Design Of Current Limiting Transformer Using Virtual Air Gap

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Abstract- *In this paper the new concept of fault current limiting in transformer is explained which results in lowering the risk and cost for the equipment's used in power system. In this invention, the fault current limiting capability is enabled in power transformers by adopting the theory of virtual-air-gap (VAG) in electromagnetic core of transformer. The concept of VAG is to saturate a certain portion of the magnetic core to change the reluctance of magnetic loops. VAG is not an actual air gap but a saturated portion of the magnetic core, which restricts the magnetic flux to follow through it. In power transformers, electric power is transferred between electric windings through the magnetic core interface. By changing the dc current, the redistribution of magnetic flux and isolation between the electric windings can be achieved. The power rating of the power electronics drive in VAG can be much smaller than the power rating of power transformers, which would greatly reduce the cost of device.*

Keywords- CSTR-PID-ZN-Fuzzy-MRAM-MATLAB.

I. INTRODUCTION

In core transformer the Virtual Air Gap is used to saturate a certain portion of the magnetic core to change the reluctance of magnetic loops. VAG is not an actual air gap but a saturated portion of the magnetic core, which restricts the magnetic flux to follow through it. In power transformers, electric power is transferred between electric windings through the magnetic core interface.

The Virtual Air Gap concept was originally used to limit inrush currents in transformers. These auxiliary windings locally saturate the core and act as a virtual air gap to alter reactance. There is an AC voltage induced onto the auxiliary windings it is difficult to provide a controllable DC current from a prepackaged DC voltage source

II. IDENTIFY, RESEARCH AND COLLECT IDEA

When the fault is occur then the dc winding circuit are ON and the core between primary and secondary winding the virtual air gap is created are non-conducting part acts. The BH-cure are only half part that is I-quadrant current control.

A virtual air gap describes a physical portion of a magnetic core that behaves similarly to a real air gap.

This behavior is accomplished by saturating a local region using embedded DC windings within the core.

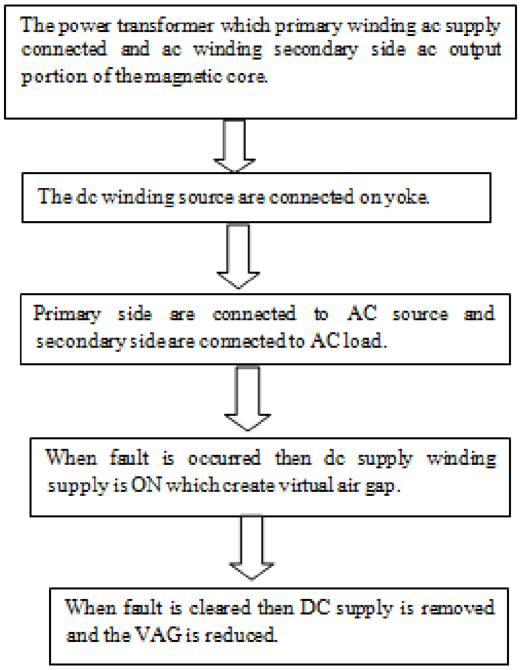


Figure 1 flowchart

For instance, if a DC flux was added to the circuit, this would increase the core saturation level and decrease the permeability, thereby increasing reluctance. If this were done only locally, then the effect would be similar to adding an air gap. This is the essence of the concept of a virtual air gap. A pair of DC windings is embedded in the core such that they produce opposing DC flux which cancels in the whole of the core. A virtual air gap becomes less effective as the saturation in the local region surrounding the windings increases due to Core portion showing local relative permeability due to embedded DC current windings DC winding current = 2A. Core portion showing local relative permeability due to embedded DC current windings) the main AC flux. This is due to the already reduced permeability in the local area before addition of DC flux. One practical use of the virtual air gap that has been documented is in the reduction of inrush current in transformers, where for control purposes, an equivalent air gap length was computed.

The LCD are show the fault current and voltage and current limiting time. This LCD are connected to NANO 3 IC which is separately programed for voltage and current. The NANO3 required 5-volt dc supply so the step down transformer are used which is rating of 230/12V, 2A this supply is filter by using rectifier and stable dc supply by using regulator. Arduino software is used to write program in Arduino Nano3.

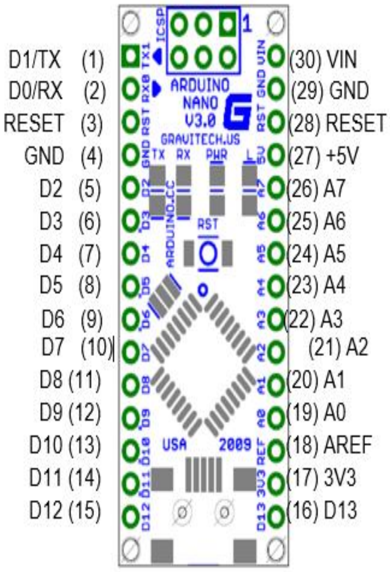


Figure 2 arduino nano 3

Pin No.	Name	Type	Description
1-2, 5-16	D0-D13	I/O	Digital input/output port 0 to 13
3, 28	RESET	Input	Reset (active low)
4, 29	GND	PWR	Supply ground
17	3V3	Output	+3.3V output (from FTDI)
18	AREF	Input	ADC reference
19-26	A0-A7	Input	Analog input channel 0 to 7
27	+5V	Output or Input	+5V output (from on-board regulator) or +5V
30	VIN	PWR	Supply voltage

Table 1 arduino nano 3 pin description

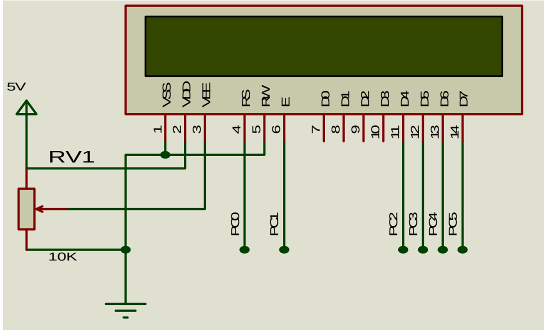


Figure 3 lcd interfacing

The interfacing between the Arduino Nano3 microcontroller and LCD as following:

The reset pin of microcontroller is connected to pin no2 of LCD. Enable pin is connected to pin no3and data pins D4 toD7 are connected to pin no 4,5,6,7 respectively.

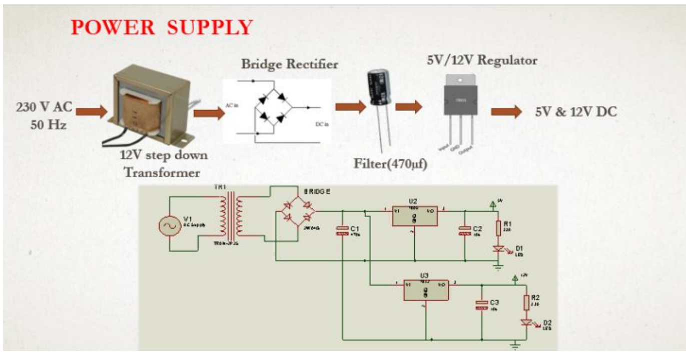


Figure 4 power supply circuit

This power supply is given to Arduino Nano 3 & LCD. The 230 v AC supply is given to the transformer which is step down & convert it to 12 v. This 12 v AC supply is converted into DC with the help of bridge rectifier. The Harmon present in the DC supply are removed by the filter circuit, for filter circuit we have used a capacitor of rating 470 microfarad. The stable 5v DC supply is obtained by regulator circuit. This 5v DC supply is provided to Arduino Nano 3 for its operation.

Figure 5 relay

An electromechanical relay contains an electromagnetic coil (right side of image) that moves a metal arm to make and break an electrical connection.

Electromechanical relays can be used to switch high current and also AC devices.

They provide electrical isolation between the control signal and the load and are relatively low cost.

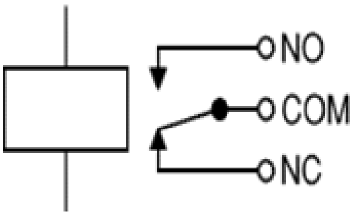


Figure 6 relay contact

The relay's switch connections are usually labelled COM, NC and NO:

- COM = Common, always connect to this; it is the moving part of the switch.
- NC = Normally Closed, COM is connected to this when the relay coil is off.
- NO = Normally Open, COM is connected to this when the relay coil is on.

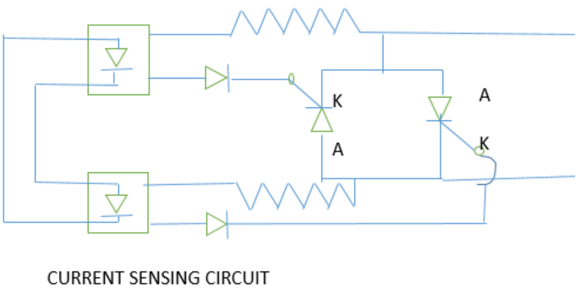


Figure 7 current sensing circuit

Current sensor device is designed and compared with the multi meter for calibration, so that the readings will be more accurate. Virtual air gap created in transformer core, experiment results that the fault current is limited by 35-40%.

Short circuit current is 2 Amp. & the current limited by 1.7 Amp.

The virtual air gap fault current limiting response time is very less. The virtual air gap fault current limiting is quick working action as before circuit breaker trip.

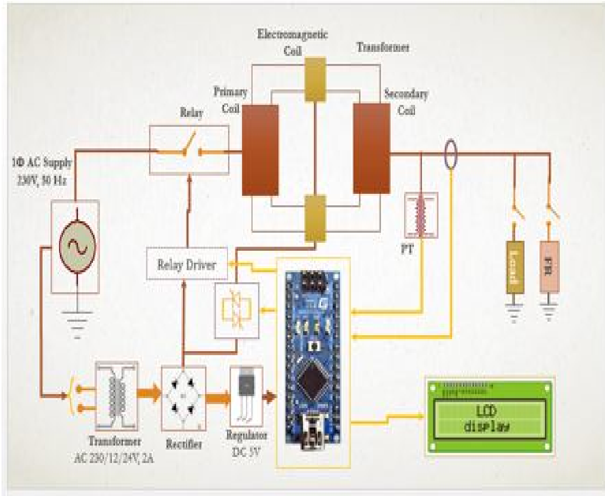
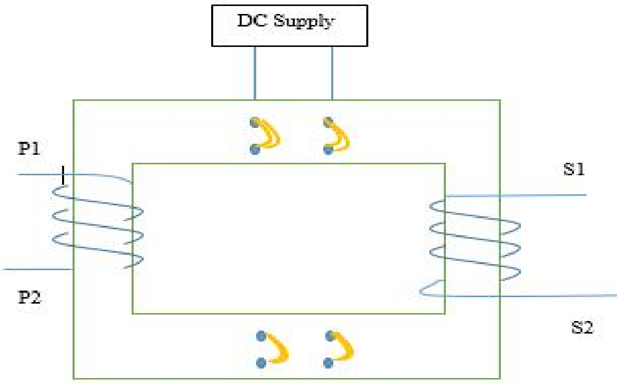


Figure 8 block diagram of t/f with vag

Fig. shows the block diagram of Current Limiting Transformer with Virtual Air Gap. A single phase 230v supply is given to the primary side i.e. P1 & P2. On secondary side we get 230v. A third winding i.e. Dc source winding is connected between primary and secondary winding on the yoke. Four holes are formed on the transformer yoke to place the DC source winding. This winding is energized by a DC source in case of fault & creates a reluctance for the flow of flux which will ultimately reduce the fault current. When fault is removed then the DC source is disconnected and transformer operation continuous as normal. The operation of ON/OFF of DC source performed automatically with the help of microcontroller & the parameters are shown on LCD like fault current, transformer normal output current, fault limiting time.



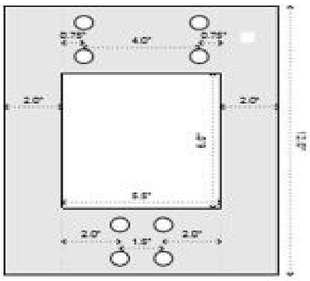


Figure 9 core design

Fig. 9 shows the connection of DC source winding & required specification of core.

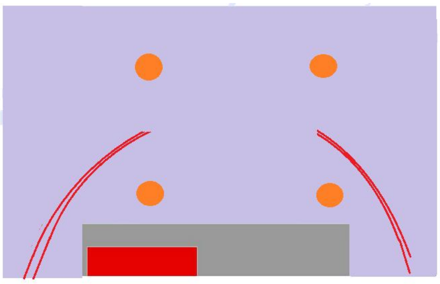


Figure 10 flow of flux with dc source winding

When fault is occurred DC source winding is energized & flux are cut within 0.02 seconds as shown in fig. 10.

Figure 11 arc production in isolator

Above fig. shows the arc production in isolator when contacts are opened & air acts as a conducting medium for few seconds which is a hazard for costlier equipment's.

III. GETPEERREVIEWED

We design of current Limiting Transformer using Virtual Air Gap. This technique reduces harmonics and better than other.

IV. CONCLUSION

The basic operation and performance of a prototype Virtual Air Gap is presented. Dc winding's response time is too fast than the circuit breaker. It is protected to system and reduces the cost of heavy equipment's. More safe and automatic and advance system.

V. APPENDIX

In paper "Novel power transformer with fault-current-limiting capability" Dr. Yucheng Zhang Assistant Professor Electrical and Computer Engineering (ECE) demonstrated a methodology and some considerations in this the fault current decrease enabled in power transformers.

VI. ACKNOWLEDGMENT

The preferred spelling of the word "acknowledgment" in American English is without an "e" after the "g." Use the singular heading even if you have many acknowledgments.

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