Tetra Centri H 610HGD

Spec. No. 881154-01-03

Issue 0205 Order No. C120055

Tetra Pak

This document is valid for:

C120055 / 881154-01-03

Order No./Specification No.

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Tetra Pak

Tetra Pak
Tetra Pak Processing Components AB

Declaration of Conformity

Tetra Pak Processing Components AB, Box 103, S-221 00 LUND, Sweden, declares that

Control Panel SCS 92A
(Type)

31821-9860-1	C120055
(article number)	(serial number)

to which this declaration relates complies with

- [ ] Directive 89/392 EEC with amendments 91/368 EEC and 93/44 EEC (Machinery Directive).
- [X] Directive 73/23 EEC with amendment EEC 93/68 EEC (Low Voltage Directive).
- [X] Directive 89/336 EEC with amendments EEC 92/31 EEC and 93/68 EEC (EMC-Directive).

Lund, Sweden 15 May 2002

Hans Engwall, Product Manager Centrifugal Separation

Tetra Pak Processing Components AB SWEDEN

Tetra Pak
Tetra Pak Processing Components AB

Declaration of Conformity

Tetra Pak Processing Components AB, Box 103, S-221 00 LUND, Sweden, declares that

Inverter Starter
(Type)

31821-9855-1	C120055
(article number)	(serial number)

to which this declaration relates complies with

- [ ] Directive 89/392 EEC with amendments 91/368 EEC and 93/44 EEC (Machinery Directive).
- [x] Directive 73/23 EEC with amendment EEC 93/68 EEC (Low Voltage Directive).
- [x] Directive 89/336 EEC with amendments EEC 92/31 EEC and 93/68 EEC (EMC-Directive).

Lund, Sweden 15 May 2002

Hans Engwall, Product Manager Centrifugal Separation

Tetra Pak Processing Components AB SWEDEN

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1. Control Panel

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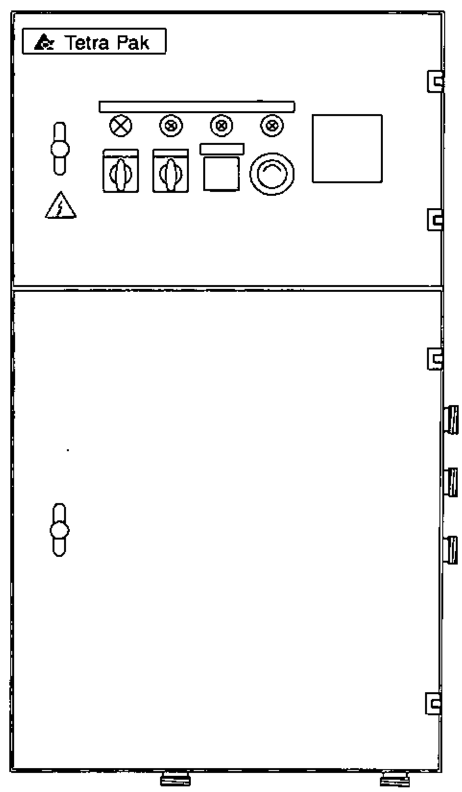
IM

Instruction Manual

Separator Control System SCS92B



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Tetra Pak

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Introduction

General information

Installation

Operation

Maintenance

Electricity

Spare parts/components

To the owner

This instruction manual is your instant guide when dealing with your Tetra Pak equipment.

Tetra Pak advises you to study it carefully, and - above all - to ensure its availability to those who install, maintain and operate the equipment on a daily basis. This documentation will be of no value to you if it is locked away when your personnel needs it!

Furthermore it is important that you:

- keep this instruction manual and other documentation for the life of the equipment
- incorporate any amendments in the text
- pass the documentation on to any subsequent holder or user of the equipment

Tetra Pak will not be responsible for any breakdown of the equipment caused by the owner's failure to follow the instructions given in this document.

This instruction manual describes the authorised way to use the equipment. Tetra Pak will take no responsibility for injury or damage if the equipment is used in any other way.

Notice on safety precautions

Before attempting to unpack, install and operate this unit, please read through concerned part of the manual. Pay particular attention to all dangers, warnings, cautions and notes. Failure to do so could result in serious injury to involved personnel or damage to the equipment.

Use of Danger, Warning, Caution and Note:

Danger, Warning, Caution and Notes used in this manual have the following significance:

DANGER! Failure to observe this information results in immediate danger of life.

WARNING! Failure to observe this information can result in major personal injury or loss of life.

CAUTION! Failure to observe this information can result in minor personal injury or damage to equipment.

Note! Information that requires special emphasis.

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Health and safety regulations

Read and follow the instructions in the instruction manual.

- regard all electrical equipment as live.

Before carrying out maintenance and repair:

- switch off power,
- inform the operator and other concerned personnel about the work you intend to do,
- post warning signs,
- take note of warnings given for actual separator.

Read the health and safety regulations for concerned separator.

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General information

Introduction

The Tetra Pak SCS 92 is an electronic control system specially designed to continuously control the operation of an Tetra Pak separator.

The control system comprises the:

UPPER CABINET consisting of electric and electronic components such as:

- SCS 92 Module
- Switches, relays, timers and push-buttons
- Transformers and fuses.
- LOWER CABINET consisting of water control components such as:
- Solenoid valves
- Reducing valves
- Pressure gauge
- Interconnecting piping

and of air control component such as:

- Reducing valves
- Solenoid valves.

The upper and lower cabinets with their components are on the following pages referred to as a "Control Unit".

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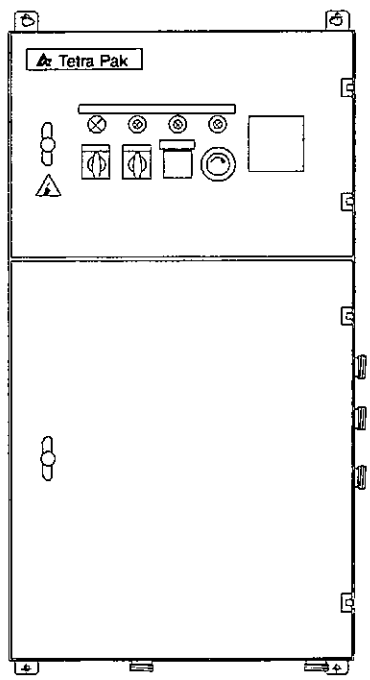


SCS 92 control unit

Technical data

This description includes data concerning the complete Separator Control System type SCS 92. For technical data on special components please see "Spare parts/components".

Manufacturer: Tetra Pak Processing Components AB

P.O. Box 103, S-221 00 Lund, Sweden

Machine type: SCS 92

Weight: approx. 80 kg.

Electric Power: Power supply voltage:

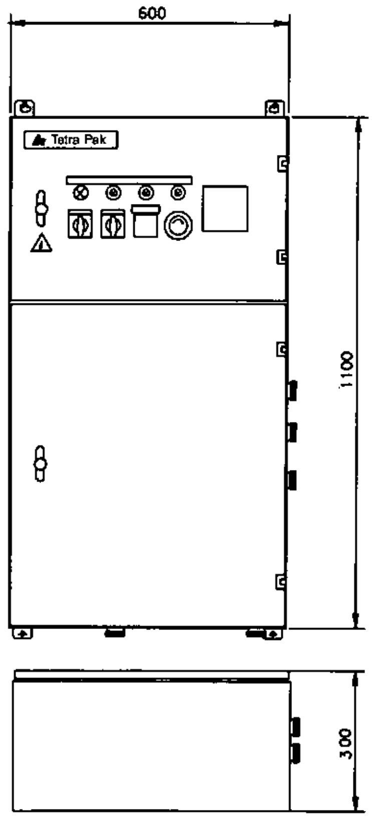
- 24V AC +10%, -15%
- 50/60 Hz
- External fuse 6A

Control voltage: 24 V DC

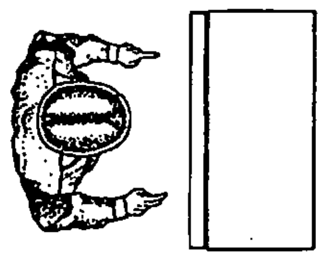
Max. ambient temperature 40°C

Measurements:1100 x 600 x 300 mm

Operator position in front of the control cabinet.



Measurement drawing



Operator position

Requirements on air and water

Compressed air

used as instrument air (valves and instruments).

- dry and oil free
- operating pressure 6 00 +/- 50 kPa
- max. oil content 10 mg/l
- max. water content none
- max. dew point 20°C
- solid particles max. 0.01 mm

Water

used as drinking water and cleaning water. The quality shall meet the WHO guidelines or the European Union's EC drinking water directive.

- min. pressure 400 kPa
- max. pressure 600 kPa
- temperature 10-40°C

Note! Variations in water pressure may influence the discharge volume from the separator

See specification for separator in separate instruction.

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CAUTION! **Non compliance.**
Non compliance with these requirements may damage the equipment.

Consumption material/data

Air

The cabinet has no internal consumption of air. The connected air is used for the operation of the pneumatic valves to be controlled. For consumption see valve instruction.

Water

The cabinet has no internal consumption of water. The connected water is used for the operation of the separator to be controlled. For consumption see separator instruction.

Electricity

installed load: 6 A

Description

The SCS 92 control unit is equipped with the required control functions for discharge, system valves, alarm indication, program selection etc.

The control panel is placed on the upper part of the SCS 92 and contains switches and buttons for starting the separator, selection of running mode, acknowledgment of alarm, manual discharge initiation and emergency stop.

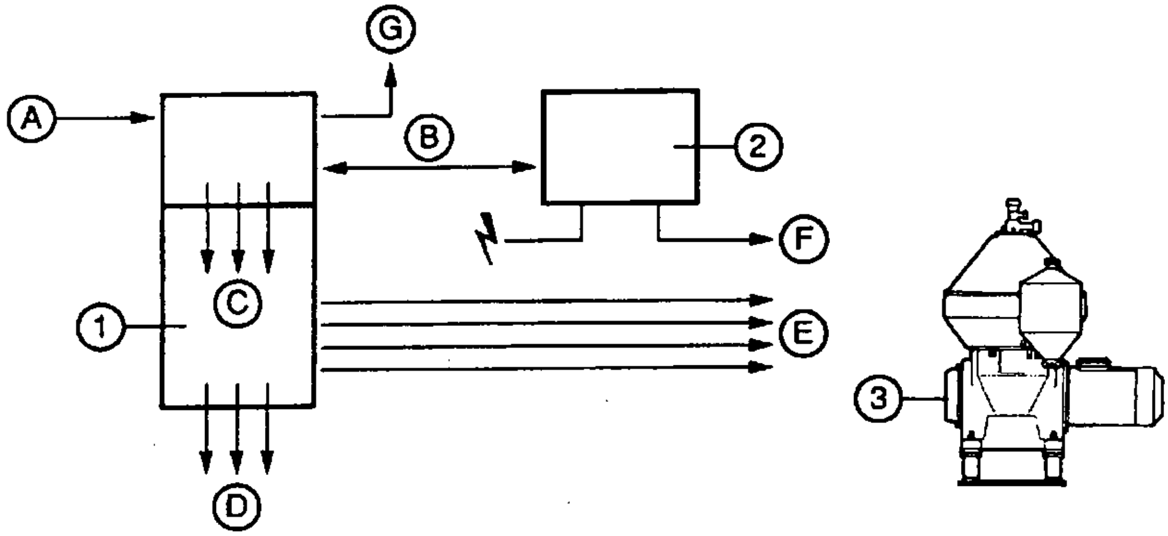
A control module (SCS 92) is located inside the door of the upper cabinet. At delivery the module is programmed with a standard application program. At commissioning, necessary adjustments are easily made.

The inside of the lower cabinet contains air and water control valves. For detailed descriptions of components please see "Spare parts/components".

Function

The SCS 92 control system, automatically controls and monitors a separation system. Motor starter, external components and sensors are electrically connected to the upper cabinet. Pipings for operating water, flushing etc., are connected to the lower cabinet.

The separation system is controlled in accordance with a control program in the control module of the upper cabinet. Signals for control of the separator function are sent to the solenoids in the lower cabinet and to the motor starter.



1) SCS 92 control unit
2) Motor starter
3) Separator

a) Electric signals from remote operation
b) Electric signals to/from motor starter
c) Electric signals to lower cabinet
d) Pneumatic signals to separation system
e) Service water to separator
f) Power to separator motor
g) Alarm signal

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Control system

The control system operates in four different modes:

- STAND STILL
- START
- RUN
- STOP

These four modes can all be controlled from the operators panel or via remote signals.

Stand still mode

The program is in the mode STAND STILL when the main power to the control unit is ON and the separator is not yet started. This is also the condition the program enters after a completed stop sequence.

Operation (Start/Run/Stop)

It is possible to select 8 different Run modes by use of the function selector on the control panel.

- L/A CIP lye/acid
- WATER CIP water
- FEED OFF Feed-off
- P1 Production 1
- P2 Production 2
- P3 Production 3
- STD.BY Stand-by
- REMOTE Remote control

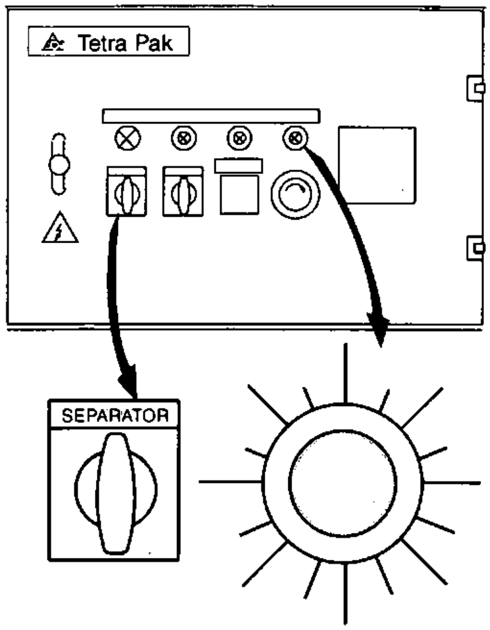
A function can be selected before start, during the start sequence and when the separator has attained full speed.

CIP (L/A or WATER)

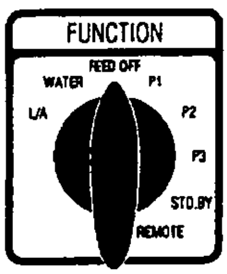
At Cleaning-In-Place (CIP) there are two possible selections.

- Cleaning with lye/acid (L/A).
- Flushing with water (WATER).

The control unit will enter a new cycle for discharge interval time and effect an appropriate discharge type.



Stand-still



Switch FUNCTION

FEED OFF

The flow to the separator is stopped.

Discharge is not possible in this mode.

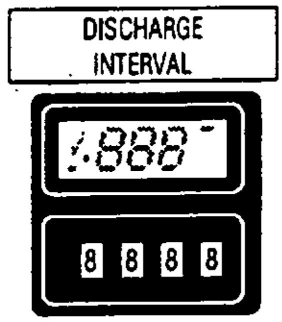
- When the feed-off timer has elapsed an alarm is triggered.

P 1-3

There are three different run modes for production.

- In production 1 and 2 the discharge interval is set by parameters P1 and P2 . See "Minor adjustments".
- In production 3 the discharge interval time is set on the timer in the front of the control panel.

Use production 3 when a frequent change of discharge interval time is needed.



Timer for PRODUCTION 3

STAND-BY

The separator is at full speed with flow and is waiting for a new command.

- Discharges are initiated during stand-by according to parameter values.

REMOTE CONTROL

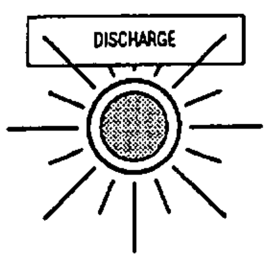
The control system and thus the separator is controlled by external binary signals.

DISCHARGE

A discharge can be triggered in three ways.

- Automatic by timers (parameter values).
- Manually by pressing the discharge push-button.
- Remote by an input signal.

- The discharge indication lamp is lit during the discharge sequence.
- A discharge takes place some seconds after the sequence is initiated.
- The discharge sequence will always take at least 60 seconds.



Discharge lamp is lit during discharge

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Installation

Introduction

Before installation, carefully read through this chapter.

Requirements on installation personnel:
Electrician:

Certified according to local regulations with at least 3 years experience from similar types of installations. Proven skills in reading and working from drawings and cable lists.

Knowledge of local safety regulations for power and automation. Furthermore he shall make sure that the electrical installation and equipment or device the work comprises has been checked in an adequate way regarding safety for personnel and property before it is put into operation.

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CAUTION!

Unauthorized Personnel.
Operation by unauthorized personnel may endanger personnel and property.

Storage

To avoid damage to the equipment during storage the following requirements should be met:

Storage class A
Type of equipment:

- control panels
- electronic equipment
- electric control equipment (contactors, instruments...)
- machines with built-in control equipment

to be stored indoors, warm and dry.

Temperatures: +10°C - +40°C

Humidity: 20% - 85%

CAUTION!

Non compliance.
Non compliance with these requirements may damage the equipment.

Unloading and transportation

Unloading and transportation of SCS 92 crates are most conveniently made by use of a fork lift. Please observe the signs “center of gravity”.

Moving crates

Unpacking and inspection

Opening and unpacking of crate shall be done in the presence of a Tetra Pak or customer representative. It is advisable not to unpack the equipment until it is time for installation.

Check unpacked equipment against the packing list attached to the crate and report any damage to Tetra Pak immediately.

Packing list

Connections

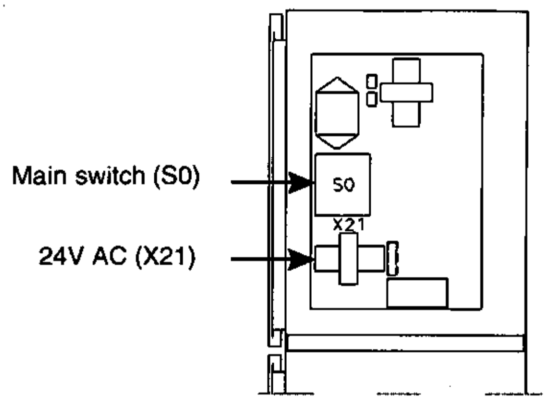
Electricity

Screened signal cables must be used for input signals. These cables must be kept well away from the power cables (min. 300 mm = 1 foot). Avoid parallel power and signal cables.

Reference is made to appropriate “Timer Diagram” and “Interconnection Diagram” for the separation system.

Before power is switched on by the main switch (S0):

- Check power supply, 24 VAC +10/-15%
- Check that ground and common for connected components are wired.

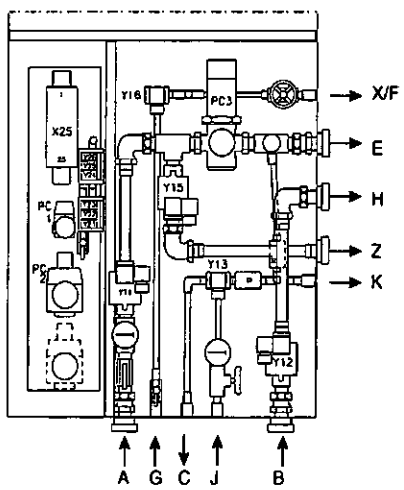


Upper cabinet

Piping

For piping see installation drawings.

A Operating water supply Pipe 1”
C Drain R1/4”
B Flushing water supply Pipe 1”
F Oil cooler R1/4”
H Sludge cover flushing Pipe 1”
K Seal lubrication R1/4”
G Cooling water supply R1/4”
J Return from oil cooler R1/4”
X Frame water R1/4”
E Make-up water Pipe 1”
Z Discharge water Pipe 1”



Lower cabinet

Positioning and erection

The control unit should be installed close to the separator in a vertical position free from heavy vibrations. It is important for the operator to be able to see the separator from operator position.

Before positioning the control unit make sure that the wall or holding equipment are of adequate quality.

Do as follows:

1) Prepare the wall or holding equipment (drill holes etc.).
2) Position the cabinet and fix it with 4 bolts.
3) Make all necessary connections.

Check after installation

Check after installation is to be done in conjunction with commissioning.

Commissioning

The SCS 92 control system is to be commissioned before it is put in commercial operation.
Adhere strictly to the steps below. See also previous page concerning "Check after installation".

Requirements on commissioning personnel:

- skilled process engineer with adequate experience of commissioning of industrial liquid processes
- knowledge of process controllers
- proven skill in reading flow charts
- knowledge in local safety regulations

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CAUTION!

Unauthorized Personnel.
Operation by unauthorized personnel may endanger personnel and property.

Note! Before commencing commissioning the engineer is requested to read through the complete instruction manual thoroughly.

Do as follows:

External utilities:

Check that all connections are in accordance with the requirements set out in the Technical data and related documents. Flush through new piping to ensure that dirt will not enter and block valves etc.

Pressurize:

Ensure that no leakage exists.

- Set air reducing valve PC1 and PC2.
- Set water reducing valve PC3.

Test of wiring:

Check that there are no short circuits in the external connections and also check the wiring for the input signals.

A functional test can be performed by running a built-in test program.

Test of emergency stop button:

Check the function of the emergency stop button.

- Power supply to separator will be cut off when emergency stop button is pressed.
- The separator can be restarted when emergency stop button is reset (released).

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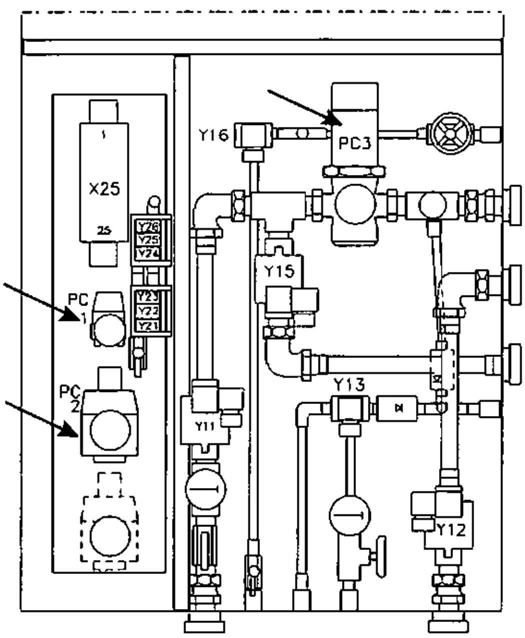

Air reducing valves PC1 and PC2
Water reducing valve PC3

Built-in test programs

The built-in test programs can be used only when the separation system is out of operation.

To run the test programs, proceed as follows:

1) Close manual shut off valves for air and water
2) Switch off control unit power by using the main switch (S0) inside the cabinet.
3) Simultaneously press the two lowest push-buttons on the control module. Switch on power while holding the two buttons pressed.

   Hold the buttons pressed for a few seconds until the test program is started - indicated by a sequential test of LEDs (Light Emitting Diodes) and indicating segments, see illustrations below.
4) To operate the test programs use the three upper push-buttons;

a) Step **between test programs**: Press upper push-button
b) Step **within test program**: Press second upper push-button
c) Switching digital outputs ON/OFF: Press second lower push-button.

Note! Only 6 of the 9 possible test programs are utilized. Progr. 7 - 9 are not applicable and are just to be stepped through.

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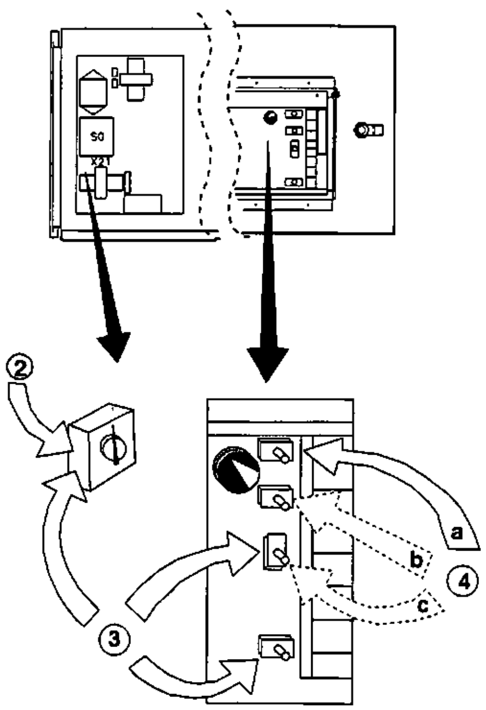


Start and operation of test procedure

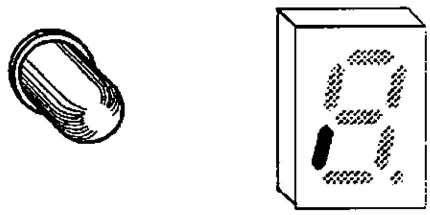
WARNING!

Accidental activation.
Output test signals will activate connected objects.
Disconnect power cables.
Depressurize pipes.

Display test

To visually show that the display works properly

Test	Note
0.1	Light one segment at a time on all displays
0.2	Light all segments in one display at a time
Interval time = 5 seconds	



One of eight segments

Display test

Memory test

To ensure that no faults exist in the control unit memory

Test	Memory	Note
1.1	Prom	checksum test
1.2	Internal RAM	test if writeable
1.3	External RAM	test if writeable
1.4	EEPROM	checksum test
Display indication: 0 = correct, E = faulty		

Current correct

Circuit faulty

Digital input test

Activate/deactivate input switches and observe 1 - 0 changes.

Test	Control Module	SCS 92 component or terminal	Designation
2.1	X7.4	A11:4-1	Too high current
2.2	X7.3	24V	Not used
2.3	X7.2	X24:6-4	D contactor response
2.4	X7.1	X24:7-4	Motor failure
2.5	X8.4	S3.X24:8-4	Emergency stop button
2.6	X8.3	K50, SH1 X24:16-15 (S2)	Discharge initiation
2.7	X8.2	S1, X24:17-15 (S2)	Start/Stop
2.8	X8.1	SH2, X24:18-15 (S2)	Alarm acknowledge
3.1	X9.4	X24:21-15 (S2)	See timer diagram
3.2	X9.3	X24:22-15 (S2)	See timer diagram
3.3	X9.2	X24:23-15 (S2)	See timer diagram
Display indication:1 = input ON (Circuit closed) 0 = input OFF (Circuit open)			

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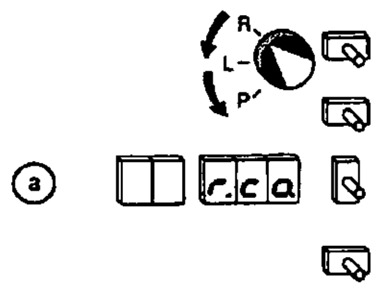
Circuit open

Circuit closed

Selector switch test

To ensure proper function of selector switch.

Test	Note
a	Display indicates (r. co.) if switch is in position for Remote control (R)
b	Display indicates (Loc) if switch is in position for Local control (L)
c	Display indicates (Pro) if switch is in position for Program mode (P)



Remote position

Local position

Program position

WARNING! **Pressurized equipment.**
This unit works under pressure.
Depressurize before running digital output tests 5.3, and 5.7 to avoid jets. Watch out for leakage.

WARNING! **Accidental start.**
Output test signals will start motors.
Disconnect power cables at starter cabinet or motor before running digital output test 5.5, 6.4.

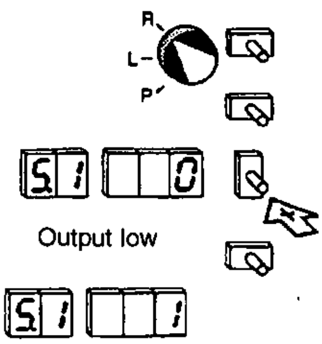
Digital output test

To ensure activation/deactivation of output signal is working properly

- To activate/deactivate push second lower push-button.
  Observe valves and contactors

Test of digital output signals must be done only when the separator is in stand-still position.

Test	Control Module	SCS 92 component or terminal	Designation
5.1	X4.4	X25:12-11	Pneumatic brake
5.2	X5.1	Y16 (X25:9-10)	Oil an sealing cooling
5.3	X5.2	Y23, Y13 (X25:14-11) (X25:5-6)	CIP valve
5.4	X5.3	Y11 (X25:1-2)	Make-up water
5.5	X5.4	Y24, Y22 (X25:15-11) (X25:13-11) (X24:12-13)	Start/Stop flow
5.6	X6.1	Y12 (X25:3-4)	Cover flush
5.7	X6.2	Y15 (X25:7-8)	Discharge
5.8	X6.3	SH1	Discharge lamp
6.1	X6.4		Not used
6.2	X4.2		Not used
6.3	X4.3		Not used
6.4	X1.1	X24:109 (S3)	Start/Stop
6.5	X1.3	X24:11-9	Delta signal
6.6	X2.1	K100, K101	Alarm
6.7	X2.3-4	K50	Discharge interval timer, prod. 3
Display indication:1 = activated output 0 = deactivated output			



Output low

Output high

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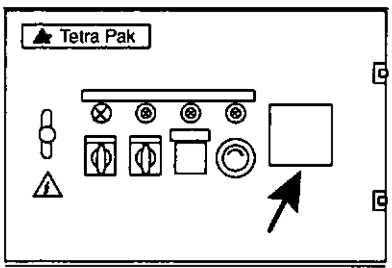
WARNING!

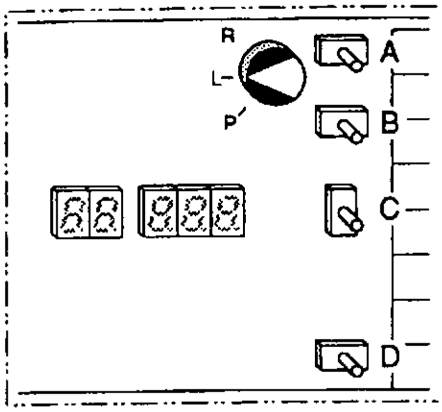
Start of motors.
Never use a digital output test signal for initializing start of motors.

Initial start-up

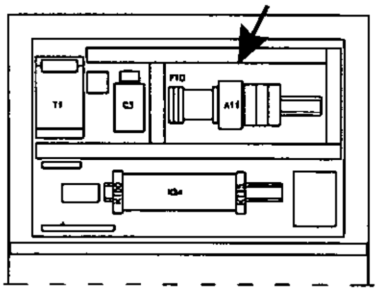
- Perform a lamp test by pressing the alarm reset push-button (D) on the control module inside the cabinet (more than 5 seconds) to ensure all diodes and display segments are working.
- Set P90 to "1" as a guidance during the first start and stop. See "Parameters".
- Check start and stop timers. Set with margin (T51-53, T81-82). Second lower push-button (C) on the control module can be used to shorten but not to prolong a set time. See "Timer reset" at the bottom of the page.
- Make adjustment of timers T61-67 if needed. Refer to the requirements of the actual separator. See "Parameters".
- Record during the first run the maximum reading of the ampere meter during discharges.
- After first start and stop set the timers to final settings and record set values for all parameters in this manual. See "Parameters".
- During the second start sequence it is possible to adjust the current relay to a value slightly above the value at normal maximum discharge size. Use values from first run. Current relay (A11) is placed inside the upper cabinet.
- Perform an emergency stop. See "Emergency stop".
- Set P90 to "4" before handing over to the operator. See "Parameters".



Panel - mounted ampere meter



Control module inside the upper cabinet door



Current relay inside the upper cabinet

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Timer reset

If restart is done when the separator is at almost full speed and a full start sequence is not necessary (e.g. after a short power failure) it is possible to cancel one or several of the timers in the start sequence (T51-T55).

Open the upper cabinet door and push the second lower push-button (C) once for each timer to be cancelled.

Note! Setpoint is still valid for next start of the timer.

CAUTION!

Cancellation of timer.
Cancellation of timers during START and STOP mode may cause malfunction.

Operation

Introduction

The SCS 92 can be controlled from the operators panel or via remote signals.

Requirements on operating personnel:

Basic knowledge of process and process controller.

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CAUTION! **Unauthorized Personnel.**
Operation by unauthorized personnel may endanger personnel and property.

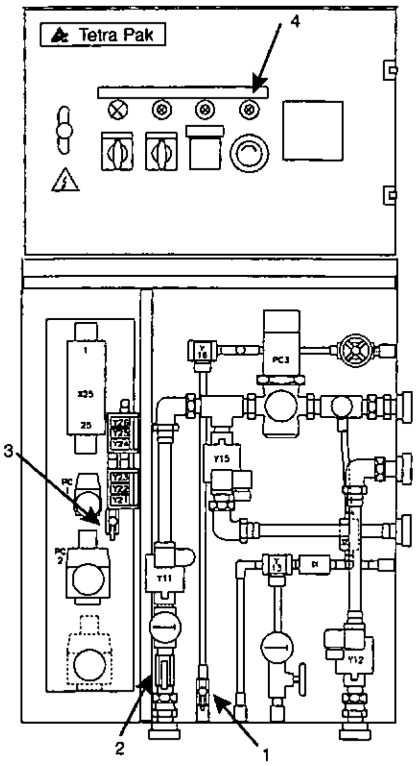
CAUTION! **Electrical hazard.**
While power supply is switched on:
Open the upper cabinet door only to investigate/reset alarm.

Preparation before start

To ensure a safe and easy operation, do as follows:

Check that required utilities are available

1) cooling water supply, manual shut off valve
2) water (pressure), manual shut off valve
3) air (pressure), manual shut off valve
4) electricity, power to control unit



Control panel and the interior of lower cabinet

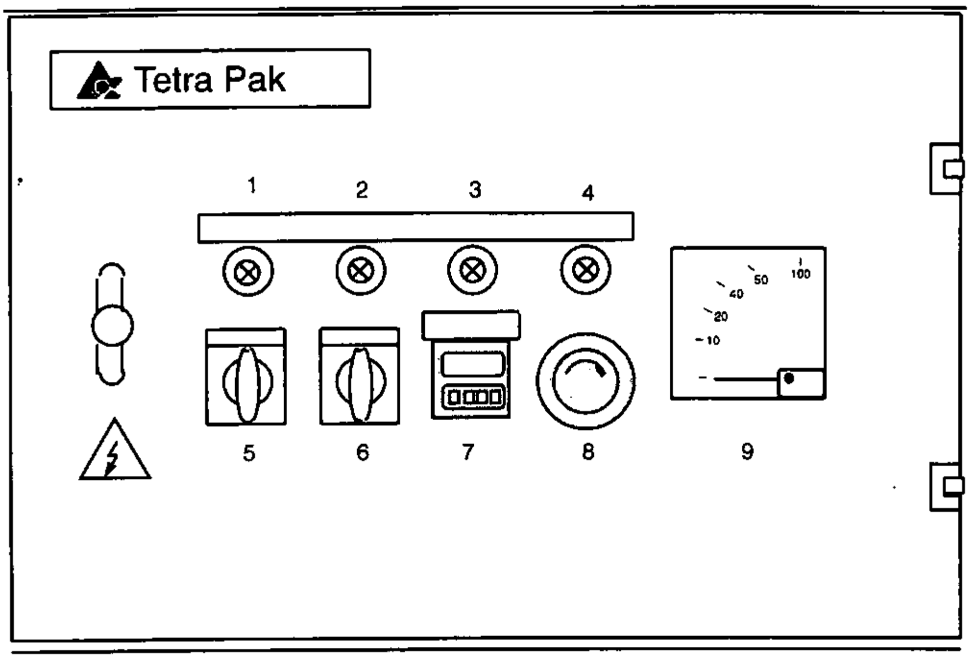
CAUTION!

Condensate.
Condensate may damage the equipment. Keep power switch ON to avoid condensate inside the cabinet.

Start/Run/Stop

Control panel design

The control panel contains switches and lamp/push-buttons for control and alarm acknowledge and an ampere-meter for indication of the motor current.



Motor power indication lamp (1)

No light – Separator at STAND STILL or STOP mode.
Steady light – Separator at START or RUN mode.

Discharge indication lamp/push-button (2)

Steady light – DISCHARGE.
Push to initiate a DISCHARGE.

Alarm indication lamp (3)

Steady light – ALARM.

Alarm acknowledge push-button (3)

Push once to acknowledge ALARM.
See "Alarm function" for reset of alarm

Control voltage indication lamp (4)

No light – Power to control unit OFF.
Steady light – Power to control unit ON.

Separator start/stop switch (5) *

Position 0 – Separator at STAND STILL or STOP mode.
Position 1 – Separator at START or RUN mode.
* when not remote controlled

Function selector switch (6)

Selector for RUN modes.
See "Function"

Timer (7)

Discharge interval timer for PRODUCTION 3 (P3).

Emergency stop button (8)

Push for direct stop of separator. The program omits the STOP-sequence. At emergency stop the product feed valve will remain open. See "Alarm function".

Ampere-meter (9)

Indicates separator motor current.

Start

CAUTION! **Before start.**
Make sure that the machine is in operable condition.

1) Select an operating mode with the switch FUNCTION.
2) Start separator by turning the switch SEPARATOR to position 1 (if not FUNCTION switch in remote control position).

- The lamp MOTOR POWER is lit.
- The ampere-meter rises to a high value.

Note! If REMOTE is chosen the start signal is received from an external source.

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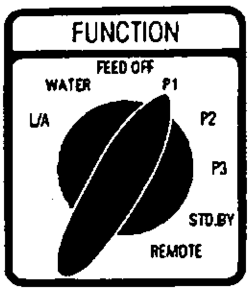
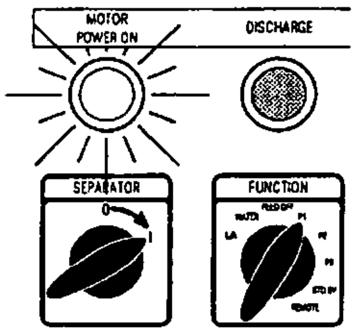
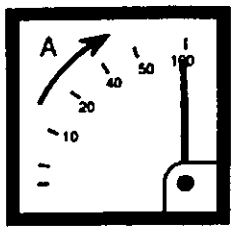




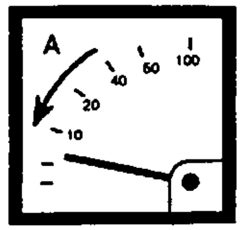
Switch FUNCTION

CAUTION! **Vibrations.**
In case of heavy vibrations stop the separator by using the emergency stop push-button.

- When full speed is attained the amperage has fallen to a lower steady value.
- The program changes to selected program function.



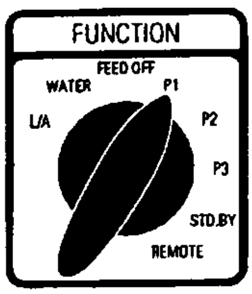
Starting



Separator attained full speed

Run

1) The operating mode can be altered during operation by use of the switch FUNCTION.

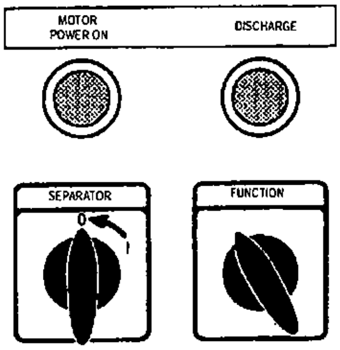


Switch FUNCTION

Stop

1) Stop the separator by turning the switch SEPARATOR to position 0 (if the FUNCTION switch is not in remote control position).
1) The lamp MOTOR POWER will go out.

- The switch FUNCTION remains in its position.
- The control program will enter the STOP sequence and power to the separator will be switched off.



Stopping

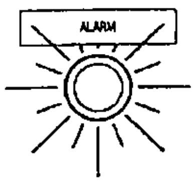
CAUTION!

Moving parts.
Aways check on the tachometer knob on the separator that the machine has come to a complete standstill before starting to disassemble the separator.

Alarm function

Alarm indication

When a fault occurs, the signal lamp “ALARM” will light up.
Faults are displayed, on the control module inside the cabinet, in the following way (from left to right):



Alarm indication

H3 A5

Faults from external sensors

- Timer running when the fault appeared (in picture – 63).
- Control module terminal number of the fault signal (in picture – 7.4).

Faults detected by software

- Alarm group (in picture – A1).
- Complementary information (in picture – 5).

Too high current during production 3

Selector switch error

CAUTION!

Fault indication.
Always investigate the cause of a fault indication. Otherwise you may endanger the equipment.

Alarm acknowledge and reset

1) Press the alarm lamp/push-button once, in order to acknowledge the alarm.
   - The alarm lamp/push-button will go out.
   - Any possible external warning indication devices will also stop.
2) Open the upper cabinet door.
   - The display is flashing revealing the appropriate alarm code.
   - The two red ALARM-LEDs are flashing.
3) Record the displayed alarm code.

4) Press the lowest push-button to reset the alarm function.
   - Three reactions are possible:

a) The flashing light changes to normal display and the two LEDs goes out.
   - The alarm cause has disappeared and no other alarm is triggered.

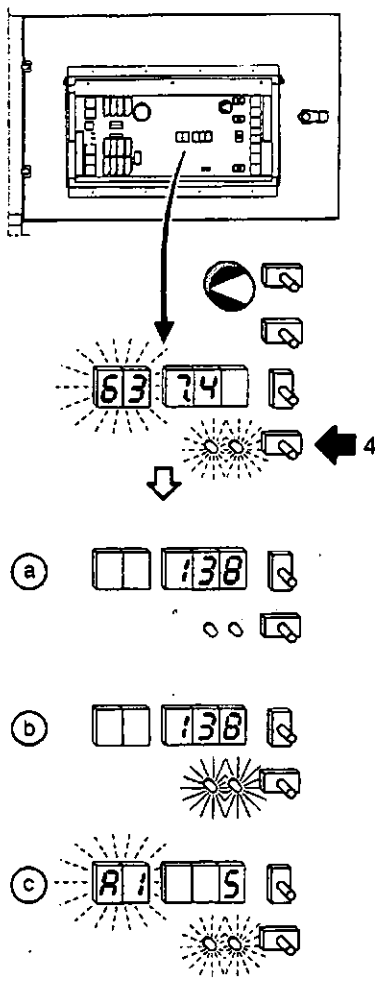
b) The flashing code disappears but the two LEDs changes to steady.
   - The alarm cause(-s) is remaining, and no other alarms exist.

c) The flashing alarm code changes to another flashing alarm code.
   - The first alarm is reset and another alarm indication has started. Repeat from step 3.

Note! Remaining alarms may be inspected again by pressing the lowest push-button. After the display of all remaining alarms the F-value will show. See "Parameters".

5) Remedy the fault(-s).

6) Close the upper cabinet door when all alarms have been reset.
   - All alarms are reset when the display is at normal display and the two LED's have gone out.



Alarm condtion

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FAULT LIST			
Display	**Alarm function**	**Action**	**Reset**
74	Too high current. Activate when the preset value at the current relay is exceeded.	Program steps to FEED-OFF (T61).	Normal reset. When current has decreased below alarm limit program will return to selected function.
72	Delta-contactor response.	Program steps to stop (T81).	Normal reset.
71	Motor failure. Occurs when the thermal relay or the thermistor (if applicable) of the separator motor is released.	Program steps to stop (T81).	Normal reset when motor temperature recovered.
84	Emergency button. When emergency button is pressed.	Program steps to stop (T81). Product feed valve will remain open.	Normal reset when emergency button is released.
83	Too frequent discharges. Too many discharges within a period of time.	Alarm signal only.	Normal reset.
A1 1	Internal RAM error.	Alarm signal only.	Switch control unit OFF and ON to reset. Restart.
A1 2	External RAM error.		
A1 3	E2 RAM error.		
A1 4	PROM error.		
A1 5	Selector switch error.	Alarm signal only.	Normal reset.
A2	In programming mode too long.	Alarm signal only.	Reset enabled when selector switch shifted.
A3	Power failure.	Alarm signal only.	Normal reset.
A4	Not used.		

FAULT LIST			
Display	**Alarm function**	**Action**	**Reset**
A5 0	Rotation - No pulses received (within time set in T51).	Program steps to STOP. An alarm is activated.	Remedy fault or set P25=0 before normal reset.
	Rotation - No pulses received during T52-T81.	Alarm signal only.	Remedy fault or set P25=0 before normal reset.
	Rotation - No pulses received (during T82-T83 and Stand-still).	None	None
A5 53	Speed not attained Full speed not attained when T53 has elapsed.	Program steps to stop. An alarm is activated.	Normal reset
A5 1.40	Low speed. Speed is lower than set point for delta switch over during T55-T78 (*1).	Program steps to FEED OFF. An alarm is activated.	Wait for speed to recover before normal reset.
A5 82	Too long stop time RPM pulses continues after T82 has elapsed.	An alarm is activated. T83 does not start until rpm=0.	Resets automatically when T83 starts. Restart is possible.
A5 1.50	High speed. Speed is higher than max. speed (*2).	Program steps to stop. An alarm is activated.	Normal reset when speed is lower than max. speed.
A6	Start function blocked.	Alarm signal only.	Local restart only.
A7 - A8	Not used.		
A9 0	Vibration - shortage in con-nection.	Alarm signal only.	Normal reset when fault is corrected.
A9 1	Vibration - No connection.	Alarm signal only.	Normal reset when fault is localized.
A9 10	Vibration - pre-warning. Vibration limit low (P31) is exceeded (*3).	Alarm only.	Normal reset when vibrations have ceased.
A9 15	Vibration - Shut down. Vibration high level (P32) is exceeded (*4).	An alarm is activated. Program steps to STOP with feed valve open during T81 or until vibrations are lower than P32.	Normal reset in STANDSTILL. Restart from stop sequence not possible.
(*1) Value of P25xP26, e.g. 1500x93% = 1,395 = 1.40. (*2) 1.80 for 60 Hz machines. (*3) Value of P31 indicated. (*4) Value of P32 indicated.			

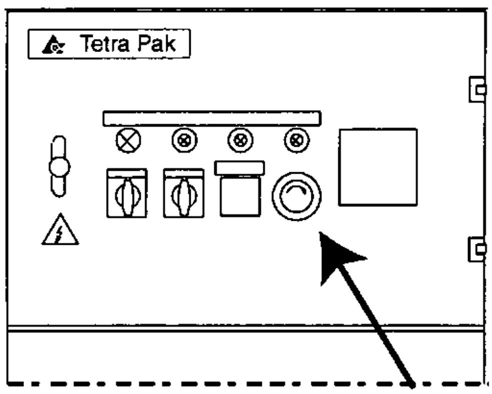
Emergency stop

In case of emergency press the red emergency stop button located on the control panel.

This will stop the separator in the following way:

- The program steps directly to stop mode (T81).
- The product feed valve will remain open.

The emergency stop button will stay activated until manually released. When released the separator control will remain in stop sequence.



Emergency stop button on control panel

CAUTION!

Emergency stopped.
The machine may contain hot liquid or cleaning solution. Handle with outmost care to avoid exposure.

Start after emergency stop

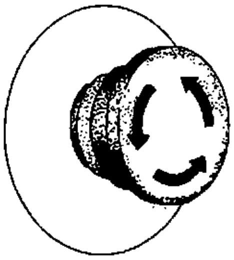
1) Make sure that the cause of the emergency stop is no longer valid.
2) Release the emergency stop button.

- If separator has stopped with sludge in the bowl it has to be cleaned manually. See instructions for separator.

CAUTION!

Vibrations.
Imbalance may occurs if start sequence is entered with sludge in the separator bowl. If necessary: disassemble and clean the bowl.

3) Make a normal start up. See “Start/Run/Stop”.



Resetting the emergency stop button

Cleaning

See instructions for separator.

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F-value readings

The alarm reset push-button in the control panel can be used to display the following information about the separator.

- separator speed in 1000 rpm with decimal point, e.g. 6.14 = 6142 rpm.
- vibration level in mm/s.

When the push-button is used for this purpose there must not be unacknowledged alarms present.

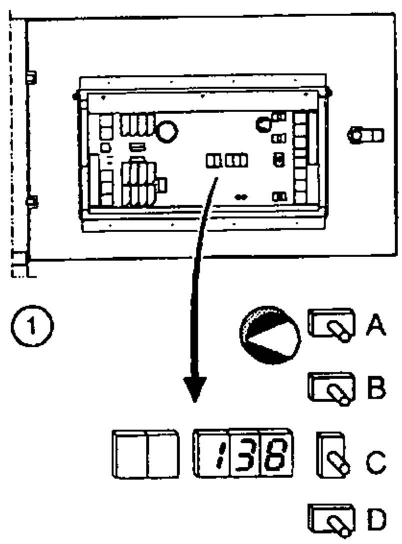
Note! If the button is not pressed for 10 minutes the display will return to normal indication.

To display information do as follows:

1) Open the upper cabinet door.

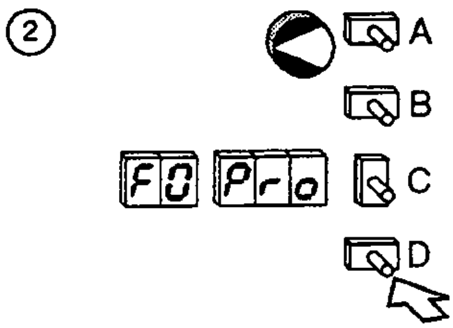
- Locate the four push-buttons and the display.

Note! Ensure that no unacknowledged alarms are present.



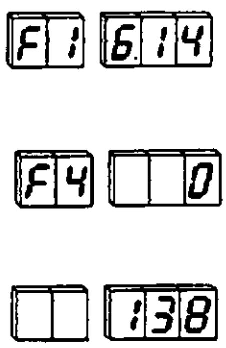
2) Press push-button 4 to set the control unit in program mode **F0 Pro**.

- Step through not reset alarms (if any) by repeatedly pressing push-button 4 until **F0-Pro** is displayed.



Program mode

3) Press push-button 4 to display F1 separator speed.
4) Press push-button 4 to display F4 Vibration level.
5) Press push-button 4 to return to normal indication.



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Minor adjustments

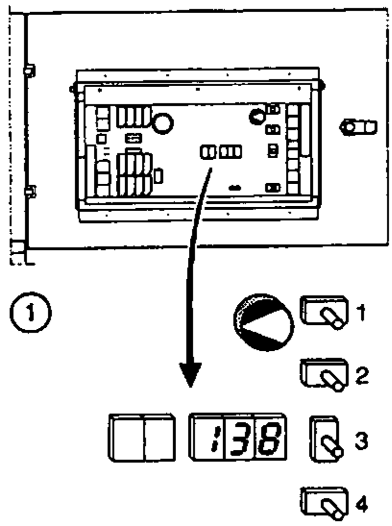
Change of discharge interval

To change discharge interval setting for production 1 and 2 do as follows:

1) Open the upper cabinet door.

- Locate the four push-buttons and the display.

Note! Ensure that no unacknowledged alarms are present.



Push-button and display

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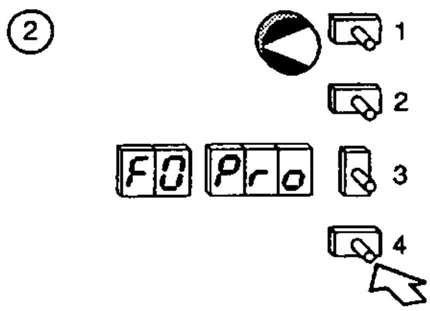
CAUTION!

Change of values.
A change of value will change the machine's way of working.

2) Press push-button 4 to set the control unit in program mode **F0 Pro**.

- Step through not reset alarms (if any) by repeatedly pressing push-button 4 until **F0 Pro** is displayed.

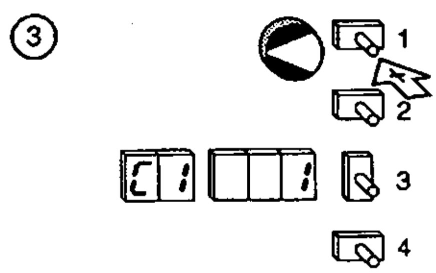


Program mode

3) Press push-button 1 to step to concerned parameter for production 1 and 2.

- Each pressing will display the following in turn:

C1	**1**	(Open parameters)
1	**30**	Parameter 1 (interval timer for production 1 set to 30 min.)
2	**45**	Parameter 2 (interval timer for production 1 set to 45 min.)
C2	**2**	(Plant parameters)
F0	**Pro**	Program mode



Stepping in program

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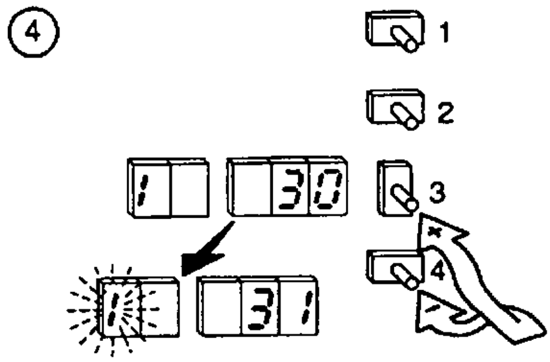
4) Press push-button 3 or 4 to set new discharge interval time (press button 3 to increase and button 4 to decrease in steps by one).

- The parameter number starts to flash.
- Press both push-buttons simultaneously to restore previous value.

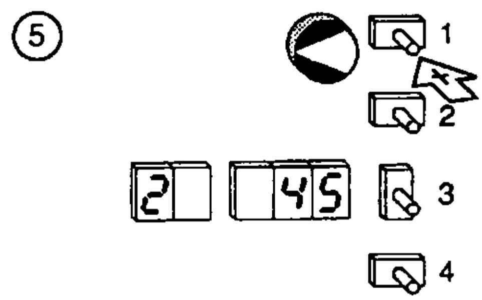


Setting of timer value

5) Press push-button 1 to:

- store new value and
- step to next parameter

If needed repeat step 4 above.

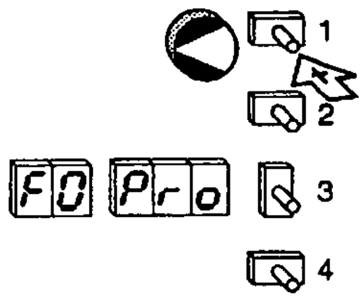


Storing of timer value when stepping

6) Press push-button 1 until **F0 Pro** is displayed.

- Program mode is ended.

6

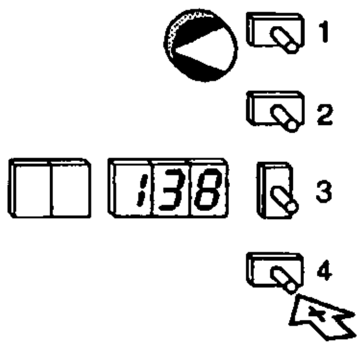


Ending of program mode

7) Press push-button 4 to:

- leave program mode
- resume normal indication on display

7



Leaving program mode

For further information regarding parameters see “Parameters”.

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Maintenance

Introduction

A disciplined maintenance programme is essential to minimise breakdowns and maximise equipment life.

Requirements on personnel:

Skilled mechanic with at least 2 years experience of industrial maintenance. Proven skill in reading engineering drawings.

During repair and maintenance he shall take all necessary precautions to guarantee the safety of personnel and to avoid machine risks (e.g. switch off power, post signs, fence off a safety area).

If you need assistance or have questions - please contact Tetra Pak.

CAUTION!

Unauthorized Personnel.
Operation by unauthorized personnel may endanger personnel and property.

DANGER!

Electrical hazard.
An electric shock can cause bodily injury or death.
Treat all electrical equipment as powered.
Switch off power before maintenance and repair.
Avoid contact.

Preventive maintenance

Preventive maintenance primarily consists of visual inspection of the equipment followed by necessary adjustments.

- silicon greasing of packing in cabinet doors once a month
- test function of emergency stop once a week

Corrective maintenance

In case of repair work in the lower cabinet:

1) Switch off power inside the upper cabinet
2) Shut off the water and air supply
3) Replace necessary parts

If a persistent fault is found in the control module it must not be repaired but replaced and submitted to Tetra Pak representatives for repair.

Replacing the control module

1) Open the upper cabinet door and switch off the control voltage by the main switch (S0).

Note! Before touching the control module circuit board, discharge static electricity by touching the cabinet earth terminal.

Note! Check present position of jumpers for comli and vibration transmitters. Fig. 7.

2) Pull out the wire terminal sockets by hand and remaining wires with tools.

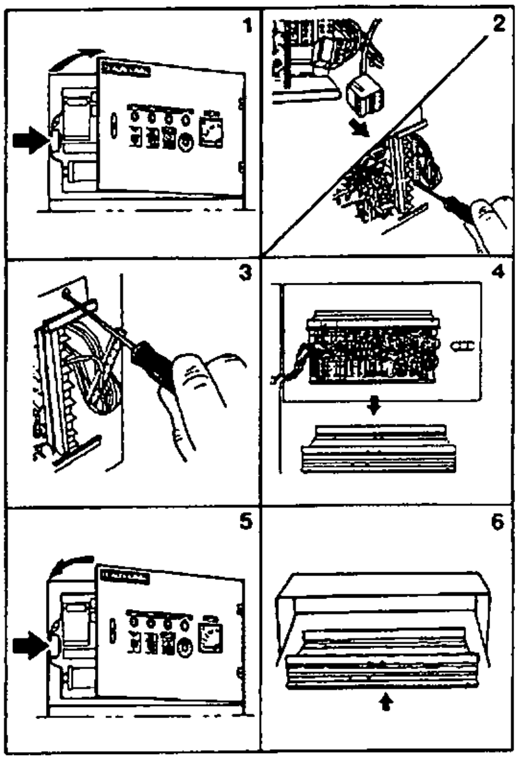
Note! Sockets are marked with terminal numbers.

3) Remove the two screws holding the module by using a screw driver and hinge the control module outwards.
4) Lift off the control module from the cabinet door and replace it with a spare module.

Note! Before touching the control module circuit board, discharge static electricity by touching the cabinet earth terminal.

5) Fit the spare module in reverse order. When replacement is completed switch on the control voltage, set parameters to appropriate values and shut the cabinet door.
6) Fill in a return note (state fault symptoms and running time) and send it together with the old module in the return package.

7) Make sure that the jumpers for comli and vibration are put in the same position on the new circuit board. If necessary check against circuit drawing. (Comli connection is not in use for Control System SCS92B).



Replacing control module

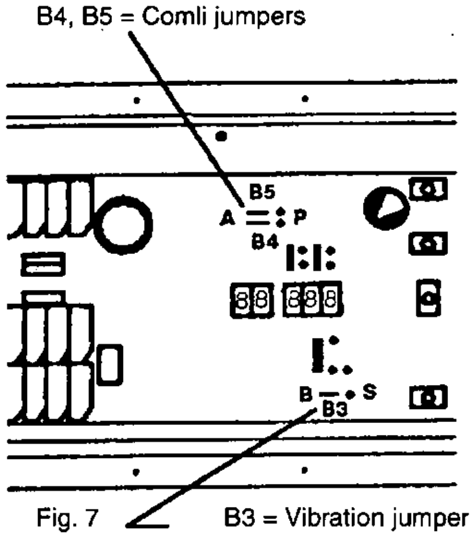


Fig. 7

Part of circuit board

Parameters

There are two types of parameters:

- open parameters (P1 and P2)
- plant parameters (P20 - P99)

Open parameters (P1-P2)

The open parameters P1 and P2 can be reached by the operator and are used for setting discharge interval for Production 1 and Production 2 respectively (See "Minor adjustments"). The values of the parameters P1 and P2 are limited by the value of parameters P64 and P65 respectively.

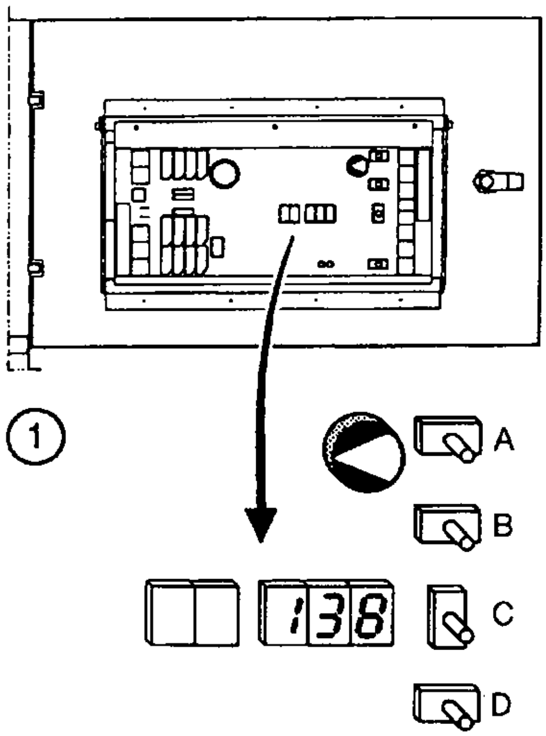
Plant parameters (P20-P83)

Plant parameters are set at factory (default) but may in some cases be adjusted at commissioning. Among plant parameters are:

- separation system specific parameters (P20-39)
- timer sequences (P51-P83)
- service parameter (P90)

1) Open the upper cabinet door and set the selector switch in position P.

- **Pro** is intermittently displayed.



CAUTION!

Change of values.
A change of value will change the machine's way of working.

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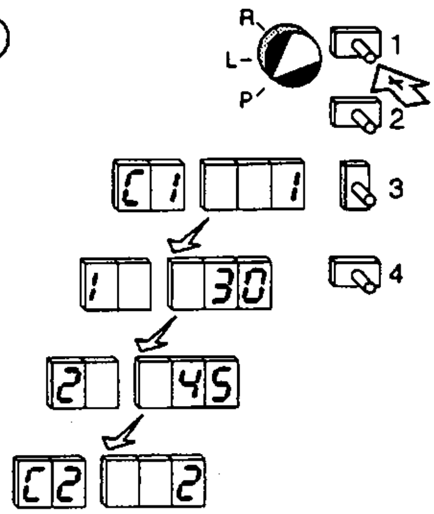
2) Press push-button 1 four times

- to display **C2 2**
  - Each pressing will displayed the following in turn:

C1	**1**	Open parameters
1	**30**	Open parameter 1 can be adjusted
2	**45**	Open parameter 2 can be adjusted
C2	**2**	Plant parameters "entry"

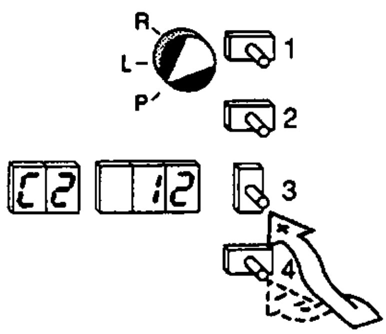
2



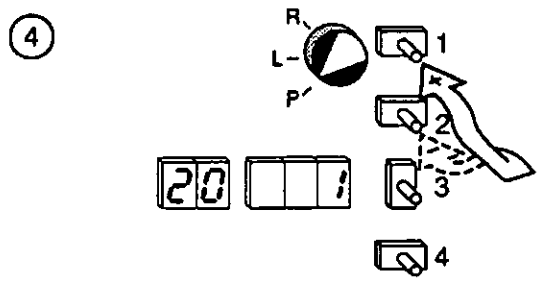
3) Press push-button 3

- to set the parameter code C2 to 12 for access to the plant parameters.
  - Push-button 3 will increase value.
  - Push-button 4 will decrease value.

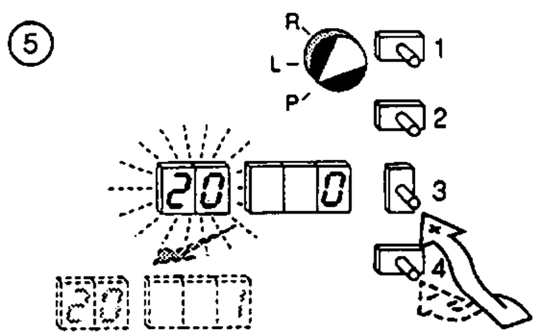
3



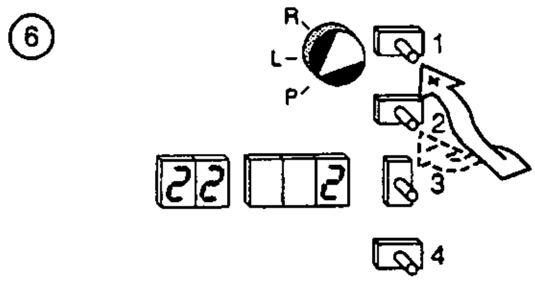
4) Press push-button 1 or 2
- to select parameter to adjust.
  - Parameter is displayed to the left.
  - Value is displayed to the right.



5) Press push-button 3 or 4
- to adjust the parameter value.
  - When one of the two push-buttons is pressed the parameter number starts to flash.
  - Press both push-buttons simultaneously to restore previous value.

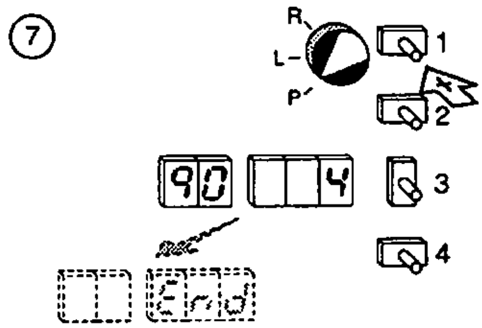


6) Press push-button 1 or 2
- to store the value and step to next or previous parameter.
  - Push-button 1 will step to next parameter.
  - Push-button 2 will step to previous parameter.



7) Repeat step

- 5 and 6 above to make all necessary parameter adjustments.
  - After **P99 End** will appear in the display.



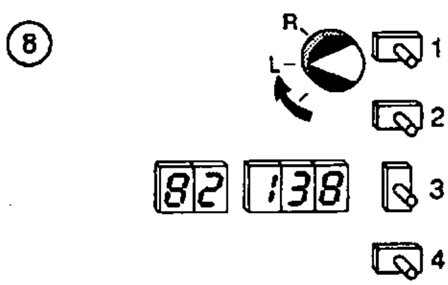
8) Set the mode selector switch in position L or R, whichever applicable, when the parameter value(s) is/are set.

   L = Local control (No serial communication)

   R= Remote control (Serial communication)

Note! Switching of the mode selector can be done at any parameter display.

For information concerning various parameters, see "Parameter list".



Parameter list

OPEN PARAMETERS					
Parameter		Designation/Unit	Range	Default	Plan set value
P1	Discharge interval time for production 1.	Minutes	see P64	30	
P2	Discharge interval timer for production 2.	Minutes	see P65	45	

PLANT PARAMETERS					
P20	Control mode.	0 = local control. 1 = external control.	0-1	1	
P21	Not used.				
P22	Alarm delay. Delta-contactor response.	0 = not defined. 1 = direct start. 2 = Y-D start, friction coupling. 3 = Y-D start, CT-motor.	0-3	2 = P51 = P51 = sum P51-53	
P23-24	Not used.				
P25	Max. motor speed provided P43=1	0 = Speed monitoring off 150 = 1500 rpm 180 = 1800 rpm	0		
P26	Delta switch over speed (if P43=1). Also used as low speed limit	% of P25		93	
P27	Not used				
P28	Not used				
P29	Not applicable				
P30	Vibration max. indication	mm/s (if applicable)		20	
P31	Vibration pre-warning limit	mm/s (if applicable)		10	
P32	Vibration shut-down limit	mm/s (if applicable)		15	
P33-49	Not used				

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PLANT PARAMETERS					
P90	Service mode.	0 = not used (display indicates "F0 0". 1 = show running timer no. and time left. 2 = not used. 3 = prom version. 4 = enable enter of prog mode ("F0 Pro"). 5 = no. of discharges today. 6 = no. of discharge indication faults today. 7 = no. of vibration alarms today. 8 = run time today "h.m" (eg. 2.4 = 2h 40min.).			
P91	No. of discharges.	1000's			
P92	No. of discharges.	total no. = P91x1000+P92.			
P93	Total no. of failed discharges.				
P94	Total no. of vibration alarms (pre-warnings).				
P95	Total run time.	1000 hours.			
P96	Total run time.	hours total hours = P95x1000+P96.			
P97-99	Not used.				

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Timer list

TIMERS				
Timer		**Comment**	**Plant set value**	
P50	Not used			
P51	Start timer (see P22)	seconds	______	Total start time
P52	Start timer	seconds	______	} ______
P53	Start timer	seconds	______	
P54	Start timer	seconds	______	
P55	Start timer	seconds	______	
P56-59	Not used			
P60		default mode when no signal		
P61	Feed off	minutes before alarm	______	
P62	Stand-by	minutes, discharge interval	______	
P63	Not possible to set	time present in production 3		
P64	Prod. 1	minutes, discharge interval	______	
P65	Prod. 2	minutes, discharge interval	______	
P66	CIP water	minutes, discharge interval	______	
P67	CIP lye/acid	minutes, discharge interval	______	
P68-70	Not used			
P71	Discharge sequence	seconds	______	
P72	Discharge sequence	seconds	______	
P73	Discharge sequence	seconds	______	
P74	Discharge sequence	seconds	______	
P75	Discharge sequence	seconds	______	
P76	Discharge sequence	seconds	______	
P77	Discharge sequence	seconds	______	
P78	Discharge sequence	set by program, seconds		
P79-80	Not used			
P81	Stop timer	seconds	______	Total stop time
P82	Stop timer	seconds	______	} ______
P83	Stop timer	seconds	______	
P84-89	Not used			

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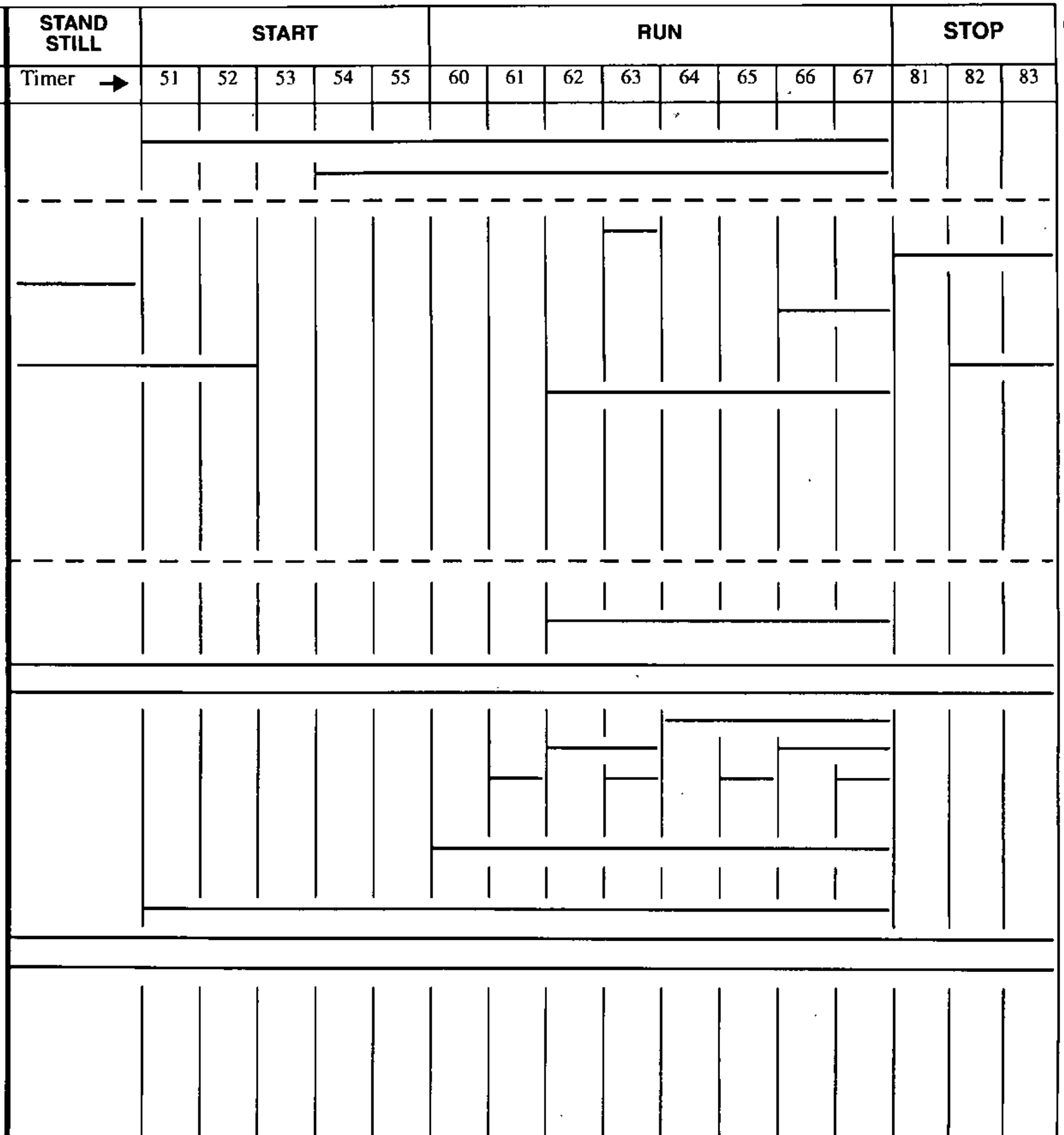
FUNCTIONS	TERMINALS Module	TERMINALS Panel
OUTPUTS		
Start/Stop separator	X1:1	S3-X24:10-9
Delta signal	X1:3	X24:11-9
Alarm	X2:1	K100, K101
Discharge interval timer prod. 3	X2:3-4	K50
Pneumatic brake	X4:4	X25:12-11
Oil and seal cooling, Y16	X5:1	X25:9
CIP-valve, Y23, Y13	X5:2	X25: 14-11
		X25: 5-6
Make-up water, Y11	X5:3	X25: 1-2
Start / Stop flow, Y24	X5:4	X25: 15-11
		X24: 13-11
		X24: 12-13
Sediment cover flush, Y12	X6:1	X25: 3-4
Discharge signal, Y15	X6:2	X25: 7-8
Discharge indication lamp	X6:3	--
Remote control	--	X24: 19-20
COMMUNICATION INPUTS		
Discharge initiation	X8:3	K50, SH1, X24:16
Start / Stop	X8:2	S1, X24:17
Alarm acknowledge	X8:1	SH2, X24:18
	X9:4	S2, X24:21
Choice of RUN-mode	X9:3	S2, X24:22
	X9:2	S2, X24:23
BINARY ALARM INPUTS (Alarm condition)		
Too high current (0)	X7:4	A11: 4-1
Not used	X7:3	--
D-contactor response (0)	X7:2	X24: 6-4
Motor failure (1)	X7:1	X24: 7-4
Emergency button (0)	X8:4	X24: 8-4
ANALOGUE MONITORING INPUTS		
Not used	X10:1-3	--
Not used	X11: 1-3	--
Speed, Namur	X12: 3-4	X24:25-24
Vibration, Schenk (option)	X12: 1-2	--



Title SCS92B

Type of document Timer diagram

Date

FUNCTIONS	TERMINALS		RUN	DISCHARGE SEQUENCE								RUN	COMMENTS
	Module	Panel	Timer →	71	72	73	74	75	76	77	78		
OUTPUTS **MRPX610**													
Start/Stop separator	X1:1	S3-X24: 10-9											
Delta signal	X1:3	X24: 11-9											
Alarm	X2:1	K100, K101											Apply in production 3 only
Discharge interval timer prod. 3	X2:3-4	K50											
Pneumatic brake	X4:4	X25: 12-11											
Oil and seal cooling, Y16	X5:1	X25:9											
CIP-valve, Y23, Y13	X5:2	X25: 14-11											Apply in CIP only
		X25:5-6											
Make-up water, Y11	X5:3	X25: 1-2											
Start / Stop flow, Y24, Y22	X5:4	X25: 15-11											
		X25: 13-11											
		X24: 12-13											
Sediment cover flush, Y12	X6:1	X25: 3-4											
Discharge signal, Y15	X6:2	X25: 7-8											
Discharge indication lamp	X6:3	--											
Remote control	--	X24: 19-20											

Title SCS92B

Type of document Timer diagram

Date

Electricity

Electrical installations place special demands on layout, safety and the personnel handling them.

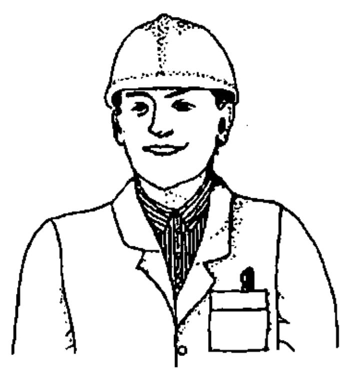
This chapter is valid for both power, control and automation. Please see separate file for detailed information about:

- list of components
- layout/design
- circuit diagrams
- cable connections

Requirements on installation personnel:

Electrician:

Certified according to local regulations with at least 3 years experience of similar type of installation. Proven skills in reading and working from drawings and cable lists. Knowledge of local safety regulations for power and automation. Furthermore he shall make sure that the part of the electrical installation or device the work comprises has been checked in an adequate way regarding safety for person and property before it is put into operation.



CAUTION!

Unauthorized Personnel.
Operation by unauthorized personnel may endanger personnel and property.

DANGER!

Electrical hazard.
An electric shock can cause bodily injury or death.
Treat all electrical equipment as powered.
Switch off power before maintenance and repair.
Avoid contact.

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Spare parts/components

All machinery is subject to wear and tear. To help you cope with this Tetra Pak is prepared to quote tailor made spare parts kits for your equipment. To minimize process stops it is advisable to always have these kits available in your plant.

For inquires and orders please contact your nearest Tetra Pak representative.

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Tetra Pak

Tetra Pak Processing Components AB, Box 103, S-221-00 Lund, Sweden

0 1 2 3 4 5 6 7 8 9

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SCS92B

IDENTIFICATION OF DOCUMENTS

THE LAST DIGIT IN THE DRAWING NUMBER IS USED TO IDENTIFY THE TYPE OF DOCUMENT:

-0 LIST OF CONTENTS
-1 PARTS LIST
-2 FUNCTION EXPLANATION
-3 SOFTWARE DOCUMENTATION
-4 ASSEMBLY DRAWING
-5 CIRCUIT DIAGRAM
-6 INTERCONNECTION TABLE
-7 INSTALLATION DRAWING

(E.G. 3541-xxxx-5 IS A CIRCUIT DIAGRAM)

IDENTIFICATION OF DOCUMENTS

Note			
Sign.			
Date	.		

Drawing remarks

Tetra Pak
Processing Systems

Project No.

Drawing No. 35411-410-0

Department	Designer	Date	Verified	Name of Eplan-project	No. of pages
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POS. No.	ARTICLE No.	PAGE REF.	QUANTITY	DENOMINATION	REV. No.
0V	3530210213	5/2.6	5,0	TERMINAL,WDU4	
1	252240101	5/16.2	1,0	MUFF,OUTS.1"-INS.3/4"R	
1	3180150871	5/16.2	1,0	STRAIGHT RADIATOR JOINT OF PIPES,3/4"R	
1	3180150881	5/16.2	1,0	BALL VALVE,3/4"R,BALLOFIX	
1	52633605	5/16.2	2,0	NIPPLE,3/4"R	
1	3180150911	5/16.2	1,0	T-PIPE,3/4"R	
1	3180150861	5/16.2	1,0	NIPPLE,3/4"R	
1	52637301	5/16.2	1,0	HOSE SLEEVE,3/4"R	
1	224510206	5/16.2	1,0	HOSE CLAMP,19-28MM	
1	3180150921	5/16.2	1,0	MUFF,OUTS.3/4"-INS.1/4"R	
1.	3180152102	5/16.2	1,0	SOLENOID VALVE,24VDC,5W,BÜRKERT 281B	
1.	3180151946	5/16.2	1,0	PRESSURE GAUGE,0-1MPa,1/4"R,GLYCERINE	
2	224510206	5/16.2	1,0	HOSE CLAMP,19-28MM	
2	52637301	5/16.2	1,0	HOSE SLEEVE,3/4"R	
2	3180150861	5/16.2	1,0	NIPPLE,3/4"R	
2	3180150872	5/16.2	1,0	L-RADIATOR JOINT OF PIPES,3/4"R	
2	3180150911	5/16.2	1,0	T-PIPE,3/4"R	
2	3180150921	5/16.2	1,0	MUFF,OUTS.3/4"-INS.1/4"R	
2	3180150871	5/16.2	1,0	STRAIGHT RADIATOR JOINT OF PIPES,3/4"R	
2	52633707	5/16.2	1,0	NIPPLE,1"-3/4"R	
2.	52635105	5/16.3	1,0	PLUG,3/4"R,STAINLESS STEEL	
3	52633605	5/16.3	1,0	NIPPLE,3/4"R	
3	3180152101	5/16.3	1,0	SOLENOID VALVE,24VDC,5W,BÜRKERT 281A	
3	3180150872	5/16.3	1,0	L-RADIATOR JOINT OF PIPES,3/4"R	
3	3180150861	5/16.3	1,0	NIPPLE,3/4"R	
3	52637301	5/16.3	1,0	HOSE SLEEVE,3/4"R	
3	224510206	5/16.3	1,0	HOSE CLAMP,19-28MM	

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Sign.					Project No.	31821-9860-1 SEPARATOR SCS92B					Cont. on page: 2
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POS. No.	ARTICLE No.	PAGE REF.	QUANTITY	DENOMINATION	REV. No.
4	224510206	5/16.3	1.0	HOSE CLAMP,19-28MM	
4	52637301	5/16.3	1.0	HOSE SLEEVE,3/4"R	
4	52633707	5/16.3	1.0	NIPPLE,1"-3/4"R	
5	52633707	5/16.4	1.0	NIPPLE,1"-3/4"R	
5	3180150871	5/16.4	1.0	STRAIGHT RADIATOR JOINT OF PIPES,3/4"R	
5	3180150861	5/16.4	1.0	NIPPLE,3/4"R	
5	52637301	5/16.4	1.0	HOSE SLEEVE,3/4"R	
5	224510206	5/16.4	1.0	HOSE CLAMP,19-28MM	
5	3180152101	5/16.4	1.0	SOLENOID VALVE,24VDC,5W,BÜRKERT 281A	
6	224510206	5/16.4	1.0	HOSE CLAMP,19-28MM	
6	52637301	5/16.4	1.0	HOSE SLEEVE,3/4"R	
6	3180150872	5/16.4	1.0	L-RADIATOR JOINT OF PIPES,3/4"R	
6	3180150861	5/16.4	1.0	NIPPLE,3/4"R	
6	252240101	5/16.4	1.0	MUFF,OUTS.1"-INS.3/4"R	
7	3180150831	5/16.2	1.0	BALL VALVE,1/4"R	
8	3180152111	5/16.2	1.0	SOLENOID VALVE,24VDC,5W,BÜRKERT 330F	
9	51784609	5/16.2	1.0	NEEDLE VALVE,1/4"R	
12	3180152111	5/16.3	1.0	SOLENOID VALVE,24VDC,5W,BÜRKERT 330F	
12	3180150901	5/16.3	1.0	NONRETURN VALVE,3/8"R	
12.	3180150901	5/16.4	1.0	NONRETURN VALVE,3/8"R	
13	51784609	5/16.4	1.0	NEEDLE VALVE,1/4"R	
13	3180151945	5/16.4	1.0	PRESSURE GAUGE,0-250kPa,1/4"R,GLYCERINE	
A1	3183054623	5/3.1	1.0	CONTROL MODULE FOR SCS 92	
A1	3183061092	5/3.1	1.0	PROGRAM FOR SCS92,VERSION 2.	
A1	3183058011	5/3.1	1.0	INSTRUCTION LABEL FOR SCS 92	
A1	3183052181	5/3.1	1.0	SET OF TERMINALS FOR SCS 92,PHOENIX	
A1	490106904	5/3.1	1.0	CONNECTOR BODY,4-POLE,AMP280591	

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POS. No.	ARTICLE No.	PAGE REF.	QUANTITY	DENOMINATION	REV. No.
A11	3180152132	5/5.3	1,0	CURRENT RELAY,4-20mA,24VDC,ELECTROMATIC	
C1	3180152201	5/3.3	1,0	CAPACITOR, 0,47UF,63V	
C2	3180152201	5/3.3	1,0	CAPACITOR, 0,47UF,63V	
C3	3180152121	5/3.5	1,0	CAPACITOR,22.000UF,40V	
F10	490085220	5/3.6	1,0	FUSE,2AF	
F10	3180151821	5/3.6	1,0	FUSE HOLDER,5X20MM,IND.,WSI6 24/48V	
H1	3180151741	5/7.1	1,0	LAMP LENS,GREEN,TELEMECANIQUE	
H1	3180151781	5/7.1	1,0	LAMP UNIT,BA9S,<=380V,TELEMECANIQUE	
H1	3180104051	5/7.1	1,0	BULB,BA9S,24V,2W	
I1	3180196321	5/5.2	1,0	AMPERE METER, 4-20mA DC, IME R096	
K50	3180190981	5/11.7	1,0	TIME RELAY,12-24VDC,OMRON H5CL	
K50	3180151024	5/11.7	1,0	SPLASH GUARD FOR H3CA TIME RELAY	
K100	3180195271	5/11.5	1,0	TERMINAL RELAY,SPDT,24V,LED,WEIDM. DK5R	
K101	3180159561	5/11.6	1,0	MINIATURE RELAY,2-POLE,24VDC,LED	
K105	3180159561	5/11.1	1,0	MINIATURE RELAY,2-POLE,24VDC,LED	
K110	3180159561	5/13.1	1,0	MINIATURE RELAY,2-POLE,24VDC,LED	
K115	3180195271	5/13.2	1,0	TERMINAL RELAY,SPDT,24V,LED,WEIDM. DK5R	
PC1	53940003	5/15.2	1,0	MIN.REDUCING VALVE,0-700kPa,1/8"R,NORGR.	
PC1	3180151943	5/15.2	1,0	PRESSURE GAUGE,0-1MPA,1/8"R,PLASTIC	
PC2	3180125172	5/15.4	1,0	REDUCING VALVE,0-800kPa,1/4"R,NORGREN	
PC2	3180151946	5/15.4	1,0	PRESSURE GAUGE,0-1MPa,1/4"R,GLYCERINE	
PC3	3180125151	5/16.0	1,0	REDUCING VALVE FOR WATER,3/4"R,BRAUKMAN	
PC3	3180151945	5/16.0	1,0	PRESSURE GAUGE,0-250kPa,1/4"R,GLYCERINE	
PC3	3180150911	5/16.0	1,0	T-PIPE,3/4"R	
PC3	3180150921	5/16.0	1,0	MUFF,OUTS.3/4"-INS.1/4"R	
PC3	3180150871	5/16.0	1,0	STRAIGHT RADIATOR JOINT OF PIPES,3/4"R	
PC3	52633707	5/16.0	1,0	NIPPLE,1"-3/4"R	

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POS. No.	ARTICLE No.	PAGE REF.	QUANTITY	DENOMINATION	REV. No.
S0	3180151372	5/2.2	1.0	SWITCH,K&N CA10-A201,ENCLOSED	
S1	3180152191	5/9.5	1.0	SWITCH,K&N CG8-A201	
S2	3180152192	5/9.1	1.0	SWITCH,K&N CG8-S	
S3	3180151769	5/8.4	1.0	MUSHROOM ACTUATOR,RED,TELEMECANIQUE	
S3	3180151783	5/8.4	1.0	CONTACT BLOCK WITH HOLDER,NO+NC,TELEMEC.	
S3	3180151789	5/8.4	3.0	CONTACT BLOCK,NC,TELEMECANIQUE	
S3	4868260001	5/8.4	1.0	SIGN FOR EMERGENCY STOP,YELLOW,70MM DIAMETER	
SH1	3180151751	5/11.8	1.0	LAMP PUSHBUTTON ACTUATOR,GREEN,TELEMEC.	
SH1	3180151782	5/11.8	1.0	LAMP UNIT WITH CONTACT BLOCK,NO+NC,TELEM	
SH1	3180104051	5/11.8	1.0	BULB,BA9S,24V,2W	
SH2	3180151753	5/4.1	1.0	LAMP PUSHBUTTON ACTUATOR,YELLOW,TELEMEC.	
SH2	3180151782	5/4.1	1.0	LAMP UNIT WITH CONTACT BLOCK,NO+NC,TELEM	
SH2	3180104051	5/4.1	1.0	BULB,BA9S,24V,2W	
SH3	3180151755	5/4.4	1.0	LAMP PUSHBUTTON ACTUATOR,WHITE,TELEMEC.	
SH3	3180151782	5/4.4	1.0	LAMP UNIT WITH CONTACT BLOCK,NO+NC,TELEM	
SH3	3180104051	5/4.4	1.0	BULB,BA9S,24V,2W	
SH3	3180151788	5/4.4	2.0	CONTACT BLOCK,NO,TELEMECANIQUE	
T1	3180152181	5/3.1	1.0	TRANSFORMER,130VA,SHIELDED,SCS 92	
V1	3180113581	5/3.5	1.0	RECTIFIER,25A,60V	
V2	3180114751	5/12.1	1.0	DIODE,1A,1000V	
V3	3180114751	5/12.2	1.0	DIODE,1A,1000V	
V4	3180114751	5/12.4	1.0	DIODE,1A,1000V	
V5	3180114751	5/12.5	1.0	DIODE,1A,1000V	
V6	3180114751	5/12.6	1.0	DIODE,1A,1000V	
V7	3180114751	5/12.8	1.0	DIODE,1A,1000V	
WO_1	3180151708	5/2.5	6.0	EARTH TERMINAL,WPE2.5	
WO_2	3180159611	5/2.6	2.0	METAL SUPPORT FOR CONNECTION BAR	

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W10	3180159611	5/2.5	2,0	METAL SUPPORT FOR CONNECTION BAR	
W10	3180111782	5/2.5	1,0	CONNECTION BAR,10X3MM	
X21	3180151707	5/1.0	1,0	TERMINAL ROW,2-POLE+PE,WDU2,5	
X21	353021401	5/1.0	5,0	TOUCH PROTECTION FOR TERMINAL,WAD5	
X22	3180151707	5/3.2	1,0	TERMINAL ROW,2-POLE+PE,WDU2,5	
X24	3180152612	5/5.1	1,0	TERMINAL ROW,1-35,WDU2,5	
X24	3180152612	5/5.2	1,0	TERMINAL ROW,1-35,WDU2,5	
X25	3180151701	5/12.1	1,0	TERMINAL ROW,1-25,WDU2,5	
Y21_	3180152012	5/13.3	1,0	SOLENOID VALVE,1X3,24V,2W,BÜRKERT	
Y24_	3180152012	5/13.6	1,0	SOLENOID VALVE,1X3,24V,2W,BÜRKERT	
Z1	3180116161	5/2.2	1,0	MAINS FILTER,5A	
ZPNE	3180150831	5/1.2	1,0	BALL VALVE,1/4"R	
ZPNE1	1995101048	5/1.2	2,0	AIR TUBE,6/4	
ZPNE1	1995106130	5/1.2	2,0	CABLE,612X0,5mmD	
ZWAT	1995101050	5/1.3	2,0	AIR TUBE,10/8	
ZWAT	1995101045	5/1.3	1,0	PLASTIC HOSE,26/19	
ZWAT	1995106491	5/1.3	3,0	CABLE,63X0,75mmD	
ZWAT	3182030441	5/1.3	2,0	HOLDER FOR SOLENOID VALVE,SCS,2PCS	
ZZA	3180118742	5/1.2	5,0	RUBBER GROMMET,5-7MM	
ZZA	352103111	5/1.2	8,0	CABLE INLET,9-14mm,PR22,5,PLASTIC	
ZZA	9904000003	5/1.2	1,0	SIGN,"TETRA PAK,LOGOTYPE",260X38mm	
ZZA	3182030421	5/1.2	1,0	CABINET FOR SCS92,STAINLESS STEEL	
ZZA	901940016	5/1.2	3,0	CAUTION SIGN,"VOLTAGE ARROW",50x50mm	
ZZA	3180118743	5/1.2	5,0	RUBBER GROMMET,7-10MM	
ZZA	3180118744	5/1.2	6,0	RUBBER GROMMET,10-14MM	

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Note				Drawing remarks	Tetra Pak Processing Systems	Department: CCP	Designer: UN	Date: 01.02.13	Verified: MA	Name of Eplan-project: 35411-410	No. of pages: 30
Sign.					Project No.	31821-9860-1 SEPARATOR SCS92B					Cont. on page: 6
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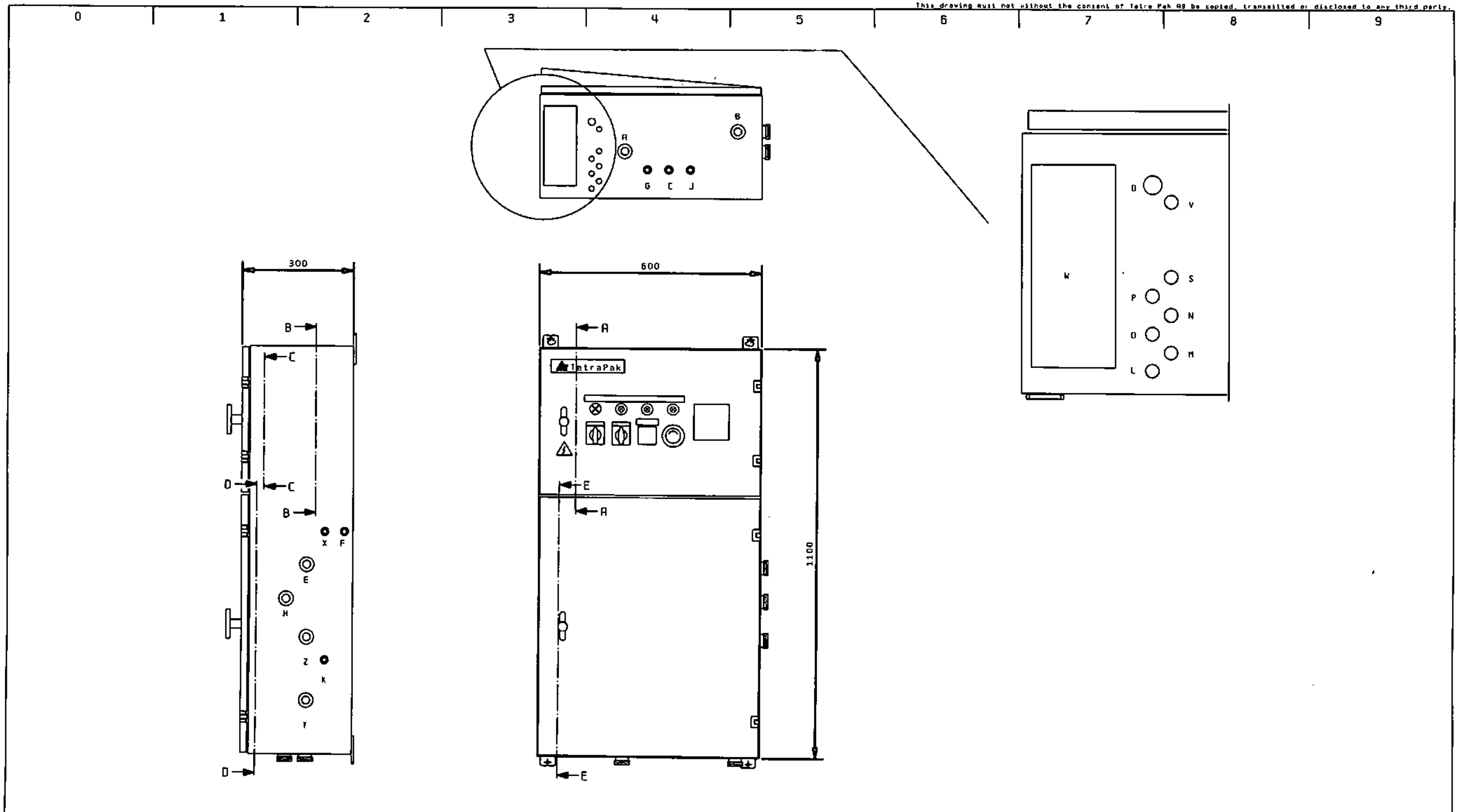
POS. No.	ARTICLE No.	PAGE REF.	QUANTITY	DENOMINATION	REV. No.
ZZE	3180151922	5/1.2	1.0	PLASTIC FLANGE,FL21,12XPR22,5,MB10014	
ZZE	3180112492	5/1.2	1.0	RUBBER GASKET,FL21	
ZZE	3180152699	5/1.2	4,0	RIVET FOR FLANGE,GASKET	

PARTS LIST

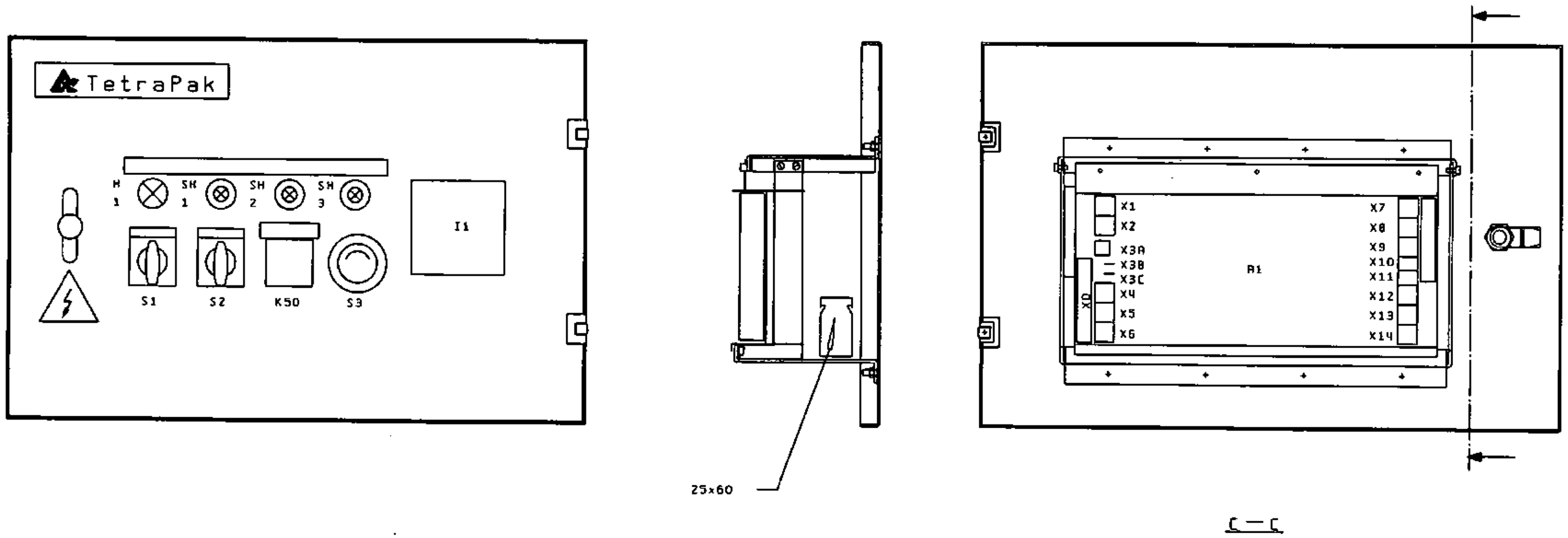
Noto					Tetra Pak Processing Systems	Department: CCP	Designer: UN	Date: 01.02.13	Verified: MA	Name of Eplan-project: 35411-410	No. of pages: 30
Sign.					Project No.	31821-9860-1 SEPARATOR SCS92B					Cont. on page: =4/1
Date				Drawing remarks	Drawing No. 35411-410-1						Page: 6



ASSEMBLY DRAWING 1

Note				Tetra Pak Processing Systems	Department: CCP	Designer: UN	Date: 01.02.13	Verified: HA	Name of Eplan-project: 35411-410	No. of pages: 30
Sign.				Project No.	31821-9860-1 SEPARATOR SCS92B					Cont. on page: 2
Date				Drawing No. 35411-410-4						Page: 1
			Drawing remarks							

0 1 2 3 4 5 6 7 8 9



ASSEMBLY DRAWING 2

Note					Tetra Pak Processing Systems	Department: CCP	Designer: UN	Date: 01.02.13	Verified: HA	Name of Eplan-project: 35411-410	No. of pages: 30
Sign.					Project No.	31821-9860-1 SEPARATOR SCS92B					Cont. on page: 3
Date					Drawing No. 35411-410-4						Page: 2
				Drawing remarks							

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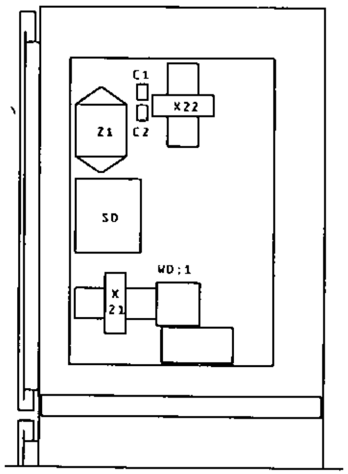
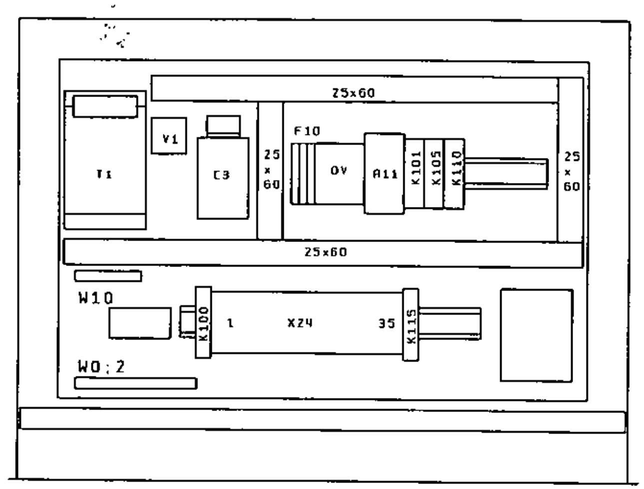


A — A



B — B

ASSEMBLY DRAWING 3

Note				
Sign.				
Date				
				Drawing remarks

Tetra Pak
Processing Systems

Department	Designer	Date	Verified	Name of Eplan-project	No. of pages
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Drawing No.: 35411-410-4

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SEPARATOR
SCS92B

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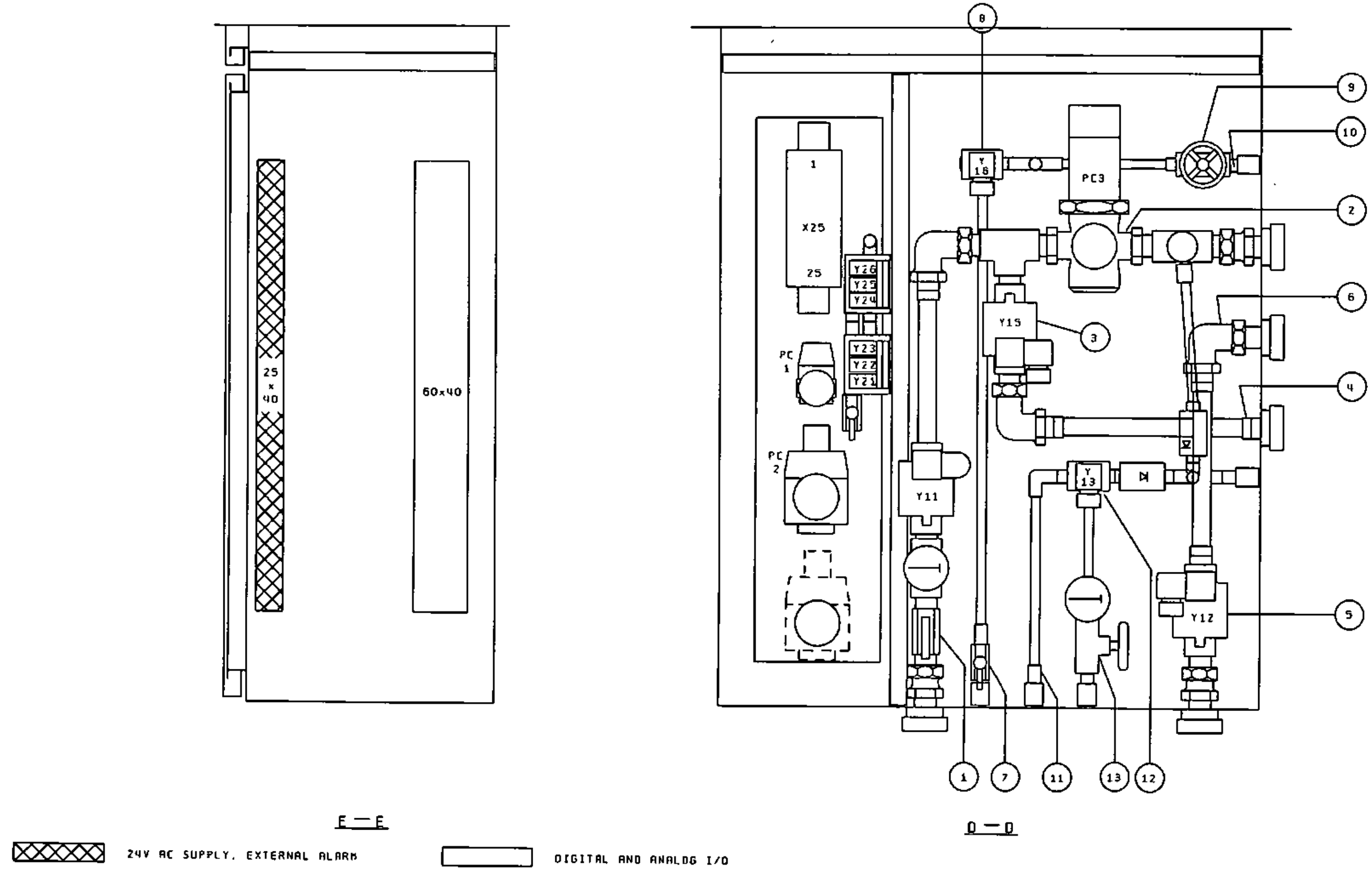


ASSEMBLY DRAWING 4

Note					Tetra Pak Processing Systems	Department: CCP	Designer: UN	Date: 01.02.13	Verified: MA	Name of Eplan-project: 35411-410	No. of pages: 30
Sign.					Project No.	31821-9860-1 SEPARATOR SCS92B					Cont. on page: =5/0
Date					Drawing No.						Page
				Drawing remarks	35411-410-4						4

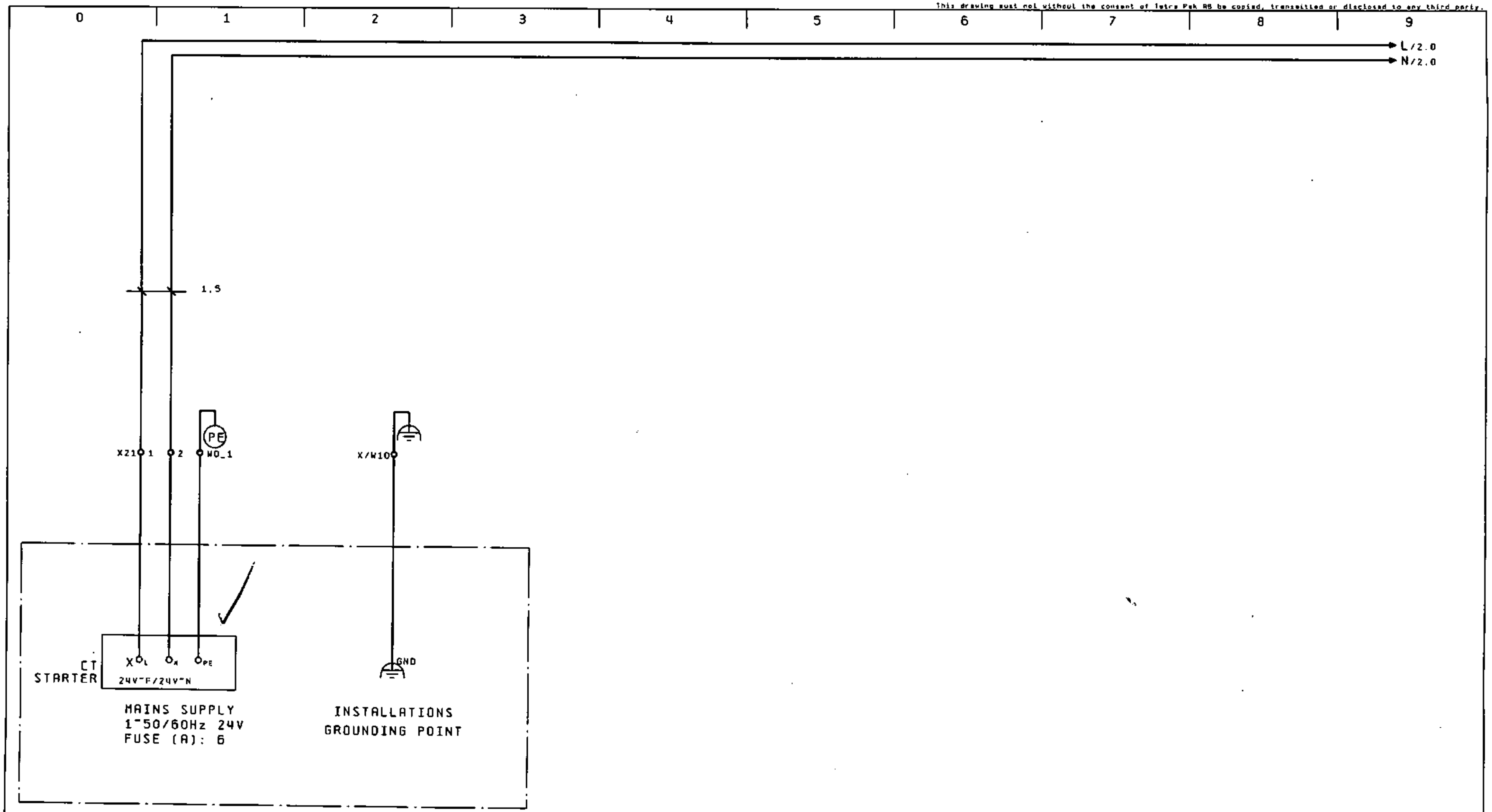
0	1	2	3	4	5	6	7	8	9

IDENTIFICATION OF WIRING INSIDE CONTROL CABINET

COLOR CODING IS USED FOR IDENTIFICATION OF SINGLE-CORE CABLES:

GREEN-AND-YELLOW	EARTH CONDUCTORS
BLUE	NEUTRAL CONDUCTORS
BLACK	POWER CIRCUITS
RED	A.C. CONTROL CIRCUITS
BLUE	D.C. CONTROL CIRCUITS
ORANGE	INTERLOCKING CONTROL CIRCUITS, SUPPLIED FROM EXTERNAL POWER

CROSS-SECTION OF SINGLE-CORE CABLES IS 0,75mm² IF NOTHING ELSE IS SPECIFIED.



CONTROL, SUPPLY VOLTAGE

Note			
Sign.			
Date			

ZZA ZPNE ZWAT

ZZE ZPNE1

Drawing remarks

Tetra Pak
Processing Systems

Department	Designer	Date	Verified	Name of Eplan-project	No. of pages
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Drawing No.
35411-410-5

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SEPARATOR
SCS928

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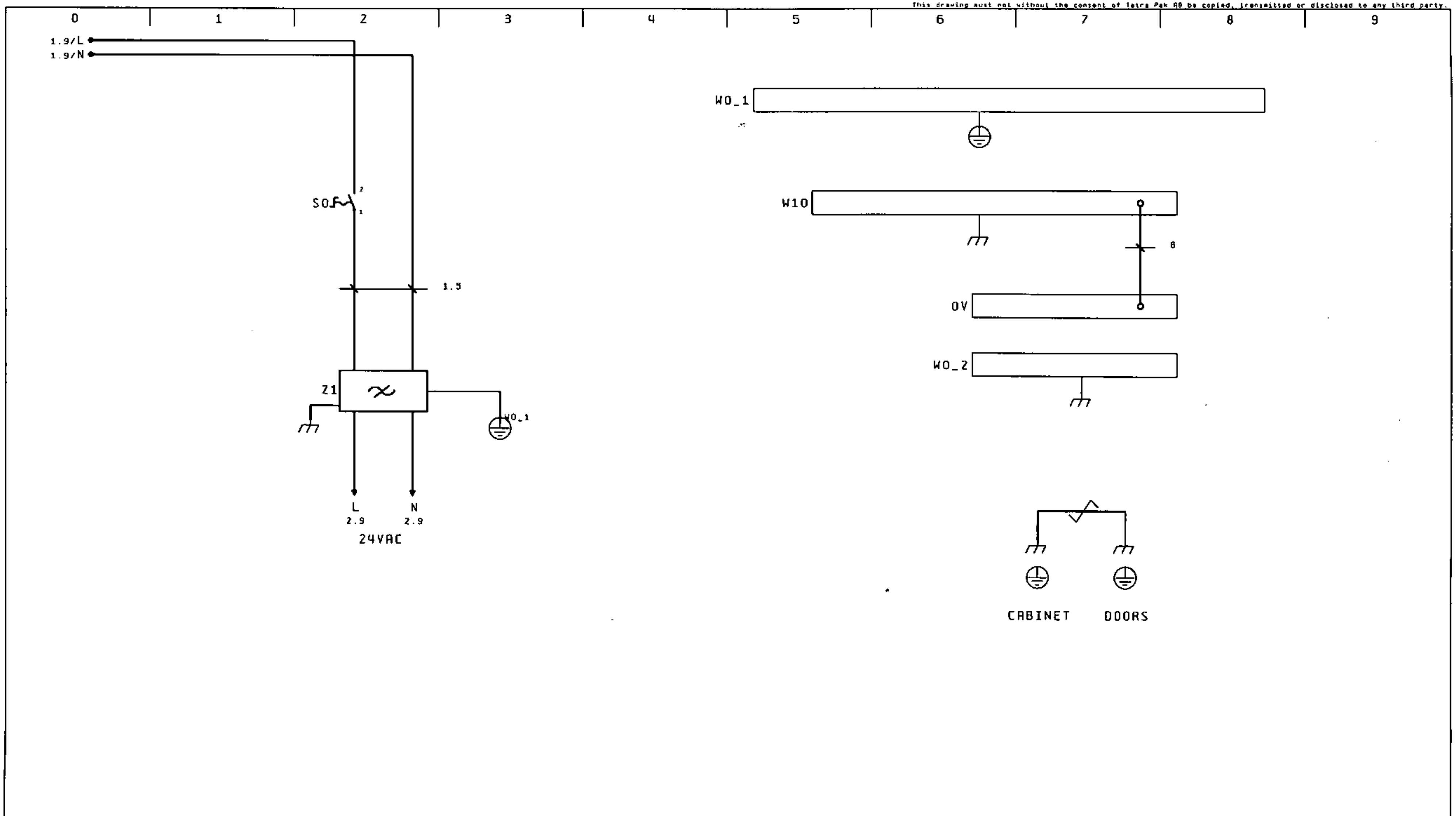

CONTROL, SUPPLY VOLTAGE

Note				
Sign.				
Date				
				Drawing remarks

Tetra Pak
Processing Systems

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Drawing No.: 35411-410-5

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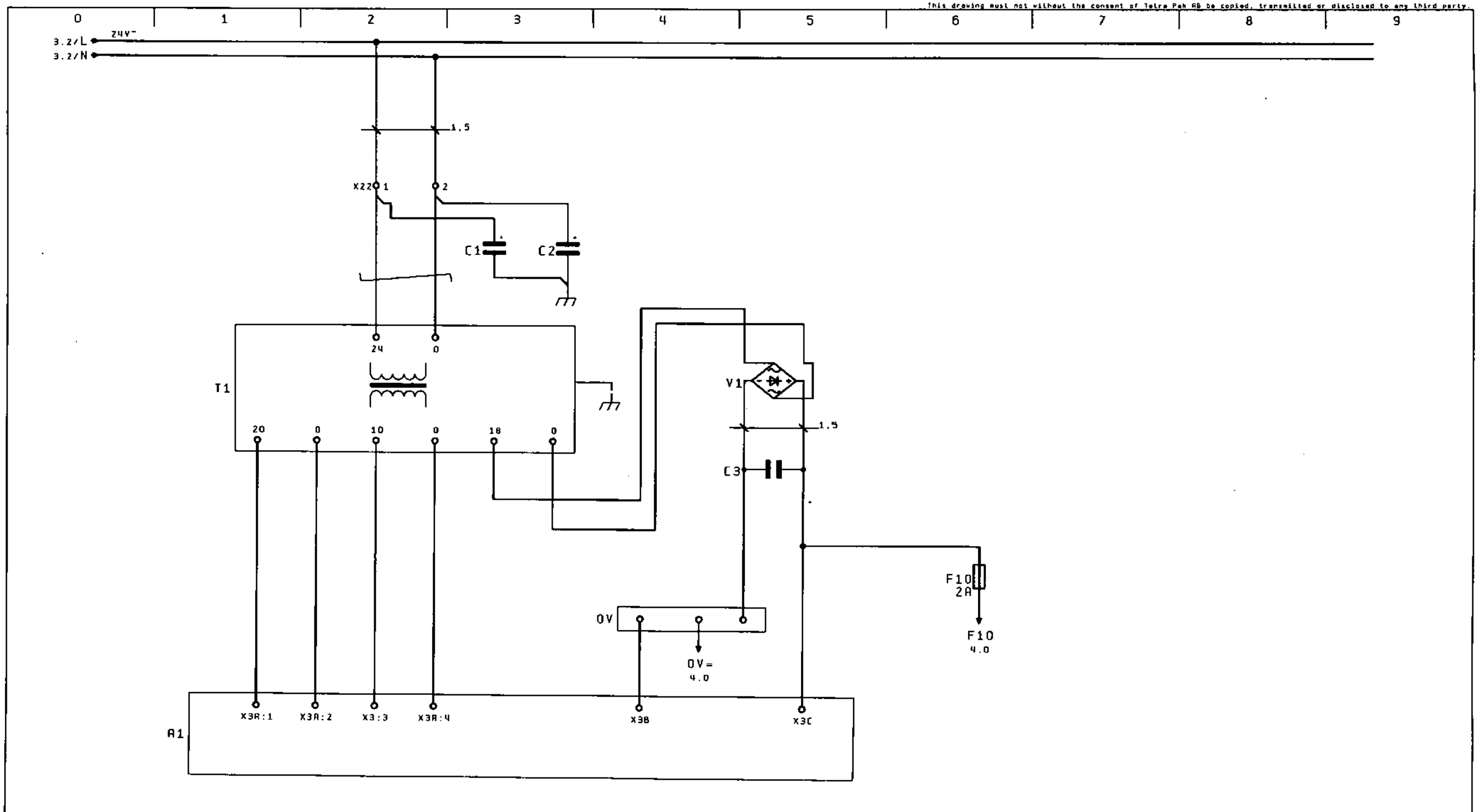
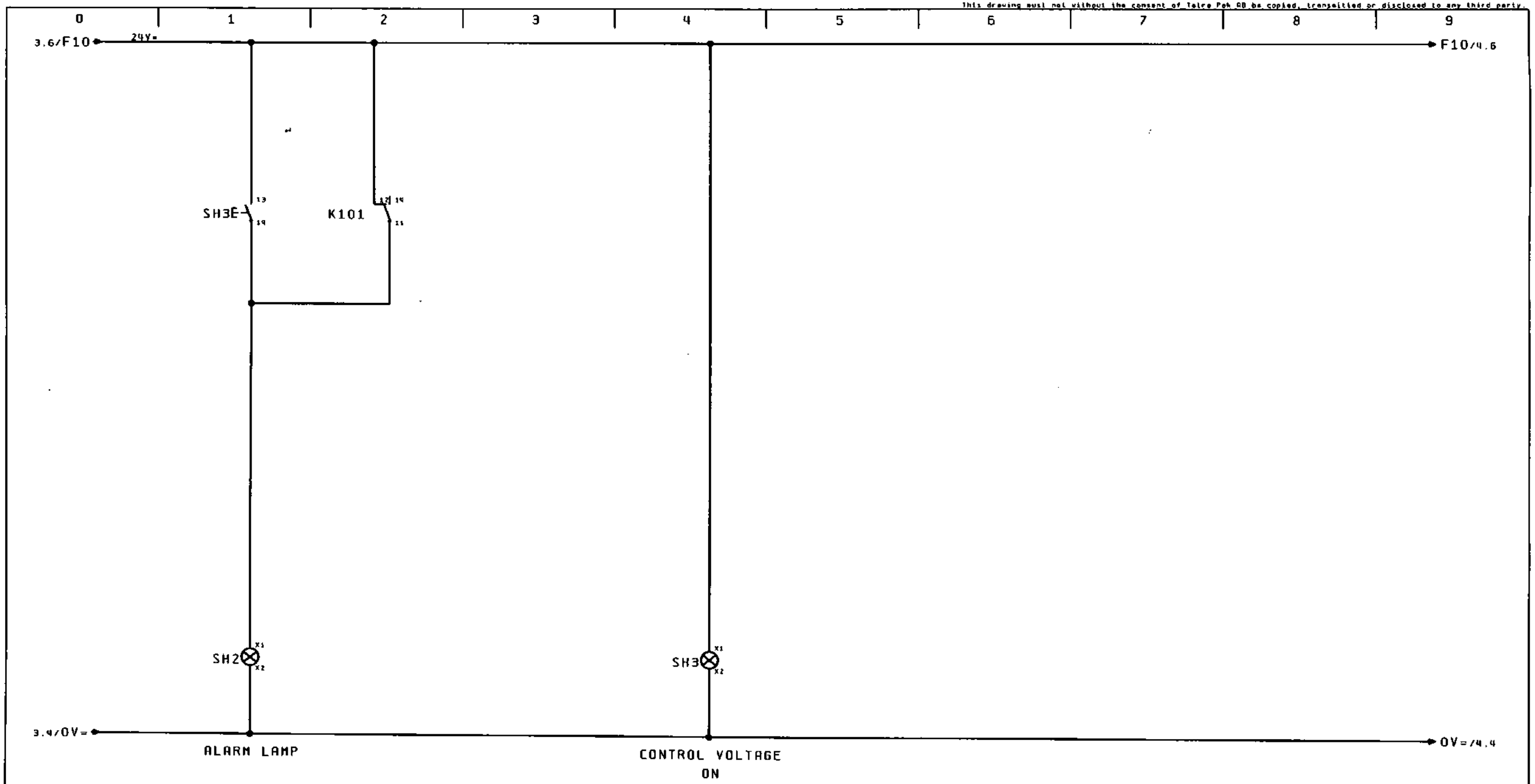


CONTROL, SUPPLY VOLTAGE

Note					Tetra Pak Processing Systems	Department: CCP	Designer: UN	Date: 01.02.13	Verified: MA	Name of Eplan-project: 35411-410	No. of pages: 30
Sign.					Project No.	31821-9860-1 SEPARATOR SCS92B					Cont. on page: 4
Date					Drawing No. 35411-410-5						Page: 3
				Drawing remarks							



ALARM

Note				
Sign.				
Date				
				Drawing remarks

Tetra Pak Processing Systems

Department	Designer	Date	Verified	Name of Eplan-project	No. of pages
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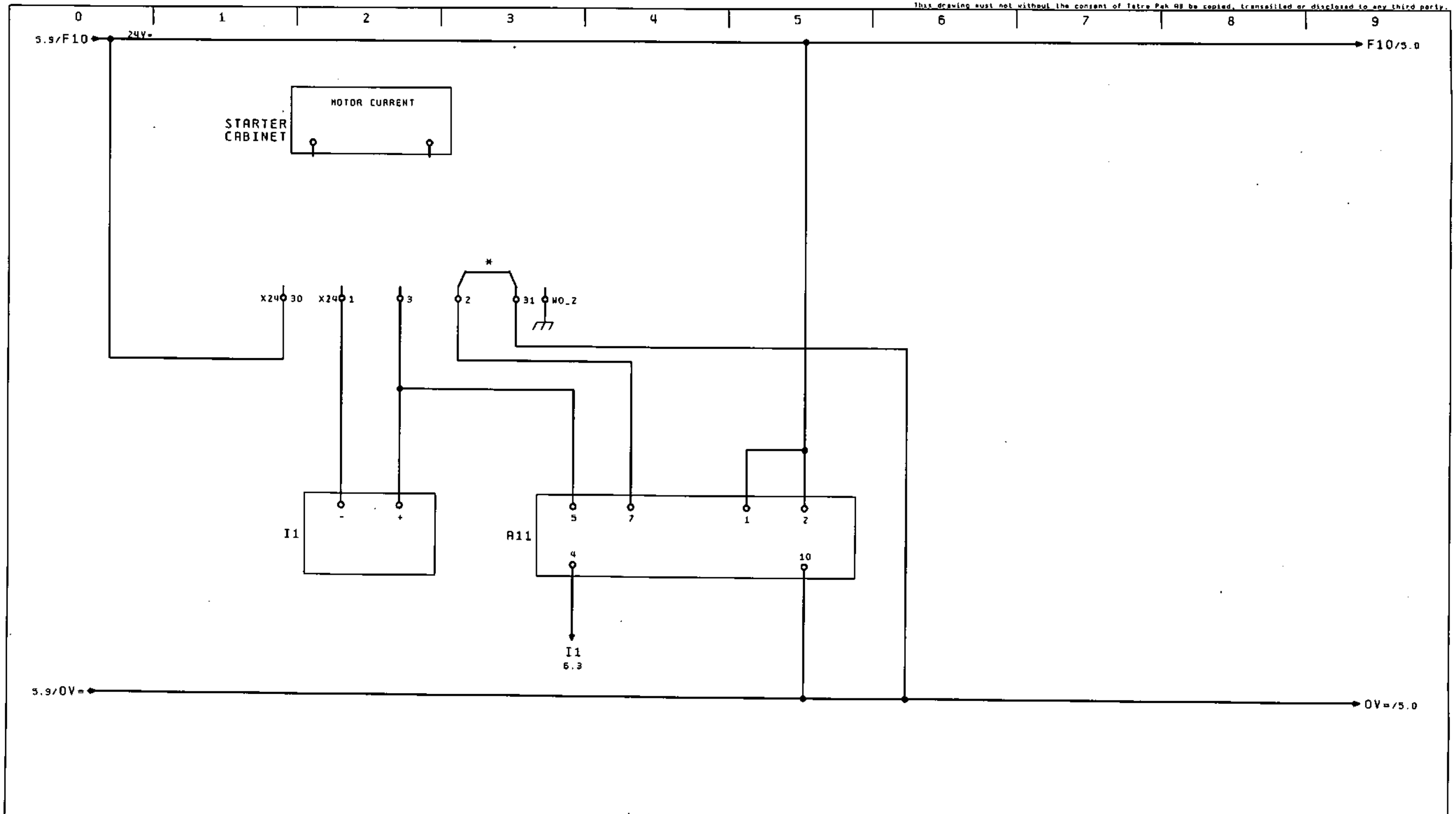
Drawing No.: 35411-410-5

31821-9860-1
SEPARATOR
SCS92B

Cont. on page: 5



MOTOR CURRENT

Note				* CONNECT IF CURRENTTRANSFORMER
Sign.				
Date				
				Drawing remarks

Tetra Pak Processing Systems

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Drawing No. 35411-410-5

Department	Designer	Date	Verified	Name of Sales-object	No. of pages
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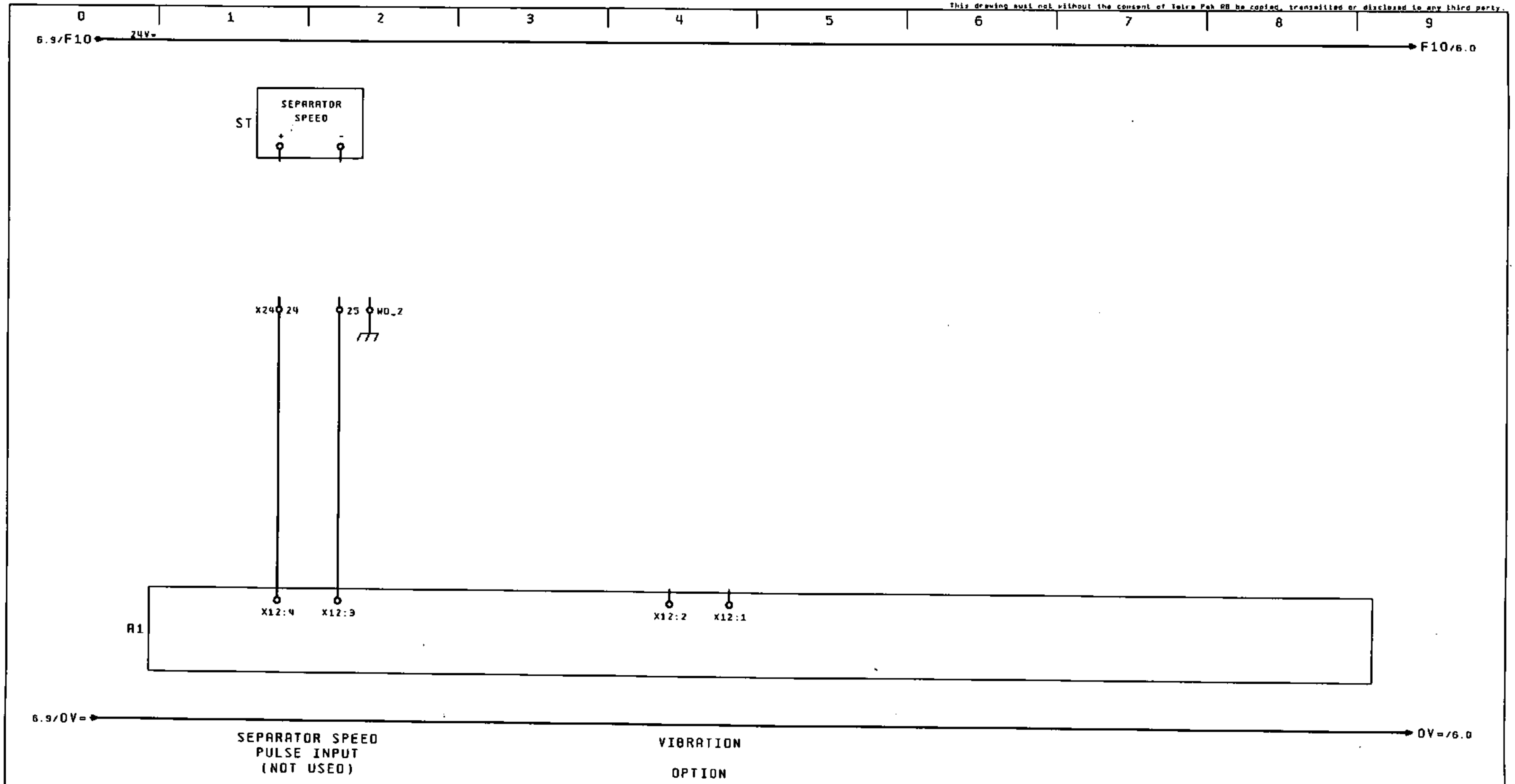
SCS92B

Cont. on page 6



CENTRAL UNIT, ANALOG INPUTS

Note				
Sign.				
Date				
				Drawing remarks

Tetra Pak Processing Systems

Department	Designer	Date	Verified	Name of Eplan-project	No. of pages
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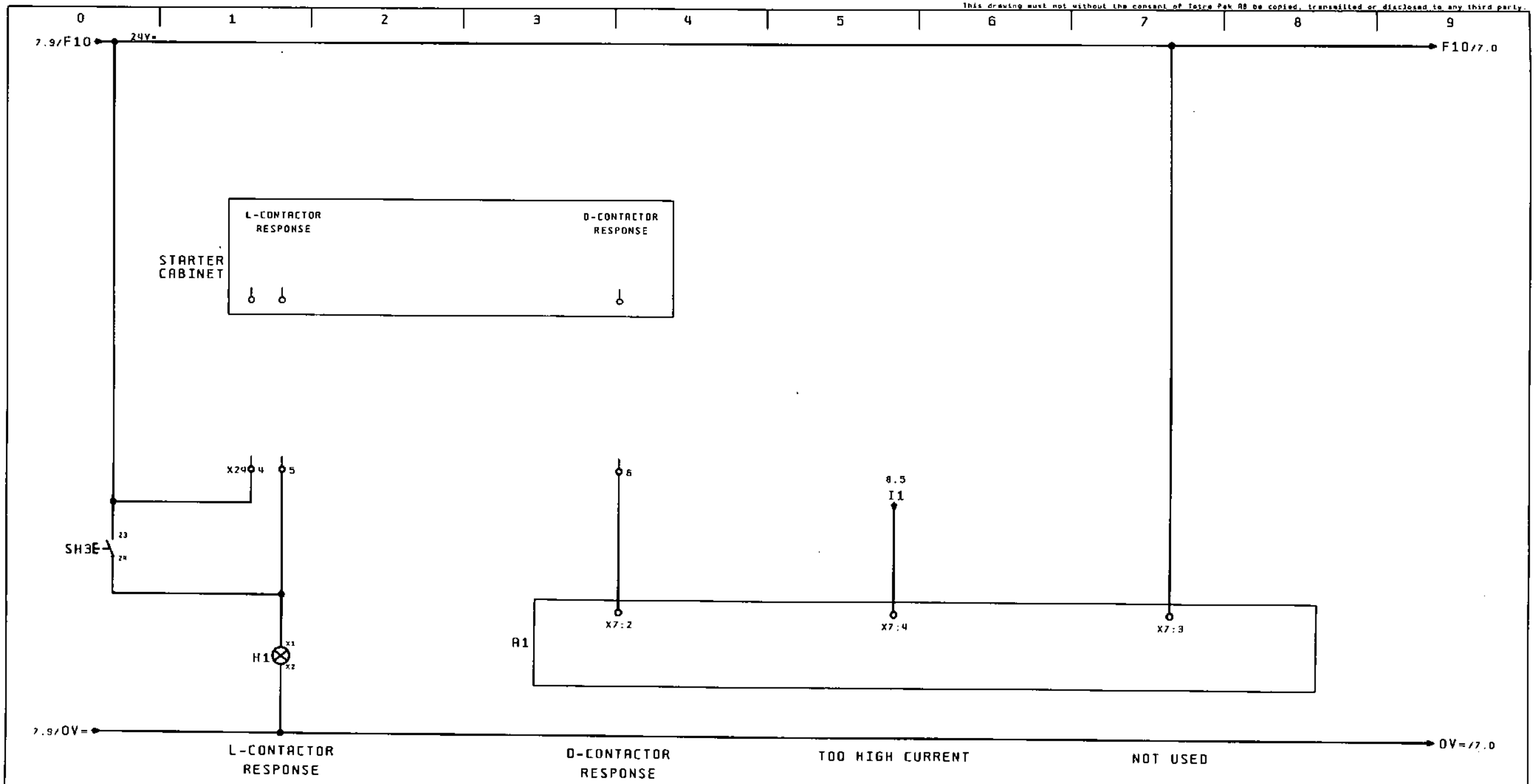

CENTRAL UNIT, DIGITAL INPUTS

Note					Tetra Pak Processing Systems	Department: CCP	Designer: UN	Date: 01.02.13	Verified: MA	Name of Enlan-project: 35411-410	No. of pages: 30
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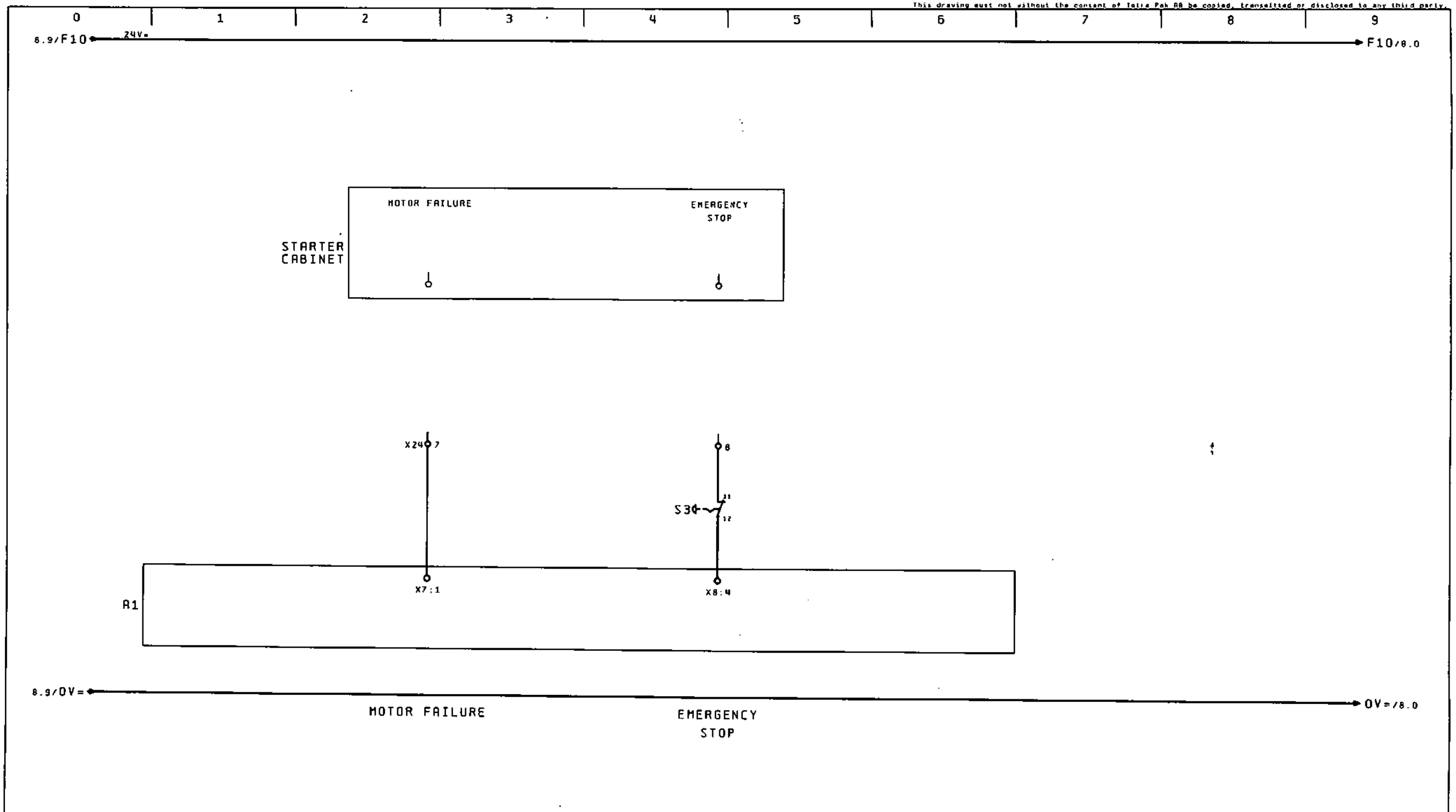
				Drawing remarks							



CENTRAL UNIT, DIGITAL INPUTS

Note					
Sign.					
Date					
				Drawing remarks	

Tetra Pak
Processing Systems

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SCS92B

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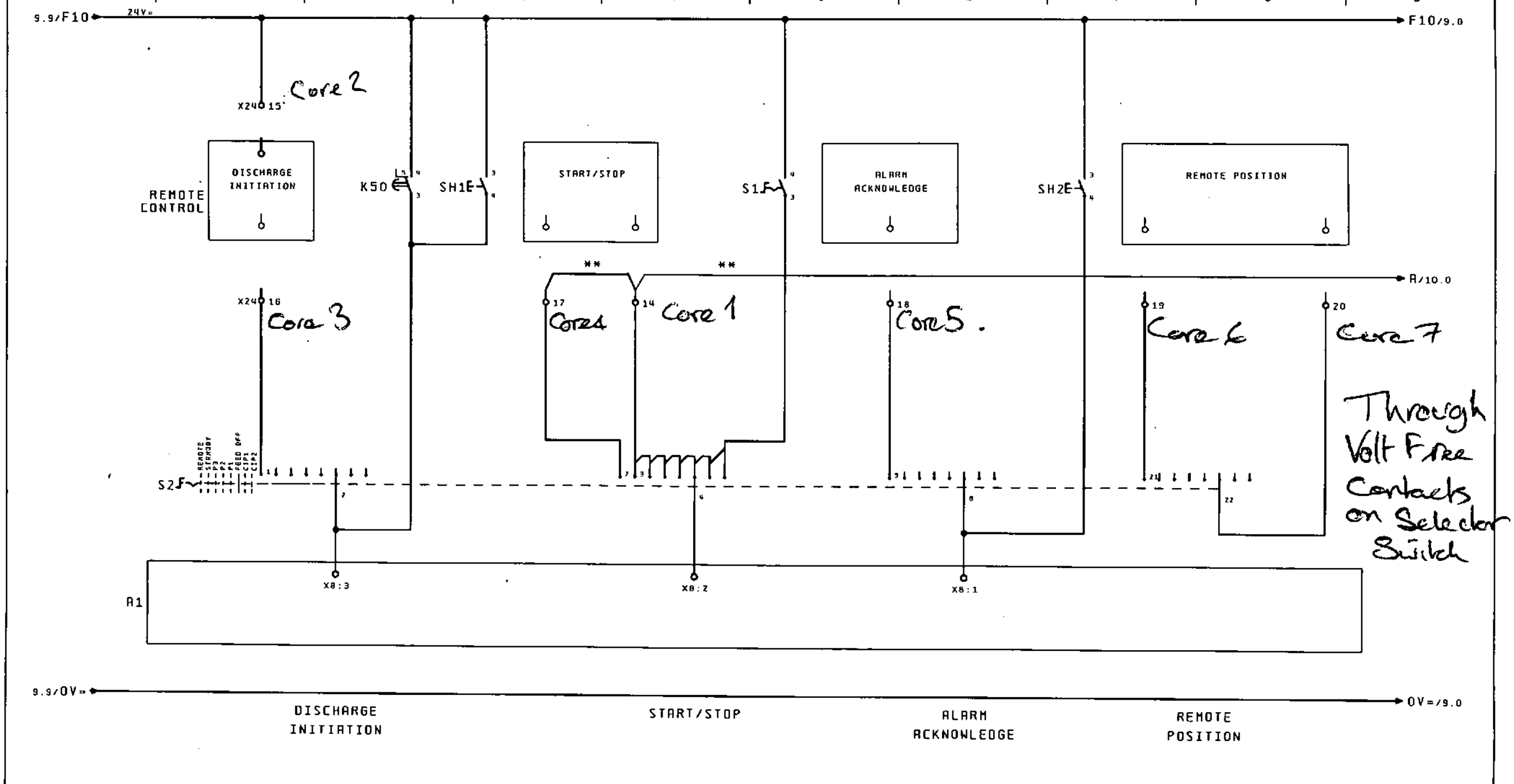

CENTRAL UNIT. DIGITAL INPUTS

Note	Sign.	Date

** REMOVE JUMPER IF REMOTE CONTROL

Drawing remarks

Tetra Pak
Processing Systems

Project No.

Drawing No. 35411-410-5

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SEPARATOR
SCS92B

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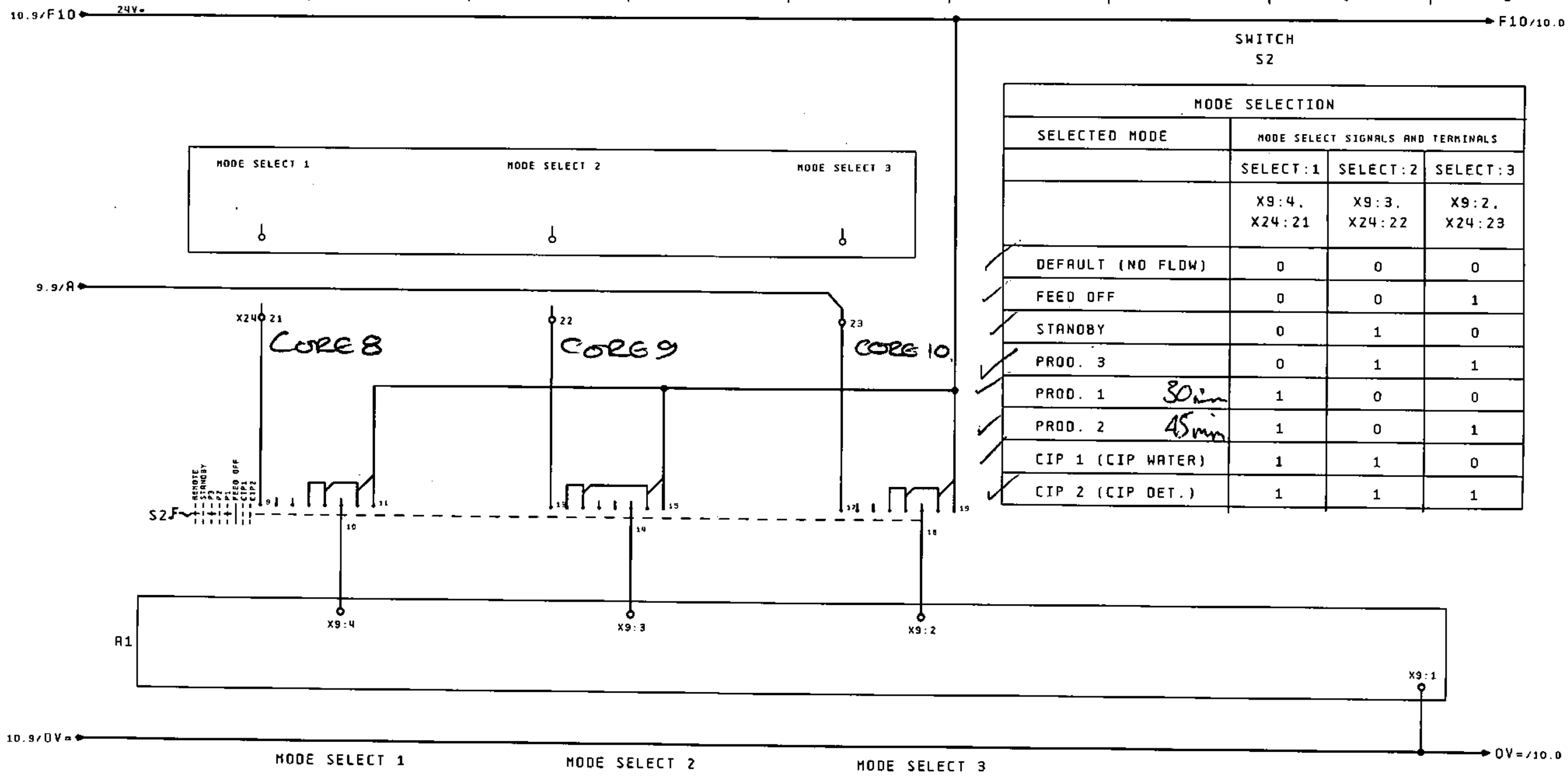

MODE SELECTION

SELECTED MODE	MODE SELECT SIGNALS AND TERMINALS		
	SELECT:1	SELECT:2	SELECT:3
	X9:4, X24:21	X9:3, X24:22	X9:2, X24:23
DEFAULT (NO FLOW)	0	0	0
FEED OFF	0	0	1
STANDBY	0	1	0
PROD. 3	0	1	1
PROD. 1 30min	1	0	0
PROD. 2 45min	1	0	1
CIP 1 (CIP WATER)	1	1	0
CIP 2 (CIP DET.)	1	1	1

CENTRAL UNIT, DIGITAL INPUTS

Note				** REMOVE JUMPER IF REMOTE CONTROL
Sign.				
Date				
				Drawing remarks

Tetra Pak Processing Systems

Department	Designer	Date	Verified	Name of Belam-project	No. of pages
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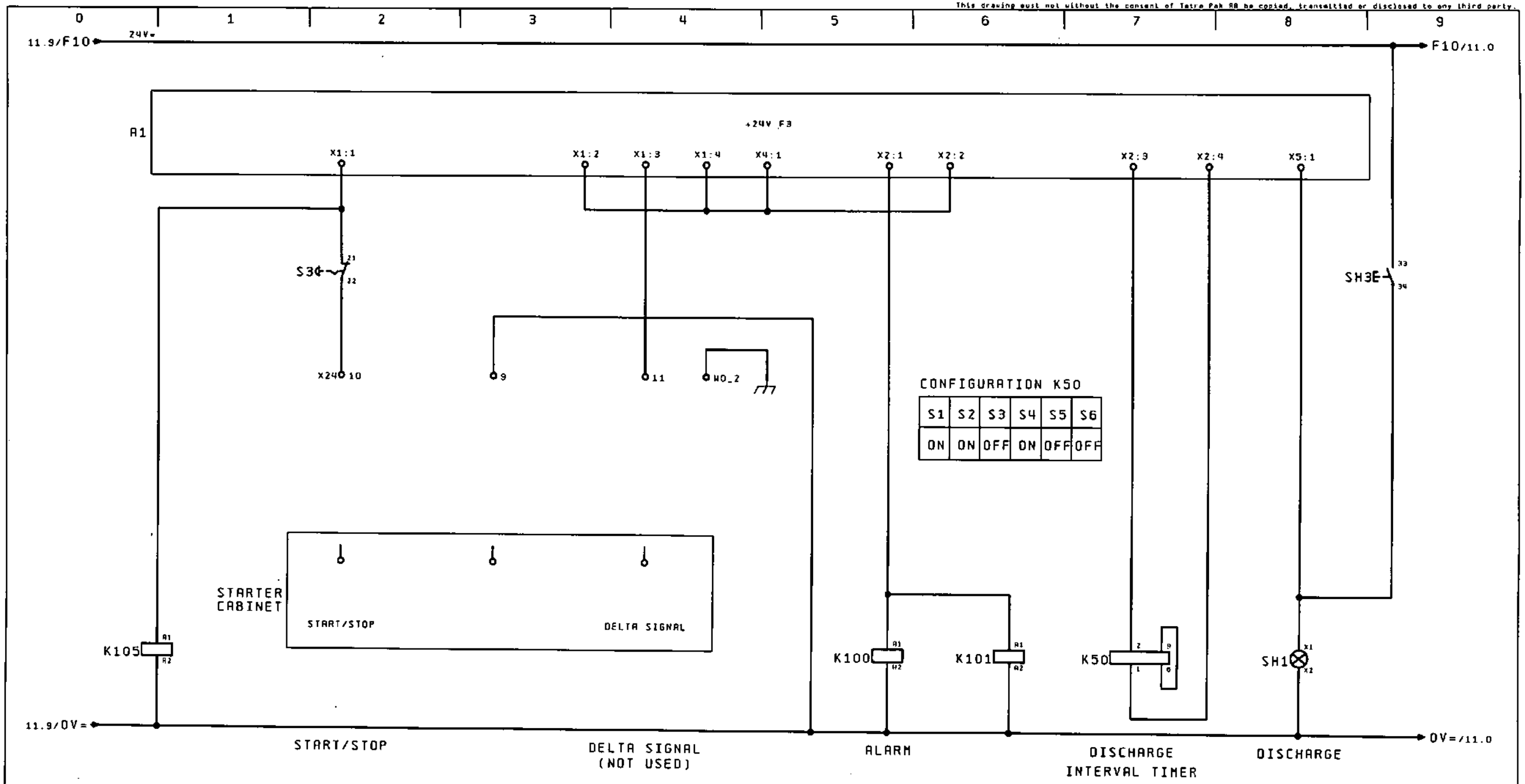
Drawing No. 35411-410-5

31821-9860-1
SEPARATOR
SCS92B

Cont. on page 11

Page 10



S1	S2	S3	S4	S5	S6
ON	ON	OFF	ON	OFF	OFF

CENTRAL UNIT, DIGITAL OUTPUTS

Note			
Sign.			
Date			

Drawing remarks

Tetra Pak
Processing Systems

Project No.

Drawing No.
35411-410-5

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31821-9860-1
SEPARATOR
SCS92B

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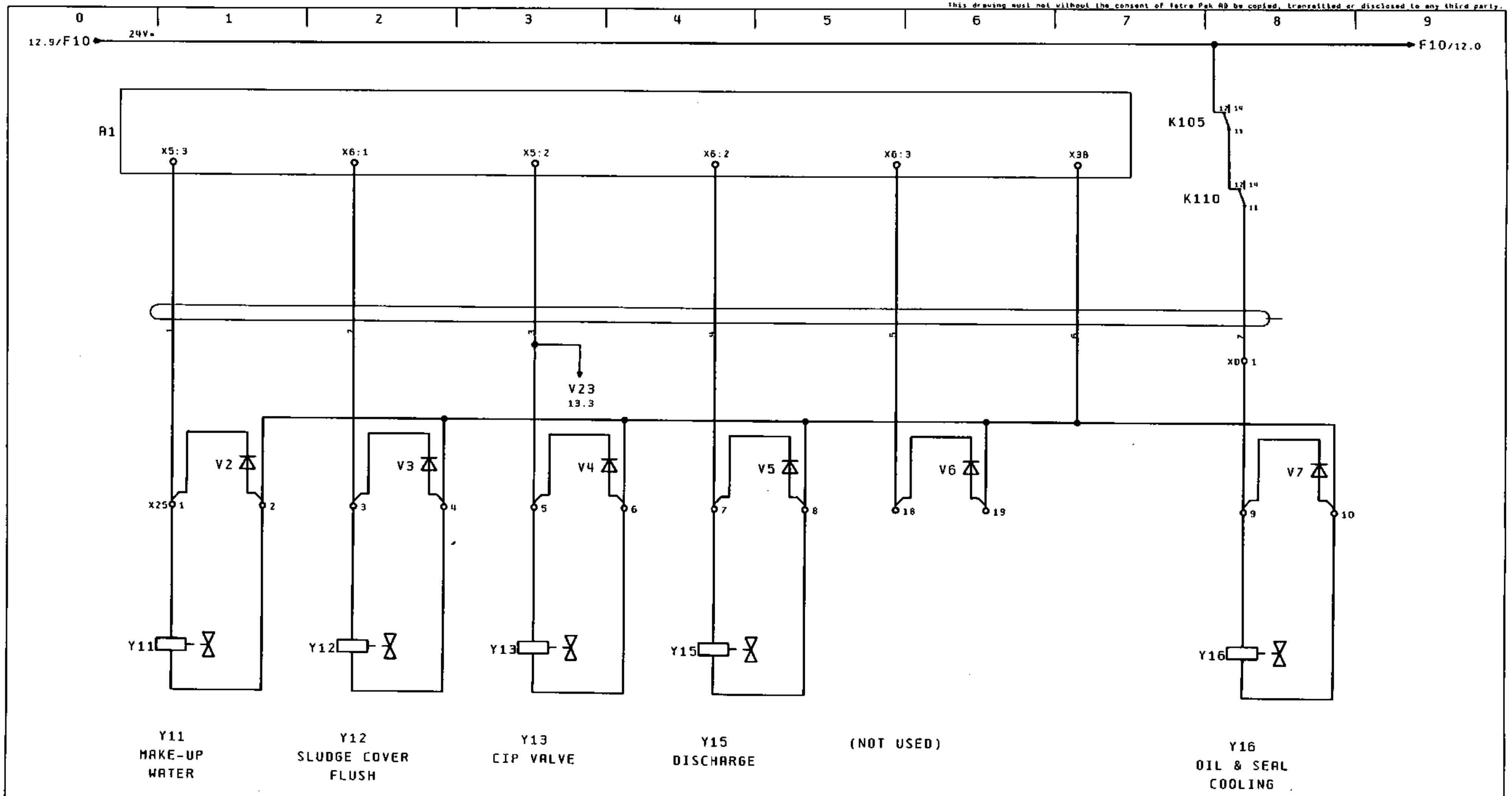

CENTRAL UNIT, DIGITAL OUTPUTS

Note		
Sign.		
Date		
Drawing remarks		

Tetra Pak Processing Systems	Department: CCP	Designer: UN	Date: 01.02.13	Verified: MA	Name of Eplan-project: 35411-410	No. of pages: 30
Project No.	31821-9860-1 SEPARATOR SCS92B					Cont. on page: 13
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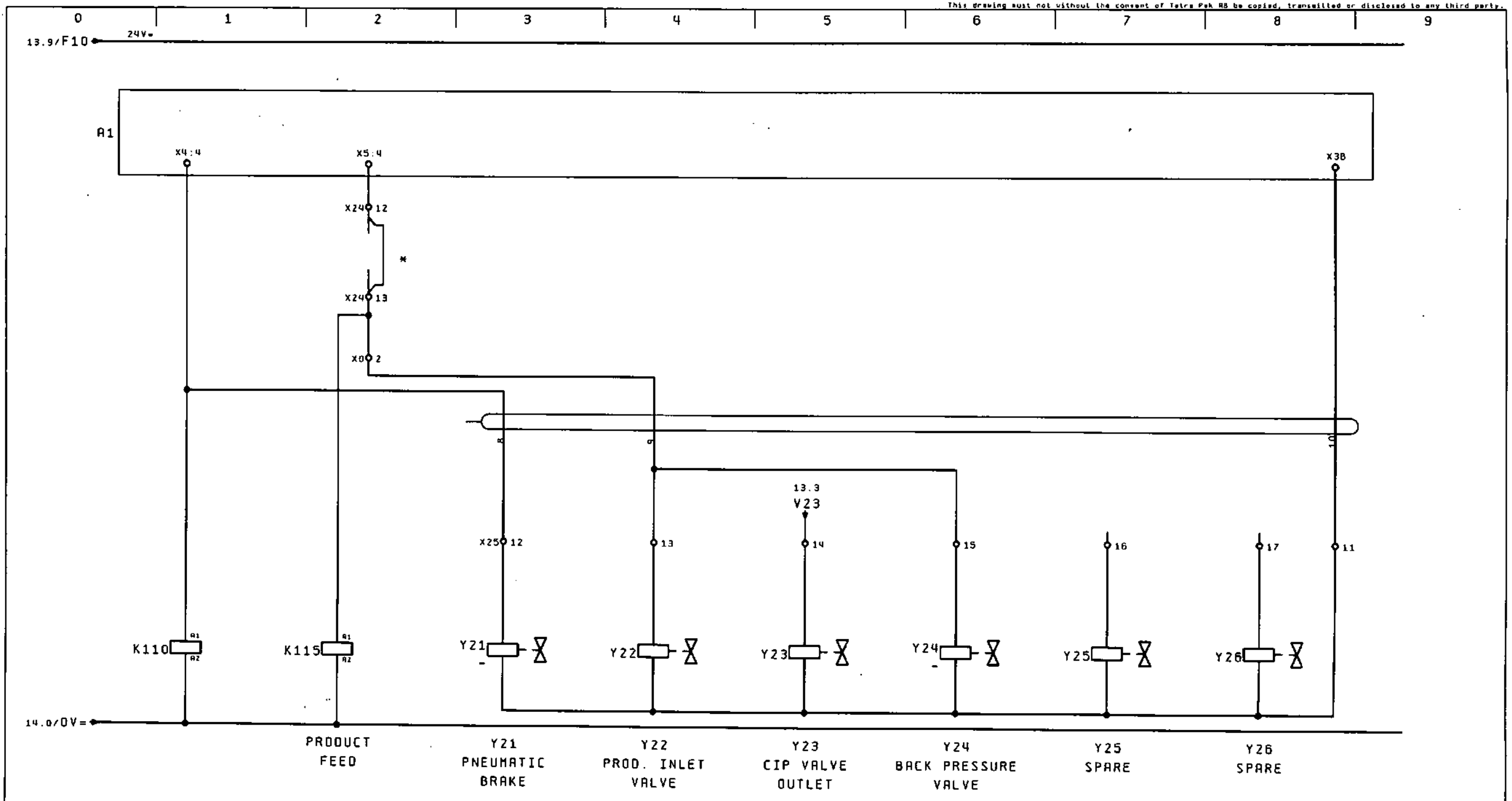

CENTRAL UNIT, DIGITAL OUTPUTS

Note				* REMOVE JUPER IF USED
Sign.				
Date				
				Drawing remarks

Tetra Pak
Processing Systems

Department	Designer	Date	Verified	Name of Eplan-project	No. of pages
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Project No.

Drawing No.
35411-410-5

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SEPARATOR
SCS92B

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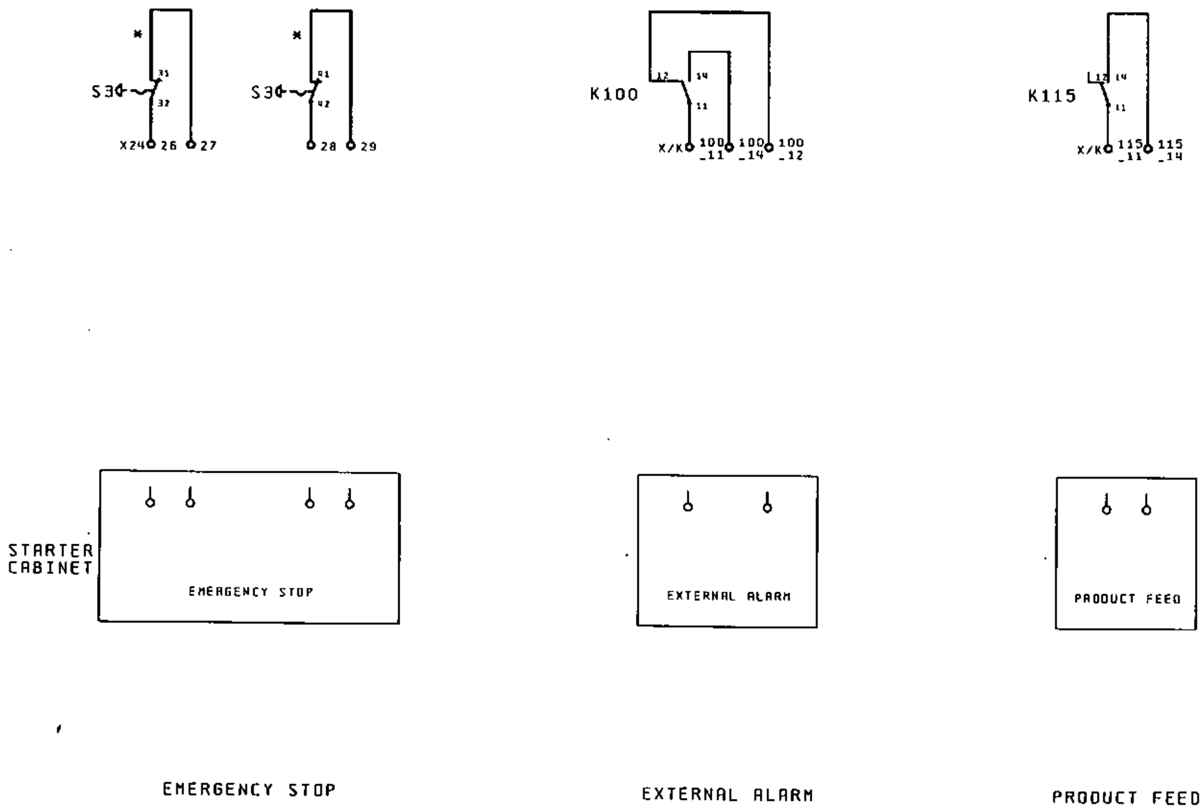
0 1 2 3 4 5 6 7 8 9



SIGNALS

Note				* ORANGE	Tetra Pak Processing Systems	Department: CCP	Designer: UN	Date: 01.02.13	Verified: MA	Name of Emlan-project: 35411-410	No. of pages: 30
Sign.					Project No.	31821-9860-1 SEPARATOR SCS92B					Cont. on page: 15
Date					Drawing No. 35411-410-5						Page: 14
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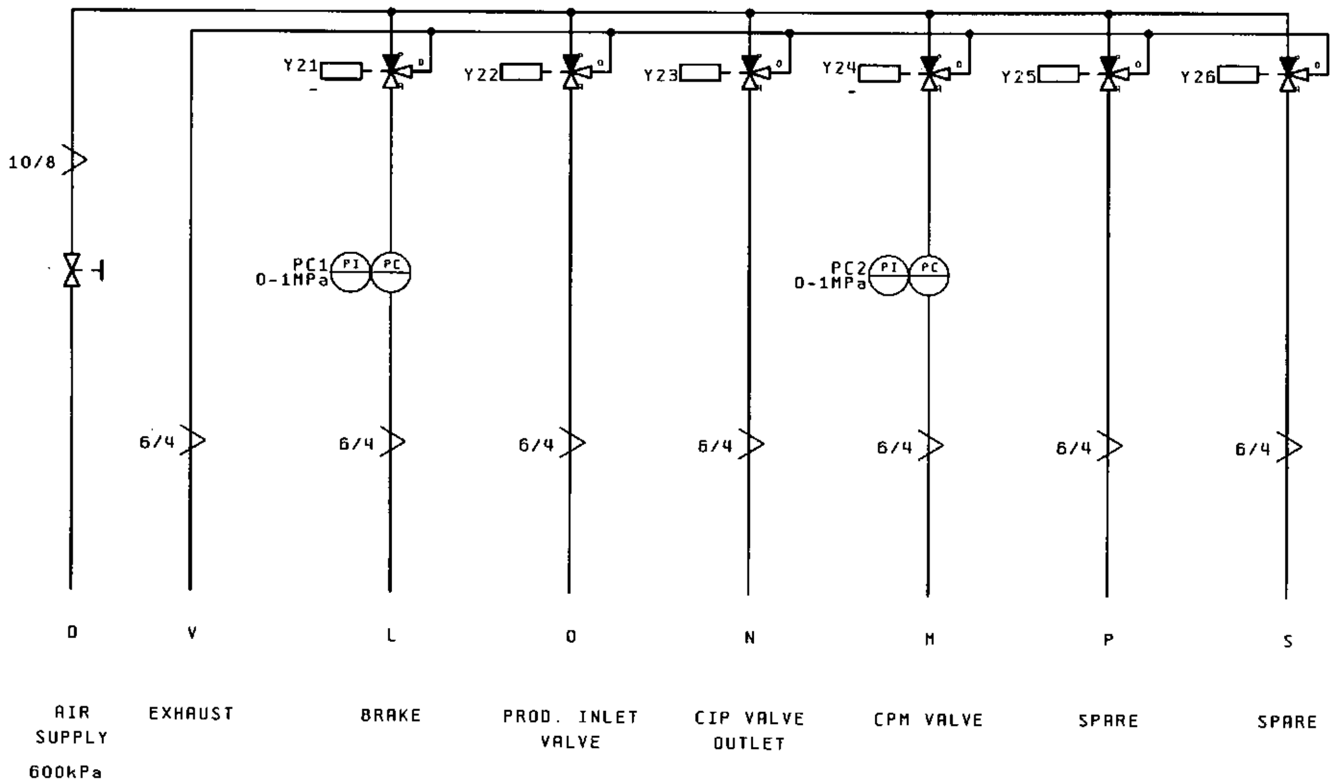
0	1	2	3	4	5	6	7	8	9



PNEUMATICS

Note					Tetra Pak Processing Systems	Department: CCP	Designer: UN	Date: 01.02.13	Verified: MA	Name of Eplan-project: 35411-410	No. of pages: 30
Sign.					Project No.	31821-9860-1 SEPARATOR SCS92B					Cont. on page: 16
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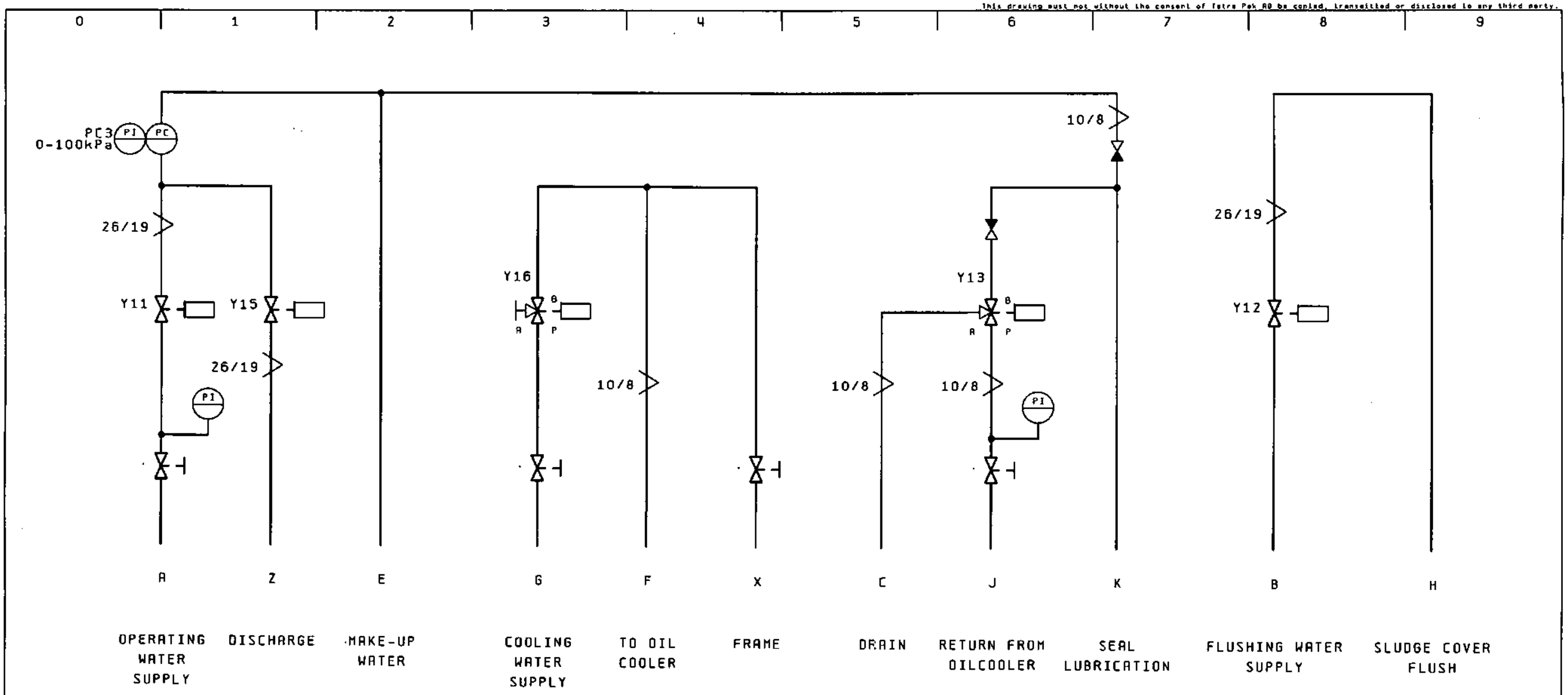

WATER

Note			
Sign.			
Date			

1 1. 2 2. 3 4 5 6
7 8 9 10 11 12 12. 13

Drawing remarks

Tetra Pak
Processing Systems

Project No.

Drawing No.
35411-410-5

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SEPARATOR
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16

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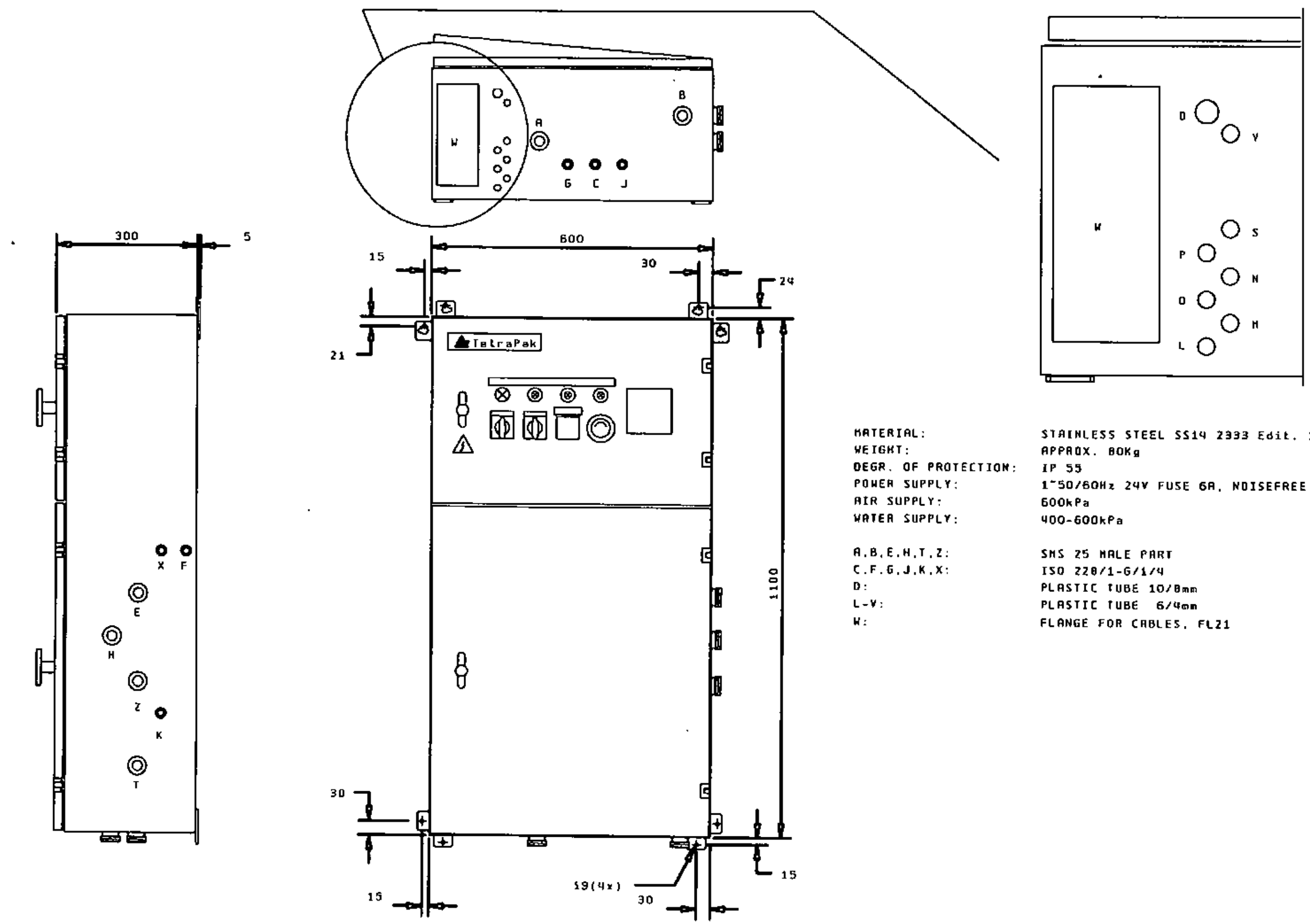

MATERIAL:	STAINLESS STEEL SS14 2333 Edit. 11
WEIGHT:	APPROX. 80Kg
DEGR. OF PROTECTION:	IP 55
POWER SUPPLY:	1~50/60Hz 24V FUSE 6A, NOISEFREE
AIR SUPPLY:	600kPa
WATER SUPPLY:	400-600kPa
A,B,E,H,T,Z:	SMS 25 MALE PART
C,F,G,J,K,X:	ISO 228/1-G/1/4
D:	PLASTIC TUBE 10/8mm
L-V:	PLASTIC TUBE 6/4mm
W:	FLANGE FOR CABLES, FL21

INSTALLATION DRAWING

Note					Tetra Pak Processing Systems	Department: CCP	Designer: UN	Date: 01.02.13	Verified: MA	Name of Eplan-project: 35411-410	No. of pages: 30
Sign.					Project No.	31821-9860-1 SEPARATOR SCS92B					Cont. on page
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				Drawing remarks							

0	1	2	3	4	5	6	7	8	9

SCS92 - INV.STARTER

INTERCONNECTION DIAGRAM

IDENTIFICATION OF DOCUMENTS

THE LAST DIGIT IN THE DRAWING NUMBER IS USED TO IDENTIFY THE TYPE OF DOCUMENT:

-0 LIST OF CONTENTS
-1 PARTS LIST
-2 FUNCTION EXPLANATION
-3 SOFTWARE DOCUMENTATION
-4 ASSEMBLY DRAWING
-5 CIRCUIT DIAGRAM
-6 INTERCONNECTION TABLE
-7 INSTALLATION DRAWING

(E.G. 3541-xxxx-5 IS A CIRCUIT DIAGRAM)

IDENTIFICATION OF DOCUMENTS

Note			
Sign.			
Date			

Drawing remarks

Tetra Pak
Processing Systems

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Project No.

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SCS92 - INV.STARTER
INTERCONNECTION DIAGRAM

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Page: 0

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LIST OF CONTENTS

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Sign.	UN		
Date	01.04.09		

Drawing remarks

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SCS92 - INV.STARTER

INTERCONNECTION DIAGRAM

Cont. on page =5/1

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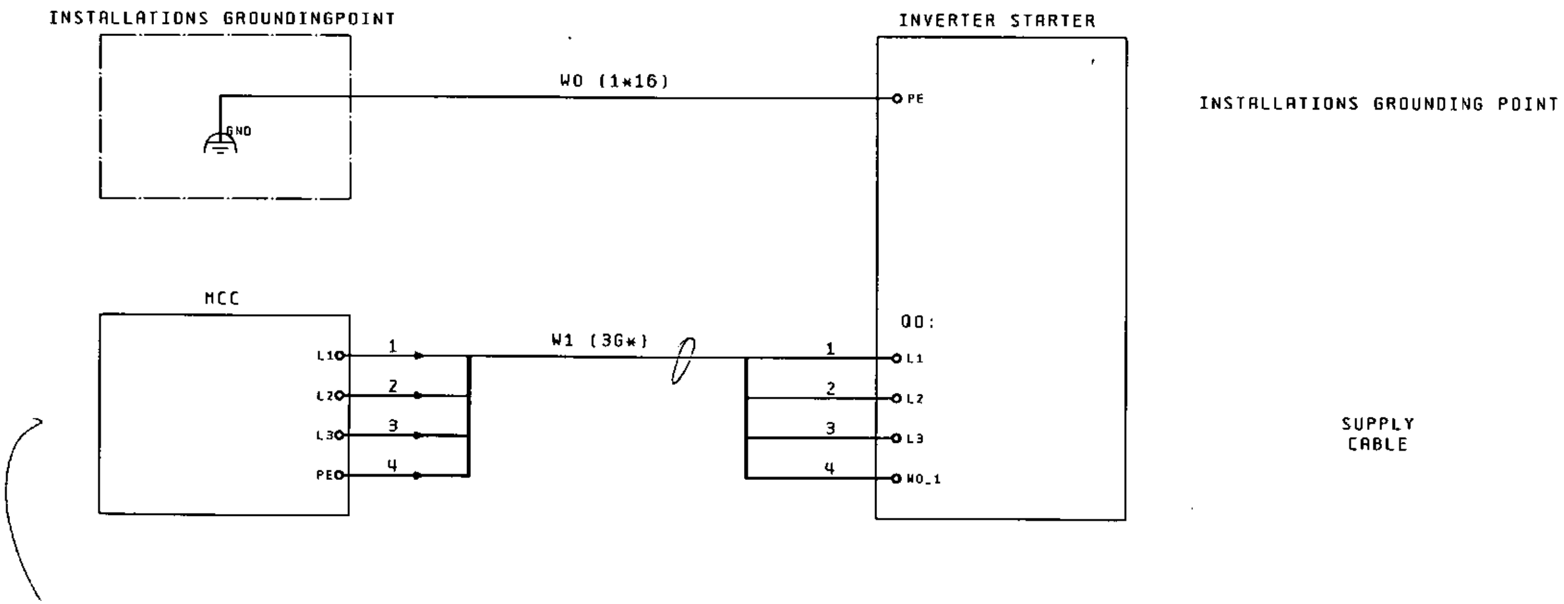

INVERTER STARTER SUPPLY

Note				
Sign.				
Date				
				Drawing remarks

Tetra Pak
Processing Systems

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Drawing No.
35411-420-5

SCS92 - INV.STARTER

INTERCONNECTION DIAGRAM

Cont. on page 2

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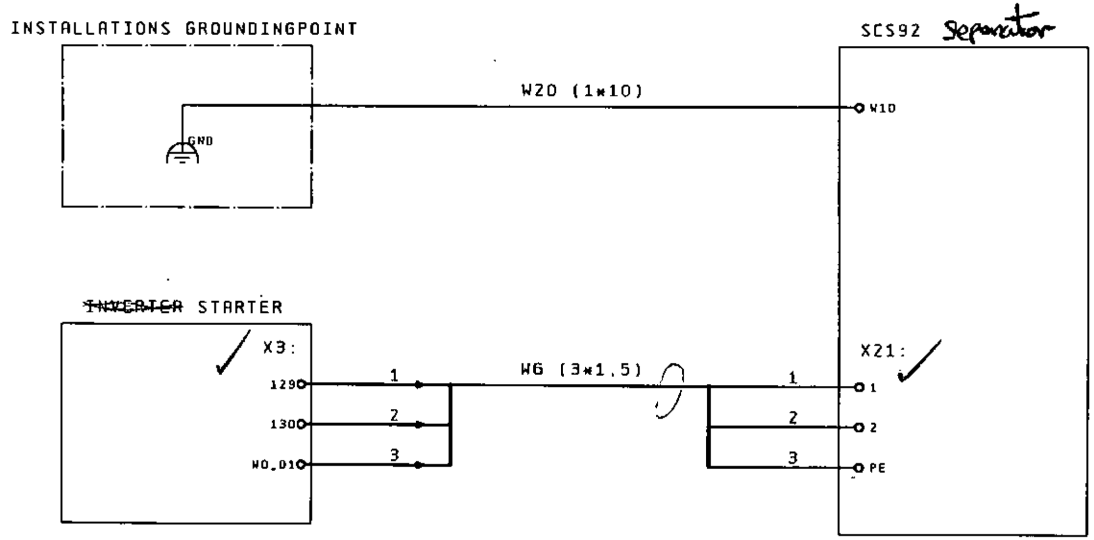


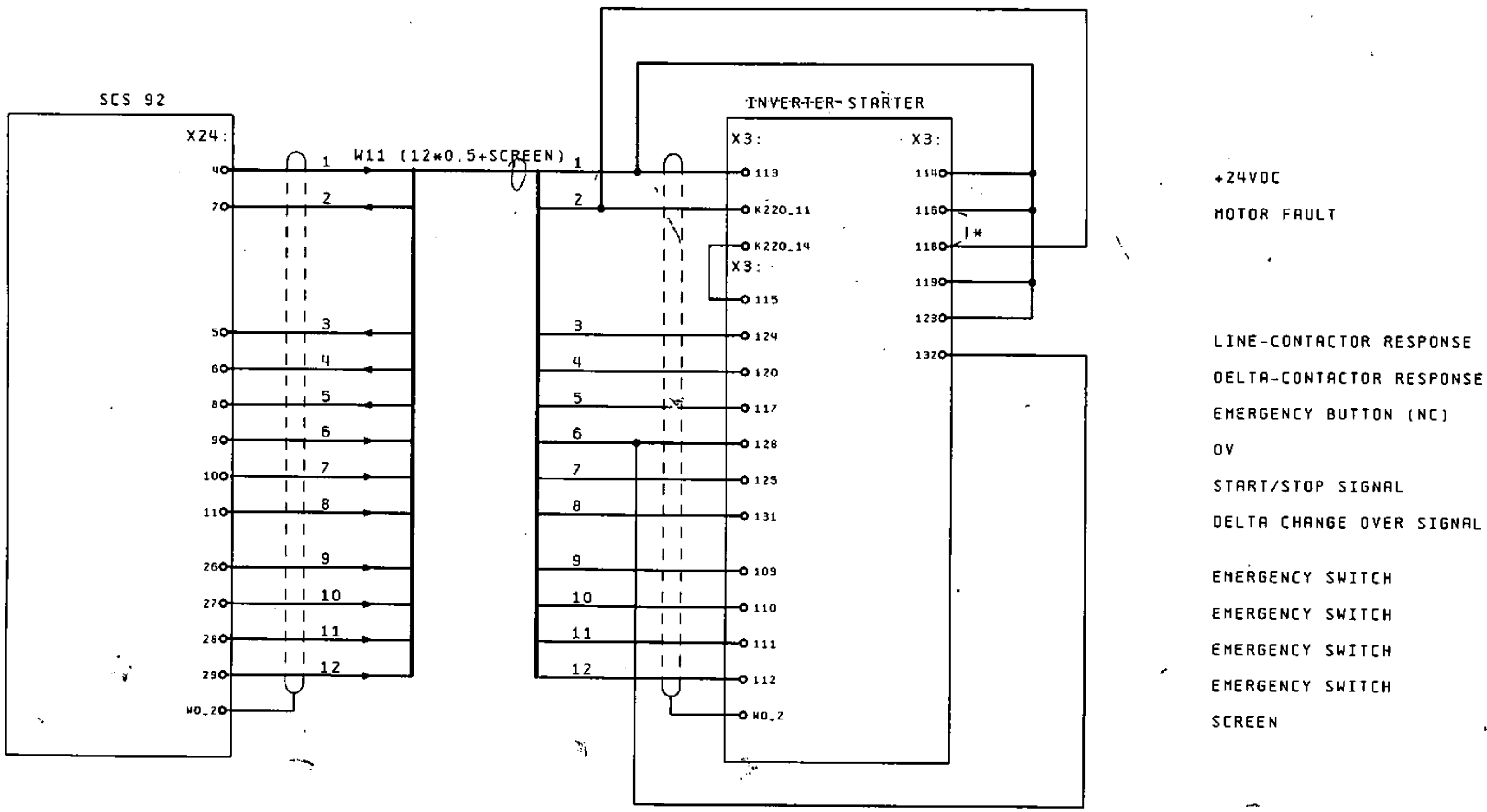
INSTALLATIONS GROUNDING POINT

SUPPLY CABLE

(24V~, 6A)

SCS92 SUPPLY

Note					Tetra Pak Processing Systems	Department: CCP	Designer: UN	Date: 01.03.12	Verified: MA	Name of Eplan-project: 35411-420A1	No. of pages: 12
Sign.					Project No.	SCS92 - INV.STARTER	Cont. on page: 3
Date					Drawing No.: 35411-420-5	INTERCONNECTION DIAGRAM	Page: 2
				Drawing remarks			



* DISCONNECT JUMPER IF SIGNAL IS USED

SC92 TO INVERTER STARTER

Note	1
Sign.	UN
Date	01.04.09

Drawing remarks

Tetra Pak Processing Systems

Department	Designer	Date	Verified	Name of Eplan-project	No. of pages
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Drawing No. 35411-420-5

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INTERCONNECTION DIAGRAM

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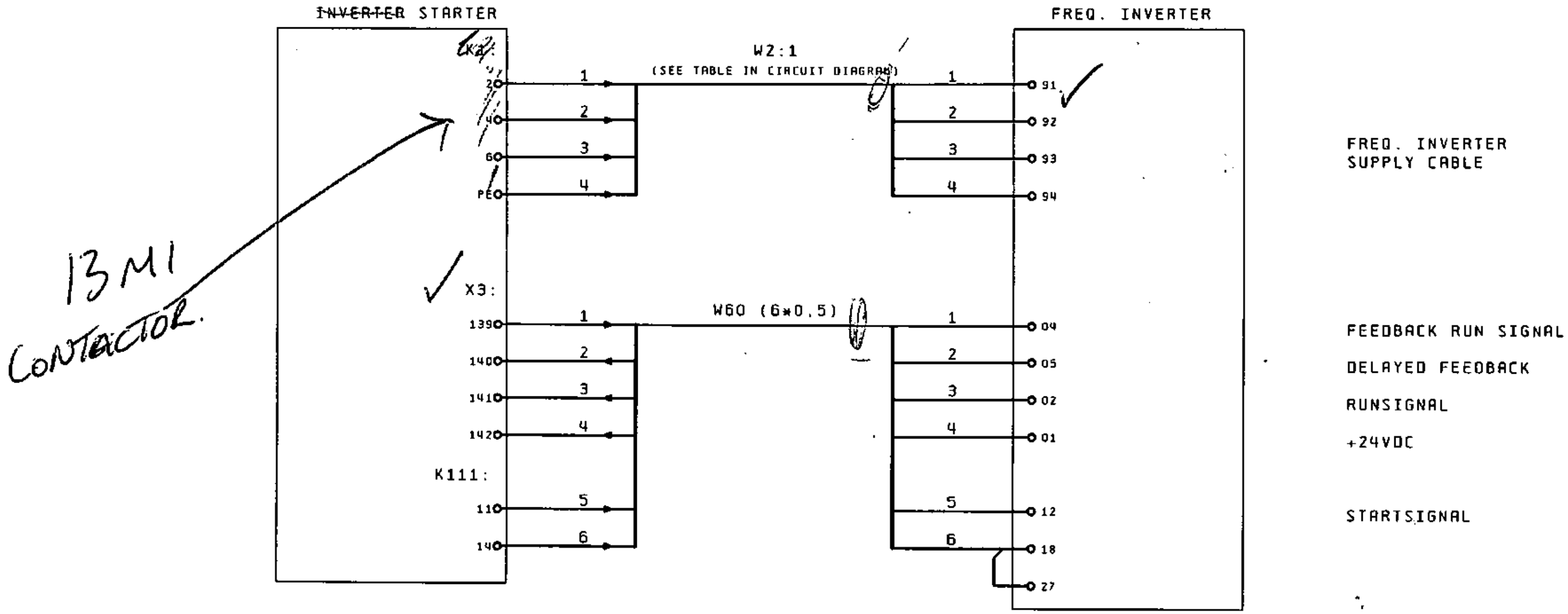

INVERTER STARTER TO FREQ. INVERTER

Note	1		
Sign.	UN		
Date	01.04.09		

Drawing remarks

Tetra Pak
Processing Systems

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Drawing No. 35411-420-5

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SCS92 - INV.STARTER

INTERCONNECTION DIAGRAM

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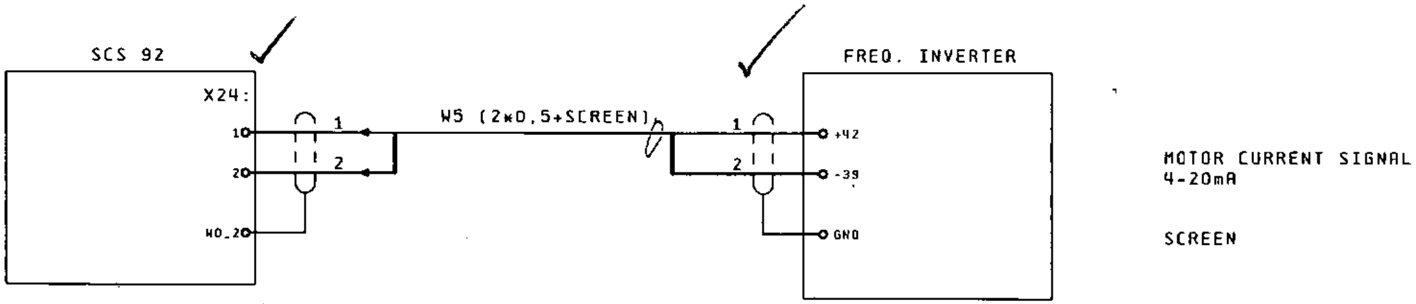
Page 4

0 1 2 3 4 5 6 7 8 9



SCS92 TO FREQ. INVERTER

Note				
Sign.				
Date				
				Drawing remarks

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INTERCONNECTION DIAGRAM

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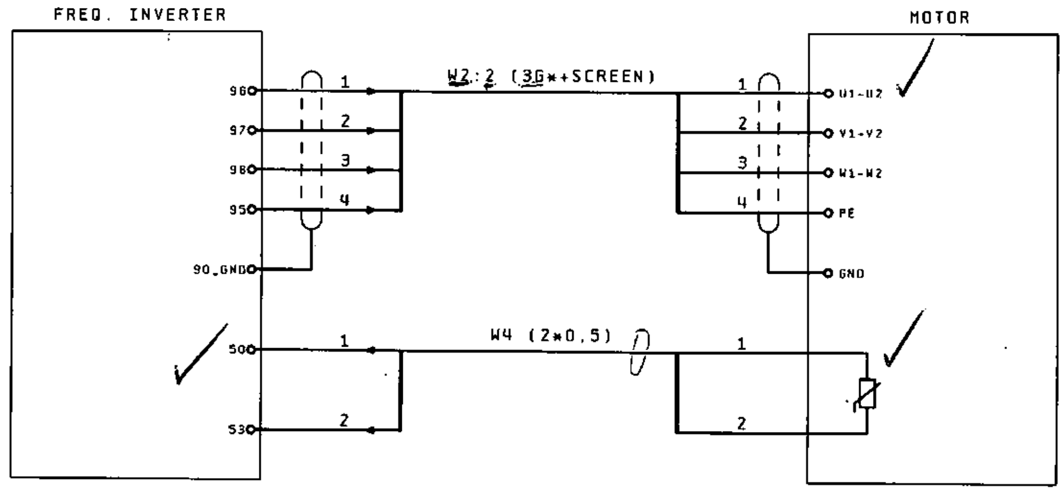
0 1 2 3 4 5 6 7 8 9



MOTOR SUPPLY CABLE

THERMISTOR

FREQ. INVERTER TO MOTOR

Note			
Sign.			
Date			

Drawing remarks

Tetra Pak
Processing Systems

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INTERCONNECTION DIAGRAM

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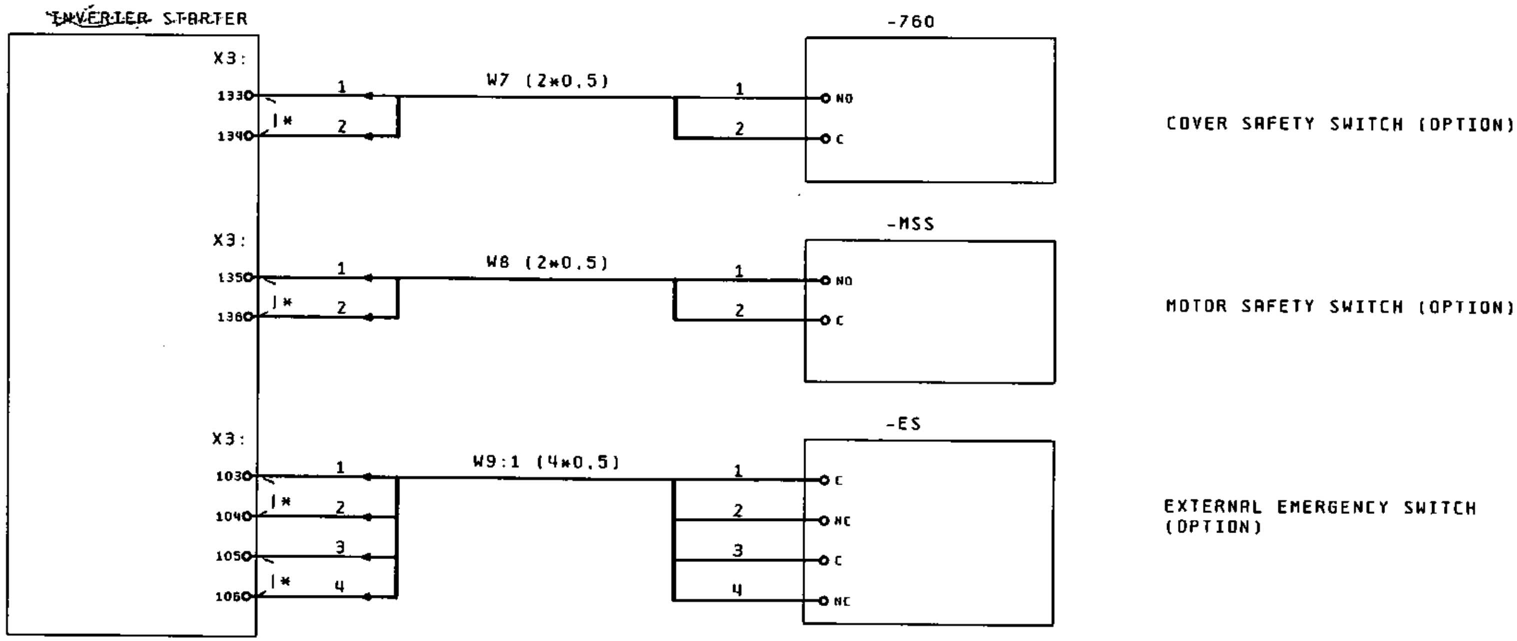

* DISCONNECT JUMPER IF SIGNAL IS USED

CONTROL CABLES TO INVERTER STARTER

Note				
Sign.				
Date				
				Drawing remarks

Tetra Pak Processing Systems

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CCP	UN	01.03.12	MA	35411-420A1	12

Project No.

Drawing No. 35411-420-5

SCS92 - INV.STARTER

INTERCONNECTION DIAGRAM

Cont. on page 8

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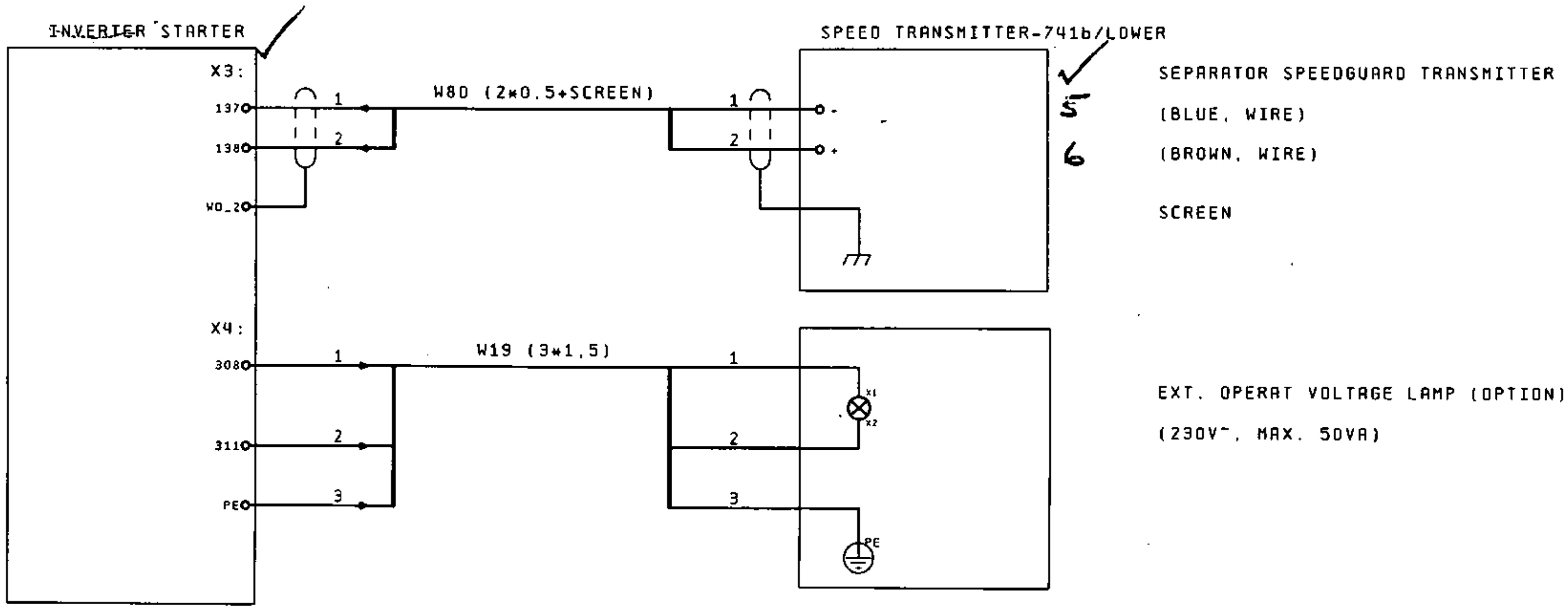

CONTROL CABLES TO INVERTER STARTER

Note			
Sign.			
Date			

Drawing remarks

Tetra Pak Processing Systems

Project No.

Drawing No. 35411-420-5

Department	Designer	Date	Verified	Name of Eplan-project	No. of pages
CCP	UN	01.03.12	HA	35411-420A1	12

SCS92 - INV.STARTER

INTERCONNECTION DIAGRAM

Cont. on page 9

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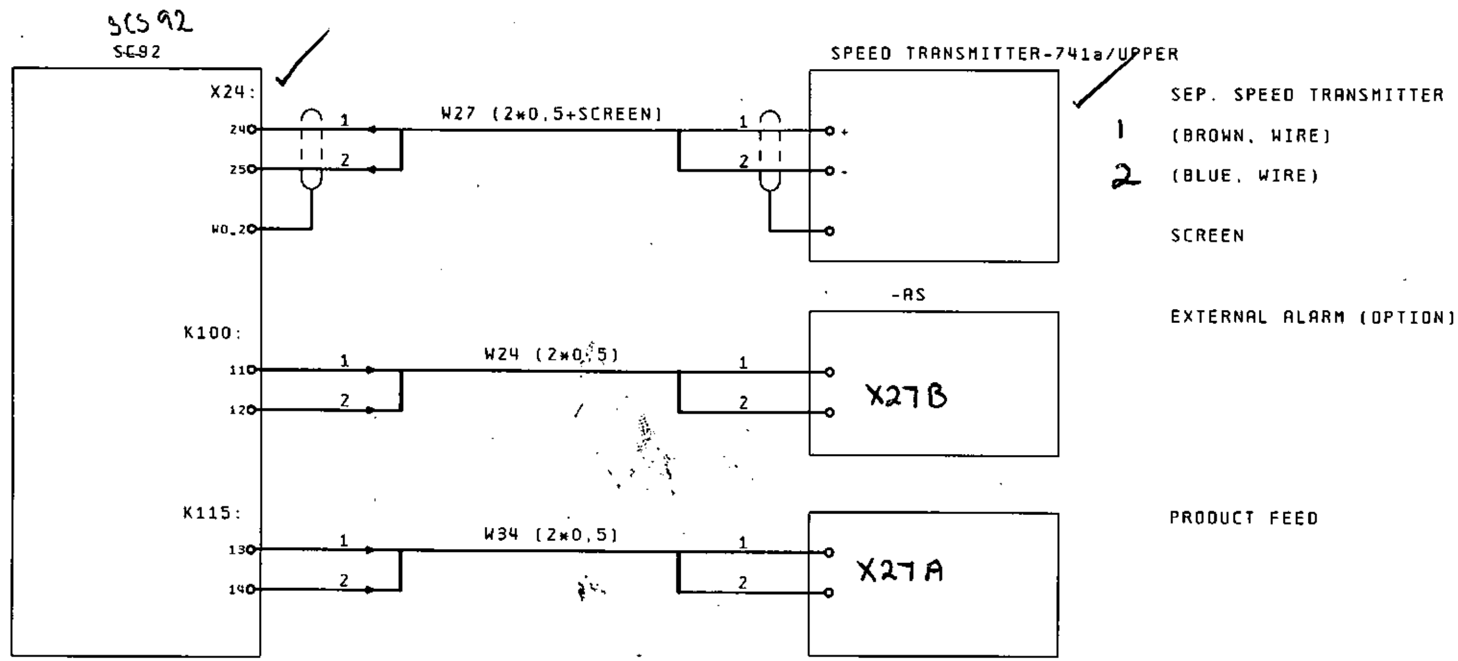

CONTROL CABLES TO SCS92

- Note
- Sign.
- Date
- Drawing remarks
- Tetra Pak Processing Systems
- Project No.
- Drawing No.: 35411-420-5
- Department: CCP
- Designer: UN
- Date: 01.03.12
- Verified: HA
- Name of Eplan-project: 35411-420A1
- No. of pages: 12
- Cont. on page: 10
- SCS92 - INV.STARTER
- INTERCONNECTION DIAGRAM
- Page: 9

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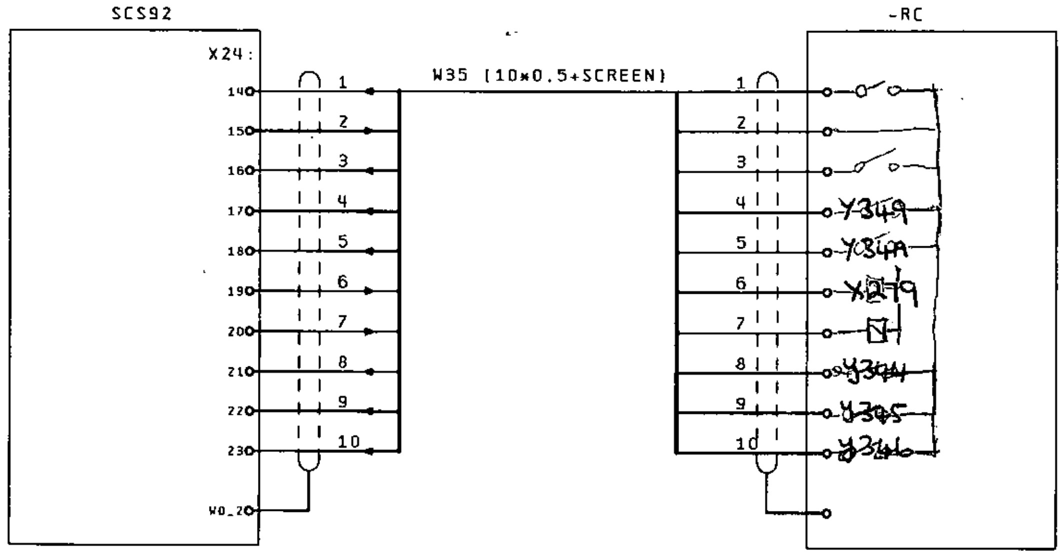

REMOTE CONTROL (OPTION)

STANDBY SIGNAL

+24V

DISCHARGE INITIATION

START/STOP SIGNAL

ALARM ACKOWLEDGE SIGNAL

REMOTE POSITION

PRODUCT 1 SIGNAL

PRODUCT 2 SIGNAL

PRODUCT 3 SIGNAL

SCREEN

Modes = Standstill
Start
Standby
Product
CIP water
CIP Det
Stop

REMOTE CONTROL CABLES TO SCS92

Note					
Sign.					
Date					
				Drawing remarks	

Tetra Pak
Processing Systems

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35411-420-5

SCS92 - INV.STARTER

INTERCONNECTION DIAGRAM

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2

2. Motor starter

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0 1 2 3 4 5 6 7 8 9

31821-9855-1
SEPARATOR
INVERTER STARTER PANEL

IDENTIFICATION OF DOCUMENTS

THE LAST DIGIT IN THE DRAWING NUMBER IS USED TO IDENTIFY THE TYPE OF DOCUMENT:

-0 LIST OF CONTENTS
-1 PARTS LIST
-2 FUNCTION EXPLANATION
-3 SOFTWARE DOCUMENTATION
-4 ASSEMBLY DRAWING
-5 CIRCUIT DIAGRAM
-6 INTERCONNECTION TABLE
-7 INSTALLATION DRAWING

(E.G. 3541-xxxx-5 IS A CIRCUIT DIAGRAM)

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Date	01.02.05	01.04.09	01.12.06

Drawing remarks

Tetra Pak
Processing Systems

Department	Designer	Date	Verified	Name of Eplan-project	No. of pages
CCP	MA	01.12.12	JL	35411-404A3	19

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35411-404-0

31821-9855-1
SEPARATOR
INVERTER STARTER PANEL

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=1/1

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1

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POS. No.	ARTICLE No.	PAGE REF.	QUANTITY	DENOMINATION	REV. No.
A10	3180191551	5/7.4	1.0	F/I CONVERTER,24VDC,PR ELECTRONICS 5225A2	3
F31	99049251	5/2.1	1.0	CIRCUIT BREAKER,1-POLE,2AD	
F34	99049205	5/2.3	1.0	CIRCUIT BREAKER,1-POLE,6A	
G1	99050346	5/8.1	1.0	FREQUENCY AC DRIVE,400V,IP54,VLT5032	3
G1	99050348	5/8.1	1.0	FREQUENCY AC DRIVE,400V,IP54,VLT5052	3
G1	99050394	5/8.1	1.0	FREQUENCY AC DRIVE,400V,IP54,VLT5062C	3
K1	3180191992	5/6.1	1.0	CONTACTOR,DIL-2M,44A,230VAC,K&M	
K1	3180151646	5/6.1	1.0	AUXILIARY CONTACT,11DIL,K&M	
K10	901190111	5/4.1	1.0	SAFETY RELAY,230VAC,JOKAB RT6	
K100	3180195271	5/5.2	1.0	TERMINAL RELAY,SPDT,24V,LED,WEIDM. DK5R	
K101	3180159561	5/5.3	1.0	MINIATURE RELAY,2-POLE,24VDC,LED	
K105	3180195271	5/5.4	1.0	TERMINAL RELAY,SPDT,24V,LED,WEIDM. DK5R	
K106	3180159561	5/5.5	1.0	MINIATURE RELAY,2-POLE,24VDC,LED	
K110	3180159561	5/6.6	1.0	MINIATURE RELAY,2-POLE,24VDC,LED	
K111	3180195271	5/6.7	1.0	TERMINAL RELAY,SPDT,24V,LED,WEIDM. DK5R	
K115	3180159561	5/6.8	1.0	MINIATURE RELAY,2-POLE,24VDC,LED	
K200	3180159561	5/7.5	1.0	MINIATURE RELAY,2-POLE,24VDC,LED	
K210	3180159561	5/8.9	1.0	MINIATURE RELAY,2-POLE,24VDC,LED	1
K220	3180195271	5/7.2	1.0	TERMINAL RELAY,SPDT,24V,LED,WEIDM. DK5R	1
K221	3180159561	5/7.3	1.0	MINIATURE RELAY,2-POLE,24VDC,LED	2
P1	3180151802	5/6.0	1.0	OPERATING TIME METER,230VAC,MÜLLER	
Q0	99049014	5/1.0	1.0	HANDLE,K&M H-NZM7	
Q0	99049015	5/1.0	1.0	SHAFT,K&M A-400-NZM7	
Q0	99049022	5/1.0	2.0	TERMINAL,K&M ST160-NZM7	
Q0	99049009	5/1.0	1.0	AUXILIARY CONTACT,K&M EK10	
Q0	99049010	5/1.0	1.0	AUXILIARY CONTACT,K&M EK01	
Q0	3592410124	5/1.0	1.0	SYMBOL SIGN "MAIN SWITCH"	

PARTS LIST

Note	1	2	3
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Tetra Pak
Processing Systems

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SEPARATOR
INVERTER STARTER PANEL

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POS. No.	ARTICLE No.	PAGE REF.	QUANTITY	DENOMINATION	REV. No.
00	99049002	5/1.0	1.0	CIRCUIT BREAKER,K&M NZM7-63N-M+DA	
00	99049003	5/1.0	1.0	CIRCUIT BREAKER,K&M NZM7-80N-M+DA	
00_1	99048506	5/2.2	1.0	MOTOR PROTECT,PKZM0-1,6	
00_1	99048507	5/2.2	1.0	MOTOR PROTECT,PKZM0-2,5	
T0	3180152592	5/2.1	1.0	TRANSFORMER,200-480/230+24V,600VA,SHIELDED	
W0_1	3180111782	5/3.1	1.0	CONNECTION BAR,10X3MM	
W0_1	3180159611	5/3.1	3.0	METAL SUPPORT FOR CONNECTION BAR	
W0_2	3180159611	5/3.1	2.0	METAL SUPPORT FOR CONNECTION BAR	
W10	3180159611	5/3.2	2.0	METAL SUPPORT FOR CONNECTION BAR	
X3/4/K	3180152245	5/5.5	1.0	TERMINAL ROW,SCS CT	
Z0	3180116161	5/2.1	1.0	MAINS FILTER,5A	
Z1	3180115963	5/2.3	1.0	MAINS FILTER,10A	
Z2	3180191701	5/7.4	1.0	MAINS FILTER,1A,SCHAFFNER FN332	
ZZA	9904000003	5/1.2	1.0	SIGN,"TETRA PAK,LOGOTYPE",260X38mm	
ZZA1	352103111	5/1.2	3.0	CABLE INLET,9-14mm,?R22,5,PLASTIC	
ZZAP	3182030462	5/1.3	1.0	CABINET FOR SCS CT,PAINTED,ELDON AS08083	
ZZAP	3180151922	5/1.3	1.0	PLASTIC FLANGE,FL21,12XPR22,5,MB10014	
ZZAP	3180151924	5/1.3	1.0	PLASTIC FLANGE,21,4XPR22,5+3X37,MB10017	
ZZAP	352103121	5/1.3	3.0	CABLE INLET,14-25mm,PR37,PLASTIC	
ZZAP	3180112492	5/1.3	2.0	RUBBER GASKET,FL21	
ZZAP	3180152699	5/1.3	8.0	RIVET FOR FLANGE,GASKET	
ZZAS	3182030432	5/1.3	1.0	CABINET FOR SCS CT,670x900x300,STAINL. STEEL	
ZZAS	3182030433	5/1.3	1.0	CABINET FOR SCS CT,800x1200x300,STAINL. STEEL	
ZZAS	99048046	5/1.3	3.0	CABLE INLET,17-26mm,PR47,PLASTIC	

PARTS LIST

Note					Tetra Pak Processing Systems	Department: CCP	Designer: MA	Date: 01.12.12	Verified: JL	Name of Eplan-project: 35411-404A3	No. of pages: 19
Sign.					Project No.	31821-9855-1 SEPARATOR INVERTER STARTER PANEL					Cont. on page =4/1.1
Date					Drawing No. 35411-404-1						Page 2
				Drawing remarks							

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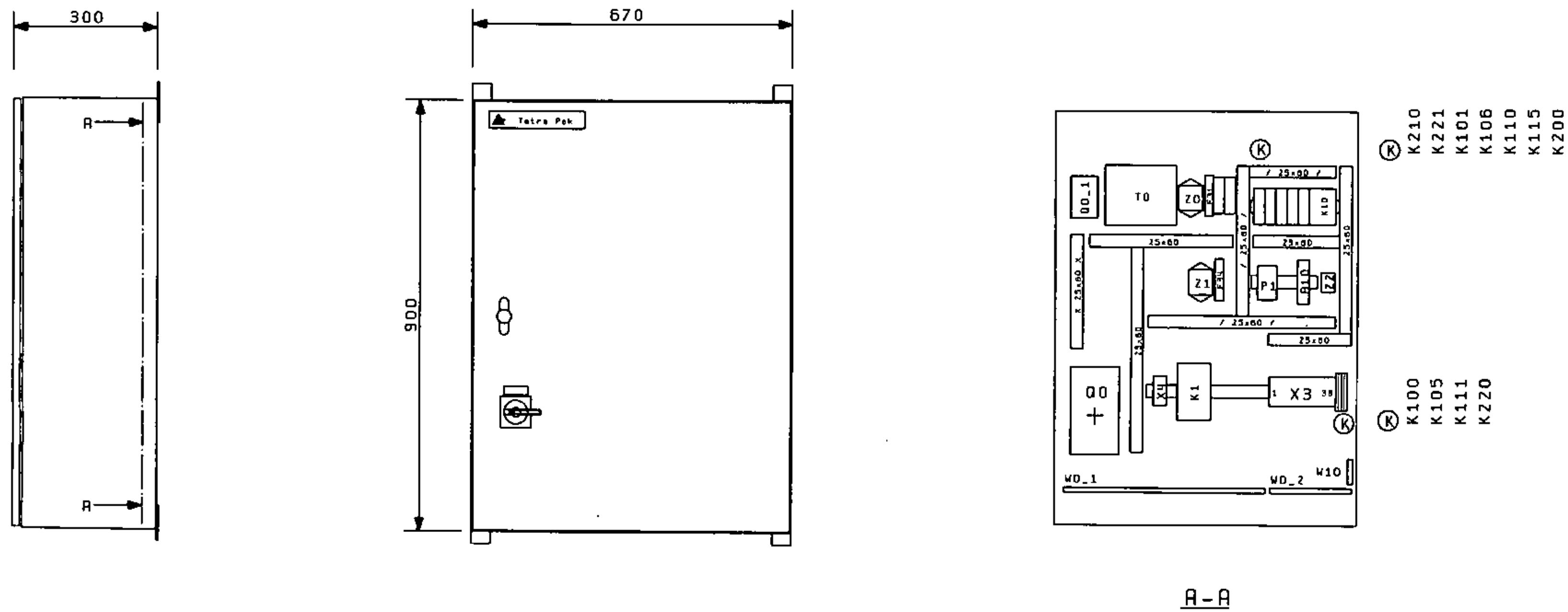

X 40x60 X	MAINS VOLTAGE, UNFILTERED
/ 40x60 /	MAINS VOLTAGE, FILTERED
40x60	EXTRA LOW VOLTAGE, FILTERED

ASSEMBLY DRAWING (3182030432)

Note	1	2
Sign.	UN	UN
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Drawing remarks

Tetra Pak
Processing Systems

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35411-404-4

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INVERTER STARTER PANEL

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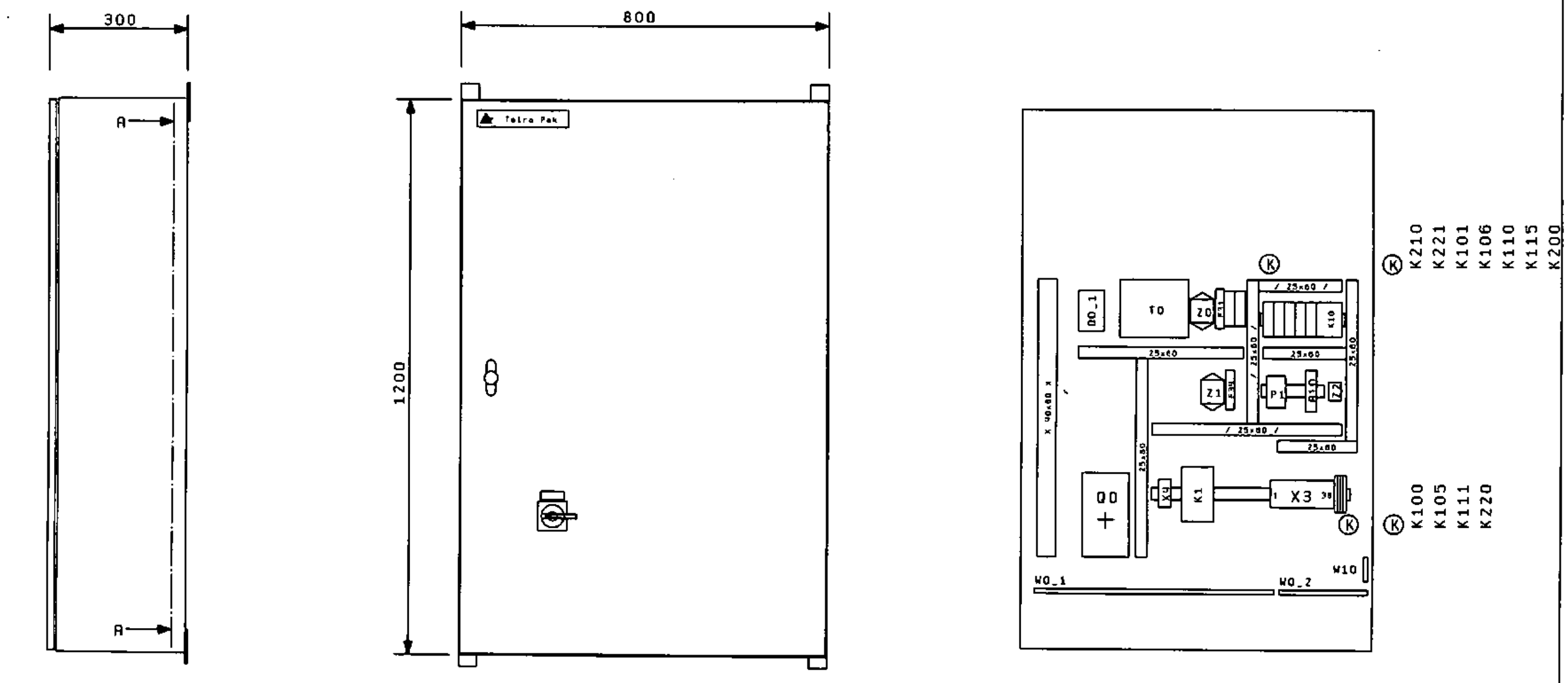

A-A

X 40x60 X	MAINS VOLTAGE, UNFILTERED
/ 40x60 /	MAINS VOLTAGE, FILTERED
40x60	EXTRA LOW VOLTAGE, FILTERED

ASSEMBLY DRAWING (3182030433)

Note	1	2
Sign.	UN	UN
Date	01.02.05	01.04.09

Drawing remarks

Tetra Pak
Processing Systems

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SEPARATOR
INVERTER STARTER PANEL

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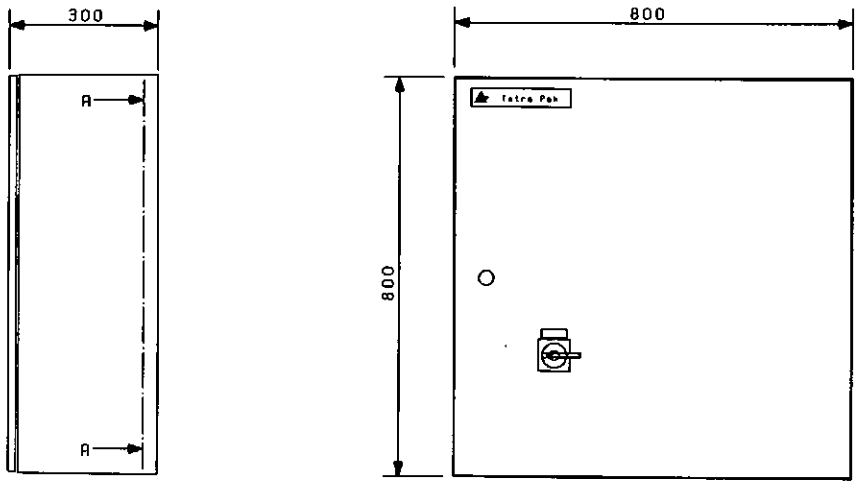

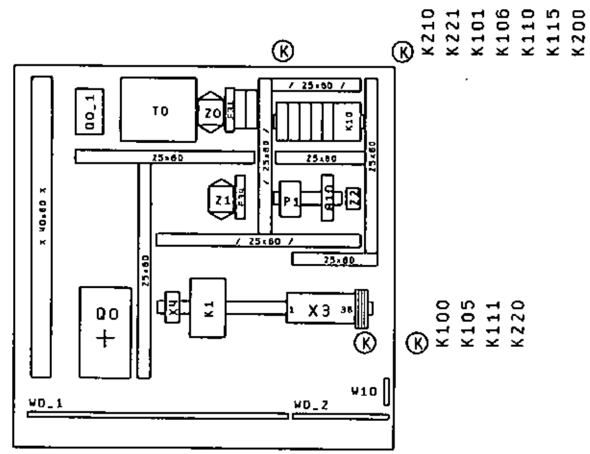

A-A

X 40x60 X	MAINS VOLTAGE, UNFILTERED
/ 40x60 /	MAINS VOLTAGE, FILTERED
40x60	EXTRA LOW VOLTAGE, FILTERED

ASSEMBLY DRAWING (3182030462)

Note	1	2
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Drawing remarks

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IDENTIFICATION OF WIRING INSIDE CONTROL CABINET

COLOR CODING IS USED FOR IDENTIFICATION OF SINGLE-CORE CABLES:

GREEN-AND-YELLOW	EARTH CONDUCTORS
BLUE	NEUTRAL CONDUCTORS
BLACK	POWER CIRCUITS
RED	A.C. CONTROL CIRCUITS
BLUE	D.C. CONTROL CIRCUITS
ORANGE	INTERLOCKING CONTROL CIRCUITS, SUPPLIED FROM EXTERNAL POWER

CROSS-SECTION OF SINGLE-CORE CABLES IS 0,75mm² IF NOTHING ELSE IS SPECIFIED.

IDENTIFICATION OF WIRING INSIDE CONTROL CABINET

Note			
Sign.			
Date			

Drawing remarks

Tetra Pak
Processing Systems

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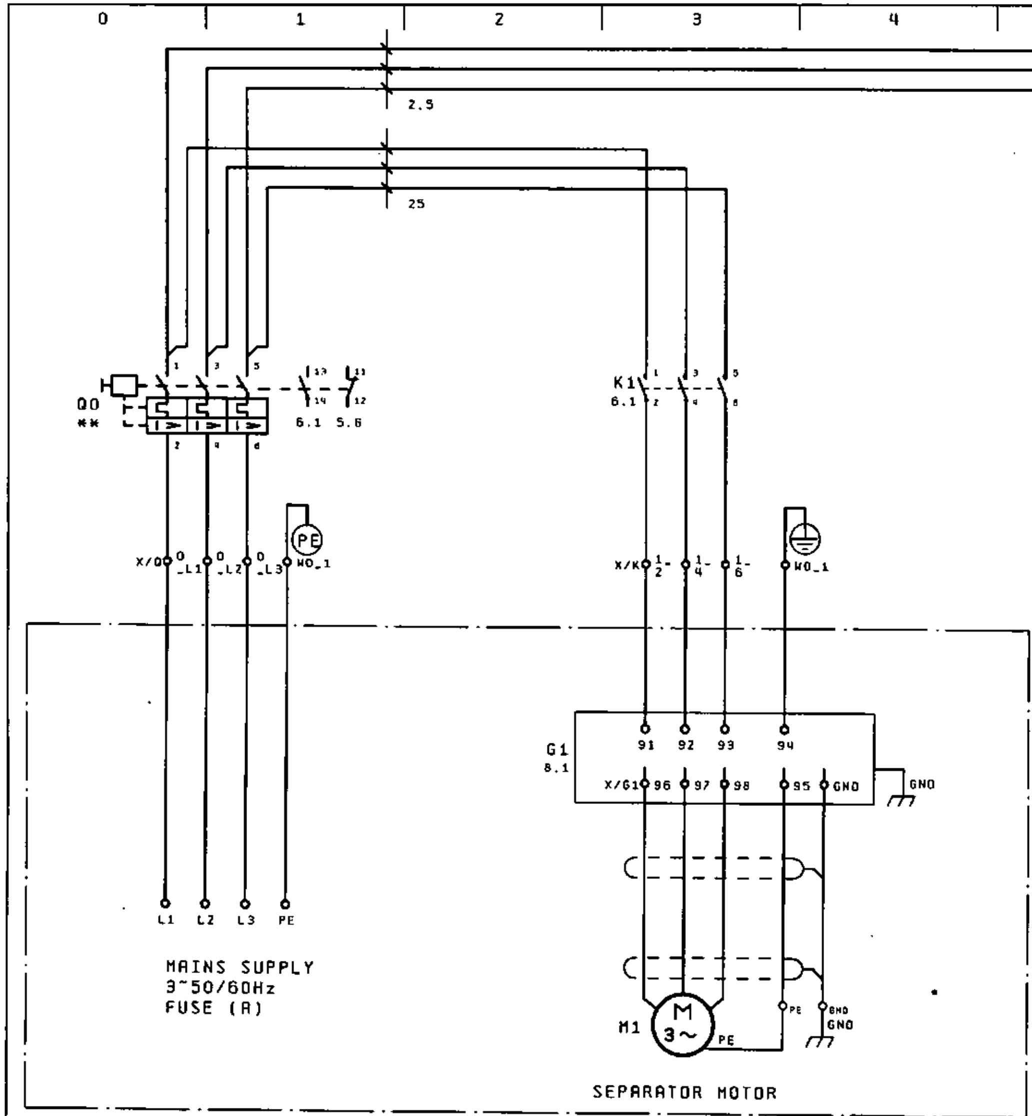

MOTOR **

Motor (KW)	U (V)	Fuse (A)	Q0
18.5	380-415	50	NZM7-63N
18.5	440-460	50	NZM7-63N
22	380-415	50	NZM7-63N
22	440-460	50	NZM7-63N
25	380-415	63	NZM7-63N
25	440-460	63	NZM7-63N
30	380-415	63	NZM7-63N
30	440-460	63	NZM7-63N
37	380-415	80	NZM7-80N
37	440-460	80	NZM7-80N

MOTOR, SUPPLY VOLTAGE

Note	1
Sign.	UN
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ZZA ZZAP
ZZA1 ZZAS
ZZC ZZS

Drawing remarks

Tetra Pak
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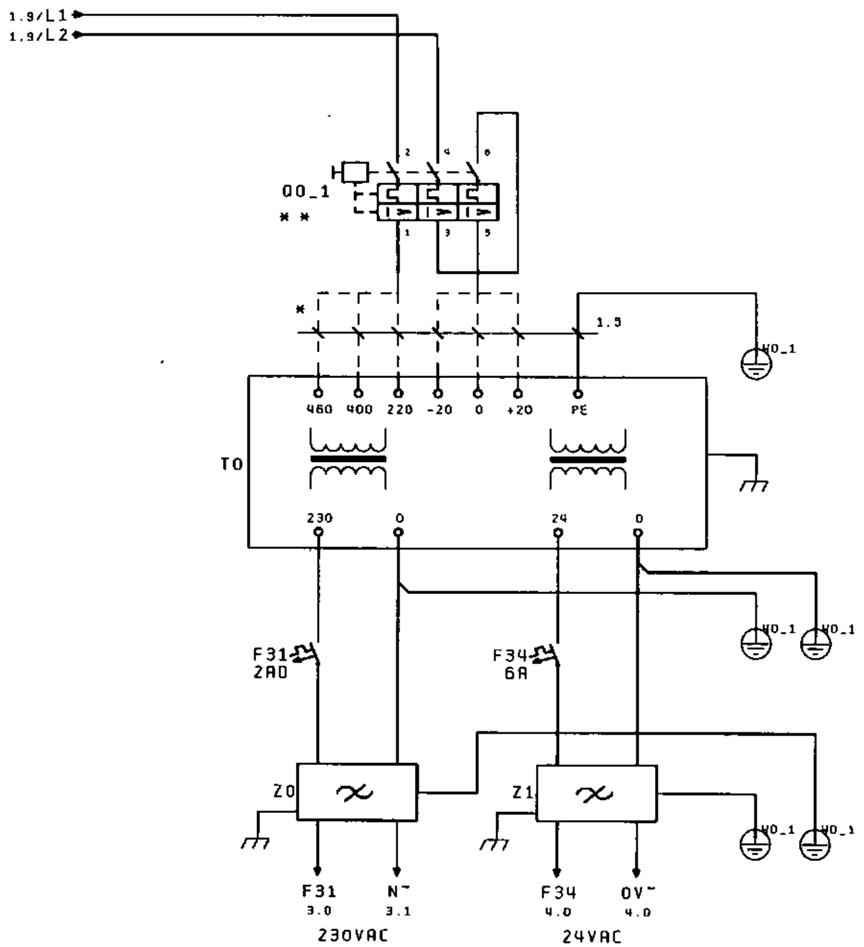

* *

Main Supply U (V)	QQ:1	QQ:1 I (A)
380	PKZMO-2,5	1,8
400-415	PKZMO-2,5	1,6
440-460	PKZMO-1,6	1,4

CONTROL, SUPPLY VOLTAGE

Note	1		
Sign.	UN		
Date	01.02.05		

* SEE MAIN SUPPLY

Drawing remarks

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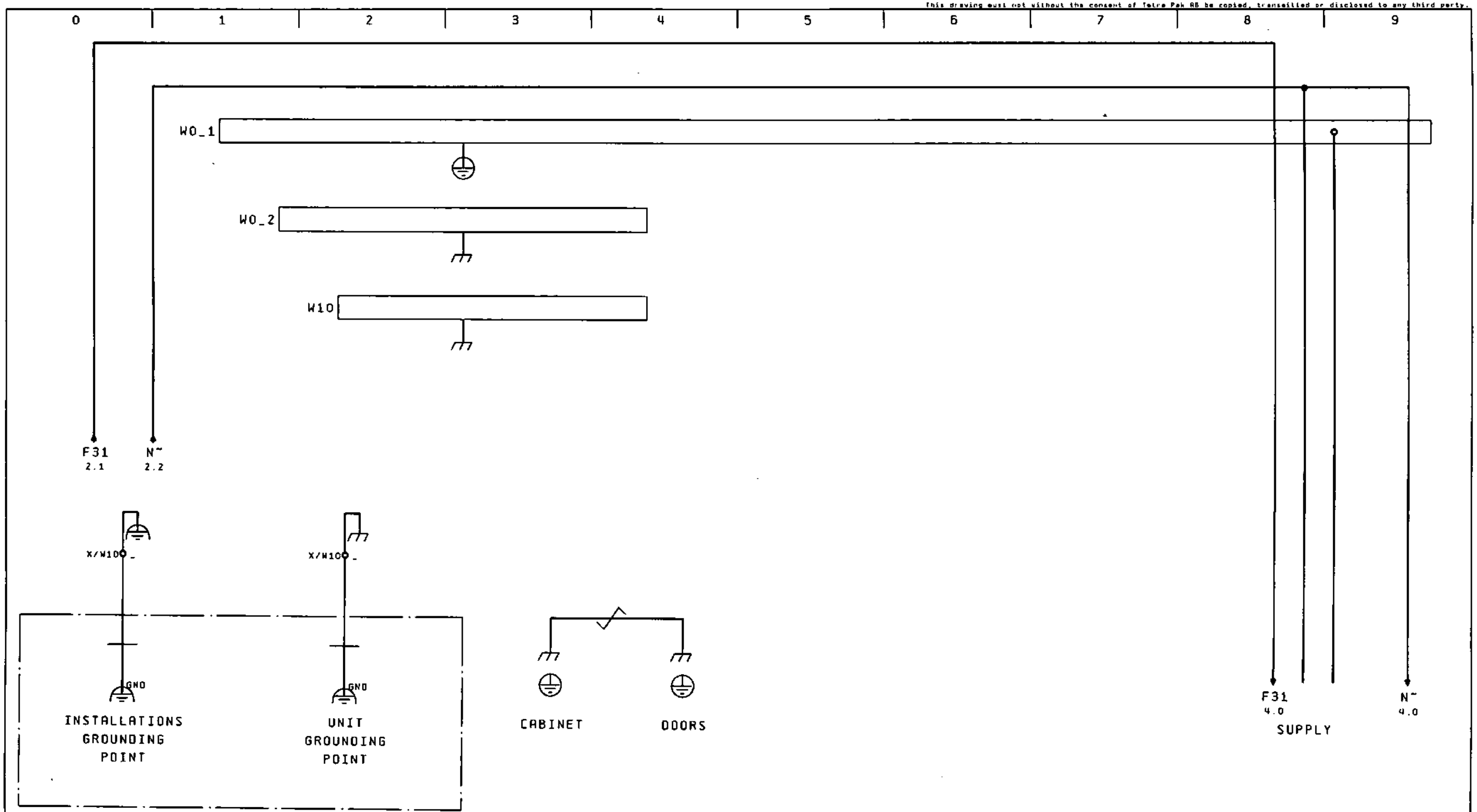

CONTROL, SUPPLY VOLTAGE

Note				
Sign.				
Date				
				Drawing remarks

Tetra Pak
Processing Systems

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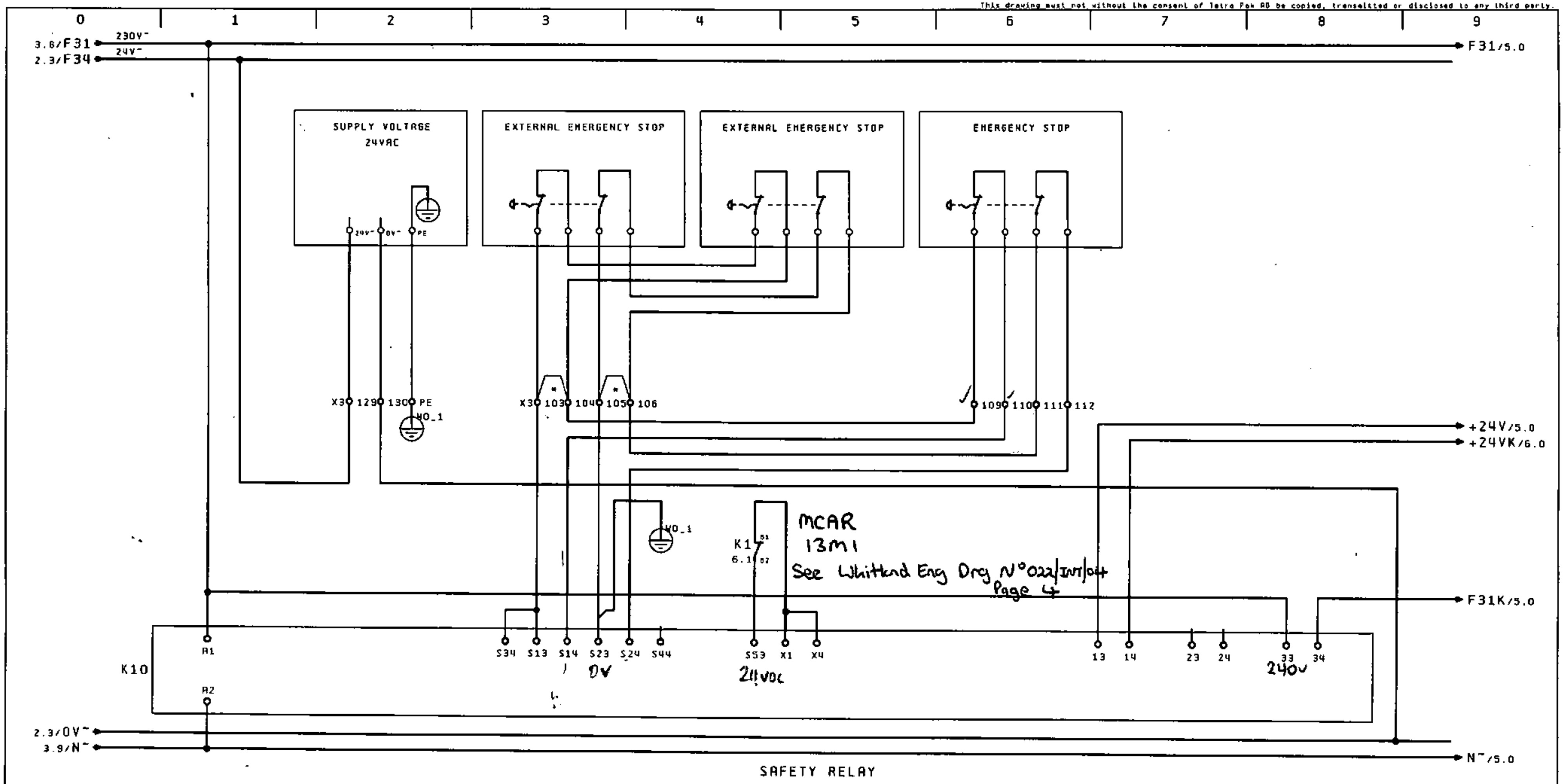

CONTROL LOGIC

Note	1		
Sign.	UN		
Date	01.02.05		

* DISCONNECT JUMPER IF SIGNAL IS USED

Drawing remarks

Tetra Pak
Processing Systems

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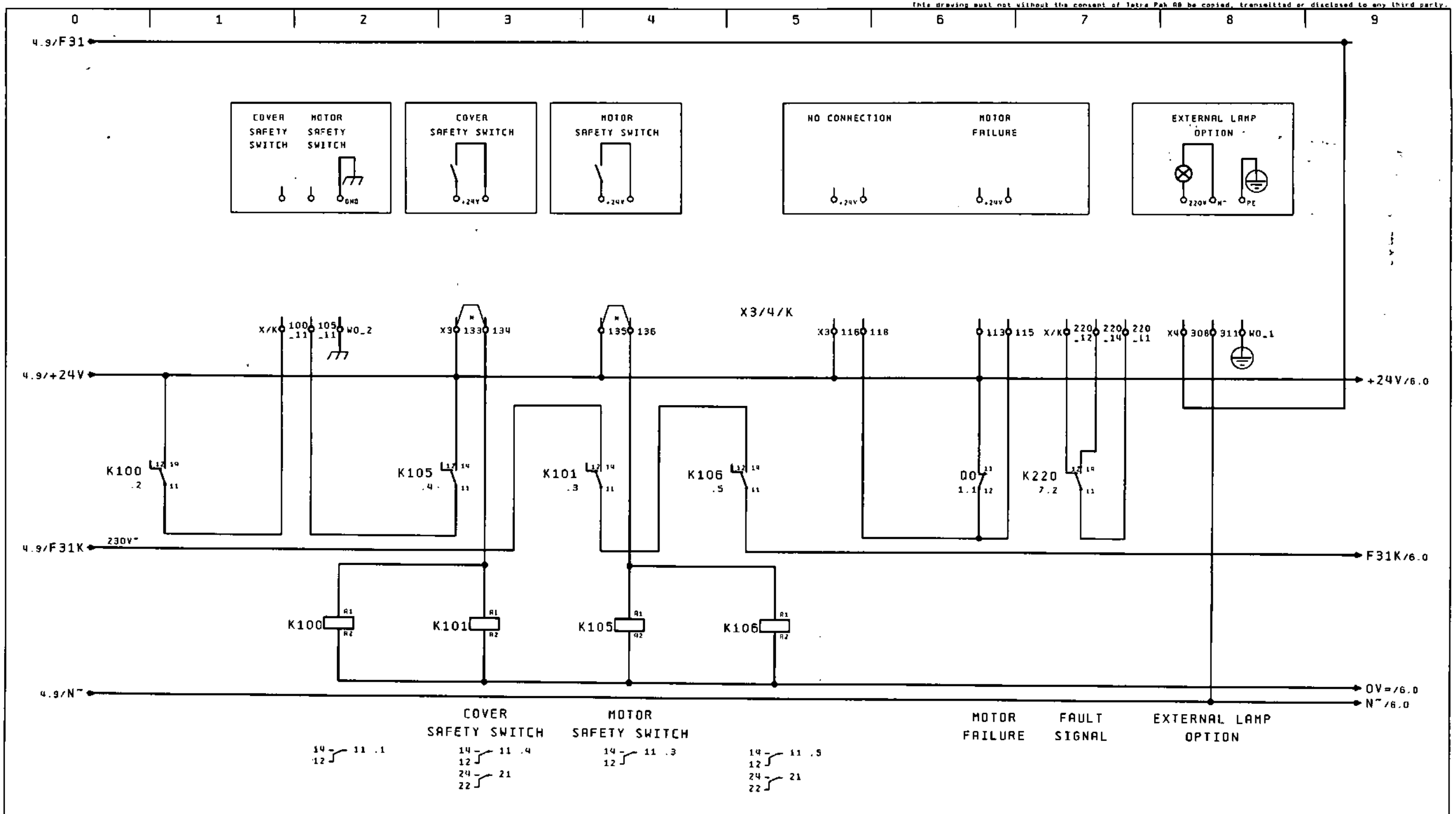

CONTROL LOGIC

Note	1	2	3
Sign.	UN	UN	AL
Date	01.02.05	01.04.09	01.12.06

* DISCONNECT JUMPER IF SIGNAL IS USED

Drawing remarks

Tetra Pak
Processing Systems

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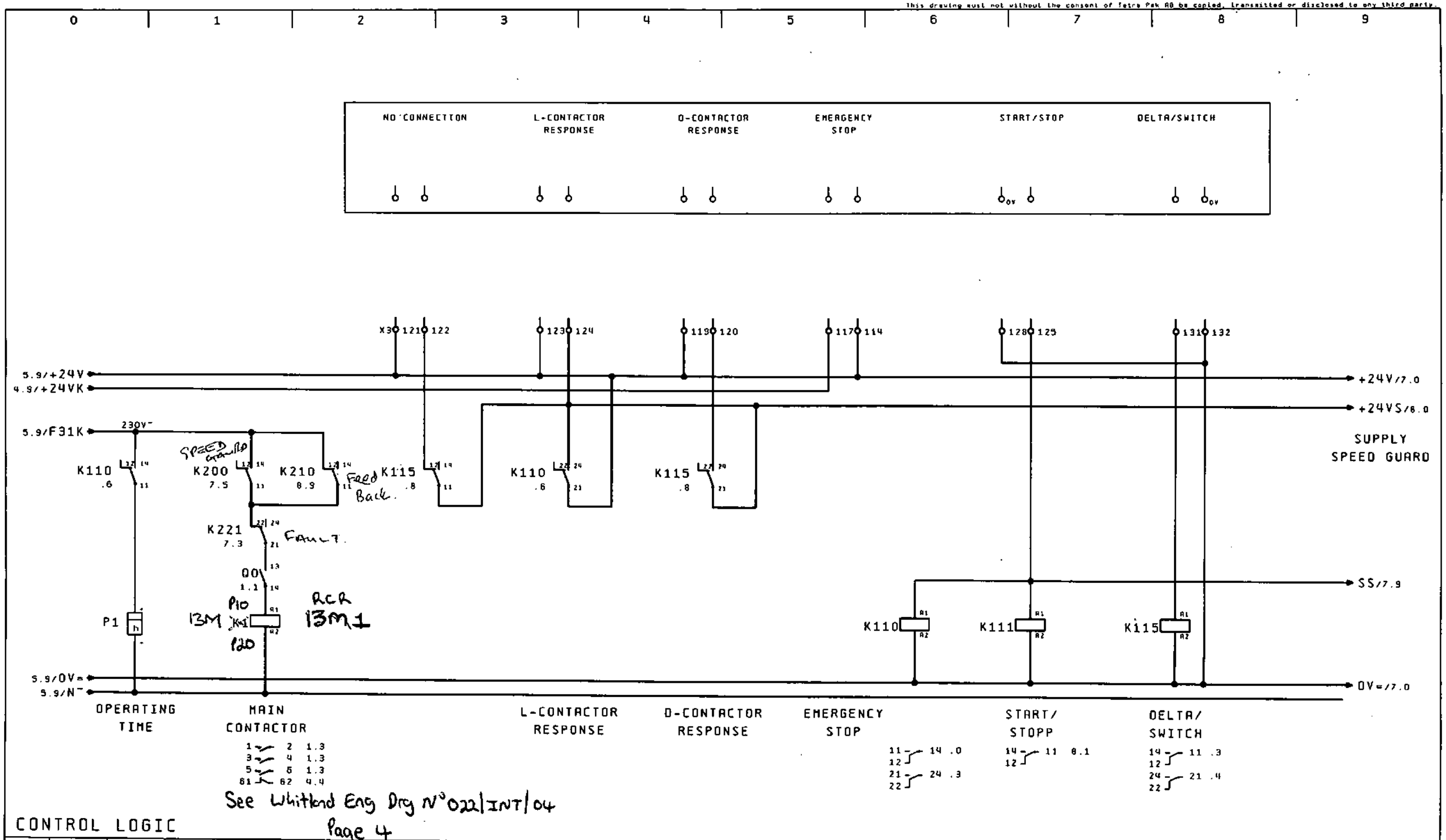

CONTROL LOGIC

Note	1	2	3		Tetra Pak Processing Systems	Department	Designer	Date	Verified	Name of Eplan-project	No. of pages
						CCP	MA	01.12.12	JL	35411-404A3	19
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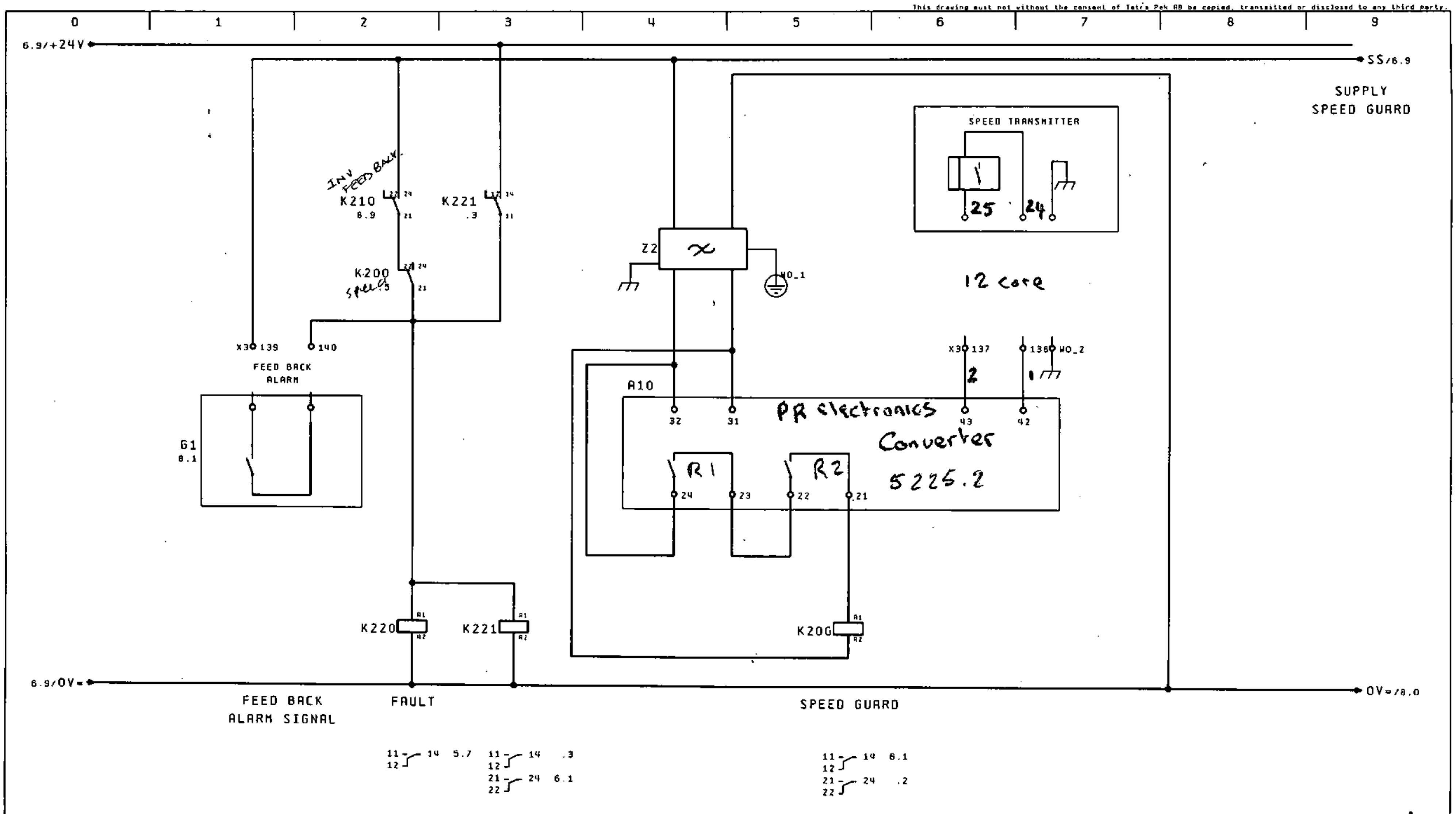

SPEED GUARD

Note	1	2	3								
Sign.	UN	UN	AL		Tetra Pak Processing Systems	Department: CCP	Designer: MA	Date: 01.12.12	Verified: JL	Name of Eplan-project: 35411-404A3	No. of pages: 19
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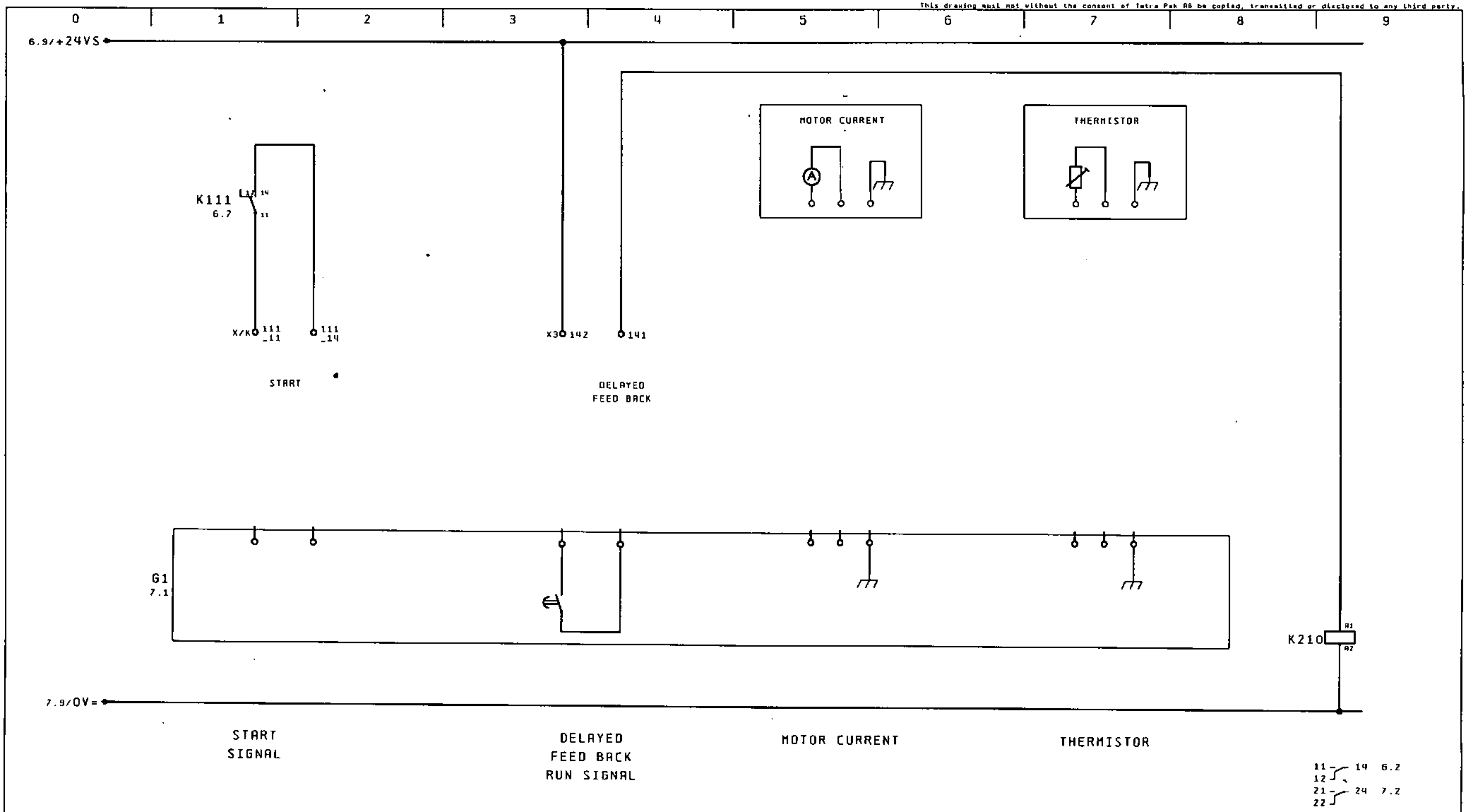
				Drawing remarks	Drawing No. 35411-404-5	SEPARATOR INVERTER STARTER PANEL					Page: 7



SIGNALS FOR FREQ. INVERTER

Note	1	2		
Sign.	UN	UN		
Date	01.02.05	01.04.09		
				Drawing remarks

Tetra Pak Processing Systems	Department: CCP	Designer: MA	Date: 01.12.12	Verified: JL	Name of Eplan-project: 35411-404A3
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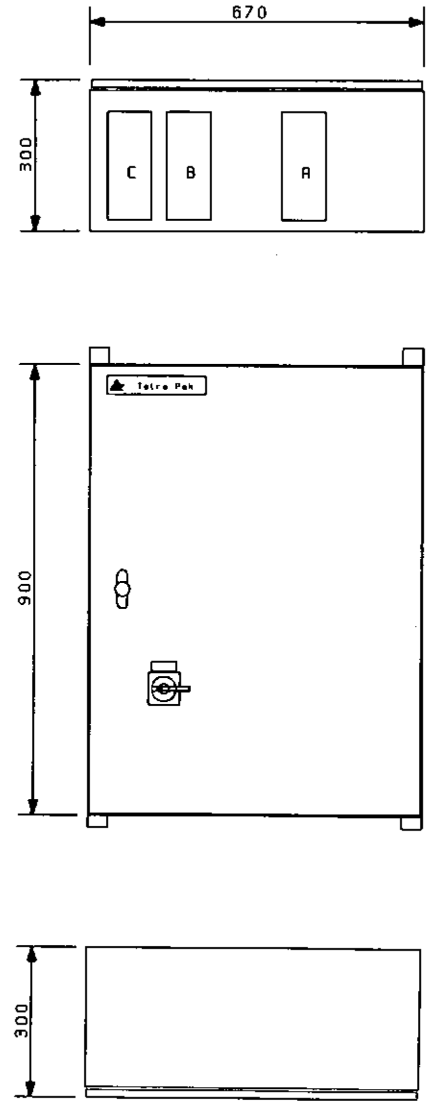

MATERIAL: STAINLESS STEEL SS142333

WEIGHT (kg): APPROXIMATE 70

DEGREE OF PROTECTION: IP55

POWER SUPPLY: 3~

(SEE LIST OF CABLES)

A: FLANGE FOR SIGNAL CABLES

B: FLANGE FOR MOTOR CABLES

C: FLANGE FOR MAIN POWER CABLE AND MOTOR CABLES

INSTALLATION DRAWING (3182030432)

Note				
Sign.				
Date				
				Drawing remarks

Tetra Pak
Processing Systems

Project No.:

Drawing No.: 35411-404-7

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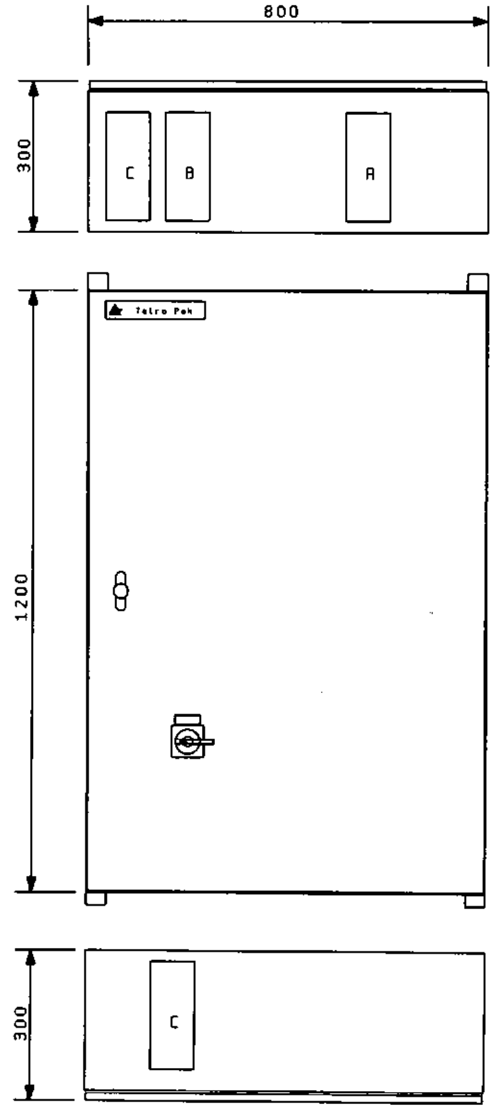

MATERIAL: STAINLESS STEEL SS142333

WEIGHT (kg): APPROXIMATE 90

DEGREE OF PROTECTION: IP55

POWER SUPPLY: 3~

(SEE LIST OF CABLES)

A: FLANGE FOR SIGNAL CABLES

B: FLANGE FOR MOTOR CABLES

C: FLANGE FOR MAIN POWER CABLE AND MOTOR CABLES

INSTALLATION DRAWING (3182030433)

Note				
Sign.				
Date				Drawing remarks

Tetra Pak
Processing Systems

Project No.:

Drawing No.: 35411-404-7

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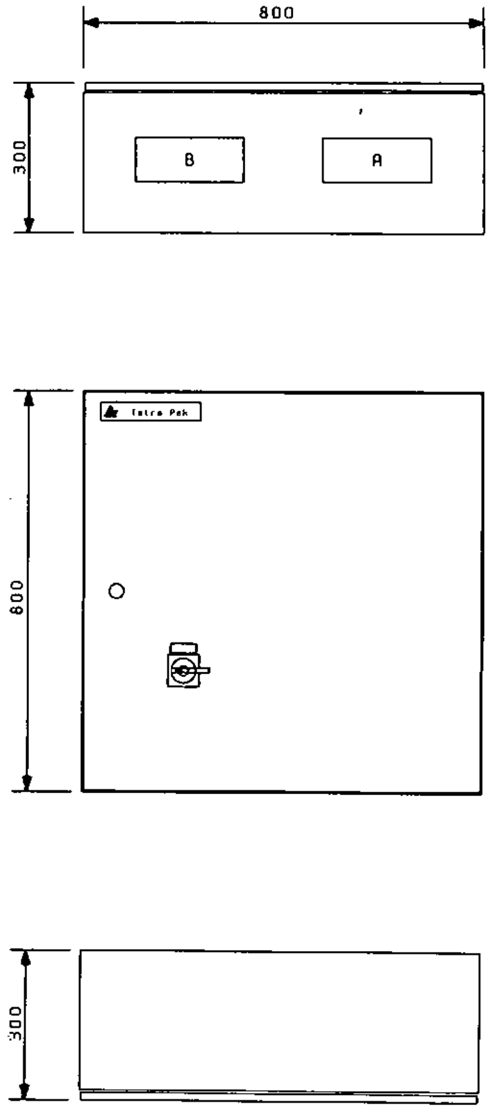
Page: 1.2

0 1 2 3 4 5 6 7 8 9



MATERIAL: PAINTED MILD STEEL
WEIGHT (kg): APPROXIMATE 90
DEGREE OF PROTECTION: IP55
POWER SUPPLY: 3~
(SEE LIST OF CABLES)
A: FLANGE FOR SIGNAL CABLES
B: FLANGE FOR MAIN POWER CABLE AND
MOTOR CABLES

INSTALLATION DRAWING (3182030462)

Note			
Sign.			
Date			

Drawing remarks

Tetra Pak
Processing Systems

Project No.

Drawing No. 35411-404-7

Department	Designer	Date	Verified	Name of Eplan-project	No. of pages
CCP	MA	01.12.12	JL	35411-404A3	19

31821-9855-1
SEPARATOR
INVERTER STARTER PANEL

Cont. on page

Page 1.3

3

3. Other components

MM2.2100013_1en2.fm

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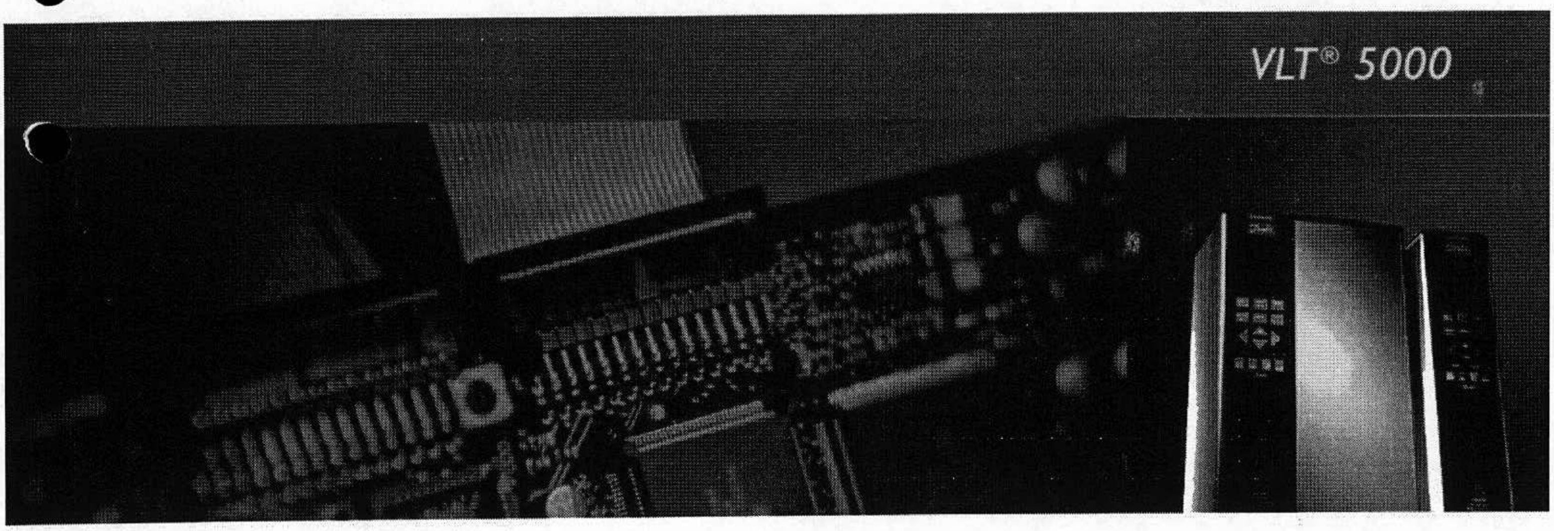
MM2.2100013_1en2.fm

Danfoss

Drives and Controls



VLT® The Real Drive

990503-01 R1

Changes in parameters and settings for the VLT 5000 Series Software version 3.4x

New parameters for Software Version 3.4x

455 Frequency range monitor
(MON. FREQ. RANGE)

Value:

	Disable	[0]
★	Enable	[1]

Function:
This parameter is used if warning 35 *Out of frequency range* must be turned off in the display in process control closed loop. This parameter does not affect the extended status word.

Description of choice:
Select *Enable* [1] to enable the readout in the display if warning 35 *Out of frequency range* occurs. Select *Disable* [0] to disable the readout in the display if warning 35 *Out of frequency range* occurs.

557 Data read-out: Motor RPM
(MOTOR RPM)

Value:
Unit: RPM

Function:
This parameter can be read out via the serial communication port. The value is updated every 80 ms.

Description of choice:
The displayed value corresponds to the actual motor RPM. In open loop or closed loop process control, the motor RPM is estimated. In speed closed loop modes, it is measured.

558 Data read-out: Motor RPM x scaling
(MOTOR RPM X SCALE)

Value:
Unit: RPM x scale

Function:
This parameter can be read out via the serial communication port. The value is updated every 80 ms.

Description of choice:
The displayed value corresponds to the actual motor RPM multiplied by a factor (scaling) set in parameter 008.

New parameter settings

- For parameters 009-012 the following settings have been added for software version 3.4x:

RPM [min^{-1}] (MOTOR RPM [RPM])	[31]
RPM x scaling [min^{-1}] (MOTOR RPM X SCALE)	[32]

RPM [min^{-1}] indicates the motor speed. In speed closed loop, the value is measured. In other modes the value is calculated based on the motor slip.
RPM x scaling [min^{-1}] indicates the motor RPM multiplied by a factor set in parameter 008

- For parameter 200 the following settings have been added for software version 3.4x:

Only counter clockwise, 0-132 Hz (132 Hz COUNTERCLOCK)	[4]
Only counter clockwise, 0-1000 Hz (1000 Hz COUNTERCLOCK)	[5]

Note that if *Clockwise, 0-132 Hz* [0], *Clockwise, 0-1000 Hz* [2], *Counter clockwise, 0-132 Hz* [4] or *Counter clockwise, 0-1000 HZ* [5] is selected, the output frequency will be limited to the range f_{MIN} - f_{MAX}.

continued....

For parameter 319 and 321 the following settings have been added:

Outputs	terminal no.	42	45
	parameter	319	321
Value:			
Mechanical brake control	(MECH. BRAKE CONTROL)	[32]	[32]
Extended mechanical brake control	(EXT. MECH. BRAKE)	[34]	[34]
0 - SyncRPM ⇒ 0-20 mA	(0-SYNCRPM = 0-20 mA)	[60]	[60]
0 - SyncRPM ⇒ 4-20 mA	(0-SYNCRPM = 4-20 mA)	[61]	[61]
0 - SyncRPM ⇒ 0-32000 p	(0-SYNCRPM = 0-32000 p)	[62]	[62]
0 - RPM at F_{MAX} ⇒ 0-20 mA	(0-RPMFMAX = 0-20 mA)	[63]	[63]
0 - RPM at F_{MAX} ⇒ 4-20 mA	(0-RPMFMAX = 4-20 mA)	[64]	[64]
0 - RPM at F_{MAX} ⇒ 0-32000 p	(0-RPMFMAX = 32000 p)	[65]	[65]

0 - SyncRPM ⇒ 0-20 mA and
0 - SyncRPM ⇒ 4-20 mA and
0 - SyncRPM⇒ 0-32000 p, an output signal proportional to the synchronous motor RPM is obtained.

0 - RPM at F_{MAX} ⇒ 0-20 mA and
0 - RPM at F_{MAX} ⇒ 4-20 mA and
0 - RPM at F_{MAX} ⇒ 0-32000 p, an output signal proportional to the rated motor RPM at F_{MAX} (parameter 202) is obtained.

■ Conversion index and data type

PNU #	Parameter description	Factory setting	Conversion index	Data type
455	Frequency range monitor	Enable	0	5
557	Data read-out: Motor RPM		0	4
558	Data read-out: Motor RPM x scaling		-2	4

■ Change of name

The name *Profidrive* is generally changed to *Fieldbus profile* including parameter 512.

Contents

VLT 5000 Series

Operating Instructions
Software version: 3.3x

CE

These Operating Instructions can be used for all VLT 5000 Series frequency converters with software version 3.3x. The software version can be seen from parameter 624.

■ The voltage of the frequency converter is dangerous whenever the equipment is connected to mains. Incorrect installation of the motor or the frequency converter may cause damage to the equipment, serious personal injury or death.
Consequently, the instructions in this manual, as well as national and local rules and safety regulations, must be complied with.

■ Safety regulations

1. The VLT frequency converter must be disconnected from mains if repair work is to be carried out. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.
2. The [STOP/RESET] key on the control panel of the VLT frequency converter does not disconnect the equipment from mains and is thus not to be used as a safety switch.
3. Correct protective earthing of the equipment must be established, the user must be protected against supply voltage, and the motor must be protected against overload in accordance with applicable national and local regulations.
4. The earth leakage currents are higher than 3.5 mA.
5. Protection against motor overload is not included in the factory setting. If this function is desired, set parameter 128 to data value *ETR trip* or data value *ETR warning*.
   Note: The function is initialised at 1.16 x rated motor current and rated motor frequency (see page 92).
   For the North American market: The ETR functions provide class 20 motor overload protection in accordance with NEC.
6. Do not remove the plugs for the motor and mains supply while the VLT frequency converter is connected to mains. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.
7. Please note that the VLT frequency converter has more voltage inputs than L1, L2 and L3, when loadsharing (linking of DC intermediate circuit) and external 24 V DC have been installed.
   Check that all voltage inputs have been disconnected and that the necessary time has passed before repair work is commenced.

■ Warning against unintended start

1. The motor can be brought to a stop by means of digital commands, bus commands, references or a local stop, while the frequency converter is connected to mains.
   If personal safety considerations make it necessary to ensure that no unintended start occurs, these stop functions are not sufficient.
2. While parameters are being changed, the motor may start. Consequently, the stop key [STOP/RESET] must always be activated, following which data can be modified.
3. A motor that has been stopped may start if faults occur in the electronics of the VLT frequency converter, or if a temporary overload or a fault in the supply mains or the motor connection ceases.

Warning:

Touching the electrical parts may be fatal - even after the equipment has been disconnected from mains.
Also make sure that other voltage inputs have been disconnected, such as external 24 V DC, load-sharing (linkage of DC intermediate circuit), as well as the motor connection for kinetic back-up.

Using VLT 5001-5006: wait at least 4 minutes
Using VLT 5008-5500: wait at least 15 minutes

These Operating Instructions are a tool intended for persons who are to install, operate and program the VLT 5000 Series.

Specific technical publications on the VLT 5000 Series: Operating Instructions, Design Guide and Quick Setup.

Operating Instructions: Gives instructions in optimum installation, commissioning and service.

Design Guide: Gives all required information for design purposes, and gives a good insight into the technology, product range, technical data, etc.

Quick Setup: Helps the great majority of users to quickly get their VLT 5000 Series unit installed and running.

The Operating Instructions and the Quick Setup are delivered with the unit.

When reading these Operating Instructions, you will come across different symbols that require special attention.

The symbols used are the following:


Indicates a general warning


Indicates something to be noted by the reader


Indicates a high-voltage warning

■ Why choose Danfoss?

Danfoss manufactured the world's first mass-produced frequency converter back in 1968. We have set the standard for quality drives ever since. That is why our VLT frequency converters are today sold and serviced in more than 100 countries covering six continents.

With the new VLT 5000 Series, we are introducing VVC^plus. This is our new Sensorless Vector Drive System for torque and speed control of induction motors.

If compared with a standard voltage/frequency ratio control, VVC^plus offers improved dynamics and stability, both when the speed reference and the load torque are changed. We have implemented a fully digitalised protection concept, which ensures reliable operation, even under the worst possible operating conditions. Naturally, the VLT 5000 Series also offers full protection against short-circuiting, earthing fault and overload.

Danfoss drives with the VVC^plus control system tolerate load shocks throughout their speed range and react swiftly to changes in reference.

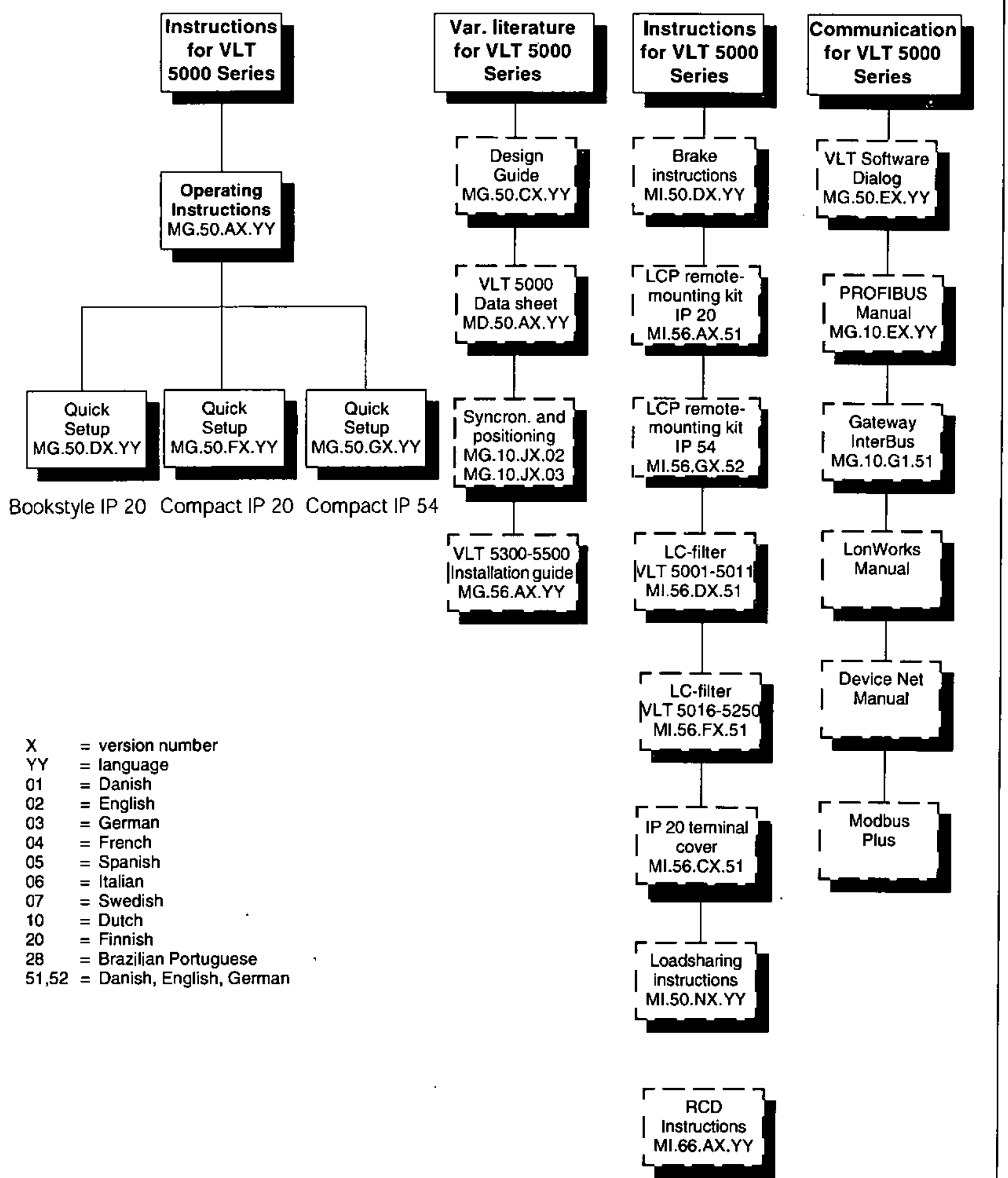
However, it must also be easy to reach this performance. Danfoss is convinced that high-technology drives can be made user-friendly. The VLT 5000 Series proves us right. In order to make programming simple and easy-to-grasp, we have divided the parameters into different groups. The Quick menu guides users quickly through the programming of the few parameters that must be set to get started. The control panel is detachable. It features a four-line alphanumeric display, enabling four measuring values to be displayed at the same time. Via the detachable control panel, the programmed settings can be copied from one VLT frequency converter to the next. This means that there is no time to be spent on programming when changing drives or integrating an extra drive in the installation.

The entire programming process is easier than ever before. The VLT 5000 Series makes most adjustments automatically.

If you have any questions concerning VLT frequency converters, please call us. We have drive specialists all over the world ready to advise you on applications, programming, training and service.

Available literature

The chart below gives an overview of the literature available for the VLT 5000 Series.
Please note that variations may occur from one country to the next.



X = version number
YY = language
01 = Danish
02 = English
03 = German
04 = French
05 = Spanish
06 = Italian
07 = Swedish
10 = Dutch
20 = Finnish
28 = Brazilian Portuguese
51,52 = Danish, English, German

■ General technical data

Mains supply (L1, L2, L3):

- Supply voltage 200-240 V units .... 3 x 200/208/220/230/240 V ±10%
- Supply voltage 380-500 V units .... 3 x 380/400/415/440/460/500 V ±10%
- Supply frequency .... 50/60 Hz +/- 1%
- Max. imbalance of supply voltage:
- VLT 5001 - 5011 / 380 - 500 V and VLT 5001 - 5006 / 200 - 240 V .... ±2.0% of rated supply voltage
- VLT 5016 - 5052 / 380 - 500 V and VLT 5008 - 5027 / 200 - 240 V .... ±1.5% of rated supply voltage
- VLT 5060 - 5500 / 380 - 500 V and VLT 5032 - 5052 / 200 - 240 V .... ±3.0% of rated supply voltage
- Power factor / cos. φ .... 0.90/1.0 at rated load
- No. of switches on supply input L1, L2, L3 .... approx. 1 time/min.
- Max. shortcircuit rating .... 100,000 A

See the section on special conditions in the Design Guide

VLT output data (U, V, W):

- Output voltage .... 0-100% of supply voltage
- Output frequency .... 0 - 132 Hz, 0 - 1000 Hz
- Rated motor voltage, 200-240 V units .... 200/208/220/230/240 V
- Rated motor voltage, 380-500 V units .... 380/400/415/440/460/480/500 V
- Rated motor frequency .... 50/60 Hz
- Switching on output .... Unlimited
- Ramp times .... 0.05-3600 sec.

Torque characteristics:

- Starting torque, VLT 5001-5027, 200 - 240 V and VLT 5001-5052, 380 - 500 V .... 160% for 1 min.
- Starting torque, VLT 5032 - 5052, 200 - 240 V and VLT 5060-5500, 380 - 500 V .... 150% for 1 min.
- Starting torque .... 180% for 0.5 sec.
- Acceleration torque 100%
- Overload torque, VLT 5001-5027, 200 - 240 V and VLT 5001 - 5052, 380 - 500 V 160%
- Overload torque, VLT 5032 - 5052, 200 - 240 V and VLT 5060-5500, 380 - 500 V 150%
- Arresting torque at 0 rpm (closed loop) 100%

The torque characteristics given are for the VLT frequency converter at the high overload torque level (160%). At the normal overload torque (110%), the values are lower.

Control card, digital inputs:

- Number of programmable digital inputs 8
- Terminal nos. 16, 17, 18, 19, 27, 29, 32, 33
- Voltage level .... 0-24 V DC (PNP positive logics)
- Voltage level, logical '0' .... < 5 V DC
- Voltage level, logical '1' .... > 10 V DC
- Maximum voltage on input .... 28 V DC
- Input resistance, R_i .... approx. 2 kΩ
- Scanning time per input .... 3 msec.

Reliable galvanic isolation: All digital inputs are galvanically isolated from the supply voltage (PELV). In addition, the digital inputs can be isolated from the other terminals on the control card by connecting an external 24 V DC supply and opening switch 4. See drawing on page 45.

General technical data

Control card, analogue inputs:

- No. of programmable analogue voltage inputs/thermistor inputs 2
- Terminal nos. 53, 54
- Voltage level .... 0 - ±10 V DC (scalable)
- Input resistance, R_i .... approx. 10 kΩ
- No. of programmable analogue current inputs 1
- Terminal no. 60
- Current range .... 0/4 - ±20 mA (scalable)
- Input resistance, R_i .... 200 Ω
- Resolution .... 10 bit + sign
- Accuracy on input .... Max. error 1% of full scale
- Scanning time per input .... 3 msec.
- Terminal no. ground 55

Reliable galvanic isolation: All analogue inputs are galvanically isolated from the supply voltage (PELV) as well as other inputs and outputs.

Control card, pulse/encoder input:

- No. of programmable pulse/encoder inputs 4
- Terminal nos. 17, 29, 32, 33
- Max. frequency on terminal 17 .... 5 kHz
- Max. frequency on terminals 29, 32, 33 .... 20 kHz (PNP open collector)
- Max. frequency on terminals 29, 32, 33 .... 65 kHz (Push-pull)
- Voltage level .... 0-24 V DC (PNP positive logics)
- Voltage level, logical '0' .... < 5 V DC
- Voltage level, logical '1' .... > 10 V DC
- Maximum voltage on input .... 28 V DC
- Input resistance, R_i .... approx. 2 kΩ
- Scanning time per input .... 3 msec.
- Resolution .... 10 bit + sign
- Accuracy (100-1 kHz), terminals 17, 29, 33 .... Max. error: 0.5% of full scale
- Accuracy (1-5 kHz), terminal 17 .... Max. error: 0.1% of full scale
- Accuracy (1-65 kHz), terminals 29, 33 .... Max. error: 0.1% of full scale

Reliable galvanic isolation: All pulse/encoder inputs are galvanically isolated from the supply voltage (PELV). In addition, pulse and encoder inputs can be isolated from the other terminals on the control card by connecting an external 24 V DC supply and opening switch 4. See drawing on page 45.

Control card, digital/pulse and analogue outputs:

- No. of programmable digital and analogue outputs 2
- Terminal nos. 42, 45
- Voltage level at digital/pulse output .... 0 - 24 V DC
- Minimum load to ground (terminal 39) at digital/pulse output .... 600 Ω
- Frequency ranges (digital output used as pulse output) .... 0-32 kHz
- Current range at analogue output .... 0/4 - 20 mA
- Maximum load to ground (terminal 39) at analogue output .... 500 Ω
- Accuracy of analogue output .... Max. error: 1.5% of full scale
- Resolution on analogue output. .... 8 bit

Reliable galvanic isolation: All digital and analogue outputs are galvanically isolated from the supply voltage (PELV) as well as other inputs and outputs.

■ General technical data

Control card, 24 V DC supply:

Terminal nos.	12, 13
Max. load (short-circuit protection)	200 mA
Terminal nos. ground	20, 39

Reliable galvanic isolation: The 24 V DC supply is galvanically isolated from the supply voltage (PELV), but has the same potential as the analogue outputs.

Control card, RS 485 serial communication:

Terminal nos.	68 (TX+, RX+), 69 (TX-, RX-)

Reliable galvanic isolation: Full galvanic isolation.

Relay outputs:

No. of programmable relay outputs	2
Terminal nos., control card	4-5 (make)
Max. terminal load (AC) on 4-5, control card	50 V AC, 1 A, 60 VA
Max. terminal load (DC) on 4-5, control card	75 V DC, 1 A, 30 W
Max. terminal load (DC) on 4-5, control card for UL/cUL applications	30 V AC, 1 A / 42.5 V DC, 1A
Terminal nos., power card	1-3 (break), 1-2 (make)
Max. terminal load (AC) on 1-3, 1-2, power card and relay card	240 V AC, 2 A, 60 VA
Max. terminal load on 1-3, 1-2, power card and relay card	50 V DC, 2 A
Min. terminal load on 1-3, 1-2, power card and relay card	24 V DC 10 mA, 24 V AC 100 mA

Brake resistor terminals (only SB and EB units):

Terminal nos.	81, 82

External 24 Volt DC supply:

Terminal nos.	35, 36
Voltage range	24 V DC ±15% (max. 37 V DC for 10 sec.)
Max. voltage ripple	2 V DC
Power consumption	15 W - 50 W (50 W for start-up, 20 msec.)
Min. pre-fuse	6 Amp

Reliable galvanic isolation: Full galvanic isolation if the external 24 V DC supply is also of the PELV type.

Cable lengths and cross-sections:

Max. motor cable length, screened cable	150 m
Max. motor cable length, unscreened cable	300 m
Max. motor cable length, screened cable VLT 5011 380-500 V	100 m
Max. brake cable length, screened cable	20 m

Max. loadsharing cable length, screened cable 25 m from frequency converter to DC bar.

Max. cable cross-section for motor, brake and loadsharing, see next section

Max. cable cross-section for 24 V external DC supply	4.0 mm²/10 AWG
Max. cross-section for control cables	1.5 mm²/16 AWG
Max. cross-section for serial communication	1.5 mm²/16 AWG

Accuracy of display readout (parameters 009-012):

Motor current [6] 0-140% load	Max. error: ±2.0% of rated output current
Torque % [7], -100 - 140% load	Max. error: ±5% of rated motor size
Output [8], power HP [9], 0-90% load	Max. error: ±5% of rated output

General technical data

Control characteristics:

Frequency range	0 - 1000 Hz
Resolution on output frequency	±0.003 Hz
System response time	3 msec.
Speed, control range (open loop)	1:100 of synchro. speed
Speed, control range (closed loop)	1:1000 of synchro. speed
Speed, accuracy (open loop)	< 1500 rpm: max. error ± 7.5 rpm > 1500 rpm: max. error of 0.5% of actual speed
Speed, accuracy (closed loop)	< 1500 rpm: max. error ± 1.5 rpm > 1500 rpm: max. error of 0.1% of actual speed
Torque control accuracy (open loop)	0- 150 rpm: max. error ±20% of rated torque 150-1500 rpm: max. error ±10% of rated torque > 1500 rpm: max. error ±20% of rated torque
Torque control accuracy (speed feedback)	Max. error ±5% of rated torque

All control characteristics are based on a 4-pole asynchronous motor

Externals:

Enclosure	IP 00, IP 20, IP 54
Vibration test	0.7 g RMS 18-1000 Hz random. 3 directions for 2 hours (IEC 68-2-34/35/36)
Max. relative humidity	93 % (IEC 68-2-3) for storage/transport
Max. relative humidity	95 % non condensing (IEC 721-3-3; class 3K3) for operation
Ambient temperature IP 20 (high overload torque 160%)	Max. 45°C (24-hour average max. 40°C)
Ambient temperature IP 20 (normal overload torque 110%)	Max. 40°C (24-hour average max. 35°C)
Ambient temperature IP 54 (high overload torque 160%)	Max. 40°C (24-hour average max. 35°C)
Ambient temperature IP 54 (normal overload torque 110%)	Max. 40°C (24-hour average max. 35°C)
Ambient temperature IP 20/54 VLT 5011 500 V	Max. 40°C (24-hour average max. 35°C)

Derating for high ambient temperature, see page 96 of the Design Guide

Min. ambient temperature in full operation	0°C
Min. ambient temperature at reduced performance	-10°C
Temperature during storage/transport	-25 - +65/70°C
Max. altitude above sea level	1000 m

Derating for high altitude, see page 96 of the Design Guide

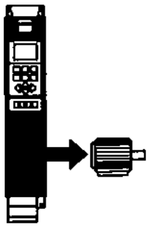
EMC standards applied, Emission	EN 50081-1/2, EN 61800-3, EN 55011, EN 55014
Immunity	EN 50082-2, EN 61000-4-2, IEC 1000-4-3, EN 61000-4-4 EN 61000-4-5, ENV 50140, ENV 50141, VDE 0160/1990.12

See section on special conditions in the Design Guide

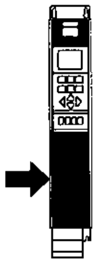
VLT 5000 Series protection:

- Electronic motor thermal protection against overload.
- Temperature monitoring of heat-sink ensures that the VLT frequency converter cuts out if the temperature reaches 90°C for IP 00 and IP 20. For IP 54, the cut-out temperature is 80°C. An overtemperature can only be reset when the temperature of the heat-sink has fallen below 60°C.
- The VLT frequency converter is protected against short-circuiting on motor terminals U, V, W.
- The VLT frequency converter is protected against earth fault on motor terminals U, V, W.
- Monitoring of the intermediate circuit voltage ensures that the VLT frequency converter cuts out if the intermediate circuit voltage gets too high or too low.
- If a motor phase is missing, the VLT frequency converter cuts out, see parameter 234 *Motor phase monitor.*
- If there is a mains fault, the VLT frequency converter is able to carry out a controlled deramping.
- If a mains phase is missing, the VLT frequency converter will cut out when a load is placed on the motor.

■ Mains supply 3 x 200 - 240 V

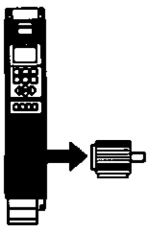


According to international requirements	VLT type	5001	5002	5003	5004	5005	5006
Output current	$I_{VLT,N}$ [A]	3.7	5.4	7.8	10.6	12.5	15.2
	$I_{VLT,MAX}$ (60 s) [A]	5.9	8.6	12.5	17	20	24.3
Output (240 V)	$S_{VLT,N}$ [kVA]	1.5	2.2	3.2	4.4	5.2	6.3
Typical shaft output	$P_{VLT,N}$ [kW]	0.75	1.1	1.5	2.2	3.0	3.7
Typical shaft output	$P_{VLT,N}$ [HP]	1	1.5	2	3	4	5
Max. cable cross-section to motor, brake and loadsharing	[mm²]/[AWG] 2)	4/10	4/10	4/10	4/10	4/10	4/10

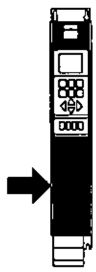


Rated input current	(200 V) $I_{L,N}$ [A]	3.4	4.8	7.1	9.5	11.5	14.5
Max. cable cross-section power	[mm²]/[AWG] 2)	4/10	4/10	4/10	4/10	4/10	4/10
Max. pre-fuses	[-]/UL 1) [A]	16/10	16/10	16/15	25/20	25/25	35/30
Efficiency 3)		0.95					
Weight IP 20 EB	[kg]	7	7	7	9	9	9,5
Power loss at max. load. [W]	Total	58	76	95	126	172	194
Enclosure	VLT type IP 20						

■ Mains supply 3 x 380 - 500 V



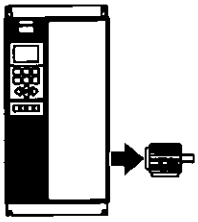
According to international requirements	VLT type	5001	5002	5003	5004	5005	5006	5008	5011
Output current	$I_{VLT,N}$ [A] (380-440 V)	2.2	2.8	4.1	5.6	7.2	10	13	16
	$I_{VLT,MAX}$ (60 s) [A] (380-440 V)	3.5	4.5	6.5	9	11.5	16	20.8	25.6
	$I_{VLT,N}$ [A] (441-500 V)	1.9	2.6	3.4	4.8	6.3	8.2	11	14.5
	$I_{VLT,MAX}$ (60 s) [A] (441-500 V)	3	4.2	5.5	7.7	10.1	13.1	17.6	23.2
Output	$S_{VLT,N}$ [kVA] (380-440 V)	1.7	2.1	3.1	4.3	5.5	7.6	9.9	12.2
	$S_{VLT,N}$ [kVA] (441-500 V)	1.6	2.3	2.9	4.2	5.5	7.1	9.5	12.6
Typical shaft output	$P_{VLT,N}$ [kW]	0.75	1.1	1.5	2.2	3.0	4.0	5.5	7.5
Typical shaft output	$P_{VLT,N}$ [HP]	1	1.5	2	3	4	5	7.5	10
Max. cable cross-section to motor, brake and loadsharing	[mm²]/[AWG] 2)	4/10	4/10	4/10	4/10	4/10	4/10	4/10	4/10



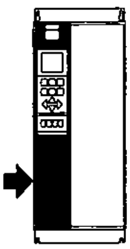
Rated input current	$I_{L,N}$ [A] (380 V)	2.3	2.6	3.8	5.3	7	9.1	12.2	15.0
	$I_{L,N}$ [A] (460 V)	1.9	2.5	3.4	4.8	6	8.3	10.6	14.0
Max. cable cross-section, power	[mm²]/[AWG]2)	4/10	4/10	4/10	4/10	4/10	4/10	4/10	4/10
Max. pre-fuses	[-]/UL1) [A]	16/6	16/6	16/10	16/10	16/15	25/20	25/25	35/30
Efficiency3)		0.96							
Weight IP 20 EB	[kg]	7	7	7	7.5	7.5	9.5	9.5	9.5
Power loss at max. load. [W]	Total	55	67	92	110	139	198	250	295
Enclosure	VLT type	IP 20							

1. If UL/cUL is to be complied with, pre-fuses type Bussmann KTN-R 200 V, KTS-R 500 V or similar must be used. Pre-fuses type gG must be used for VLT 5001 - VLT 5027, 200/240 V and VLT 5001 - VLT 5052, 380/500 V. Pre-fuses type gR must be used for VLT 5032 - 5052, 200/240 V and VLT 5060 - VLT 5500, 380/500 V. Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 Amps rms (symmetrical), 500 V maximum.
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.

■ Mains supply 3 x 200 - 240 V



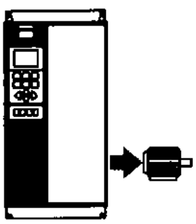
According to international requirements	VLT type	5001	5002	5003	5004	5005	5006
High overload torque (160 %):							
Output current	$I_{VLT,N}$ [A]	3.7	5.4	7.8	10.6	12.5	15.2
	$I_{VLT,MAX}$ (60 s) [A]	5.9	8.6	12.5	17	20	24.3
Output (240 V)	$S_{VLT,N}$ [kVA]	1.5	2.2	3.2	4.4	5.2	6.3
Typical shaft output	$P_{VLT,N}$ [kW]	0.75	1.1	1.5	2.2	3.0	3.7
Typical shaft output	$P_{VLT,N}$ [HP]	1	1.5	2	3	4	5
Max. cable cross-section to motor, brake and loadsharing	[mm^2]/[AWG][2]	4/10	4/10	4/10	4/10	4/10	4/10



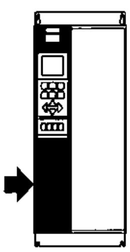
		5001	5002	5003	5004	5005	5006
Rated input current	(200 V) $I_{L,N}$ [A]	3.4	4.8	7.1	9.5	11.5	14.5
Max. cable cross-section, power	[mm^2]/[AWG][2]	4/10	4/10	4/10	4/10	4/10	4/10
Max. pre-fuses	[-]/UL [1] [A]	16/10	16/10	16/15	25/20	25/25	35/30
Efficiency [3]		0.95					
Weight IP 20 EB	[kg]	8	8	8	10	10	10
Weight IP 54	[kg]	11.5	11.5	11.5	13.5	13.5	13.5
Power loss at max. load. [W]	Total	58	76	95	126	172	194
Enclosure		IP 20/IP 54					

■ Mains supply 3 x 200 - 240 V

According to international requirements	VLT type		5008	5011	5016	5022	5027
Normal overload torque (110 %):							
Output current	$I_{VLT,N}$ [A]		32	46	61.2	73	88
	$I_{VLT,MAX}$ (60 s) [A]		35.2	50.6	67.3	80.3	96.8
Output (240 V)	$S_{VLT,N}$ [kVA]		13.3	19.1	25.4	30.3	36.6
Typical shaft output	$P_{VLT,N}$ [kW]		7.5	11	15	18.5	22
Typical shaft output	$P_{VLT,N}$ [HP]		10	15	20	25	30



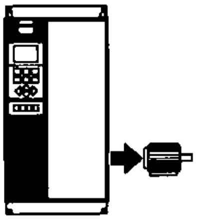
			5008	5011	5016	5022	5027
High overload torque (160 %):							
Output current	$I_{VLT,N}$ [A]		25	32	46	61,2	73
	$I_{VLT,MAX}$ (60 s) [A]		40	51.2	73.6	97.9	116.8
Output (240 V)	$S_{VLT,N}$ [kVA]		10	13	19	25	30
Typical shaft output	$P_{VLT,N}$ [kW]		5.5	7.5	11	15	18.5
Typical shaft output	$P_{VLT,N}$ [HP]		7.5	10	15	20	25
Max. cable cross-section to motor,		IP 54	16/6	16/6	35/2	35/2	50/0
brake and loadsharing	[mm^2/AWG] [2]	IP 20	16/6	35/2	35/2	35/2	50/0
Min. cable cross-section to motor, brake and loadsharing [4]	[mm^2/AWG] [2]		10/8	10/8	10/8	10/8	16/6



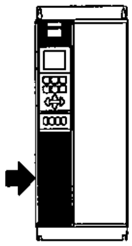
			5008	5011	5016	5022	5027
Rated input current (200 V)	$I_{L,N}$ [A]		32	46	61	73	88
Max. cable cross-section,		IP 54	16/6	16/6	35/2	35/2	50/0
power	[mm^2]/[AWG] [2]	IP 20	16/6	35/2	35/2	35/2	50/0
Max. pre-fuses	[-]/UL [1] [A]		50	60	80	125	125
Pre-fuse SMPS	[-]/UL [1] [A]		4.0/4.0				
Efficiency [3]			0.95				
Weight IP 00	[kg]						
Weight IP 20 EB	[kg]		23	23	30	30	48
Weight IP 54	[kg]		35	38	49	50	55
Power loss at max. load.							
- high overload torque (160 %)	[W]		340	426	626	833	994
- normal overload torque (110 %)	[W]		426	545	783	1042	1243
Enclosure			IP 20+NEMA 1 kit, IP 54/NEMA 12				

1. If UL/cUL is to be complied with, pre-fuses type Bussmann KTN-R or similar must be used. Pre-fuses type gG must be used for VLT 5001 - VLT 5027, 200/240 V and VLT 5001 - VLT 5052, 380/500 V. Pre-fuses type gR must be used for VLT 5032 - 5052, 200/240 V and VLT 5060 - VLT 5500, 380/500 V. Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 Amps rms (symmetrical), 500 V maximum.
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.
4. Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals. Always comply with national and local regulations on min. cable cross-section.

■ Mains supply 3 x 380 - 500 V



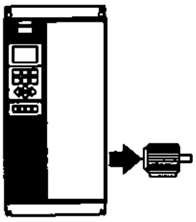
According to international requirements	VLT type	5001	5002	5003	5004	5005	5006	5008	5011
High overload torque (160 %):									
Output current	$I_{VLT,N}$ [A] (380-440 V)	2.2	2.8	4.1	5.6	7.2	10	13	16
	$I_{VLT,MAX}$ (60 s) [A] (380-440 V)	3.5	4.5	6.5	9	11.5	16	20.8	25.6
	$I_{VLT,N}$ [A] (441-500 V)	1.9	2.6	3.4	4.8	6.3	8.2	11	14.5
	$I_{VLT,MAX}$ (60 s) [A] (441-500 V)	3	4.2	5.5	7.7	10.1	13.1	17.6	23.2
Output	$S_{VLT,N}$ [kVA] (380-440 V)	1.7	2.1	3.1	4.3	5.5	7.6	9.9	12.2
	$S_{VLT,N}$ [kVA] (441-500 V)	1.6	2.3	2.9	4.2	5.5	7.1	9.5	12.6
Typical shaft output	$P_{VLT,N}$ [kW]	0.75	1.1	1.5	2.2	3.0	4.0	5.5	7.5
Typical shaft output	$P_{VLT,N}$ [HP]	1	1.5	2	3	4	5	7.5	10
Max. cable cross-section to motor, brake and loadsharing	[mm²]/[AWG]²⁾	4/10	4/10	4/10	4/10	4/10	4/10	4/10	4/10



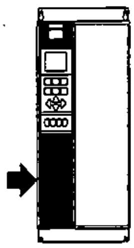
Rated input current	$I_{L,N}$ [A] (380 V)	2.3	2.6	3.8	5.3	7	9.1	12.2	15.0
	$I_{L,N}$ [A] (460 V)	1.9	2.5	3.4	4.8	6	8.3	10.6	14.0
Max. cable cross-section, power	[mm²]/[AWG]²⁾	4/10	4/10	4/10	4/10	4/10	4/10	4/10	4/10
Max. pre-fuses	[-]/UL ¹⁾[A]	16/6	16/6	16/10	16/10	16/15	25/20	25/25	35/30
Efficiency ³⁾		0.96							
Weight IP 20 EB	[kg]	8	8	8	8.5	8.5	10.5	10.5	10.5
Weight IP 54	[kg]	11.5	11.5	11.5	12	12	14	14	14
Power loss at load [W]	Total	55	67	92	110	139	198	250	295
Enclosure		IP 20/IP 54							

1. If UL/cUL is to be complied with, pre-fuses type Bussmann KTS-R or similar must be used. Pre-fuses type gG must be used for VLT 5001 - 5027, 200/240 V and VLT 5001 - 5052, 380/500 V. Pre-fuses type gR must be used for VLT 5032 - 5052, 200/240 V and VLT 5060 - 5500, 380/500 V. Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 Amps ms (symmetrical), 500 V maximum.
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.

■ Mains supply 3 x 380 - 500 V



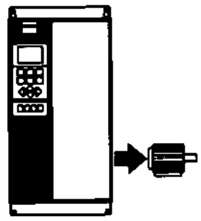
According to international requirements	VLT type	5016	5022	5027	5032	5042	5052
Normal overload torque (110 %):							
Output current	$I_{VLT,N}$ [A] (380-440 V)	32	37.5	44	61	73	90
	$I_{VLT,MAX}$ (60 s) [A] (380-440 V)	35.2	41.3	48.4	67.1	80.3	99
	$I_{VLT,N}$ [A] (441-500 V)	27.9	34	41.4	54	65	78
	$I_{VLT,MAX}$ (60 s) [A] (441-500 V)	30.7	37.4	45.5	59.4	71.5	85.8
Output	$S_{VLT,N}$ [kVA] (380-440 V)	24.4	28.6	33.5	46.5	55.6	68.6
	$S_{VLT,N}$ [kVA] (441-500 V)	24.2	29.4	35.8	46.8	56.3	67.5
Typical shaft output	$P_{VLT,N}$ [kW]	15	18.5	22	30	37	45
Typical shaft output	$P_{VLT,N}$ [HP]	20	25	30	40	50	60
High overload torque (160 %):							
Output current	$I_{VLT,N}$ [A] (380-440 V)	24	32	37.5	44	61	73
	$I_{VLT,MAX}$ (60 s) [A] (380-440 V)	38.4	51.2	60	70.7	97.6	116.8
	$I_{VLT,N}$ [A] (441-500 V)	21.7	27.9	34	41.4	54	65
	$I_{VLT,MAX}$ (60 s) [A] (441-500 V)	34.7	44.6	54.4	66.2	86	104
Output	$S_{VLT,N}$ [kVA] (380-440 V)	18.3	24.4	28.6	33.5	46.5	55.6
	$S_{VLT,N}$ [kVA] (441-500 V)	18.8	24.2	29.4	35.9	46.8	56.3
Typical shaft output	$P_{VLT,N}$ [kW]	11	15	18.5	22	30	37
Typical shaft output	$P_{VLT,N}$ [HP]	15	20	25	30	40	50
Max. cable cross-section to motor,	IP 54	16/6	16/6	16/6	35/2	35/2	50/0
brake and loadsharing [mm2]/[AWG][2]	IP 20	16/6	16/6	35/2	35/2	35/2	50/0
Min. cable cross-section to motor,							
brake and loadsharing [mm2]/[AWG]		10/8	10/8	10/8	10/8	10/8	16/6



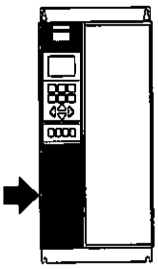
Rated input current	$I_{L,N}$ [A] (380 V)	32	37.5	44	60	72	89
	$I_{L,N}$ [A] (460 V)	27.6	34	41	53	64	77
Max. cable cross-section,	IP 54	16/6	16/6	16/6	35/2	35/2	50/0
power [mm²]/[AWG]	IP 20	16/6	16/6	35/2	35/2	35/2	50/0
Max. pre-fuses	[-]/UL [1] [A]	63/40	63/50	63/60	80/80	100/100	125/125
Pre-fuse SMPS	[-]/UL [1] [A]	4.0/4.0					
Efficiency		0.96					
Weight IP 20 EB	[kg]	23	23	30	30	48	48
Weight IP 54	[kg]	48	48	51	61	67	70
Power loss at max. load.							
- high overload torque (160 %)	[W]	419	559	655	768	1065	1275
- normal overload torque (110 %)	[W]	559	655	768	1065	1275	1571
Enclosure		IP 20/IP 54					

1. If UL/cUL is to be complied with, pre-fuses type Bussmann KTS-R or similar must be used. Pre-fuses type gG must be used for VLT 5001 - 5027, 200/240 V and VLT 5001 - 5052, 380/500 V. Pre-fuses type gR must be used for VLT 5032 - 5052, 200/240 V and VLT 5060 - 5500, 380/500 V. Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 Amps ms (symmetrical), 500 V maximum.
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.
4. Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals. Always comply with national and local regulations on min. cable cross-section.

■ Mains supply 3 x 200 - 240 V



According to international requirements	VLT type	5032	5042	5052
Normal overload torque (110 %):				
Output current	$I_{VLT,N}$ [A] (200-230 V)	115	143	170
	$I_{VLT,MAX}$ (60 s) [A] (200-230 V)	127	158	187
	$I_{VLT,N}$ [A] (231-240 V)	104	130	154
	$I_{VLT,MAX}$ (60 s) [A] (231-240 V)	115	143	170
Output	$S_{VLT,N}$ [kVA] (200-230 V)	41	52	61
	$S_{VLT,N}$ [kVA] (231-240 V)	41	52	61
Typical shaft output (200-240 V)	$P_{VLT,N}$ [kW]	30	37	45
Typical shaft output (200-240 V)	$P_{VLT,N}$ [HP]	40	50	60
High overload torque (150 %):				
Output current	$I_{VLT,N}$ [A] (200-230 V)	88	115	143
	$I_{VLT,MAX}$ (60 s) [A] (200-230 V)	132	173	215
	$I_{VLT,N}$ [A] (231-240 V)	80	104	130
	$I_{VLT,MAX}$ (60 s) [A] (231-240 V)	120	156	195
Output	$S_{VLT,N}$ [kVA] (200-230 V)	32	41	52
	$S_{VLT,N}$ [kVA] (231-240 V)	32	41	52
Typical shaft output (200-240 V)	$P_{VLT,N}$ [kW]	22	30	37
Typical shaft output (200-240 V)	$P_{VLT,N}$ [HP]	30	40	50
Max. cross-section of copper cable to motor, brake and loadsharing (200-240 V)	[mm²] 5)	70	90	120
Max. cross-section of aluminium cable to motor, brake and loadsharing (200-240 V)	[mm²] 5)	95	95	120
Max. cross-section of copper cable to motor, brake and loadsharing (200-240 V)	[AWG] 2) 5)	1/0	3/0	4/0
Max. cross-section of aluminium cable to motor, brake and loadsharing (200-240 V)	[AWG] 2) 5)	3/0	250mcm	300mcm
Min. cable cross-section to motor, brake and loadsharing 4)	[mm²/AWG] 2) 5)	10/8	10/8	10/8

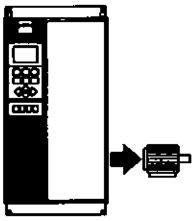


Rated input current	$I_{L,N}$ [A] (230 V)	101.3	126.6	149.9
Max. cross-section of copper cable to power (200-240 V)	[mm²] 5)	70	90	120
Max. cross-section of aluminium cable to power (200-240 V)	[mm²] 5)	95	95	120
Max. cross-section of copper cable to power (200-240 V)	[AWG] 2) 5)	1/0	3/0	4/0
Max. cross-section of aluminium cable to power (200-240 V)	[AWG] 2) 5)	3/0	250mcm	300mcm
Min. cable cross-section to motor, brake and loadsharing 4)	[mm²/AWG] 2) 5)	10/8	10/8	10/8
Max. pre-fuses (mains)	[-]/UL 1) [A]	150	200	250
Integral pre-fuses (softcharge circuit)	[-]/UL 1) [A]	15/15	15/15	15/15
Integral pre-fuses (softcharge resistors)	[-]/UL 1) [A]	12/12	12/12	12/12
Integral pre-fuses (SMPS)	[-]/UL 1) [A]	12/12		
Efficiency 3)		0.96-0.97		
Weight IP 00	[kg]	90	90	90
Weight IP 20 EB	[kg]	101	101	101
Weight IP 54	[kg]	104	104	104
Power loss at max. load	[W]	1089	1361	1613
Enclosure		IP 00 / IP 20/ IP 54		

1. If UL/cUL is to be complied with, pre-fuses type Bussmann FWH and FWX or similar must be used. Pre-fuses type gG must be used for VLT 5001 - 5027, 200/240 V and VLT 5001 - 5052, 380/500 V. Pre-fuses type gR must be used for VLT 5032 - 5052, 200/240 V and VLT 5060 - 5500, 380/500 V. Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 Amps ms (symmetrical), 500 V maximum.
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.
4. Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals. Always comply with national and local regulations on min. cable cross-section.
5. Connection stud 1 x M8/2 x M8.

■ Mains supply 3 x 380-500 V

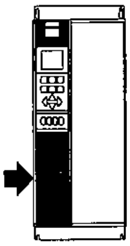
According to international requirements



	VLT type	5060	5075	5100	5125	5150	5200	5250
Normal overload torque (110 %):								
Output current	$I_{VLT,N}$ [A] (380-440 V)	106	147	177	212	260	315	368
	$I_{VLT,MAX}$ (60 s) [A] (380-440 V)	117	162	195	233	286	347	405
	$I_{VLT,N}$ [A] (441-500 V)	106	130	160	190	240	302	361
	$I_{VLT,MAX}$ (60 s) [A] (441-500 V)	117	143	176	209	264	332	397
Output	$S_{VLT,N}$ [kVA] (380-440 V)	73	102	123	147	180	218	255
	$S_{VLT,N}$ [kVA] (441-500 V)	92	113	139	165	208	262	313
Typical shaft output (380-440 V)	$P_{VLT,N}$ [kW]	55	75	90	110	132	160	200
Typical shaft output (380-440 V)	$P_{VLT,N}$ [HP]	75	100	125	150	200	250	300
Typical shaft output (441-500 V)	$P_{VLT,N}$ [kW]	75	90	110	132	160	200	250
Typical shaft output (441-500 V)	$P_{VLT,N}$ [HP]	100	125	150	200	250	300	350
High overload torque (150 %):								
Output current	$I_{VLT,N}$ [A] (380-440 V)	90.0	106	147	177	212	260	315
	$I_{VLT,MAX}$ (60 s) [A] (380-440 V)	135	159	221	266	318	390	473
	$I_{VLT,N}$ [A] (441-500 V)	80.0	106	130	160	190	240	302
	$I_{VLT,MAX}$ (60 s) [A] (441-500 V)	120	159	195	240	285	360	453
Output	$S_{VLT,N}$ [kVA] (380-440 V)	62.0	73.0	102	123	147	180	218
	$S_{VLT,N}$ [kVA] (441-500 V)	69.0	92.0	113	139	165	208	262
Typical shaft output (380-440 V)	$P_{VLT,N}$ [kW]	45	55	75	90	110	132	160
Typical shaft output (380-440 V)	$P_{VLT,N}$ [HP]	60	75	100	125	150	200	250
Typical shaft output (441-500 V)	$P_{VLT,N}$ [kW]	55	75	90	110	132	160	200
Typical shaft output (441-500 V)	$P_{VLT,N}$ [HP]	75	100	125	150	200	250	300
Max. cross-section of copper cable to motor, brake and loadsharing (380-440 V)	[mm²][5]	70	95	120	2x70	2x70	2x95	2x120
Max. cross-section of copper cable to motor, brake and loadsharing (441-500 V)	[mm²][5]	70	70	95	2x70	2x70	2x95	2x120
Max. cross-section of aluminium cable to motor, brake and loadsharing (380-440 V)	[mm²][5]	95	120	150	2x70	2x120	2x120	2x150
Max. cross-section of aluminium cable to motor, brake and loadsharing (441-500 V)	[mm²][5]	70	90	120	2x70	2x95	2x120	2x150
Max. cross-section of copper cable to motor, brake and loadsharing (380-440 V)	[AWG][2][5]	1/0	3/0	4/0	2x1/0	2x2/0	2x3/0	2x250mcm
Max. cross-section of copper cable to motor, brake and loadsharing (441-500 V)	[AWG][2][5]	1/0	2/0	3/0	2x1/0	2x1/0	2x3/0	2x4/0
Max. cross-section of aluminium cable to motor, brake and loadsharing (380-440 V)	[AWG][2][5]	3/0	250mcm	300mcm	2x2/0	2x4/0	2x250mcm	2x350mcm
Max. cross-section of aluminium cable to motor, brake and loadsharing (441-500 V)	[AWG][2][5]	3/0	4/0	250mcm	2x2/0	2x3/0	2x250mcm	2x300mcm
Min. cable cross-section to motor, brake and loadsharing [4]	[mm²/AWG][2][5]	10/8	10/8	10/8	10/8	10/8	16/6	

1. If UL/cUL is to be complied with, pre-fuses type Bussmann FWH and FWX or similar must be used. Pre-fuses type gG must be used for VLT 5001 - 5027, 200/240 V and VLT 5001 - 5052, 380/500 V. Pre-fuses type gR must be used for VLT 5032 - 5052, 200/240 V and VLT 5060 - 5500, 380/500 V. Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 Amps ms (symmetrical), 500 V maximum.
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.
4. Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals. Always comply with national and local regulations on min. cable cross-section.
5. Connection stud 1 x M8/2 x M8.

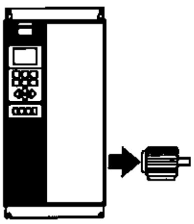
■ Mains supply 3 x 380-500 V



According to international requirements	VLT type	5060	5075	5100	5125	5150	5200	5250
Rated input current	$I_{L,N}$ [A] (400 V)	87.6	103	145	174	206	256	318
	$I_{L,N}$ [A] (460 V)	77.9	103	128	158	185	236	304
Max. cross-section of copper cable to power (380-440 V)	[mm²][5]	70	95	120	2x70	2x70	2x95	2x120
Max. cross-section of copper cable to power (441-500 V)	[mm²][5]	70	70	95	2x70	2x70	2x95	2x120
Max. cross-section of aluminium cable to power (380-440 V)	[mm²][5]	95	120	150	2x70	2x120	2x120	2x150
Max. cross-section of aluminium cable to power (441-500 V)	[mm²][5]	70	90	120	2x70	2x95	2x120	2x150
Max. cross-section of copper cable to power (380-440 V)	[AWG][2][5]	1/0	3/0	4/0	2x1/0	2x2/0	2x3/0	2x250mcm
Max. cross-section of copper cable to power (441-500 V)	[AWG][2][5]	1/0	2/0	3/0	2x1/0	2x1/0	2x3/0	2x4/0
Max. cross-section of aluminium cable to power (380-440 V)	[AWG][2][5]	3/0	250mcm	300mcm	2x2/0	2x4/0	2x250mcm	2x350mcm
Max. cross-section of aluminium cable to power (441-500 V)	[AWG][2][5]	3/0	4/0	250mcm	2x2/0	2x3/0	2x250mcm	2x300mcm
Min. cable cross-section to motor, brake and loadsharing [4]	[mm²/AWG][2][5]	10/8	10/8	10/8	10/8	10/8	16/6	
Max. pre-fuses (mains)	[-]/UL [1][A]	150/150	250/220	250/250	300/300	350/350	450/400	500/500
Integral pre-fuses (softcharge circuit)	[-]/UL [1][A]	15/15	15/15	15/15	30/30	30/30	30/30	30/30
Integral pre-fuses (softcharge resistors)	[-]/UL [1][A]	12/12	12/12	12/12	12/12	12/12	12/12	12/12
Integral pre-fuses (SMPS)	[-]/UL [1][A]	5.0/5.0						
Efficiency		0.96-0.97						
Weight IP 00	[kg]	109	109	109	146	146	146	146
Weight IP 20 EB	[kg]	121	121	121	161	161	161	161
Weight IP 54	[kg]	124	124	124	177	177	177	177
Power loss at max. load	[W]	1430	1970	2380	2860	3810	4770	5720
Enclosure		IP 00 / IP 20/ IP 54						

1. If UL/cUL is to be complied with, pre-fuses type Bussmann FWH and FWX or similar must be used. Pre-fuses type gG must be used for VLT 5001 - 5027, 200/240 V and VLT 5001 - 5052, 380/500 V. Pre-fuses type gR must be used for VLT 5032 - 5052, 200/240 V and VLT 5060 - 5500, 380/500 V. Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 Amps rms (symmetrical), 500 V maximum.
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.
4. Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals. Always comply with national and local regulations on min. cable cross-section.
5. Connection stud 1 x M8/2 x M8.

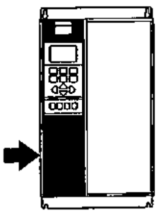
■ Mains supply 3 x 380-500 V



According to international requirements	VLT type	5300	5350	5450	5500
Normal overload torque (110 %):					
Output current	$I_{VLT,N}$ [A] (380-440 V)	480	600	658	745
	$I_{VLT,MAX}$ (60 s) [A] (380-440 V)	528	660	724	820
	$I_{VLT,N}$ [A] (441-500 V)	443	540	590	678
	$I_{VLT,MAX}$ (60 s) [A] (441-500 V)	487	594	649	746
Output	$S_{VLT,N}$ [kVA] (380-440 V)	333	416	456	516
	$S_{VLT,N}$ [kVA] (441-500 V)	384	468	511	587
Typical shaft output (380-440 V) $P_{VLT,N}$ [kW]		250	315	355	400
Typical shaft output (380-440 V) $P_{VLT,N}$ [HP]		300	350	450	500
Typical shaft output (441-500 V) $P_{VLT,N}$ [kW]		315	355	400	500
Typical shaft output (441-500 V) $P_{VLT,N}$ [HP]		350	450	500	600
High overload torque (150 %):					
Output current	$I_{VLT,N}$ [A] (380-440 V)	395	480	600	658
	$I_{VLT,MAX}$ (60 s) [A] (380-440 V)	593	720	900	987
	$I_{VLT,N}$ [A] (441-500 V)	361	443	540	590
	$I_{VLT,MAX}$ (60 s) [A] (441-500 V)	542	665	810	885
Output	$S_{VLT,N}$ [kVA] (380-440 V)	274	333	416	456
	$S_{VLT,N}$ [kVA] (441-500 V)	313	384	468	511
Typical shaft output (380-440 V) $P_{VLT,N}$ [kW]		200	250	315	355
Typical shaft output (380-440 V) $P_{VLT,N}$ [HP]		300	350	450	500
Typical shaft output (441-500 V) $P_{VLT,N}$ [kW]		250	315	355	400
Typical shaft output (441-500 V) $P_{VLT,N}$ [HP]		350	450	500	600
Max. cross-section of copper cable to motor, brake and loadsharing (380-440 V)	$[mm^2]$ 5)	2 x 150 3 x 70	2 x 185 3 x 95	2 x 240 3 x 120	2 x 300 3 x 150
Max. cross-section of copper cable to motor, brake and loadsharing (441-500 V)	$[mm^2]$ 5)	2 x 120 3 x 70	2 x 150 3 x 95	2 x 185 3 x 95	2 x 300 3 x 120
Max. cross-section of aluminium cable to motor, brake and loadsharing (380-440 V)	$[mm^2]$ 5)	2 x 185 3 x 120	2 x 240 3 x 150	2 x 300 3 x 185	3 x 185
Max. cross-section of aluminium cable to motor, brake and loadsharing (441-500 V)	$[mm^2]$ 5)	2 x 150 3 x 95	2 x 185 3 x 120	2 x 240 3 x 150	3 x 185
Max. cross-section of copper cable to motor, brake and loadsharing (380-440 V)	[AWG] 2) 5)	2 x 250mcm 3 x 2/0	2 x 350mcm 3 x 3/0	2 x 400mcm 3 x 4/0	2 x 500mcm 3 x 250mcm
Max. cross-section of copper cable to motor, brake and loadsharing (441-500 V)	[AWG] 2) 5)	2 x 4/0 3 1/0	2 x 300mcm 3 x 3/0	2 x 350mcm 3 x 3/0	2 x 500mcm 3 x 4/0
Max. cross-section of aluminium cable to motor, brake and loadsharing (380-440 V)	[AWG] 2) 5)	2 x 350mcm 3 x 4/0	2 x 500mcm 3 x 250mcm	2 x 600mcm 3 x 300mcm	2 x 700mcm 3 x 350mcm
Max. cross-section of aluminium cable to motor, brake and loadsharing (441-500 V)	[AWG] 2) 5)	2 x 300mcm 3 x 3/0	2 x 400mcm 3 x 4/0	2 x 500mcm 3 x 250mcm	2 x 600mcm 3 x 300mcm

1. If UL/cUL is to be complied with, pre-fuses type Bussmann FWH and FWX or similar must be used. Pre-fuses type gG must be used for VLT 5001 - VLT 5027, 200/240 V and VLT 5001 - VLT 5052, 380/500 V. Pre-fuses type gR must be used for VLT 5032 - 5052, 200/240 V and VLT 5060 - VLT 5500, 380/500 V. Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 Amps rms (symmetrical), 500 V maximum.
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.
4. Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals. Always comply with national and local regulations on min. cable cross-section.
5. Connection stud 2 x M12 / 3 x M12.

Mains supply 3 x 380-500 V



According to international requirements	VLT type	5300	5350	5450	5500
Rated input current	$I_{L,MAX}$ [A] (400 V)	389	467	584	648
	$I_{L,MAX}$ [A] (460 V)	356	431	526	581
Max. cross-section of copper cable to power (380-440 V)	[mm^2][5]	2 x 150 3 x 70	2 x 185 3 x 95	2 x 240 3 x 120	2 x 300 3 x 150
Max. cross-section of copper cable to power (460-500 V)	[mm^2][5]	2 x 120 3 x 70	2 x 150 3 x 95	2 x 185 3 x 95	2 x 300 3 x 120
Max. cross-section of aluminium cable to power (380-440 V)	[mm^2][5]	2 x 185 3 x 120	2 x 240 3 x 150	2 x 300 3 x 185	3 x 185
Max. cross-section of aluminium cable to power (460-500 V)	[mm^2][5]	2 x 150 3 x 95	2 x 185 3 x 120	2 x 240 3 x 150	3 x 185
Max. cross-section of copper cable to power (380-440 V)	[AWG][2][5]	2 x 250mcm 3 x 2/0	2 x 350mcm 3 x 3/0	2 x 400mcm 3 x 4/0	2 x 500mcm 3 x 250mcm
Max. cross-section of copper cable to power (460-500 V)	[AWG][2][5]	2 x 4/0 3 1/0	2 x 300mcm 3 x 3/0	2 x 350mcm 3 x 3/0	2 x 500mcm 3 x 4/0
Max. cross-section of aluminium cable to power (380-440 V)	[AWG][2][5]	2 x 350mcm 3 x 4/0	2 x 500mcm 3 x 250mcm	2 x 600mcm 3 x 300mcm	2 x 700mcm 3 x 350mcm
Max. cross-section of aluminium cable to power (460-500 V)	[AWG][2][5]	2 x 300mcm 3 x 3/0	2 x 400mcm 3 x 4/0	2 x 500mcm 3 x 250mcm	2 x 600mcm 3 x 300mcm
Max. pre-fuses (mains)	[-]/UL [1] [A]	630/600	700/700	800/800	800/800
Integral pre-fuses (softcharge circuit)	[-]/UL [1] [A]	15/15	15/15	15/15	30/30
Integral pre-fuses (softcharge resistors)	[-]/UL [1] [A]	12/12	12/12	12/12	12/12
Integral pre-fuses (SMPS)	[-]/UL [1] [A]	5.0/5.0			
Efficiency		0.97			
Weight IP 00	[kg]	480	515	560	585
Weight IP 20	[kg]	595	630	675	700
Weight IP 54	[kg]	605	640	685	710
Power loss at max. load	[W]	7500	9450	10650	12000
Enclosure		IP 00 / IP 20/ IP 54			

1. If UL/cUL is to be complied with, pre-fuses type Bussmann FWH and FWX or similar must be used. Pre-fuses type gG must be used for VLT 5001 - VLT 5027, 200/240 V and VLT 5001 - VLT 5052, 380/500 V. Pre-fuses type gR must be used for VLT 5032 - 5052, 200/240 V and VLT 5060 - VLT 5500, 380/500 V. Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 Amps ms (symmetrical), 500 V maximum.
2. American Wire Gauge.
3. Measured using 30 m screened motor cables at rated load and rated frequency.
4. Min. cable cross-section is the smallest cable cross-section allowed to be fitted on the terminals. Always comply with national and local regulations on min. cable cross-section.
5. Connection stud 2 x M12 / 3 x M12.

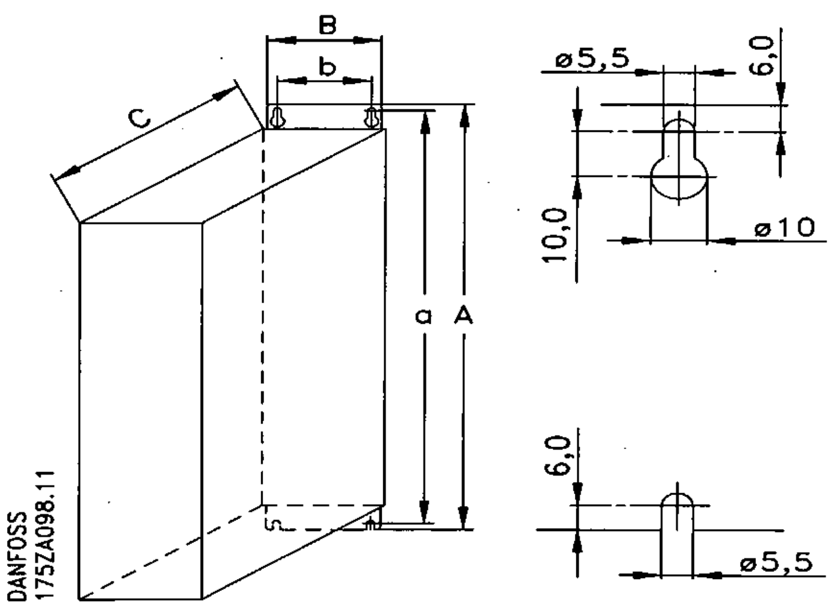
■ Bookstyle IP 20

IP 20 enclosure	200-240 V						
VLT type	A (mm)	B (mm)	C (mm)	a (mm)	b (mm)	ab/be (mm)	l/r (mm)
5001 - 5003	395	90	260	384	70	100	0
5004 - 5006	395	130	260	384	70	100	0

IP 20 enclosure	380-500 V						
VLT type	A (mm)	B (mm)	C (mm)	a (mm)	b (mm)	ab/be (mm)	l/r (mm)
5001 - 5005	395	90	260	384	70	100	0
5006 - 5011	395	130	260	384	70	100	0

ab: Min. space above enclosure.
be: Min. space below enclosure.
l/r: Min. distance between VLT frequency converter and other plant components, left and right sides.

VLT 5001 - 5006/200-240 V
VLT 5001 - 5011/380-500 V

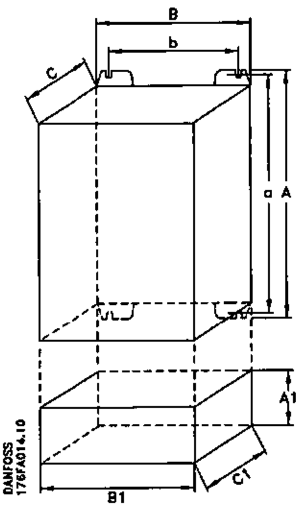


■ Compact IP 00

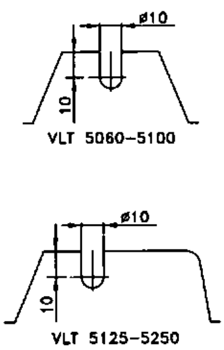
IP 00 enclosure	200-240 V						
VLT type	A (mm)	B (mm)	C (mm)	a (mm)	b (mm)	ab/be (mm)	l/r (mm)
5032 - 5052	800	370	335	780	270	225	0

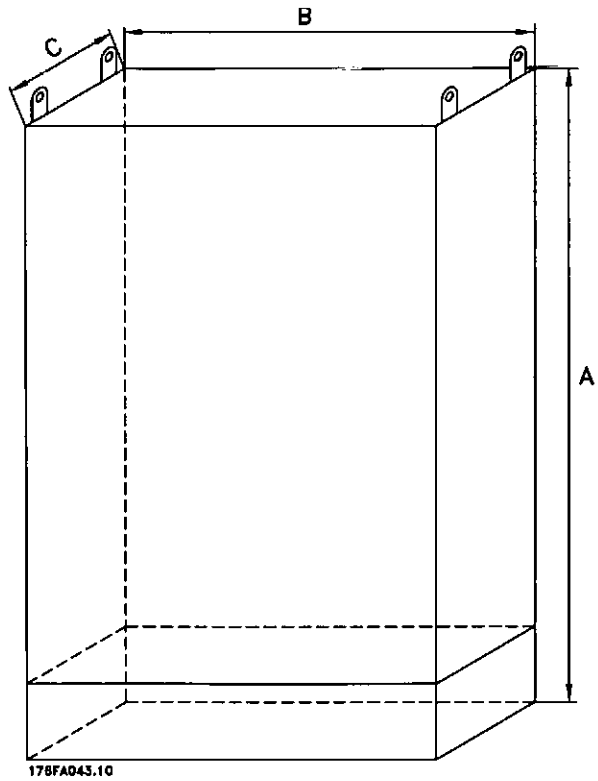
IP 00 enclosure	380-500 V						
VLT type	A (mm)	B (mm)	C (mm)	a (mm)	b (mm)	ab/be (mm)	l/r (mm)
5060 - 5100	800	370	335	780	270	225	0
5125 - 5250	1400	420	400	1380	350	225	0
5300 - 5500	1896	1099	490	-	-	400	0

ab:Min. space above enclosure. be: Min. space below enclosure.
l/r: Min. distance between VLT frequency converter and other plant components, left and right sides.



VLT 5060 - 5250/380-500 V





VLT 5300 - 5500/380-500 V

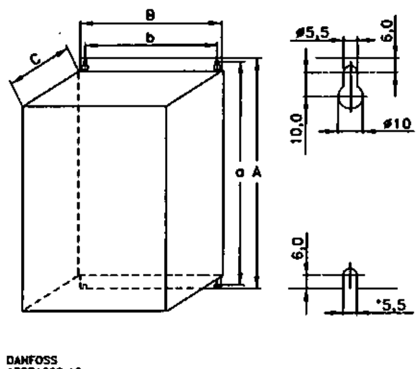
IP 20 bottom cover			
VLT type	A1 (mm)	B1 (mm)	C1 (mm)
5060 - 5100	175	370	335
5125 - 5250	175	420	400

■ Compact IP 20

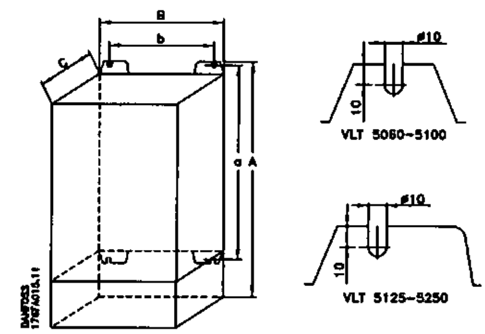
IP 20 enclosure 200-240 V							
VLT type	A (mm)	B (mm)	C (mm)	a (mm)	b (mm)	ab/be (mm)	l/r (mm)
5001 - 5003	395	220	160	384	200	100	0
5004 - 5006	395	220	200	384	200	100	0
5008	560	242	260	540	200	200	0
5011 - 5016	700	242	260	680	200	200	0
5022 - 5027	800	308	296	780	270	200	0
5032 - 5052	954	370	335	780	270	225	0

IP 20 enclosure 380-500 V							
VLT type	A (mm)	B (mm)	C (mm)	a (mm)	b (mm)	ab/be (mm)	l/r (mm)
5001 - 5005	395	220	160	384	200	100	0
5006 - 5011	395	220	200	384	200	100	0
5016 - 5022	560	242	260	540	200	200	0
5027 - 5032	700	242	260	680	200	200	0
5042 - 5052	800	308	296	780	270	200	0
5060 - 5100	975	370	335	780	270	225	0
5125 - 5250	1575	420	400	1380	350	225	0
5300 - 5500	2010	1200	600	-	-	400	0

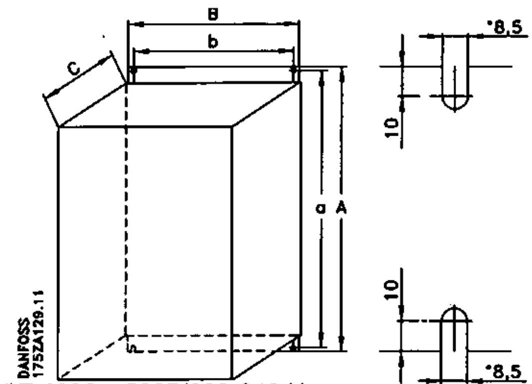
ab:Min. space above enclosure. be: Min. space below enclosure.
l/r: Min. distance between VLT frequency converter and other plant components, left and right sides.



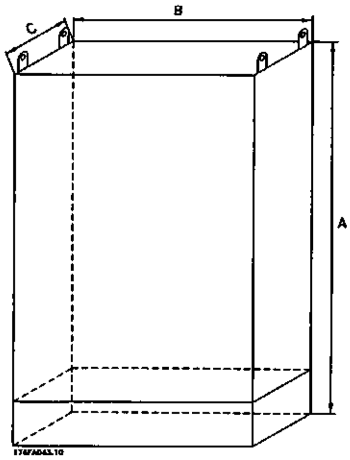
VLT 5001 - 5006/200-240 V
VLT 5001 - 5011/380-500 V



VLT 5032 - 5052/200-240 V
VLT 5060 - 5250/380-500 V



VLT 5008 - 5027/200-240 V
VLT 5016 - 5052/380-500 V



VLT 5300 - 5500/380-500 V

■ Compact IP 54

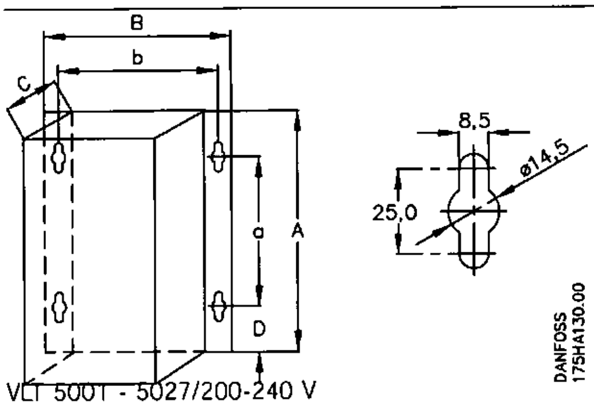
IP 54 enclosure 200-240 V

VLT type	A (mm)	B (mm)	C (mm)	D (mm)	a (mm)	b (mm)	ab/be (mm)	l/r (mm)
5001 - 5003	460	282	195	85	260	258	100	0
5004 - 5006	530	282	195	85	330	258	100	0
5008 - 5011	810	355	280	70	560	330	200	0
5016 - 5027	940	400	280	70	690	375	200	0
5032 - 5052	937	495	421	-	830	374	225	50

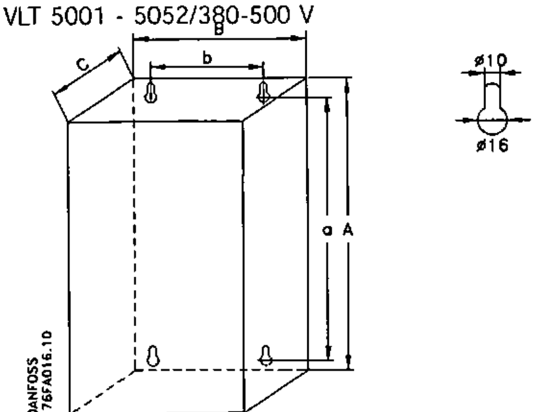
IP 54 enclosure 380-500 V

VLT type	A (mm)	B (mm)	C (mm)	D (mm)	a (mm)	b (mm)	ab/be (mm)	l/r (mm)
5001 - 5005	460	282	195	85	260	258	100	0
5006 - 5011	530	282	195	85	330	258	100	0
5016 - 5027	810	355	280	70	560	330	200	0
5032 - 5052	940	400	280	70	690	375	200	0
5060 - 5100	937	495	421	-	830	374	225	50
5125 - 5250	1572	495	425	-	1465	445	225	0
5300 - 5500	2010	1200	600	-	-	-	400	0

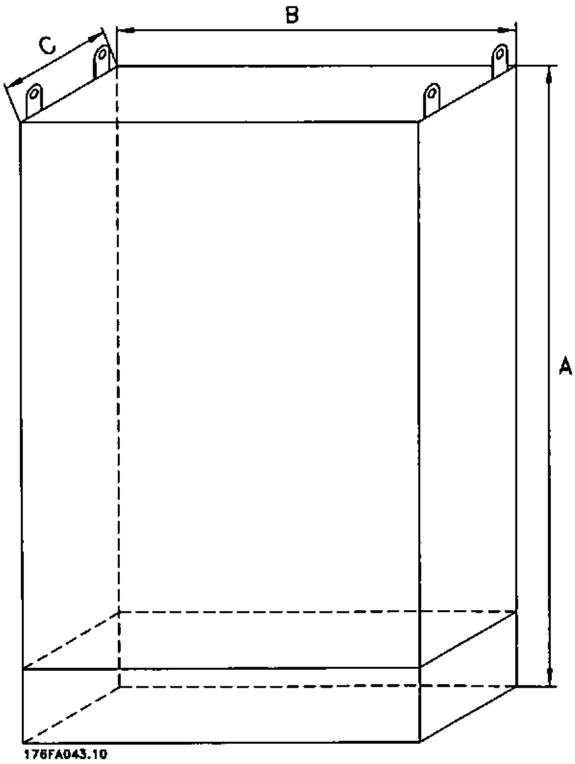
ab: Min. space above enclosure. be: Min. space below enclosure.
l/r: Min. distance between VLT frequency converter and other plant components, left and right sides.



VLT 5001 - 5027/200-240 V
VLT 5001 - 5052/380-500 V



VLT 5060 - 5250/380-500 V
VLT 5032 - 5052/200-240 V



VLT 5300 - 5500/380-500 V

■ Mechanical installation

Please pay attention to the requirements that apply to integration and field mounting kit, see the below list. The information given in the list must be observed to avoid serious damage or injury, especially when installing large units.

The VLT frequency converter *must* be installed vertically.

The VLT frequency converter is cooled by means of air circulation. For the unit to be able to release its cooling air, the *minimum* distance over and below the unit must be as shown in the illustration below.
To protect the unit from overheating, it must be ensured that the ambient temperature *does not rise above the max. temperature stated for the VLT frequency converter* and that the 24-hour average temperature *is not exceeded*. The max. temperature and 24-hour average can be seen from the General Technical Data on page 11.
If the ambient temperature is in the range of 45° C - 55° C, derating of the VLT frequency converter will be required in accordance with the diagram on page 96 of the Design Guide. The service life of the VLT frequency converter will be reduced if no allowance is made for the derating for ambient temperature.

■ Enclosure protection

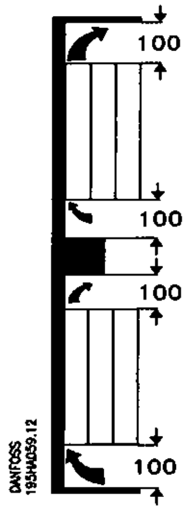
	IP 00	IP 20	IP 54
Bookstyle	-	OK	-
Compact			
VLT 5001-5027 200-240 V	-	OK	OK
VLT 5001-5250 380-500 V	OK	OK	OK
VLT 5300-5500 380-500 V	OK	OK	OK

■ Field mounting

	IP 00	IP 20	IP 54
Bookstyle	-	No	-
Compact			
VLT 5001-5027 200-240 V	-	No	OK
VLT 5001-5250 380-500 V	No	No	OK
VLT 5300-5500 380-500 V	No	No	OK
Compact w/IP 4x top cover			
VLT 5001-5006 200 V	-	OK	OK
VLT 5001-5011 500 V	-	OK	OK
Compact w/IP 20 terminal cover			
VLT 5008-5027 200 V	-	OK	OK
VLT 5016-5052 500 V	-	OK	OK

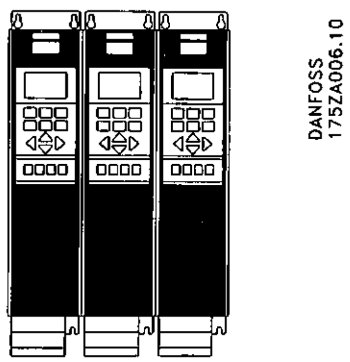
■ Installation of VLT 5001-5006 200-240 V, VLT 5001-5011 380-500 V Bookstyle IP 20

Cooling



All Bookstyle units require a minimum space of 100 mm above and below the enclosure.

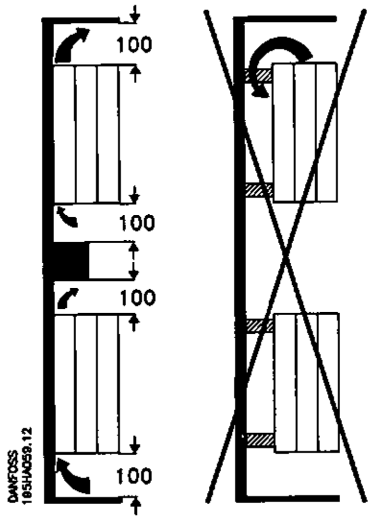
Side-by-side



All Bookstyle units can be installed side by side without any space between them, since the units do not require any cooling on the sides.

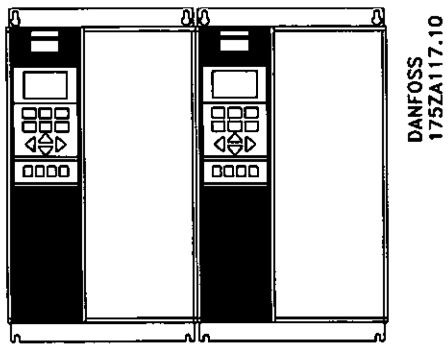
■ Installation of VLT 5001-5006 200-240 V, VLT 5001-5011 380-500 V Compact IP 20 and IP 54

Cooling



All Compact units require a minimum space of 100 mm above and below the enclosure and must be installed on a plane, vertical surface (no spacers). This applies to both IP 20 and IP 54 units.

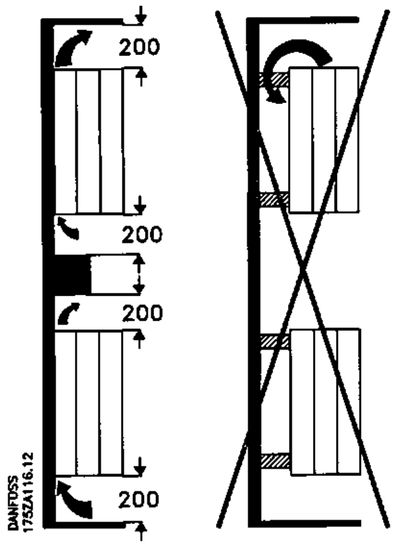
Side-by-side



All Compact units can be installed side-by-side without any space between them, since the units do not require any cooling on the sides.

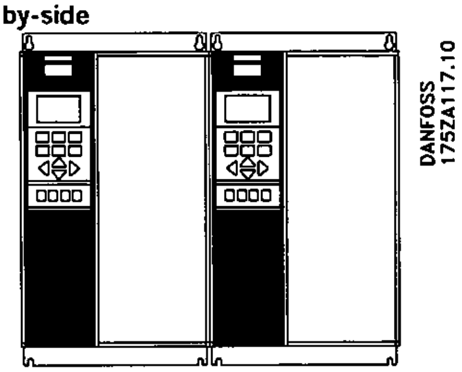
■ Installation of VLT 5008-5027 200-240 V, VLT 5016-5052 380-500 V Compact IP 20 and IP 54

Cooling

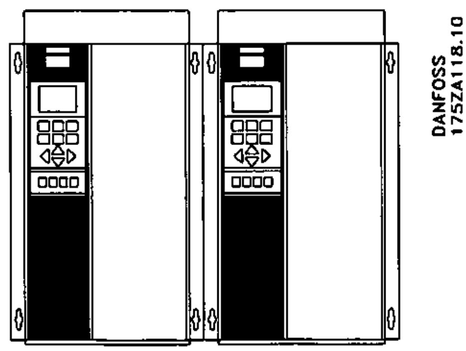


All Compact units in the above-mentioned series require a minimum space of 200 mm above and below the enclosure and must be installed on a plane, vertical surface (no spacers). This applies to both IP 20 and IP 54 units.

Side-by-side



Compact IP 20

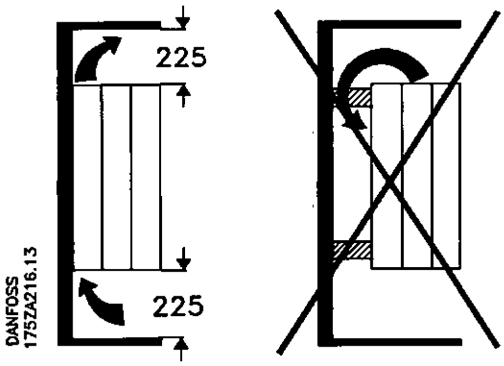


Compact IP 54 (flange-by-flange)

All IP 20 and IP 54 units in the above-mentioned series can be installed side by side without any space between them, since these units do not require cooling on the sides.

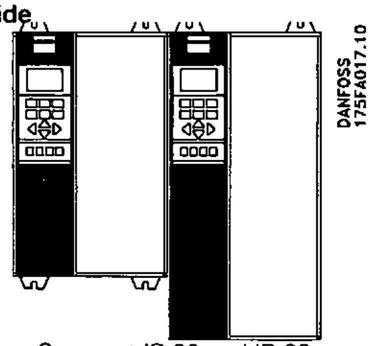
■ Installation of VLT 5060-5100 380-500 V, VLT 5032-5052 200-240 V Compact IP 00, IP 20 and IP 54

Cooling

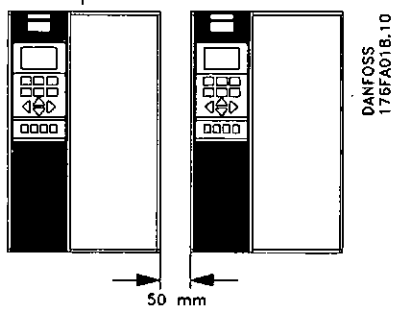


All Compact units in the above-mentioned series require a minimum space of 225 mm above and below the enclosure and must be installed on a plane, vertical surface (no spacers). This applies to both IP 00, IP 20 and IP 54 units.

Side-by-side



Compact IP 00 and IP 20

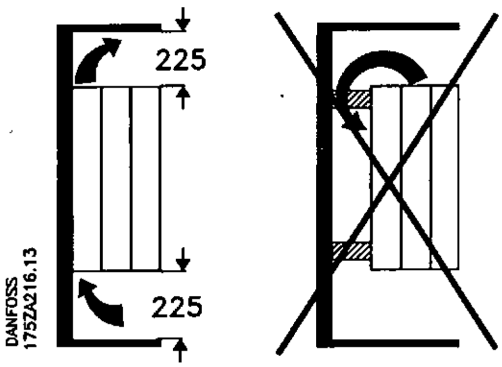


Compact IP 54

All IP 00 and IP 20 units in the above-mentioned series can be installed side by side without any space between them.

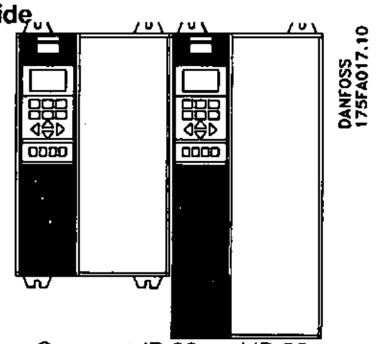
■ Installation of VLT 5125-5250 380-500 V Compact IP 00, IP 20 and IP 54

Cooling

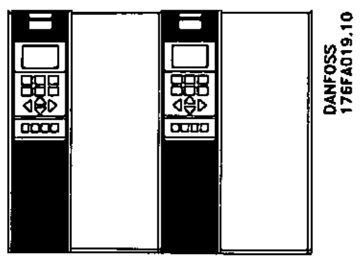


All Compact units in the above-mentioned series require a minimum space of 225 mm above and below the enclosure and must be installed on a plane, vertical surface (no spacers). This applies to both IP 00, IP 20 and IP 54 units.

Side-by-side



Compact IP 00 and IP 20

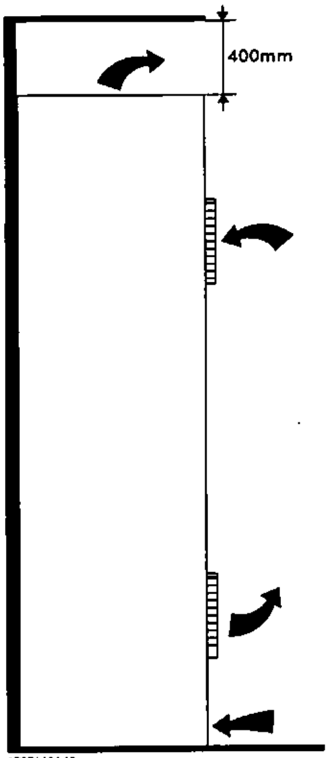


Compact IP 54

All IP 00, IP 20 and IP 54 units in the above-mentioned series can be installed side by side without any space between them, since these units do not require cooling on the sides.

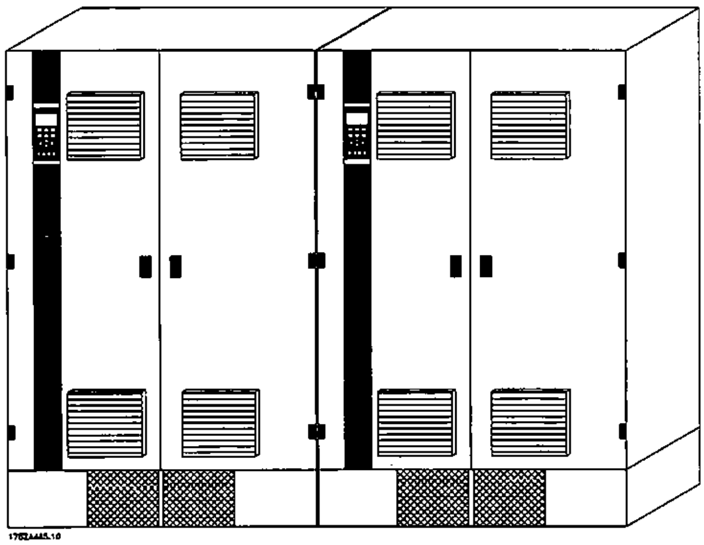
■ Installation of VLT 5300-5500 380-500 V Compact IP 00, IP 20 and IP 54

Cooling



All units in the above-mentioned series require a minimum space of 400 mm above the enclosure and must be installed on a plane floor. This applies to both IP 00, IP 20 and IP 54 units.
Gaining access to the VLT 5300-5500 requires a minimum space of 605 mm in front of the VLT frequency converter.

Side-by-side



Compact IP 00, IP 20 and IP 54

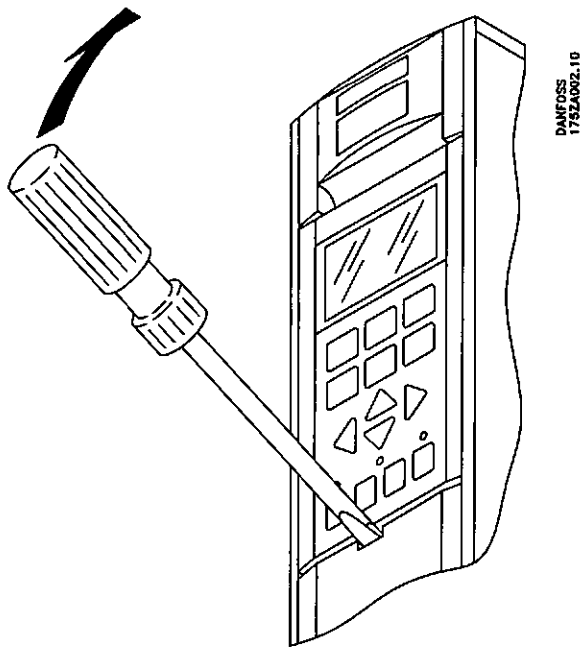
All IP 00, IP 20 and IP 54 units in the above-mentioned series can be installed side by side without any space between them, since these units do not require cooling on the sides.

■ Electrical installation

The voltage on the frequency converter is dangerous when the unit is connected to mains. Incorrect installation of the motor or VLT frequency converter may lead to material damage or serious injury or it may be fatal. Consequently, the instructions in this manual as well as national and local rules and safety regulations must be complied with.

Touching the electrical parts may be fatal, even after the mains supply has been disconnected.
Wait at least 4 minutes if using VLT 5001-5006 and at least 15 minutes if using VLT 5008-5500.

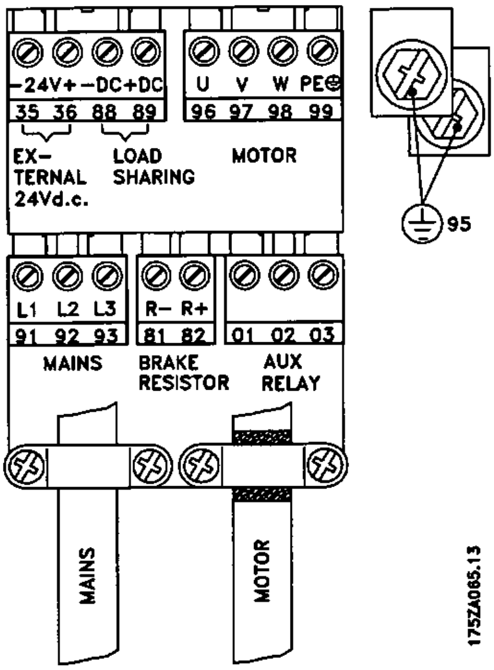
NB!
It is the user's or certified electrician's responsibility to ensure correct earthing and protection in accordance with applicable national and local norms and standards.



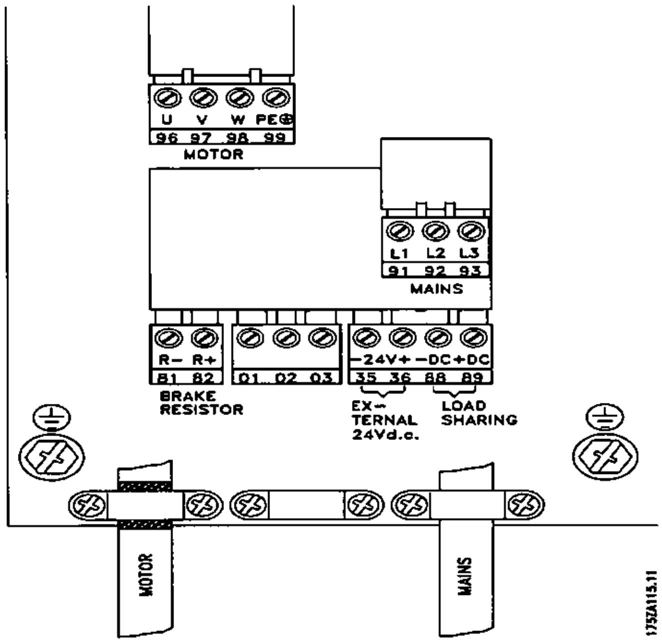
All terminals for the control cables are located under the protective cover of the VLT frequency converter. The protective cover (see drawing) can be removed by means of a pointed object - a screwdriver or similar.

Once the protective cover has been removed, the actual EMC-correct installation can start.
See drawings on pages 30-32.

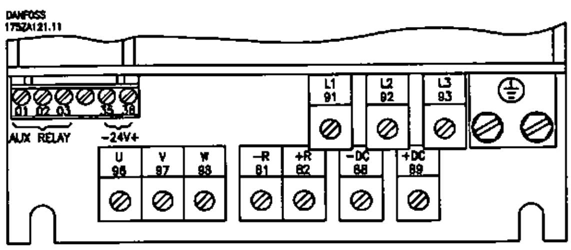
■ Electrical installation, power cables



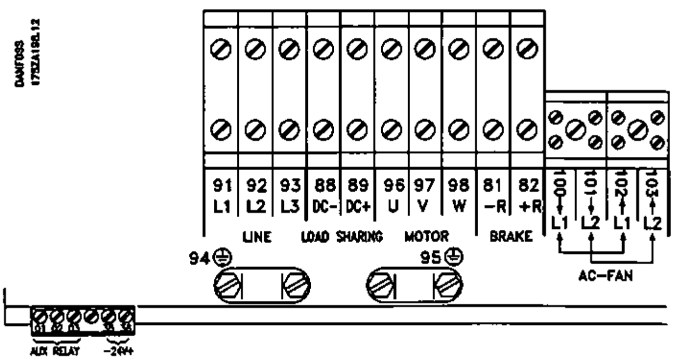
Bookstyle
0.75 - 7.5 kW



Compact IP 20/IP 54
0.75 - 7.5 kW

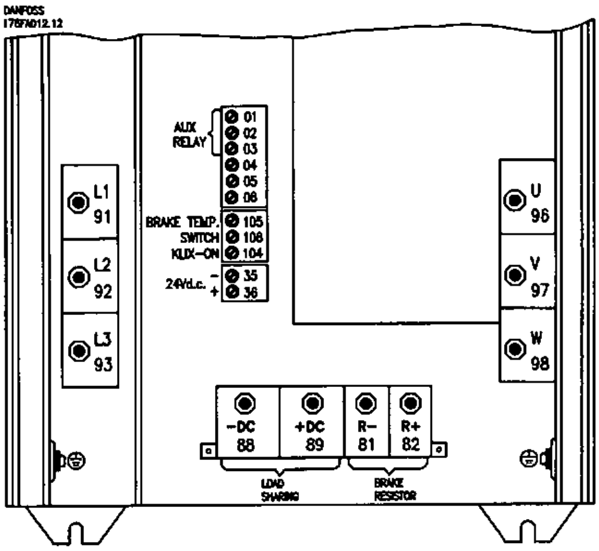


Compact IP 20
11 - 37 kW

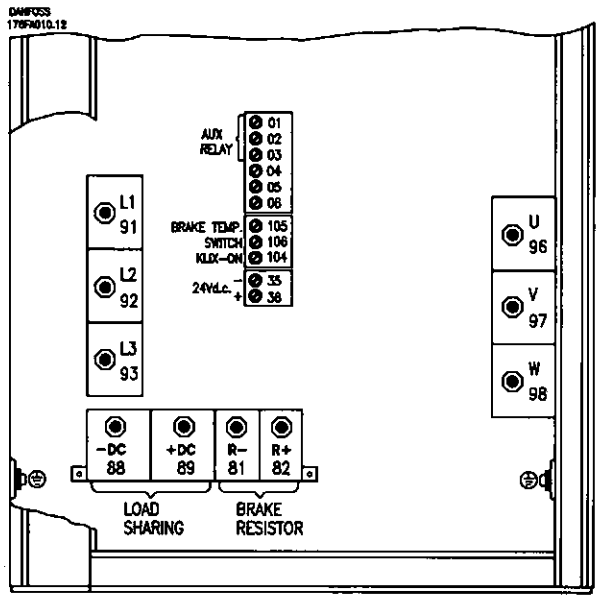


Compact IP 54
11 - 37 kW

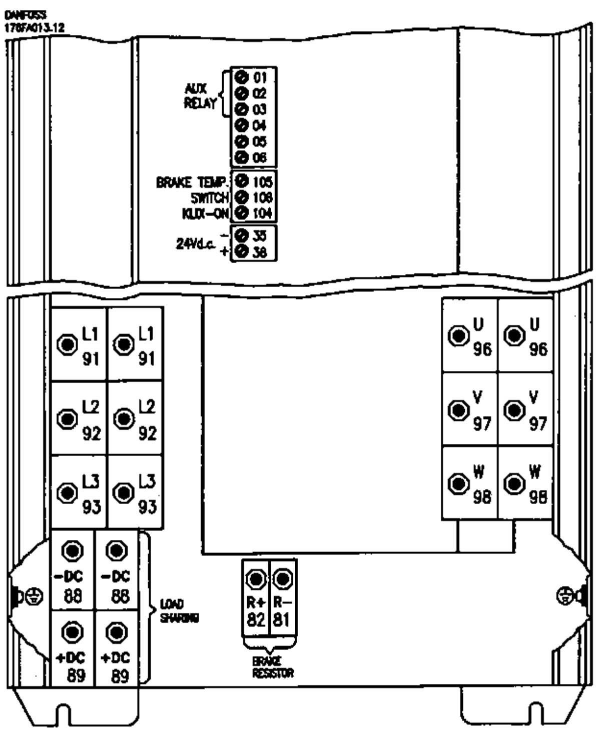
■ Electrical installation, power cables



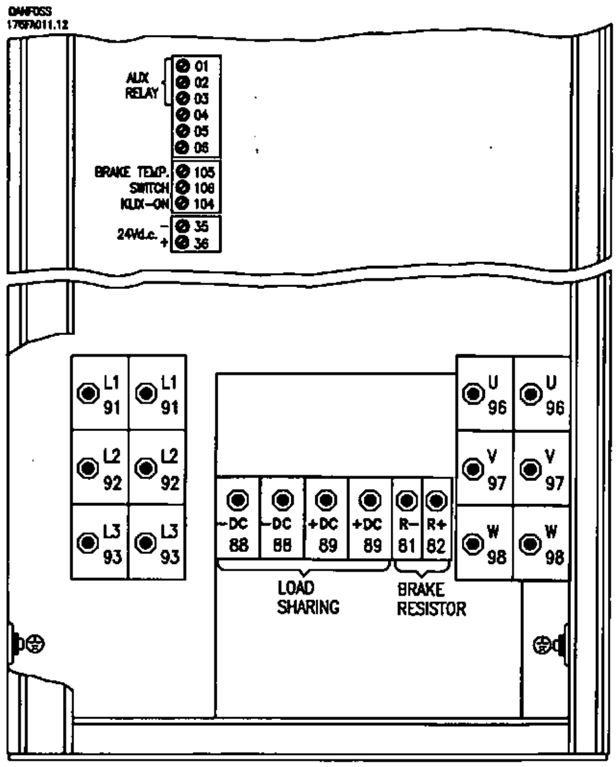
Compact IP 00/IP 20
45 - 75 kW



Compact IP 54
45 - 75 kW

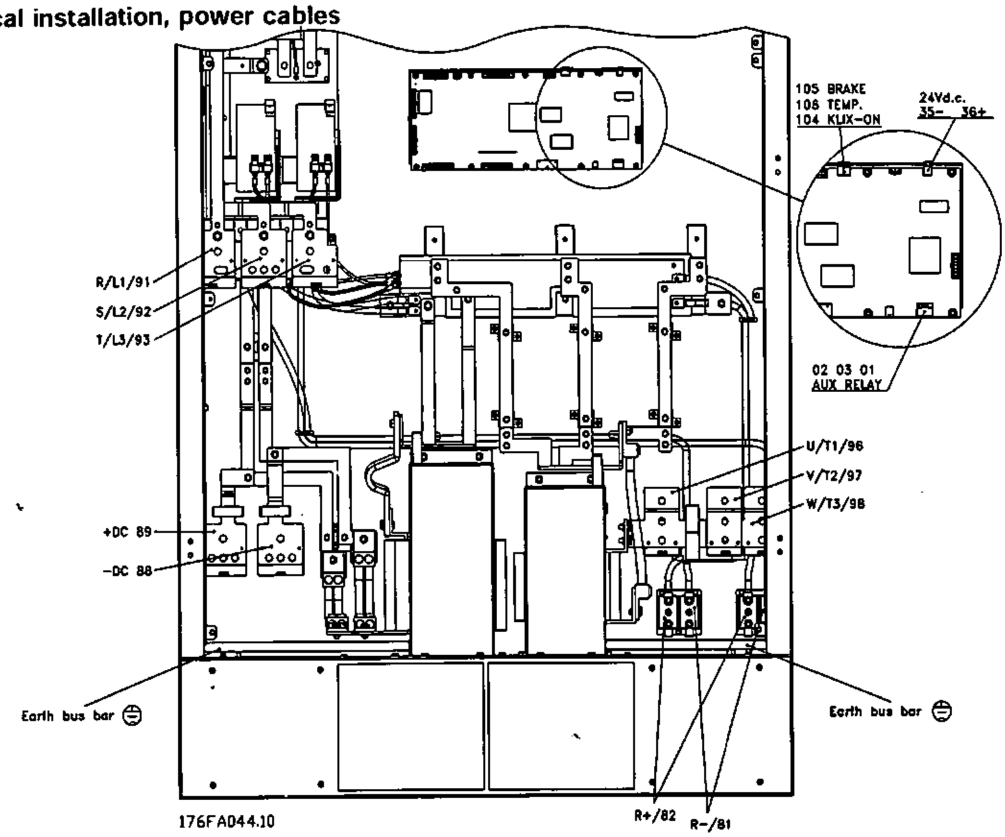


Compact IP 00/IP 20
90 - 160 kW

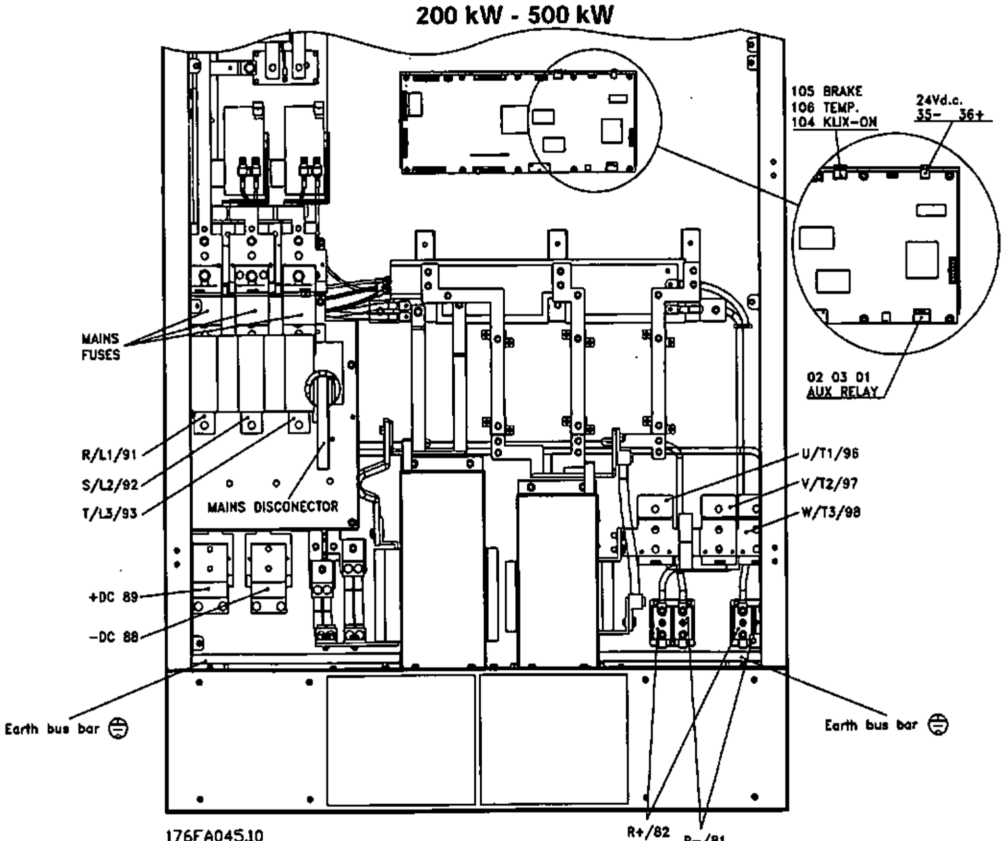


Compact IP 54
90 - 160 kW

■ **Electrical installation, power cables**

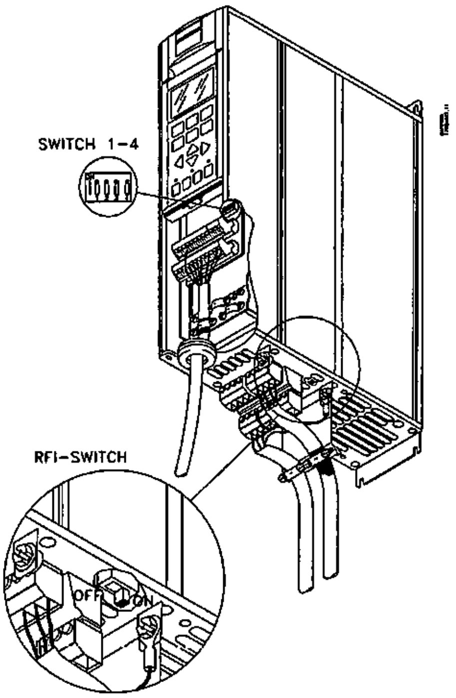


Compact IP 20/IP 54
without disconnector and mains fuses
200 kW - 500 kW

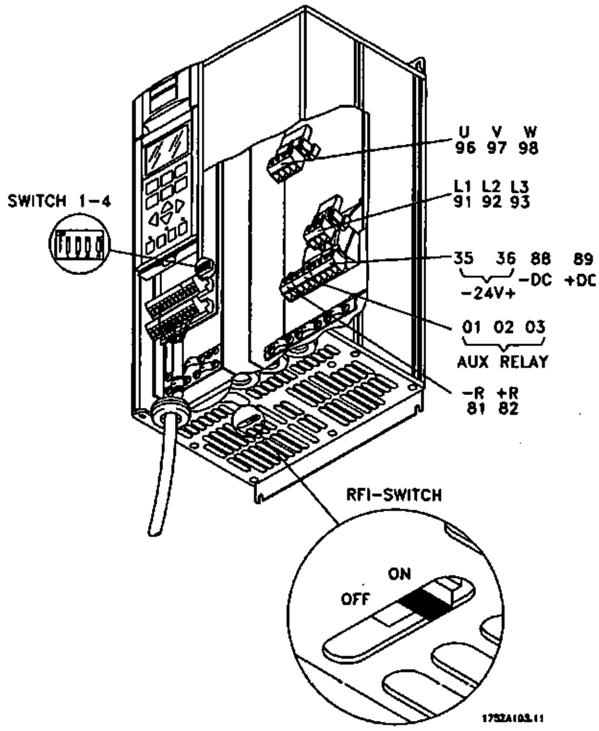


Compact IP 20/IP 54
with disconnector and mains fuses
200 - 500 kW

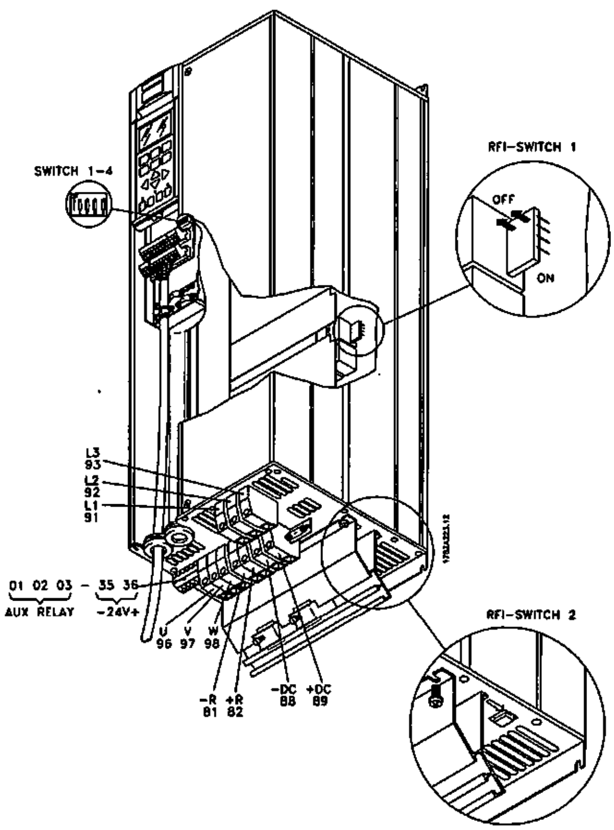
■ Electrical installation, enclosures



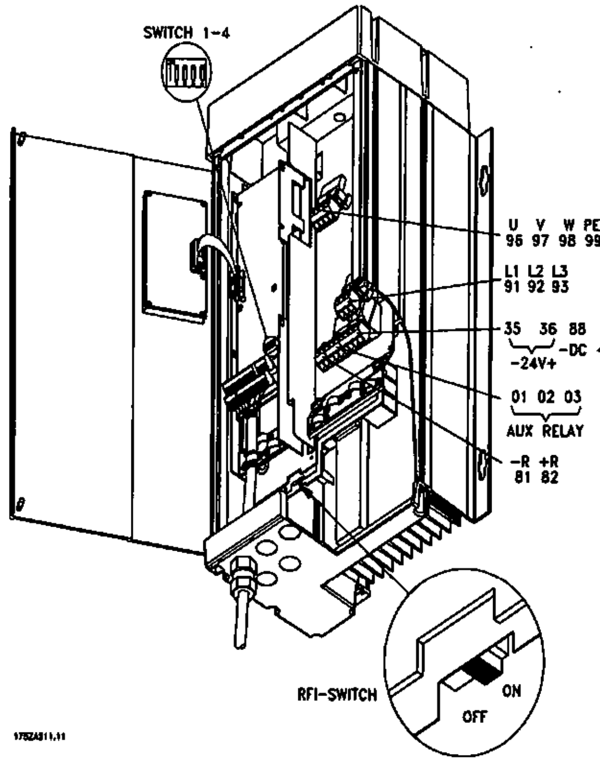
Bookstyle IP 20
VLT 5001-5006, 200-240 V
VLT 5001-5011, 380-500 V



Compact IP 20
VLT 5001-5006, 200-240 V
VLT 5001-5011, 380-500 V

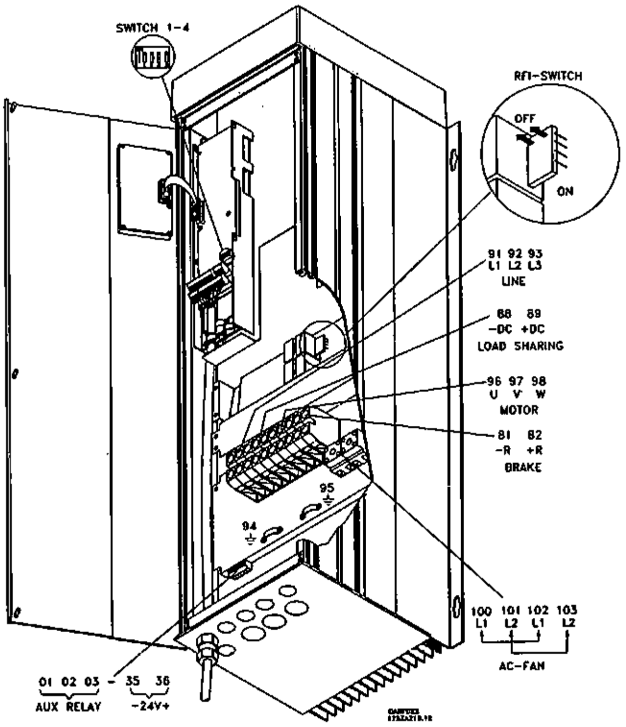


Compact IP 20
VLT 5008-5027, 200-240 V
VLT 5016-5052, 380-500 V

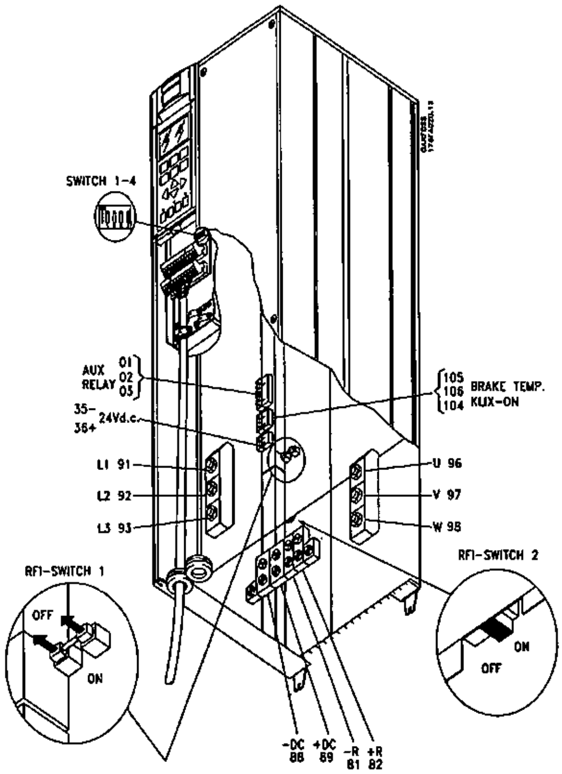


Compact IP 54
VLT 5001-5006, 200-240 V
VLT 5001-5011, 380-500 V

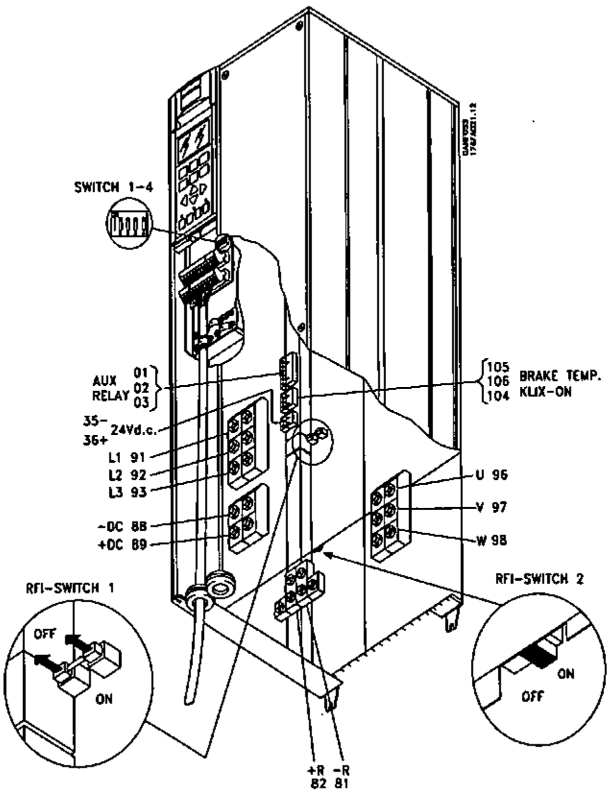
■ Electrical installation, enclosures



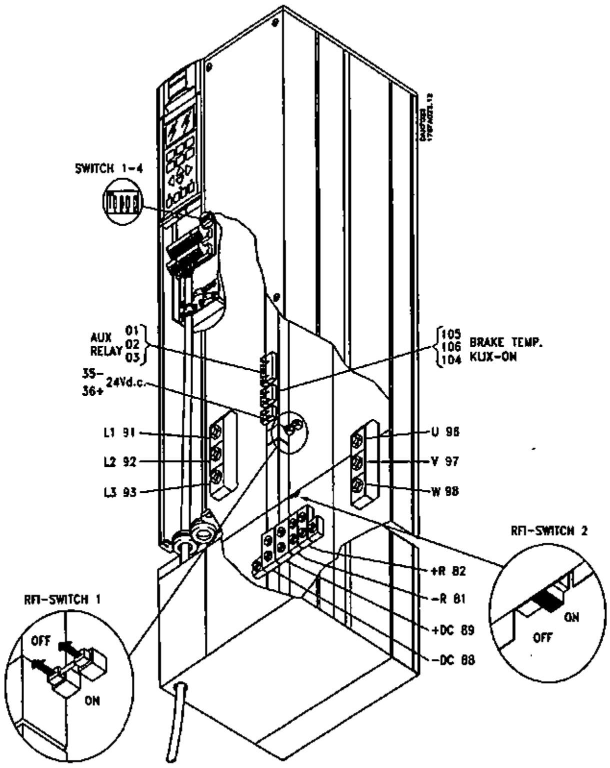
Compact IP 54
VLT 5008-5027, 200-240 V
VLT 5016-5052, 380-500 V



Compact IP 00
VLT 5032-5052, 200-240 V
VLT 5060-5100, 380-500 V

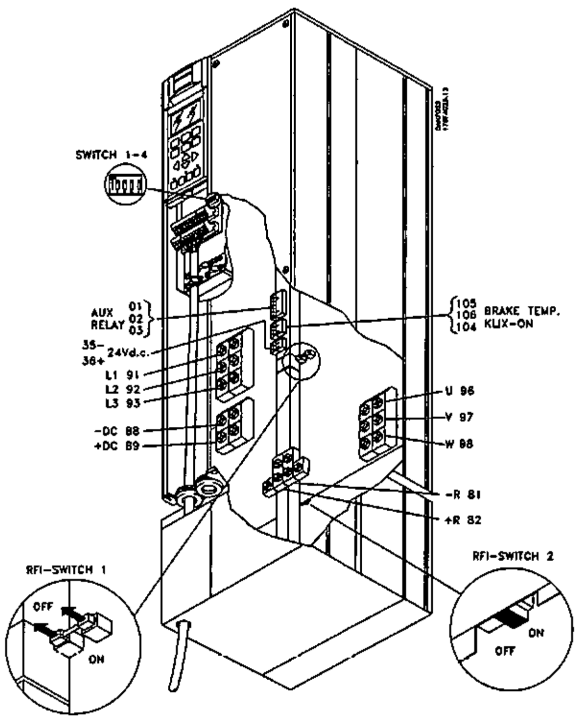


Compact IP 00
VLT 5125-5250, 380-500 V

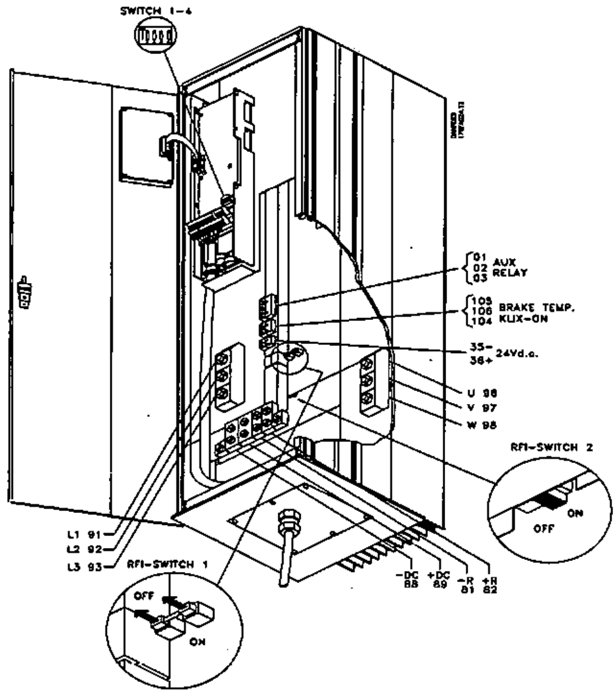


Compact IP 20
VLT 5032-5052, 200-240 V
VLT 5060-5100, 380-500 V

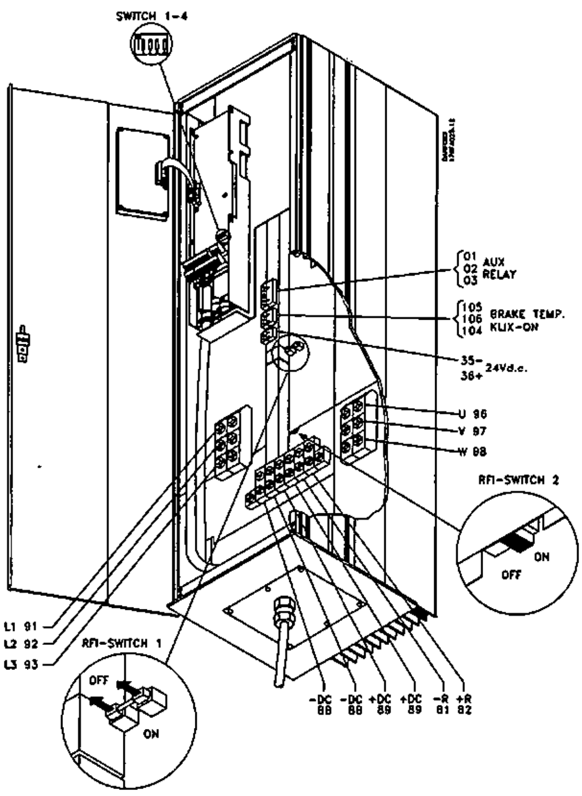
■ Electrical installation, enclosures



Compact IP 20
VLT 5125-5250, 380-500 V

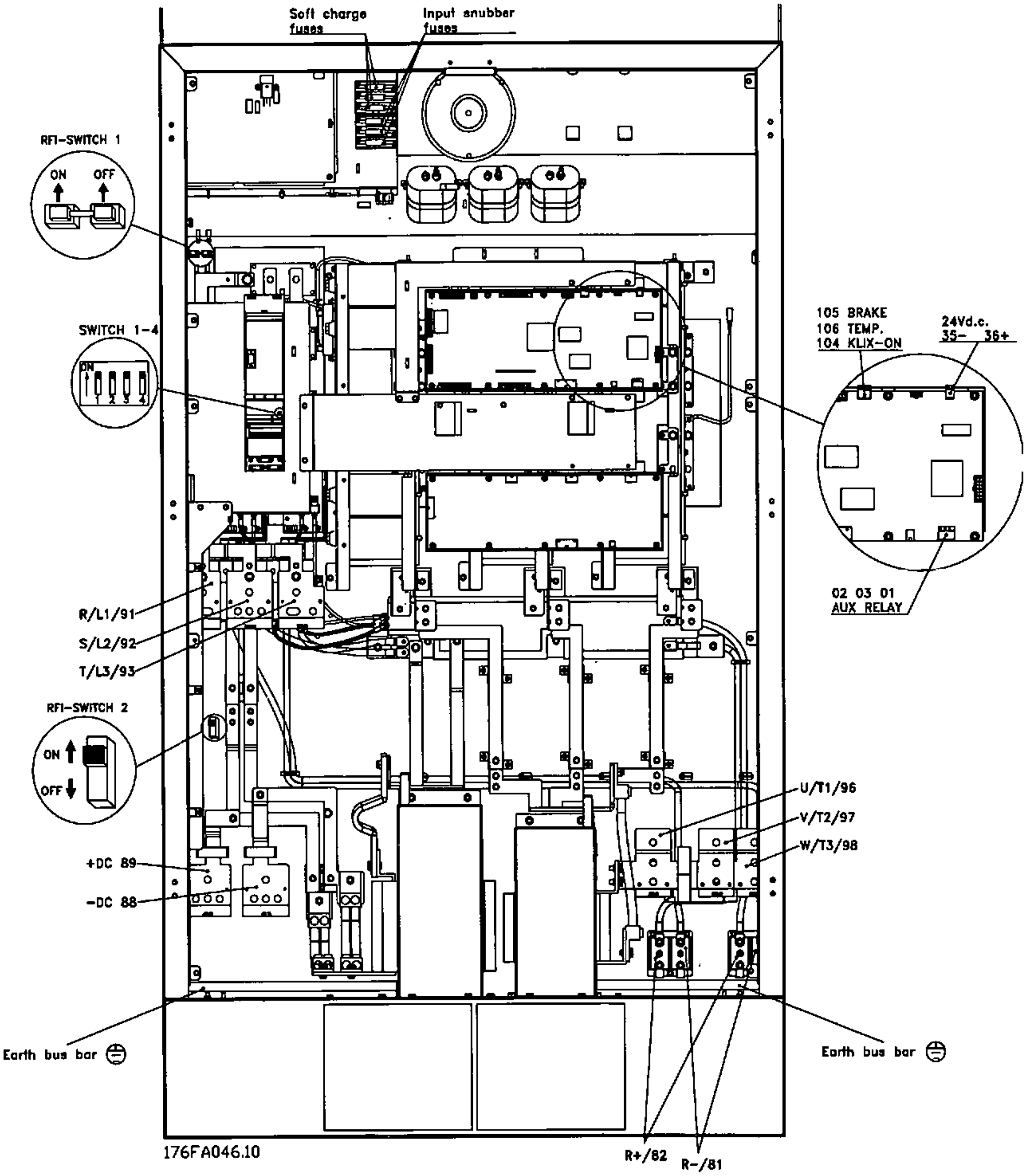


Compact IP 54
VLT 5032-5052, 200-240 V
VLT 5060-5100, 380-500 V



Compact IP 54
VLT 5125-5250, 380-500 V

■ Electrical installation, enclosures



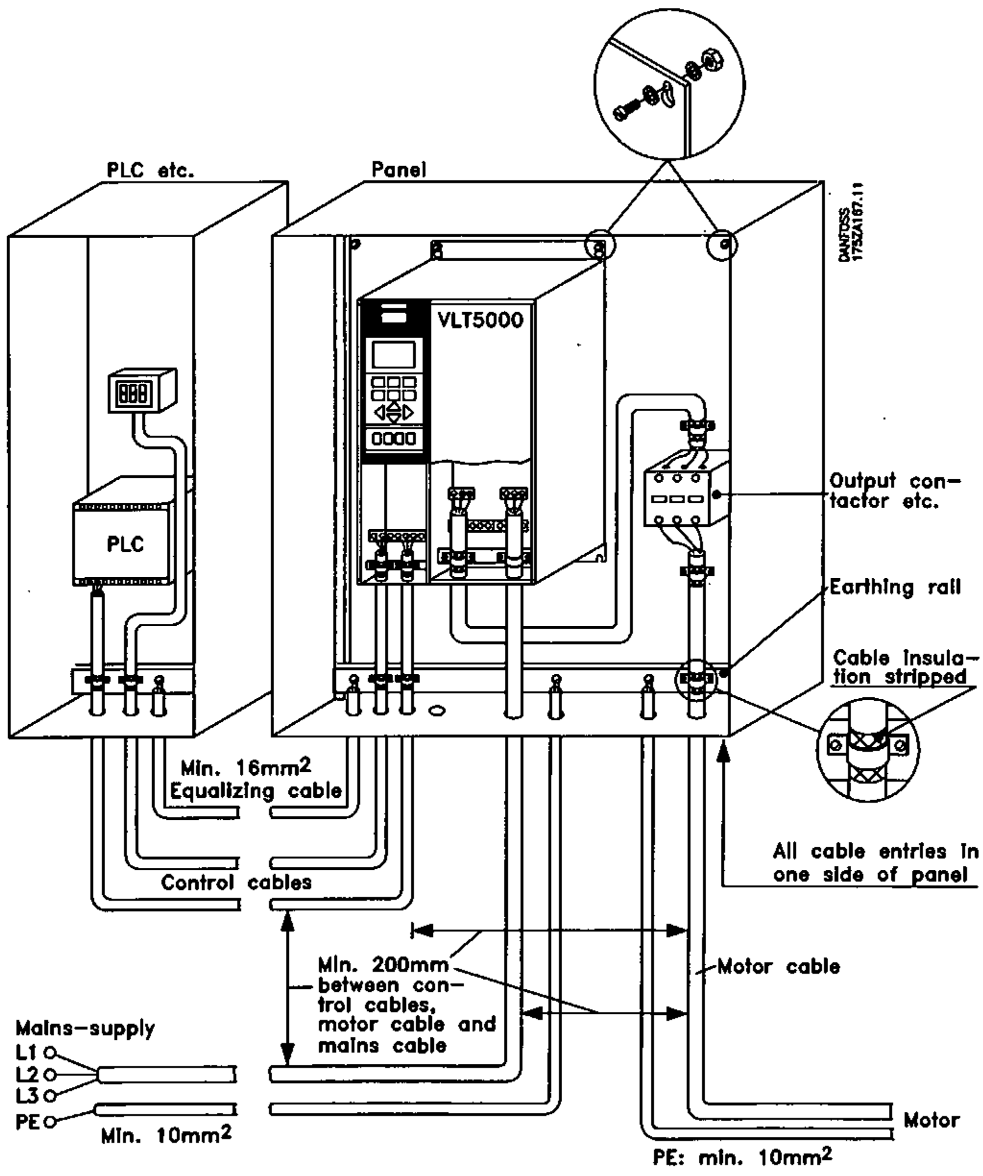
Compact IP 20 / IP 54
VLT 5300-5500, 380-500 V

■ EMC-correct electrical installation

General points to be observed to ensure EMC-correct electrical installation:

- Use only braided screened/armoured motor cables and braided screened/armoured control cables.
- Connect the screen to earth at both ends.
- Avoid installation with twisted screen ends (pigtails), since this ruins the screening effect at high frequencies. Use cable clamps instead.
- It is important to ensure good electrical contact from the installation plate through the installation screws to the metal cabinet of the VLT frequency converter.
- Use starwashers and galvanically conductive installation plates.
- Do not use unscreened/unarmoured motor cables in the installation cabinets.

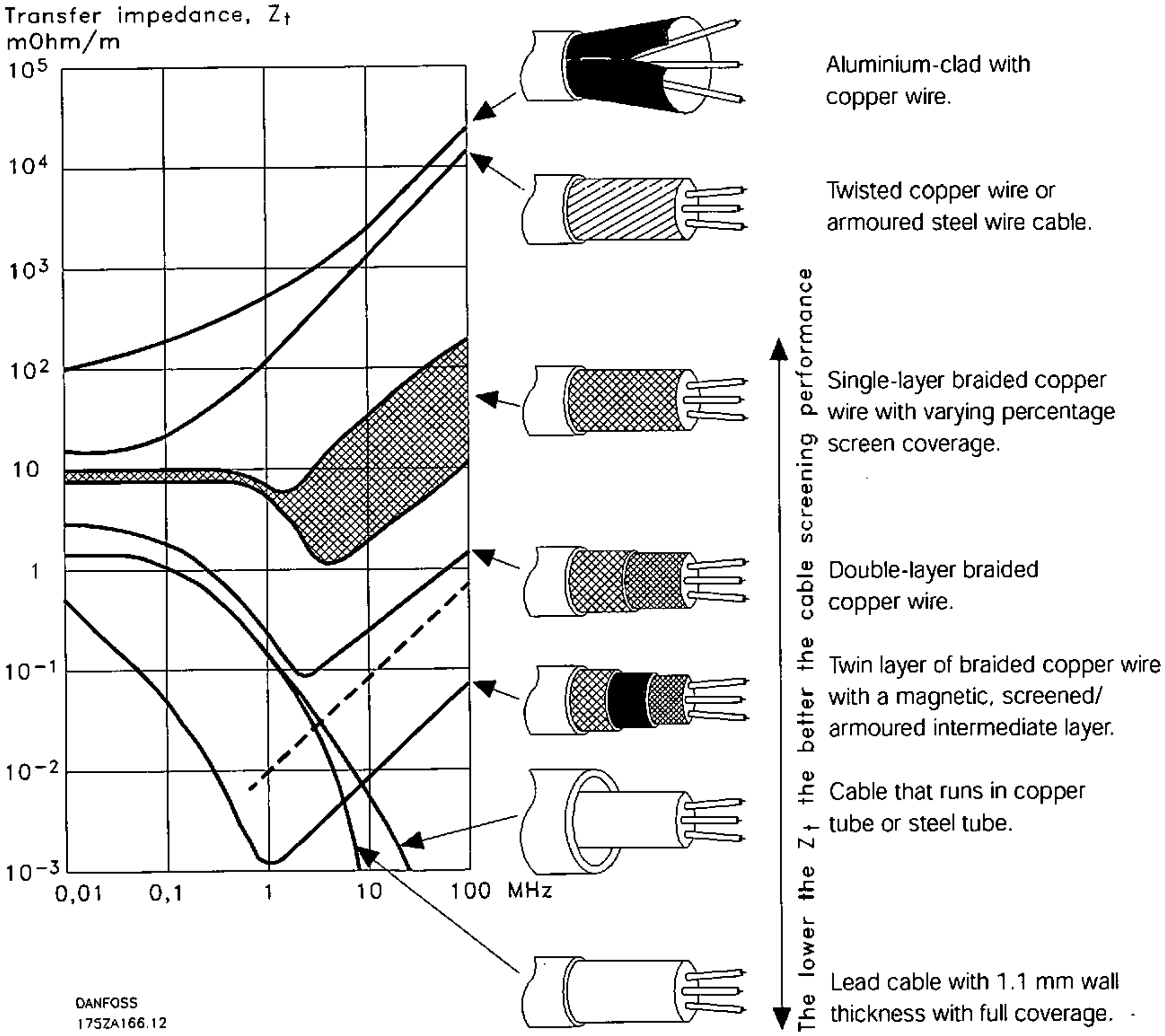
The illustration below shows EMC-correct electrical installation; the VLT frequency converter has been fitted in an installation cabinet and connected to a PLC.



■ **Use of EMC-correct cables**
Braided screened/armoured cables are recommended to optimise EMC immunity of the control cables and the EMC emission from the motor cables.
The ability of a cable to reduce the in- and outgoing radiation of electric noise depends on the transfer impedance (Z_T). The screen of a cable is normally designed to reduce the transfer of electric noise; however, a screen with a lower transfer impedance (Z_T) value is more effective than a screen with a higher transfer impedance (Z_T).

Transfer impedance (Z_T) is rarely stated by cable manufacturers, but it is often possible to estimate transfer impedance (Z_T) by assessing the physical design of the cable.

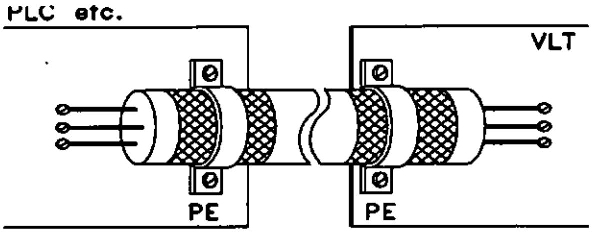
Transfer impedance (Z_T) can be assessed on the basis of the following factors:
- The conductibility of the screen material.
- The contact resistance between the individual screen conductors.
- The screen coverage, i.e. the physical area of the cable covered by the screen - often stated as a percentage value.
- Screen type, i.e. braided or twisted pattern.



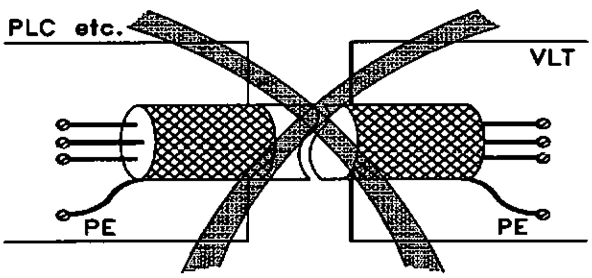
■ Earthing of braided screened/armoured control cables

Generally speaking, control cables must be braided screened/armoured and the screen must be connected by means of a cable clamp at both ends to the metal cabinet of the unit.

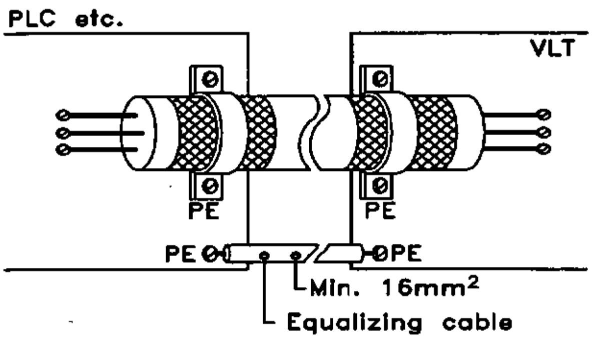
The drawing below indicates how correct earthing is carried out and what to be done if in doubt.



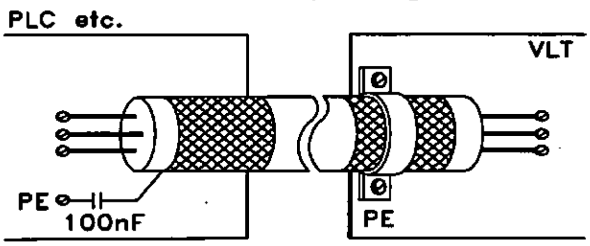
Correct earthing
Control cables and cables for serial communication must be fitted with cable clamps at both ends to ensure the best possible electrical contact.



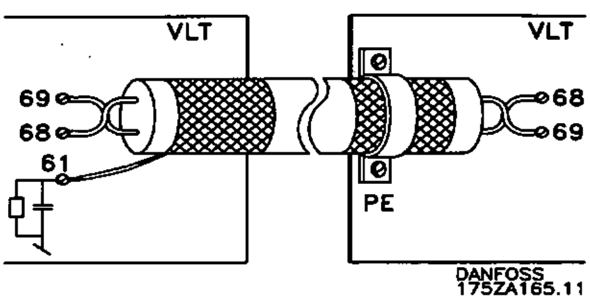
Wrong earthing
Do not use twisted cable ends (pigtails), since these increase the screen impedance at high frequencies.



Protection with respect to earth potential between PLC and VLT
If the earth potential between the VLT frequency converter and the PLC (etc.) is different, electric noise may occur that will disturb the whole system. This problem can be solved by fitting an equalising cable, to be placed next to the control cable. Minimum cable cross-section: 16 mm².



For 50/60 Hz earth loops
If very long control cables are used, 50/60 Hz earth loops may occur. This problem can be solved by connecting one end of the screen to earth via a 100nF capacitor (keeping leads short).



Cables for serial communication
Low-frequency noise currents between two VLT frequency converters can be eliminated by connecting one end of the screen to terminal 61. This terminal is connected to earth via an internal RC link. It is recommended to use twisted-pair cables to reduce the differential mode interference between the conductors.

■ Tightening-up torques and screw sizes

The table shows the torque required when fitting terminals to the VLT frequency converter. For VLT 5001-5027 200-240 V, VLT 5001-5052 380-500 V the cables must be fastened with screws. For VLT 5032 - 5052 200-240 V, VLT 5060-5500 380-500 V the cables must be fastened with bolts.
These figures apply to the following terminals:

Mains terminals	Nos 91, 92, 93
Motor terminals	L3 Nos 96, 97, 98 U, V, W
Earth terminal	No 95
Brake resistor terminals	81, 82
Loadsharing	88, 89

VLT type 3 x 200-240 V	Tightening-up torque	Screw size
VLT 5001-5006	0.5 - 0.6 Nm	M3
VLT 5008-5011	1.8 Nm	M4
VLT 5016-5022	3.0 Nm	M5
VLT 5027	4.0 Nm	M6

VLT type 3 x 200-240 V	Tightening-up torque	Screw size
VLT 5032-5052 [1]	11.3 Nm	M8

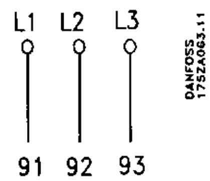
VLT type 3 x 380-500 V	Tightening-up torque	Screw size
VLT 5001-5011	0.5 - 0.6 Nm	M3
VLT 5016-5027	1.8 Nm	M4
VLT 5032-5042	3.0 Nm	M5
VLT 5052	4.0 Nm	M6

VLT type 3 x 380-500 V	Tightening-up torque	Bolt size
VLT 5060-5100 [1]	11.3 Nm	M8
VLT 5125-5250	11.3 Nm	M8
VLT 5300-5500 [2]	42 Nm	M12

1) For the brake terminals, the tightening-up torque is 3.0 Nm and the bolt size M6.
2) For the brake terminals, the tightening-up torque is 42 Nm and the bolt size M8.

■ Connection of mains

Connect the three mains phases to terminals L_1, L_2, L_3.



■ High voltage test

A high voltage test can be carried out by short-circuiting terminals U, V, W, L_1, L_2 and L_3 and energizing by max. 2.15 kV DC for one second between this short-circuit and the chassis.

NB!
The RFI switch must be closed (position ON) when high voltage tests are carried out (see pages 33-36, RFI switch).
The mains and motor connection must be interrupted in the case of high voltage tests of the total installation if the leakage currents are too high.

■ Safety earthing:

NB!
The VLT frequency converter has a high leakage current and must be earthed appropriately for safety reasons. Use earth terminal (see drawing pages 30-32), which enables reinforced earthing.
Apply national safety regulations.

■ Motor thermal protection

The electronic thermal relay in UL-approved VLT frequency converters has received the UL-approval for single motor protection when parameter 128 has been set for *ETR Trip* and parameter 105 has been programmed to the rated motor current (see motor nameplate).

■ Extra protection (RCD)

ELCB relays, multiple protective earthing or earthing can be used as extra protection, provided that local safety regulations are complied with.

In the case of an earth fault, a DC content may develop in the faulty current.

If ELCB relays are used, local regulations must be observed. Relays must be suitable for protection of 3-phase equipment with a bridge rectifier and for a brief discharge on power-up.

See also the section Special Conditions in the Design Guide.

RFI switch

Mains supply isolated from earth:

If the VLT frequency converter is supplied from an isolated mains source (IT mains), the RFI switch can be turned off (OFF). In OFF position, the internal RFI capacities (filter capacitors) between the chassis and the intermediate circuit are cut off to avoid damage to the intermediate circuit and to reduce the earth capacity (according to IEC 1800-3).
See position of RFI switch on pages 33-36.

NB!
The RFI switch is not to be operated with mains connected to the unit. Check that the mains supply has been disconnected before operating the RFI switch.

NB!
Open RFI switch is only allowed at factory set switching frequencies.

NB!
The RFI switch disconnects the capacitors galvanically; however, transients higher than approx. 1,000 V will be bypassed by a spark gap.

Mains supply connected to earth:

The RFI switch must be in ON position in order for the frequency converter to comply with the EMC-standard.

Installation of motor cables

NB!
If an unscreened cable is used, some EMC requirements are not complied with, see the Design Guide chapter 11: Special conditions.

If the EMC specifications regarding emission are to be complied with, the motor cable must be screened, unless otherwise stated for the RFI filter in question. It is important to keep the motor cable as short as possible so as to reduce the noise level and leakage currents to a minimum.

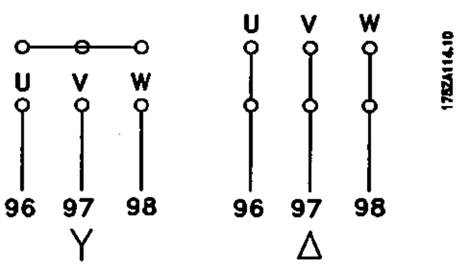
The motor cable screen must be connected to the metal cabinet of the frequency converter and to the metal cabinet of the motor. The screen connections are to be made with the biggest possible surface (cable clamp). This is enabled by different installation devices in the different VLT frequency converters.

Mounting with twisted screen ends (pigtails) is to be avoided, since these spoil the screening effect at higher frequencies.
If it is necessary to break the screen to install a motor isolator or motor contactor, the screen must be continued at the lowest possible HF impedance.

The frequency converter has been tested with a given length of cable and a given cross-section of that cable. If the cross-section is increased, the cable capacitance - and thus the leakage current - increases, and the cable length must be reduced correspondingly.

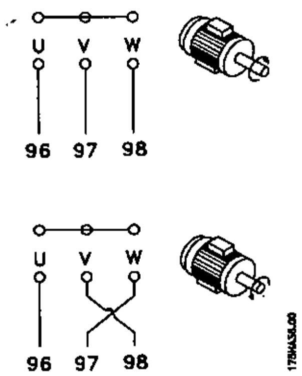
Connection of motor

All types of 3-phased asynchronous standard motors can be used with the VLT 5000 Series.



Normally, small motors are star-connected (200/400 V, Δ/Y).
Large motors are delta-connected (400/690 V, Δ/Y).

■ Direction of motor rotation

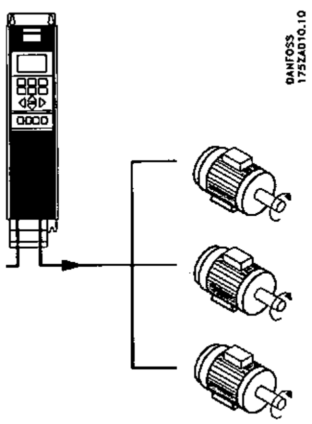


The factory setting is for clockwise rotation with the VLT frequency transformer output connected as follows.

Terminal 96 connected to U-phase
Terminal 97 connected to V-phase
Terminal 98 connected to W-phase

The direction of rotation can be changed by switching two phases in the motor cable.

■ Parallel coupling of motors



VLT 5000 Series is able to control several motors connected in parallel. If the motors are to have different rpm values, the motors must have different rated rpm values. Motor rpm is changed simultaneously, which means that the ratio between the rated rpm values is maintained across the range.

The total current consumption of the motors is not to exceed the maximum rated output current $I_{VLT,N}$ for the VLT frequency converter.

Problems may arise at the start and at low rpm values if the motor sizes are widely different. This is because the relatively high ohmic resistance in small motors calls for a higher voltage at the start and at low rpm values.

In systems with motors connected in parallel, the electronic thermal relay (ETR) of the VLT frequency converter cannot be used as motor protection for the individual motor. Consequently, additional motor protection is required, such as thermistors in each motor (or individual thermal relays).

Please note that the individual motor cable for each motor must be summed and is not to exceed the total motor cable length permitted.

■ Installation of brake cable

No.	Function
81, 82	Brake resistor terminals

The connection cable to the brake resistor must be screened. Connect the screen by means of cable clamps to the conductive back plate at the VLT frequency converter and to the metal cabinet of the brake resistor.
Size the brake cable cross-section to match the brake torque.

NB!
Please note that voltages up to 850 V DC may occur on the terminals.

■ **Installation of loadsharing**

No.	Function
89	Loadsharing

ction cable must be screened and the max. length from the VLT frequency converter to the DC bar is 25 metres.
Load sharing enables linking of the DC intermediate circuits of several VLT frequency converters.

NB!
Please note that voltages up to 850 V DC will occur on the terminals.

Load sharing calls for extra equipment. For further information please consult Loadsharing Instructions MI.50.NX.XX.

■ **Installation of relay terminals:**
Torque: 0.5 - 0.6 Nm
Screw size: M3

No.	Function
1-3	Relay output, 1+3 break, 1+2 make See parameter 323 of the Operating Instructions. See also *General technical data.*
4, 5	Relay output, 4+5 make See parameter 326 of the Operating Instructions. See also *General technical data.*

■ **Installation of 24 Volt external DC supply:**
Torque: 0.5 - 0.6 Nm
Screw size: M3

No.	Function
35, 36	24 V external DC supply

24 V external DC supply can be used as low-voltage supply to the control card and any option cards installed. This enables full operation of the LCP (incl. parameter setting) without connection to mains. Please note that a warning of low voltage will be given when 24 V DC has been connected; however, there will be no tripping. If 24 V external DC supply is connected or switched on at the same time as the mains supply, a time of min. 200 msec. must be set in parameter 120 *Start delay.*
A pre-fuse of min. 6 Amp, slow-blow, can be fitted to protect the external 24 V DC supply. The power consumption is 15-50 W, depending on the load on the control card.

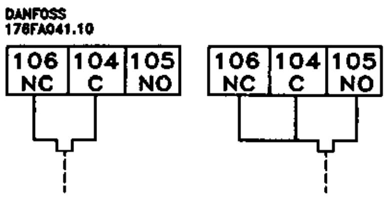
NB!
Use 24 V DC supply of type PELV to ensure correct galvanic isolation (type PELV) on the control terminals of the VLT frequency converter.

■ **Installation of brake resistor temperature switch:**
Torque: 0.5-0.6 Nm
Screw size: M3

Nos.	Function
106, 104, 105	Brake resistor temperature switch.

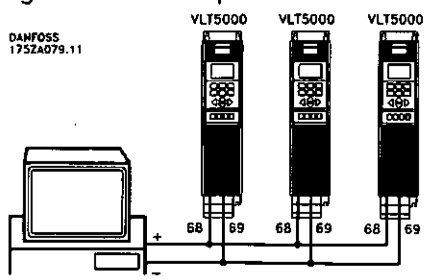
NB!:
This function is only available on VLT 5032-5052 200-240 V and VLT 5060-5500 380-500 V.

If the temperature of the brake resistor gets too high and the KLIXON switch drops out, the VLT frequency converter will stop braking. The motor will start coasting.
A KLIXON switch must be installed that can either be 'normally closed' or 'normally open'. If this function is not used, 106 and 104 must be short-circuited together.



■ **Bus connection**
The serial bus connection in accordance with the RS 485 (2-conductor) norm is connected to terminals 68/69 of the frequency converter (signals P and N). Signal P is the positive potential (TX+,RX+), while signal N is the negative potential (TX-,RX-).

If more than one frequency converter is to be connected to a given master, use parallel connections.

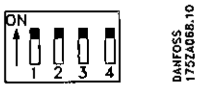


In order to avoid potential equalizing currents in the screen, the cable screen can be earthed via terminal 61, which is connected to the frame via an RC-link.

Bus termination
The bus must be terminated by a resistor network at both ends. For this purpose, set switches 2 and 3 on the control card for "ON".

■ **Switches 1-4:**

The dipswitch is located on the control card.
It is used for serial communication, terminals 68 and 69.
The switching position shown is the factory setting.

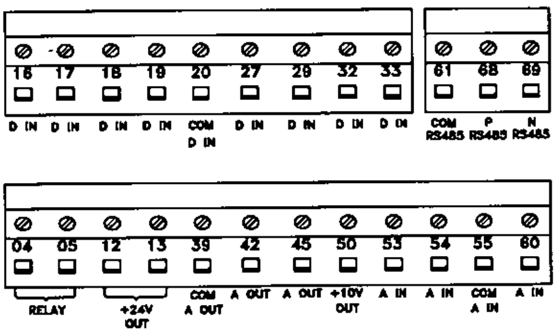


Switch 1 has no function.
Switches 2 and 3 are used for terminating an RS 485 interface, serial communication.
Switch 4 is used for separating the common potential for the internal 24 V DC supply from the common potential of the external 24 V DC supply.

NB!
Please note that when Switch 4 is in position "off", the external 24 V DC supply is galvanically isolated from the VLT frequency converter.

■ **Installation of control cables**

Tightening-up torque: 0.5-0.6 Nm
Screw size: M3
See page 39 for correct earthing of screened control cables.



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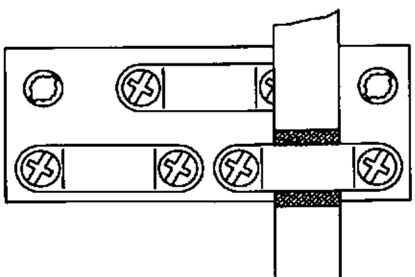

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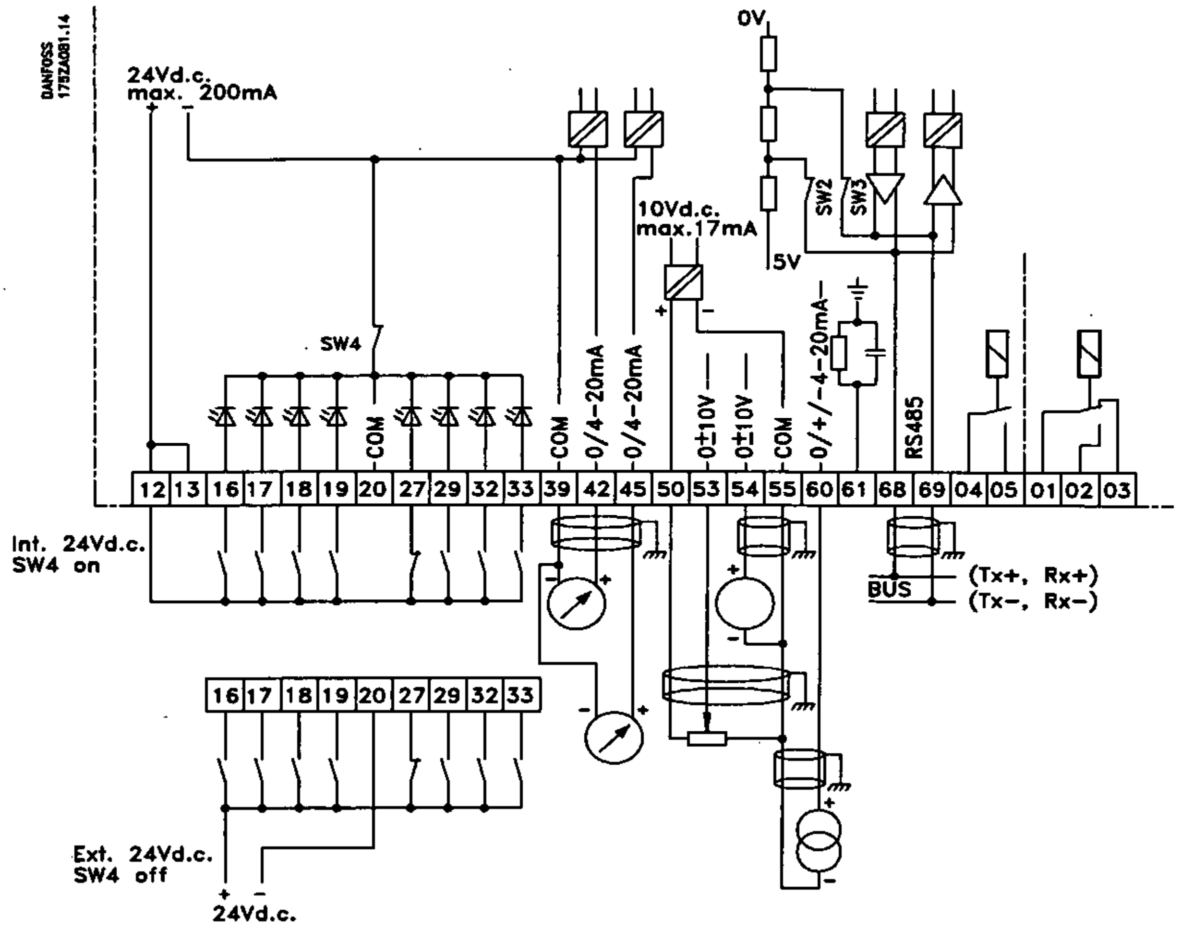
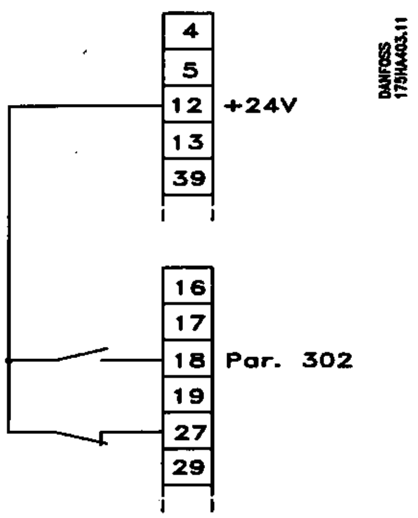
Nos.	Function
12,13	Voltage supply to digital inputs For the internal 24 V DC to be usable for the digital inputs, switch 4 on the control card must be closed. position "ON".
16-33	Digital inputs/encoder inputs
20	Ground for digital inputs
39	Ground for analogue/digital outputs
42, 5	Analogue/digital outputs for indicating frequency, reference, current and torque
50	Supply voltage to potentiometer and thermistor 10 V DC
53,54	Analogue input, voltage 0 - ±10 V
55	Ground for analogue inputs
60	Analogue input, current 0/4-20 mA
61	Termination for serial communication. See page 34.This terminal is normally not to be used.
68, 69	RS 485 interface, serial communication. Where the VLT frequency converter is connected to a bus, switches 2 and 3 (switches 1- 4) must be closed on the first and the last VLT frequency converter. On the remaining VLT frequency converters, switches 2 and 3 must be open. The factory setting is closed (position "ON").

■ Electrical installation



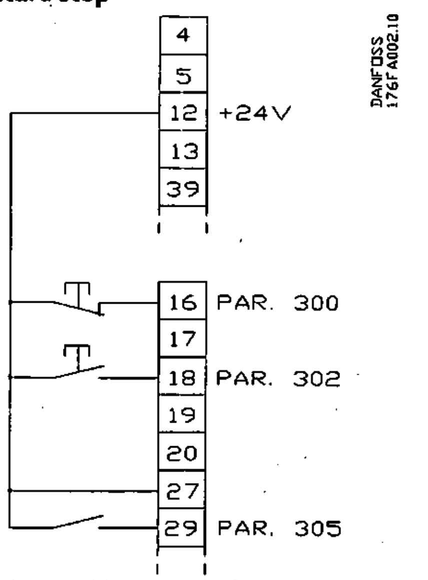
■ Connection examples

2-wire start/stop



- Start/stop using terminal 18.
  Parameter 302 = *Start* [1]
- Quick-stop using terminal 27.
  Parameter 304 = *Coasting stop inverted* [0]

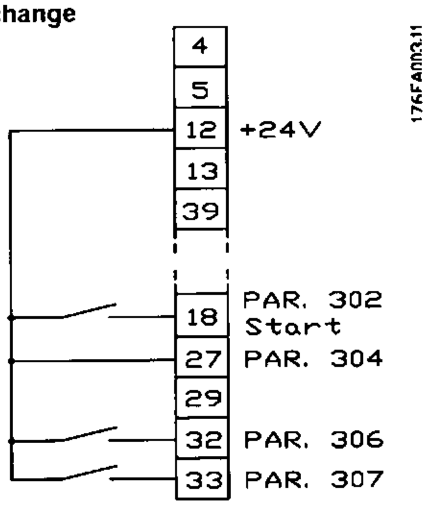
Pulse start/stop



- Stop inverted by means of terminal 16.
  Parameter 300 = *Stop inverted* [2]
- Pulse start using terminal 18.
  Parameter 302 = *Pulse start* [2]
- Jog by means of terminal 29.
  Parameter 305 = *Jog* [5]

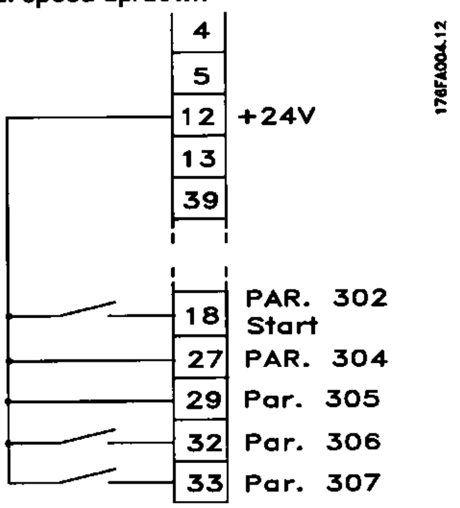
■ Connection examples, cont.

Setup change



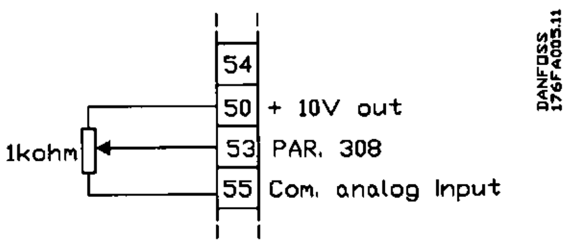
- Selection of setup using terminals 32 and 33.
  Parameter 306 = *Selection of setup, lsb* [10]
  Parameter 307 = *Selection of setup, msb* [10]
  Parameter 004 = *Multi-setup* [5].

Digital speed up/down



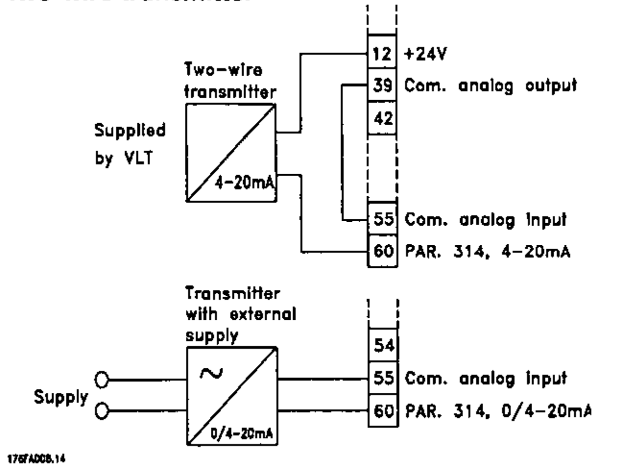
- Speed up and down using terminals 32 and 33.
  Parameter 306 = *Speed up* [9]
  Parameter 307 = *Speed down* [9]
  Parameter 305 = *Freeze reference* [9].

Potentiometer reference



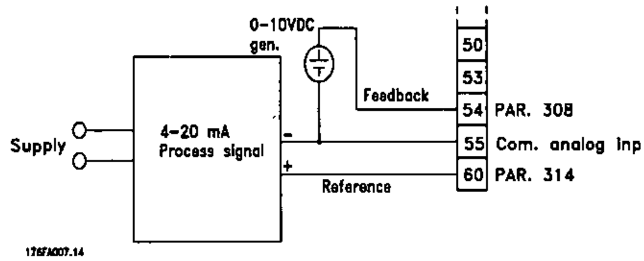
Parameter 308 = *Reference* [1]
Parameter 309 = *Terminal 53, min. scaling*
Parameter 310 = *Terminal 53, max. scaling*

Two-wire transmitter



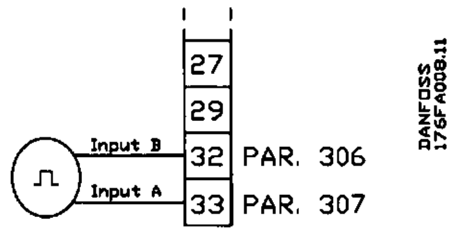
Parameter 314 = *Reference* [1], *Feedback* [2]
Parameter 315 = *Terminal 60, min. scaling*
Parameter 316 = *Terminal 60, max. scaling*

4-20 mA reference with speed feedback



Parameter 100 = *Speed control, closed loop*
Parameter 308 = *Feedback* [2]
Parameter 309 = *Terminal 53, min. scaling*
Parameter 310 = *Terminal 53, max. scaling*
Parameter 314 = *Reference* [1]
Parameter 315 = *Terminal 60, min. scaling*
Parameter 316 = *Terminal 60, max. scaling*

Encoder connection



Parameter 306 = *Encoder input B* [24]
Parameter 307 = *Encoder input A* [25]

If an encoder is connected that only has one output to *Encoder input A* [25], *Encoder input B* [24] must be set to *No function* [0].

■ Cross-reference for terminals/parameter functions.

Digital inputs	Terminal no.	16	17	18	19	27	29	32	33
	parameter	300	301	302	303	304	305	306	307
Value:									
No function	(NO OPERATION)	[0]	[0]	[0]	[0]		[0]	[0]	[0]
Reset	(RESET)	[1]★	[1]				[1]	[1]	[1]
Coasting stop, inverse	(COAST INVERSE)					[0]★			
Reset and coasting stop, inverse	(COAST & RESET INVERS)					[1]			
Quick-stop, inverse	(QSTOP INVERSE)					[2]			
DC-braking, inverse	(DCBRAKE INVERSE)					[3]			
Stop inverse	(STOP INVERSE)	[2]	[2]			[4]	[2]	[2]	[2]
Start	(START)			[1]★					
Latched start	(LATCHED START)			[2]					
Reversing	(REVERSING)				[1]★				
Start reversing	(START REVERSE)				[2]				
Only start clockwise, on	(ENABLE START FWD.)	[3]		[3]			[3]	[3]	
Only start anti-clockwise, on	(ENABLE START REV)		[3]		[3]		[4]		[3]
Jog	(JOGGING)	[4]	[4]				[5]★	[4]	[4]
Preset reference, on	(PRESET REF ON)	[5]	[5]				[6]	[5]	[5]
Preset reference, lsb	(PRESET REF. SEL. LSB)	[6]					[7]	[6]	
Preset reference, msb	(PRESET REF. MSB)		[6]				[8]		[6]
Freeze reference	(FREEZE REFERENCE)	[7]	[7]★				[9]	[7]	[7]
Freeze output	(FREEZE OUTPUT)	[8]	[8]				[10]	[8]	[8]
Speed up	(SPEED UP)	[9]					[11]	[9]	
Speed down	(SPEED DOWN)		[9]				[12]		[9]
Choice of Setup, lsb	(SETUP SELECT LSB)	[10]					[13]	[10]	
Choice of Setup, msb	(SETUP SELECT MSB)		[10]				[14]		[10]
Choice of Setup, msb/speed up	(SETUP MSB/SPEED UP)							[11]★	
Choice of Setup, lsb/speed down	(SETUP LSB/SPEED DOWN)								[11]★
Catch-up	(CATCH UP)	[11]					[15]	[12]	
Slow-down	(SLOW DOWN)		[11]				[16]		[12]
Ramp 2	(RAMP 2)	[12]	[12]				[17]	[13]	[13]
Mains failure inverted	(MAINS FAILURE INVERSE)	[13]	[13]				[18]	[14]	[14]
Pulse reference	(PULSE REFERENCE)		[23]				[28][1]		
Pulse feedback	(PULSE FEEDBACK)								[24]
Encoder feedback input, A	(ENCODER INPUT 2A)								[25]
Encoder feedback input, B	(ENCODER INPUT 2B)							[24]	

1) If this function is selected for terminal 29, the same function for terminal 17 will not be valid, even if it has been selected to be active.

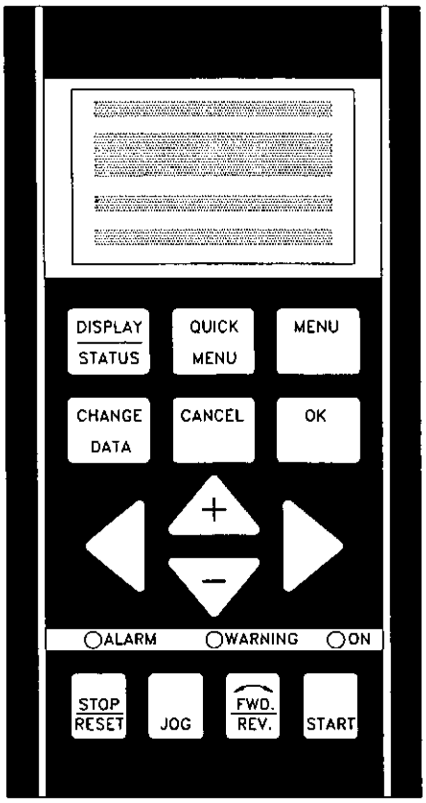
★ = factory setting

■ Control panel

The front of the VLT frequency converter features a control panel - LCP (Local Control Panel), which makes up a complete interface for operation and monitoring of the VLT 5000 Series.
The control panel is detachable and can - as an alternative - be installed up to 3 metres away from the VLT frequency converter, e.g. on a front panel, by means of a mounting kit option.
The functions of the control panel can be divided into three groups:

- display
- keys for changing program parameters
- keys for local operation

All data are indicated by means of a 4-line alphanumeric display, which in normal operation is able to show 4 measurements and 3 operating conditions continuously. During programming, all the information required for quick, effective parameter Setup of the VLT frequency converter will be displayed. As a supplement to the display, there are three LEDs for voltage (power or 24 V external), warning and alarm.
All program parameters of the VLT frequency converter can be changed immediately from the control panel, unless this function has been blocked via parameter 018.



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■ Display

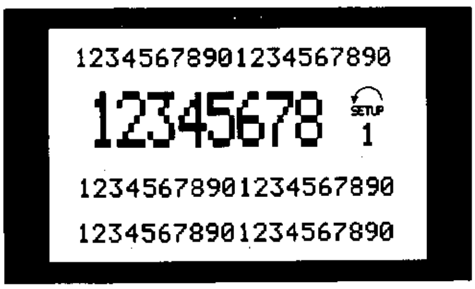
The LCD-display has rear lighting and a total of 4 alpha-numeric lines together with a box that shows the direction of rotation (arrow) and the chosen Setup as well as the Setup in which programming is taking place if that is the case.

1st line

2nd line

3rd line

4th line



1st line shows up to 3 measurements continuously in normal operating status or a text which explains the 2 nd line.

2nd line shows a measurement with related unit continuously, regardless of status (except in the case of alarm/warning).

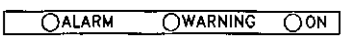
3rd line is normally blank and is used in the menu mode to show the selected parameter number or parameter group number and name.

4th line is used in operating status for showing a status text or in data change mode for showing the mode or value of the selected parameter.

An arrow indicates the direction of rotation of the motor. Furthermore, the Setup which has been selected as the Active Setup in parameter 004 is shown. When programming another Setup than the Active Setup, the number of the Setup which is being programmed will appear to the right. This second Setup number will flash.

■ LEDs

At the bottom of the control panel is a red alarm LED and a yellow warning LED, as well as a green voltage LED.

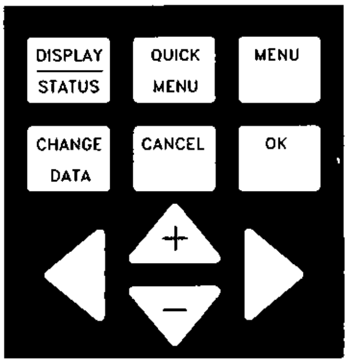


red yellow green

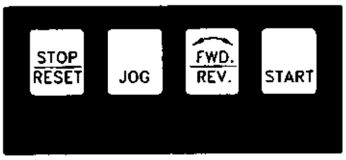
If certain threshold values are exceeded, the alarm and/or warning LED lights up together with a status and alarm text on the control panel.
The voltage LED is activated when the VLT frequency converter receives voltage, or 24 V external supply; at the same time the rear lighting of the display will be on.

■ Control keys

The control keys are divided into functions. This means that the keys between display and indicator lamps are used for parameter Setup, including choice of display indication during normal operation.



Keys for local control are found under the indicator LEDs.



■ Control key functions

[DISPLAY / STATUS] is used for selecting the mode of display or for changing back to Display mode from either the Quick menu mode or the Menu mode.

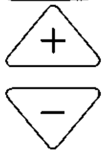
[QUICK MENU] is used for programming the parameters that belong under the Quick menu mode. It is possible to switch directly between Quick menu mode and Menu mode.

[MENU] is used for programming all parameters. It is possible to switch directly between Menu mode and Quick menu mode.

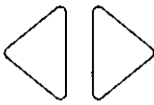
[CHANGE DATA] is used for changing the parameter selected either in the Menu mode or the Quick menu mode.

[CANCEL] is used if a change of the selected parameter is not to be carried out.

[OK] is used for confirming a change of the parameter selected.



[+/-] is used for selecting parameter and for changing the chosen parameter or for changing the read out in line 2.



[<>] is used for selecting group and to move the cursor when changing numerical parameters.

[STOP / RESET] is used for stopping the motor connected or for resetting the VLT frequency converter after a drop-out (trip). Can be selected via parameter 014 to be active or inactive. If stop is activated, line 2 will flash, and [START] must be activated.

[JOG] overrides the output frequency to a preset frequency while the key is kept down. Can be selected via parameter 015 to be active or inactive.

[FWD / REV] changes the direction of rotation of the motor, which is indicated by means of the arrow on the display although only in Local.
Can be selected via parameter 016 to be active or inactive.

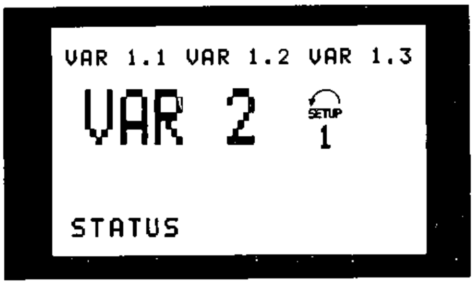
[START] is used for starting the VLT frequency converter after stop via the "Stop" key. Is always active, but cannot override a stop command given via the terminal strip.

NB!
If the keys for local control have been selected as active, they will remain active both when the VLT frequency has been set for *Local Control* and for *Remote Control* via parameter 002, although with the exception of [FWD/REV], which is only active in Local operation.

NB!
If no external stop function has been selected and the [STOP] key has been selected as inactive, the motor can be started and can only be stopped by disconnecting the voltage to the motor.

■ **Display read-out state**
The display read-out state can be varied - see the list below - depending on whether the VLT frequency converter is in normal operation or is being programmed.

■ **Display mode**
In normal operation, up to 4 different operating variables can be indicated continuously: 1.1 and 1.2 and 1.3 and 2, and in line 4 the present operating status or alarms and warnings that have arisen.



■ **Display mode - selection of read-out state**
There are three options in connection with the choice of read-out state in the Display mode - I, II and III. The choice of read-out state determines the number of operating variables read out.

Read-out state:	I:	II:	III:
Line 1	Description for operating variable in line 2	Data value for 3 operating variables in line 1	Description for 3 operating variables in line 1

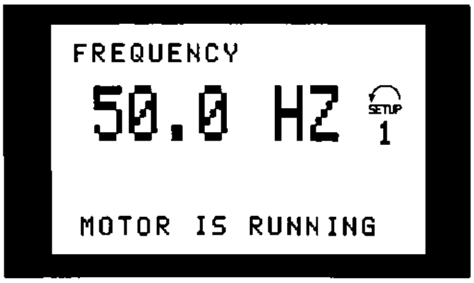
The table below gives the units linked to the variables in the first and second line of the display.

Operating variable:	Unit:
Reference	[%]
Reference	[unit]
Feedback	[unit]
Frequency	[Hz]
Frequency x scaling	[-]
Motor current	[A]
Torque	[%]
Power	[kW]
Power	[HP]
Output energy	[kWh]
Motor voltage	[V]
DC-link voltage	[V]
Motor thermal load	[%]
VLT thermal load	[%]
Hours run	[Hours]
Input status, dig. Input	[Binary code]
Input status, analogue terminal 53	[V]
Input status, analogue terminal 54	[V]
Input status, analogue terminal 60	[mA]
Pulse reference	[Hz]
External reference	[%]
Status word	[Hex]
Brake effect/2 min.	[kW]
Brake effect/sec.	[kW]
Heat sink temp.	[°C]
Alarm word	[Hex]
Control word	[Hex]
Warning word 1	[Hex]
Extended status word	[Hex]
Communication option card warning	[Hex]

Operating variables 1.1 and 1.2 and 1.3 in the first line, and operating variable 2 in the second line are selected via parameter 009, 010, 011 and 012.

- Read-out state I:

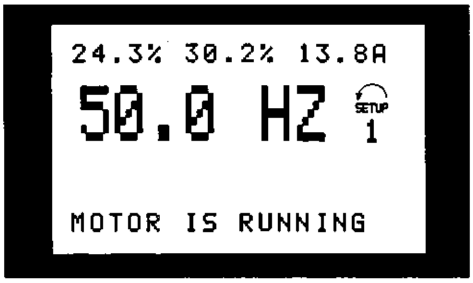
This read-out state is standard after starting up or after initialisation.



Line 2 gives the data value of an operating variable with related unit, and line 1 provides a text which explains line 2, cf. table. In the example, Frequency has been selected as variable via parameter 009. During normal operation another variable can immediately be read out by using the [+/-] keys.

- Read-out state II:

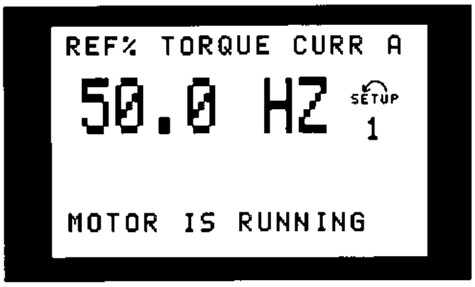
Switching between read-out states I and II is effected by pressing the [DISPLAY / STATUS] key.



In this state, data values for four operating values are shown at the same time, giving the related unit, cf. table. In the example, Reference, Torque, Current and Frequency are selected as variables in the first and second line.

- Read-out state III:

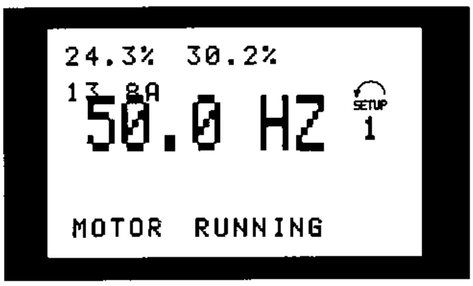
This read-out state can be held as long as the [DISPLAY/STATUS] key is pressed. When the key is released, the system switches back to Read-out state II, unless the key is pressed for less that approx. 1 sec., in which case the system always reverts to Read-out state I.



This is where parameter names and units for operating variables in the first and second line are given - operating variable 2 remains unchanged.

- Display state IV:

This display state can be produced during operation if another setup is to be changed without stopping the VLT frequency converter. This function is activated in parameter 005, *Programming Setup*.



The selected programming setup number will flash to the right of the active setup.

Parameter Setup

The VLT 5000 Series can be used for practically all assignments, which is why the number of parameters is quite large. Also, this series offers a choice between two programming modes - a Menu mode and a Quick menu mode.
The former provides access to all parameters. The latter takes the user through a few parameters which make it possible in most cases to start operating the VLT frequency converter.
Regardless of the mode of programming, a change of a parameter will take effect and be visible both in the Menu mode and in the Quick menu mode.

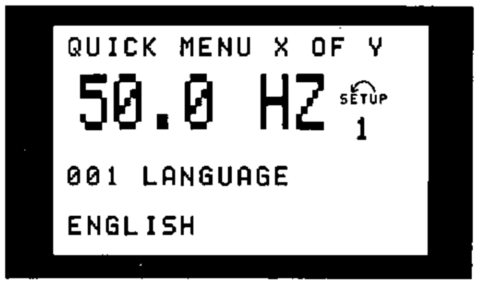
Structure for the Quick menu mode versus the Menu mode

In addition to having a name, each parameter is linked up with a number which is the same regardless of the programming mode. In the Menu mode, the parameters are divided into groups, with the first digit of the parameter number (from the left) indicating the group number of the parameter in question.

- The quick menu takes the user through a number of parameters that may be enough to get the motor to run nearly optimally, if the factory setting for the other parameters takes the desired control functions into account, as well as the configuration of signal inputs/outputs (control terminals).
- The Menu mode makes it possible to select and change all parameters at the user's option. However, some parameters will be "missing", depending on the choice of configuration (parameter 100), e.g. open loop hides all the P.I.D. parameters.

Quick Setup via Quick menu

The Quick Setup starts with pressing the [QUICK MENU] key, which brings out the following read-out on the display:



At the bottom of the display, the parameter number and name are given together with the status/value of the first parameter under Quick Setup. The first time the [Quick Menu] key is pressed after the unit has been switched on, the read-outs always start at pos. 1 - see table below.

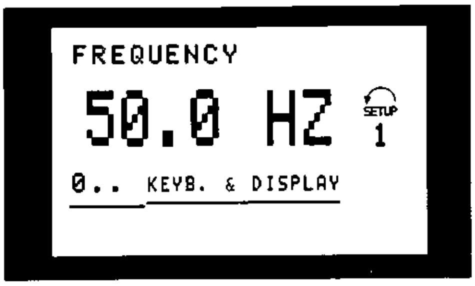
Parameter selection

The selection of parameter is effected by means of the [+/-] keys. The following parameters are accessible:

Pos.:	No.:	Parameter:	Unit:
1	001	Language	
2	102	Motor output	[kW]
3	103	Motor voltage	[V]
4	104	Motor frequency	[Hz]
5	105	Motor current	[A]
6	106	Rated motor speed	[rpm]
7	107	Automatic motor adaptation, AMA	
8	204	Minimum reference	[Hz]
9	205	Maximum reference	[Hz]
10	207	Ramp-up time 1	[sec.]
11	208	Ramp-down time 1	[sec.]
12	002	Local/remote control	
13	003	Local reference	

■ **Menu mode**

The Menu mode is started by pressing the [MENU] key, which produces the following read-out on the display:



Line 3 on the display shows the parameter group number and name.

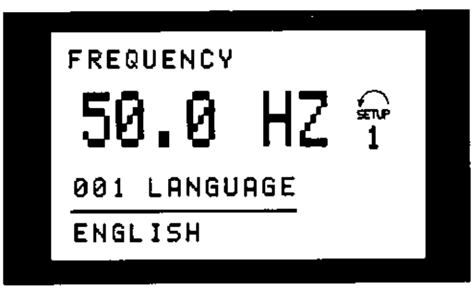
■ **Parameter selection**

In the Menu mode the parameters are divided into groups. Selection of parameter group is effected by means of the [<>] keys.

The following parameter groups are accessible:

Group no.	Parameter group:
0	Operation & Display
1	Load & Motor
2	References & Limits
3	Inputs & Outputs
4	Special functions
5	Serial communication
6	Technical functions

When the desired parameter group has been selected, each parameter can be chosen by means of the [+/-] keys:



The 3rd line of the display shows the parameter number and name, while the status/value of the selected parameter are shown in line 4.

■ **Changing data**

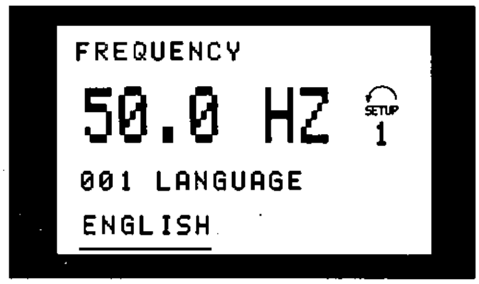
Regardless of whether a parameter has been selected under the Quick menu or the Menu mode, the procedure for changing data is the same.

Pressing the [CHANGE DATA] key gives access to changing the selected parameter, following which the underlining in line 4 will flash on the display.

The procedure for changing data depends on whether the selected parameter represents a numerical data value or a text value.

■ **Changing a text value**

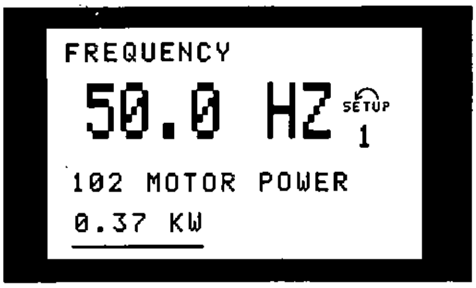
If the selected parameter is a text value, the text value is changed by means of the [+/-] keys.

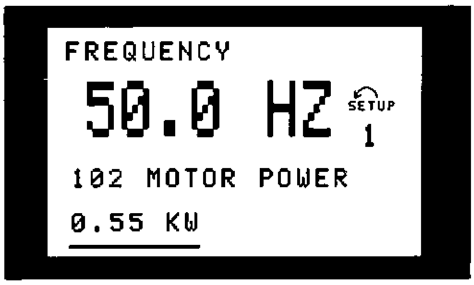


The bottom display line shows the text value that will be entered (saved) when acknowledgement is given [OK].

■ **Change of group of numeric data values**

If the chosen parameter represents a numeric data value, the chosen data value is changed by means of the [+/-] keys.

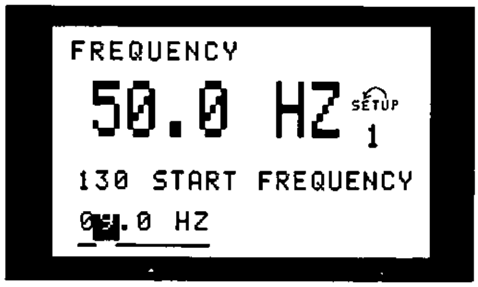




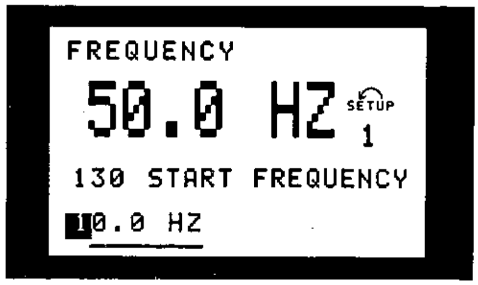
The chosen data value is indicated by the digit flashing.
The bottom display line shows the data value that will be entered (saved) when signing off with [OK].

■ **Infinitely variable change of numeric data value**

If the chosen parameter represents a numeric data value, a digit is first selected by means of the [<>] keys.



Then the chosen digit is changed infinitely variably by means of the [+/-] keys:



The chosen digit is indicated by the digit flashing.
The bottom display line shows the data value that will be entered (saved) when signing off with [OK].

■ **Manual initialisation**

Disconnect from mains and hold the [DISPLAY/ STATUS] + [CHANGE DATA] + [OK] keys down while at the same time reconnecting the mains supply. Release the keys; the VLT frequency converter has now been programmed for the factory setting.

The following parameters are not zeroed by means of manual initialisation:

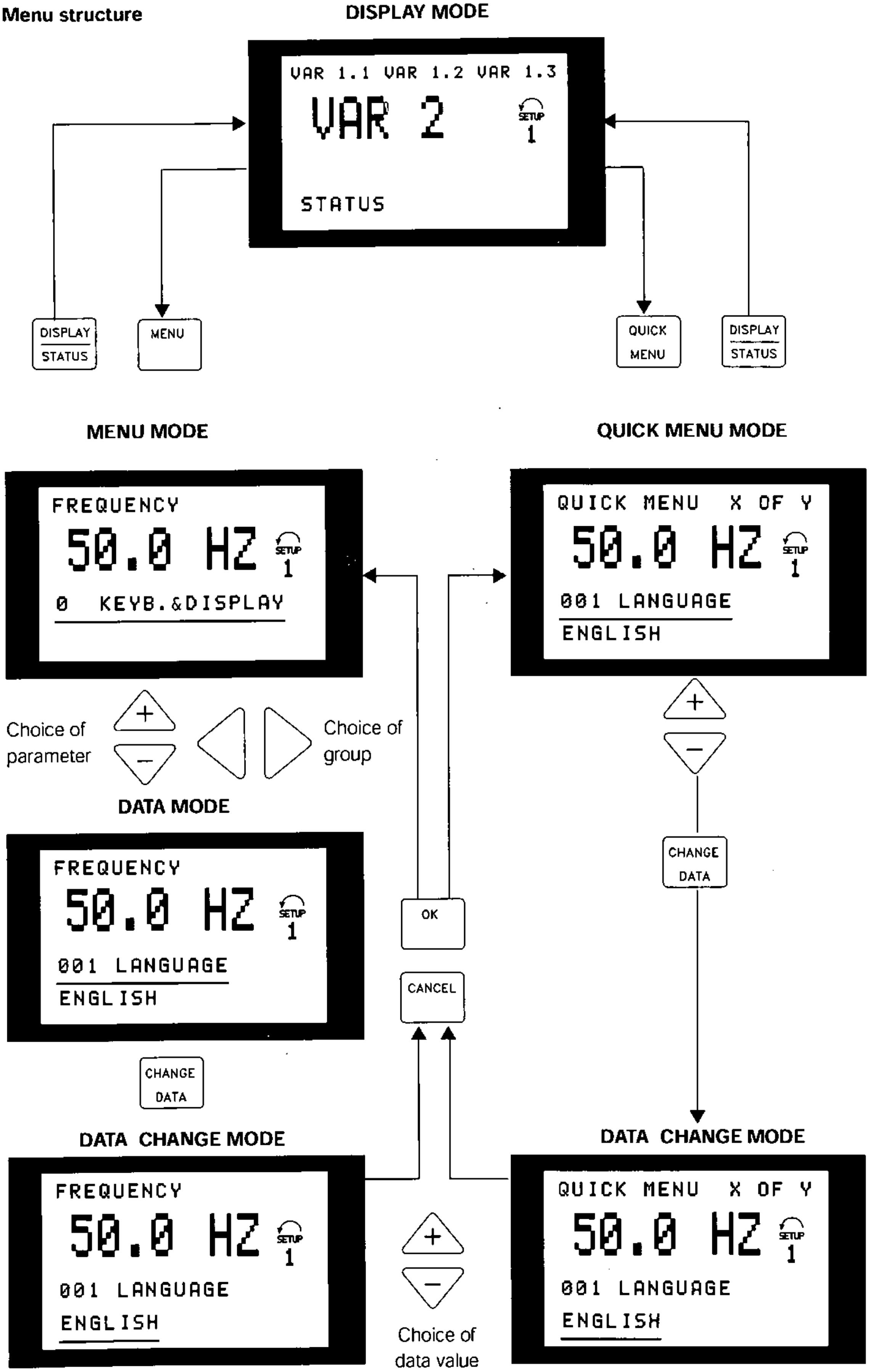
parameter 600, Operating hours
601, Hours run
602, kWh counter
603, Number of power-ups
604, Number of overtemperatures
605, Number of overvoltages

It is also possible to carry out initialisation via parameter 620, see page 144 regarding procedure.

■ **Changing of data value, step-by-step**

Certain parameters can be changed step by step or infinitely variably. This applies to Motor power (parameter 102), Motor voltage (parameter 103) and Motor frequency (parameter 104).
This means that the parameters are changed both as a group of numeric data values and as numeric data values infinitely variably.

■ Menu structure



■ Application configuration

Using this parameter enables the choice of a configuration (setting) of the VLT frequency converter that fits the application in which the VLT frequency converter is to be active.

NB!
First, the motor nameplate data must be set in parameters 102-106.

There is a choice of the following configurations:
- Speed control, open loop
- Speed control, closed loop
- Process control, closed loop
- Torque control, open loop
- Torque control, speed feedback

The selection of special motor characteristics can be combined with any application configuration.

■ Setting of parameters

Select *Speed control, open loop* if a normal speed adjustment without external feedback signals is required (the internal slip compensation is operating) from motor or unit.
Set the following parameters in order shown:

Speed control, open loop:

Parameter		Setting:	Data value:
100	Configuration	Speed control, open loop	[0]
200	Output frequency range/direction		
201	Output frequency low limit	Only if [0] or [2] in par. 200	
202	Output frequency high limit		
203	Reference/feedback range		
204	Minimum reference	Only if [0] in par. 203	
205	Maximum reference		

Select *Speed control, closed loop* if the application has a feedback signal and the accuracy in *Speed control, open loop* is not sufficient or a full holding torque is required.
Set the following parameters in order shown:

Speed control, closed loop (PID):

Parameter		Setting:	Data value:
100	Configuration	Speed control, closed loop	[1]
200	Output frequency range/direction	Output frequency low limit	
202	Output frequency high limit		
203	Reference/feedback range		
414	Minimum feedback	Only if [0] or [2] in par. 200	
415	Maximum feedback		
204	Minimum reference	Only if [0] in par. 203	
205	Maximum reference		
417	Speed PID proportional gain		
418	Speed PID integration time		
419	Speed PID differentiation time		
420	Speed PID diff. gain limit		
421	Speed PID lowpass filter time		

■ Setting of parameters, cont.

Select *Process control, closed loop* if the application has a feedback signal that is not directly related to motor speed (rpm/Hz), but some other unit, such as temperature, pressure, etc. Set the following parameters in the order shown:

Process control, closed loop (Process PID):

Parameter:		Setting:	Data value:
100	Configuration	Process control, closed loop	[3]
200	Output frequency range/direction		
201	Output frequency low limit		
202	Output frequency high limit		
203	Reference/feedback range		
414	Minimum feedback	Only if [0] or [2] in par. 200	
415	Maximum feedback		
204	Minimum reference	Only if [0] in par. 203	
205	Maximum reference		
416	Process units		
437	Process PID normal/inverse		
438	Process PID anti-windup		
439	Process PID start frequency		
440	Process PID proportional gain		
441	Process PID integration time		
442	Process PID differentiation time		
443	Process PID diff. gain limit		
444	Process PID lowpass filter		

Select *Torque control, open loop* if PI control is required, to change the motor frequency in order to maintain the torque reference (Nm).
This is relevant for winding and extrusion applications.

Torque control, open loop, is to be selected if the speed direction is not to be changed during operation; this means that either a positive or a negative torque reference is used at all times.

Set the following parameters in order shown:

Torque control, open loop:

Parameter:		Setting:	Data value:
100	Configuration	Torque control, open loop	[4]
200	Output frequency range/direction		
201	Output frequency low limit		
202	Output frequency high limit		
203	Reference/feedback range		
204	Minimum reference	Only if [0] in par. 203	
205	Maximum reference		
414	Minimum feedback		
415	Maximum feedback		
433	Torque proportional gain		
434	Torque integration time		

■ Setting of parameters, cont.

Select *Torque control, speed feedback,* if an encoder feedback signal is to be generated. This is relevant in winder and extruder applications.

Torque control, speed feedback, is selected if it is to be possible to change the speed direction, while at the same time maintaining the torque reference.
Set the following parameters in order shown:

Torque control, speed feedback:

Parameter:		Setting:	Data value:
100	Configuration	Torque control, speed feedback	[5]
200	Output frequency, range/direction		
201	Output frequency, low limit		
202	Output frequency, high limit		
203	Reference/feedback range		
204	Minimum reference	Only if [0] in par. 203	
205	Maximum reference		
414	Minimum feedback		
415	Maximum feedback		
306	Encoder feedback, input B		[24]
307	Encoder feedback, input A		[25]
329	Encoder feedback, pulse/rev.		
421	Speed PID low-pass filter time		
448	Gear ratio		
447	Torque control, speed feedback		
449	Friction loss		

After *Torque control, speed feedback,* has been selected, the VLT frequency converter should be calibrated to ensure that the current torque equals the torque of the VLT frequency converter. For this to be ensured, a torque gauge must be fitted to the shaft so as to enable accurate adjustment of parameter 447, *Torque compensation,* and parameter 449, *Friction loss.* It is recommended to run an AMA before torque calibration.
Proceed as follows before beginning to use the system:

1. Fit a torque gauge to the shaft.
2. Start the motor with a positive torque reference and a positive direction of rotation.
   Read the torque gauge.
3. Using the same torque reference, change the direction of rotation from positive to negative. Read the torque and adjust it to the same level as for the positive torque reference and direction of rotation. This can be done by means of parameter 449, *Friction loss.*
4. Using a warm motor and approx. 50% load, set parameter 447, *Torque compensation,* to match the torque gauge. The VLT frequency converter is now ready for operation.

■ Special motor characteristics

Select *Special motor characteristics* if the VLT frequency converter is to be adapted to a synchronous motor, parallel motor operation or if slip-compensation is not required.

Set the following parameters in order shown:

Special motor characteristics:

Parameter:	Setting:	Data value:
101	Torque characteristics	Special motor characteristics [5] or [15]
432+431	F5 frequency/U5 voltage	
430+429	F4 frequency/U4 voltage	
428+427	F3 frequency/U3 voltage	
426+425	F2 frequency/U2 voltage	
424+423	F1 frequency/U1 voltage	
422	U0 voltage	

■ Shift between local and remote control

The VLT can be operated manually or remotely.
The following is a list of the functions/commands given via the control panel, the digital inputs or the serial communication port in the two situations (modes).

If parameter 002 is set to *Local* [1]:

On the LCP, the following keys can be used for local control:

Key:	Parameter:	Data value:
[STOP]	014	[1] Enable
[JOG]	015	[1] Enable
[RESET]	017	[1] Enable
[FWD/REV]	016	[1] Enable

Set parameter 013 for *LCP control and open loop* [1] or *LCP control as parameter 100* [3]:

1. Local reference is set in parameter 003; can be changed via the "+/-" keys.
2. Reversing can be effected by means of the [FWD/REV] key.

Set parameter 013 for *LCP digital control and open loop* [2] or *LCP digital control as parameter 100* [4]:
For the above parameter setting, it is now possible to control the VLT frequency converter as follows:
Digital inputs:

1. Local reference set in parameter 003 can be changed via the "+/—" keys.
2. Reset via digital terminal 16, 17, 29, 32 or 33.
3. Stop inverse via digital terminal 16, 17, 27, 29, 32 or 33.
4. Choice of Setup, lsb via digital terminal 16, 29 or 32.
5. Choice of Setup, msb via digital terminal 17, 29 or 33.
6. Ramp 2 via digital terminal 16, 17, 29, 32 or 33.
7. Quick-stop via digital terminal 27.
8. DC braking via digital terminal 27.
9. Reset and motor coasting stop via digital terminal 27.
10. Motor coasting stop via digital terminal 27.
11. Reversing via digital terminal 19.
12. Choice of Setup, msb/speed up via digital terminal 32.
13. Choice of Setup, lsb/speed down via digital terminal 33.

The serial communication port:

1. Ramp 2
2. Reset
3. Choice of Setup, lsb
4. Choice of Setup, msb
5. Relay 01
6. Relay 04

If parameter 002 is set to *Remote control* [0]:

Key:	Parameter:	Data value:
[STOP]	014	[1]
[JOG]	015	[1]
[RESET]	017	[1]

Control with brake function

The function of the brake is to limit the voltage in the intermediate circuit when the motor is acting as a generator. This occurs, for example, when the load drives the motor and the power enters the intermediate circuit. The brake is built up in the form of a chopper circuit with the connection of an external brake resistor. Placing the brake resistor externally offers the following advantages:

- The brake resistor can be selected on the basis of the application in question.
- The brake energy is dissipated outside the control panel, i.e. where the energy can be utilized.
- The electronics of the VLT frequency converter will not be overheated if the brake resistor is overloaded.

The brake is protected against short-circuiting of the brake resistor, and the brake transistor is monitored to ensure that short-circuiting of the transistor is detected. By using a relay/digital output, the latter can be used for protecting the brake resistor against overloading in connection with a fault in the VLT frequency converter.
In addition, the brake makes it possible to read out the momentary power and the mean power for the latest 120 seconds, as well as to monitor that the power energizing does not exceed a monitoring limit selected via parameter 402. In parameter 403 select the function to be carried out when the power transmitted to the brake resistor exceeds the limit set in parameter 402.

NB!
Monitoring of the brake power is not a safety function; a thermal switch is required for that purpose. The brake resistor circuit is not earth leakage protected.

Selection of brake resistor

In order to select the right brake resistor, the application must be known through-and-through, i.e. it must be known how often to brake and by how much power braking is effected.

The resistor ED, which is often used by motor suppliers when stating the permissible load, is an indication of the duty cycle at which the resistor is working.

The resistor ED is calculated as follows:

$$\text{ED (duty cycle)} = \frac{tb}{(t2\text{-}t1)}$$

in which t2-t1 = cycle time in seconds and tb is the braking time in seconds (of the cycle time).

The maximum permissible load on the brake resistor is stated as a peak power at a given ED. That is why the peak power for the brake resistor and the resistor value must be determined.
The following example and formula apply to VLT 5000 only.
The peak power can be calculated on the basis of the highest brake resistance required for braking:

$$P_{PEAK} = P_{MOTOR} \times M_{BR(\%)} \times \eta_{MOTOR} \times \eta_{VLT}$$
[W]

where $M_{BR(\%)}$ is expressed as a percentage of the rated torque. The brake resistance is calculated as follows:

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

As can be seen, the brake resistance depends on the intermediate circuit voltage (UDC).
With VLT 5000 frequency converters that have a mains voltage of 3 x 380-500 Volts, the brake will be active at 822 Volts (UDC); if the frequency converter has a mains voltage of 3 x 200-240 Volts, the brake will be active at 397 Volts (UDC).

NB!
Remember to check whether the brake resistor used is able to cope with a voltage of 850 Volts or 430 Volts - unless Danfoss brake resistors are used.

R_{REC} is the brake resistance recommended by Danfoss, i.e. one that guarantees the user that the frequency converter is able to brake at the highest braking torque (M_{br}) of 160%.

η_{MOTOR} is typically at 0.90, while η_{VLT} is typically at 0.98. For 500 V and 200 V VLT frequency converters, respectively, R_{REC} at 160% braking torque can be written as:

$$R_{REC} = \frac{478801}{P_{MOTOR}} \quad [\Omega]$$

$$R_{REC} = \frac{111684}{P_{MOTOR}} \quad [\Omega]$$

NB!
The max. brake resistance selected should have an ohmic value max. 10% lower than that recommended by Danfoss.
If a brake resistor with a higher ohmic value is selected, the 160% braking torque will not be achieved and there is a risk that the VLT 5000 Series will cut out for safety reasons.
For further information, please consult Brake Instructions MI.50.DX.XX.

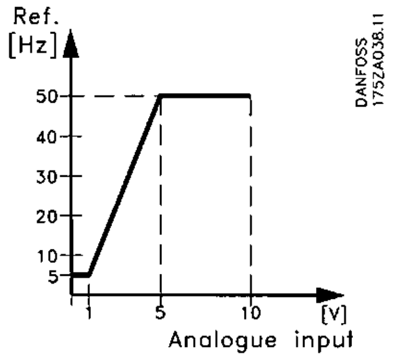
NB!
If a short circuit in the brake transistor occurs, power dissipation in the brake resistor can only be prevented by using a mains switch or contactor to disconnect the mains for the VLT. (The contactor can be controlled by the VLT).

Handling of single references

Using a single reference, only one active reference signal is connected, either in the form of an external or in the form of a preset (internal) reference.
The external reference can be voltage, current, frequency (pulse) or binary via the serial port.
Two examples are given below of the way the single references are handled by VLT 5000 Series.

Single ref. = External: U/f on terminal 53, 54 or 60. f (pulse) on terminal 17 or 29 binary (serial port). / Preset references (par. 215-218)

Example 1:
External reference signal = 1 V (min) - 5 V (max)
Reference = 5 Hz - 50 Hz
Configuration (parameter 100) - Speed control, open loop.

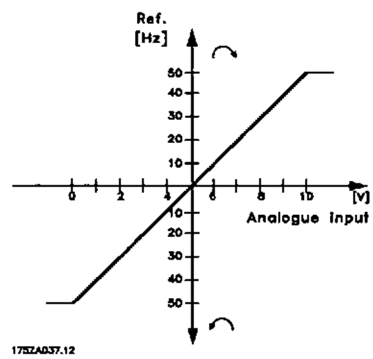


Setting:

Parameter:		Setting:	Data value:
100	Configuration	Speed control, open loop	[0]
308	Funct. of analogue input	Reference	[1]
309	Min. reference signal	Min.	1 V
310	Max. reference signal	Max.	5 V
203	Reference range	Reference range	Min - Max [0]
204	Minimum reference	Min. reference	5 (Hz)
205	Maximum reference	Max. reference	50 (Hz)

The following can be used:
- Catch-up/slow-down via digital input terminals 16,17, 29, 32 or 33
- Freeze reference via digital input terminals 16,17, 29, 32 or 33.

Example 2:
External reference signal = 0 V (min) - 10 V (max)
Reference = 50 Hz ccw - 50 Hz cw
Configuration (parameter 100) = Speed control, open loop.



Setting:

Parameter:		Setting:	Data value:
100	Configuration	Speed control, open loop	[0]
308	Funct. of analogue input	Reference	[1]
309	Min. reference signal	Min.	0 V
310	Max. reference signal	Max.	10 V
203	Reference range	Reference range	- Max - + Max [1]
205	Max. reference		100 Hz
214	Reference type	Sum	[0]
215	Preset reference		-50%
200	Output frequency range/direction	Both directions, 0-132 Hz	[1]

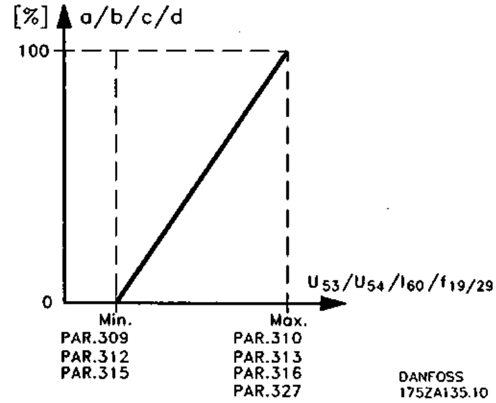
The following can be used:
- Catch-up/slow-down via digital input terminals 16,17, 29, 32 or 33
- Freeze reference via digital input terminals 16,17, 29, 32 or 33.

Handling of multi-references

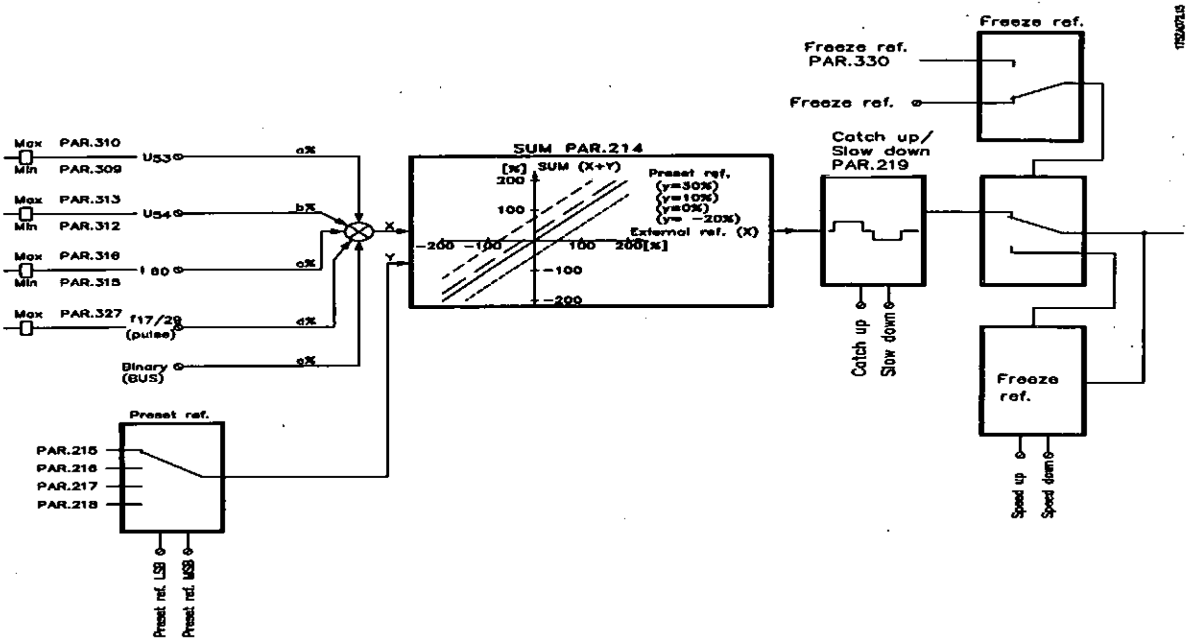
If the multi-reference is used, two or more reference signals are connected, either in the form of external or preset reference signals. Via parameter 214 these can be combined in three different ways:

Multi-ref. <
- Sum
- Relative
- External/preset

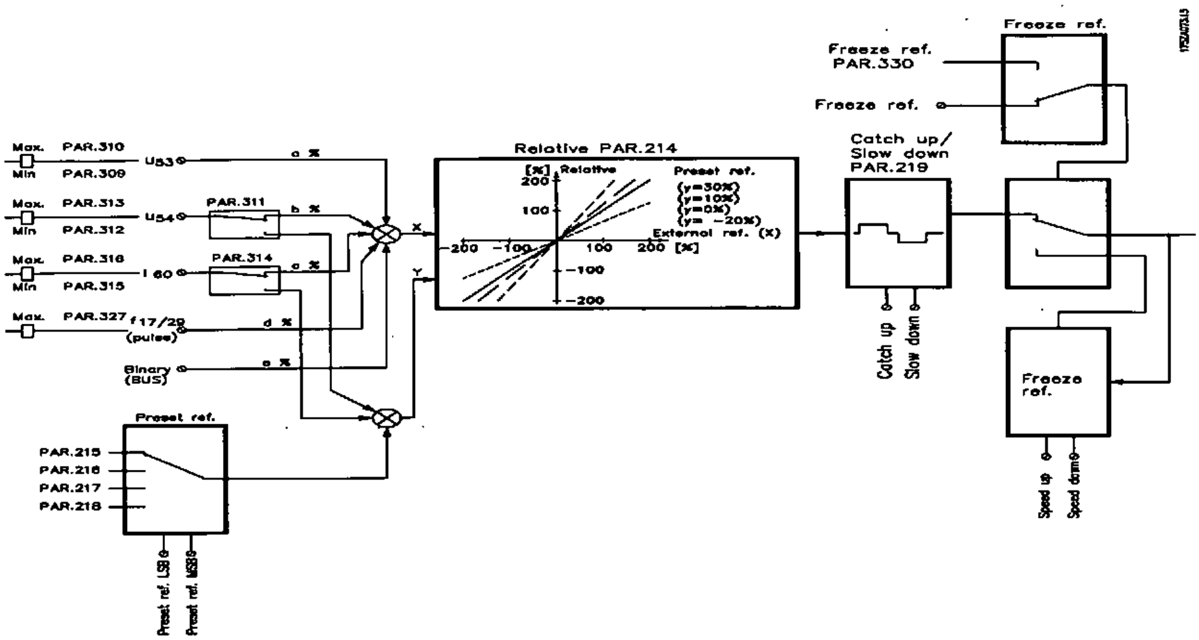
In the following, each reference type (sum, relative and external/preset) is shown:



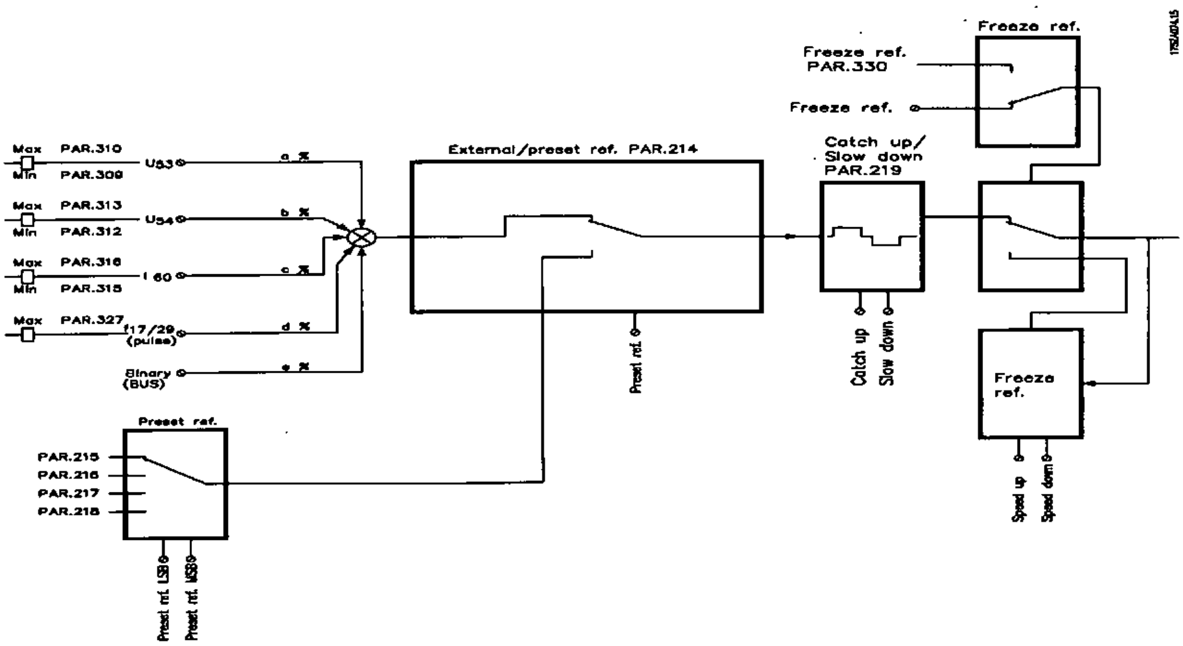
SUM



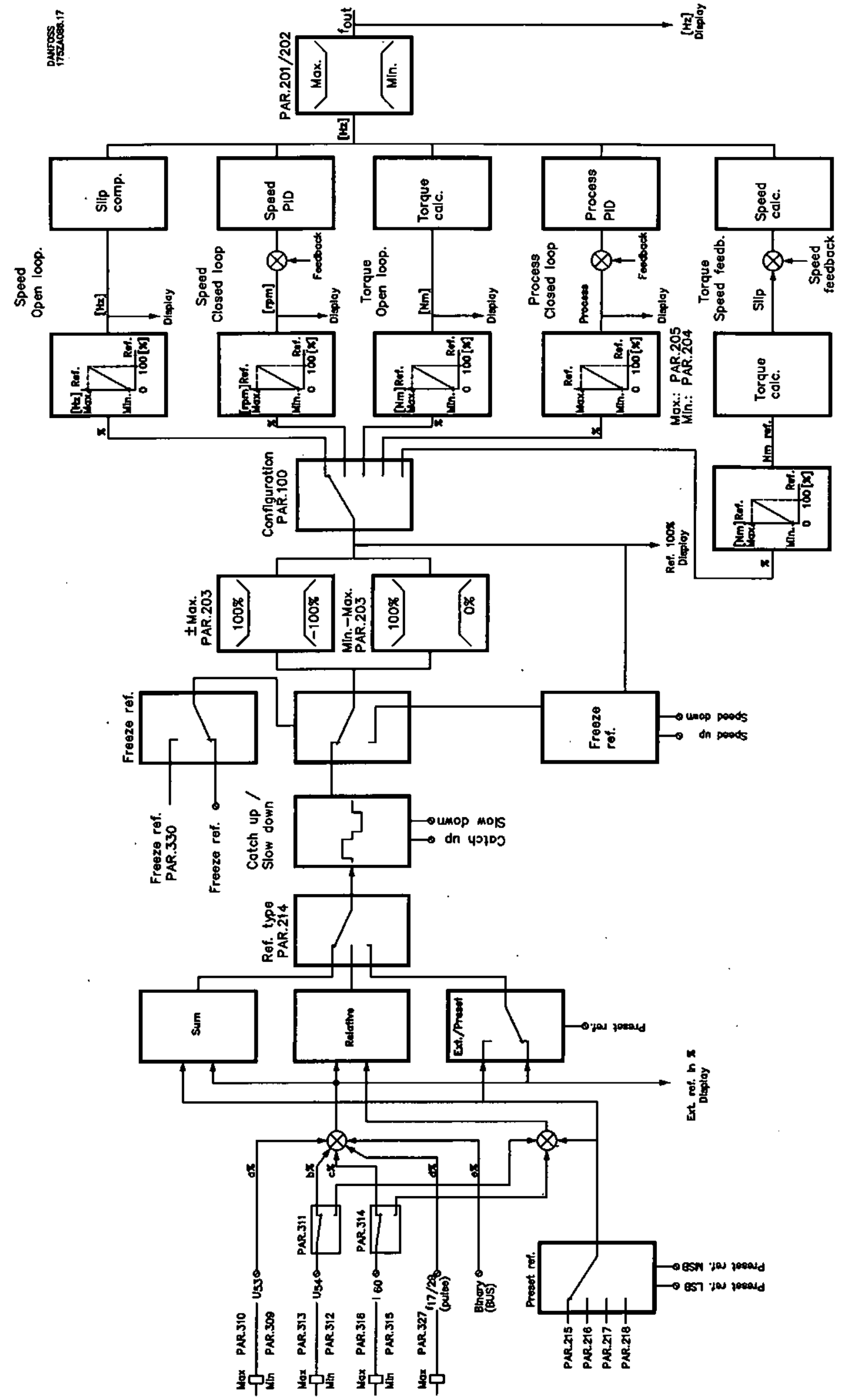
RELATIVE



EXTERNAL/PRESET



■ List of handling of multi-references



■ Automatic Motor Adaptation, AMA

Automatic motor adaptation is a test algorithm that measures the electrical motor parameters at motor standstill. This means that AMA itself does not supply any torque.
AMA is useful when commissioning systems, where the user wants to optimise the adjustment of the VLT frequency converter to the motor applied. This feature is used in particular where the factory setting does not adequately cover the motor in question.

There are two motor characteristics which are of primary significance in automatic motor adaptation:
- Stator resistance, R_s
- Reactance at normal magnetising level, X_s.

For the best adjustment of the VLT frequency converter, it is recommended to carry out AMA on a cold motor.
It must be noted that repeated AMA runs may lead to a heating of the motor that will result in an increase of the stator resistance R_S. However, in most cases this is not critical.
Parameter 107 allows a choice of automatic motor adaptation, with determination of both X_S and R_S, or reduced automatic motor adaptation with determination of only R_S.

Please note the following with respect to the AMA function and its use:
- If a LC filter has been inserted between the VLT frequency converter and the motor, it will only be possible to carry out a reduced test. If an overall setting is required, remove the LC filter while running a total AMA. After completion of the AMA, re-insert the LC filter.
- For AMA to be able to determine the motor parameters optimally, the correct nameplate data for the motor connected to the VLT frequency converter must be entered in parameters 102 to 106.
- The duration of a total automatic motor adaptation varies from a few minutes to approx. 10 minutes, depending on the rating of the motor used (the time for a 7.5 kW motor, for example, is approx. 4 minutes).
- Alarms and warnings will be shown in the display if faults occur during motor adaptation.
- AMA can only be carried out if the rated motor current is min. 35% of the rated output current of the VLT frequency converter. AMA can be carried out up to one oversize motor.
- AMA cannot be carried out on synchronous or parallel-coupled motors.
- If automatic motor adaptation is to be discontinued, press the [STOP/RESET] key.

Procedure for automatic motor adaptation:

1.	Press the [STOP/RESET] key.	
2.	Set motor power as per motor nameplate data	parameter 102
3.	Set motor voltage as per motor nameplate data	parameter 103
4.	Set motor frequency as per motor nameplate data	parameter 104
5.	Set motor current as per motor nameplate data	parameter 105
6.	Set rated motor speed as per motor nameplate data	parameter 106
7.	Select whether total or reduced automatic motor adjustment is required	parameter 107
8.	Connect terminal 12 (24 V DC) to terminal 27 on the control card.	
9.	Press the [START] key or connect terminal 18 (start) to terminal 12 (24 V DC).	

If automatic motor adaptation is to be stopped:

1. Press the [STOP/RESET] key.

After normal sequence the display shows: ALARM 21

1. Press the [STOP/RESET] key. The VLT frequency converter is now ready for operation.

In the case of fault, the display shows: ALARM 22

1. Press the [STOP/RESET] key.
2. Check possible causes of fault relating to alarm given. See page 154.

If Warning is given, the display shows: WARNING 39-42

1. Check possible fault causes in accordance with the warning. See page 154.
2. Press the [CHANGE DATA] key and select "Continue" if AMA is to continue despite the warning, or press the [STOP/RESET] key to discontinue the automatic motor adaptation.

■ Automatic motor adaptation, AMA, via VLT Software Dialog

Automatic motor adaptation can also be activated by means of the VLT Software Dialog. This can be done locally or in the form of remote-control via a modem.

Procedure for automatic motor adaptation via VLT Software Dialog:	
1	Start Parameter Setup and select "Start new setting".
2	Select VLT type and voltage. Then choose "Off-line".
3	Start "Wizard", which quickly sets up relevant motor parameters.
4	When "Wizard" has been completed, select total or reduced motor adaptation in parameter 107.
5	Save the parameter setup file and finish the parameter setup.
6	Start Parameter Setup again and select "Open existing setting".
7	Open the saved file and select "On-line".
8	Send the file to the VLT frequency converter(s) that is/are to run the automatic motor adaptation programme.
9	End Parameter Setup.

Start of automatic motor adaptation, AMA:	
1	Start Test-run.
2	Scan for VLT frequency converters and select the relevant frequency converter that has been prepared for automatic motor adaptation.
3	Press the "Start" button in Test-run mode. Automatic motor adaptation is now in progress.

After normal cycle and completion:	
1	Wait until a trip message appears.
2	Press the [RESET] button in the Test-run mode.
3	AMA has now been completed and the VLT frequency converter is ready for operation.

If Alarm is given, the display shows:	ALARM 22
1	Press the [RESET] button.
2	Check for possible fault causes in accordance with the alarm message.

■ Control of mechanical brake

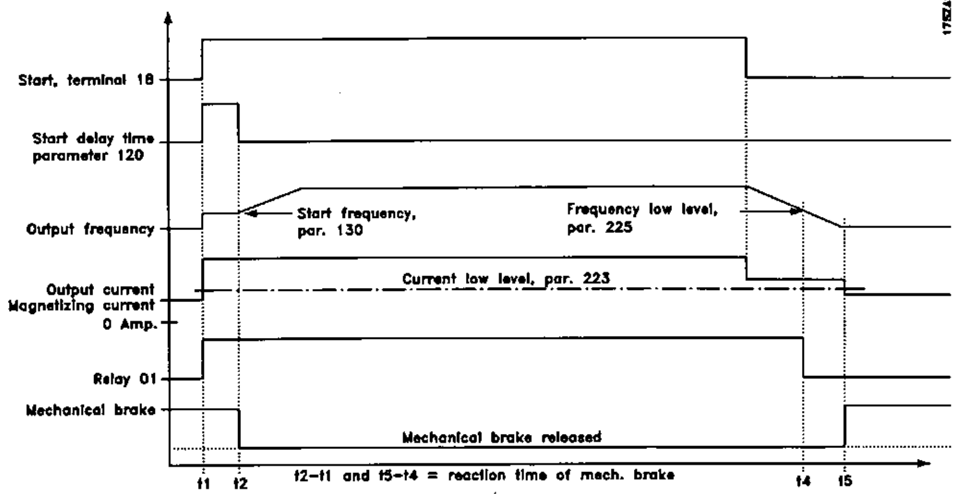
For hoisting applications, it is necessary to be able to control an electro-magnetic brake.
For controlling the brake, a relay output (01 or 04) is required. This output must be kept closed (voltage-free) during the time when the VLT frequency converter is not able to 'hold' the motor, e.g. because of too high load. In parameter 323 or 326 (relay outputs 01, 04), select *Mechanical brake control* [32] or *Extended mechanical brake control* [34] for applications with an electro-magnetic brake.
During start/stop and ramp-down, the output current is monitored. If *Mechanical brake control* [32] is selected and the current is below the level selected in parameter 223 *Warning: Low current*, the mechanical brake is closed (voltage-free).
As a point of departure, a current can be selected which is approx. 70% of the magnetising current.
Parameter 225 *Warning: Low frequency* states the frequency during ramp-down at which the mechanical brake is to close again.

If *Extended mechanical brake control* [34] is selected the mechanical brake is closed (voltage-free) during start until the output current is above the level selected in parameter 223 *Warning: Low Current*.
During stop mechanical brake is released until the frequency is below the level selected in parameter 225 *Warning: Low frequency*.
Notice by *Extended mechanical brake control* [34] that the brake does not close if the output current gets under parameter 223 *Warning: Low current*

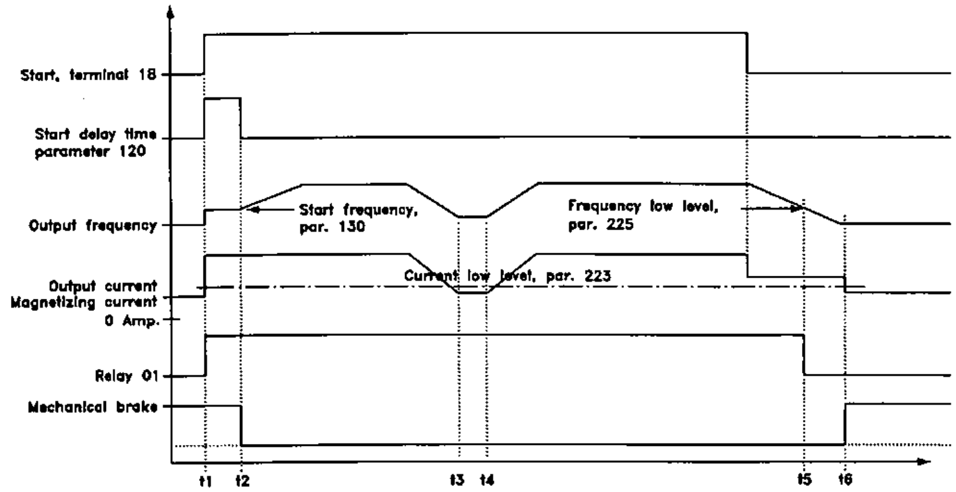
If the VLT frequency converter is brought into an alarm condition or an overcurrent or overvoltage situation, the mechanical brake will immediately cut in.

NB!
The application shown is only for hoisting without counterweight.

Mechanical brake control



Extended mechanical brake control



t2-t1 and t6-t5 = reaction time of mech. brake
t3-t4 = motor current below current low level

Control of mechanical brake

Control of mechanical brake:		
Parameter:	Setting:	Data value:
323 Relay 01 or par. 326 relay 04	Mechanical brake control	[32]
323 Relay 01 or par. 326 relay 04	Extended mechanical brake control	[34]
223 Warning: Low current	approx. 70% of magnetising current[1]	
225 Warning: Low frequency	3-5 Hz [2]	
122 Function at stop	Pre-magnetisation	[3]
120 Start delay time	0.1-0.3 sec.	
121 Start function	Start frequency/voltage clockwise [3]	[3]
130 Start frequency	Set to slip frequency	
131 Extra voltage at start	Set to rated motor current $I_{M,N}$ (not higher than 160% of $I_{M,N}$)	

1) During start and stop, the current limit in parameter 223 decides the switching level.
2) This value indicates the frequency during ramp-down at which the mechanical brake is to be closed again. This assumes that a stop signal has been given.
3) It must be ensured that the motor starts clockwise (hoist), since otherwise the VLT frequency converter may drop the load. Switch U, V, W connections, if required.

PID for process control

Feedback

The feedback signal must be connected to a terminal on the frequency converter. Use the list below to decide which terminal is to be used and which parameters are to be programmed.

Feedback type	Terminal	Parameters
Pulse	33	307
Voltage	53	308, 309, 310
Current	60	314, 315, 316

Furthermore, the minimum and maximum feedback (parameters 414 and 415) must be set to a value in the process unit that corresponds to the minimum and maximum value on the terminal.
Select process unit in parameter 416.

Reference

A minimum and a maximum reference can be set (204 and 205), which limit the sum of all references. The reference range cannot exceed the feedback range.
If one or several setpoint references are required, the simplest way is to set such reference directly in parameters 215 to 218. Select between the preset references by connecting terminals 16, 17, 29, 32 and/or 33 to terminal 12. Which terminals that are used depends on the choice made in the parameters of the various terminals (parameters 300, 301, 305, 306 and/or 307). Use the table below when selecting preset references.

	Preset ref. msb	Preset ref. lsb
Preset ref. 1 (par. 215)	0	0
Preset ref. 2 (par. 216)	0	1
Preset ref. 3 (par. 217)	1	0
Preset ref. 4 (par. 218)	1	1

If an external reference is required, this can either be an analogue or a pulse reference. If current is used as a feedback signal, only voltage can be used as an analogue reference. Use the following list to decide which terminal to use and which parameters to program.

Reference type	Terminal	Parameters
Pulse	17 or 29	301 or 305
Voltage	53 or 54	308, 309, 310 or 311, 312, 313
Current	60	314, 315, 316

Relative references can be programmed. A relative reference is a percentage value (Y) of the sum of the external references (X). This percentage value is added to the sum of the external references, which produces the active reference (X + XY). See drawing on pages 62 and 63.
If relative references are to be used, parameter 214 is to be set to *Relative* [1]. This makes the preset references relative. Furthermore, *Relative reference* [4] can be programmed on terminal 54 and/or 60. If an external relative reference is selected, the signal on the input will be a percentage value of the full range of the terminal. The relative references are added with signs.

NB!
Terminals that are not in use should preferably be set to *No function* [0].

Inverse control

Normal control means that the motor speed increases when the feedback signal is low. If there is a need to use inverse control, in which the speed is reduced when the feedback signal is low, *Inverse* must be programmed in parameter 437.

Anti Windup

The process regulator comes with the anti windup function in active position. This function ensures that when either a frequency limit or a torque limit is reached, the integrator will be set to a gain that corresponds to the actual frequency. This avoids integrating on an error that cannot in any case be compensated for by means of a speed change. This function can be disabled in parameter 438.

Start-up conditions

In some applications, optimum setting of the process regulator will mean that it takes an excessive time for the desired process value to be reached. In such applications it might be an advantage to fix a motor frequency to which the frequency converter is to bring the motor before the process regulator is activated. This is done by programming a *Process PID* start frequency in parameter 439.

PID for process control, cont.

Differentiator gain limit
If there are quick changes in reference or feedback in a given application - which means that the error changes swiftly - the differentiator may soon become too dominant. This is because it reacts to changes in the error. The quicker the error changes, the stronger the differentiator gain is. The differentiator gain can thus be limited to allow setting of the reasonable differentiation time for slow changes and a suitably quick gain for quick changes. This is done in parameter 443, *Process PID Differentiator gain limit.*

Lowpass filter
If there are oscillations of the current/voltage feedback signal, these can be dampened by means of a lowpass filter. Set a suitable lowpass filter time constant. This time constant represents the limitfrequency of the ripples occurring on the feedback signal. If the lowpass filter has been set to 0.1s, the limit frequency will be 10 RAD/sec., corresponding to (10/2 x π) = 1.6 Hz. This will mean that all currents/voltages that vary by more than 1.6 oscillations per second will be removed by the filter. In other words, control will only be carried out on a feedback signal that varies by a frequency of less than 1.6 Hz. Choose a suitable time constant in parameter 444, *Process PID Lowpass filter.*

Optimisation of the process regulator
The basic settings have now been made; all that needs to be done is to optimise the proportional gain, the integration time and the differentiation time (parameters 440, 441, 442). In most processes, this can be done by following the guidelines given below.

1. Start the motor

2. Set parameter 440 (proportional gain) to 0.3 and increase it until the feedback signal again begins to vary continuously. Then reduce the value until the feedback signal has stabilised. Now lower the proportional gain by 40-60%.

3. Set parameter 441 (integration time) to 20s and reduce the value until the feedback signal again begins to vary continuously. Increase the integration time until the feedback signal stabilises, followed by an increase of 15-50%.

4. Only use parameter 442 for very fast-acting systems only (differentiation time). The typical value is four times the set integration time. The differentiator should only be used when the setting of the proportional gain and the integration time has been fully optimised.

NB!
If necessary, start/stop can be activated a number of times in order to provoke a variation of the feedback signal.

See also the examples of connection given in the Design Guide.

■ PID for speed control

Feedback
Use the list below to decide which terminal to use for the feedback signal and which parameters to program.

Feedback type	Terminal	Parameters
Pulse	32	306
Pulse	33	307
Feedback pulse/rev.		329
Voltage	53	308, 309, 310
Current	60	314, 315, 316

Furthermore, the minimum and maximum feedback (parameters 414 and 415) are to be set to values in the process unit that correspond to the actual minimum and maximum process feedback values and units. The minimum feedback cannot be set to a value lower than 0. Choose unit in parameter 416.

Reference
A minimum and a maximum reference can be set (204 and 205) which limit the sum of all references. The reference range cannot exceed the feedback range.
If one or several preset references are required, the simplest way of doing this is by setting such references directly in parameters 215 to 218. Choose between the preset references by connecting terminals 16,17,29,32 and/or 33 to terminal 12. Which of them that are to be used depends on the choice in the parameters of the terminals in question (parameters 300, 301, 305, 306 and/or 307). The table below can be used to select the preset references.

	Preset ref. msb	Preset ref. lsb
Preset ref. 1 (par. 215)	0	0
Preset ref. 2 (par. 216)	0	1
Preset ref. 3 (par. 217)	1	0
Preset ref. 4 (par. 218)	1	1

If an external reference is required, this can either by an analogue reference or a pulse reference. If current is used as a feedback signal, voltage can be used as an analogue reference. Use the list below to decide which terminal to use and which parameters to program.

Reference type	Terminal	Parameters
Pulse	17 or 29	301 or 305
Voltage	53 or 54	308, 309, 310 or 311, 312, 313
Current	60	314, 315, 316

Relative references can be programmed. A relative reference is a percentage value (Y) of the sum of the external references (X). This percentage value is added to the sum of the external references, which produces the active reference (X + XY). See drawing on pages 62 and 63.
If relative references are to be used, parameter 214 is to be set to *Relative* [1]. This makes the preset references relative. Furthermore, Relative reference [4] can be programmed on terminal 54 and/or 60. If an external relative reference is selected, the signal on the input will be a percentage value of the full range of the terminal. The relative references are added with signs.

NB!
Terminals that are not in use should preferably be set to *No function* [0].

Differentiator gain limit
If there are quick changes in reference or feedback in a given application - which means that the error changes swiftly - the differentiator may soon become too dominant. This is because it reacts to changes in the error. The quicker the error changes, the stronger the differentiator gain is. The differentiator gain can thus be limited to allow setting of the reasonable differentiation time for slow changes and a suitably quick gain for quick changes. This is done in parameter 420, *Speed PID Differentiator gain limit.*

Lowpass filter
If are oscillations of the current/voltage on the feedback signal, these can be dampened by means of a lowpass filter. Set a suitable lowpass filter time constant. This time constant represents the limit frequency of the ripples occurring on the feedback signal. If the lowpass filter has been set to 0.1s, the break frequency will be 10 RAD/sec., corresponding to (10/2 x π) = 1.6 Hz. This will mean that all currents/ voltages that vary by more than 1.6 oscillations per second will be removed by the filter.
In other words, control will only be carried out on a feedback signal that varies by a frequency of less than 1.6 Hz. Choose a suitable time constant in parameter 421, *Speed PID Lowpass filter.*

■ Quick discharge

This function calls for a VLT of type EB. This function is used for discharging the capacitors in the intermediate circuit after the mains supply has been interrupted. This is a useful function for servicing the VLT frequency converter and/or the motor installation.
The motor must be stopped before quick discharge is activated. If the motor acts as a generator, quick discharge is not possible.

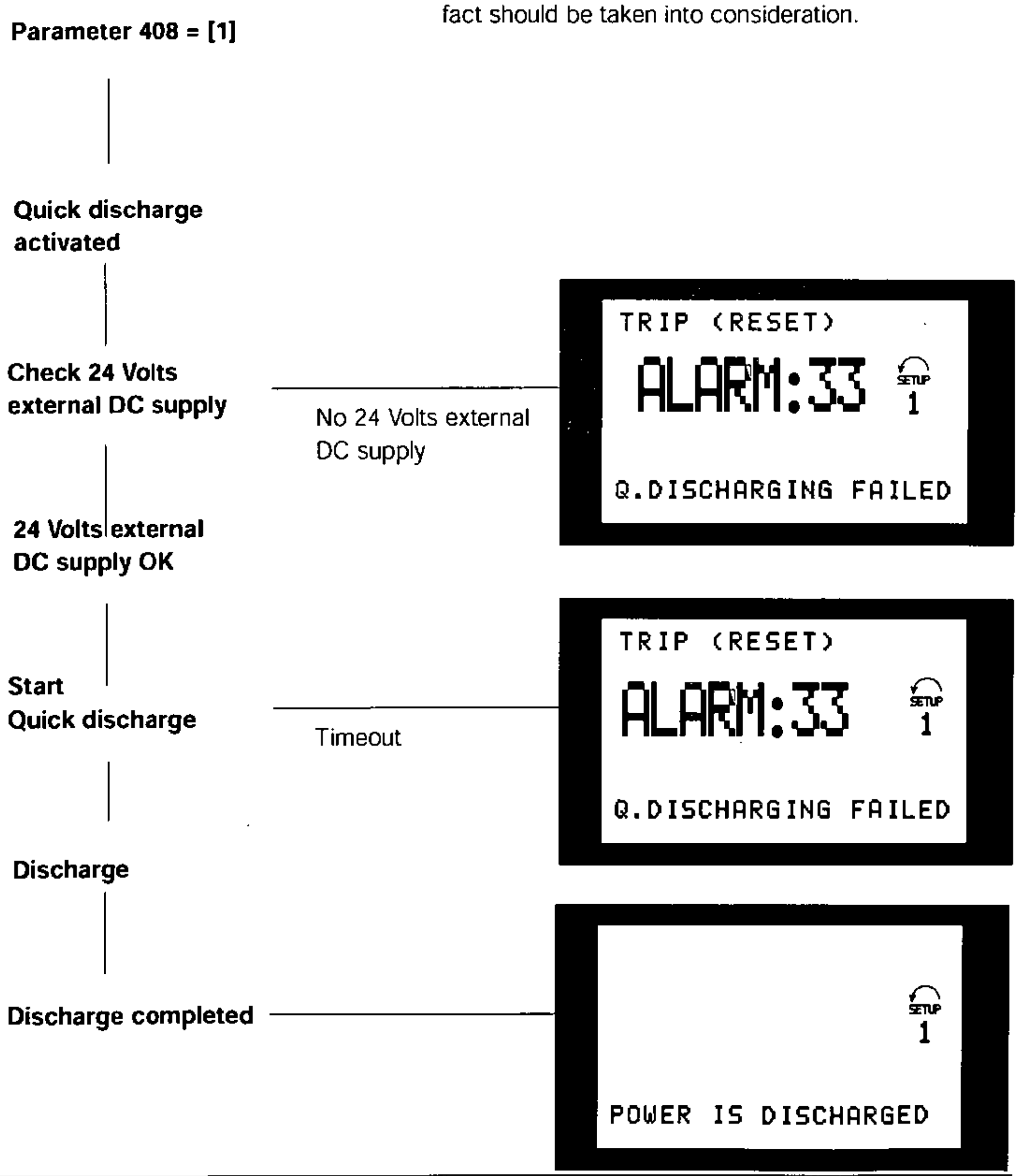
The quick discharge function can be selected via parameter 408. The function starts when the intermediate circuit voltage has declined to a given value and the rectifier has stopped.
In order to obtain the possibility of a quick discharge, the VLT frequency converter requires an external 24 V DC supply to terminals 35 and 36, as well as a suitable brake resistor on terminals 81 and 82, see page 43.

For sizing of the discharge resistor for quick discharge, see Brake Instructions MI.50.DX.XX.

NB!
Quick discharge is only possible if the VLT frequency converter has 24 Volts external DC supply and if an external brake/discharge resistor has been connected.

Before servicing the installation (VLT frequency converter + motor), it must be checked that the intermediate circuit voltage is below 60 V DC. This is done by measuring terminals 88 and 89, load-sharing.

NB!
The power dissipation during quick discharge does not form part of the power monitoring function, parameter 403. When sizing resistors, this fact should be taken into consideration.



Mains failure/quick discharge with mains failure inverse

The first column in the table shows *Mains failure*, which is selected in parameter 407. If no function is selected, the mains failure procedure will not be carried out. If *Controlled ramp-down* [1] is selected, the VLT frequency converter will take the motor down to 0 Hz. If *Enable* [1] has been selected in parameter 408, a quick discharge of the intermediate circuit voltage will be carried out after the motor has stopped.

Using a digital input, it is possible to activate mains failure and/or quick discharge. This is done by selecting *Mains failure inverse* on one of the control terminals (16, 17, 29, 32, 33). *Mains failure inverse* is active in the logical '0' situation.

NB!
The VLT frequency converter can be completely damaged if the Quick-discharge function is repeated, using the digital input while mains voltage is on.

Mains failure par. 407	Quick discharge par. 408	Mains failure inverse digital input	Function
No function [0]	Disable [0]	Logical '0'	1
No function [0]	Disable [0]	Logical '1'	2
No function [0]	Enable [1]	Logical '0'	3
No function [0]	Enable [1]	Logical '1'	4
[1]-[4]	Disable [0]	Logical '0'	5
[1]-[4]	Disable [0]	Logical '1'	6
[1]-[4]	Enable [1]	Logical '0'	7
[1]-[4]	Enable [1]	Logical '1'	8

Function no. 1

Mains failure and quick discharge are not active.

Function no. 2

Mains failure and quick discharge are not active.

Function no. 3

The digital input activates the quick discharge function, regardless of the intermediate circuit voltage level and regardless of whether the motor is running.

Function no. 4

Quick discharge is activated when the intermediate circuit voltage has dropped to a given value and the inverters have stopped. See procedure on previous page.

Function no. 5

The digital input activates the mains failure function, regardless of whether the unit receives any supply voltage. See the different functions in parameter 407.

Function no. 6

The mains failure function is activated when the intermediate circuit voltage has dropped to a given value. The selected function in case of mains failure is selected in parameter 407.

Function no. 7

The digital input activates both the quick discharge and the mains failure function, regardless of the intermediate circuit voltage level and regardless of whether the motor is running. First the mains failure function will be active; subsequently there will be a quick discharge.

Function no. 8

Quick discharge and mains failure function are activated when the intermediate circuit level drops to a given level.
First the mains failure function will be active; subsequently there will be a quick discharge.

■ Flying start

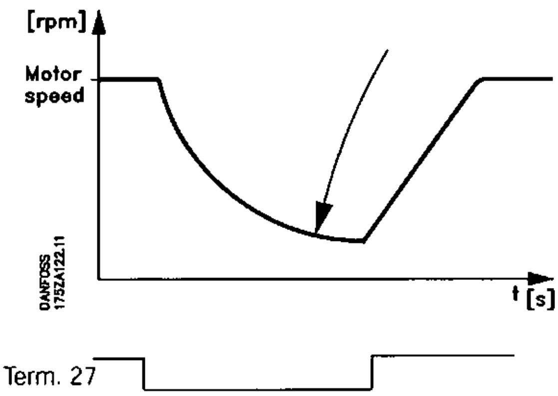
This function makes it possible to "catch" a motor that is spinning freely and for the VLT to take control of the motor speed. This function can be enabled or disabled via parameter 445.

If *flying start* has been selected, there will be four situations in which the function is activated:

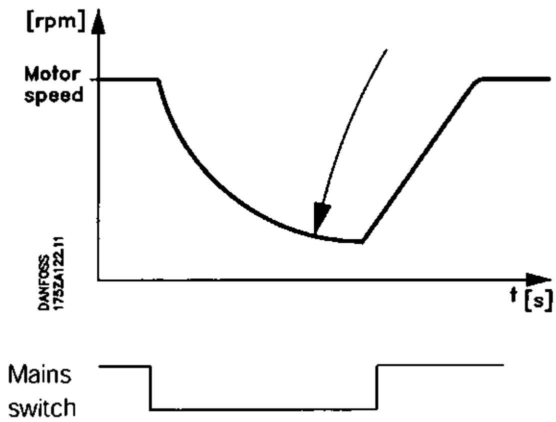
1. After a coast has been given via terminal 27.
2. After power-up.
3. If the VLT frequency converter is in a trip state and a reset signal has been given.
4. If the VLT frequency converter releases the motor because of a fault state and the fault disappears before a trip, the VLT frequency converter will catch the motor and go back to the reference.

The search sequence for the spinning motor depends on *Rotation, frequency/direction* (parameter 200). If only *clockwise* is selected, the VLT frequency converter will start looking from *Maximum frequency* (parameter 202) down to 0 Hz. If the VLT frequency converter does not find the spinning motor during the search sequence, it will carry out a DC braking so as to try to bring the speed of the spinning motor down to 0 rpm. This requires that the DC brake is active via parameters 125 and 126. If *Both directions* is selected, the VLT frequency converter will first find out in which direction the motor rotates and then search for the frequency. If the motor is not found, the system assumes that the motor is at a standstill or is rotating at a low speed, and the VLT frequency converter will start the motor in the normal way after searching.

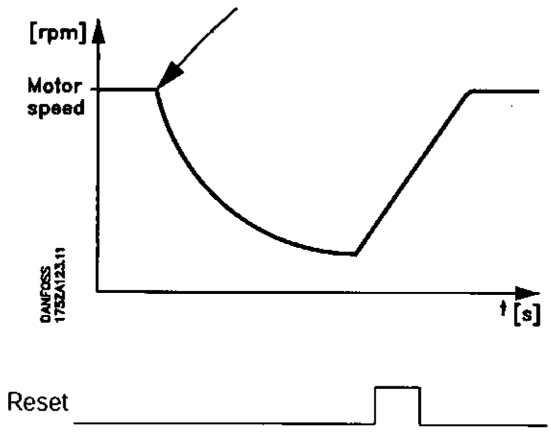
1. *Flying start* is active.



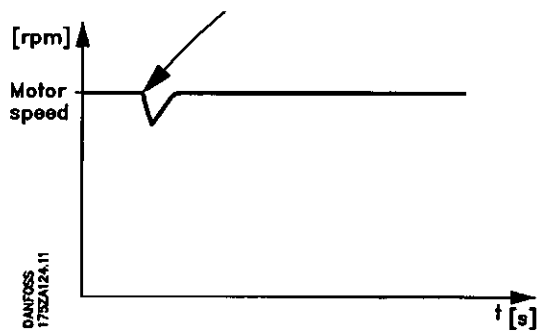
2. *Flying start* is active.



3. The VLT frequency converter trips and *Flying start* is active.



4. The VLT frequency converter momentarily releases the motor. *Flying start* is activated and catches the motor again.



■ Normal/high overload Torque control, open loop

This function enables the VLT frequency converter to perform a constant 100% torque, using an oversize motor.
The choice between a normal or a high overload torque characteristic is made in parameter 101.

This is also where to choose between a high/normal constant torque characteristic (CT) or a high/normal VT torque characteristic.

If a *high torque characteristic* is chosen, a rated motor with the VLT frequency converter obtains up to 160% torque for 1 min. in both CT and VT.
If a *normal torque characteristic* is chosen, an oversize motor allows up to 110% torque performance for up to 1 min. in both CT and VT. This function is used mainly for pumps and fans, since these applications do not require an overload torque.

The advantage of choosing a normal torque characteristic for an oversize motor is that the VLT frequency converter will be able constantly to yield 100% torque, without derating as a result of a bigger motor.

NB!
This function cannot be chosen for VLT 5001-5006, 200-240 Volts, and VLT 5001-5011, 380-500 Volts.

■ Internal current regulator

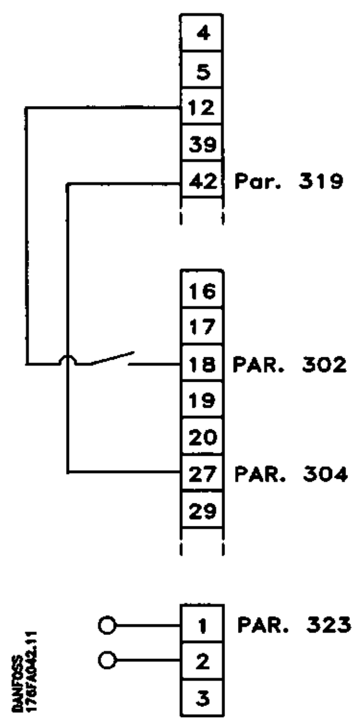
The VLT 5000 features an integral current limit regulator which is activated when the motor current, and thus the torque, is higher than the torque limits set in parameters 221 and 222.
When VLT 5000 Series is at the current limit during motor operation or regenerative operation, the VLT frequency converter will try to get below the preset torque limits as quickly as possible without losing control of the motor.
While the current regulator is active, the VLT frequency converter can *only* be stopped by means of terminal 27 if set to *Coasting stop, inverse* [0] or *Reset and coasting stop, inverse* [1]. A signal on terminals 16-33 will *not* be active until the VLT frequency converter has moved away from the current limit.
Please note that the motor will not use the ramp-down time, since terminal 27 must be programmed for *Coasting stop, inverse* [0] or *Reset and coasting stop, inverse* [1].

■ Programming of *Torque limit and stop*

In applications with an external electro-mechanical brake, such as hoisting applications, it is possible to stop the VLT frequency converter via a 'standard' stop command, while at the same time activating the external electro-mechanical brake.
The example given below illustrates the programming of VLT frequency converter connections.
The external brake can be connected to relay 01 or 04, see Control of mechanical brake on page 66.
Program terminal 27 to *Coasting stop, inverse* [0] or *Reset and coasting stop, inverse* [1], as well as terminal 42 to *Torque limit and stop* [27].

Description:

If a stop command is active via terminal 18 and the VLT frequency converter is not at the torque limit, the motor will ramp down to 0 Hz.
If the VLT frequency converter is at the torque limit and a stop command is activated, terminal 42 *Output* (programmed to *Torque limit and stop* [27]) will be activated. The signal to terminal 27 will change from 'logic 1' to 'logic 0' and the motor will start coasting.



- Start/stop via terminal 18.
  Parameter 302 = *Start* [1].
- Quickstop via terminal 27.
  Parameter 304 = *Coasting stop, inverse* [0].
- Terminal 42 Output
  Parameter 319 = *Torque limit and stop* [27].
- Terminal 01 Relay output
  Parameter 323 = *Mechanical brake control* [32].

001 Language
(LANGUAGE)

Value:

★ English (ENGLISH)	[0]
German (DEUTSCH)	[1]
French (FRANCAIS)	[2]
Danish (DANSK)	[3]
Spanish (ESPAÑOL)	[4]
Italian (ITALIANO)	[5]

State when delivered may vary from factory setting.

Function:
The choice in this parameter defines the language to be used on the display.

Description of choice:
There is a choice of *English* [0], *German* [1], *French* [2], *Danish* [3], *Spanish* [4] and *Italian* [5].

---

002 Local/remote control
(OPERATION SITE)

Value:

★ Remote control (REMOTE)	[0]
Local control (LOCAL)	[1]

Function:
There is a choice of two methods of controlling the VLT frequency converter: *Remote control* [0] and *Local control* [1].

Description of choice:
If *Remote control* [0] is selected, the VLT frequency converter can be controlled via:

1. The control terminals or the serial communication port .
2. The [START] key However, this cannot overrule Stop commands (also start-disable) entered via the digital inputs or the serial communication port.
3. The [STOP], [JOG] and [RESET] keys, provided that these are active (see parameters 014, 015 and 017).

If *Local control* [1] is selected, the VLT frequency converter can be controlled via:

1. The [START] key. However, this cannot override Stop commands on the digital terminals (if [2] or [4] has been selected in parameter 013).
2. The [STOP], [JOG] and [RESET] keys, provided that these are active (see parameters 014, 015 and 017).
3. The [FWD/REV] key, provided that this has been activated in parameter 016 and that in parameter 013 a choice of [1] or [3] has been made.
4. Via parameter 003 the local reference can be controlled by means of the "Arrow up" and "Arrow down" keys.
5. An external control command that can be connected to terminal 16, 17, 19, 27, 29, 32 or 33. However, [2] or [4] must be selected in parameter 013.

See also the description on page 58.

---

003 Local reference
(LOCAL REFERENCE)

Value:
Par 013 set for [1] or [2]:
0 - f_{MAX} ★ 000.000

Par 013 set for [3] or [4] and par. 203 = [0] set for:
Ref_{MIN} - Ref_{MAX} ★ 000.000

Par 013 set for [3] or [4] and par. 203 = [1] set for:
-Ref_{MAX} - + Ref_{MAX} ★ 000.000

Function:
This parameter allows manual setting of the desired reference value (speed or reference for the selected configuration, depending on the choice made in parameter 013).
The unit follows the configuration selected in parameter 100, provided *Process control, closed loop* [3] or *Torque control, open loop* [4] has been selected.

Description of choice:
Local [1] must be selected in parameter 002 for this parameter to be used.
The set value is saved in the case of a voltage drop-out, see parameter 019.
In this parameter Data Change Mode is not exited automatically (after time out).
Local reference cannot be set via the serial communication port.

⚠ Warning: Since the value set is remembered after the power has been cut, the motor may start without warning when the power is reinstated; if parameter 019 is changed to *Auto restart, use saved ref.* [0].

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

004 Active Setup (ACTIVE SETUP)

Value:

	Factory Setup (FACTORY SETUP)	[0]
★	Setup 1 (SETUP 1)	[1]
	Setup 2 (SETUP 2)	[2]
	Setup 3 (SETUP 3)	[3]
	Setup 4 (SETUP 4)	[4]
	MultiSetup (MULTI SETUP)	[5]

Function:

The choice in this parameter defines the Setup number you want to control the functions of the VLT frequency converter.
All parameters can be programmed in four individual parameter Setups, Setup 1 - Setup 4. In addition, there is a pre-programmed Setup, called Factory Setup, that cannot be modified.

Description of choice:

Factory Setup [0] contains the data set at the works. Can be used as a data source if the other Setups are to be returned to a known state.
Parameters 005 and 006 allow copying from one Setup to one or more of the other Setups.
Setups 1-4 [1]-[4] are four individual Setups that can be selected as required.
Multi-Setup [5] is used if remote-mounting switching between Setups is desired. Terminals 16/17/29/32/33 as well as the serial communication port can be used for switching between Setups.

---

005 Programming Setup (EDIT SETUP)

Value:

	Factory Setup (FACTORY SETUP)	[0]
	Setup 1 (SETUP 1)	[1]
	Setup 2 (SETUP 2)	[2]
	Setup 3 (SETUP 3)	[3]
	Setup 4 (SETUP 4)	[4]
★	Active Setup (ACTIVE SETUP)	[5]

Function:

The choice is of the Setup in which programming (change of data) is to occur during operation (applies both via the control panel and via the serial communication port). It is possible to programme the 4 Setups independently of the Setup selected as the active Setup (selected in parameter 004).

Description of choice:

The Factory Setup [0] contains the data set at the works and can be used as a data source if the other Setups are to be returned to a known state.
Setups 1-4 [1]-[4] are individual Setups which can be used as required. They can be programmed freely, regardless of the Setup selected as the active Setup and thus controlling the functions of the VLT frequency converter.

NB!
If a general change of data or a copying to the active Setup is effected, this immediately affects the functioning of the unit.

---

006 Copying of Setups (SETUP COPY)

Value:

★	No copying (NO COPY)	[0]
	Copy to Setup 1 from # (COPY TO SETUP 1)	[1]
	Copy to Setup 2 from # (COPY TO SETUP 2)	[2]
	Copy to Setup 3 from # (COPY TO SETUP 3)	[3]
	Copy to Setup 4 from # (COPY TO SETUP 4)	[4]
	Copy to Setup all from # (COPY TO ALL)	[5]

= the Setup selected in parameter 005

Function:

A copy is made from the Setup selected in parameter 005 to one of the other Setups or to all the other Setups simultaneously. The setup copying function does not copy parameters 001, 004, 005, 500 and 501.

Copying is only possible in Stop Mode (motor stopped on a Stop command).

Description of choice:

The copying starts when the desired copying function has been entered and confirmed by pressing the [OK] key.
The display indicates when copying is in progress.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

007 LCP copy (LCP COPY)

Value:

★ No copying (NO COPY)	[0]
Upload all parameters (UPLOAD ALL PARAM)	[1]
Download all parameters (DOWNLOAD ALL)	[2]
Download power-independent par. (DOWNLOAD SIZE INDEP.)	[3]

Function:

Parameter 007 is used if it is desired to use the integrated copying function of the control panel. The control panel is detachable. You can therefore easily copy parameter value(s) from one VLT to another.

Description of choice:

Select *Upload all parameters* [1] if all parameter values are to be transmitted to the control panel. Select *Download all parameters* [2] if all transmitted parameter values are to be copied to the VLT frequency converter on which the control panel has been mounted.
Select *Download power-independent par.* [3] if only the power-independent parameters are to be downloaded. This is used if downloading to a VLT frequency converter that has a different rated power that the one from where the parameter Setup originates.
Please note that the power-dependent parameters 102-106 must be programmed after copying.

NB!
Uploading/Downloading can only be carried out in the Stop mode.

008 Display scaling of motor frequency (FREQUENCY SCALE)

Value:

0.01 - 100.00 ★ 1

Function:

This parameter chooses the factor to be multiplied by the motor frequency, f_M, for presentation in the display, when parameters 009-012 have been set for Frequency x Scaling [5].

Description of choice:

Set the desired scaling factor.

009 Display line 2 (DISPLAY LINE 2)

Value:

Reference [%] (REFERENCE [%])	[1]
Reference [unit] (REFERENCE [UNIT])	[2]
Feedback [unit] (FEEDBACK [UNIT])	[3]
★ Frequency [Hz] (FREQUENCY [Hz])	[4]
Frequency x Scaling [-] (FREQUENCY X SCALE)	[5]
Motor current [A] (MOTOR CURRENT [A])	[6]
Torque [%] (TORQUE [%])	[7]
Power [kW] (POWER [kW])	[8]
Power [HP] (POWER [hp] [US])	[9]
Output energy [kWh] (OUTPUT ENERGY [kWh])	[10]
Motor voltage [V] (MOTOR VOLTAGE [V])	[11]
DC link voltage [V] (DC LINK VOLTAGE [V])	[12]
Thermal load, motor [%] (MOTOR THERMAL [%])	[13]
Thermal load, VLT [%] (VLT THERMAL [%])	[14]
Hours run [Hours] (RUNNING HOURS)	[15]
Digital input [Binary code] (DIGITAL INPUT [BIN])	[16]
Analogue input 53 [V] (ANALOG INPUT 53 [V])	[17]
Analogue input 54 [V] (ANALOG INPUT 54 [V])	[18]
Analogue input 60 [mA] (ANALOG INPUT 60 [mA])	[19]
Pulse reference [Hz] (PULSE REF. [Hz])	[20]
External reference [%] (EXTERNAL REF [%])	[21]
Status word [Hex] (STATUS WORD [HEX])	[22]
Brake effect/2 min. [KW] (BRAKE ENERGY/2 min)	[23]
Brake effect/sec. [kW] (BRAKE ENERGY/s)	[24]
Heat sink temp. [°C] (HEATSINK TEMP [°C])	[25]
Alarm word [Hex] (ALARM WORD [HEX])	[26]
Control word [Hex] (CONTROL WORD [HEX])	[27]
Warning word 1 [Hex] (WARNING WORD 1 [HEX])	[28]
Extended status word [Hex] (EXT STATUS WORD[HEX])	[29]
Communication option card warning (COMM OPT WARN [HEX])	[30]

Function:

This parameter allows a choice of the data value to be displayed in line 2 of the display.
Parameters 010-012 enable the use of three additional data values to be displayed in line 1.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

Description of choice:
Reference [%] corresponds to the total reference (sum of digital/analogue/preset/bus/freeze ref./ catch-up and slow-down).
Reference [unit] gives the status value of terminals 17/ 29/53/54/60 using the unit stated on the basis of configuration in parameter 100 (Hz, Hz and rpm).
Feedback [unit] gives the status value of terminal 33/ 53/60 using the unit/scale selected in parameter 414, 415 and 416.
Frequency [Hz] gives the motor frequency, i.e. the output frequency from the VLT frequency converter.
Frequency x Scaling [-] corresponds to the present motor frequency f_M (without resonance dampening) multiplied by a factor (scaling) set in parameter 008.
Motor current [A] states the phase current of the motor measured as effective value.
Torque [%] gives the current motor load in relation to the rated motor torque.
Power [kW] states the actual power consumed by the motor in kW.
Power [HP] states the actual power consumed by the motor in HP.
Output energy [kWh] states the energy consumed by the motor since the latest reset was made in parameter 618.
Motor voltage [V] states the voltage supplied to the motor.
DC link voltage [V] states the intermediate circuit voltage in the VLT frequency converter.
Thermal load, motor [%] states the calculated/ estimated thermal load on the motor. 100% is the cut-out limit.
Thermal load, VLT [%] states the calculated/estimated thermal load on the VLT frequency converter. 100% is the cut-out limit.
Hours run [Hours] states the number of hours that the motor has run since the latest reset in parameter 619.
Digital input [Binary code] states the signal states from the 8 digital terminals (16, 17, 18, 19, 27, 29, 32 and 33) Input 16 corresponds to the bit at the far left. '0' = no signal, '1' = connected signal.
Analogue input 53 [V] states the signal value on terminal 53.
Analogue input 54 [V] states the signal value on terminal 54.
Analogue input 60 [V] states the signal value on terminal 60.
Pulse reference [Hz] states the possible frequency in Hz connected to the terminals 17 or 29.
External reference [%] gives the sum of the external reference as a percentage (the sum of analogue/ pulse/bus).
Status word [Hex] gives the status word sent via the serial communication port in Hex code from the VLT frequency converter.
Brake power/2 min. [KW] states the brake power transferred to an external brake resistor. The mean power is calculated continuously for the latest 120 seconds.
It is assumed that a resistor value has been entered in parameter 401.
Brake power/sec. [kW] states the present brake power transferred to an external brake resistor. Stated as an instantaneous value.
It is assumed that a resistor value has been entered in parameter 401.
Heat sink temp. [°C] states the present heat sink temperature of the VLT frequency converter. The cut-out limit is 90 ± 5°C; cutting back in occurs at 60 ± 5°C.
Alarm word [Hex] indicates one or several alarms in a Hex code. See page 160 for further information.
Control word. [Hex] indicates the control word for the VLT frequency converter. See *Serial communication* in the Design Guide.
Warning word 1. [Hex] indicates one or more warnings in a Hex code. See page 160 for further information.
Extended status word [Hex] indicates one or more status states in a Hex code. See page 160 for further information.
Communication option card warning [Hex] gives a warning word if there is a fault on the communication bus. Is only active if communication options have been installed. Without communication options, 0 Hex is displayed.

---

010 Display line 1.1 (DISPLAY LINE 1.1)

Value:
See parameter 009. ★ Reference [%]

Function:
This parameter enables a choice of the first of three data values to be shown on the display, line 1, position 1.
For display read-outs, press the [DISPLAY/STATUS] button, see also page 50.

Description of choice:
There is a choice of 30 different data values, see parameter 009.

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

011 Display line 1.2 (DISPLAY LINE 1.2)

Value:

See parameter 009 ★ Motor current [A]

Function:

This parameter enables a choice of the second of the three data values to be shown on the display, line 1, position 2.
For Display read-outs, press the [DISPLAY/STATUS] button, see also page 50.

Description of choice:

There is a choice of 30 different data values, see parameter 009.

012 Display line 1.3 (DISPLAY LINE 1.3)

Value:

See parameter 009 ★ Power [kW]

Function:

This parameter enables a choice of the third of the three data values to be shown on the display, line 1, position 3.
This is a useful function, i.a. when setting the PID regulator.
Display read-outs are made by pressing the [DISPLAY/STATUS] button, see also page 50.

Description of choice:

There is a choice of 30 different data values, see parameter 009.

013 Local Control/Configuration as parameter 100 (LOCAL CTRL/CONFIG.)

Value:

	Local not active (DISABLE)	[0]
	LCP control and open loop. (LCP CTRL/OPEN LOOP)	[1]
	LCP digital control and open loop. (LCP+DIG CTRL/OP.LOOP)	[2]
	LCP control/as parameter 100. (LCP CTRL/AS P100)	[3]
★	LCP digital control/as parameter 100. (LCP+DIG CTRL/AS P100)	[4]

Function:

This is where the desired function is to be selected if Local control has been chosen in parameter 002.
See also the description of parameter 100.

Description of choice:

If *Local not active* [0] is selected, a possible setting of *Local reference via parameter* 003 is blocked.
It is only possible to change to *Local not active* [0] from one of the other setting options in parameter 013, when the VLT frequency converter has been set to *Remote control* [0] in parameter 002.

LCP control and open loop [1] is used when the speed is to be adjustable (in Hz) via parameter 003, when the VLT frequency converter has been set to *Local control* [1] in parameter 002.

If parameter 100 has not been set to *Speed control open loop* [0], switch to *Speed control open loop* [0].

LCP digital control and open loop [2] functions as *LCP control and open loop* [1], the only difference being that when parameter 002 has been set to *Local operation* [1], the motor is controlled via the digital inputs, according to the list on page 58.

LCP control/as parameter 100 [3] is selected if the reference is to be set via parameter 003.

LCP digital control/as parameter 100 [4] functions as *LCP control/as parameter 100* [3], although, when parameter 002 has been set to *Local operation* [1], the motor may be controlled via the digital inputs in accordance with the list on page 58.

NB!
Shift from *Remote control* to *LCP digital control and open loop:*

The present motor frequency and direction of rotation must be maintained. If the present direction of rotation does not correspond to the reversing signal (negative reference), the motor frequency f_M will be set at 0 Hz.

Shift from *LCP digital control and open loop* to *Remote control:*
The selected configuration (parameter 100) will be active. Shifts are effected without any abrupt movement.

Shift from *Remote control to LCP control/as parameter 100* or *LCP digital control/as parameter 100.*
The present reference will be maintained. If the reference signal is negative, the local reference will be set at 0.

Shift from *LCP control/as parameter 100* or *LCP remote control as parameter 100* to *Remote control.*
The reference will be replaced by the active reference signal from the remote control.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

014 Local stop (LOCAL STOP)

Value:

	Not possible (DISABLE)	[0]
★	Possible (ENABLE)	[1]

Function:

This parameter disables/enables the local stop function in question from the control panel.
This key is used when parameter 002 has been set for *Remote control* [0] or *Local* [1].

Description of choice:

If *Disable* [0] is selected in this parameter, the [STOP] key will be inactive.

NB!
If *Enable* is selected, the [STOP] key overrules all Start commands.

015 Local jog (LOCAL JOGGING)

Value:

★	Not possible (DISABLE)	[0]
	Possible (ENABLE)	[1]

Function:

In this parameter, the jog function can be enabled/ disabled on the control panel.
The key can be used when parameter 002 has been set for *Remote control* [0] or *Local* [1].

Description of choice:

If *Disable* [0] is selected in this parameter, the [JOG] key will be inactive.

016 Local reversing (LOCAL REVERSING)

Value:

★	Not possible (DISABLE)	[0]
	Possible (ENABLE)	[1]

Function:

In this parameter, the reversing function can be enabled/disabled on the control panel.
This key can only be used if parameter 002 has been set to *Local operation* [1] and parameter 013 to *LCP control with open loop* [1] or *LCP control as parameter 100* [3].

Description of choice:

If *Disable* [0] is selected in this parameter, the [FWD/ REV] key will be inactive.
See Parameter 200.

017 Local reset of trip (LOCAL RESET)

Value:

	Not possible (DISABLE)	[0]
★	Possible (ENABLE)	[1]

Function:

In this parameter, the reset function can be selected/ removed from the keyboard.
This key can be used when parameter 002 has been set for *Remote control* [0] or *Local control* [1].

Description of choice:

If *Disable* [0] is selected in this parameter, the [RESET] key will be inactive.

NB!
Only select *Disable* [0] if an external reset signal has been connected via the digital inputs.

018 Lock for data change (DATA CHANGE LOCK)

Value:

★	Not locked (NOT LOCKED)	[0]
	Locked (LOCKED)	[1]

Function:

In this parameter, the software can "lock" the control, which means that data changes cannot be made via LCP (however, this is still possible via the serial communication port).

Description of choice:

If *Locked* [1] is selected, data changes cannot be made.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

019 Operating state at power up, local control (POWER UP ACTION)

Value:

Auto restart, use saved ref.(AUTO RESTART) [0]
★ Forced stop, use saved ref. (LOCAL=STOP) [1]
Forced stop, set ref. to 0 (LOCAL=STOP, REF=0) [2]

Function:

Setting of the desired operating mode when the mains voltage is reconnected.
This function can only be active in connection with *Local control* [1] in parameter 002.

Description of choice:

Auto restart, use saved ref. [0] is selected if the unit is to start up with the same local reference (set in parameter 003) and the same start/stop conditions (given via the [START/STOP] keys) that the frequency converter had before it was switched off.
Forced stop, use saved ref. [1] is used if the unit is to remain stopped when the mains voltage is connected, until the [START] key is pressed. After the start command, the local reference used is set in parameter 003.
Forced stop, set ref. to 0 [2] is selected if the unit is to remain stopped when the mains voltage is connected. Local reference (parameter 003) is reset.

NB!
In remote controlled operation (parameter 002), the start/stop condition at power up will depend on the external control signals. If *Pulse start* [2] is selected in parameter 302, the motor will remain stopped at power-up.

---

100 Configuration (CONFIG. MODE)

Value:

★ Speed control, open loop (SPEED OPEN LOOP) [0]
Speed control, closed loop (SPEED CLOSED LOOP) [1]
Process control, closed loop (PROCESS CLOSED LOOP) [3]
Torque control, open loop (TORQUE OPEN LOOP) [4]
Torque control, speed feedback (TORQUE CONTROL SPEED) [5]

Function:

This parameter is used for selecting the configuration to which the VLT frequency converter is to be adapted. This makes adaptation to a given application simple, because the parameters that are not used in the given configuration are covered up (not active). By changing between the different application configurations, bumpless transfer (frequency only) is ensured.

Description of choice:

If *Speed control, open loop* [0] is selected, a normal speed control (without feedback signal) is obtained, but with automatic slip compensation, ensuring a nearly constant speed at varying loads.
Compensations are active, but may be disabled as required in parameter group 100.

If *Speed control, closed loop* [1] is selected, a full holding torque is obtained at 0 rpm, in addition to increased speed accuracy. A feedback signal must be provided and the PID controller must be set. (See also connection examples in the Design Guide).

If *Process control, closed loop* [3] is selected, the internal process regulator will be activated, thereby enabling accurate control of a process with respect to a given process signal. The process signal can be set using the actual process unit or as a percentage. A feedback signal must be supplied from the process, and the process setpoint must be adjusted (See also connection examples in the Design Guide).

If *Torque control, open loop* [4] is selected, the speed is regulated and the torque is kept constant. This is done without a feedback signal, since VLT 5000 accurately calculates the torque on the basis of the current measurement (See also connection examples in the Design Guide).

If *Torque control, speed feedback* [5] is selected, an encoder speed feedback signal must be connected to the digital terminals 32/33.

Parameter 205 *Maximum reference* and parameter 415 *Maximum feedback* must be adapted to the application if [1], [3], [4] or [5] is selected.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

101 Torque characteristics
(TORQUE CHARACT)

Value:

High overload torque (150/160%) - one size down

★	High-constant torque (H-CONSTANT TORQUE)	[1]
	High-variable torque low (H-VAR.TORQ.: LOW)	[2]
	High-variable torque medium (H-VAR.TORQ.: MEDIUM)	[3]
	High-variable torque high (H-VAR.TORQ.: HIGH)	[4]
	High-special motor characteristics (H-SPEC.MOTOR CHARACT)	[5]
	High-variable torque with low starting torque (H-V.T LOW W. CT-START)	[6]
	High-variable torque with medium starting torque (H-V.T MED W. CT-START)	[7]
	High-variable torque with high starting torque (H-V.T HIGH W. CT-START)	[8]

Normal overload torque (110%)

Normal-constant torque (N-CONSTANT TORQUE)	[11]
Normal-variable torque low (N-VAR.TORQ.: LOW)	[12]
Normal-variable torque medium (N-VAR.TORQ.: MEDIUM)	[13]
Normal-variable torque high (N-VAR.TORQ.: HIGH)	[14]
Normal-special motor characteristics (N-SPEC.MOTOR CHARACT)	[15]
Normal-variable torque with low constant starting torque (N-VT LOW W. CT-START)	[16]
Normal-variable torque with medium constant starting torque (N-VT MED W. CT-START)	[17]
Normal-variable torque with high constant starting torque (N-VT HIGH W. CT-START)	[18]

Function:

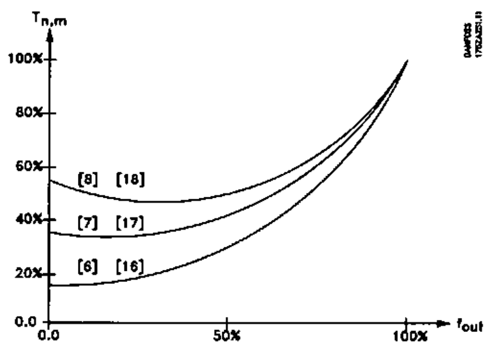
In this parameter, the principle for adjusting the U/f characteristics of the VLT frequency converter to the torque characteristics of the load is selected. By changing between the different torque characteristics, bumpless transfer (voltage only) is ensured.

Description of choice:

NB!
For VLT 5001-5006, 200-240 V, and VLT 5001-5011, 380-500 V, it is only possible to choose torque characteristics from [1] to [8].

If a high torque characteristic [1]-[5] is selected, the VLT frequency converter is able to provide 160% torque.
If a normal torque characteristic [11]-[15] is selected, the VLT frequency converter is able to provide 110% torque. The normal mode is used for oversize motors. See description on page 74.
Please note that the torque can be limited in parameter 221.

If *Constant torque* is selected, a load-dependent U/f characteristic is obtained in which the output voltage is increased in the case of an increasing load (current) so as to maintain constant magnetisation of the motor.
Select *Variable torque low, Variable torque medium* or *Variable torque high* if the load is variable (centrifugal pumps, fans).
Select High-variable torque with low [6], *medium* [7] or *high* [8] *starting torque* if a higher breakaway torque is required than that obtainable with the three first-mentioned characteristics, see fig. below.



Choose the torque characteristics giving the most reliable operation, the lowest possible energy consumption and the lowest acoustic noise.
Select *Special motor characteristics* if a special U/f setting is required to match the motor in question. Set the break points in parameters 422-432.

NB!
Slip compensation is not active if a variable torque or special motor characteristics are used.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

It is important for the set values to correspond to the motor coupling (star or delta)

102 Motor power (MOTOR POWER)

Value:

0.18 kW (0.18 KW)	[18]
0.25 kW (0.25 KW)	[25]
0.37 kW (0.37 KW)	[37]
0.55 kW (0.55 KW)	[55]
0.75 kW (0.75 KW)	[75]
1.1 kW (1.10 KW)	[110]
1.5 kW (1.50 KW)	[150]
2.2 kW (2.20 KW)	[220]
3 kW (3.00 KW)	[300]
4 kW (4.00 KW)	[400]
5.5 kW (5.50 KW)	[550]
7.5 kW (7.50 KW)	[750]
11 kW (11.00 KW)	[1100]
15 kW (15.00 KW)	[1500]
18.5 kW (18.50 KW)	[1850]
22 kW (22.00 KW)	[2200]
30 kW (30.00 KW)	[3000]
37 kW (37.00 KW)	[3700]
45 kW (45.00 KW)	[4500]
55 kW (55.00 KW)	[5500]
75 kW (75.00 KW)	[7500]
90 kW (90.00 KW)	[9000]
110 kW (110.00 KW)	[11000]
132 kW (132.00 KW)	[13200]
160 kW (160.00 KW)	[16000]
200 kW (200.00 KW)	[20000]
250 kW (250.00 KW)	[25000]
280 kW (280.00 KW)	[28000]
315 kW (315.00 KW)	[31500]
355 kW (355.00 KW)	[35500]
400 kW (400.00 KW)	[40000]
450 kW (450.00 KW)	[45000]
500 kW (500.00 KW)	[50000]

★ Depends on the unit

Function:

This is where to select the kW value that corresponds to the rated power of the motor. At the works, a rated kW value has been selected that depends on the type of unit.

Description of choice:

Select a value that equals the nameplate data on the motor. There are 4 possible undersizes or 1 oversize in comparison with the factory setting. Also, alternatively it is possible to set the value for motor power as an infinitely variable value, see the procedure on page 53.
The set value automatically changes the values of the motor parameters in parameter 108-118.

NB!
If the setting in parameter 102-109 is changed, the parameters 110-118 will return to factory setting.

103 Motor voltage (MOTOR VOLTAGE)

Value:

200 V	[200]
208 V	[208]
220 V	[220]
230 V	[230]
240 V	[240]
380 V	[380]
400 V	[400]
415 V	[415]
440 V	[440]
460 V	[460]
480 V	[480]
500 V	[500]

★ Depends on the unit

Function:

Select a value that equals the nameplate data on the motor.

NB!
The motor will always see the peak voltage, corresponding to the connected supply voltage, in case of regenerative operation, the voltage can be higher.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

Description of choice:
Select a value that equals the nameplate data on the motor, regardless of the mains voltage of the VLT frequency converter.
Furthermore, alternatively it is possible to set the value of the motor voltage infinitely variably, see also the procedure on page 53.
The value set automatically changes values for the motor parameters in parameters 108-118.
For 87 Hz operation with 230/400 V motors, set the nameplate data for 230 V. Adapt parameter 202 *Output frequency high limit* and parameter 205 *Maximum reference* to the 87 Hz application.

NB!
If a delta connection is used, the rated motor frequency for the delta connection must be selected.

NB!
If the setting in parameter 102-109 is changed, the parameters 110-118 will return to factory setting.

104 Motor frequency (MOTOR FREQUENCY)

Value:

★ 50 Hz	(50 HZ)	[50]
60 Hz	(60 HZ)	[60]

Max. motor frequency 1000 Hz.

Function:
This is where the rated motor frequency $f_{M,N}$ is selected (nameplate data).

Description of choice:
Select a value that equals the nameplate data on the motor.
Alternatively it is also possible to set the value for motor frequency infinitely variably, see procedure on page 53.
If a value different from 50 Hz or 60 Hz is selected, it is necessary to correct parameters 108 and 109.

For 87 Hz operation with 230/400 V motors, set the nameplate data for 230 V. Adapt parameter 202 *Output frequency high limit* and parameter 205 *Maximum reference* to the 87 Hz application.

NB!
If a delta connection is used, the rated motor frequency for the delta connected must be selected.

NB!
If the setting in parameter 102-109 is changed, the parameters 110-118 will return to factory setting.

105 Motor current (MOTOR CURRENT)

Value:

0.01 - $I_{VLT,MAX}$	[0.01 - XXX.X]

★ Depends on the choice of motor.

Function:
The rated motor current $I_{M,N}$ forms part of the VLT frequency converter calculations i.a. of torque and motor thermal protection.

Description of choice:
Select a value that equals the nameplate data on the motor.
Enter the value in Ampere.

NB!
It is important to enter the correct value, since this forms part of the VVC^{plus} control feature.

NB!
If the setting in parameter 102-109 is changed, the parameters 110-118 will return to factory setting.

106 Rated motor speed
(MOTOR NOM. SPEED)

Value:

100 - 60000 rpm [100 - 60000]

★ Depends on the choice of motor.

Function:

This is where the value is selected that corresponds to the rated motor speed $n_{M,N}$, which can be seen from the nameplate data.

Description of choice:

The rated motor speed $n_{M,N}$ is used i.a. for calculating the optimal slip compensation.

NB!

It is important to enter the correct value, since this forms part of the VVC^{plus} control feature.
The max. value equals $f_{M,N}$ x 60.
Set $f_{M,N}$ in parameter 104.

NB!

If the setting in parameter 102-109 is changed, the parameters 110-118 will return to factory setting.

107 Automatic motor adaptation, AMA
(AUTO MOTOR ADAPT)

Value:

★	Adaptation off (OFF)	[0]
	Adaptation on, R_s and X_s (ENABLE (RS,XS))	[1]
	Adaptation on, R_s (ENABLE (RS))	[2]

Function:

If this function is used, the VLT frequency converter automatically sets the necessary control parameters (parameters 108/109) with the motor stationary.
Automatic motor adaptation ensures optimum use of the motor.
For the best possible adaptation of the VLT frequency converter, it is recommended to run AMA on a cold motor.
The AMA function is activated by pressing the [START] key after selecting [1] or [2].
See also the description given of automatic motor adaptation on page 64.
Page 65 shows how automatic motor adaptation can be activated by means of VLT Software Dialog.

After a normal sequence, the display will read "ALARM 21". Press the [STOP/RESET] key. The VLT frequency converter is now ready for operation.

Description of choice:

Select *Enable, R_s and X_s* [1] if the VLT frequency converter is to be able to carry out automatic motor adaptation of both the stator resistance R_s and the stator reactance X_s.

Select *Optimisation on, R_s* [2] if a reduced test is to be carried out, in which only the ohmic resistance in the system is determined.

NB!

It is important to set motor parameters 102-106 correctly, since these form part of the AMA algorithm. In most applications, correct entering of motor parameters 102-106 is sufficient. For optimum dynamic motor adaptation, an AMA must be carried out.
Motor adaptation may take up to 10 minutes, depending on the output of the motor in question.

NB!

There must not be any externally generating torque during automatic motor adaptation.

NB!

If the setting in parameter 102-109 is changed, the parameters 110-118 will return to factory setting.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

Normally, this parameter is not to be set if the nameplate data have been entered.

108 Stator resistor (STATOR RESIST)

Value:

★ Depends on the choice of motor

Function:

After setting motor data in parameters 102-106, a number of adjustments of various parameters are made automatically, including the stator resistance R_S. A manually entered R_s must apply to a cold motor. The shaft performance can be improved by fine-tuning R_S and X_S, see procedure below.

Description of choice:

R_S can be set as follows:

1. Automatic motor adaptation, where the VLT frequency converter measures on the motor to determine the value. All compensations are reset to 100%.
2. The values are stated by the motor supplier.
3. The values are obtained by means of manual measurements:
   - R_S can be calculated by measuring the resistance $R_{PHASE\text{-}to\text{-}PHASE}$ between two phase terminals.
     If $R_{PHASE\text{-}to\text{-}PHASE}$ is lower than 1-2 ohm (typically motors > 4-5.5 kW, 400 V), a special ohm-meter should be used (Thomson bridge or similar). $R_S = 0.5 \times R_{PHASE\text{-}to\text{-}PHASE}$
4. The factory settings of R_S, selected by the VLT frequency converter itself on the basis of the motor nameplate data, are used.

NB!
If the setting in parameter 102-109 is changed, the parameters 110-118 will return to factory setting.

Normally, this parameter is not to be set if the nameplate data have been entered.

109 Stator reactance (STATOR REACT.)

Value:

★ depends on the choice of motor

Function:

After setting motor data in parameters 102-106, a number of adjustments of various parameters are made automatically, including the stator resistance X_s. The shaft performance can be improved by fine-tuning R_S and X_S, see procedure below.

Description of choice:

X_S can be set as follows:

1. Automatic motor adaptation, where the VLT frequency converter measures on the motor to determine the value. All compensations are reset to 100%.
2. The values are stated by the motor supplier.
3. These values are obtained by means of manual measurements:
   - X_s can be calculated by connecting a motor to mains and measuring the phase-to-phase voltage U_L as well as the idling current I_φ. Alternatively, these values can be recorded during operation in idle running state at the rated motor frequency $f_{M,N}$, slip compensation (par. 115) = 0% and load compensation at high speed (par. 114) = 100%.

$$X_s = \frac{U_L}{\sqrt{3} \times I_\varphi}$$

4. The factory settings of X_S, selected by the VLT frequency converter itself on the basis of the motor nameplate data, are used.

NB!
If the setting in parameter 102-109 is changed, the parameters 110-118 will return to factory setting.

Normally, this parameter is not to be set if the nameplate data have been entered.

110 Motor magnetizing, 0 rpm (MOT. MAGNETIZING)

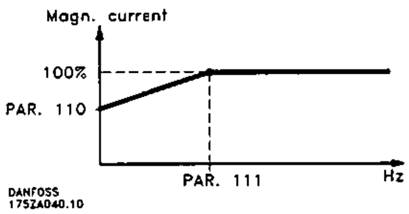
Value:

0 - 300 % ★ 100 %

Function:

This parameter can be used if a different thermal load on the motor is desired when running at low speed.

This parameter is used in connection with parameter 111.



Description of choice:

Enter a value stated as a percentage of the rated magnetizing current.

Too low setting may lead to a reduced torque on the motor shaft.

Normally, this parameter is not to be set if the nameplate data have been entered.

111 Min. frequency normal magnetizing (MIN FR NORM MAGN)

Value:

0.1 - 10.0 Hz ★ 1.0 Hz

Function:

This parameter is used in connection with parameter 110. See drawing in parameter 110.

Description of choice:

Set the required frequency (for normal magnetizing current). If the frequency is set lower than the motor slip frequency, parameters 110 and 111 are of no significance.

Normally, this parameter is not to be set if the nameplate data have been entered.

113 Load compensation at low speed (LO SPD LOAD COMP)

Value:

0 - 300 % ★ 100 %

Function:

This parameter enables compensation of voltage in relation to load when the motor is running at low speed.

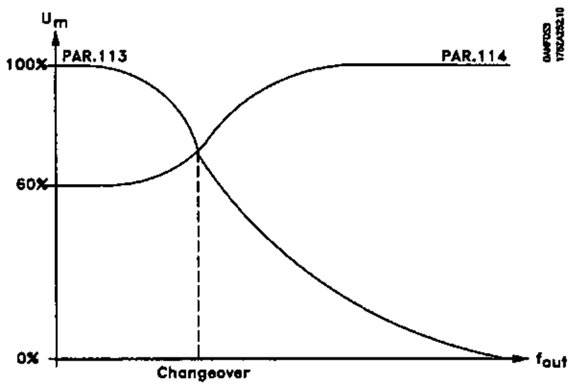
Description of choice:

Optimum U/f characteristics are obtained, i.e. compensation for the load at low speed.

The frequency range within which *Load compensation at low speed* is active, depends on the motor size.

This function is active for:

Motor size	Change-over
0.5 kW - 7.5 kW	< 10 Hz
11 kW - 37 kW	< 5 Hz
45 kW - 355 kW	< 3-4 Hz



★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

Normally, this parameter is not to be set if the nameplate data have been entered.

114 Load compensation at high speed (HI SPD LOAD COMP)

Value:

0 - 300 % ★ 100 %

Function:

This parameter enables compensation of voltage in relation to load when the motor is running at high speed.

Description of choice:

In *Load compensation at high speed* it is possible to compensate for the load from the frequency where *Load compensation at low speed* stopped working to max. frequency.

This function is active for:

Motor size	Change-over
0.5 kW - 7.5 kW	> 10 Hz
11 kW - 37 kW	> 5 Hz
45 kW - 355 kW	> 3-4 Hz

115 Slip compensation (SLIP COMPENSAT.)

Value:

-500 - 500 % ★ 100 %

Function:

Slip compensation is calculated automatically, i.e. on the basis of the rated motor speed $n_{M,N}$.
In parameter 115, slip compensation can be adjusted in detail, which compensates for tolerances in the value of $n_{M,N}$.
This function is not active together with *Variable torque* (parameter 101 - variable torque graphs), *Torque control, Speed feedback* and *Special motor characteristics.*

Description of choice:

Enter a %-value of the rated motor frequency (parameter 104).

Normally, this parameter is not to be set if the nameplate data have been entered.

116 Slip compensation time constant (SLIP TIME CONST.)

Value:

0.05 - 5.00 sec. ★ 0.50 sec.

Function:

This parameter determines the slip compensation reaction speed.

Description of choice:

A high value results in slow reaction. Conversely, a low value results in quick reaction.
If low-frequency resonance problems are encountered, the time set must be longer.

Normally, this parameter is not to be set if the nameplate data have been entered.

117 Resonance dampening (RESONANCE DAMP.)

Value:

0 - 500 % ★ 100 %

Function:

High-frequency resonance problems can be eliminated by setting parameters 117 and 118.

Description of choice:

For less resonance oscillation, the value of parameter 118 must be increased.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

Normally, this parameter is not to be set if the nameplate data have been entered.

118 Resonance dampening time constant (DAMP.TIME CONST.)

Value:

5 - 50 ms ★ 5 ms

Function:

High-frequency resonance problems can be eliminated by setting parameters 117 and 118.

Description of choice:

Choose the time constant that provides the best dampening.

---

119 High starting torque (HIGH START TORQ.)

Value:

0.0 - 0.5 sec. ★ 0.0 sec.

Function:

In order to secure a high starting torque, approx. 2 x $I_{VLT,N}$ for max. 0.5 sec. is allowed. However, the current is limited by the protection limit of the VLT frequency converter (inverter).

Description of choice:

Set the necessary time in which a high starting torque is desired.

---

120 Start delay (START DELAY)

Value:

0.0 - 10.0 sec. ★ 0.0 sec.

Function:

This parameter enables a delay of the starting time. The VLT frequency converter begins with the start function selected in parameter 121.

Description of choice:

Set the desired time until acceleration is to begin.

---

121 Start function (START FUNCTION)

Value:

DC hold in start delay time (DC HOLD/DELAY TIME) [0]
DC brake in start delay time (DC BRAKE/DELAY TIME) [1]
★ Coasting in start delay time (COAST/DELAY TIME) [2]
Start frequency/voltage clockwise. (CLOCKWISE OPERATION) [3]
Start frequency/voltage in reference direction (HORIZONTAL OPERATION) [4]
VVC^{PLUS} clockwise (VVC+ CLOCKWISE) [5]

Function:

This is where the desired state during start delay (parameter 120) is selected.

Description of choice:

Select *DC hold in the start delay time* [0] so as to energize the motor with a DC holding current (parameter 124) in the start delay time.

Select *DC brake in the start delay time* [1] so as to energize the motor with a DC braking current (parameter 125) in the start delay time.
Select *Coasting in the start delay time* [2] and the motor will not be controlled by the VLT frequency converter during the start delay time (inverter off).

Start frequency/voltage clockwise [3] and *VVC^{PLUS} clockwise* [5] is typically used in hoisting applications. *Start frequency/voltage in reference direction* [4] is used especially in applications with counterweight.

Select *Start frequency/voltage clockwise* [3] so as to have the function described in parameter 130 and 131 in the start delay time.
The output frequency will equal the setting of the start frequency in parameter 130, and the output voltage will equal the setting of the start voltage in parameter 131. Regardless of the value assumed by the reference signal, the output frequency will equal the setting of the start frequency in parameter 130 and the output voltage will correspond to the setting of the start voltage in parameter 131.
This functionality is used typically in hoisting applications.
This is used especially in applications with a cone armature motor, where the start is to be clockwise, followed by rotation in the reference direction.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

Select *Start frequency/voltage in reference direction* [4] in order to obtain the function described in parameters 130 and 131 during the start delay time. The motor will always rotate in the reference direction.
If the reference signal equals zero (0) parameter 130 *Start frequency* will be ignored and the output frequency will equal zero (0). The output voltage will correspond to the setting of the start voltage in parameter 131 *Start voltage*.

Select *VVC^PLUS clockwise* [5] so as to have only the function described in parameter 130 *Start frequency* in the start delay time. The start voltage will be calculated automatic. Notice that this function only uses the start frequency in the start delay time. Regardless of the value assumed by the reference signal, the output frequency will equal the setting of the start frequency in parameter 130.

---

122 Function at stop (FUNCTION AT STOP)

Value:

★	Coasting (COAST)	[0]
	DC hold (DC-HOLD)	[1]
	Motor check (MOTOR CHECK)	[2]
	Pre-magnetizing (PREMAGNETIZING)	[3]

Function:
Here it is possible to select the function of the VLT frequency converter after a stop command or when the frequency has been ramped down to 0 Hz.
See parameter 123 with respect to activation of this parameter regardless of whether the stop command is active.

Description of choice:
Select *Coasting* [0] if the VLT frequency converter is to 'let go' of the motor (inverter closed).
Select *DC hold* [1] when a DC holding current set in parameter 124 is to be activated.
Select *Motor check* [2] if the VLT frequency converter is to check whether or not a motor has been connected.
Select *Pre-magnetizing* [3]. The magnetic field is built up in the motor while it remains stopped. This ensures that the motor can produce torque as quickly as possible on starting.

---

123 Min. frequency for activating function at stop (MIN.F. FUNC.STOP)

Value:
0.0 - 10.0 Hz ★ 0.0 Hz

Function:
This parameter sets the frequency at which the function selected in parameter 122 is to be activated.

Description of choice:
Enter the desired frequency.

---

124 DC holding current (DC-HOLD CURRENT)

Value:
0 (OFF) - $\frac{I_{VLT,N}}{I_{M,N}}$ x 100 % ★ 50 %

The maximum value depends on the rated motor current.

If the DC holding current is active, the VLT frequency converter has a switching frequency of 4 kHz.

Function:
This parameter is used to uphold the motor function (holding torque) or to pre-heat the motor.

Description of choice:
This parameter can only be used if *DC hold* [1] has been selected in parameter 121 or 122. Set it as a percentage value in relation to the rated motor current $I_{M,N}$ set in parameter 105.
100% DC holding current corresponds to $I_{M,N}$.

Warning: 100 % supply for too long may damage the motor.

---

125 DC braking current (DC BRAKE CURRENT)

Value:
0 (OFF) - $\frac{I_{VLT,MAX}}{I_{M,N}}$ x 100 % ★ 50 %

The maximum value depends on the rated motor current.

If the DC braking current is active, the VLT frequency converter has a switching frequency of 4 kHz.

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

Function:
This parameter is used for setting the DC brake current that is activated upon a stop when the DC brake frequency set in parameter 127 has been reached, or if the DC brake inverse is active via digital terminal 27 or via a serial communication port. The DC braking current will be active for the duration of the DC braking time set in parameter 126.

Description of choice:
To be set as a percentage value of the rated motor current $I_{M,N}$ set in parameter 105.
100% DC braking current corresponds to $I_{M,N}$.

Warning: 100 % supply for too long may damage the motor.

126 DC braking time
(DC BRAKING TIME)

Value:

0.0 (OFF) - 60.0 sec. ★ 10.0 sec.

Function:
This parameter is for setting the DC braking time for which the DC braking current (parameter 125) is to be active.

Description of choice:
Set the desired time.

127 DC brake cut-in frequency
(DC BRAKE CUT-IN)

Value:

0.0 - parameter 202 ★ 0.0 Hz (OFF)

Function:
This parameter is for setting the DC brake cut-in frequency at which the DC braking current (parameter 125) is to be active, in connection with a stop command.

Description of choice:
Set the desired frequency.

128 Motor thermal protection
(MOT.THERM PROTEC)

Value:

★	No protection (NO PROTECTION)	[0]
	Thermistor warning (THERMISTOR WARN)	[1]
	Thermistor trip (THERMISTOR TRIP)	[2]
	ETR Warning 1 (ETR WARNING1)	[3]
	ETR Trip 1 (ETR TRIP1)	[4]
	ETR Warning 2 (ETR WARNING2)	[5]
	ETR Trip 2 (ETR TRIP2)	[6]
	ETR Warning 3 (ETR WARNING3)	[7]
	ETR Trip 3 (ETR TRIP3)	[8]
	ETR Warning 4 (ETR WARNING 4)	[9]
	ETR Trip 4 (ETR TRIP4)	[10]

Function:
The VLT frequency converter is able to monitor the motor temperature in two different ways:

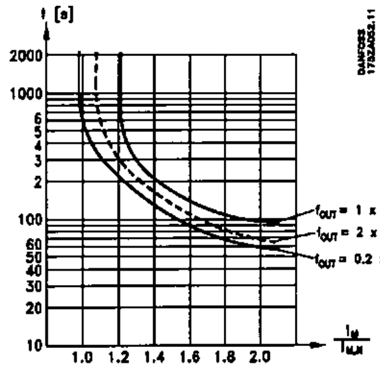
- Via a thermistor sensor connected to one of the analogue inputs, terminals 53 and 54 (parameters 308 and 311).
- Calculation of the thermal load, based on the current load and the time. This is compared with the rated motor current $I_{M,N}$ and the rated motor frequency $f_{M,N}$. The calculations made take into account the need for a lower load at lower speeds because of less cooling from the fan.

ETR functions 1-4 do not start calculating the load until there is a switch-over to the Setup in which they were selected. This enables the use of the ETR function, even where two or several motors alternate.
For the North American market: The ETR functions provide class 20 motor overload protection in accordance with NEC.

Description of choice:
Select *No protection* if no warning or tripping is required when the motor is overloaded.
Select *Thermistor warning* if a warning is desired when the connected thermistor - and thus the motor - gets too hot.
Select *Thermistor trip* if cutting out (trip) is desired when the connected thermistor - and thus the motor - overheats.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

Description of choice, cont.:
Select *ETR Warning 1-4*, if a warning is to come up on the display when the motor is overloaded according to the calculations.
Select *ETR Trip 1-4* if tripping is desired when the motor is overloaded according to the calculations.
The VLT frequency converter can also be programmed to give off a warning signal via one of the digital outputs, in which case the signal is given both for warning and for trip (thermal warning).



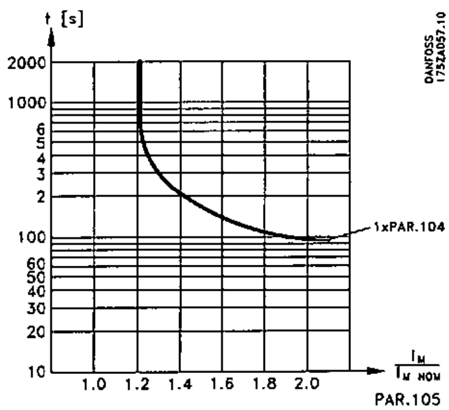
129 External motor fan (MOTOR EXTERN FAN)

Value:

★ No (NO)	[0]
Yes (YES)	[1]

Function:
This parameter makes it possible to tell the VLT frequency converter whether the motor has an external separately supplied fan on the motor (external ventilation), indicating that derating at low speed is unnecessary.

Description of choice:
If *Yes* [1] is selected, the graph in the drawing below is followed if the motor frequency is lower. If the motor frequency is higher, the time will still derate as if no fan had been installed.



130 Start frequency (START FREQUENCY)

Value:
0.0 - 10.0 Hz ★ 0.0 Hz

Function:
This parameter allows setting of the output frequency at which the motor is to start.
The output frequency 'leaps' to the set value. This parameter can be used e.g. for hoist applications (cone rotor motors).

Description of choice:
Set the desired start frequency.
It is assumed that the start function in parameter 121 has been set to [3] or [4] and that a start delay time has been set in parameter 120; also, a reference signal must be present.

131 Initial voltage (INITIAL VOLTAGE)

Value:
0.0 - parameter 103 ★ 0.0 Volt

Function:
Some motors, such as cone rotor motors, need extra voltage/starting frequency (boost) when starting, so as to disengage the mechanical brake.
For this purpose use parameters 130/131.

Description of choice:
Set the desired value required to disengage the mechanical brake.
It is assumed that the start function in parameter 121 has been set to [3] or [4] and that a start delay time has been set in parameter 120; also, a reference signal must be present.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

200 Output frequency range/direction (OUT FREQ RNG/ROT)

Value:

★ Only clockwise, 0-132 Hz (132 Hz CLOCK WISE)	[0]
Both directions, 0-132 Hz (132 Hz BOTH DIRECT)	[1]
Only clockwise, 0-1000 Hz (1000 Hz CLOCK WISE)	[2]
Both directions, 0-1000 Hz (1000 Hz BOTH DIRECT)	[3]

Function:

This parameter guarantees protection against unwanted reversing. Furthermore, the maximum output frequency can be selected that is to apply, regardless of the settings of other parameters.

NB!
The output frequency of the VLT frequency converter can never assume a value higher than 1/10 of the switching frequency, see parameter 411.

Is not to be used together with *Process control, closed loop (parameter 100).*

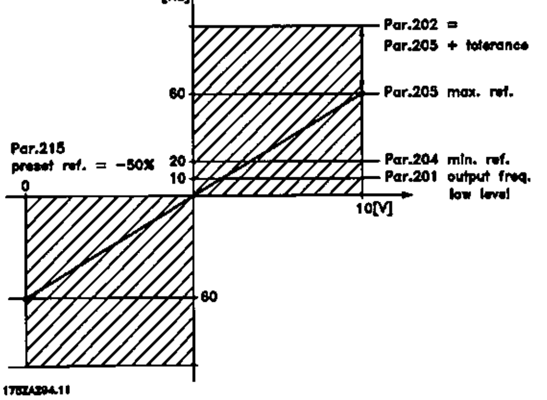
Description of choice:

Select the desired direction as well as output frequency

Note that if *Clockwise, 0-132 Hz* [0] or *Clockwise, 0-1000 Hz* [2] is selected, the output frequency will be limited to the range f_{MIN} - f_{MAX}.

If *Both directions, 0-132 Hz* [1] or *Both directions, 0-1000 Hz* [3] is selected, the output frequency will be limited to the range ± f_{MAX} (the minimum frequency is of no significance).

Example:



Parameter 200 *Output frequency range/direction = both directions.*

201 Output frequency low limit (F_{MIN}) (OUT FREQ LOW LIM)

Value:

0.0 - f_{MAX} ★ 0.0 Hz

Function:

In this parameter, a minimum motor frequency limit can be selected that corresponds to the minimum frequency at which the motor is to run.
The minimum frequency can never be higher than the maximum frequency, f_{MAX}.
If *Both directions* has been selected in parameter 200, the minimum frequency is of no significance.

Description of choice:

A value from 0.0 Hz to the max. frequency selected in parameter 202 (f_{MAX}) can be chosen.

202 Output frequency high limit (F_{MAX}) (OUT FREQ HI LIM)

Value:

f_{MIN} - 132/1000 Hz (parameter 200)
★ depends on unit

Function:

In this parameter, a maximum motor frequency can be selected that corresponds to the highest frequency at which the motor is to run. The factory setting is 132 Hz for VLT 5001-5052 380-500 V and 5001-5027 200-240 V. For VLT 5060-5250 380-500 V and 5032-5052 200-240 V the factory setting is 66 Hz.

See also parameter 205.

NB!
The output frequency of the VLT frequency converter can never assume a value higher than 1/10 of the switching frequency.

Description of choice:

A value from f_{MIN} to the choice made in parameter 200 can be selected.

NB!
If the maximum motor frequency is set at more than 500 Hz, parameter 446 must be set at *60° AVM* [0] switching pattern.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

203 Reference/feedback area
(REF/FEEDB. RANGE)

Value:

★ Min - Max (MIN - MAX) [0]
- Max - + Max (-MAX-+MAX) [1]

Function:
This parameter decides whether the reference signal and the feedback signal are to be positive or can be both positive and negative.
The minimum limit may be a negative value, unless *Speed control, closed loop* has been selected (parameter 100).
Choose *Min - Max* [0] if *Process control, closed loop* has been selected in parameter 100.

Description of choice:
Choose the desired range.
See drawing on page 63.

---

204 Minimum reference
(MIN. REFERENCE)

Value:

-100,000.000 - Ref_{MAX}
★ 0.000
Depends on parameter 100.

Function:
The *Minimum reference* gives the minimum value that can be assumed by the sum of all references. *Minimum reference* is only active if *Min - Max* [0] has been set in parameter 203; however, it is always active in *Process control, closed loop* (parameter 100).

Description of choice:
Is only active when parameter 203 has been set to *Min - Max* [0].
Set the desired value.
The unit follows the choice of configuration in parameter 100.

Speed control, open loop:	Hz
Speed control, closed loop:	rpm
Torque control, open loop:	Nm
Torque control, speed feedback:	Nm
Process control, closed loop:	Process units (par. 416)

Special motor characteristics, activated in parameter 101, use the unit selected in parameter 100.
See drawing on page 63.

---

205 Maximum reference
(MAX. REFERENCE)

Value:

Ref_{MIN} - 100,000.000 ★ 50.000

Function:
The *Maximum reference* gives the highest value that can be assumed by the sum of all references. If closed loop has been selected in parameter 100, the maximum reference cannot be set higher than the maximum feedback (parameter 415).

Description of choice:
Set the desired value.
The unit follows the choice of configuration in parameter 100.

Speed control, open loop:	Hz
Speed control, closed loop:	rpm
Torque control, open loop:	Nm
Torque control, speed feedback:	Nm
Process control, closed loop:	Process units (par. 416)

Special motor characteristics, activated in parameter 101, use the unit selected in parameter 100.
See drawing on page 63.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

References & Limits

206 Ramp type (RAMP TYPE)

Value:

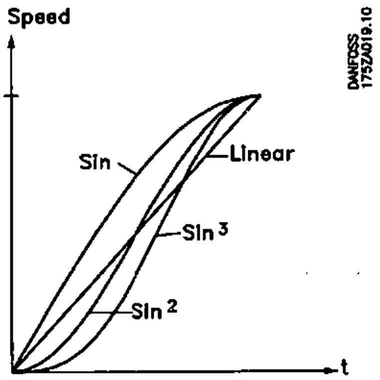
★ Linear (LINEAR)	[0]
Sinusoidal (S1)	[1]
Sin² (S2)	[2]
Sin³ (S3)	[3]

Function:

There is a choice of 4 different ramp types.

Description of choice:

Select the desired ramp type, depending on requirements concerning acceleration/deceleration.



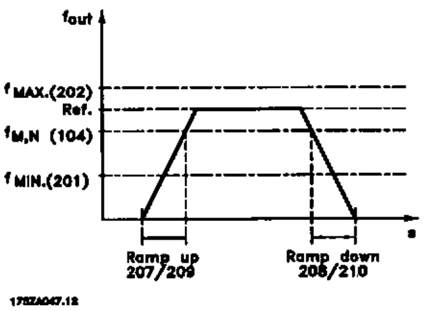
207 Ramp-up time 1 (RAMP UP TIME 1)

Value:

0.05 - 3600 sec. ★ depends on unit

Function:

The ramp-up time is the acceleration time from 0 Hz to the rated motor frequency $f_{M,N}$ (parameter 104) or the rated motor speed $n_{M,N}$ (if *Speed control, closed loop* has been selected in parameter 100). This presupposes that the output current does not reach the torque limit (to be set in parameter 221).



Description of choice:

Program the desired ramp-up time.

208 Ramp-down time 1 (RAMP DOWN TIME 1)

Value:

0.05 - 3600 sec. ★ depends on unit

Function:

The ramp-down time is the deceleration time from the rated motor frequency $f_{M,N}$ (parameter 104) to 0 Hz or from the rated motor speed $n_{M,N}$, provided there is no over-voltage in the inverter because of regenerative operation of the motor, or if the generated current reaches the torque limit (to be set in parameter 222).

Description of choice:

Program the desired ramp-down time.

209 Ramp-up time 2 (RAMP UP TIME 2)

Value:

0.05 - 3600 sec. ★ depends on unit

Function:

See description of parameter 207.

Description of choice:

Program the desired ramp-up time.
Switching from ramp 1 to ramp 2 is effected via a signal on digital input terminal 16, 17, 29, 32 or 33.

210 Ramp-down time 2 (RAMP DOWN TIME 2)

Value:

0.05 - 3600 sec. ★ depends on unit

Function:

See description of parameter 208.

Description of choice:

Program the desired ramp-down time.
Switching from ramp 1 to ramp 2 is effected via a signal on digital input terminal 16, 17, 29, 32 or 33.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

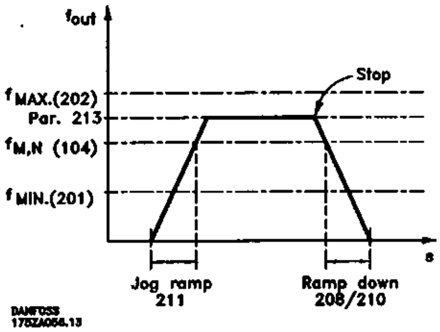
211 Jog ramp time (JOG RAMP TIME)

Value:

0.05 - 3600 sec. ★ depends on unit

Function:

The jog ramp time is the acceleration/deceleration time from 0 Hz to the rated motor frequency $f_{M,N}$ (parameter 104). It is assumed that the output current is not higher than the torque limit (set in parameter 221).



The jog ramp time starts if a jog signal is given via the control panel, the digital inputs or the serial communication port.

Description of choice:

Set the desired ramp time.

212 Quick stop ramp-down time (Q STOP RAMP TIME)

Value:

0.05 - 3600 sec. ★ depends on unit

Function:

The ramp-down time is the deceleration time from the rated motor frequency to 0 Hz, provided no overvoltage arises in the inverter because of generating operation of the motor or if the generated current becomes higher than the torque limit (set in parameter 222).

Quick-stop is activated by means of a signal on digital input terminal 27, or via the serial communication port.

Description of choice:

Program the desired ramp-down time.

213 Jog frequency (JOG FREQUENCY)

Value:

0.0 - parameter 202 ★ 10.0 Hz

Function:

The jog frequency f_{JOG} is the fixed output frequency at which the VLT frequency converter is running when the jog function is activated.

Description of choice:

Set the desired frequency.

214 Reference function (REF FUNCTION)

Value:

★	Sum (SUM)	[0]
	Relative (RELATIVE)	[1]
	External/preset (EXTERNAL/PRESET)	[2]

Function:

It is possible to define how the preset references are to be added to the other references. For this purpose, *Sum* or *Relative* is used. It is also possible - by using the *External/preset* function - to select whether a shift between external references and preset references is desired.

Description of choice:

If *Sum* [0] is selected, one of the adjusted preset references (parameters 215-218) is added as a percentage of the maximum possible reference.

If *Relative* [1] is selected, one of the adjusted preset references (parameters 215-218) is added to the external references as a percentage of the actual reference.

In addition, it is possible to use parameter 308 to select whether the signals on terminals 54 and 60 are to be added to the sum of the active references.

If *External/preset* [2] is selected, it is possible to shift between external references or preset references via terminal 16, 17, 29, 32 or 33 (parameter 300, 301, 305, 306 or 307). Preset references will be a percentage value of the reference range.

External reference is the sum of the analogue references, pulses and bus references.

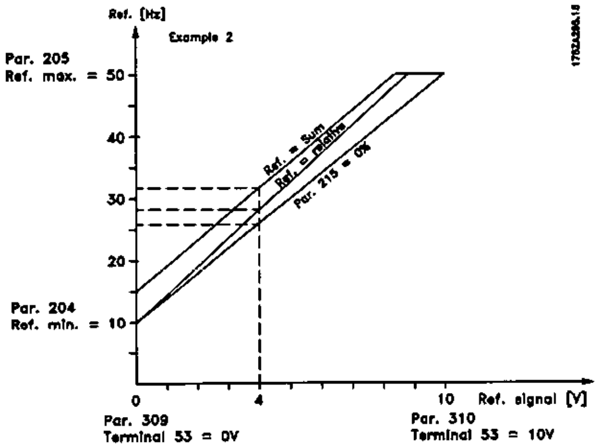
See also drawings on pages 61-63.

NB!
If *Sum* or *Relative* is selected, one of the preset references will always be active. If the preset references are to be without influence, they should be set to 0 % (as in the factory setting).

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

The example shows how to calculate the output frequency if using *Preset references* together with *Sum* and *Relative* in parameter 214.
Parameter 205 *Maximum reference* has been set to 50 Hz.

Par. 204 *Min. reference*	Increase [Hz/V]	Frequency by 4.0 V	Par. 215 *Preset ref.*	Par 214 Reference type = *Sum* [0] Output frequency	Par. 214 Reference type = *Relative* [1] Output frequency
1) 0	5	20 Hz	15 %	00+20+7.5 = 27.5 Hz	00+20+3 = 23.0 Hz
2) 10	4	16 Hz	15 %	10+16+6.0 = 32.0 Hz	10+16+2.4 = 28.4 Hz
3) 20	3	12 Hz	15 %	20+12+4.5 = 36.5 Hz	20+12+1.8 = 33.8 Hz
4) 30	2	8 Hz	15 %	30+8+3.0 = 41.0 Hz	30+8+1.2 = 39.2 Hz
5) 40	1	4 Hz	15 %	40+4+1.5 = 45.5 Hz	40+4+0.6 = 44.6 Hz



215 Preset reference 1 (PRESET REF. 1)
216 Preset reference 2 (PRESET REF. 2)
217 Preset reference 3 (PRESET REF. 3)
218 Preset reference 4 (PRESET REF. 4)

Value:

-100.00 % - +100.00 % ★ 0.00%
of the reference range/external reference

Function:

Four different preset references can be programmed in parameters 215-218.
The preset reference is stated as a percentage of the value Ref_{MAX} or as a percentage of the other external references, depending on the choice made in parameter 214. If a $Ref_{MIN} \neq 0$ has been programmed, the preset reference as a percentage will be calculated on the basis of the difference between Ref_{MAX} and Ref_{MIN}, following which the value is added to Ref_{MIN}.

Description of choice:

Set the fixed reference(s) that is/are to be the options.

To use the fixed references, it is necessary to have selected Preset ref. enable on terminal 16, 17, 29, 32 or 33.
Choices between fixed references can be made by activating terminal 16, 17, 29, 32 or 33 - see the table below.

Terminals 17/29/33 preset ref. msb	Terminals 16/29/32 preset ref. lsb	
0	0	Preset ref. 1
0	1	Preset ref. 2
1	0	Preset ref. 3
1	1	Preset ref. 4

See drawings on pages 56-58.

219 Catch up/slow down value (CATCH UP/SLW DWN)

Value:

0.00-100% of the current reference ★ 0.00 %

Function:

This parameter enables the entry of a percentage value (relative) which will either be added to or deducted from the actual reference.

Description of choice:

If *Catch up* has been selected via one of the terminals 16, 29 or 32 (parameters 300, 305 and 306), the percentage (relative) value selected in parameter 219 will be added to the total reference.
If *Slow down* has been selected via one of the terminals 17, 29 or 33 (parameters 301, 305 and 307), the percentage (relative) value selected in parameter 219 will be deducted from the total reference.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

221 Torque limit for motor mode (TORQ LIMIT MOTOR)

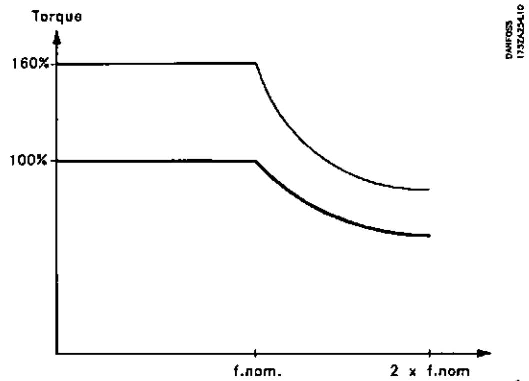
Value:

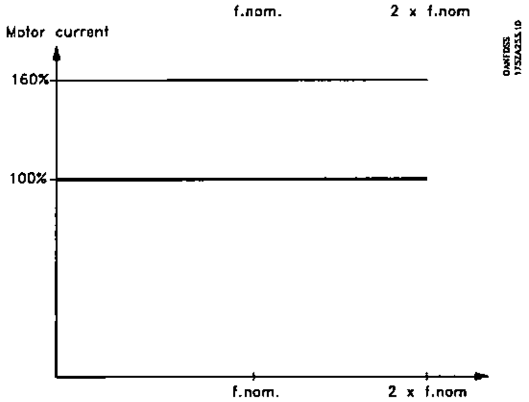
0.0 % - xxx.x % of $T_{M,N}$ ★ 160 % of $T_{M,N}$

The max. torque depends on the unit and the motor size selected.

Function:

This function is relevant for all application configurations; speed, process and torque control.
This is where to set the torque limit for motor operation. The torque limiter is active in the frequency range up to the rated motor frequency (parameter 104).
In the oversynchronous range, where the frequency is higher than the rated motor frequency, this function acts as a current limiter.
See fig. below.





Description of choice:

In order to protect the motor from reaching pull-out torque, the factory setting is 1.6 x the rated motor torque (calculated value).
If a synchronous motor is used, the torque limit must be increased in relation to the factory setting.
If a setting in parameters 101-106 is changed, parameters 221/222 are not automatically reversed to the factory setting.

222 Torque limit for generating operation (TORQ LIMIT GENER)

Value:

0.0 % - xxx.x % of $T_{M,N}$

★ 160 %

The max. torque depends on the unit and the motor size selected.

Function:

This function is relevant for all application configurations; speed, process and torque control.
This is where to set the torque limit for generating operation. The torque limiter is active in the frequency range up to the rated motor frequency (parameter 104).
In the oversynchronous range, where the frequency is higher than the rated motor frequency, this function acts as a current limiter.
See fig. for parameter 221.

Description of choice:

If *Resistor brake* [1] has been selected in parameter 400, the torque limit is changed to 1.6 x the rated motor torque.

223 Warning: Low current (WARN. CURRENT LO)

Value:

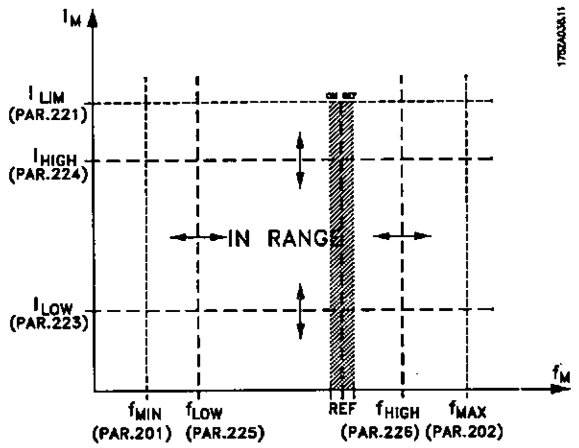
0.0 - parameter 224 ★ 0.0 A

Function:

When the motor current is below the limit, I_{LOW}, programmed in this parameter, the display indicates CURRENT LOW.
The signal outputs can be programmed to transmit a status signal via terminal 42 or 45 as well as via relay output 01 or 04 (parameter 319, 321, 323 or 326).

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

Description of choice:
The lower signal limit I_{LOW} of the motor current must be programmed within the normal working range of the frequency converter.



224 Warning: High current (WARN. CURRENT HI)

Value:

Parameter 223 - $I_{VLT,MAX}$ ★ $I_{VLT,MAX}$

Function:
If the motor current gets above the limit programmed in this parameter, I_{HIGH}, the display will indicate CURRENT HIGH.
The signal outputs can be programmed to transmit a status signal via terminal 42 or 45 and via relay output 01 or 04 (parameter 319, 321, 323 or 326).

Description of choice:
The upper signal limit of the motor current, I_{HIGH}, must be programmed within the normal working range of the frequency converter. See drawing at parameter 223.

225 Warning: Low frequency (WARN. FREQ. LOW)

Value:

0.0 - parameter 226 ★ 0.0 Hz

Function:
When the motor frequency is below the limit programmed in this parameter, f_{LOW}, the display indicates FREQUENCY LOW.
The signal outputs can be programmed to transmit a status signal via terminal 42 or 45 and via relay output 01 or 04 (parameter 319, 321, 323 or 326).

Description of choice:
The lower signal limit of the motor frequency, f_{LOW}, is to be programmed within the normal working range of the frequency converter.
See drawing at parameter 223.

226 Warning: High frequency (WARN. FREQ. HIGH)

Value:

parameter 225 - parameter 202 ★ 132.0 Hz

Function:
When the motor frequency is above the limit programmed in this parameter, f_{HIGH}, the display will indicate FREQUENCY HIGH.
The signal outputs can be programmed to transmit a status signal via terminal 42 or 45 and via relay output 01 or 04 (parameter 319, 321, 323 or 326).

Description of choice:
The upper signal limit of the motor frequency, f_{HIGH}, must be programmed within the normal working range of the frequency converter.
See drawing at parameter 223.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

227 Warning: Low feedback (WARN. FEEDB. LOW)

Value:

-100,000.000 - parameter 228. ★ -4000.000

Function:

If the connected feedback signal gets below the value set in this parameter, the signal outputs can be programmed to transmit a status signal via terminal 42 or 45 and via relay output 01 or 04 (parameter 319, 321, 323 or 326).

Description of choice:

Set the desired value.

---

228 Warning: High feedback (WARN. FEEDB HIGH)

Value:

parameter 227 - 100,000.000 ★ 4000.000

Function:

If the connected feedback signal gets above the value set in this parameter, the signal outputs can be programmed to transmit a status signal via terminal 42 or 45 and via relay output 01 or 04 (parameter 319, 321, 323 or 326).

Description of choice:

Set the desired value.

---

229 Frequency bypass, bandwidth (FREQ BYPASS B.W.)

Value:

0 (OFF) - 100% ★ 0 (OFF) %

Function:

Some systems call for some output frequencies to be avoided because of resonance problems in the system.

In parameters 230-233 these output frequencies can be programmed for bypassing (Frequency bypass). In this parameter (229), a bandwidth can be defined on either side of these frequency bypasses.

The frequency bypass function is not active if par. 002 is set to *Local* and par. 013 is set to *LCP ctrl/Open loop* or *LCP+dig ctrl/Open loop*.

Description of choice:

The bypass bandwidth is set as a percentage of the bypass frequency which is selected in parameter 230-233.

The bypass bandwidth indicates max. variation of the bypass frequency.

Example: A bypass frequency of 100 Hz and a bypass bandwidth of 1% are selected. In this case the bypass frequency can vary between 99.5 Hz and 100.5 Hz i.e. 1% of 100 Hz.

---

230 Frequency bypass 1 (FREQ. BYPASS 1)
231 Frequency bypass 2 (FREQ. BYPASS 2)
232 Frequency bypass 3 (FREQ. BYPASS 3)
233 Frequency bypass 4 (FREQ. BYPASS 4)

Value:

0.0 - parameter 200 ★ 0.0 Hz

Function:

Some systems call for some output frequencies to be avoided because of resonance problems in the system.

Description of choice:

Enter the frequencies to be avoided.

See also parameter 229.

---

234 Motor phase monitor (MOTOR PHASE MON)

Settings:

★	Enable (ENABLE)	[0]
	Disable (DISABLE)	[1]

Function:

In this parameter it is possible to select monitoring of the motor phases.

Description of choice:

If *Enable* is selected, the frequency converter will react on a missing motor phase which will result in alarm 30, 31 or 32.

If *Disable* is selected, **no** alarm is given if a motor phase is missing. The motor can be damaged/overheated if it runs on only two phases. It is therefore recommended to keep the missing motor phase function ENABLED.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

300 Terminal 16, input
(DIGITAL INPUT 16)

Digital inputs	Terminal no. / parameter	16 / 300	17 / 301	18 / 302	19 / 303	27 / 304	29 / 305	32 / 306	33 / 307
Value:									
No function	(NO OPERATION)	[0]	[0]	[0]	[0]		[0]	[0]	[0]
Reset	(RESET)	[1]★	[1]				[1]	[1]	[1]
Coasting stop, inverse	(COAST INVERSE)					[0]★			
Reset and coasting stop, inverse	(COAST & RESET INVERS)					[1]			
Quick-stop, inverse	(QSTOP INVERSE)					[2]			
DC-braking, inverse	(DCBRAKE INVERSE)					[3]			
Stop inverse	(STOP INVERSE)	[2]	[2]			[4]	[2]	[2]	[2]
Start	(START)			[1]★					
Latched start	(LATCHED START)			[2]					
Reversing	(REVERSING)				[1]★				
Start reversing	(START REVERSE)				[2]				
Only start clockwise, on	(ENABLE START FWD.)	[3]		[3]			[3]	[3]	
Only start anti-clockwise, on	(ENABLE START REV)		[3]		[3]		[4]		[3]
Jog	(JOGGING)	[4]	[4]				[5]★	[4]	[4]
Preset reference, on	(PRESET REF. ON)	[5]	[5]				[6]	[5]	[5]
Preset reference, lsb	(PRESET REF. SEL. LSB)	[6]					[7]	[6]	
Preset reference, msb	(PRESET REF. MSB)		[6]				[8]		[6]
Freeze reference	(FREEZE REFERENCE)	[7]	[7]★				[9]	[7]	[7]
Freeze output	(FREEZE OUTPUT)	[8]	[8]				[10]	[8]	[8]
Speed up	(SPEED UP)	[9]					[11]	[9]	
Speed down	(SPEED DOWN)		[9]				[12]		[9]
Choice of Setup, lsb	(SETUP SELECT LSB)	[10]					[13]	[10]	
Choice of Setup, msb	(SETUP SELECT MSB)		[10]				[14]		[10]
Choice of Setup, msb/speed up	(SETUP MSB/SPEED UP)							[11]★	
Choice of Setup, lsb/speed down	(SETUP LSB/SPEED DOWN)								[11] ★
Catch-up	(CATCH UP)	[11]					[15]	[12]	
Slow-down	(SLOW DOWN)		[11]				[16]		[12]
Ramp 2	(RAMP 2)	[12]	[12]				[17]	[13]	[13]
Mains failure inverted	(MAINS FAILURE INVERSE)	[13]	[13]				[18]	[14]	[14]
Pulse reference	(PULSE REFERENCE)		[23]				[28][1]		
Pulse feedback	(PULSE FEEDBACK)								[24]
Encoder feedback input, A	(ENCODER INPUT 2A)								[25]
Encoder feedback input, B	(ENCODER INPUT 2B)							[24]	

1) If this function is selected for terminal 29, the same function for terminal 17 will not be valid, even if it has been selected to be active.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

300 Terminal 16, input
(DIGITAL INPUT 16)

Function:

In this and the following parameters it is possible to choose between the different possible functions related to the inputs on terminals 16-33.
The function options are shown in the table on page 101.
The maximum frequency for terminal 16, 17, 18 and 19 is 5 kHz. The maximum frequency for terminals 29, 32 and 33 is 65 kHz.

Description of choice:

No function is selected if the VLT frequency converter is not to react to signals transmitted to the terminal.

Reset zeroes the VLT frequency converter after an alarm; however, not all alarms can be reset.

Coasting stop inverse is used for making the VLT frequency converter let go of the motor to make it coast freely to stop. Logic '0' leads to coasting stop and reset.

Reset and coasting stop inverse, is used for activating coasting stop at the same time as reset. Logic '0' leads to coasting stop and reset

Quick-stop inverse is used for stopping the motor in accordance with the quick-stop ramp (set in parameter 212). Logic '0' leads to a quick-stop.

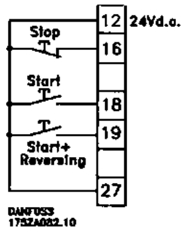
DC braking inverse is used for stopping the motor by energizing it with a DC voltage for a given time, see parameters 125-127.
Please note that this function is only active if the value of parameters 126-127 is different from 0. Logic '0' leads to DC braking.

Stop inverse is activated by interrupting the voltage to the terminal. This means that if the terminal has no voltage, the motor cannot run. The stop will be effected in accordance with the selected ramp (parameters 207/208/209/210).

None of the above-mentioned stop commands (start-disable) are to be used as disconnection switch in connection with repairs. Cut mains instead.

NB!:
It must be noted that when the VLT frequency converter is at the torque limit and has received a stop command, it will only stop if terminal 42, 45, 01 or 04 has been connected to terminal 27. The data choice on terminal 42, 45, 01 or 04 must be *Torque limit* and *stop* [27].

Start, is selected if a start/stop (operating command, group 2) command is desired. Logic '1' = start, logic '0' = stop.



Latched start - if a pulse is applied for min. 3 ms, the motor will start, provided no stop command (operating command, group 2). The motor stops if Stop inverse is activated briefly.

Reversing is used for changing the direction of rotation of the motor shaft. Logic "0" will not lead to reversing. Logic "1" will lead to reversing. The reversing signal only changes the direction of rotation; it does not activate the start function.
Reversing requires that *Both directions* has been selected in parameter 200.
Is not active if *Process control, closed loop* or *Torque control, speed feedback* has been selected.

Start reversing, is used for start/stop (operating command, group 2) and for reversing with the same signal. No signal is allowed on terminal 18 at the same time. Acts as latch start reversing, provided latch start has been chosen for terminal 18.
Is not active if *Process control, closed loop* has been selected.

Start clockwise only, on is used if the motor shaft is only to be able to rotate clockwise when starting.
Should not be used with *Process control, closed loop*.

Start anti-clockwise only, is used if the motor shaft is to rotate anti-clockwise when started.
Should not be used with *Process control, closed loop*.

Jog is used for overriding the output frequency to the jog frequency set in parameter 213. The ramp time can be set in parameter 211. Jog is not active if a coast command has been given via terminal 27. Jog overrides stop (operating command, group 2).

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

Preset reference, on is used for shifting between external reference and preset reference. It is assumed that *External/preset* [2] has been selected in parameter 214. Logic '0' = external references active; logic '1' = one of the four preset references is active in accordance with the table below.

Preset reference, lsb and ***Preset reference, msb*** enables a choice of one of the four preset references, in accordance with the table below.

	Preset ref. msb	Preset ref. lsb
Preset ref. 1	0	0
Preset ref. 2	0	1
Preset ref. 3	1	0
Preset ref. 4	1	1

Freeze reference - freezes the actual reference. The frozen reference is now the point of enable/condition for *Speed up* and *Speed down* to be used.
If speed up/down is used, the speed change always follows ramp 2 (parameters 209/210) in the range 0 - Ref_{MAX}.

Freeze output - freezes the actual motor frequency (Hz). The frozen motor frequency is now the point of enable/condition for *Speed up* and *Speed down* to be used.
If speed up/down is used, the speed change always follows ramp 2 (parameters 209/210) in the range 0 - $f_{M,N}$.

NB!:
If *Freeze output* is active, the VLT frequency converter cannot be stopped via terminals 18 and 19, but only via terminal 27 (to be programmed for *Coasting stop, inverse* [0] or *Reset and coasting stop, inverse* [1]).

After ***Freeze output***, the PID integrators are reset.

Speed up and ***Speed down*** are selected if digital control of the up/down speed is desired (motor potentiometer). This function is only active if *Freeze reference* or *Freeze output* has been selected.
As long as there is a logic '1' on the terminal selected for speed up, the reference or the output frequency will increase.

As long as there is a logic '1' on the terminal selected for speed down, the reference or the output frequency will be reduced.
Pulses (logic '1' minimum high for 3 ms and a minimum pause of 3 ms) will lead to a change of speed of 0.1% (reference) or 0.1 Hz (output frequency).

Example:

	Terminal (16)	(17)	Freeze ref./ Freeze output
No speed change	0	0	1
Speed down	0	1	1
Speed up	1	0	1
Speed down	1	1	1

The speed reference frozen via the control panel can be changed even if the VLT frequency converter has stopped. The frozen reference will be remembered in case of a mains drop-out.

Selection of Setup, lsb and ***Selection of Setup, msb*** enables a choice of one of the four Setups; however, this presupposes that parameter 004 has been set at *Multi Setup*.

Selection of Setup, msb/Speed up and ***Selection of Setup, lsb/Speed down*** - together with the use of *Freeze reference* or *Freeze output* - enable up/down speed change.

The selection of Setup occurs in accordance with the below verification table:

	Selection of Setup (33)msb	(32)lsb	Freeze ref/ Freeze output
Setup 1	0	0	0
Setup 2	0	1	0
Setup 3	1	0	0
Setup 4	1	1	0
No speed change	0	0	1
Speed down	0	1	1
Speed up	1	0	1
Speed down	1	1	1

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

Catch-up/Slow-down is selected if the reference value is to be increased or reduced by a programmable percentage value set in parameter 219.

	Slow-down	Catch-up
Unchanged speed	0	0
Reduced by %-value	1	0
Increased by %-value	0	1
Reduced by %-value	1	1

Ramp 2 is selected if a change between ramp 1 (parameters 207-208) and ramp 2 (209-210) is desired. Logic '0' leads to ramp 1, while logic '1' leads to ramp 2.

Mains failure inverted is to be selected if parameter 407 *Mains failure* and/or parameter 408 *Quick discharge* is to be activated. Mains failure inverted is active in the logical '0' situation.
See also Mains fault/quick discharge on page 72, if required.

NB!
The VLT frequency converter can be totally damaged by repeating the Quick discharge function on the digital input with mains voltage connected to the system.

Pulse reference is selected if a pulse sequence (frequency) of 0 Hz is used, corresponding to Ref_{MIN}, parameter 204. The frequency is set in parameter 327, corresponding to Ref_{MAX}.

Pulse feedback is selected if a pulse sequence (frequency) is selected as a feedback signal.

Select Encoder feedback, input A, if encoder feedback is to be used after choosing *Speed control, closed loop* or *Torque control, speed feedback* in parameter 100. Set Pulse/rpm in parameter 329.

Select Encoder feedback, input B, if encoder feedback is to be used with a 90° pulse to register the direction of rotation.

---

301 Terminal 17, input
(DIGITAL INPUT 17)

Value:
See parameter 300.

Function:
This parameter allows a choice between the different options on terminal 17. The functions are shown in the table on page 102.
Maximum frequency for terminal 17 is 5 kHz.

Description of choice:
See parameter 300.

---

302 Terminal 18 Start, input
(DIGITAL INPUT 18)

Value:
See parameter 300.

Function:
This parameter allows a choice between the different options on terminal 18. The enabled functions are shown in the table on page 102.
Maximum frequency for terminal 18 is 5 kHz.

Description of choice:
See parameter 300.

303 Terminal 19, input (DIGITAL INPUT 19)

Value:
See parameter 300.

Function:
This parameter allows a choice between the different options on terminal 19. The functions are shown in the table on page 102.
Maximum frequency for terminal 19 is 5 kHz.

Description of choice:
See parameter 300.

---

304 Terminal 27, input (DIGITAL INPUT 27)

Value:
See parameter 300.

Function:
This parameter allows a choice between the different options on terminal 27.
Functions are shown in the table on page 102.
Maximum frequency for terminal 27 is 5 kHz.

Description of choice:
See parameter 300.

---

305 Terminal 29, input (DIGITAL INPUT 29)

Value:
See parameter 300.

Function:
This parameter allows a choice between the different options on terminal 29. The functions are shown in the table on page 102.
Maximum frequency for terminal 29 is 65 kHz.

Description of choice:
See parameter 300.

---

306 Terminal 32, input (DIGITAL INPUT 32)

Value:
See parameter 300.

Function:
This parameter allows a choice between the different options on terminal 32. The functions are shown in the table on page 102.
Maximum frequency for terminal 32 is 65 kHz.

Description of choice:
See parameter 300.

---

307 Terminal 33, input (DIGITAL INPUT 33)

Value:
See parameter 300.

Function:
This parameter allows a choice between the different options on terminal 33. The functions are shown in the table on page 102.
Maximum frequency for terminal 33 is 65 kHz.

Description of choice:
See parameter 300.

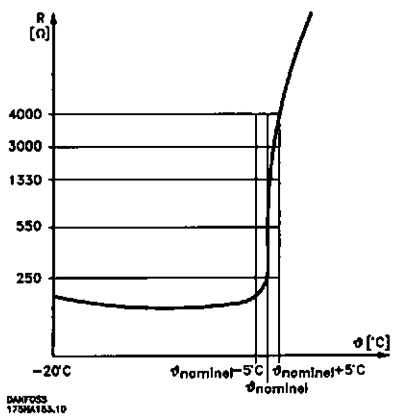
★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

308 Terminal 53, analogue input voltage (AI [V] 53 FUNCT.)

Analogue inputs	terminal no.	53(voltage)	54(voltage)	60(current)
	parameter	308	311	314
Value:				
No operation	(NO OPERATION)	[0]	[0] (★)	[0]
Reference	(REFERENCE)	[1] (★)	[1]	[1] (★)
Feedback signal	(FEEDBACK)	[2]		[2]
Torque limit	(TORQUE LIMIT CTRL)	[3]	[2]	[3]
Thermistor	(THERMISTOR INPUT)	[4]	[3]	
Relative reference	(RELATIVE REFERENCE)		[4]	[4]
Max. torque frequency	(MAX. TORQUE FREQ.)		[5]	

Function:
This parameter allows a choice of the desired option on terminal 53.
Scaling of the input signal is effected in parameters 309 and 310.

Description of choice:
See drawing on page 61.
No operation. Is selected if the VLT frequency converter is not to react to signals connected to the terminal.
Reference. Is selected to enable change of reference by means of an analogue reference signal.
If other inputs are connected, these are added up, taking account of their signs.
Feedback-signal. Is selected if closed loop control with an analogue signal is used.
Torque limit. Is used if the torque limit value set in parameter 221 is to be changed by means of an analogue signal.
Thermistor. Is selected if a thermistor integrated in the motor is to be able to stop the VLT frequency converter in case of motor overtemperature. The cut-out value is > 3 kohm.



If a motor features a KLIXON thermal switch instead, this can also be connected to the input. If motors run in parallel, the thermistors/thermal switches can be connected in series (total resistance < 3 kohm).
Parameter 128 must be programmed for *Thermistor warning* [1] or *Thermistor trip* [2].
Relative reference is selected if a relative adjustment of the reference sum is required.
This function is only active if *Relative* has been selected (parameter 214). The relative reference on terminal 54/60 is a percentage of the full range of the terminal in question. This will be added to the sum of the other references. If several relative references have been selected (preset reference 215-218, 311 and 314), these will be added first, following which this sum will be added to the sum of the active references.

NB!
If *Reference* or *Feedback* signal has been selected on more than one terminal, these signals will be added with signs.

Max. torque frequency. This is only used in *Torque control, open loop* (parameter 100) for limiting the output frequency. Selected if the max. output frequency is to be controlled by an analogue input signal. The frequency range goes from *Output frequency low limit* (parameter 201) to *Output frequency high limit* (parameter 202).

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

309 Terminal 53, min. scaling
(AI 53 SCALE LOW)

Value:

0.0 - 10.0 Volt ★ 0.0 Volt

Function:

This parameter is used for setting the signal value that corresponds to the minimum reference value set in parameter 204.

Description of choice:

Set the desired voltage value.
See drawing on page 60.

310 Terminal 53, max. scaling
(AI 53 SCALE HIGH)

Value:

0.0 - 10.0 Volt ★ 10.0 Volt

Function:

This parameter is used for setting the signal value that corresponds to the maximum reference value set in parameter 205.

Description of choice:

Set the desired voltage value.
See drawing on page 60.

311 Terminal 54, analogue input voltage
(AI [V] 54 FUNCT.)

Value:

See description of parameter 308.

★ No operation

Function:

This parameter chooses between the different functions available for the input, terminal 54.
Scaling of the input signal is effected in parameters 312 and 313.

Description of choice:

See description of parameter 308.

312 Terminal 54, min. scaling
(AI 54 SCALE LOW)

Value:

0.0 - 10.0 Volt ★ 0.0 Volt

Function:

This parameter is used for setting the signal value that corresponds to the minimum reference value set in parameter 204.

Description of choice:

Set the desired voltage value.
See drawing on page 60.

313 Terminal 54, max. scaling
(AI 54 SCALE HIGH)

Value:

0.0 - 10.0 Volt ★ 10.0 Volt

Function:

This parameter is used for setting the signal value that corresponds to the maximum reference value set in parameter 205.

Description of choice:

Set the desired voltage value.
See drawing on page 60.

314 Terminal 60, analogue input current
(AI [mA] 60 FUNCT.)

Value:

See description of parameter 308.

★ Reference

Function:

This parameter allows a choice between the different functions available for the input, terminal 60.
Scaling of the input signal is effected in parameters 315 and 316.

Description of choice:

See description of parameter 308.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

315 Terminal 60, min. scaling (AI 60 SCALE LOW)

Value:

0.0 - 20.0 mA ★ 0.0 mA

Function:

This parameter determines the value of the reference signal that is to correspond to the minimum reference value set in parameter 204.
If the Time-out function of parameter 317 is to be used, the value must be set at > 2 mA.

Description of choice:

Set the desired current value.
See drawing on page 60.

316 Terminal 60, max. scaling (AI 60 SCALE HIGH)

Value:

0.0 - 20.0 mA ★ 20.0 mA

Function:

This parameter sets the value of the reference signal that is to correspond to the maximum reference value set in parameter 205.

Description of choice:

Set the desired current value.
See drawing on page 60.

317 Time out (LIVE ZERO TIME O)

Value:

0 - 99 sec. ★ 10 sec.

Function:

If the signal value of the reference signal connected to the input, terminal 60, falls below 50% of the value set in parameter 315 for a period longer than the time set in parameter 317, the function selected in parameter 318 will be activated.

Description of choice:

Set the desired time.

318 Function after time out (LIVE ZERO FUNCT.)

Value:

★ Off (OFF)	[0]
Freeze output frequency (FREEZE OUTPUT FREQ.)	[1]
Stop (STOP)	[2]
Jog (JOGGING)	[3]
Max. speed (MAX SPEED)	[4]
Stop and trip (STOP AND TRIP)	[5]

Function:

This parameter allows a choice of the function to be activated if the input signal on terminal 60 drops below 2 mA, provided parameter 315 has been set higher than 2 mA and that the preset time for time-out (parameter 317) has been exceeded.

If more time-outs occur at the same time the VLT frequency converter will give the following priority to the time-out function:

1. Parameter 318 *Function after time out*
2. Parameter 346 *Function after encoder loss*
3. Parameter 514 *Bus time interval function*

Description of choice:

The output frequency of the VLT frequency converter can be:

- frozen at the present value
- overruled to stop
- overruled to jog frequency
- overruled to max. frequency
- overruled to stop with subsequent trip.

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

319 Terminal 42 output, (AO 42 FUNCT.)

Outputs	terminal no.	42	45	01(relay)	04 (relay)
	parameter	319	321	323	326
Value:					
No function	(NO OPERATION)	[0]	[0]	[0]	[0]
Control ready	(CONTROL READY)	[1]	[1]	[1]	[1]
Ready signal	(UNIT READY)	[2]	[2]	[2]	[2]
Ready - remote control	(UNIT READY/REM CTRL)	[3]	[3]	[3]	[3] (★)
Enable, no warning	(ENABLE/NO WARNING)	[4]	[4]	[4]	[4]
Running	(VLT RUNNING)	[5]	[5]	[5]	[5]
Running, no warning	(RUNNING/NO WARNING)	[6]	[6]	[6]	[6]
Running within range, no warning	(RUN IN RANGE/NO WARN)	[7]	[7]	[7]	[7]
Running at reference value, no warning	(RUN ON REF/NO WARN)	[8]	[8]	[8]	[8]
Fault	(ALARM)	[9]	[9]	[9]	[9]
Fault or warning	(ALARM OR WARNING)	[10]	[10]	[10]	[10]
Torque limit	(TORQUE LIMIT)	[11]	[11]	[11]	[11]
Out of current range	(OUT OF CURRENT RANGE)	[12]	[12]	[12]	[12]
Over I low	(ABOVE CURRENT,LOW)	[13]	[13]	[13]	[13]
Under I high	(BELOW CURRENT,HIGH)	[14]	[14]	[14]	[14]
Out of frequency range	(OUT OF FREQ RANGE)	[15]	[15]	[15]	[15]
Over f low	(ABOVE FREQUENCY LOW)	[16]	[16]	[16]	[16]
Under f high	(BELOW FREQUENCY HIGH)	[17]	[17]	[17]	[17]
Out of feedback range	(OUT OF FDBK RANGE)	[18]	[18]	[18]	[18]
Over feedback low	(ABOVE FDBK, LOW)	[19]	[19]	[19]	[19]
Under feedback high	(BELOW FDBK, HIGH)	[20]	[20]	[20]	[20]
Thermal warning	(THERMAL WARNING)	[21]	[21]	[21]	[21]
Ready - no thermal warning	(READY &NOTHERM WARN)	[22]	[22]	[22] (★)	[22]
Ready - remote control - no therm. warn.	(REM RDY&NO THERMWAR)	[23]	[23]	[23]	[23]
Ready - mains voltage within range	(RDY NO OVER/UNDERVOL)	[24]	[24]	[24]	[24]
Reversing	(REVERSE)	[25]	[25]	[25]	[25]
Bus ok	(BUS OK)	[26]	[26]	[26]	[26]
Torque limit and stop	(TORQUE LIMIT AND STOP)	[27]	[27]	[27]	[27]
Brake, no brake warning	()	[28]	[28]	[28]	[28]
Brake ready, no fault	(BRAKE RDY (NO FAULT))	[29]	[29]	[29]	[29]
Brake fault	(BRAKE FAULT (IGBT))	[30]	[30]	[30]	[30]
Relay 123	(RELAY 123)	[31]	[31]	[31]	[31]
Mechanical brake control	(MECH. BRAKE CONTROL)			[32]	[32]
Control word bit 11/12	(CTRL WORD BIT 11/12)			[33]	[33]
Extended mechanical brake control	(EXT MECH. BRAKE)			[34]	[34]

Continued..

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

Outputs	terminal no.	42	45	01(relay)	04 (relay)
	parameter	319	321	323	326
Value (cont.)					
0-100 Hz ⇒ 0-20 mA	(0-100 Hz = 0-20 mA)	[36]	[36]		
0-100 Hz ⇒ 4-20 mA	(0-100 Hz = 4-20 mA)	[37]	[37]		
0-100 Hz ⇒ 0-32000 p	(0-100 Hz = 0-32000P)	[38]	[38]		
0 - f_{MAX} ⇒ 0-20 mA	(0-FMAX = 0-20 mA)	[39]	[39] ★		
0 - f_{MAX} ⇒ 4-20 mA	(0-FMAX = 4-20 mA)	[40]	[40]		
0 - f_{MAX} ⇒ 0-32000 p	(0-FMAX = 0-32000P)	[41]	[41]		
Ref_{MIN} - Ref_{MAX} ⇒ 0-20 mA	(REF MIN-MAX = 0-20 mA)	[42]	[42]		
Ref_{MIN} - Ref_{MAX} ⇒ 4-20 mA	(REF MIN-MAX = 4-20 mA)	[43]	[43]		
Ref_{MIN} - Ref_{MAX} ⇒ 0-32000 p	(REF MIN-MAX = 0-32000P)	[44]	[44]		
FB_{MIN} - FB_{MAX} ⇒ 0-20 mA	(FB MIN-MAX = 0-20 mA)	[45]	[45]		
FB_{MIN} - FB_{MAX} ⇒ 4-20 mA	(FB MIN-MAX = 4-20 mA)	[46]	[46]		
FB_{MIN} - FB_{MAX} ⇒ 0-32000 p	(FB MIN-MAX = 0-32000P)	[47]	[47]		
0 - I_{MAX} ⇒ 0-20 mA	(0-IMAX = 0-20 mA)	[48] ★	[48]		
0 - I_{MAX} ⇒ 4-20 mA	(0-IMAX = 4-20 mA)	[49]	[49]		
0 - I_{MAX} ⇒ 0-32000 p	(0-IMAX = 0-32000P)	[50]	[50]		
0 - T_{LIM} ⇒ 0-20 mA	(0-TLIM = 0-20 mA)	[51]	[51]		
0 - T_{LIM} ⇒ 4-20 mA	(0-TLIM = 4-20 mA)	[52]	[52]		
0 - T_{LIM} ⇒ 0-32000 p	(0-TLIM = 0-32000P)	[53]	[53]		
0 - T_{NOM} ⇒ 0-20 mA	(0-TNOM = 0-20 mA)	[54]	[54]		
0 - T_{NOM} ⇒ 4-20 mA	(0-TNOM = 4-20 mA)	[55]	[55]		
0 - T_{NOM} ⇒ 0-32000 p	(0-TNOM = 0-32000P)	[56]	[56]		
0 - P_{NOM} ⇒ 0-20 mA	(0-PNOM = 0-20 mA)	[57]	[57]		
0 - P_{NOM} ⇒ 4-20 mA	(0-PNOM = 4-20 mA)	[58]	[58]		
0 - P_{NOM} ⇒ 0-32000 p	(0-PNOM = 0-32000P)	[59]	[59]		

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

Function:
This output can act both as a digital and an analogue output. If used as a digital output (data value [0]-[59]), a 24 V DC signal is transmitted; if used as an analogue output either a 0-20 mA signal, a 4-20 mA signal or a pulse output is transmitted.

Description of choice:
Control ready, the VLT frequency converter is ready for use; the control card receives supply voltage.

Ready signal, the VLT frequency converter control card is receiving a supply signal and the frequency converter is ready for operation.

Ready, remote control, the VLT frequency converter control card is receiving a supply signal and parameter 002 has been set to *remote control.*

Enable, no warning, the VLT frequency converter is ready for use; no start or stop command has been given (start/disable). No warning.

Running, a start command has been given.

Running, no warning, the output frequency is higher than the frequency set in parameter 123. A start command has been given. No warning.

Runs in range, no warning, runs within the programmed current/frequency ranges set in parameters 223-226.

Runs on reference, no warning, speed according to reference. No warning.

Fault, output is activated by alarm.

Fault or warning, the output is activated by alarm or warning.

Torque limit, the torque limit in parameter 221 has been exceeded.

Out of current range, the motor current is outside the range programmed in parameters 223 and 224.

Over I low, the motor current is higher than set in parameter 223.
Under I high, the motor current is lower than set in parameter 224.

Out of frequency range, the output frequency is outside the frequency range programmed in parameters 225 and 226.

Over f low, the output frequency is higher than the value set in parameter 225.

Under f high, the output frequency is lower than the value set in parameter 226.

Out of feedback range, the feedback signal is outside the range programmed in parameters 227 and 228.

Over feedback low, the feedback signal is higher than the value set in parameter 227.

Under feedback high, the feedback signal is lower that the value set in parameter 228.

Thermal warning, above the temperature limit in either the motor, the VLT frequency converter, the brake resistor or the thermistor.

Ready - no thermal warning, the VLT frequency converter is ready for use, the control card receives supply voltage and there are no control signals on the inputs. No over-temperature.

Ready - remote control - no thermal warning, the VLT frequency converter is ready for use and set at remote control, the control card receives supply voltage. No over-temperature.

Ready - mains voltage within range, the VLT frequency converter is ready for use, the control card receives supply voltage and there are no control signals on the inputs. The mains voltage is within the permitted voltage range (see chapter 8).

Reversing. Logic '1' = relay activated, 24 V DC on the output when the direction of rotation of the motor is clockwise. Logic '0' = relay not activated, no signal on the output, when the direction of rotation of the motor is anti-clockwise.

Bus-ok, active communication (no time-out) via the serial communication port.

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

Torque limit and stop is used in connection with coasting stop (terminal 27), where it is possible to give a stop even if the VLT frequency converter is at the torque limit. The signal is inverted, i.e. a logic '0' when the VLT frequency converter has received a stop signal and is at the torque limit.

Brake, no brake warning, the brake is active and there are no warnings.

Brake ready, no fault, the brake is ready for operation and there are no faults.

Brake fault, the output is a logical "1" when the brake IGBT has short-circuited. This function is used to protect the VLT frequency converter if there is a fault on the brake modules. To avoid a potential fire in the brake resistor, the output/relay can be used to cut out the supply voltage from the VLT frequency converter.

Relay 123, if Profidrive [0] has been selected in parameter 512, the relay is activated. If either OFF1, OFF2 or OFF3 (bit in the control word) is logic '1'.

Mechanical brake control, enables control of an external mechanical brake, see description *Control of mechanical brake.*

Control word bits 11/12, relay controlled via bits 11/12 in serial control word. Bit 11 relates to relay 01 and bit 12 to relay 04. If parameter 514 *Bus time interval function* is active, relays 01 and 04 will be voltage-free.
See section on *Serial communication* in the Design Guide.

Extended mechanical brake control, enables control of an external mechanical brake, see description *Control of mechanical brake.*

0-100 Hz $\Rightarrow$ *0-20 mA* and
0-100 Hz $\Rightarrow$ *4-20 mA* and
0-100 Hz $\Rightarrow$ *0-32000 p,* a pulse output signal proportional to the output frequency in the range 0-100 Hz.

$0\text{-}f_{MAX} \Rightarrow$ *0-20 mA* and
$0\text{-}f_{MAX} \Rightarrow$ *4-20 mA* and
$0\text{-}f_{MAX} \Rightarrow$ *0-32000 p,* an output signal proportional to the output frequency range in the range 0 - f_{MAX} (parameter 202).

Ref_{MIN} - $Ref_{MAX} \Rightarrow$ *0-20 mA* and
Ref_{MIN} - $Ref_{MAX} \Rightarrow$ *4-20 mA* and
Ref_{MIN} - $Ref_{MAX} \Rightarrow$ *0-32000 p,* an output signal proportional to the reference value in the interval Ref_{MIN} - Ref_{MAX} (parameters 204/205) is obtained.

FB_{MIN}-$FB_{MAX} \Rightarrow$ *0-20 mA* and
FB_{MIN}-$FB_{MAX} \Rightarrow$ *4-20 mA* and
FB_{MIN}-$FB_{MAX} \Rightarrow$ *0-32000 p,* an output signal proportional to the feedback value in the interval FB_{MIN}-FB_{MAX} (parameters 414/415) is obtained.

0 - $I_{VLT,MAX} \Rightarrow$ *0-20 mA* or
0 - $I_{VLT,MAX} \Rightarrow$ *4-20 mA* and
0 - $I_{VLT,MAX} \Rightarrow$ *0-32000 p,* an output signal proportional to the output current in the interval 0 - $I_{VLT,MAX}$ is obtained. $I_{VLT,MAX}$ depends on the settings in parameter 101 and 103 and can be seen from the *Technical data* ($I_{VLT,MAX}$ (60 s)).

0 - $T_{LIM} \Rightarrow$ *0-20 mA* and
0 - $T_{LIM} \Rightarrow$ *4-20 mA* and
0 - $T_{LIM} \Rightarrow$ *0-32000 p,* an output proportional to the output torque in the interval 0 - T_{LIM} (parameter 221) is obtained. 20 mA corresponds to the value set in parameter 221.

0 - $T_{NOM} \Rightarrow$ *0-20 mA* and
0 - $T_{NOM} \Rightarrow$ *4-20 mA* and
0 - $T_{NOM} \Rightarrow$ *0-32000 p,* an output signal proportional to the output torque of the motor. 20 mA corresponds to the rated torque for the motor.

0 - $P_{NOM} \Rightarrow$ *0-20 mA* and
0 - $P_{NOM} \Rightarrow$ *4-20 mA* and
0 - $P_{NOM} \Rightarrow$ *0-32000 p,* 0 - $P_{NOM} \Rightarrow$ *0-32000 p,* an output signal proportional to the rated motor output is obtained. 20 mA corresponds to the value set in parameter 102.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

320 Terminal 42, output, pulse scaling
(AO 42 PULS SCALE)

Value:

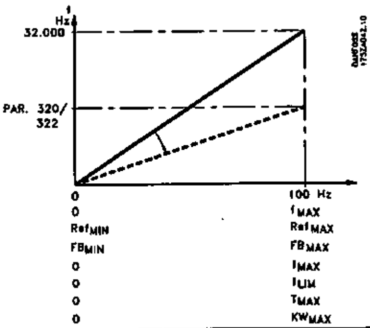
1 - 32000 Hz ★ 5000 Hz

Function:

This parameter allows scaling of the pulse output signal.

Description of choice:

Set the desired value.



321 Terminal 45, output
(AO 45 FUNCT.)

Value:

See description for parameter 319.

Function:

This output can function both as a digital and an analogue output. Used as a digital output (data value [0]-[35]) it generates a 24 V (max. 40 mA) signal; on the analogue outputs (data value [36]-[59]) there is a choice of 0-20 mA, 4-20 mA or a scalable pulse output.

Description of choice:

See description for parameter 319.

322 Terminal 45, output, pulse scaling
(AO 45 PULS SCALE)

Value:

1 - 32000 Hz ★ 5000 Hz

Function:

This parameter allows scaling of the pulse output signal.

Description of choice:

Set the desired value.

323 Relay 01, output
(RELAY 1-3 FUNCT.)

Value:

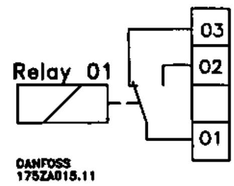
See description of parameter 319.

Function:

This output activates a relay switch.
Relay switch 01 can be used for bringing status and warnings. The relay is activated when the conditions for the relevant data values have been fulfilled.
Activation/deactivation can be delayed in parameter 324/325.

Description of choice:

See description of parameter 319.
Connections - see the below drawing.



324 Relay 01, ON delay
(RELAY 1-3 ON DL)

Value:

0.00 - 10.00 min. ★ 0.00 sec.

Function:

This parameter allows a delay of the cut-in time of relay 01 (terminals 01-02).

Description of choice:

Enter the desired value (can be set at intervals of 0.02 sec.).

325 Relay 01, OFF delay
(RELAY 1-3 OFF DL)

Value:

0.00 - 10.00 min. ★ 0.00 sec.

Function:

This parameter makes it possible to delay the cut-out time of relay 01 (terminals 01-03).

Description of choice:

Enter the desired value (can be set at intervals of 0.02 sec.).

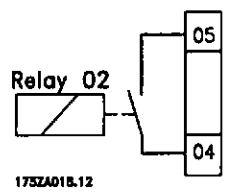
★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

326 Relay 04, output
(RELAY 4-5 FUNCT.)

Value:
See description of parameter 319.

Function:
This output activates a relay switch.
Relay switch 04 can be used for bringing status and warnings. The relay is activated when the conditions for the relevant data values have been fulfilled.

Description of choice:
See description of parameter 319.
Connections - see the below drawing.



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327 Pulse reference, max. frequency
(PULSE REF MAX)

Value:

100 - 65000 Hz at terminal 29	★ 5000 Hz
100 - 5000 Hz at terminal 17	

Function:
In this parameter, the signal value is set that corresponds to the maximum reference value set in parameter 205.

Description of choice:
Set the desired pulse reference.

---

328 Pulse feedback, max. frequency
(PULSE FEEDB MAX)

Value:

100 - 65000 Hz at terminal 33	★ 25000 Hz

Function:
This is where to set the feedback value that is to correspond to the maximum feed back value.

Description of choice:
Set the desired feedback value.

---

329 Encoder feedback pulse/rev.
(ENCODER PULSES)

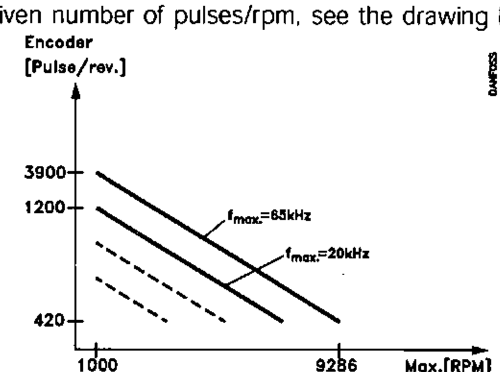
Value:

	128 pulses /rev. (128)	[128]
	256 pulses /rev. (256)	[256]
	512 pulses /rev. (512)	[512]
★	1024 pulses /rev. (1024)	[1024]
	2048 pulses /rev. (2048)	[2048]
	4096 pulses /rev. (4096)	[4096]

This value can also be set between 1-4096 pulses/rev.

Function:
This is where to set the encoder pulses per revolution that correspond to the motor rpm.
This parameter is only available in *Speed control, closed loop* and *in Torque control, speed feedback* (parameter 100).

Description of choice:
Read the correct value from the encoder.
Pay attention to the speed limitation (rpm) for a given number of pulses/rpm, see the drawing below:



The encoder used is to be of the Open Collector PNP 0/24 V DC type (max. 20 kHz) or a Push-Pull circuit 0/24 V DC (max. 65 kHz).

---

330 Freeze reference/output function
(FREEZE REF/OUTP.)

Settings:

★	No operation (NO OPERATION)	[0]
	Freeze reference (FREEZE REFERENCE)	[1]
	Freeze output (FREEZE OUTPUT)	[2]

Function:
In this parameter it is possible to freeze either the reference or the output.

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

Description of choice:
Freeze reference [1] freezes the actual reference. The frozen reference is now the basis for *Speed up* and *Speed down*.
Freeze output [2] freezes the actual motor frequency (Hz). The frozen frequency is now the basis for *Speed up* and *Speed down*.

NB!:
If *Freeze output* is active, the frequency converter cannot be stopped via terminals 18 and 19, but only via terminal 27 (to be programmed for *Coasting stop, inverse* [0] or *Reset and coasting stop, inverse* [1]).

After *Freeze output*, the PID integrators are reset.

---

345 Encoder loss timeout
(ENC LOSS TIMEOUT)

Value:
0 - 60 sec. ★ 0 sec.

Function:
If the encoder signal is interrupted from terminal 32 or 33 the function selected in parameter 346 will be activated.
If the encoder feedback signal is different from the output frequency +/- 3 x nominal motor slip the encoder loss function will be activated.
An encoder loss timeout can occur even if the encoder works all right. Check the motor parameter in group 100 if no error can be found on the encoder.
The Encoder loss function is only active in *Speed control, closed loop* [1] and *Torque control, speed feedback* [5], see parameter 100 *Configuration*.

Description of choice:
Set the required time.

---

346 Encoder loss function
(ENC. LOSS FUNC)

Value:

★	Off (OFF)	[0]
	Freeze output frequency (FREEZE OUTPUT FREQ.)	[1]
	Jog (JOGGING)	[3]
	Max. speed (MAX SPEED)	[4]
	Stop and trip (STOP AND TRIP)	[5]
	Select Setup 4 (SELECT SETUP 4)	[7]

Function:
In this parameter the function can be activated if the encoder signal is disconnected from terminal 32 or 33.

If more time-outs occur at the same time the VLT frequency converter will give the following priority to the time-out function:
1. Parameter 318 *Function after time out*
2. Parameter 346 *Function after encoder loss*
3. Parameter 514 *Bus time interval function.*

Description of choice:
The output frequency of the VLT frequency converter can be:
- frozen at the present value
- overruled to jog frequency
- overruled to max. frequency
- overruled to stop with subsequent trip.
- overruled to Setup 4

---

400 Brake function/overvoltage control
(BRAKE FUNCTION)

Value:

★	Off (OFF)	[0]
	Resistor brake (RESISTOR)	[1]
	Overvoltage control (OVERVOLTAGE CONTROL)	[2]
	Overvoltage control and stop (OVERVOLT CTRL. & STOP)	[3]

Function:
The factory setting is *Off* [0] for VLT 5001-5052 380-500 V and 5001-5027 200-240 V. For VLT 5060-5250 380-500 V and 5032-5052 200-240 V the factory setting is *Overvoltage control* [2].
Resistor brake [1] is used for programming the VLT frequency converter for connection of a brake resistor.
The connection of a brake resistor allows a higher intermediate circuit voltage during braking (generating operation).
The *Resistor brake* [1] function is only active in units with an integral dynamic brake (SB and EB units).

Overvoltage control (excl. brake resistor) can be selected as an alternative. This function is active for all units (ST, SB and EB).

The function ensures that a trip can be avoided if the intermediate circuit voltage increases. This is done by increasing the output frequency so as to use the energy from the intermediate circuit. This is a very useful function, e.g. if the ramp-down time is too short, since tripping of the VLT frequency converter is avoided. In this situation, the ramp-down time is extended.

NB!
Please note that the ramp-down time is extended in the case of overvoltage control, which in some applications may not be appropriate.

Description of choice:
Select *Resistor brake* [1] if a brake resistor is part of the system.
Select *Overvoltage control* [2] if the overvoltage control function is required in all cases - also if stop is pressed. The VLT frequency converter will not stop in the case of a stop command when the overvoltage control is active.
Select *Overvoltage control and stop* [3] if the overvoltage control function is not required during ramp-down after stop has been pressed.

Warning: If *Overvoltage control* [2] is used at the same time as the supply voltage to the VLT frequency converter is close to or above the maximum limit, there is a risk that the motor frequency will increase and that, consequently, the VLT frequency converter will not stop the motor when stop is pressed. If the supply voltage is higher than 264 V for 200-240 V units or higher than 550 V for 380-500 V units, *Overvoltage control and stop* [3] should be selected so that the motor can be stopped.

401 Brake resistor, ohm
(BRAKE RES. (OHM))

Value:

Depends on the unit ★ Depends on the unit

Function:
This parameter gives the ohmic value of the brake resistor. This value is used for monitoring the power to the brake resistor provided this function has been selected in parameter 403.

Description of choice:
Set the present resistor value.

402 Brake power limit, kW
(BR.POWER. LIM.KW)

Value:

Depends on the unit ★ Depends on the unit

Function:
This parameter gives the monitoring limit of the power transmitted to the brake resistor.

Description of choice:
The monitoring limit is determined as a product of the maximum duty cycle (120 sec.) that will occur and the maximum power of the brake resistor at that duty cycle according to the following formula.

For 200 - 240 V units: $P = \dfrac{397^2 \times t}{R \times 120}$

For 380 - 500 V units: $P = \dfrac{822^2 \times t}{R \times 120}$

403 Power monitoring
(POWER MONITORING)

Value:

Off (OFF)	[0]
★ Warning (WARNING)	[1]
Trip (TRIP)	[2]

Function:
This parameter allows monitoring of the power transmitted to the brake resistor. The power is calculated on the basis of the resistor ohm value (parameter 401), the intermediate circuit voltage and the resistor running time. If the power transmitted over 120 sec. exceeds 100% of the monitoring limit (parameter 402) and *Warning* [1] has been selected, a warning will come up on the display. The warning will disappear if the power goes below 80%. If the calculated power exceeds 100% of the monitoring limit and *Trip* [2] has been selected in parameter 403 *Power monitoring*, the VLT frequency converter will cut out while giving an alarm. If power monitoring has been selected as *Off* [0] or *Warning* [1], the brake function will remain active, even if the monitoring limit has been exceeded.This may lead to thermal overload of the resistor. It is also possible to have a warning via the relay/digital outputs.
The typical measuring accuracy of the power monitoring depends on the accuracy of the resistor ohmic value (better than ± 20%).

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

NB!
The power dissipation during quick discharge does not form part of the power monitoring function.

Description of choice:
Select whether this function is to be active (*Warning/Alarm*) or inactive (*Off*).

404 Brake check (BRAKE TEST)

Value:

★	Off (OFF)	[0]
	Warning (WARNING)	[1]
	Trip (TRIP)	[2]

Function:
In this parameter a testing and monitoring function can be integrated which will give a warning or an alarm. On power-up it will be tested whether the brake resistor is disconnected. The test of whether the brake resistor is disconnected is carried out during braking, while the test of whether the IGBT is disconnected is carried out when there is no braking. A warning or trip disconnects the brake function.
The testing sequence is as follows:
1. If the intermediate circuit voltage is higher than the brake starting voltage, discontinue the brake check.
2. If the intermediate circuit voltage is unstable, discontinue the brake check.
3. Carry out a brake test.
4. If the intermediate circuit voltage is lower than the starting voltage, discontinue the brake check.
5. If the intermediate circuit voltage is unstable, discontinue the brake check.
6. If the braking power is higher than 100%, discontinue the brake check.
7. If the intermediate circuit voltage is higher than the intermediate circuit voltage -2% before the brake test, discontinue the brake check and give off a warning or alarm.
8. Brake check OK.

Description of choice:
If *Off* [0] is selected, this function will still monitor whether the brake resistor and the brake IGBT short-circuit during operation, in which case it will give off a warning.
If *Warning* [1] is selected, the brake resistor and brake IGBT will be monitored with respect to short-circuiting. In addition, on power-up it will be checked whether the brake resistor has been disconnected.

NB!:
A warning in connection with *Off* [0] or *Warning* [1] can only be removed by disconnecting the mains supply and turning it back on, provided the fault has been corrected. Please note that in connection with *Off* [0] or *Warning* [1] the VLT frequency converter will continue even if a fault has been found.

In the case of *Trip* [2], the VLT frequency converter will cut out while giving an alarm (trip locked) if the brake resistor has short-circuited or been disconnected or if the brake IGBT has short-circuited.

405 Reset function (RESET MODE)

Value:

★	Manual reset (MANUAL RESET)	[0]
	Automatic reset x 1 (AUTOMATIC X 1)	[1]
	Automatic reset x 2 (AUTOMATIC X 2)	[2]
	Automatic reset x 3 (AUTOMATIC X 3)	[3]
	Automatic reset x 4 (AUTOMATIC X 4)	[4]
	Automatic reset x 5 (AUTOMATIC X 5)	[5]
	Automatic reset x 6 (AUTOMATIC X 6)	[6]
	Automatic reset x 7 (AUTOMATIC X 7)	[7]
	Automatic reset x 8 (AUTOMATIC X 8)	[8]
	Automatic reset x 9 (AUTOMATIC X 9)	[9]
	Automatic reset x 10 (AUTOMATIC X 10)	[10]

Function:
This parameter makes it possible to select the reset function desired after tripping.
After reset, the VLT frequency converter can be restarted.

Description of choice:
If *Manual reset* [0] is selected, reset must be effected via the [RESET] key or via the digital inputs.
If the VLT frequency converter is to carry out an automatic reset (1-10 times) after tripping, select data value [1]-[10].

NB!
The internal AUTOMATIC RESET counter is reset 10 minutes after the first AUTOMATIC RESET has occurred.

Warning: The motor may start without warning.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

406 Automatic restart time (AUT RESTART TIME)

Value:

0 - 10 sec. ★ 5 sec.

Function:

This parameter allows setting of the time from tripping until the automatic reset function begins.
It is assumed that automatic reset has been selected in parameter 405.

Description of choice:

Set the desired time.

407 Mains failure (MAINS FAILURE)

Value:

★	No function (NO FUNCTION)	[0]
	Controlled ramp-down (CONTROL RAMP DOWN)	[1]
	Controlled ramp-down and trip (CTRL. RAMP DOWN-TRIP)	[2]
	Coasting (COASTING)	[3]
	Kinetic back-up (KINETIC BACKUP)	[4]

Function:

Using the mains failure function, it is possible to ramp down the load to 0 Hz if the mains supply to the VLT frequency converter fails.
In parameter 450 *Mains voltage during mains fault*, the voltage limit must be set at which the *Mains fault* function is to be active.
This function can also be activated by selecting *Mains failure inverted* on a digital input.
When *Kinetic backup [4]* is selected, the ramp function in parameter 206-212 is deactivated.

Description of choice:

Select *No function* [0] if this function is not required. *If Controlled ramp-down* [1] is selected, the motor will ramp via the quick-stop ramp set in parameter 212.
If the supply voltage is re-established during ramp-down, the VLT frequency converter will start up again.
If *Controlled ramp-down* and *trip* [2] is selected, the motor will ramp via the quick-stop ramp set in parameter 212.
At 0 Hz the VLT frequency converter will trip (ALARM 36, mains failure). If the supply voltage is re-established during ramp-down, the VLT frequency converter will continue the quick-stop ramp and trip.
If *Coasting* [3] is selected, the VLT frequency converter will turn off the inverters and the motor will start coasting.
Parameter 445 *Flying motor* must be active, so that if the supply voltage is re-established, the VLT frequency converter will be able to catch the motor and start up again.
If Kinetic back-up [4] is selected, the VLT frequency converter will try to utilise the energy from the load to maintain a constant intermediate circuit voltage.
If the supply voltage is re-established, the VLT frequency converter will start up again.

408 Quick discharge (QUICK DISCHARGE)

Value:

★	Not possible (DISABLE)	[0]
	Possible (ENABLE)	[1]

Function:

The option is given of quickly discharging the intermediate circuit capacitors by means of an external resistor.

Description of choice:

This function is only active in extended units, since it requires the connection of external 24 V DC and a brake resistor or discharge resistor; otherwise, the data selection is limited to *Disable* [0].
This function can be activated by selecting a digital input signal for *Mains failure inverted*.
Select *Disable* if this function is not required.
Select *Enable* and connect 24 V DC external supply and a brake/discharge resistor.
See description on page 71.

409 Trip delay torque (TRIP DELAY TORQ.)

Value:

0 - 60 sec. (OFF) ★ OFF

Function:

When the VLT frequency converter registers that the output torque has increased up to the torque limits (parameters 221 and 222) in the set time, cutting out is effected when that time has passed.

Description of choice:

Select how long the VLT frequency converter is to be able to run at the torque limit before cutting out. 60 sec. = OFF means that the time is infinite; however, the thermal VLT monitoring will still be active.

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

410 Trip delay-inverter (INV.FAULT DELAY)

Value:

0 - 35 sec. ★ Depends on type of unit

Function:

When the VLT frequency converter registers an overvoltage in the set time, cutting out is effected after that time has passed.

Description of choice:

Select how long the VLT frequency converter is to be able to run at overvoltage before cutting out.

NB!
If this value is reduced from the factory setting, the unit may report a fault when the mains voltage is turned on.

411 Switching frequency (SWITCH FREQ.)

Value:

★ Depends on the unit output.

Function:

The set value determines the switching frequency of the inverter. If the switching frequency is changed, this may help to minimize possible acoustic noise from the motor.

NB!
The output frequency of the VLT frequency converter can never assume a value higher than 1/10 of the switching frequency.

Description of choice:

When the motor is running, the switching frequency is adjusted in parameter 411 until the frequency has been obtained at which the motor is as low-noise as possible.
See also parameter 446 - switching pattern. See derating in the Design Guide.

NB!
Switching frequencies higher than 3.0 kHz (4.5 kHz for 60° AVM) lead to automatic derating of the maximum output of the VLT frequency converter.

412 Output frequency dependent switching frequency (VAR CARRIER FREQ)

Value:

★ Not possible (DISABLE)	[0]
Possible (ENABLE)	[1]

Function:

This function makes it possible to increase the switching frequency at a falling output frequency. Used in applications with square torque characteristics (centrifugal pumps and fans) in which the load declines depending on the output frequency. However, the maximum switching frequency is determined by the value set in parameter 411.

Description of choice:

Select *Not possible* [0] if a permanent switching frequency is desired.
Set the switching frequency in parameter 411.
If *Possible* [1] is selected the switching frequency will decline at an increasing output frequency.

413 Overmodulation function (OVERMODUL)

Value:

Off (OFF)	[0]
★ On (ON)	[1]

Function:

This parameter allows connection of the overmodulation function for the output voltage.

Description of choice:

Off means that there is no overmodulation of the output voltage, which means that torque ripple on the motor shaft is avoided. This can be a good feature, e.g. on grinding machines.
On means that an output voltage can be obtained which is greater than the mains voltage (up to 15%).

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

414 Minimum feedback
(MIN. FEEDBACK)

Value:

-100,000.000 - Max. feedback ★ 0.000

Function:

Parameters 414 and 415 are used to scale the display text to make it show the feedback signal as the actual unit proportional to the signal on the input.
This value should be 10% higher than, par. 205 *Maximum reference*, to keep the VLT frequency converter from integrating as a response to a possible offset fault.
This value will be displayed if *Feedback [unit]* [3] has been selected in one of parameters 009-012 and in the display mode. Choose the feedback signal unit in parameter 416.
Used together with *Speed control, closed loop*; *Process control, closed loop* and *Torque control, speed feedback* (parameter 100).

Description of choice:

Is only active when parameter 203 has been set to *Min-Max* [0].
Set the value to be shown on the display when *Minimum feedback is obtained on the selected feedback input (parameter 308 or 314)*.
The minimum value can be limited by the choice of configuration (parameter 100) and reference/feedback range (parameter 203).
If *Speed control, closed loop* [1] has been selected in parameter 100, minimum feedback cannot be set under 0.

415 Maximum feedback
(MAX. FEEDBACK)

Value:

Min. feedback - 100,000.000 ★ 1,500.000

Function:

See description of parameter 414.

Description of choice:

Set the value to be shown on the display when *Maximum feedback is obtained on the selected feedback input (parameter 308 or 314)*.
The maximum value can be limited by the choice of configuration (parameter 100).

416 Reference/feedback unit
(REF/FEEDB. UNIT)

Value:

NO UNIT	[0]	t/min	[21]
★ %	[1]	t/h	[22]
PPM	[2]	m	[23]
RPM	[3]	Nm	[24]
bar	[4]	m/s	[25]
CYCLE/min	[5]	m/min	[26]
PULSE/s	[6]	°F	[27]
UNITS/s	[7]	in wg	[28]
UNITS/min	[8]	gal/s	[29]
UNITS/h	[9]	ft^3/s	[30]
°C	[10]	gal/min	[31]
Pa	[11]	ft^3/min	[32]
l/s	[12]	gal/h	[33]
m^3/s	[13]	ft^3/h	[34]
l/min	[14]	lb/s	[35]
m^3/min	[15]	lb/min	[36]
l/h	[16]	lb/h	[37]
m^3/h	[17]	lb ft	[38]
kg/s	[18]	ft/s	[39]
kg/min	[19]	ft/min	[40]
kg/h	[20]		

Function:

Choose among different units to be shown on the display.
This unit is also used directly in *Process control, closed loop* as a unit for *Minimum/Maximum reference (parameters 204/205)* and *Minimum/Maximum feedback (parameters 414/415)*.
The possibility of choosing a unit in parameter 416 will depend on the choices made in the following parameters:
Par. 002 *Local/remote control*.
Par. 013 *Local control/config. as par. 100*.
Par. 100 *Configuration*.

Select parameter 002 as *Remote control*

If parameter 100 is selected as *Speed control, open loop* or *Torque control, open loop*, the unit selected in parameter 416 can be used in displays (par. 009-12 *Feedback [unit]*) of process parameters.
The process parameter to be displayed can be connected in the form of an external analogue signal to terminal 53 (par. 308: *Feedback signal*) or terminal 60 (par. 314: *Feedback signal*), as well as in the form of a pulse signal on terminal 33 (par 307: *Pulse feedback*).
Note: The reference can only be shown in Hz (*Speed control, open loop*) or Nm (*Torque control, open loop*).

★ = factory setting. () = display text [] = value for use in communication via serial communication port

Function, cont.:
If par. 100 is selected as *Speed control, closed loop,* parameter 416 is not active, since both reference and feedback are always shown as RPM.
If parameter 100 is selected as *Process control, closed loop,* the unit selected in parameter 416 will be used when displaying both reference (par. 009-12: *Reference [unit]*) and feedback (par 009-12: *Feedback [unit]*).
Scaling of the display indication as a function of the selected range (par. 309/310, 312/313, 315/316, 327 and 328) for a connected, external signal is effected for a reference in parameters 204 and 205 and for feedback in parameters 414 and 415.

Select parameter 002 as *Local control*
If parameter 013 is chosen as *LCP control and open loop* or *LCP digital control and open loop*, the reference will be given in Hz, regardless of the choice made in parameter 416. A feedback or process signal connected to terminal 53, 60 or 33 (pulse), will, however, be displayed in the form of the unit selected in parameter 416. If parameter 013 is chosen as *LCP control/as par. 100* or *LCP digital control/as par. 100*, the unit will be as described above under parameter 002, Remote-control.

NB!
The above applies to display of *Reference [unit]* and *Feedback [unit]*. If *Reference [%]* or *Feedback [%]* is selected, the value displayed will be in the form of a percentage of the selected range.

Description of choice:
Select the desired unit for the reference/feedback signal.

417 Speed PID proportional gain (SPEED PROP GAIN)

Value:
0.000 (OFF) - 0.150 ★ 0.015

Function:
Proportional gain indicates how many times the fault (deviation between the feedback signal and the set-point) is to be amplified. Used together with *Speed control, closed loop* (parameter 100).

Description of choice:
Quick control is obtained at high amplification, but if the amplification is too high, the process may become unstable in the case of overshooting.

418 Speed PID integral time (SPEED INT. TIME)

Value:
2.00 - 999.99 ms (1000 = OFF) ★ 8 ms

Function:
The integral time determines how long the PID regulator takes to correct the error. The greater the error, the quicker the gain increases. The integral time results in a delay of the signal and thus has a dampening effect. Used together with *Speed control, closed loop* (parameter 100).

Description of choice:
Quick control is obtained through a short integral time.
However, if this time is too short, it can make the process unstable.
If the integral time is long, major deviations from the required reference may occur, since the process regulator will take long to regulate if an error has occurred.

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

419 Speed PID differential time (SPEED DIFF. TIME)

Value:

0.00 (OFF) - 200.00 ms ★ 30 ms

Function:

The differentiator does not react to a constant error. It only provides a gain if the error changes. The quicker the error changes, the stronger the gain from the differentiator will be.
The gain is proportional to the speed at which errors change.
Used together with *Speed control, closed loop* (parameter 100).

Description of choice:

Quick control is obtained by a long differential time. However, if this time is too long, it can make the process unstable.
When the differential time is 0 ms, the D-function is not active (OFF).

420 Speed PID D-gain limit (SPEED D-GAIN LIMIT)

Value:

5.0 - 50.0 ★ 5.0

Function:

It is possible to set a limit for the gain provided by the differentiator. Since the D-gain increases at higher frequencies, limiting the gain may be useful. This enables obtaining a pure D-link at low frequencies and a constant D-link at higher frequencies.
Used together with *Speed control, closed loop* (parameter 100).

Description of choice:

Select the desired gain limit.

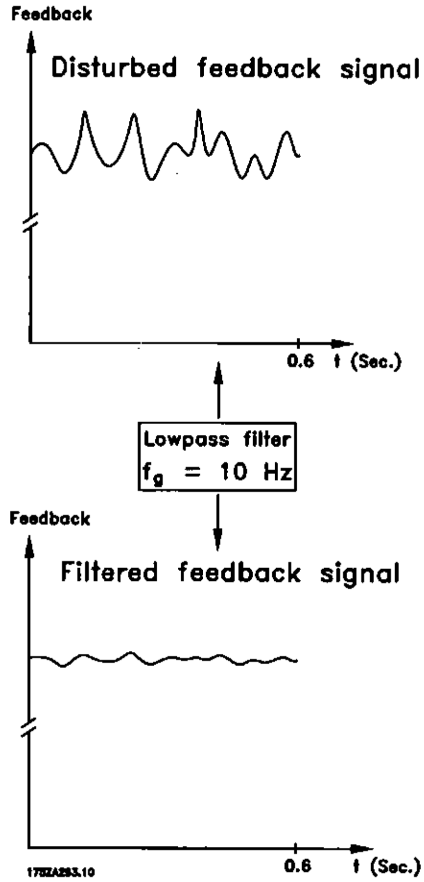
421 Speed PID lowpass filter time (SPEED FILT. TIME)

Value:

5 - 200 ms ★ 10 ms

Function:

Oscillations on the feedback signal are dampened by a lowpass filter so as to reduce their influence on control. This might be an advantage, e.g. if there is a great amount on noise on the system. See drawing.
Used together with *Speed control, closed loop* and *Torque control, speed feedback* (parameter 100).



Description of choice:

If a time constant (τ) e.g. of 100 ms is programmed, the cut-off frequency for the lowpass filter will be 1/0.1 = 10 RAD/sec., corresponding to (10/2 x π) = 1.6 Hz. This means that the PID regulator will <u>only</u> regulate 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 will not react.

422 U 0 voltage at 0 Hz (U0 VOLTAGE (0HZ))

Value:

0.0 - parameter 103 ★ 20.0 volt

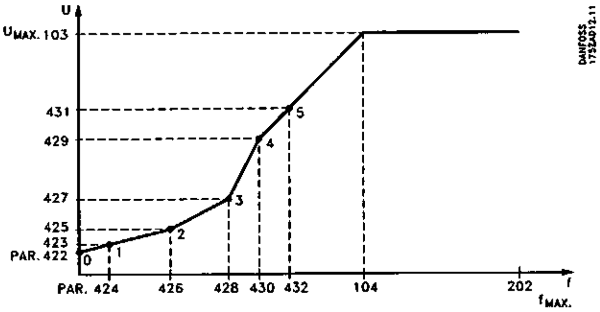
Function:

Parameters 422-432 can be used together with Special motor characteristics (par. 101). It is possible to make a U/f characteristic on the basis of six definable voltages and frequencies.

Description of choice:

Set the desired voltage at 0 Hz.

See the below drawing.



423 U 1 voltage (U1 VOLTAGE)

Value:

0.0 - $U_{VLT,MAX}$ ★ parameter 103

Function:

This parameter sets the Y-value of the 1st break point.

Description of choice:

Set the voltage desired at the F1 frequency set in parameter 424.

See drawing for parameter 422.

424 F 1 frequency (F1 FREQUENCY)

Value:

0.0 - parameter 426 ★ parameter 104

Function:

This parameter sets the X-value of the 1st break point.

Description of choice:

Set the frequency desired at the U1 voltage set in parameter 423.

See drawing for parameter 422.

425 U 2 voltage (U2 VOLTAGE)

Value:

0.0 - $U_{VLT,MAX}$ ★ parameter 103

Function:

This parameter sets the Y-value of the 2nd break point.

Description of choice:

Set the voltage desired at the F2 frequency set in parameter 426.

See drawing for parameter 422.

426 F 2 frequency (F2 FREQUENCY)

Value:

parameter 424 - parameter 428★ parameter 104

Function:

This parameter sets the X-value of the 2nd break point.

Description of choice:

Set the frequency desired at the U2 voltage set in parameter 425.

See drawing for parameter 422.

427 U 3 voltage (U3 VOLTAGE)

Value:

0.0 - $U_{VLT,MAX}$ ★ parameter 103

Function:

This parameter sets the Y-value of the 3rd break point.

Description of choice:

Set the voltage desired at the F3 frequency set in parameter 428.

See drawing for parameter 422.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

428 F 3 frequency (F3 FREQUENCY)

Value:

parameter 426 - parameter 430 ★ parameter 104

Function:

This parameter sets the X-value of the 3rd break point.

Description of choice:

Set the frequency desired at the U3 voltage set in parameter 427.
See drawing for parameter 422.

429 U 4 voltage (U4 VOLTAGE)

Value:

0.0 - $U_{VLT,MAX}$ ★ parameter 103

Function:

This parameter sets the Y-value of the 4th break point.

Description of choice:

Set the voltage desired at the F4 frequency set in parameter 430.
See drawing for parameter 422.

430 F 4 frequency (F4 FREQUENCY)

Value:

parameter 428 - parameter 432★ parameter 104

Function:

This parameter sets the X-value of the 4th break point

Description of choice:

Set the frequency desired at the U4 voltage set in parameter 429.
See drawing for parameter 422.

431 U 5 voltage (U5 VOLTAGE)

Value:

0.0 - $U_{VLT,MAX}$ ★ parameter 103

Function:

This parameter sets the Y-value of the 5th break point.

Description of choice:

Set the voltage desired at the F5 frequency set in parameter 432.

432 F 5 frequency (F5 FREQUENCY)

Value:

parameter 430 - 1000 Hz ★ parameter 104

Function:

This parameter sets the X-value of the 5th break point.
This parameter is not limited by parameter 200.

Description of choice:

Set the frequency desired at the U5 voltage set in parameter 431.
See drawing for parameter 422.

433 Torque control, open loop proportional gain (TOR-OL PROP. GAIN)

Value:

0 (Off) - 500% ★ 100%

Function:

The proportional gain indicates how many times the error (the deviation between feedback signal and set point) is to be applied.
Used together with *Torque control, open loop* (parameter 100).

Description of choice:

Fast control is obtained with a high gain, but if the gain is too high, the process may become unstable.

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

434 Torque control, open loop Integration time (TOR-OL INT.TIME)

Value:

0.002 - 2.000 sec. ★ 0.02 sec.

Function:

The integrator provides an increasing gain if there is a constant error between reference and current measuring signal. The greater the error, the quicker the gain increases. The integral time is the time required by the integrator to reach the same gain as the proportional gain.
Used together with *Torque control, open loop* (parameter 100).

Description of choice:

Fast control is obtained if the integral time is short. However, this time may become too short, in which case the process may become unstable.

---

437 Process PID Normal/inverse control (PROC NO/INV CTRL)

Value:

★ Normal (NORMAL)	[0]
Inverse (INVERSE)	[1]

Function:

It is possible to choose whether the process regulator is to increase/reduce the output frequency. This is done by having a difference between the reference signal and the feedback signal.
Used together with *Process control, closed loop* (parameter 100).

Description of choice:

If the VLT frequency converter is to reduce the output frequency in case the feedback signal increases, select *Normal* [0].
If the VLT frequency converter is to increase the output frequency in case the feedback signal increases, select *Inverse* [1].

---

438 Process PID anti windup (PROC ANTI WINDUP)

Value:

Off (DISABLE)	[0]
★ On (ENABLE)	[1]

Function:

It is possible to select whether the process regulator is to continue regulating on an error even if it is not possible to increase/reduce the output frequency.
Used together with *Process control, closed loop* (parameter 100).

Description of choice:

The factory setting is *Enable* [1], which means that the integration link is adjusted in relation to the actual output frequency if either the current limit or the max./ min. frequency has been reached. The process regulator will not engage again until either the error is zero or its sign has changed.
Select *Disable* [0] if the integrator is to continue integrating on an error, even if it is not possible to remove the fault by such control.

NB!
If *Disable* [0] is selected, it will mean that when the error changes its sign, the integrator will first have to integrate down from the level obtained as a result of the former error, before any change to the output frequency occurs.

---

439 Process PID start frequency (PROC START VALUE)

Value:

f_{MIN}-f_{MAX} (parameter 201 and 202) ★parameter 201

Function:

When the start signal comes, the VLT frequency converter will react in the form of *Speed control, open loop* following the ramp. Only when the programmed start frequency has been obtained, will it change over to *Process control, closed loop*. In addition, it is possible to set a frequency that corresponds to the speed at which the process normally runs, which will enable the required process conditions to be reached sooner.
Used together with *Process control, closed loop* (parameter 100).

Description of choice:

Set the required start frequency.

NB!
If the VLT frequency converter is running at the current limit before the desired start frequency is obtained, the process regulator will not be activated. For the regulator to be activated anyway, the start frequency must be lowered to the required output frequency. This can be done during operation.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

440 Process PID proportional gain
(PROC. PROP. GAIN)

Value:
0.00 - 10.00 ★ 0.01

Function:
The proportional gain indicates the number of times the error between the set point and the feedback signal is to be applied.
Used together with *Process control, closed loop* (parameter 100).

Description of choice:
Quick control is obtained by a high gain, but if the gain is too high, the process may become unstable.

441 Process PID integral time
(PROC. INTEGR. T.)

Value:
0.01 - 9999.99 sec. (OFF) ★ OFF

Function:
The integrator provides an increasing gain at a constant error between the set point and the feedback signal. The greater the error, the quicker the gain will increase. The integral time is the time needed by the integrator to reach the same gain as the proportional gain.
Used together with *Process control, closed loop* (parameter 100).

Description of choice:
Quick control is obtained at a short integral time. However, this time may become too short, which can make the process unstable.
If the integral time is long, major deviations from the required set point may occur, since the process regulator will take a long time to regulate in relation to a given error.

442 Process PID differentiation time
(PROC. DIFF. TIME)

Value:
0.00 (OFF) - 10.00 sec. ★ 0.00 sec.

Funktion:
The differentiator does not react to a constant error. It only provides a gain when the error changes. The quicker the error changes, the stronger the gain from the differentiator.
The gain is proportional to the speed at which the error changes.
Used together with *Process control, closed loop* (parameter 100).

Description of choice:
Quick control is obtained with a long differentiation time. However, this time may become too long, which can make the process unstable.

443 Process PID diff. gain limit
(PROC. DIFF. GAIN)

Value:
5.0 - 50.0 ★ 5.0

Function:
It is possible to set a limit for the differentiator gain. The differentiator gain will increase if there are fast changes, which is why it can be beneficial to limit this gain, thereby obtaining a pure differentiator gain at slow changes and a constant differentiator gain where quick changes to the error occur.
Used together with *Process control, closed loop* (parameter 100).

Description of choice:
Select a limit to differentiator gain as required.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

444 Process PID lowpass filter time
(PROC FILTER TIME)

Value:

0.01 - 10.00 ★ 0.01 sec.

Function:

Oscillations on the feedback signal are dampened by the lowpass filter in order to reduce their impact on the process control. This can be an advantage e.g. if there is a lot of noise on the signal.
Used together with *Process control, closed loop* (parameter 100).

Description of choice:

Select the desired time constant (τ). If a time constant (τ) of 100 ms is programmed, the break frequency for the lowpass filter will be 1/0.1 = 10 RAD/sec., corresponding to $(10/2 \times \pi) = 1.6$ Hz.
The process regulator will thus only regulate a feedback signal that varies by a frequency lower than 1.6 Hz.
If the feedback signal varies by a higher frequency than 1.6 Hz, the Process regulator will not react.

---

445 Flying start
(FLYING START)

Value:

★	Off (DISABLE)	[0]
	On (ENABLE)	[1]

Function:

This function makes it possible to 'catch' a motor, which is spinning freely because of a mains drop-out .

Description of choice:

Select *Disable* if this function is not required.
Select *Enable* if the VLT frequency converter is to be able to 'catch' and catch and control a spinning motor. See also the explanation of this function offered on page 73.

---

446 Switching pattern
(SWITCH PATTERN)

Value:

	60° AVM (60° AVM)	[0]
★	SFAVM (SFAVM)	[1]

Function:

Choose between two different switching patterns: 60° AVM and SFAVM.

Description of choice

Select *60° AVM* if the option of using a switching frequency up to 14/10 kHz is required. Derating of the rated output current $I_{VLT,N}$ is effected from a switching frequency of 4.5 kHz.
Select *SFAVM* if the option of using a switching frequency up to 5/10 kHz is required. Derating of the rated output current $I_{VLT,N}$ is effected from a switching frequency of 3.0 kHz.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

447 Torque, speed feedback Torque compensation (TOR-SF COMP.)

Value:

-100 - 100% ★ 0%

Function:

This parameter is only used if *Torque control, speed feedback* [5] has been selected in parameter 100.
Torque compensation is used in connection with calibration of the VLT frequency converter. By adjusting parameter 447, *Torque compensation*, the output torque can be calibrated.
See procedure for torque calibration on page 57.

Description of choice:

Set the required value.

448 Torque, speed feedback Gear ratio with encoder (TOR-SF GEARRATIO)

Value:

0.001 - 100.000 ★ 1.000

Function:

This parameter is only used if *Torque control, speed feedback* [5] has been selected in parameter 100.
If an encoder has been fitted to the gearshaft, a gear ratio must be set - otherwise the VLT frequency converter will not be able to calculate the output frequency correctly.
For a gear ratio of 1:10 (gearing down of motor rpm), set the parameter value to 10.
If the encoder has been fitted directly on the motor shaft, set the gear ratio to 1.00.

Description of choice:

Set the required value.

449 Torque, speed feedback Friction loss (TOR-SF FRIC. LOSS)

Value:

0.00 - 50.00% of rated motor torque ★0.00%

Function:

This parameter is only used if *Torque control, speed feedback* [5] has been selected in parameter 100.

Set the friction loss as a fixed percentage loss of rated torque. In motor operation, the friction loss will be added to the torque, while in generating operation it will be deducted from the torque.
See procedure for torque calibration on page 57.

Description of choice:

Set the required value.

450 Mains voltage at mains fault (MAINS FAIL VOLT.)

Value:

180-240 V for 200-240 V units ★ 180
342-500 V for 380-500 V units ★ 342

Function:

This is where to set the voltage level at which parameter 407 *Mains fault* is to be activated.
The voltage level for activating the mains fault functions must be lower than the rated mains voltage supplied to the VLT frequency converter. As a rule of thumb, parameter 450 can be set to 10% below the rated mains voltage.

Description of choice:

Set the level for activating mains fault functions.

NB!:
If this value is set at too high a level, the mains fault function set in parameter 407 can be activated, even if the mains voltage is present.

453 Speed closed loop gear ratio
(SPEED GEARRATIO)

Value:
0.01 - 100.00 ★ 1.00

Function:
This parameter is only used if *Speed control, closed loop* [1] has been selected in parameter 100 *Configuration*.
If the feedback has been fitted to the gearshaft, a gear ratio must be set - otherwise the VLT frequency converter will not be able to detect an encoder loss.
For a gear ratio of 1:10 (gearing down of motor rpm), set the parameter value to 10.
If the encoder has been fitted directly on the motor shaft, set the gear ratio to 1.00.

Description of choice:
Set the required value.

---

454 Dead time compensation
(DEADTIME COMP.)

Value:

Off (OFF)	[0]
★ On (ON)	[1]

Function:
The active inverter dead time compensation which is part of the VLT 5000 control algorithm (VCC+) is causing instability at standstill when working in closed loop control. The purpose of this parameter is switching off the active dead time compensation to avoid instability.

Description of choice:
Select *Off* [0] to inactivate the dead time compensation.
Select *On* [1] to activate the dead time compensation.

---

500 Address (BUS ADDRESS)

Value:

1 - 126 ★ 1

Function:

This parameter allows specification of the address of each VLT frequency converter. This feature is used in connection with PLC/PC connection.

Description of choice:

The individual VLT frequency converters can be given an address between 1 and 126. The address 0 is used if a master (PLC or PC) wishes to send a telegram that is to be received by all VLT frequency converters connected to the serial communication port at the same time. In this case, the VLT frequency converter will not acknowledge receipt. If the number of units connected (VLT frequency converters + master) exceeds 31, a repeater is required. Parameter 500 cannot be selected via the serial communication port.

501 Baudrate (BAUDRATE)

Value:

	300 Baud (300 BAUD)	[0]
	600 Baud (600 BAUD)	[1]
	1200 Baud (1200 BAUD)	[2]
	2400 Baud (2400 BAUD)	[3]
	4800 Baud (4800 BAUD)	[4]
★	9600 Baud (9600 BAUD)	[5]

Function:

This parameter is for programming the speed at which data is to be transmitted via the serial connection. Baud rate is defined as the number of bits transferred per second.

Description of choice:

The transmission speed of the VLT frequency converter is to be set at a value that corresponds to the transmission speed of the PLC/PC. Parameter 501 cannot be selected via the serial port, RS 485.
The data transmission time proper, which is determined by the set baud rate, is only part of the total communication time.

502 Coasting (COASTING SELECT)
503 Quick-stop (Q STOP SELECT)
504 DC-brake (DC BRAKE SELECT)
505 Start (START SELECT)
506 Reversing (REVERSING SELECT)
507 Selection of Setup (SETUP SELECT)
508 Selection of speed (PRES.REF. SELECT)

Value:

	Digital input (DIGITAL INPUT)	[0]
	Bus (SERIAL PORT)	[1]
	Logic and (LOGIC AND)	[2]
★	Logic or (LOGIC OR)	[3]

Function:

Parameters 502-508 allow a choice between controlling the VLT frequency converter via the terminals (digital input) and/or via the bus.
If *Logic and* or *Bus* is selected, the command in question can only be activated if transmitted via the serial communication port. In the case of *Logic and*, the command must additionally be activated via one of the digital inputs.

Description of choice:

Digital input [0] is selected if the control command in question is only to be activated via a digital input.
Bus [1] is selected if the control command in question is only to be activated via a bit in the control word (serial communication).
Logic and [2] is selected if the control command in question is only to be activated when a signal is transmitted (active signal = 1) via both a control word and a digital input.

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

Digital input 505-508	Bus	Control command
0	0	0
0	1	0
1	0	0
1	1	1

Logic or [3] is selected if the control command in question is to be activated when a signal is given (active signal = 1) either via a control word or via a digital input.

Digital input 505-508	Bus	Control command
0	0	0
0	1	1
1	0	1
1	1	1

NB!
Parameters 502-504 deal with stop functions - see examples regarding 502 (coasting) below. Active stop command "0".

Parameter 502 = *Logic and*

Digital input	Bus	Control command
0	0	1 Coasting
0	1	0 Motor running
1	0	0 Motor running
1	1	0 Motor running

Parameter 502 = *Logic or*

Digital input	Bus	Control command
0	0	1 Coasting
0	1	1 Coasting
1	0	1 Coasting
1	1	0 Motor running

503 Quick-stop (Q STOP SELECT)

Value:

Digital input (DIGITAL INPUT)	[0]
Bus (SERIAL PORT)	[1]
Logic and (LOGIC AND)	[2]
★ Logic or (LOGIC OR)	[3]

Function:
See description under parameter 502.

Description of choice:
See description under parameter 502.

504 DC-brake (DC BRAKE SELECT)

Value:

Digital input (DIGITAL INPUT)	[0]
Bus (SERIAL PORT)	[1]
Logic and (LOGIC AND)	[2]
★ Logic or (LOGIC OR)	[3]

Function:
See description under parameter 502.

Description of choice:
See description under parameter 502.

505 Start (START SELECT)

Value:

Digital input (DIGITAL INPUT)	[0]
Bus (SERIAL PORT)	[1]
Logic and (LOGIC AND)	[2]
★ Logic or (LOGIC OR)	[3]

Function:
See description under parameter 502.

Description of choice:
See description under parameter 502.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

506 Reversing (REVERSING SELECT)

Value:

★ Digital input (DIGITAL INPUT)	[0]
Bus (SERIAL PORT)	[1]
Logic and (LOGIC AND)	[2]
Logic or (LOGIC OR)	[3]

Function:

See description under parameter 502.

Description of choice:

See description under parameter 502.

507 Selection of Setup (SETUP SELECT)

Value:

Digital input (DIGITAL INPUT)	[0]
Bus (SERIAL PORT)	[1]
Logic and (LOGIC AND)	[2]
★ Logic or (LOGIC OR)	[3]

Function:

See description under parameter 502.

Description of choice:

See description under parameter 502.

508 Selection of speed (PRES.REF. SELECT)

Value:

Digital input (DIGITAL INPUT)	[0]
Bus (SERIAL PORT)	[1]
Logic and (LOGIC AND)	[2]
★ Logic or (LOGIC OR)	[3]

Function:

See description under parameter 502.

Description of choice:

See description under parameter 502.

509 Bus jog 1 (BUS JOG 1 FREQ.)

Value:

0.0 - parameter 202 ★ 10.0 Hz

Function:

This is where to set a fixed speed (jog) that is activated via the serial communication port.
This function is the same as in parameter 213.

Description of choice:

The jog frequency f_{JOG} can be selected in the range between f_{MIN} (parameter 201) and f_{MAX} (parameter 202).

510 Bus jog 2 (BUS JOG 2 FREQ.)

Value:

0.0 - parameter 202 ★ 10.0 Hz

Function:

This is where to set a fixed speed (jog) that is activated via the serial communication port.
This function is the same as in parameter 213.

Description of choice:

The jog frequency f_{JOG} can be selected in the range between f_{MIN} (parameter 201) and f_{MAX} (parameter 202).

512 Telegram profile (TELEGRAM PROFILE)

Value:

Profidrive (PROFIDRIVE)	[0]
★ FC Drive (FC DRIVE)	[1]

Function:

There is a choice of two different control word profiles.

Description of choice:

Select the desired control word profile.
See *Serial communication*, in the Design Guide for further information about the control word profiles.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

513 Bus time interval
(BUS TIMEOUT TIME)

Value:

1 - 99 sec. ★ 1 sec.

Function:

This parameter sets the maximum time expected to pass between the receipt of two consecutive telegrams. If this time is exceeded, the serial communication is assumed to have stopped and the desired reaction is set in parameter 514.

Description of choice:

Set the desired time.

514 Bus time interval function
(BUS TIMEOUT FUNC)

Value:

★ Off (OFF)	[0]
Freeze output (FREEZE OUTPUT)	[1]
Stop (STOP)	[2]
Jogging (JOGGING)	[3]
Max. speed (MAX SPEED)	[4]
Stop and trip (STOP AND TRIP)	[5]

Function:

This parameter selects the desired reaction of the VLT frequency converter when the set time for bus timeout (parameter 513) has been exceeded.
If choices [1] to [5] are activated, relay 01 and relay 04 will be de-activated.

If more time-outs occur at the same time the VLT frequency converter will give the following priority to the time-out function:
1. Parameter 318 *Function after time out*
2. Parameter 346 *Function after encoder loss*
3. Parameter 514 *Bus time interval function.*

Description of choice:

The output frequency of the VLT frequency converter can: be frozen at the present value, be frozen at the reference, go to stop, go to jogging frequency (parameter 213), go to max. output frequency (parameter 202) or stop and activate a trip.

515 Data read-out: Reference %
(REFERENCE)

Value:

Unit: %

Function:

This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:

The value shown corresponds to the total reference (sum of digital/analogue/preset/bus/freeze ref./catch-up and slow-down).
This value is updated every 80 ms.

516 Data read-out: Reference unit
(REFERENCE [UNIT])

Value:

Unit: Hz, Nm or rpm.

Function:

This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.
See also parameters 205 and 416, if required.

Description of choice:

Gives the present value of terminals 17/29/53/54/60 in the unit resulting from the choice of configuration in parameter 100 (Hz, Nm or rpm) or in parameter 416.
This value is updated every 80 ms.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

517 Data read-out: Feedback
(FEEDBACK [UNIT])

Value:
Unit: to be selected via parameter 416.

Function:
This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:
Indicates the status value of terminals 33/53/60 at the unit/scale selected in parameters 414, 415 and 416.
This value is updated every 80 ms.

---

518 Data read-out: Frequency
(FREQUENCY)

Value:
Unit: Hz

Function:
This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:
The value shown corresponds to the actual motor frequency f_M (without resonance dampening).
This value is updated every 80 ms.

---

519 Data read-out: Frequency x Scaling
(FREQUENCY x SCALE)

Value:
Unit: (Hz x Scale)

Function:
This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:
The value shown corresponds to the actual motor frequency f_M (without resonance dampening) multiplied by a factor (scaling) set in parameter 008.
This value is updated every 80 ms.

---

520 Data read-out: Current
(MOTOR CURRENT)

Value:
Unit: (Amp x 100)

Function:
This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:
The value shown corresponds to the given motor current measured as a mean value I_{RMS}.
The value is filtered, which means that approx. 1.3 seconds may pass from an input value changes until the data read-out changes values.
This value is updated every 80 ms.

---

521 Data read-out: Torque
(TORQUE)

Value:
Unit: %

Function:
This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:
The value shown is the torque, with sign, supplied to the motor shaft. The value is given as a percentage of the rated torque.
There is not exact linearity between 160% motor current and torque in relation to the rated torque. Some motors supply more torque than that. Consequently, the min. value and the max. value will depend on the max. motor current as well as the motor used.
The value is filtered, which means that approx. 1.3 seconds may pass from an input changes value until the data read-out changes values.
This value is updated every 80 ms.

NB!
If the setting of the motor parameters does not match the motor applied, the read-out values will be inaccurate and may become negative, even if the motor is not running or is producing a positive torque.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

522 Data read-out: Power, kW (POWER (kW))

Value:
Unit: kW

Function:
This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:
The value shown is calculated on the basis of the actual motor voltage and motor current.
The value is filtered, which means that it may take approx. 1.3 seconds from an input value changes until the data read-out changes values.
This value is updated every 80 ms.

523 Data read-out: Power, HP (POWER (hp))

Value:
Unit: HP (US)

Function:
This parameter can be read out via the serial communication port and the display in Display mode, see also parameters 009-012.

Description of choice:
The value shown is calculated on the basis of the actual motor voltage and motor current.
The value is indicated in the form of HP.
The value is filtered, which means that approx. 1.3 seconds may pass from an input value changes until the data read-out changes values.
This value is updated every 80 ms.

524 Data read-out: Motor voltage (MOTOR VOLTAGE)

Value:
Unit: V

Function:
This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:
The value shown is a calculated value used for controlling the motor.
This value is updated every 80 ms.

525 Data read-out: DC link voltage (DC LINK VOLTAGE)

Value:
Unit: V

Function:
This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:
The value shown is a measured value.
The value is filtered, which means that approx. 1.3 seconds may pass from an input value changes until the data read-out changes values.
This value is updated every 80 ms.

526 Data read-out: Motor temp. (MOTOR THERMAL)

Value:
0 - 100%

Function:
This parameter can be read out via the serial communication port and via the display (Display mode).

Description of choice:
This value is updated every 80 ms.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

527 Data read-out: VLT temp. (VLT THERMAL)

Value:
0 - 100%

Function:
This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:
Only whole numbers are displayed.
This value is updated every 80 ms.

528 Data read-out: Digital input (DIGITAL INPUT)

Value:
Unit: binary code

Function:
This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:
The value shown indicates the signal status from the 8 digital terminals (16, 17, 18, 19, 27, 29, 32 and 33). The read-out is binary and the digit at the extreme left gives the status of terminal 16, while the digit at the extreme right gives the status of terminal 33.
This value is updated every 2 ms.

529 Data read-out: Terminal 53, analogue input (ANALOG INPUT 53)

Value:
Unit: V

Function:
This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:
The value shown indicates the signal value on terminal 53.
The scaling (parameters 309 and 310) does not influence the read-out. Min. and max. are determined by the offset and gain adjustment of the AD-converter.
This value is updated every 20 ms.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

530 Data read-out: Terminal 54, analogue input (ANALOG INPUT 54)

Value:

Unit: V

Function:

This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:

The value shown indicates the signal value on terminal 54.

The scaling (parameters 312 and 313) does not influence the read-out. Min. and max. are determined by the offset and gain adjustment of the AD-converter.

This value is updated every 20 ms.

531 Data read-out: Terminal 60, analogue input (ANALOG INPUT 60)

Value:

Unit: mA

Function:

This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:

The value shown indicates the signal value on terminal 60.

The scaling (parameters 315 and 316) does not influence the read-out. Min. and max. are determined by the offset and gain adjustment of the AD-converter.

This value is updated every 20 ms.

532 Data read-out: Pulse reference (PULSE REFERENCE)

Value:

Unit: Hz

Function:

This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:

The value shown indicates any pulse reference in Hz connected to one of the digital inputs.

This value is updated every 20 ms.

533 Data read-out: External reference % (EXT. REFERENCE)

Value:

-200 - +200 %

Function:

This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:

The value stated gives, as a percentage, the sum of external references (sum of analogue/bus/pulse).

This value is updated every 20 ms.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

534 Data read-out: Status word,
(STATUS WORD [HEX])

Value:
Unit: Hex code

Function:
This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:
Indicates the status word transmitted via the serial communication port in Hex code from the VLT frequency converter. See the Design Guide.

---

535 Data read-out: Brake power/2 min.
(BR. ENERGY/2min)

Value:
Unit: kW

Function:
This parameter can be read out via the serial communication port and via the display in Display mode, see also parameter 009-012.

Description of choice:
Indicates the brake power transmitted to an external brake resistor. The mean power is calculated on an ongoing basis for the latest 120 sec.

---

536 Data read-out: Brake power/sec.
(BRAKE ENERGY/s)

Value:
Unit: kW

Function:
This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:
Indicates the given brake power transmitted to an external brake resistor. Stated as an instantaneous value.

---

537 Data read-out: Heat sink temperature
(HEATSINK TEMP.)

Value:
Unit: °C

Function:
This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:
States the given heat sink temperature of the VLT frequency converter. The cut-out limit is 90 ± 5°C, while the unit cuts back in at 60 ± 5°C.

---

538 Data read-out: Alarm word,
(ALARM WORD [HEX])

Value:
Unit: Hex code

Function:
This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:
States in Hex format whether there is an alarm on the VLT frequency converter. See page 160 for further information.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

539 Data read-out: VLT control word, (CONTROLWORD[HEX])

Value:
Unit: Hex code

Function:
This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:
Gives the control word sent via the serial communication port in Hex code to the VLT frequency converter. See the Design Guide.

540 Data read-out: Warning word, 1 (WARN. WORD 1)

Value:
Unit: Hex code

Function:
This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:
States in Hex format whether there is a warning on the VLT frequency converter. See page 160 for further information.

541 Data read-out: Extended status word Hex (EXT. STATUS WORD)

Value:
Unit: Hex code

Function:
This parameter can be read out via the serial communication port and via the display in Display mode, see also parameters 009-012.

Description of choice:
States in Hex format whether there is a warning on the VLT frequency converter. See page 160 for further information.

600 Operating data: Operating hours (OPERATING HOURS)

Value:
Unit: hours 0.0 - 130,000.0

Function:
This parameter can be read out via the serial communication port or via the display. The value cannot be reset.

Description of choice:
Indicates the number of hours in which the VLT frequency converter has been in operation.
The value is updated in the VLT frequency converter every hour and saved when the unit is turned off.

601 Operating data: Hours run (RUNNING HOURS)

Value:
Unit: hours 0.0 - 130,000.0

Function:
This parameter can be read out via the serial communication port or via the display. The value can be reset via parameter 619.

Description of choice:
Indicates the number of hours in which the VLT frequency converter has been in operation since reset in parameter 619.
The value is updated in the VLT frequency converter every hour and saved when the unit is turned off.

602 Operating data: kWh counter (KWh COUNTER)

Value:
Unit: kWh 0 - depends on the unit

Function:
This parameter can be read out via the serial communication port or via the display.
The value can be reset via parameter 618.

Description of choice:
States the kW consumption of the motor as a mean value over one hour, since the reset in parameter 618.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

603 Operating data: Number of power-up's (POWER UP'S)

Value:

Unit: number

0 - 9999

Function:

This parameter can be read out via the serial communication port or via the display.

Description of choice:

States the number of power-ups of the supply voltage to the VLT frequency converter.

---

604 Operating data: Number of overtemperatures (OVER TEMP'S)

Value:

Unit: number

0 - 9999

Function:

This parameter can be read out via the serial communication port or via the display.

Description of choice:

States the number of temperature faults there has been on the VLT frequency converter.

---

605 Operating data: Number of overvoltages (OVER VOLT'S)

Value:

Unit: number

0 - 9999

Function:

This parameter can be read out via the serial communication port or via the display.

Description of choice:

States the number of overvoltages there has been on the VLT frequency converter

---

606 Data log: Digital inputs (LOG: DIGITAL INP)

Value:

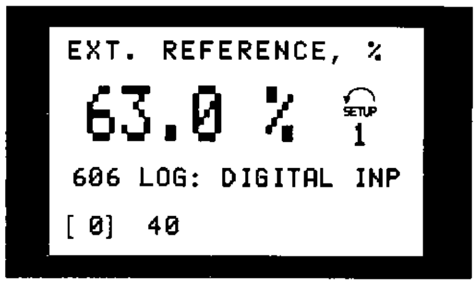
Unit: Decimal

Function:

Via this parameter it is possible to see up to 20 data-logs, where [0] is the latest log and [19] the oldest. Each data-log is made every 160 ms as long as a start signal has been given. If a stop signal is given, the latest 20 data-logs will be saved and the values will be available on the display. This is useful, e.g. when carrying out service after a trip.
This parameter can be read out via the serial communication port or via the display.

Description of choice:

The value for the digital inputs is given as a decimal figure within the range of 0-255.
The data-log number is stated in square brackets: [1]



Free a data-log if there is a trip and release it when resetting the VLT frequency converter. Data-logging is active when the motor is running.

---

607 Data log: Control word (LOG: CONTROL WORD)

Value:

Unit: Decimal

Function:

See parameter 606.

Description of choice:

The value for the control word is given as a decimal figure within the range of 0-65535.
The data-log number is stated in square brackets: [1].
Data-logs are frozen if there is a trip and released when the VLT frequency converter is subsequently reset.
Data-logging is active while the motor is running.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

608 Data log: Bus status word
(LOG: BUS STAT.WD)

Value:
Unit: Decimal

Function:
See parameter 606.

Description of choice:
The value for the bus status word is given as a decimal figure within the range of 0-65535.
The data-log number is stated in square brackets: [1].
Data-logs are frozen if there is a trip and released when the VLT frequency converter is subsequently reset.
Data-logging is active while the motor is running.

---

609 Data log: Reference
(LOG: REFERENCE)

Value:
Unit: %

Function:
See parameter 606.

Description of choice:
The value of the reference is stated as a % in the interval 0 - 100%.
The data-log number is stated in square brackets: [1].
Data-logs are frozen if there is a trip and released when the VLT frequency converter is subsequently reset.
Data-logging is active while the motor is running.

---

610 Data log: Feedback
(LOG: FEEDBACK)

Value:
Depends on the choice in parameter 416.

Function:
See parameter 606.

Description of choice:
The data-log number is stated in square brackets: [1]. Data-logs are frozen if there is a trip and released when the VLT frequency converter is subsequently reset.
Data-logging is active while the motor is running.

---

611 Data log: Motor frequency
(LOG: MOTOR FREQ)

Value:
Unit: Hz

Function:
See parameter 606.

Description of choice:
The value of the motor frequency is stated as a frequency in the interval 0.0 - 999.9 Hz.
The data-log number is stated in square brackets: [1].
Data-logs are frozen if there is a trip and released when the VLT frequency converter is subsequently reset.
Data-logging is active while the motor is running.

---

612 Data log: Motor voltage
(LOG: MOTOR VOLT)

Value:
Unit: V

Function:
See parameter 606.

Description of choice:
The value of the motor voltage is stated as Volts in the interval 50 - 1000 V.
The data-log number is stated in square brackets: [1].
Data-logs are frozen if there is a trip and released when the VLT frequency converter is subsequently reset.
Data-logging is active while the motor is running.

★ = factory setting. () = display text [ ] = value for use in communication via serial communication port

613 Data log: Motor current
(LOG: MOTOR CURR)

Value:
Unit: Amp.

Function:
See parameter 606.

Description of choice:
The value for the motor current is stated as Amps in the interval 0.0 - 999.9 A.
The data-log number is stated in square brackets: [1].
Data-logs are frozen if there is a trip and released when the VLT frequency converter is subsequently reset.
Data-logging is active while the motor is running.

614 Data log: DC link voltage
(LOG: DCLINK VOLT)

Value:
Unit: Volt

Function:
See parameter 606.

Description of choice:
The value of the DC link voltage is stated as Volts in the interval 0.0 - 999.9 V.
The data-log number is stated in square brackets: [1].
Data-logs are frozen if there is a trip and released when the VLT frequency converter is subsequently reset.
Data-logging is active while the motor is running.

615 Fault log: Error code
(F.LOG: ERROR COD)

Value:
[Index 0-36]

Function:
This parameter makes it possible to see the reason why a trip occurs.
10 (0-9) log values are stored.
The lowest log number (0) contains the latest/most recently saved data value; the highest log number (9) contains the oldest data value.

Description of choice:
Given as a number code, in which the trip number refers to an alarm code that can be seen from the table on page 154.
Reset the fault log after manual initialisation.

616 Fault log: Time
(F.LOG: TIME)

Value:
[Indication range 0.0 - 9999.9]
Unit Hours

Function:
This parameter makes it possible to see the total number of operating hours before the trip occurred.
10 (0-9) log values are stored.
The lowest log number (0) contains the latest/most recently saved data value, while the highest log number (9) contains the oldest data value.

Description of choice:
Read out as an option.
Indication range: 0.0 - 9999.9.
Reset the fault log after manual initialisation.

617 Fault log: Value
(F.LOG: VALUE)

Value:
[Index 0.0 - 999.9]

Function:
This parameter makes it possible to see at what current or voltage a given trip occurred.

Description of choice:
Read out as one value.
Indication range: 0.0 - 999.9.
Reset the fault log after manual initialisation.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

618 Reset of kWh counter (RESET KWH COUNT)

Value:

★ No reset (DO NOT RESET)	[0]
Reset (RESET COUNTER)	[1]

Function:
Reset to zero of kWh hour counter (parameter 602).

Description of choice:
If *Reset* [1] has been selected and when the [OK] key is pressed, the kWh counter of the VLT frequency converter is reset. This parameter cannot be selected via the serial port, RS 485.

NB!
When the [OK] key has been activated, the reset has been carried out.

619 Reset of hours-run counter (RESET RUN. HOUR)

Value:

★ No reset (DO NOT RESET)	[0]
Reset (RESET COUNTER)	[1]

Function:
Reset to zero of hours-run counter (parameter 601).

Description of choice:
If *Reset* [1] has been selected and when the [OK] key is pressed, the hours-run counter of the VLT frequency converter is reset. This parameter cannot be selected via the serial port, RS 485.

NB!
When the [OK] key has been activated, the reset has been carried out.

620 Operating mode (OPERATION MODE)

Value:

★ Normal function (NORMAL OPERATION)	[0]
Function with de-activated inverter (OPER. W/INVERT DISAB)	[1]
Control card test (CONTROL CARD TEST)	[2]
Initialisation (INITIALIZE)	[3]

Function:
In addition to its normal function, this parameter can be used for two different tests.
Also, all parameters (except parameters 603-605) can be initialised.
This function will not become active until the mains supply to the VLT frequency converter has been turned off and then turned on again.

Description of choice:
Normal function [0] is selected for normal operation with the motor in the selected application.
Function with deactivated inverter [1] is selected if control is desired over the influence of the control signal over the control card and its functions - without the inverter driving the motor.
Control card test [2] is selected if control of the analogue and digital inputs, as well as the analogue, digital relay outputs and the +10 V control voltage is desired. A test connector with internal connections is required for this test.

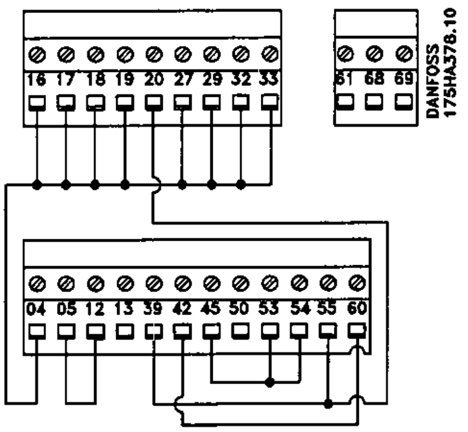
Use the following procedure for the control card test:

1) Select *Control card test.*
2) Cut off the mains supply and wait for the light in the display to go out.
3) Insert the test plug (see below).
4) Connect to mains.
5) The VLT frequency converter expects the [OK] key to be pressed (if no LCP, set to *Normal operation,* when the VLT frequency converter will start up as usual).
6) Carry out various tests.
7) Press the [OK] key.
8) Parameter 620 is automatically set to *Normal operation.*

If a test fails, the VLT frequency converter will move into an infinite loop. Replace control card.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

Test plugs (connect the following terminals to each other):
4 - 16 - 17 - 18 - 19 - 27 - 29 - 32 - 33
5 - 12
39 - 20 - 55
42 - 60
45 - 53 - 54



Initialisation [3] is selected if the factory setting of the unit is desired without resetting parameters 500, 501 + 600 - 605 + 615 - 617.

NB!
The motor must be stopped before initialisation can be carried out.

Procedure for initializing:

1) Select *Initialisation*.
2) Press the [OK] key.
3) Cut off the mains supply and wait for the light in the display to go out.
4) Connect to mains.

Manual initialisation can be carried out by holding down three keys at the same time as the mains voltage is connected. Manual initialisation sets all parameters to the factory setting, except 600-605. The procedure for manual initialisation is as follows:

1) Disconnect the mains voltage and wait for the light in the display to disappear.
2) Hold down [DISPLAY/STATUS]+[MENU]+[OK] while at the same time connecting the mains supply. The display will now read MANUAL INITIALIZE.
3) When the display reads UNIT READY, the VLT frequency converter has been initialized.

621 Nameplate: VLT type (VLT TYPE)

Value:
Depends on unit

Function:
The key data of the unit can be read out via the display or the serial communication port.

Description of choice:
Type indicates the unit size and basic function concerned.
For example: VLT 5008 380-500 V.

622 Nameplate: Power section (POWER SECTION)

Value:
Depends on unit

Function:
The key data of the unit can be read out via the display or the serial communication port.

Description of choice:
The power section states the given power section being used.
For example: Extended with brake.

623 Nameplate: VLT ordering number (VLT ORDERING NO)

Value:
Depends on unit

Function:
The key data of the unit can be read out via the display or the serial communication port.

Description of choice:
Ordering number gives the ordering number of the VLT type in question.
For example: 175Z0072.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

624 Nameplate: Software version no. (SOFTWARE VERSION)

Value:
Depends on unit

Function:
The key data of the unit can be read out via the display or the serial communication port.

Description of choice:
Software version gives the version number.
For example: V 3,10.

625 Nameplate: LCP identification no. (LCP ID no.)

Value:
Depends on unit

Function:
The key data of the unit can be read out via the display or the serial communication port.
For example: ID 1,42 2 kB.

626 Nameplate: Database identification no. (PARAM DB ID)

Value:
Depends on unit

Function:
The key data of the unit can be read out via the display or the serial communication port.
For example: ID 1,14.

627 Nameplate: Power section identification no. (POWER UNIT DB ID)

Value:
Depends on unit

Function:
The key data of the unit can be read out via the display or the serial communication port.
For example: ID 1,15.

628 Nameplate: Application option type (APP. OPTION)

Value:

Function:
The key data of the unit can be read out via the display or the serial communication port.

629 Nameplate: Application option ordering no. (APP. ORDER NO)

Value:

Function:
The key data of the unit can be read out via the display or the serial communication port.

630 Nameplate: Communication option type (COM. OPTION)

Value:

Function:
The key data of the unit can be read out via the display or the serial communication port.

631 Nameplate: Communication option ordering no. (COM. ORDER NO)

Value:

Function:
The key data of the unit can be read out via the display or the serial communication port.

★ = factory setting. ( ) = display text [ ] = value for use in communication via serial communication port

NB!
Parameters 700-711 for the relay card are only activated if a relay option card is installed in the VLT 5000.

700	Relay 6, function (RELAY6 FUNCTION)
703	Relay 7, function (RELAY7 FUNCTION)
706	Relay 8, function (RELAY8 FUNCTION)
709	Relay 9, function (RELAY9 FUNCTION)

Function:
This output activates a relay switch.
Relay outputs 6/7/8/9 can be used for showing status and warnings. The relay is activated when the conditions for the relevant data values have been fulfilled.
Activation/deactivation can be programmed in parameters 701/704/707/710 *Relay* 6/7/8/9, *ON delay* and parameters 702/705/708/711 *Relay* 6/7/8/9, *OFF delay*.

Description of choice:
For data choice and connections see parameter 319 - 326.

701	Relay 6, ON delay (RELAY6 ON DELAY)
704	Relay 7, ON delay (RELAY7 ON DELAY)
707	Relay 8, ON delay (RELAY8 ON DELAY)
710	Relay 9, ON delay (RELAY9 ON DELAY)

Value:
0 - 600 sec. ★ 0 sec.

Function:
This parameter allows a delay of the cut-in time of relays 6/7/8/9 (terminals 1-2).

Description of choice:
Enter the required value.

702	Relay 6, OFF delay (RELAY6 OFF DELAY)
705	Relay 7, OFF delay (RELAY7 OFF DELAY)
708	Relay 8, OFF delay (RELAY8 OFF DELAY)
711	Relay 9, OFF delay (RELAY9 OFF DELAY)

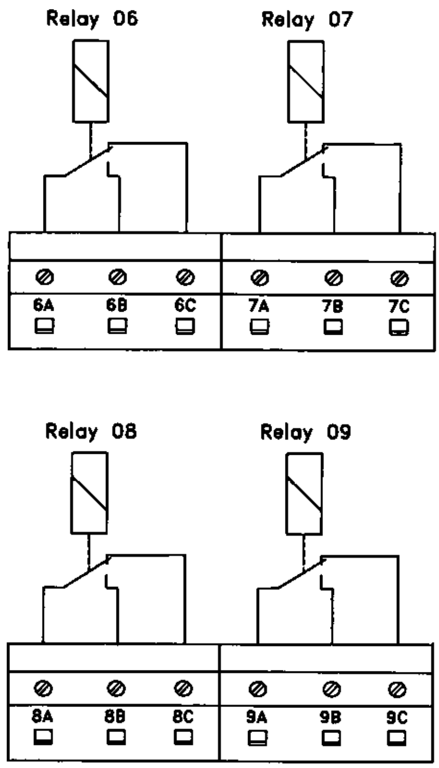
Value:
0 - 600 sec. ★ 0 sec.

Function:
This parameter is used to delay the cut-out time of relays 6/7/8/9 (terminals 1-2).

Description of choice:
Enter the required value.

■ **Electrical installation of the relay card**
The relays are connected as shown below.

Relay 6-9:
A-B make, A-C break
Max. 240 V AC, 2 Amp.



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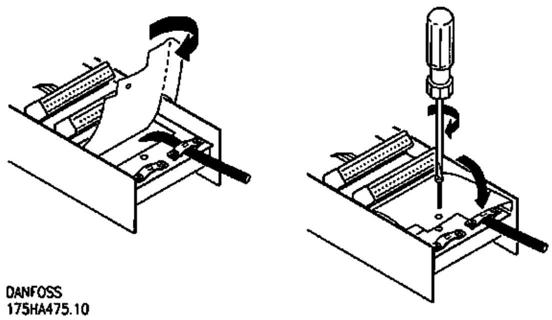
To achieve double isolation, the plastic foil must be mounted as shown in the drawing below.



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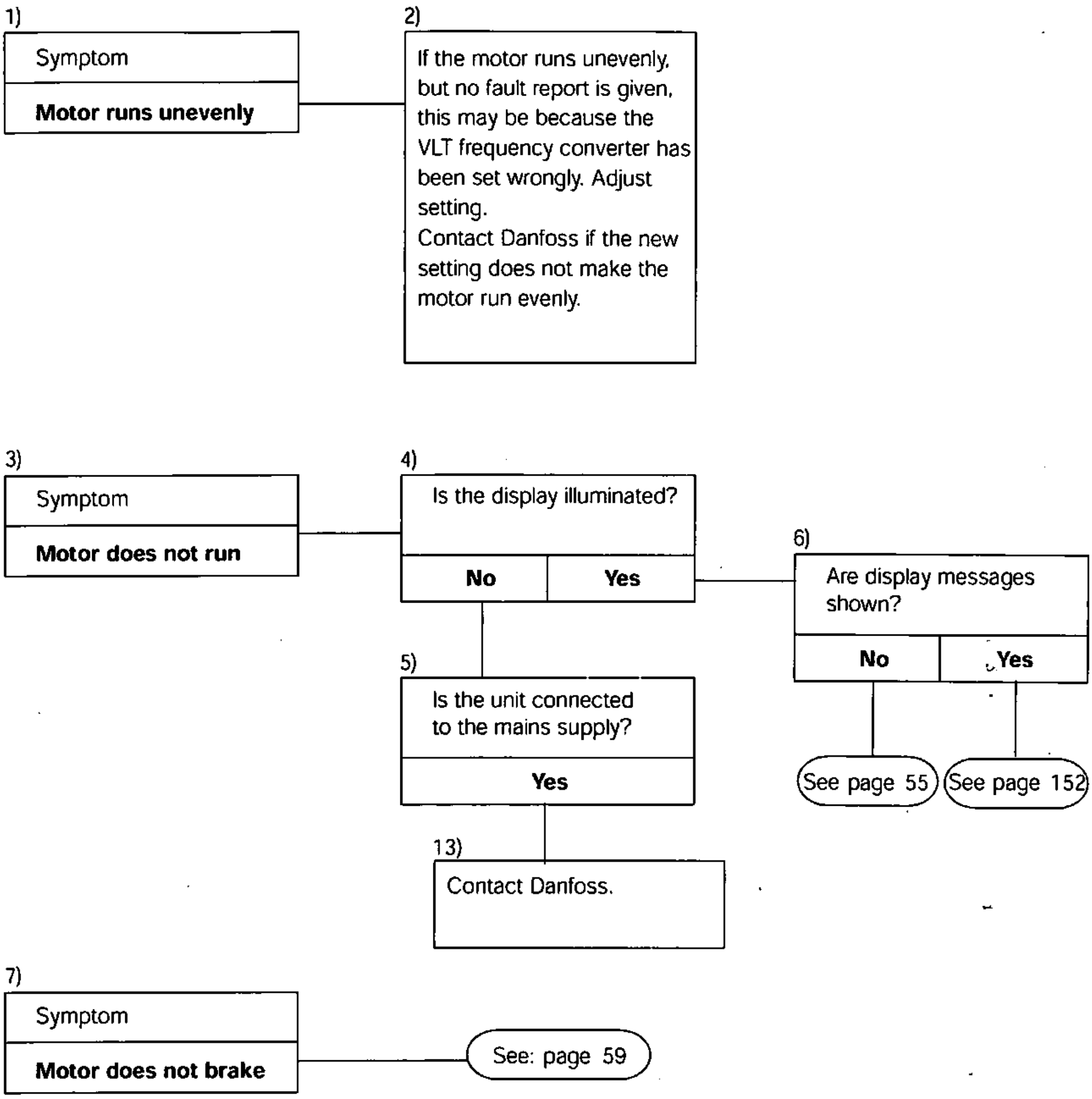
Outputs	terminal no.	Relay 06	Relay 07	Relay 08	Relay 09
	parameter	700	703	706	709
Value:					
No function	(NO OPERATION)	[0]	[0]	[0]	[0]
Control ready	(CONTROL READY)	[1]	[1]	[1]	[1]
Ready signal	(UNIT READY)	[2](★)	[2]	[2]	[2]
Ready - remote control	(UNIT READY/REM CTRL)	[3]	[3]	[3]	[3]
Enable, no warning	(ENABLE/NO WARNING)	[4]	[4]	[4]	[4]
Running	(VLT RUNNING)	[5]	[5]	[5]	[5]
Running, no warning	(RUNNING/NO WARNING)	[6]	[6]	[6]	[6]
Running within range, no warning	(RUN IN RANGE/NO WARN)	[7]	[7]	[7]	[7]
Running at reference value, no warning	(RUN ON REF/NO WARN)	[8]	[8]	[8]	[8]
Fault	(ALARM)	[9]	[9]	[9]	[9](★)
Fault or warning	(ALARM OR WARNING)	[10]	[10]	[10]	[10]
Torque limit	(TORQUE LIMIT)	[11]	[11]	[11]	[11]
Out of current range	(OUT OF CURRENT RANGE)	[12]	[12]	[12]	[12]
Over I low	(ABOVE CURRENT,LOW)	[13]	[13]	[13]	[13]
Under I high	(BELOW CURRENT,HIGH)	[14]	[14]	[14]	[14]
Out of frequency range	(OUT OF FREQ RANGE)	[15]	[15]	[15]	[15]
Over f low	(ABOVE FREQUENCY LOW)	[16]	[16]	[16]	[16]
Under f high	(BELOW FREQUENCY HIGH)	[17]	[17]	[17]	[17]
Out of feedback range	(OUT OF FDBK RANGE)	[18]	[18]	[18]	[18]
Over feedback low	(ABOVE FDBK, LOW)	[19]	[19]	[19]	[19]
Under feedback high	(BELOW FDBK, HIGH)	[20]	[20]	[20]	[20]
Thermal warning	(THERMAL WARNING)	[21]	[21]	[21]	[21]
Ready - no thermal warning	(READY &NOTHERM WARN)	[22]	[22]	[22]	[22]
Ready - remote control - no therm. warn.	(REM RDY&NO THERMWAR)	[23]	[23]	[23]	[23]
Ready - mains voltage within range	(RDY NO OVER/UNDERVOL)	[24]	[24]	[24]	[24]
Reversing	(REVERSE)	[25]	[25]	[25]	[25]
Bus ok	(BUS OK)	[26]	[26]	[26]	[26]
Torque limit and stop	(TORQUE LIMIT AND STOP)	[27]	[27]	[27]	[27]
Brake, no brake warning	()	[28]	[28]	[28]	[28]
Brake ready, no fault	(BRAKE RDY (NO FAULT))	[29]	[29]	[29]	[29]
Brake fault	(BRAKE FAULT (IGBT))	[30]	[30]	[30]	[30]
Relay 123	(RELAY 123)	[31]	[31]	[31]	[31]
Mechanical brake control	(MECH. BRAKE CONTROL)	[32]	[32]	[32]	[32]
Control word bit 11/12	(CTRL WORD BIT 11/12)	[33]	[33]	[33]	[33]
Mains ON	(MAINS ON)	[50]	[50]	[50](★)	[50]
Motor running	(MOTOR RUNNING)	[51]	[51](★)	[51]	[51]

Description of choice:
For description of choice please see parameter 319.

Mains ON [50], has the same logical function as *Running* [5].

Motor running [51], has the same logical function as *Mechanical brake control* [32].


1)
Symptom
Motor runs unevenly
2)
If the motor runs unevenly, but no fault report is given, this may be because the VLT frequency converter has been set wrongly. Adjust setting.
Contact Danfoss if the new setting does not make the motor run evenly.
3)
Symptom
Motor does not run
4)
Is the display illuminated?
No
Yes
5)
Is the unit connected to the mains supply?
Yes
13)
Contact Danfoss.
6)
Are display messages shown?
No
Yes
See page 55
See page 152
7)
Symptom
Motor does not brake
See: page 59

8)

Symptom
No fault report or light in display

9)

Have prefuses for the VLT frequency converter blown?

No	Yes

10)

Contact Danfoss.

11)

Is the control card over-loaded? Disconnect all control signal wires on the control card. (Remove control plugs)
Does that remove the fault?

No	Yes

12)

Check that the previous points are in order: The fault may have been caused by a short-circuiting of the control signals. Perhaps the 24 V supply has short-circuited.

13)

Contact Danfoss.

19)

Symptom

Motor stopped. Light in display, but no fault report.

20)

Start the VLT frequency converter by pressing [START] on the control panel.

21)

Has the display locked, i.e. it cannot be changed or is illegible?

No | **Yes**

22)

Check whether the following precautions have been taken!

- Have screened control cables been used?
- Are the screened cables connected correctly?

Yes

23)

Has the motor been correctly connected and are all motor phases in order?

Yes

24)

Put the frequency converter on local reference. Change the parameter setting as follows: Parameter 002 = *Local operation*. Parameter 003 = *desired reference value*.
Connect 24 V DC to terminal 27.
The reference is changed by means of the '+' and '-' keys. Is the motor running?

Yes | **No**

25)

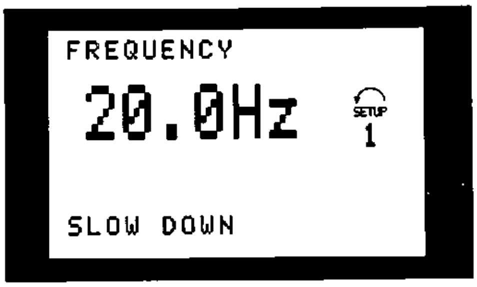
Check whether the control signals to the control card are in order.

26)

Contact Danfoss.

■ Status messages

Status messages appear in the 4th line of the display, see the below example. The status message will be on the display for approx. 3 seconds.



Start clockwise/anti-clockwise (START FORW./REV):
Input on digital inputs and parameter data are in conflict.

Slow-down (SLOW DOWN):
The output frequency of the VLT frequency converter is reduced by the percentage value chosen in parameter 219.

Catch-up (CATCH UP):
The output frequency of the VLT frequency converter is increased by the percentage value chosen in parameter 219.

Feedback high (FEEDBACK HIGH):
The FB value is higher than the value set in parameter 228. This message is only shown when the motor is running.

Feedback low (FEEDBACK LOW):
The FB value is lower than the value set in parameter 227. This message is only shown when the motor is running.

Output frequency high (FREQUENCY HIGH):
The output frequency is higher than the value set in parameter 226. This message is only shown when the motor is running.

Output frequency low (FREQUENCY LOW):
The output frequency is lower than the value set in parameter 225. This message is only shown when the motor is running.

Output current high (CURRENT HIGH):
The output current is higher than the value set in parameter 224. This message is only shown when the motor is running.

Output current low (CURRENT LOW):
The output current is lower than the value set in parameter 223. This message is only shown when the motor is running.

Braking max. (BRAKING MAX):
The brake is functioning.
Optimum braking is effected when the value in parameter 402 *Braking power limit, KW* is exceeded.

Braking (BRAKING):
The brake is functioning.

Ramp operation (REM/ RAMPING):
Remote has been selected in parameter 002 and the output frequency is changed in accordance with the ramps set.

Ramp operation (LOCAL/ RAMPING):
Local has been selected in parameter 002 and the output frequency is changed in accordance with the ramps set.

Status messages - cont.

VLT ready, remote control (REM/UNIT READY)
Remote control has been selected in parameter 002 and *Coasting stop* inverse in parameter 304, and there is 0 V on terminal 27.

VLT ready, local control (LOCAL/ UNIT READY)
Local has been selected in parameter 002 and *Coasting inverse* in parameter 304, and there is 0 V on terminal 27.

Quick-stop, remote control (REM/QSTOP)
Remote control has been selected in parameter 002 and the VLT frequency converter has stopped via a quick-stop signal on terminal 27 (or possibly via the serial communication port).

Quick-stop, local (LOCAL/ QSTOP)
Local has been selected in parameter 002 and the VLT frequency converter has stopped via a quick-stop signal on terminal 27 (or possibly via the serial communication port).

DC stop, remote control (REM/DC STOP)
Remote control has been selected in parameter 002 and the VLT frequency converter has stopped via a DC stop signal on a digital input (or possibly via the serial communication port).

DC braking, local (LOCAL/ DC STOP)
Local has been selected in parameter 002 and the VLT frequency converter has stopped via a DC braking signal on terminal 27 (or possibly via the serial communication port).

Stop, remote controlled (REM/STOP)
Remote control has been selected in parameter 002 and the VLT frequency converter has stopped via the control panel or a digital input (or possibly via the serial communication port).

Stop, local (LOCAL/ STOP)
Local has been selected in parameter 002 and the VLT frequency converter has stopped via the control panel or the digital input (or possibly via the serial communication port).

LCP stop, local (LOCAL/LCP STOP)
Local has been selected in parameter 002 and the VLT frequency converter has stopped via the control panel. The coast signal on terminal 27 is high.

Stand by (STAND BY)
Remote control has been selected in parameter 002. The frequency converter will start when it receives a start signal via a digital input (or the serial communication port).

Freeze output (FREEZE OUTPUT)
Remote control has been selected in parameter 002 together with *Freeze reference* in parameter 300, 301, 305, 306 or 307, and the terminal in question (16, 17, 29, 32 or 33) has been activated (or possibly via the serial communication port).

Jog operation, remote controlled (REM/RUN JOG)
Remote control has been selected in parameter 002 and *Jog* in parameter 300, 301, 305, 306 or 307, and the terminal in question (16, 17, 29, 32 or 33) has been activated (or possibly via the serial communication port).

Jog operation, local (LOCAL/ RUN JOG)
Local has been selected in parameter 002 and *Jog* in parameter 300, 301, 305, 306 or 307, and the terminal in question (16, 17, 29, 32 or 33) has been activated (or possibly via the serial communication port).

Overvoltage control (OVER VOLTAGE CONTROL)
The intermediate circuit voltage of the VLT frequency converter is too high. The frequency converter is trying to avoid a trip by increasing the output frequency.
This function is activated in parameter 400.

Exceptions XXXX (EXCEPTIONS XXXX)
The microprocessor of the control card has stopped and the VLT frequency converter is out of operation. The cause may be noise on the mains, motor or control cables, leading to a stop of the control card microprocessor.
Check for EMC-correct connection of these cables.

Warnings and alarms

List of warnings and alarms

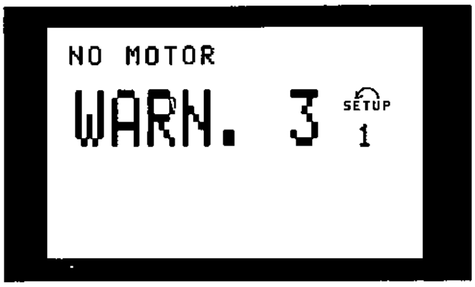
The table gives the different warnings and alarms and indicates whether the fault locks the VLT frequency converter. After Trip locked, the mains supply must be cut and the fault must be corrected. Reconnect the mains supply and reset the VLT frequency converter before being ready.

Wherever a cross is placed under both Warning and Alarm, this can mean that a warning precedes the alarm. It can also mean that it is possible to program whether a given fault is to result in a warning or an alarm. This is possible, e.g. in parameter 404 *Brake check*. After a trip, alarm and warning will flash, but if the fault is removed, only alarm will flash. After a reset, the VLT frequency converter will be ready to start operation again.

No.	Description	Warning	Alarm	Trip locked	Help
1	10 Volts low (10 VOLT LOW)	X			Page 155
2	Live zero fault (LIVE ZERO ERROR)	X	X		Page 155
3	No motor (NO MOTOR)	X			Page 155
4	Phase fault (MAINS PHASE LOSS)	X	X	X	Page 155
5	Voltage warning high (DC LINK VOLTAGE HIGH)	X			Page 155
6	Voltage warning low (DC LINK VOLTAGE LOW)	X			Page 155
7	Overvoltage (DC LINK OVERVOLT)	X	X		Page 155
8	Undervoltage (DC LINK UNDERVOLT)	X	X		Page 156
9	Inverter overladed (INVERTER TIME)	X	X		Page 156
10	Motor overloaded (MOTOR TIME)	X	X		Page 156
11	Motor thermistor (MOTOR THERMISTOR)	X	X		Page 156
12	Torque limit (TORQUE LIMIT)	X	X		Page 156
13	Overcurrent (OVERCURRENT)		X	X	Page 156
14	Earth fault (EARTH FAULT)		X	X	Page 156
15	Switch mode fault (SWITCH MODE FAULT)		X	X	Page 156
16	Short-circuit (CURR.SHORT CIRCUIT)		X	X	Page 156
17	Standard bus timeout (STD BUS TIMEOUT)	X	X		Page 156
18	HPFB bus timeout (HPFB TIMEOUT)	X	X		Page 157
19	Fault in EEprom on power card (EE ERROR POWER CARD)	X			Page 157
20	Fault in EEprom on conrol card (EE ERROR CTRL. CARD)	X			Page 157
21	Auto-optimisation OK (AUTO MOTOR ADAPT OK)		X		Page 157
22	Auto-optimisation not OK (AUTO MOT ADAPT FAIL)		X		Page 157
23	Brake test failed (BRAKE TEST FAILED)	X			Page 158
25	Brake resistor short-circuited (BRAKE RESISTOR FAULT)	X			Page 158
26	Brake resistor power 100% (BRAKE POWER 100%)	X	X		Page 158
27	Brake transistor short-circuited ( )	X			Page 158
29	Heat-sink temperature too high (HEAT SINK OVER TEMP.)		X	X	Page 158
30	Motor phase U missing (MISSING MOT.PHASE U)		X		Page 158
31	Motor phase V missing (MISSING MOT.PHASE V)		X		Page 158
32	Motor phase W missing (MISSING MOT.PHASE W)		X		Page 158
33	Quick discharge not OK (QUICK DISCHARGE FAIL)		X	X	Page 158
34	Profibus communication fault (PROFIBUS COMM. FAULT)	X	X		Page 159
35	Out of frequency range (OUT FREQ RNG/ROT LIM)	X			Page 159
36	Mains failure (MAINS FAILURE)	X	X		Page 159
37	Inverter fault (INVERTER FAULT)		X	X	Page 159
39	Check parameters 104 and 106 (CHECK P.104 & P.106)	X			Page 159
40	Check parameters 103 and 105 (CHECK P.103 & P.105)	X			Page 159
41	Motor too big (MOTOR TOO BIG)	X			Page 159
42	Motor too small (MOTOR TOO SMALL)	X			Page 159
43	Brake fault (BRAKE FAULT)		X	X	Page 159
44	Encoder loss (ENCODER FAULT)	X	X		Page 159

Warnings

The display flashes between normal state and warning. A warning comes up on the first and second line of the display. See examples below:



Alarm messages

The alarm comes up in the 2. and 3. line of the display, see example below:

WARN. 1
Under 10 Volts (10 VOLT LOW):
The 10 Volts voltage from terminal 50 on the control card is below 10 Volts.
Remove some of the load from terminal 50, as the 10 Volts supply is overloaded. Max. 17 mA/min. 590 Ω.

WARNING/ALARM 2
Live zero fault (LIVE ZERO ERROR):
The current signal on terminal 60 is less than 50% of the value set in parameter 315 *Terminal 60, min. scaling*.

WARNING/ALARM 3
No motor (NO MOTOR):
The motor check function (see parameter 122) indicates that no motor has been connected to the output of the VLT frequency converter.

WARNING/ALARM 4
Phase fault (MAINS PHASE LOSS):
Phase missing on the supply side or mains voltage imbalance too high.
Check the supply voltage to the VLT frequency converter.

WARNING 5
Voltage warning high
(DC LINK VOLTAGE HIGH):
The intermediate circuit voltage (DC) is higher than the overvoltage limit of the control system, see table on this page. The VLT frequency converter is still active.

WARNING 6
Voltage warning low (DC LINK VOLTAGE LOW):
The intermediate circuit voltage (DC) is below the undervoltage limit of the control system, see table below. The VLT frequency converter is still active.

WARNING/ALARM 7
Overvoltage (DC LINK OVERVOLT):
If the intermediate circuit voltage (DC) exceeds the inverter overvoltage limit (see table), the VLT frequency converter will trip after the time set in parameter 410 has passed.
Furthermore, the voltage will be stated in the display. The fault can be eliminated by connecting a brake resistor (if the VLT frequency converter has an integral brake chopper, EB or SB) or by extending the time chosen in parameter 410. In addition, *Brake function/overvoltage control* can be activated in parameter 400.

Alarm/warning limits:

VLT 5000 Series	3 x 200 - 240 V	3 x 380 - 500 V	
	[VDC]	[VDC]	
Undervoltage	211	402	
Voltage warning low	222	423	
Voltage warning high	384/405	801/840	(w/o brake - w/brake)
Overvoltage	425	855	

The voltages stated are the intermediate circuit voltage of the VLT frequency converter with a tolerance of ± 5 %. The corresponding mains voltage is the intermediate circuit voltage divided by √2.

Warnings and alarms, cont.

WARNING/ALARM 8
Undervoltage (DC LINK UNDERVOLT):
If the intermediate circuit voltage (DC) drops below the inverter lower voltage limit (see table on previous page), it will be checked whether 24 V power supply is connected.
If no 24 V power supply is connected, the VLT frequency converter will trip after a given time that depends on the unit.
Furthermore, the voltage will be stated in the display. Check whether the supply voltage matches the VLT frequency converter, see technical data.

WARNING/ALARM 9
Inverter overload (INVERTER TIME):
The electronic, thermal inverter protection reports that 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 gives a warning at 98% and trips at 100%, while giving an alarm. The VLT frequency converter cannot be reset until the counter is below 90%.
The fault is that the VLT frequency converter is overloaded by more than 100% for too long.

WARNING/ALARM 10
Motor overtemperature (MOTOR TIME):
According to the electronic thermal protection (ETR), the motor is too hot. Parameter 128 allows a choice of whether the VLT frequency converter is to give a warning or an alarm when the counter reaches 100%. The fault is that the motor is overloaded by more than 100% for too long. Check that motor parameters 102-106 have been set correctly.

WARNING/ALARM 11
Motor thermistor (MOTOR THERMISTOR):
The thermistor or the thermistor connection has been disconnected. Parameter 128 allows a choice of whether the VLT frequency converter is to give a warning or an alarm. Check that the thermistor has been correctly connected between terminal 53 or 54 (analogue voltage input) and terminal 50 (+ 10 Volts supply).

WARNING/ALARM 12
Torque limit (TORQUE LIMIT):
The torque is higher than the value in parameter 221 (in motor operation) or the torque is higher than the value in parameter 222 (in regenerative operation).

WARNING/ALARM 13
Overcurrent (OVERCURRENT):
The inverter peak current limit (approx. 200% of the rated current) has been exceeded. The warning will last approx. 1-2 seconds, following which the VLT frequency converter will trip, while giving an alarm. Turn off the VLT frequency converter and check whether the motor shaft can be turned and whether the motor size matches the VLT frequency converter.

ALARM: 14
Earth fault (EARTH FAULT):
There is a discharge from the output phases to earth, either in the cable between the frequency converter and the motor or in the motor itself.
Turn off the VLT frequency converter and remove the earth fault.

ALARM: 15
Switch mode fault (SWITCH MODE FAULT):
Fault in the switch mode power supply (internal ± 15 V supply).
Contact your Danfoss supplier.

ALARM: 16
Short-circuiting (CURR.SHORT CIRCUIT):
There is short-circuiting on the motor terminals or in the motor itself.
Turn off the VLT frequency converter and remove the short-circuit.

WARNING/ALARM 17
Standard bus timeout (STD BUSTIMEOUT)
There is no communication to the VLT frequency converter.
The warning will only be active when parameter 514 has been set to another value than *OFF*.
If parameter 514 has been set to *stop and trip*, it will first give a warning and then ramp down until it trips, while giving an alarm.
Parameter 513 *Bus time interval* could possibly be increased.

Warnings and alarms, cont.

WARNING/ALARM 18
HPFB bus timeout (HPFB BUS TIMEOUT)
There is no communication with the VLT frequency converter.
The warning will only be active when parameter 804 has been set to another value than *OFF*.
If parameter 804 has been set to *Stop and trip*, it will first give a warning and then ramp down until it trips, while giving an alarm.
Parameter 803 *Bus time interval* could possibly be increased.

WARNING 19
Fault in the EEprom on the power card
(EE ERROR POWER CARD)
There is a fault on the power card EEPROM. The VLT frequency converter will continue to function, but is likely to fail at the next power-up. Contact your Danfoss supplier.

WARNING 20
Fault in the EEprom on the control card
(EE ERROR CTRL CARD)
There is a fault in the EEPROM on the control card. The VLT frequency converter will continue to function, but is likely to fail at the next power-up. Contact your Danfoss supplier.

ALARM 21
Auto-optimisation OK
(AUTO MOTOR ADAPT OK)
The automatic motor tuning is OK and the VLT frequency converter is now ready for operation.

ALARM: 22
Auto-optimisation not OK
(AUTO MOT ADAPT FAIL)
A fault has been found during automatic motor adaptation. The text shown in the display indicates a fault message. The figure after the text is the error code, which can be seen in the fault log in parameter 615.

CHECK P.103,105 [0]
Parameter 102, 103 or 105 has a wrong setting. Correct the setting and start AMA all over.

LOW P.105 [1]
The motor is too small for AMA to be carried out. If AMA is to be enabled, the rated motor current (parameter 105) must be higher than 35% of the rated output current of the VLT frequency converter.

ASYMMETRICAL IMPEDANCE [2]
AMA has detected an asymmetrical impedance in the motor connected to the system. The motor could be defective.

MOTOR TOO BIG [3]
The motor connected to the system is too big for AMA to be carried out. The setting in parameter 102 does not match the motor used.

MOTOR TOO SMALL [4]
The motor connected to the system is too small for AMA to be carried out. The setting in parameter 102 does not match the motor used.

TIME OUT [5]
AMA fails because of noisy measuring signals. Try to start AMA all over a number of times, until AMA is carried out. Please note that repeated AMA runs may heat the motor to a level where the stator resistance R_S is increased. In most cases, however, this is not critical.

INTERRUPTED BY USER [6]
AMA has been interrupted by the user.

INTERNAL FAULT [7]
An internal fault has occurred in the VLT frequency converter. Contact your Danfoss supplier.

LIMIT VALUE FAULT [8]
The parameter values found for the motor are outside the acceptable range within which the VLT frequency converter is able to work.

MOTOR ROTATES [9]
The motor shaft rotates. Make sure that the load is not able to make the motor shaft rotate. Then start AMA all over.

NB!
AMA can only be carried out if there are no alarms during tuning.

Warnings and alarms, cont.

WARNING/ALARM 23
Fault during brake test (BRAKE TEST FAILED):
The brake test is only run after power-up. If *Warning* has been selected in parameter 404, the warning will come when the brake test finds a fault.
If *Trip* has been selected in parameter 404, the VLT frequency converter will trip when the brake test finds a fault.
The brake test may fail for the following reasons:
No brake resistor connected or fault in the connections; defective brake resistor or defective brake transistor. A warning or alarm will mean that the brake function is still active.

WARNING 25
Brake resistor fault
(BRAKE RESISTOR FAULT):
The brake resistor is monitored during operation and if it short-circuits, the brake function is disconnected and the warning comes up. The VLT frequency converter will still be able to work, although without the brake function. Turn off the VLT frequency converter and replace the brake resistor

WARNING 26
Brake resistor power 100%
(BRAKE PWR WARN 100%):
The power transmitted to the brake resistor is calculated as a percentage, as a mean value over the last 120 sec., on the basis of the resistance value of the brake resistor (parameter 401) and the intermediate circuit voltage. The warning is active when the dissipated braking power is higher than 100%. If *Trip* [2] has been selected in parameter 403, the VLT frequency converter will cut out while giving this alarm.

WARNING 27
Brake transistor fault
(BRAKE IGBT FAULT):
The brake transistor is monitored during operation and if it short-circuits, the brake function is disconnected and the warning comes up. The VLT frequency converter will still be able to run, but since the brake transistor has short-circuited, substantial power will be transmitted to the brake resistor, even if it is inactive.
Turn off the VLT frequency converter and remove the brake resistor.

⚠ Warning: There is a risk of substantial power being transmitted to the brake resistor if the brake transistor has short-circuited.

WARNING 29
Heat sink temperature too high
(HEAT SINK OVER TEMP.):
If the enclosure is IP 00 or IP 20, the cut-out temperature of the heat-sink is 90°C. If IP 54 is used, the cut-out temperature is 80°C.
The tolerance is ± 5°C. The temperature fault cannot be reset, until the temperature of the heat-sink is below 60°C.
The fault could be the following:
- Ambient temperature too high
- Too long motor cable
- Too high switching frequency.

ALARM: 30
Motor phase U missing
(MISSING MOT.PHASE U):
Motor phase U between VLT frequency converter and motor is missing.
Turn off the VLT frequency converter and check motor phase U.

ALARM: 31
Motor phase V missing
(MISSING MOT.PHASE V):
Motor phase V between VLT frequency converter and motor is missing.
Turn off the VLT frequency converter and check motor phase V.

ALARM: 32
Motor phase W missing
(MISSING MOT.PHASE W):
Motor phase W between VLT frequency converter and motor is missing.
Turn off the VLT frequency converter and check motor phase W.

ALARM: 33
Quick discharge not OK
(QUICK DISCHARGE NOT OK):
Check whether a 24 Volt external DC supply has been connected and that an external brake/discharge resistor has been fitted.

Warnings and alarms, cont.

WARNING/ALARM: 34
Profibus communication fault
(PROFIBUS COMMUNICATION FAULT):
The profibus on the communication option card is not working.

WARNING: 35
Out of frequency range
(OUT OF FREQUENCY RANGE):
This warning is active if the output frequency has reached its *Output frequency low limit* (parameter 201) or *Output frequency high limit* (parameter 202). If the VLT frequency converter is in *Process control, closed loop* (parameter 100), the warning will be active in the display. If the VLT frequency converter is in another mode than *Process control, closed loop*, bit 008000 *Out of frequency range* in warning word 2 will be active, while there will be no warning in the display.

WARNING/ALARM: 36
Mains failure (MAINS FAILURE):
This warning/alarm is only active if the supply voltage to the VLT frequency converter is lost and if parameter 407 *Mains fault* has been set to another value than *OFF*.
If parameter 407 has been set to *Contr. ramp-down trip* [2], the VLT frequency converter will first give a warning and then ramp down and trip, while giving an alarm. Check the fuses to the VLT frequency converter.

ALARM: 37
Inverter fault (INVERTER FAULT):
IGBT or the power card is defective. Contact your Danfoss supplier.
Auto-optimisation warnings
Automatic motor adaptation has stopped, since some parameters have probably been set wrongly, or the motor used in too big/small for AMA to be carried out. A choice must thus be made by pressing [CHANGE DATA] and choosing 'Continue' + [OK] or 'Stop' + [OK].
If parameters need to be changed, select 'Stop'; start up AMA all over.

WARNING: 39
CHECK P.104,106
The setting of parameter 102, 104 or 106 is probably wrong. Check the setting and choose 'Continue' or 'Stop'.

WARNING: 40
CHECK P.103,105
The setting of parameter 102, 103 or 105 is probably wrong. Check the setting and choose 'Continue' or 'Stop'.

WARNING: 41
MOTOR TOO BIG
The motor used is probably too big for AMA to be carried out. The setting in parameter 102 may not match the motor. Check the motor and choose 'Continue' or 'Stop'.

WARNING: 42
MOTOR TOO SMALL
The motor used is probably too small for AMA to be carried out. The setting in parameter 102 may not match the motor. Check the motor and choose 'Continue' or 'Stop'.

ALARM: 43
Brake fault (BRAKE FAULT)
A fault has arisen on the brake. The text shown in the display indicates a fault message. The figure after the text is the fault code that can be seen in the fault log, parameter 615.

Brake check failed (BRAKE CHECK FAILED) [0]
The brake check carried out during power-up indicates that the brake has been disconnected. Check whether the brake has been connected correctly and that it has not been disconnected.

Brake resistor short-circuited
(BRAKE RESISTOR FAULT) [1]
The brake output has short-circuited. Replace the brake resistor.

Brake IGBT short-circuited
(BRAKE IGBT FAULT) [2]
The brake IGBT has short-circuited. This fault means that the unit is not able to stop the brake and that, consequently, the resistor is constant being energized.

WARNING/ALARM: 44
Encoder loss (ENCODER FAULT)
The encoder signal is interrupted from terminal 32 or 33. Check the connections.

■ Warning word 1, Extended status word and Alarm word

Warning word 1, extended status word and alarm word are shown on the display in Hex format. If there are more than one warning or alarm, a sum of all warnings or alarms will be shown.
Warning word 1, extended status word and alarm word can also be displayed using the serial bus in parameter 540, 541 and 538.

Bit (Hex)	Warning word 1
000001	Fault during brake test
000002	EE-prom power card fault
000004	EE-prom control card
000008	HPFP bus timeout
000010	Standard bus timeout
000020	Overcurrent
000040	Torque limit
000080	Motor thermistor
000100	Motor overload
000200	Inverter overload
000400	Undervoltage
000800	Overvoltage
001000	Voltage warning low
002000	Voltage warning high
004000	Phase fault
008000	No motor
010000	4-20 mA current signal low
020000	10 Volts low
040000	
080000	Brake resistor power 100%
100000	Brake resistor fault
200000	Brake transistor fault
400000	Out of frequency range
800000	Profibus communication fault
1000000	
2000000	Mains failure
4000000	Encoder loss

Bit (Hex)	Extended status word
000001	Ramping
000002	Automatic motor tuning
000004	Start clockwise/anti-clockwise
000008	Slow down
000010	Catch-up
000020	Feedback high
000040	Feedback low
000080	Output current high
000100	Output current low
000200	Output frequency high
000400	Output frequency low
000800	Brake test ok
001000	Braking max.
002000	Braking
004000	Quick discharge OK
008000	Out of frequency range

Bit (Hex)	Alarm word 1
000001	Brake test failed
000002	Trip locked
000004	AMA tuning not OK
000008	AMA tuning OK
000010	Power-up fault
000020	ASIC fault
000040	HPFP bus timeout
000080	Standard bus timeout
000100	Short-circuiting
000200	Switchmode fault
000400	Earth fault
000800	Overcurrent
001000	Torque limit
002000	Motor thermistor
004000	Motor overload
008000	Inverter overload
010000	Undervoltage
020000	Overvoltage
040000	Phase fault
080000	Live zero fault
100000	Heat sink temperature too high
200000	Motor phase W missing
400000	Motor phase V missing
800000	Motor phase U missing
1000000	Quick discharge not ok
2000000	Profibus communication fault
4000000	Mains failure
8000000	Inverter fault
10000000	Encoder loss

Definitions

VLT:

$I_{VLT,MAX}$
The maximum output current.

$I_{VLT,N}$
The rated output current supplied by the VLT frequency converter.

$U_{VLT\ MAX}$
The maximum output voltage.

Output:

I_M
The current transmitted to the motor.

U_M
The voltage transmitted to the motor.

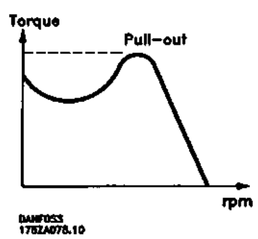
f_M
The frequency transmitted to the motor.

f_{JOG}
The frequency transmitted to the motor when the jog function is activated (via digital terminals or the keypad).

f_{MIN}
The minimum frequency transmitted to the motor.

f_{MAX}
The maximum frequency transmitted to the motor

Break-away torque:



η_{VLT}
The efficiency of the VLT frequency converter is defined as the ratio between the power output and the power input.

Input:

Control command:
By means of LCP and the digital inputs, it is possible to start and stop the connected motor.
Functions are divided into two groups, with the following priorities:

Group 1 Reset, Coasting stop, Reset and Coasting stop, Quick-stop, DC braking, Stop and the "Stop" key.
Group 2 Start, Pulse start, Reversing, Start reversing, Jog and Freeze output

Group 1 functions are called Start-disable commands. The difference between group 1 and group 2 is that in group 1 all stop signals must be cancelled for the motor to start. The motor can then be started by means of a single start signal in group 2.
A stop command given as a group 1 command results in the display indication STOP.
A missing stop command given as a group 2 command results in the display indication STAND BY.

Start-disable command:
A stop command that belongs to group 1 of the control commands - see this group.

Stop command:
See Control commands.

Motor:

$I_{M,N}$
The rated motor current (nameplate data).

$f_{M,N}$
The rated motor frequency (nameplate data).

$U_{M,N}$
The rated motor voltage (nameplate data).

$P_{M,N}$
The rated power delivered by the motor (nameplate data).

$n_{M,N}$
The rated motor speed (nameplate data).

$T_{M,N}$
The rated torque (motor).

Definitions

References:

preset ref.
A firmly defined reference which can be set from -100% to +100% of the reference range. There are four preset references, which can be selected via the digital terminals.

analogue ref.
A signal transmitted to input 53, 54 or 60. Can be voltage or current.

pulse ref.
A signal transmitted to the digital inputs (terminal 17 or 29).

binary ref.
A signal transmitted to the serial communication port.

Ref_{MIN}
The smallest value which the reference signal may have. Set in parameter 204.

Ref_{MAX}
The maximum value which the reference signal may have. Set in parameter 205.

Miscellaneous:

ELCB:
Earth Leakage Circuit Breaker.

lsb:
Least significant bit.
Used in serial communication.

msb
Most significant bit.
Used in serial communication.

PID:
The PID regulator maintains the desired speed (pressure, temperature, etc.) by adjusting the output frequency to match the varying load.

Trip:
A state which occurs in different situations, e.g. if the VLT frequency converter is subjected to an over-temperature. A trip can be cancelled by pressing reset or, in some cases, automatically.

Trip locked:
A state which occurs in different situations, e.g. if the VLT frequency converter is subject to an overtemperature. A locked trip can be cancelled by cutting off mains and restarting the VLT frequency converter.

Initializing:
If initializing is carried out (see page 144), the VLT frequency converter returns to the factory setting.

Setup:
There are four Setups, in which it is possible to save parameter settings. It is possible to change between the four parameter Setups and to edit one Setup, while another Setup is active.

LCP:
The control panel, which makes up a complete interface for control and programming of VLT 5000 Series. The control panel is detachable and may, as an alternative, be installed up to 3 metres away from the VLT frequency converter, i.e. in a front panel, by means of the installation kit option.

VVC plus
If compared with standard voltage/frequency ratio control, VVCplus improves the dynamics and the stability, both when the speed reference is changed and in relation to the load torque.

Slip compensation:
Normally, the motor speed will be affected by the load, but this load dependence is unwanted. The VLT frequency converter compensates for the slip by giving the frequency a supplement that follows the measured effective current.

Thermistor:
A temperature-dependent resistor placed where the temperature is to be monitored (VLT or motor).

Analogue inputs:
The analogue inputs can be used for controlling various functions of the VLT frequency converter.
There are two types of analogue inputs:
Current input, 0-20 mA
Voltage input, 0-10 V DC.

Analogue outputs:
There are two analogue outputs, which are able to supply a signal of 0-20 mA, 4-20 mA or a digital signal.

Digital inputs:
The digital inputs can be used for controlling various functions of the VLT frequency converter.

Digital outputs:
There are four digital outputs, two of which activate a relay switch. The outputs are able to supply a 24 V DC (max. 40 mA) signal.

Brake resistor:
The brake resistor is a module capable of absorbing the brake power that is generated in regenerative braking. This regenerative braking power increases the intermediate circuit voltage and a brake chopper ensures that the power is transmitted to the brake resistor.

Pulse encoder:
An external, digital pulse transmitter used for feeding back information on motor speed. The encoder is used in applications where great accuracy in speed control is required.

AWG:
Means American Wire Gauge, i.e. the American measuring unit for cable cross-section.

Manual initialisation:
Press the [CHANGE DATA] + [MENU] + [OK] keys at the same time to carry out manual initialisation. See also page 144.

60° AVM
Switching pattern called 60° Asynchronous Vector Modulation.

SFAVM
Switching pattern called Stator Flux oriented Asynchronous Vector Modulation.

Automatic motor adjustment, AMA:
Automatic motor adjustment algorithm, which determines the electrical parameters for the connected motor, at standstill.

On-line/off-line parameters:
On-line parameters are activated immediately after the data value is changed. Off-line parameters are not activated until OK has been entered on the control unit.

VT characteristics:
Variable torque characteristics, used for pumps and fans.

CT characteristics:
Constant torque characteristics, used for all applications, such as conveyor belts and cranes. CT characteristics are not used for pumps and fans.

MCM:
Stands for Mille Circular Mil, an American measuring unit for cable cross-section.
1 MCM ≅ 0.5067 mm².

PNU #	Parameter description	Factory setting	Range	Changes during operation	4-Setup	Conversion index	Data type
001	Language	English		Yes	No	0	5
002	Local/remote control	Remote control		Yes	Yes	0	5
003	Local reference	000.000		Yes	Yes	-3	4
004	Active setup	Setup 1		Yes	No	0	5
005	Programming setup	Active setup		Yes	No	0	5
006	Copying of setups	No copying		No	No	0	5
007	LCP copy	No copying		No	No	0	5
008	Display scaling of motor frequency	1	0.01 - 100.00	Yes	Yes	-2	6
009	Display linie 2	Frequency [Hz]		Yes	Yes	0	5
010	Display line 1.1	Reference [%]		Yes	Yes	0	5
011	Display line 1.2	Motor current [A]		Yes	Yes	0	5
012	Display line 1.3	Power [kW]		Yes	Yes	0	5
013	Local control/configura	LCP digital control/as par.100		Yes	Yes	0	5
014	Local stop	Possible		Yes	Yes	0	5
015	Local jog	Not possible		Yes	Yes	0	5
016	Local reversing	Not possible		Yes	Yes	0	5
017	Local reset of trip	Possible		Yes	Yes	0	5
018	Lock for data change	Not locked		Yes	Yes	0	5
019	Operating state at power-up, local control	Forced stop, use saved ref.		Yes	Yes	0	5
100	Configuration	Speed control, open loop		No	Yes	0	5
101	Torque characteristics	High - constant torque		Yes	Yes	0	5
102	Motor power	Depends on the unit	0.18-500 kW	No	Yes	1	6
103	Motor voltage	Depends on the unit	200 - 500 V	No	Yes	0	6
104	Motor frequency	50 Hz / 60 Hz		No	Yes	0	6
105	Motor current	Depends on the unit	0.01-$I_{VLT,MAX}$	No	Yes	-2	7
106	Rated motor speed	Depends on the unit	100-60000 rpm	No	Yes	0	6
107	Automatic motor adaptation, AMA	Adaptation off		No	No	0	5
108	Stator resistor	Depends on the unit		No	Yes	-4	7
109	Stator reactance	Depends on the unit		No	Yes	-2	7
110	Motor magnetizing, 0 rpm	100 %	0 - 300 %	Yes	Yes	0	6
111	Min. frequency normal magnetizing	1.0 Hz	0.1 - 10.0 Hz	Yes	Yes	-1	6
112							
113	Load compensation at low speed	100 %	0 - 300 %	Yes	Yes	0	6
114	Load compensation at high speed	100 %	0 - 300 %	Yes	Yes	0	6
115	Slip compensation	100 %	-500 - 500 %	Yes	Yes	0	3
116	Slip compensation time constant	0.50 s	0.05 - 1.00 s	Yes	Yes	-2	6
117	Resonance dampening	100 %	0 - 500 %	Yes	Yes	0	6
118	Resonance dampening time constant	5 ms	5 - 50 ms	Yes	Yes	-3	6
119	High starting torque	0.0 sec.	0.0 - 0.5 s	Yes	Yes	-1	5
120	Start delay	0.0 sec.	0.0 - 10.0 s	Yes	Yes	-1	5
121	Start function	Coasting in start delay time		Yes	Yes	0	5
122	Function at stop	Coasting		Yes	Yes	0	5
123	Min. frequency for activating function at stop	0.0 Hz	0.0 - 10.0 Hz	Yes	Yes	-1	5
124	DC holding current	50 %	0 - 100 %	Yes	Yes	0	6
125	DC braking current	50 %	0 - 100 %	Yes	Yes	0	6
126	DC braking time	10.0 sec.	0.0 - 60.0 sec.	Yes	Yes	-1	6
127	DC brake cut-in frequency	Off	0.0-par. 202	Yes	Yes	-1	6
128	Motor thermal protection	No protection		Yes	Yes	0	5
129	External motor fan	No		Yes	Yes	0	5
130	Start frequency	0.0 Hz	0.0-10.0 Hz	Yes	Yes	-1	5
131	Initial voltage	0.0 V	0.0-par. 103	Yes	Yes	-1	6

PNU #	Parameter description	Factory setting	Range	Changes during operation	4-Setup	Conversion index	Data type
200	Output frequency range/direction	Only clockwise, 0-132 Hz		No	Yes	0	5
201	Output frequency low limit	0.0 Hz	0.0 - f_{MAX}	Yes	Yes	-1	6
202	Output frequency high limit	66 / 132 Hz	f_{MIN} - par. 200	Yes	Yes	-1	6
203	Reference/feedback area	Min - max		Yes	Yes	0	5
204	Minimum reference	0.000	-100,000.000-Ref_{MAX}	Yes	Yes	-3	4
205	Maximum reference	50.000	Ref_{MIN}-100,000.000	Yes	Yes	-3	4
206	Ramp type	Linear		Yes	Yes	0	5
207	Ramp-up time 1	Depends on unit	0.05 - 3600	Yes	Yes	-2	7
208	Ramp-down time 1	Depends on unit	0.05 - 3600	Yes	Yes	-2	7
209	Ramp-up time 2	Depends on unit	0.05 - 3600	Yes	Yes	-2	7
210	Ramp-down time 2	Depends on unit	0.05 - 3600	Yes	Yes	-2	7
211	Jog ramp time	Depends on unit	0.05 - 3600	Yes	Yes	-2	7
212	Quick stop ramp-down time	Depends on unit	0.05 - 3600	Yes	Yes	-2	7
213	Jog frequency	10.0 Hz	0.0 - par. 202	Yes	Yes	-1	6
214	Reference function	Sum		Yes	Yes	0	5
215	Preset reference 1	0.00 %	- 100.00 - 100.00 %	Yes	Yes	-2	3
216	Preset reference 2	0.00 %	- 100.00 - 100.00 %	Yes	Yes	-2	3
217	Preset reference 3	0.00 %	- 100.00 - 100.00 %	Yes	Yes	-2	3
218	Preset reference 4	0.00 %	- 100.00 - 100.00 %	Yes	Yes	-2	3
219	Catch up/slow down value	0.00 %	0.00 - 100 %	Yes	Yes	-2	6
220							
221	Torque limit for motor mode	160 %	0.0 % - xxx %	Yes	Yes	-1	6
222	Torque limit for regenerative operation	160 %	0.0 % - xxx %	Yes	Yes	-1	6
223	Warning: Low current	0.0 A	0.0 - par. 224	Yes	Yes	-1	6
224	Warning: High current	$I_{VLT,MAX}$	Par. 223 - $I_{VLT,MAX}$	Yes	Yes	-1	6
225	Warning: Low frequency	0.0 Hz	0.0 - par. 226	Yes	Yes	-1	6
226	Warning: High frequency	132.0 Hz	Par. 225 - par. 202	Yes	Yes	-1	6
227	Warning: Low feedback	-4000.000	-100,000.000 - par. 228	Yes		-3	4
228	Warning: High feedback	4000.000	Par. 227 - 100,000.000	Yes		-3	4
229	Frequency bypass, bandwidth	OFF	0 - 100 %	Yes	Yes	0	6
230	Frequency bypass 1	0.0 Hz	0.0 - par. 200	Yes	Yes	-1	6
231	Frequency bypass 2	0.0 Hz	0.0 - par. 200	Yes	Yes	-1	6
232	Frequency bypass 3	0.0 Hz	0.0 - par. 200	Yes	Yes	-1	6
233	Frequency bypass 4	0.0 Hz	0.0 - par. 200	Yes	Yes	-1	6
234	Motor phase monitor	Enable		Yes	Yes	0	5

PNU #	Parameter description	Factory setting	Range	Changes during operation	4-Setup	Conversion index	Data type
300	Terminal 16, input	Reset		Yes	Yes	0	5
301	Terminal 17, input	Freeze reference		Yes	Yes	0	5
302	Terminal 18 Start, input	Start		Yes	Yes	0	5
303	Terminal 19, input	Reversing		Yes	Yes	0	5
304	Terminal 27, input	Coasting stop, inverse		Yes	Yes	0	5
305	Terminal 29, input	Jog		Yes	Yes	0	5
306	Terminal 32, input	Choice of setup, msb/speed up		Yes	Yes	0	5
307	Terminal 33, input	Choice of setup, lsb/speed down		Yes	Yes	0	5
308	Terminal 53, analogue input voltage	Reference		Yes	Yes	0	5
309	Terminal 53, min. scaling	0.0 V	0.0 - 10.0 V	Yes	Yes	-1	5
310	Terminal 53, max. scaling	10.0 V	0.0 - 10.0 V	Yes	Yes	-1	5
311	Terminal 54, analogue input voltage	No operation		Yes	Yes	0	5
312	Terminal 54, min. scaling	0.0 V	0.0 - 10.0 V	Yes	Yes	-1	5
313	Terminal 54, max. scaling	10.0 V	0.0 - 10.0 V	Yes	Yes	-1	5
314	Terminal 60, analogue input current	Reference		Yes	Yes	0	5
315	Terminal 60, min. scaling	0.0 mA	0.0 - 20.0 mA	Yes	Yes	-4	5
316	Terminal 60, max. scaling	20.0 mA	0.0 - 20.0 mA	Yes	Yes	-4	5
317	Time out	10 sec.	1 - 99 sec.	Yes	Yes	0	5
318	Function after time out	Off		Yes	Yes	0	5
319	Terminal 42, output	0 - $I_{MAX} \Rightarrow$ 0-20 mA		Yes	Yes	0	5
320	Terminal 42, output, pulse scaling	5000 Hz	1 - 32000 Hz	Yes	Yes	0	6
321	Terminal 45, output	0 - $f_{MAX} \Rightarrow$ 0-20 mA		Yes	Yes	0	5
322	Terminal 45, output, pulse scaling	5000 Hz	1 - 32000 Hz	Yes	Yes	0	6
323	Relay 01, output	Ready - no thermal warning		Yes	Yes	0	5
324	Relay 01, ON delay	0.00 sec.	0.00 - 600 sec.	Yes	Yes	-2	6
325	Relay 01, OFF delay	0.00 sec.	0.00 - 600 sec.	Yes	Yes	-2	6
326	Relay 04, output	Ready - remote control		Yes	Yes	0	5
327	Pulse reference, max. frequency	5000 Hz		Yes	Yes	0	6
328	Pulse feedback, max. frequency	25000 Hz		Yes	Yes	0	6
329	Encoder feedback pulse/rev.	1024 pulses/rev.	1 - 4096pulses/rev.	Yes	Yes	0	6
330	Freeze reference/output function	No operation		Yes	No	0	5
345	Encoder loss timeout	0 sec.	0 - 60 sec	No	Yes	-1	6
346	Encoder loss function	OFF		Yes	Yes	0	5

Changes during operation:
"Yes" means that the parameter can be changed, while the VLT frequency converter is in operation. "No" means that the VLT frequency converter must be stopped before a change can be made.

4-Setup:
"Yes" means that the parameter can be programmed individually in each of the four setups, i.e. the same parameter can have four different data values. "No" means that the data value will be the same in all four setups.

Conversion index:
This number refers to a conversion figure to be used when writing or reading by means of a VLT frequency converter.

Conversion index	Conversion factor
74	0.1
2	100
1	10
0	1
-1	0.1
-2	0.01
-3	0.001
-4	0.0001

Data type:
Data type shows the type and length of the telegram.

Data type	Description
3	Integer 16
4	Integer 32
5	Unsigned 8
6	Unsigned 16
7	Unsigned 32
9	Text string

PNU #	Parameter description	Factory setting	Range	Changes during operation	4-Setup	Conversion index	Data type
400	Brake function/overvoltage control	Off		Yes	No	0	5
401	Brake resistor, ohm	Depends on the unit		Yes	No	-1	6
402	Brake power limit, kW	Depends on the unit		Yes	No	2	6
403	Power monitoring	On		Yes	No	0	5
404	Brake check	Off		Yes	No	0	5
405	Reset function	Manual reset		Yes	Yes	0	5
406	Automatic restart time	5 sec.	0 - 10 sec.	Yes	Yes	0	5
407	Mains Failure	No function		Yes	Yes	0	5
408	Quick discharge	Not possible		Yes	Yes	0	5
409	Trip delay torque	Off	0 - 60 sec.	Yes	Yes	0	5
410	Trip delay-inverter	Depends on type of unit	0 - 35 sec.	Yes	Yes	0	5
411	Switching frequency	Depends on type of unit	3 - 14 kHz	Yes	Yes	2	6
412	Output frequency dependent switching frequency	Not possible		Yes	Yes	0	5
413	Overmodulation function	On		Yes	Yes	-1	5
414	Minimum feedback	0.000	-100,000.000 - FB_{HIGH}	Yes	Yes	-3	4
415	Maximum feedback	1500.000	FB_{LOW} - 100,000.000	Yes	Yes	-3	4
416	Process unit	%		Yes	Yes	0	5
417	Speed PID proportional gain	0.015	0.000 - 0.150	Yes	Yes	-3	6
418	Speed PID integration time	8 ms	2.00 - 999.99 ms	Yes	Yes	-4	7
419	Speed PID differentiation time	30 ms	0.00 - 200.00 ms	Yes	Yes	-4	6
420	Speed PID diff. gain ratio	5.0	5.0 - 50.0	Yes	Yes	-1	6
421	Speed PID low-pass filter	10 ms	5 - 200 ms	Yes	Yes	-4	6
422	U 0 voltage at 0 Hz	20.0 V	0.0 - parameter 103	Yes	Yes	-1	6
423	U 1 voltage	parameter 103	0.0 - $U_{VLT, MAX}$	Yes	Yes	-1	6
424	F 1 frequency	parameter 104	0.0 - parameter 426	Yes	Yes	-1	6
425	U 2 voltage	parameter 103	0.0 - $U_{VLT, MAX}$	Yes	Yes	-1	6
426	F 2 frequency	parameter 104	par.424-par.428	Yes	Yes	-1	6
427	U 3 voltage	parameter 103	0.0 - $U_{VLT, MAX}$	Yes	Yes	-1	6
428	F 3 frequency	parameter 104	par.426 -par.430	Yes	Yes	-1	6
429	U 4 voltage	parameter 103	0.0 - $U_{VLT, MAX}$	Yes	Yes	-1	6
430	F 4 frequency	parameter 104	par.426-par.432	Yes	Yes	-1	6
431	U 5 voltage	parameter 103	0.0 - $U_{VLT, MAX}$	Yes	Yes	-1	6
432	F 5 frequency	parameter 104	par.426 - 1000 Hz	Yes	Yes	-1	6
433	Torque proportional gain	100%	0 (OFF) - 500%	Yes	Yes	0	6
434	Torque integral time	0.02 sec.	0.002 - 2.000 sec.	Yes	Yes	-3	7
437	Process PID Normal/inverse control	Normal		Yes	Yes	0	5
438	Process PID anti windup	On		Yes	Yes	0	5
439	Process PID start frequency	parameter 201	f_{MIN} - f_{MAX}	Yes	Yes	-1	6
440	Process PID proportional gain	0.01	0.00 - 10.00	Yes	Yes	-2	6
441	Process PID integral time	9999.99 sec. (OFF)	0.01 - 9999.99 sec.	Yes	Yes	-2	7
442	Process PID differentiation time	0.00 sec. (OFF)	0.00 - 10.00 sec.	Yes	Yes	-2	6
443	Process PID diff. gain limit	5.0	5.0 - 50.0	Yes	Yes	-1	6
444	Process PID lowpass filter time	0.01	0.01 - 10.00	Yes	Yes	-2	6
445	Flying start	Disable		Yes	Yes	0	5
446	Switching pattern	SFAVM		Yes	Yes	0	5
447	Torque compensation	100%	-100 - +100%	Yes	Yes	0	3
448	Gear ratio	1	0.001 - 100.000	No	Yes	-2	4
449	Friction loss	0%	0 - 50%	No	Yes	-2	6
450	Mains voltage at mains fault	Depends on unit	Depends on unit	Yes	Yes	0	6
453	Speed closed loop gear ratio	1	0.01-100	No	Yes	0	4
454	Dead time compensation	On		No	No	0	5

PNU #	Parameter description	Factory setting	Range	Changes during operation	4-Setup	Conversion index	Data type
500	Address	1	0 - 126	Yes	No	0	6
501	Baudrate	9600 Baud		Yes	No	0	5
502	Coasting	Logic or		Yes	Yes	0	5
503	Quick-stop	Logic or		Yes	Yes	0	5
504	DC-brake	Logic or		Yes	Yes	0	5
505	Start	Logic or		Yes	Yes	0	5
506	Reversing	Logic or		Yes	Yes	0	5
507	Selection of setup	Logic or		Yes	Yes	0	5
508	Selection of speed	Logic or		Yes	Yes	0	5
509	Bus jog 1	10.0 Hz	0.0 - parameter 202	Yes	Yes	-1	6
510	Bus jog 2	10.0 Hz	0.0 - parameter 202	Yes	Yes	-1	6
511							
512	Telegram profile	FC Drive		No	Yes	0	5
513	Bus time interval	1 sec.	1 - 99 s	Yes	Yes	0	5
514	Bus time interval function	Off		Yes	Yes	0	5
515	Data read-out: Reference %			No	No	-1	3
516	Data read-out: Reference unit			No	No	-3	4
517	Data read-out: Feedback			No	No	-3	4
518	Data read-out: Frequency			No	No	-1	6
519	Data read-out: Frequency x Scaling			No	No	-2	7
520	Data read-out: Current			No	No	-2	7
521	Data read-out: Torque			No	No	-1	3
522	Data read-out: Power, kW			No	No	-1	7
523	Data read-out: Power, HP			No	No	-2	7
524	Data read-out: Motor voltage			No	No	-1	6
525	Data read-out: DC link voltage			No	No	0	6
526	Data read-out: Motor temp.			No	No	0	5
527	Data read-out: VLT temp.			No	No	0	5
528	Data read-out: Digital input			No	No	0	5
529	Data read-out: Terminal 53, analogue input			No	No	-2	3
530	Data read-out: Terminal 54, analogue input			No	No	-2	3
531	Data read-out: Terminal 60, analogue input			No	No	-5	3
532	Data read-out: Pulse reference			No	No	-1	7
533	Data read-out: External reference %			No	No	-1	3
534	Data read-out: Status word, binary			No	No	0	6
535	Data read-out: Brake power/2 min.			No	No	2	6
536	Data read-out: Brake power/sec.			No	No	2	6
537	Data read-out: Heat sink temperature			No	No	0	5
538	Data read-out: Alarm word, binary			No	No	0	7
539	Data read-out: VLT control word, binary			No	No	0	6
540	Data read-out: Warning word, 1			No	No	0	7
541	Data read-out: Warning word, 2			No	No	0	7

PNU #	Parameter description	Factory setting	Range	Changes during operation	4-Setup	Conversion index	Data type
600	Operating data: Operating hours			No	No	74	7
601	Operating data: Hours run			No	No	74	7
602	Operating data: kWh counter			No	No	2	7
603	Operating data: Number of power-up's			No	No	0	6
604	Operating data: Number of overtemperatures			No	No	0	6
605	Operating data: Number of overvoltages			No	No	0	6
606	Data log: Digital input			No	No	0	5
607	Data log: Bus commands			No	No	0	6
608	Data log: Bus status word			No	No	0	6
609	Data log: Reference			No	No	-1	3
610	Data log: Feedback			No	No	-3	4
611	Data log: Motor frequency			No	No	-1	3
612	Data log: Motor voltage			No	No	-1	6
613	Data log: Motor current			No	No	-2	3
614	Data log: DC link voltage			No	No	0	6
615	Fault log: Error code			No	No	0	5
616	Fault log: Time			No	No	-1	7
617	Fault log: Value			No	No	0	3
618	Reset of kWh counter	No reset		Yes	No	0	5
619	Reset of hours-run counter	No reset		Yes	No	0	5
620	Operating mode Normal function	Normal function		No	No	0	5
621	Nameplate: VLT type			No	No	0	9
622	Nameplate: Power section			No	No	0	9
623	Nameplate: VLT ordering number			No	No	0	9
624	Nameplate: Software version no.			No	No	0	9
625	Nameplate: LCP identification no.			No	No	0	9
626	Nameplate: Database identification no.			No	No	-2	9
627	Nameplate: Power section identification no.			No	No	0	9
628	Nameplate: Application option type			No	No	0	9
629	Nameplate: Application option ordering no.			No	No	0	9
630	Nameplate: Communication option type			No	No	0	9
631	Nameplate: Communication option ordering no.			No	No	0	9

Changes during operation:

"Yes" means that the parameter can be changed, while the VLT frequency converter is in operation. "No" means that the VLT frequency converter must be stopped before a change can be made.

4-Setup:

"Yes" means that the parameter can be programmed individually in each of the four setups, i.e. the same parameter can have four different data values. "No" means that the data value will be the same in all four setups.

Conversion index:

This number refers to a conversion figure to be used when writing or reading by means of a VLT frequency converter.

Conversion index	Conversion factor
74	0.1
2	100
1	10
0	1
-1	0.1
-2	0.01
-3	0.001
-4	0.0001

Data type:

Data type shows the type and length of the telegram.

Data type	Description
3	Integer 16
4	Integer 32
5	Unsigned 8
6	Unsigned 16
7	Unsigned 32
9	Text string

PNU #	Parameter description	Factory setting	Range	Changes during operation	4-Setup	Conversion index	Data type
700	**Relay 6, function**	Ready signal		Yes	Yes	0	5
701	**Relay 6, ON delay**	0 sec.	0.00-600 sec.	Yes	Yes	-2	6
702	**Relay 6, OFF delay**	0 sec.	0.00-600 sec.	Yes	Yes	-2	6
703	**Relay 7, function**	Motor running		Yes	Yes	0	5
704	**Relay 7, ON delay**	0 sec.	0.00-600 sec.	Yes	Yes	-2	6
705	**Relay 7, OFF delay**	0 sec.	0.00-600 sec.	Yes	Yes	-2	6
706	**Relay 8, function**	Mains ON		Yes	Yes	0	5
707	**Relay 8, ON delay**	0 sec.	0.00-600 sec.	Yes	Yes	-2	6
708	**Relay 8, OFF delay**	0 sec.	0.00-600 sec.	Yes	Yes	-2	6
709	**Relay 9, function**	Fault		Yes	Yes	0	5
710	**Relay 9, ON delay**	0 sec.	0.00-600 sec.	Yes	Yes	-2	6
711	**Relay 9, OFF delay**	0 sec.	0.00-600 sec.	Yes	Yes	-2	6

L

M

N

O

P

Q

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S

T

V

W

Parameter settings

Parameter No.	Settings			
	1	2	3	4

Parameter settings

Parameter No.	Settings			
	1	2	3	4

Parameter settings

Parameter No.	Settings 1	Settings 2	Settings 3	Settings 4

Parameter settings

Parameter No.	Settings			
	1	2	3	4

Parameter settings

Parameter No.	Settings			
	1	2	3	4

Parameter settings

Parameter No.	Settings			
	1	2	3	4

4

4. Parameters for VLT

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WARNING! **Electrical installation**

The voltage on the frequency converter is dangerous when the unit is connected to mains. Incorrect installation of the motor or VLT frequency converter may lead to material damage or serious injury or it may be fatal. Consequently, the instructions in this manual as well as national and local rules and safety regulations must be complied with.

Touching the electrical parts may be fatal, even after the mains supply has been disconnected. Wait at least 4 minutes if using VLT 5001-5006 and at least 15 minutes if using VLT 5008-5500.

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	Action	Value	Remark
1	Power off the VLT		Wait until the display on the Danfoss VLT is off
2	Check that the motor cables are connected to delta		
3	Power on the VLT		
4	Press stop button on Danfoss VLT		Display is flashing
5	Select 'Initialize' in Parameter P 620	'Initialize'	This will reset all parameters in the VLT
6	Power off the Danfoss VLT		Wait until the display on the Danfoss VLT is off
7	Power on the Danfoss VLT		The parameters in the Danfoss VLT are reset to factory setting
8	Press stop button on Danfoss VLT		Display is flashing
9	Feed in values from the motor plate to Parameter P 102, P 103, P 104, P 105, P 106		Values from the motor plate
10	Bridge terminal 12 and 27 in the Danfoss VLT		
11	Set Parameter 107	Full motor tuning Enable (Rs, Xs)	
12	Press start button on the VLT		The tuning takes 5 to 10 minutes. Shows "working" or "Auto motor tuning" while motor tuning is made. When alarm 21 appears, the tuning is ready.
13	Press STOP button on the VLT		Display is flashing
14	Remove bridge in the VLT between terminals 12 and 27		
15	New values will apeear in the parameters P 108 and P 109 from the mutor tuning.		Values automatically set by the motor tuning
16	Set parameter P 115	0%	Slip compensation

	Action	Value	Remark
17	Set parameter P 128	'Termistor trip'	Motors for frequenzy drive shall have termistors in windings
18	Set parameter P 202	See table 1	Out freq. High limit
19	Set parameter P 204	See table 1	Min. freq.
20	Set parameter P 205	See table 1	Max. Ref.
21	Set parameter P 207	800 sec.	Ramp up time
22	Set parameter P 208	900 sec.	Ramp down time
23	Set parameter P 211	600 sec.	Jog ramp time
24	Set parameter P 213	See table 1	Jog frequenzy
25	Set parameter P 308	Termistor input	Terminal 53 , Termistor input
26	Set parameter P 319	0-I max 4-20 mA (Current signal)	Terminal 42 output, current signal
27	Set parameter P 323	VLT running	Relay 01, Output
28	Set parameter P 324	5 sec.	Relay 01, Delay
29	Set parameter P 326	Alarm	Relay 04, Output
30	Set parameter P 400	Overvoltage control	Brake function (necessary for 2-speed)
31	Set parameter P 445	Enable	(Flying start)
32	Press 'START' on VLT		Display goes steady (not flashing). The programming of the Danfoss VLT is now ready
33	Press "Display/Status" push-button on the Danfoss VLT to get wanted display		

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Parameter list for 50 Hz

Separator Tetra Centri	Motor [kW]	VLT type Danfoss	Parameter P202 gear	Parameter P204 gear	Parameter P205 gear	Parameter P213 gear
610	18,5	5032	50	50	50	50
614	18,5	5032	50	50	50	50
714	22	5032	50	50	50	50
518	22	5052	50	50	50	50
618	25/37	5052	50	50	50	50
718	25	5052	50	50	50	50
617 *	37	5052	50	50	50	50
617 *	45	5060	50	50	50	50
818	37	5052	55	55	55	55

* Different motor alternatives

Parameter list for 60 Hz

Separator Tetra Centri	Motor [kW]	VLT type Danfoss	Parameter P202 gear	Parameter P204 gear	Parameter P205 gear	Parameter P213 gear
610	18,5	5032	60	60	60	60
614	18,5	5032	60	60	60	60
714	22	5032	60	60	60	60
518	22	5052	60	60	60	60
618	25/37	5052	60	60	60	60
718	25	5052	60	60	60	60
617 *	37	5052	60	60	60	60
617 *	45	5060	60	60	60	60
818	37	5052	66	66	66	66

* Different motor alternatives

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