DATA SHEET

Grid feeding monitoring for generating plants connected to distribution systems

CM-UFD.M33

The CM-UFD.M33 with Modbus RTU is a multifunctional grid feeding monitoring relay. It provides different monitoring functions 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 distributed generation and the public grid in order to disconnect the distributed generation in case of problems (e.g. unstable grid), faults or maintenance on the grid. Additionaly, monitoring of ROCOF (rate of change of frequency) and vector shift can be configured.

2CDC251005S0014

Characteristics

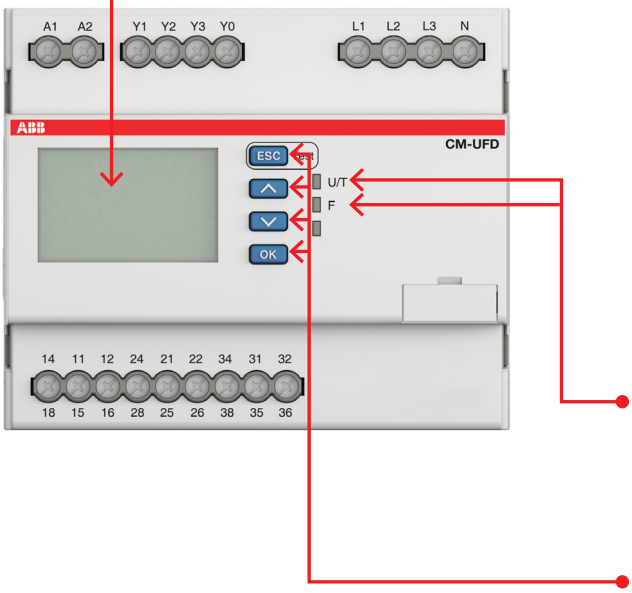
- Monitoring of voltage and frequency in single- and three-phase mains (2-wire, 3-wire or 4-wire AC systems)
- Pre-settings in accordance with G98/1 and G99/1
- Integrated management of redundancy function
- Multiline, backlit LCD display
- True RMS measuring principle
- Over- and undervoltage, 10-minutes average value as well as over- and underfrequency monitoring
- Two-level threshold settings for over-/undervoltage and over-/underfrequency
- ROCOF (rate of change of frequency) monitoring and vector shift configurable
- Interrupted neutral detection
- All threshold values and tripping delays adjustable
- Error memory for up to 99 entries (incl. cause of error, measured value, relative timestamp)
- Test function
- Password setting protection
- 3 control inputs, e.g. for feedback signal, remote trip
- 3 c/o (SPDT) contacts
- Various certifications and approvals
  (see overview, document no. 2CDC112249D0201)

Ordering details

Type	Rated control supply voltage	Measuring range	Order code
CM-UFD.M33	24-240 V AC/DC	L-L: 0-550 V AC / L-N: 0-317 V AC	1SVR560730R3402

Functions

Operating controls



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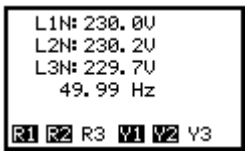
Display



R1 R2 R3: relay status; in this case R3 is de-energized
Y1: status feedback loop Y1-Y0
Y2: status feedback loop Y2-Y0
Y3: status control input Y3-Y0, in this case Y3-Y0 is open

Indication of operational states

U/T: green LED - ⎍ Control supply voltage applied
⎍⎍ Timing
F: red LED - Fault message

Keypad

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

Application

The CM-UFD.M33 is a grid feeding monitoring relay, which is connected between the public grid and the distributed generation such as photovoltaic systems, wind turbines, block-type thermal power stations. It monitors the voltage and the frequency in the grid and disconnects the distributed generation whenever the measured values are not within the range of the adjusted thresholds. The fault is indicated by LED and the corresponding plain text message is shown on the display. The CM-UFD.M33 relay can be used in all low voltage plants and in medium voltage plants.

Operating mode

The CM-UFD.M33 can be set up 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 presettings as well as the precise adjustment of the different threshold values and corresponding time delays. Furthermore, the display visualizes the measured values clearly. Together with the front-face LEDs, it shows all information about operational states of output relays and control inputs.

The CM-UFD.M33 provides 3 output relays and 3 control inputs. Output relays R1 (11_{15}-12_{16}/14_{18}) and R2 (21_{25}-22_{26}/24_{28}) are required for disconnection of a distributed generation from the public grid. The corresponding feedback signals from the external contacts are monitored via the control inputs Y1-Y0 and Y2-Y0.

The third output relay R3 (31_{35}-32_{36}/34_{38}) can be used for signalization of an event in the grid or a bus fault or the closing command of a motor drive for circuit breaker. Additionally, it can be configured to act synchronously with R1/R2 or controlled via bus.

The control inputs Y1-Y0 and Y2-Y0 monitor the corresponding feedback signals from the first and the second switching device. The third control input Y3-Y0 allows to trip the grid feeding monitoring relay (remote trip), to suppress Y1, to suppress Y2, to suppress Y1/Y2 or to suppress the vector shift detection.

Protective functions

If control supply voltage is applied, all phases are present and the switch-on conditions for voltages and frequency are fulfilled, output relays R1 and R2 energize synchronously after the adjusted switch-on delay. The green LED U/T flashes while timing and turns steady when the switch-on delay is complete.

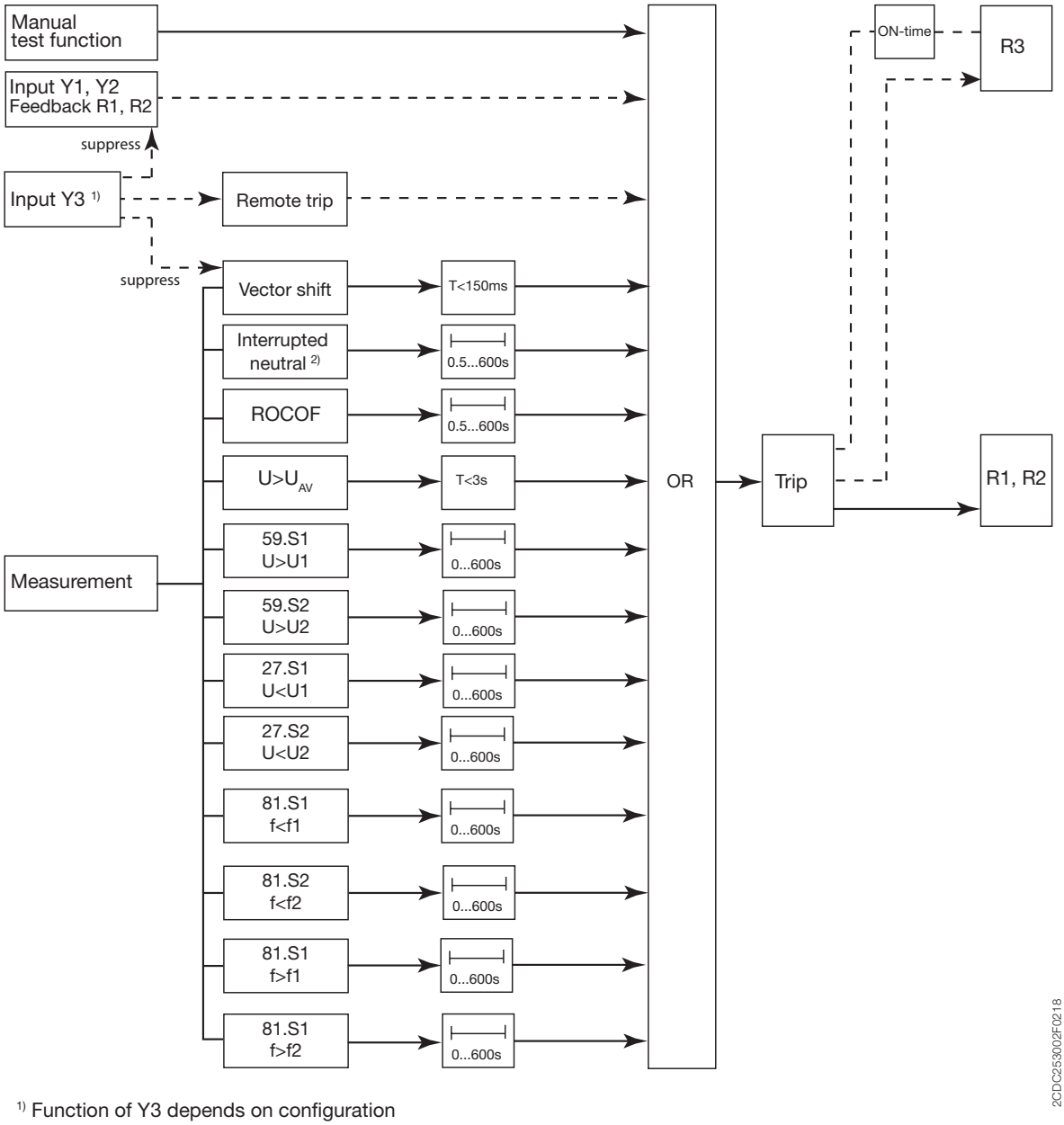
If a measured value exceeds or falls below the set threshold value (overvoltage, undervoltage, overfrequency or underfrequency), R1 and R2 de-energize after the adjusted tripping delay. As soon as the measured value returns to the tolerance range - taking into account an adjustable hysteresis – and all further switch-on conditions are fulfilled, R1 and R2 re-energize. The fault is indicated by the red LED F and the type of fault is shown on the display as a plain text message. The event that has caused tripping of the relay is recorded in the event list. The green LED U/T flashes while timing and turns steady when the delay is complete.

Output relay R3 (31_{35}-32_{36}/34_{38})

The output relay R3 can be used for:

- Trip signalization
  R3 reacts synchronously with R1/R2. ON-time of R3 is inactive.
- Closing command of a breaker motor
  In case output relays R1 and R2 energize, the adjusted ON-delay starts. When timing is complete, output relay R3 will be activated for the duration of the ON-time or until relay R1 and R2 de-energize.
- Bus fault signalization
  In case of no bus communication during the adjusted bus timeout, the bus fault is signalized by R3 (e.g. no sign of life from the bus master)
- Additionally the control of R3 via bus or a deactivation is possible. With these configurations the settings for the ON-delay and the ON-time have no influence on the operating function.

Operating principle / Monitoring functions



1) Function of Y3 depends on configuration
2) Active when one of the phase-neutral measuring principles is selected in the menu “Nominal voltage”

The device utilizes several separately adjustable monitoring functions for:

- Over voltage protection: > U_{AV}, > U1, > U2
- Under voltage protection: < U1, < U2
- Over frequency protection: > F1, > F2
- Under frequency protection: < F1, < F2

Protective function U_{AV} (10-minutes average value):
The CM-UFD.M33 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.

Control inputs Y1-Y0, Y2-Y0

Both control inputs Y1-Y0 and Y2-Y0 are used as feedback contacts for the 2 switching devices of the section switch. The current status of the switching devices is monitored by the grid feeding monitoring relay. The function of these control inputs can be configured as “disabled“, “enabled“ or “tripping only“ The working principle of the control inputs can be configured as “normally closed”, “normally open” or “auto detection”. Please note that “normally” here refers to “good status” of the grid, when all the monitored voltages and the frequency stay within the set threshold values and output relays R1 and R2 are energized. A failure in the feedback loop has to be removed manually on the device.

The grid feeding standards vary from country to country. Some require that a section switch consists of 2 independent switching devices, while others require only 1 switching device working as section switch. In addition, not all standards require monitoring of the switching devices by the feedback monitoring. Therefore the monitoring functions of control inputs Y1-Y0 and Y2-Y0 are disabled by default. They can be manually enabled in the menu.

Control input Y3-Y0

The function of control input Y3-Y0 can be configured as “remote trip”, “suppress Y1”, “suppress Y2”, “suppress Y1/Y2”, “suppress vector shift detection” or completely “disabled”. Working principle of the control input can be configured as “normally open” or “normally closed”.

Remote trip: With Y3-Y0 configured as “normally closed”, output relays R1 and R2 de-energize if Y3-Y0 is opened, and vice versa.

Suppress Y1, suppress Y2, suppress Y1/Y2: These functions can be used to suppress evaluation of the chosen feedback loop during synchronization of a generator, so that the status of the feedback signal will not be considered as a feedback error. An alternative solution is to set the release window of the corresponding feedback loop larger than the possible duration of synchronization process.

Remote trip

The Modbus RTU and the control input Y3-Y0 allow remote tripping of the grid feeding monitoring relay. The remote trip input can be configured as normally open or normally closed. If normally closed is configured, the relay trips if Y3-Y0 is opened. If normally open is configured, the relay trips if Y3-Y0 is closed. The output relay R1 is tripped by the remote trip within less than 20 ms. When the remote trip input is deactivated, the output relay R1 energizes again.

ROCOF (Rate of change of frequency df/dt)

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 detects zero crossings of the grid voltages. 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 output relay R1 trips. After the adjusted error time the relay de-energizes automatically.

The ROCOF monitoring function is deactivated per default and must be activated in the menu.

Vector shift detection

This function is another possibility of detecting a loss of mains (islanding).

The vector shift detection is disabled by default and can be manually enabled in the menu. Through zero crossings the device detects the vector shift of mains voltage and de-energizes output relays R1 immediately if the shift exceeds the adjusted threshold value, e.g. 12 °. Only after the set error time the switch-on conditions will be evaluated in order to start an auto reconnection.

Switch-on conditions

In order to switch on the section switch after having applied control supply voltage or after a fault, the voltages as well as the frequency must stay within the set switch-on conditions during the switch-on delay. This window of voltage and frequency can be further restricted in the menu “Switch-on conditions”. If one parameter leaves the window, the switch-on process is interrupted. When all parameters fulfill the switch-on conditions again, the switch-on delay restarts. When the switch-on time is complete, relays R1 and R2 re-energize automatically. If the function “Short interruption” is enabled in the menu “Switch-on conditions” -> “Switch-on delay”, the switch-on delay will be reduced to 5 s in case of a short interruption of < 3 s.

Interrupted neutral detection

Interrupted neutral detection is always active when a phase-neutral measuring principle is selected in the menu “Nominal voltage”. The interruption of the neutral conductor will result in an immediate tripping of output relays R1 and R2.

Automatic reconnecting attempts

If an error occurs at feedback loop Y1-Y0 or Y2-Y0 (e.g. undervoltage release because of a lightning strike), 0…3 automatic reconnecting attempts will be carried out, taking into account the switch-on conditions. Therefore a temporary feedback error doesn’t have to be handled manually. The corresponding error in the feedback loop is stored in the error list.

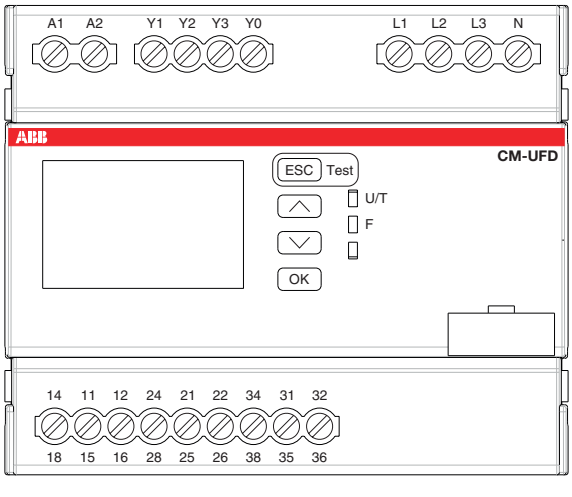
Error memory

The CM-UFD.M33 records and logs the last 99 events that caused tripping of the grid feeding monitoring relay as well as 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 via the menu. The list is stored internally in a non-volatile memory which can be reset by the user.

Test function

The test function can be used to simulate an error in the installation. This way, the time delays of the feedback loops can be determined. A feedback loop includes the output relay, the corresponding switching device and the feedback contact.
The test function can be started by pressing the ESC button for 3 seconds. The output relays R1 and R2 de-energize immediately and the CM-UFD.M33 gets feedback signals from the section switch through control inputs Y1-Y0 and Y2-Y0 respectively. The time intervals from de-energizing both output relays to receiving both feedback signals is shown on the display. Return to the menu is realized by confirming with the OK button.

Electrical connection



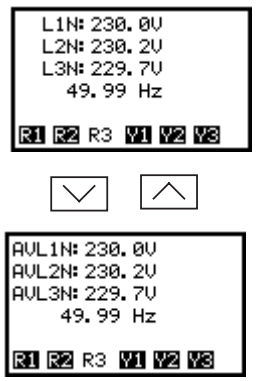
A1-A2	Control supply voltage
Y1-Y0	Control input 1, for feedback from switching device 1
Y2-Y0	Control input 2, for feedback from switching device 2
Y3-Y0	Control input 3, configurable
L1, L2, L3, N	Measuring input
11_{15}-12_{16}/14_{18}	Relay R1, c/o (SPDT) contact
21_{25}-22_{26}/24_{28}	Relay R2, c/o (SPDT) contact
31_{35}-32_{36}/34_{38}	Relay R3, c/o (SPDT) contact

Configuration

The 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

- If the display is dark, 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.

Pre-settings

The CM-UFD.M33 is delivered with 3 sets of pre-settings according to EREC (Engineering Recommendation) G98/1 and G99/1 low voltage protection and G99/1 high voltage protection, which can be loaded in the submenu “General settings” -> “Load settings”.

- Pre-setting 1 (default): G99/1 LV - applies to Generating Unit(s) which are not compliant with EREC G98 requirements.
- Pre-setting 2: G99/1 HV - If the EREC G99 protection takes its voltage reference from an HV source
- Pre-setting 3: G98/1 - applies to Fully Type Tested Micro-generators (up to and including 16 A per phase) in parallel with public Low Voltage Distribution Networks

Additionally, 5 sets of self-defined pre-settings can be saved in the memory and loaded by the user.

Global delay settings

The “Tripping delay offset” within the submenu “Global delay settings” reduces the tripping delay of every single monitoring function in order to extend the operating time of the circuit breaker.

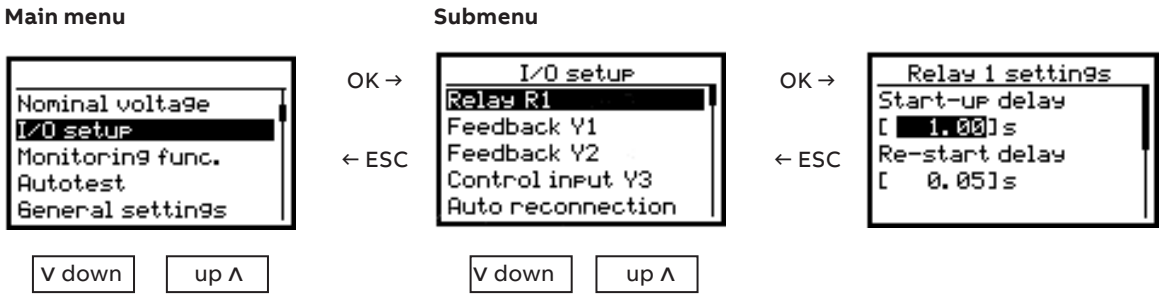
Password protection

Every CM-UFD.M33 relay is delivered with the same default password [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.

Menu structure



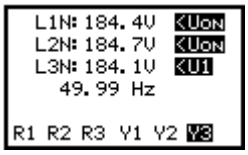
					G99		G98
Menu			**Configuration possibilities**	**Step size**	**G99 LV (Default)**	**G99 HV**	**G98**
Nominal voltage	Measuring principle		[3L-N + 3L-L], [3L-N], [3L-L], [1L-N]		3L-N	3L-L	3L-N
	Nominal voltage		[57.7]-[240.0] V L-N / [99.9]-[415.7] V L-L	0.1 V	230 V L-N	110 V L-L	230 V L-N
I/O setup	Relay R3	Working principle	[disabled], [open-circuit], [closed-circuit], [sync. with R1/R2]		disabled	disabled	disabled
		ON-delay	[0.00]-[10.00] s	0.01 s	0 s	0 s	0 s
		ON-time	[0.05]-[10.00] s	0.01 s	0.5 s	0.5 s	0.5 s
	Feedback Y1	Monitoring	[disabled], [enabled], [tripping only]		disabled	disabled	disabled
		Working principle	[normally closed], [normally open], [auto detection]		auto detection	auto detection	auto detection
		Trip window	[0.05]-[0.50] s	0.01 s	0.1 s	0.1 s	0.1 s
		Release window	[0.5]-[6000.0] s	0.1 s	0.5 s	0.5 s	0.5 s
	Feedback Y2	Monitoring	[disabled], [enabled], [tripping only]		disabled	disabled	disabled
		Working principle	[normally closed], [normally open], [auto detection]		auto detection	auto detection	auto detection
		Trip window	[0.05]-[0.50] s	0.01 s	0.1 s	0.1 s	0.1 s
		Release window	[0.5]-[6000.0] s	0.1 s	0.5 s	0.5 s	0.5 s
	Control Input Y3	Function	[disabled], [remote trip], [suppress Y1], [suppress Y2], [suppress Y1/Y2], [suppress VS]		disabled	disabled	disabled
		Working principle	[normally closed], [normally open]		normally open	normally open	normally open
	Auto reconnection	Number of attempts	[0]-[3]	1	0	0	0

					G99		G98
Menu			**Configuration possibilities**	**Step size**	**G99 LV (Default)**	**G99 HV**	**G98**
Monitoring functions	(U>) Overvoltage >UAV	Monitoring	[disabled], [enabled]		disabled	disabled	disabled
		Threshold value	[0.100]-[1.300] xU_n	0.005 xU_n	1.1 xU_n	1.1 xU_n	1.1 xU_n
		Hysteresis	[0.1]-[10.0] %	0.1 %	0.1 %	0.1 %	0.1 %
	(U>>) Overvoltage >U1	Monitoring	[disabled], [enabled]		enabled	enabled	enabled
		Threshold value	[0.100]-[1.300] xU_n	0.005 xU_n	1.14 xU_n	1.1 xU_n	1.14 xU_n
		Hysteresis	[0.5]-[10.0] %	0.1 %	1 %	1 %	1 %
		Tripping delay	[0.06]-[600.00] s	0.01 s	0.1 s	0.1 s	0.1 s
	Overvoltage >U2	Monitoring	[disabled], [enabled]		enabled	enabled	enabled
		Threshold value	[0.100]-[1.300] xU_n	0.005 xU_n	1.19 xU_n	1.13 xU_n	1.19 xU_n
		Hysteresis	[0.5]-[10.0] %	0.1 %	1 %	1 %	1 %
		Tripping delay	[0.00]-[600.00] s	0.01 s	0.5 s	0.5 s	0.5 s
	Undervoltage <U1	Monitoring	[disabled], [enabled]		enabled	enabled	enabled
		Threshold value	[0.100]-[1.300] xU_n	0,005 xU_n	0.8 xU_n	0.8 xU_n	0.8 xU_n
		Hysteresis	[0.5]-[10.0] %	0.1%	1 %	1%	1%
		Tripping delay	[0.00]-[600.00] s	0.01 s	2.5 s	2.5 s	2.5 s
	Undervoltage <U2	Monitoring	[disabled], [enabled]		disabled	disabled	disabled
		Threshold value	[0.100]-[1.300] xU_n	0,005 xU_n	0.45 xU_n	0.45 xU_n	0.45 xU_n
		Hysteresis	[0.5]-[10.0] %	0.1%	1%	1%	1%
		Tripping delay	[0.00]-[600.00] s	0.01 s	0.1 s	0.1 s	0.1 s
Monitoring functions	Overfrequency >F1	Monitoring	[disabled], [enabled]		enabled	enabled	enabled
		Threshold value	[45.00]-[65.00] Hz	0.01 Hz	52.0 Hz	52.0 Hz	52.0 Hz
		Hysteresis	[0.05]-[4.00] Hz	0.01 Hz	0.1 Hz	0.1 Hz	0.1 Hz
		Tripping delay	[0.00]-[600.00] s	0.01 s	0.5 s	0.5 s	0.5 s
	Overfrequency >F2	Monitoring	[disabled], [enabled]		disabled	disabled	disabled
		Threshold value	[45.00]-[65.00] Hz	0.01 Hz	51.5 Hz	51.5 Hz	51.5 Hz
		Hysteresis	[0.05]-[4.00] Hz	0.01 Hz	0.1 Hz	0.1 Hz	0.1 Hz
		Tripping delay	[0.00]-[600.00] s	0.01 s	0.1 s	0.1 s	0.1 s
	Underfrequency <F1	Monitoring	[disabled], [enabled]		enabled	enabled	enabled
		Threshold value	[45.00]-[65.00] Hz	0.01 Hz	47.5 Hz	47.5 Hz	47.5 Hz
		Hysteresis	[0.05]-[4.00] Hz	0.01 Hz	0.1 Hz	0.1 Hz	0.1 Hz
		Tripping delay	[0.00]-[600.00] s	0.01 s	20.0 s	20.0 s	20.0 s
	Underfrequency <F2	Monitoring	[disabled], [enabled]		enabled	enabled	enabled
		Threshold value	[45.00]-[65.00] Hz	0.01 Hz	47.0 Hz	47.0 Hz	47.0 Hz
		Hysteresis	[0.05]-[4.00] Hz	0.01 Hz	0.1 Hz	0.1 Hz	0.1 Hz
		Tripping delay	[0.00]-[600.00] s	0.01 s	0.5 s	0.5 s	0.5 s
	ROCOF	Monitoring	[disabled], [enabled]		enabled	enabled	enabled
		Threshold value	[0.100]-[5.000] Hz/s	0.005 Hz/s	1 Hz/s	1 Hz/s	1 Hz/s
		Number of cycles	[4]-[50]	1	25	25	25
		Tripping delay	[0.00]-[600.00] s	0.01 s	0.5 s	0.5 s	0.5 s
		Error time	[0.50]-[600.00] s	0.01 s	30 s	30 s	30 s
	Vector Shift VS	Monitoring	[disabled], [enabled]		disabled	disabled	disabled
		Threshold value	[2.0]-[50.0] °	0.1 °	50 °	50 °	50 °
		Error time	[0.50]-[600.00] s	0.01 s	30 s	30 s	30 s
	Global delay setting	Trip. delay offset	[000]-[100] ms	1 ms	0 ms	0 ms	0 ms

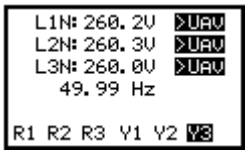
					G99		G98
Menu			**Configuration possibilities**	**Step size**	**G99 LV (Default)**	**G99 HV**	**G98**
Switch-on conditions	Switch-on delay	Switch-on delay	[0.5]-[6000.0] s	0.1 s	20 s	20 s	20 s
		Short interruption	[disabled], [enabled]		disabled	disabled	disabled
	Voltage window	Monitoring	[disabled], [enabled]		disabled	disabled	disabled
		Minimum	[0.100]-[1.000] xU_n	0,005 xU_n	0.8 xU_n	0.8 xU_n	0.8 xU_n
		Maximum	[1.000]-[1.300] xU_n	0.005 xU_n	1.14 xU_n	1.1 xU_n	1.14 xU_n
	Frequency window	Monitoring	[disabled], [enabled]		disabled	disabled	disabled
		Minimum	[45.00]-[60.00] Hz	0.01 Hz	47.5	47.5	47.5
		Maximum	[50.00]-[65.00] Hz	0.01 Hz	52.0	52.0	52.0
General settings	Language	Language	[English], [Deutsch]		English *)	English *)	English *)
	Display	Switch-off delay	[10]-[600]s	1 s	10 s *)	10 s *)	10 s *)
		Contrast	[0]-[9]	1	5 *)	5 *)	5 *)
	Password	Protection	[disabled], [enabled]		disabled *)	disabled *)	disabled *)
		Change password	[****]		0000 *)	0000 *)	0000 *)
	Load settings	"Setting name"					
	Save settings	"Setting name"					
	Information						
Error memory	Error list						
	Error recording	Remote trip via Y3	[disabled], [enabled]		enabled *)	enabled *)	enabled *)
		Remote trip via bus	[disabled], [enabled]		enabled *)	enabled *)	enabled *)
		Power OFF	[disabled], [enabled]		enabled *)	enabled *)	enabled *)
	Reset error memory						
	Operating counter						
	Cumulated OFF-time						
	Trip counter						

*) Device defaults, not affected by loading a setting

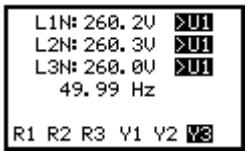
Display and failure messages



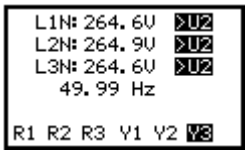
The voltage at L3 has fallen below the first undervoltage threshold. The voltages at L1 and L2 have fallen below the switch-on conditions, yet not below the undervoltage threshold.



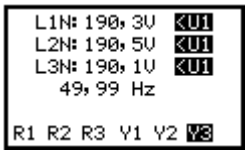
Error overvoltage U_{AV} in all three phases detected. If overvoltage occurs in one phase only, $>U_{AV}$ indicates the phase with overvoltage.



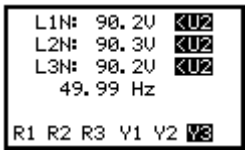
Error overvoltage >U1 in all three phases detected. If overvoltage occurs in one phase only, >U1 indicates the phase with overvoltage.



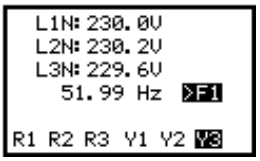
Error overvoltage >U2 in all three phases detected. If overvoltage occurs in one phase only, >U2 indicates the phase with overvoltage.



Error undervoltage <U1 in all three phases detected. If undervoltage occurs in one phase only, <U1 indicates the phase with undervoltage.

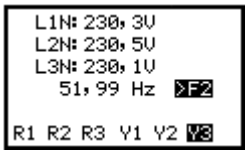


Error undervoltage <U2 in all three phases detected. If undervoltage occurs in one phase only, <U2 indicates the phase with undervoltage.

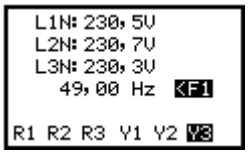


Error overfrequency >F1 detected

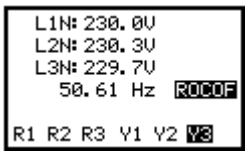
* For CM-UFD.M33M only



Error overfrequency >F2 detected

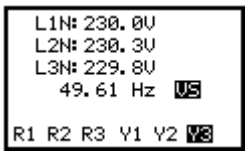


Error underfrequency <F1 detected



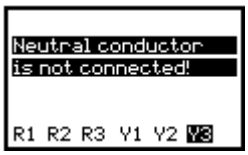
Error, ROCOF

Threshold for rate of change of frequency exceeded.

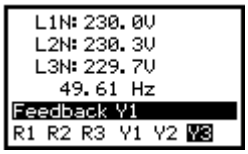


Error, vector shift

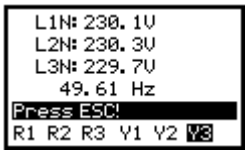
Threshold for vector shift exceeded.



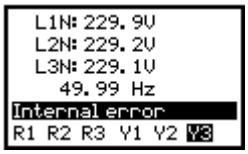
4-wire connection
The neutral conductor is disconnected or interrupted.
Please check wiring.



Error in feedback loop Y1-Y0, e.g. wiring failure or welded feedback contact.
Please check wiring.

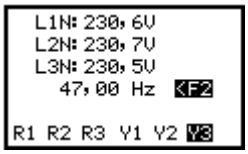


Error in feedback loop is removed. Press ESC to reset the grid feeding monitoring relay.



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.

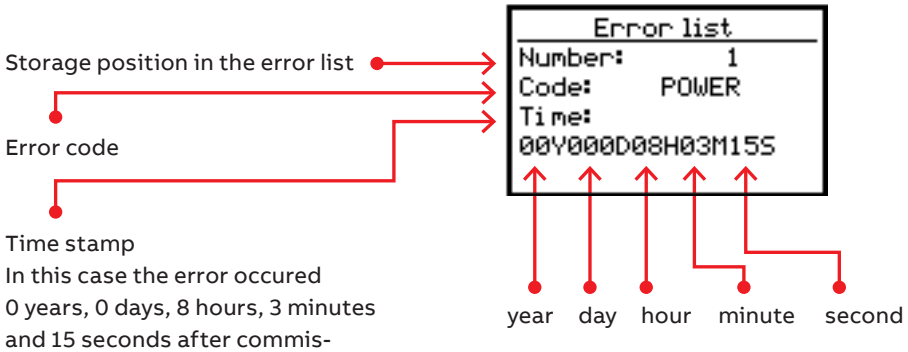
Remote trip via Y3
Shows that the remote trip is activated via control input Y3



Error underfrequency <F2 detected

Error memory

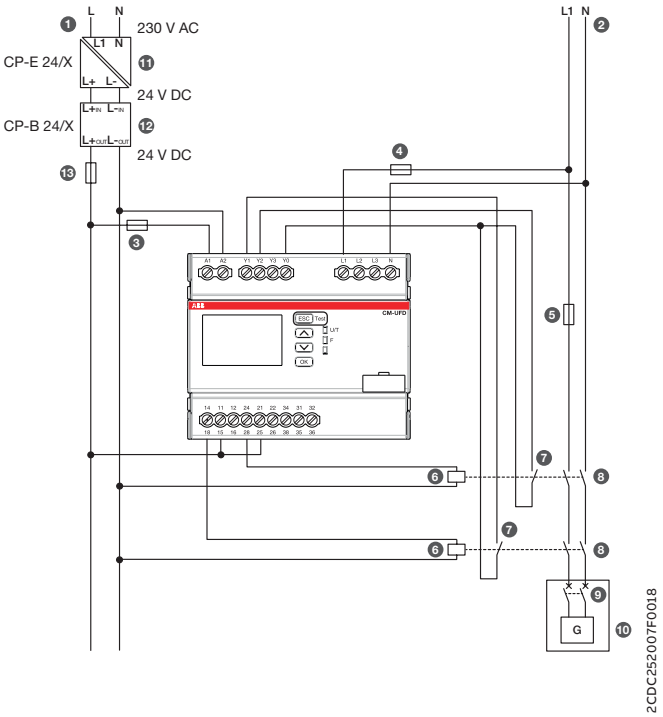
As soon as one of the above errors occurs, subsequent error codes with the corresponding time stamp will be stored in the error memory:



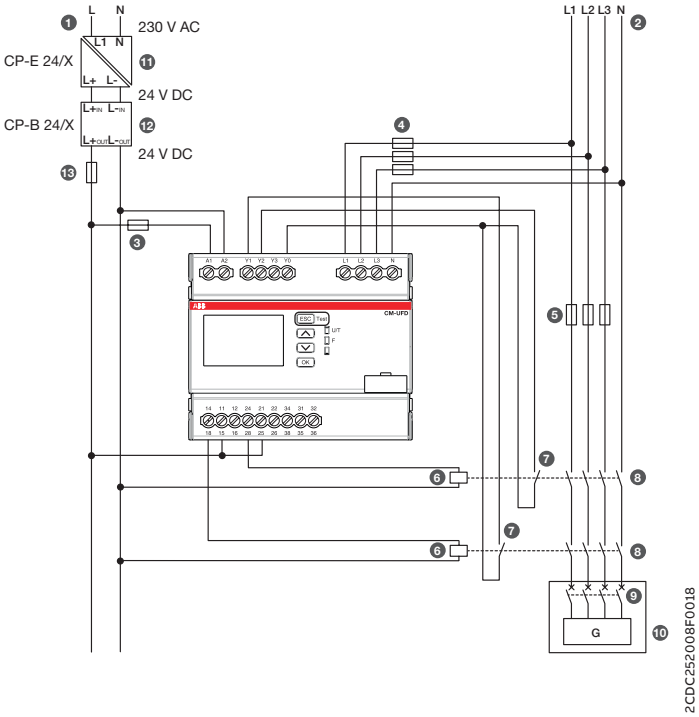
Error code	Explanation	
AVL1N>U_{AV} or AVL2N>U_{AV} or AVL3N>U_{AV}	Error, Error, overvoltage U_{AV}	10-minutes average value
AVL12>U_{AV} or AVL23>U_{AV} or AVL31>U_{AV}	Error, overvoltage U_{AV}	10-minutes average value
L1N<U1 or L2N<U1 or L3N<U1	Error, overvoltage U1	
L12>U1 or L23>U1 or L31>U1	Error, overvoltage U1	
L1N>U2 or L2N>U2 or L3N>U2	Error, overvoltage U2	
L12>U2 or L23>U2 or L31>U2	Error, overvoltage U2	
L1N<U1 or L2N<U1 or L3N<U1	Error, undervoltage U1	
L12<U1 or L23<U1 or L31<U1	Error, undervoltage U1	
L1N<U2 or L2N<U2 or L3N<U2	Error, undervoltage U2	
L12<U2 or L23<U2 or L31<U2	Error, undervoltage U2	
F>F1	Error, overfrequency F1	
F>F2	Error, overfrequency F2	
F<F1	Error, underfrequency F1	
F<F2	Error, underfrequency F2	
ROCOF	Error, ROCOF	
VECTOR	Error, Vector shift	
TEST	Error, test function	
REMOTE Y3	Error, remote trip via control input Y3	
FB1	Error, feedback of switching device 1	Malfunction of the first switching device
FB2	Error, feedback of switching device 2	Malfunction of the second switching device
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



Example of three-phase application



Legend

1. Control supply voltage for CM-UFD.M33
2. Public grid
3. Protection fuse for the CM-UFD.M33
4. Protection fuse for the measuring circuit of the CM-UFD.M33 (optional)
5. Short-circuit protection
6. Undervoltage release
7. Control input for feedback function
8. Switching device of the section switch
9. Switching device of the generator and/or inverter
10. Generator and/or inverter
11. Primary switch mode power supply unit CP-E (230 V AC / 24 V DC) for the buffer module CP-B
12. Ultra-capacitor based buffer module CP-B (24 V DC in/out)
13. Wire protection fuse for the output of the buffer module CP-B

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		24-240 V AC/DC
Rated control supply voltage U_s tolerance		- 15...+ 10 %
Rated frequency		DC or 50/60 Hz
Frequency range AC		40-70 Hz
Typical current / power consumption	24 V DC	60 mA / 1.4 W
	230 V AC	22 mA / 5.0 V A
Power failure buffering time		200 ms, acc. LVFRT (110-240 V AC)
		10 ms, acc. IEC/EN 60255-26 (24 V AC/DC)

Measuring circuits		L1, L2, L3, N
Nominal voltage of the distribution system U_n		57.7-240.0 V AC / 99.9-415.7 V AC
Measuring ranges	voltage: line to neutral	0-317 V AC
	voltage: line to line	0-550 V AC
	frequency	40-70 Hz
Accuracy within the temperature range	voltage	≤ 0,5 % ± 0,5 V
	frequency	± 20 mHz
	delay times	≤ 0,1 % ± 20 ms (unless otherwise specified)
Monitoring functions	overvoltage 10-min average (> U_{AV})	threshold adjustable, 1.000-1.300 x U_n in 0.005 x U_n steps
	overvoltage (> U1)	
	overvoltage (> U2)	
	undervoltage (< U1)	threshold adjustable, 0.100-1.000 x U_n in 0.005 x U_n steps
	undervoltage (< U2)	
	overfrequency (> F1)	threshold adjustable, 50.00-65.00 Hz in 0.01 Hz steps
	overfrequency (> F2)	
	underfrequency (< F1)	threshold adjustable, 45.00-60.00 Hz in 0.01 Hz steps
	underfrequency (< F2)	
	ROCOF	threshold adjustable, 0.1-5 Hz/s in 0.005 Hz/s steps
	vector shift	threshold adjustable, 2.0-40.0 °, in 0.1 ° steps
Hysteresis related to the threshold values	overvoltage 10-min average (> U_{AV})	adjustable, 0.1-10.0 % in 0.1 % steps
	overvoltage (> U1, > U2)	adjustable, 0.5-10.0 % in 0.1 % steps
	undervoltage (< U1, < U2)	
	overfrequency (> F1, > F2)	adjustable, 0.05-4.00 Hz in 0.01 Hz steps
	underfrequency (< F1, < F2)	
Measuring method		true RMS
Measuring cycle	ROCOF	adjustable between 4 and 50 periods

Control circuits		Y0, Y1, Y2, Y3
Number of control inputs		3
Type of triggering		volt-free triggering, signal source Y0
Control function	Y1-Y0 control input 1	feedback switching device 1
	Y2-Y0 control input 2	feedback switching device 2
	Y3-Y0 control input 3	remote trip, suppression of Y1, Y2, Y1/Y2 or suppression of vector shift detection
Electrical isolation	from the supply voltage	yes
	from the measuring circuit	no
	from the relay outputs	yes
Maximum switching current in the control circuit		6 mA
No-load voltage at the control inputs		typ. 24 V DC
Minimum control pulse length		20 ms
Maximum cable length at the control inputs		10 m

Timing functions

Switch-on delay (prior to first grid connection or re-connection after interruption)		adjustable, 1.00-600.00 s in 0.01 s steps
ON-delay R3		adjustable, 0.00-10.00 s in 0.01 s steps
ON-time R3		adjustable, 0.05-10.00 s in 0.01 s steps
Trip window, feedback loop		adjustable, 0.05-0.50 s in 0.01 s steps
Release window, feedback loop		adjustable, 0.5-6000.0 s in 0.1 s steps
Tripping delay	overvoltage	adjustable, 0.06-600.00 s in 0.01 s steps; + 0 / - 50 ms
	undervoltage	
	overfrequency	
	underfrequency	
	ROCOF	
Error time	ROCOF	adjustable, 0.5-600.00 s in 0.01 s steps
	vector shift	
Reaction time	overvoltage av.	max. 3 s
	vector shift	< 50 ms
	interrupted neutral conductor	< 150 ms

User interface

Indication of operational states		
Control supply voltage applied / timing	U/T	LED green on / flashing
Fault message	F	LED red on
For details see the message on the display		

Display		
Backlight	on	press any button
	off	switch-off delay adjustable, 10-600 s (default 10 s)
Resolution		112 x 64 pixel
Display size		36 x 22 mm

Operating controls
4 push-buttons for menu navigation, setting and entering

Output circuits

Kind of outputs	11-12/14 (15-16/18)	relay R1, c/o (SPDT) contact, tripping relay for switching device 1
	21-22/24 (25-26/28)	relay R2, c/o (SPDT) contact, tripping relay for switching device 2
	31-32/34 (35-36/38)	relay R3, c/o (SPDT) contact, configurable
Operating principle	11-12/14	closed-circuit principle*
	21-22/24	closed-circuit principle*
	31-32/34	configurable (disabled, open-circuit, closed-circuit, sync. with R1/2, bus-controlled, bus fault)*
Contact material		AgNi alloy, Cd-free
Minimum switching voltage / minimum switching current		24 V / 10 mA
Maximum switching voltage / maximum switching current		see "Load limit curves"
Rated operational voltage U_e and rated operational current I_e	AC-12 (resistive) at 230 V	4 A
	AC-15 (inductive) at 230 V	3 A
	DC-12 (resistive) at 24 V	4 A
	DC-13 (inductive) at 24 V	2 A
AC rating (UL 508)	utilization category (Control Circuit Rating Code	B 300
	max. rated operational voltage	300 V
	max. continous thermal current at B 300	5 A
	max. making/breaking apparent power at B 300	3600/360 VA
Mechanical lifetime		30 x 10^6 switching cycles
Electrical lifetime	at AC-12, 230 V AC, 4 A	0.1 x 10^6 switching cycles
Maximum fuse rating to achieve short-circuit protection	n/c contact	10 A fast-acting
	n/c contact	10 A fast-acting
Conventional thermal current I_{th}		5 A

* Closed-circuit principle: Output relay de-energizes if a fault is occuring
Open-circuit principle: Output relay energizes if a fault is occuring

General data

MTBF		on request
Duty cycle		100 %
Dimensions		see "Dimensional drawing"
Weight	net	0.312 kg (0.687 lb)
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	IP20

Electrical connection

Connecting capacity	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)
Recommended screw driver		PH1 / Ø 4.0 mm

Environmental data

Ambient temperature ranges	operation	-20 °C...+60 °C (-4...+140 °F)
	storage	-20 °C...+80 °C (-4...+176 °F)
Damp heat, cyclic	IEC/EN 60068-2-30	6 x 24 h cycle, 55 °C, 95 % RH
Climatic class	IEC/EN 60721-3-3	3K5 (no condensation, no ice formation)
Vibration, sinusoidal		class 2
Shock		class 2

Isolation data

Rated insulation voltage Ui, overvoltage category		
basic insulation	measuring (L1/L2/L3/N)	300 V, IV 600 V, III
	output 1 / output 2 / output 3	300 V, III
reinforced/doubled insulation	supply / control inputs / outputs	300 V, III
	measuring (L1/L2/L3/N) / (supply / outputs)	300 V, IV
Rated impulse withstand voltage U_{imp}	output 1 / output 2 / output 3	4 kV; 1.2/50 µs
	supply / control inputs / outputs	6 kV; 1.2/50 µs
	measuring (L1/L2/L3/N) / (supply / outputs)	8 kV; 1.2/50 µs
Pollution degree		3

Standards/Directives

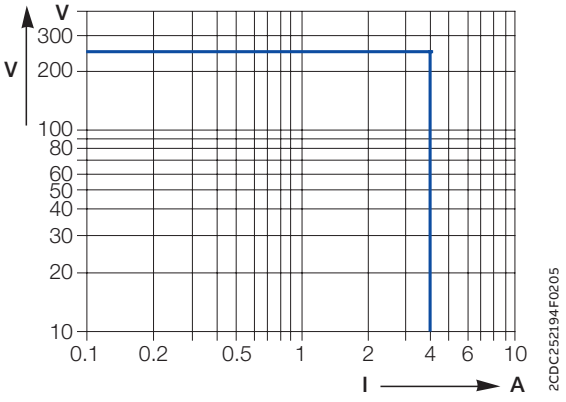
Standards	IEC/EN 60255-1, IEC/EN 60255-26, IEC/EN 60255-27, ENA - G98/1, G99/1
Low Voltage Directive	2014/35/EU
EMC Directive	2014/30/EU
RoHS Directive	2011/65/EU

Electromagnetic compatibility

Interference immunity to		IEC/EN 60255-26
electrostatic discharge	IEC/EN 61000-4-2	level 3, 6 kV contact discharge, 8 kV air discharge
radiated, radio-frequency, electromagnetic field	IEC/EN 61000-4-3	level 3, 10 V/m; 2.7 GHz
electrical fast transient / burst	IEC/EN 61000-4-4	zone B / level 3, 2 kV / 5 kHz
surge	IEC/EN 61000-4-5	supply circuit and measuring circuit zone B / level 3; 1 kV L-L
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
Interference emission		IEC/EN 61000-6-3
high-frequency radiated		fulfilled
high-frequency conducted		fulfilled

Technical diagrams

Load limits curves



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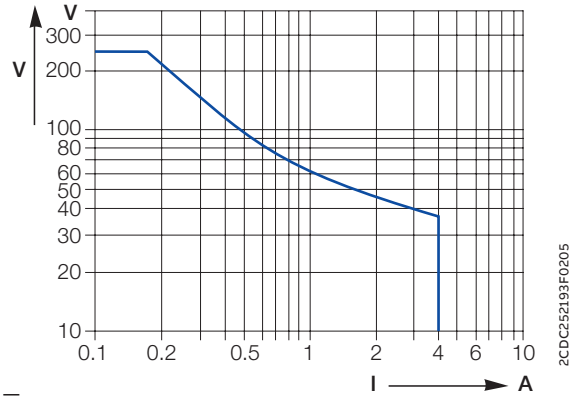
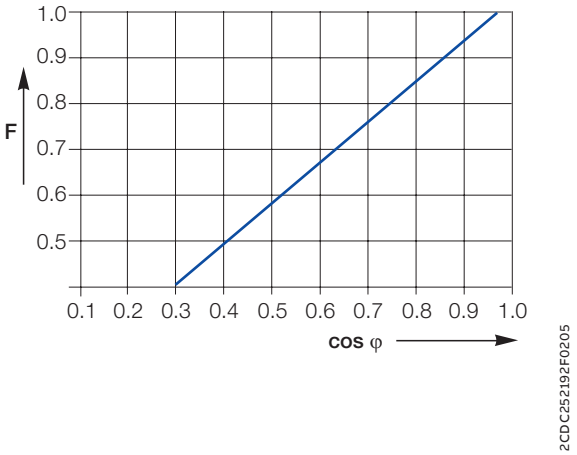
AC load (resistive)



—
DC load (resistive)



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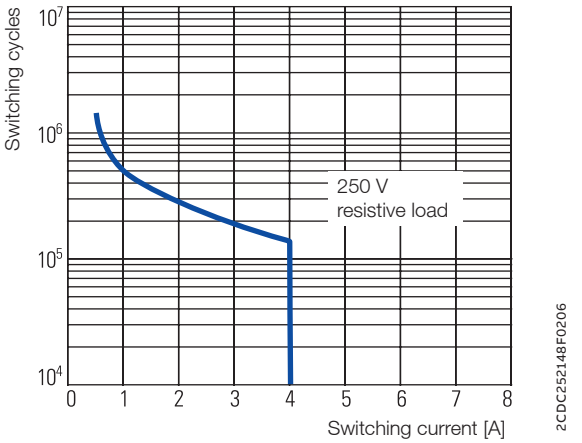
Derating factor F at inductive AC load



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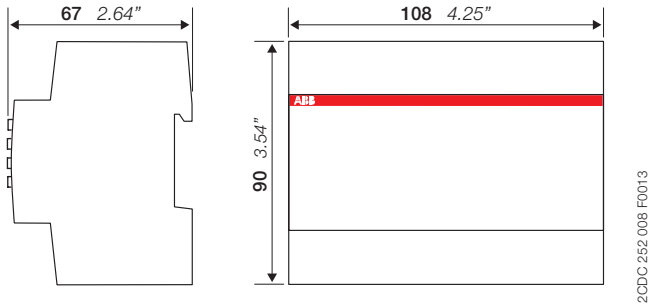
Contact lifetime

Dimensional drawings

in mm and inches



Further documentation

Document title	Document type	Document number
Electronic relays and controls	Catalog	2CDC110004C02xx
CM-UFD.M33M Grid feeding monitoring relay	Instruction sheet	1SVC560516M0000
CM-UFD.M*M integration into ABB Ability EDCS	Application note	2CDC112280M0101

You can find the documentation on the internet at www.abb.com/lowvoltage
-> Automation, control and protection -> Electronic relays and controls -> Measuring and monitoring relays.

CAD system files

You can find the CAD files for CAD systems at http://abb-control-products.partcommunity.com
-> Low Voltage Products & Systems -> Control Products -> Electronic Relays and Controls.

Declaration of conformity

Protection Relay Type-Test Verification Report

According to the Engineering Recommendation G99/1-3

Product details	Model	CM-UFD.M33
	Part Number	1SVR560730R3402
	Software Version	1.1.3
	Date	2019/05/29
	G99 Version	G99/1-3
Manufactured details	Name	ABB STOTZ-KONTAKT GmbH
	Adress	Eppelheimer Straße 82 69123 Heidelberg Germany

Over and Under Voltage Protection Tests LV

Calibration and Accuracy Tests

Phase	Setting	Time Delay	Pickup Voltage				Relay Operating Time - step from 230 V to test value				
Stage 1 Over Voltage			Lower Limit	Measured Value	Upper Limit	Result	Test Value	Lower Limit	Measured Value	Upper Limit	Result
L1 - N	**262.2 V** 230 V system	**1.0 s**	258.75	261.87 V	265.65	Pass	266.2	1.0 s	1.05 s	1.1 s	Pass
L2 - N				261.81 V		Pass			1.06 s		Pass
L3 - N				261.78 V		Pass			1.06 s		Pass
Stage 2 Over Voltage			Lower Limit	Measured Value	Upper Limit	Result	Test Value	Lower Limit	Measured Value	Upper Limit	Result
L1 - N	**273.7 V** 230 V system	0.5 s	270.25	273.37 V	277.15	Pass	277.7	0.5 s	0.57 s	0.6 s	Pass
L2 - N				273.31 V		Pass			0.56 s		Pass
L3 - N				273.30 V		Pass			0.56 s		Pass
Under Voltage			Lower Limit	Measured Value	Upper Limit	Result	Test Value	Lower Limit	Measured Value	Upper Limit	Results
L1 - N	**184.0 V** 230 V system	2.5 s	180.55	183.96 V	187.45	Pass	180	2.5 s	2.56 s	2.6 s	Pass
L2 - N				183.87 V		Pass			2.56 s		Pass
L3 - N				183.93 V		Pass			2.56 s		Pass

Stability Tests

Test Description	Setting	Time Delay	Test Condition (3-Phase Value)	Test Voltage all phases ph-n	Test Duration	Confirm No Trip	Result
Inside Normal band	---------	---------	< OV Stage 1	258.2 V	5.00 s	Pass	Pass
Stage 1 Over Voltage	**262.2 V**	**1.0 s**	> OV Stage 1	269.7 V	0.95 s	Pass	Pass
Stage 2 Over Voltage	**273.7 V**	**0.5 s**	> OV Stage 2	277.7 V	0.45 s	Pass	Pass
Inside Normal band	---------	---------	> UV	188 V	5.00 s	Pass	Pass
Under Voltage	**184.0 V**	**2.5 s**	< UV	180 V	2.45 s	Pass	Pass

Overvoltage test - Voltage shall be stepped from 258 V to the test voltage and held for the test duration and then stepped back to 258 V.

Undervoltage test – Voltage shall be stepped from 188 V to the test voltage and held for the test duration and then stepped back to 188 V.

Over and Under Voltage Protection HV

Tests referenced to 110 V ph-ph VT output

Calibration and Accuracy Tests

Phase	Setting	Time Delay	Pickup Voltage				Relay Operating Time - measured value ± 2 V				
Stage 1 Over Voltage			Lower Limit	Measured Value	Upper Limit	Result	Test Value	Lower Limit	Measured Value	Upper Limit	Result
L1 - N	**121 V** 110 V VT secondary	**1.0 s**	119.35	120.75 V	122.65	Pass	Measured value plus 2 V	1.0 s	1.06 s	1.1 s	Pass
L2 - N				121.27 V		Pass			1.06 s		Pass
L3 - N				120.82 V		Pass			1.06 s		Pass
Stage 2 Over Voltage			Lower Limit	Measured Value	Upper Limit	Result	Test Value	Lower Limit	Measured Value	Upper Limit	Result
L1 - N	**124.3 V** 110 V VT secondary	0.5 s	122.65	124.06 V	125.95	Pass	Measured value plus 2 V	0.5 s	0.56 s	0.6 s	Pass
L2 - N				124.12 V		Pass			0.56 s		Pass
L3 - N				124.02 V		Pass			0.56 s		Pass
Under Voltage			Lower Limit	Measured Value	Upper Limit	Result	Test Value	Lower Limit	Measured Value	Upper Limit	Results
L1 - N	**88.0 V** 110 V VT secondary	2.5 s	86.35	87.85 V	89.65	Pass	Measured value minus 2 V	2.5 s	2.56 s	2.6 s	Pass
L2 - N				87.91 V		Pass			2.56 s		Pass
L3 - N				87.70 V		Pass			2.56 s		Pass

Stability Tests

Test Description	Setting	Time Delay	Test Condition (3-Phase Value)	Test Voltage all phases s ph-ph	Test Duration	Confirm No Trip	Result
Inside Normal band	---------	---------	< OV Stage 1	119 V	5.00 s	Pass	Pass
Stage 1 Over Voltage	**121 V**	**1.0 s**	> OV Stage 1	122.3 V	0.95 s	Pass	Pass
Stage 2 Over Voltage	**124.3 V**	**0.5 s**	> OV Stage 2	126.3 V	0.45 s	Pass	Pass
Inside Normal band	---------	---------	> UV	90 V	5.00 s	Pass	Pass
Under Voltage	**88 V**	**2.5 s**	< UV	86 V	2.45 s	Pass	Pass

Over and Under Frequency Protection

Calibration and Accuracy Tests

Setting	Time Delay	Pickup Frequency				Relay Operating Time				
Over Frequency		Lower Limit	Measured Value	Upper Limit	Result	Freq step	Lower Limit	Measured Value	Upper Limit	Result
52 Hz	0.5 s	51.90	52.00 Hz	52.10	Pass	51.7-52.3 Hz	0.50 s	0.54 s	0.60 s	Pass
Stage 1 Under Frequency		Lower Limit	Measured Value	Upper Limit	Result	Freq step	Lower Limit	Measured Value	Upper Limit	Result
47.5 Hz	20	47.40	47.51 Hz	47.60	Pass	47.8-47.2 Hz	20.0 s	20.04 s	20.2 s	Pass
Stage 2 Under Frequency		Lower Limit	Measured Value	Upper Limit	Result	Freq step	Lower Limit	Measured Value	Upper Limit	Results
47 Hz	0.5 s	46.90	47.01 Hz	47.1	Pass	47.3-46.7 Hz	0.50 s	0.54 s	0.60 s	Pass

Stability Tests

Test Description	Setting	Time Delay	Test Condition	Test Frequency	Test Duration	Confirm No Trip	Result
Inside Normal band	---------	---------	< OF	51.8 Hz	120 s	Pass	Pass
Over Frequency	**52 Hz**	**0.5 s**	> OF	52.2 Hz	0.45 s	Pass	Pass
Inside Normal band	---------	---------	> UF Stage 1	47.7 Hz	30 s	Pass	Pass
Stage 1 Under Frequency	**47.5 Hz**	**20 s**	< UF Stage 1	47.2 Hz	19.5 s	Pass	Pass
Stage 2 Under Frequency	**47 Hz**	**0.5 s**	< UF Stage 2	46.8 Hz	0.45 s	Pass	Pass

Over frequency test - Frequency shall be stepped from 51.8 Hz to the test frequency and held for the test durationand then stepped back to 51.8 Hz.

Under frequency test - Frequency shall be stepped from 47.7 Hz to the test frequency and held for the test duration and then stepped back to 47.7 Hz.

Loss-of-Mains (LOM) Protection Test

Calibration and Accuracy Tests

Ramp in range 49.0 - 51.0 Hz	Pickup (+ / - 0.025 Hzs^{-1})				Relay Operating Time RoCoF = ± 0.05 / 0.10 Hzs^{-1} above setting				
Setting = 0.5 / 1.0 Hzs^{-1}	Lower Limit	Measured Value	Upper Limit	Result	Test Condition	Lower Limit	Measured Value	Upper Limit	Result
Increasing Frequency	0.475 0.975	0.508Hz/s 1.008Hz/s	0.525 1.025	Pass	0.55 Hzs^{-1} 1.10 Hzs^{-1}	> 0.5 s	0.51 s 0.52 s	< 1.0 s	Pass
Reducing Frequency	0.475 0.975	0.508Hz/s 1.008Hz/s	0.525 1.025	Pass	0.55 Hzs^{-1} 1.10 Hzs^{-1}	> 0.5 s	0.51 s 0.52 s	< 1.0 s	Pass

Stability Tests

Ramp in range 49.0-51.0 Hz	Test Condition	Test frequency ramp	Test Duration	Confirm No Trip	Result
Inside Normal band	< RoCoF (increasing f)	0.45 Hzs^{-1} 0.95 Hzs^{-1}	4.4 s	Pass	Pass
Inside Normal band	< RoCoF (reducing f)		2.1 s	Pass	Pass

LOM Protection - Stability Tests

	Start Frequency	Change	Confirm No trip
Positive Vector Shift	49.5 Hz	+ 50 degrees	Pass
Negative Vector Shift	50.5 Hz	- 50 degrees	Pass

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