# Grid feeding monitoring according to CEI 0-21 CM-UFD.M22

The CM-UFD.M22 is a multifunctional grid feeding monitoring relay. It provides different monitoring functions in accordance with CEI 0-21 to detect over- and undervoltage (10 minutes average value, voltage increase and decrease protection) as well as any changes in grid frequency (frequency increase and decrease protection).

The device is connected between the decentralized electrical energy source and the public grid in order to disconnect the decentral power source, in case of problems (e.g. unstable grid), faults or maintenance on the grid. Additionaly monitoring of ROCOF (rate of change of frequency) can be configured.
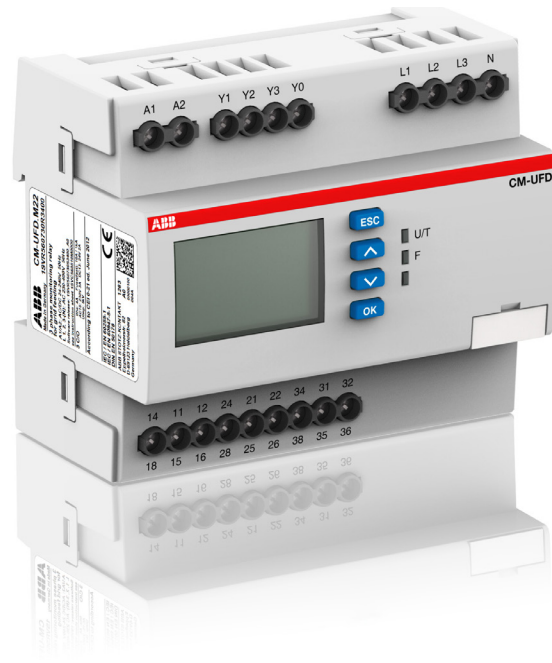
## Characteristics
– Monitoring of voltage and frequency in single- and three-phase mains 2-wire, 3-wire or 4-wire AC systems
– Type tested in accordance to CEI 0-21
– Over- and undervoltage, 10 minutes average value as well as over- and underfrequency monitoring
– Two-level threshold settings for over-/undervoltage and frequency
– ROCOF (rate of change of frequency) monitoring configurable
– Integrated management of redundancy function (acc. CEI 0-21, mandatory in plants with P>20 kW)
– Measured values, thresholds and settings shown on the display
– All threshold values adjustable as absolute values
– Default setting according to CEI 0-21
– True RMS measuring principle
– High measurement accuracy
– 3 control inputs for remote trip, feedback signal, and external signal
– Tripping delay for each threshold adjustable

– Interrupted neutral detection
– Error memory for up to 99 entries (incl. cause of error, measured value, relative timestamp)
– Autotest function
– Password setting protection
– 3 c/o (SPDT) contacts
– LEDs for the indication of operational states
– Multiline, backlit LCD display

## Approvals
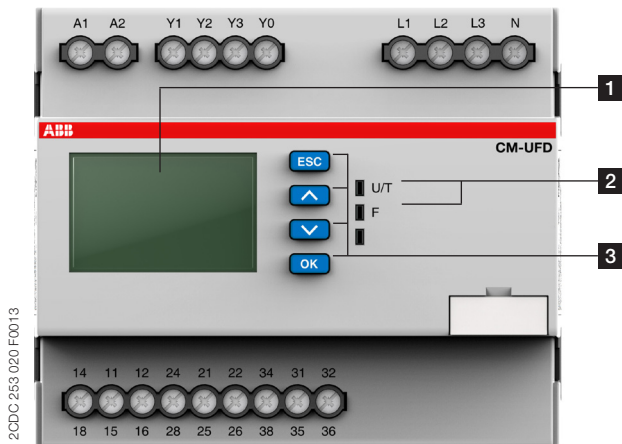Type tested acc. to CEI 0-21: 2012-06 +
CEI 0-21; V1: 2012-12

## Marks
CE   CE

## Order data

| Type | Rated control supply voltage | Measuring range | Order code |
|------|------------------------------|-----------------|------------|
| CM-UFD.M22 | 24-240 V AC/DC | L-L: 0-540 V AC / L-N: 0-312 V AC | 1SVR 560 730 R3400 |

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## Functions

### Operating controls



**1** Display

```
L1N: 229.7V
L2N: 229.7V
L3N: 229.7V
    49.99 Hz

R1 R2 R3 FB EXT REM
```
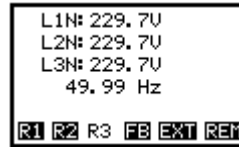
R1 R2 R3 - relay status; in this case R3 is de-energized
FB - status feedback loop Y0-Y1; in this case FB is closed
EXT – status input external signal; in this case input is closed
REM – status remote trip input; in this case input is closed

**2** Indication of operational states
U/T: green LED – supply voltage applied / flashing = timing active
F: red LED - failure

**3** Keypad
ESC: escape / return to previous menu
∧: up / value increase
∨: down / value decrease
OK: enter / confirm selection

### Application

The CM-UFD.M22 is a grid feeding monitoring relay (SPI), which is connected between the decentral electrical energy source such as photovoltaic systems, wind turbines, block-type thermal power stations and the public grid. It monitors the voltage and frequency in the grid and will disconnect the distributed generation (GD) whenever the measured values are not within the range of the adjusted thresholds. The alarm is indicated by LED and the corresponding plain text message is shown on the display.

The grid feeding monitoring relay is completely adjustable and assures the necessary flexibility to integrate medium and small generation plant. In conformity to CEI 0-21: 2012-06 and CEI 0-21; V1: 2012-12, the CM-UFD.M22 relay can be used in all low voltage plants and in medium voltage plants with power less than 30 kW. The SPI relay is mandatory in all low voltage production plants with power > 6 kW or with more than 3 generators (e.g. plants with more than 3 inverters).

### Operating mode

The CM-UFD.M22 can be used to monitor single- and three-phase mains (2-wire, 3-wire as well as 4-wire AC systems). The unit is configurable by front-face push buttons. A display with the corresponding menu enables the selection of pre-settings as well as the precise adjustment of the different threshold values and corresponding delay times. Furthermore, the display visualizes the measured values and states clearly. It shows the user all information about operational states on the display together with the front-face LEDs.

The CM-UFD.M22 provides 3 output relays and 3 control inputs. The first output contact $11_{15}$-$12_{16}$/$14_{18}$ is required for disconnection of the decentral electrical energy source from the public grid (DDI). The corresponding feedback signal from the external contact is monitored via the first control input Y0-Y1 by the internal logic. The second output contact $21_{25}$-$22_{26}$/$24_{28}$ is redundant to the first one and only activated if relay $11_{15}$-$12_{16}$/$14_{18}$ has de-energized, but no changed state of the feedback from the external contact (DDI) has been recognized within the adjusted time delay. In case a feedback signal is present, the redundancy relay does not trip.

Once the feedback loop did not change its status after the first output changed the status and the DDI should disconnect, the CM-UFD.M22 detects this as a failure (e.g. welded contacts of the DDI contactor) and trips the second output (rincalzo function). The third output contact $31_{35}$-$32_{36}$/$34_{38}$ can be used for the closing command of a motor drive for circuit breaker. In case output relay $11_{15}$-$12_{16}$/$14_{18}$ energizes, the adjustable ON-delay starts. When the ON-delay is complete, output relay $31_{35}$-$32_{36}$/$34_{38}$ will be activated for the duration of the ON-time or until relay $11_{15}$-$12_{16}$/$14_{18}$ de-energizes. In this last case the ON-time is inactive. It is also adjustable to sychronize tripping relay R3 with relay R1.

The operating principle of the relays $21_{25}$-$22_{26}$/$24_{28}$ and $31_{35}$-$32_{36}$/$34_{38}$ is configurable as normally energized (closed-circuit principle) or normally de-energized (open-circuit principle). For safety reasons, the operating principle of relay 1 is fixed as normally energized (closed-circuit principle) .

Two additional control inputs allow to switch from remote between two sets of frequency threshold settings via Y0-Y2 or to trip the grid feeding monitoring relay via the control input Y0-Y3 (remote trip).

## Protective functions

If control supply voltage is applied and all phases are present with voltage and frequency values within their permissible range, output relay $11_{15}$-$12_{16}$/$14_{18}$ (DDI) energizes after the adjustable start-up delay and output relay $21_{25}$-$22_{26}$/$24_{28}$ (DG) energizes or de-energizes, depending on the configuration, after a fixed delay of 1 s. Using the default factory setting, both output relays $11_{15}$-$12_{16}$/$14_{18}$ (DDI) and $21_{25}$-$22_{26}$/$24_{28}$ (DG) will be activated synchronously. The green LED U/T flashes while timing and turns steady when the start-up delay is compete.

If one of the measured values exceeds or falls below the set threshold value, output relay $11_{15}$-$12_{16}$/$14_{18}$ (DDI) de-energizes after the adjusted delay. The fault is indicated by the red LED F and the type of fault is shown on the display as a clear type message. The event that has caused tripping of the relay is recorded in the event list. During the delay the green LED U/T flashes while timing and turns steady when the delay is compete.

As soon as the measured value returns back into the tolerance range, taking into account a fixed hysteresis, the red LED F turns of and output relay $11_{15}$-$12_{16}$/$14_{18}$ (DDI) re-energizes after the adjusted re-start delay. During the delay the green LED U/T flashes while timing and turns steady when the delay is compete.

Protective function 59 S1 (10 minutes average value):

The CM-UFD.M22 calculates the sliding average value of the 3 phases over a period of 10 minutes. The voltage values are updated every 3 seconds. If the 10 minutes average value exceeds the threshold value, the output relays trip when the adjusted delay is complete.

## Redundancy functions

The redundancy relay $21_{25}$-$22_{26}$/$24_{28}$ (DG) is activated if relay $11_{15}$-$12_{16}$/$14_{18}$ (DDI) has de-energized and if no feedback from the external contact has been recognized by the internal logic via the first control input Y0-Y1 within the adjustable time delay. In case a feedback signal is present, the redundancy relay does not trip.

## Relay 3 ($31_{35}$-$32_{36}$/$34_{38}$)

Output relay 3 can be used for the closing command of the motor drive for circuit breaker. In case output relay $11_{15}$-$12_{16}$/$14_{18}$ (DDI) energizes, the adjusted ON-delay starts. When the ON-delay is complete, output relay $31_{35}$-$32_{36}$/$34_{38}$ will be activated for the duration of the ON-time or until relay $11_{15}$-$12_{16}$/$14_{18}$ de-energizes. In this last case the ON-time is inactive. The operating principle of relay $31_{35}$-$32_{36}$/$34_{38}$ is configurable as closed-circuit or open-circuit principle.

## ROCOF

This function monitors the rate of change of frequency within a very short time and detects an imminent loss of mains (islanding).

The ROCOF function will detect zero crossings of the grid voltage. It measures the time between the zero crossings and calculates a new frequency after each zero crossing. In case the frequency changes too much since the last zero crossing, the relay will trip. After the adjustable error time the relay de-energizes automatically.

If a loss of mains is not detected, the connected generator causes a safety hazard to the network and might get damaged due to the fast frequency shift of the mains voltage. This is why islanding is not permitted in most countries. The ROCOF monitoring function is deactivated per default. It can be activated through the menu.

## Interrupted neutral detection

Interrupted neutral detection is always active when phase-neutral measuring principle is selected in menu "I/O setup". The interruption of the neutral conductor will result in an immediate tripping of relay $11_{15}$-$12_{16}$/$14_{18}$ (DDI).

## Error memory

The CM-UFD.M22 records and logs the last 99 events that caused tripping of the grid feeding monitoring relay and any interruption of the control supply voltage. The type of error as well as the current value of the operation counter is recorded into the internal error list, accessible in the menu "Error memory". The list is stored internally in a non-volatile memory which can be reset by the user.

## Local command and external signal

The CEI 0-21 standard defines "restrictive thresholds", the under- and overfrequency thresholds S1 (49.5-50.5 Hz), and "permissive thresholds", the under- and overfrequency thresholds S2 (47.5-51.5 Hz). Selection of S1 or S2 thresholds is made by the corresponding combination of the external signal Y0-Y2 and the local command (see tables on page 4).

| Working principle | Input state | Control input |
|---|---|---|
| normally open | open | 0 |
| normally open | closed | 1 |
| normally closed | open | 1 |
| normally closed | closed | 0 |

Table: Truth table for control inputs External Signal Y0-Y2 and Remote trip Y0-Y3

| External signal | Local command | Active thresholds |
|---|---|---|
| 0 | disabled | only S2 |
| 1 | disabled | only S2 |
| 0 | enabled | only S2 |
| 1 | enabled | S1 and S2 |

Table: Truth table for frequency thresholds

## Remote trip

Control input Y0-Y3 allows tripping of the grid feeding monitoring relay from remote. The remote trip input can be configured as normally open or normally closed. If normally closed is configured, the relay trips if Y0-Y3 is opened. If normally open is configured, the relay trips if Y0-Y3 is closed. The output relay $11_{15}$-$12_{16}$/$14_{18}$ is tripped by the remote trip within less than 20 ms. When the remote trip input is deactivated, the output relay $11_{15}$-$12_{16}$/$14_{18}$ (DDI) energizes again.

## Autotest

The autotest function allows the verification of the protective functions by increasing the lowest threshold and decreasing the highest threshold respectively, until the measured value for input voltage or frequency equals the threshold. Confirming the start of the autotest routine initiates the threshold sweep with the objective of tripping the relay. For each threshold the device displays the measured switching time up from tripping the output relay till the feedback signal from the external contact of the switching device. If the autotest fails, the cause of error has to be analysed and the test needs to be repeated. Output relay $11_{15}$-$12_{16}$/$14_{18}$ remains de-energized as long as the test has not been passed successfully.

Note: The autotest will cause the CM-UFD.M22 to trip four times within a short time. This may lead to voltage fluctuations in the public grid. Therefore, we recommend to disconnect the generating plant manually from the grid before executing the auto test procedure.

## Operating principle
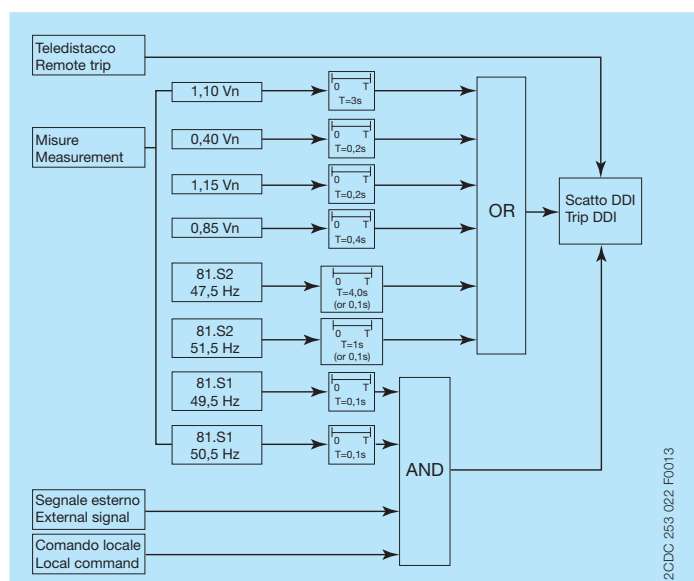
## Electrical connection



| | |
|---|---|
| A1-A2 | Control supply voltage |
| Y0-Y1 | Control input for feedback signal |
| Y0-Y2 | Control input for external signal |
| Y0-Y3 | Control input for remote trip |
| L1, L2, L3, N | Measuring input |
| $11_{15}$-$12_{16}$/$14_{18}$ | 1st c/o (SPDT) contact |
| $21_{25}$-$22_{26}$/$24_{28}$ | 2nd c/o (SPDT) contact |
| $31_{35}$-$32_{36}$/$34_{38}$ | 3rd c/o (SPDT) contact |

## Configuration

The relay is delivered with default settings in accordance to CEI 0-21 table 8. Thanks to the wide backlit display and to appropriate buttons all parameters can be easily set. The user-friendly menu structure starts with the main page that shows the real time measured values. Use the arrow keys to switch between the real time voltages and the 10 minutes average voltages.

## Display menu structure, navigation and possible configurations

### Main page
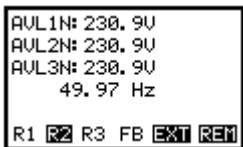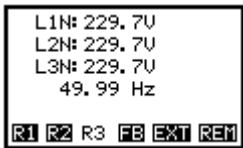


### Menu navigation

- With a dark display, press any button to light it up

- Press OK button to enter the menu

- Press arrow buttons to move between functions and parameters

- Press OK button to enter the chosen page

- Press arrow buttons to modify the values of the parameters

- Press OK button to confirm the value and proceed

- Press ESC button to return to the previous menu

- Press arrow buttons more than 1 s to scroll through the menu or password menu

Changes of parameters can be cancelled by pressing the ESC button.

## Password protection

Any CM-UFD.M22 relay is delivered with the same default passwords [0000] for protection of its settings and local command. The installer is responsible for the verification of the parameter values and the change of the password with a personal one in order to avoid unwanted modifications.

Visualization of the parameters is always possible, modification only after having entered the password. While entering the password, the password protection is temporarily disabled until the menu is exited.

Only the parameters 'autotest', 'language', 'display switch-off delay' and 'contrast' are not password protected.

## Default setting table

| Protective functions | Threshold | | Tripping delay |
|---|---|---|---|
| | relative | absolute | |
| 1st overvoltage av. (59 S1) | 1.10 $V_n$ | 253 V | |
| 2nd overvoltage (59 S2) | 1.15 $V_n$ | 265 V | 0.2 s |
| 1st undervoltage (27 S1) | 0.85 $V_n$ | 196 V | 0.4 s |
| 2nd undervoltage (27 S2) | 0.40 $V_n$ | 92 V | 0.2 s |
| 1st overfrequency (81> S1) | | 50.5 Hz | 0.1 s |
| 1st underfrequency (81< S1) | | 49.5 Hz | 0.1 s |
| 2nd overfrequency (81> S2) | | 51.5 Hz | 0.1 s |
| 2nd underfrequency (81< S2) | | 47.5 Hz | 0.1 s |

Note: The voltage values in this table refer to phase-neutral ($V_n$ 230 V).


## Indication of operational states

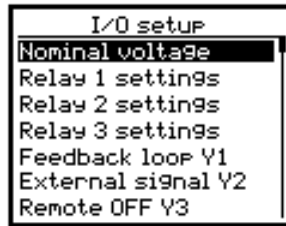| LED | Status information |
|---|---|
| U/T: green LED ON | Control supply voltage applied |
| U/T: green LED flashing | Timing |
| F: red LED ON | Failure |

## Menu structure

**Main menu displays**

```
         Menu
I/O setup
Monitoring func.
Autotest
General settings
Error memory
```

OK →

← ESC

∨ down        up ∧

**Submenus  displays**

```
       I/O setup
Nominal voltage
Relay 1 settings
Relay 2 settings
Relay 3 settings
Feedback loop Y1
External signal Y2
Remote OFF Y3
```

OK →

← ESC

∨ down            up ∧

```
     Nominal voltage
Meas. Principle
[ Line to neutral  ]
Nominal voltage
[ 230.0] V
```
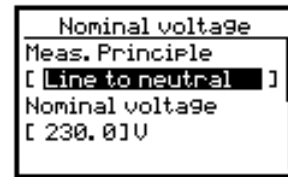
| Main menu displays | Submenus displays | | Configuration possibilities | Step size |
|---|---|---|---|---|
| I/O setup | Nominal voltage | Meas. principle | [Line to neutral], [Line to line] | |
| | | Nominal voltage | [100.0] - [230.9] V L-N / [173.2] - [400.0] V L-L | 0.1 V |
| | Relay 1 settings | Start-up delay | [1.00] - [600.00] s | 0.05 s |
| | | Restart delay | [0.05] - [600.00] s | 0.05 s |
| | Relay 2 settings | Working principle | [closed-circuit], [open-circuit] | |
| | Relay 3 settings | Working principle | [closed-circuit], [open-circuit], [disabled], [sync. with relay 1] | |
| | | ON-delay | [0.00] - [10.00] s | 0.05 s |
| | | ON-time | [0.05] - [10.00] s | 0.05 s |
| | Feedback loop Y1 | Working principle | [normally closed], [normally open], [auto detection] | |
| | | Trip window | [0.05] - [0.50] s | 0.05 s |
| | | Release window | [0.50] - [10.00] s | 0.05 s |
| | External signal Y2 | Working principle | [normally closed], [normally open] | |
| | Remote OFF * Y3 | Working principle | [normally closed], [normally open] | |
| Monitoring func. | Overvoltage >S1 | Threshold value | [1.00] - [1.20] * $U_n$ | 0.01 * $U_n$ |
| | Overvoltage >S2 | Threshold value | [1.00] - [1.30] * $U_n$ | 0.01 * $U_n$ |
| | | Tripping delay | [0.05] - [600.00] s | 0.05 s |
| | Undervoltage <S1 | Threshold value | [0.20] - [1.00] * $U_n$ | 0.01 * $U_n$ |
| | | Tripping delay | [0.05] - [600.00] s | 0.05 s |
| | Undervoltage <S2 | Threshold value | [0.05] - [1.00] * $U_n$ | 0.01 * $U_n$ |
| | | Tripping delay | [0.05] - [600.00] s | 0.05 s |
| | Overfrequency >S1 | Threshold value | [50.0] - [54.0] Hz | 0.1 Hz |
| | | Tripping delay | [0.05] - [600.00] s | 0.05 s |
| | Overfrequency >S2 | Threshold value | [50.0] - [54.0] Hz | 0.1 Hz |
| | | Tripping delay | [0.05] - [600.00] s | 0.05 s |
| | Underfrequency <S1 | Threshold value | [46.0] - [50.0] Hz | 0.1 Hz |
| | | Tripping delay | [0.05] - [600.00] s | 0.05 s |
| | Underfrequency <S2 | Threshold value | [46.0] - [50.0] Hz | 0.1 Hz |
| | | Tripping delay | [0.05] - [600.00] s | 0.05 s |
| | ROCOF | ROCOF | [disabled], [enabled] | |
| | | Threshold value | [0.1] - [1.0] Hz/s | 0.1 Hz/s |
| | | Error-time | [0.05] - [600.00] s | 0.05 s |
| Autotest | | | | |
| General settings | Local command | Local command | [No], [Yes] | |
| | | Change LC password | [****] | |
| | Language | Language | [English], [Italian] | |
| | Display | Switch-off delay | [10] - [600] s | 1 s |
| | | Contrast | [0] - [9] | |
| | Password | Protection | [disabled], [enabled] | |
| | | Change password | [****] | |
| | Load settings | "*Setting name*" | | |
| | Save settings | "*Setting name*" | | |
| | Information | | | |
| Error memory | Error list | | | |
| | Error recording | Remote OFF * | [disabled], [enabled] | |
| | | Power OFF | [disabled], [enabled] | |
| | Reset error memory | | | |
| | Operating counter | | | |
| | Cumulated OFF-time | | | |

* = Remote trip

## Display and failure messages

```
     Password
Enter password
E4W3
```
When entering, the password is required, in this case E4W3

```
L1N: 260.2U  >S1
L2N: 260.3U  >S1
L3N: 260.0U  >S1
    49.99 Hz

R1 R2 R3 FB EXT REM
```
Error overvoltage S1 in all three phases detected.
If overvoltage occurs in one phase only, >S1 indicates the phase with overvoltage.

```
L1N: 264.6U  >S2
L2N: 264.9U  >S2
L3N: 264.6U  >S2
    49.99 Hz

R1 R2 R3 FB EXT REM
```
Error overvoltage S2 in all three phases detected.
If overvoltage occurs in one phase only, >S2 indicates the phase with overvoltage.

```
L1N: 190.3U  <S1
L2N: 190.5U  <S1
L3N: 190.1U  <S1
    49.99 Hz

R1 R2 R3 FB EXT TSC
```
Error undervoltage S1 in all three phases detected.
If undervoltage occurs in one phase only, <S1 indicates the phase with undervoltage.

```
L1N:  90.2U  <S2
L2N:  90.3U  <S2
L3N:  90.2U  <S2
    49.99 Hz

R1 R2 R3 FB EXT REM
```
Error undervoltage S2 in all three phases detected.
If undervoltage occurs in one phase only, <S2 indicates the phase with undervoltage.

```
L1N: 230.4U
L2N: 230.5U
L3N: 230.2U
    51.00 Hz  >S1

R1 R2 R3 FB EXT TSC
```
Error overfrequency S1 detected

```
L1N: 230.3U
L2N: 230.5U
L3N: 230.1U
    51.99 Hz  >S2

R1 R2 R3 FB EXT TSC
```
Error overfrequency S2 detected

```
L1N: 230.5U
L2N: 230.7U
L3N: 230.3U
    49.00 Hz  <S1

R1 R2 R3 FB EXT TSC
```
Error underfrequency S1 detected

```
L1N: 230.6U
L2N: 230.7U
L3N: 230.5U
    47.00 Hz  <S2

R1 R2 R3 FB EXT TSC
```
Error underfrequency S2 detected

```
L1N: 199.9U
L2N: 200.1U
L3N: 199.7U
    49.99 Hz  ROCOF

R1 R2 R3 FB EXT REM
```
Error, ROCOF

```
Neutral conductor
is not connected!



R1 R2 R3 FB EXT REM
```
4-wire connection,
neutral disconnected or interrupted,
check wiring

```
L1N: 230.4U
L2N: 230.6U
L3N: 230.3U
    49.99 Hz
R1-FB Press ESC!
R1 R2 R3 FB EXT REM
```
Failure in the feedback loop FB. E.g. wiring failure, configuration failure, welded feedback contact in DDI.
Please check configuration and installation for failures. After failure removal, press ESC to restart/reset.

```
L1N: 220.5U
L2N: 220.6U
L3N: 220.4U
    49.99 Hz
R1-FB check loop!
R1 R2 R3 FB EXT REM
```
Permanent failure in the feedback loop FB. E.g. wiring failure, configuration failure, welded feedback contact in DDI.
Failure in configuration or installation must be removed before the failure can be receipted with ESC.

```
L1N: 229.9U
L2N: 229.2U
L3N: 229.1U
    49.99 Hz
Internal error
R1 R2 R3 FB EXT REM
```
Failure within the logic or hardware of the device. Remove supply and restart. If failure still occurs, there is a permanent failure in the device.

```
    Autotest
U> 230.2U    16ms
Autotest failed


```
Feedback of DDI interrupted or failure.

```
L1N: 229.9U
L2N: 230.2U
L3N: 229.9U
    49.99 Hz
Autotest failed
R1 R2 R3 FB EXT REM
```
Main display / start display after autotest failure.
Restart autotest

```
L1N: 230.6U
L2N: 230.3U
L3N: 230.9U
    49.99 Hz
Remote OFF
R1 R2 R3 FB EXT REM
```
Remote OFF / Remote trip
shows that the remote trip is activated and output relay 1 is de-energized.

## Error memory

As soon as one of the above errors occurs, subsequent error codes with the corresponding time stamp will be stored in the error memory:

Storage position in the error list

Error code

```
 ┌──────────────────────┐
 │      Error list      │
 │ Number:          1   │
 │ Code:       POWER    │
 │ Time:                │
 │ 00Y000D08H03M15S     │
 └──────────────────────┘
```

Time stamp
In this case the error was present for 8 hours, 3 minutes and 15 seconds

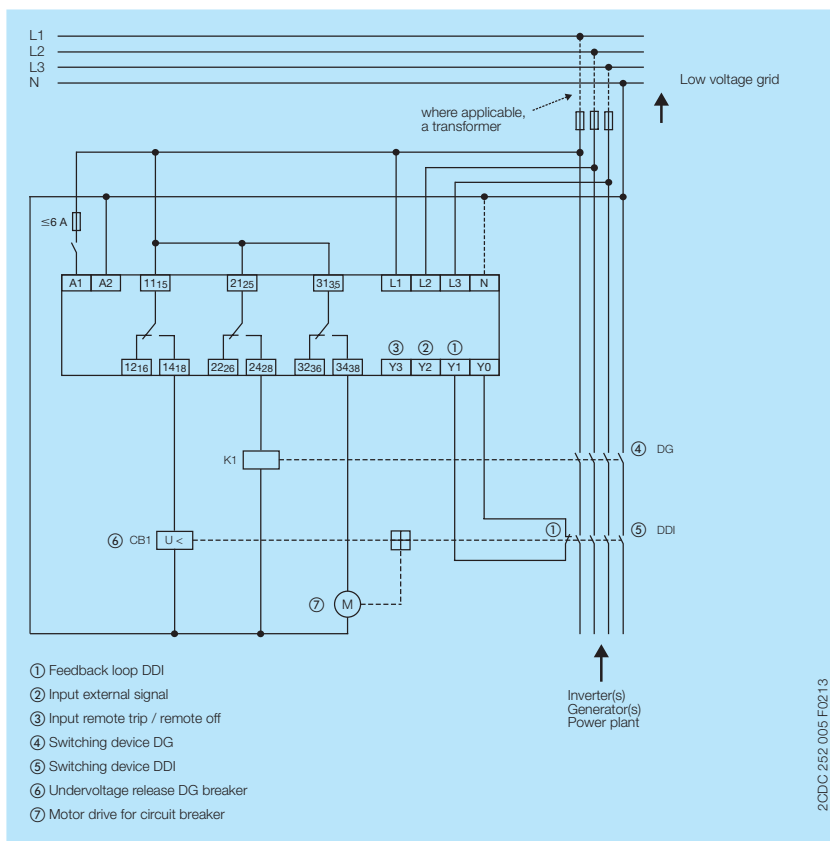| Error code | Explanation | |
|---|---|---|
| L1N>S1 or L2N>S1 or L3N>S1 | Error, overvoltage S1 | 10 minutes average value |
| L1N>S2 or L2N>S2 or L3N>S2 | Error, overvoltage S2 | |
| L1N<S1 or L2N<S1 or L3N<S1 | Error, undervoltage S1 | |
| L1N<S2 or L2N<S2 or L3N<S2 | Error, undervoltage S2 | |
| L12>S1 or L23>S1 or L31>S1 | Error, overvoltage S1 | 10 minutes average value |
| L12>S2 or L23>S2 or L31>S2 | Error, overvoltage S2 | |
| L12<S1 or L23<S1 or L31<S1 | Error, undervoltage S1 | |
| L12<S2 or L23<S2 or L31<S2 | Error, undervoltage S2 | |
| F>S1 | Error, overfrequency S1 | |
| F>S2 | Error, overfrequency S2 | |
| F<S1 | Error, underfrequency S1 | |
| F<S2 | Error, underfrequency S2 | |
| ROCOF | Error, ROCOF | |
| AUTO | Error, autotest | Failure during the autotest routine |
| REMOTE | Error, remote trip | |
| DDI-FB | Error, DDI feedback | Malfunction of the DDI |
| POWER | Error, power | Supply voltage is disconnected or too low |
| NEUTRAL | Error, interrupted neutral detection | |
| Exxx (e.g. E123) | Internal error | Failure within the logic or hardware of the device |

## Connection and wiring

### Example of single-phase application

Contactor as DDI



① Feedback loop DDI
② Input external signal
③ Input remote trip / remote off
④ Switching device DG
⑤ Switching device DDI

L1
L2
L3
N
Low voltage grid
where applicable, a transformer
≤6 A
A1 A2 | 11 15 | 21 25 | 31 35 | L1 L2 L3 N
12 16 | 14 18 | 22 26 | 24 28 | 32 36 | 34 38 | ③ ② ① — Y3 Y2 Y1 Y0
K1
K2
④ DG
⑤ DDI
Inverter(s) Generator(s) Power plant
2CDC 252 004 F0213
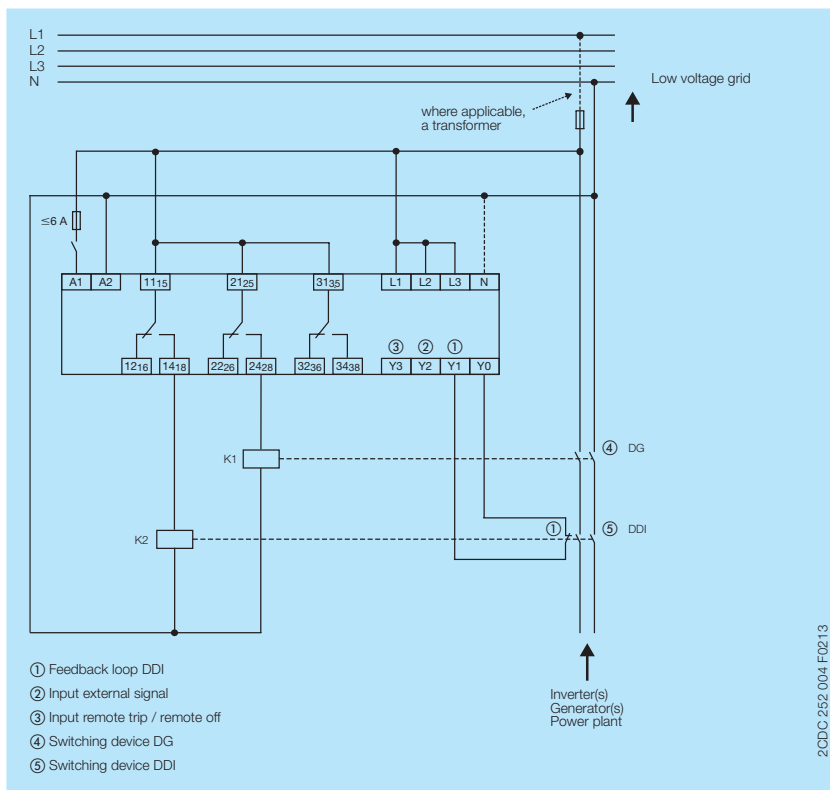
### Example of three-phase application

Contactor as DDI, breaker as DG



① Feedback loop DDI
② Input external signal
③ Input remote trip / remote off
④ Switching device DG
⑤ Switching device DDI
⑥ Undervoltage release DG breaker
⑦ Motor drive for circuit breaker

L1
L2
L3
N
Low voltage grid
where applicable, a transformer
≤6 A
A1 A2 | 11 15 | 21 25 | 31 35 | L1 L2 L3 N
12 16 | 14 18 | 22 26 | 24 28 | 32 36 | 34 38 | ③ ② ① — Y3 Y2 Y1 Y0
K1
⑥ CB1 U<
⑦ M
④ DG
⑤ DDI
Inverter(s) Generator(s) Power plant
2CDC 252 005 F0213

## Technical data

Data at $T_a$ = 25 °C and rated values, unless otherwise indicated

### Input circuits

| Supply circuit | A1, A2 |
|---|---|
| Rated control supply voltage $U_s$ tolerance | 24-240 V AC/DC |
| Rated control supply voltage $U_s$ tolerance | -15…+10 % |
| Control supply voltage range | 20.4-264 V AC/DC |
| Rated frequency | DC or 50 Hz |
| Frequency range AC | 40-60 Hz |
| Typical current / power consumption      24 V DC | 64 mA / 1.5 W |
|      230 V AC | 6.4 mA / 1.5 VA |
| Power failure buffering time | 200 ms, according LVFRT* |

| Measuring circuit | | L1-N, L2-N, L3-N or L-L |
|---|---|---|
| Monitoring functions | Overvoltage av. (59 S1) | ■ |
| acc. to CEI 0-21: 2012-06 | Overvoltage (59 S2) | ■ |
| | Undervoltage (27 S1) | ■ |
| | Undervoltage (27 S2) | ■ |
| | Overfrequency (81>S1) | ■ |
| | Underfrequency (81<S1) | ■ |
| | Overfrequency (81>S2) | ■ |
| | Underfrequency (81<S2) | ■ |
| | ROCOF | ■ configurable |
| | Neutral | ■ activated, if L-N |
| Measuring ranges | Voltage (4-wire system L1, L2, L3-N) | 0-312 V AC |
| | (3-wire system L1, L2, L3) | 0-540 V AC |
| | (2-wire system L-N) | 0-312 V AC |
| | Frequency | 40-60 Hz |
| Accuracy of measurements | Voltage | ≤ 2 % |
| | Frequency | ± 20 mHz |
| | Delay times | ≤ 5 % ± 20 ms |
| Threshold values | Overvoltage av. (59 S1) | adjustable, 1.00-1.30 * $U_s$ in 0.01*$U_s$ steps |
| | Overvoltage (59 S2) | adjustable, 1.00-1.20 * $U_s$ in 0.01*$U_s$ steps |
| | Undervoltage (27 S1) | adjustable, 0.20-1.00 * $U_s$ in 0.01*$U_s$ steps |
| | Undervoltage (27 S2) | adjustable, 0.05-1.00 * $U_s$ in 0.01*$U_s$ steps |
| | Overfrequency (81>S1) | adjustable, 50.0-54.0 Hz in 0.1 Hz steps |
| | Underfrequency (81<S1) | adjustable, 46.0-50.0 Hz in 0.1 Hz steps |
| | Overfrequency (81>S2) | adjustable, 50.0-54.0 Hz in 0.1 Hz steps |
| | Underfrequency (81<S2) | adjustable, 46.0-50.0 Hz in 0.1 Hz steps |
| | ROCOF | adjustable, 0.1-1.0 Hz/s, in 0.1 Hz/s steps |
| Hysteresis related to the | Overvoltage | 0.95-0.97 * $U_s$ |
| threshold values | Undervoltage | 1.03-1.05 * $U_s$ |
| | Overfrequency | 0.997-0.999 * $f_n$ |
| | Underfrequency | 1.001-1.003 * $f_n$ |
| Rated frequency of the measuring signal | | 50 Hz |
| Frequency range of the measuring signal | | 40-60 Hz |
| Accuracy within ithe temperature range | | ΔU ≤ 0.02 %/°C |
| Reaction time acc. CEI 0-21 chapter A.4.3 | Overvoltage 2 | |
| | Undervoltage 1 | |
| | Undervoltage 2 | |
| | Overfrequency 1 | adjustable, 0.05-600.00 s in 0.05 s steps, ±3 % ±20 ms |
| | Overfrequency 2 | |
| | Underfrequency 1 | |
| | Underfrequency 2 | |
| Measuring cycle at 50 Hz | ROCOF | 640 ms |
| Reaction time neutral interruption | | < 150 ms |

* LVFRT = Low Voltage Fault Ride Through

| Control circuits | | Y0, Y1, Y2, Y3 |
|---|---|---|
| Number | | 3 |
| Type of triggering | | volt-free triggering, signal source Y0 |
| Function of the control inputs | Y0-Y1 Control input 1 | DDI feedback, trip and release monitoring times adjustable |
| | Y0-Y2 Control input 2 | External signal |
| | Y0-Y3 Control input 3 | Remote trip |
| Electrical isolation | from supply voltage | yes |
| | from the measuring circuit | no |
| | from the relay outputs | yes |
| Max. switching current in the control circuit | | 6 mA |
| No-load voltage at the control inputs (V0-V1, V2, V3) | | 22-26 V DC |
| Minimum control pulse length | | 20 ms |
| Max. cable length at the control inputs (unshielded) | | 10 m |

## Timing functions

| | |
|---|---|
| Start-up delay, R1 (prior to first grid connection or re-connection after interruption) | adjustable, 1.00-600.00 s in 0.05 s steps |
| Restart delay, R1 | adjustable, 0.05-600.00 s in 0.05 s steps |
| Start-up delay, R2 (prior to first grid connection or re-connection after interruption) | 1 s, fixed |
| ON-delay, R3 | adjustable, 0.00-10.00 s in 0.05 s steps |
| ON-time, R3 | adjustable, 0.05-10.00 s in 0.05 s steps |
| Trip window, feedback loop Y1 | adjustable, 0.05-0.50 s in 0.05 s steps |
| Release window, feedback loop Y1 | adjustable, 0.05-10.0 s in 0.05 s steps |
| Tripping delays | adjustable, 0.05-600.00 s in 0.05 s steps |
| ROCOF error time | adjustable, 0.05-600.00 s in 0.05 s steps |

## User interface

| Indication of operational states | | |
|---|---|---|
| Control supply voltage applied / tripping delay relay 1 active | U/T | LED green on / flashing |
| Failure indication | F | LED red on |
| The operational states are additionally displayed through text on the LCD, details see table 'Indication of operational states' | | |
| **Display** | | |
| Backlighted | | yes |
| Back light | on | pressing any key button |
| | off | adjustable, 10-600 s, default: automatic switch-off after 10 s |
| Operating temperature range of the display | clearly visible | -20…+60 °C |
| Resolution | | 112 x 64 pixel |
| Display size | | 36 x 22 mm |
| **Operating elements** | | |
| 4 push buttons for menu navigation, setting and entering | | |

## Output circuits

| | | |
|---|---|---|
| Kind of outputs | 11-12/14 (15-16/18) | relay, 1st c/o (SPDT) contact, trip relay for DDI |
| | 21-22/24 (25-26/28) | relay, 2nd c/o (SPDT) contact, redundancy relay for DG |
| | 31-32/34 (35-26/38) | relay, 3rd c/o (SPDT) contact, closing command for breaker motor, also sync. with relay 1 |
| Operating principle | 11-12/14 | closed-circuit principle |
| | 21-22/24 | open- or closed-circuit principle configurable |
| | 31-32/34 | open- or closed-circuit principle configurable |
| Contact material | | AgNi alloy, Cd-free |
| Rated operational voltage $U_e$ (IEC/EN 60947-1) | | 250 V |
| Minimum switching voltage / minimum switching current | | 24 V / 10 mA |
| Maximum switching voltage / maximum switching current | | see load limit curves |
| Rated operational current $I_e$ (IEC/EN 60947-5-1) | AC12 (resisitive) at 230 V | 4 A |
| | AC15 (inductive) at 230 V | 3 A |
| | DC12 (resistive) at 24 V | 4 A |
| | DC13 (inductive)  at 24 V | 2 A |
| Mechanical lifetime | | $30 \times 10^6$ switching cycles |

| Electrical lifetime | at AC12, 230 V AC, 4 A | 50 x 10³ switching cycles |
|---|---|---|
| Maximum fuse rating to achieve short-circuit protection | n/c contact | 10 A fast tripping |
| | n/o contact | 10 A fast tripping |
| Conventional thermal current $I_{th}$ (IEC/EN 60947-1) | | 5 A |

## General data

| MTBF | | on request |
|---|---|---|
| Repeat accuracy (constant parameters) | | < ±0,5 % |
| Duty time | | 100 % |
| Dimensions (W x H x D) | product dimensions | 108 x 90 x 67 mm (4.25 x 3.54 x 2.64 in) |
| | packaging dimensions | 121 x 99 x 71 mm (4.76 x 3.90 x 2.80 in) |
| Weight | net weight | 0.283 kg (0.624 lb) |
| | gross weight | 0.334 kg (0.736 lb) |
| Material of housing | | PA666FR |
| Mounting | | DIN rail (IEC/EN 60715) TH 35-7.5 and TH 35-15, snap-on mounting without any tool |
| Mounting position | | any |
| Minimum distance to other units | horizontal / vertical | not necessary |
| Degree of protection | housing / terminals | IP 20 |

## Electrical connection

| Wire size | fine-strand with wire end ferrule | 1 x 0.25-4 mm² (1 x 24-12 AWG) |
|---|---|---|
| | | 2 x 0.25-0.75 mm² (2 x 24-18 AWG) |
| | fine-strand without wire end ferrule | 1 x 0.2-4 mm² (1 x 24-12 AWG) |
| | | 2 x 0.2-1.5 mm² (2 x 24-16 AWG) |
| | rigid | 1 x 0.2-6 mm² (1 x 24-10 AWG) |
| | | 2 x 0.2-1.5 mm² (2 x 24-16 AWG) |
| Stripping length | | 8 mm (0.31 in) |
| Tightening torque | | 0.5-0.6 Nm (4.4 -5.3 lb.in) |

## Environmental data

| Ambient temperature ranges | operation | -20...+60 °C |
|---|---|---|
| | rated load | -20...+80 °C |
| | storage | -20...+80 °C |
| Climatic category (EN 50178) | | 3K5 (w/o condensation, w/o icing) |
| Damp heat, cyclic (IEC/EN 60068-2-30) | | 6 x 24 h cycle, 55 °C, 95 % RH |
| Vibration, sinusodial (IEC/EN 60255-21-1) | | Class 2 |
| Shock (IEC/EN 60255-21-2) | | Class 2 |

## Isolation data

| Rated insulation voltage $U_i$ | supply/measuring/output circuits | 600 V |
|---|---|---|
| (IEC/EN 60947-1, IEC/EN 60664-1, VDE 0110-1) | output 1/output 2/output 3 | 300 V |
| Rated impulse withstand voltage $U_{imp}$ | supply/measuring/output circuits | 6 kV; 1.2/50 µs |
| (IEC/EN 60947-1, IEC/EN 60664-1, VDE 0110-1) | output 1/output 2/output 3 | 4 kV; 1.2/50 µs |
| Basic insulation acc. rated control | supply/measuring/output circuits | 600 V |
| supply voltage (IEC/EN 60664-1, VDE 0110-1) | output 1/output 2/output 3 | 300 V |
| Protective separation acc. rated voltage | supply/measuring/output circuits | 250 V |
| (VDE 0106 part 101 and 101/A1; IEC/EN 61140) | output 1/output 2/output 3 | 250 V |
| Test voltage, routine test | supply/measuring/output circuits | 2.2 kV, 50 Hz, 1 s |
| (IEC/EN 60255-5, IEC/EN 61010-1) | output 1/output 2/output 3 | 2.2 kV, 50 Hz, 1 s |
| Test voltage, type test | supply/measuring /output circuits | 5 kV, 50 Hz, 1 s |
| (CEI 0-21) | output 1/output 2/output 3 | 4 kV, 50 Hz, 1 s |
| Pollution degree (IEC/EN 60664-1, VDE 0110-1) | | 3 |
| Overvoltage category (IEC/EN 60664-1, VDE 0110-1) | | IV |

## Standards

| | |
|---|---|
| Product standard | IEC/EN 60255-1 |
| Application standards (Italian grid feeding standard) | CEI 0-21: 2012-06 + CEI 0-21; V1: 2012-12 + A70 Terna |
| Low Voltage Directive | 2006/95/EC |
| EMC Directive | 2004/108/EC |
| RoHS Directive | 2011/65/EC |

## Electromagnetic compatibility

| | | |
|---|---|---|
| Interference immunity to | | IEC/EN 61000-6-1, IEC/EN 61000-6-2, CEI 0-21 Tab.11 |
| electrostatic discharge | IEC/EN 61000-4-2 | Level 3 (6 kV / 8 kV) |
| radiated, radio-frequency, electromagnetic field | IEC/EN 61000-4-3 | Level 3, 10 V/m |
| electrical fast transient/burst | IEC/EN 61000-4-4 | Level 3, 2 KV / 5 kHz |
| surge | IEC/EN 61000-4-5 | Level 3, installation class 3, supply and measuring input 1 kV L-L, 2 kV L-earth |
| conducted disturbances, induced by radio-frequency fields | IEC/EN 61000-4-6 | Level 3, 10 V |
| voltage dips, short interruptions and voltage variations | IEC/EN 61000-4-11 | Class 3 |
| harmonics and interharmonics | IEC/EN 61000-4-13 | Class 3 |
| Interference emission | | IEC/EN 61000-6-3, IEC/EN 61000-6-4 |
| high-frequency radiated | IEC/CISPR 22, EN 55022 | Class B |
| high-frequency conducted | IEC/CISPR 22, EN 55022 | Class B |

## Technical diagrams

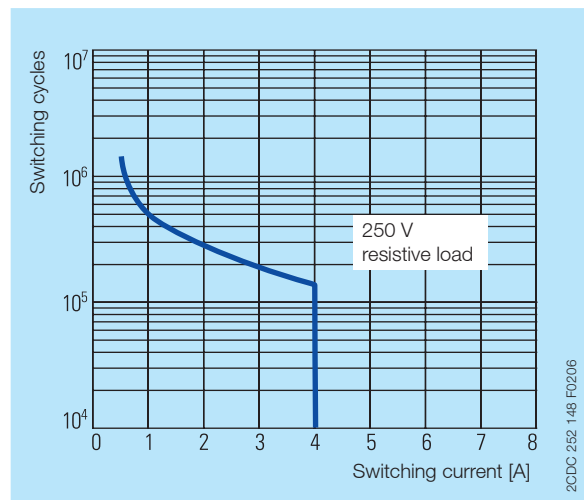### Load limits curves
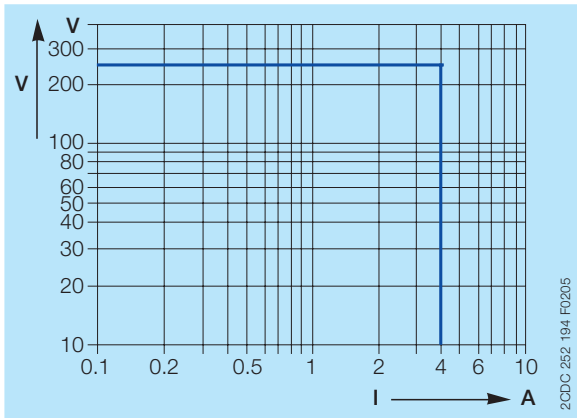


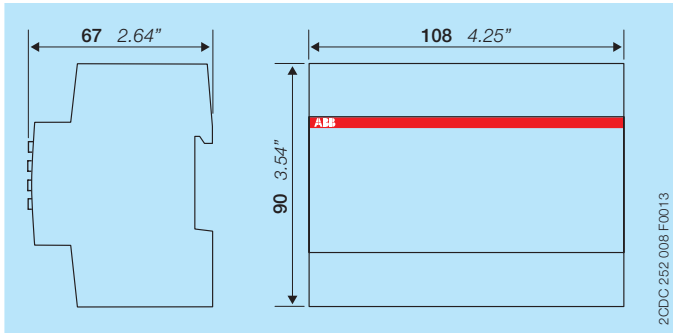AC load (resistive)
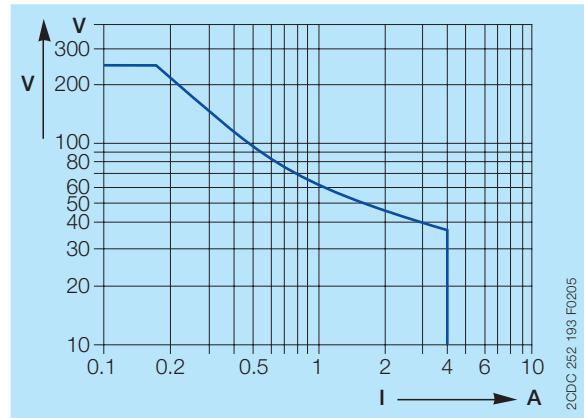


DC load (resistive)
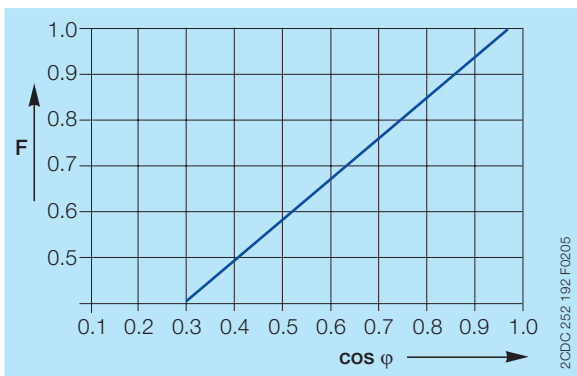


Derating factor F at inductive AC load



Contact lifetime

## Dimensions

in **mm** and *inches*



## Further documentation

| Document title | Document type | Document number |
|---|---|---|
| Electronic products and relays | Catalog | 2CDC 110 004 C02xx |
| CM-UFD.M22 Grid feeding monitoring relay | Instruction sheet | 1SVC 560 510 M0000 |

You can find the documentation on the internet at www.abb.com/lowvoltage -> Control Products -> Electronic Relays and Controls -> Three Phase Monitors

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**Note:**