

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

**NCAEE 2017** 



National Conference on Advances in Electrical Engineering NMAM Institute of Technology, Nitte Vol. 5, Special Issue 2, April 2017

# MATFORM: Tool for Modelling of Transformer in MATLAB

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Abstract: MATLAB software widely used for the simulations of electrical distribution network. It meets all the necessary requirements for power system simulations. But most of the users make use of default values available in the blocks in their model. This document gives the information about the tool developed for the modelling of the transformer in MATLAB which is named MATFORM.

Keywords: MATFORM, MATLAB, MATHWORK, Transformer, Modelling.

## I. INTRODUCTION

Power system simulation is one of the essential things to B. Modelling in MATLAB do for the validation of any system circuit model. There The modeling here is done using the SimPowerSystems® are different software in which it is done. MATLAB is the Library. The models made are meant to represent the most preferred one. There are many blocks present in MATLAB which can be used to develop the required model. But most of the times the difficulty lies in modelling of the components.

The parameters present in MATLAB blocks are difficult to understand and change. And hence many people tend to use default parameters. The MATFORM tool is developed so that person can use the transformers real manufacturing data to insert in MATLAB models. By doing this we can make MATLAB model as real as possible to the actual network.

## **II. ELECTRICAL POWER SYSTEM**

Electrical power system consists of many segments right from the generation, transmission to distribution. Protection of this system is very vital and now as nation is heading towards the Smart Grid the development in power system networks is getting more focused.

## A. Power system simulator

MATLAB is an acronym for MATrix LABoratory and is a high-performance language for technical computing computation, visualization, and integrating the programming environment. MATLAB's broader platform gives a better degree of simulation and because of more components to choose while making the models, multiple making use of all those formulae. In the first sheet there test cases are possible.

MATLAB updates its software database regularly and B. The Tool GUI significantly providing the users with additional packages The tool GUI gives the interface to put inputs and it gives which are an obvious advantage.

transient conditions of an actual system. But the simulation results vary from the actual results. This occurs due to use of default parameters in simulation blocks hence modeling have to be done. This modeling normally is very difficult due to the parameters which are present in blocks.

Hence for modeling of the transformer we have developed a tool by using visual basic tool of Microsoft excel.

## **III. MATFORM**

In simulation of a distribution network many components and blocks are present. We have developed the tool taking transformer into consideration. The description of the tool is given in detail. The tool is developed by using the visual basic coding tool in Microsoft excels. It consists of 5 parts which are the 5 sheets which covers the transformer block parameters in detail.

## A. Introduction of MATFORM

The introduction sheet gives the details of how to use the tool what all are the input and outputs. This programmed is developed to generate MATLAB transformer block parameters from the manufactures data. The block parameters which we have to insert in MATLAB are not available from the manufacture's data. So it has to be calculated using different formulae. This GUI is made by are also keys to navigate to and fro. (Refer Figure 1)

output. The inputs which GUI ask are no load loss, no load



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National Conference on Advances in Electrical Engineering

NMAM Institute of Technology, Nitte

Vol. 5. Special Issue 2. April 2017

magnetising resistance. magnetising inductance of HV side and inductance of LV side. The formulae which are required to do the calculation are E. Saturation characteristics running into background. These parameters can be The transformer block parameters can be changed in order inserted into MATLAB model and the model can be made to simulate saturation of transformer core. For simulation close to actual model. Figure 2 shows the GUI page of the of saturation of core we need to put saturation MATFORM.

#### C. Parameters

The third page of the tool gives information about the parameters which transformer block requires. It shows transformer parameter block. The parameters required are power of the transformer, frequency of the transformer, Magnetising inductance, magnetising resistance, voltages, and resistance of both the windings and inductances of both the windings. There are also provisions to simulate F. B-H curve saturation characteristics of transformer. Figure 3 shows As I-Phi curve is coinciding with the B-H curve we tried tool interface for parameters detailing

#### D. Test Certificate

The tools works on the inputs which can be obtained from further simulation. Figure 6 shows the B-H curve page of the transformer test certificate. The test certificate is the tool present with all the transformers. And the tests which are carried out are the routine test as per the standards. The G. Validation standard followed is IEC 60075-1 Clause 11.4 and 11.5. The open circuit test was developed and run successfully Open circuit test and the short circuit test are conducted on with help of this tool and the result where within 5% of the the transformer. In open circuit test the HV side winding is required value the model image is shown in Figure 7. kept open and rated voltage at rated frequency is applied at

voltage no, load current load loss load loss current and the LV winding side. For short circuit test the LV winding turns ratio. This parameters are available on the is short circuited and the rated current is applied to HV transformer test certificate the output of the GUI is the side. Page three of the tool shows the example of inductance, transformer test certificate and is shown in Figure 4.

characteristics. This can be obtained by B-H curve of the transformer core. But parameters which MATLAB requires are in terms of current (I) and magnetic flux (phi). After searching for the relation between the B-H curve and the I-phi curve on the MATHWORK website we came on conclusion that this two curves coincide with each other. This is explained in page 5 of the tool as showed in Figure 5

to find more relation and in next page of the tool we have given B-H curve for different materials which are been used in distribution network so that user can use them for

Disclaimer: This program is provided as is, without warranty, either								
expressed or implied. It does not purport to be free of errors.								
Therefore, its use is the sole responsibility of the user.								
MATLAB allowes us to perform simulations to great extent. But mostly the simulation results vary from the actual results. This occurs due to use of default parameters in simulation blocks. So in this attempt is made to use the manufacture's data in MATLAB simulation								
This program is devloped to generate MATLAB transformer block parameters from the manufactures data								
The block parameters which we have to insert in MATLAB are not available from the manufacture's data. So it has to be calculated using different formulae. This GUI is made by making use of all those formulae.								
Instruction to use this GUI ie. MATFORM one have to enter the following inputs								
no load power(PnI),voltage(VnI),current(InL) full load power(PfI),current(IfL) Turns ratio								
This input values are present on the test certificate of the transformer								
To navigate to MATFORM click here								
GO TO MATFORM								
This program can be used to simulate saturation characteristics of transformer; to know more about it click below								
Saturation char.								
To know more about transformer block parameters click below								
Parameters								
To know about transformer tests and transformer test certificcate click below								
Transformer test								
Figure 1: Introductory Page of the MATFORM tool								



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Electrical, Electronics, Instrumentation and Control Engineering



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Vol. 5, Special Issue 2, April 2017



Figure2: MATFORM GUI

Block parameters of transformer

#### The dialogue box of matlab block parameters of transformer is shown below:

r		
I	Block Parameters: Three-Phase Transformer (Two Windings)	the rec
I	Three-Phase Transformer (Two Windings) (mask) (link)	
I	This block implements a three-phase transformer by using three single-phase	power
1	transformers. Set the winding connection to 'Yn' when you want to access the	voltage
ł	neutral point of the Wye.	voltage
	Click the Apply or the OK button after a change to the Units popup to confirm the conversion of parameters.	resista
	Configuration Parameters Advanced	and ma
	Units SI 🔹	resista them f
	Nominal power and frequency [ Pn(VA) , fn(Hz) ] [ 250e6 , 60 ]	saturat
1	Winding 1 parameters [ V1 Ph-Ph(Vrms) , R1(Ohm) , L1(H) ] ++05 4.3218 0.45856]	
1	Winding 2 parameters [ V2 Ph-Ph(Vrms) , R2(Ohm) , L2(H) ] +05 0.7938 0.084225]	
I	Magnetization resistance Rm (Ohm) 1.0805e+06	
	Magnetization inductance Lm (H) 2866	
	Saturation characteristic [ i1(A) , phi1(V.s) ; i2 , phi2 ; ] 1910.3;277.72 2419.7]	
	Initial fluxes [ phi0A , phi0B , phi0C ] (V.s): [1273.5 -1273.5 1114.3]	
I		
I		
I		
I	OK Cancel Help Apply	

requirements of the matlab block are: ver and frequency tages istance and inductance of winding I magnetizing inductance. istance and inductance are not specified directly hence to calculate m formulas are used uration characteristic can be changed by use of B-H curve, to know more about it click here Go To Instruction Go To Instruction GO TO NEXT SHEET GO TO PREVIOUS SHEET

Figure3: Transformer Parameters



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The example of test certificate used is shown in this sheet

	Un Place	47.40 40 47.35 40	30 45.20 525 45.15	44.10 44.05	43.00	41.90 40 41.85 40
Go To Instruction		1	2 3	-		
	Withstood : Withstool : Induced Over Voltage Withse Withstood : 1130004000 HBF = NF+	3 30V feet 60 500 cannod Text 8666 w free 00 beers 94	at 100 Hz, applied to LV & tHV+2	(arth) 1		
for short circuit test the L¥ winding is short circuited and the rated current is applied to H¥ side	and Loss test at solid curren Voltage Applied to HV Wind Lond Lows	st et 75 °C on Principal" ling. 6268 W stand Test	Tap 3	t 4.500 teopreti Sector	prog Voltage	495
In open circuit test the HV side winding is kept open and rated voltage at rated frequency is applied at the LV winding side	Average Winding Resistance p Principal Top No. 3 wo Lond Test at mired Voltage No Lond Lons :	r and Frequency Applie 1100 Warn No. Loo	98 Ohm EV: ad to LV Windings. d Convet :	1.973 stati-0 20.00 Junp-	Shetti	
The standard followed is IEC 60075-1 Clause 11.4 and 11.5.	H.V. Cornet J. V. Conset Topology on IV Por HAN By off Circu Do: 4-5% is ency of 	26.24 /augs. 666.71 /augs. /, Variation uit Switch to -5% 2.5 \sigma	Vector Onesp 1 1 Frequency 1 2 Coaling 0 Outrasteed 1 Trasperstor IV e of vil - of vil - of Waindhap 1	50 Hz. ONAN 50 *C 55 *C		
The tests which are carried out in the test certificate are routine tests. From these tests we will get the required data to be entered	Pointner Owler No 134/KPP Point : Rallag : II. V. Volinge : 1. V. Volinge :	500 KMA 11 KN 433 V	Counciliant :	Copper/Alamininn 3 Delta/Star		
from this test certificate we will get the data which is required to be entered in	Tearland fr. No. : PRAVIN	2612 NENTERPRISES	THEFT CLERTIPICATE	2026	Dur :	04.02.98

## Figure 4: Test Certificate



Figure 5: Saturation Characteristics



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Figure 7: Open Circuit Test Model



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Vol. 5, Special Issue 2, April 2017

## **IV.DISCUSSION**

Further the tool can be developed for the transmission line and CT and all other components which are used in distribution network.

The tool can be directly merged with the MATLAB so that the values can be directly changed

## V. CONCLUSION

The output parameters obtain from the tool was used in conducting the open circuit test and short circuit test and the results obtain can be crossed checked with the test certificate value

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## BIOGRAPHY



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