

Relay Testing

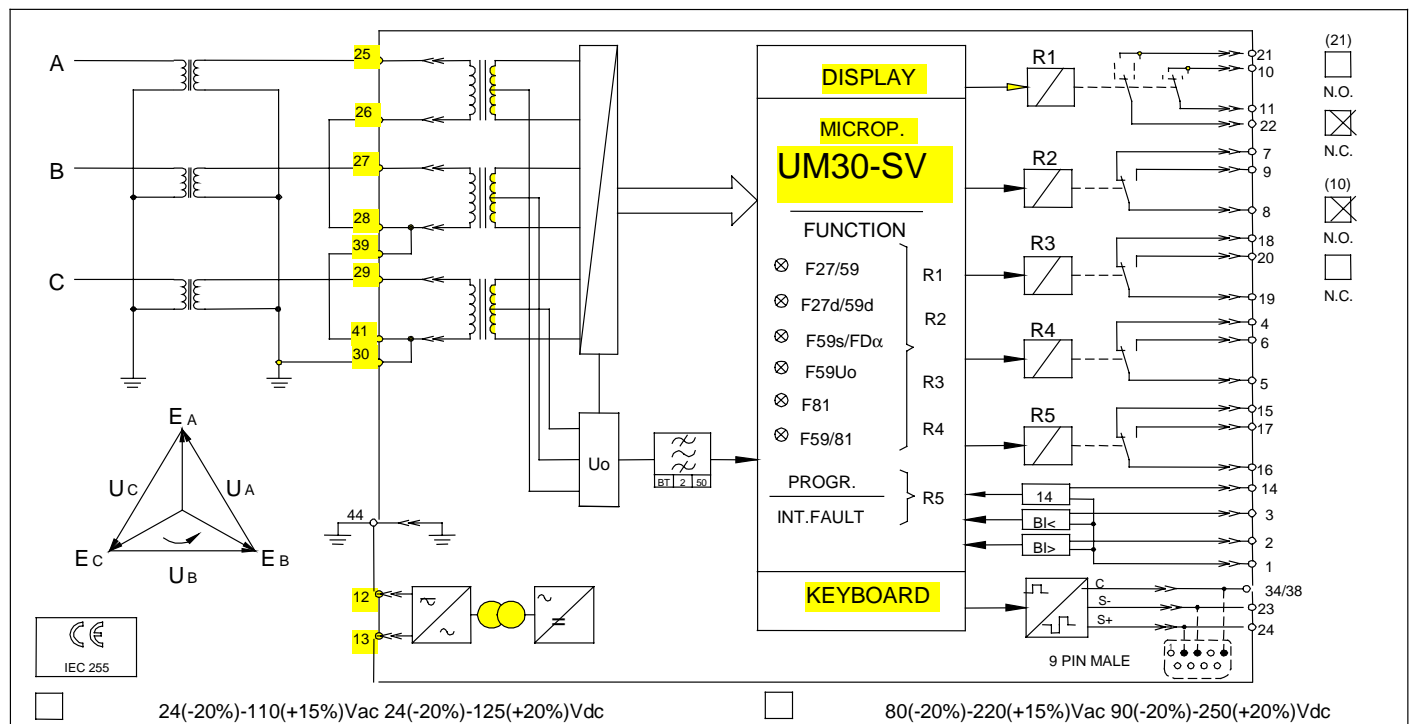
Testing the UM30-SV Relay -- Three-Phase Voltage, Frequency, V/Hz, and Vector Jump functions

REFERENCE INFORMATION

R150-23-1

This Reference Information is provided to help test the UM30-SV or the "Vector Jump" relay. It is assumed that the user of this document has read and understood the Operations Manual for the UM30-SV Three-Phase Voltage, Frequency, and "Vector Jump" Relay, S150-23-1. It is also assumed that the user has access to a relay test set with a modicum of functions and capabilities including applying controlled increments of voltage magnitude, voltage phase angle, and frequency. It is also helpful, but **not** necessary to download the latest version of EdisonComLite a free relay communications software from www.cooperpower.com. The use of EdisonComLite Version 1.40 would require a RS485/232 converter to communicate with the relay under test from the user's computer. EdisonComLite would enable faster setting changes to be made while testing the relay.

Connection Diagram



Default Relay Settings and Output relay assignments

The user can employ the default relay settings and the default relay output assignments. **Please verify the frequency is set at the correct test set frequency.** Alternatively, it **may** be preferred to use the default setting of the function being tested and all other functions **not** being tested set to **Disable**. Or, the actual setpoints as calculated by the relay engineer can be entered in the relay and the relay tested according to the setpoints one function at a time. If there is a case of interacting functions, such as negative sequence function picking up or V/Hz function picking up while testing overvoltage functions, then disable the negative sequence and V/Hz functions while testing the overvoltage functions. Another option to avoid interacting settings is to change output relay assignments such that the tested function pickup and the tested function time-delayed outputs are mapped to output relays 1 and 2, respectively, while all other functions are mapped to output relays 3 and 4. Yet another option to avoid interacting settings is to use extremely high settings on the functions **not** under test.

Test LED's and Output Relays

Connect relay outputs R1 - R5 to Test Set Monitor

Observe R5 output changes state from off to on when unit is powered up.

Run relay internal test to verify LED's and relay outputs.

Check Blocking Inputs

Short terminals 1 & 2, then check that "BLOCK ACTIVE" LED flashing.

Short terminals 1 & 3, then check that "BLOCK ACTIVE" LED flashing.

Short terminals 1 & 14, then check that Breaker Active Status in EdisonComLite – note these terminals **must** be shorted to test the vector jump function of the relay. Shorting this function indicates that the tie-breaker is closed and the vector jump function is thus activated. (A contact input operated by a normally open auxiliary contact (52a) of a Circuit Breaker blocks the Vector Jump functions when the Circuit Breaker is open as well as for 5 seconds after closing the breaker.)

Check RS485 Communications

Connect RS485 converter from PC to unit under test.

Load and run EdisonComLite software.

Verify that proper relay model is detected and can be connected.

Bring up measurement window and status window and observe values for the rest of the test.

Change Fn to system frequency.

Check Voltage Control Element Pickup

It is assumed that all other elements are Disabled and only the second voltage control element Un has its setting set to $\pm u''$, i.e., both the overvoltage and undervoltage settings are applicable. To first test the u'' element, set the u' element to 90%Un. The default setting for u'' of 20% trip differential voltage can be used and the value of 20% voltage of the rated secondary voltage is calculated. It is assumed that the output relay assignments for u'' and tu'' are 4 and 2 respectively. Apply 1.2-1.3 times rated secondary voltage and wait for the applicable time delay of this function for this element to operate. Determine the actual pickup of this element. Now block the over voltage elements by shorting the terminals 1-2 and apply the pickup voltage of this voltage control element – the output relay will NOT pickup now.

Note the red LED on the top row (second from left) marked Voltage flashes when picked up and turns ON after the time delay of the function. After applying normal voltage push the yellow ENTER/RESET key to turn OFF the LED. The operations manual explains how to navigate to and the data available in "LASTTRIP" mode, including the cause of the LASTTRIP.

Now apply 0.7-0.8 times the rated secondary voltage and wait for the applicable time delay of this function for this element to operate. Determine the actual pickup of this element. Now block the under voltage elements by shorting the terminals 1-3 and apply the pickup voltage of this voltage control element – the output relay will NOT pickup now.

Note that the first control voltage element can be tested by setting $Un/\pm u'$, setting u' to 20%Un and tu' to 1.0 s. The second control voltage element can be set to Dis or set to 90%Un to avoid any interaction.

Check Voltage Control Element Pickup Timing

In the above case verify that the time of operation of the overvoltage pickup element (output relay 2) is within the setting and the tolerances. Note that the u'' element has been tested at the 20%Un setting in the example above. The actual relay setpoint can be entered for this element and the relay retested.

Check Zero Sequence Voltage Elements (U0) Pickup and Time delayed elements

The procedure to test the Zero Sequence Voltage Element is similar to Voltage Control Element described above. It may be desirable to disable the negative sequence voltage element, the positive sequence voltage element, and the voltage control elements to test the Zero Sequence Voltage Elements.

Note the red LED on the bottom row (third from left) marked U0> flashes when picked up and turns ON after the time delay of the function. After applying normal voltage push the yellow ENTER/RESET key to turn OFF the LED. The operations manual explains how to navigate to and the data available in "LASTTRIP" mode, including the cause of the LASTTRIP.

Check Positive Sequence Voltage Elements (U0) Pickup and Time delayed elements

The procedure to test the Positive Sequence Voltage Element is similar to Voltage Control Element described above. It may be desirable to disable the negative sequence voltage element, the zero sequence voltage element, and the voltage control elements to test the Positive Sequence Voltage Elements.

Note the red LED on the top row (third from left) marked Pos. Seq. flashes when picked up and turns ON after the time delay of the function. After applying normal voltage push the yellow ENTER/RESET key to turn OFF the LED. The operations manual explains how to navigate to and the data available in "LASTTRIP" mode, including the cause of the LASTTRIP.

Check Negative Sequence Voltage Element (Es) Pickup and Time delayed element

The procedure to test the Negative Sequence Voltage Element is similar to the Voltage Control Element described above. It may be desirable to disable the positive sequence voltage element, the zero sequence voltage element, and the voltage control elements to test the Negative Sequence Voltage Elements.

Note the red LED on the top row (fourth from left) marked Neg. Seq. flashes when picked up and turns ON after the time delay of the function. After applying normal voltage push the yellow ENTER/RESET key to turn OFF the LED. **Note that this LED is also mapped to the Vector Jump function.** The operations manual explains how to navigate to and the data available in "LASTTRIP" mode, including the cause of the LASTTRIP.

Check Volt/Hz functions pickup levels and time delay elements

The procedure to test the V/Hz Elements is similar to Voltage Control Element described above. It may be desirable to disable the voltage control elements and the frequency elements to test the V/Hz Elements. The V/Hz element can be tested by either increasing the Voltage or decreasing the frequency or by simultaneously increasing the Voltage and decreasing the frequency.

Note the red LED on the bottom row (second from left) marked U/f> flashes when picked up and turns ON after the time delay of the function. After applying normal voltage push the yellow ENTER/RESET key to turn OFF the LED. The operations manual explains how to navigate to and the data available in "LASTTRIP" mode, including the cause of the LASTTRIP.

Check Frequency control elements pickup levels and time delay elements

The procedure to test the Frequency control Elements is similar to Voltage Control Element described above. It may be desirable to disable the V/Hz elements to test the frequency elements.

Note the red LED on the top row (first from left) marked FREQ. flashes when picked up and turns ON after the time delay of the function. After applying normal frequency push the yellow ENTER/RESET key to turn OFF the LED. The operations manual explains how to navigate to and the data available in "LASTTRIP" mode, including the cause of the LASTTRIP.

Check Vector Jump function elements

The setting of the Vector Jump function $D\alpha$ can be set to 10° . The operation mode of the Vector Jump element $D\alpha$ can be set to 3 -- to trip the Vector Jump function above 10° on all three phases at the same time. The undervoltage blocking level setting U_b can initially be set to $10\%U_n$ to eliminate the possibility of any false blocking. The Vector Jump function $D\alpha$ can be programmed to output relay 1 with the contacts of output relay 1 being monitored. The test set should be able to create the vector jump at the instant commanded by the engineer and NOT at the voltage zero of the individual phase. It is **necessary** to short terminals 1 and 14 for greater than 5 seconds to simulate the closed breaker, otherwise the vector jump function is effectively blocked. It is desirable to disable the negative sequence element since the red LED on the top row (fourth from left) is mapped to **both** the Negative Sequence and the Vector Jump functions. However, note that the LASTTRIP menu provides details about the cause of the LASTTRIP. It may be desired by the user to disable all other settings or alternatively to map other settings too different output relays.

The three-phase vector jump of 11° - 12° should cause an operation of output relay 1 and the red LED on the top row marked NEG. SEQ to light up. Conversely a three-phase vector jump of 8° - 9° should NOT cause an operation of output relay 1 and the red LED on the top row marked NEG. SEQ should NOT light up. Also a single-phase vector jump of 11° - 15° should NOT cause an operation of output relay 1 and the red LED on the top row marked NEG. SEQ should NOT light up.

The $D\alpha$ setting of 1 can be employed and the single-phase vector jump of 11° - 12° should cause an operation of output relay 1 and the red LED on the top row marked NEG. SEQ to light up. Conversely a three-phase vector jump of 8° - 9° should NOT cause an operation of output relay 1 and the red LED on the top row marked NEG. SEQ should NOT light up.

Note the red LED on the top row (fourth from left) marked Neg. Seq. turns ON after the detection of the Vector Jump function. After applying normal voltage push the yellow ENTER/RESET key to turn OFF the LED. **Note that this LED is also mapped to the Negative Sequence function.** The operations manual explains how to navigate to and the data available in "LASTTRIP" mode, including the cause of the LASTTRIP.

Reset Counters & Default Settings

Make a record of the trip counters to track future trips in the field.
Reset any changed settings back to their default or desired settings.

Special Note on Voltage Transformers connected Line-to-line

Sometimes only two voltage transformers connected line-to-line are used on a three-phase system. An artificial star point has to be created externally by connecting 3 small resistors (10W, 1 kohm) in parallel to the relay voltage input. Thus, from terminals 25, 27, and 29 connect the external resistors in star and connect the star point of the resistors to terminal 30 of the relay.

