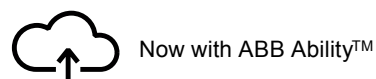


Grid feeding monitoring according to DEWA DRRG standard

CM-UFD.M34M with Modbus RTU



Now with ABB Ability™

The CM-UFD.M34M with Modbus RTU is a multifunctional grid feeding monitoring relay. It provides different monitoring functions in accordance with the DRRG standard of DEWA 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. Additionally, monitoring of ROCOF (rate of change of frequency) and vector shift can be configured.



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Characteristics

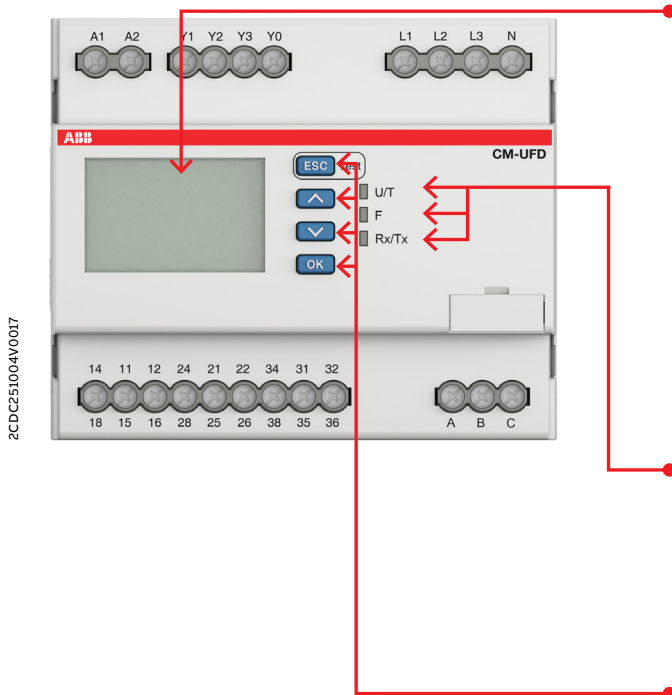
- Monitoring of voltage and frequency in single- and three-phase mains (2-wire, 3-wire or 4-wire AC systems)
- Type-tested in accordance with the DRRG standard of DEWA
- Default settings in accordance with the DRRG standard of DEWA
- Integrated management of redundancy function (acc. to DRRG standard of DEWA, mandatory in plants with P>10 kW)
- Modbus RTU communication interface
- 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)
- Autotest function
- Password setting protection
- 3 control inputs, e.g. for feedback signal, remote trip
- 3 c/o (SPDT) contacts
- Can be connected to ABB Ability™ Electrical Distribution Control System (see EDCS Getting Started, document no. 1SDC200063B0204)
- Various certifications and approvals (see overview, document no. 2CDC112249D0201)

Ordering details

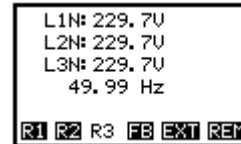
Type	Rated control supply voltage	Measuring range	Order code
CM-UFD.M34M	24-240 V AC/DC	L-L: 0-540 V AC / L-N: 0-312 V AC	1SVR 560 731 R3703

Functions

Operating controls



Display



R1 R2 R3: relay status; in this case R3 is de-energized

FB: status feedback loop Y1-Y0; in this case FB is closed

EXT: status external signal; (Y2-Y0/Modbus)

REM: status remote trip input; (Y3-Y0/Modbus)

Indication of operational states

U/T: green LED - Control supply voltage applied
 Timing

F: red LED - Fault message

Rx/Tx: yellow LED - Modbus frame reception and transmission

Keypad

ESC: escape / return to previous menu

Λ: up / value increase

V: down / value decrease

OK: enter / confirm selection

Application

The CM-UFD.M34M is a grid feeding monitoring relay (I.P.), 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. In conformity with the DRRG standard of DEWA, the CM-UFD.M34M relay can be used in all low voltage plants and in medium voltage plants. The I.P. relay is mandatory in all low voltage generation plants with power > 10 kW.

Operating mode

The CM-UFD.M34M 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.M34M provides 3 output relays and 3 control inputs. In case an event occurs, the first output relay R1 (1115-1216/1418) disconnects the distributed generation from the public grid by means of the first switching device. The second output relay R2 (2125-2226/2428) is redundant to the first one. It only trips the second switching device if no change of the state of the first switching device has been recognized within the adjusted time delay.

The third output relay R3 (3135-3236/3438) 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 or controlled via bus.

The first control input Y1-Y0 monitors the corresponding feedback signal from the first switching device. Two additional control inputs allow to switch remotely between two sets of frequency threshold settings via Y2-Y0 or to trip the grid feeding monitoring relay via the control input Y3-Y0 (remote trip).

With the Modbus RTU interface, all process values and status information from the CM-UFD.M34M can be read out and control commands can be executed.

Protective functions

If the control supply voltage is applied and all phases are present with voltage and frequency values within their permissible range, output relay R1 (switching device 1) energizes after the adjusted start-up delay and output relay R2 (switching device 2) energizes or de-energizes, depending on the configuration, after a fixed delay of 1 s. Using the default factory setting, both output relays R1 and R2 will be activated synchronously. The green LED U/T flashes while timing and turns steady when the start-up delay is complete.

If a measured value exceeds or falls below the set threshold value, output relay R1 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 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.

As soon as the measured value returns to the tolerance range, taking into account a fixed hysteresis, the red LED F turns off and output relay R1 re-energizes after the adjusted re-start delay. The green LED U/T flashes while timing and turns steady when the delay is complete.

Redundancy functions

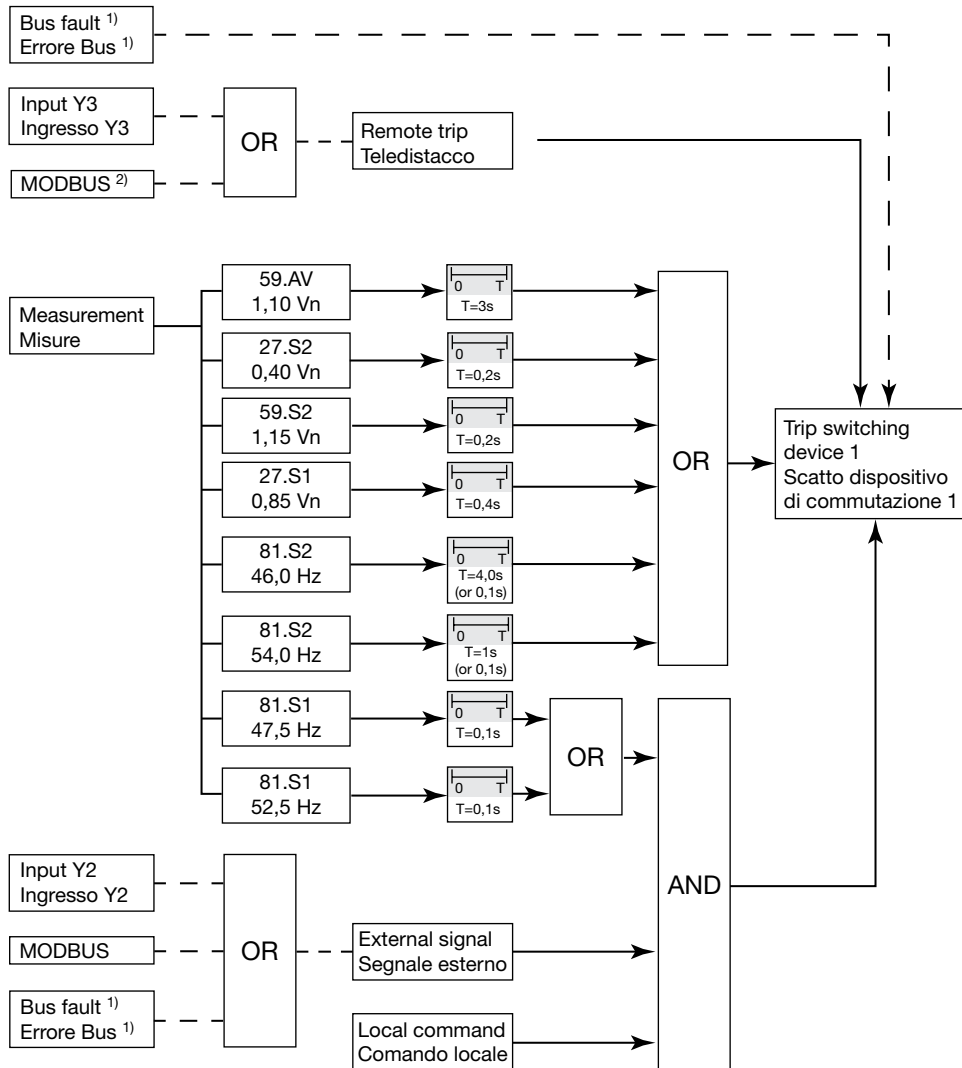
The redundancy relay R2 is activated if relay R1 has de-energized and if no feedback from the external contact has been recognized by the internal logic via the first control input Y1-Y0 within the adjustable time delay. In case a feedback signal is present, the redundancy relay does not trip.

Output relay R3 (31₃₅-32₃₆/34₃₈)

The output relay R3 can be used for:

- Trip signalization
R3 reacts synchronously with R1. ON-time of R3 is inactive.
- Closing command of a breaker motor
In case output relay R1 energizes, 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 de-energizes.
- 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⁾ The bus fault reaction has to be configured in the Modbus menu.
La reazione ad un errore Bus deve essere configurato nel menu Modbus.

²⁾ Remote trip via Modbus has to be enabled in the Modbus menu.
Teledistacco tramite Modbus deve essere abilitato nel menu Modbus.

The device utilises several separately adjustable monitoring functions for:

- Over voltage protection: $U > (59.AV)$, $U >> (59.S2)$
- Under voltage protection: $U < (27.S1)$, $U << (27.S2)$
- Over frequency protection: $f > (81>.S1)$, $f >> (81>.S2)$
- Under frequency protection: $f < (81<.S1)$, $f << (81<.S2)$

Protective function 59.AV (10-minutes average value):

The CM-UFD.M34M 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.

Local command and external signal

Only some local standards such as CEI 0-21 in Italy define “restrictive thresholds”, the under- and overfrequency thresholds S1 (49.5Hz/50.5 Hz), and “permissive thresholds”, the under- and overfrequency thresholds S2 (47.5Hz/51.5 Hz).

Selection of S1 or S2 thresholds is done by the corresponding combination of the external signal Y2-Y0 or Modbus RTU and the local command (see tables below).

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

Operating principle	Input state	Control input
normally open	open	0
normally open	closed	1
normally closed	open	1
normally closed	closed	0

Truth table for frequency thresholds

External signal			Local command	Active thresholds
Input Y2	MODBUS	Bus fault*		
X	X	X	disabled	S2
0	0	0	enabled	S2
One or more = 1			enabled	S1 + S2

* The bus fault reaction has to be configured in the Modbus menu.

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. 10 °. Only after the set error time the switch-on conditions will be evaluated in order to start an auto reconnection.

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 relay R1.

Error memory

The CM-UFD.M34M 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.

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 output relay R1. For each threshold the device displays the measured switching time up from tripping the output relay until 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 R1 remains de-energized as long as the test has not been passed successfully.

Note: The autotest will cause the CM-UFD.M34M 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. Return to the menu is realized by confirming with the OK button.

Modbus RTU

This communication interface enables control commands (remote trip, frequency thresholds S1 or S2) to the CM-UFD.M34M and provides status information as well as actual process values.

RS-485 Standard

RS-485 is a serial interface standard for communication over a twisted-pair cable. The RS-485 standard specifies only the electrical characteristics of the bus system. The RS-485 transmission line consists of three wires: A, B and C. The signal transmission is based on the voltage difference between the wires. The isolated signal ground should be connected to prevent common mode voltage between the network devices from drifting outside the allowable limits. RS-485 bus cable should be terminated with a resistor on both ends to prevent signal reflection.

Network characteristics

Bus termination is required to prevent signal reflections from the bus cable ends. The CM-UFD.M34M is not equipped with internal bus termination, therefore external termination resistors have to be used according to Modbus specifications. The Modbus slave address, baud rate and communication timeout can be set in the CM-UFD.M34M. It is possible to configure a maximal time without telegrams from the master before the CM-UFD.M34M triggers the configured bus fault reaction. Per default, a timeout of 10 s is set. When changing communication parameters, no power cycle is necessary. Cable type and cable length have to be selected according to the Modbus specification. The use of passive bus sublines should be avoided. For integrating Modbus devices into a Modbus TCP network a Serial/Ethernet gateway is required.

Configuration of the Modbus RTU communication menu

- The bus address can be adjusted with the CM-UFD.M34M menu. The CM-UFD.M34M allows an address to be set between 001 and 247
- For Modbus RTU it is necessary to configure at least the baud rate and the parity

Bus fault reaction

The bus fault reaction can be set the following ways:

- Trip R1 - Disconnection of the distributed generation from the grid
- Signalization of a bus fault via R3
- Signalization of a bus fault via fault message in the display
- Force external signal - Only some local standards such as CEI 0-21 in Italy define "restrictive thresholds" and "permissive thresholds" for frequency. In case of a missing communication interface, the restrictive thresholds S1 will be activated additionally (see chapter "Operating principle / Monitoring functions").

ABB Ability™ Electrical Distribution Control System

Over Modbus RTU the CM-UFD.M34M can be connected to the ABB Ability™ Electrical Distribution Control System.

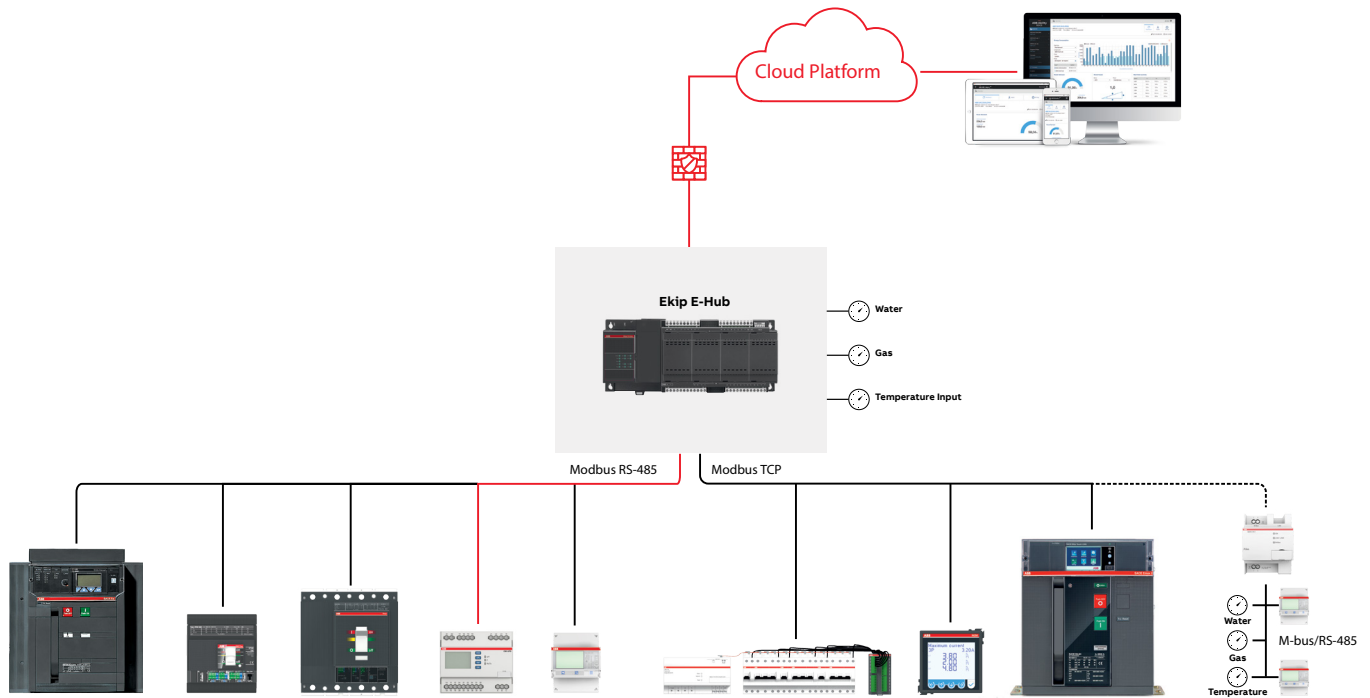
ABB Ability™ Electrical Distribution Control System is built on a state-of-the-art cloud architecture for data collection, processing and storage.

Following information are available in the cloud:

- All measured values (e.g. frequency and voltage)
- I/O Data (e.g. state of relays)
- Diagnostic data (e.g. Last trip reason)

For the initial setup please see "Ekip Com Hub Getting Started" (1SDC200063B0204)

For a detailed integration of the CM-UFD.M34M into ABB Ability™, please see the application note (2CDC112280D0201).



Modbus Address Map

Register map

Measuring, read only (FC03, FC04)

Address	Register	Value	Format
0x0000	1	Device Type	34 = CM-UFD.M34M
0x0001	2	Average voltage L1-N	1 Bit = 10 mV
0x0002	3	Average voltage L2-N	1 Bit = 10 mV
0x0003	4	Average voltage L3-N	1 Bit = 10 mV
0x0004	5	Average voltage L1-L2	1 Bit = 10 mV
0x0005	6	Average voltage L2-L3	1 Bit = 10 mV
0x0006	7	Average voltage L3-L1	1 Bit = 10 mV
0x0007	8	Voltage L1-N	1 Bit = 10 mV
0x0008	9	Voltage L2-N	1 Bit = 10 mV
0x0009	10	Voltage L3-N	1 Bit = 10 mV
0x000A	11	Voltage L1-L2	1 Bit = 10 mV
0x000B	12	Voltage L2-L3	1 Bit = 10 mV
0x000C	13	Voltage L3-L1	1 Bit = 10 mV
0x000D	14	Frequency	1 Bit = 10 mHz
0x000E	15	Last trip reason	see table "Last trip reasons Modbus RTU"
0x000F	16	Trip counter	0-65535

Status bits, read only (FC03, FC04)

Address	Register	Coil no.																LSB
0x0010	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
0x0011	18	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	
0x0012	19	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	
0x0013	20	64	63	62	61	60	59	58	57	56	55	54	53	52	51	40	49	
0x0014	21	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	

Commands, read/write (FC03, FC04, FC06, FC16)

Address	Register	Coil no.																LSB
0x0015	22	96	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	

Coils map

Status coils at register 17, read only (FC01, FC02)

Address	Coil	CM-UFD.M34M	Description
0x0000	1	Error summary	1, if any coil from 17 to 80 is 1
0x0001	2	Restart delay	No error, restart delay running
0x0002	3	Relay 1	Relay status, 1 = energized
0x0003	4	Relay 2	Relay status, 1 = energized
0x0004	5	Relay 3	Relay status, 1 = energized
0x0005	6	Input Y1	Input status, 1 = closed
0x0006	7	Input Y2	Input status, 1 = closed
0x0007	8	Input Y3	Input status, 1 = closed
0x0008	9	Frequency value invalid	1 = value invalid
0x0009	10	-	-
0x000A	11	-	-
0x000B	12	-	-
0x000C	13	-	-
0x000D	14	-	-
0x000E	15	-	-
0x000F	16	-	-

Status coils at register 18

Address	Coil	CM-UFD.M34M	Description
0x0010	17	-	-
0x0011	18	-	-
0x0012	19	-	-
0x0013	20	OV2 L1-N	Overvoltage 2, L1-N
0x0014	21	OV2 L2-N	Overvoltage 2, L2-N
0x0015	22	OV2 L3-N	Overvoltage 2, L3-N
0x0016	23	UV1 L1-N	Undervoltage 1, L1-N
0x0017	24	UV1 L2-N	Undervoltage 1, L2-N
0x0018	25	UV1 L3-N	Undervoltage 1, L3-N
0x0019	26	UV2 L1-N	Undervoltage 2, L1-N
0x001A	27	UV2 L2-N	Undervoltage 2, L2-N
0x001B	28	UV2 L3-N	Undervoltage 2, L3-N
0x001C	29	OVAV L1-N	Overvoltage 10 min average L1-N
0x001D	30	OVAV L2-N	Overvoltage 10 min average L2-N
0x001E	31	OVAV L3-N	Overvoltage 10 min average L3-N
0x001F	32	-	-

Status coils at register 19

Address	Coil	CM-UFD.M34M	Description
0x0020	33	-	-
0x0021	34	-	-
0x0022	35	-	-
0x0023	36	OV2 L1-L2	Overvoltage 2, L1-L2
0x0024	37	OV2 L2-L3	Overvoltage 2, L2-L3
0x0025	38	OV2 L3-L1	Overvoltage 2, L3-L1
0x0026	39	UV1 L1-L2	Undervoltage 1, L1-L2
0x0027	40	UV1 L2-L3	Undervoltage 1, L2-L3
0x0028	41	UV1 L3-L1	Undervoltage 1, L3-L1
0x0029	42	UV2 L1-L2	Undervoltage 2, L1-L2
0x002A	43	UV2 L2-L3	Undervoltage 2, L2-L3
0x002B	44	UV2 L3-L1	Undervoltage 2, L3-L1
0x002C	45	OVAV L1-L2	Overvoltage 10 min average L1-L2
0x002D	46	OVAV L2-L3	Overvoltage 10 min average L2-L3
0x002E	47	OVAV L3-L1	Overvoltage 10 min average L3-L1
0x002F	48	-	-

Status coils at register 20

Address	Coil	CM-UFD.M34M	Description
0x0030	49	OF1	Overfrequency 1
0x0031	50	OF2	Overfrequency 2
0x0032	51	UF1	Underfrequency 1
0x0033	52	UF2	Underfrequency 2
0x0034	53	ROCOF	Rate of change of frequency
0x0035	54	VECTOR	Vector shift
0x0036	55	REMOTE	Remote trip via Y3
0x0037	56	NEUTRAL	Neutral conductor broken
0x0038	57	DDI-FB	Feedback error Y1
0x0039	58	-	-
0x003A	59	AUTOTEST	Autotest failed
0x003B	60	INTERNAL	Internal error
0x003C	61	-	-
0x003D	62	BUS TRIP	Remote trip via BUS
0x003E	63	BUS FAULT	Bus fault (timeout)
0x003F	64	-	-

Status coils at register 21

Address	Coil	CM-UFD.M34M	Description
0x0040	65	-	-
0x0041	66	-	-
0x0042	67	-	-
0x0043	68	-	-
0x0044	69	-	-
0x0045	70	-	-
0x0046	71	-	-
0x0047	72	-	-
0x0048	73	-	-
0x0049	74	-	-
0x004A	75	-	-
0x004B	76	-	-
0x004C	77	-	-
0x004D	78	-	-
0x004E	79	-	-
0x004F	80	-	-

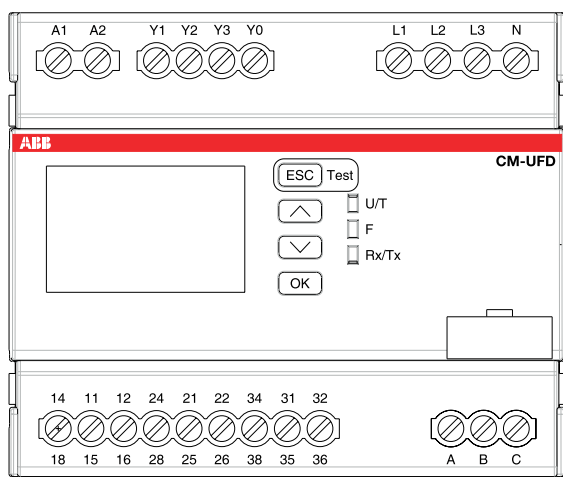
Command coils at register 22, read/write (FC01, FC02, FC05, FC15)

Address	Coil	CM-UFD.M34M	Description
0x0050	81	TRIP R1	Trip error relays
0x0051	82	TRIP R3	Trip relay R3
0x0052	83	EXT	External signal
0x0053	84	-	-
0x0054	85	-	-
0x0055	86	-	-
0x0056	87	-	-
0x0057	88	-	-
0x0058	89	-	-
0x0059	90	-	-
0x005A	91	-	-
0x005B	92	-	-
0x005C	93	-	-
0x005D	94	-	-
0x005E	95	-	-
0x005F	96	-	-

Last trip reasons Modbus RTU

Dezimal	HEX	Comment
0		
1		
2		
3	0x03	Overvoltage L1-N, threshold 2
4	0x04	Overvoltage L2-N, threshold 2
5	0x05	Overvoltage L3-N, threshold 2
6	0x06	Undervoltage L1-N, threshold 1
7	0x07	Undervoltage L2-N, threshold 1
8	0x08	Undervoltage L3-N, threshold 1
9	0x09	Undervoltage L1-N, threshold 2
10	0x0A	Undervoltage L2-N, threshold 2
11	0x0B	Undervoltage L3-N, threshold 2
12	0x0C	Overvoltage L1-N, average value
13	0x0D	Overvoltage L2-N, average value
14	0x0E	Overvoltage L3-N, average value
15	0x0F	Overvoltage L1-L2, threshold 1
16	0x10	Overvoltage L2-L3, threshold 1
17	0x11	Overvoltage L3-L1, threshold 1
18	0x12	Overvoltage L1-L2, threshold 2
19	0x13	Overvoltage L2-L3, threshold 2
20	0x14	Overvoltage L3-L1, threshold 2
21	0x15	Undervoltage L1-L2, threshold 1
22	0x16	Undervoltage L2-L3, threshold 1
23	0x17	Undervoltage L3-L1, threshold 1
24	0x18	Undervoltage L1-L2, threshold 2
25	0x19	Undervoltage L2-L3, threshold 2
26	0x1A	Undervoltage L3-L1, threshold 2
27	0x1B	Overvoltage L1-L2, average value
28	0x1C	Overvoltage L2-L3, average value
29	0x1D	Overvoltage L3-L1, average value
30	0x1E	Overfrequency, threshold 1
31	0x1F	Overfrequency, threshold 2
32	0x20	Underfrequency, threshold 1
33	0x21	Underfrequency, threshold 2
34	0x22	ROCOF
35	0x23	Vector shift
36	0x24	Remote trip via Y3
37	0x25	Interrupted neutral detection
38	0x26	Failure in feedback loop 1, feedback switching device 1
39	-	-
40	0x28	Auto test
41	0x29	Internal error
42	-	-
43	0x2B	Remote trip via bus
44	0x2C	Bus fault
255	0xFF	No error after power on

Electrical connection



A1-A2	Control supply voltage
Y1-Y0	Control input 1 for feedback signal
Y2-Y0	Control input 2 for external signal
Y3-Y0	Control input 3 for remote trip
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
A, B, C	Modbus RTU interface
	A / D0
	B / D1
	C / Common

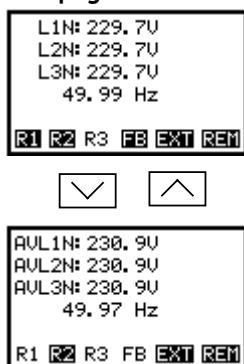
2CDC 253 030 F0017

Configuration

The CM-UFD.M34M is delivered with default settings in accordance to the DRRG standard of DEWA. 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

- 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.

Password protection

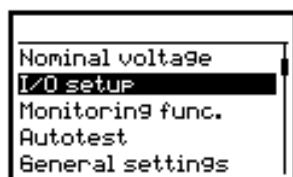
Every CM-UFD.M34M relay is delivered with the same default password [0000] for protection of its settings and local command. The installer is responsible for the verification of the parameter values and the change of the password with a personal one in order to avoid unwanted modifications.

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

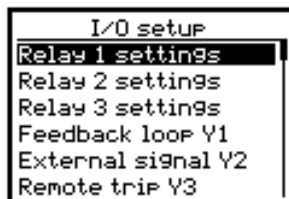
Main menu



v down

up ^

Submenu



v down

up ^



Main menu	Submenu	Options	Configuration possibilities	Step size	DEWA LV	DEWA MV	
Nominal voltage	Measuring principle		[3L-N], [3L-L], [1L-N]		3L-N	3L-L	
	Nominal voltage		[57.7] - [230.9] V L-N / [99.9] - [400.0] V L-L	0.1 V	230 V L-N	100 V L-L	
I/O setup	Relay 1 settings	Start-up delay	[1.00] - [600.00] s	0.05 s	1 s	1 s	
		Re-start delay	[0.04] - [600.00] s	0.01 s	0.05 s	0.04 s	
	Relay 2 settings	Working principle	[closed-circuit], [open-circuit], [synchronous with relay 1]		closed-circuit	closed-circuit	
	Relay 3 settings	Working principle	[disabled], [open-circuit], [closed-circuit], [synchronous with relay 1], [bus controlled], [bus fault]		synchronous with relay 1	synchronous with relay 1	
		ON-delay	[0.00] - [10.00] s	0.05 s	0 s	0 s	
		ON-time	[0.05] - [10.00] s	0.05 s	0.5 s	0.5 s	
	Feedback loop Y1	Monitoring	[disabled], [enabled], [tripping only]		enabled	enabled	
		Working principle	[normally closed], [normally open], [auto detection]		normally closed	normally closed	
		Trip window	[0.05] - [0.50] s	0.05 s	0.5 s	0.5 s	
		Release window	[0.5] - [6000.00] s	0.1 s	0.5 s	0.5 s	
		External signal Y2	Working principle	[normally closed], [normally open]		normally closed	normally closed
		Remote trip Y3	Working principle	[normally closed], [normally open]		normally open	normally open
Monitoring function	Overvoltage >AV	Threshold value	[1.00] - [1.20] * U _n	0.01 x U _n	1.1 x U _n	1.1 x U _n	
	Overvoltage >S2	Threshold value	[1.00] - [1.30] * U _n	0.01 x U _n	1.15 x U _n	1.2 x U _n	
		Tripping delay	[0.05] - [600.00] s	0.05 s	0.2 s	0.6 s	
	Undervoltage <S1	Threshold value	[0.20] - [1.00] * U _n	0.01 x U _n	0.85 x U _n	0.85 x U _n	
		Tripping delay	[0.05] - [600.00] s	0.05 s	0.4 s	1.5 s	
	Undervoltage <S2	Threshold value	[0.05] - [1.00] * U _n	0.01 x U _n	0.4 x U _n	0.3 x U _n	
		Tripping delay	[0.05] - [600.00] s	0.05 s	0.2 s	0.2 s	
	Overfrequency >S1	Threshold value	[50.0] - [54.0] Hz	0.1 Hz	52.5 Hz	52.5 Hz	
		Tripping delay	[0.05] - [600.00] s	0.05 s	0.1 s	0.1 s	
	Overfrequency >S2	Threshold value	[50.0] - [54.0] Hz	0.1 Hz	54.0 Hz	54.0 Hz	
		Tripping delay	[0.05] - [600.00] s	0.05 s	10.0 s	10.0 s	
	Underfrequency <S1	Threshold value	[46.0] - [50.0] Hz	0.1 Hz	47.5 Hz	47.5 Hz	
		Tripping delay	[0.05] - [600.00] s	0.05 s	4.0 s	4.0 s	
	Underfrequency <S2	Threshold value	[46.0] - [50.0] Hz	0.1 Hz/s	46.0 Hz	46.0 Hz	
		Tripping delay	[0.05] - [600.00] s	0.05 s	10.0 s	10.0 s	
	ROCOF	Monitoring	[disabled], [enabled]		disabled	disabled	
		Threshold value	[0.100] - [5.000] Hz/s	0.005 Hz/s	1 Hz/s	1 Hz/s	
		Number of cycles	[4] - [50]	1	20	20	
		Tripping delay	[0.00] - [600.00] s	0.01 s	0.1 s	0.1 s	
Error time		[0.05] - [600.00] s	0.01 s	1 s	1 s		

Main menu	Submenu	Options	Configuration possibilities	Step size	DEWA LV	DEWA MV
	Vector Shift VS	Monitoring	[disabled], [enabled]		disabled	disabled
		Threshold value	[1.0] - [50.0] °	0.1 °	10 °	10 °
		Error time	[0.05] - [600.00] s	0.01 s	1 s	1 s
Autotest						
General settings	Local command	Local command	[disabled], [enabled]		enabled 1)	
		Change LC password	[****]			
	Language	Language	[English], [Italiano]		English 1)	
	Display	Switch-off delay	[10] - [600] s	1 s	10 s 1)	
		Contrast	[0] - [9]	1	5 1)	
	Password	Protection	[disabled], [enabled]		disabled 1)	
		Change password	[****]		0000 1)	
	Load settings	"Setting name"				
	Save settings	"Setting name"				
	Information					
Modbus	Bus mode	Communication	[disabled], [enabled]		disabled*	
		Remote trip via bus	[disabled], [enabled]		disabled*	
		Fault reaction	[trip R1], [fault message], [force external signal]		fault message*	
		Timeout	1-600 s	1 s	10 s*	
	Bus config.	Slave address	1-247	1	1*	
		Baud rate	[1200], [2400], [4800], [9600], [19200], [38400], [57600], [115200]		19200*	
		Parity	[EVEN, ODD, NONE]		EVEN*	
Error memory	Error list					
	Error recording	Remote trip via Y3	[disabled], [enabled]		enabled*	
		Remote trip via bus	[disabled], [enabled]		enabled*	
		Power OFF	[disabled], [enabled]		enabled*	
	Reset error memory					
	Operating counter					
	Cumulated OFF-time					
	Trip counter					

* Device default, not affected by loading a setting

Display and failure messages

```

L1N: 260. 2V >AV
L2N: 260. 3V >AV
L3N: 260. 0V >AV
49. 99 Hz
R1 R2 R3 FB EXT REM

```

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

```

L1N: 199. 9V
L2N: 200. 1V
L3N: 199. 7V
49. 61 Hz VS
R1 R2 R3 FB EXT REM

```

Error, vector shift

```

L1N: 264. 6V >S2
L2N: 264. 9V >S2
L3N: 264. 6V >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.

```

Neutral conductor
is not connected!
R1 R2 R3 FB EXT REM

```

4-wire connection

The neutral conductor is disconnected or interrupted. Please check wiring.

```

L1N: 190. 3V <S1
L2N: 190. 5V <S1
L3N: 190. 1V <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: 230. 4V
L2N: 230. 6V
L3N: 230. 3V
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 switching device 1. Please check configuration and installation for failures. After failure removal, press ESC to restart/reset.

```

L1N: 90. 2V <S2
L2N: 90. 3V <S2
L3N: 90. 2V <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: 220. 5V
L2N: 220. 6V
L3N: 220. 4V
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 switching device 1. Failure in configuration or installation must be removed before the failure can be receipted with ESC.

```

L1N: 230. 4V
L2N: 230. 5V
L3N: 230. 2V
51. 00 Hz >S1
R1 R2 R3 FB EXT TSC

```

Error overfrequency S1 detected

```

L1N: 229. 9V
L2N: 229. 2V
L3N: 229. 1V
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.

```

L1N: 230. 3V
L2N: 230. 5V
L3N: 230. 1V
51. 99 Hz >S2
R1 R2 R3 FB EXT TSC

```

Error overfrequency S2 detected

```

Autotest
U> 230. 2V 16ms
Autotest failed

```

Feedback of switching device 1 interrupted or failure during test

```

L1N: 230. 5V
L2N: 230. 7V
L3N: 230. 3V
49. 00 Hz <S1
R1 R2 R3 FB EXT TSC

```

Error underfrequency S1 detected

```

L1N: 229. 9V
L2N: 230. 2V
L3N: 229. 9V
49. 99 Hz
Autotest failed
R1 R2 R3 FB EXT REM

```

Main display / start display after autotest failure. Restart autotest

```

L1N: 230. 6V
L2N: 230. 7V
L3N: 230. 5V
47. 00 Hz <S2
R1 R2 R3 FB EXT TSC

```

Error underfrequency S2 detected

```

L1N: 229. 9V
L2N: 230. 3V
L3N: 229. 7V
49. 99 Hz
Remote trip via Y3
R1 R2 R3 FB EXT REM

```

Remote trip via Y3

Shows that the remote trip is activated via control input Y3 and output relay R1 is de-energized.

```

L1N: 229. 9V
L2N: 230. 3V
L3N: 229. 7V
49. 99 Hz
Ext. signal via bus
R1 R2 R3 FB EXT REM

```

Device has received an external signal via Bus, to select restrictive threshold for under- and overfrequency.

```

L1N: 229. 9V
L2N: 230. 3V
L3N: 229. 7V
49. 99 Hz
Remote trip via bus
R1 R2 R3 FB EXT REM

```

Remote trip via Bus

Shows that the remote trip is achieved via Bus and output relay R1 is de-energized.

```

L1N: 199. 9V
L2N: 200. 1V
L3N: 199. 7V
49. 99 Hz ROCOF
R1 R2 R3 FB EXT REM

```

Error, ROCOF

```

L1N: 229. 9V
L2N: 230. 3V
L3N: 229. 7V
49. 99 Hz
Bus fault
R1 R2 R3 FB EXT REM

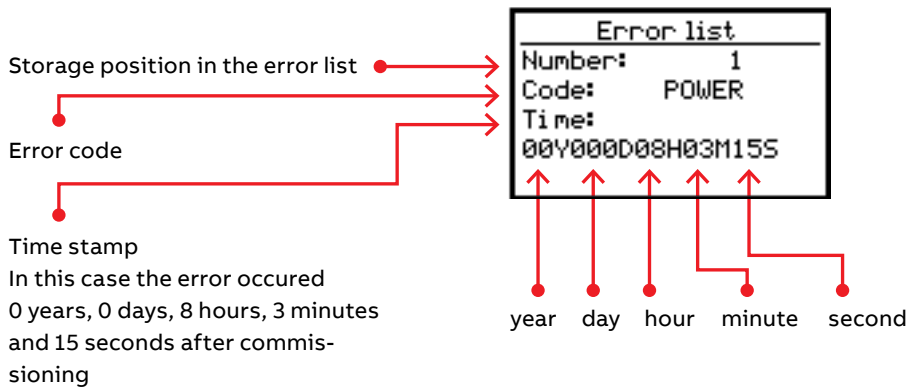
```

Error Bus fault

Device has detected a bus fault, e.g. a cyclic bus master is missing.

Error memory

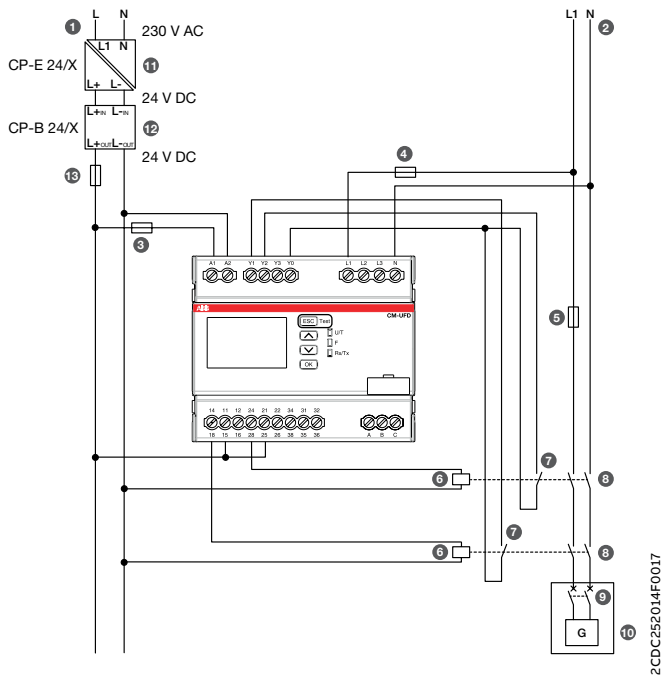
As soon as one of the above errors occurs, subsequent error codes with the corresponding time stamp will be stored in the error memory:



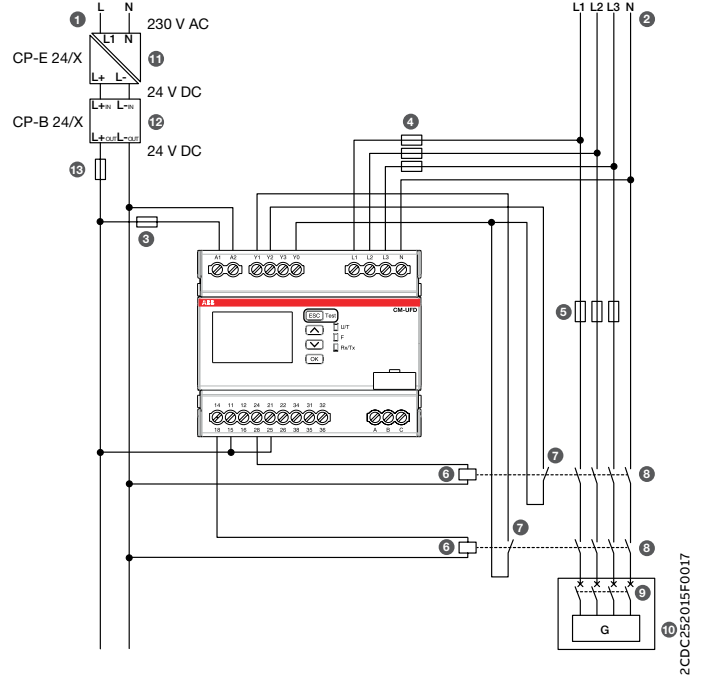
Error code	Explanation	
L1N>AV or L2N>AV or L3N>AV	Error, overvoltage AV	10-minutes average value
L1N>S2 or L2N>S2 or L3N>S2	Error, overvoltage S2	
L1N<S1 or L2N<S1 or L3N<S1	Error, undervoltage S1	
L1N<S2 or L2N<S2 or L3N<S2	Error, undervoltage S2	
L12>AV or L23>AV or L31>AV	Error, overvoltage S1	10-minutes 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	
VECTOR SHIFT	Error, vector shift	
AUTO	Error, autotest	Failure during the autotest routine
REMOTE Y3	Error, remote trip via control input Y3	
REMOTE BUS	Error, remote trip via Bus	
BUS FAULT	Error, Bus fault	CM-UFD.M34M has detected a bus fault (e.g. cyclic bus master is missing)
DDI-FB	Error, feedback of first switching device	Malfunction of the first 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.M34M (SPI) and tripping device*
2. Shunt trip coil for feedback function (P>20 kW)
3. Main circuit breaker
4. Device protection fuse for the CM-UFD.M34M
5. Protection fuse for the measuring circuit of the CM-UFD.M34M (optional)
6. Short-circuit protection
7. Automatic circuit breaker or contactor equipped with low voltage coil and motor for automatic closure
8. Auxiliary contact, necessary for realizing the feedback function
9. Generator
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

* In accordance to the DRRG standard of DEWA, in case of loss of control supply voltage it's asked to guarantee, at least for 5 seconds, the functionality of the CM-UFD.M34M, the operability of the first switching device and when present the command coil for operating the redundancy device. This function has to be realized by external buffer or UPS devices.

Technical data

Data at $T_a = 25\text{ °C}$ 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)
		1000 ms (230 V AC, 24°C - typical value)

Measuring circuits		L1, L2, L3, N
Nominal voltage of the distribution system U_n		57.7-230.9 V AC / 99.9-400.0 V AC
Measuring ranges	voltage: line to neutral	0-312 V AC
	voltage: line to line	0-540 V AC
	frequency	40-70 Hz
Accuracy within the temperature range	voltage	$\leq 0,5\% \pm 0,5\text{ V}$
	frequency	$\pm 20\text{ mHz}$
	delay times	$\leq 0,1\% \pm 20\text{ ms}$ (unless otherwise specified)
Monitoring functions	overvoltage av. (59 AV)	threshold adjustable, $1.00-1.20 \times U_n$ in $0.01 \times U_n$ steps
	overvoltage (59 S2)	threshold adjustable, $1.00-1.30 \times U_n$ in $0.01 \times U_n$ steps
	undervoltage (27 S1)	threshold adjustable, $0.20-1.00 \times U_n$ in $0.01 \times U_n$ steps
	undervoltage (27 S2)	threshold adjustable, $0.05-1.00 \times U_n$ in $0.01 \times U_n$ steps
	overfrequency (81>S1)	threshold adjustable, 50.0-54.0 Hz in 0.1 Hz steps
	overfrequency (81>S2)	
	underfrequency (81<S1)	threshold adjustable, 46.0-50.0 Hz in 0.1 Hz steps
	underfrequency (81<S2)	
	ROCOF	threshold adjustable, 0.1-5 Hz/s in 0.005 Hz/s steps
Hysteresis related to the threshold values	vector shift	threshold adjustable, 1.0-50.0 °, in 0.1 ° steps
	overvoltage av.	4 %
	overvoltage	0.1 Hz
	undervoltage	
	overfrequency	
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, trip and release monitoring times adjustable
	Y2-Y0 control input 2	external signal
	Y3-Y0 control input 3	remote trip
Electrical isolation	from the supply voltage	yes
	from the measuring circuit	no
	from the relay outputs	yes
	from the communication interface	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

*Voltage transformers may be used in low voltage applications to transform and adapt the measuring input to ensure the voltage magnitude applied to the input terminals fall within the beforementioned voltage range. This to allow for the effective application of the Under-/Overvoltage and Under-/Overfrequency monitoring functions.

Timing functions

Start-up delay R1		adjustable, 1.00-600.00 s in 0.05 s steps
Re-start delay R1 (re-connection after interruption)		adjustable, 0.05-600.00 s in 0.05 s steps
Start-up delay R2		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		adjustable, 0.05-0.50 s in 0.05 s steps
Release window, feedback loop		adjustable, 0.5-6000.0 s in 0.1 s steps
Tripping delay	overvoltage	adjustable, 0.05-600.00 s in 0.05 s steps; \pm 20 ms
	undervoltage	
	overfrequency	
	underfrequency	
Error time	ROCOF	adjustable, 0.00-600.00 s in 0.01 s steps; \pm 20 ms
	ROCOF	adjustable, 0.05-600.00 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
Modbus frame reception and transmission	Rx/Tx	LED yellow flashing
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

Communication interface

Supported communication protocol	Modbus RTU
Physical interface	3-wire RS-485
Integrated termination resistors	no
Possible bus addresses	1-247
Baud rates	1.2 / 2.4 / 4.8 / 9.6 / 19.2 / 38.4 / 57.6 / 115.2 kBit/s
Typical response time	< 10 ms
Timeout	1-600 s (default 10 s)
RS-485 unit load	¼ unit load (max. 128 devices)

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, configurable
	31-32/34 (35-36/38)	relay R3, c/o (SPDT) contact, configurable
Operating principle	11-12/14	closed-circuit principle*
	21-22/24	configurable (open-circuit, closed-circuit, sync. with R1)*
	31-32/34	configurable (disabled, open-circuit, closed-circuit, sync. with R1, 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
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 occurring
 Open-circuit principle: Output relay energizes if a fault is occurring

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 mm ² (1 x 24-12 AWG) 2 x 0.25-0.75 mm ² (2 x 24-18 AWG)
	fine-strand without wire end ferrule	1 x 0.2-4 mm ² (1 x 24-12 AWG) 2 x 0.2-1.5 mm ² (2 x 24-16 AWG)
	rigid	1 x 0.2-6 mm ² (1 x 24-10 AWG) 2 x 0.2-1.5 mm ² (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 U_i , 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 / com.interface	300 V, III
	measuring (L1/L2/L3/N) / (supply / outputs / com.interface)	300 V, IV
Rated impulse withstand voltage U_{imp}	output 1 / output 2 / output 3	4 kV; 1.2/50 μ s
	supply / control inputs / outputs / com.interface	6 kV; 1.2/50 μ s
	measuring (L1/L2/L3/N) / (supply / outputs / com.interface)	8 kV; 1.2/50 μ s
Pollution degree		3

Standards/Directives

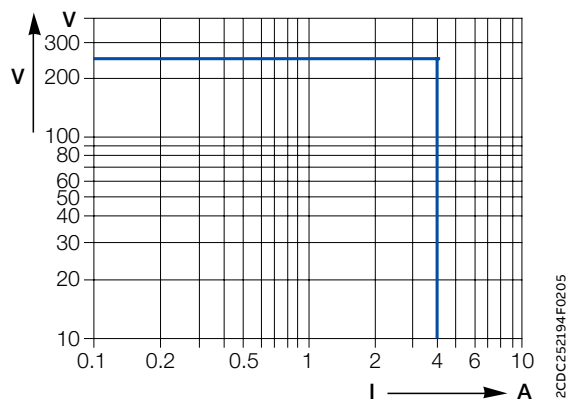
Standards	IEC/EN 60255-1, IEC/EN 60255-26, IEC/EN 60255-27, DRRG standard of DEWA
Low Voltage Directive	2014/35/EU
EMC Directive	2014/30/EU
RoHS Directive	2011/65/EU

Electromagnetic compatibility

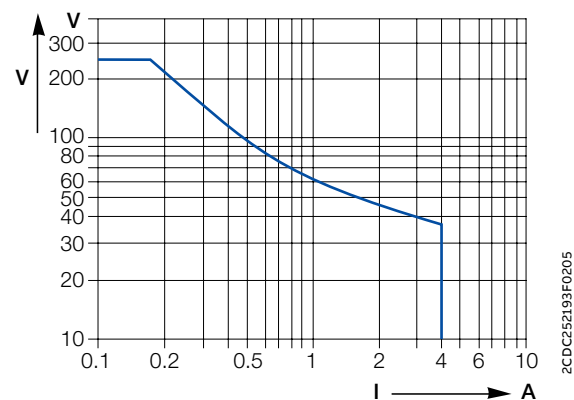
Interference immunity to		IEC/EN 60255-26
electrostatic discharge	IEC/EN 61000-4-2	level 3, 6 kV contact discharge, 8 kV air discharge
radiated, radio-frequency, electromagnetic field	IEC/EN 61000-4-3	level 3, 10 V/m; 2.7 GHz
electrical fast transient / burst	IEC/EN 61000-4-4	zone B / level 3, 2 kV / 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

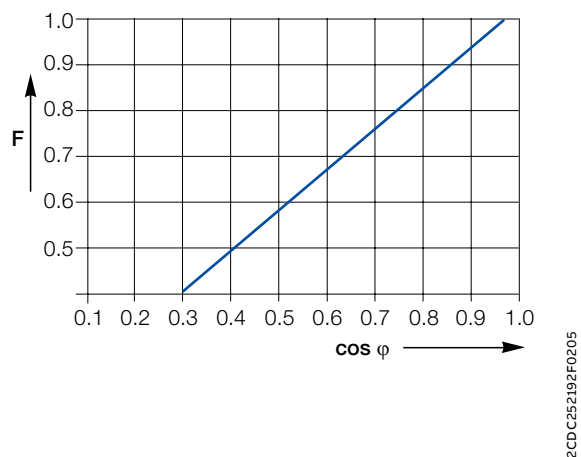
Load limits curves



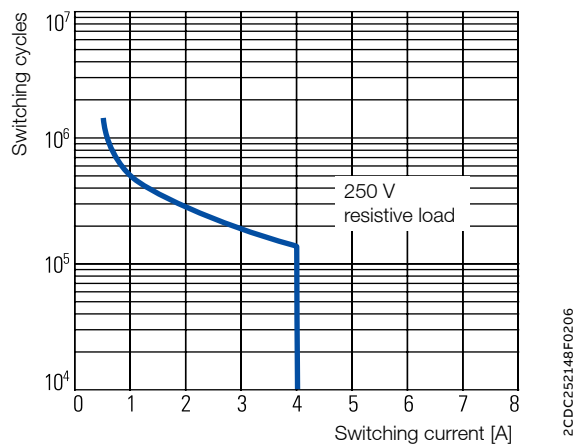
AC load (resistive)



DC load (resistive)



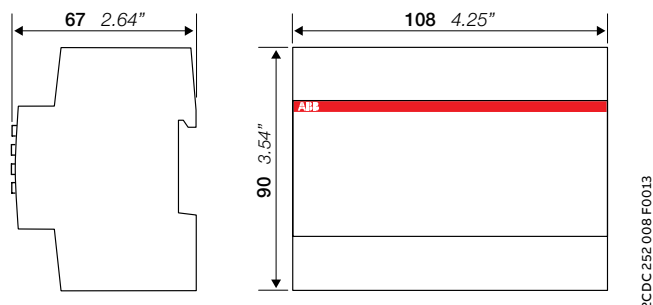
Derating factor F at inductive AC load



Contact lifetime

Dimensional drawings

in mm and inches



Further documentation

Document title	Document type	Document number
Electronic relays and controls	Catalog	2CDC110004C02xx
CM-UFD.M34M Grid feeding monitoring relay	Instruction sheet	1SVC 560 517 M0000
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.

Cyber security

Legal disclaimer

The CM-UFD.MxxM is designed to be connected in the ABB and 3rd party products and communicate information data via network interface. It is the user's sole responsibility to provide and continuously ensure a secure connection between the product and the user's network or any other. The user shall establish and maintain any appropriate measures (such as but not limited to the installation of fire-walls, application of authentication measures, encryption of data, installation of anti-virus programs, etc.) to protect the product, the network, its system, and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information. The data, examples and diagrams in this manual are included solely for the concept or product description and are not to be deemed as a statement of guaranteed properties. All people responsible for applying the equipment addressed in this manual must satisfy themselves that each intended application is suitable and acceptable, including that any applicable safety or other operational requirements are complied with. Any risks in applications where a system failure and/or product failure would create a risk for harm to property or persons (including but not limited to personal injuries or death) shall be the sole responsibility of the person or entity applying the equipment, and those so responsible are hereby requested to ensure that all measures are taken to exclude or mitigate such risks. This document has been carefully checked by ABB, but deviations cannot be completely ruled out. In case any errors are detected, the reader is kindly requested to notify the manufacturer. Other than under explicit contractual commitments, in no event shall ABB be responsible or liable for any loss or damage resulting from the use of this manual or the application of the equipment.

Enhancing network security

The implementation of the following measures is highly recommended in order to enhance the security of networks:

1. Network Isolation – separate the OT network (operation technology) from the IT network (information technology). This helps prevent any attack reaching the IT network from spreading to the OT network.
2. Use of firewalls – Implement firewalls to prevent unauthorized access to the OT network.
3. Use of access control – Implement access controls to restrict the human and device access to the OT network.
4. Keep software up to date – Make sure all software/firmware of the devices are up to date to have the latest security updates installed.
5. Reduce attack surface on devices – Disable device functions, services and ports not needed.
6. Replace default passwords – Replace all default passwords of the devices to prevent attacker from getting access using default credentials.
7. Monitor network activity – Monitor the OT network for any malicious activities that could be a sign of an attack. Example of network monitoring tool is intrusion detection system (IDS).
8. Train employees – Train operators and service people on IT and OT security best practices.
9. Train employees – Train operators and service people on IT and OT security best practices.

