



Transformer Oil Breakdown Voltage Tester With Results On Mobile

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ABSTRACT :

Transformers play an important role in electrical systems and are an integral part of the system. Electricity production, transmission and distribution are done by increasing or decreasing the voltage according to need, with the help of transformers. All power transformers are oil- cooled, and the oil used for cooling and insulating the transformer windings must be tested at every maintenance program. The traditional way of using breakdown voltage tester to test the transformer oil is accurate but when it comes to reading the bdv value from the analog voltmeter human mistakes can happen. so in this project we modified the BDV tester to use digital voltmeter and a module that can send the test results on mobile phone. By using the developed transformer bdv test device, the voltage breakdown can be read accurately and a message is sent to the mobile phone directly.. Compared to traditional methodology of reading the values and writing it down, this modified transformer oil bdv testing systems eliminates the hassle..

INTRODUCTION :

In Electrical Engineering transformers are the core part of system, the power transformers used for step up and step down the voltage needs to be working at there optimal efficiency, the majority of transformers are oil cooled, the power transformers at generating and substations are Oil natural air forced (ONAF), the oil used in transformers is mineral oil having chemical name hydrotreated light naphthenic distillate, the transformer oil also known as insulation oil, is responsible for cooling and insulation of the transformer windings and the core more specifically known as transformer coolant.

Transformer oil not only helps to preserve the core and windings which are fully immersed in oil, but also prevents direct contact of atmospheric oxygen which causes oxidation of cellulose made paper insulation around the winding. The oil can get contaminated by the dust dirt debris moisture and gases present in the transformer housing.

The transformer oil needs to be tested and filtered in every periodic service, the oil is tested by using a BDV Tester by applying a high voltage of upto 60kv to the oil taken from transformer, the voltage is increased gradually untill the breakdown occurs in the oil, that voltage is noted down manually by reading the analog voltmeter, but in our project we've used a digital display that will show accurate readings and instead of noting down the readings manually the read data will be sent on the mobile number set in arduino uno, the gsm module attached to arduino will send the reading of bdv tester to the mobile phone.

By this way the voltage readings will be accurate and there will be no chance for error to happen while testing the oil with faster operation and no space for human error, taking accurate readings will help taking better decisions for the transformer oil if to replace it filter it will be easy.

MODIFIED TRANSFORMER OIL BDV TESTER DIAGRAM:

Figure below shows Transformer oil BDV tester with result on mobile block diagram, In this project we are using Transformer BDV tester which has analog output is modified and connected to A/D converter which is then connected to digital display where we get the accurate digital value.

The BDV tester can inject up to 60Kv of voltage in the transformer oil test cell, the analog signal from tester is provided to the Arduino uno which is the latest board from Arduino, the analog signal is provided to the input analog pins of Arduino, the signal is then passed on to the GSM module sim900 sim 800 which supports 2G network for calls and SMS incoming and outgoing, the GSM module can work on 12 v power input, a sim card is to be inserted in the module with active SMS plan.

When the transformer oil bdv test is completed the bdv voltage is displayed on the digital display and same value is sent as input signal to Arduino board which then forwards the value to GSM module that sends SMS on user's mobile phone.

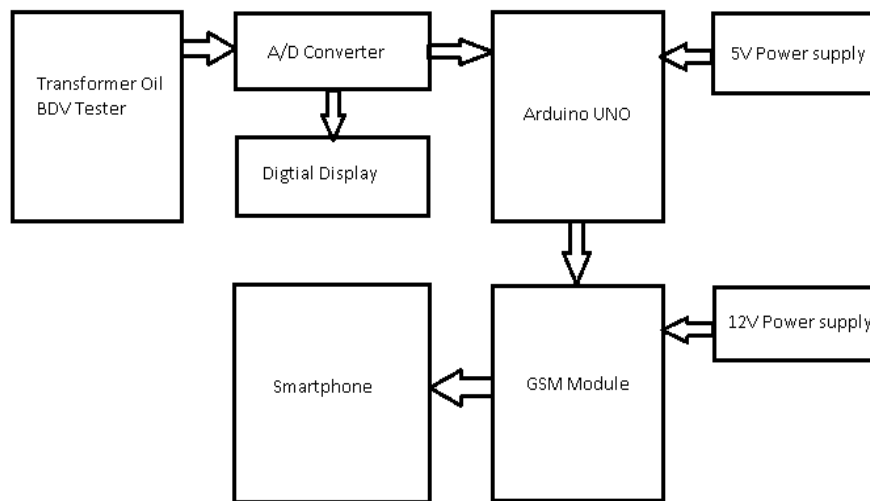


Fig.1. Transformer Oil Breakdown Voltage Tester With Results On Mobile

WORKING PRINCIPLE :

To assess the insulating property of dielectric transformer oil, a sample of the transformer oil is taken and its breakdown voltage is measured. The lower the resulting breakdown voltage, the poorer the quality of the transformer oil.

The transformer oil is filled in the vessel of the testing device.

Two standard-compliant test electrodes with a typical clearance of 2.5 mm are surrounded by the dielectric oil.

A test voltage is applied to the electrodes and is continuously increased up to the breakdown voltage with a constant, standard-compliant slew rate of e.g. 2 kV/s.

At a certain voltage level breakdown occurs in an electric arc, leading to a collapse of the test voltage.

An instant after ignition of the arc, the test voltage is switched off automatically by the testing device. Ultra fast switch off is highly desirable, as the carbonisation due to the electric arc must be limited to keep the additional pollution as low as possible.

The transformer oil testing device measures and reports the root mean square value of the breakdown voltage.

After the transformer oil test is completed, the insulation oil is stirred manually and the test sequence is performed repeatedly: typically 5 repetitions, depending on the standard.

As a result the breakdown voltage is calculated as mean value of the individual measurements.

COMPONENTS REQUIRED :

1) Transformer oil bdv tester

The BDV of transformer oil is the breakdown voltage of transformer oil. The BDV or dielectric strength of oil is the maximum voltage withstand capacity of the oil without breakdown. BDV test of transformer oil is very important for the trouble-free operation of the transformer. Therefore, periodical testing of the transformer oil BDV is compulsory for ensuring the healthiness of the transformer oil. As per IEC, the minimum BDV of transformer oil should be 30 KV as per transformer oil BDV test standard.

The dielectric breakdown voltage test is a quick and easy way of determining the contamination in the transformer oil. Water is the major contaminant. However, other contaminants like conductive particles, dirt, debris, insulating particles, and by-products of oxidation and aging of the transformer oil can deteriorate the dielectric strength of the mineral-insulating transformer oil.

The sample is taken out from the transformer tank, and the BDV of the oil is checked by the BDV tester. The BDV test kit is basically a high-voltage unit, and the voltage can be regulated from 0–70 KV. The BDV tester has two electrodes separated by 2.5 mm.



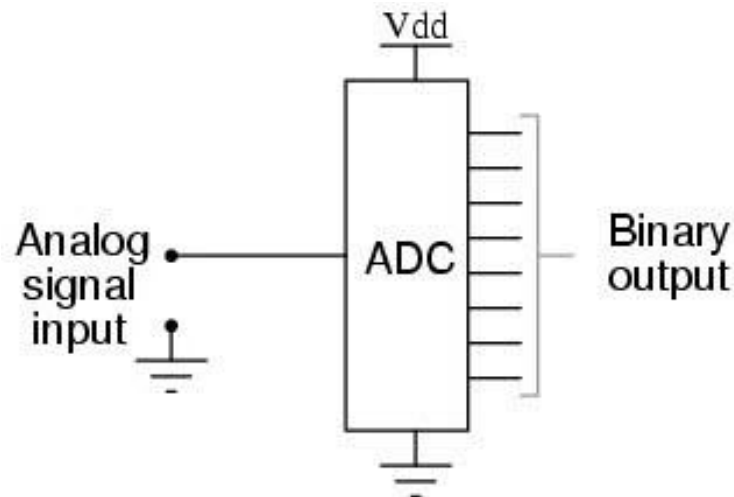
2) *Arduino uno*

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.



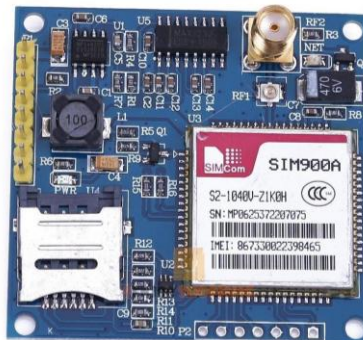
3) *A to D converter*

A converter that is used to change the analog signal to digital is known as an analog to digital converter or ADC converter. This converter is one kind of integrated circuit or IC that converts the signal directly from continuous form to discrete form. This converter can be expressed in A/D, ADC, A to D. One of the major benefits of ADC converter is the high data acquisition rate even at multiplexed inputs. With the invention of a wide variety of ADC integrated circuits (IC's), data acquisition from various sensors becomes more accurate and faster. Dynamic characteristics of the high-performance ADCs are improved measurement repeatability, low power consumption, precise throughput, high linearity, excellent Signal-to-Noise Ratio (SNR), and so on. First, the analog signal is applied to the first block namely a sample wherever it can be sampled at an exact sampling frequency. The amplitude value of the sample like an analog value can be maintained as well as held within the second block like Hold. The hold sample can be quantized into discrete value through the third block like quantize. Finally, the last block like encoder changes the discrete amplitude into a binary number.



4) Gsm module

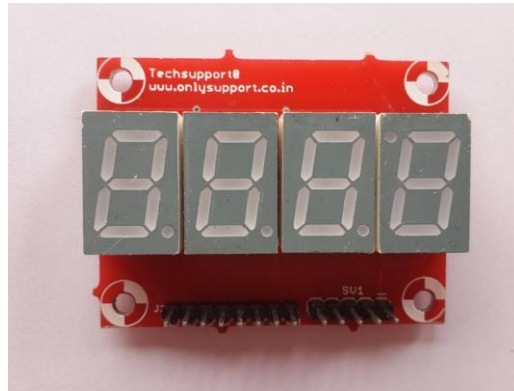
SIM900A Modem is built with Dual Band GSM/GPRS based SIM900A modem from SIMCOM. It works on frequencies 900/ 1800 MHz. SIM900A can search these two bands automatically. The frequency bands can also be set by AT Commands. The baud rate is configurable from 1200-115200 through AT command. The GSM/GPRS Modem is having internal TCP/IP stack to enable you to connect with internet via GPRS. SIM900A is an ultra compact and reliable wireless module. This is a complete GSM/GPRS module in a SMT type and designed with a very powerful single-chip processor integrating AMR926EJ-S core, allowing you to benefit from small dimensions and cost-effective solutions.



5) Digital display

The 7-segment display, also written as “seven segment display”, consists of seven LEDs (hence its name) arranged in a rectangular fashion as shown. Each of the seven LEDs is called a segment because when illuminated the segment forms part of a numerical digit (both Decimal and Hex) to be displayed. An additional 8th LED is sometimes used within the same package thus allowing the indication of a decimal point, (DP) when two or more 7-segment displays are connected together to display numbers greater than ten.

Each one of the seven LEDs in the display is given a positional segment with one of its connection pins being brought straight out of the rectangular plastic package. These individually LED pins are labelled from a through g representing each individual LED. The other LED pins are connected together and wired to form a common pin. So by forward biasing the appropriate pins of the LED segments in a particular order, some segments will be light and others will be dark allowing the desired character pattern of the number to be generated on the display. This then allows us to display each of the ten decimal digits 0 through to 9 on the same 7-segment display.



6) Power supply

A power supply or a power adapter is an AC to DC which can be of 230v to 12v , 5v, 24v, etc. Here we are required a 12 v dc power supply. The 230v ac supply is supplied to the fuse on live and neutral terminal then a double bridge rectifier is connected, which converts it to dc, a capacitor is used to filter out any noises in the supply, then the supply is provided to the step down transformer which reduces the voltage to around 15v for 12v supply, then an zener diode is connected in parallel to clamp the extra 3v and we get around 12.6v the supply is finally filtered again using capacitors and given to output.



ADVANTAGES, DISADVANTAGES AND APPLICATIONS :

Advantages

1. Improve Transparency In Oil Testing
2. Reliable And Accurate Measurements
3. Time To Manually Write Readings Is Saved
4. Results Are Received On Mobile For Cross Verification
5. Ideal For Continuous Operation
6. No More Random Values In Maintainance Sheet
7. Easy To Implement The Circuit In Any Bdv Testing Kit

Disadvantages

1. Arduino Code Need Modification Everytime When Registered Mobile Is To Be Changed .

Applications

1. Transformer oil filtration in industries, factories, substations, laboratory and educational institutions.

CONCLUSIONS :

The main aim behind this capstone project was to design a system or plug and play module that will be installed in the bdv tester to make the function of it better and enhance the user experience while testing the transformer oil.

The project also aims to reduce the human mistakes made during taking the test results with the human eyes which might sometimes mistaken the analog output readings.

FUTURE SCOPE :

It is undeniable that there is still work to be done and further research to be made. The largest challenge or limitation that we faced during this project was the unavailability of some important equipment. In the future, this project can be developed further at a larger scale with the availability of all necessary parts. That being said, this capstone project was an amazing and fun experience overall, it allowed me to put to practice a large array of concepts that I have learnt throughout my degree, as well as to discover some new ones and apply them.

ACKNOWLEDGEMENT :

The acknowledgment section for a Transformer oil bdv tester with results on mobile project typically includes recognition of those who contributed to the project's success, such as financial supporters, technical advisors, and research participants. This section may also express gratitude to institutions that provided resources or facilities for the project. Research papers often include this section to give credit to individuals, organizations, or agencies. It is an important part of scholarly writing, highlighting the collaborative nature of scientific work.

REFERENCES:

- 1) https://datasheetspdf.com/datasheet/search.php?sWord=sim900a&gclid=EAIaIQobChMIgMv_i-n8ggMV4CWDax2lcwbLEAAYASAAEgLuvfD_BwE
- 2) <https://www.sigmatest.org/transformer-oil-testing-india.html#:~:text=BDV%20test%20means%20the%20Breakdown,dielectric%20Strength%20of%20Transformer%20Oil.>
- 3) <https://www.mahadiscom.in/supplier/wp-content/uploads/2020/05/OIL-BDV-TESTER.pdf>
- 4) <https://www.kritester.com/new/How-to-test-transformer-oil-breakdown-voltage-by-oil-BDV-tester.html>
- 5) <https://docs.arduino.cc/hardware/uno-rev3>
- 6) <https://www.arduino.cc/en/Guide/ArduinoUno>
- 7) <https://www.learnrobotics.org/blog/four-steps-to-writing-an-arduino-program>