Relay Setting

COOPER Power Systems

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

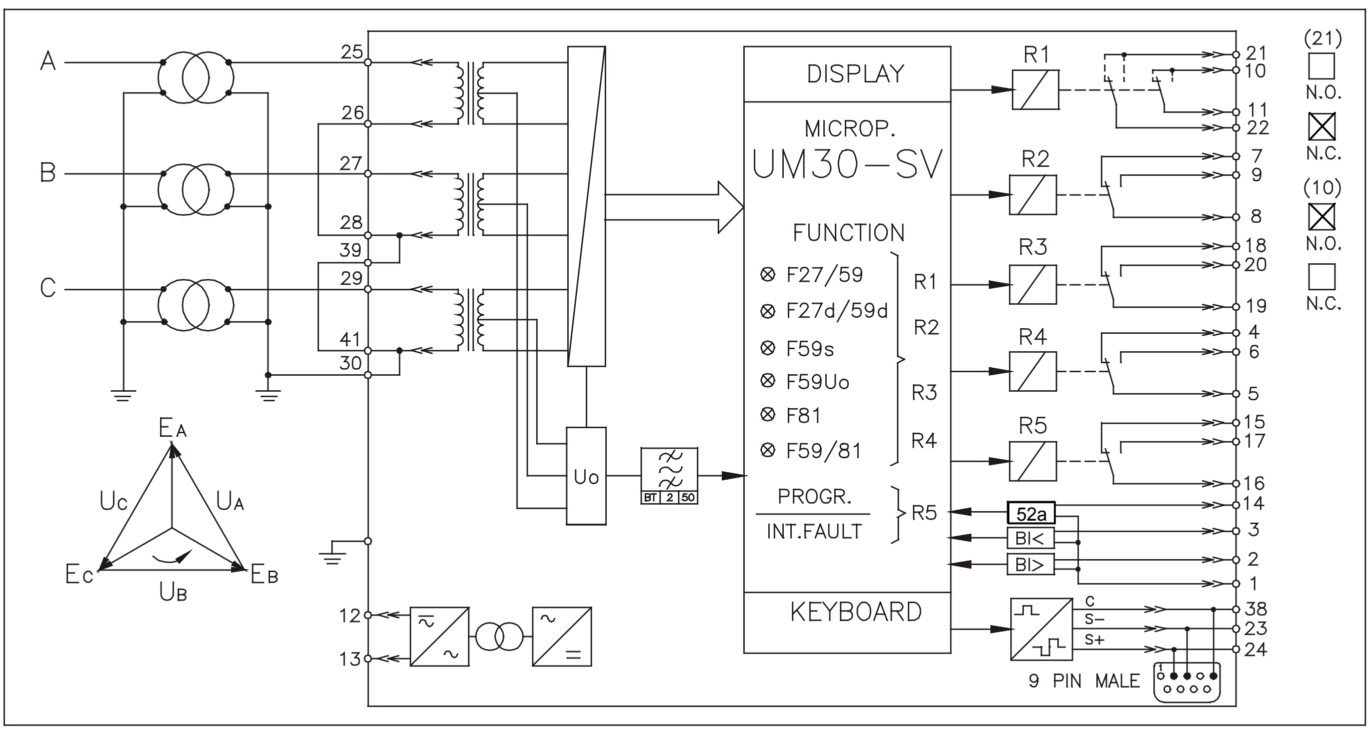
REFERENCE INFORMATION

R150-23-2

This Reference Information is provided to help set the UM30-SV or the “Vector Jump” relay. It is assumed that the user of this document has read and has understood the Operations Manual for the UM30-SV Three-Phase Voltage, Frequency, and “Vector Jump” Relay, S150-23-1. It is recommended to read the relay testing Reference information R150-23-1, which provides more information on the relay. It is also helpful, but **not** necessary to download the latest version of EdisonComLite, which is 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 being set from the user’s computer. EdisonComLite would enable settings to be made to the relay more quickly.

The use of a computer based transient stability analysis program, which can model machine dynamics including speed, frequency, inertia constant (H), and terminal voltage, is **strongly recommended**. The programs that are listed here are for the user’s convenience - Cyme Corporation’s CYMSTAB, EDSA Corporation’s EDSA, Electrical Transients Analysis Program (ETAP), Power Technologies Inc. PSS/E, etc...

Connection Diagram



Background Information

The definitions for relay dependability and security are given below:

“Dependability is defined as the measure of certainty that the relays will operate correctly for all faults for which they are designed to operate.”

“Security is defined as the measure of the certainity that the relays will not operate incorrectly for any fault.” (e.g. a fault outside the intended zone of protection.)

The “Vector Jump” relay must be set to pickup when the utility main feed is disconnected – it is **essential** that there is an interchange of power occuring at this time. If there is no interchange of power occuring at this time it is impossible to detect the loss of the utility main feed. This is the issue of dependability. In order to be certain that the relay will detect the system's vector jump, the setting for the "vector jump" should be set lower than the expected vector jump that occurs during the minimum power interchange.

The "Vector Jump" relay has to be set such that it does not operate for an external fault on the system and also does not operate when the largest load is being picked up by the local generator. Ideally, the "Vector Jump" relay should not pickup for a fault on the internal system. These are the issues of security. The settings for the "vector jump" should be higher than the vector jumps these conditions create to avoid operation with certainity. Security of the relay can be enhanced by using the three phase mode in preference to the single phase mode. The vector jump function can be ANDED with underfrequency AND undervoltage AND **(.not.** negative sequence voltage) AND **(.not.** zero sequence voltage) by using the four output relays and connecting the contacts of these relays in series for even greater security.

It is recommended that the UM30-SV relay voltage input be fed from voltage transformers located at the local generator terminals. This location will provide larger vector jump magnitudes and the ability to trip the generator breaker when the main utility feed is lost. The 52a contact of the generator breaker or the local disconnect breaker is required as an input to the UM30-SV relay at terminals 1 and 14.

<u>Information needed to provide the settings</u>

1. The rating of the local generator
2. The minimum interchange power condition, either to the utility or from the utility.
3. The change in the generator's teminal voltage angle ($\Delta\alpha$) when the utility main is lost at minimum interchange power. Also the change in frequency and in voltage under this condition.
4. The change in the generator's teminal voltage angle ($\Delta\alpha$) when an external 3-ϕ fault occurs on the main utility and is cleared by the main utility relaying system. Also the change in frequency and in voltage under this condition. Note that 3-ϕ fault condition is specified, implicitly assuming use of the 3-ϕ mode of the relay.
5. The change in the generator's teminal voltage angle ($\Delta\alpha$) when an internal 3-ϕ fault occurs on the local system and is cleared by the local system relaying. Also the change in frequency and in voltage under this condition. Note that 3-ϕ fault condition is specified, implicitly assuming use of the 3-ϕ mode of the relay.

<u>Calculations needed to provide the settings</u>

Note that $\Delta\alpha \cong \Delta P(\%)$. Therefore, it is not possible to detect the loss of the utility main when the net interchange of power is zero or an extremely low.

Therefore, the minimum pickup setting level for $\Delta\alpha$ can be at $0.5^*(\Delta P(\%))$, provided it is above the changes in $\Delta\alpha$ for external and internal 3-ϕ faults. The factor of 0.5 allows for a greater certainity in detecting the loss of the utility main. The minimum available setting for $\Delta\alpha$ is $2°$ and hence the preceding shows that the minimum amount of interchange power should be 4% of the local generator machine rating for the loss of the utility main feed to be detected with certainity. In theory it may be possible to detect loss of main utility at 2% of the local generator rating, by employing other characteristics such as undervoltage (or overvoltage) and underfrequency (or overfrequency) with suitable time delays and logically ANDing these characteristics with the vector jump function.

Approximately 90% percent of faults are L-G and the **three-phase mode** of the vector jump function provides an inherent amount of security. The difficulty in setting this relay arises for a **small** (approximately 5%) number of 3-phase faults internally in the local system (either during islanding or tied operation) or externally in the system. Transient stability simulations mentioned earlier, need to be performed to determine if the voltage, frequency, (.not.negative sequence voltage), (.not.zero sequence voltage), and time delays can be logically implemented within this relay to allow for the primary relaying to remove the fault and not cause the vector jump relay to trip the local generator. The developed scheme should allow for the trip of the local generator for the loss of the utility main (dependability).