



# Operating Instructions

## Motor Protection Relay MS 220



for integration with the  
VLT® AutomationDrive FC 302

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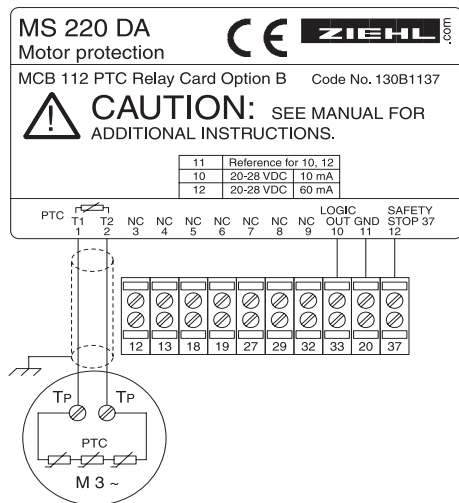
# Operating manual motor protection MS 220 DA

## Application and short description

TMP tripping device MS 220 DA - MCB 112 PTC Relay Option B is designed as a passive option interface for Danfoss Frequency Converter series VLT®. The MS 220 DA fulfils the requirements of the document P400 Platform "Identification of passive option" and will be recognized automatically by the drive. TMP tripping device is according EN 60947-8 (VDE 0660 part 0302). PTC-thermistor sensors according DIN 44081 und 44082 (VDE 0660 part 0303) can be connected. The TMP tripping device can be used to protect electrical machines against inadmissible heating due to overload. With ATEX marking it can also be used as protection device for explosion-protected motors in areas with explosive gas atmospheres Zone 1 (refer to marking G) and locations with explosive dust atmospheres Zone 21 (refer to marking D). All functions in the TMP tripping device serve to protect non-explosive-protected motors and explosive-protected motors in regular operation and in case of failure.

Approvals: marking see type plate on the device.

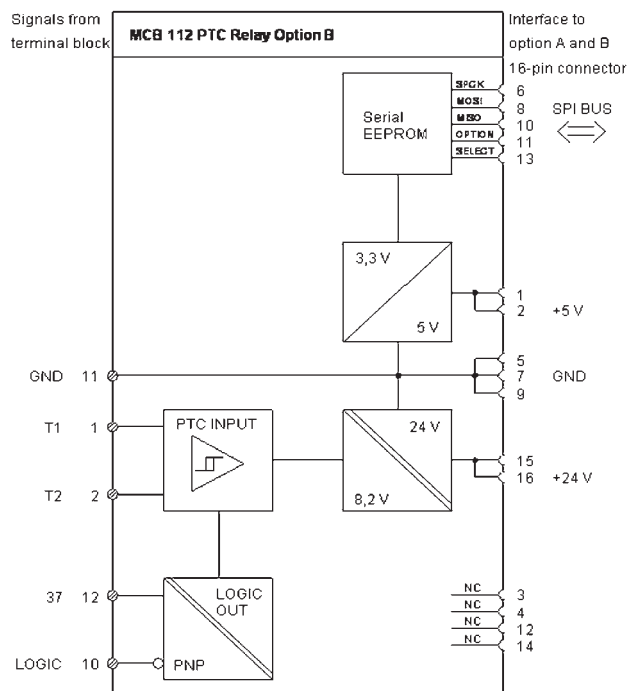
## Connection plan



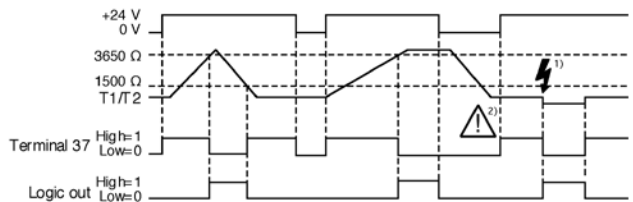
## Overview of functions

The TMP tripping device MS 220 DA - MCB 112 PTC Relay Option B includes a tripping stage for PTC-thermistor sensors with save potential separation from supply voltage and ground. The tripping function switches of the +24 Volt voltage directly at the Safety Stop terminal 37 of the drive. The PNP logic output terminal 10 signals the status in case of failure. The TMP tripping device works according to the closed-circuit principle. The device trips in case of short-circuit or line interruption. The MS 220 DA needs +24 VDC supply voltage. The serial EEPROM enables the drive to recognize the built-in option module.

## Block diagram



## Detailed description



1) Shortcut - 2) Attention! Tripping will not be saved and is not protected against zero voltage.

A current monitors continuously the resistance of the sensors. In cold state, the resistance is  $< 250 \Omega$  per sensor (sensor circuit  $< 1,5 \text{ k}\Omega$ ). The output to terminal 37 is high = 1. The resistance of the sensor rises rapidly at nominal response temperature TNF. At a resistance of 3...4 kΩ output to terminal 37 changes to low = 0. The devices also switch off in the case of sensor or line short-circuit ( $< \text{approx. } 20 \Omega$ ) or sensor or line interruption. It switches on automatically when the temperature has decreased approx. 5 °C.

Depending on the number of sensors the following tripping and release temperatures will be achieved with respect of TNF (nominal response temperature of the sensors):

	Trip temperature	Release temperature
3 sensors in series	TNF + 5 K	TNF - 5 K
3 sensors in series	TNF	TNF - 20 K

## ■ Important notes

To use the equipment flawless and safe, transport and store properly, install and start professionally and operate as directed.

Only let persons work with the equipment who are familiar with installation, start and use and who have appropriate qualification corresponding to their function. They must observe the contents of the instructions manual, the information written on the equipment and the relevant security instructions for the setting up and the use of electrical units.

The equipments are built according to EN 60947 and checked and leave the plant according to security in perfect condition. To keep this condition, observe the security instructions with the headline „Attention“ written in the instructions manual. Ignoring of the security instructions may lead to death, physical injury or damage of the equipment itself and of other apparatus and equipment.

If, in any case the information in the instructions manual is not sufficient, please contact our company or the responsible representative.

Instead of the industrial norms and regulations written in this instructions manual valid for Europe, you must observe out of their geographical scope the valid and relevant regulations of the corresponding country.



**Attention!**  
Safety Circuits according to EN 60204. The equipment must not be used alone for functions, when a automatic start must be avoided.

## ■ Assembly

The TMP tripping device MS 220 DA - MCB 220 PTC Relay Option B is intended to be used in Danfoss Automation Drives series VLT®. PTC-thermistor sensors are connected directly to the terminals T1, T2. The lines of Safety Stop 37 and Logic Out are to be routed separately. Attention: Routed lines must keep enough distance to sensor lines and other mainstream lines.

## Putting into operation

The correct function of the TMP tripping device has to be tested by simulation of the sensor resistance at terminals T1, T2.

This test can additionally be done with maintenance services:

Short circuit test: resistance 20 Ω in parallel to sensor terminals T1, T2

Line interruption test: disconnect sensor line at terminal T1 or T2

Temperature test: increase resistance 50...1500 Ω up to 4000 Ω.

The tripping function will be displayed on the drive display and must be reseted manually.

Please notice the admissible ambient conditions  
-> Technical data.



### Attention!

The TMP tripping device MS 220 DA was designed for Class A. The use of this product in home applications can cause radio frequency distortions.

## Maintenance and repair

The devices are maintenance-free. Only the manufacturer may accomplish repairs. We recommend an examination within the regular maintenance periods of the plant, in which the equipment is installed.

## Warranty

The guarantee presupposes the observance of this operating instruction (safety and start-up instructions).

## Safety Integrity Level (IEC 61508)

The safety function of the safety equipment

- achieves SIL 1 within a test interval of 3 years
- achieves SIL 2 within a test interval of 2 years.

The safety function fulfils the recommendations of category 2 according ISO 13849-1. More safety-related parameters -> Technical data

## Operating manual motor protection MS 220 DA

### Trouble shooting

- The resistance within the sensor circuit must have a value  $50 \Omega < R < 1500 \Omega$ . The voltage at terminals T1, T2 must be  $< 2,5 \text{ VDC}$  when PTC-thermistor sensor are connected and the temperature is below TNF.
- The TMP tripping device must shut down when the sensor circuit is open. The voltage at terminals T1, T2 must be  $< 8 \text{ VDC}$ .

### Testing conditions

	EN 60 947-8, EN 50178
Rated impulse voltage	6000 V
Over voltage category	III
Contamination level	2
Rated insulation voltage $U_i$	690 V
Safe separation up to $U_i$	500 V
Rated ambient temperature range	-20 °C ... +60 °C
	EN 60068-2-1 Dry Heat
Rel. humidity	5...95% without condensation
EMC – Immunity industry standard	EN 61000-6-2
EMC – Emission industry standard	EN 61000-6-4
Vibration resistance	10...1000 Hz 1,14g
Shock resistance	50 g

### Safety-related parameters

ISO 13849	Cat. 2
EN 61508 ( $T_a = 75 \text{ °C}$ ):	
SIL 1 within a test interval of 3 years	
SIL 2 within a test interval of 2 years	
HFT	0
PFD (test interval one year)	$4,10 \cdot 10^{-03}$
SFF	90 %
$\lambda_S + \lambda_{DD}$	8515 FIT
$\lambda_{DU}$	932 FIT

### Housing

	<b>Form 130B4065</b>
Dimensions (H x B x T) mm	82,5 x 69,5 x 29,5
Line connection solid wire	1 x 0,5 ... 1,5 mm <sup>2</sup>
	(AWG 20...16 solid wire)
Protection class housing EN 60529	IP 20
Protection class terminals EN 60529	IP 20
Weight	approx. 50 g

### ■ Technical Data

#### Power supply

Rated supply voltage $U_s$	DC 24 V
Tolerance voltage $U_s$	DC 21 ... 28 V
Power consumption	$< 1 \text{ W}$

#### PTC-thermistor connection

DIN 44081 / DIN 44082

Numbers	set with 3 ... 6 PTCs in series
Cut-out-point	3,3 k $\Omega$ ...3,65 k $\Omega$ ...3,85 k $\Omega$
Reclosing point	1,7 k $\Omega$ ...1,8 k $\Omega$ ...1,95 k $\Omega$
Collective resistance cold sensors	$\leq 1,65 \text{ k}\Omega$
Terminal voltage (sensors)	$\leq 2,5 \text{ V}$ at $R \leq 3,65 \text{ k}\Omega$ , 9 V bei $R = \infty$
Terminal current (sensors)	$\leq 1 \text{ mA}$
Short circuit	$20 \Omega \leq R \leq 40 \Omega$
Power consumption	$\leq 2 \text{ mW}$

#### Safety Stop 37

	PNP Transistor output
Logic Voltage Level	0...24 VDC
Voltage	Low = 0 PNP $< 4 \text{ VDC}$ HIGH = 1 PNP $> 20 \text{ VDC}$
Current	60 mA

#### Logic Out

	PNP Transistor output
Logic Voltage Level	0...24VDC
Voltage	Low = 0 PNP $< 5 \text{ VDC}$ High = 1 PNP $> 10 \text{ VDC}$
Current	10 mA





**Attention!**

**Safety Instructions and references for putting into operation– please read carefully!**

**Special remarks for explosive gas atmosphere areas! (Zone 1 and Zone 2)**

- The increased danger within hazardous areas requires the careful attention of the safety instructions and references for putting into operation. Observe the national safety rules and regulations for prevention of accidents as well as the European Standard EN 60079-14 „Electrical apparatus for explosive gas atmospheres - Part 14: Electrical installations in hazardous areas (other than mines)“. Installation, electrical connection and commissioning to be carried out by trained service personnel only. Inappropriate behaviour can cause heavy personal damage and damages to property.
- The response of the thermal motor protection must directly switch off the motor, also when used together with converters. This must be realized in the logic section or configuration in the converter.
- The relay may be installed only outside potentially explosive atmospheres for the protection of explosive-protected motors. Within potentially explosive atmospheres the equipment is to be provided with a pressurized enclosure according EN 60079-2

**Special remarks for use in the presence of combustible dust! (Zone 21 and Zone 22)**

- The increased danger within hazardous areas of combustible dust requires the careful attention of the safety instructions and references for putting into operation. Observe the national safety rules and regulations for prevention of accidents as well as the European Standard EN 50281-1-2 „Electrical apparatus for use in the presence of combustible dust“. Installation, electrical connection and commissioning to be carried out by qualified service personnel only. Inappropriate behaviour can cause heavy personal damage and damages to property.
- The relay may be installed only outside potentially explosive atmospheres for the protection of explosive-protected motors. Within potentially explosive atmospheres the equipment is to be provided with a dust proofed enclosure according to EN 60529.

**Wiring**

- The lines of the sensor circuit are to be routed as separate control lines. The use of lines of the supply cable or other mainstream lines is not permissible. If extreme inductive or capacitive stray effects are to be expected by parallel cables of the power installation, shielded control lines should be used.

**MS 220 DA**

- The line resistance within the sensor circuit may not exceed a value of 20 Ω.
- Maximum of permissible length for sensor circuit lines:

Wire cross section	Wire length
1,5 mm <sup>2</sup>	2 x 150 m
1,0 mm <sup>2</sup>	2 x 100 m
0,75 mm <sup>2</sup>	2 x 50 m
0,5 mm <sup>2</sup>	2 x 50 m

- With commissioning and after modification of the plant the sensor resistance must be checked with a suitable measuring instrument. With a resistance < 50 Ω the sensor circuit is to be examined for short-circuit.



**Attention! Check PTC's only with measuring voltages of < 2.5 V.**

**Safe Separation**

- PTC-thermistor circuit (T1, T2) has a safe separation to low-voltage electric circuits PELV (37, Logic Out and Interface). -> Technical data.

**Stop function, Stop category 0**

- A stop function released by the protection device must transfer the machine after manipulation of this function as fast as possible into a safe condition. The stop function must have top priority.
- In case of failure the MS 220 DA motor protection causes a stop command at the Safety Stop terminal 37 and the drive directly stops the engine.

**Start and Restart**

A restart may take place automatically only if no dangerous condition can be present.

The MS 220 DA motor protection switches on automatically when the engine has cooled down.

If automatically restart is programmed additional measures are required to prevent a restart of the engine in case of risk of a dangerous situation.

**Manual resetting**

After introducing a stop by the protection device this must be maintained, until the manual resetting mechanism is operated and safe conditions for a restart are given. The manual resetting may only be possible, if all safety functions and protection devices are effective.

**Additional notes for the SIL category according EN 61508**

- The safety function must be tested within regular intervals. It is recommended to test once annually or within the maintenance cycle of the plant. For recurring examinations of electrical systems in hazardous areas the inspection period must be kept within 3 years. One fault is recognized by the safety test. One fault between safety tests can cause the loss of protection.
- The following must be tested additionally to recurring examinations with maintenance services:
  - Short circuit test: resistance 20  $\Omega$  in parallel to sensor terminals T1, T2
  - Line interruption test: disconnect sensor line at terminal T1 or T2
  - Temperature test: increase resistance 50...1500  $\Omega$  to 4000  $\Omega$
- The tripping function will be stated at the drive display and can be reset manually when the failure is removed.
- If an error is detected no restart must be induced until the error is cleared.

**Maintenance and repair**

The devices are maintenance-free. Only the manufacturer may accomplish repairs. EN 60079-17 and/or EN 50281-1-2 are to be observed.

■ Install the MS 220 DA option in the frequency converter



**Attention!**  
**Before start, disconnect the supply voltage to the frequency converter!**  
**Do never install an option card into the frequency converter while in operation!**

The MS 220 DA option is exclusively intended for use in option slot „B“.

- Remove LCP control unit, terminal cover and standard frame (see Photo 1 or 2).



Photo 1



Photo 2

- If necessary, wire the terminal block with terminal 39 - 55 first.

- Insert the MS 220 DA option into slot „B“. (see Photo 3 or 4)



Photo 3



Photo 4

- The plastic cover must point downwards.
- Connect the motor resistor (thermistor) to terminals T1 and T2 of the MS 220 DA. Open jumper 12-37 on the frequency converter and connect terminal 12 on the MS 220 DA with terminal 37 (Safe stop) (see Photo 5 or Photo 6). Only then can the VLT® AutomationDrive FC 302 be safely shut down in the case of malfunction. The output on terminal 12 of the MS 220 DA must always be wired into the chain on the Safe Stop input on terminal 37 on the frequency converter in order to ensure shutdown of power in case of malfunction.



Photo 5



Photo 6

- Continue the necessary wiring of the MS 220 DA. See connection diagram on page 3.
- Afterwards, remove the gaps for slot „B“ from the deeper frame supplied, and reinsert the frame, terminal cover, and the LCP control unit. (see Photos 7, 8 or 9)



Photo 7





Photo 8



Photo 9

- Close the device with the cover or with the enclosure cover in order to restore the enclosure to its initial condition.
- Restore the supply voltage to the frequency converter.

**Attention!**

Depending on the programmed parameters, the motor may start after the supply voltage is restored!

- Configure new additional functions in the corresponding parameters.

**Attention!**

The operator or electrical installer is responsible for proper earthing and adherence to all applicable national and local safety regulations!



## EC-TYPE-EXAMINATION CERTIFICATE

(Translation)

(2) Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres - **Directive 94/9/EC**

(3) EC-type-examination Certificate Number:

**PTB 06 ATEX 3024**



(4) Equipment: TMP tripping device, type MS220DA integrated into Danfoss frequency converter of series VLT@Automation Drive FC302

(5) Manufacturer: Ziehl industrie-elektronik GmbH +Co

(6) Address: Daimlerstraße 13, 74523 Schwäbisch Hall, Germany

(7) This equipment and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.

(8) The Physikalisch-Technische Bundesanstalt, notified body No. 0102 in accordance with Article 9 of the Council Directive 94/9/EC of 23 March 1994, certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres, given in Annex II to the Directive.

The examination and test results are recorded in the confidential report PTB Ex 06-36039.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

**EN 60947-8**

**EN 60079-14**

**EN 61508**

**EN ISO 13849-1**

**EN 60079-7**

**EN 954-1**

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-type-examination Certificate relates only to the design, examination and tests of the specified equipment in accordance to the Directive 94/9/EC. Further requirements of the Directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.

(12) The marking of the equipment shall include the following.

**II (2) GD**

Zertifizierungsstelle Explosionsschutz

By order:

Dr.-Ing. F. Lienesch  
Oberregierungsrat



Braunschweig, May 09, 2007

sheet 1/3

## (13) SCHEDULE

### (14) EC-TYPE-EXAMINATION CERTIFICATE PTB 06 ATEX 3024

#### (15) Description of equipment

The TMP tripping device of type MS220DA-MCB 112 PTC (Relay Option B), integrated into the Danfoss frequency converter of series VLT@Automation Drive FC302, consists of an evaluation unit for PTC thermistor detectors with safe separation. Switch-off in the case of failure is performed directly via terminal 12 of the TMP tripping device to the safety input "Safety Stop 37" of the converter (for safe stop, see BGA Type-examination Certificate 05 06004), which disconnects the non-explosion-protected motor or the explosion-protected motor from the network in routine operation or in disturbance case.

Another logic output serves for status detection in case of failure. Type MS220DA works in accordance with the closed-circuit principle. Manual acknowledgement may be performed only when the detector resistance value is in a valid range.

Among the most important functions are: overtemperature detection, detection of wire interruption and short-circuit detection in the detector circuit.

For type MS220DA with a "1001" architecture, a risk analysis and a functional safety analysis were performed in accordance with EN 61508 parts 1, 2, 6 and 8. According to EN 61508, part 1 Table 2 (operating mode with low requirement rate), safety integrity level 1 (SIL 1 for a test cycle of three years) and safety integrity level 2 (SIL 2 for a test cycle of two years) are reached. In accordance with part 2 Table 2, a safe failure fraction of 90.1% was demonstrated for SIL 1 and an SFF value of 78.3% for SIL 2, at an ambient temperature of 75°C. The safety functions comply with the requirements according to EN 954-1 and EN ISO 13849-1, category 2.

Additional information can be taken from:

- the operating instructions "Motor protection device MS220DA" for installation in VLT@Automation Drive FC302 (MG33.V1.02, edition 11/2006)
- Internet page under [www.ziehl.de](http://www.ziehl.de) and [www.Danfoss.de/VLT](http://www.Danfoss.de/VLT)

Remark: The TMP tripping device with Safe Stop is part of the EC-Type-Examination Certificate. Further functions of the converter have not been tested.

#### (16) Test report PTB Ex 06-36039

#### (17) Special conditions for safe use none



(18) Essential health and safety requirements

The tests carried out and their positive results as well as the proof furnished of June 12, 2006 (12030-1601-00) have confirmed compliance with the standards and thus with Directive 94/9/EC, Annex II (in particular point 1.5). Suitably selected and adjusted safety devices of this type are necessary for the safe operation of explosion-protected motors and must themselves be installed outside potentially explosive atmospheres.

Zertifizierungsstelle Explosionsschutz

Braunschweig, May 09, 2007

By order:



Dr.-Ing. F. Lienesch  
Oberregierungsrat



## EG-Konformitätserklärung

*EC-Declaration of Conformity*

*CE-Déclaration de conformité*

Hersteller: **Ziehl industrie-elektronik GmbH & Co KG**  
*Manufacturer/fabricant:*

Anschrift: **Daimlerstr. 13**  
*Adress/adresse:* **D-74523 Schwäbisch Hall**

Produktbezeichnung: **Motorschutzgerät**  
*Product specification/Description du produit:* Thermistor motor protection  
Appareil de déclenchement à sondes PTC

Typen: **MS 220 DA**  
*Types/types:*

Wir erklären in alleiniger Verantwortung, daß das (die) oben bezeichnete Produkt(e) mit folgenden Europäischen Richtlinien übereinstimmt (übereinstimmen):

*We declare under our sole responsibility that above product(s) is (are) in conformity with the following directives: / Déclarons sous notre seule responsabilité, que le(s) produit(s) repond(ent) aux directives suivantes:*

**73/23/EWG**

73/23/EEC

73/23/CEE

**2004/108/EG**

2004/108/EC

2004/108/CE

**94/9/EG**

94/9/EC

94/9/CE

**Niederspannungsrichtlinie**

Low Voltage Directive

Directive Basse Tension

**EMV Richtlinie**

EMC Directive

Directive CEM

**ATEX Richtlinie**

ATEX Directive

ATEX Directive

Angewandte harmonisierte Normen und technischen Spezifikationen:  
*Applied harmonised standards and technical specifications:*  
*Normes harmonisées et spécifications techniques:*

**EN 60 947-8: 2003**

**EN 60079-14:2003**

**EN 50281-1-2:1998**

**EN 50178: 1997**

**IEC 61800-5-1: 2003**

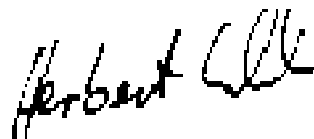
Benannte Stelle und Nummer der EG-Baumusterprüfbescheinigung:  
*Notified Body and number of the EC-type-examination certificate:*  
*Organisme agréé et numéro du certificate des test CE:*

PTB Physikalisch Technische Bundesanstalt 0102

PTB 06 ATEX 3024

Schwäbisch Hall, 08.08.2006  
Ort, Datum der Ausstellung  
*(Place, date of issue)*  
*(Lieu, date de lédition)*

i.V.



Herbert Wahl

Name und Unterschrift des Befugten  
name and signature of authorized person  
Nom et signature de la personne autorisée



*Danfoss*



## Operating Instructions

# MCB 112 VLT<sup>®</sup> PTC Thermistor Card



VLT<sup>®</sup> AutomationDrive FC 302



design award  
winner  
**2004**



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# 1. How to Read these Operating Instructions

## 1.1.1. How to Read these Operating Instructions

These Operating Instructions will help you get started, install, program, and troubleshoot your MCB 112 VLT® PTC Thermistor Card option. Please read these operating instructions in full and, in order to be able to work with the system safely and professionally, particularly observe the hints and cautionary remarks.

Chapter 1, **How to Read these Operating Instructions**, introduces the manual and informs you about the approvals, symbols, and abbreviations used in this literature.

Chapter 2, **Safety and Conformity**, contains safety instructions and certificates for the MCB 112 VLT PTC Thermistor Card option and the VLT AutomationDrive FC 302.

Chapter 3, **Introduction to the MCB 112 VLT PTC Thermistor Card**, informs you about the general aspects of the option and its functions. It also contains the technical data about the MCB 112 VLT PTC Thermistor Card.

Chapter 3, **How to Install**, guides you through mechanical and technical installation.

Chapter 4, **Parameter setup**, shows you the parameter settings associated with the MCB 112 VLT PTC Thermistor Card option.

Chapter 6, **Troubleshooting**, assists you in solving problems that may occur when using the MCB 112 VLT PTC Thermistor Card.

## 1.1.2. Available Literature for VLT AutomationDrive FC 302

- The VLT® AutomationDrive FC 300 Operating Instructions provide the necessary information for getting the drive up and running.
- The VLT® AutomationDrive FC 300 Design Guide entails all technical information about the drive design and applications including encoder, resolver and relay options.
- The VLT® AutomationDrive FC 300 Profibus Operating Instructions provide the information required for controlling, monitoring and programming the drive via aProfibus fieldbus.
- The VLT® AutomationDrive FC 300 DeviceNet Operating Instructions provide the information required for controlling, monitoring and programming the drive via aDeviceNet fieldbus.
- The VLT® AutomationDrive FC 300MCT 10 Operating Instructions provide information for installation and use of the software on a PC.
- The VLT® AutomationDrive FC 300 IP21 / Type 1 Instruction provides information for installing the IP21 / Type 1 option.
- The VLT® AutomationDrive FC 300 24 V DC Backup Instruction provides information for installing the 24 V DC Backup option.

Danfoss Drives technical literature is also available online at [www.danfoss.com/drives](http://www.danfoss.com/drives).



1

### 1.1.3. Approvals



### 1.1.4. Symbols

Symbols used in these Operating Instructions.

 **NB!**  
Indicates something to be noted by the reader.

 Indicates a general warning.

 Indicates a high-voltage warning.

\* Indicates default setting

### 1.1.5. Abbreviations

Alternating current	AC
American wire gauge	AWG
Ampere/AMP	A
Degrees Celsius	°C
Direct current	DC
Electro Magnetic Compatibility	EMC
Electronic Thermal Relay	ETR
Drive	FC
Gram	g
Hertz	Hz
Kilohertz	kHz
Local Control Panel	LCP
Meter	m
Millihenry Inductance	mH
Milliampere	mA
Millisecond	ms
Minute	min
Nanofarad	nF
Newton Meters	Nm
Parameter	par.
Protective Extra Low Voltage	PELV
Second	s
Volts	V

## 2. Safety and Conformity

### 2.1.1. Important notes

Proper, safe operation of a device requires that it be properly transported and stored, professionally installed and commissioned, and used as intended. Only those personnel may work on the device who are familiar with its installation, commissioning, and operation and have appropriate qualifications for their activities. They must observe the contents of the operating instructions, the notes attached to the device, and all applicable safety regulations for the setup and operation of electrical installations. These devices are built and tested in compliance with EN 60947-8 and leave our plant in perfect condition from a safety standpoint. To keep them in this state, you must observe the safety guidelines marked "Warning" in the operating instructions. Failure to observe safety guidelines can result in death, bodily injury, or damage to the device itself and to other devices and systems. If the information contained in the operating instructions is insufficient for a particular case, please contact us directly or the representative responsible for you. Instead of the industry standards and regulations named in these operating instructions and valid in Europe, when operating the device outside their area of applicability, you must follow the regulations applicable to the country of use.



**NB!**

The MCB 112 PTC Thermistor Card can only be used together with the VLT AutomationDrive FC 302.



**NB!**

The MCB 112 PTC Thermistor Card cannot be used for protection of an increased safety protected motor, unless the motor and the frequency converter are type tested for this duty as a unit. For use with the "e" increased safety protected motor the product need an EC-type-examination certificate for this purpose.



Warning! EN60204-1 safety circuits. The devices may not be used alone for functions where an automatic restart must be prevented.

### 2.1.2. Safety Precautions



The voltage of the frequency converter is dangerous whenever connected to mains. Incorrect installation of the motor, frequency converter or fieldbus 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 mains supply to the frequency converter must be disconnected whenever repair work is to be carried out. Check that the mains supply has been disconnected and that the necessary time has elapsed before removing motor and mains supply plugs.
2. The [OFF] button on the control panel of the frequency converter does not disconnect the mains supply and consequently it must not be used as a safety switch.
3. The equipment must be properly earthed, 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 current exceeds 3.5 mA.
5. Protection against motor overload is not included in the factory setting. If this function is desired, set par. 1-90 Motor Thermal Protection to data value ETR trip 1 [4] or data value ETR warning 1 [3].
6. Do not remove the plugs for the motor and mains supply while the frequency converter is connected to mains. Check that the mains supply has been disconnected and that the necessary time has elapsed before removing motor and mains plugs.
7. Please note that the frequency converter has more voltage sources than L1, L2 and L3, when load sharing (linking of DC intermediate circuit) or external 24 V DC are installed. Check that all voltage sources have been disconnected and that the necessary time has elapsed before commencing repair work.

**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 (e.g. risk of personal injury caused by contact with moving machine parts following an unintentional start) make it necessary to ensure that no unintended start occurs, these stop functions are not sufficient. In such cases the mains supply must be disconnected or the *Safe Stop* function must be activated.
2. The motor may start while setting the parameters. If this means that personal safety may be compromised (e.g. personal injury caused by contact with moving machine parts), motor starting must be prevented, for instance by use of the *Safe Stop* function or secure disconnection of the motor connection.
3. A motor that has been stopped with the mains supply connected, may start if faults occur in the electronics of the frequency converter, through temporary overload or if a fault in the power supply grid or motor connection is remedied. If unintended start must be prevented for personal safety reasons (e.g. risk of injury caused by contact with moving machine parts), the normal stop functions of the frequency converter are not sufficient. In such cases the mains supply must be disconnected or the *Safe Stop* function must be activated.

**NB!**

When using the *Safe Stop* function, always follow the instructions in the *Safe Stop* section.

4. Control signals from, or internally within, the frequency converter may in rare cases be activated in error, be delayed or fail to occur entirely. When used in situations where safety is critical, e.g. when controlling the electromagnetic brake function of a hoist application, these control signals must not be relied on exclusively.



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.

Systems where frequency converters are installed must, if necessary, be equipped with additional monitoring and protective devices according to the valid safety regulations, e.g. law on mechanical tools, regulations for the prevention of accidents etc. Modifications on the frequency converters by means of the operating software are allowed.

Hoisting applications:

FC functions for controlling mechanical brakes cannot be considered as a primary safety circuit. There must always be a redundancy for controlling external brakes.

**Protection Mode**

Once a hardware limit on motor current or dc-link voltage is exceeded the drive will enter "Protection mode". "Protection mode" means a change of the PWM modulation strategy and a low switching frequency to minimize losses. This continues 10 sec after the last fault and increases the reliability and the robustness of the drive while re-establishing full control of the motor.

In hoist applications "Protection mode" is not usable because the drive will usually not be able to leave this mode again and therefore it will extend the time before activating the brake – which is not recommendable.

The "Protection mode" can be disabled by setting parameter 14-26 "Trip Delay at Inverter Fault" to zero which means that the drive will trip immediately if one of the hardware limits is exceeded.

**NB!**

It is recommended to disable protection mode in hoisting applications (par. 14-26 = 0)

### 3. Introduction to MCB 112 VLT PTC Thermistor Card

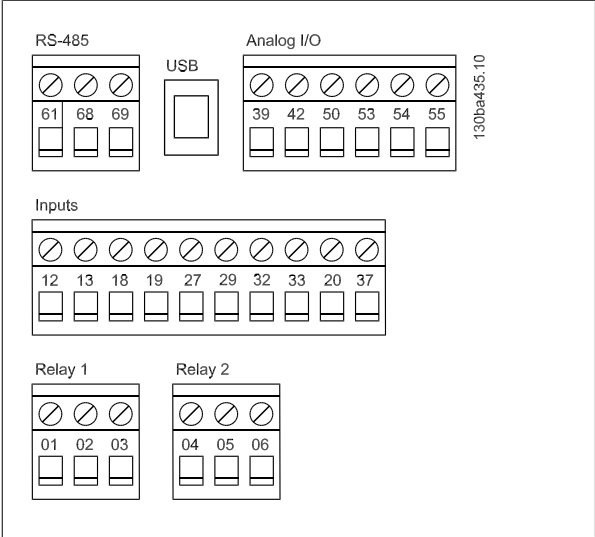
#### 3.1.1. Introduction to MCB 112 PTC Thermistor Card

The MCB 112 PTC Thermistor Card is constructed as a standard option for the Danfoss VLT® AutomationDrive FC 302 and is automatically detected after mounting. The MCB 112 is used to protect electrical motors against impermissible heating and overload. The option monitors the temperature level via connected PTC thermistors and uses the Safe Stop function of the Danfoss VLT® AutomationDrive to stop the motor. The option is developed for Danfoss by Ziehl and also wears the name MS 220 DA that is the name under which it has been ATEX approved. This means that explosion-protected motors can be used in explosion hazardous areas in Zone 1(Category 2 G), 2 (Category 3 G) as well as in Zone 21(Category 2 D) and 22 (Category 3 D)\*. All functions of the MCB 112 serve to protect both non-explosion-protected and explosion-protected motors in normal operation. For approvals, see labelling on device. See also PTB-certificate and EC-Declaration of Conformity in the *Safety and Conformity* section.

\* The categories indicate the level of protection "Very High(1), High(2) and Normal(3)" and the atmosphere is identified by G for Gas or D for Dust."

#### 3.1.2. VLT AutomationDrive Terminals

The VLT AutomationDrive control card contains input and output logic terminals used by the MCB 112 option. The option does not assign a function to all of the inputs and outputs on the control card. The terminals required for proper operation of the MCB 112 VLT PTC Thermistor Card are discussed in this manual. See the VLT AutomationDrive Operating Instructions for further details.



### 3.1.3. Connection Schematic

Below, the electrical connections for the MCB 112 VLT PTC Thermistor Card are shown:

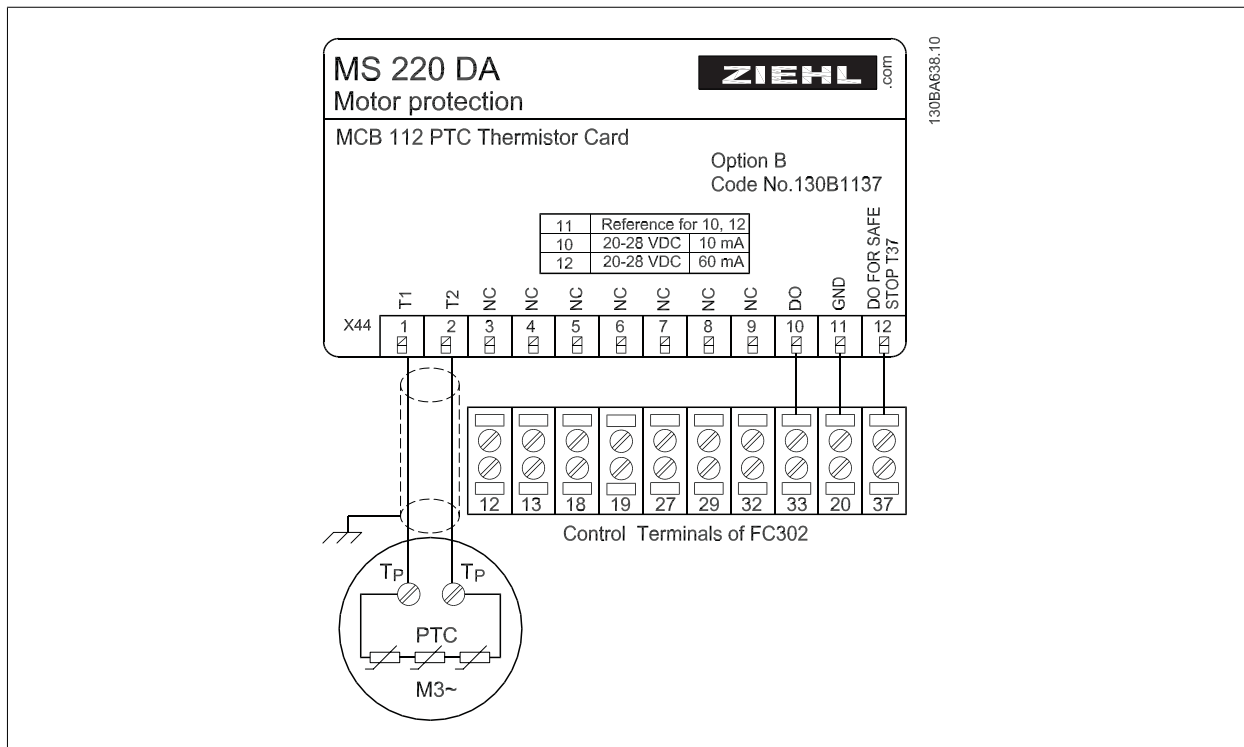


Illustration 3.1: Connection schematic

### 3.1.4. Overview of functions

The MS 220 DA - MCB 112 VLT PTC Thermistor option is a thermistor monitoring unit with integrated safe isolation and sensor circuit monitoring. The output X44/12 is connected to the FC302 Safe Stop input (Terminal 37). For more details regarding the use of the SafeStop function, see section 4.1.1 *Particular instructions for EN 61508 category SIL 1 and 2*

At normal operation the output (X44/12) is "High = 1". In case of motor overtemperature it changes to "Low = 0" and activates Safe Stop. The output changes back to "High = 1" when the temperature has fallen below the critical temperature level. This means that the tripping device has removed its request for safe stop (however, another safety device may still require safe stop to be enabled). If safe stop is configured for Alarm (default), a manual reset is required before safe stop is deactivated.

In case of short circuit of sensor or wiring, the output will also change to "Low = 0" and activate Safe Stop. The Safe Stop input on the FC302 can be connected to more signals at the same time, meaning Safe Stop can be activated by other external signals. In that case output X44/10 can be used to identify if the alarm originates from the thermistor or another external signal.

In the FC302 the following parameters must be set:

- Par 5-19: Safe Stop input must be configured to the relevant functionality including identification if other signals are connected.
- A digital input must be set to "PTC Card 1" [80], if the output X44/10 is used to identify the origin of the Safe Stop signal.



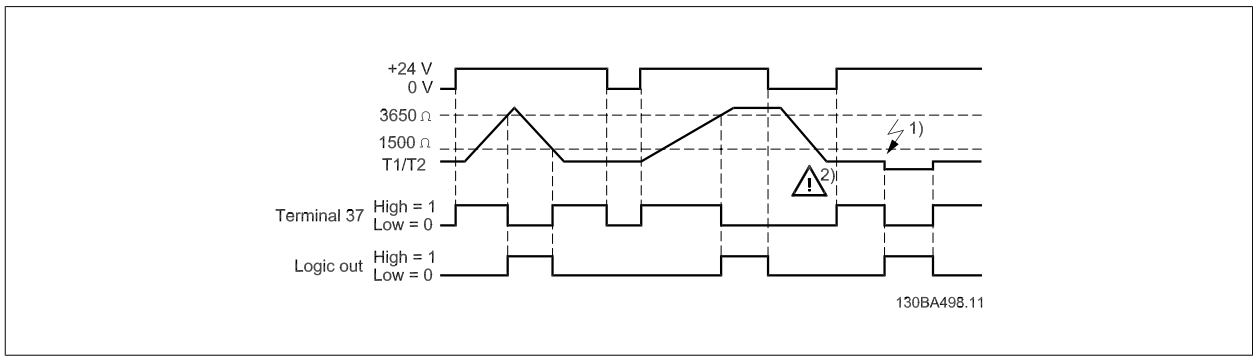


Illustration 3.2: Description of function

1) Short circuit

2) Warning: the trigger is not stored and is not zero-voltage safe.

4

## 4. How to Install

### 4.1.1. Particular instructions for EN 61508, category SIL 1 and 2

Additional information to the ZIEHL documentation, page 7, section *Additional notes for the SIL category according EN 61508*.

The MCB112 VLT PTC Thermal option uses the approved option's feature of the sensor and temperature supervision in connection with the safety function SafeStop. Using this function does not generally lead into a safety function circuit, that has to be tested according to SIL recommendations, stated in EN61508. Connecting the MCB112 VLT PTC Thermal option's output X44/12 with the drive's terminal X2/37 ensures the energy cut-off to the motor, if a failure or an exceeded temperature is detected by the MCB112 VLT PTC Thermal option. Only if additional components are used at the same time in the above described circuit, and these components have to fulfill the SIL recommendation EN 61508 (e.g. an emergency stop), testing of this circuit in accordance to the SIL recommendations is necessary.

To meet the requirements of the local explosion hazardous safety regulations, the local ATEX regulations must be observed. This could for instance be the German *"Betriebssicherheitsverordnung"*, that guides maintenance and test procedures for which the end-user is responsible.

For further details, please refer to page 5 of the ZIEHL documentation part, section *Technical Data*.

### 4.1.2. Installation of option in the frequency converter



Warning! Before start, interrupt the power supply voltage to the frequency converter. Never install an option card into the frequency converter during operation.

The **MCB 112 VLT PTC Thermistor Card** option is exclusively intended for use in option slot "B". The mounting position of B options is shown in the drawings below.

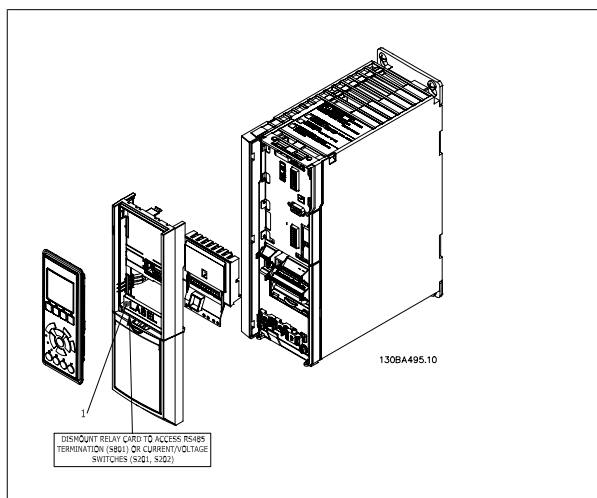


Illustration 4.1: A2 and A3 Enclosure

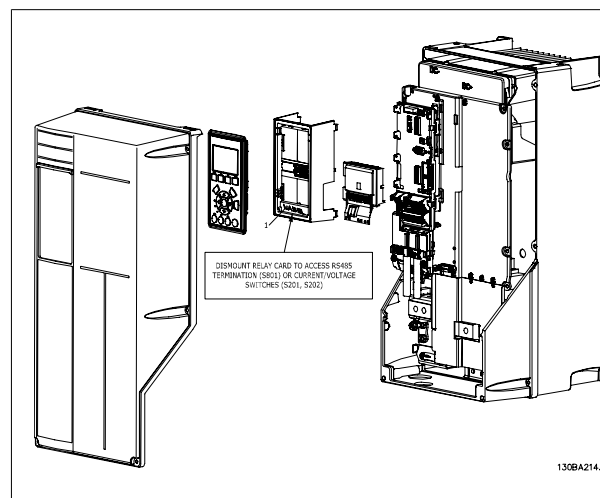
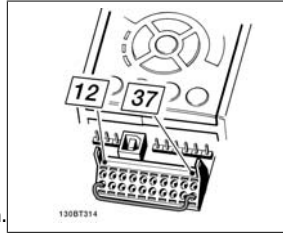


Illustration 4.2: A5, B and C Enclosures

The TMS tripping device MS 220 DA - MCB 220 PTC Relay Option B may be operated with Danfoss VLT® AutomationDrive FC 302.

- Remove LCP control unit, terminal cover, and standard frame (see figures above)
- If necessary, wire the terminal block with terminals 39 - 55 first.
- Insert the MCB 112 VLT PTC Thermistor Card option into slot "B".
- The plastic cover must point downwards.
- Connect the PTC thermistors to terminals T1 and T2 of the MCB 112 VLT PTC Thermistor Card.
- To carry out an installation of a Category 0 Stop (EN60204-1) in conformity with Safety Category 3, follow these instructions:

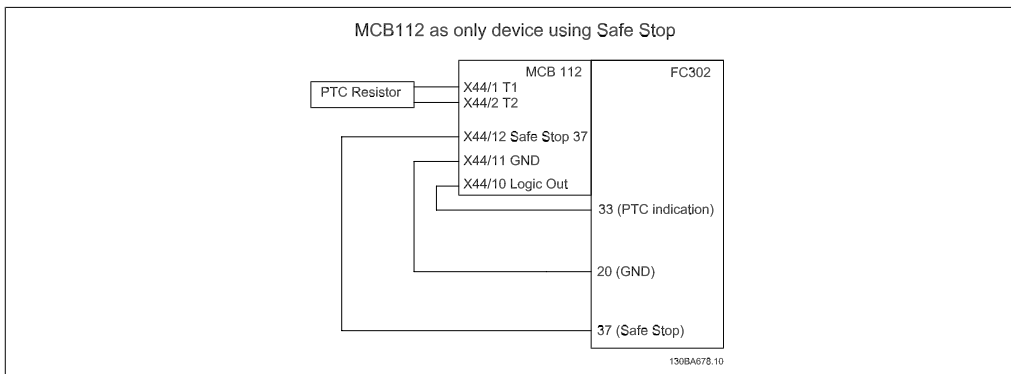
- The bridge (jumper) between Terminal 37 and 24 V DC must be removed. Cutting or breaking the jumper is not sufficient. Remove it



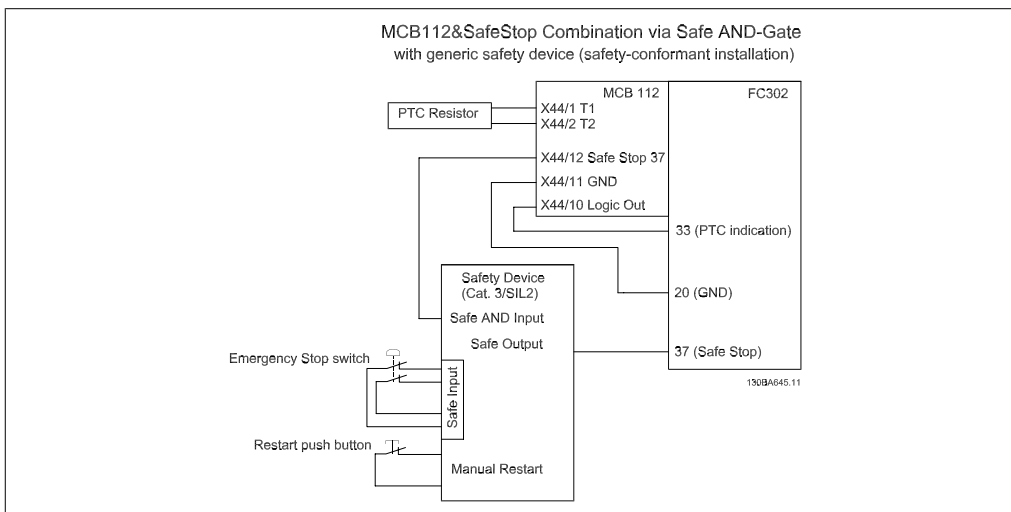
entirely to avoid short-circuiting. See jumper on illustration.

Illustration 4.3: Bridge jumper between terminal 37 and 24 VDC

- Connect terminal 37 to terminal X44/ 12 of the MCB 112 VLT PTC Thermistor Card with a regular cable. Only then can the frequency converter reliably be shut down in case of malfunction. Please see the VLT Automation Guide FC 300 for a Safe Stop Commissioning Test.
- The lines for safety output 37 and logic must be laid separately. Warning: Maintain sufficient distance from the supply lines for the PTC resistors!
- When MCB 112 VLT PTC Thermistor Card is the only device that uses safe stop, the installation should be carried out according to the drawing below:



- When MCB 112 VLT PTC Thermistor Card is one of many devices that uses Safe Stop (in combination with other safety sensors such as emergency stop buttons, door contacts etc.), the installation should be as described in the picture below:



- The output on terminal 12 of the MCB 112 VLT PTC Thermistor Card must always be wired into the chain of the Safe Stop input on terminal 37 in order to ensure shutdown of power in case of malfunction. The MCB 112 VLT PTC Thermistor Card must always be the first device in such a chain!
  - By connecting terminal X44/ 10 of the MCB 112 VLT PTC Thermistor Card to a digital input of the drive, the drive can determine whether safe stop was enabled by the MCB 112 VLT PTC Thermistor Card.
- Continue the necessary wiring of the MCB 112 VLT PTC Thermistor Card. See *Connection Schematic* in the previous chapter.
  - Afterwards, remove the gaps for slot "B" from the deeper frame supplied, and reinsert the frame, terminal cover, and the LCP control unit.
  - Close the device with the cover or with the enclosure cover in order to restore the enclosure to its initial condition.
  - Restore the power supply to the frequency converter.
  - Configure new additional functions in the corresponding parameters.



Warning! Depending on the settings in par 5-19, the motor may start after the power supply voltage is restored!



Warning! The operator or the electrical installer is responsible for proper earthing and adherence to all applicable national and local safety regulations!

### 4.1.3. Startup

Before starting the system, the correct function of the motor protection device can be tested using resistance simulation on the sensor input. In the context of service work, these tests can also be performed.

- Testing short circuit: Resistance 20  $\Omega$  in parallel with the sensor input
- Testing line breaks: Disconnect sensor line
- Testing temperature: Resistance of 50... 1500  $\Omega$  increase to 4000  $\Omega$

Tripping of the motor protection device is displayed on the converter and must be manually reset.

The permissible ambient conditions must be observed (see electrical data).



## 5. Parameter Setup

### 5.1.1. Alarm Handling

The digital input is configured in parameter group 5-1\*.

#### 5-1\* Digital Inputs

Digital input function	Select	Terminal
No operation	[0]	All *term 32, 33
Reset	[1]	All
...		
PTC Card 1	[80]	All
...		

For further description, please refer to the VLT Automation Drive FC 300 Programming Guide (MG.33.MX.YY).

### 5.1.2. Safe Stop Functionality

The desired Safe Stop functionality is specified in Par. 5-19. When a MCB 112 PTC Thermistor Card is mounted, one of the PTC choices should be selected in order to get the full benefit from the alarm handling. Choices 4 and 5 are relevant when the MCB 112 is the only interrupt device using Safe Stop whereas choices 6-9 are relevant when also other safety sensors are connected to Safe Stop. See section 4.1.1 *Particular instructions for EN 61508 category SIL 1 and 2.*

Alarm - Drive coasts and Alarm must be manually reset (via Bus, Digital I/O, or by pressing [RESET]). Auto reset does not apply here.

Warning - Drive coasts but resumes operation when safe stop AND the DI from X44/ 10 are disabled.

Configuring a digital input in 5-1\* makes it possible to give a warning/ alarm that specifies what enabled the safe stop.

When selecting warning instead of alarm, the drive opens up for Automatic Restart! See *Installation of Safe Stop in combination with MCB 112* in the Design Guide.

#### 5-19 Terminal 37 Safe Stop

Option:	Function:
[1] * Safe Stop Alarm	Coasts frequency converter when safe stop is activated. Manual reset from LCP, digital input or fieldbus.
[3] Safe Stop Auto Reset	Coasts frequency converter when safe stop is activated (term 37 off). When safe stop circuit is reestablished, the drive will continue without manual reset.
[4] PTC 1 Alarm	Coasts frequency converter when safe stop is activated. Manual reset from LCP, digital input or fieldbus. Choice 4 is only available when the MCB 112 PTC Thermistor Card is connected.
[5] PTC 1 Warning	Coasts frequency converter when safe stop is activated (term 37 off). When safe stop circuit is reestablished, the drive will continue without manual reset, unless a Digital Input set to PTC Card 1 [80] is still enabled. Choice 5 is only available when the MCB 112 PTC Thermistor Card is connected.
[6] PTC 1 & Relay A	This choice is used when the PTC option is gated together with a Stop button through a Safety relay to T-37. Coasts frequency converter when safe stop is activated. Manual reset from LCP, digital input or fieldbus. Choice 6 is only available when the MCB 112 PTC Thermistor Card is connected.
[7] PTC 1 & Relay W	This choice is used when the PTC option is gated together with a Stop button through a Safety relay to T-37. Coasts frequency converter when safe stop is activated (term 37 off). When safe stop circuit is reestablished, the drive will continue without manual reset, unless a Digital Input set to PTC Card 1 [80] is (still) enabled. Choice 7 is only available when the MCB 112 PTC Thermistor Card is connected.



- [8] PTC 1 & Relay A/W This choice makes it possible to use a combination of Alarm and Warning. Choice 8 is only available when the MCB 112 PTC Thermistor Card is connected.
- [9] PTC 1 & Relay W/A This choice makes it possible to use a combination of Alarm and Warning. Choice 9 is only available when the MCB 112 PTC Thermistor Card is connected.



**NB!**

When Auto Reset/ Warning is selected the drive opens up for automatic restart.

**Overview of functions, alarms and warnings**

Function	No.	PTC	Relay
No Function	[0]	-	-
Safe Stop Alarm	[1]*	-	Safe Stop [A68]
Safe Stop Warning	[3]	-	Safe Stop [W68]
PTC 1 Alarm	[4]	PTC 1 Safe Stop [A71]	-
PTC 1 Warning	[5]	PTC 1 Safe Stop [W71]	-
PTC 1 & Relay A	[6]	PTC 1 Safe Stop [A71]	Safe Stop [A68]
PTC 1 & Relay W	[7]	PTC 1 Safe Stop [W71]	Safe Stop [W68]
PTC 1 & Relay A/W	[8]	PTC 1 Safe Stop [A71]	Safe Stop [W68]
PTC 1 & Relay W/A	[9]	PTC 1 Safe Stop [W71]	Safe Stop [A68]

W means warning and A means alarm. For further information, see Alarms and Warnings in section *Troubleshooting* in the Design Guide or the Operating Instructions

A dangerous failure related to Safe Stop will give Alarm: Dangerous Failure [A72].

## 6. Troubleshooting

### 6.1.1. Troubleshooting

- The resistance in the sensor circuit must have a value  $50 \Omega < R < 1500 \Omega$  . The terminal voltage must be  $< 2.5 \text{ V}$  with the resistors attached.
- If terminal T1-T2 is open, the relay must shut off. The terminal voltage must be about 8 V.

### 6.1.2. Alarm/ Warning code list

The alarms and warnings directly related to the use of the Safe Stop functionality set-up in Par. 5-19 are listed in the following table.

No.	Description	Warning	Alarm/ Trip	Alarm/ Trip Lock	Par. Ref.
68	Safe Stop Activated	X	X <sup>1)</sup>		5-19
71	PTC 1 Safe Stop	X	X <sup>1)</sup>		5-19
72	Dangerous Failure			X <sup>1)</sup>	5-19

1) Can not be auto reset via par. 14-20

### 6.1.3. Description of Alarm Word, Warning Word and extended Status Word

The Dangerous Failure Alarm [A72] is issued if the combination of safe stop commands is considered dangerous (e.g. if the MCB 112 VLT PTC Thermistor Card enables X44/ 10 but safe stop is somehow not enabled).

Bit	Hex	Dec	AlarmWord	AlarmWord2	WarningWord	WarningWord2
30	40000000	1073741824	Safe Stop [A68]	PTC 1 Safe Stop [A71]	Safe Stop [W68]	PTC 1 Safe Stop [W71]
31	80000000	2147483648		Dangerous Failure [A72]		

#### Alarm 68, Safe Stop

Safe Stop has been activated. To resume normal operation, apply 24 V DC to T-37, then send a reset signal (via Bus, Digital I/O, or by pressing [RESET]).

#### Warning 68, Safe Stop

Safe Stop has been activated. Normal operation is resumed when Safe Stop is disabled. Warning: Automatic Restart!

#### Alarm 71, PTC 1 Safe Stop

Safe Stop has been activated from the MCB 112 PTC Thermistor Card (motor too warm). Normal operation can be resumed when the MCB 112 applies 24 V DC to T-37 again (when the motor temperature reaches an acceptable level) and when the Digital Input from the MCB 112 is deactivated. When that happens, a reset signal must be sent (via Bus, Digital I/O, or by pressing [RESET]).

#### Warning 71, PTC 1 Safe Stop

Safe Stop has been activated from the MCB 112 PTC Thermistor Card (motor too warm). Normal operation can be resumed when the MCB 112 applies 24 V DC to T-37 again (when the motor temperature reaches an acceptable level) and when the Digital Input from the MCB 112 is deactivated. Warning: Automatic Restart.

#### Alarm 72, Dangerous Failure

Safe Stop with Trip Lock. Unexpected signal levels on Safe Stop and Digital Input from the MCB 112 PTC Thermistor Card.



For correct and safe use of the Safe Stop function follow the related information and instructions in the Design Guide.



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