A Project Review

On

A STATCOM CONTROL SCHEME FOR POWER QUALITY IMPROVEMENT OF GRID CONNECTED WIND ENERGY SYSTEM

Submitted

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INTRODUCTION

In integration of power generation system with grid we will experience the power quality problems.

Power electronic based FACTS devices like STATCOM can be effectively utilized to improve the quality of power supplied to the customers The increasing use of power electronic based loads (adjustable speed drives, switch mode power supplies, etc) to improve system efficiency and Controllability is increasing concern for harmonic distortion levels in end use facilities and on overall power system.

Aim of the Project

To eliminate the harmonic contents (flickers, variation of voltage, active and reactive power) by using STATCOM with Battery Energy Storage System(BESS).

Objective of the Project

The grid connected wind energy generation system for power quality improvement by using STATCOM has the following objectives.

- To maintains power factor as unity at the source end.
- To meet the reactive power to wind generator and non-linear load.
- To provides hysteresis current controller for STATCOM to achieve fast dynamic response.

FACTS devices

A Flexible Alternating Current Transmission System (**FACTS**) is used to enhance controllability and increase power transfer capability of the network. In most of the applications the controllability is used to avoid cost intensive. Types of FACTS devices are

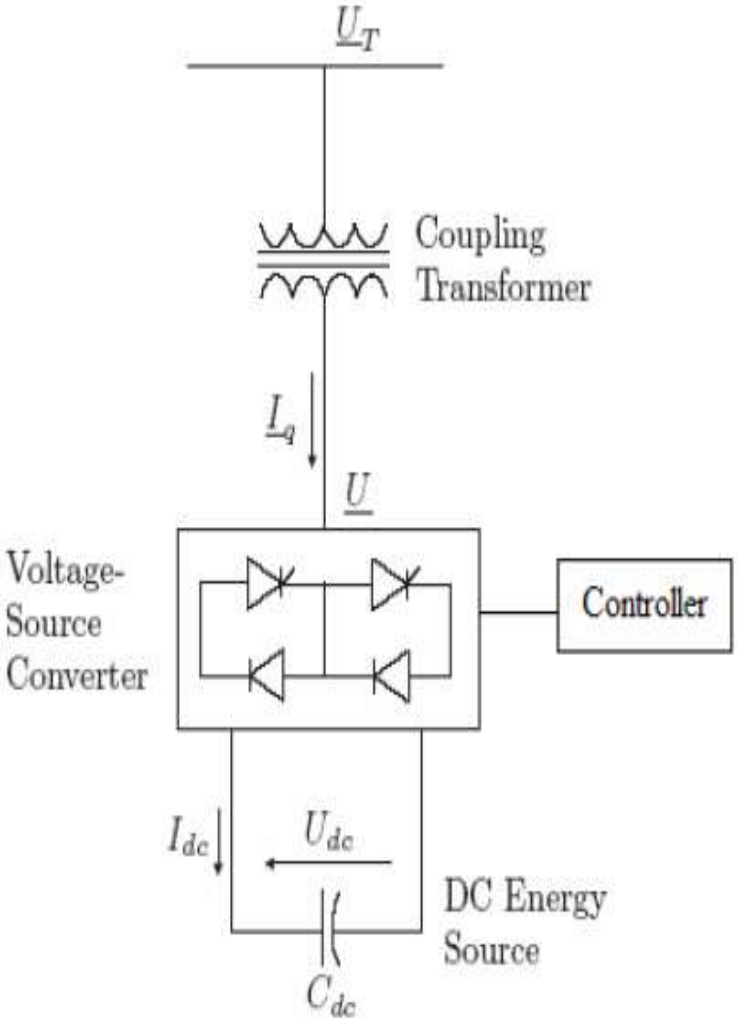
- Series Devices - SSSC,TCSC
- Shunt Devices - STATCOM,SVC
- Series-series devices - IPFC,UPFC
- Series-shunt devices - HVDC link

INTRODUCTION TO STATCOM

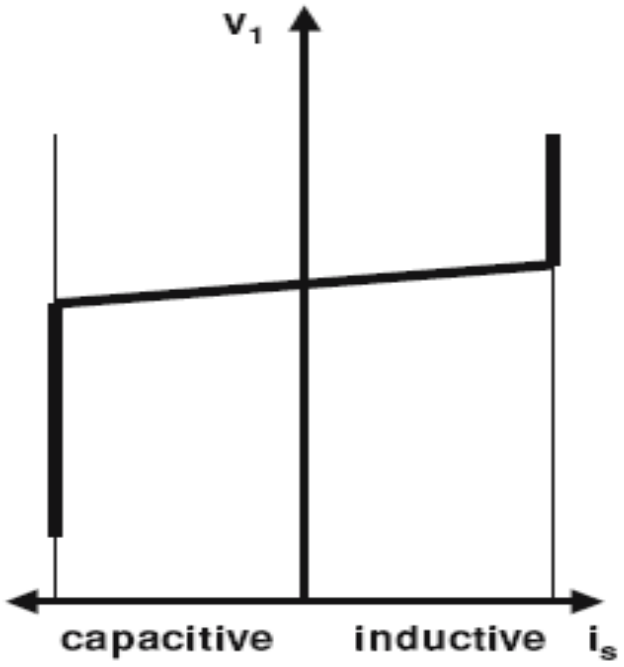
- STATCOM is a Static Synchron -ous shunt Compensator.

- It is a solid state based power converter version of the SVC .

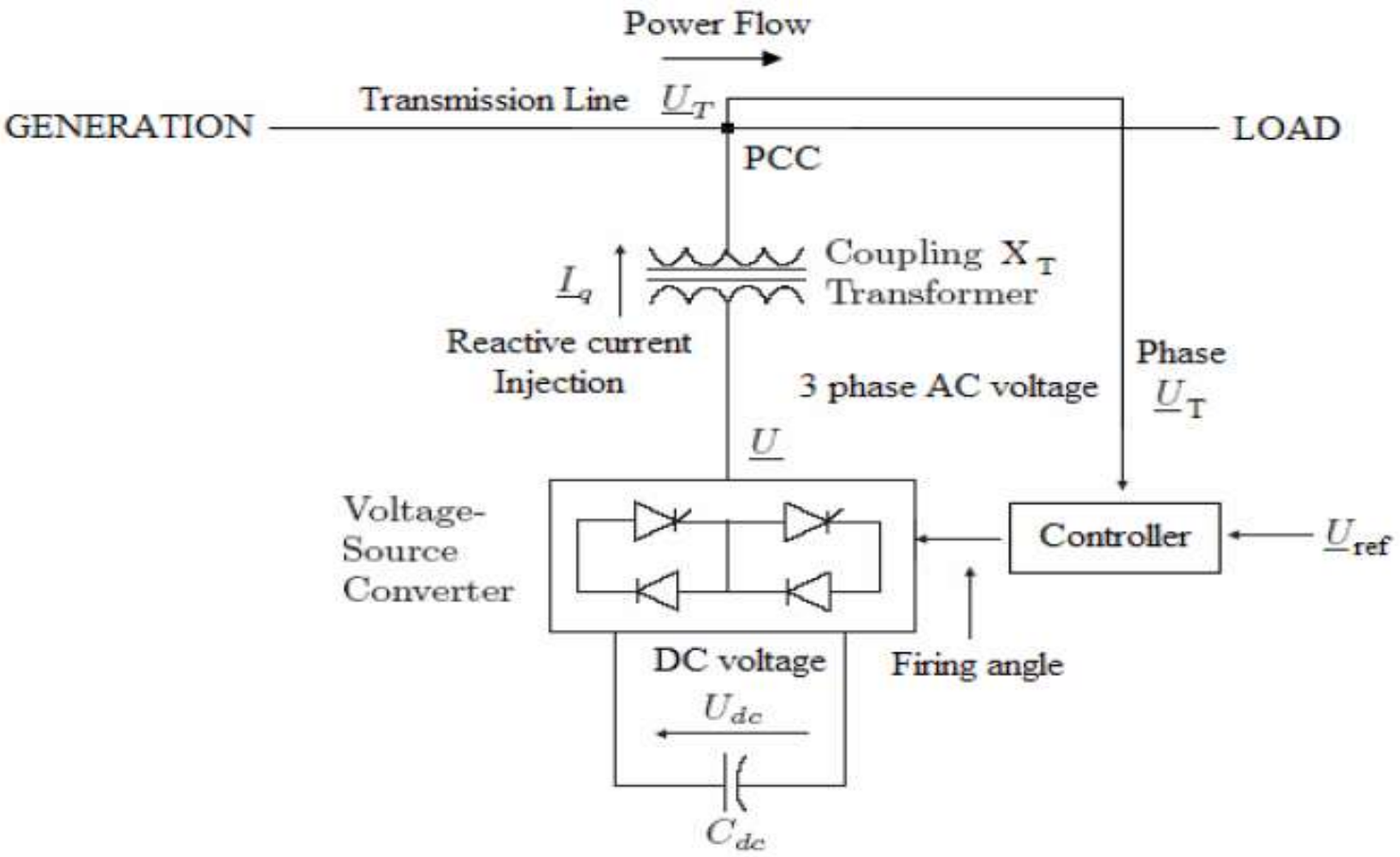
- The capacitive or inductive output currents can be controlled indepen -dently from its AC bus voltage.



Control characteristics of STATCOM



STATCOM operation in a power system



RENEWABLE ENERGY SOURCES

The sources which will be replenished naturally in the course of time.

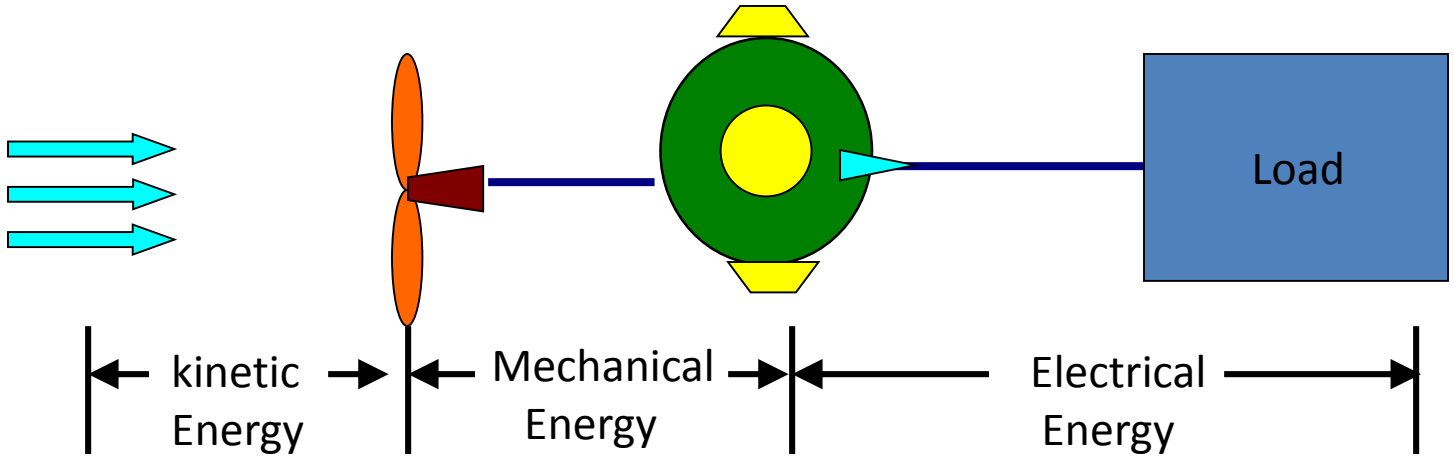
- Solar energy
- Wind energy
- Hydal energy
- Tidal energy
- Geothermal energy
- Biomass energy
- Ocean energy

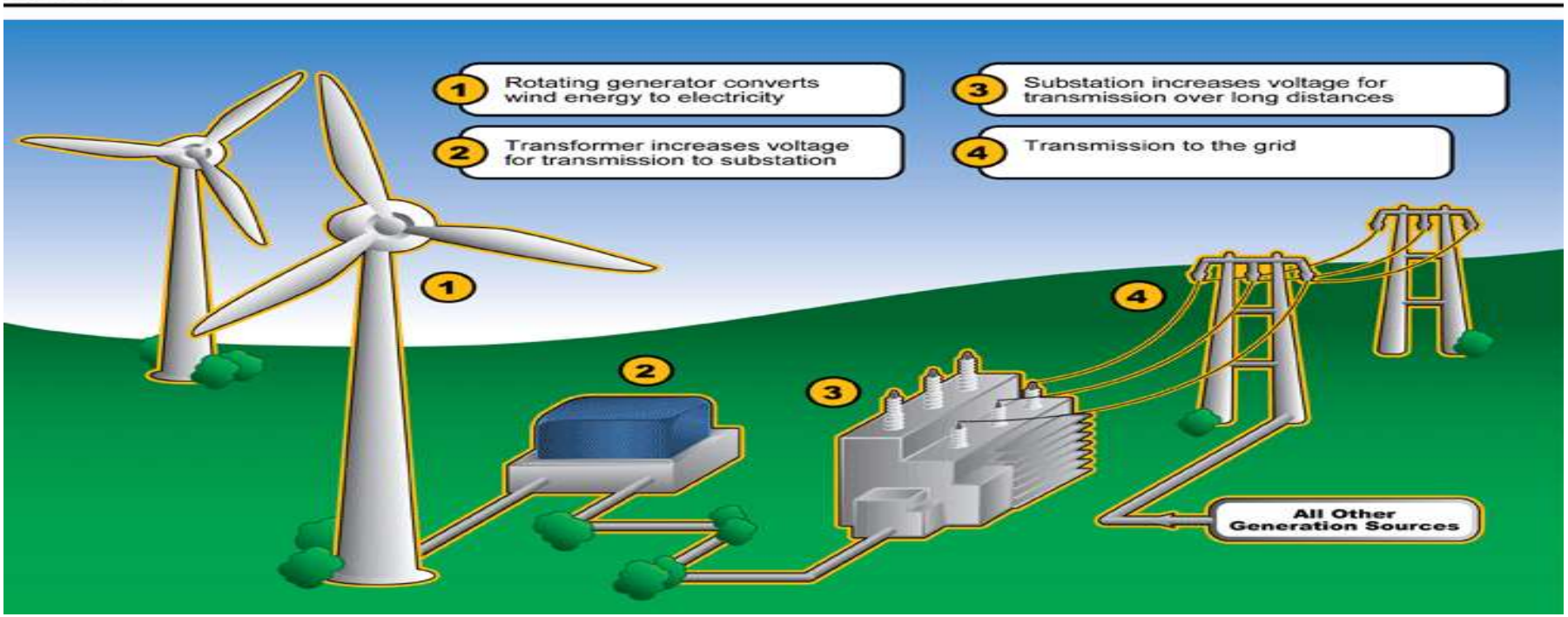
WIND ENERGY

Wind is abundant almost in any part of the world.

Its existence in nature caused by uneven heating on the surface of the earth as well as the earth’s rotation means that the wind resources will always be available.

WIND ENERGY GENERATING SYSTEM





TYPES OF WIND FARMS

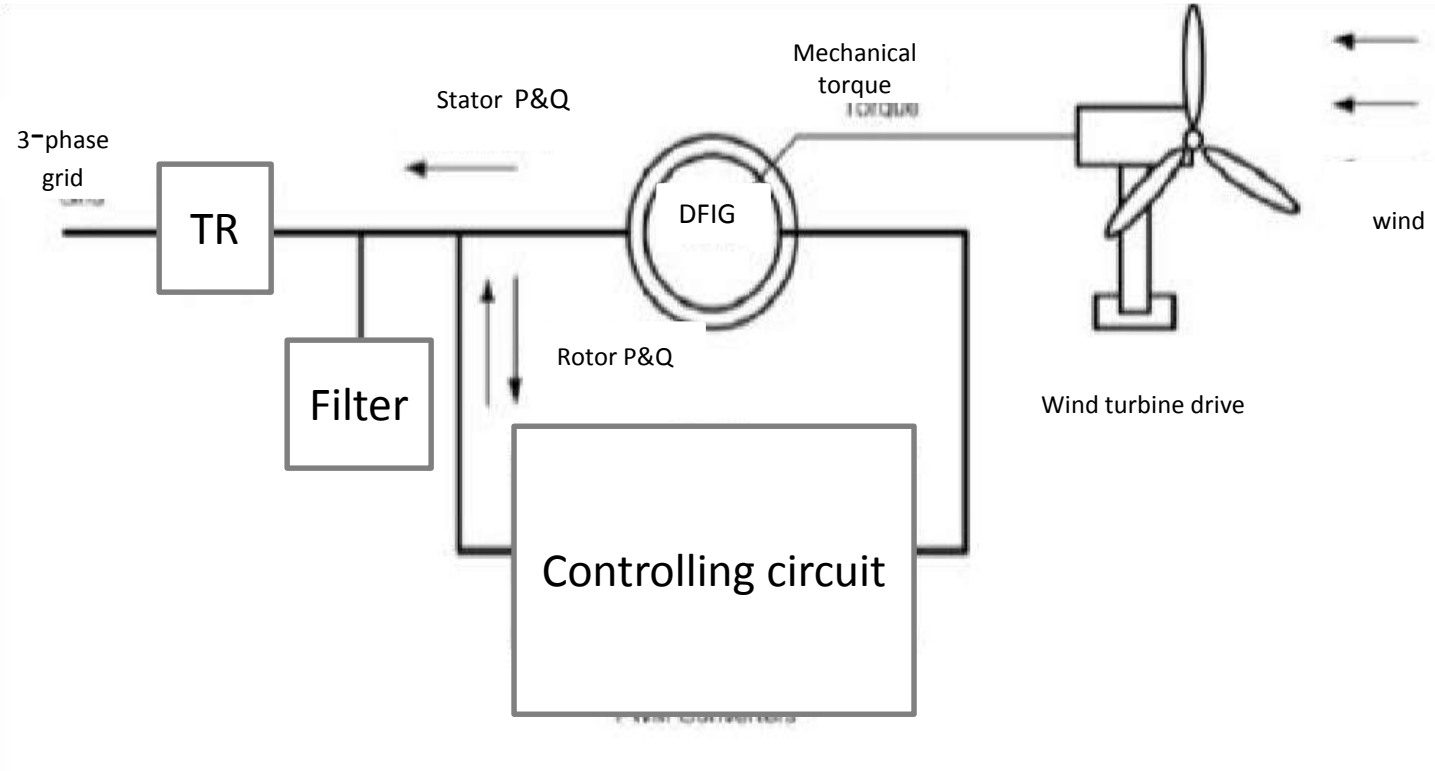
Based on the type of the generator, wind farms are classified into two types:

1. Variable speed wind farm-Double fed induction generator.
2. Constant speed wind farm-synchronous generator.

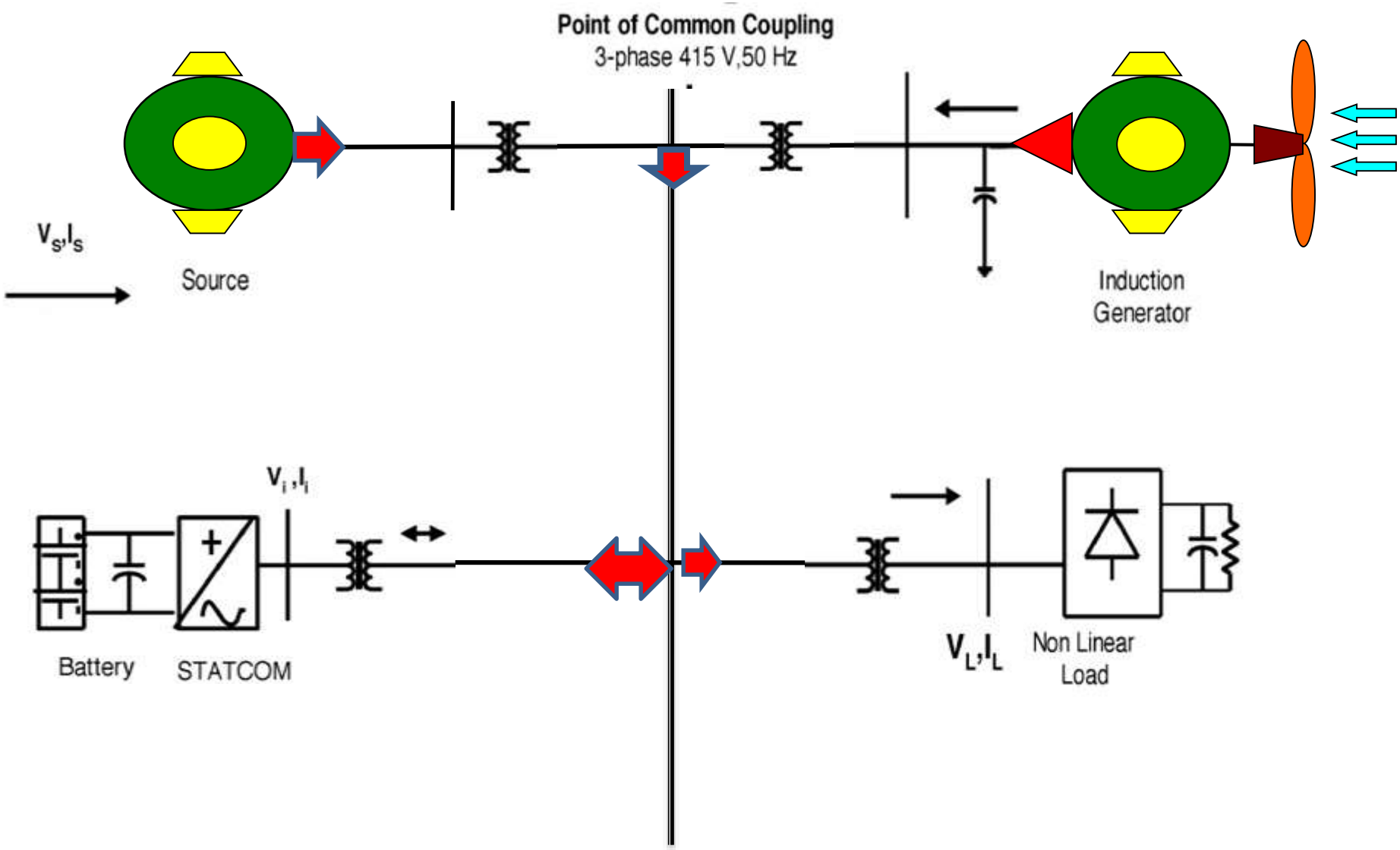
DOUBLE FED INDUCTION GENERATOR:

The term doubly fed, refers to the fact that the voltage on the stator is applied from the grid and the voltage on the rotor is induced by the rotor-side converter. This system allows a variable-speed operation over large, but restricted, range.

Operation of DFIG with controlling circuit



BLOCK DIAGRAM



MATLAB

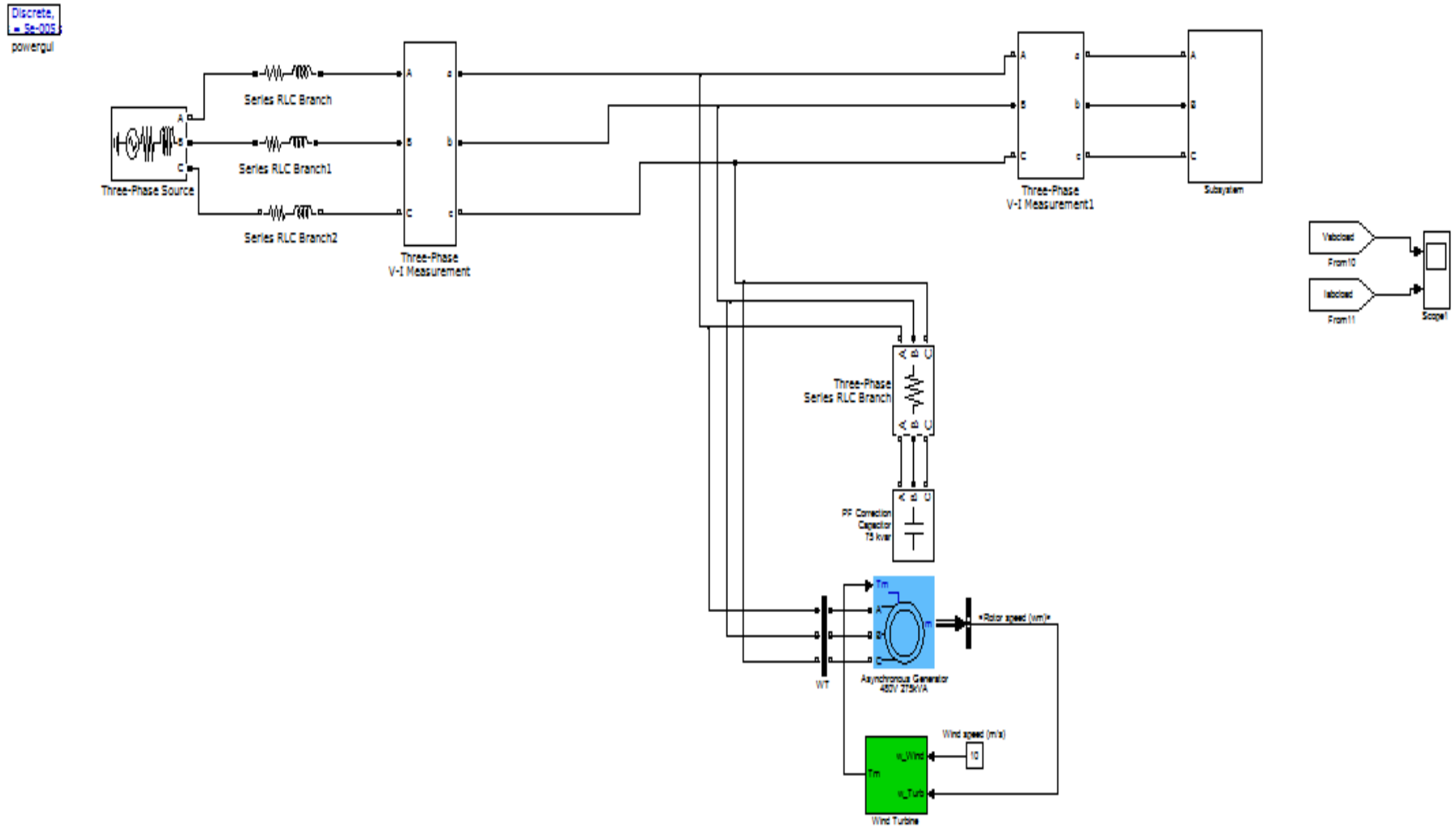
The name MATLAB stands for MATrix laboratory. MATLAB is a software package for high-performance numerical computation and visualization it provides an interactive environment with hundred of built-in function for its own high level programming language.

Advantages and Disadvantages of Simulink

- No Programming skills are required.
- Relatively easy to simulate and generate results.
- The source code is not available and hence it is not possible to modify the simulation package.

SIMULATION

Block Diagram Without STATCOM


Discrete,
powergui
Three-Phase Source
Series RLC Branch
Series RLC Branch1
Series RLC Branch2
Three-Phase
V-I Measurement
Three-Phase
V-I Measurement1
Subsystem
Three-Phase
Series RLC Branch
PF Correction
Capacitor
75 kvar
WT
Asynchronous Generator
460V 275kVA
Rotor speed (wm)
Wind speed (m/s)
10
Wind Turbine
Vabcload
From10
Iabcload
From11
Scope1

Voltage & Current waveform without STATCOM

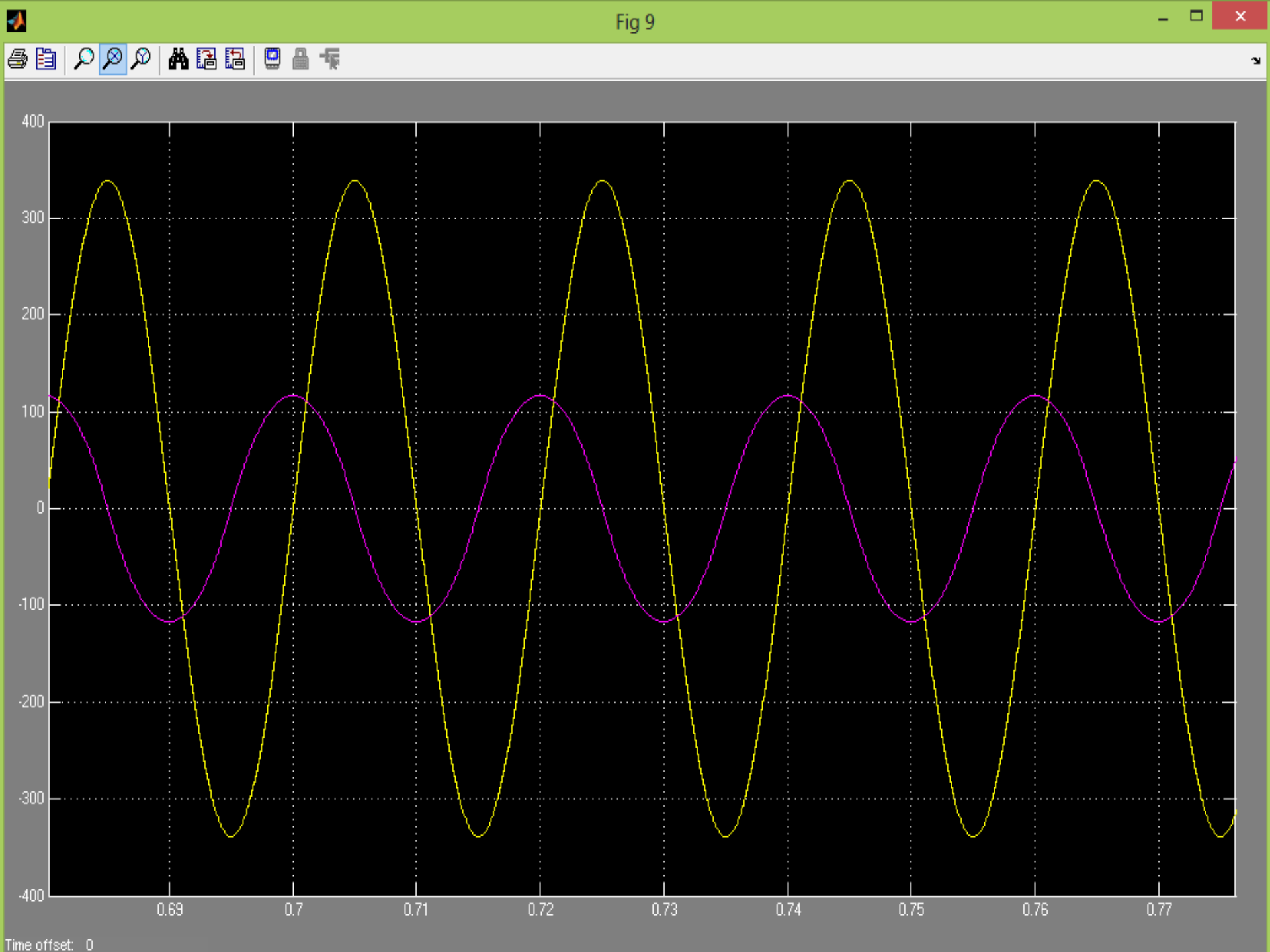
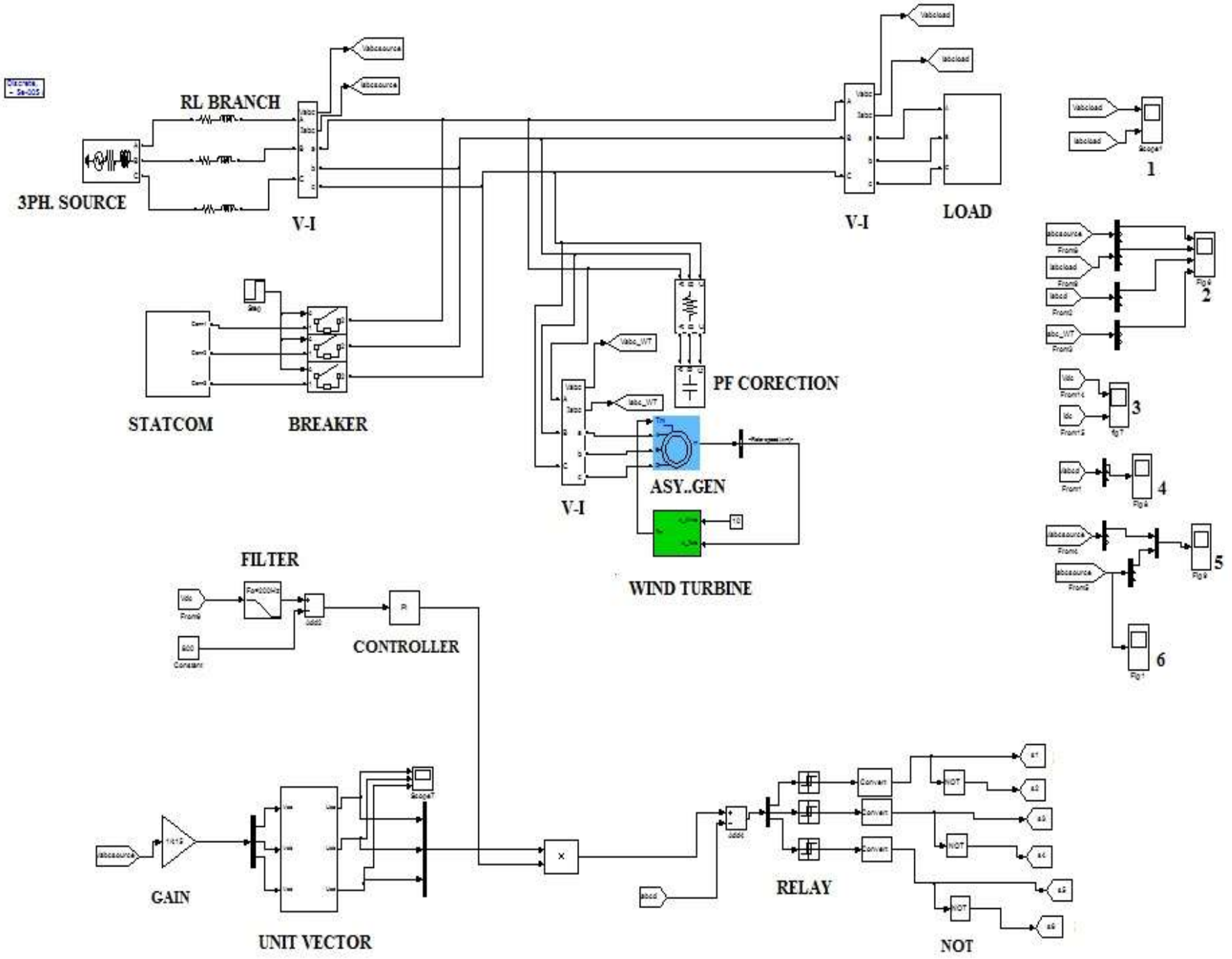


Fig 9
400
300
200
100
0
-100
-200
-300
-400
0.69
0.7
0.71
0.72
0.73
0.74
0.75
0.76
0.77
Time offset: 0

Block Diagram With STATCOM


RL BRANCH
3PH. SOURCE
V-I
V-I
LOAD
STATCOM
BREAKER
PF CORECTION
V-I
ASY..GEN
WIND TURBINE
FILTER
CONTROLLER
GAIN
UNIT VECTOR
RELAY
NOT
1
2
3
4
5
6

Voltage & Current waveform with STATCOM

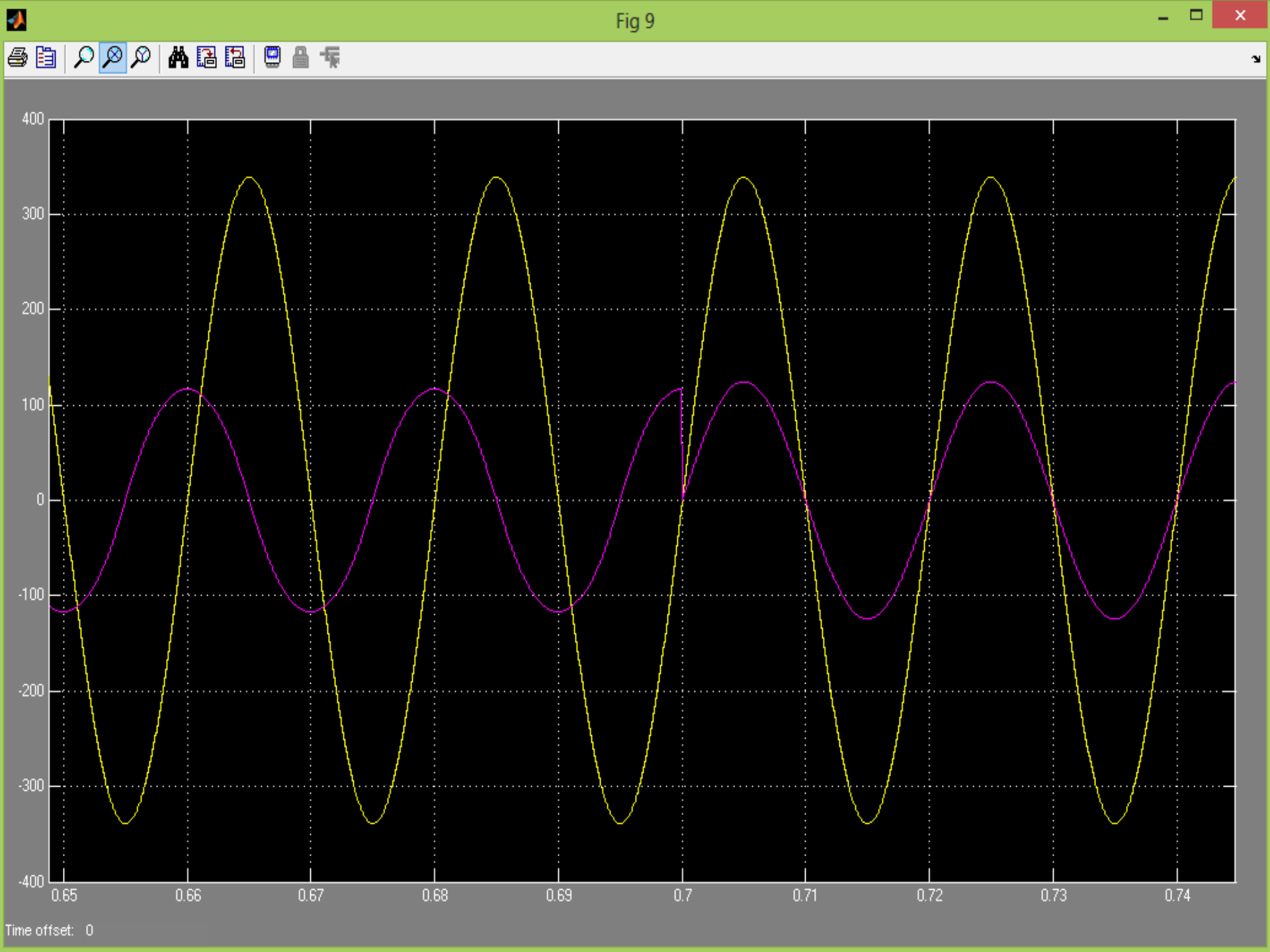


Fig 9
400
300
200
100
0
-100
-200
-300
-400
0.65
0.66
0.67
0.68
0.69
0.7
0.71
0.72
0.73
0.74
Time offset: 0

STATCOM Voltage

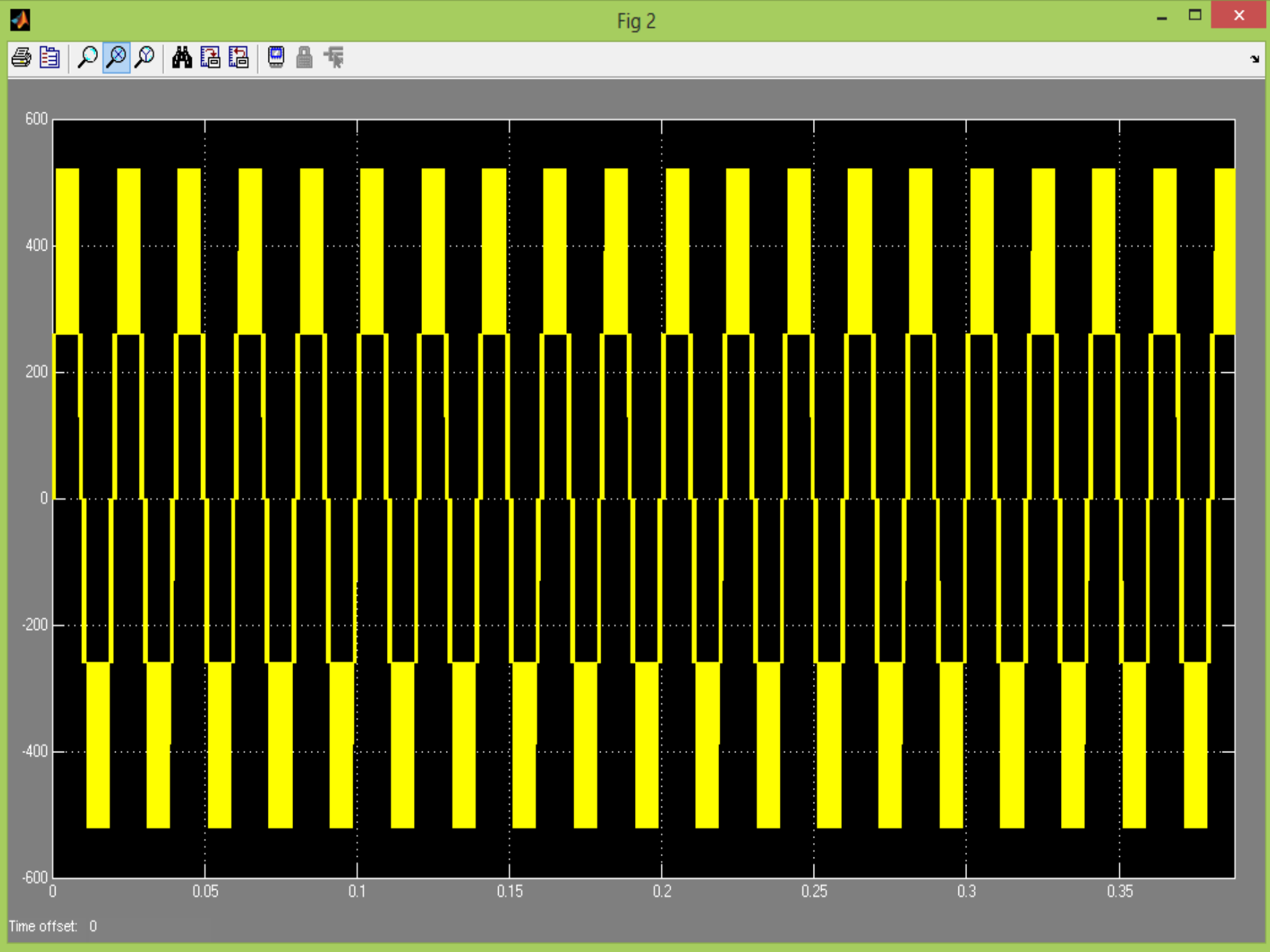
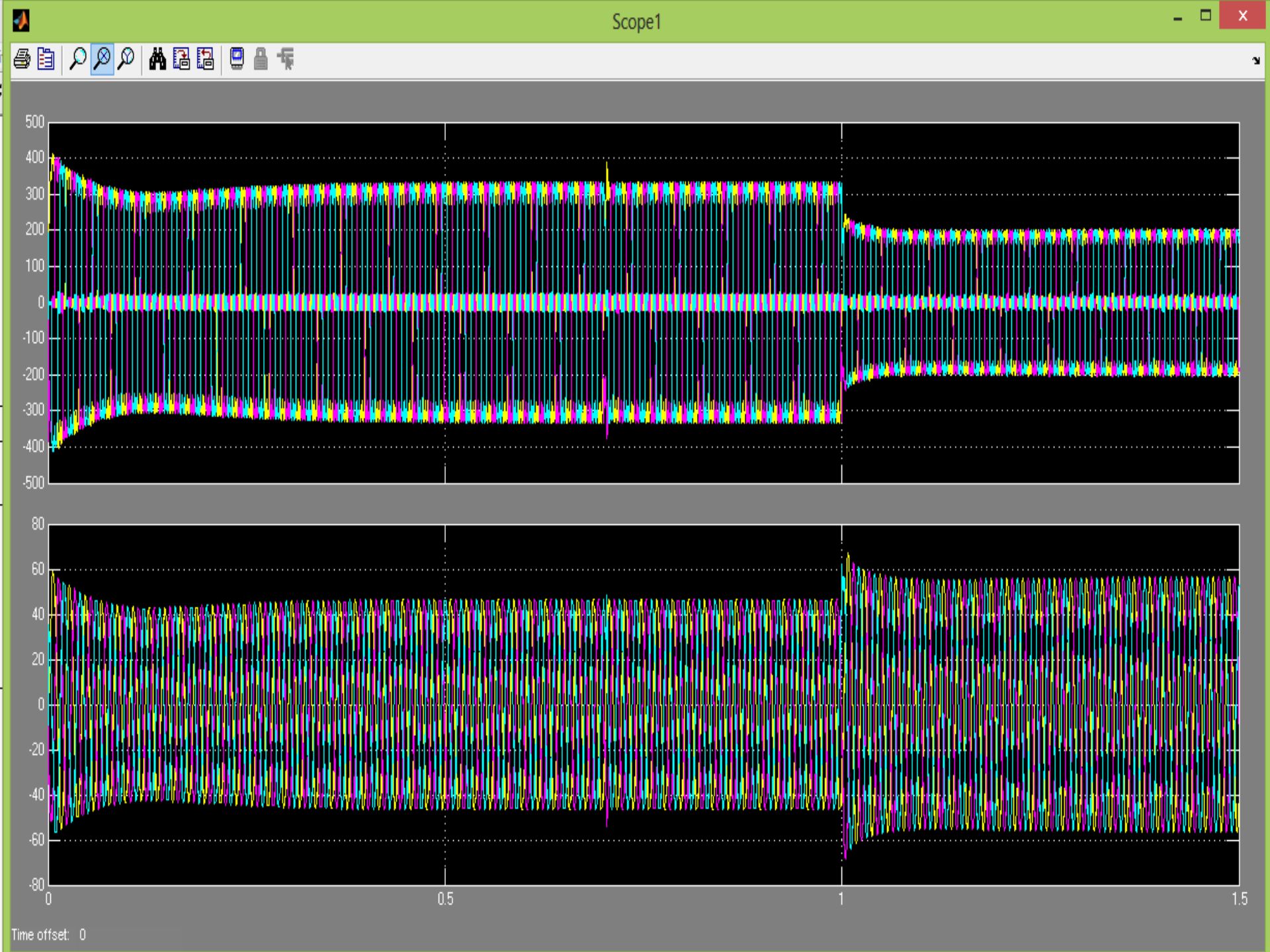


Fig 2
600
400
200
0
-200
-400
-600
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
Time offset: 0

Voltage & Current Waveforms Of Load


Scope1
500
400
300
200
100
0
-100
-200
-300
-400
-500
80
60
40
20
0
-20
-40
-60
-80
0
0.5
1
1.5
Time offset: 0

Current waveforms of Source, Load, STATCOM & WT

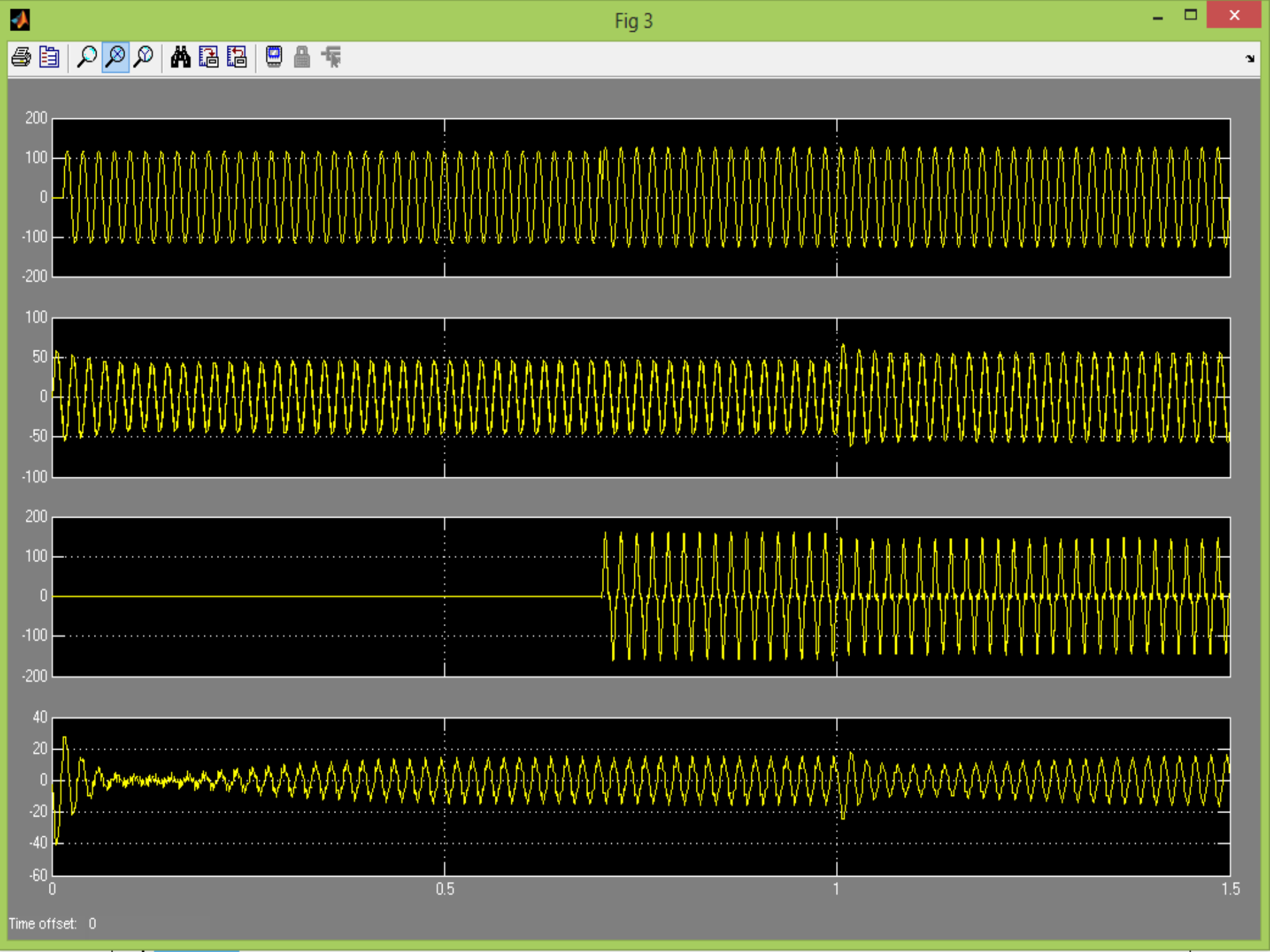


Fig 3
200
100
0
-100
-200
100
50
0
-50
-100
200
100
0
-100
-200
40
20
0
-20
-40
-60
0
0.5
1
1.5
Time offset: 0

CONCLUSION

To eliminate the harmonic content of the load current the STATCOM-BESS control system is used. So that power quality is maintained at the point of common Coupling. And hysteresis current control scheme in the STATCOM is used for the fast dynamic response. It also maintains voltage and current in phase. That means unity power factor is maintained at the source end.

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Thank You