Operations Manual

COOPER Power Systems

Electrical Apparatus

UFD14 Frequency/Load Shedding Relay

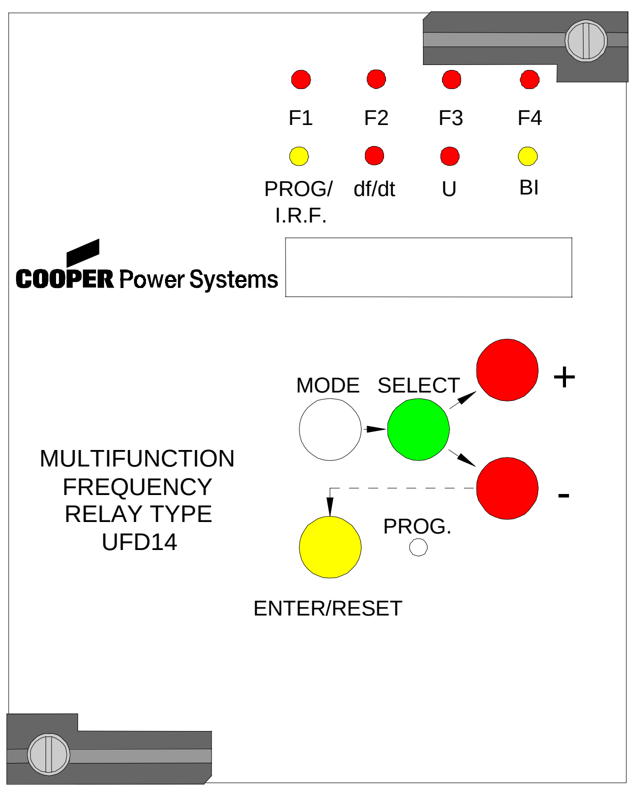
S150-21-1

MICROPROCESSOR FREQUENCY AND LOAD-SHEDDING RELAY

TYPE

UFD14

OPERATIONS MANUAL



The Operations Manual is designed to familiarize the reader with how to install, program, and set up the relay for operation. For programming the relay via computer software, consult the appropriate manual. Contact your local Cooper Power Systems representative for ordering information.

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1. INTRODUCTION

UFD14 is a microprocessor-based frequency/load shedding relay. The relay is suitable for utility load shedding, industrial, and co-gen applications. UFD14 provides the following functions:

- Four over/under definite time frequency elements (81O/U).
- Two definite time Hz/second rate of frequency change elements, which can be logically ANDed to any or all of the 81 elements.
- One undervoltage (27) supervisory element.
- Three blocking inputs to control the frequency operation.
- Four programmable output contacts. Up to 12 additional output contacts may be added through the optional REX-8 modules.

UFD14X has an additional RS485 port to control the optional REX-8 modules. All other functions are similar to the UFD14.

2. HANDLING

As with any piece of electronic equipment, care should be taken when handling the relay, particularly in regards to electrostatic discharge as the damage may not be immediately obvious. All Edison relays are immune to electrostatic discharge when left in their protective case. However, when the relay is removed from its case, the following practices should be observed.

- Touch the case to ensure that your body and the relay are at the same potential.
- Whenever possible, handle the exposed relay by the front panel, the rear connector, or by the edges of the printed circuit boards. Avoid touching the individual electronic components or the embedded traces on the circuit boards.
- If you must handle the exposed (i.e., drawn-out) relay to another person, make sure you are both at the same electrical potential.
- When setting the drawn-out relay down, make sure the surface is either anti-static or is at the same electrical potential as your body.
- Relays should always be placed in storage in their protective case. If storage of the drawn-out relay outside of its protective case is required, then the exposed relay should be placed in a suitable anti static plastic or foam container.

3. INSTALLATION

Edison relays are shipped either in single or double width cabinets, or in standard 19” 3U rack mount enclosures capable of housing up to four Edison relays. Outline dimensions for the single relay housing is shown in Figure 3.1. For dimensions of other cabinets, see catalog section 150-05.

The double case mounting is similar to the single case, but requires a 113mm L x 142mm H panel opening. The 19” rack mount case is a standard 3U high 19” cabinet.

To remove the relay from its case, refer to Figure 3.2. The relay may be removed from its protective case by turning with a flat bladed screwdriver the locking screws ① and ② on the front panel latches ③ so that the slot on the screw is parallel to the ground. The latches may then be pulled from the inside edge to release the relay. Carefully pull on the latches to remove the relay from the housing.

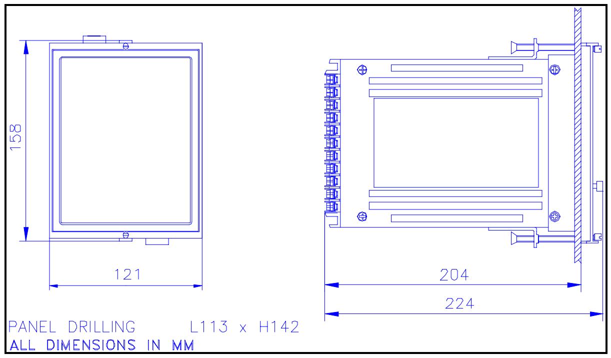


Figure 3.1: Single Module Enclosure Mounting

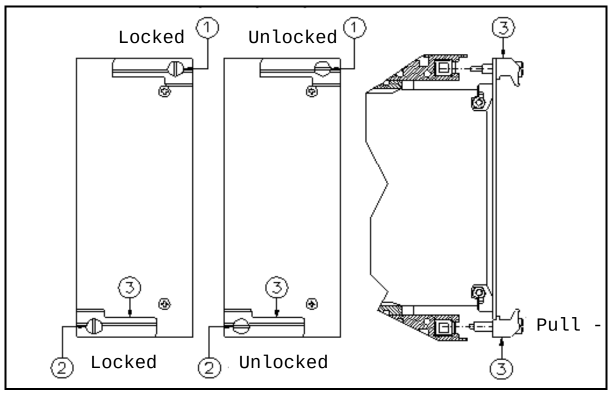


Figure 3.2: Latch Mechanism for Removal of Relay from Case

To re-install the relay in its case, align the printed circuit boards with the guides in the relay case and slide the relay in most of the way. For single and double cases, make sure the locking arm on the back of each of the latches ③ lines up with the locking pins in the case. Then push the latches in, seating the relay. Turn the screws on the latches until the slot is perpendicular to the ground.

4. ELECTRICAL CONNECTIONS

Power is supplied via terminals 12 and 13, with chassis ground at terminal 44. All Edison relays are available with one of two autoranging power supplies. Descriptions of the input voltage ranges are given in Table 4.1. The input supply voltage is noted on the relay case. In the event the relay is fitted with the incorrect power supply, the power supply boards are easily field replaceable. See Bulletin S150-99-1 for instructions and part numbers.

Table 4.1: Power Supply Input Range

POWER SUPPLY	DC VOLTAGE RANGE	AC VOLTAGE RANGE
L	24V (-20%) to 125V (+20%)	24V (-20%) to 110V (+15%) 50/60 Hz
H	90V (-20%) to 250V (+20%)	80V (-20%) to 220V (+15%) 50/60 Hz

All electrical connections, including the RS485 connections, are made on the back of the relay. See Figure 4.1. All the terminals will accept up to a No. 6 stud size spade connector (or any type of lug up to 0.25" (6.3mm) wide), 12 AWG wire (4 mm²), or FASTON connectors. Electrical connections must be made in accordance with the relay's wiring diagram found in Figure 4.2.

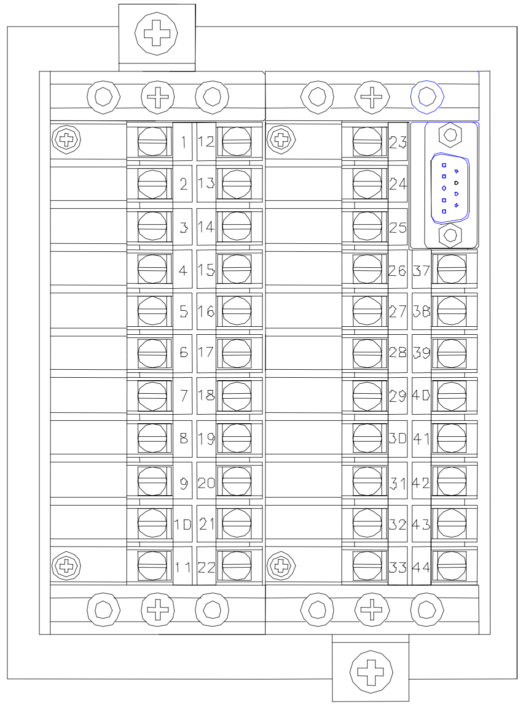


Figure 4.1: View of Rear Terminal Connections

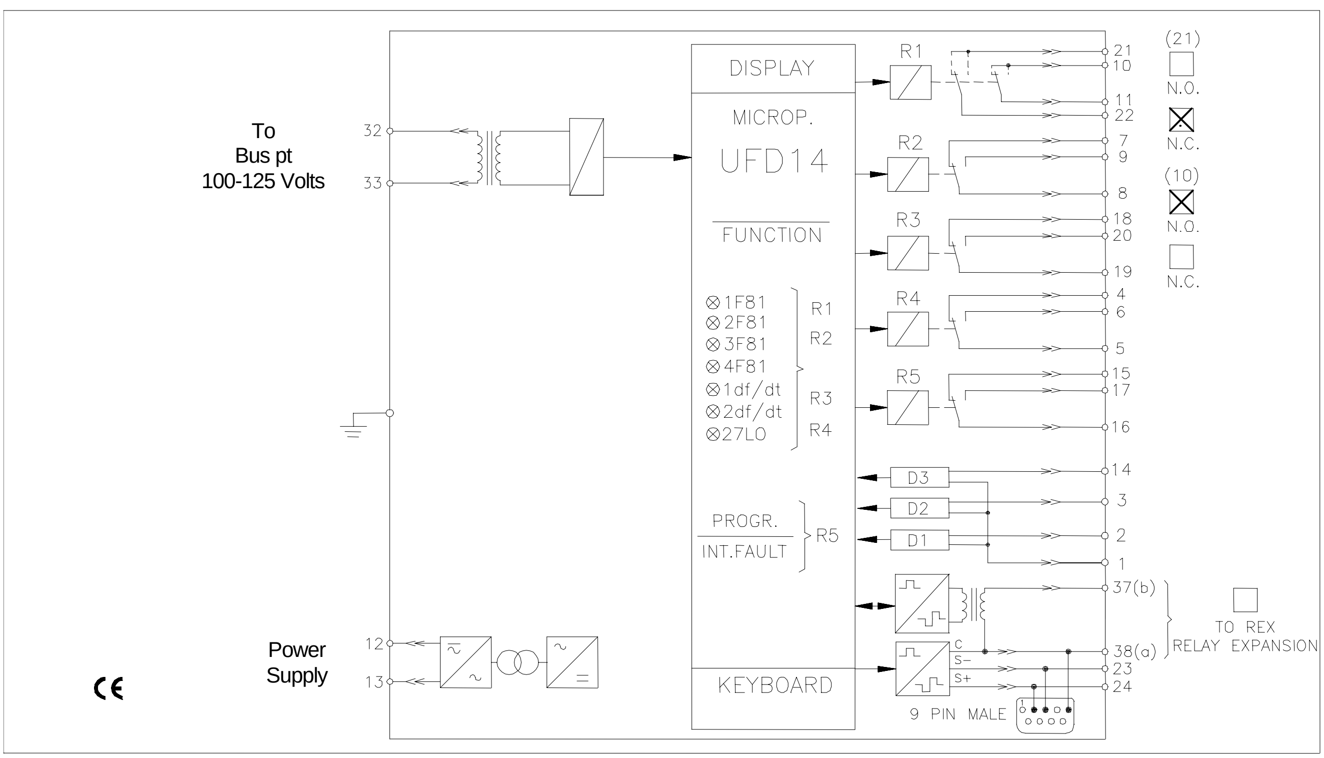


Figure 4.2: UFD14 Wiring Diagram

5. OUTPUT RELAYS

Output relays 1 through 4 are user programmable to operate in conjunction with the tripping of any protective element or elements. Relay 1 consists of two isolated SPST terminals, which may be selected as being either normally open or normally closed. The other three output relays, 2-4, are have form C (i.e., SPDT) contact arrangements.

Output relay 5 is normally energized (shown de-energized) and operates only upon power supply failure or on an internal relay fault.

5.1 REX-8 EXPANSION MODULES

The number of output contacts can be increased by adding one or two optional REX-8 expansion modules. The REX-8 modules are controlled by the UFD14X relay. The modules are connected to the UFD14 relay via the dedicated RS485 communication port on the relay.

UFD14X controls eight output contacts (A through H) on the first REX-8 module and four output contacts (I through L) on the second REX-8 module. The four remaining output contacts on the second REX-8 module can be grouped with any of the output contacts I, J, K, or L on that module. Figure 5.1 shows the connection between the UFD14 relay and two REX-8 modules.

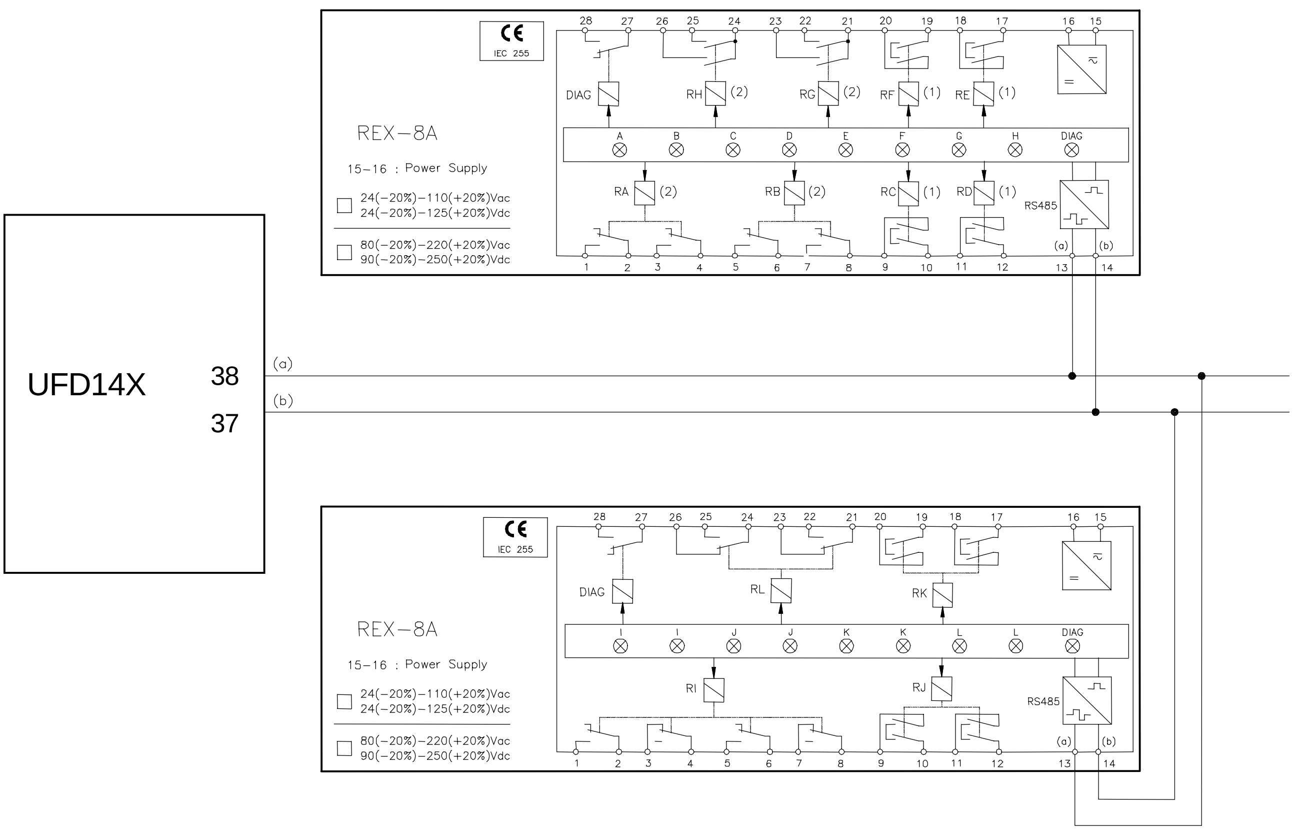


Figure 5.1: Optional REX-8 Expansion Modules

6. BLOCKING INPUTS

The UFD14 has three digital inputs. Inputs D1 and D2 are used to block the internal elements. Input D3 is used to reset the targets for remote operation. Refer to section 9.5 for a more detailed explanation on the digital inputs.

The open circuit voltage across the terminals of these inputs is 15 VDC. The internal resistance is 2.2 kΩ. When the external resistance across these terminals is less than 2.0kΩ, they are considered to be shorted. See Programming the Relay for more information on the function of these inputs.

7. TARGET DESCRIPTION

The front panel of the UFD14 contains eight LEDs, which act as the targets for the relay elements. See Figure 7.1 for identification of the targets. The top row of four targets corresponds to the four frequency elements. As soon as the measured frequency level exceeds the trip level defined by the programming variables 1f, 2f, 3f, and 4f, the appropriate LED begins to flash. Once the timer associated with the frequency element has expired (1t, 2t, 3t, and 4t), the relay will have tripped and the LED goes to a constant ON state. Table 7.1 summarizes the target functions.

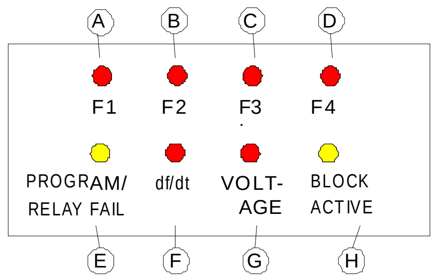


Figure 7.1: UFD14 Front Panel Targets

Table 7.1: Target Description

TARGET ID	COLOR	LEGEND	DESCRIPTION
A	Red	F1	Flashing when measured frequency exceeds the first frequency setpoint, 1f. Steady ON when the timer associated with this element expires.
B	Red	F2	Same as above related to the second frequency element, 2f.
C	Red	F3	Same as above related to the third frequency element, 3f.
D	Red	F4	Same as above related to the fourth frequency element, 4f.
E	Yellow	PROGRAM/ RELAY FAIL	Flashes when the relay is in programming mode. Constantly illuminated in case of an Internal Relay Fault.
F	Red	df/dt	Flashes when any one of the df/dt elements pickup. Steady ON when any one of the four frequency elements trip in conjunction with the df/dt element.
G	Red	VOLTAGE	Flashing when the sensing voltage drops below the undervoltage inhibit setting, U<.
H	Yellow	BLOCK ACTIVE	Flashing when any one of the blocking inputs is asserted.

Reset of the LEDs takes place as follows:

- From flashing to off, automatically when the cause disappears.
- From ON to OFF, by "ENTER/RESET" push button only if the associated element is not picked up.
- From ON to OFF, by assertion of the digital input, D3.

In case of an auxiliary power supply failure the status of the targets is recorded to non-volatile memory. The status of the targets is maintained when auxiliary power is restored.

8. KEYBOARD OPERATION

All measurements, programmed settings, and recorded data may be accessed through the front panel. The five buttons are color coded and their sequence of operation is indicated on the front panel by means of arrows directing the user to the next appropriate button to press. Figure 8.1and Figure 8.2 give an overview of the keyboard operation.

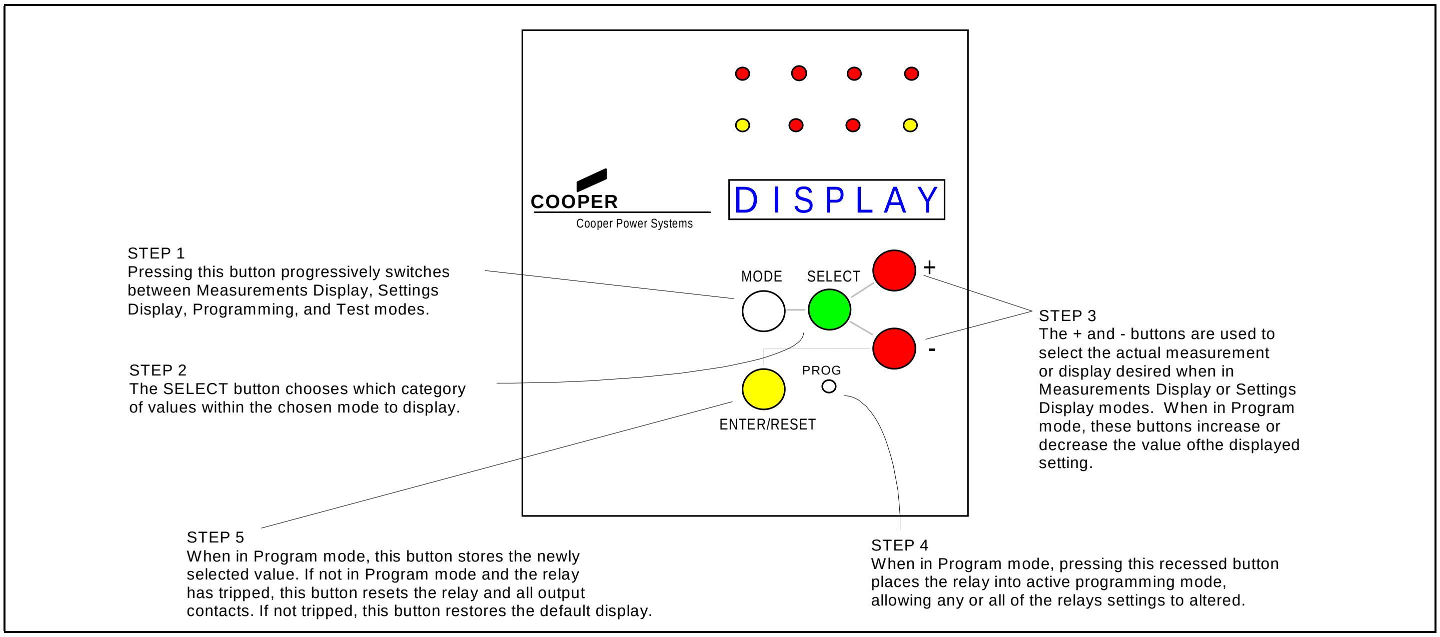


Figure 8.1: Keyboard Operation Overview

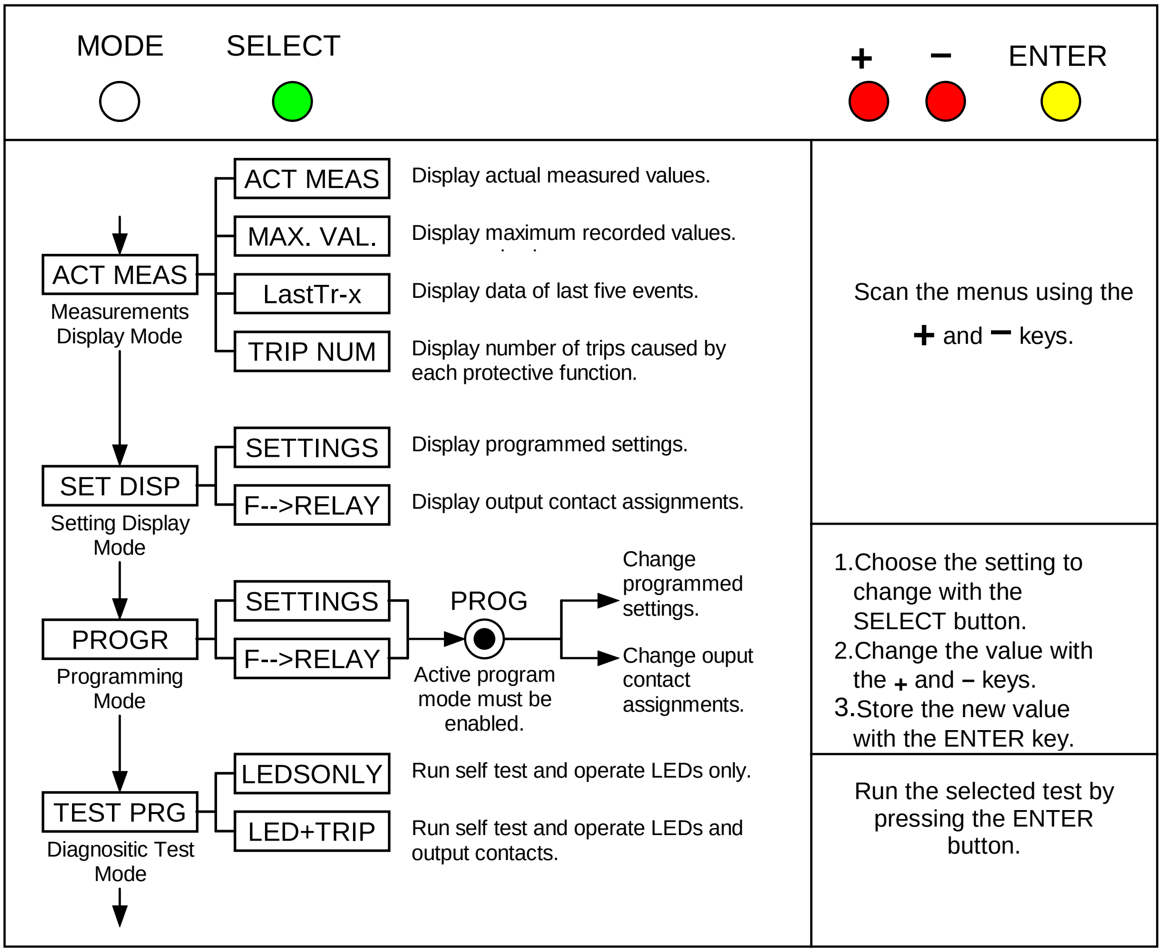


Figure 8.2: Keyboard Menu Structure

9. PROGRAMMING THE RELAY

Two programming modes are available. The first is the SETTINGS mode, where all of the input parameters (e.g., pt ratio, rated frequency) and settings (e.g., frequency setpoints and time delays) are set. The second is the F➔Relay mode where the various output relays are assigned to the various protective elements. To enter the **PROGRAM** mode, follow these steps:

1. Make sure the input sensing voltage is zero. As a security measure, the relay will not go into program mode when sensing voltage is present. This prevents the settings from being altered while the relay is actively protecting the system.
2. Press the **MODE** button, to get into the **PROGRAM** mode.
3. Press the **SELECT** button to obtain either the **SETTINGS** or **F➔Relay** display.
4. Using a thin tool (e.g., a small screwdriver) press the recessed **PROG** button. The **PROGRAM** LED will now be flashing, indicating that **PROGRAM** mode has been successfully entered.

9.1 CHANGING A SETTING

Once in active PROGRAM SETTINGS mode, relay settings may be changed. For instruction on changing the output relay assignments see the section titled Changing Output Relay Assignments. Change the settings as follows:

1. Press the SELECT button to scroll through the various input parameters available for programming.
2. When the desired parameter to be changed is displayed, press the + and – buttons to change the displayed value. For numerical values where the range of settings is large, the display may be sped up by pressing the SELECT button at the same time the + or – is pressed.
3. When the desired value in displayed, press the ENTER/RESET button to store the new setting for that parameter.
4. Repeat steps 1 - 3 for each setting.

When finished, press the MODE button to leave programming mode and return the relay to normal operation.

9.2 DESCRIPTION OF RELAY SETTING VARIABLES

Table 9.1 describes each variable in the PROGRAM SETTINGS mode. The following conventions are used:

The name of the variable and any unit of measure displayed (Volts, Hz, etc.) is in bold face type. The default value is shown in regular typeface.

For example:

UnP 10**KV**

UnP is the name of the variable.

10 is the setting default.

KV is the unit of measure.

Table 9.1: Program Setting Variables

DISPLAY	DESCRIPTION	SETTING RANGE
Fn 60**Hz**	System frequency	50 or 60 Hz
UnP 10**KV**	Rated primary voltage of the pts.	0.1 to 655 kV in 0.01 steps for 0.1 to 1.0 0.1 steps for 1.1 to 9.9 1.0 steps for 10 to 655
UnS 100**V**	Rated secondary voltage of the pts.	100 to 125 volts in 1V steps
NCy 3	Number of cycles to be used for measuring frequency and df/dt	3 to 10 cycles in 1 cycle steps
Fn - 1f	Operation mode of the 1st frequency element: + Overfrequency - Underfrequency -/+ Under/overfrequency Dis Function is disabled	+ - -/+ Dis
1f .50 **Hz**	Pickup level of the 1st frequency element	0.05 to 9.99 Hz in 0.01 Hz steps
1t 2.00 **s**	Time delay of the 1st frequency element, 1f	0.05 to 99.99 seconds in 0.01 second steps
1&f' OFF	Operation of the 1st frequency element with df/dt:	OFF 1f'

DISPLAY	DESCRIPTION	SETTING RANGE
	OFF: No df/dt operation 1f': 1st df/dt element 2f': 2nd df/dt element	2f'
1& 1.00 **s**	Time delay of the 1st frequency element with df/dt	0.05 to 99.9 seconds in 0.01 second steps
Fn - 2f	Operation mode of the 2nd frequency element: + Overfrequency - Underfrequency -/+ Under/overfrequency Dis Function is disabled	+ - -/+ Dis
2f 1.00 **Hz**	Pickup level of the 2nd frequency element	0.05 to 9.99 Hz in 0.01 Hz steps
2t 1.50 **s**	Time delay of the 2nd frequency element, 2f	0.05 to 99.99 seconds in 0.01 second steps
2&f' OFF	Operation of the 2nd frequency element with df/dt: OFF: No df/dt operation 1f': 1st df/dt element 2f': 2nd df/dt element	OFF 1f' 2f'
2& 2.00 **s**	Time delay of the 2nd frequency element with df/dt	0.05 to 99.9 seconds in 0.01 second steps
Fn - 3f	Operation mode of the 3rd frequency element: + Overfrequency - Underfrequency -/+ Under/overfrequency Dis Function is disabled	+ - -/+ Dis
3f 1.50 **Hz**	Pickup level of the 3rd frequency element	0.05 to 9.99 Hz in 0.01 Hz steps
3t 1.00 **s**	Time delay of the 3rd frequency element, 3f	0.05 to 99.99 seconds in 0.01 second steps
3&f' 1f'	Operation of the 3rd frequency element with df/dt: OFF: No df/dt operation 1f': 1st df/dt element 2f': 2nd df/dt element	OFF 1f' 2f'
3& .75 **s**	Time delay of the 3rd frequency element with df/dt	0.05 to 99.9 seconds in 0.01 second steps
Fn - 4f	Operation mode of the 4th frequency element: + Overfrequency - Underfrequency -/+ Under/overfrequency Dis Function is disabled	+ - -/+ Dis
4f 1.50 **Hz**	Pickup level of the 4th frequency element	0.05 to 9.99 Hz in 0.01 Hz steps
4t .75 **s**	Time delay of the 4th frequency element, 4f	0.05 to 99.99 seconds in 0.01 second steps
4&f' 2f'	Operation of the 4th frequency element with df/dt:	OFF 1f'

DISPLAY	DESCRIPTION	SETTING RANGE
	OFF: No df/dt operation 1f': 1st df/dt element 2f': 2nd df/dt element	2f'
4& .50 **s**	Time delay of the 4th frequency element with df/dt	0.05 to 99.9 seconds in 0.01 second steps
1df -/+	Operation mode of the 1st df/dt element: + df/dt>0 rate of rise – df/dt<0 rate of decline -/+ $\left\|df/dt\right\|>0$ rate of change	+ - -/+
1f .2**Hz/s**	Pickup level of the 1st df/dt element	0.1 to 9.9 in 0.1 Hz/s steps
2df -/+	Operation mode of the 2nd df/dt element: + df/dt>0 rate of rise – df/dt<0 rate of decline -/+ $\left\|df/dt\right\|>0$ rate of change	+ - -/+
2f .5**Hz/s**	Pickup level of the 2nd df/dt element	0.1 to 9.9 in 0.1 Hz/s steps
U< 30%**Un**	Pickup level of the undervoltage element	30 to 90% of the nominal voltage in 1% steps
NodAd 1	Modbus device address	1 to 250 in steps of 1

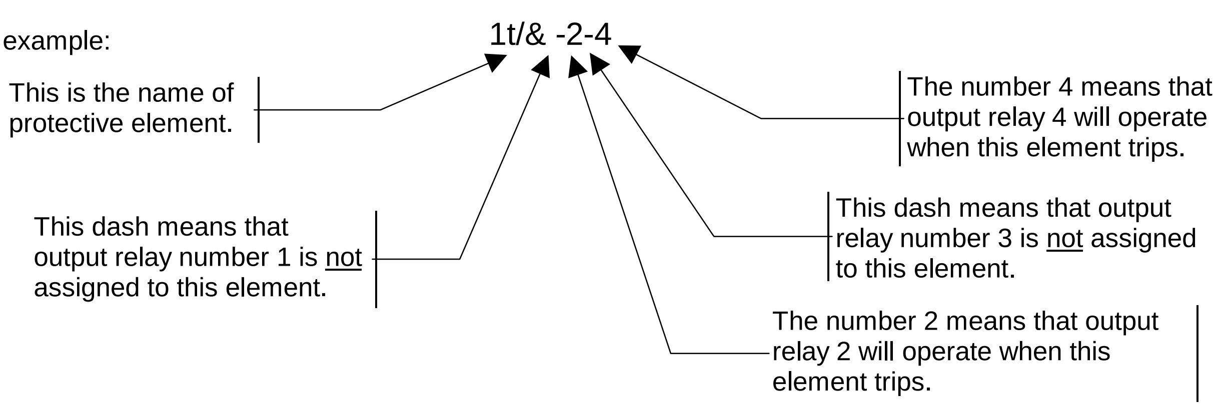
9.3 CHANGING OUTPUT RELAY ASSIGNMENTS

Output relays 1 through 4 may be assigned to any protective element, or any combination of elements. The only exception is that the relay cannot be assigned to both pick-up (start-time) elements, and time dependent protective elements.

1. First, enter the F➔Relay program mode.
2. Press the SELECT button to display the protective element for which the relay's assignments are to be made or changed.
3. Press the + key to select the output relay. Each press of the + key selects the next output relay. Once selected, the relay position blinks.
4. Press the - key to toggle whether the element is assigned to the output relay or not. If assigned, the output relay number appears. If not, only a hyphen (-) will be displayed.
5. Press the ENTER/RESET button to store the changes.
6. Repeat steps 1 through 5 for each protective element.

When finished, press the MODE button to leave programming mode and return the relay to normal operation.

For example:



9.4 DESCRIPTION OF OUTPUT RELAY VARIABLES

This section describes each variable in the PROGRAM, F➔Relay mode. The following conventions are used:

- The name of the variable is in bold face type.
- The default output relay settings are shown in regular typeface.

Table 9.2: Output Relay Programming Variables

DISPLAY	DESCRIPTION
1f ----	Pickup element associated with the 1st frequency element.
1t/& 1---	Time delayed element associated with the 1st frequency element and df/dt control.
2f ----	Pickup element associated with the 2nd frequency element.
2t/& -2--	Time delayed element associated with the 2nd frequency element and df/dt control.
3f ----	Pickup element associated with the 3rd frequency element.
3t/& --3-	Time delayed element associated with the 3rd frequency element and df/dt control.
4f ----	Pickup element associated with the 4th frequency element.
4t/& ---4	Time delayed element associated with the 4th frequency element and df/dt control.
U< **----**	Undervoltage blocking element.
1f' **----**	Pickup element associated with the 1st df/dt element.
2f' **----**	Pickup element associated with the 2nd df/dt element.
1tr Aut.	Reset mode for output contact 1: Aut: Automatically after the trip condition is removed. Time delayed: 0.01-99.99 seconds (in steps of 0.01 seconds) after the trip condition is removed. Man: Manually via the front panel ENTER/RESET key.
2tr Aut.	Reset mode for output contact 2: Aut: Automatically after the trip condition is removed. Time delayed: 0.01-99.99 seconds (in steps of 0.01 seconds) after the trip condition is removed. Man: Manually via the front panel ENTER/RESET key.
3tr Aut.	Reset mode for output contact 3: Aut: Automatically after the trip condition is removed. Time delayed: 0.01-99.99 seconds (in steps of 0.01 seconds) after the trip condition is removed. Man: Manually via the front panel ENTER/RESET key.
4tr Aut.	Reset mode for output contact 4: Aut: Automatically after the trip condition is removed. Time delayed: 0.01-99.99 seconds (in steps of 0.01 seconds) after the trip condition is

DISPLAY	DESCRIPTION
	removed. Man: Manually via the front panel ENTER/RESET key.
Atr Aut.	Reset mode for output contact A (provided through the 1st optional REX-8 module): Aut: Automatically after the trip condition is removed. Time delayed: 0.01-99.99 seconds (in steps of 0.01 seconds) after the trip condition is removed. Man: Manually via the front panel ENTER/RESET key.
Btr Aut.	Reset mode for output contact B (provided through the 1st optional REX-8 module): Aut: Automatically after the trip condition is removed. Time delayed: 0.01-99.99 seconds (in steps of 0.01 seconds) after the trip condition is removed. Man: Manually via the front panel ENTER/RESET key.
Ctr Aut.	Reset mode for output contact C (provided through the 1st optional REX-8 module): Aut: Automatically after the trip condition is removed. Time delayed: 0.01-99.99 seconds (in steps of 0.01 seconds) after the trip condition is removed. Man: Manually via the front panel ENTER/RESET key.
Dtr Aut.	Reset mode for output contact D (provided through the 1st optional REX-8 module): Aut: Automatically after the trip condition is removed. Time delayed: 0.01-99.99 seconds (in steps of 0.01 seconds) after the trip condition is removed. Man: Manually via the front panel ENTER/RESET key.
Etr Aut.	Reset mode for output contact E (provided through the 1st optional REX-8 module): Aut: Automatically after the trip condition is removed. Time delayed: 0.01-99.99 seconds (in steps of 0.01 seconds) after the trip condition is removed. Man: Manually via the front panel ENTER/RESET key.
Ftr Aut.	Reset mode for output contact F (provided through the 1st optional REX-8 module): Aut: Automatically after the trip condition is removed. Time delayed: 0.01-99.99 seconds (in steps of 0.01 seconds) after the trip condition is removed. Man: Manually via the front panel ENTER/RESET key.
Gtr Aut.	Reset mode for output contact G (provided through the 1st optional REX-8 module): Aut: Automatically after the trip condition is removed. Time delayed: 0.01-99.99 seconds (in steps of 0.01 seconds) after the trip condition is removed. Man: Manually via the front panel ENTER/RESET key.
Htr Aut.	Reset mode for output contact H (provided through the 1st optional REX-8 module): Aut: Automatically after the trip condition is removed. Time delayed: 0.01-99.99 seconds (in steps of 0.01 seconds) after the trip condition is removed. Man: Manually via the front panel ENTER/RESET key.
Itr Aut.	Reset mode for output contact I (provided through the 2nd optional REX-8 module): Aut: Automatically after the trip condition is removed.

DISPLAY	DESCRIPTION
	Time delayed: 0.01-99.99 seconds (in steps of 0.01 seconds) after the trip condition is removed. Man: Manually via the front panel ENTER/RESET key.
Jtr Aut.	Reset mode for output contact J (provided through the 2nd optional REX-8 module): Aut: Automatically after the trip condition is removed. Time delayed: 0.01-99.99 seconds (in steps of 0.01 seconds) after the trip condition is removed. Man: Manually via the front panel ENTER/RESET key.
Ktr Aut.	Reset mode for output contact K (provided through the 2nd optional REX-8 module): Aut: Automatically after the trip condition is removed. Time delayed: 0.01-99.99 seconds (in steps of 0.01 seconds) after the trip condition is removed. Man: Manually via the front panel ENTER/RESET key.
Ltr Aut.	Reset mode for output contact L (provided through the 2nd optional REX-8 module): Aut: Automatically after the trip condition is removed. Time delayed: 0.01-99.99 seconds (in steps of 0.01 seconds) after the trip condition is removed. Man: Manually via the front panel ENTER/RESET key.
D1f ----	Assertion of blocking input D1 blocks the pickup of the selected frequency elements 1f, 2f, 3f, and 4f.
D1f' ----	Assertion of blocking input D1 blocks the pickup of the selected df/dt elements 1f', 2f'.
D2t ----	Assertion of blocking input D2 blocks the operation of the selected time delayed elements 1t&, 2t&, 3t&, and 4t&.

9.5 DIGITAL INPUTS

Three digital inputs are provided with the UFD14 relay. Their function is described in Table 9.3.

Table 9.3: UFD14 Blocking Inputs

DIGITAL INPUT	DESCRIPTION
D1	Assertion of digital input D1 (terminals 1-2) blocks all the frequency and df/dt pickup elements (1f, 2f, 3f, 4f, 1f', and 2f') selected under D1f and D1f' setting parameters. For example: If D1f is set to **-2f--,** and D1f' is set to**1f'**, assertion of blocking input D1 will block the 2nd frequency element (2f) and the first df/dt element (1f') from operating.
D2	Assertion of digital input D2 (terminals 1-3) blocks all the time delayed frequency elements 1t&, 2t&, 3t&, and 4t&.
D3	Assertion of digital input D3 (terminals 1-14) will reset the front panel LED targets. This is used for remote resetting of the targets through the RTU.

10. READING OF MEASUREMENTS AND RECORDED PARAMETERS

Enter the MODE "MEASURE", SELECT the menus "ACT.MEAS"-"MAX VAL"-"LASTTRIP"--"TRIP NUM", scroll available information by key "+" or "-".

10.1 ACT.MEAS

Actual values as measured during the normal operation. The values displayed are continuously refreshed.

Table 10.1: Actual Measurement Display

DISPLAY	DESCRIPTION
FxxxxxHz	Measured system frequency
Uxxx**V,kV**	Measured primary system voltage

10.2 LASTTRIP

Display of the function that caused the tripping of the relay plus values of the parameters at the moment of tripping. The memory buffer is refreshed at each new relay tripping. Each of the previous five event records are stored into the FIFO memory.

Table 10.2: Last Trip Display

DISPLAY	DESCRIPTION
LastTr-x	Indication of the recorded event (x= 0 to 4) Example: Last event (LastTr –0) The one before last event (LastTr-1) etc…
Cau:xxxxx	Display of the time delayed function which caused the last tripping: --1t = 1st frequency element only -1t& = 1st frequency element with df/dt control --2t = 2nd frequency element only -2t& = 2nd frequency element with df/dt control --3t = 3rd frequency element only -3t& = 3rd frequency with df/dt control --4t = 4th frequency element only -4t& = 4th frequency element with df/dt control
Fxxxx**Hz**	Frequency measured at time of trip

Uxxx**%Un**	Voltage measured at time of trip
F' xxx	Frequency rate of change at time of trip

10.3 TRIP NUM

Counters of the number of operations for each of the relay functions.

Table 10.3: Trip Number Display

DISPLAY	DESCRIPTION
1t xxxxx	1st frequency delayed element only
1t& xxxxx	1st frequency & df/dt delayed element
2t xxxxx	2nd frequency delayed element only
2t& xxxxx	2nd frequency & df/dt delayed element
3t xxxxx	3rd frequency delayed element only
3t& xxxxx	3rd frequency & df/dt delayed element
4t xxxxx	4th frequency delayed element only
4t& xxxxx	4th frequency & df/dt delayed element

10.4 RESETTING STORED PARAMETERS

Resetting of stored parameters such as Events and Trip Number data is accomplished by the following procedure:

1. Use to mode button for the display to show “Settings” (Program-Settings).
2. Press the recessed button (to enter program mode). At the same time, press the two red buttons (+ and -) and the green button (select).
3. After the message “Clear?” is displayed, press the Enter/Reset button to clear the data.

11. FREQUENCY OPERATION

UFD14 has four frequency and two df/dt elements. Each frequency element has its own timer and it can be programmed for either overfrequency, underfrequency, or both.

Each frequency element can also be individually controlled with either one of the df/dt elements. A separate timer (1&, 2&, 3&, and 4&) is provided for each frequency element with df/dt control.

The output of the frequency timer (1t) and the frequency with df/dt control timer (1&) produce the output variable 1t/&. This variable is used for mapping the time delayed frequency elements (with and without df/dt control) to the output contacts. Figure 11.1 shows the frequency and df/dt operation for the UFD14 relay where the third and fourth frequency elements are setup with df/dt control.

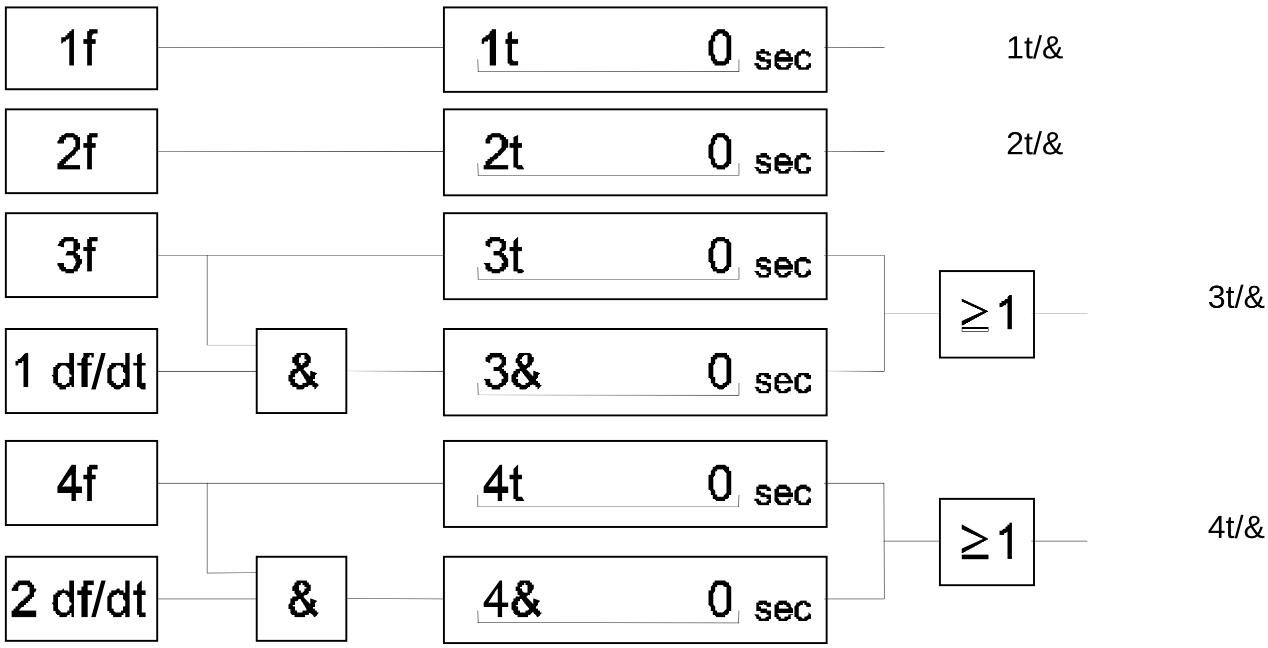


Figure 11.1: UFD14 Frequency and df/dt Operation

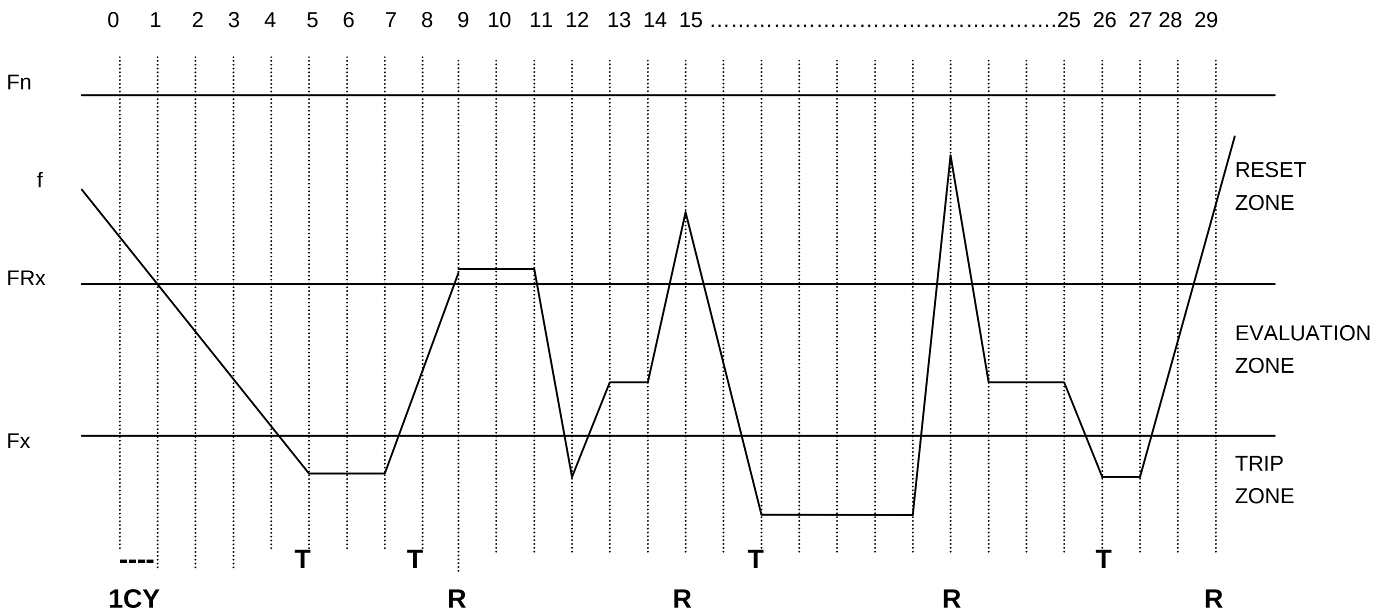
11.1 FREQUENCY MEASUREMENT

The measured frequency for each cycle is stored in a FIFO (First in-First out) memory location. The number of stored values in the FIFO memory equals the “NCy” (number of cycles) setting for the relay. The “NCy” setting range is 3 to 10 cycles in steps of 1.

A frequency trip condition is declared if among the “NCy” frequency measurements at least ‘NCY-1’ are either in the evaluation zone or the trip zone, and at least one value among the “NCy” measurements is in the trip zone.

The frequency element is reset when one or more of the measured frequency values enter the reset zone.

Example of Underfrequency Operation – NCy = 3



Fx = Underfrequency trip level

FRx = Reset level = Fx – 0.02 Hz

Fn = Rated frequency

0 = No trip

T = Trip

R = Reset

$(f_0, f_1, f_2) = 0$

$(f_1, f_2, f_3) = 0$

$(f_2, f_3, f_4) = 0$

$(f_3, f_4, f_5) = T$

$(f_4, f_5, f_6) = T$.

$(f_5, f_6, f_7) = T$.

$(f_6, f_7, f_8) = T$

.

$(f_7, f_8, f_9) = R$

$(f_{27}, f_{28}, f_{29}) = R$

11.2 OPERATING TIME

Operating time for the frequency elements is dependent on the 'NCy" setting. Operating time for when the relay has been in service for Ncy cycles is defined as (NCy – 1) cycles, plus 10 ms for output contact operating time.

When the relay is switched-on, operating time is defined as:

$$t = \left[\frac{NCy}{f} + 0.01\right] \text{seconds}$$

Where:	NCy	is the number of cycles setting
	f	is the system frequency

11.3 UNDERVOLTAGE INHIBIT

An undervoltage element supervises and blocks all the frequency elements. The operating range for the undervoltage element is 30 to 90% of the nominal input voltage. The undervoltage element can also be directed to an output contact for alarming.

11.4 RATE OF FREQUENCY CHANGE ELEMENTS

There are two df/dt elements (1f' and 2f') available in the UFD14 relay. Each df/dt element can be programmed as a rate of rise, rate of decline, or a rate of change element:

Rate of rise: $\frac{df}{dt} > 0$

Rate of decline: $\frac{df}{dt} < 0$

Rate of change: $\left|\frac{df}{dt}\right| > 0$

The df/dt elements can be used to control the frequency elements or be directed to any of the output contacts.

11.5 FREQUENCY OPERATION WITH df/dt CONTROL

Each frequency element can be individually programmed to operate in conjunction with either one of the df/dt elements, 1f' or 2f'. A separate timer is provided for the frequency operation with df/dt control.

12. SERIAL COMMUNICATION

UFD14 is equipped with a RS485 communication ports. All the operations that can be performed locally (for example reading of measured data and changing of relay's settings) are also possible via the serial communication interface. The RS485 interface port is used to connect either directly to a P.C. via a dedicated cable or to a RS485 network. Therefore, many relays can exchange data with a single master P.C. using the same physical serial bus. An optional RS485/232 converter is available.

The communication protocol is MODBUS RTU, but only functions 3, 4 and 6 are implemented. Each relay is identified by its programmable address code (NodAd) and can be called from the P.C. Dedicated communication software EdisonCom for Windows 3.11 and Windows 95 is available. Please refer to the EdisonCom instruction manual for more information. A separate Modbus communication reference manual is available. Request reference bulletin R150-05-3.

UFD14X is equipped with a second RS485 port that is used to connect to the optional REX-8 modules. This allows the user the expand the output contact capability of the UFD14 from 4 to 16.

13. RUNNING THE TEST PROGRAMS

If desired, the start up diagnostic routines may be run at any time by accessing the TEST PRG mode. Two tests may be run, both of which are identical except for the effect on the output relays.

1. Press the Mode button until **TEST PRG** is displayed.
2. Select the test to run by pressing the **SELECT** button once to show **LEDSONLY**, or twice to display **LED+TRIP**.
   A. If the **LEDSONLY** test is selected, pressing the **ENTER/RESET** button will run the test. All the LEDs should illuminate during the duration of the test. If any error is found, an error code will be displayed and the **RELAY FAIL** light will remain illuminated. The test lasts approximately five seconds. No output relays will be operated or will change status.
   B. If the **LED+TRIP** test is selected, pressing the **ENTER/RESET** button will then display **TestRun?.** To run the test the **ENTER/RESET** button must be pressed again. At this point the test will run and all of the output relays will also be operated. The test lasts approximately five seconds.

CAUTION

Running the **LED+TRIP** test will operate all of the output relays. Care must be taken to ensure that no unexpected or harmful equipment operations will occur as a result of running this test. It is generally recommended that this test be run only when all dangerous output connections are removed.

14. ELECTRICAL SPECIFICATIONS

- Reference standards	IEC 255, IEC1000; IEEE C37; CE Directive	
- Dielectric test voltage	IEC 255-5	: 2kV, 1 min.
- Impulse test voltage	IEC 255-5	: 5kV (c.m.), 2 kV (d.m.) -
1,2/50µs		
- HF disturbance test with damped oscillatory wave (1MHz burst test)	IEC255-22-1 class 3	: 2,5kV (m.c.), 1kV (d.m.)
- Electrostatic discharge test	IEC1000-4-2 level 4	: 15 kV
- Conducted disturbances immunity test	IEC1000-4-6 level 3	: 0.15-80MHz, 10V/m
- Radiated electromagnetic field immunity test	IEC1000-4-3 level 3	: 80-1000MHz, 10V/m
- Electrical fast transient/burst	IEC1000-4-4 level 4	: 4kV, 2.5kHz, 15/300ms (c.m.) 2kV, 5kHz, 15/300ms (d.m.)
- Surge immunity test	IEC1000-4-5 level 4	: 4kV(c.m.), 2kV(d.m.)
- Oscillatory waves (Ring waves)	IEC1000-4-12 level 4	: 4kV(c.m.), 2kV(d.m.)
- Power frequency magnetic test	IEC1000-4-8	: 1000A/m
- Pulse magnetic field	IEC1000-4-9	: 1000A/m, 8/20 s
- Damped oscillatory magnetic field	IEC1000-4-10	: 1000A/m, 0.1-1MHz
- Immunity test for voltage dips, short interruptions and voltage variations	IEC1000-4-11	
- HF inducted voltage	IEC1000-4-1 A.2.6 level 4	: 100V, 0.01-1MHz

CE EMC Compatibility:

- Electromagnetic emission	EN50081-2
- Radiated electromagnetic disturbance test	EN50082-2
- Resistance to vibration and shocks	IEC255-21-1, IEC255-21-2
- Accuracy at reference value of influencing factors	1% In; 0,1% On for measure +/- 10ms for times
- Rated Voltage	Un = 100V (different on request)
- Voltage overload	2 Un continuous
- Burden on voltage input	0,2 VA at Un
- Average power supply consumption	10 VA
- Output relays	rating 5 A; Vn = 380 V A.C. resistive switching = 1100W (380V max) make = 30 A (peak) 0,5 sec. break = 0.3 A, 110 Vcc, L/R = 40 ms (100.000 op.)
- Operation ambient temperature	-20°C / +60°C
- Storage temperature	-30°C / +80°C

15. UFD14 SETTING SHEET

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Variable	Factory default	Units	Description	Range	Step	Setting
Fn	50	Hz	System frequency	50 or 60	---	
UnP	10	kV	Rated primary voltage of the pts.	0.1 to 655	0.01 (0.1-1.0) 0.1 (1.1-9.9) 1.0 (10-655)	
UnS 100**V**	100	Volts	Rated secondary voltage of the pts.	100 to 125	1	
NCy	3	Cycles	Number of cycles to be used for measuring frequency and df/dt	3 to 10	1	
Fn	-	1f	Operation mode of the 1st frequency element:	+ - -/+ Dis	---	
1f	0.50	Hz	Pickup level of the 1st frequency element	0.05 to 9.99	0.01	
1t	2	Seconds	Time delay of the 1st frequency element, 1f	0.05 to 99.99	0.01	
1&f'	OFF	---	Operation of the 1st frequency element with df/dt:	OFF 1f' 2f'	---	
1&	1	Seconds	Time delay of the 1st frequency element with df/dt	0.05 to 99.9	0.01	
Fn	-	2f	Operation mode of the 2nd frequency element:	+ - -/+ Dis	---	
2f	1	Hz	Pickup level of the 2nd frequency element	0.05 to 9.99	0.01	
2t	1.5	Seconds	Time delay of the 2nd frequency element, 2f	0.05 to 99.99	0.01	
2&f'	OFF	---	Operation of the 2nd frequency element with df/dt:	OFF 1f' 2f'	---	
2&	2	Seconds	Time delay of the 2nd frequency element with df/dt	0.05 to 99.9	0.01	
Fn	-	3f	Operation mode of the 3rd frequency element:	+ - -/+ Dis	---	

Variable	Factory default	Units	Description	Range	Step	Setting
3f	1.5	Hz	Pickup level of the 3rd frequency element	0.05 to 9.99	0.01	
3t	1	Seconds	Time delay of the 3rd frequency element, 3f	0.05 to 99.99	0.01	
3&f'	1f'	---	Operation of the 3rd frequency element with df/dt:	OFF 1f' 2f'	---	
3&	0.75	Seconds	Time delay of the 3rd frequency element with df/dt	0.05 to 99.9	0.01	
Fn - 4f	-	4f	Operation mode of the 4th frequency element:	+ - -/+ Dis	---	
4f	1.5	Hz	Pickup level of the 4th frequency element	0.05 to 9.99	0.01	
4t	0.75	Seconds	Time delay of the 4th frequency element, 4f	0.05 to 99.99	0.01	
4&f'	2f'		Operation of the 4th frequency element with df/dt:	OFF 1f' 2f'	---	
4&	0.5	Seconds	Time delay of the 4th frequency element with df/dt	0.05 to 99.9	0.01	
1df	-/+	---	Operation mode of the 1st df/dt element: + df/dt>0 rate of rise – df/dt<0 rate of decline -/+ $\lvert df/dt \rvert >0$ rate of change	+ - -/+	---	
1f'	0.2	Hz/s	Pickup level of the 1st df/dt element	0.1 to 9.9	0.1	
2df -/+			Operation mode of the 2nd df/dt element: + df/dt>0 rate of rise – df/dt<0 rate of decline -/+ $\lvert df/dt \rvert >0$ rate of change	+ - -/+		
2f'	0.2	Hz/s	Pickup level of the 2nd df/dt element	0.1 to 9.9	0.1	
U<	30	%Un	Pickup level of the undervoltage element	30 to 90%	1	
NodAd	1	---	Modbus device address	1 to 250	1	

UFD14 SETTING SHEET PAGE 3 OF 5

OUTPUT RELAY PROGRAMMING ASSIGNMENTS (ACCESSIBLE VIA THE F→Relay PROGRAM MODE.)					
Variable	**Factory default**	**Units**	**Description**	**Range**	**Setting**
1f	- - - -	Outputs	Pickup element associated with the 1st frequency element.	1 2 3 4 *	
1t/&	1 - - -	Outputs	Time delayed element associated with the 1st frequency element and df/dt control.	1 2 3 4 *	
2f	- - - -	Outputs	Pickup element associated with the 2nd frequency element.	1 2 3 4 *	
2t/&	- 2 - -	Outputs	Time delayed element associated with the 2nd frequency element and df/dt control.	1 2 3 4 *	
3f	- - - -	Outputs	Pickup element associated with the 3rd frequency element.	1 2 3 4 *	
3t/&	- - 3 -	Outputs	Time delayed element associated with the 3rd frequency element and df/dt control.	1 2 3 4 *	
4f	- - - -	Outputs	Pickup element associated with the 4th frequency element.	1 2 3 4 *	
4t/&	- - - 4	Outputs	Time delayed element associated with the 4th frequency element and df/dt control.	1 2 3 4 *	
U<	- - - -	Outputs	Undervoltage blocking element.	1 2 3 4 *	
1f'	- - - -	Outputs	Pickup element associated with the 1st df/dt element.	1 2 3 4 *	
2f'	- - - -	Outputs	Pickup element associated with the 2nd df/dt element.	1 2 3 4 *	
1tr	Aut.	---	Reset mode for output contact 1:	Aut. 0.01-99.99 Man.	
2tr	Aut.	---	Reset mode for output contact 2:	Aut. 0.01-99.99 Man.	
3tr	Aut.		Reset mode for output contact 3:	Aut. 0.01-99.99 Man.	
4tr	Aut.		Reset mode for output contact 4:	Aut. 0.01-99.99 Man.	
Atr	Aut.		Reset mode for output contact A (provided through the 1st optional REX-8 module):	Aut. 0.01-99.99 Man.	

OUTPUT RELAY PROGRAMMING ASSIGNMENTS (ACCESSIBLE VIA THE F➔Relay PROGRAM MODE.)					
Variable	**Factory default**	**Units**	**Description**	**Range**	**Setting**
Btr	Aut.		Reset mode for output contact B (provided through the 1st optional REX-8 module):	Aut. 0.01-99.99 Man.	
Ctr	Aut.		Reset mode for output contact C (provided through the 1st optional REX-8 module):	Aut. 0.01-99.99 Man.	
Dtr	Aut.		Reset mode for output contact D (provided through the 1st optional REX-8 module):	Aut. 0.01-99.99 Man.	
Etr	Aut.		Reset mode for output contact A (provided through the 1st optional REX-8 module):	Aut. 0.01-99.99 Man.	
Ftr	Aut.		Reset mode for output contact B (provided through the 1st optional REX-8 module):	Aut. 0.01-99.99 Man.	
Gtr	Aut.		Reset mode for output contact C (provided through the 1st optional REX-8 module):	Aut. 0.01-99.99 Man.	
Htr	Aut.		Reset mode for output contact D (provided through the 1st optional REX-8 module):	Aut. 0.01-99.99 Man.	
Itr	Aut.		Reset mode for output contact I (provided through the 2nd optional REX-8 module):	Aut. 0.01-99.99 Man.	
Jtr	Aut.		Reset mode for output contact J (provided through the 2nd optional REX-8 module):	Aut. 0.01-99.99 Man.	
Ktr	Aut.		Reset mode for output contact K (provided through the 2nd optional REX-8 module):	Aut. 0.01-99.99 Man.	
Ltr	Aut.		Reset mode for output contact L (provided through the 2nd optional REX-8 module):	Aut. 0.01-99.99 Man.	
D1f	- - - -		Assertion of blocking input D1 blocks the pickup of the selected frequency elements 1f, 2f, 3f, and 4f.	1f, 2f, 3f, 4f	
D1f’	- - - -		Assertion of blocking input D1 blocks the pickup of the selected frequency elements 1f, 2f, 3f, and 4f.		
D2t	- - - -		Assertion of blocking input D2 blocks the operation	1t&, 2t&,	

OUTPUT RELAY PROGRAMMING ASSIGNMENTS (ACCESSIBLE VIA THE F➔Relay PROGRAM MODE.)					
Variable	**Factory default**	**Units**	**Description**	**Range**	**Setting**
			of the selected time delayed elements 1t&, 2t&, 3t&, and 4t&.	3t&, 4t&	

* Optional REX-8 Modules: 1: Output contacts A through H
2: Output contacts I through L

Operations Manual

Electrical Apparatus

S150-21-1

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