

Group5_Exp7

AIM : To compute the equivalent circuit parameters of a 3- ϕ induction machine using the no-load and blocked rotor tests.

PROCEDURE :

1.No load Test:

- Open a Blank Model in Simulink
- Select the preset model of Asynchronous Machine with name plate reading (5HP,460V,60Hz,1750rpm)
- Make a circuit as shown in Circuit Diagram in MATLAB section.
- Set the voltage in Three-Phase Programmable voltage source to 460V(rated voltage) and Load Torque(T_m) to 0.
- Take the readings in voltage measurement,Current measurement and Power measurement devices respectively to get V_o , I_o and P_o .

2.Blocked Rotor Test:

- Open a Blank Model in Simulink
- Select the preset model of Asynchronous Machine with name plate reading (5HP,460V,60Hz,1750rpm)
- Make a circuit as shown in Circuit Diagram in MATLAB section.
- Adjust the voltage in Three-Phase Programmable voltage source so as to get Rated Current (I_{rated}) in the current measurement block.
- Also,set the speed of the rotor (w_m) to 0.
- Now, take the readings in voltage measurement,Current measurement and Power measurement devices respectively to get V_{BR} , I_{BR} and P_{BR} .

CIRCUIT DIAGRAM IN MATLAB:

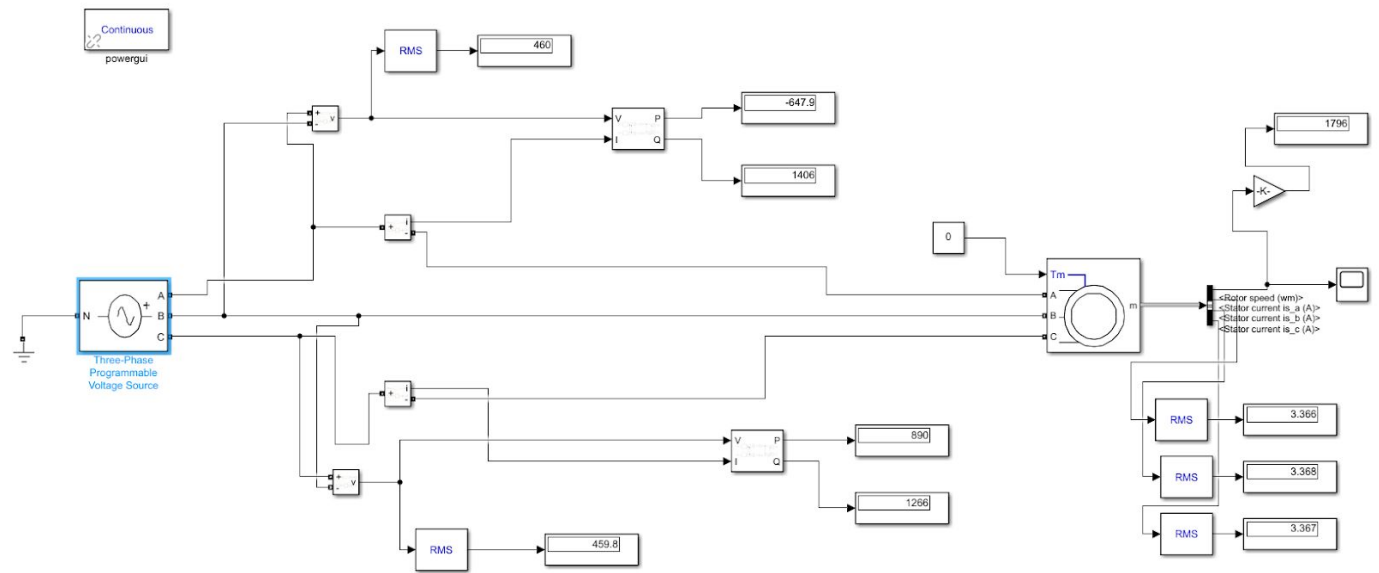


Figure1:Circuit Diagram in simulink for No load test

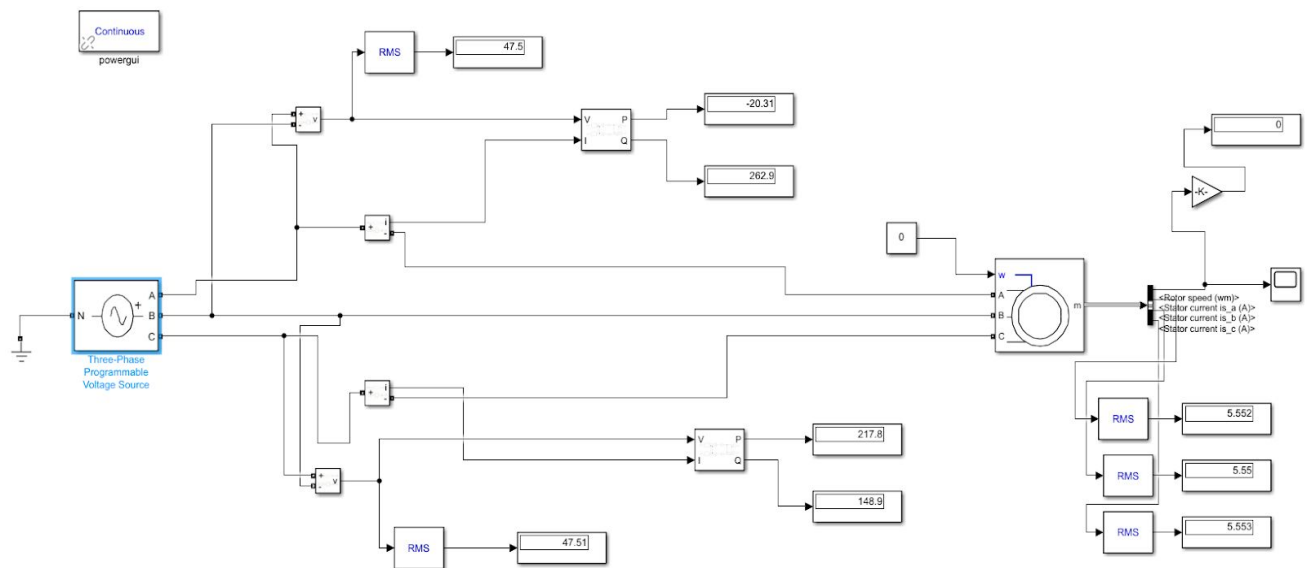


Figure2:Circuit Diagram in simulink for Blocked Rotor test

Asynchronous Machine (mask) (link)

Implements a three-phase asynchronous machine (wound rotor, squirrel cage or double squirrel cage) modeled in a selectable dq reference frame (rotor, stator, or synchronous). Stator and rotor windings are connected in wye to an internal neutral point.

Configuration	Parameters	Load Flow
Nominal power, voltage (line-line), and frequency [Pn(VA),Vn(Vrms),fn(Hz)]: [3730 460 60]		
Stator resistance and inductance[Rs(ohm) Lls(H)]: [1.115 0.005974]		
Rotor resistance and inductance [Rr'(ohm) Llr'(H)]: [1.083 0.005974]		
Mutual inductance Lm (H): 0.2037		
Pole pairs p (): 2		
Initial conditions		
[slip, th(deg), ia,ib,ic(A), pha,phb,phc(deg)]:		
[0 0 0 0 0 0 0]		
<input type="checkbox"/> Simulate saturation		Plot
[i(Arms) ; v(VLL rms)]: , 302.9841135, 428.7778367 ; 230, 322, 414, 460, 506, 552, 598, 644, 690]		

Figure3:Asynchronous Machine Parameters for (5HP,460V,60HZ,1750RPM) model

CALCULATIONS AND RESULTS:

1. Here for this machine, $V_{rated}=460V$
, $N_{rated}=1750rpm$, $f=50Hz$, $P=50HP$, $Pf=\cos\phi=0.85$, Efficiency=1

2. We can calculate I_{rated} as

$$I = \frac{P \cdot 745.699872}{\sqrt{3} \cdot V \cdot \cos \phi \cdot \eta}$$

$$\Rightarrow I_{rated}=5.50A$$

3. Also, here the net power P_o or P_{BR} is the

$$\Rightarrow P_{net} = \text{Wattmeter 1 reading} + \text{Wattmeter 2 reading}.$$

4. The stator resistance $R_1 = 1.115 \Omega$ (Figure 3) which is obtained from Machine Parameters.

No load Values :-

V_o	460V
I_o	3.36A
P_o	$890 - 674.9 = 242.1W$

Blocked-Rotor Values :-

V_{BR}	47.5
I_{BR}	5.50A
P_{BR}	$217.8 - 20.31 = 197.28W$

$$Z_0 = \frac{(V_0/\sqrt{3})}{I_0} = \frac{460}{\sqrt{3} \cdot (3.36)} = 79.04 \Omega$$

$$R_0 = \frac{P_0/3}{I_0^2} = \frac{2420.1}{3 \times (3.36)^2} = 7.14 \Omega$$

$$X_0 = \sqrt{Z_0^2 - R_0^2} = 78.71 \Omega$$

$$Z_{BR} = \frac{(V_{BR}/\sqrt{3})}{I_{BR}} = \frac{47.5}{\sqrt{3} \times 5.5} = 4.98 \Omega$$

$$R_{BR} = \frac{(P_{BR}/3)}{I_{BR}^2} = \frac{197.4}{3(5.5)^2} = 2.17 \Omega$$

$$X_{BR} = \sqrt{Z_{BR}^2 - R_{BR}^2} = 4.48 \Omega$$

$$X_1 + X_2' = 4.48 = X_{BR}$$

$$\text{Taking } X_1 = X_2' = \frac{X_{BR}}{2} = 2.24 \Omega$$

$$\boxed{\therefore X_1 = 2.24 \Omega, X_2' = 2.24 \Omega}$$

$$X_m = X_0 - X_1 = 78.71 - 2.24$$

$$= 76.47 \Omega$$

$$\boxed{X_m = 76.47 \Omega}$$

$$R_1 = 1.115 \Omega$$

$$R_2' = (R_{BR} - R_1) \left(\frac{X_m + X_2'}{X_m} \right)^2$$

$$= (2.17 - 1.115) \left(\frac{76.47 + 2.24}{76.47} \right)^2$$

$$\Rightarrow, \boxed{R_2' = 1.11 \Omega}$$

$$R_{iwf} = \frac{X_m^2}{R_0 - R_1} = \frac{(76.47)^2}{7.14 - 1.115} = 970.5 \Omega$$

$$\therefore \boxed{R_{iwf} = 970.5 \Omega}$$

$$\therefore R_1 = 1.115 \Omega, X_1 = 2.24 \Omega, X_m = 76.47 \Omega,$$

$$R_{iwf} = 970.5 \Omega, R_2' = 1.11 \Omega, X_2' = 2.24 \Omega$$

OBSERVATIONS :

STATOR IN STAR
OBSERVATIONS
$V_o = 460V$
$I_o = 3.36A$
$P_o = 242.1W$
$V_{BR} = 47.5V$
$I_{BR} = 5.50A$
$P_{BR} = 197.49W$

RESULTS AND CONCLUSION :

Rated Voltage and Rated Current

STATOR IN STAR
$V_{\text{rated}} = 460\text{V}$
$I_{\text{rated}} = 5.50\text{A}$

Here, the voltage is line-to-line voltage and the current is line current.

$Z_O = 79.04\Omega$
$R_O = 7.14\Omega$
$X_O = 78.71\Omega$
$Z_{BR} = 4.98\Omega$
$R_{BR} = 2.17\Omega$
$X_{BR} = 4.48\Omega$
$R_1 = 1.115\Omega$
$R'_2 = 1.11\Omega$
$X_1 = 2.24\Omega$
$X'_2 = 2.24\Omega$
$R_i = 970.5\Omega$
$X_m = 76.47\Omega$

COMMENTS:

1. We can observe that the calculated values of machine parameters is approximately equal to the actual preset model parameters in Fig(3).

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