ETAP TIP – No. 008

Parameter Estimation

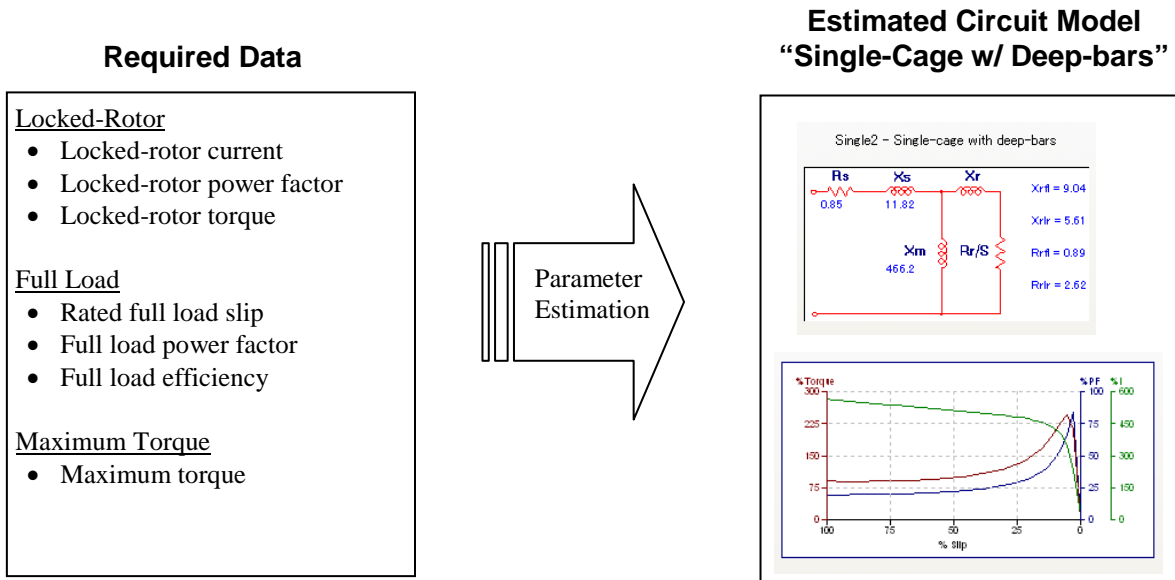Applicable ETAP Versions: 5.5.0, 5.5.5, 5.5.6
(For lower versions, some of the descriptions and procedures below may differ in some ways)

In Transient Stability Analysis, if the influence of induction motors is perceived to be crucial to the stability of the system or if the motor acceleration or reacceleration profiles are to be analyzed in detail, their dynamic model should be specified in the study. The motor dynamic model is comprised of the following:

a) Motor Equivalent Circuit
b) Motor Load Torque Characteristics
c) Motor, Load, and Coupling Inertias

The above may be available from the motor manufacturer. More often than not, rather than the motor equivalent circuit, the manufacturer provides machine performance characteristic data (i.e. Motor Speed Vs Torque, Current, and Power Factor curves). However, even with this machine performance characteristic data only, ETAP can be able to estimate a corresponding equivalent circuit model of the motor using the PARAMETER ESTIMATION program.

The required data for Parameter Estimation and the corresponding estimated circuit model (Single-Cage Circuit) are as follows:

Required Data

**Estimated Circuit Model
"Single-Cage w/ Deep-bars"**

Locked-Rotor
- Locked-rotor current
- Locked-rotor power factor
- Locked-rotor torque

Full Load
- Rated full load slip
- Full load power factor
- Full load efficiency

Maximum Torque
- Maximum torque

Parameter
Estimation

See Fig. 8 for sample of determining the above data from the Motor Characteristic Curves

<u>Illustration:</u>

In the "Example-ANSI.oti" sample project, let's add a new induction motor at Sub 2A bus and perform the Parameter Estimation:

Refer to "Toolbars Map" on page 8 of ETAP TIP No. 003 to map out the toolbars that will be identified in the succeeding procedures.

Procedures:

1. Activate the "Study View" one line diagram presentation by clicking its window (or you can go to "project view" and double click "Study View" folder)

2. Switch to Edit Mode by clicking the "Pencil" icon [icon] on the mode toolbar.

3. Add and connect new induction motor to the "Sub2A" bus. See Fig. 1
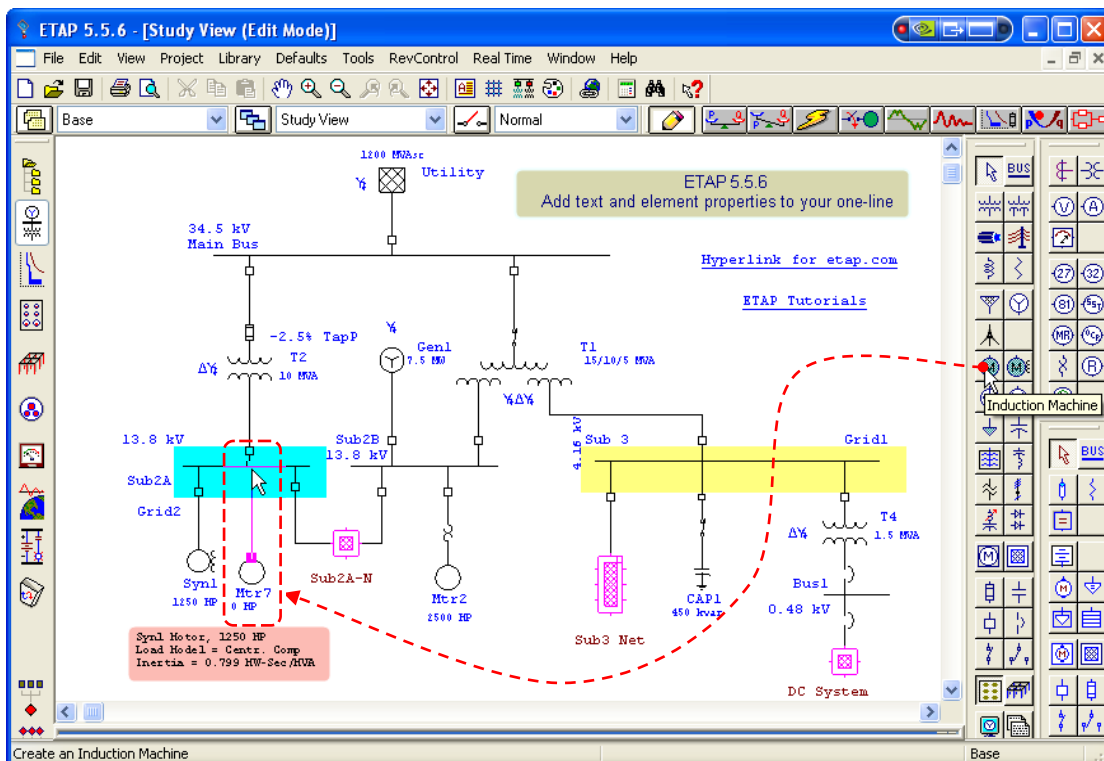
Fig. 1

4. Double-click "Mtr7" (this tag name maybe different with yours) symbol to open the "Induction Motor Editor" dialog window.

5. Click on the "Nameplate" tab and populate the "Ratings" frame with the following data:

HP = 2,500

kV = 13.2

%PF@100% = 92.83

%Eff@100% = 97.99
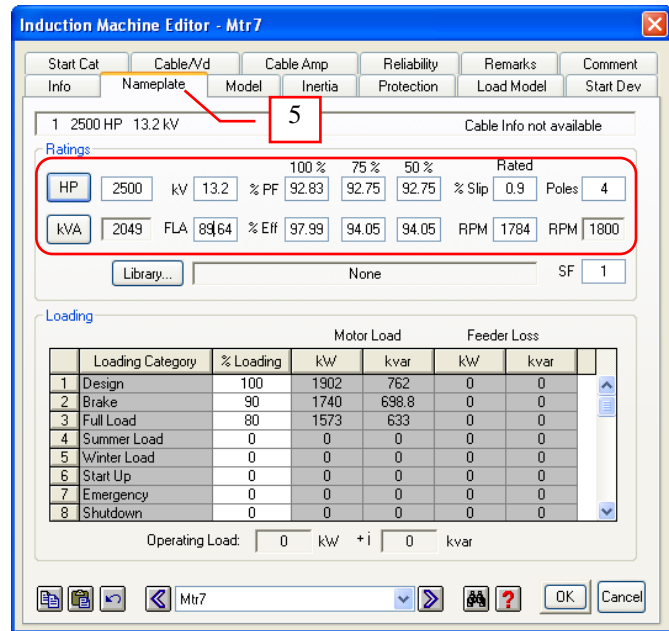
%Slip = 0.9

Poles = 4

See Fig. 2

Fig. 2

6. Click on the "Model" tab and enter the following data:

At "Locked Rotor" Frame

LRC = 576 %

PF = 19%

At "Torque" Frame

LRT = 88%

Max T = 244%

See Fig. 3
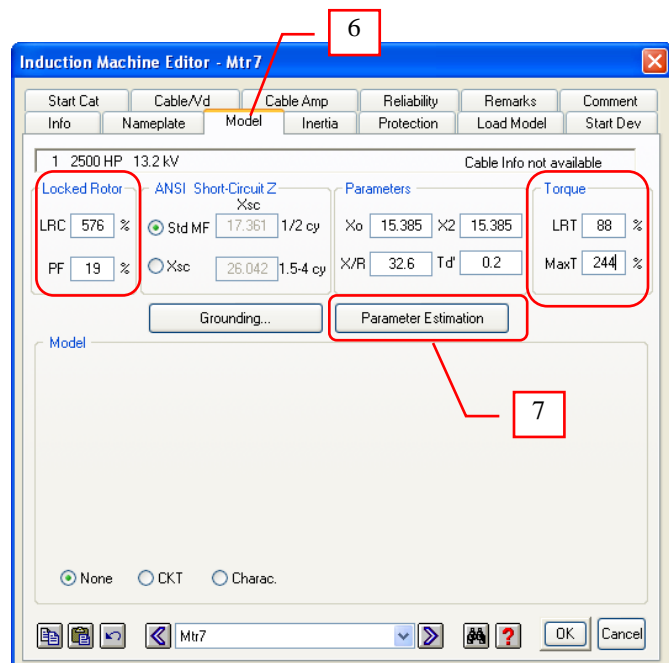
7. Click "Parameter Estimation" button. See Fig. 3.

Fig. 3

8. On the "Requirement" frame of the "Parameter Estimation" dialog window, click the "Refresh" button to transfer the motor nameplate data (which we input on Steps 5 & 6) that will be used as input data of the parameter estimation program. See Fig. 4

9. On the "Solution Parameters" frame, enter the "Precision" and "Acceleration Factor". The default values are 2% and 0.25 respectively. See Fig. 4

10. Under the "Report Selection List", select "Prompt". This selection will prompt you for report file name when you perform the estimation (by clicking the "Estimate" button). See Fig. 4

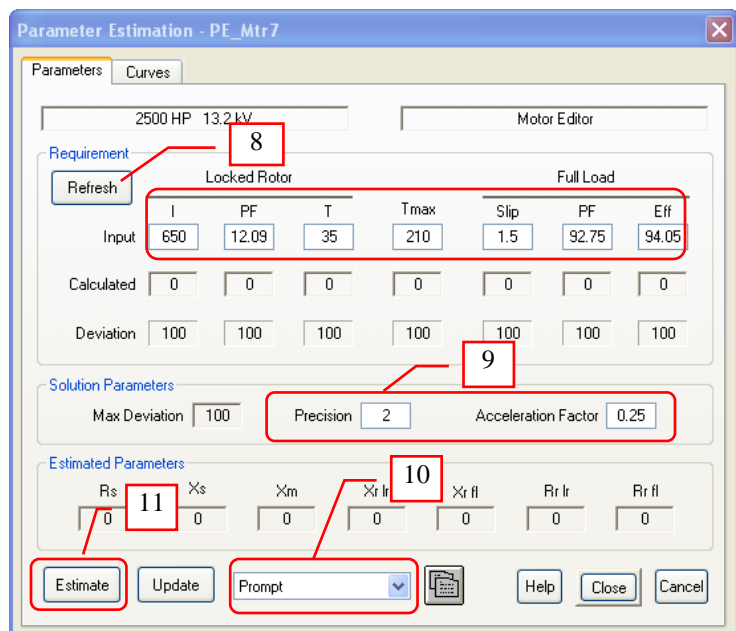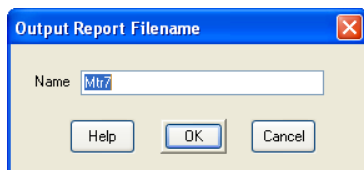11. Click the "Estimate" button. See Fig. 4.

Note: A dialog box "Output Report Filename" as shown below will be displayed. Enter a name (by default, the name of the output report is the same as the ID of the motor under consideration) and click "Ok" button.

Fig. 4

12. Notice that the Motor Circuit parameters were estimated and based on these parameters; new motor data were calculated. See Fig. 5

Note: In some cases, you might encounter the below message when you perform the estimation. This means that ETAP can not estimate the motor circuit parameters based on the Input Data and Solution parameters. You may need to re-evaluate your input data and make the necessary adjustments.
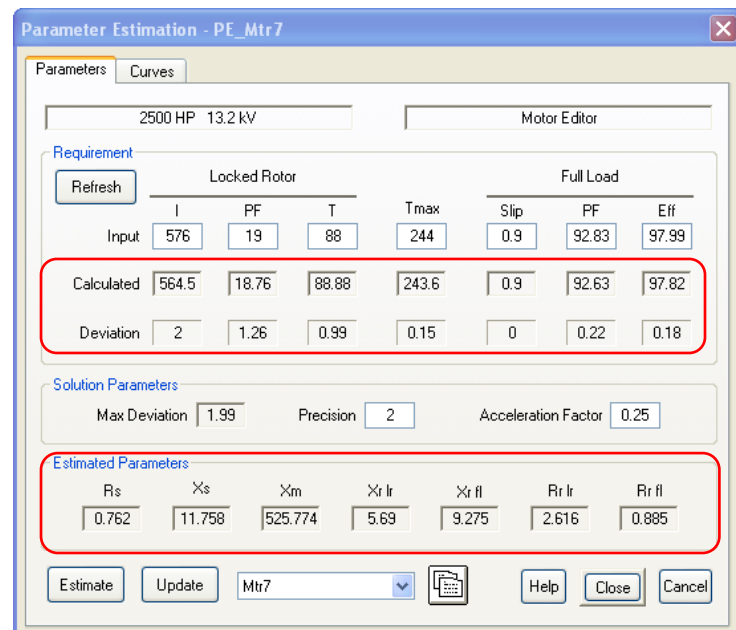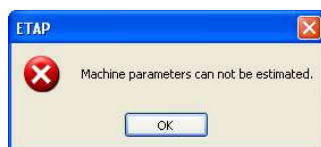
Fig. 5

13. Select the "Curve" tab to display and verify the estimated circuit model and the corresponding Motor Slip vs. Torque, Current & Power Factor curves. See Fig. 6

14. Click the "Update" button to open the "Motor Parameter Update Editor".

15. The "Motor Parameter Update" will be displayed as shown in Fig. 7. You can inspect from this dialog the existing data, calculated data based from the estimated model and the estimated parameters model.

16. Click the "Update" button to update the existing data with the calculated ones where the "Update" check box is "Checked". See Fig. 7.

17. That's it. We're done with the Motor equivalent circuit model by Parameter Estimation. To complete the motor dynamic model eventually, you may enter the machine Inertia and the Load torque Model on the "Inertia" and "Load Model" tabs of the "Induction Machine Editor" dialog window. See Fig. 2
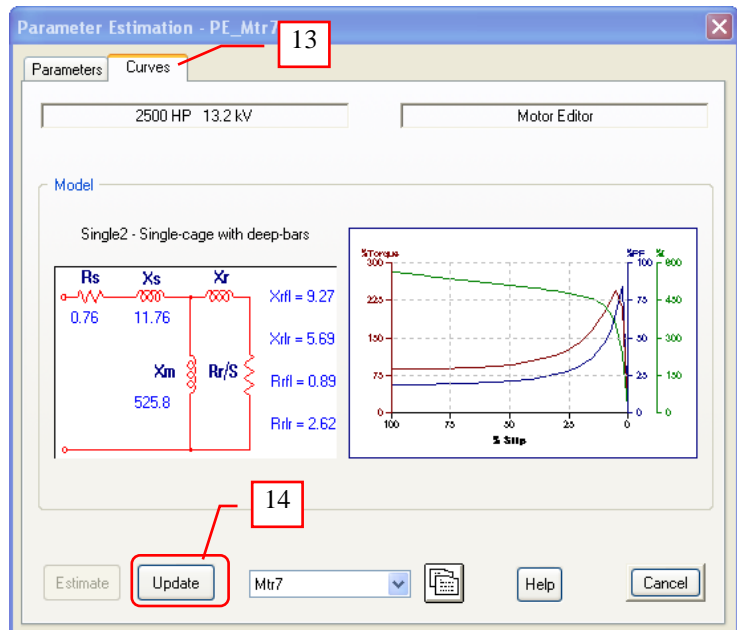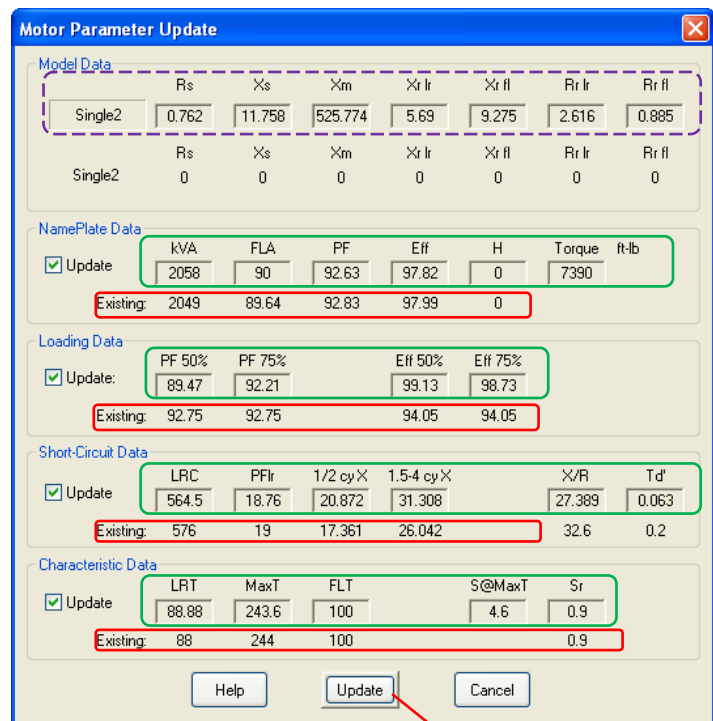

Fig. 6

Fig. 7

Motor Characteristics

Fig. 8