UM30 Three-Phase Frequency and Universal Voltage Relay

The Operations Manual is designed to familiarize the reader with how to install, program, and set up the relay for operation. For more detailed information regarding the relay's theory of operation, application notes, internal schematics, service information, etc., please refer to the UM30 section of the Edison® Relay Technical Reference Manual, bulletin R150-00-1. Contact your local Cooper Power Systems representative for ordering information.

CONTENTS

INTRODUCTION

The UM30 relay provides all of the voltage and frequency-related functions necessary for the protection of a feeder or rotating equipment. Two digital inputs are available to provide selective blocking of various functions. Five output relays are provided, of which four are programmable. All settings, measurements, and programming of the relay are possible through its front panel controls, or by means of a computer connected to the relay's RS485 communications port. The functions provided by the UM30 are:

- Two frequency elements each configurable as either under (81U), over (81O), or under and over (81U and 81O) elements.
- Two overexcitation elements (24).
- Two voltage elements each configurable as either under (27), over (59), or under and over (27 and 59) elements.
- One positive sequence voltage element configurable as either an under (27pos), over (59pos), or under and over (27pos and 59pos).
- One negative sequence overvoltage element (59neg).
- Two zero sequence overvoltage elements (59zero), with indication of the faulted phase.

The UM30 offers two programmable inputs, which can serve to block the operation of the over and under protective elements.

Separate pickup functions are also provided for all elements which may be used to operate output relays to in order to implement various control, blocking, logic, or SCADA functions.

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 hand 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 in nature or is at the same electrical potential as your body.
- Relays should always be placed in storage in their protective cases. 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.

INSTALLATION

Edison 'M' Series relays are shipped either in single or double width cases, or in standard 19" 3RU rack mount enclosures capable of housing up to four 'M' Series relays. The double case mounting is similar to the single case, but requires a 235 x 142mm panel opening. The 19" rack mount case is a standard 3RU high 19" cabinet. See catalog section 150-00 for cabinet dimensions.

To remove the relay from its case, refer to Figure 1. 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.

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.

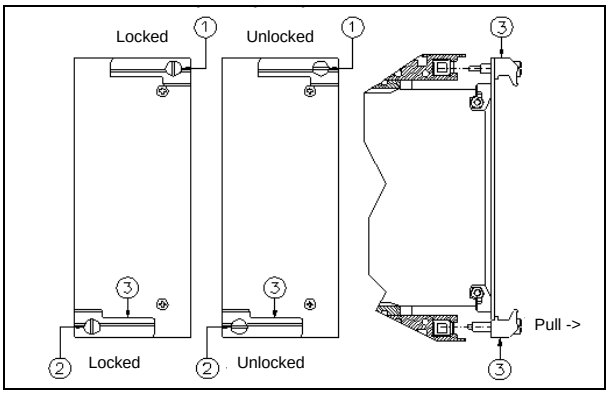


FIGURE 1: LATCH MECHANISM FOR REMOVAL OF RELAY FROM CASE

ELECTRICAL CONNECTIONS

Power is supplied via terminals 12 and 13, with common at terminal 44. Chassis ground is made via the external screw provided on the case. All Series 'M' relays are available with one of two autoranging power supplies. Descriptions of the input voltage ranges are given in Table 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 1: POWER SUPPLY INPUT RANGES

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 2. All the terminals will accept up to a No. 6 stud size spade connector (or any type of lug up to 0.25" 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 3. The numbers next to the circles along the edge of the functional block diagram of the relay indicate the terminal numbers corresponding to the terminal numbers on the back of the relay as shown in Figure 2. The VT inputs must provide the relay with phase-to-ground voltages per the phase rotation shown.

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 (R1) consists of two isolated SPST (one From A and one Form B) terminals as being either normally open or normally closed. The other three output relays, R2, R3, and R4, all 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.

BLOCKING INPUTS

The UM30 has two inputs, which perform blocking functions. The open circuit voltage across the terminals of these inputs is 15 VDC. The internal resistance is 2.2 k Ω. 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.

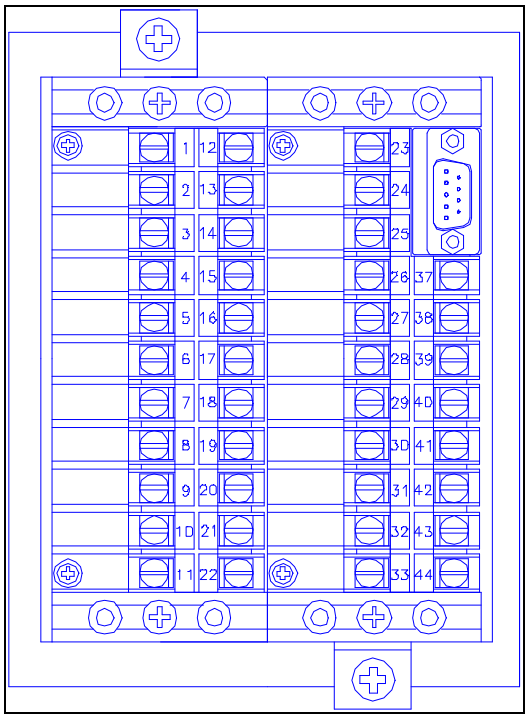


FIGURE 2: VIEW OF REAR TERMINAL CONNECTIONS

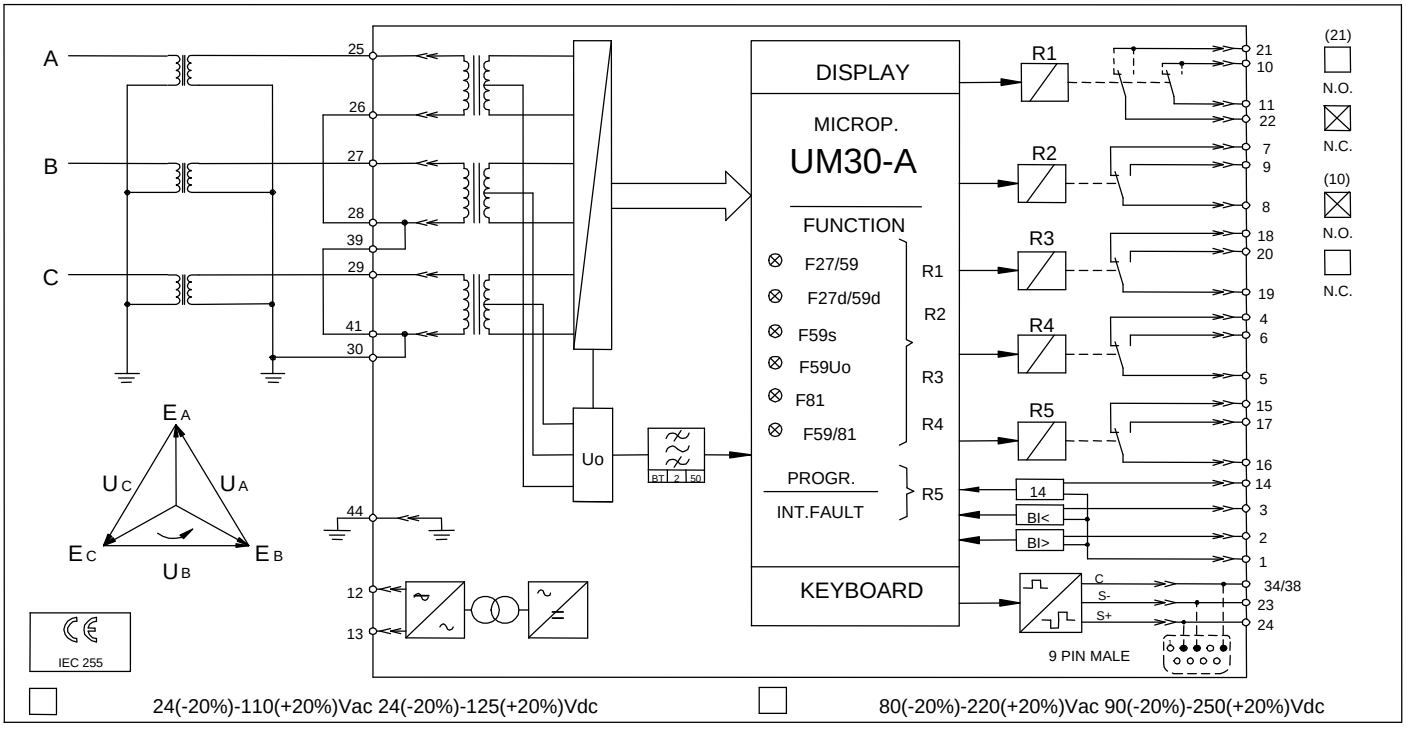


FIGURE 3 - UM30 WIRING DIAGRAM

TARGET DESCRIPTION

The front panel of the UM30 contains eight LEDs, which act as the targets for the relay elements. The top row of four targets correspond to frequency, voltage, positive sequence voltage, and negative sequence voltage respectively. As soon as the measured quantities exceed the trip level defined by the respective programming variable, the appropriate LED begins to flash. Once the time delay associated with that element has expired, the relay will have tripped and the LED goes to a constant ON state.

The two center RED LEDs on the bottom row correspond to the volts/Hz and the zero sequence voltage elements. The left most yellow LED will blink when the relay is in programming mode and will illuminate constantly when an internal relay failure has occurred. The right most yellow LED will flash when either of the two blocking inputs is active.

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.

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. Figures 4 and 5 give an overview of the keyboard operation.

PROGRAMMING THE RELAY

The relay may be programmed from the front panel or by external computer control. This section will describe the procedure for setting the relay from the front panel. Consult the program's User's Manual for instructions on programming the relay via software.

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

1. Press the **MODE** button, to get into **PROGRAM** mode.
2. Press the **SELECT** button to obtain either the **SETTINGS** or **F Relay** display.
3. Using a thin tool (e.g., a small screwdriver) press the recessed **PROG** button. The **PROGRAM** LED will now be flashing, indicating that the **PROGRAM** mode has been successfully entered.

CHANGING A SETTING

Once in active **PROGRAM SETTINGS** mode, you may now change the relay settings. For instructions on changing the output relay assignments see the section titled Changing Output Relay Assignments. Change the settings as follows:

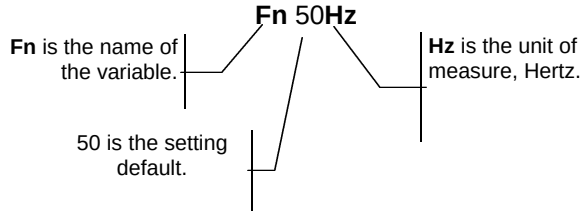
1. Press the **SELECT** button to scroll through the various input parameters available for programming.
2. When the desired parameter to be changed is displayed, press the **+** and **–** buttons to change the displayed value. For numerical values where the range of settings is large, the display may 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.
5. When finished, press the **MODE** button to leave programming mode and return the relay to normal operation.

DESCRIPTION OF RELAY SETTING VARIABLES

This section 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. Some variables do not have a unit of measures displayed. An example of these are variables that define curve shapes.
- The default value is shown in regular typeface.

For example:



A value of "Dis" in the Setting range column indicates that when the variable is set to this value, the related function is disabled.

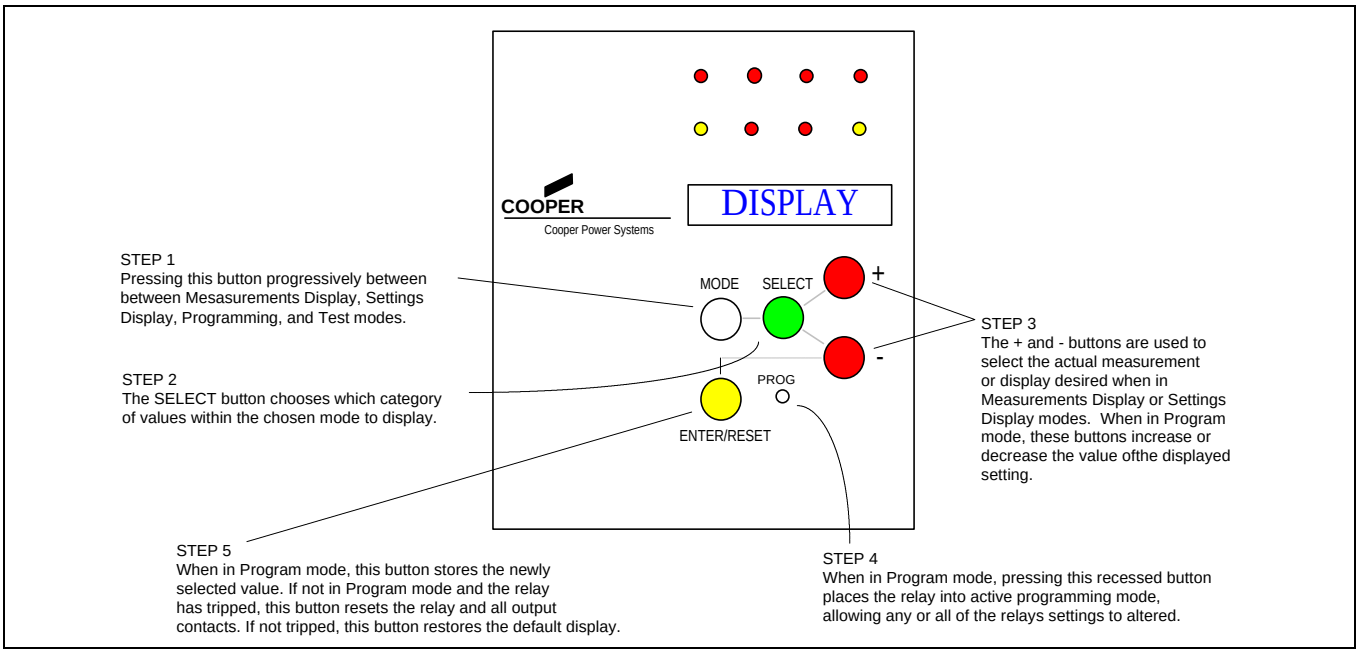


FIGURE 4 - KEYBOARD OPERATION

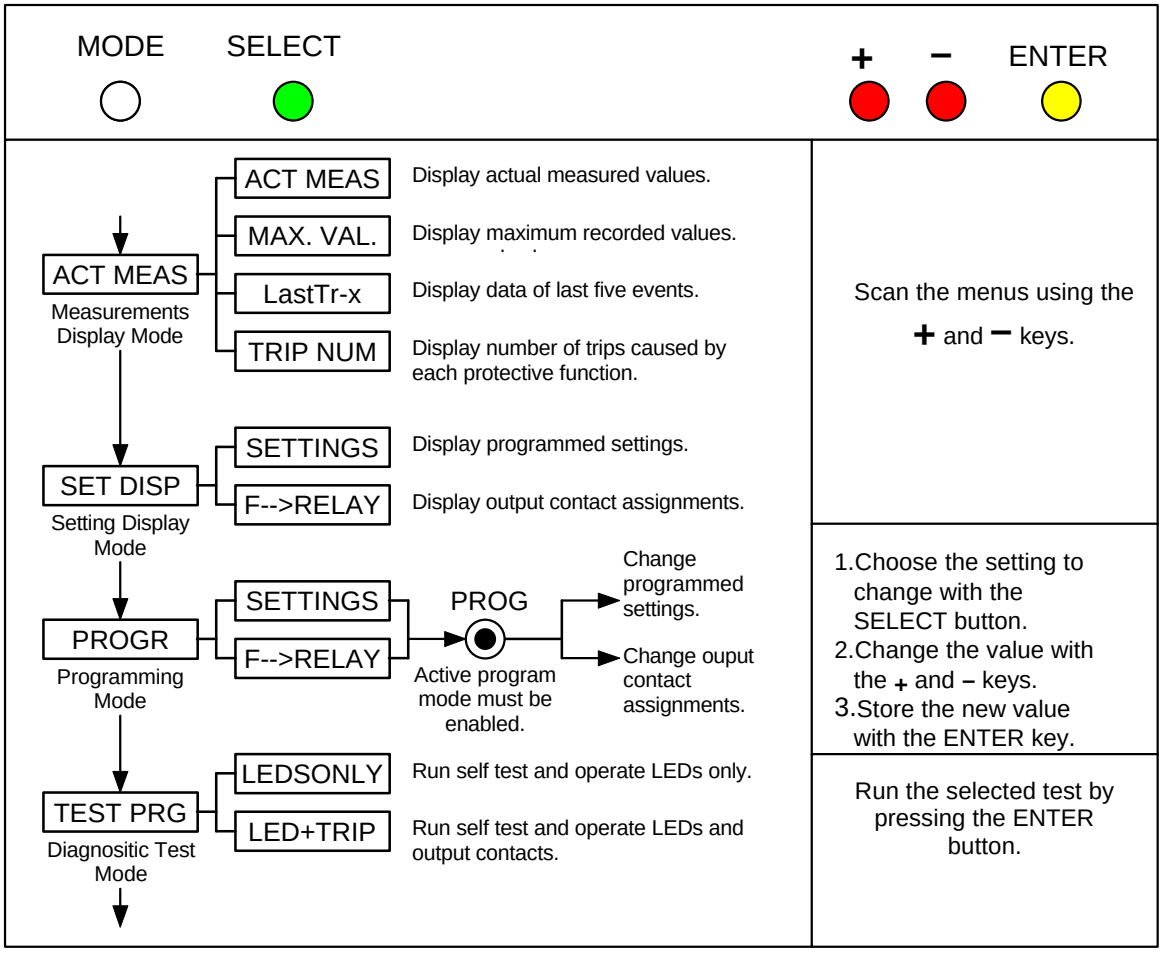


FIGURE 5- KEY BOARD OPERATION OVERVIEW

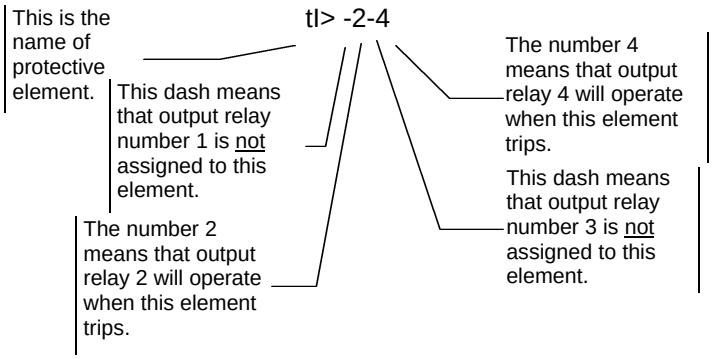
TABLE 2: PROGRAM SETTING VARIABLES

DISPLAY	DESCRIPTION	SETTING RANGE
Fn 50**Hz**	System frequency	50 or 60 Hz
UnP 10**kV**	Rated primary phase to phase voltage of the system VTs	0.10 to 655 kV. Step size varies: 0.10 to 1.00 kV in 0.01 kV steps 1.1 to 9.9 kV in 0.1 kV steps 10 to 655kV in 1kV steps
UnS 100**V**	Rated secondary voltage of the system VTs	100 to 125 V in 1V steps
1ϕ> 1.2**pU**	Trip level of the first V/Hz element	1.0 to 2.0 in 0.1 pu steps
K 5.0	Trip time delay coefficient of the first V/Hz element	0.5 to 5.0 in 0.1 steps
2ϕ> 1.2**pU**	Trip level of the second V/Hz element	1.0 to 2.0 in 0.1 pu steps
t2ϕ 5.0**s**	Trip time delay of the second V/Hz element	0.1 to 60 in 0.1 second steps
Fn -/+ f'	Operation mode of the first frequency control element	**+** over-frequency, **-** under-frequency, **-/+** under/over frequency, disable
f' 0.50 **Hz**	Trip differential level of the first frequency control element	0.05 to 9.9 in 0.01 Hz steps
tf' 1.0 **s**	Trip time delay of the first frequency control element	0.1 to 60.0 in 0.1 steps
Fn - f"	Operation mode of the second frequency control element	**+** over-frequency, **-** under-frequency, **-/+** under/over frequency, disable
f"1.00 **Hz**	Trip differential level of the second frequency control element	0.05 to 9.99 in 0.01 Hz steps
tf" 2.0 **s**	Trip time delay of second frequency control element	0.1 to 60 in 0.1 second steps
Un -/+ **u'**	Operation mode of the first voltage control element	**+** overvoltage, **-** undervoltage, **-/+** under/over voltage, disable
u' 10%**Un**	Trip differential level of the first voltage control element	5 to 90 in 1% Un steps
tu' 1.0 **s**	Trip time delay of the first voltage control element	0.1 to 60 in 0.1 second steps
Un -/+ **u"**	Operation mode of the second voltage control element	**+** overvoltage, **-** undervoltage, **-/+** under/over voltage, disable
u"20%**Un**	Trip differential level of the second voltage control element	5 to 90 in 1% Un steps
tu" 2.0 **s**	Trip time delay of the second voltage control element	0.1 to 60 in 0.1 second steps
Edn-/+Ed	Operation mode of the positive sequence voltage element	**+** overvoltage, **-** undervoltage, **-/+** under/over voltage, disable
Ed20%**En**	Trip differential level of the positive sequence voltage element	5 to 90 in 1% En steps or disable
tEd 5.0**s**	Trip time delay of the positive sequence voltage element	0.1 to 60 in 0.1 second steps
Es10%**En**	Trip level of the negative sequence voltage element	1 to 99 in 1% En steps or disable
tEs 5.0 **s**	Trip time delay of the negative sequence voltage element	0.1 to 60 in 0.1 second steps
U_0> 10**V"**	Trip level of the low-set zero sequence voltage element	1 to 99 in 1.0 volt steps
t_0> 0.5**s**	Trip time delay of the low-set zero sequence voltage element	0.05 to 9.9 in 0.05 second steps 10.0 to 60.0 in 0.1 second steps
U_0>>20**V"**	Trip level of the high-set zero sequence voltage element	1 to 99 in 1.0 volt steps
t_0>> 0.2**s**	Trip time delay of the high-set zero sequence voltage element	0.05 to 9.9 in 0.05 second steps
NodAd 1	Modbus communication address	1 to 250 in steps of 1

CHANGING OUTPUT RELAY ASSIGNMENTS

Output relays R1 through R4 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 (delayed) protective elements.

1. First, enter the **F Relay** program mode.
2. Press the SELECT button to display the protective element for which the relay 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 whose assignments you desire to change.
7. For example:



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 3 - OUTPUT RELAY PROGRAMMING DISPLAY DEFINITIONS

DISPLAY		DESCRIPTION
f'	---4	Pick-up (or start-time) element associated with the first frequency element
tf'	1---	Time delayed element associated with the first frequency element
f"	---4	Pick-up element associated with the second frequency element
tf"	-2--	Time delayed element associated with the second frequency
u'	---4	Pick-up element associated with the first voltage element
tu'	1---	Time delayed element associated with the first voltage element
u"	---4	Pick-up element associated with the second voltage element
tu"	-2--	Time delayed element associated with the second voltage element
U_0>	---4	Pick-up element associated with the low-set zero sequence voltage element
t_0>	1---	Time delayed element associated with the low-set zero sequence voltage element
U_0>>	---4	Pick-up element associated with the high-set zero sequence voltage element
t_0>>	--3-	Time delayed element associated with the high-set zero sequence voltage element
Ed	---4	Pick-up element associated with the positive sequence voltage element
tEd	--3-	Time delayed element associated with the positive sequence voltage element
Es	---4	Pick-up element associated with the negative sequence voltage element
tEs	--3-	Time delayed element associated with the negative sequence voltage element
1ϕ	---4	Pick-up element associated with the first V/Hz element
t1ϕ	--3-	Time delayed element associated with the first V/Hz element
2ϕ	---4	Pick-up element associated with the second V/Hz element
t2ϕ	--3-	Time delayed element associated with the second V/Hz element

TABLE 3 - OUTPUT RELAY PROGRAMMING DISPLAY DEFINITIONS -- CONTINUED

DISPLAY	DESCRIPTION
R1tr3.0**s**	Reset mode for all elements associated with output relay 1. Reset may be programmed to take in one of three manners: 1. Instantaneously upon the input or calculated quantities dropping below the pickup value. This is signified by **Aut** in the display. 2. Automatically, but with a time delay adjustable between 0.1 and 9.9 seconds in 0.1 second steps. (Default is this mode with a 3 sec delay). 3. Manual reset (by front panel or computer command) only. This is signified by **Man** in the display.
R2tr Aut	Same as for R1tr but for output relay 2 assigned functions.
R3tr Aut	Same as for R1tr but for output relay 3 assigned functions.
R4tr Aut	Same as for R1tr but for output relay 4 assigned functions.

BLOCKING VARIABLES

Two blocking inputs are provided. One input is dedicated toward blocking all "under level" functions, and one dedicated to blocking all "over level" functions as follows:

Blocking input **BI>**: shorting terminals 1 and 2 activates This blocking input. The operation of any output relay controlled by an "over level" function is inhibited for as long as the input terminal pair is shorted. This includes any over-frequency, over-voltage, positive sequence over-voltage, negative sequence over-voltage, zero sequence over-voltage, and over-volts/Hz elements.

Blocking input **BI<**: shorting terminals 1 and 3 activates This blocking input. The operation of any output relay controlled by an "under level" function is inhibited for as long as the input terminal pair is shorted. This includes any under-frequency, under-voltage, and positive sequence under-voltage.

While the blocking inputs are active (i.e., shorted), the tripping of any element associated with the blocking input(s) is prevented. Continued sensing of the input quantities and the countdown of any timers continues however, so that when the blocking is removed, any picked up elements will either trip instantaneously, or will trip after any remaining time delay.

PROGRAMMING VIA SOFTWARE

The UM30 may also be programmed using any of the programming interface software packages provided by Cooper Power Systems or others. Please consult the user manual for the appropriate software.

The UM30 uses the Modbus© communication protocol. For details on the memory map used in the UM30 in order to interface it with other Modbus programs or devices, consult the Edison 'M' Series Relay Technical Reference Manual.

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 an error is found, the error code will be displayed and the **RELAY FAIL** light will remain illuminated. The test lasts approximately five seconds. No output relays will operate or 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.

An external computer running the appropriate software may also initiate these test routines.

REAL TIME MEASUREMENTS

To display the real-time measured values of the relay's quantities, enter the ACT MEAS mode of operation as follows:

1. Press the **MODE** button, to get into **MEASURES** mode.
2. Press the **SELECT** button to select the ACT MEAS mode.

3. Press the + or – buttons to scroll through the available measurements. The data available is summarized in Table 4.

TABLE 4 - AVAILABLE METERED VALUES IN "ACT MEAS" MODE

DISPLAY	MEASURED QUANTITY
F	System frequency
Ua	Phase A - B voltage
Ub	Phase B - C voltage
Uc	Phase C - A voltage
U_0	Zero sequence voltage
Ea	Phase A - neutral voltage
Eb	Phase B - neutral voltage
Ec	Phase C - neutral voltage
Ed	Positive sequence voltage
Es	Negative sequence voltage

LAST EVENT DATA

The relay stores all information associated with the last trip event. To access this data, enter the LASTTRIP mode of operation as follows:

1. Press the **MODE** button, to get into **MEASURES** mode.
2. Press the **SELECT** button to select the LASTTRIP mode.
3. Press the + or – buttons to scroll through the event record. The data available is summarized in Table 5.

TABLE 5 - AVAILABLE LAST EVENT DATA IN "LASTTRIP" MODE

DISPLAY	HISTORICAL QUANTITY
Cau:xxxx	"xxxx" is the element which caused the last trip operation as follows: f' 1st frequency element f" 2nd frequency element u' 1st voltage element u" 2nd voltage element O>A or O>B or O>C Low set zero sequence voltage element phase A, B, or C O>>A or O>>B or O>>C High set zero sequence voltage element phase A, B, or C Ed Positive sequence voltage element Es Negative sequence voltage element 1ϕ 1st V/Hz element 2ϕ 2nd V/Hz element
F	Frequency at time of trip
Ua	Phase A - B voltage at time of trip
Ub	Phase B - C voltage at time of trip
Uc	Phase C - A voltage at time of trip
U_0	Zero sequence Voltage at time of trip
Ed	Positive sequence Voltage at time of trip
Es	Negative sequence Voltage at time of trip

CUMULATIVE TRIP COUNTERS

To display how many times the relay has tripped for each of the protective elements, enter the TRIP NUM mode of operation as follows:

1. Press the **MODE** button, to get into **MEASURES** mode.
2. Press the **SELECT** button to select the TRIP NUM mode.
3. Press the + or – buttons to scroll through the available measurements. The data available is summarized in Table 6.

TABLE 6 - CUMULATIVE TRIP COUNTER DATA IN "TRIP NUM" MODE

DISPLAY	NUMBER OF TRIPS DUE TO...
f' xxxxx	1st frequency delayed element
f" xxxxx	2nd frequency delayed element
u' xxxxx	1st voltage delayed element
u" xxxxx	2nd voltage delayed element
U_0> xxxx	Low set zero sequence voltage delayed element
U_0>>xxxx	High set zero sequence voltage delayed element
Ed xxxxx	Positive sequence voltage delayed element
Es xxxxx	Negative sequence voltage delayed element
1ϕ> xxxx	1st V/Hz delayed element
2ϕ> xxxx	2nd V/Hz delayed element

SPECIFICATIONS

Operating Temperature Range ..... -20 to +60°C at 95% humidity
Storage Temperature ..... -30 to +80°C
Rated Input Voltage 125V
Voltage Circuits Overload ..... 2.0 pu Continuous
Burden on Voltage Inputs ..... 0.2 VA at rated voltage
Dielectric test Voltage ..... 2000V, 50/60Hz, 1 minute
Impulse Test Voltage ..... 5kV common mode, 1 kV differential mode, 1.2 x 50 µsec wave
Immunity to high frequency burst ..... 1 kV common mode, 0.5 kV differential mode at 100 kHz,
..... 2.5 kV common mode, 1 kV differential mode at 1 MHz
Immunity to electrostatic discharge ..... 15 kV
Immunity to Sinusoidal Wave Burst ..... 100V over 10 - 1000kHz range
Immunity to radiated electromagnetic field ..... 10V/m over 20 - 1000MHz range
Immunity to High Energy Burst ..... 4 kV common mode, 2V differential mode
Immunity to 50/60Hz magnetic field ..... 1000 A/m
Immunity to impulse magnetic field ..... 1000 A/m 8 x 20 µs
Immunity to magnetic burst ..... 100 A/m over 100 - 1000kHz range
Resistance to vibration ..... 1g from 10 -500 Hz
Rear Connection Terminals ..... Up to 12AWG (4mm²) stranded wire
..... Lugs up to 0.25 inch (6.5mm) wide, or FASTON connectors
Output Contacts ..... rated current 5 A
..... rated voltage 380 V
..... nominal switching power with AC resistive load 1100W(380V max.)
..... breaking capacity at 110 VDC: 0.3A with L/R=40ms for 100,000 operations
..... make and carry capacity for 0.5 sec = 30 A (peak)
..... mechanical life over 2,000,000 (2 x 10^6) operations
PC Board Connectors ..... Gold plated, 10A continuous, 200A 1 sec.
Power Supply Input Voltage Range: ..... Two Available at 24 - 110 V AC-DC ± 20%
..... or 90 - 220 V AC-DC; ± 20%
A**Error! Objects cannot be created from editing field codes.**erage Power Supply consumption8**Error! Objects cannot be created from editing field**
Weight (in single relay case) 2.3kg (5.0lbs)

SETTINGS SHEET FOR UM30 RELAY - PAGE 1 OF 4

Variable	Factory default	Units	Description	Range	Step	Setting
Fn	50	Hz	System frequency	50 or 60 Hz	--	
UnP	10KV	Primary volts or kV	Rated primary phase-to-phase voltage of the system VTs	0.10 to 655 kV	0.01 kV (0.1-1) 0.1 kV (1.1-9.9) 1.0 kV (10-655)	
UnS	100	Volts	Rated secondary phase-to-phase voltage of the system VTs	100 to 125 V	1V	
1ϕ	1.2	Per unit	Trip level of the first V/Hz element	1.0-2.0 per unit, disable	0.1	
K	5.0	----	Trip time delay coefficient of the first V/Hz element	0.5-5.0	0.1	
2ϕ	1.2	Per unit	Trip level of the second V/Hz element	1.0-2.0 per unit, disable	0.1	
t2ϕ	5.0	seconds	Trip time delay of the second V/Hz element	0.1-60.0 seconds	0.1	
Fn –/+ f’	–/+	----	Operation mode of the first frequency control element	–, +, –/+, disable	--	
F’	0.5	Hz	Trip differential level of the first frequency control element	0.05-9.99 Hz	0.01	
tf’	1.0	seconds	Trip time delay of the first frequency control element	0.1-60.0 seconds	0.1	
Fn –f”	–	----	Operation mode of the second frequency control element	–, +, –/+, disable	--	
F”	1.00	Hz	Trip differential level of the second frequency control element	0.05-9.99 Hz	0.01	
tf”	2.0	seconds	Trip time delay of second frequency control element	0.1-60.0 seconds	0.1	
Un –/+ u’	–/+	----	Operation mode of the first voltage control element	–, +, –/+, disable	--	
U’	10	% rated voltage	Trip differential level of the first voltage control element	5-90% Un	1	
tu’	1.0	seconds	Trip time delay of the first voltage control element	0.1-60.0 seconds	0.1	
Un + u”	+	----	Operation mode of the second voltage control element	–, +, –/+, disable	--	
U”	20	% rated voltage	Trip differential level of the second voltage control element	5-90% Un	1	
tu”	2.0	seconds	Trip time delay of the second voltage control element	0.1-60.0 seconds	0.1	
Edn	–/+	----	Operation mode of the positive sequence voltage element	–, +, –/+, disable	--	
Ed	20	% rated voltage	Trip differential level of the positive sequence voltage element	5-90% En	1	
tEd	5.0	seconds	Trip time delay of the positive sequence voltage element	0.1-60.0 seconds	0.1	

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Variable	Factory default	Units	Description	Range	Step	Setting
Es	10	% rated voltage	Trip level of the negative sequence voltage element	1-99% En, disable	1	
tEs	5.0	seconds	Trip time delay of the negative sequence voltage element	0.1-60.0 seconds	0.1	
U_0>	10	Volts	Trip level of the low-set zero sequence voltage element	1-99 volts, disable	1V	
t_0>	0.5	seconds	Trip time delay of the low-set zero sequence voltage element	0.05-60.0 seconds	0.05 (0.05-9.9) 0.1 (10.0-60.0)	
U_0>>	20	Volts	Trip level of the high-set zero sequence voltage element	1-99 volts, disable	1V	
t_0>>	0.2	seconds	Trip time delay of the high-set zero sequence voltage element	0.05-9.9 seconds	0.05	
NodAd	1	None	Modbus communication address	1-250	1	

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OUTPUT RELAY PROGRAMMING ASSIGNMENTS (ACCESSIBLE VIA THE F Relay PROGRAM MODE.)					
Variable	**Factory default**	**Units**	**Description**	**Range**	**Setting**
f'	- - - 4	Outputs	Pick-up (or start-time) element associated with the first frequency element	1 2 3 4	
tf'	1 - - -	Outputs	Time delayed element associated with the first frequency element	1 2 3 4	
f"	- - - 4	Outputs	Pick-up element associated with the second frequency element	1 2 3 4	
tf"	- 2 - -	Outputs	Time delayed element associated with the second frequency	1 2 3 4	
u'	- - - 4	Outputs	Pick-up element associated with the first voltage element	1 2 3 4	
tu'	1 - - -	Outputs	Time delayed element associated with the first voltage element	1 2 3 4	
u"	- - - 4	Outputs	Pick-up element associated with the second voltage element	1 2 3 4	
tu"	- 2 - -	Outputs	Time delayed element associated with the second voltage element	1 2 3 4	
U_0>	- - - 4	Outputs	Pick-up element associated with the low-set zero sequence voltage element	1 2 3 4	
t_0>	1 - - -	Outputs	Time delayed element associated with the low-set zero sequence voltage element	1 2 3 4	
U_0>>	- - - 4	Outputs	Pick-up element associated with the high-set zero sequence voltage element	1 2 3 4	
t_0>>	- - 3 -	Outputs	Time delayed element associated with the high-set zero sequence voltage element	1 2 3 4	
Ed	- - - 4	Outputs	Pick-up element associated with the positive sequence voltage element	1 2 3 4	
tEd	- - 3 -	Outputs	Time delayed element associated with the positive sequence voltage element	1 2 3 4	
ES	- - - 4	Outputs	Pick-up element associated with the negative sequence voltage element	1 2 3 4	
tEs	- - 3 -	Outputs	Time delayed element associated with the negative sequence voltage element	1 2 3 4	
1ϕ	- - - 4	Outputs	Pick-up element associated with the first V/Hz element	1 2 3 4	
t1ϕ	- - 3 -	Outputs	Time delayed element associated with the first V/Hz element	1 2 3 4	
2ϕ	- - - 4	Outputs	Pick-up element associated with the second V/Hz element	1 2 3 4	

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Variable	Factory default	Units	Description	Range	Setting
t2ϕ	- - 3 -	Outputs	Time delayed element associated with the second V/Hz element	1 2 3 4	
R1tr	3.0	seconds	Reset characteristic of output relay R1	seconds, Manual, or Auto	
R2tr	Aut.	----	Reset characteristic of output relay R2	seconds, Manual, or Auto	
R3tr	Man.	----	Reset characteristic of output relay R3	seconds, Manual, or Auto	
R4tr	Aut.	----	Reset characteristic of output relay R4	seconds, Manual, or Auto	

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