



Operating Instructions

Motor Protection Relay MS 220 DA



for integration with the
VLT® AutomationDrive FC 302

The documentation for the MS 220 DA/ MCB 112 VLT® PTC Thermistor Card contains two parts.

The first part documents the basic functionality of the option and has been developed with ZIEHL industrie-elektronik to serve as the basis for the ATEX approval from PTB. The option is referred to as MS 220 DA in this part as this is the name selected by ZIEHL industrie-elektronik and the name on the ATEX certificate.

The second part follows the standard Danfoss Drives documentation structure and the option is referred to as MCB 112 VLT® PTC Thermistor Card which is in line with the naming of the other options available. This part includes the dedicated parameter setup for the advanced alarm handling of the MCB 112. Furthermore, this part includes more elaborations regarding Safe Stop, considerations related to the drive and further safety precautions.

It is strongly recommended to read both parts of the documentation.

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1 Application and short description

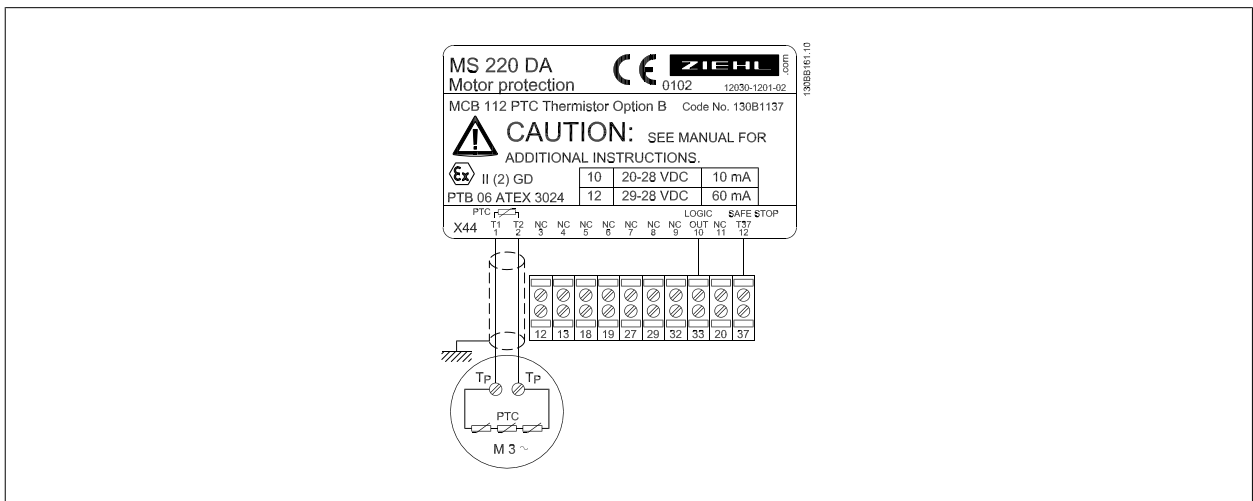
1.1 Application and Short Description

TMP tripping device MS 220 DA - MCB 112 PTC Thermistor 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 and 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.

1.2 Connection Plan



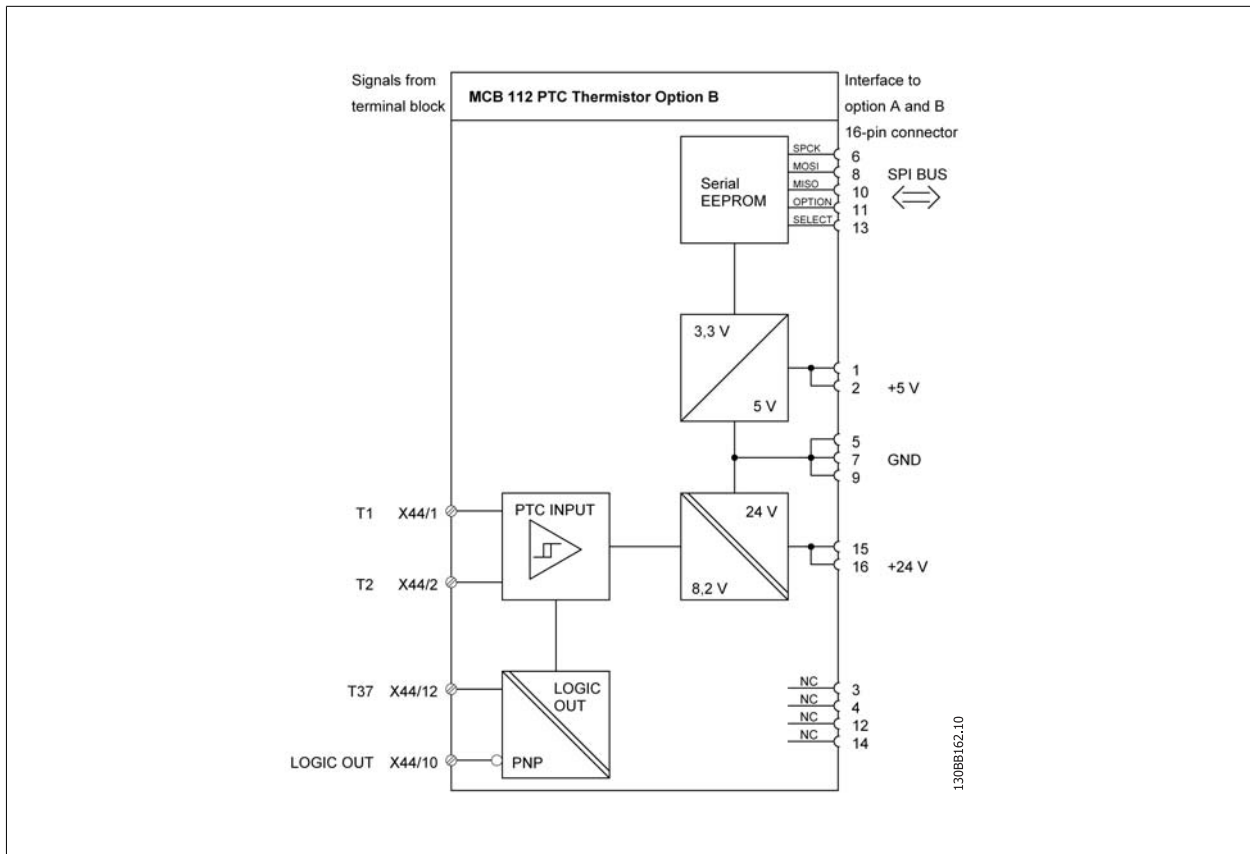
1.3 Overview of Functions

The TMP tripping device MS 220 DA - MCB 112 PTC Thermistor Option B includes a tripping stage for PTC-thermistor sensors with save potential separation from supply voltage and ground. The tripping function switches off the +24 V DC-voltage directly at the Safety Stop T37 of the drive. The PNP logic output terminal X44/10 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.

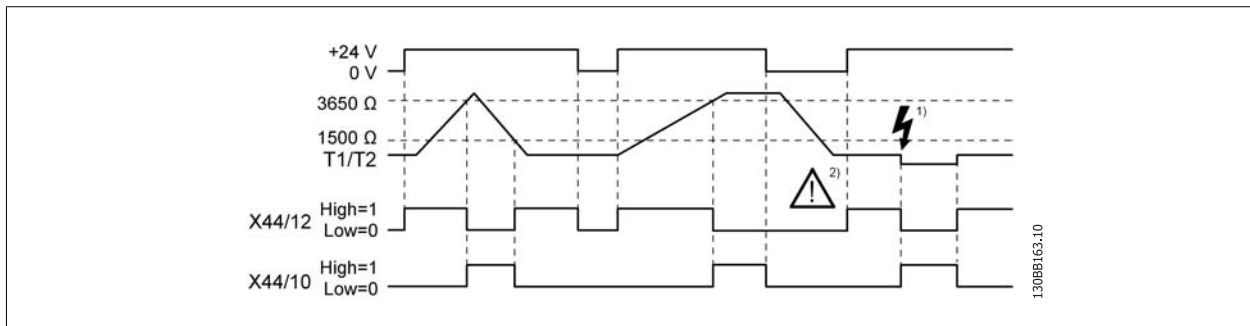
The MS 220 DA needs +24 VDC supply voltage. The serial EEPROM enables the drive to recognize the built-in option module.

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1.4 Block Diagram



1.5 Detailed Description



A current monitors continuously the resistance of the sensors. In cold state, the resistance is <math>< 250 \Omega</math> per sensor (sensor circuit <math>< 1.5 \text{ k}\Omega</math>). The output to X44/12 is high = 1. The resistance of the sensor rises rapidly at nominal response temperature TNF. At a resistance of 3...4 k Ω output to X44/12 changes to low = 0. The devices also switches off in the case of sensor or line short-circuit ¹⁾ (<math>< 20 \Omega</math>) or sensor or line interruption. It switches on automatically when the temperature has decreased approx. 5 °C.

Attention ! ²⁾: trip status is not stored and not non-volatile.

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
6 sensors in series	TNF	TNF - 20 K

2 Important Notes

2.1 Important Notes

To use the equipment flawless and safely, 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 safety in perfect condition. To keep this condition, observe the safety instructions with the headline *Attention* written in the instructions manual. Ignoring of the safety 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 an automatic start must be avoided.

3 Assembly

3.1 Assembly

The TMP tripping device MS 220 DA - MCB 220 PTC Thermistor 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 Safe Stop T37 and Logic Out are to be routed separately.

Attention: Routed lines must keep enough distance to sensor lines and other mainstream lines.

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3.2 Putting into Operation

After installation and before first 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 must also be done after modifications in the installation.

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.

3.3 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.

3.4 Warranty

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

3.5 Safety Integrity Level (EN 61508)

The safety function of the safety equipment

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

The safety function fulfils the recommendations of category 2 according ISO 13849-1:1999 (EN 954-1:1996). More safety-related parameters -> Technical data

3.6 Troubleshooting

- 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 sensors 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 $< 9 \text{ VDC}$.

4 Technical Data

4.1 Technical Data

Power supply	
Rated supply voltage U_s	DC 24 V
Tolerance voltage U_s	DC 21...28 V
Power consumption	< 1 W
PTC-thermistor connection X44/1+X44/2	
Standard	DIN 44081 / DIN 44082
Numbers	set with 3 - 6 PTCs in series
Cut-out-point	3.3 k Ω ...3.65 k Ω ...3.85 k Ω
Reclosing point	1.7 k Ω ...1.8 k Ω ...1.95 k Ω
Collective resistance cold sensors	≤ 1.65 k Ω
Terminal voltage (sensors)	≤ 2.5 V at $R \leq 3.65$ k Ω , ≤ 9 V at $R = \infty$
Terminal current (sensors)	< 1 mA
Short circuit	$20 \Omega \leq R \leq 40 \Omega$
Power consumption	< 2 mW
Safety Stop X44/12	
-	PNP Transistor output
Logic voltage level	0...24 VDC
	Low = 0, PNP < 4 VDC
Voltage	High = 1, PNP > 20 VDC
Current	60 mA
Safety Stop X44/10	
-	PNP logic output
Logic voltage level	0...24 VDC
	Low = 0, PNP < 5 VDC
Voltage	High = 1, PNP > 10 VDC
Current	10 mA
Testing conditions	
Standard	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
	-20 - +60 °C
Rated ambient temperature range	EN 60068-2-2 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...10000 Hz 1.14 g
Shock resistance	50 g
Safety-related parameters	
ISO 13849-1	Cat. 2
	SIL 1 within a proof test interval of 3 years
EN 61508	SIL 2 within a proof test interval of 2 years

HFT	Proof test interval	PFDav	SFF	$\lambda_S + \lambda_{DD}$	λ_{DU}
0	1 year	4.10×10^{-3}	90 %	8515 FIT	932 FIT



Housing

-	Form 130B4065
Dimensions (H x W x D)	mm 82.5 x 69.5 x 29.5
	1 x 0.5 - 1.5 mm ²
Line connection solid wire	(AWG 20...AWG 16 solid wire)
Protection class EN 60529	IP 20
Weight	approx. 50 g

5 Safety Instructions and References



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

5.2 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.

5.3 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.

5.4 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.

5.5 Resistance and Length of Sensor Circuit Lines

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 ²	2 x 150 m
1.0 mm ²	2 x 100 m
0.75 mm ²	2 x 50 m
0.5 mm ²	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.



Check PTCs only with measuring voltages of < 2.5 V.

5.6 Safe Separation

PTC-thermistor circuit (T1, T2) has a safe separation to low-voltage electric circuits PELV (T37, Logic Out and Interface). -> Technical data.

5.7 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.

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In case of failure the MS 220 DA motor protection causes a stop command at the Safe Stop T37 and the drive directly stop the engine.

5.8 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.

5.9 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.

5.10 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 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 to 4000 Ω

The tripping function will be stated at the drive display and can be manually reset when the failure is removed. If an error is detected no restart must be induced until the error is cleared.

5.11 Maintenance and Repair

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

6 Install the MS 220 DA Option in the Frequency Converter



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).



Illustration 6.1: Photo 1



Illustration 6.2: Photo 2

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- If necessary, wire the terminal block with terminal 39 - 55 first.
- Insert the MS 220 DA option into slot „B“. (see Photo 3)

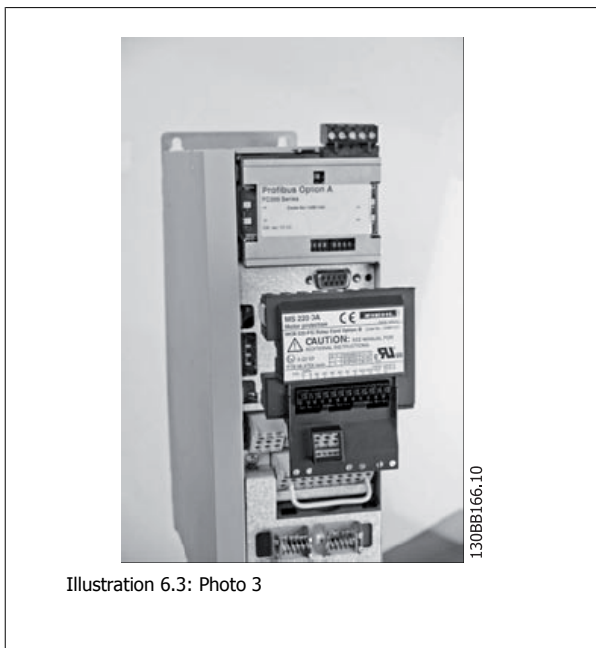


Illustration 6.3: Photo 3

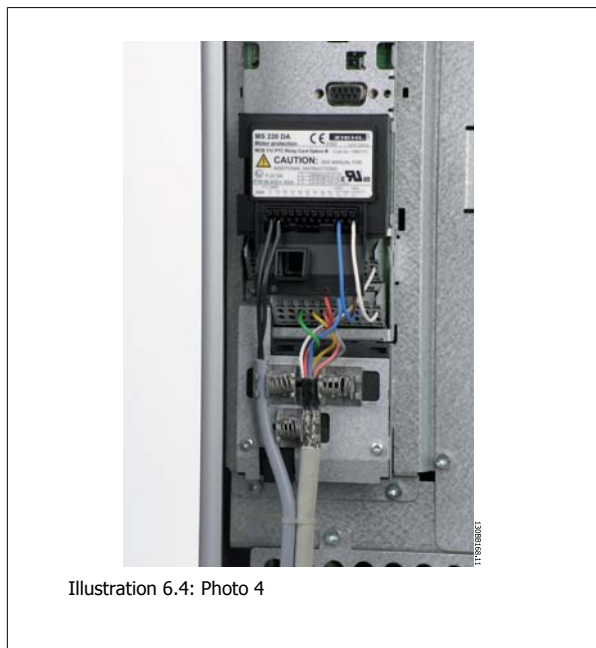



Illustration 6.4: Photo 4

- 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 X44/12 on the MS 220 DA with terminal 37 (Safe Stop) on the frequency converter (see Photo 4). Only then can the VLT AutomationDrive FC 302 be safely shut down in the case of malfunction. The output on terminal X44/12 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.
- Continue the necessary wiring of the MS 220 DA. See connection diagram in section 1.2.
- 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 5 or 6)

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- 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!

7 Certificates

Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin



(1) **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

Braunschweig, May 09, 2007

By order:

Dr.-Ing. F. Lienesch
Oberregierungsrat



sheet 1/3

EC-type-examination Certificates without signature and official stamp shall not be valid. The certificates may be circulated only without alteration. Extracts or alterations are subject to approval by the Physikalisch-Technische Bundesanstalt. In case of dispute, the German text shall prevail.

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Physikalisch-Technische Bundesanstalt

Braunschweig und Berlin



(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 BGIA 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 and 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

sheet 2/3

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Physikalisch-Technische Bundesanstalt



Braunschweig und Berlin

SCHEDULE TO EC-TYPE-EXAMINATION CERTIFICATE PTB 06 ATEX 3024

(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



sheet 3/3

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ZIEHL

ZIEHL industrie-elektronik GmbH+Co KG, Daimlerstr.13, D-74523 Schwäbisch Hall, Tel.: +49 791 504-0, Fax: -56, e-mail: info@ziehl.de

EG-Konformitätserklärung

EC-Declaration of Conformity
CE-Déclaration de conformité

Hersteller: **Ziehl industrie-elektronik GmbH & Co KG**
 Manufacturer/fabricant:
 Anschrift: **Daimlerstr. 13**
 Address/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	Niederspannungsrichtlinie
73/23/EEC	Low Voltage Directive
73/23/CEE	Directive Basse Tension
2004/108/EG	EMV Richtlinie
2004/108/EC	EMC Directive
2004/108/CE	Directive CEM
94/9/EG	ATEX Richtlinie
94/9/EC	ATEX Directive
94/9/CE	ATEX Directive

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

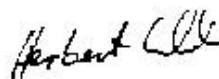
EN 60 947-8: 2003
 EN 60079-14:2003
 EN 50281-1-2:1998
 EN 50178: 1997
 IEC 61800-5-1: 2003

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 0 102
 PTB 06 ATEX 3024

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

i.V.



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

Revision: 2007-05-11

Dokument: CE_ATEX_MS220DA_070511

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Operating Instructions

MCB 112 PTC Thermistor Card



for integration with the
VLT® AutomationDrive FC 302

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1

1 How to Read these Operating Instructions

1

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

Chapter 5, **Parameter setup**, shows you the parameter settings associated with the MCB 112 VLT PTC Thermistor Card option.

Chapter 6, **Application Example**, shows two examples of how the MCB 112 VLT PTC Thermistor Card can be used.

Chapter 7, **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 300

- 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 Programming Guide contains information on how to programme the VLT AutomationDrive. Furthermore, you will find descriptions of the parameters and parameter lists, which give an overview of the parameters in each group.
- The VLT® AutomationDrive FC 300 Profibus Operating Instructions provide the information required for controlling, monitoring and programming the drive via a Profibus fieldbus.
- The VLT® AutomationDrive FC 300 DeviceNet Operating Instructions provide the information required for controlling, monitoring and programming the drive via a DeviceNet fieldbus.
- The VLT® AutomationDrive FC 300 MCT 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.

1.1.3 Approvals

1



1.1.4 Symbols

Symbols used in this 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

1.1.6 Special Abbreviation

Short	Unit	Value	Description
$\lambda_s + \lambda_{DD}$	FIT	8515	(λ_{DD}): Dangerous failure rate detected by diagnostics. Meaning: These failures could cause a dangerous state on the machine, but are detected and reacted upon safely. (λ_s): Safe failure rate. Meaning: These failures do not cause a dangerous state on the machine.
λ_{DU}	FIT	932	(λ_{DU}): Rate of dangerous failures not detected by diagnostics. Meaning: These failures cause a dangerous state on the machine.
HFT		0	Hardware Fault Tolerance (HFT): HFT = n means, that n+1 faults could cause a loss of the safety function. Example: HFT=1 means, the required function is still performed in the presence of 1 arbitrary fault of the safety device.
PFD		4.1e-3	The Probability of Failure of Demand (PFD) specifies the average probability of a failure to perform the safety function on demand. In the low demand mode the frequency of demands for operation made on a safety related system is not greater than one per year and no greater than twice the proof-test frequency. The PFD, equivalent to the unavailability of a system at the time of a process demand. Calculated on the basis of an FMEDA. Calculated for test interval one year
oo			Abbreviation for "out of"
PFH	h^{-1}	λ_{DU}	The Probability of dangerous failure per hour (PFH) specifies the failure rate (e.g. per hour) to perform the safety function continuously. This value shall be considered if the safety device is operated in high demand (more often than once per year) or continuous mode of operation, where the frequency of demands for operation made on a safety-related system is greater than one per year or greater than twice the proof-test frequency. The PFH, may approximately be calculated to PFD/8760h under the assumption that the safety function is needed less than once per year and a diagnostic test is performed more than once per year. If the safety function is used more than once per year, or continuously, then PFH is equal to λ_{DU} for a 1oo1D system.
SFF	%	90	Safe Failure Fraction (SFF): Percentage part of safe failures and dangerous detected failures of a safety function or a subsystem related to all failures.
SIL	1-4	2	Safety Integrity Level (SIL) is defined as a relative level of risk-reduction provided by a safety function, or to specify a target level of risk reduction. Four SIL levels are defined, with SIL4 being the most dependable and SIL1 being the least. A SIL is determined based on a number of quantitative factors in combination with qualitative factors such as development process and safety life cycle management. The requirements for a given SIL are not consistent among all of the functional safety standards.
FIT	1E-9/ hour		Failure In Time: 1E-9 failures/hour
SIL2			One of the four safety integrity levels defined by IEC 61508. See also table below.
ISO 13849	Cat 2.		The standard ISO 13849 deals with "shutdown" systems, which perform a shut-down of the hazardous motion to achieve a safe state when a fault occurs. For this reason, what are termed "designated architectures" have been created, in accordance to the categories B, 1, 2, 3, and 4. In the case of categories B and 1, the architectures are identical, but the requirements of the safety principles differ; the same applies to categories 3 and 4. Here, the requirements for fault detection, in particular, differ. The categories are mainly characterised by the structure. So the first parameter that has to be evaluated is the fault-tolerance. If the control system is tolerant to any single fault, category 3 or 4 can be claimed. In the other case, only category B, 1 or 2 is possible.
FMEDA			Failure Modes, Effects, and Diagnostic Analysis
1oo1D system			The architecture consists of a single channel for the safety function (HFT=0)
λ_s			Safe failure rate (per hour)
λ_{SU}			Safe undetectable failures
λ_{SD}			Safe detectable failures
λ_{DU}			Undetectable dangerous failure rate (per hour)
λ_{DD}			Detectable dangerous failure rate (per hour)
λ_{tot}			$\lambda_{tot} = \lambda_{SU} + \lambda_{SD} + \lambda_{DU} + \lambda_{DD}$
MTBF			Mean Time Between Failure ; $MTBF = 1 / \lambda_{tot}$



1

SIL	IEC 61508	ANSI S84.01	PFD	Availability Required	1/PFD
4	YES	NO	10 ⁻⁵ to 10 ⁻⁴	99.99%	100,000 to 10,000
3	YES	YES	10 ⁻⁴ to 10 ⁻³	99.90 to 99.99%	10,000 to 1,000
2	YES	YES	10 ⁻³ to 10 ⁻²	99.90 to 99.99%	1,000 to 100
1	YES	YES	10 ⁻² to 10 ⁻¹	99.90 to 99.99%	100 to 10

Table 1.1: Correlation of SIL and PFD

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 needs an EC-type-examination certificate.



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. F-10 *Electronic Overload* 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.

- 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

- 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.
- 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.
- 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 of the VLT AutomationDrive Design Guide.

- 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:

The frequency converter 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 par. 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 *Trip Delay at Inverter Fault* = 0)

3 Introduction to MCB 112 VLT PTC Thermistor Card

3

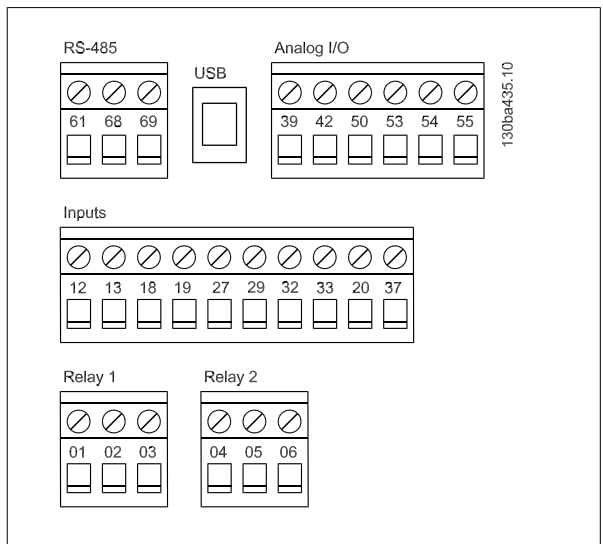
3.1.1 Introduction to MCB 112 PTC Thermistor Card

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 ZIEHL documentation part.

* 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

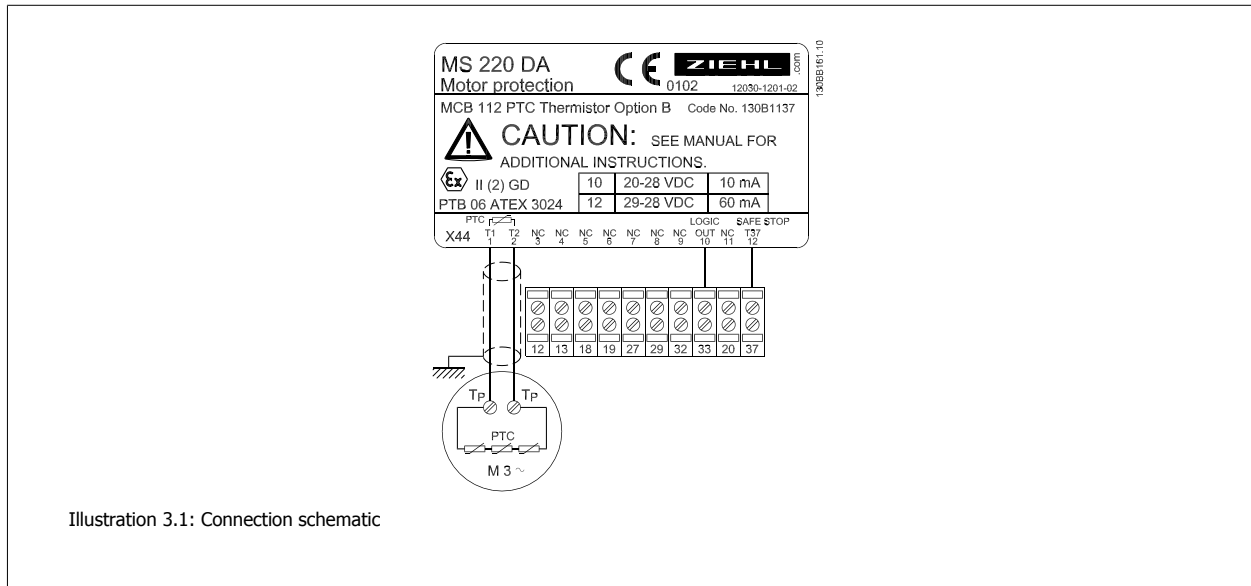
The VLT AutomationDrive control card contains input and output logic terminals. The MCB 112 option makes use of the input terminals but does not assign a function to all of the inputs and outputs on the control card. The terminals required for proper operation of the MCB 112 VLT PTC Thermistor Card are 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:

3



NB!

The connections are not pre-wired from factory.

3.1.4 Overview of Functions

The 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 FC 302 Safe Stop input (Terminal 37). For more details regarding the use of the Safe Stop 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 over temperature 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 FC 302 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 FC 302 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] for the output X44/10 to identify the origin of the Safe Stop signal.

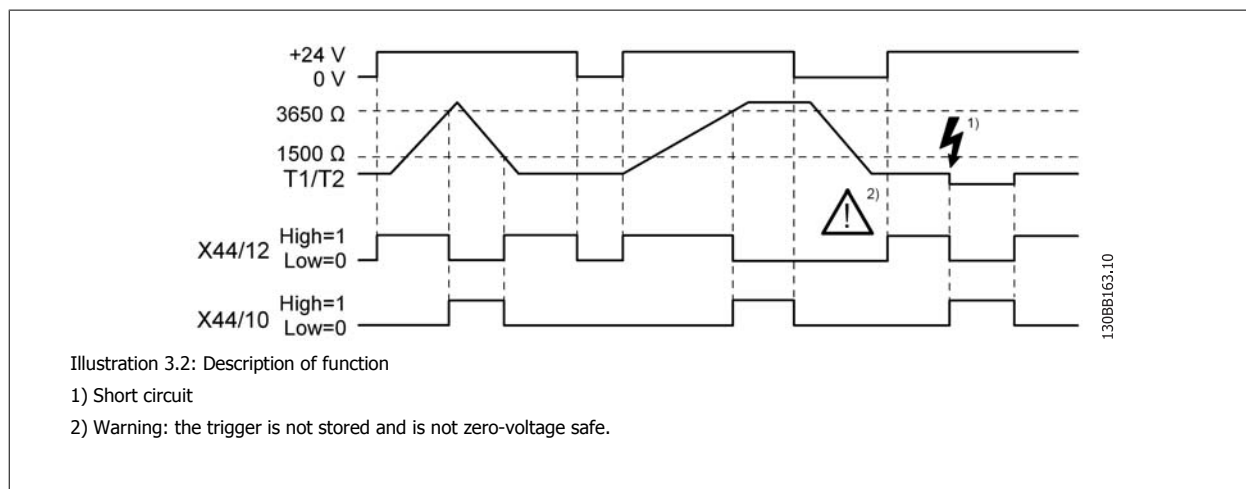


Illustration 3.2: Description of function

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 MCB 112 VLT PTC Thermistor Card uses the approved option's feature of the sensor and temperature supervision in connection with the safety function Safe Stop. 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 MCB 112 VLT PTC Thermistor card's output X44/12 with the drive's terminal 37 ensures the energy cut-off to the motor, if a failure or an exceeded temperature is detected by the MCB 112 VLT PTC Thermistor Card. 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 "*Betriebsicherheitsverordnung*", 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*.

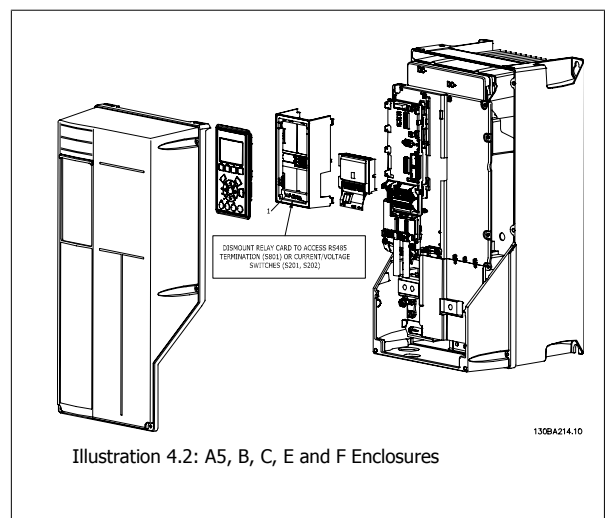
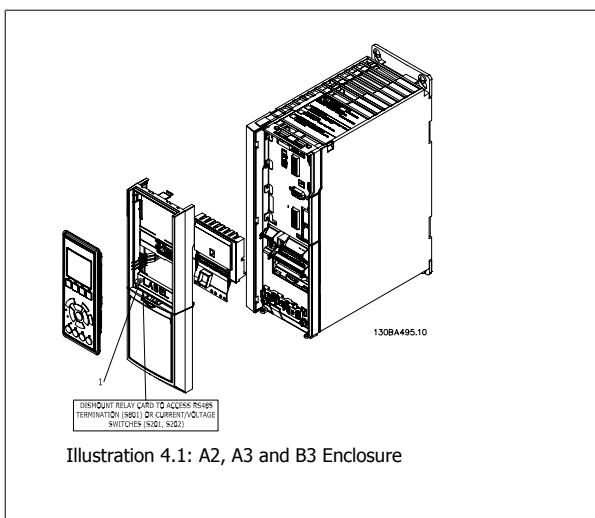
4


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.





NB!
Please note that the MCB 112 VLT PTC Thermistor Card can be used in the complete power range of the 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.

- Continue the necessary wiring of the MCB 112 VLT PTC Thermistor Card. See *Connection Schematic* in the previous chapter and in the chapter *Application Examples*.
- 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!

4



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 Installation of a Category 0 Stop

To carry out an installation of a Category 0 Stop (EN 60204-1) 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 the illustration below.

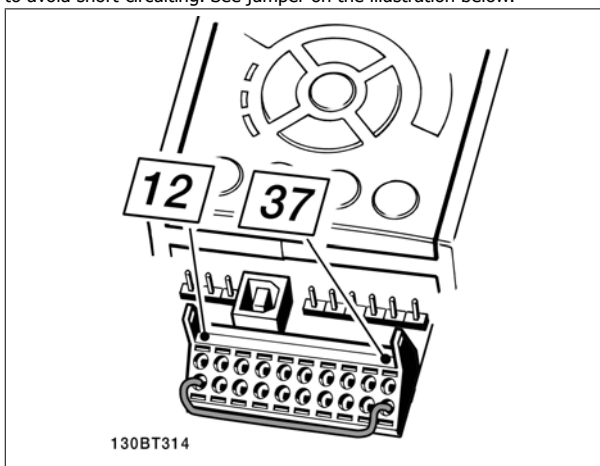


Illustration 4.3: Bridge jumper between terminal 37 and 24 VDC

- 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 AutomationDrive 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!
- The output on terminal X44/12 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!
- Terminal X44/10 of the MCB 112 VLT PTC Thermistor Card must be connected to a digital input of the drive, which enables the drive to determine whether safe stop was enabled by the MCB 112 VLT PTC Thermistor Card.

For further information please refer to the chapter *Application Examples* placed in a later section.

4.1.4 Startup

After installation and before starting the system, the correct function of the motor protection device must be tested using resistance simulation on the sensor input. This test must also be done after modifications in the installation.


In the context of service work, these tests should also be performed:

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


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).





NB!
Refer to MCB 112 manual, ZIEHL part for detailed information regarding commissioning test and wiring.



NB!
If conformance with a SIL (EN 61508) is required, then the commissioning test must be performed at least once per year, in order to assure the PDF of $4,1 \cdot 10^{-3}$. Refer to MCB 112 manual, ZIEHL-part for detailed information.

5

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
...		

All DI can be set to PTC Card 1 [80]. However, only one DI must be set to this choice.

Take care that the DI that is set to [80] is not also connected as Themistor Resource (motor protection) in par. 1-93.

For further description, please refer to the VLT AutomationDrive 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 Warning	Coasts frequency converter when safe stop is activated (T-37 off). When safe stop circuit is reestablished, the frequency converter 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 (T-37 off). When safe stop circuit is reestablished, the frequency converter 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 (T-37 off). When safe stop circuit is reestablished, the frequency converter 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.

Choices 4 - 9 are only available when the MCB 112 PTC Thermistor Card is connected.



NB!

When Auto Reset/ Warning is selected the frequency converter 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].

Please refer to the section *Description of Alarm Word, Warning Word and extended Status Word* in the chapter *Troubleshooting*.

6 Application Example

6.1.1 MCB 112 PTC Thermistor Card

The following two examples show the possibilities, when using the VLT PTC Thermistor Card MCB 112.

Connection of MCB 112

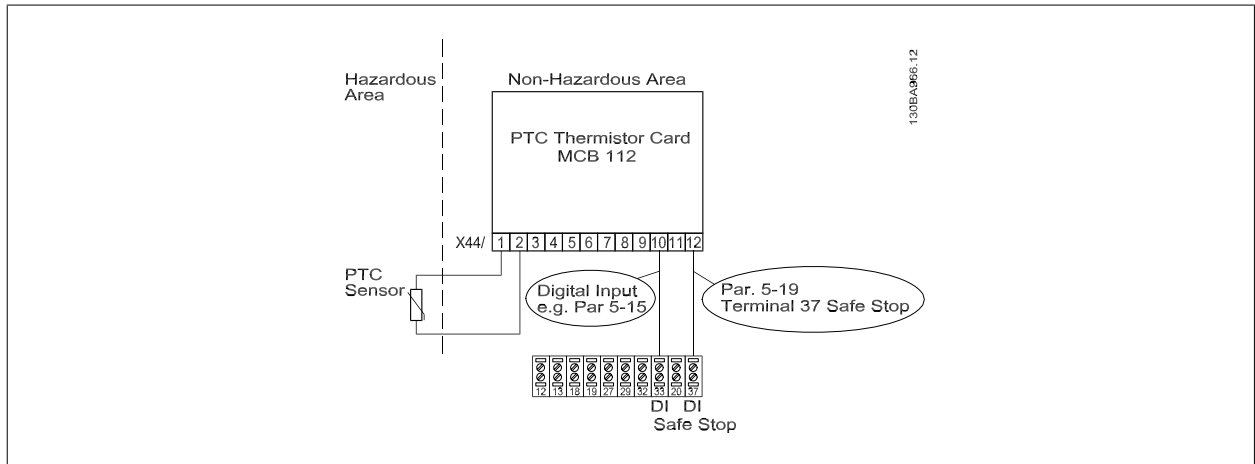
Terminals X44/ 1 and X44/ 2 (T1 and T2) are used to connect the PTCs from the motor with the option card. X44/ 12 is connected with Safe Stop terminal 37 of the FC 302.

Terminal X44/ 10 is connected to a digital input of the FC 302. This digital input can be terminal 33, but this is only an example - any other digital input could be used instead. The use of this signal allows the drive to determine, which source has activated the Safe Stop, as other components can be connected to the Safe Stop terminal 37 of the FC 302 at the same time.

NB!
Terminal X44/10 must be connected.



Standard use



Programming example 1

Par. 5-19 Terminal 37 Safe Stop

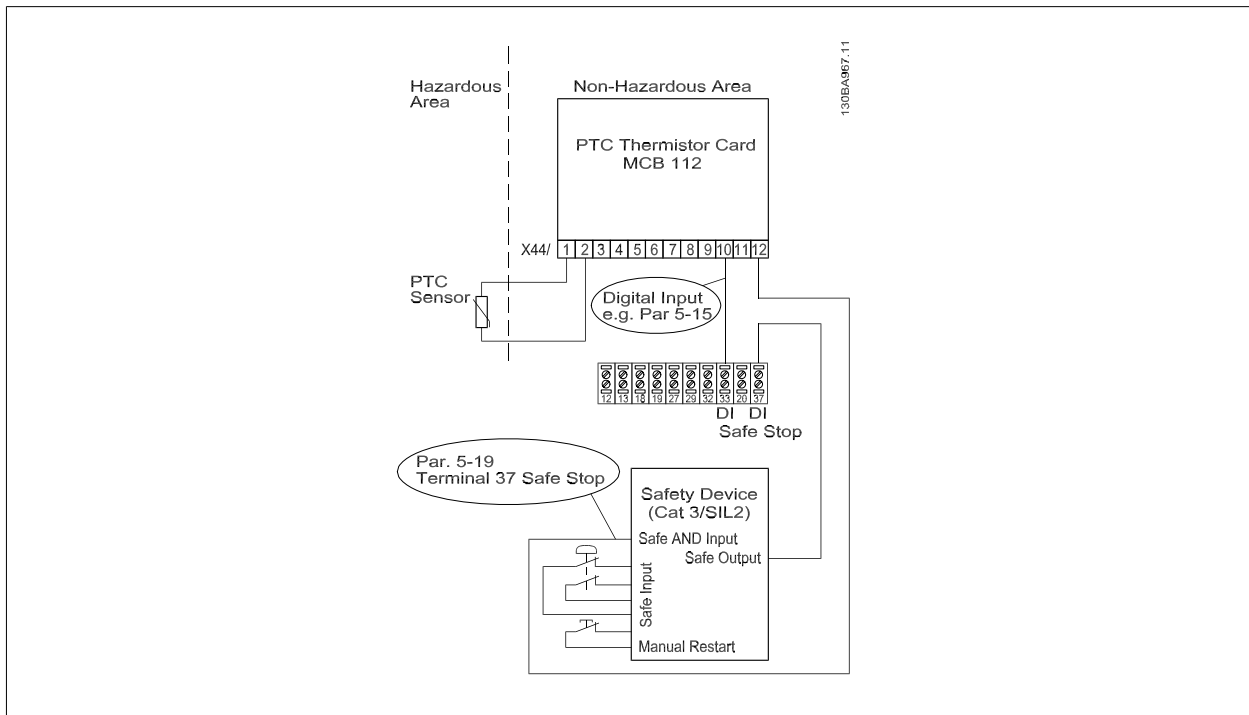
[4] PTC 1 Alarm In case the motor temperature is too high or in case of a PTC failure, the MCB 112 activates the Safe Stop of the FC 302 (Safe Stop terminal 37 goes LOW (active) and digital input 33 goes HIGH (active)). This parameter decides the consequence of the Safe Stop. With this choice the FC 302 coasts and "PTC 1 SafeStop [A71]" is displayed in the LCP. The drive must be manually reset from LCP, digital input or fieldbus when the conditions of the PTC are acceptable again (temperature of motor has dropped)

Par. 5-15 Terminal 33 Digital Input

[80] PTC Card 1 Connects the Digital Input of terminal 33 in the FC 302 to the MCB 112 which makes it possible for the MCB 112 to indicate when Safe Stop has been activated from here

Alternatively, par. 5-19 could be set to selection [5] (PTC 1 Warning), what means an automatic restart when the conditions of the PTC circuit have returned to acceptable. The choice depends on customer demands.

Combination with other component using Safe Stop



6

Programming example 2**Par. 5-19 Terminal 37 Safe Stop**

[6] PTC 1 & Relay Alarm In case the motor temperature is too high or in case of a PTC failure, the MCB 112 activates the Safe Stop of the FC 302 (Safe Stop terminal 37 goes LOW (active) and digital input 33 goes HIGH (active)). This parameter decides the consequence of the Safe Stop. With this choice the FC 302 coasts and "PTC 1 SafeStop [A71]" is displayed in the LCP. The drive must be manually reset from LCP, digital input or fieldbus when the conditions of the PTC are acceptable again (temperature of motor has dropped). An emergency stop can also activate the Safe Stop of the FC 302 (Safe Stop terminal 37 goes LOW (active) but digital input 33 is not triggered by MCB 112 X44/ 10 as the MCB 112 did not need to activate the Safe Stop, hence digital input 33 remains HIGH (inactive)).

Par. 5-15 Terminal 33 Digital Input

[80] PTC Card 1 Connects the Digital Input of terminal 33 in the FC 302 to the MCB 112 which makes it possible for the MCB 112 to indicate when Safe Stop has been activated from here

Alternatively, par. 5-19 could be set to [7] (PTC 1 & Relay Warning), what means an automatic restart when the conditions of the PTC circuit and/ or emergency stop circuit have returned to normal. The choice depends on customer demands. Also, the setting of parameter 5-19 could be [8] (PTC 1 & Relay A/W) or [9] (PTC 1 & Relay W/A), which are combinations of alarm and warning. The choice depends on the customer needs.

**NB!**

Selection [4] – [9] in par. 5-19 will only be visible in case the MCB 112 is plugged into the B-option slot.



Take care that the DI that is set to [80] is not also configured as Thermistor Resource (motor protection) in par. 1-93.

Please refer to *Parameter settings for external safety device in combination with MCB 112* in the *Introduction to FC 300* section for more information about the combination.

7 Troubleshooting

7.1.1 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 9V.

7.1.2 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 ¹⁾		5-19
71	PTC 1 Safe Stop	X	X ¹⁾		5-19
72	Dangerous Failure			X ¹⁾	5-19

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

Alarm 11, Motor Thermistor over temp., has to do with par. 1-93 and not MCB 112.



7.1.3 Description of Alarm Word, Warning Word and Extended Status Word

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. The Dangerous Failure Alarm is issued if the combination of safe stop commands is unexpected. This is the case if the MCB 112 VLT PTC Thermistor Card enables X44/10 but safe stop is somehow not enabled. Furthermore, if the MCB 112 is the only device using safe stop (specified through selection [4] or [5] in par. 5-19), an unexpected combination is activation of safe stop without the X44/10 being activated. The following table summarizes the unexpected combinations that lead to Alarm 72. Note that if X44/10 is activated in selection 2 or 3, this signal is ignored! However, the MCB 112 will still be able to activate Safe Stop.

The following table shows the various combinations that will course Alarm 72.

Example:

PTC 1 Warning [5] is selected in par. 5-19 and X44/10 is not activated but Safe Stop is. This is unexpected as selection [5] in par. 5-19 specifies that Safe Stop will only be triggered from MCB 112.

+: Activated

-: Not activated

Function	No.	X44/10 (DI)	Safe Stop T37
PTC 1 Alarm	[4]	+	-
		-	+
PTC 1 Warning	[5]	+	-
		-	+
PTC 1 & Relay A	[6]	+	-
PTC 1 & Relay W	[7]	+	-
PTC 1 & Relay A/W	[8]	+	-
PTC 1 & Relay W/A	[9]	+	-



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



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