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Multi-Testing Kit for Power and Distribution Transformer

Miss.Kiran Lagad[1], Yogita Lokhande[1], Sapna Mhaske[1], Prof. Shweta.R.Desai[2]

UG Student, Department of Electrical Engineering, D Y Patil Institute of Engineering and Technology, Ambi, Pune, India[1]

Assistant Professor, Department of Electrical Engineering, D Y Patil Institute of Engineering and Technology, Ambi, Pune, India[2]

ABSTRACT: Electricity plays a very important role in day todays life. This Electricity has several components and equipments helping human to transform and regulate the current flow in their usage. Transformer is very important component as the name suggest they are equipments that allows us to either step up or step down the AC \DC current as well as voltage supplied to important accessories we use every day.

The fault free operation of a power transformer is a factor of major economic importance and safety in power supply utilities. Transformer. transformer is provide electricity as per our requirement it is also called as the heart of electrical system , so it is very important to protection is provided to it .transformer is fail is rarely because is most sustainable device.

So we have to maintain the electrical equipments as per specification we do the testing of transformer for knows the if any failure occurs in future check it out the proper voltage current ratings we knows about healthy operation of transformer hence testing is very important for transformer. In this paper, various important and technical techniques are used to test transformer.

Such techniques used are Open circuit and short circuit test, Magnetic Balance test, transformer back charge test, transformer ratio test, transformer vector group test etc.

KEYWORDS:(Ammeter, MCB, Multifunction meter, transfoermer ratio test, vector group test, short circuit and open circuit test, magnetic balance test etc.)

I. INTRODUCTION

The transformer testing five basic test is carried out that is Open circuit and short circuit test, Transformer Ratio Test, Magnetic Balance Test, Transformer Vector Group Test, Transformer back charge Test. The project topic is "Transformer Testing Kit". The kit is designed for the testing of transformer which is available at different site there it installed and verify the operation of this transformer to check the healthy condition.

This all five test needed different equipments separately because of that increase the cost of transportation, required more men power for that and also chances of damaging the equipment.

Hence we find the solution of that problems that is we designed the transformer testing kit that is so useful on think is more advantage that is only single person carry this kit and taking this tests from th at kit.this kit perform different tests i.e. Open circuit and short circuit test , Mangnetic balance test, Transformer ratio test , transformer vector group test,Transformer Back Charge Test etc.

This kit is designed to test transformer of the ratings of 500 KVA to 20MVA.This methos gives many advantages over the previous tests advantages because previous method is more time wasting and difficult there chances of damage the equipment is more.Now this kit is overcome all that complications and working will done with very less time . At site ,to verify the operation of transformer is very important so by using this testing kit we can verify very easily to this transformer.

II NEED OF PROJECT

The need of transformer testing is very much to check the functioning and healthy operation of transformer. To avoid the accident occur in future transformer testings are taken then we know the operation of it and prevent this fault.so need of testing is very much hence we make a testing kit of transformer by using this we can test the transformer easily.

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III.LITERATURE SURVEY

1] M.Wang and A. Vandemaar published that life of transformer zzcan be as long as 60 years with appropriate maintenance. When transformer is new it has the sufficient electrical and mechanical strength to withstand the stresses of it.To prevent failure preventive maintenance is carried out by using traditional diagonostic techniques for detection of incipient fault in transformer.

2] Shivaji chakravoti has workshop at Mahatransco on condition monitoring of oil-paper composite insulation system of power transformer. He explained various diagnostic techniques used for power transformer.

3] 90 SM 317-8 JAN 1991 REAOSANT POWER SUPPLY KIT SYSTEM FOR HIGH VOLTAGE TESTING ,H.G.GerlachHarns Kull AG,CH-4552 DerendingenSwtzerland.

4] In carring out tests, for three phase transformer, three phase supply is preferable. However,when the test capability do not allow three phase tests in order to ascertain the status the transformer , alternate single phase source can be applied.the transformer under test shall be judged to have performed satisfactorily when the visual inspection and other test criteria have been satisfactorily met.

IV.EQUIPMENT LIST

Material list:

Transformer Testing Range: 500 KVA to 30 MVA

Sr.no	Material	Quantity
1	Encloser/box/body	1 nos.
2	Multifunction Meter	2 nos.
3	Selector switch	2 nos.
4	Indicator 415v	4 nos.
5	1 SQMM Wire	5 Mtr
6	1.5 SQMM/3 core wire	5 Mtr
7	Clamp with lugs	8 set
8	Socket	20 set
9	Printed label	1 set
10	Switch with plug	1 set
11	MCB 1 pole	4 nos.
12	MCB 4 pole	1 nos.
13	CT 50/5	3 Nos

Table.1 Testing Material List

Fig. 1. Transformer Actual View

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V. TYPES OF TRANSFORMER TESTING

1. Open circuit and short circuit test
2. Transformer ratio test
3. Magnetic balance test
4. Transformer vector group test
5. Transformer back charge test

1] SHORT CIRCUIT AND OPEN CIRCUIT TEST

A) Short Circuit test:

The short circuit test is conducted on the high voltage side of the transformer where low voltage side means secondary side is short circuited. A wattmeter is connected on primary side winding. Voltmeter is not needed because applied voltage is sam as reading of voltmeter.

The low voltage (LV) side of the transformer means secondary winding of the transformer is short circuited.Then by using variac applied voltage is slowly increases upto ammeter gives the reading equal to the rated current of the high voltage side of the winding of transformer,if this is done then take the reading of (Ammeter, voltmeter and watt meter) it was recorded. Then after reaching at rated current of high voltage side, all three instruments reading (Voltmeter, Ammeter and Watt-meter readings) are recorded.

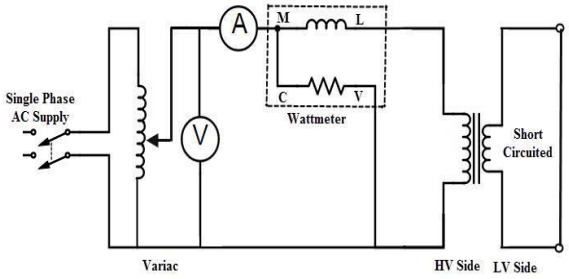

Fig. 2 Short Circuit Test Circuit Diagram

In short circuit test of the transformer the voltage applied for full load current is small to the rated primary voltage of the transformer. The iron losses in transformer can be taken as negligible here. HV/LV jumps and disconnect neutral from the earth/ground. Short low voltage phases and connect these short circuited terminals to the neutral.Wattmeter is indicates the total copper loss of the transformer and iron loss is negligible. Hence it is proved that the copper loss is depends on the current.

Test Procedure:

1] Isolate the power transformer from circuit. Remove HV/LV jumps and disconnect neutral from the earth.
2] Make the Short LV phases and connect these short circuited terminals to neutral.
3] Then energize HV side by LV supply. Measure the current in neutral, HV voltage and HV line currents.
4] Wattmeter indicates total cu loss of the transformer

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Test Result:

Tap	IR	IY	IB	Ir	Iy	Ib	Voltage Applied
1	31.2	31.2	30.8	98.4	97.7	98.4	396
3	34.1	33.6	33.6	103.2	102.4	102.6	
16	62.2	62.1	61.7	141.3	141.2	141.6	

Table.2. Result of short circuit test

B) Open circuit test:

- The open circuit test is carried out by this kit is very easily. by using this test we can find out the shunt and no load parameters of the equivalent circuit of the transformer also this test gives the no load current value and also iron loss is find out by using this test. There by we can determine the no load equivalent parameters with simple calculations.As the name indicates, secondary side of the transformer load terminals of the transformer or secondary of transformer are kept open and the input voltage is applied on the other side. Since this test is carried out by without applying any load, this test is also named as no load test. The open circuit test is carried out by connecting LV side of the transformer to the ac supply by using variac, ammeter and wattmeter instruments. The secondary side of transformer terminals are kept open and in some cases a voltmeter is connected across it to measure the secondary voltage of the transformer.

- In primary side connected the voltmeter that reads the applied voltage to the transformer, ammeter reads the no load current of the transformer, wattmeter gives the input power and the variac used to vary the voltage applied to the transformer so that the rated voltage is applied at rated frequency of the transformer. The OC test arrangement of a transformer is shown in below figure.

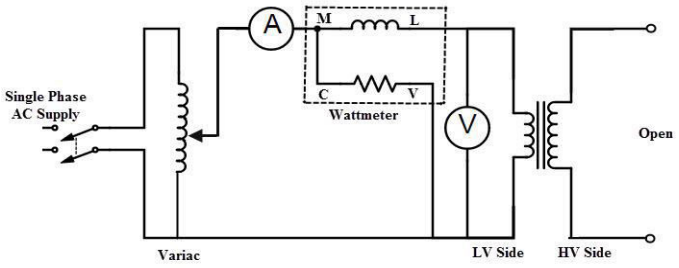

Fig.3. open circuit test circuit diagram

Procedure:

1] Give the supply to the transformer,

2] By using variac rated value of primary voltage is adjust by varying the variac.

3] At this rated voltage, the ammeter and wattmeter readings are to be taken.

4] From this test, we get rated voltage Vo, input or no load current Io and input power Wo.

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2] TRANSFORMER RATIO TEST

The Power transformer turns ratio test is the **AC low voltage test** which can be determines the ratio of the high voltage winding to the all other windings at no-load. The turns ratio test is performed on all the tap of each winding .

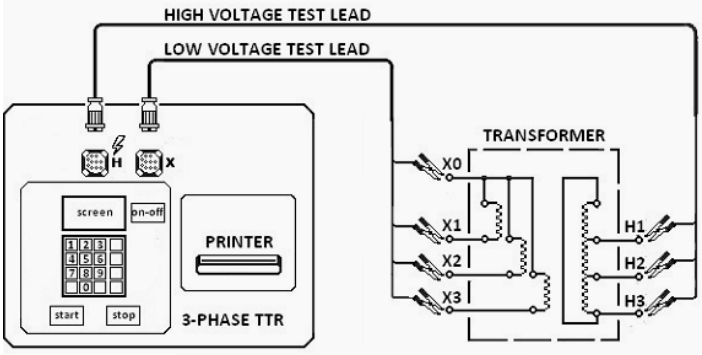

Fig.4 Transformer Ratio Test

The transformer ratio is measurements are conducted on the all the tap positions of winding and calculated by the dividing the induced voltage reading into the applied voltage value.
The turns ratio of a transformer is defined as the number of turns on secondary winding of transformer to the number of turns on its primary winding of transformer.
The voltage ratio of an ideal transformer is directly proportional to the turns ratio:

- Vs/Vp=Ns/Np

The current ratio of an ideal transformer is inversely proportional to the turns ratio:

- Ip/Is=Ns/Np

Where, Vs = secondary voltage,
Vp = primary voltage, Is = secondary current
Ip = primary current Np = number of turns of the primary winding of transformer
Ns = number of turns of the secondary winding of transformer.
By suing turns ratio we knows the transformer if it is step up or step down.

- **Voltage ratio test:**

The Turns ratio of a transformer is the ratio of number of turns in high voltage winding of transformer to the low voltage winding of transformer. By using this testing kit it is very easily taken out.

Procedure:
1] This test verifies or carried out that the transformer windings have the correct number of turns or not so it has to produce the required voltages.
2]The 3 phase 400V ac supply is connected to the primary winding of transformer.
3] When turning ON the supply, voltage starts inducing in the secondary winding of the transformer.
4] The ratio meter, a potential divider on which the tapping are provided, so that the voltage across tapping and voltage applied to the ratio meter are constant ratio.
3] Then by suitably adjusting the voltage ratio of ratio meter the current flowing through the ammeter made zero, which indicates
that the secondary voltage of the ratio meter and transformer under test voltage are equal in magnitude but act in opposite direction.voltage ratio of transformer under test is equal to voltage ratio of ratio meter

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Test Result ;Voltage applied=405 V

Tap	Secondary Measured Voltage					
	Vry	Vrb	Vbr	Vrn	Vyn	Vbn
1	129.1	129.8	129.8	74.2	74.2	73.3
3	133.8	134.4	134.1	76.5	76.6	77.0
16	175.4	175.4	175.4	100.3	100.2	100.4

Table 3. Result of voltage ratio test

3] MAGNETIC BALANCE TEST

The Magnetic balance test is conducted only on the three-phase transformers to check the imbalance in the magnetic circuit of the transformer. The result of this test indicates that the uniform distribution of flux insulation. For this test 3 phase 400V AC is applied to the one winding, then measured the induced voltages on the other two winding on same side of transformer.

Hence ,it cleared that the magnetic balanced test is carried out from HV side of the transformer.it is most important test of the transformer is taken by this testing kit very easily as per proper ways.

Transformer is connected in either two connection.

- Star
- Delta

Star connection:

In case of failure of two phases of transformer (either RY, YB or BR) then only one limb of transformer will produce flux by using the neutral point. The main aim of this test is to proved , that flux produced by one limb is the sum of fluxes of the other two limbs. Then if it is proved we can say that the core of the transformer is in the healthy condition.

Delta Connection:

In case of failure of one phase of transformer (either R, Y, or B) then only one limb of the transformer will produce flux and the remaining two limbs will provide the return path for that flux produced by that one limb. The main aim of this test is to prove, flux produced by one limb is the sum of fluxes of other two limbs so that the we can say that core don't have any problem for path of the flux it is in good condition.

Test procedure:

1]First apply the 3 phase 415V voltage to primary winding of transformer and then remove the any one phase for delta connection winding and remove any two phase for star connection winding.

2] Then note down the voltages in three phases by using multi meter in primary winding and secondary windings of the transformer.

3] line to line voltage in case of delta connection of transformer is measured.

4] line to neutral voltage in case of star connection of the transformer is measured.

5]Repeat the same procedure for the remaining two cases.

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Testresult

Tap No.	Voltage Applied Across	Voltage measured		
1	R-Y	400	283.3	114.4
	Y-B	188.3	401	211.3
	B-R	103.3	296	401
3	R-Y	401.5	289.6	110
	Y-B	190.7	401.5	208.6
	B-R	102.2	296.5	112.6
16	R-Y	401.1	285.6	112.6
	Y-B	187.6	401.1	210.5
	B-R	98.2	301.6	401.4

Table.4. Result of Magnetic Balance Test

4] TRANSFORMER VECTOR GROUP TEST

Vector group test is done when the parallel operation of three phase transformer is connected in the electrical power system.

There are different ways of connecting three phase transformers with the phase shift of 0,±30 and 180 degree .This phase shift is due to the different ways for connecting the primary and secondary windings of the transformer.

The transformer vector group test is the International Electrotechnical Commission (IEC) method of categorizing the high voltage (HV) windings and low voltage (LV) winding configurations of the three-phase transformers of the system.

The transformer vector group test is indicates that the windings configurations and the difference in phase angle between them.

Example: a wye HV winding and delta LV winding with a 30-degree lead is denoted as "Yd11"

PROCEDURE:

1. First apply maximum LV voltage that is available from power supply on HV side of transformer.
2. The Voltage should in the range of 430V to 450V. when higher the voltage then higher the measurement accuracy.
3. Then voltages should be balanced. For calculation purposes, the average of three phase or line voltages as measured is used.
4. It is very important that, the phase sequence of applied voltage is to be positive sequence that is by using phase sequence meter.

YNd_{11} transformer.

1. Connect neutral point of star connected winding with earth.
   Join 1U of HV and 2W

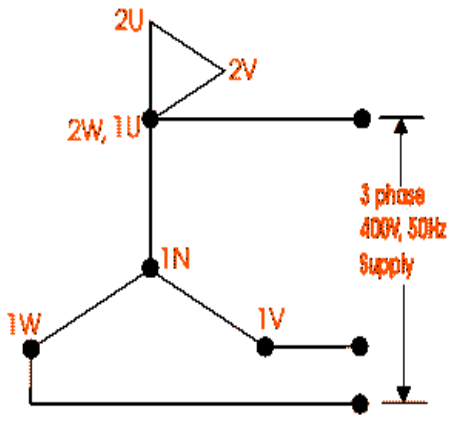

Fig.5 Transformer Vector Group Test

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2. Apply 415 V, three phase supply to HV terminals.
3. Then measure voltages between terminals 2U-1N, 2V-1N, 2W-1N, that means voltages between each LV terminal and HV neutral.
4. Also measure voltages between terminals 2V-1V, 2W-1W and 2V-1W.

RESULT:

Voltage	LoadShared	Ammeter	Ammeter
230	1.5	0.8	0.8
230	1.5	1.1	1.1
230	1.5	1.5	1.64

Table.5. Result of Vector Group Test

Need of test:

All the transformer should have the same vector group, while connecting in parallel, otherwise the large circulating currents will flow because of that the short circuit in the transformer.

5] TRANSFORMER BACK CHARGE TEST

The transformer back charge test is most important test this can also taken by using this transformer testing kit. When the transformer is installed newly then first check its current of each phase because we check if it is ok or not.
For back charge test give the reverse wiring to the transformer if the transformer is step down then give the high voltage to the LV winding and it act as step up transformer and low voltage to the HV winding so at low voltage side having the high voltage but current rating is low hence we easily check the current by using ammeter.

When transformer is back fed, the compensated winding is work against the user. Not only does the 3-5% drop is occur this winding ratio also add the 3-5% of voltage drop.
As result, back fed transformer can have 6-10% of voltage drop at the full load condition this can be adjusted by using the tappings of transformer if available .
We check the current of each winding that was same for each transformer winding is necessary . If it is not same ,means one phase reading was high and another phaehaivg low current then it is consider that the transformer is damaged or some problems occurs in it .

Hence we can say that back charge test is carried out for checking the healthy condition of the transformer. when we installed transformer then first give the back charging to it ,it is necessary.

PROCEDURE

[1] Give the high voltage at LV winding and give the low voltage at HV winding.
[2] When give the high voltage to LV winding then its current value is less because voltage is high hence we measure the current value.
[3] Measure the current value of each phase of transformer,note down it
[4] check the reading off this three phases same or not , if it is not same then some problems are in the transformer occur if it is same then transformer is ok or safe.

Result:
In this test measured the current of each phase of transformer winding.

Applied voltage	Ir(Amp)	Iy(Amp)	Ib(Amp)
415	1.6	1.6	1.6

Table.6. Result of Back Charge Test

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VI. RESULT

This paper is giving us the correct technique of testing and taking the five test on a single transformer testing kit.
This testing kit is made for checking the healthy condition of transformer.
We have to take the five main tests of transformer from this testing kit by taking this test we know the healthy operation of transformer and also we know if any fault occurs in future.
Hence result of this kit is to know the performance of transformer at site, we came to know quality of product and prevent the accident.

Hence this project is so useful because the transformer is the heart of electrical system so it is very necessary to maintain the transformer as per its specifications

VII. CONCLUSION

1. This project mainly aims at reducing the failure of transformer in the future for that monitoring the transformer by using this five tests i.e. Transformer short circuit and open circuit test, Magnetic balance test, Transformer ratio test , Transformer vector group test, Transformer back charge test etc
2. After the completion of our project, the testing process will be improved.
3. In previous methods as we had to carry different testing equipment's for various tests which causes trouble to carry huge luggage while going on site and there will be more chances of the equipment gets damaged. But using this kit the danger of equipment's getting damaged is reduced.

VIII. FUTURE SCOPE

WE can use PLC SCADA for the automatic operation of this testing kit that displays the value of testing parameters on the screen.

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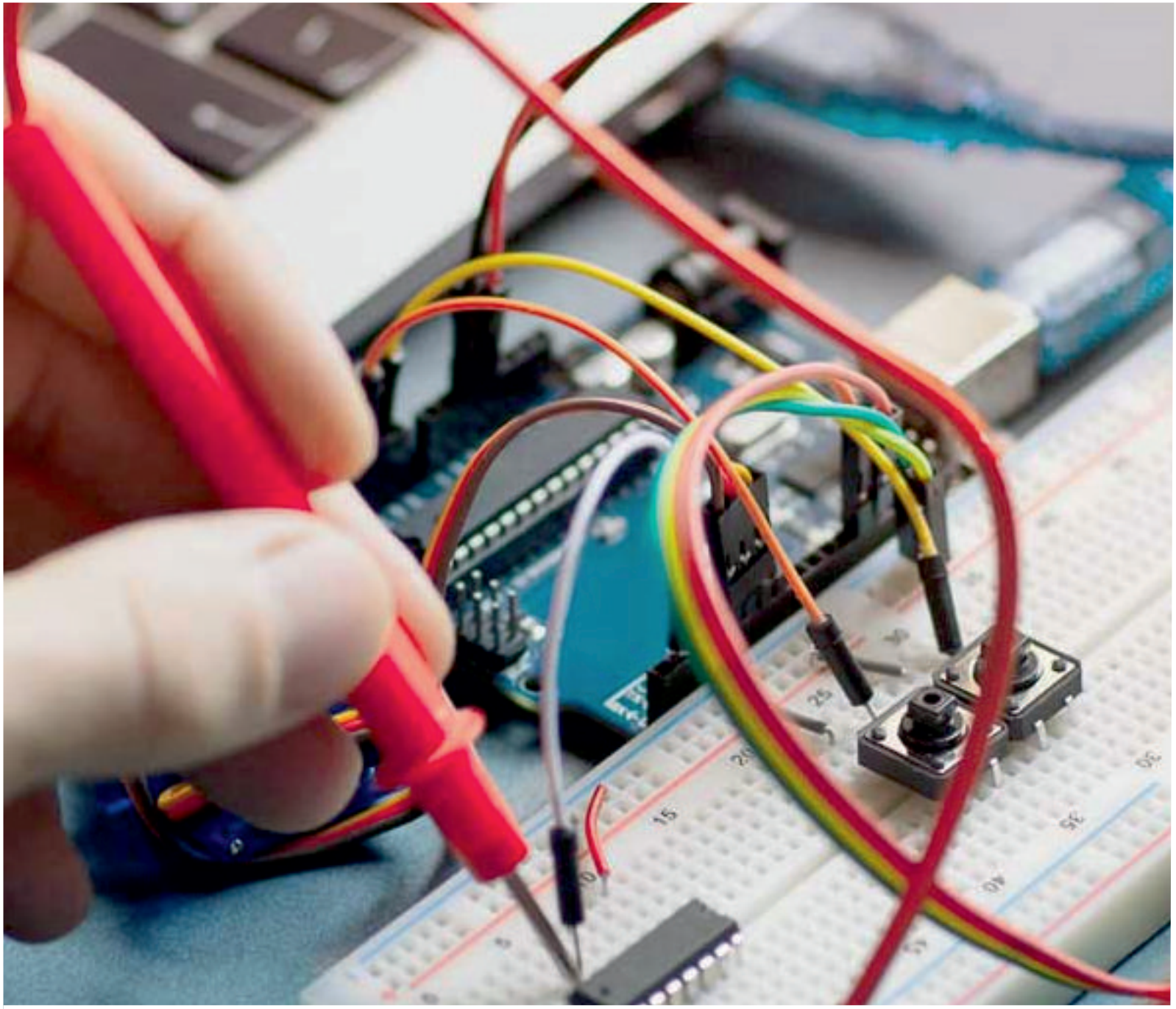

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