Transformer Switching Relay -- Adjustment Procedure

Fig.1a

Incorrect adjustment:

Premagnetization is too weak. The potentiometer is too far CCW. Large (≈40 A) negative inrush current peaks are visible after full turn-on. (seriously wrong)

negative polarity saturation

Fig.1b

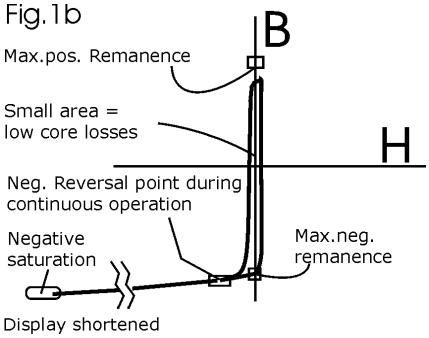
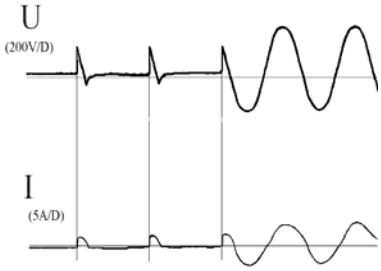


Fig. 2a

Correct adjustment:

No inrush current peak is visible. Only the resistive load current is visible after full turn-on.



no saturation

Fig. 2b Shape of a toroidal core hysteresis loop in continuous operation

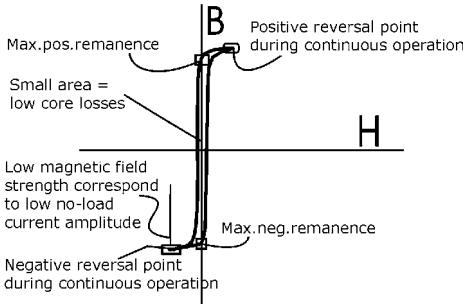
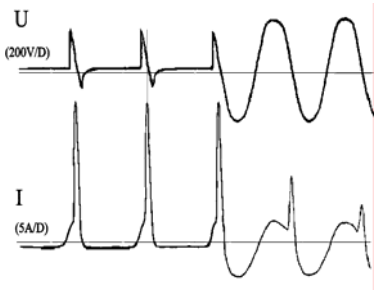


Fig. 3a

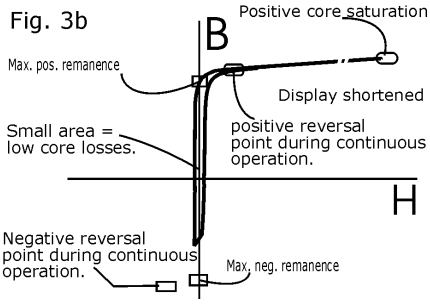
Incorrect adjustment:

Premagnetization is too strong. The potentiometer is too far CW. Large (≈20 A) positive premagnetization current pulses are visible (less seriously wrong)



positive polarity saturation

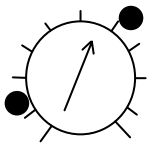
Fig. 3b



As shown in the above illustrations, premagnetizing positive voltage pulses of approximately 2 millisecond duration are applied to a toroidal core transformer by the TSR. The positive voltage pulses magnetize the core in the direction of the upper (positive) reversal point of its hysteresis curve. During the interval between pulses, the core continues to be magnetized in a positive direction but with zero field strength. Each successive pulse moves the magnetization a little bit higher. When the core magnetization reaches the maximum positive remanence point, the next pulse moves it to the positive reversal point of the hysteresis curve. During the interval following that pulse, the core will return to the maximum positive remanence point. Extra pulses will cause the transformer core to cycle between the positive reversal point and the maximum positive remanence point. If a sufficient number of premagnetizing pulses are applied to the transformer, the magnetization is positioned at the positive reversal point after the last pulse and the transformer is fully turned on at the next zero crossing. No inrush current peak occurs. If the premagnetization pulses are too low and too few, the core will not reach the positive reversal point before turn-on, and a large negative inrush current will result. If the premagnetizing pulses are too large, the pulses will generate positive current spikes during the TSR turn-on sequence. The optimum width and number of premagnetizing pulses are dependent upon of the type of transformer, (the shape of its hysteresis curve), and must be adjusted by means of the TSR potentiometer.

Initial adjustment of the premagnetizing level potentiometer according to transformer type:

Toroidal core = R



P = rectangular core = standard factory setting

> P = transformers with air gap

For toroidal cores, (**R**ing kern trafo)**: turn pot to the "R" Mark.**
For rectangular cores, (**P**aket-Kern-Trafo)**, turn pot to "P" Mark.**

For conventional rectangular laminated transformers, the correct adjustment of the potentiometer can range between the 10 and 2 o'clock position, depending on the small air gaps between the lamination legs which will vary with stacking method. The adjustment of the potentiometer is not critical and once set, will not drift over time. For most accurate potentiometer adjustment, monitor the turn-on voltage and current waveforms while switching the power line to the TSR. An AC ammeter in series with the TSR, can be used to display the current pulses. The best way to monitor this is with a current clamp together with a storage oscilloscope. See graphics above. In most cases, simply setting the potentiometer to R or P, depending on core type is sufficient for proper operation.