. parameter 1-23 Motor Frequency.
6. parameter 1-24 Motor Current.
7. parameter 1-25 Motor Nominal Speed.
8. 19-02 Motor cosphi.

#### Setting motor data for permanent magnet motors

1. 19-01 Motor number.
2. 1-10 Motor Construction.
3. parameter 1-24 Motor Current.
4. parameter 1-25 Motor Nominal Speed.
5. parameter 1-26 Motor Cont. Rated Torque.
6. parameter 1-30 Stator Resistance (Rs).
7. parameter 1-37 d-axis Inductance (Ld).
8. parameter 1-39 Motor Poles.
9. parameter 1-40 Back EMF at 1000 RPM.

#### Setting the incremental encoder data

1. parameter 32-00 Incremental Signal Type.
2. parameter 32-01 Incremental Resolution.

#### Motor adaptation for asynchronous motors

1. 19-63 Motor adaptation (asynchron motor).

#### Setting the lift-construction data

1. 19-10 Traction sheave [mm].
2. 19-11 Ration 100.
3. 19-12 Suspension.

**Setting the control type**

1. 19-86 Enable simple control.
2. 19-50 Run-in mode.

**Save data and calculate internal settings**

1. 19-64 Store parameter.

**Pre-start check**

The 2 LEDs at terminal block X55 show the status of channels A and B of the incremental encoder.

Check that the LEDs are on. If the LEDs are off, there is a broken wire or a short circuit.

**Starting the frequency converter in inspection mode**

1. Set the speed signal (vi) and the direction signal (32/33).
2. Set the enable signal (X57.1 and 27).

The motor is now magnetised, the brake is released, and the frequency converter starts. If the motor does not start, see *chapter 8.3.1 Basic Troubleshooting*.

The motor runs controlled in both directions and the frequency converter can control the lift motor.

**Start speed controller - asynchronous motor**

1. Set *19-13 Brake lift delay* to a value between 300 and 800 ms.
2. Set *19-14 Brake delay* to a value between 30 and 500 ms.
3. Set *19-40 KP-gain at start* to 100.
4. Set *19-42 I-time at start* to 200 ms.
5. Set *19-44 Filtertime at start* to 10 ms.
6. Set *19-46 Pos gain start* to 0.1.

**Start speed controller - permanent magnet motor**

1. Set *19-13 Brake lift delay* to 0 ms.
2. Set *19-14 Brake delay* to a value between 300 and 500 ms.
3. Set *19-40 KP-gain at start* to a value between 500 and 100.
4. Set *19-42 I-time at start* to a value between 12 and -50 ms.
5. Set *19-44 Filtertime at start* to 1 ms.
6. Set *19-46 Pos gain start* to a value between 0.2 and 0.5.

**Operation speed controller - asynchronous motor**

1. Set *19-41 KP-gain at operation* to 100.
2. Set *19-43 I-time operation* to 200 ms.
3. Set *19-45 Filtertime operation* to 10 ms.

**Operation speed controller - permanent magnet motor**

1. Set *19-41 KP-gain at operation* to a value between 10 and 70.
2. Set *19-43 I-time operation* to 200 ms.
3. Set *19-45 Filtertime operation* to 10 ms.

**Stop behaviour**

1. 19-15 Brake close delay.
2. 19-58 Delay after stop.
3. 19-59 Torque down time.

**Setting of speeds**

1. 19-20 Max. speed [m/s].
2. 19-21 V4 [m/s], Nominal speed.
3. 19-22 V0 [m/s], Levelling speed.
4. 19-23 Vi [m/s], Inspection speed.
5. 19-24 V3 [m/s], Intermediate speed 1.
6. 19-25 V2 [m/s], Intermediate speed 2.
7. 19-26 Vn [m/s], Releveling speed.
8. 19-28 V1 [m/s], Intermediate speed 3.

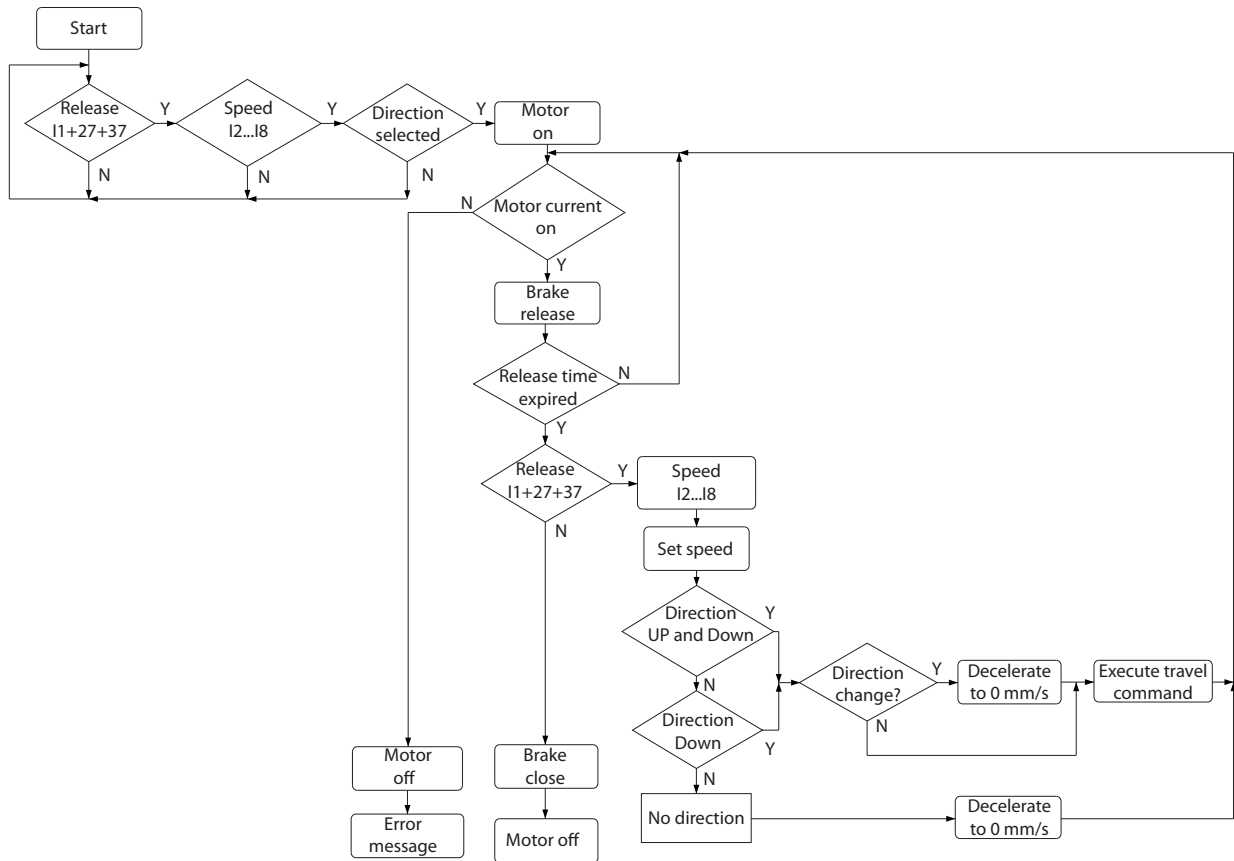
**Adjusting the motion profile**

1. 19-19 Run in distance [mm].
2. 19-21 V4 [mm/s].
3. 19-22 V0 [mm/s].
4. 19-30 Acceleration [mm/s<sup>2</sup>].
5. 19-31 Deceleration [mm/s<sup>2</sup>].
6. 19-32 Start at jerk [mm/s<sup>3</sup>].
7. 19-33 Accel. jerk [mm/s<sup>3</sup>].
8. 19-34 Decel. jerk [mm/s<sup>3</sup>].
9. 19-35 Run in jerk [mm/s<sup>3</sup>].
10. 19-55 L-start acc [mm/s<sup>2</sup>].
11. 19-56 L-start speed [mm/s].
12. 19-57 L-start time [ms].

6.3.1 Start and Stop Sequences

**NOTICE**

Start and stop sequences in lift operating mode.



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Illustration 6.1 Lift Control Start Sequence

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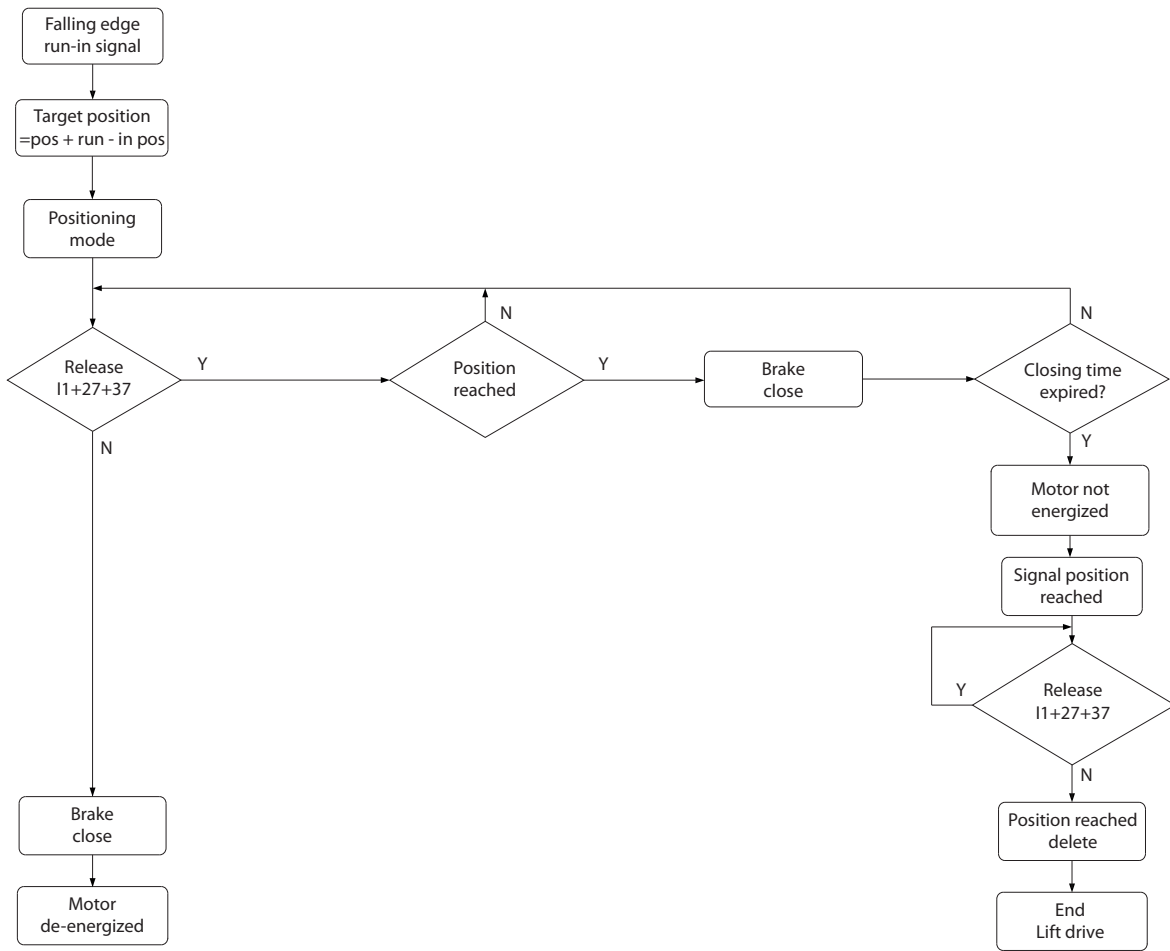


Illustration 6.2 Lift Control Stop Sequence

## 7 Functions

### 7.1 Brake Functions

#### 7.1.1 Introduction

Brake function is applied for braking the load on the motor shaft, either as dynamic brake or static brake.

##### 7.1.1.1 Mechanical Holding Brake

A mechanical holding brake mounted directly on the motor shaft normally performs static braking. In some applications, the static holding torque works as static holding of the motor shaft (synchronous permanent motors). A PLC or a digital output from the frequency converter (relay or solid state) controls the holding brake.

#### **NOTICE**

When the holding brake is included in a safety chain: A frequency converter cannot provide a safe control of a mechanical brake. A redundancy circuitry for the brake control must be included in the total installation.

##### 7.1.1.2 Dynamic Brake

Establish a dynamic brake by using a brake resistor. A brake IGBT keeps the overvoltage below a certain threshold by directing the brake energy from the motor to the connected brake resistor.

#### 7.1.2 Brake Resistor Requirements

A brake resistor can handle regenerative braking and ensure that energy is absorbed in the brake resistor and not in the frequency converter. For more information, see *Brake Resistor Design Guide*.

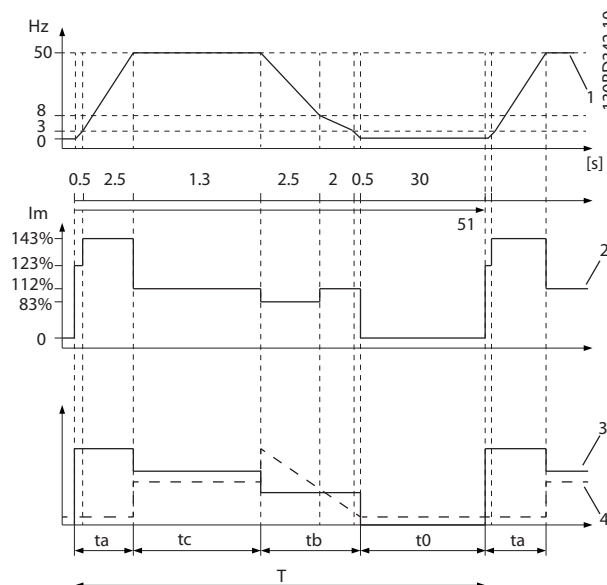
The amount of kinetic energy transferred to the resistor in each braking period can be calculated based on the cycle time and braking time (intermittent duty cycle).

Calculate the intermittent duty cycle for the resistor as follows:

$$\text{Duty cycle} = t_b/T$$

T = cycle time in s

t<sub>b</sub> is the braking time in s (of the cycle time)



1	Load cycle
2	Motor current
3	Motor operation
4	Generator operation

Illustration 7.1 Intermittent Duty Cycle

	380-400 V PK37-P75K
Cycle time (s)	120
Braking duty cycle at 100% torque	Continuous
Braking duty cycle at over torque (150/160%)	40%

Table 7.1 Braking at High Overload Torque Level

If a 10% duty cycle is applied, the brake resistors are able to absorb brake power for 10% of the cycle time. The remaining 90% of the cycle time is used on dissipating excess heat. Danfoss offers brake resistors with duty cycle of 5%, 10% and 40%.

#### **NOTICE**

Make sure that the resistor is designed to handle the required braking time.

The max. permissible load on the brake resistor is stated as a peak power at a given intermittent duty cycle and can be calculated as:

$$R_{br} [\Omega] = \frac{U_{dc}^2}{P_{peak}}$$

where

$$P_{\text{peak}} = P_{\text{motor}} \times M_{\text{br}} [\%] \times \eta_{\text{motor}} \times \eta_{\text{VLT}} [W]$$

As can be seen, the brake resistance depends on the intermediate circuit voltage ( $U_{dc}$ ).

Size	Brake active	Warning before cut out	Cut out (trip)
LD 302 3x380-400 V*	650 V	840 V/828 V	850 V/855 V

Table 7.2 Intermediate Circuit Voltage

\* Power size dependent

**NOTICE**

Ensure that the brake resistor is rated for 850 V.

Danfoss recommends that the brake resistance  $R_{\text{rec}}$  that enables the frequency converter to brake at the highest braking torque ( $M_{\text{br}}(\%)$ ) of 160%. The formula can be written as:

$$R_{\text{rec}} [\Omega] = \frac{U_{dc}^2 \times 100}{P_{\text{motor}} \times M_{\text{br}} (\%) \times \eta_{\text{VLT}} \times \eta_{\text{motor}}}$$

$\eta_{\text{motor}}$  is typically at 0.90

$\eta_{\text{VLT}}$  is typically at 0.98

For 480 V frequency converters,  $R_{\text{rec}}$  at 160% braking torque is written as:

$$480 \text{ V: } R_{\text{rec}} = \frac{375300}{P_{\text{motor}}} [\Omega] \text{ 1)}$$

$$480 \text{ V: } R_{\text{rec}} = \frac{428914}{P_{\text{motor}}} [\Omega] \text{ 2)}$$

1) For frequency converters  $\leq 7.5 \text{ kW}$  [10 hp] shaft output

2) For frequency converters 11-75 kW [15-100 hp] shaft output

**NOTICE**

Do not apply resistor brake circuit resistances higher than recommended by Danfoss. If a brake resistor with a higher ohmic value is selected, the 160% braking torque may not be achieved as the frequency converter may cut out for safety reasons.

**NOTICE**

If there is a short circuit in the brake transistor, prevent power dissipation in the brake resistor by using a mains switch or contactor to disconnect the mains for the frequency converter. (The frequency converter can control the contactor).

**CAUTION**

**FIRE HAZARD!**

Do not touch the brake resistor as it can get hot while/ after braking. To avoid fire, place the brake resistor in a secure environment. Failure to follow these guidelines can cause personal injury and property/equipment damage.

7.1.2.1 Mechanical Brake Control

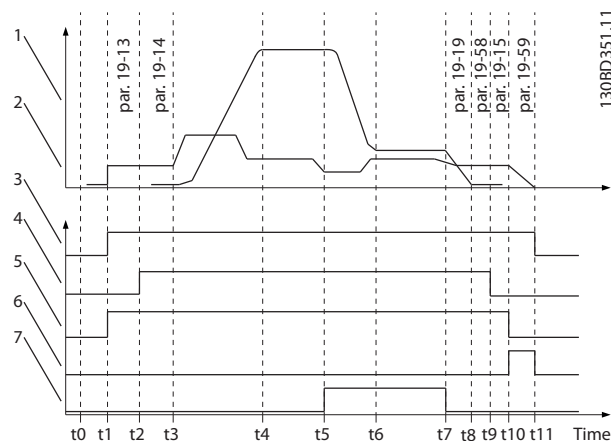
The VLT Lift Drive LD 302 features a mechanical brake control specifically designed for lift applications. Output 29 is used for controlling the brake.

The LD 302 automatically implements control of the mechanical brake and setting of controller parameters.

**WARNING**

Risk of mechanical brake malfunction. Do not alter the settings of mechanical brake function parameters.

Interrupt the power supply by 2 from each other independent electrical devices. These devices could be the same as the devices for switching terminal 37 (Safe Torque Off). If the switching elements did not open one of the 2 contacts at stop of the elevator, prevent renewed starting at the latest with the next direction change.



1	Motor speed
2	Motor current
3	Drive enable X57.1
4	Brake close/open
5	Control active X59.4
6	In position X59.7
7	Low speed V0

Illustration 7.2 Brake Release Sequence for Mechanical Brake Control



Time	Description
t0	In- Position
t1	Motor control on
t2	Delay and open brake
t3	Speed reference
t4	Max. speed
t5	Deceleration command
t6	Low speed V0
t7	Stop command
t8	Positioning
t9	Brake close
t10	Motor off
t11	In- Position
Parameter	Description
19-13	Brake Lift delay
19-14	Brake delay
19-19	Run in distance
19-58	Delay after Stop
19-15	Brake close delay

Table 7.3 Brake Release Sequence for Mechanical Brake Control

### 7.1.3 Brake Resistor Cabling

#### **NOTICE**

##### EMC (twisted cables/screening)

To reduce the electrical noise from the wires between the brake resistor and the frequency converter, the wires must be twisted.

For enhanced EMC performance, use a metal screen.

### 7.2 DCP Communication

The Drive Control and Position protocol (DCP) is used for the serial link between a lift controller and frequency converter, based on an RS-485 interface.

The DCP protocol distinguishes between 3 modes:

#### DCPComChan

This mode provides only the DCP communication channel without actuating the travel commands.

#### DCP3

For lift controllers without absolute encoder system:

- Control via the serial DCP link instead of the terminal board.
- Status messages, such as fault and over temperature, are transmitted via the DCP link instead of by relay.
- Monitoring speed (such as releveling-, deceleration- and overspeed)

#### DCP4

For lift controllers with absolute encoder system

- As DCP3, plus:
- Time-optimised direct levelling depending on remaining distance
- Millimetre accurate adjustment depending on distance
- Supervising the deceleration at the shaft ends

#### Physical

- Point-to-Point link
- Frequency converter and lift controller are linked, based on RS-485 interface (semi-duplex mode).
  - Baud rate: 38.400 Baud
  - Parity: none
  - Data bits: 8
  - Stop bits: 1

#### Master/follower

- The lift controller is the master
- The frequency converter is the follower
- The messages are transferred in a 15 ms cycle

The LD 302 supports DCP 3 and DCP 4 protocol. Terminal 60 is used as communication interface to the master.

#### DCP-Manufacturer Codes for VLT Lift Drive LD 302

- Frequency converter manufacturer: Danfoss GmbH
- DCP-Identification: DA

## 8 Diagnostics and Troubleshooting

### 8.1 Status Messages

The frequency converter automatically generates status messages that appear in the middle of the display.

Lift application message	Description
Act. inspection mode!	Control mode is active
AMA active	AMA, Automatic Motor Adaptation is active
Auto on!!	Frequency converter is not in automatic mode
Counter expired!!!	Direction change counter expired
Counter low	Direction change counter low/call service
Operating Mode	Lift Drive ready
Set parameter	Internal parameter calculation and adjustment
MCO track error	Monitor tracking error
MCO encoder error	Encoder - fault, - short circuit, - wire breakage
No motor data!!	Motor data not assigned
Overspeed	Shutdown due to overspeed
Overtemp heatsink	Overtemperature on heatsink
Overtemp motor	Overtemperature on motor
Please wait	Wait until frequency converter is ready
Positioning n compl.	Positioning not completed
VLT alarm	There is a fault in the frequency converter

Table 8.1 Lift Application Messages and Descriptions

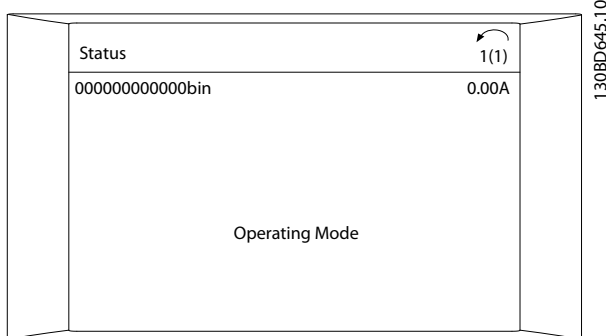


Illustration 8.1 Status Display

### 8.2 Warnings and Alarms

The frequency converter monitors the condition of

- input power
- output
- motor factors
- other system performance indicators

A warning or alarm either indicates a problem internal to the frequency converter or external failure conditions such as

- input voltage
- motor load or temperature
- external signals
- other areas monitored by the frequency converter

#### Warnings

A warning is issued when an alarm condition is impending or when an abnormal operating condition makes the frequency converter issue an alarm. A warning clears itself, when the abnormal condition has ended.

#### Alarms

##### Trip

The frequency converter suspends operation to prevent frequency converter or system damage. The motor coasts to a stop. The frequency converter continues to monitor the frequency converter status. Remedy the fault condition and reset the frequency converter.

#### Resetting the frequency converter after trip/trip lock

A trip can be reset in any of 4 ways:

- Press [Reset] on the LCP
- Digital reset input command
- Serial communication reset input command
- Auto reset

#### Trip-lock

Input power is cycled. The motor coasts to a stop. The frequency converter continues to monitor the frequency converter status.

1. Remove input power to the frequency converter.
2. Correct the cause of the fault.
3. Reset the frequency converter.

A warning is displayed in the LCP along with the warning number.

An alarm flashes on display along with the alarm number.

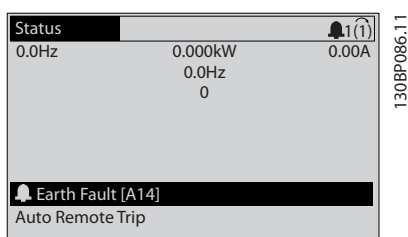


Illustration 8.2 Display Example of an Alarm

See *chapter 5.3.4 Navigation Keys* for explanation of the indicator lights.

The following warning/alarm information defines each warning/alarm condition, provides the probable cause for the condition, and details a remedy or troubleshooting procedure.

#### WARNING 1, 10 Volts low

The control card voltage is below 10 V from terminal 50. Remove some of the load from terminal 50, as the 10 V supply is overloaded. Max. 15 mA or minimum 590 Ω.

A short circuit in a connected potentiometer or improper wiring of the potentiometer can cause this condition.

#### Troubleshooting

Remove the wiring from terminal 50. If the warning clears, the problem is with the wiring. If the warning does not clear, replace the control card.

#### WARNING/ALARM 2, Live zero error

This warning or alarm only appears if programmed in *6-01 Live Zero Timeout Function*. The signal on one of the analog inputs is less than 50% of the minimum value programmed for that input. Broken wiring or faulty device sending the signal can cause this condition.

#### Troubleshooting

Check connections on all the analog input terminals. Control card terminals 53 and 54 for signals, terminal 55 common. MCB 101 terminals 11 and 12 for signals, terminal 10 common. MCB 109 terminals 1, 3, 5 for signals, terminals 2, 4, 6 common).

Check that the frequency converter programming and switch settings match the analog signal type.

Perform input terminal signal test.

#### WARNING/ALARM 3, No motor

No motor has been connected to the output of the frequency converter.

#### WARNING/ALARM 4, Mains phase loss

A phase is missing on the supply side, or the mains voltage imbalance is too high. This message also appears for a fault in the input rectifier on the frequency converter. Options are programmed at *14-12 Function at Mains Imbalance*.

#### Troubleshooting

Check the supply voltage and supply currents to the frequency converter.

#### WARNING 5, DC link voltage high

The intermediate circuit voltage (DC) is higher than the high-voltage warning limit. The limit is dependent on the frequency converter voltage rating. The unit is still active.

#### WARNING 6, DC link voltage low

The intermediate circuit voltage (DC) is lower than the low-voltage warning limit. The limit is dependent on the frequency converter voltage rating. The unit is still active.

#### WARNING/ALARM 7, DC overvoltage

If the intermediate circuit voltage exceeds the limit, the frequency converter trips after a time.

#### Troubleshooting

Connect a brake resistor

Extend the ramp time

Change the ramp type

Activate the functions in *2-10 Brake Function*

Increase *14-26 Trip Delay at Inverter Fault*

If the alarm/warning occurs during a power sag, use kinetic back-up (*14-10 Mains Failure*)

#### WARNING/ALARM 8, DC under voltage

If the DC-link voltage drops below the undervoltage limit, the frequency converter checks if a 24 V DC backup supply is connected. If no 24 V DC backup supply is connected, the frequency converter trips after a fixed time delay. The time delay varies with unit size.

#### Troubleshooting

Check that the supply voltage matches the frequency converter voltage.

Perform input voltage test.

Perform soft charge circuit test.

#### WARNING/ALARM 9, Inverter overload

The frequency converter is about to cut out because of an overload (too high current for too long). The counter for electronic, thermal inverter protection issues a warning at 98% and trips at 100%, while giving an alarm. The frequency converter cannot be reset until the counter is below 90%.

The fault is that the frequency converter has run with more than 100% overload for too long.

#### Troubleshooting

Compare the output current shown on the LCP with the frequency converter rated current.

Compare the output current shown on the LCP with measured motor current.

Display the thermal drive load on the LCP and monitor the value. When running above the frequency converter continuous current rating, the counter increases. When running below the

frequency converter continuous current rating, the counter decreases.

#### **WARNING/ALARM 10, Motor overload temperature**

According to the electronic thermal protection (ETR), the motor is too hot. Select whether the frequency converter issues a warning or an alarm when the counter reaches 100% in *1-90 Motor Thermal Protection*. The fault occurs when the motor runs with more than 100% overload for too long.

##### **Troubleshooting**

Check for motor overheating.

Check if the motor is mechanically overloaded

Check that the motor current set in *1-24 Motor Current* is correct.

Ensure that Motor data in parameters 1-20 to 1-25 are set correctly.

If an external fan is in use, check in *1-91 Motor External Fan* that it is selected.

Running AMA in *19-63 Automatic Motor Adaptation* tunes the frequency converter to the motor more accurately and reduces thermal loading.

#### **WARNING/ALARM 11, Motor thermistor over temp**

The thermistor might be disconnected. Select whether the frequency converter issues a warning or an alarm in *1-90 Motor Thermal Protection*.

##### **Troubleshooting**

Check for motor overheating.

Check if the motor is mechanically overloaded.

Check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply). Also check that the terminal switch for 53 or 54 is set for voltage. Check that 1-93 Thermistor Source selects terminal 53 or 54.

When using digital inputs 18 or 19, check that the thermistor is connected correctly between either terminal 18 or 19 (digital input PNP only) and terminal 50.

If a KTY sensor is used, check for correct connection between terminals 54 and 55

If using a thermal switch or thermistor, check that the programming of *1-93 Thermistor Resource* matches sensor wiring.

If using a KTY Sensor, check the programming of *1-95 KTY Sensor Type*, *1-96 KTY Thermistor Resource* and *1-97 KTY Threshold level* match sensor wiring.

#### **WARNING/ALARM 12, Torque limit**

The torque has exceeded the value in *4-16 Torque Limit Motor Mode* or the value in *4-17 Torque Limit Generator Mode*. *14-25 Trip Delay at Torque Limit* can change this

warning from a warning-only condition to a warning followed by an alarm.

##### **Troubleshooting**

If the motor torque limit is exceeded during ramp up, extend the ramp up time.

If the generator torque limit is exceeded during ramp down, extend the ramp down time.

If torque limit occurs while running, possibly increase the torque limit. Make sure that the system can operate safely at a higher torque.

Check the application for excessive current draw on the motor.

#### **WARNING/ALARM 13, Over current**

The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts about 1.5 s, then the frequency converter trips and issues an alarm. Shock loading or quick acceleration with high inertia loads can cause this fault. If the acceleration during ramp up is quick, the fault can also appear after kinetic back-up. If extended mechanical brake control is selected, trip can be reset externally.

##### **Troubleshooting**

Remove power and check if the motor shaft can be turned.

Check that the motor size matches the frequency converter.

Check parameters 1-20 to 1-25 for correct motor data.

#### **ALARM 14, Earth (ground) fault**

There are current from the output phases to ground, either in the cable between the frequency converter and the motor or in the motor itself.

##### **Troubleshooting**

Remove power to the frequency converter and repair the ground fault.

Check for ground faults in the motor by measuring the resistance to the ground of the motor cables and the motor with a megohmmeter.

Perform current sensor test.

#### **ALARM 15, Hardware mismatch**

A fitted option is not operational with the present control board hardware or software.

Record the value of the following parameters and contact Danfoss:

*15-40 FC Type*

*15-41 Power Section*

*15-42 Voltage*

*15-43 Software Version*

*15-45 Actual Typecode String*

15-49 SW ID Control Card

15-50 SW ID Power Card

15-60 Option Mounted

15-61 Option SW Version (for each option slot)

#### ALARM 16, Short circuit

There is short-circuiting in the motor or motor wiring.

Remove power to the frequency converter and repair the short circuit.

#### WARNING/ALARM 22, Hoist mechanical brake

Report value shows what kind it is.

0 = The torque ref. was not reached before time out.

1 = Expected brake feedback not received before time out.

#### WARNING 23, Internal fan fault

The fan warning function is an extra protective function that checks if the fan is running/mounted.

##### Troubleshooting

Check fan resistance.

Check soft charge fuses.

#### WARNING 24, External fan fault

The fan warning function is an extra protective function that checks if the fan is running/mounted.

##### Troubleshooting

Check fan resistance.

Check soft charge fuses.

#### WARNING 25, Brake resistor short circuit

The brake resistor is monitored during operation. If a short circuit occurs, the brake function is disabled and the warning appears. The frequency converter is still operational, but without the brake function. Remove power to the frequency converter and replace the brake resistor.

#### WARNING/ALARM 26, Brake resistor power limit

The power transmitted to the brake resistor is calculated as a mean value over the last 120 s of run time. The calculation is based on the intermediate circuit voltage and the brake resistance value. The warning is active when the dissipated braking is higher than 90% of the brake resistance power.

### **⚠ WARNING**

If the brake transistor is short-circuited, there is a risk of substantial power being transmitted to the brake resistor.

#### WARNING/ALARM 27, Brake chopper fault

The brake transistor is monitored during operation and if a short circuit occurs, the brake function is disabled and a warning is issued. The frequency converter is still operational but, since the brake transistor has short-circuited, substantial power is transmitted to the brake resistor, even if it is inactive.

Remove power to the frequency converter and remove the brake resistor.

This alarm/warning could also occur if the brake resistor overheats.

#### WARNING/ALARM 28, Brake check failed

The brake resistor is not connected or not working.

#### ALARM 29, Heat Sink temp

The maximum temperature of the heat sink has been exceeded. The temperature fault resets when the temperature falls below a defined heat sink temperature. The trip and reset points are different based on the frequency converter power size.

##### Troubleshooting

Check for the following conditions.

Ambient temperature too high.

Motor cables too long.

Incorrect airflow clearance above and below the frequency converter

Blocked airflow around the frequency converter.

Damaged heat sink fan.

Dirty heat sink.

##### Troubleshooting

Check fan resistance.

Check soft charge fuses.

IGBT thermal sensor.

#### ALARM 30, Motor phase U missing

Motor phase U between the frequency converter and the motor is missing.

Remove power from the frequency converter and check motor phase U.

#### ALARM 31, Motor phase V missing

Motor phase V between the frequency converter and the motor is missing.

Remove power from the frequency converter and check motor phase V.

#### ALARM 32, Motor phase W missing

Motor phase W between the frequency converter and the motor is missing.

Remove power from the frequency converter and check motor phase W.

#### ALARM 33, Inrush fault

Too many power-ups have occurred within a short time period. Let the unit cool to operating temperature.

#### WARNING/ALARM 36, Mains failure

This warning/alarm is only active if the supply voltage to the frequency converter is lost and *14-10 Mains Failure* is not set to *[0] No Function*. Check the fuses to the frequency converter and mains supply to the unit.

**ALARM 38, Internal fault**

When an internal fault occurs, a code number defined in Table 8.2 is displayed.

**Troubleshooting**

Cycle power

Check that the option is properly installed

Check for loose or missing wiring

It may be necessary to contact Danfoss service or the supplier. Note the code number for further troubleshooting directions.

No.	Text
0	Serial port cannot be initialised. Contact your Danfoss supplier or Danfoss Service Department.
256–258	Power EEPROM data is defective or too old
512	Control board EEPROM data is defective or too old.
513	Communication time-out reading EEPROM data
514	Communication time-out reading EEPROM data
515	Application-oriented control cannot recognise the EEPROM data.
516	Cannot write to the EEPROM because a write command is on progress.
517	Write command is under time-out
518	Failure in the EEPROM
519	Missing or invalid barcode data in EEPROM
783	Parameter value outside of min/max limits
1024–1279	A CAN telegram that has to be sent could not be sent.
1281	Digital signal processor flash time-out
1282	Power micro software version mismatch
1283	Power EEPROM data version mismatch
1284	Cannot read digital signal processor software version
1299	Option SW in slot A is too old
1300	Option SW in slot B is too old
1301	Option SW in slot C0 is too old
1302	Option SW in slot C1 is too old
1315	Option SW in slot A is not supported (not allowed)
1316	Option SW in slot B is not supported (not allowed)
1317	Option SW in slot C0 is not supported (not allowed)
1318	Option SW in slot C1 is not supported (not allowed)
1379	Option A did not respond when calculating platform version
1380	Option B did not respond when calculating platform version
1381	Option C0 did not respond when calculating platform version.
1382	Option C1 did not respond when calculating platform version.
1536	An exception in the application-oriented control is registered. Debug information written in LCP.

No.	Text
1792	DSP Watch Dog is active. Debugging of power part data, motor-oriented control data not transferred correctly.
2049	Power data restarted
2064–2072	H081x: Option in slot x has restarted
2080–2088	H082x: Option in slot x has issued a powerup-wait
2096–2104	H983x: Option in slot x has issued a legal powerup-wait
2304	Could not read any data from power EEPROM
2305	Missing SW version from power unit
2314	Missing power unit data from power unit
2315	Missing SW version from power unit
2316	Missing lo_statepage from power unit
2324	Power card configuration is determined to be incorrect at power-up
2325	A power card has stopped communicating while main power is applied
2326	Power card configuration is determined to be incorrect after the delay for power cards to register.
2327	Too many power card locations have been registered as present.
2330	Power size information between the power cards does not match.
2561	No communication from DSP to ATACD
2562	No communication from ATACD to DSP (state running)
2816	Stack overflow control board module
2817	Scheduler slow tasks
2818	Fast tasks
2819	Parameter thread
2820	LCP stack overflow
2821	Serial port overflow
2822	USB port overflow
2836	cfListMempool too small
3072–5122	Parameter value is outside its limits
5123	Option in slot A: Hardware incompatible with control board hardware
5124	Option in slot B: Hardware incompatible with control board hardware.
5125	Option in slot C0: Hardware incompatible with control board hardware.
5126	Option in slot C1: Hardware incompatible with control board hardware.
5376–6231	Out of memory

**Table 8.2 Internal Fault, Code Numbers**

**ALARM 39, Heat Sink sensor**

No feedback from the heat sink temperature sensor.

The signal from the IGBT thermal sensor is not available on the power card. The problem could be on the power card, on the gate drive card, or the ribbon cable between the power card and gate drive card.

**WARNING 40, Overload of digital output terminal 27**

Check the load connected to terminal 27 or remove short-circuit connection. Check *5-00 Digital I/O Mode* and *5-01 Terminal 27 Mode*.

**WARNING 41, Overload of digital output terminal 29**

Check the load connected to terminal 29 or remove short-circuit connection. Check *5-00 Digital I/O Mode* and *5-02 Terminal 29 Mode*.

**WARNING 47, 24 V supply low**

The 24 V DC is measured on the control card. The external 24 V DC back-up power supply may be overloaded, otherwise contact the Danfoss supplier.

**WARNING 48, 1.8 V supply low**

The 1.8 V DC supply used on the control card is outside of allowable limits. The power supply is measured on the control card. Check for a defective control card. If an option card is present, check for an overvoltage condition.

**WARNING 49, Speed limit**

When the speed is not within the specified range in *4-11 Motor Speed Low Limit [RPM]* and *4-13 Motor Speed High Limit [RPM]*, the frequency converter shows a warning. When the speed is below the specified limit in *1-86 Trip Speed Low [RPM]* (except when starting or stopping), the frequency converter trips.

**ALARM 50, AMA calibration failed**

Contact Danfoss supplier or Danfoss service department.

**ALARM 51, AMA check  $U_{nom}$  and  $I_{nom}$** 

The settings for motor voltage, motor current and motor power are wrong. Check the settings in parameters 1-20 to 1-25.

**ALARM 52, AMA low  $I_{nom}$** 

The motor current is too low. Check the settings.

**ALARM 53, AMA motor too big**

The motor is too big for the AMA to operate.

**ALARM 54, AMA motor too small**

The motor is too small for the AMA to operate.

**ALARM 55, AMA parameter out of range**

The parameter values of the motor are outside of the acceptable range. AMA cannot run.

**ALARM 56, AMA interrupted by user**

The user has interrupted the AMA.

**ALARM 57, AMA internal fault**

Try to restart AMA again a number of times, until the AMA is carried out.

**NOTICE**

Repeated runs may heat the motor to a level where the resistance  $R_s$  and  $R_r$  are increased. In most cases, however, this behaviour is not critical.

**ALARM 58, AMA Internal fault**

Contact the Danfoss supplier.

**WARNING 59, Current limit**

The current is higher than the value in *4-18 Current Limit*. Ensure that motor data in parameters 1–20 to 1–25 are set correctly. Possibly increase the current limit. Be sure that the system can operate safely at a higher limit.

**ALARM 64, Voltage Limit**

The load and speed combination demands a motor voltage higher than the actual DC-link voltage.

**WARNING/ALARM 65, Control card over temperature**

The cut-out temperature of the control card is 80 °C.

**Troubleshooting**

- Check that the ambient operating temperature is within limits
- Check for clogged filters
- Check fan operation
- Check the control card

**WARNING 66, Heat sink temperature low**

The frequency converter is too cold to operate. This warning is based on the temperature sensor in the IGBT module.

**Troubleshooting**

The heat sink temperature measured as 0 °C could indicate that the temperature sensor is defective, causing the fan speed to increase to the maximum. If the sensor wire between the IGBT and the gate drive card is disconnected, this warning would result. Also, check the IGBT thermal sensor.

**ALARM 67, Option module configuration has changed**

One or more options have either been added or removed since the last power-down. Check that the configuration change is intentional and reset the unit.

**ALARM 68, Safe Stop activated**

Safe Torque Off has been activated. To resume normal operation, apply 24 V DC to terminal 37, then send a reset signal (via bus, digital I/O, or by pressing [Reset]).

**ALARM 69, Power card temperature**

The temperature sensor on the power card is either too hot or too cold.

**Troubleshooting**

Check that the filters for the door fans are not blocked.

**ALARM 70, Illegal FC configuration**

The control card and power card are incompatible. To check compatibility, contact the Danfoss supplier with the type code of the unit from the nameplate and the part numbers of the cards.

**WARNING 76, Power unit setup**

The required number of power units does not match the detected number of active power units.

**WARNING 77, Reduced power mode**

The frequency converter is operating in reduced power mode (less than the allowed number of inverter sections). This warning is generated on power cycle when the frequency converter is set to run with fewer inverters, and remains on.

**ALARM 79, Illegal power section configuration**

The scaling card has an incorrect part number or is not installed. The MK102 connector on the power card could not be installed.

**ALARM 80, Drive initialised to default value**

Parameter settings are initialised to default settings after a manual reset. To clear the alarm, reset the unit.

**ALARM 81, CSIV corrupt**

CSIV file has syntax errors.

All lift controller messages are shown in the LCP in short text. See *Table 8.3* for more information.

**ALARM 82, CSIV parameter error**

CSIV failed to init a parameter.

**ALARM 85, Dang fail PB**

Profibus/Profisafe error.

**WARNING/ALARM 104, Mixing fan fault**

The fan is not operating. The fan monitor checks that the fan is spinning at power-up or whenever the mixing fan is turned on.

**Troubleshooting**

Cycle power to the frequency converter to determine if the warning/alarm returns.

Error no.	LCP display	Error text
102	Too many CAN objects	There are no more CAN objects available (CANINI).
103	Illegal axis num.	Axis not in system.
105	Error not reset	Error not cleared.
106	Home not done	Failed to move to HOME position.
107	Home vel. zero	Home velocity 0
108	Position error	Position error.
109	Index not found	Index pulse (encoder) not found.
110	Unknown com.	Unknown command.
111	SW end limit	Software end limit activated.
112	Unknown param.	Illegal parameter number.
113	FC not enabled	VLT Error Status
114	Too many loops.	Too many nested loops.
115	Par. save failed	INLONG command got an illegal string
116	Param. memory	Parameters in memory are corrupted.
117	Progr. Memory	Programs in memory are corrupted.
118	Reset by CPU	Reset by CPU.
119	User abort	User abort.
121	No more SDO chn	Number of SDO channels exceeded.
125	HW end limit	Limit switch activated.
149	Too many inter.	Too many interrupt functions.
150	No ext. 24 V	External supply is missing.
151	Too many gosub	Too many nested GOSUB commands
152	Too many returns	Too many RETURN commands.
154	D. out overload	Digital output overloaded.
155	LINK failed	LINKGPARG failed.
156	Illegal double arg.	A floating point function was called with an invalid argument.
160	Internal Intr. error	Interrupt happened, but interrupt address is no longer valid.
162	Memory error	Error in verifying
170	Too many DIM arrays	Too many DIM arrays defined.
171	Array too small	Array too small
175	Out of array mem.	No more memory space for the new array defined by DIM.
176	Array size wrong	Array size does not correspond to the size of the existing array.
179	Waitndx time-out	Time-out while waiting for index.
184	Too many ontime	Too many ONTIME or ONPERIODS interrupts.



Error no.	LCP display	Error text
187	Out of memory	Not enough memory for variables
188	CAN guarding error	A guarding error happened.
189	CAN send-receive error	CAN send or receive error.
190	Memory locked	Memory locked
191	Illegal cam array	Illegal curve array in SETCURVE.
192	Encoder error	Encoder error
193	Stack overflow	Stack overflow: Too many local variables or nested function calls.
194	Out of dyn. mem	Out of dynamic memory.
195	Too many testindices	Too many test indices in data logging command.
196	Code too old	Code is too old for the current firmware.
198	Limit sw. violation	Wrong direction after limit switch tripped and error reset.
199	Internal MCO fault	Internal MCO fault

Table 8.3 Overview of Error Messages

## 8.3 Basic Troubleshooting

### **NOTICE**

Press [OK] and [Cancel] simultaneously to save changed parameter settings.

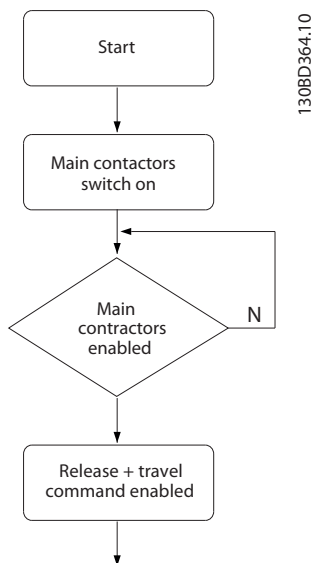
Symptom	Possible Cause	Test	Solution
Motor is stopped with MCO Track-error or accelerates unexpectedly	The encoder direction is different from the motor direction		Change 19-05 Encoder direction. If the problem still occurs, check 34-50 Actual Position if encoder pulses are counted correctly. If not, check encoder wiring or replace the encoder.
Motor runs controlled, but in wrong direction.	Direction of movement depends on the mechanical construction.		Change 19-04 Car direction.
Motor makes noise or vibrations			Reduce the value in 19-41 KP-gain at operation.
Motor needs too much current.	Wrong motor data may be entered.	Check that motor data is correct.	If using an asynchronous motor, perform AMA.

Table 8.4 Troubleshooting

## 9 Application Examples

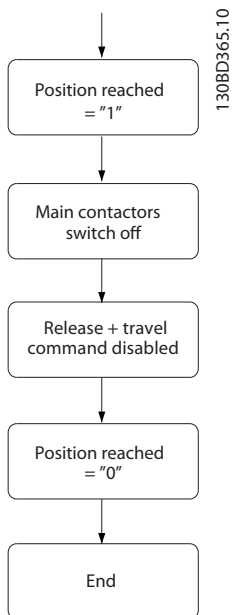
### 9.1 Main Contactors

Prolong the life time of the main contactors by only switching off the main contactors if the lift motor is deenergised (no current load). For load-free switching of the main contactors, control of the lift should proceed as illustrated in *Illustration 9.1* and *Illustration 9.2*.



1308BD364.10

Illustration 9.1 Main Contactors Power-on



1308BD365.10

Illustration 9.2 Main Contactors Power-off

### 9.2 Operation with Absolute Encoder (SSI/ EnDat)

For running PM-motors with frequency converters, it is necessary to know the exact rotor position. Usually, the rotor position is determined by using a single-turn absolute encoder mounted on the rotor shaft. The LD 302 does not need an absolute encoder for operating PM-motors. It detects the rotor position by creating a test signal before the first motor start. However, it is possible to use a single-turn absolute encoder for rotor position detection. Switch to absolute encoder type after normal commissioning is finished.

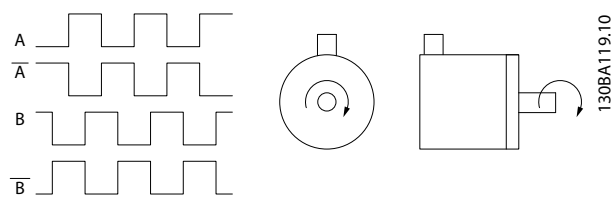
1. 19-08 Abs. encoder type.
2. 19-09 Abs. encoder offs.
3. 19-98 Abs. enc. position.

### 9.3 Check Encoder Rotation

If encoder feedback is used, check the encoder rotation.

The encoder is connected on the MCO 361 terminal block X55.

The pulse input to the frequency converter determines the encoder direction. Clockwise direction of the shaft end means that channel A is 90 electrical degrees before channel B. Counter clockwise direction means that channel B is 90 electrical degrees before A.



130BA119.10

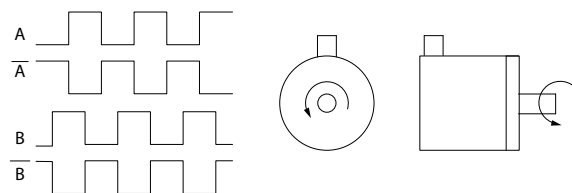


Illustration 9.3 Encoder Direction

**NOTICE**

If the feedback is negative, the encoder connection is wrong!

9.3.1 Encoder Connections Examples

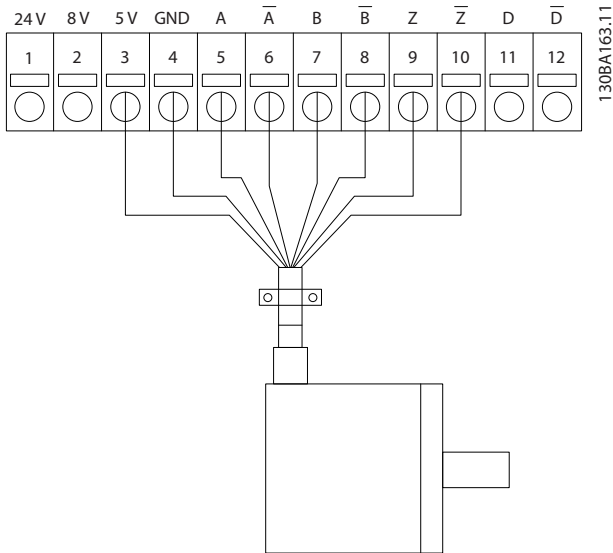


Illustration 9.4 5 V Incremental Encoder (RS-422) Supplied by MCO 361

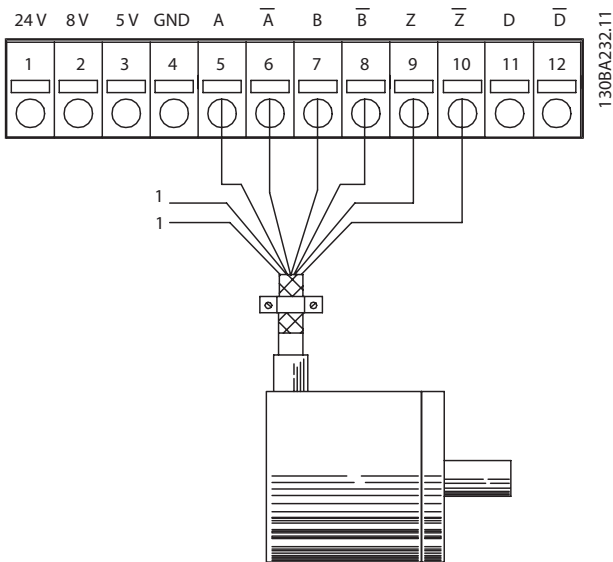


Illustration 9.5 5 V Incremental Encoder (RS-422) Supplied by an External Power Source

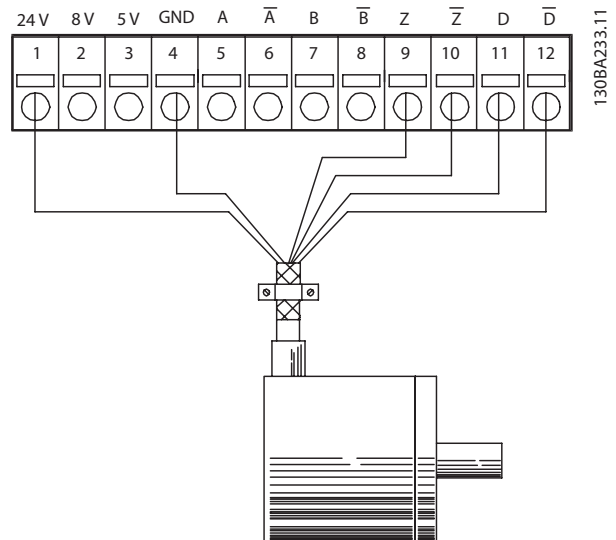


Illustration 9.6 24 V Absolute Encoder (SSI) Supplied by an External Power Source

**NOTICE**

Common mode disturbances. When external power supply is used, ensure the same potential between GND on external supply and encoder connections (4) to avoid common mode disturbance.

9.4 Emergency Operation UPS

For emergency operation in case of mains power failure, it is possible to use a 230 V UPS. Operation with a UPS requires a UPS control card connected on the frequency converter. For each lift ride, the frequency converter determines and stores the direction of the load. If a mains power failure occurs during a lift ride and after applying the UPS voltage, the lift controller starts the lift with reduced speed (Evacuation Speed Veva) in the correct direction to the next floor level. For more detailed information, contact Danfoss.

## 10 Special Conditions

### 10.1 Special Conditions

#### 10.1.1 Extreme Running Conditions

##### Short circuit (motor phase – phase)

The frequency converter is protected against short circuits. A short circuit between 2 output phases causes an overcurrent in the converter. If the short circuit current exceeds the permitted value, the frequency converter is turned off (Alarm 16 trip lock).

See the relevant *Design Guide* for protection against a short circuit at the load sharing and brake outputs.

##### Switching on the output

Switching on the output between the motor and the frequency converter may cause an error, but does not damage the frequency converter.

##### Motor-generated overvoltage

The voltage in the intermediate circuit is increased when the motor acts as a generator. The increase in voltage occurs in following cases:

- The load drives the motor (at constant output frequency from the frequency converter), that is the load generates energy.
- During ramp-down with high moment of inertia, low friction, and too short ramp-down time for the energy to be dissipated as a loss in the frequency converter, the motor, and the installation.
- Incorrect slip compensation setting may cause higher DC-link voltage.
- Back-EMF from PM motor operation. If coasted at high RPM, the PM motor back-EMF may potentially exceed the maximum voltage tolerance of the frequency converter and cause damage.

### **⚠ WARNING**

The frequency converter must be equipped with a break chopper and a connected brake resistor.

##### Mains drop-out

During a mains drop-out, the frequency converter keeps running until the intermediate circuit voltage drops below the minimum stop level. The minimum stop level is typically 15% below the frequency converter's lowest rated supply voltage. The mains voltage before the drop-out and the motor load determines how long it takes for the inverter to coast.

#### 10.1.2 Motor Thermal Protection

The frequency converter supports thermal motor protection (motor overheating) by using a motor thermistor in motor windings (PTC sensor) or a mechanical thermal switch (Klixon type). The thermistor input, terminal 50 and 53, is used to connect the PTC or Klixon.

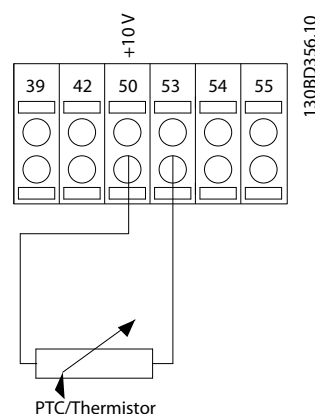


Illustration 10.1 Motor Thermistor

In operating mode, the lift operates as long as the thermistor input is below 3 kΩ. If the thermistor input is above 3 kΩ, an "Over Temperature"-warning is generated. When this warning is generated, the lift cannot be started, or it is put to a hold after completion of the ride. Further operation is only possible if the motor temperature is below the critical motor temperature.

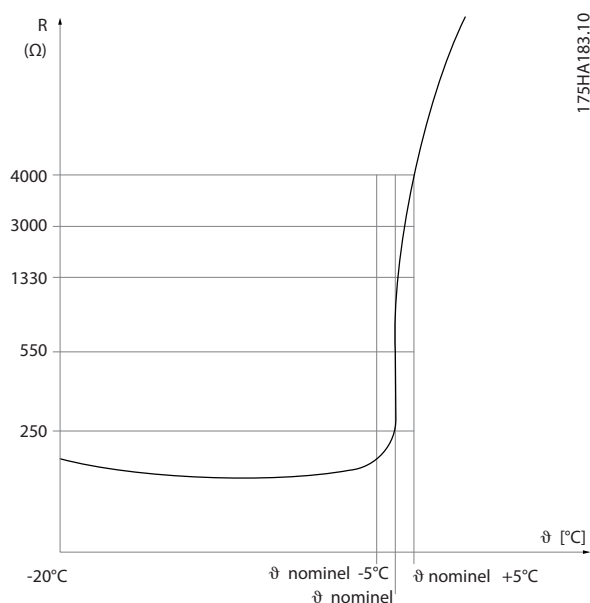


Illustration 10.2 Thermistor Input

### 10.1.3 Derating

In some applications, manual and/or automatic derating is necessary.

#### Manual Derating

Manual derating must be considered for:

- Installation at altitudes above 1,000 m [3,300 ft]
- Continuous operation at low RPM in constant torque applications
- Ambient temperatures above 45 °C [113 °F]

#### Automatic Derating

The frequency converter constantly checks for critical levels:

- Critical high temperature on the control card or heat sink
- High motor load
- High DC-link voltage
- Low motor speed

As a response to a critical level, the frequency converter adjusts the switching frequency. For critical high internal temperatures and low motor speed, the frequency converter can also force the PWM pattern to SFAVM.

## 11 Parameter Overview

### 11.1 xx-\*\* Active Parameters

Table 11.1 contains active parameters for the VLT Lift Drive LD 302.

#### **NOTICE**

The Graphical LCP (LCP 102) displays all available parameters in the Quick Menu and the Main Menu. Changes to deactivated parameters have no impact.

Press [OK] and [Cancel] simultaneously to save changed parameter settings.

ID	Name	Default value	Unit
<b>0-** Operation/Display</b>			
0-01	Language	[0] English	
0-03	Regional settings	[0] International	
0-20	Display line 1.1 small	[3440] Digital Inputs	bin
0-21	Display line 1.2 small	[1614] Motor Current	A
0-22	Display line 1.3 small	[1614] Motor Current	A
0-23	Display line 2 large	[1660] Digital Inputs	bin
0-24	Display line 3 large	[3450] Actual Position	
<b>1-** Load and Motor</b>			
1-10	Motor construction	[0] Asynchron	
1-20	Motor power	Size related	kW
1-22	Motor voltage	Size related	V
1-23	Motor frequency	50	Hz
1-24	Motor current	Size related	A
1-25	Motor nominal speed	1500	RPM
1-26	Motor Cont. Rated Torque	Size related	
1-30	Stator resistance (Rs)	Size related	Ohm
1-31	Rotor resistance (Rr)	Size related	Ohm
1-33	Stator leakage reactance (X1)	Size related	Ohm
1-34	Rotor leakage reactance (X2)	Size related	Ohm
1-35	Main reactance (Xh)	Size related	Ohm
1-36	Iron loss resistance (Rfe)	Size related	Ohm
1-39	Motor poles	4	
<b>4-** Limits/Warnings</b>			
4-16	Torque limit motor mode	200	%
4-17	Torque limit generator mode	200	%
4-18	Current limit	160	%

ID	Name	Default value	Unit
<b>14-** Special Functions</b>			
14-01	Switching frequency	Size related	kHz
<b>19-** Lift Application Parameter</b>			
19-01	Motor Number	0	
19-02	Motor cos Phi	Size related	
19-03	Encoder Auto tuning	0	
19-04	Car direction	0	
19-05	Encoder direction	0	
19-06	Encoder monitor	0	
19-07	Encoder resolution	2	
19-08	Absolute encoder type	0	
19-09	Absolute encoder offset	0	
19-10	Traction sheave	650	mm
19-11	Ratio 100	36.85	
19-12	Suspension	1	
19-13	Brake Lift delay	300	ms
19-14	Brake delay	300	ms
19-15	Brake close delay	600	ms
19-16	Max. Torque	0.00	%
19-19	Run in Distance	60.0	mm
19-20	Max. Speed	1.000	m/s
19-21	V4	1.000	m/s
19-22	V0	0.100	m/s
19-23	Vi	0.300	m/s
19-24	V3	0.800	m/s
19-25	V2	0.300	m/s
19-26	Vn	0.010	m/s
19-27	Floor level distance	5.0	mm
19-28	V1	0.200	m/s
19-30	Acceleration mm/s <sup>2</sup>	0.700	mm/s <sup>2</sup>
19-31	Deceleration mm/s <sup>2</sup>	1.000	mm/s <sup>2</sup>
19-32	Start jerk	0.600	mm/s <sup>3</sup>
19-33	Acceleration jerk	0.600	mm/s <sup>3</sup>
19-34	Deceleration jerk	1.000	mm/s <sup>3</sup>
19-35	Run in jerk	0.400	mm/s <sup>3</sup>
19-38	Comfort	0	
19-40	KP – gain at start	100	
19-41	KP – gain at operation	100	
19-42	I time at start	200.0	ms
19-43	I time operation	200.0	ms
19-44	Filtertime start	1.0	ms
19-45	Filtertime operation	10.0	ms
19-46	Position gain start	0.0000	
19-50	Run – in Mode	0	

ID	Name	Default value	Unit
19-55	L- start acceleration	0.020	m/s <sup>2</sup>
19-56	L- start speed	0.050	m/s
19-57	L- start time	200	ms
19-58	Delay after stop	100	ms
19-59	Torque down time	200	ms
19-60	Test – Run Mode	0	
19-62	Open loop	0	
19-63	Motor adaption	0	
19-64	Store Parameter	0	
19-65	Brake monitor	not active	
19-66	Digital Serial	0	
19-67	Function Relay 1	1	
19-68	Time delay coast	5	ms
19-69	Sync Position	0	
19-70	Temp monitor	0	
19-71	Set up counter	0	
19-72	DCP4 corr. factor	1.000	
19-73	DCP4 slip compensation	0	%
19-80	Log No	1	
19-81	Error code	0	
19-82	Error Time	0	h
19-83	Reset Error log	0	
19-84	Function output 1	0	
19-86	Enable SC	0	
19-90	Software Version	Version No.	
19-92	Status		
19-93	Dir change cnt 1	-1	
19-94	Dir change cnt 2	0	
19-98	Abs enc position	0	
19-99	Distance during dec.	0	
<b>32-** Lift Controller Basic Settings</b>			
32-00	Incremental Signal Type	[1] RS422 (5 V TTL)	
32-01	Incremental Resolution	1024	

Table 11.1 Lift Application Parameters

## 11.2 Parameters 0-\*\* Operation and Display

0-01 Language		
Option:	Function:	
[0] * English	Defines the display language. When setting the language to [0] <i>English</i> or [1] <i>Deutsch</i> , status display messages and parameter descriptions are shown in the selected language. When setting the language to one of the other options, status display messages and parameters in parameter group 19-** <i>Application Parameters</i> are shown in English.	
[1] * Deutsch		
[2] * Français		

0-01 Language		
Option:	Function:	
[3] * Dansk		
[4] * Española		
[5] * Italiano		
[6] * Svenska		
[7] * Nederlands		
[20] * Suomi		

0-03 Regional Settings		
Option:	Function:	
	<b>NOTICE</b> This parameter cannot be adjusted while the motor is running.	
[0] * International	Activates 1-20 <i>Motor Power [kW]</i> for setting the motor power in kW and sets the default value of parameter 1-23 <i>Motor Frequency</i> to 50 Hz.	
[1] US	Activates 1-20 <i>Motor Power [kW]</i> for setting the motor power in hp and sets the default value of parameter 1-23 <i>Motor Frequency</i> to 60 Hz.	

0-20 Display Line 1.1 Small		
Option:	Function:	
	Select a variable for display in line 1, left position.	
[3440] * Digital Inputs		

0-21 Display Line 1.2 Small		
Option:	Function:	
	Select a variable for display in line 1, middle position.	
[1614] * Motor Current		

0-22 Display Line 1.3 Small		
Option:	Function:	
	Select a variable for display in line 1, right position.	
[1614] * Motor Current		

0-23 Display Line 2 Large		
Option:	Function:	
	Select a variable for display in line 2.	
[1660] * Digital Inputs		

0-24 Display Line 3 Large		
Option:	Function:	
	Select a variable for display in line 3.	
[3450] * Actual Position		

## 11.3 Parameters 1-\*\* Load and Motor

1-10 Motor Construction		
Option:	Function:	
		Select the motor design type.
[0]	Asynchron	For asynchronous motors.
[1]	PM, non-salient SPM	For salient or non-salient PM motors. PM motors are divided into 2 groups, with either surface-mounted (non-salient) or interior (salient) magnets.

1-20 Motor Power [kW]		
Range:	Function:	
Size related*	[Application dependant]	Enter the nominal motor power in kW according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit. This parameter is visible in LCP if <i>parameter 0-03 Regional Settings</i> is [0] <i>International</i> .

1-21 Motor Power [hp]		
Range:	Function:	
Size-related*	[Application dependant]	Enter the nominal motor power in hp according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit. This parameter is visible in LCP if <i>parameter 0-03 Regional Settings</i> is [1] <i>US</i> .

1-22 Motor Voltage		
Range:	Function:	
Size related*	[ 10 - 1000 V]	Enter the nominal motor voltage according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit.

1-23 Motor Frequency		
Range:	Function:	
Size related*	[20 - 1000 Hz]	Min - Max motor frequency: 20-1000 Hz. Select the motor frequency value from the motor nameplate data. If a value different from 50 Hz or 60 Hz is selected, adapt the load independent settings in <i>1-50 Motor Magnetisation at Zero Speed</i> to <i>1-53 Model Shift Frequency</i> . For 87 Hz operation with 230/400 V motors, set the nameplate data for 230 V/50 Hz. To run at 87 Hz, adapt <i>4-13 Motor Speed High Limit [RPM]</i> and <i>3-03 Maximum Reference</i> .

1-24 Motor Current		
Range:	Function:	
Size related*	[ 0.10 - 10000.00 A]	Enter the nominal motor current value from the motor nameplate

1-24 Motor Current		
Range:	Function:	
		data. The data are used for calculating torque, motor protection etc.

1-25 Motor Nominal Speed		
Range:	Function:	
Size related*	[ 10 - 60000 RPM]	Enter the nominal motor speed value from the motor nameplate data. The data are used for calculating motor compensations. $n_{m,n} = n_s - n_{slip}$ .

1-26 Motor Cont. Rated Torque		
Range:	Function:	
Size related*	[0.1 - 10000 Nm]	Enter the value from the motor nameplate data. The default value corresponds to the nominal rated output. This parameter is available when <i>1-10 Motor Construction</i> is set to [1] <i>PM, non-salient SPM</i> , i.e. the parameter is valid for PM and non-salient SPM motors only.

1-30 Stator Resistance (Rs)		
Range:	Function:	
Size related*	[ 0.0140 - 140.0000 Ohm]	Set the line to common stator resistance value. Enter the value from a motor datasheet or perform an AMA on a cold motor.

**NOTICE**

Parameters 1-31 to 1-35 do not have effect when *1-10 Motor Construction* is set to [1] *PM, non-salient SPM*.

1-31 Rotor Resistance (Rr)		
Range:	Function:	
Size related*	[ 0.0100 - 100.0000 Ohm]	Set the rotor resistance value $R_r$ to improve shaft performance.

1-33 Stator Leakage Reactance (X1)		
Range:	Function:	
Size related*	[ 0.0400 - 400.0000 Ohm]	Set the stator leakage reactance of the motor.

1-34 Rotor Leakage Reactance (X2)		
Range:	Function:	
Size related*	[ 0.0400 - 400.0000 Ohm]	Set the rotor leakage reactance of the motor.



1-35 Main Reactance (Xh)		
Range:		Function:
Size related*	[ 1.0000 - 10000.0000 Ohm]	Set the main reactance of the motor.

**NOTICE**

1. Run an AMA on a cold motor. The frequency converter measures the value from the motor.
2. Enter the X<sub>1</sub>, X<sub>2</sub> and X<sub>h</sub> values manually. Obtain the value from the motor supplier.
3. Use the X<sub>1</sub>, X<sub>2</sub> and X<sub>h</sub> default setting. The frequency converter establishes the setting based on the motor nameplate data.

1-36 Iron Loss Resistance (Rfe)		
Range:		Function:
Size related*	[ 0 - 10000.000 Ohm]	To compensate for iron loss in the motor, enter the equivalent iron loss resistance (R <sub>Fe</sub> ) value. The R <sub>Fe</sub> value cannot be found by performing an AMA. The R <sub>Fe</sub> value is especially important in torque control applications. If R <sub>Fe</sub> is unknown, leave <i>parameter 1-36 Iron Loss Resistance (Rfe)</i> on default setting.

1-37 d-axis Inductance (Ld)		
Range:		Function:
Size related*	[0.0 - 1000.0 mH]	Enter line to common direct axis inductance of the PM motor. Obtain the value from the permanent magnet motor datasheet. If only line-line data are available, divide the line-line value by 2 to achieve the line-common (star point) value. Alternatively measure the value with an inductance meter, this also takes the inductance of the cable into account. Divide the measured value by 2 and enter the result. This parameter is only active when <i>1-10 Motor Construction</i> has the value [1] PM, non-salient SPM (Permanent Magnet Motor). For a selection with one decimal, use this parameter. For a selection with three decimals, use <i>30-80 d-axis Inductance (Ld)</i> .

1-39 Motor Poles		
Range:		Function:
Size related*	[ 2 - 128 ]	Enter the number of motor poles.

Poles	~n <sub>n</sub> @ 50 Hz	~n <sub>n</sub> @ 60 Hz
2	2700-2880	3250-3460
4	1350-1450	1625-1730
6	700-960	840-1153

Table 11.2 Number of Motor Poles

Table 11.2 shows the number of poles for normal speed ranges of various motor types. Define motors designed for other frequencies separately. The motor pole value is always an even number and refers to the total number of poles. The frequency converter bases the initial setting of *parameter 1-39 Motor Poles* on *parameter 1-23 Motor Frequency* and *parameter 1-25 Motor Nominal Speed*.

1-40 Back EMF at 1000 RPM		
Range:		Function:
Size related*	[ 0 - 9000 V]	Set the nominal back EMF for the motor when running at 1,000 RPM. Back EMF is the voltage generated by a PM motor when no frequency converter is connected and the shaft is turned externally. Back EMF is normally specified for nominal motor speed or for 1,000 RPM measured between 2 lines. If the value is not available for a motor speed of 1,000 RPM, calculate the correct value as follows. If back EMF is for example. 320 V at 1,800 RPM, it can be calculated at 1,000 RPM as follows: <b>Example</b> Back EMF 320 V at 1,800 RPM. Back EMF= (Voltage/RPM)*1,000 = (320/1800)*1,000 = 178. This parameter is only active when <i>1-10 Motor Construction</i> is set to [1] PM motor (Permanent Magnet Motor).

11

11.4 Parameters 4-\*\* Limits/Warnings

4-16 Torque Limit Motor Mode		
Range:		Function:
200%*	[Application dependant]	The function limits the torque on the shaft to protect the mechanical installation.

4-17 Torque Limit Generator Mode		
Range:		Function:
200%*	[Application dependant]	The function limits the torque on the shaft to protect the mechanical installation.

**4-18 Current Limit**

Range:		Function:
200%*	[Application dependant]	This function is a true current limit function that continues in the over synchronous range. However, due to field weakening, the motor torque at current limit drops accordingly, when the voltage increase stops above the synchronised motor speed.

**11.5 Parameters 14-\*\* Special Functions**
**14-01 Switching Frequency**

Select the converter switching frequency. Changing the switching frequency can reduce acoustic noise from the motor. Default values depend on power size.

Option:	Function:
[0]	1.0 kHz
[1]	1.5 kHz Default switching frequency for 355-1200 kW [500-1600 hp], 690 V
[2]	2.0 kHz Default switching frequency for 250-800 kW [350-1075 hp], 400 V and 37-315 kW [50-450 hp], 690 V
[3]	2.5 kHz
[4]	3.0 kHz Default switching frequency for 18.5-37 kW [25-50 hp], 200 V and 37-200 kW [50-300 hp], 400 V
[5]	3.5 kHz
[6]	4.0 kHz Default switching frequency for 5.5-15 kW [7.5-20 hp], 200 V and 11-30 kW [15-40], 400 V
[7]	5.0 kHz Default switching frequency for 0.25-3,7 kW [0.34-5 hp], 200 V and 0.37-7.5 kW [0.5-10 hp], 400 V
[8]	6.0 kHz
[9]	7.0 kHz
[10]	8.0 kHz
[11]	10.0 kHz
[12]	12.0kHz
[13]	14.0 kHz
[14]	16.0kHz

**NOTICE**

The output frequency value of the frequency converter must never exceed 1/10 of the switching frequency. When the motor is running, adjust the switching frequency in *parameter 14-01 Switching Frequency* to minimise motor noise.

**NOTICE**

To avoid a trip, the frequency converter can adapt the switching frequency automatically.

**11.6 Parameters 19-\*\* Application Parameters**
**19-01 Motor Number**
**Option:      Function:**

		Select the ASM or PM motor type stored in LD 302 motor type database. By selecting a certain motor type, all required motor data are set automatically within the LD 302. See <i>Table 12.21</i> and <i>Table 12.22</i> for motor type and associated motor number. <ol style="list-style-type: none"> <li>Enter motor type number.</li> <li>Save the selected motor type.</li> <li>Press [OK] and [Cancel] to save the settings.</li> </ol> If selecting [0], enter the following parameter for ASM or PM motors. <p><b>ASM motors</b></p> <ul style="list-style-type: none"> <li>1-10 Motor Construction</li> <li>1-20 Motor Power [kW]</li> <li>parameter 1-22 Motor Voltage</li> <li>parameter 1-23 Motor Frequency</li> <li>parameter 1-24 Motor Current</li> <li>parameter 1-25 Motor Nominal Speed</li> <li>19-02 Motor Cos Phi</li> <li>19-63 Motor Adaptation</li> </ul> <p><b>PM motors</b></p> <ul style="list-style-type: none"> <li>1-10 Motor Construction</li> <li>parameter 1-23 Motor Frequency</li> <li>parameter 1-24 Motor Current</li> <li>parameter 1-26 Motor Cont. Rated Torque</li> <li>parameter 1-30 Stator Resistance (Rs)</li> <li>parameter 1-37 d-axis Inductance (Ld)</li> <li>parameter 1-39 Motor Poles</li> <li>parameter 1-40 Back EMF at 1000 RPM</li> </ul>
[0] *		No standard ASM or PM motor within LD 302 motor database.
[XXX]	[1 – 120]	The entered value enables a certain ASM or PM motor type within the LD 302 motor database.

**19-02 Motor Cos Phi**
**Range:      Function:**

Size related*	[65-95]	Set the motor cos phi value, multiplied by 100. The input of the cos phi value causes automatically a new calculation of the advanced motor data, <i>parameter 1-30 Stator</i>
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**19-02 Motor Cos Phi**
**Range:**                      **Function:**

		Resistance (Rs) to parameter 1-35 Main Reactance (Xh).
--	--	--

**19-03 Encoder Autotuning**
**Option:**                      **Function:**

		Detect the direction of the encoder rotation.
[0] *	No function	Not active
[1]	Encoder Autotuning	Determine encoder rotation direction. The detected encoder direction is automatically stored in 19-06 Encoder Monitor.

**19-04 Car Direction**
**Option:**                      **Function:**

		Change the travel direction of the elevator car.
[0] *	No function	The car direction is not changed.
[1]	Car direction	The car direction is changed.

**19-05 Encoder Direction**
**Option:**                      **Function:**

		Change the travel direction of the encoder without swapping 2 phases in the motor cable. Before switching to operating mode, set 19-62 Open Loop to [0] Closed loop control.
[0] *	No function	The encoder direction is not changed.
[1]	Encoder direction	The encoder direction is changed.

**NOTICE**

To start the car in upwards direction, motor shaft rotation must be clockwise.

**19-06 Encoder Monitor**
**Option:**                      **Function:**

		Enables the encoder monitoring for <ul style="list-style-type: none"> <li>• encoder voltage</li> <li>• wire break</li> <li>• encoder error</li> </ul>
[0] *	No function	The encoder monitoring is not active.
[1]	Encoder monitor	The encoder monitoring is active.

**19-07 Encoder Resolution**
**Range:**                      **Function:**

2*	[2-8]	Set the factor n to calculate the encoder resolution. Encoder resolution=resolution x 2 <sup>n</sup> For TTL encoder, set fixed n=2. For SinCos encoder, set 2 <sup>2</sup> or 2 <sup>3</sup> .
----	-------	--

**19-08 Absolute Encoder Type**

Select the absolute encoder type for 13-bit single turn encoder.

**Option:**                      **Function:**

[0] *	None	
[1]	SSI	
[2]	EnDat	

**19-09 Absolute Encoder Offset**

Select the absolute encoder type offset.

**Range:**                      **Function:**

0*	[8192-0002]	
----	-------------	--

**NOTICE**

Before setting up parameters 19-10 to 19-12:

1. Enter motor data.
2. Set the parameters.
3. Press [OK] + [Cancel] to save the parameter settings.

The frequency converter uses the values for calculating maximum speed.

**19-10 Traction sheave**
**Range:**                      **Function:**

650 mm*	[100-2500 mm ]	Set the traction sheave diameter in mm.
---------	----------------	---

**19-11 Ratio 100**
**Range:**                      **Function:**

36.85*	[99.99-1.00 ]	Set the gear ratio value, multiplied by 100.
--------	---------------	--

**19-12 Suspension**
**Range:**                      **Function:**

1*	[2-8]	Specifies the number of suspensions.
----	-------	--------------------------------------

**19-13 Brake Lift Delay**
**Range:**                      **Function:**

300 ms*	[6000-20 ms]	Set the delay time in ms for the lift brake. Ensure that the motor is 100% premagnetised to take over the maximum load after brake release. For asynchronous motors (ASM), the frequency converter assigns a delay time of 300 ms to 1,500 ms, depending on motor size. See also chapter 7.1.2.1 Mechanical Brake Control.
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**19-14 Brake Delay**
**Range:**                      **Function:**

300 ms*	[3000-50 ms]	Set the time delay in ms for the brake release after the 24 V output signal on terminal 29. See also chapter 7.1.2.1 Mechanical Brake Control.
---------	--------------	--

**19-15 Brake Close Delay**
**Range:**                      **Function:**

600 ms*	[6000-50 ms]	Set the time delay in ms for closing the brake after switching the output signal from 24 V to 0 V on terminal 29. The time delay ensures that the motor remains energised long enough to close the brake. See also <i>chapter 7.1.2.1 Mechanical Brake Control</i> .
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**19-16 Max. Torque**
**Range:**                      **Function:**

0.00% ms*	[200 to -200%]	Set the time delay in ms for closing the brake after switching the output signal from 24 V to 0 V, on terminal 29. This time delay ensures that the motor is energised long enough to close the brake. See also <i>chapter 7.1.2.1 Mechanical Brake Control</i> . When set to 0, there is no function. When set above or below 0, the function is active.
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**19-19 Run in Distance**
**Range:**                      **Function:**

60.0 mm*	[50000-0 mm]	Set the run-in distance in mm. See also <i>chapter 7.1.2.1 Mechanical Brake Control</i> .
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Parameter	Symbol
19-20 Max. sSpeed	
19-21 Nominal Speed	V4
19-22 Levelling Speed	V0
19-23 Inspection Speed	Vi
19-24 Intermediate Speed 1	V3
19-25 Intermediate Speed 2	V2
19-26 Relevelling Speed	Vn
19-28 Intermediate Speed	V1
Evacuation Speed, Fixed (V0)	VeVa

Table 11.3 Lift Speed Parameters

**19-20 Max. Speed**
**Range:**                      **Function:**

1.000 m/s*	[20-0.01 m/s]	Set the max. speed in m/s for the lift. Depending on the nominal motor speed and the settings in parameters 19-10 to 19-12, the maximum speed is limited to 125% of the rated motor speed.
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**19-21 V4, Nominal Speed**
**Range:**                      **Function:**

1.000 m/s*	[20-0.01 m/s]	Set the nominal speed V4, in m/s.
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**19-22 Levelling Speed, V0**
**Range:**                      **Function:**

0.100 m/s*	[20-0.01 m/s]	Set the levelling speed V0, in m/s.
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**19-23 Inspection Speed, Vi**
**Range:**                      **Function:**

0.300 m/s*	[0.630-0.01 m/s]	Set the inspection speed Vi in m/s.
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**19-24 Intermediate Speed, V3**
**Range:**                      **Function:**

0.800 m/s*	[20-0.01 m/s]	Set the intermediate speed V3 in m/s.
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**19-25 Intermediate Speed, V2**
**Range:**                      **Function:**

0.300 m/s*	[20-0.01 m/s]	Set the intermediate speed V2, in m/s.
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**19-26 Relevelling Speed, Vn**
**Range:**                      **Function:**

0.010 m/s*	[20-0.01 m/s]	Set the relevelling speed Vn, in m/s.
------------	---------------	---------------------------------------

**19-27 Floor level distance**
**Range:**                      **Function:**

5.0 mm*	[2000-10 mm]	Set the floor level distance, in mm.
---------	--------------	--------------------------------------

**19-28 Intermediate Speed, V1**
**Range:**                      **Function:**

0.200 m/s*	[20-0.01 m/s]	Set the intermediate speed V1 in m/s.
------------	---------------	---------------------------------------

**NOTICE**

Changing parameter setting of 19-38 Comfort causes changes to the parameter settings in 19-30 Acceleration  $mm/s^2$ , 19-31 Deceleration  $mm/s^2$ , 19-32 Start Jerk, 19-33, 19-34 Deceleration Jerk and 19-35 Run in Jerk.

**NOTICE**

A change of the parameter settings for 19-31 Deceleration  $mm/s^2$ , 19-34 Deceleration Jerk and 19-35 Run in Jerk, changes the braking distance.

**19-30 Acceleration  $mm/s^2$** 
**Range:**                      **Function:**

0.700 $m/s^2$ *	[2-0.1 $m/s^2$ ]	Set the maximum acceleration for the selected speed in $m/s^2$
-----------------	------------------	--

**19-31 Deceleration  $mm/s^2$** 
**Range:**                      **Function:**

1.000 $m/s^2$ *	[2-0.1 $m/s^2$ ]	Set the maximum deceleration in $mm/s^2$
-----------------	------------------	--

**19-32 Start Jerk**
**Range:**                      **Function:**

0.600 $m/s^3$ *	[9.990-0.1 $m/s^3$ ]	Set the start jerk in $mm/s^3$ . The start-up jerk is an essential comfort feature. Suggestion for start jerk setting: <ul style="list-style-type: none"> <li>• gentle: &lt; 0.3 <math>m/s^3</math></li> <li>• normal: 0.6 <math>m/s^3</math></li> <li>• dynamic: &gt; 1.0 <math>m/s^3</math></li> </ul>
-----------------	----------------------	--

**19-33 Acceleration Jerk**

**Range:** **Function:**

0.600 m/s <sup>3</sup> *	[9.990-0.1 m/s <sup>3</sup> ]	Sets the acceleration jerk in m/s <sup>3</sup> .
--------------------------	-------------------------------	--

**19-34 Deceleration Jerk**

**Range:** **Function:**

1.000 m/s <sup>3</sup> *	[9.990-0.1 m/s <sup>3</sup> ]	Set the deceleration jerk in mm/s <sup>3</sup> . The run-jerk is activated, when the levelling speed is reached. Suggestions for deceleration jerk setting: <ul style="list-style-type: none"> <li>gentle: &lt; 0.6 m/s<sup>3</sup></li> <li>normal: 1.0 m/s<sup>3</sup></li> <li>dynamic: &gt; 1.4 m/s<sup>3</sup></li> </ul>
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**19-35 Run in Jerk**

**Range:** **Function:**

0.400 m/s <sup>3</sup> *	[9.990-0.1 m/s <sup>3</sup> ]	Set the run-in jerk in mm/s <sup>3</sup> . The run-in jerk is activated when the levelling speed is reached. Suggestions for run-in jerk setting: <ul style="list-style-type: none"> <li>gentle: &lt; 0.2 m/s<sup>3</sup></li> <li>normal: 0.4 m/s<sup>3</sup></li> <li>dynamic: &gt; 0.6 m/s<sup>3</sup></li> </ul>
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**NOTICE**

Changing the settings of 19-38 Comfort, changes the settings in 19-30 Acceleration mm/s<sup>2</sup>, 19-31 Deceleration mm/s<sup>2</sup>, 19-32 Start Jerk, 19-33 Acceleration Jerk, 19-34 Deceleration Jerk and 19-35 Run in Jerk.

**19-38 Comfort**

**Option:** **Function:**

		Set the travelling comfort.
[0] *	Normal	Normal comfort
[1]	Gentle	Gentle comfort
[2]	Dynamic	Dynamic comfort
[3]	No function	

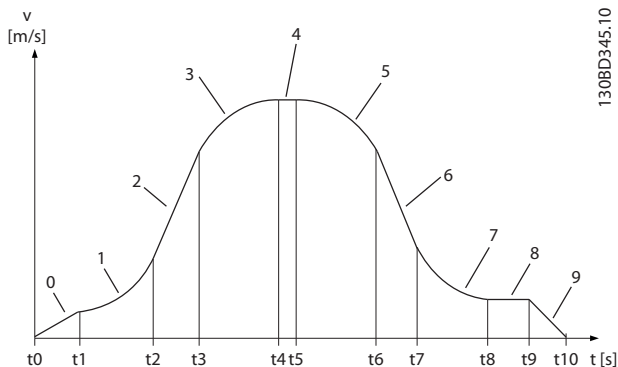


Illustration 11.1 Ramp Parameter for Acceleration, Deceleration and Jerk

Identifier	Time period	Parameter	Description
0	t0-t2	19-55 to 19-57	Line start
1	t1-t2	19-32	Start jerk
2	t2-t3	19-30	Acceleration
3	t3-t4	19-33	Accel. jerk
4	t4-t5	19-21	V4
5	t5-t6	19-34	Decel. jerk
6	t6-t7	19-31	Deceleration
7	t7-t8	19-35	Run in jerk
8	t8-t9		Low Speed V0
9	t9-t10	19-19	Run in Distance

Table 11.4 Legend to Illustration 11.1 Ramp Parameter Description

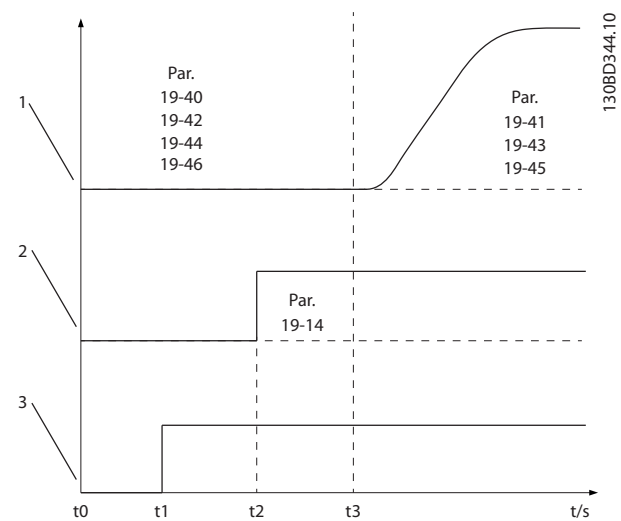


Illustration 11.2 Control Parameter Start/Operations

1	Actual speed
2	Mechanical brake
3	Motor active

Table 11.5 Legend to Illustration 11.2

**19-40 KP Gain at Start**

**Range:** **Function:**

100*	[5000-1]	Set the PID proportional gain at start. Increase the KP-start value if the motor rotates backwards after start.
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**19-41 KP Gain at Operation**

**Range:** **Function:**

100*	[5000-1]	Set the PID proportional gain for operation, travel. Decrease the KP- operating value in case of motor noise during travelling. Increase the KP- operating value in case of motor oscillations during travelling.
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19-42 TI Time at Start

Range:                      Function:

200*	[500-2 ms]	Set the PID integral time in ms at start. Increase the time value if after start the motor rotates backwards.
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19-43 TI Time Operation

Range:                      Function:

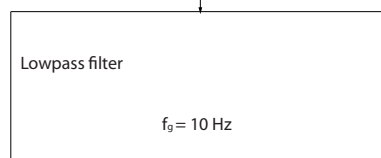
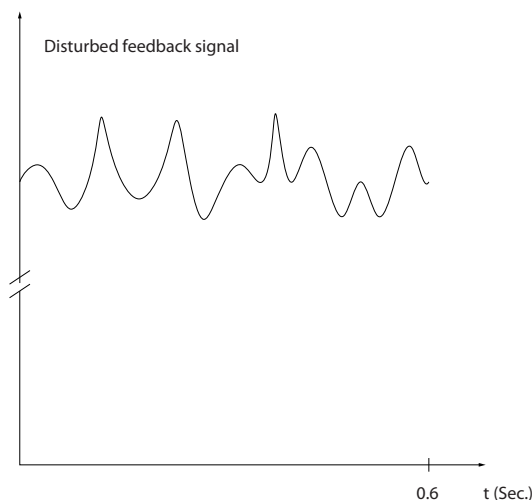
200*	[500-2 ms]	Set the PID integral time in ms for operation, travel.
------	------------	--

19-44 Filvertime Start

Range:                      Function:

1.0 ms*	[500-1 ms]	<p><b>NOTICE</b></p> <p><b>Severe filtering can cause bad dynamic performance.</b></p> <p>Set a time constant for the speed control low-pass filter. The low-pass filter improves steady-state performance and dampens oscillations on the feedback signal. This is an advantage if there is a great amount on noise in the system, see <i>Illustration 11.3</i>. For example, if a time constant (<math>\tau</math>) of 100 ms is programmed, the cut-off frequency for the low-pass filter is <math>1/0.1 = 10 \text{ RAD/s}</math>. This value corresponds to <math>(10/2 \times \pi) = 1.6 \text{ Hz}</math>. The PID regulator only regulates a feedback signal that varies by a frequency of less than 1.6 Hz. If the feedback signal varies by a higher frequency than 1.6 Hz, the PID regulator does not react.</p>
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Feedback



Feedback

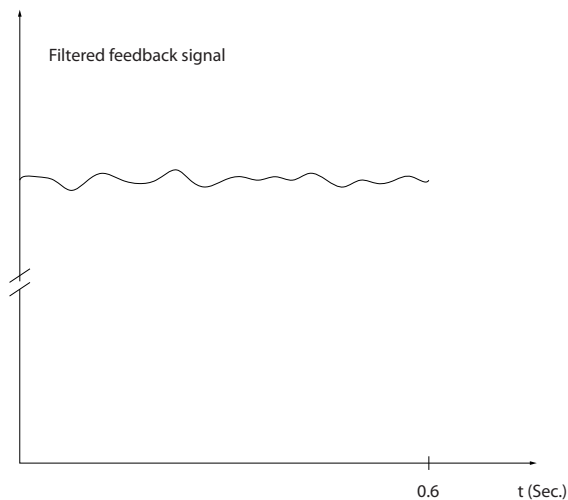


Illustration 11.3 Filtering Feedback through Lowpass Filter

19-45 Filvertime Operation

Range:                      Function:

10.0 ms*	[500-1 ms]	Set the speed controller filter time for operation mode.
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19-46 Position Gain Start

Range:                      Function:

0.0000*	[500-1 ms]	Select the position gain start.
---------	------------	---------------------------------

175ZA293.11

**19-50 Run-in Mode**

<b>Range:</b>	<b>Function:</b>
0 [255 to -255]	Set the Run-in mode function for the control travel profile and resulting speed. See also <i>Table 11.6 to Table 11.11</i> for function depending

**19-50 Run-in Mode**

<b>Range:</b>	<b>Function:</b>
	on the entered parameter value for the Run-in mode.

Input select		19-50 Run-in Mode			
+ Terminal		Possible value settings			
Drv. enable		0, 1, 7	4, 6	8	9
Selected input terminal		Resulting speed			
X57.1⇒T27	X57.2	V0	SL1	V0	SL1
X57.1⇒T27	X57.3	V4	SL2	V4	SL2
X57.1⇒T27	X57.4	V3	SL3	V3	SL3
X57.1⇒T27	X57.5	V2		Vi	
X57.1⇒T27	X57.6	Vn			
X57.1⇒T27	X57.7	Vi			Up
X57.1⇒T27	X57.8	Veva			Down
X57.1⇒T27	T32	Up	Up		Encoder A
X57.1⇒T27	T33	Down	Down		Encoder B

Table 11.6 Control Travel Profile

Digital input terminal				Parameter setting		
LD 302		Lift controller		19-50 Run-in Mode		
32	33	X57.7	X57.8	0, 1, 4	6, 7	8, 9
0	0	x	x	no move	no move	x
0	1	x	x	Down	Down	x
1	0	x	x	Up	Up	x
1	1	x	x	Up	Down	x
x	x	0	0	x	x	no move
x	x	0	1	x	x	Down
x	x	1	0	x	x	Up
x	x	1	1	x	x	Up

Table 11.7 Direction of Travel

	X57.2	X57.8	X57.7	X57.6	X57.5	X57.4	X57.3
V0	1*	X	X	X	X	X	X
Veva	0	1	X	X	X	X	X
Vi	0	0	1	X	X	X	X
Vn	0	0	0	1	X	X	X
V2	0	0	0	0	1	X	X
V3	0	0	0	0	0	1	X
V4	0	0	0	0	0	0	1**

Table 11.8 Priority of Resulting Speeds in Relation to Digital Input Setting on Terminal X57 for 19-50 Run-in mode, Value Setting 0

- \* highest priority
- \*\* lowest priority
- 1 - high signal
- 0 - low signal
- x - any state

When selecting 19-50 Run-in Mode 0 or 1, the falling edge on input X57.2 Run-in Speed, determines the positioning to the floor level (19-19 Run in Distance), independent of the selected speed.

	X57.8	X57.7	X57.6	X57.5	X57.4	X57.3	X57.2
Veva	1*	X	X	X	X	X	X
Vi	0	1	X	X	X	X	X
Vn	0	0	1	X	X	X	X
V2	0	0	0	1	X	X	X
V3	0	0	0	0	1	X	X
V4	0	0	0	0	0	1	X
V0	0	0	0	0	0	0	1**

Table 11.9 Priority of Resulting Speeds in Relation to Digital Input Setting on Terminal X57 for 19-50 Run-in mode, Value Setting 1

- \* highest priority
- \*\* lowest priority
- 1 - high signal
- 0 - low signal
- x - any state

	Speed select 3 (X57.4)	Speed select 2 (X57.3)	Speed select 1 (X57.2)
V0, Run in Speed (19-22)	0	0	1
Vi, Inspection Speed (19-23)	0	1	0
V3, Intermediate Speed 1 (19-24)	1	0	0
Vn, Relevelling Speed (19-26)	1	0	1
V2, Intermediate Speed 2 (19-25)	1	1	0
V4, Max. Speed (19-21)	0	1	1

Table 11.10 Resulting Speeds in Relation to Digital Input Setting on Terminal X57 for 19-50 Run-in mode, Value Setting 4

	Speed select 3 (X57.4)	Speed select 2 (X57.3)	Speed select 1 (X57.2)
Vn, Relevelling Speed (19-26)	0	0	1
V0, Run in Speed (19-22)	0	1	0
Vi, Inspection Speed (19-23)	0	1	1
V1, Intermediate Speed 3 (19-28)	1	0	0
V2, Intermediate Speed 2 (19-25)	1	0	1
V3, Intermediate Speed 1 (19-24)	1	1	0
V4, Max. Speed (19-21)	1	1	1

Table 11.11 Resulting Speeds in Relation to Digital Input Setting on Terminal X57 for 19-50 Run-in mode, Value Setting 6

	X57.5	X57.4	X57.3	X57.2
Vi	1*	x	x	x
V3	0	1	x	x
V4	0	0	1	x
V0	0	0	0	1**

Table 11.12 Resulting Speeds in Relation with Digital Input Setting on Terminal X57 for 19-50 Run-in mode, Value Setting 8



**19-55 L- start Acc**

Range:	Function:
0.020 m/s <sup>2</sup> * [2-0.01 ms <sup>2</sup> ]	Set the start acceleration for linear ramp in m/s <sup>2</sup> .

**19-56 L- start Speed**

Range:	Function:
0.050 m/s* [0.5-0.01 ms]	Set the start speed for linear ramp in m/s.

**19-57 L- start time**

Range:	Function:
200 ms* [2000-0 ms]	Set the time for the linear start time in ms. Entering a start time of 0 ms, disables the linear ramp function.

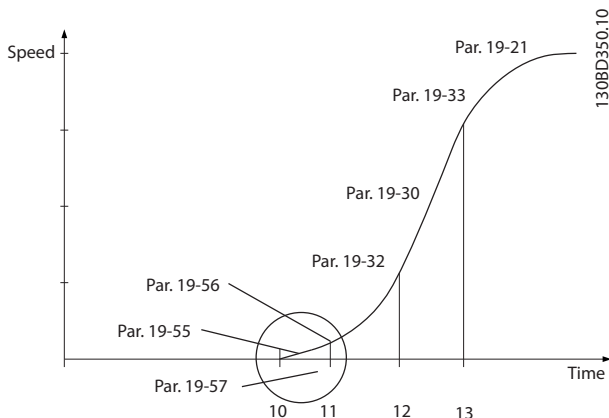


Illustration 11.4 Linear Start Time

**19-58 Delay After Stop**

Range:	Function:
100 ms* [1000-1ms]	Set the delay for mechanical brake in ms. See also <i>chapter 7.1.2.1 Mechanical Brake Control</i> .

**19-59 Torque Down Time**

Range:	Function:
200 ms* [5000-50 ms]	Set the torque down time in ms. See also <i>chapter 7.1.2.1 Mechanical Brake Control</i> .

**19-60 Test – Run Mode**

Option:	Function:
	Run mode test.
[0] *	Test not enabled.
[1]	Enable test.

**19-62 Open Loop**

Option:	Function:
	Open loop control.
[0] * Closed loop	Control with encoder, closed loop.

**19-62 Open Loop**

Option:	Function:
[1]	Open loop Emergency control without encoder, open loop using input X57.2 or X57.7 for control. Decrease the KP- operating value, <i>19-41 KP Gain at Operation</i> , in case of motor noise during travelling.

**19-63 Motor Adaptation**

Option:	Function:
	The AMA function optimises dynamic motor performance.
[0] *	No Function
[1]	Complete Adaptation Performs AMA of the stator resistance $R_s$ , the rotor resistance $R_r$ , the stator leakage reactance $X_1$ , the rotor leakage reactance $X_2$ , and the main reactance $X_h$ . ( <i>1-30 Stator Resistance (Rs) to 1-35 main reactance (Xh)</i> ). Do not select this option if an LC filter is used between the frequency converter and the motor.
[2]	Reduced Adaptation Performs a reduced AMA of the stator resistance $R_s$ in the system only.
[3]	Calculation Calculates the data values for the motor model equivalent diagram and in writes the calculated values automatically to <i>1-30 Stator Resistance (Rs) to 1-35 main reactance (Xh)</i> .
[4]	

**19-64 Store Parameter**

Option:	Function:
	Store all parameter settings.
[0] *	No Function
[1]	Store Parameter Activate store

**19-66 Digital Serial**

Option:	Function:
	Activate digital input access or DCP protocol.
[0] *	Digital input Enable digital input - access
[1]	DCP 3 Enable DCP 3- protocol
[2]	DCP 4 Enable DCP 4- protocol

**19-67 Function Relay 1**

Option:	Function:
	Select function for relay 1.
[0]	
[1] *	Open relay contact at voltage "Off"
[2]	Open relay contact at emergency shutdown, move not finished properly.

**19-68 Time Delay Coast**
**Range:**                      **Function:**

5 ms*	[0-500 ms]	Set a delay time for all inputs of the frequency converter. The delay time is the time passing until the frequency converter accepts the input status, and secures the inputs against signal bouncing.
-------	------------	--

**19-69 Sync Position**
**Range:**                      **Function:**

0*	[0-214783634]	Used for DCP4 communication to determine the position deviation of the controller encoder and motor encoder. Enter the determined value in <i>19-72 DCP4 Corr. Factor</i> .
----	---------------	---

**19-70 Temp Monitor**
**Option:**    **Function:**

		Selects the temperature monitoring.
[0] *		Only heat sinks monitoring.
[1]		Activate motor thermistor (PTC sensor) monitoring on terminal A 53 and heat sinks monitoring.
[-1]		No function

**19-71 Set-up Counter**
**Range:**                      **Function:**

0*	[2147483646 - 0]	This function is used for plastic-coated ropes to determine the number of cycle changes. The number of the cycle changes is an indication of the condition of the plastic-coated ropes used for the lift. The number of cycle changes tells if the plastic-coated ropes must be replaced or not. The number of the cycle changes is contained in the direction Counter 1 and 2, <i>19-93 Dir Change Cnt 1</i> or <i>19-94 Dir Change Cnt 2</i> . The coded parameter value for <i>19-71 Set-up Counter</i> defines the use of direction Counter 1, direction Counter 2, or warning threshold direction Counter 1. The application checks the parameter input value. After setting correct parameter input value, <i>19-71 Set-up Counter</i> is set to 0. If the input data not plausible, <i>19-71 Set-up Counter</i> is set to "-1".The data are accepted after pressing [OK] + [CANCEL].
----	------------------	---

**19-72 DCP4 Corr. Factor**
**Range:**                      **Function:**

1.000*	[1.200-0.800]	Set the DCP4 correction factor. Refer to <i>19-69 Sync Position</i> .
--------	---------------	---

**19-73 DCP4 slip comp.**
**Range:**                      **Function:**

0%*	[1.50%-0%]	Set the DCP4 slip compensation in %.
-----	------------	--------------------------------------

**19-80 Log No**
**Option:**    **Function:**

		Parameters in this group are array parameters where up to 10 fault logs can be viewed. [1] is the most recent logged data, [10] is the oldest.
[1] *		Error log no. 1
[2]		Error log no. 2
[3]		Error log no. 3
[4]		Error log no. 4
[5]		Error log no. 5
[6]		Error log no. 6
[7]		Error log no. 7
[8]		Error log no. 8
[9]		Error log no. 9
[10]		Error log no. 10

**19-81 Error Code**
**Range:**                      **Function:**

0*	[0000000000]	Displays the error code.
----	--------------	--------------------------

**19-82 Error Time**
**Range:**                      **Function:**

0h*	[0000000000h]	Displays the error time in h.
-----	---------------	-------------------------------

**19-83 Reset Error log**
**Option:**                      **Function:**

		Reset of the error log in parameters 19-80 to 19-82.
[0] *	No Function	
[1]	Reset	Reset data log

**19-84 Function Output 1**
**Option:**                      **Function:**

		Specifies the output function for output X59.1.
[0] *	Overspeed	
[1]	Direction evacuation	
[2]	Direction evacuation inverse	

**19-86 Enable SC**
**Option:**                      **Function:**

		Enable Simple control
[0] *	Standard	Standard speed control
[1]	Signal	Start with "Up" and "Down" signal

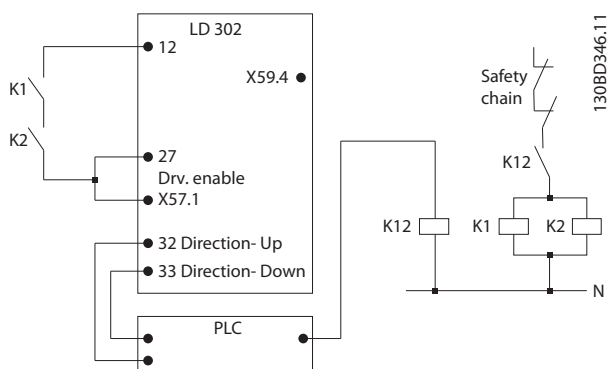


Illustration 11.5 19-86 Enable Simple Control=[0]

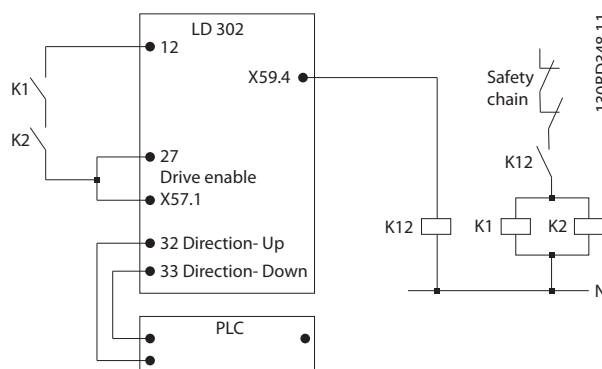


Illustration 11.7 19-86 Enable Simple Control=[1]

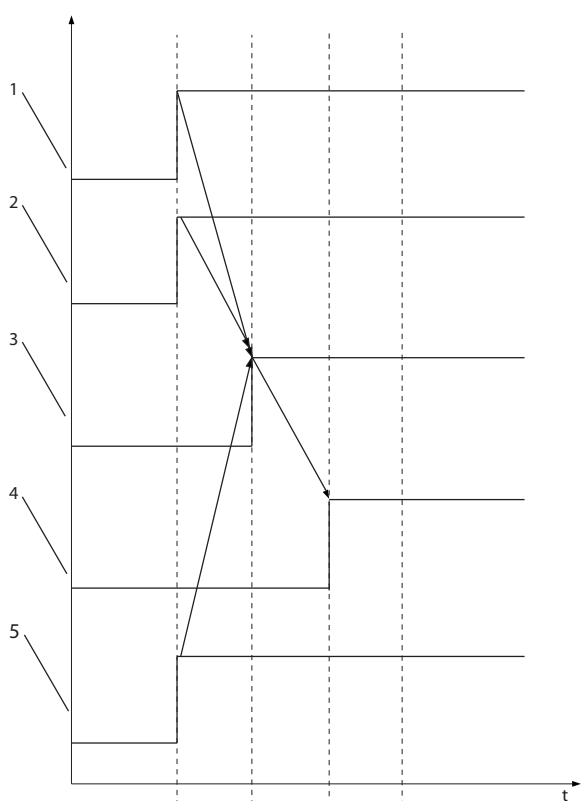


Illustration 11.6 19-86 Enable Simple Control=[0]

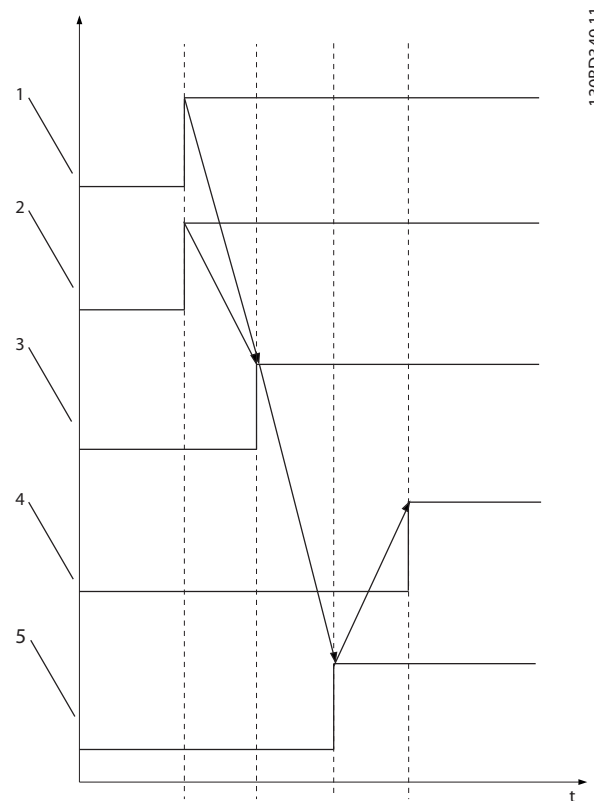


Illustration 11.8 19-86 Enable Simple Control=[1]

1	Direction
2	Selected speed
3	Output X59.4
4	Operation
5	Drv. enable

Table 11.13 Legend to Illustration 11.6

1	Direction
2	Selected speed
3	Output X59.4
4	Operation
5	Drv. enable

Table 11.14 Legend to Illustration 11.8

19-90 Software Version

Range:

Function:

0000000000 *	[Build X.XX]	Displays the software version as build number.
--------------	--------------	--

**19-92 Status**

Range:	Function:
[2147483646– 0]	Indicates internal status information.

**19-93 Dir Change Cnt 1**

Range:	Function:
-1 * [2147483646– -1]	Indicates the counter value for cycle changes. <i>19-71 Set-up counter</i> activates the counter function. Activating <i>19-93 Dir Change Cnt 1</i> changes the function for output X59.2 from default <i>Speed level 1 to counter warning</i> . Device failure or setting to factory default causes the counter readings to be lost. To avoid losing the counter readings, provide an extra external direction-counter. After each travel, with changed direction, the counter value is reduced by one (count-down).

**19-94 Dir Change Cnt 2**

Range:	Function:
0* [2147483646– 0]	Indicates the counter value for cycle changes. <i>19-71 Set-up counter</i> activates the counter function. Device failure or setting to factory default causes the counter readings to be lost. To avoid losing the counter readings, provide an extra external direction-counter. After each travel, with changed direction, the counter value counts up by one. After reaching the maximum value, the counter starts again at zero. The direction change counter 2 is always active.

**19-98 Abs Enc Position**

Range:	Function:
0* [2147483646– -1]	Absolute encoder position.

**19-99 Distance During Dec**

Range:	Function:
0* [1000000 to -1000000]	Distance during deceleration.

## 11.7 Parameters 32-\*\* Encoder

**32-00 Incremental Signal Type**

Option:	Function:
[0]	Specify type of incremental encoder connected to Encoder 2 interface (X55 and X62, if CAN encoder is used). If no incremental encoder is connected, select [0].
[1] * RS422 (5V TTL)	If a digital incremental encoder with an interface according to RS422 is connected, select [1].

**32-00 Incremental Signal Type**

Option:	Function:
[2] Sinusoidal 1Vpp	If an analog incremental encoder with 1 V peak-peak signal is connected, select [2].
[3] CAN encoder	If an MCO CAN encoder is used, select [3].

**32-01 Incremental Resolution**

Range:	Function:
1024* [1 - 1073741823 ]	Calculate velocity in RPM (rounds per minute) as well as time-out for detection of the zero pulse with HOME and INDEX. Set the resolution of the incremental encoder connected to Encoder 2 interface (X55). Encoder resolution can be found on encoder nameplate or datasheet. <ul style="list-style-type: none"> <li>Digital incremental encoder (32-00 = [1]): The resolution must be set in pulses per revolution</li> <li>Analog incremental encoder (32-00 = [2]): The resolution must be set in sinusoidal signal periods per revolution</li> <li>CAN encoder (32-00 = [3]): Incremental encoder: Pulses per revolution absolute encoder: (pulses per revolution)/4</li> </ul>

## 12 Specifications

### 12.1 Electrical Data

	P4K0	P5K5	P7K5
Typical shaft output [kW]/[hp]	4/5	5.5/7.5	7.5/10
Enclosure IP20	A2	A3	A3
Enclosure IP55	A4/A5	A5	A5
<b>Output current</b>			
<b>High overload 160% for 1 min.</b>			
Shaft output [kW]/[hp]	4/5	5.5/7.5	7.5/10
Continuous (3x380-440 V) [A]	10	13	16
Intermittent (3x380-440 V) [A]	16	20.8	25.6
Continuous (3x441-500 V) [A]	8.2	11	14.5
Intermittent (3x441-500 V) [A]	13.1	17.6	23.2
Continuous kVA (400 V AC) [kVA]	6.9	9.0	11.0
Continuous kVA (460 V AC) [kVA]	6.5	8.8	11.6
<b>Max. input current</b>			
Continuous (3x380-440 V) [A]	9.0	11.7	14.4
Intermittent (3x380-440 V) [A]	14.4	18.7	23.0
Continuous (3x441-500 V) [A]	7.4	9.9	13.0
Intermittent (3x441-500 V) [A]	11.8	15.8	20.8
<b>Additional specifications</b>			
IP20 max. cable cross section <sup>5)</sup> (mains, motor, brake, and load sharing) [mm <sup>2</sup> (AWG)] <sup>2)</sup>	4,4,4 (12,12,12) (min. 0.2(24))		
IP55 max. cable cross section <sup>5)</sup> (mains, motor, brake, and load sharing) [mm <sup>2</sup> (AWG)]	4,4,4 (12,12,12)		
Max. cable cross section <sup>5)</sup> with disconnect	6,4,4 (10,12,12)		
Estimated power loss at rated max. load [W] <sup>4)</sup>	124	187	255
Weight, enclosure IP20 [kg]/[lbs]	4.9/10.8	6.6/14.6	6.6/14.6
Weight, enclosure IP55 [kg]/[lbs]	13.5/29.8	14.2/31.3	14.2/31.3
Efficiency <sup>4)</sup>	0.97	0.97	0.97
0.37-7.5 kW [0.5-10 hp] only available as 160% high overload.			

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Table 12.1 Mains Supply 3x380-400 V AC

	P11K		P15K		P18K		P22K	
High/Normal Load <sup>1)</sup>	HO	NO	HO	NO	HO	NO	HO	NO
Typical shaft output [kW]/[hp]	11/15	15/20	15/20	18.5/25	18.5/25	22/30	22/30	30/40
Enclosure IP20	B3		B4		B4		B4	
Enclosure IP55	B1		B1		B2		B2	
<b>Output current</b>								
Continuous (3 x 380-440 V) [A]	24	32	32	37.5	37.5	44	44	61
Intermittent (60 s overload) (3 x 380-440 V) [A]	38.4	35.2	51.2	41.3	60	48.4	70.4	67.1
Continuous (3 x 441-500 V) [A]	21	27	27	34	34	40	40	52
Intermittent (60 s overload) (3 x 441-500 V) [A]	33.6	29.7	43.2	37.4	54.4	44	64	57.2
Continuous kVA (400 V AC) [kVA]	16.6	22.2	22.2	26	26	30.5	30.5	42.3
Continuous kVA (460 V AC) [kVA]		21.5		27.1		31.9		41.4
<b>Max. input current</b>								
Continuous (3 x 380-440 V) [A]	22	29	29	34	34	40	40	55
Intermittent (60 s overload) (3 x 380-440 V) [A]	35.2	31.9	46.4	37.4	54.4	44	64	60.5
Continuous (3 x 441-500 V) [A]	19	25	25	31	31	36	36	47
Intermittent (60 s overload) (3 x 441-500 V) [A]	30.4	27.5	40	34.1	49.6	39.6	57.6	51.7
<b>Additional specifications</b>								
IP55 max. cable cross-section <sup>5)</sup> (mains, brake, load sharing) [mm <sup>2</sup> (AWG)] <sup>2)</sup>	16, 10, 16 (6, 8, 6)		16, 10, 16 (6, 8, 6)		35,-,-(2,-,-)		35,-,-(2,-,-)	
IP55 max. cable cross-section <sup>5)</sup> (motor) [mm <sup>2</sup> (AWG)] <sup>2)</sup>	10, 10,- (8, 8,-)		10, 10,- (8, 8,-)		35, 25, 25 (2, 4, 4)		35, 25, 25 (2, 4, 4)	
IP20 max. cable cross-section <sup>5)</sup> (mains, brake, motor and load sharing)	10, 10,- (8, 8,-)		10, 10,- (8, 8,-)		35,-,-(2,-,-)		35,-,-(2,-,-)	
Max. cable cross-section with Disconnect [mm <sup>2</sup> (AWG)] <sup>2)</sup>	16, 10, 10 (6, 8, 8)							
Estimated power loss at rated max. load [W] <sup>4)</sup>	291	392	379	465	444	525	547	739
Weight, enclosure IP20 [kg]/[lbs]	12/26.5		12/26.5		23.5/51.8		23.5/51.8	
Weight, enclosure IP55 [kg]/[lbs]	23/50.7		23/50.7		27/59.5		27/59.5	
Efficiency <sup>4)</sup>	0.98		0.98		0.98		0.98	

**Table 12.2 Mains Supply 3x380-400 V AC**

	P30K		P55K	
High/Normal Load <sup>1)</sup>	HO	NO	HO	NO
Typical shaft output [kW]/[hp]	30/40	37/50	55/75	75/100
Enclosure IP20	B4		C4	
Enclosure IP55	C1		C2	
<b>Output current</b>				
Continuous ( 3x380-440 V) [A]	61	73	106	147
Intermittent (60 s overload) (3x380-440 V) [A]	91.5	80.3	159	162
Continuous (3x441-500 V) [A]	52	65	105	130
Intermittent (60 s overload) (3x441-500 V) [A]	78	71.5	158	143
Continuous kVA (400 V AC) [kVA]	42.3	50.6	73.4	102
Continuous kVA (460 V AC) [kVA]		51.8		104
<b>Max. input current</b>				
Continuous (3x380-440 V) [A]	55	66	96	133
Intermittent (60 s overload) (3x380-440 V) [A]	82.5	72.6	144	146
Continuous (3x441-500 V) [A]	47	59	95	118
Intermittent (60 s overload) (3x441-500 V) [A]	70.5	64.9	143	130
<b>Additional specifications</b>				
IP20 max. cable cross-section <sup>5)</sup> (mains and motor)	35 (2)		150 (300mcm)	
IP20 max. cable cross-section <sup>5)</sup> (brake and load sharing)	35 (2)		95 (4/0)	
IP55max. cable cross-section <sup>5)</sup> (mains, motor) [mm <sup>2</sup> (AWG)] <sup>2)</sup>	50 (1)		150 (300MCM)	
IP55 max. cable cross-section <sup>5)</sup> (brake, load sharing) [mm <sup>2</sup> (AWG)] <sup>2)</sup>	50 (1)		95 (3/0)	
Max. cable size with mains disconnects [mm <sup>2</sup> (AWG)] <sup>2)</sup>	50, 35, 35 (1, 2, 2)		95, 70, 70 (3/0, 2/0, 2/0)	
Estimated power loss at rated max. load [W] <sup>4)</sup>	570	698	1022	1384
Weight, enclosure IP55 [kg]/[lbs]	45/99.2		65/143.3	
Efficiency <sup>4)</sup>	0.98		0.98	

**Table 12.3 Mains Supply 3x380-400 V AC**

1) High overload = 160% torque during 60 s, Normal overload = 110% torque during 60 s

2) American Wire Gauge.

3) Measured using 5 m [16.4 ft] screened motor cables at rated load and rated frequency.

4) The typical power loss is at nominal load conditions and expected to be within ±15% (tolerance relates to variety in voltage and cable conditions).

Values are based on a typical motor efficiency (eff2/eff3 border line). Motors with lower efficiency also add to the power loss in the frequency converter and opposite.

If the switching frequency is increased compared to the default setting, the power losses may rise significantly.

LCP and typical control card power consumptions are included. Further options and customer load may add up to 30 W to the losses.

(Though typical only 4 W extra for a fully loaded control card, or options for slot A or slot B, each).

Although measurements are made with state of the art equipment, some measurement inaccuracy must be allowed for ( $\pm 5\%$ ).

5) The 3 values for the max. cable cross section are for single core, flexible wire and flexible wire with sleeve, respectively.

## 12.2 Ambient Conditions

### Environment

Enclosure	IP20, IP55
Vibration test	1.0 g
Max. THVD	10%
Max. relative humidity	5% - 93% (IEC 721-3-3; Class 3K3 (non-condensing) during operation
Aggressive environment (IEC 60068-2-43) H <sub>2</sub> S test	class Kd
Ambient temperature	Max. 50 °C (24-hour average maximum 45 °C)
Minimum ambient temperature during full-scale operation	0 °C
Minimum ambient temperature at reduced performance	- 10 °C
Temperature during storage/transport	-25 to +65/70 °C
Maximum altitude above sea level without derating	1000 m

Derating for high altitude, see special conditions in the Design Guide.

EMC standards, Emission	EN 61800-3
EMC standards, Immunity	EN 61800-3

## 12.3 Power Ratings, Weight and Dimensions

Enclosure	A2	A3	A5	B1	B2	B3	B4		
<b>Power rating [kW]/[hp]</b>	<b>4/5</b>	<b>5.5-7.5/7.5-10</b>	<b>5.5-7.5/7.5-10</b>	<b>11/15</b>	<b>18/25</b>	<b>11/15</b>	<b>15/20</b>	<b>18/25</b>	<b>22/30</b>
IP Class	IP20	IP20	IP55	IP55	IP55	IP20	IP20	IP20	IP20
Voltage [V]	400	400	400	400	400	400	400	400	400
Continuous Output current (100%) [A]	10	13-16	13-16	21	35	26	35	44	51
Overload 6 s/60 s [A]	16/16	20.8-25.6	20.8-25.6	33.6	56	46.8/41.6	59.9/56	70.4/70.4	91.3/81.6
Current at 16 kHz [A]	10	13-16	13-16	-	35	-	32	35	44
Current at 14 kHz [A]	10	13-16	13-16	-	35	-	32	35	44
Current at 12 kHz [A]	10	13-16	13-16	21	35	21	35	44	51
Current at 10 kHz [A]	10	13-16	13-16	21	35	26	35	44	51
Current at 8 kHz [A]	10	13-16	13-16	21	35	26	35	44	51
Ambient temperature [°C]	45	45	45	45	45	45	45	45	45
Load cycles: design point pr. year	2.1 mio.	2.1 mio	2.1 mio	2.1 mio	2.1 mio	2.1 mio	2.1 mio	2.1 mio	2.1 mio
Duty cycle [%]	50	50	50	50	50	50	50	50	50

Table 12.4 Enclosure Types and Power Ratings, A2-A5, B1-B4



Enclosure	C1	C2	C3	C4		
Power rating [kW]/[hp]	30/40	55/75	30/40	37/50	45/60	55/75
IP Class	IP55	IP55	IP20	IP20	IP20	IP20
Voltage [V]	400	400	400	400	400	400
Continuous Output current (100%) [A]	50	98	60	75	90	110
Overload 6 s/60 s [A]	75	147	108/90	135/112.5	162/135	198/165
Current at 16 kHz [A]	50	-	-	-	-	-
Current at 14 kHz [A]	50	-	-	-	-	-
Current at 12 kHz [A]	50	98	60	75	83	98
Current at 10 kHz [A]	50	98	60	75	90	98
Current at 8 kHz [A]	50	98	60	75	90	110
Ambient temperature [°C]	45	45	45	45	45	45
Load cycles: design point pr. year	2.1 mio	2.1 mio	2.1 mio	2.1 mio	2.1 mio	2.1 mio
Duty cycle [%]	50	50	50	50	50	50

Table 12.5 Enclosure Types and Power Ratings, C1-C4

Included upon delivery are accessory bags containing necessary

- brackets
- screws
- connectors

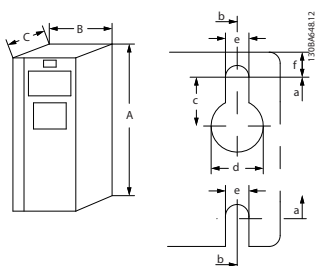


Illustration 12.1 Top and Bottom Mounting Holes

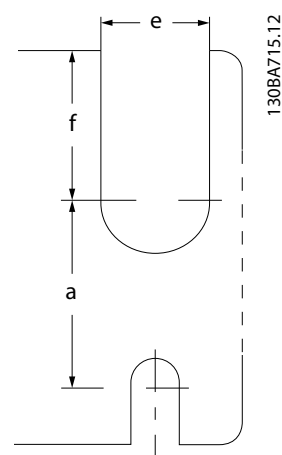


Illustration 12.2 Top and Bottom Mounting Holes (B4 only)

Enclosure type		A1	A2	A3	A4	A5	B1	B2	B3	B4
Rated power [kW]/[hp]	480 V	0.37-1.5/ 0.5-2.0	0.37-4.0/ 0.5-5.0	5.5-7.5/7. 5-10	0.37-4.0/ 0.5-5.0	0.37-7.5/ 0.5-10	11-15/15- 20	18.5-22/ 25-30	11-15/1 5-20	18.5-30/ 25-40
IP		20	20	20	55	55	55	55	20	20
NEMA		Chassis	Chassis	Chassis	Type 12	Type 12	Type 12	Type 12	Chassis	Chassis
<b>Height [mm]/[in]</b>										
Height of back plate	A	200/7.87	268/10.55	268/10.55	390/15.35	420/16.54	480/18.9	650/25.6	399/15.7 1	520/20.4 7
Height with decoupling plate for fieldbus cables	A	316/12.44	374/14.72	374/14.72	-	-	-	-	420/16.5 4	595/23.4 3
Distance between mounting holes	a	190/7.48	257/10.12	257/10.12	401/15.79	402/15.83	454/17.87	624/24.5 7	380/14.9 6	495/19.4 9
<b>Width [mm]/[in]</b>										
Width of back plate	B	75/2.95	90/3.54	130/5.12	200/7.87	242/9.53	242/9.53	242/9.53	165/6.5	230/9.06
Width of back plate with one C option	B		130/5.12	170/6.69		242/9.53	242/9.53	242/9.53	205/8.07	230/9.06
Width of back plate with 2 C options	B		150/5.91	190/7.48		242/9.53	242/9.53	242/9.53	225/8.86	230/9.06
Distance between mounting holes	b	60/2.36	70/2.76	110/4.33	171/6.73	215/8.46	210/8.27	210/8.27	140/5.51	200/7.87
<b>Depth [mm]/[in]</b>										
Depth without option A/B	C	207/8.15	205/8.07	205/8.07	175/6.89	200/7.87	260/10.24	260/10.2 4	249/9.8	242/9.53
With option A/B	C	222/8.74	220/8.66	220/8.66	175/6.89	200/7.87	260/10.24	260/10.2 4	262/10. 31	242/9.53
<b>Screw holes [mm]/[in]</b>										
	c	6.0/0.24	8.0/0.31	8.0/0.31	8.25/0.32	8.25/0.32	12/0.47	12/0.47	8/0.31	
	d	ø8	ø11	ø11	ø12	ø12	ø19	ø19	12/0.47	
	e	ø5	ø5.5	ø5.5	ø6.5	ø6.5	ø9	ø9	6.8/0.27	8.5/0.33
	f	5/0.2	9/0.35	6.5/0.26	6/0.24	9/0.35	9/0.35	9/0.35	7.9/0.31	15/0.59
<b>Max. weight [kg]/[lbs]</b>		2.7/6.0	4.9/11	6.6/14.6	9.7/21.4	13.5/14.2 29.8/31.3	23/50.7	27/59.5	12/26.5	23.5/51. 8
<b>Front cover tightening torque</b>										
Plastic cover (low IP)		Click	Click	Click	-	-	Click	Click	Click	Click
Metal cover (IP55/66) [Nm]/[lb-ft]		-	-	-	1.5/1.1	1.5/1.1	2.2/1.6	2.2/1.6	-	-

**Table 12.6 Dimensions and Power Ratings, Enclosure Types A1-A5 and B1-B4**

Enclosure type		C1	C2	C3	C4
Rated power [kW]/[hp]	480 V	30-45/40-60	55-75/75-100	37-45/50-60	55-75/75-100
IP		55	55	20	20
NEMA		Type 1/Type 12	Type 1/Type 12	Chassis	Chassis
<b>Height [mm]/[in]</b>					
Height of back plate	A	680/26.77	770/30.31	550/21.65	660/25.98
Height with decoupling plate for fieldbus cables	A			630	800
Distance between mounting holes	a	648/25.51	739/29.09	521/20.51	631/24.84
<b>Width [mm]/[in]</b>					
Width of back plate	B	308/12.13	370/14.57	308/12.13	370/14.57
Width of back plate with one C option	B	308/12.13	370/14.57	308/12.13	370/14.57
Width of back plate with 2 C options	B	308/12.13	370/14.57	308/12.13	370/14.57
Distance between mounting holes	b	272/10.71	334/13.15	270/10.63	330/12.99
<b>Depth [mm]/[in]</b>					
Depth without option A/B	C	310/12.2	335/13.19	333/13.11	333/13.11
With option A/B	C	310/12.2	335/13.19	333/13.11	333/13.11
<b>Screw holes [mm]/[in]</b>					
	c	12.5/0.49	12.5/0.49		
	d	ø19	ø19	8.5/0.33	8.5/0.33
	e	ø9	ø9	17/0.67	17/0.67
	f	9.8/0.39	9.8/0.39	35/1.38	50/1.97
<b>Max. weight [kg]/[lbs]</b>		45/99	65/143		
<b>Front cover tightening torque</b>					
Plastic cover (low IP) [Nm]/[lb-ft]		Click	Click	2.0/1.48	2.0/1.48
Metal cover (IP55/66) [Nm]/[lb-ft]		2.2/1.6	2.2/1.6	2.0/1.48	2.0/1.48

**Table 12.7 Dimensions and Power Ratings, Enclosure Types C1-C4**

## 12.4 Connection Tightening Torques

Enclosure	Power [kW]/[hp]	Torque [Nm]/[lb-ft]					
		Mains	Motor	DC connection	Brake	Ground	Relay
A2	0.37-4.0/0.5-5.0	1.8/1.3	1.8/1.3	1.8/1.3	1.8/1.3	3/2.2	0.6/0.44
A3	5.5-7.5/7.5-10	1.8/1.3	1.8/1.3	1.8/1.3	1.8/1.3	3/2.2	0.6/0.44
A4	0.37-4.0/0.5-5.0	1.8/1.3	1.8/1.3	1.8/1.3	1.8/1.3	3/2.2	0.6/0.44
A5	0.37-7.5/0.5-10	1.8/1.3	1.8/1.3	1.8/1.3	1.8/1.3	3/2.2	0.6/0.44
B1	11-15/15-20	1.8/1.3	1.8/1.3	1.5/1.1	1.5/1.1	3/2.2	0.6/0.44
B2	18-22/25-30	4.5/3.3	4.5/3.3	3.7/2.7	3.7/2.7	3/2.2	0.6/0.44
B3	11-15/15-20	1.8/1.3	1.8/1.3	1.8/1.3	1.8/1.3	3/2.2	0.6/0.44
B4	18-30/25-40	4.5/3.3	4.5/3.3	4.5/3.3	4.5/3.3	3/2.2	0.6/0.44
C1	30-45/40-60	10/7.4	10/7.4	10/7.4	10/7.4	3/2.2	0.6/0.44
C2	55-75/75-100	14/24 <sup>1)</sup> 10.3/17.7 <sup>1)</sup>	14/24 <sup>1)</sup> 10.3/17.7 <sup>1)</sup>	14/10.3	14/10.3	3/2.2	0.6/0.44
C3	37-45/50-60	10/7.4	10/7.4	10/7.4	10/7.4	3/2.2	0.6/0.44
C4	55-75/75-100	14/24 <sup>1)</sup> 10.3/17.7 <sup>1)</sup>	14/24 <sup>1)</sup> 10.3/17.7 <sup>1)</sup>	14/10.3	14/10.3	3/2.2	0.6/0.44

**Table 12.8 Tightening of Terminals**
<sup>1)</sup> For different cable dimensions x/y, where  $x \leq 95 \text{ mm}^2$  [3/0 AWG] and  $y \geq 95 \text{ mm}^2$  [3/0 AWG].

## 12.5 Lift Controller MCO 361 Specifications

### 12.5.1 Protection and Features

- All inputs, outputs and supply voltages are protected against short circuit.
- All inputs, outputs and supply voltages are isolated galvanically from high voltages such as mains supply and motor voltage (PELV).
- Encoder signals are monitored during operation and standstill.
- Customer-specific application programs can be copy-protected.
- All MCO 361 parameters including user-defined application parameters are accessible via the LCP.
- All digital inputs and outputs are isolated galvanically from the internal electronics and can be sourced from an external 24 V power supply.

### 12.5.2 Control Input/Output and Control Data

Type	Plug connectors with screw terminals
Maximum cross section, rigid wire	1.5 mm <sup>2</sup> /AWG 16
Maximum cross section, flexible wire	1.5 mm <sup>2</sup> /AWG 16
Maximum cross section, wire with enclosed core	1.5 mm <sup>2</sup> /AWG 16
Minimum cross section	0.08 mm <sup>2</sup> /AWG 28

**Table 12.9 Connection Terminals**

Number of programmable digital inputs	10
Terminal block	X57
Terminal number	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Logic	PNP or NPN <sup>1)</sup>
Voltage level	0-24 V DC
Voltage level, logic.0. PNP	< 5 V DC
Voltage level, logic.1. PNP	> 10 V DC
Voltage level, logic.0. NPN	> 19 V DC
Voltage level, logic.1. NPN	< 14 V DC
Maximum voltage on input	28 V DC

**Table 12.10 Digital Inputs**

<sup>1)</sup> Selected in parameter 5-00 Digital I/O mode. The digital inputs are isolated galvanically from the internal electronics and can be sourced by an external 24 V power supply.

Number of programmable digital outputs	8 (6) <sup>1)</sup>
Terminal block	X59
Terminal number	1 <sup>1)</sup> , 2 <sup>1)</sup> , 3, 4, 5, 6, 7, 8
Driver type	Push-pull
Logic	PNP or NPN <sup>2)</sup>
Voltage level	0-24 V DC
Max. output current (sink or source) with internal power supply (total)	40 mA
Max. output current (sink or source) with external power supply (per output)	100 mA

**Table 12.11 Digital Outputs**

<sup>1)</sup> Terminals X59-1 and X59-2 can be programmed as input, 33-60 Terminal X59/1 and X59/2 Mode.

<sup>2)</sup> Selected in 5-00 Digital I/O Mode.

Number of digital outputs which can be used as digital inputs	2 <sup>1)</sup>
Terminal block	X59
Terminal number	1, 2
Logic	PNP or NPN <sup>2)</sup>
Voltage level	0-24 V DC
Voltage level, logic.0. PNP	< 10 V DC
Voltage level, logic.1. PNP	> 17 V DC
Voltage level, logic.0. NPN	> 13 V DC
Voltage level, logic.1. NPN	< 6 V DC
Maximum voltage on input	28 V DC

**Table 12.12 Combined Digital Inputs/Outputs**

<sup>1)</sup> Terminals X59-1 and X59-2 can be programmed as input, 33-60 Terminal X59/1 and X59/2 Mode.

<sup>2)</sup> Selected in 5-00 Digital I/O Mode.

Terminal block	X58
Terminal number	1, 2
Maximum load	65 mA

**Table 12.13 24 V DC Supply Output**

The internal 24 V power supply can be disconnected via parameter 33-85, an 24 V external supply must then be connected to X58-1 and X58-2.

General specifications	
Number of encoder inputs	2
Terminal block	X55 and X56
Terminal number	5, 6, 7, 8, 9, 10, 11, 12
Input impedance	120Ω
Maximum voltage on inputs	5 V DC
Cable type	Screened cable with a twisted pair of wires for each encoder channel <sup>1)</sup>

**Table 12.14 Encoder Inputs**

Incremental encoder type	RS422/TTL
Maximum frequency	410 kHz
Phase displacement between A and B	90° ±30°
Maximum cable length	300 m <sup>2</sup>

**Table 12.15 Incremental Encoder Specifications**

Absolute encoder type	SSI
Data coding	Gray
Data length	12–32 bit
Clock frequency	78 kHz – 2 MHz <sup>1)</sup>
Maximum cable length	150 m <sup>2</sup>

**Table 12.16 Absolute Encoder Specifications**

<sup>1)</sup> Always observe specifications/limitations prescribed by the encoder supplier.

<sup>2)</sup> 150 m [492 ft] cable is possible up to 500 kHz clock frequency, above 500 kHz cable length must be limited further.

Number of encoder outputs	1
Terminal block	X56
Terminal number	5, 6, 7, 8, 9, 10, 11, 12
Signal type	RS422
Maximum frequency	410 kHz
Maximum number of followers	31 (more with repeater)
Maximum cable length	400 m

**Table 12.17 Encoder Output**

Max. number of voltage supplies	3
Terminal block	X55 and X56
Terminal number	1, 2, 3, 4
24 V, max. load	250 mA <sup>1)</sup>
8 V, max. load	250 mA <sup>1),2)</sup>
5 V, max. load	400 mA <sup>1)</sup>

**Table 12.18 Encoder Voltage Supply**

<sup>1)</sup> By one voltage supply. By more voltage supplies, reduce load according to following principle: 6 W: Load 24 V + 8 V + 5 V and 2 W: 8 V + 5 V.

<sup>2)</sup> 8 V is only available at terminal block X55.

Sample time of position PID loop	1 ms
Positioning accuracy	± 1 increment <sup>1)</sup>
Synchronising accuracy	± 1 increment <sup>1)</sup>

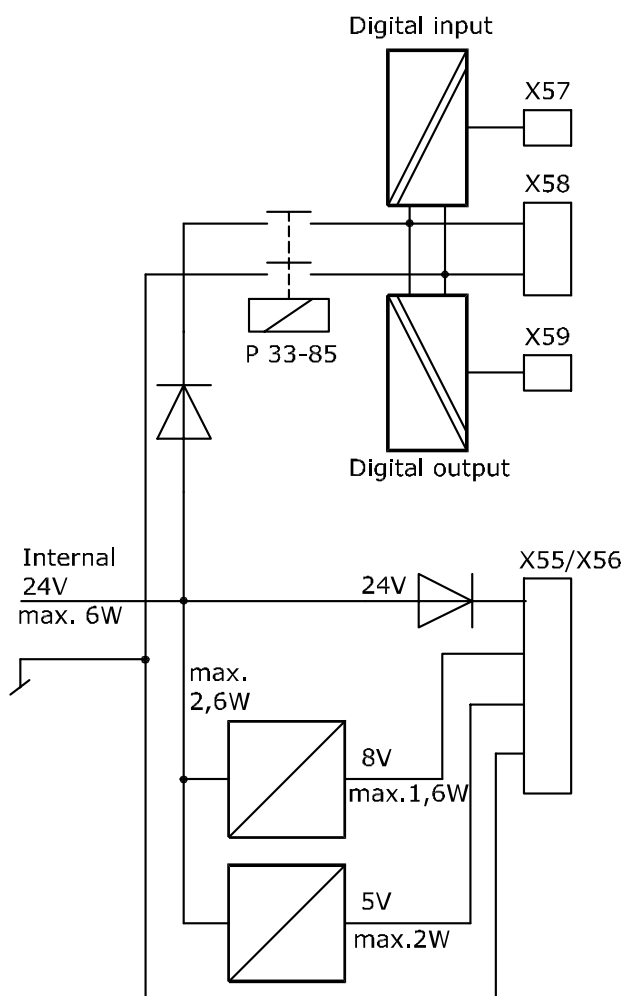
**Table 12.19 Control Characteristics**

<sup>1)</sup> This is the static accuracy; dynamic accuracy depends on many “external” factors such as encoder resolution, moment of inertia, mechanical backlash and elasticity.

Program memory size	100 Kb
Maximum number of application programs	90
Average command execution time	0.3 ms
Maximum reaction time on interrupt input	ms

**Table 12.20 Application Program**

### 12.5.3 Supply Voltage Overview



130BA227.10

**Illustration 12.3 Wiring Diagram - Supply Voltage**

## 12.6 Motor Type and Associated Motor Number

### 12.6.1 Motor Type and Associated Motor Number Stored in Motor Database

Parameter	Motor	Power	Current	Revolution	Torque	Resistor	Inductance	Poles	Back EMF
19-01	Type	P [kW]/ [hp]	I [A]	N [1/min]	T [Nm]/[lb- ft]	R1 [Ohm]	Ld [mH]	number	V/1000 RPM
[No. 39-116]	Ziehl Abegg	Par. 1-21	Par. 1-24	Par. 1-25	Par. 1-26	Par. 1-30	Par. 1-37	Par. 1-39	Par. 1-40
39	160.20	3.3/4.4	9	240	130/96	3.36	16.7	20	908
40	160.20	5.2/7	13	384	130/96	1.58	7.6	20	626
41	160.30	2.8/3.7	10.5	192	195/144	2.98	16.7	20	1126
42	160.30	3.5/4.7	13	240	195/144	2.07	11.6	20	937
43	160.30	4.4/5.9	16	300	195/144	1.39	7.8	20	796
44	160.30	5.6/7.5	19.5	384	195/144	0.91	5.1	20	626
45	160.40A	5.2/7	14	192	260/192	2.21	13.3	20	1162
46	160.40A	6.5/8.7	16.5	240	260/192	1.56	9.3	20	973
47	160.40A	8.2/11	20	300	260/192	1.05	6.4	20	807
48	160.40A	10.5/14.1	25	384	260/192	0.67	4	20	640
49	200.15C-20	2.5/3.4	9	96	250/184	6.22	37.1	20	1766
50	200.15C-20	4.4/5.9	11.3	168	250/184	2.79	17.4	20	1267
51	200.15C-20	4.3/5.8	11.5	186	220/162	2.7	16.8	20	1060
52	200.15C-20	5/6.7	14.5	192	250/184	2.29	13.3	20	1063
53	200.15C-20	6.8/9.1	18.5	258	250/184	1.37	8.1	20	818
54	200.15C-20	7.9/10.6	20.5	300	250/184	1.13	6.6	20	744
55	200.20C-20	3.3/4.4	11	96	330/243	4.66	30.8	20	1874
56	200.20C-20	4.1/5.5	12.5	120	330/243	3.46	22.7	20	1629
57	200.20C-20	5.8/7.8	16	168	330/243	2.08	13.7	20	1256
58	200.20C-20	6.6/8.8	18	192	330/243	1.58	10.5	20	1099
59	200.20C-20	8.9/11.9	24	258	330/243	0.92	6.1	20	831
60	200.20C-20	10.4/13.9	27.5	300	330/243	0.71	4.7	20	732
61	200.30C-20	4.8/6.4	14	96	475/350	3.09	23.4	20	2054
62	200.30C-20	6/8	16.5	120	475/350	2.25	17	20	1730
63	200.30C-20	6.7/9	17	168	380/280	1.58	12.2	20	1318
64	200.30C-20	8.4/11.3	21.5	168	475/350	1.35	10.1	20	1328
65	200.30C-20	9.6/12.9	24.5	192	475/350	1.05	7.9	20	1180
66	200.30C-20	12.8/17.2	31	258	475/350	0.67	5.1	20	945
67	200.30C-20	14.1/18.9	35	300	450/332	0.461	3.5	20	784
68	200.40C-20	6/8	17.5	96	600/443	2.21	18.4	20	2108
69	200.40C-20	7.5/10.1	20	120	600/443	1.63	13.4	20	1788
70	200.40C-20	10.6/14.2	27	168	600/443	0.94	7.9	20	1359
71	200.40C-20	12.1/16.2	32	192	600/443	0.67	5.6	20	1153
72	200.40C-20	16.2/21.7	39	258	600/443	0.448	3.8	20	945
73	200.40C-20	18.8/25.2	44	300	600/443	0.352	3	20	830
74	225.30-20	3.2/4.3	11	60	500/369	2.86	28.9	20	2855
75	225.30-20	5/6.7	15.5	96	500/369	1.43	14.7	20	1964
76	225.30-20	6.3/8.4	17.5	120	500/369	1.2	11.9	20	1716
77	225.30-20	8.2/11	23	156	500/369	0.66	6.6	20	1320
78	225.30-20	10/13.4	25	192	500/369	0.54	5.5	20	1216
79	225.40-20	4.5/6	16	60	710/524	2.86	28.9	20	2855
80	225.40-20	7/9.4	22.5	96	710/524	1.43	14.7	20	1964
81	225.40-20	8/10.7	22.5	108	710/524	1.43	14.9	20	1954
82	225.40-20	9/12.1	25	120	710/524	1.2	9	20	1644
83	225.40-20	11.5/15.4	33.5	156	710/524	0.66	6.6	20	1320

Parameter	Motor	Power	Current	Revolution	Torque	Resistor	Inductance	Poles	Back EMF
19-01	Type	P [kW]/ [hp]	I [A]	N [1/min]	T [Nm]/[lb- ft]	R1 [Ohm]	Ld [mH]	number	V/1000 RPM
[No. 39-116]	Ziehl Abegg	Par. 1-21	Par. 1-24	Par. 1-25	Par. 1-26	Par. 1-30	Par. 1-37	Par. 1-39	Par. 1-40
84	225.40-20	12.5/16.8	33.5	168	710/524	0.66	6.6	20	1318
85	225.40-20	13/17.4	33	192	650/479	0.539	5.5	20	1216
86	225.60B-20	7/9.4	23	60	1120/826	1.92	22	20	2999
87	225.60B-20	11/14.7	35	96	1120/826	0.86	9.8	20	1982
88	225.60B-20	12.5/16.8	35	108	1120/826	0.86	9.8	20	1986
89	225.60B-20	14/18.8	42	120	1120/826	0.563	6.7	20	1629
90	225.60B-20	18/24.1	53.5	156	1120/826	0.37	4.3	20	1309
91	225.60B-20	20/26.8	53.5	168	1120/826	0.37	4.3	20	1308
92	225.60B-20	20/26.8	53.5	192	1000/738	0.29	3.3	20	1144
93	225.60B-20	25/33.5	65	240	1000/738	0.214	2.4	20	973
94	225.60B-20	31.5/42.2	70	336	900/664	0.147	1.7	20	819
95	250.60B-20	10/13.4	30	60	1600/1180	1.36	20.9	20	3258
96	250.60B-20	16/21.4	43	96	1600/1180	0.645	9.9	20	2235
97	250.60B-20	20/26.8	52.5	120	1600/1180	0.431	6.6	20	1831
98	250.60B-20	26/34.9	68	156	1600/1180	0.263	4	20	1419
99	250.60B-20	32/42.9	80	192	1600/1180	0.193	2.9	20	1216
100	250.60B-20	38/51	92	240	1500/1106	0.132	2	20	1009
101	250.60B-20	37/49.6	85	252	1400/1033	0.132	2	20	1009
102	250.60B-20	42/56.3	94	336	1200/885	0.086	1.3	20	819
103	250.80C-20	19/25.5	58	84	2100/1549	0.533	8.4	20	2286
104	250.80C-20	25/33.5	70	114	2100/1549	0.325	5.1	20	1776
105	250.80C-20	30/40.2	80	138	2100/1549	0.239	3.7	20	1529
106	250.80C-20	27/36.2	64	156	1650/1217	0.239	3.7	20	1519
107	250.80C-20	33/44.2	81	192	1650/1217	0.164	2.4	20	1270
108	250.80C-20	42/56.3	102	240	1650/1217	0.106	1.7	20	1009
109	250.80C-20	54/72.4	137	312	1650/1217	0.06	0.9	20	771
110	250.100C-20	22/29.4	62	78	2650/1955	0.503	8.3	20	2551
111	250.100C-20	30/40.2	82	108	2650/1955	0.285	4.7	20	1906
112	250.100C-20	37/49.6	98	132	2650/1955	0.196	3.2	20	1586
113	250.100C-20	33/44.2	77	150	2100/1549	0.196	3.3	20	1592
114	250.100C-20	42/56.3	98	192	2100/1549	0.127	2.1	20	1270
115	250.100C-20	58/77.7	139	264	2100/1549	0.071	1.2	20	963
116	250.100C-20	69/92.5	167	312	2100/1549	0.05	0.8	20	793

Table 12.21 PM Motor, Ziehl Abegg Stored in Motor Database

12.6.2 Motor Type and Associated Motor Number not Stored in Motor Database

**NOTICE**

Danfoss can accept no responsibility and liability for the accuracy of the manufacturer motor data.

Motor	Power	Current	Revolution	Torque	Resistor	Inductance	Poles	Back EMF
PM-Type	P [kW]/[hp]	I [A]	N [1/min]	T [Nm]/[lb-ft]	R1 [Ohm]	Ld [mH]	number	V/1000 RPM
Ziehl Abegg	Par. 1-20	Par. 1-24	Par. 1-25	Par. 1-26	Par. 1-30	Par. 1-37	Par. 1-39	Par. 1-40
SM160.20	2.6/3.5	6.6	240	105/77	3,751	17.2	20	894
SM160.20	4.2/5.6	10	384	105/77	1,588	7.5	20	590
SM160.30	2.8/3.7	7	192	140/103	3,401	21.4	20	1144
SM160.30	3.5/4.7	8.3	240	140/103	2.38	12.7	20	952
SM160.30	4.4/5.9	10	300	140/103	1,645	8.9	20	796
SM160.30	5.6/7.5	12.5	384	140/103	1,082	5.6	20	626
SM160.40	3.7/5	8.7	192	185/136	2,581	14.9	20	1180
SM160.40	4.6/6.2	10.5	240	185/136	1,719	10.1	20	973
SM160.40	5.8/7.8	13	300	185/136	1,147	6.6	20	796
SM160.40	7.4/9.9	16.5	384	185/136	0.733	4.2	20	626
200.15B-20	1.6/2.1	5.3	84	180/133	9.51	58.2	20	1977
200.15B-20	3.2/4.3	9.5	168	180/133	2.7	16.8	20	1061
200.15B-20	3.5/4.7	9.5	186	180/133	2.7	16.8	20	1060
200.15B-20	4.3/5.8	11.5	186	220/162	2.7	16.8	20	1060
200.15B-20	4.9/6.6	13	258	180/133	1,776	10.6	20	845
200.15B-20	5.7/7.6	14	300	180/133	1,329	6.9	20	732
200.20B-20	2.1/2.8	6.7	84	240/177	7.04	45.5	20	2060
200.20B-20	4.2/5.6	10.8	168	240/177	2.79	17.4	20	1267
200.20B-20	4.7/6.3	11.7	186	240/177	2,267	14.9	20	1181
200.20B-20	6.5/	16	258	240/177	1.31	8.3	20	885
200.20B-20	7.5/10.1	17.5	300	240/177	0.992	6.6	20	784
200.30B-20	3.3/4.4	10.5	84	380/280	4.09	31.8	20	2121
200.30B-20	4.8/6.4	13	120	380/280	2.54	20	20	1687
200.30B-20	6.7/9	17	168	380/280	1.58	12.1	20	1318
200.30B-20	7.6/10.2	19	192	380/280	1.24	9.7	20	1180
200.30B-20	10.3/13.8	25	258	380/280	0.71	5.4	20	885
200.30B-20	10.7/14.3	25	258	340/251	0.551	4.2	20	952
700.09AL-30	3/4	7.6	60	500/369	4.616	73.7	30	3996
700.09AL-30	5/6.7	11.5	96	500/369	2.09	33.4	30	2691
700.12AL-30	4.5/6	11.5	60	750/553	1.833	33.8	30	3921
700.12AL-30	7.5/10.1	18	96	750/553	0.779	14	30	2518
700.12AL-30	12/16.1	29	156	750/553	0.288	5.2	30	1537
700.12AL-30	13/17.4	32.5	168	750/553	0.238	4.3	30	1403
700.14AL-30	5.5/7.4	13	60	850/627	1,833	33.8	30	3921
700.14AL-30	8.5/11.4	20.5	96	850/627	0.779	14	30	2518
700.14AL-30	14/18.8	33.5	156	850/627	0.288	5.2	30	1537
700.14AL-30	15/20.1	36.5	168	850/627	0.238	4.3	30	1403
700.14AL-30	17/22.8	40.5	192	850/627	0.189	3.5	30	1269
700.14AL-30	17.5/23.5	43	240	700/516	0.115	2.2	30	980
700.16AL-30	6.5/8.7	16.5	60	1000/738	1,333	25.9	30	3691
700.16AL-30	10/13.4	25	96	1000/738	0.555	11	30	2402
700.16AL-30	16/21.4	41.5	156	1000/738	0.201	4	30	1442
700.16AL-30	17.5/23.5	49	168	1000/738	0.159	3.1	30	1287
700.16AL-30	18/24.1	50	192	900/664	0.121	2.4	30	1115



Motor	Power	Current	Revolution	Torque	Resistor	Inductance	Poles	Back EMF
PM-Type	P [kW]/[hp]	I [A]	N [1/min]	T [Nm]/[lb-ft]	R1 [Ohm]	Ld [mH]	number	V/1000 RPM
Ziehl Abegg	Par 1-20	Par. 1-24	Par. 1-25	Par. 1-26	Par. 1-30	Par. 1-37	Par. 1-39	Par. 1-40
700.16AL-30	20/26.8	50	240	800/590	0.093	1.8	30	961
700.16AL3-30	7.2/9.7	19	60	1150/848	1,333	25.9	30	3691
700.16AL3-30	11.6/15.5	29	96	1150/848	0.555	11	30	2402
700.16AL3-30	18.8/25.2	48	156	1150/848	0.201	4	30	1442
700.16AL3-30	20/26.8	55	168	1150/848	0.159	3.1	30	1287
860.28AL-30	9.2/12.3	25.5	40	2200/1623	1,244	30.3	30	5091
860.28AL-30	17/22.8	43	75	2200/1623	0.418	10	30	2980
860.28AL-30	22/29.5	53.5	96	2200/1623	0.28	6.8	30	2402
860.28AL-30	30/40.2	68.5	132	2200/1623	0.168	4.1	30	1883
860.28AL-30	37/49.6	80.5	160	2200/1623	0.124	3	30	1614
860.28AL-30	36/48.3	80	180	1900/1401	0.085	2.1	30	1346
860.28AL-30	39/52.3	80	196	1900/1401	0.085	1.9	30	1345

Table 12.22 PM Motor, Ziehl Abegg not Stored in Motor Database

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