Practical Guide

Power Machines Guide

MATLAB

V2.1

Student Name:		Date:	Click here to enter a date.
Marks %		☐ Competent	
		☐ Not Yet Competent	
Assessed By:		Date:	Click here to enter a date.

Created By:	EIT	Date:	
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EIT ENGINEERING INSTITUTE OF TECHNOLOGY

Please refer to MATLAB Software Guide_V1 for information on the remote labs and MATLAB software.

The single line diagram of a three phase power system containing electrical machines and other three-phase models is shown below.
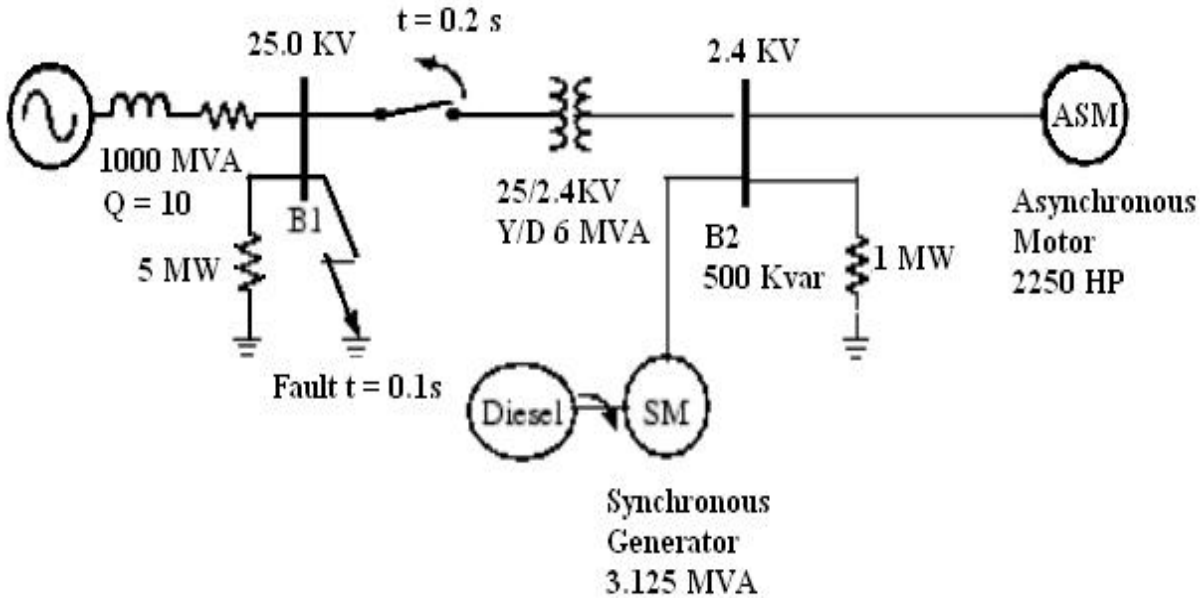
Description of the system:

This system consists of a plant (bus B2), simulated by a 1 MW resistive load and a motor load (ASM) fed at 2400 V from a distribution 25 kV network through a 6 MVA, 25/2.4 kV transformer, and from an emergency synchronous generator/diesel engine unit (SM).

The 25 kV network is modeled by a simple R-L equivalent source (short-circuit level 1000 MVA, quality factor X/R = 10) and a 5 MW load. The asynchronous motor is rated 2250 HP, 2.4 kV, and the synchronous machine is rated 3.125 MVA, 2.4 kV.

Initially, the motor develops a mechanical power of 2000 HP and the diesel generator is in standby, delivering no active power. The synchronous machine therefore operates as a synchronous condenser generating only the reactive power required to regulate the 2400 V bus B2 voltage at 1.0 pu.

At t = 0.1 s, a three-phase to ground fault occurs on the 25 kV system, causing the opening of the 25 kV circuit breaker at t = 0.2 s, and a sudden increase of the generator loading.

During the transient period following the fault and islanding of the motor-generator system, the synchronous machine excitation system and the diesel speed governor react to maintain the voltage and speed at a constant value.
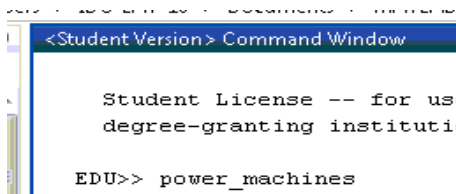
Guidelines:

This system is modeled already in the power-machines example and is pre-installed on MATLAB as the Sim power systems plugin (installed on the remote labs).

NOTE: DO NOT SAVE/OVERWRITE THE EXAMPLE FILE WHEN CLOSING!!

Access the remote lab with MATLAB installed and open MATLAB.
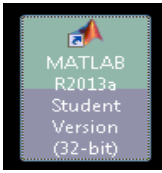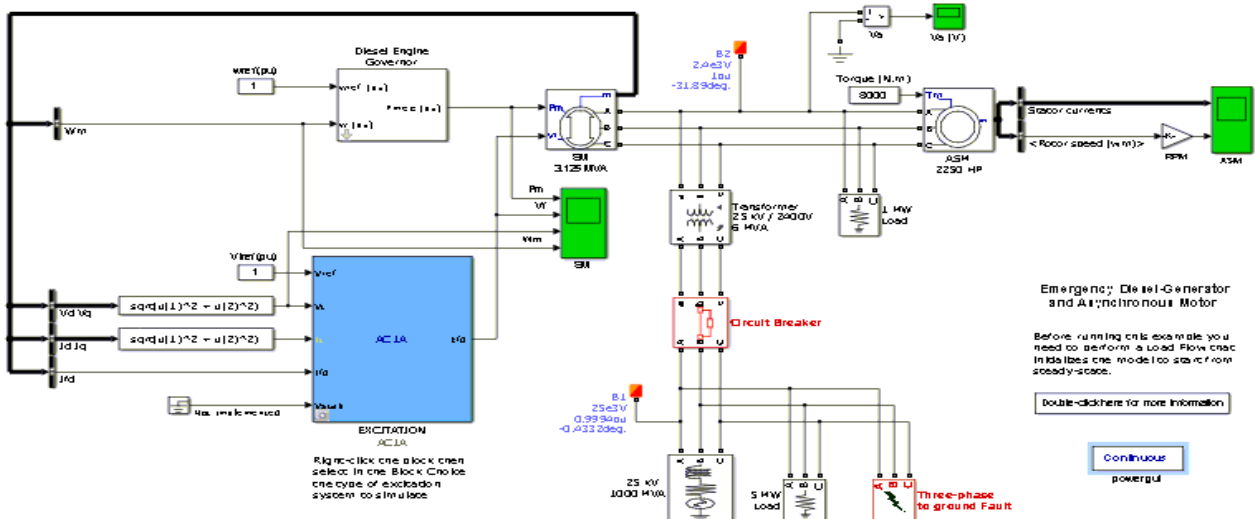

In the Command Window Type: **power_machines** in matlab command window

and press enter to open the Simulink file.

(You can zoom in and out using the mouse wheel, and double clicking a block opens it's properties.)


If you simulate this system for the first time, you normally do not know what the initial conditions are for the SM and ASM to start in steady state.

A. These initial conditions can be seen as follows:

Step 1:

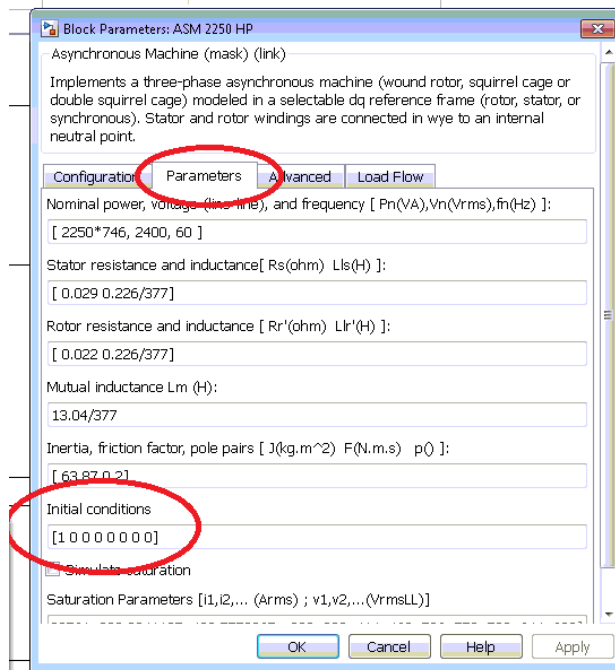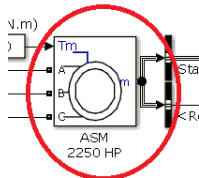Open the dialog box of the Synchronous Machine (by double clicking)

All initial conditions should be set at 0, except for the initial SM field voltage which is set at 1 pu.
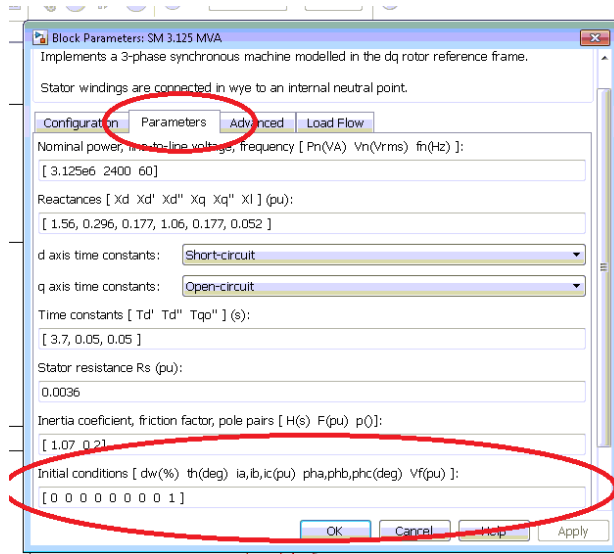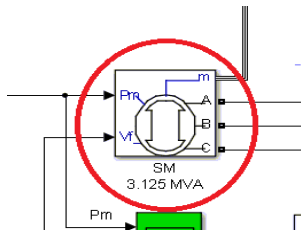
Step 2:

Open the dialog box of the Asynchronous Machine blocks.
All initial conditions should be set at 0, except for the initial ASM slip, which is set at 1 pu.
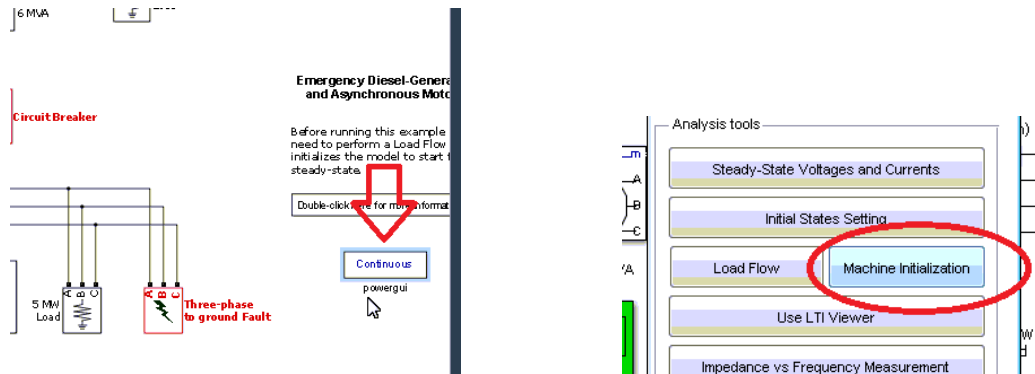

{OPTIONAL: You can run the simulation and open the green scopes before initialising the machine, for comparison purposes only.}
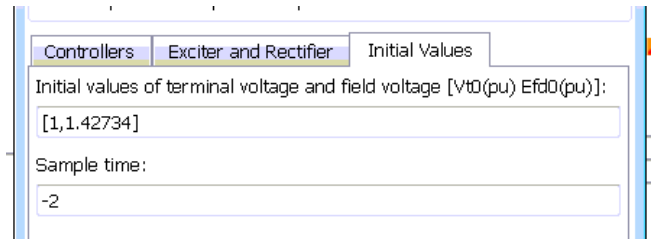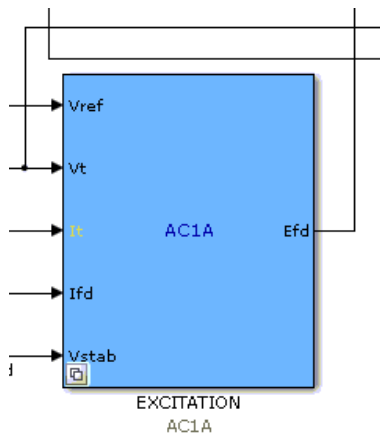
B. Machine Initialization Tool

Step 3:

- **The next step is to initialize the machine.**
- **Double-click the Powergui block, then click Machine Initialization button.**

- **A new window appears. Configuration changes can be made in the right hand side of this window.**
- **The upper-right window displays a list of the machines appearing in your system.**
- **Select SM 3.125 MVA in the machine list (if not already selected).**
- **Set the Bus Type parameter as P & V generator (indicating that the machine is controlling its active power and terminal voltage.)**
- **Terminal Voltage UAB is initialized at the nominal machine voltage (2400 Vrms).**
- **Set the Active Power to zero.**
- **Click "Update"**
- **Select ASM 2250 HP in the machine list. The only parameter that needs to be set is the Mechanical power developed by the motor. Enter 2000*746.**
- **Click the Compute and Apply button. (Click yes if there is a popup)**

- **Close the Machine Initialization tool.**
- **Now again as in step 1 and 2 - Open the SM and ASM block dialogs and see that the initial conditions have been updated.**
- **Note that the ASM torque value (7964 N.m) has been entered in the Constant block connected at the ASM torque input.**

- **Open the Governor & Diesel Engine subsystem. Notice that the initial mechanical power (lower end of the parameter window) has been automatically set to 0.0002701 pu.**
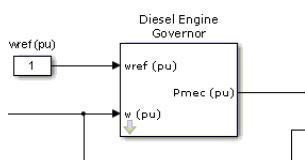
- **Open the Excitation block and note under the "Initial Values" tab, the initial terminal voltage and field voltage have been set respectively to 1.0 pu and 1.427 pu.**

Controllers   Exciter and Rectifier   Initial Values

Initial values of terminal voltage and field voltage [Vt0(pu) Efd0(pu)]:
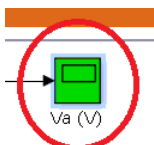
[1,1.42734]

Sample time:

-2

Step 4:

Run the simulation for a time period of **4**

Note: the simulation takes a while to run – as can be seen in the progress bar at the bottom of the Simulink window.
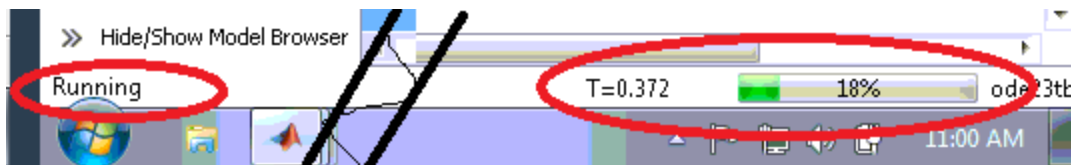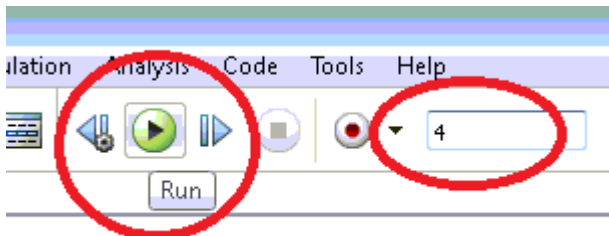
1. General: to open a scope, simply double click the required scope block

2. You can resize the scope, or "autoscale".
3. You can zoom into a specific part of the scope by clicking the magnifying glass and click+drag a box around the area you wish to zoom into.