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ICIREST-19 Fabrication of Single Phase Transformer Test Panel

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Abstract: *Panel is used to perform tests like open circuit test, short circuit test, and back to back test and under back to back test we find out efficiency and voltage regulation automatically. For this panel single phase transformer is used. Open circuit test is performed to find the iron losses or no load losses of the transformer in open circuit test secondary side or high voltage side of the transformer is open circuited. Short circuit test is performed to find the copper losses of the transformer. In short circuit test secondary side or low voltage side of the transformer is short circuited by thick wire. Back to back test is performed to determine the open circuit test and short circuit test at same time thus to find the temperature rise of the transformer when transformer is fully loaded. By using this readings we are going to find this all parameters of open circuit test and short circuit test and sumpner's test automatically by using arduino which is microcontroller board. Panel will give us correct and accurate results by using digital meters, panel will reduce the time required for calculationsand connection, panel is safe and efficient.*

Keywords: *Arduino kit programming, display, multifunction meter, , test panel, CT, PT*

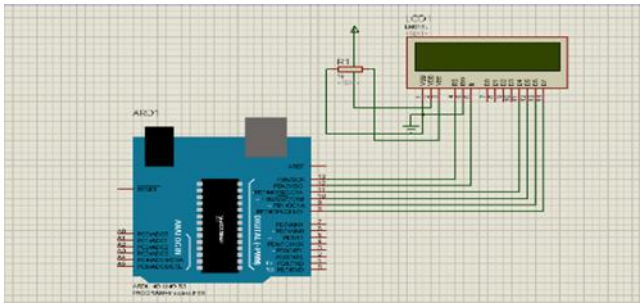
I. Introduction

Here we had made transformer test panel which will used in machine laboratory of college this panel has many functions, which may be used independently or simultaneously for different tests. We had made this panel where single phase transformer tests are performed. By using arduino all the calculations areautomatically arduino is a microcontroller

Board. Where the Aurdino IntegratedDevelopment Environment software is used for making this calculations automatically. Here we are using LCD display to take output directly from arduino, this LCD display is 2 line X 16 charactermodule. The chances mistake is less.so in this way our time is saved required for calculations.

II. Methodology

We are making a panel where we can perform the different test held on transformer. By using this panel time required for performing the test will be less as compared to the normal meathead where we need to connect different parameters which may be result in error in connections. In this panel we are using potential transformer and current transformers on both the side i; e on primary and secondary side for measuring current and voltage. Here we are using arduino kit. Arduino kit is a microcontroller board. By using this arduino we can perform all the test automatically. By using LCD Display we can see our result digitally.By using LCD Display we can see our result digitally

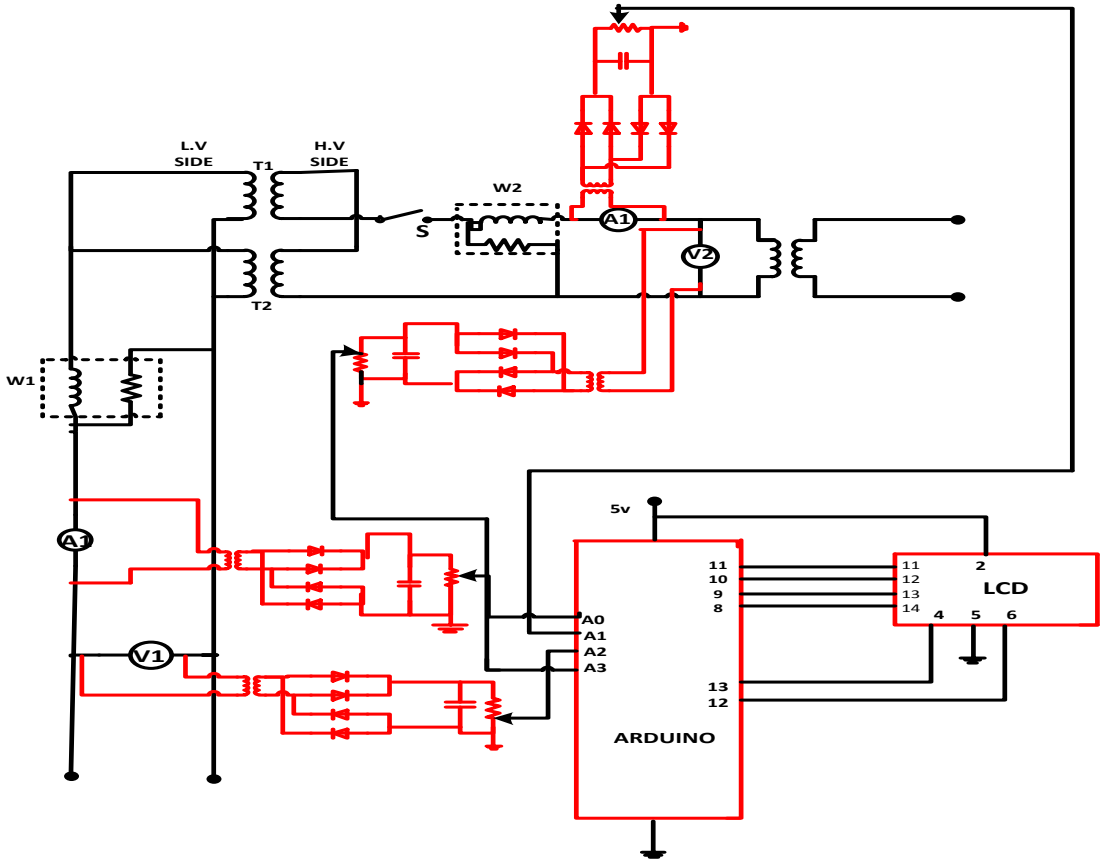


INTERFACING OF LCD

Using this panel we can perform open circuit test, short circuit test and back to back test automatically. Using the results of back to back test we can find the voltage regulation and efficiency to transformer directly without any calculation.

I. CIRCUIT DIAGRAM

PHOTO OF PANEL



Circuit diagram :- Fabrication of Single Phase Transformer Test Panel

II. OPEN CIRCUIT TEST

Open circuit test is also called as NO LOAD test. Open circuit test is performed to determine the iron losses and O.C test is performed on low voltage side of the transformer or primary side of the transformer whereas, secondary side is open . During this test primary winding draws no load current and at the same time primary winding have some copper losses of negligible amount. Here as the secondary current is absent due secondary open circuited hence, there is not any type of losses at secondary. Open circuit test is conducted at rated voltage. Core losses or Iron losses depends on the voltage of the transformer. Hence, core losses are

calculated by open circuit test. Since, we can say that core losses depends on the voltage only. If voltage is there flux is also produced and core losses are calculated
Sometimes a voltmeter is connected across secondary to measure voltage V_2.

OBSERVATION OF OPEN CIRCUIT TEST
CALCULATONS

To calculate Ø	To calculate R_0& X_0	To calculate I_m & I_c
$W_0 = V_0I_0COSØ_1$	$R_0 = V_0/I_c$	$I_m = I_1 \text{ Sin } Ø_1$
$COSØ_1 = W_1 /V_0I_0$	$X_0 = V_0/I_m$	$I_c = I_1 COSØ_1$

As no load current I_0 is very small as compared with the full load primary current. The no load current I_0 is about 3 to 5% of the full load value. The primary copper losses will be negligible because I_0 is small.

III. SHORT CIRCUIT TEST

Short circuit test is performed on the high voltage side of the transformer where the low voltage side of transformer is short circuited with the help of thick copper wire. This is used for the determination of the transformers impedance losses is carried out with relatively low applied currents of the same.

OBSERVATION TABLE OF SHORT CIRCUIT TEST

Isc	Vsc	Wsc	Req	Xeq	Zeq

CALCULATION

$W_2 = V_2 I_2 COSØ_2$	$W_2 = I_2^2 R_2$	$COSØ_2 = W_2 /V_2I_2$
$R_2 = W_2/I_2^2$	$Z_2 = V_2 / I_2$	$X_2 = (Z_2^2 - R_2^2)^{1/2}$

IV. BACK TO BACK TEST

Back to back test is efficient and minimum power consumption test which is done without actual loading to find regulation and efficiency of large power transformer. Improved method of testing transformer efficiency and other parameters. Back to back test gives the actual value of total losses accurately. In this test transformer are tested at full load condition. The secondary current can be varied to any value using regulating transformer. Determination of copper losses at full load condition or at any condition is possible.

In back to back test two identical transforms are required whose primary is connected in parallel across the supply V_1 and secondary of both the transformer is connected in series. The switch S is closed. Now no load current I_0 flows in the primaries and secondary current I_2 is zero. When the switch S is closed and the voltage at the output of the regulating transformer is varied until the full load current I_2 flows in the secondary circuit. W_1 &W_2 are the core losses and copper losses of the both transformer respectively.

Back to back test is important to test every electrical machine at its rated capacity and it's inconvenient for machine of large rating to actually full load the equipment and test. So for all the electrical machine some from of back to back test becomes important.

OBSERVATION TABLE FOR BACK TO BACK TEST

I_O	V_O	W_0	I_{SC}	V_{SC}	W_{SC}

V. VOLTAGE REGULATION

The voltage regulation of the transformer is the percentage change in the output voltage from no-load to full-load. An electrical power transformer is open circuited, means load is not connected with secondary terminals. In this situation, the secondary terminal voltage of the transformer will be its secondary induced emf E2. Whenever full load is connected to the secondary terminals of the transformer, rated current I2 flows through the secondary circuit and voltage drop comes into picture. At this situation, primary winding will also draw equivalent full load current from source. The voltage drop in the secondary is I_2Z_2 where Z_2 is the secondary impedance of transformer. Now if at this loading condition,any one measures the voltage between secondary terminals, then we get voltage V_2 across load terminals which is obviously less than no load secondary voltage E2 and this is because of I_2Z_2 voltage drop in the transformer.

$$\%R = \frac{\text{I2R2 Cos Ø2} \pm \text{I2X2 Sin Ø2}}{\text{V2}} X\ 100$$

$$\%R = \frac{\text{I1R1 Cos Ø1} \pm \text{I1X 1Sin Ø1}}{\text{V1}} X\ 100$$

VI. EFFICIENCY

The Efficiency of the transformer is defined as the ratio of useful power output to the input power.

Efficiency = output / input.

Transformers are the most highly efficient electrical devices. Most of the transformers have full load efficiency between 95% to 98.5% . As a transformer being highly efficient, output and input are having nearly same value, and hence it is ideal to measure the efficiency of transformer by using output / input. The method to find efficiency of a transformer is using.

Efficiency = (input - losses) / input

Here the losses are copper losses(at short circuit losses) and iron losses (at open circuit losses)

$$efficiancy\ (\eta) = \frac{V_2 I_2 COS\emptyset_2}{V_2\, I_2 COS\emptyset_2 + W_1 + W_2}$$

VII. CONCLUSION

This paper has represented the problem on calculating efficency and voltage regulation by lengthy techniques where as we had made a panel where open circuit test, short circuit test and back to back test are performed automatically and for this we are using arduino for making the whole concept of panel automatically. Panle has the main advantage of automatic operation to finding voltage and regulation of the transformer which dierectly or indierectly reduce time required for the calculation and errors found in calcultaion. This this way this panel is used in the college machine lab. All the functions can be programmed in the arduoin. Esay to handle and moveable from one place to another. This panel will required less maintainance.

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