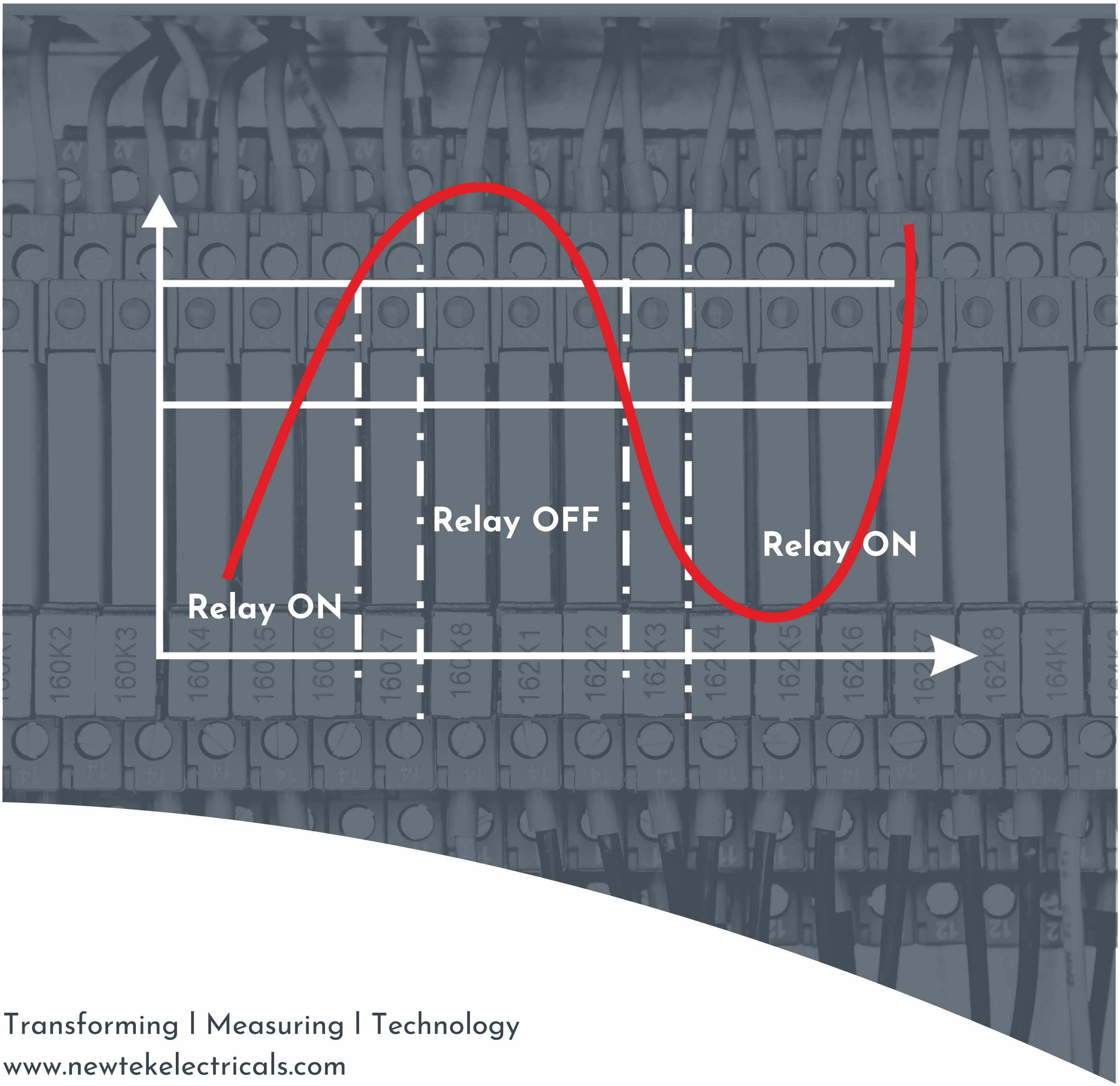
What are Relay Outputs in MFM/VAF Meters?



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What are Relay Outputs in MFM/VAF Meters?

Part I

Introduction:

Relay outputs in MFM/VAF meters are inbuilt changeover contacts that change the state of contacts based on the present condition (Less than or Greater than) for a particular measured parameter in the meter.

MFM/VAF meters have generally one or two optional relay outputs. The relay outputs can be programmed independently either as limit switch or pulse output (only for MFM). This section elaborates on relay output programmed as limit switch.

What is a Limit Switch?

A limit switch is nothing but a set point trip relay output. A set point trips relay output if the input exceeds a user defined hi/lo set point limit. This enables controlling the operation by meter based on measurements.

Consider the following parameters in the meter for a limit switch:

1) Measured parameter to be monitored.
2) Trip point
3) Hysteresis
4) condition for tripping (> or <) and Relay status after tripping
5) Energizing delay/De-energizing delay required before tripping.

Example: Consider a 3 phase induction motor of 415VLL, 5A, 3.5kKW which is to be protected from overvoltage/overcurrent. Here, we need a mechanism to automatically cut off the motor's power supply when the input voltage exceeds 500V or input current exceeds 5A, and restores the supply when the voltage/current are back to normal. This is achieved by programing the Meter for relay output:

RELAY 1: Measured parameter: VLL Trip point (Limit A) = 500VLL
Hysterisis = 10% of Trip point= 50V. Limit B = 500V-50V = 450V
Condition: Hi-Alarm –De-Energized (> 500VLL - relay should be OFF) Energizing delay: 2 sec De-Energizing delay: 2sec
(Refer Fig 1 and Fig 2)

RELAY 2: Measured parameter: A Trip point (Limit A) = 5A
Hystetisis = 10% of Trip point = 0.5A. Limit B = 5A-0.5A = 4.5A
Condition: Hi-Alarm –De-Energized (> 5A - relay should be OFF)
Energizing delay: 2sec De-Energizing delay: 2sec

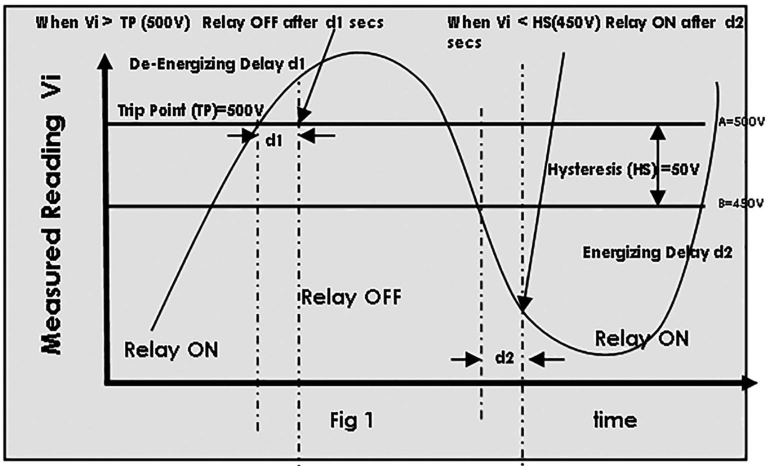
Fig 1 and Fig 2 illustrate the operation of RELAY 1. The relay is ON when Vi< A (500V). WhenVi crosses 500V, due to deenergizing delay of 2 sec, RELAY 1 trips after 2 secs. The relay remains OFF until Vi is above 450V (Limit B). When Vi < B (450V), the relay turns ON again after 2 sec due to energizing delay. Thus, the supply to 3 Phase motor is automatically cut off and then restored based on the input conditions and the user defined set-points in the Meter.

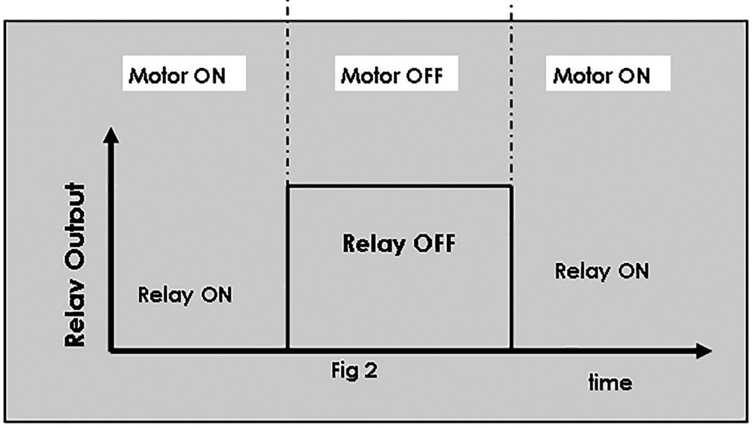
HYSTERISIS is the noise margin that prevents chattering/hunting of relay outputs. This happens when the input fluctuates around Trip point due to noise.

Energizing/De-energizing delay eliminates false tripping in case the input exceeds trip point due to noise spikes in the input waveform. Meter confirms twice (just before delay and after delay) whether the input is really above the Trip point before tripping the relay.

It will not trip if the input is found above the trip point only once. This eliminates false tripping. The protection offered by the limit switch is not restricted to voltage or current.

The user may get protection for over or under for any parameter (like Power, Frequency, Demand, Maximum Demand). When relay output is programmed as limit switch for Max Power Demand, the Meter works as a Demand Controller which cuts off the load automatically when Max Power demand is exceeded.





Conclusion

The limit switch in an electrical setup serves the dual purpose of protection and control in power consumption. By using the limit switch as a demand controller, you could significantly reduce power consumption and save costs.

What are Relay Outputs in MFM/VAF Meters?

Part II

This section discusses relay outputs in MFM meters configured as "Pulse Otput". Pulse output is related to energy measurement, and hence, is not applicable to VAF meter as the latter does not support Power/Energy measurement.

What is a Pulse Output?

Pulse output in a Meter comes either as a flashing LED or a switching relay. However, the concept remains the same for both the versions.

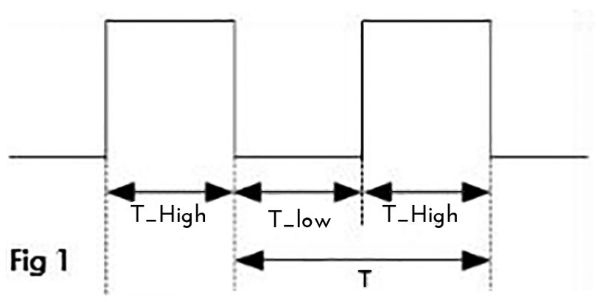


Fig 1

Pulse output is a train of pulses output by meter either in the form of switching relay or flashing LED. The time between pulses (or frequency of pulses) is proportional to the Power/Energy measured by the meter. Refer to Fig 1 for a typical pulse output from a meter. The pulse consists of time period T = T_high + T_low. T_high indicates the period for which the Pulse transmitter inside the meter is ON.

The width of T_high can be programmed to few fixed values like 60 msec or 100 msec or 200 msec. Once T_high is programmed, it remains fixed. The time between the two T_high pulses is T_low. It is a variable time period and depends on the power/energy being measured by the Meter.

The relation between this variable time and Energy is fixed by a factor called as Meter Constant. For example, Meter Constant = 1000 pulses/kWhr. As the total time period T = T_hight + T_low and T_high is fixed, T varies based on the measured power/Energy.

If Energy/Power consumed is high, T will be shorter and more pulses will be output by meter in a given time. On the other hand, if Energy/Power consumed is Low, T will be longer and fewer pulses will be output by the meter.

Energy accumulated at a particular instant can be calculated by counting the number of pulses and by dividing it by the Meter Constant specified by the manufacturer of the meter. Meter constant is constant expressed as No of pulses/kWhr. The value of Meter constant varies from manufacturer to manufacturer.

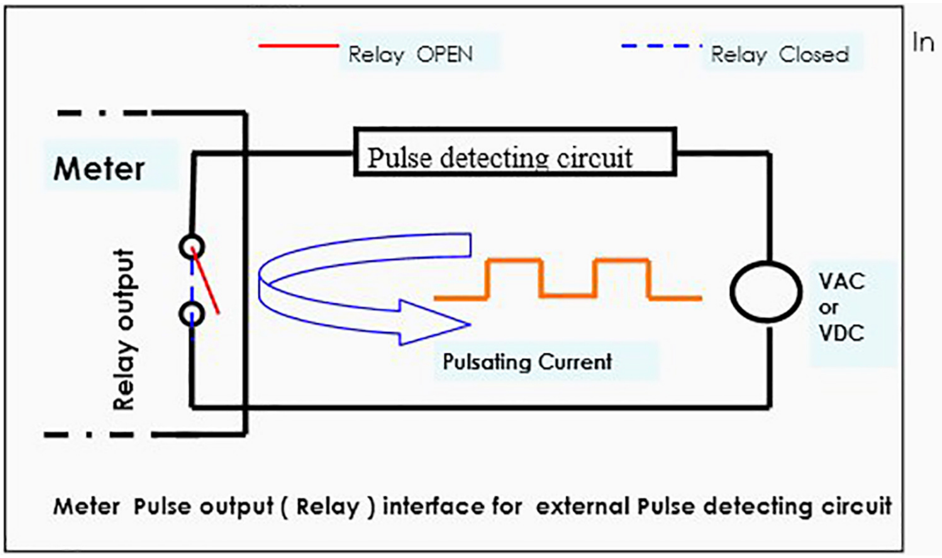
Example: Meter constant specified for a MFM is 1000 pulses/kWhr.

$$\text{Energy (kWhr)} = \frac{\text{No of Pulses}}{\text{METER CONSTANT (Pulse/kWhr)}}$$

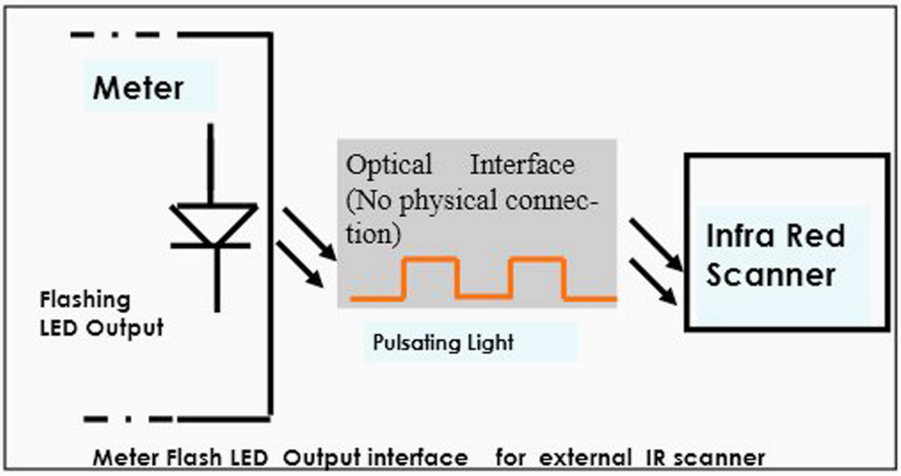
Calculating Energy: If you accumulate 500 pulses from the pulse output of the meter,
Energy count will be = 500 pulses/1000 = 0.5 kWhr.

Calculating Power: Energy (E) = Power (P) x time (T).
For meter constant = 1000 pulses/kWhr is same as 1 pulse/1 Whr.
1 Whr = 1Wx 1 hr = 1W x 3600 sec = 3600 Wsec. 1 Whr = 3600 Wsec.

Therefore instantaneous power P(W) = E/T = 3600 Wsec/T sec where T is the time between the falling edge of each pulse as shown in Fig 1. If 500 pulses were accumulated in 30 minutes (1800 secs) then T = 1800 secs/500 pulses = 3.6 sec per pulse.
Therefore Power P (W) = 3600 WSec/3.6 sec = 1kW.



In case of Meter with relay output, the changeover contact will switch ON and OFF while the external supply in series with contact would produce current pulses proportional to power/Energy. Since the Meter uses Fast switching relays having max switching time in the range of 5 msec to 10 msec, there is no issue for relays to follow the pulse timing.



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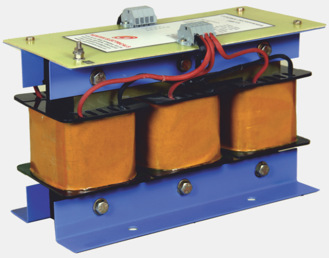

- Single-phase Resin Cast
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Digital Meter

- Energy Meter
- MFM Meter
- VAF Meter
- DPM Meter

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