

MIDDLE EAST TECHNICAL UNIVERSITY

Electrical & Electronics Engineering

Simulation Project

EE 462 – Utilization of Electric Energy

EE-464 – Static Power Conversion II

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**INTRODUCTION**

We need to make a simulation project for EE462 and EE464 courses. The aim of this project is designing a motor drive by using sinusoidal PWM for surface mount permanent magnet synchronous machine. For controlling motor, we implemented a current and speed controller by using id-iq parameters. We cannot use Simulink blocks. Therefore, we need to create our own blocks. For part B, we should use sinusoidal PWM technique. Also, in part D, we select the ideal component for project.

**PART A: PRE-DESIGN STAGE**

1-) We know a relation between torque and power. By using that equation, we can find the rated speed.

wmech = 266.67 rad/sec

Trated=300 N.m

The rated torque is given the specification.

2-) Maximum speed is given the specification. By using that, we can find maximum applied frequency.

fmaximum is 467 Hz. For switching frequency, we should take it at least 21 times of fmaximum. We can choose the switching frequency as 10 kHz.

3-) The ripple value of input voltage is not specified but we want almost DC voltage and we can choose the ripple value as %2. We can use below equation

Where I=250A (maximum motor current), f=300 Hz (since three phase rectifier output)

When we calculate by using that equation, we find DC link capacitor value as 83 mF.

**PART B: SINUSOIDAL PWM**

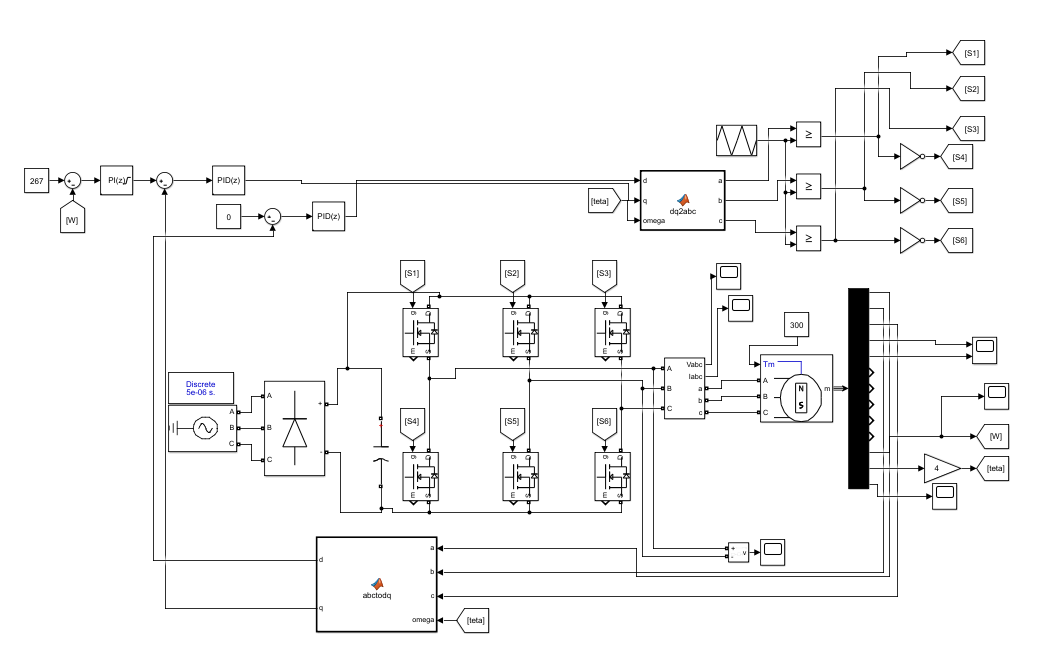


Figure 1: Whole block diagram of motor drive

1-)

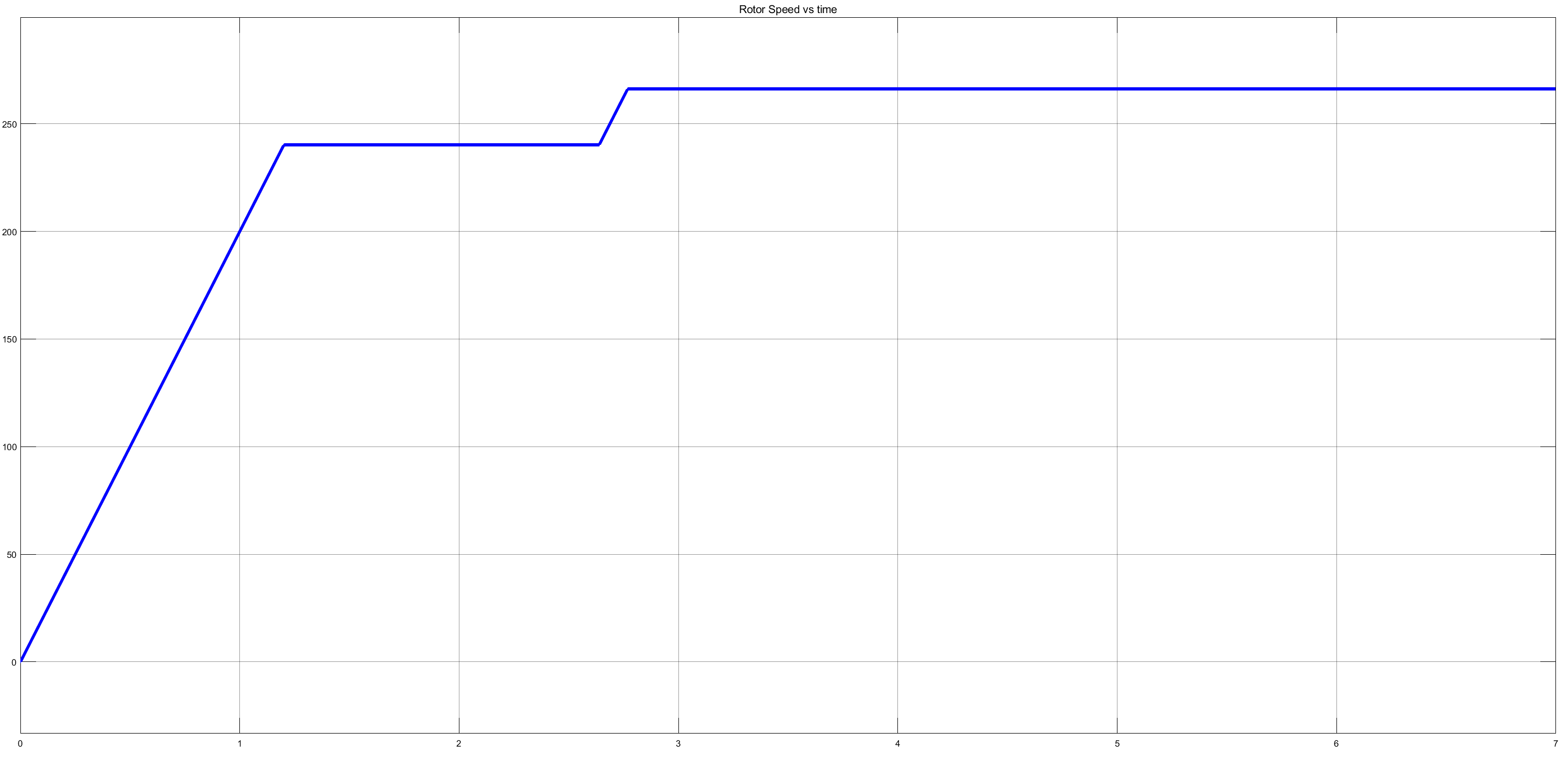


Figure : Rotor Speed(rad/sec) vs time(sec) characteristic

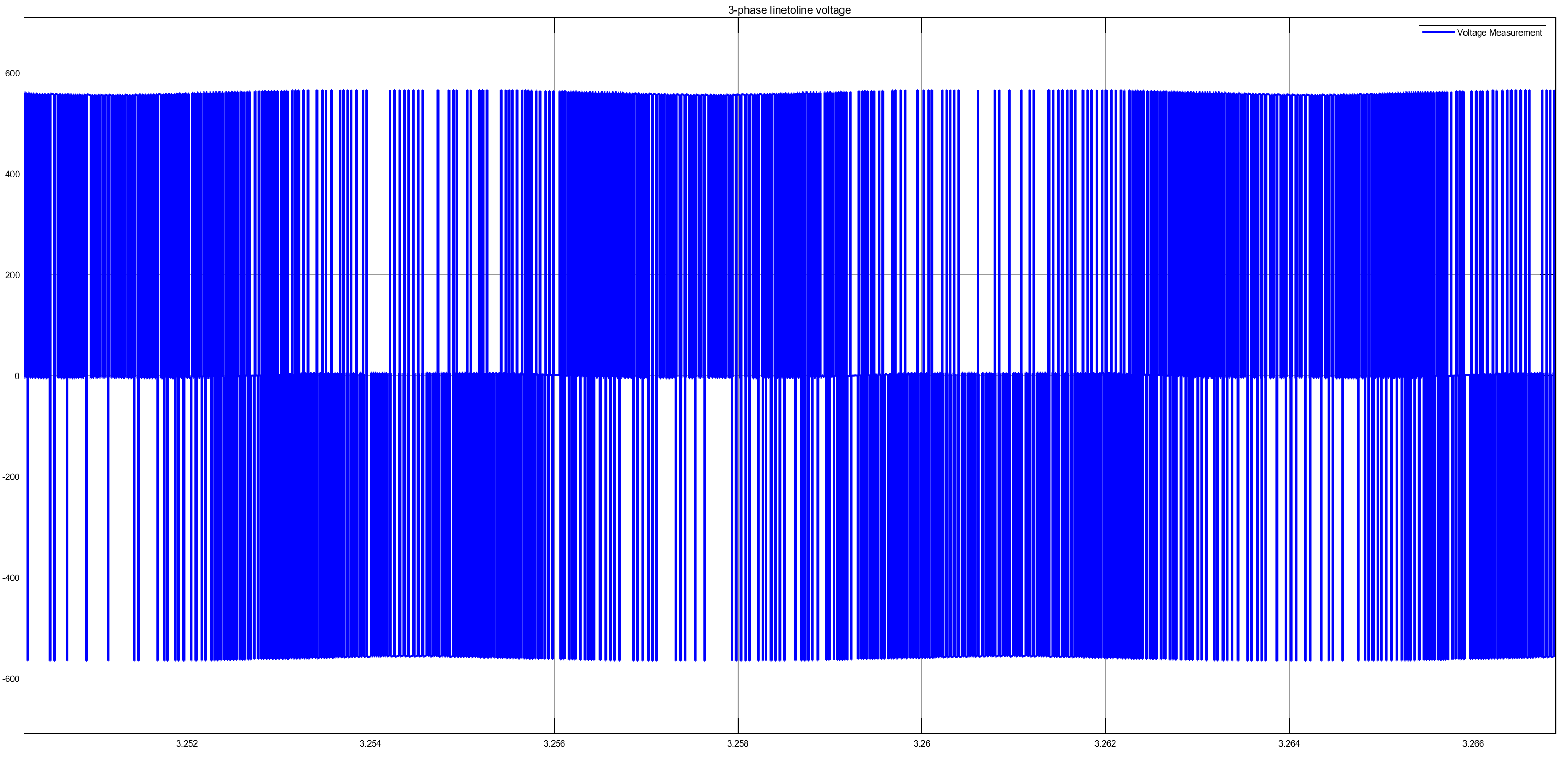


Figure : VAB linetoline voltage from a distance

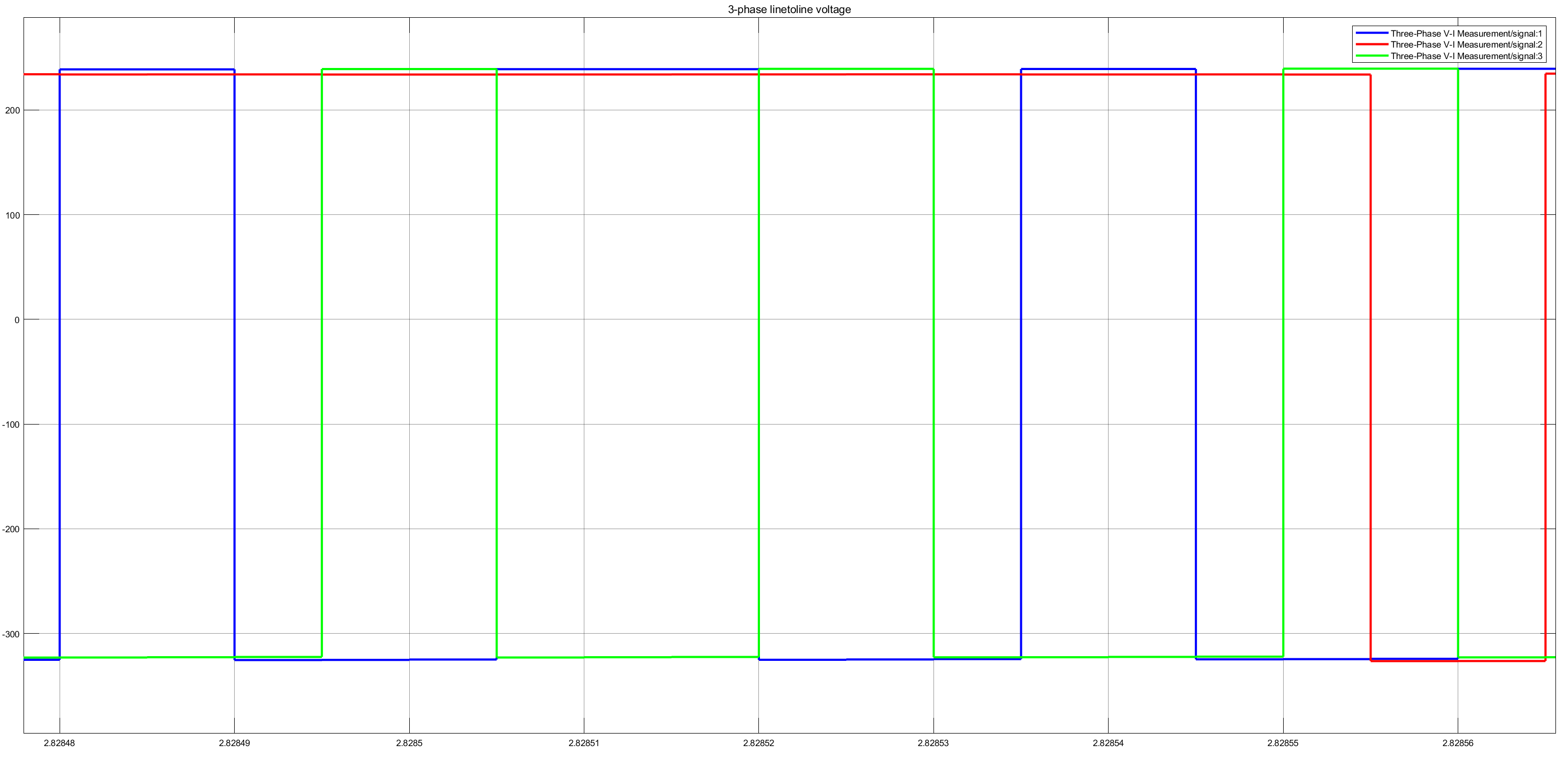


Figure : Three phase line voltages upon close look

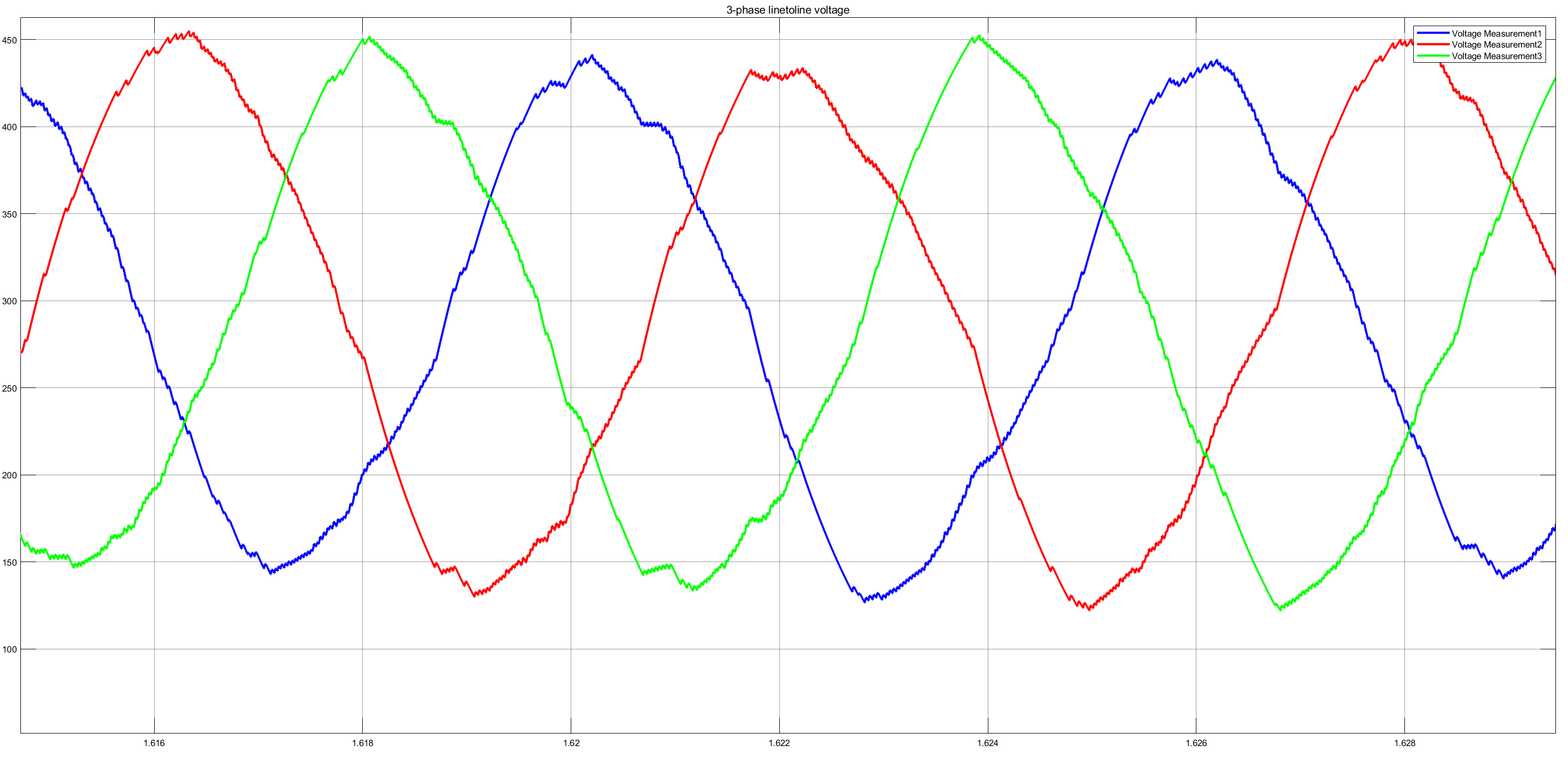


Figure : Three phase line voltages upon close look with low pass filter

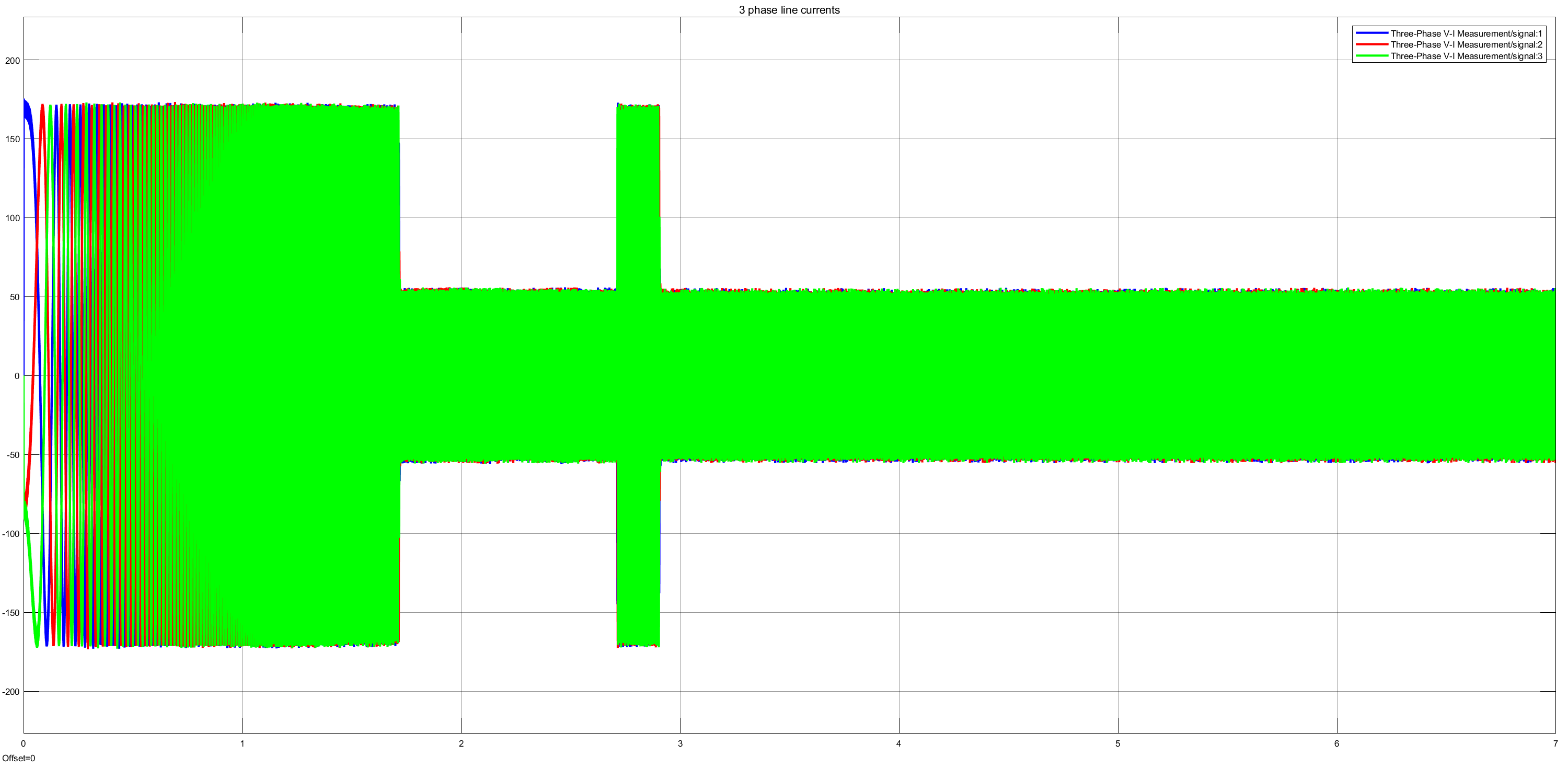


Figure : VAB linetoline currents from a distance

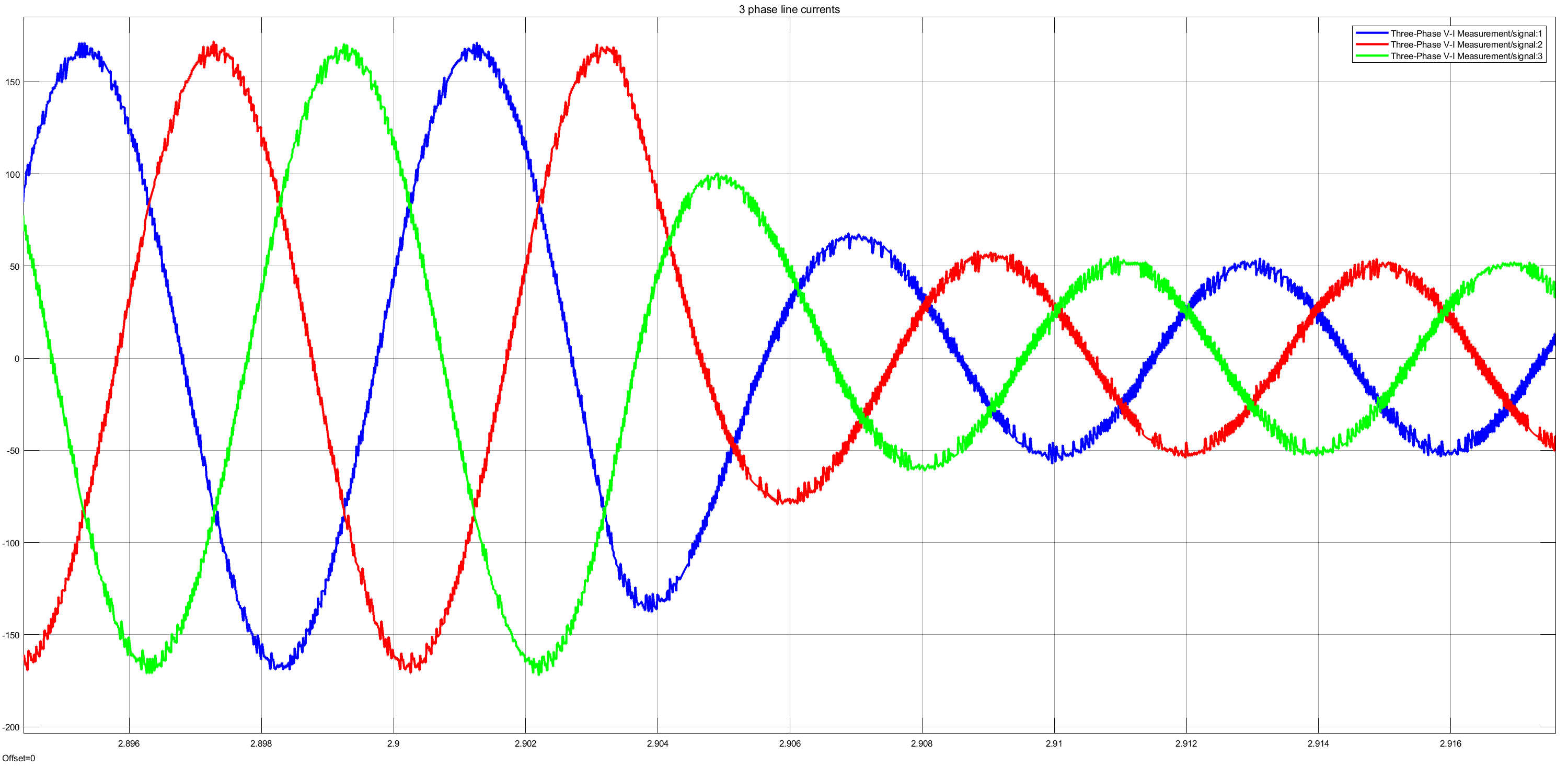


Figure : Three phase line currents upon close look

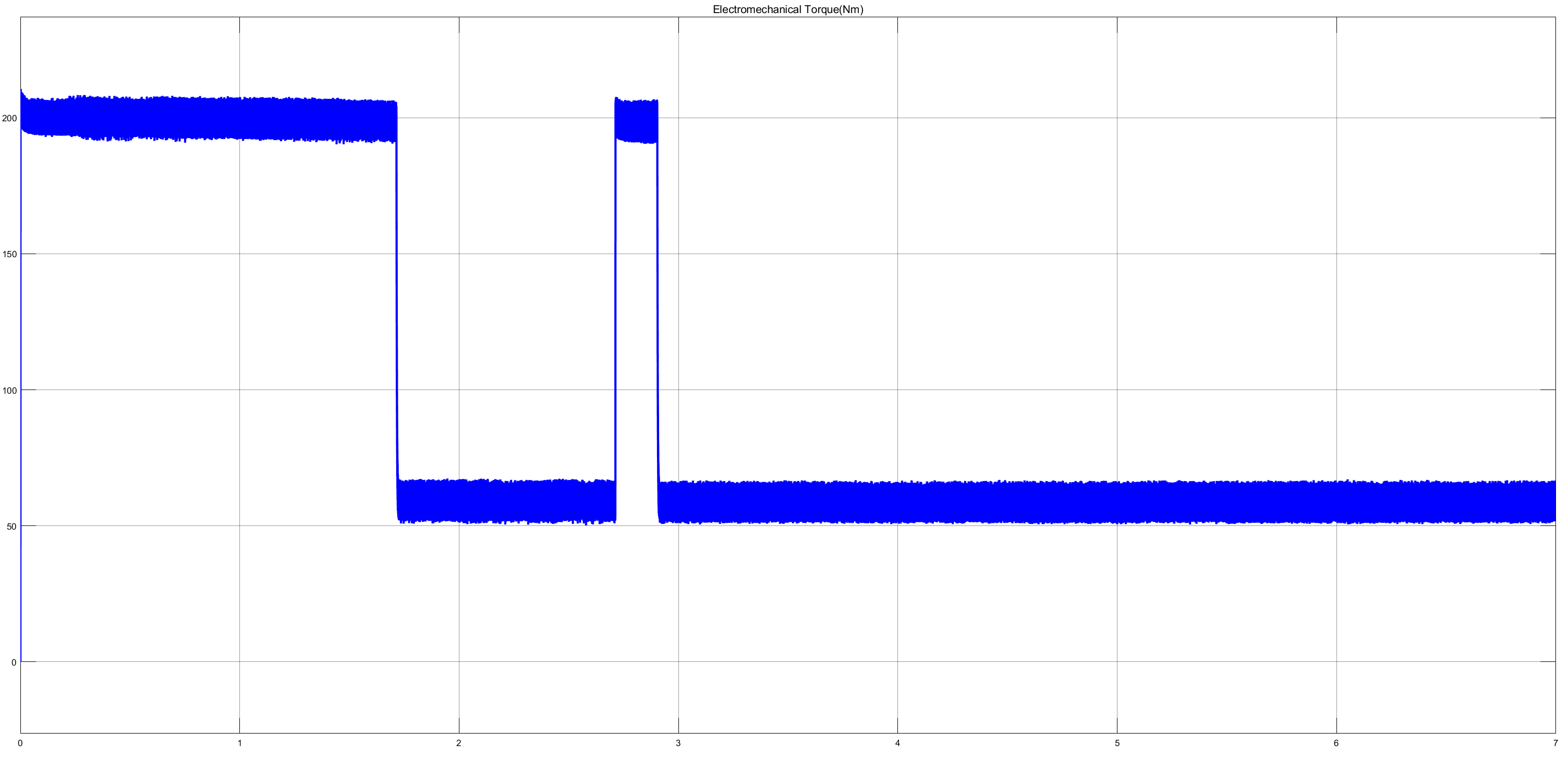


Figure : Electromechanical Torque (Nm) vs time characteristic

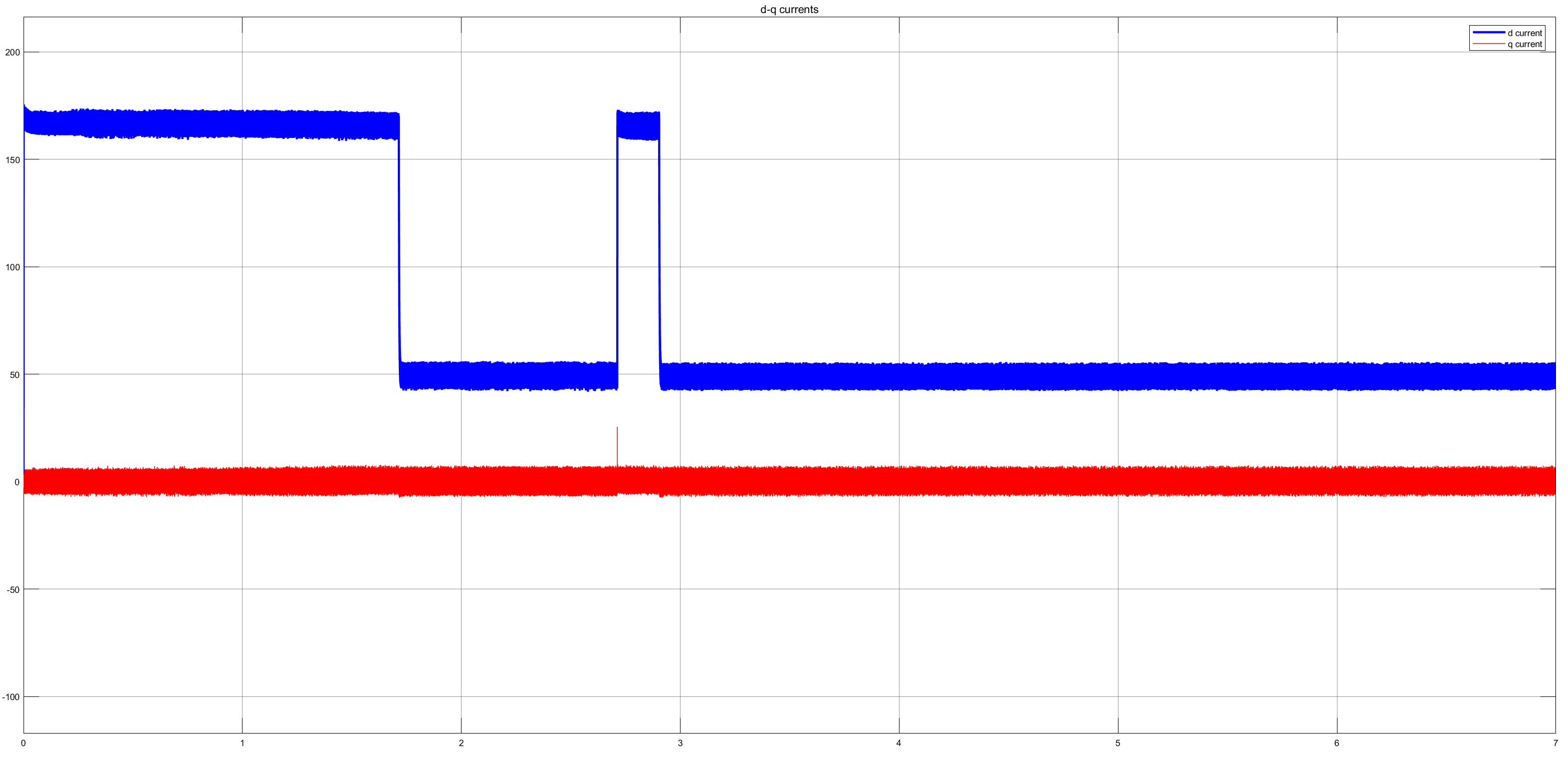


Figure : d (blue) and q(red) currents vs time characteristics

2-)

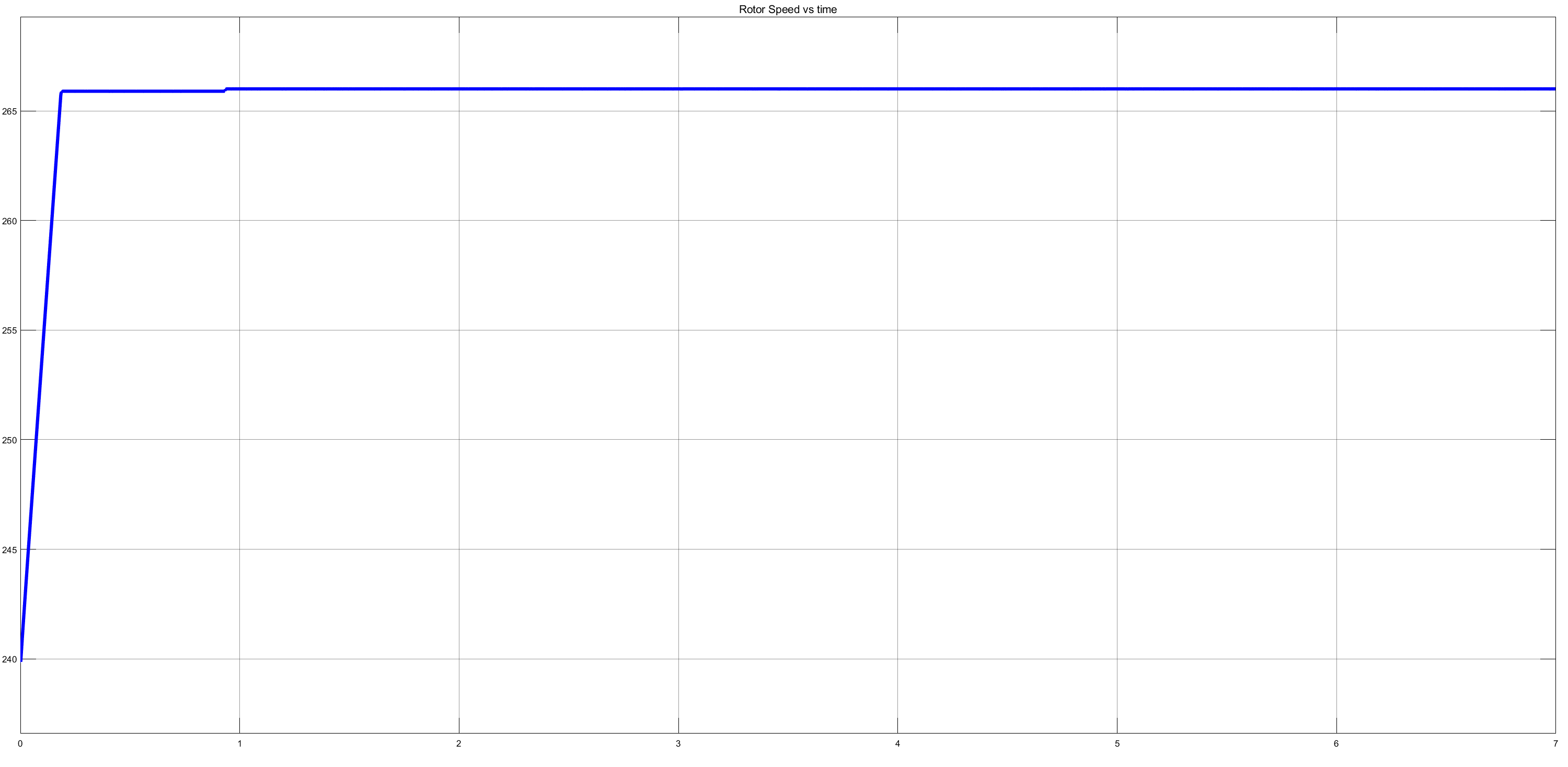


Figure : Rotor Speed(rad/sec) vs time(sec) characteristic

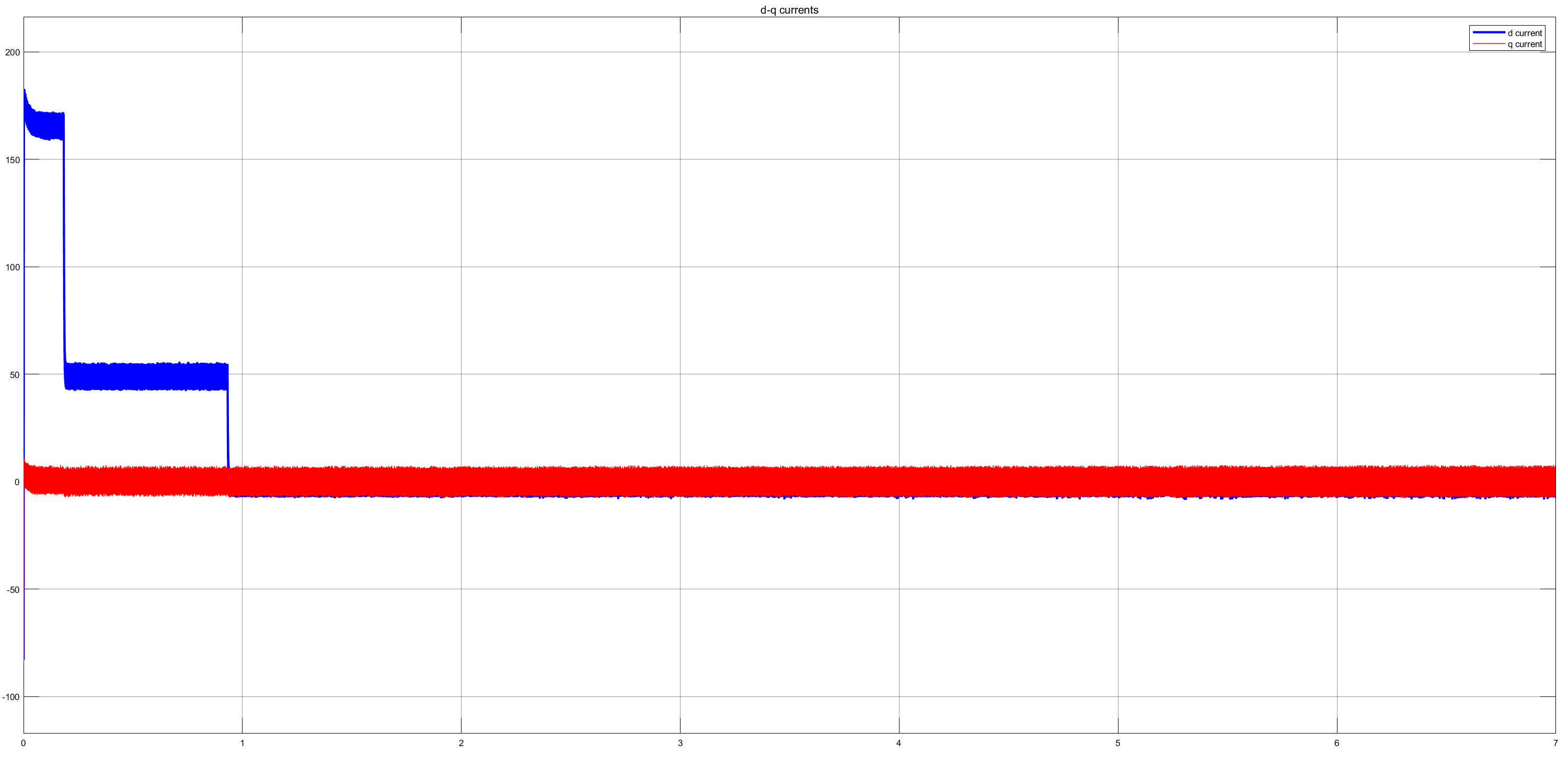


Figure : d (blue) and q(red) currents vs time characteristics

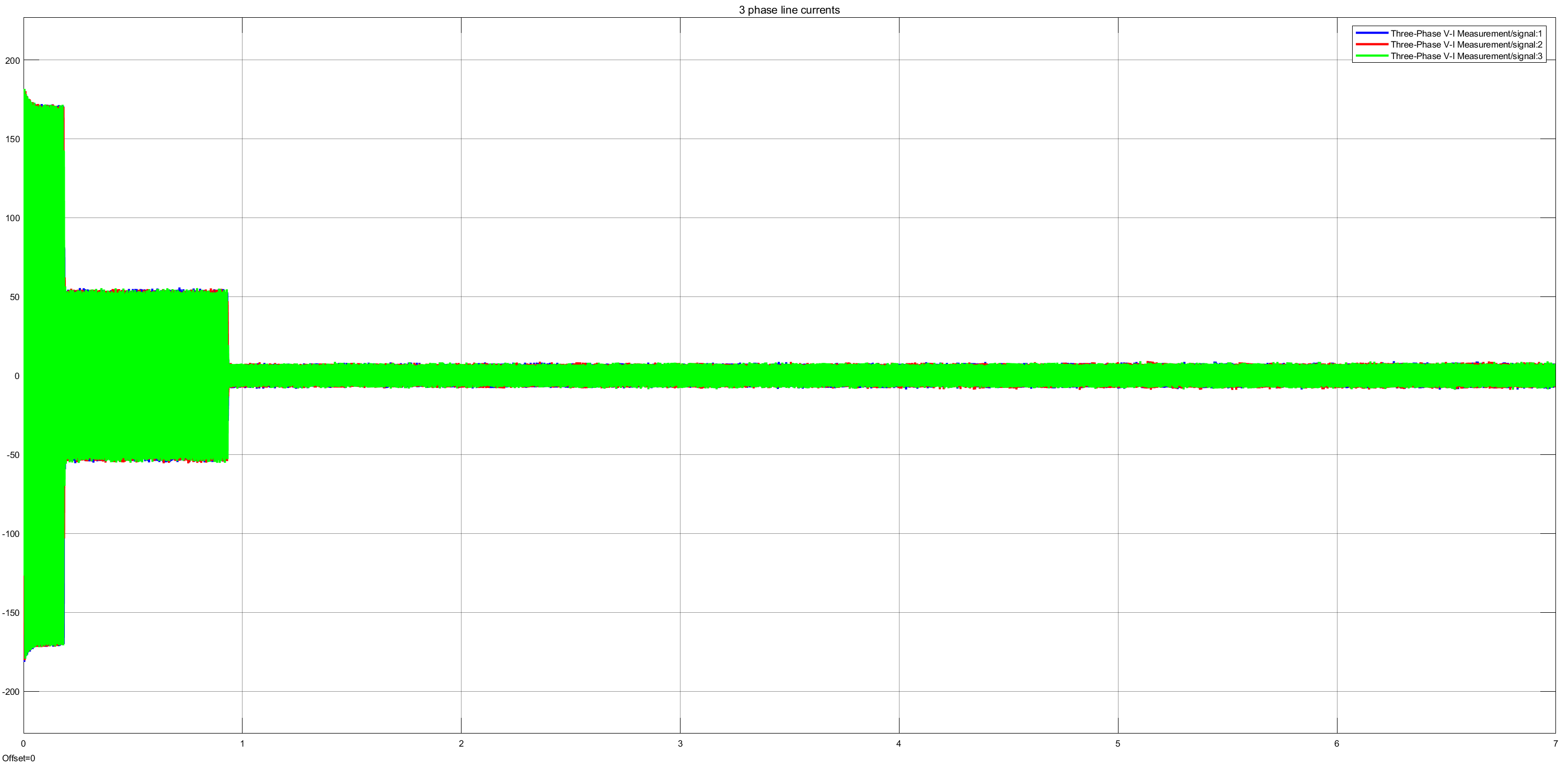


Figure : VAB linetoline currents from a distance

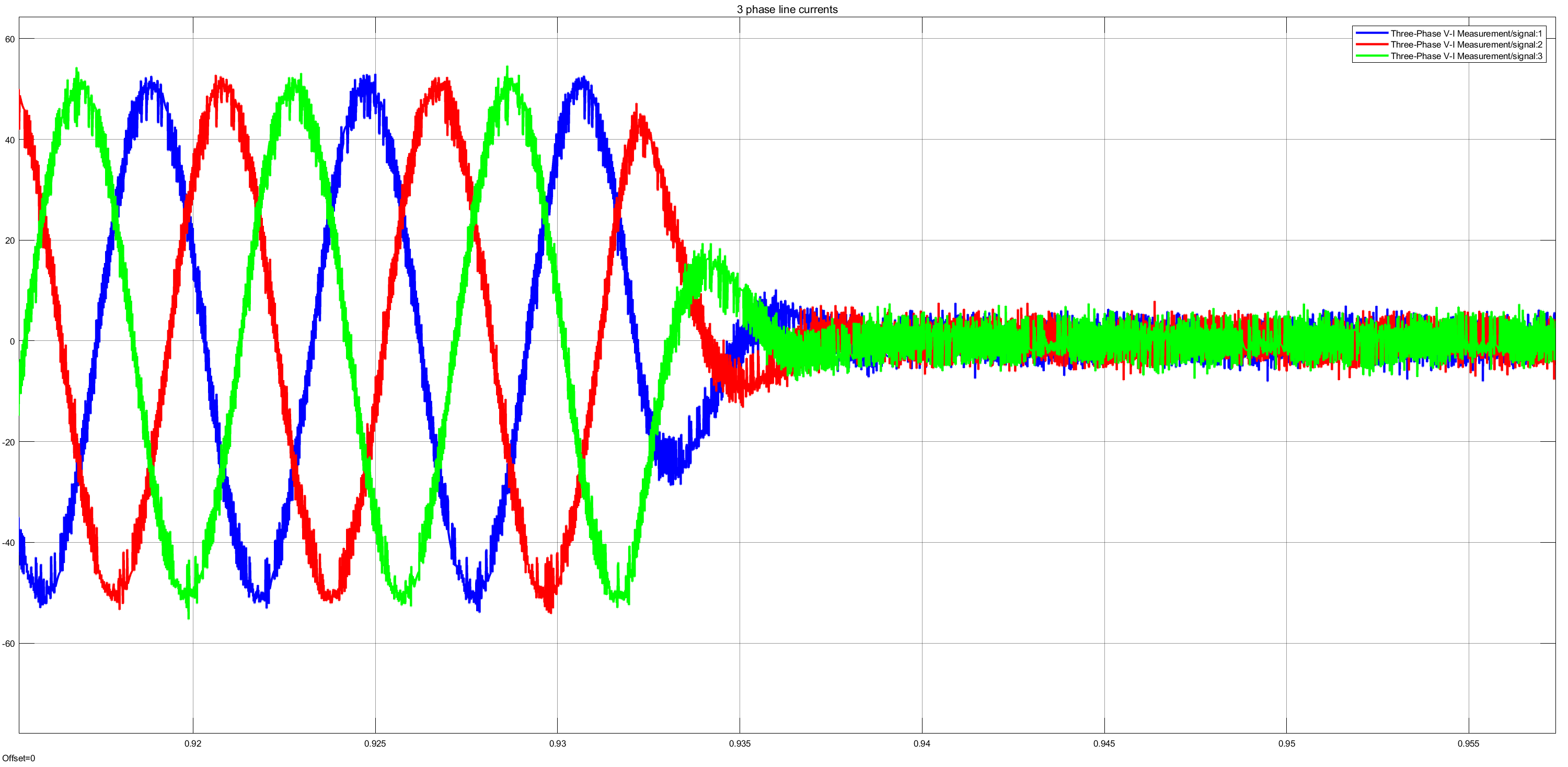
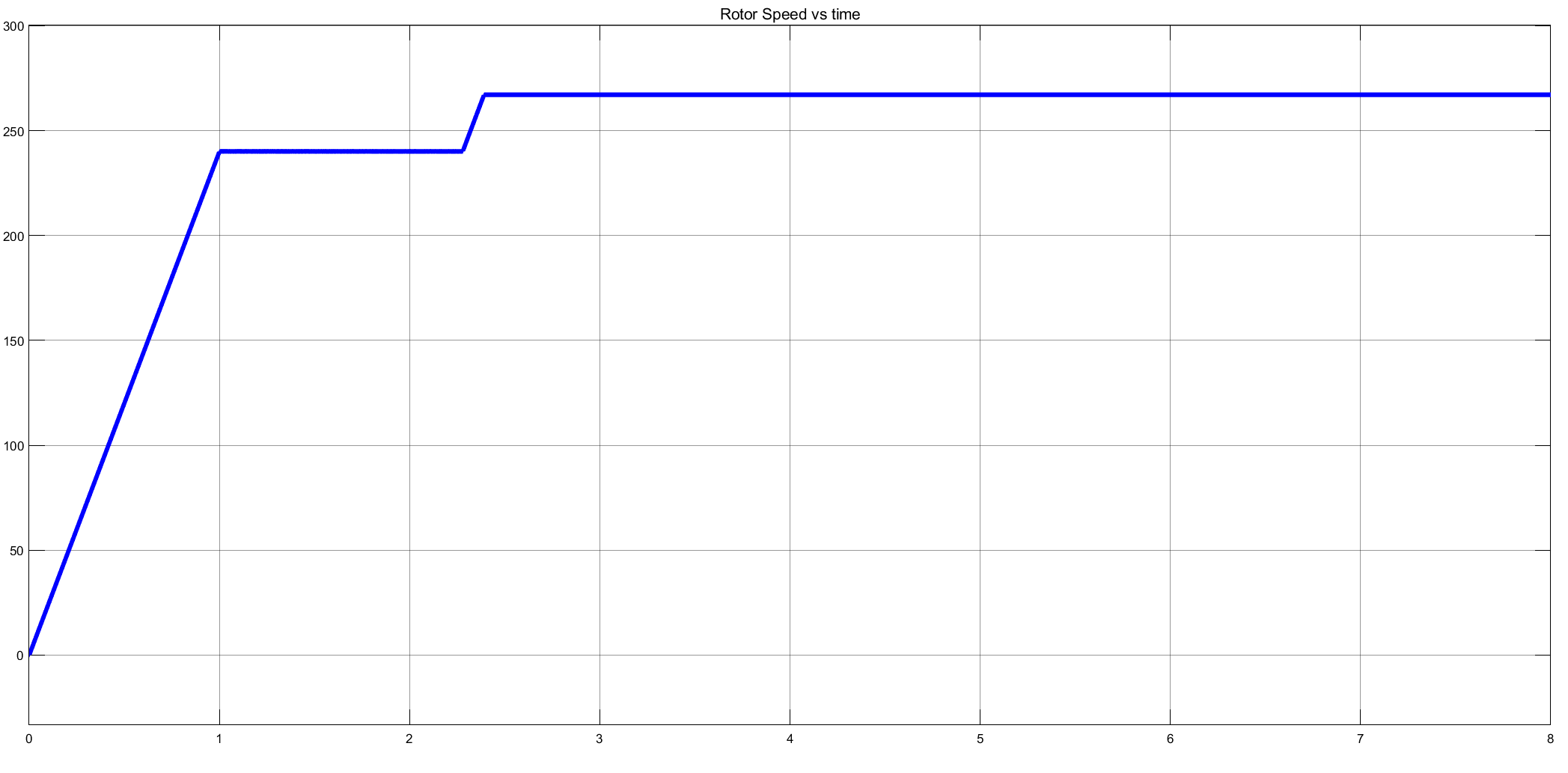
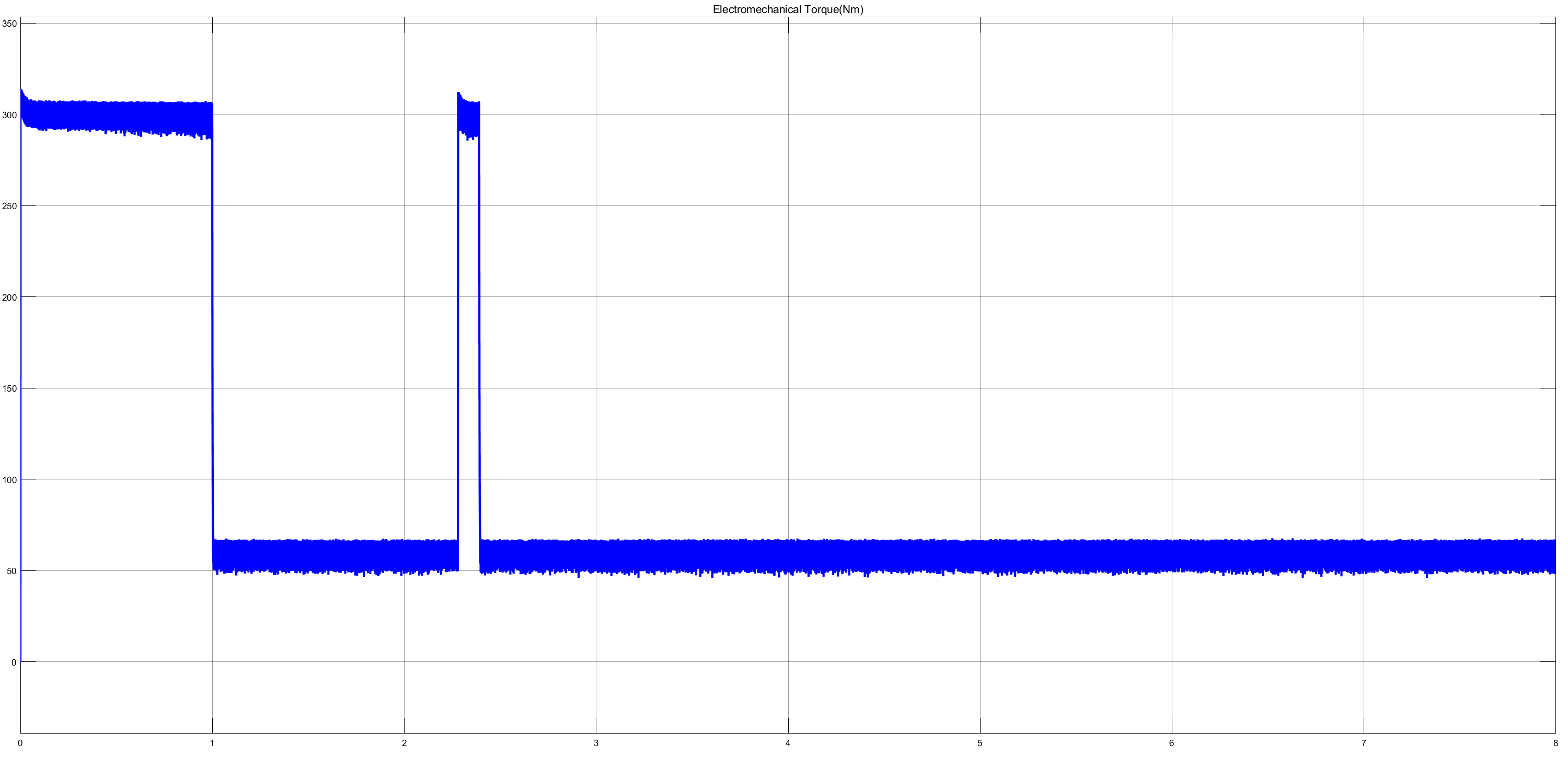
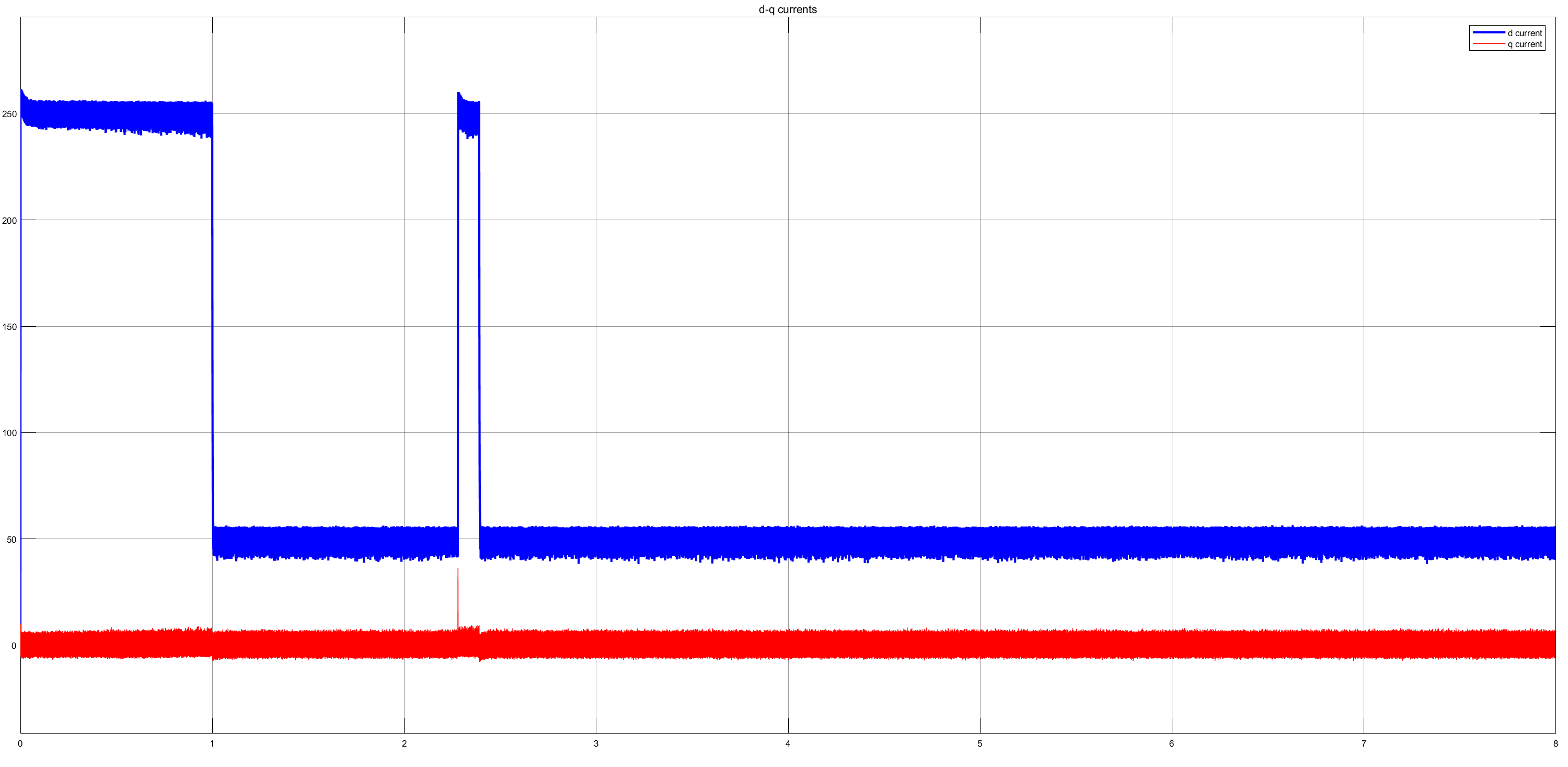


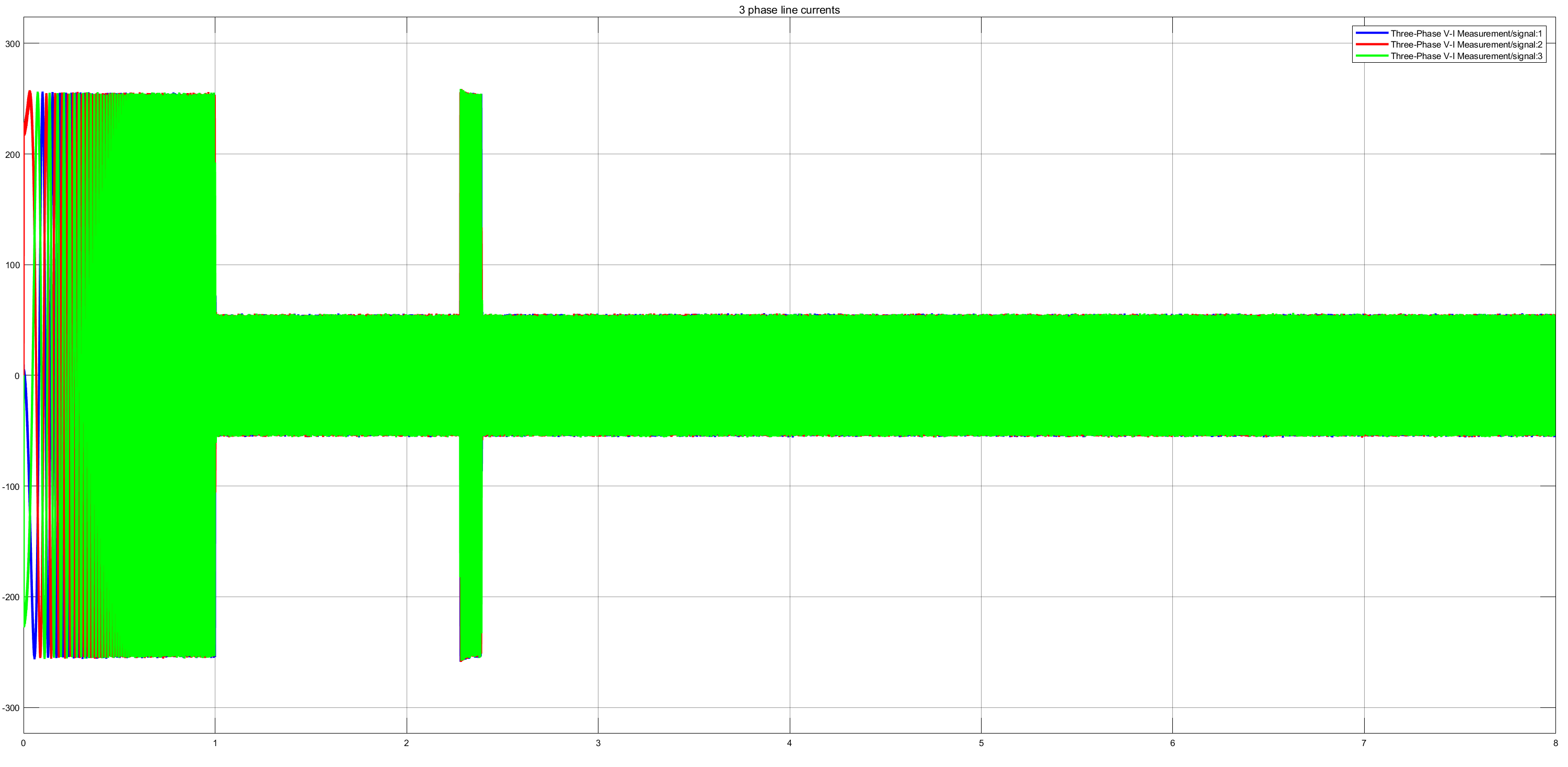
Figure : Three phase line currents upon close look

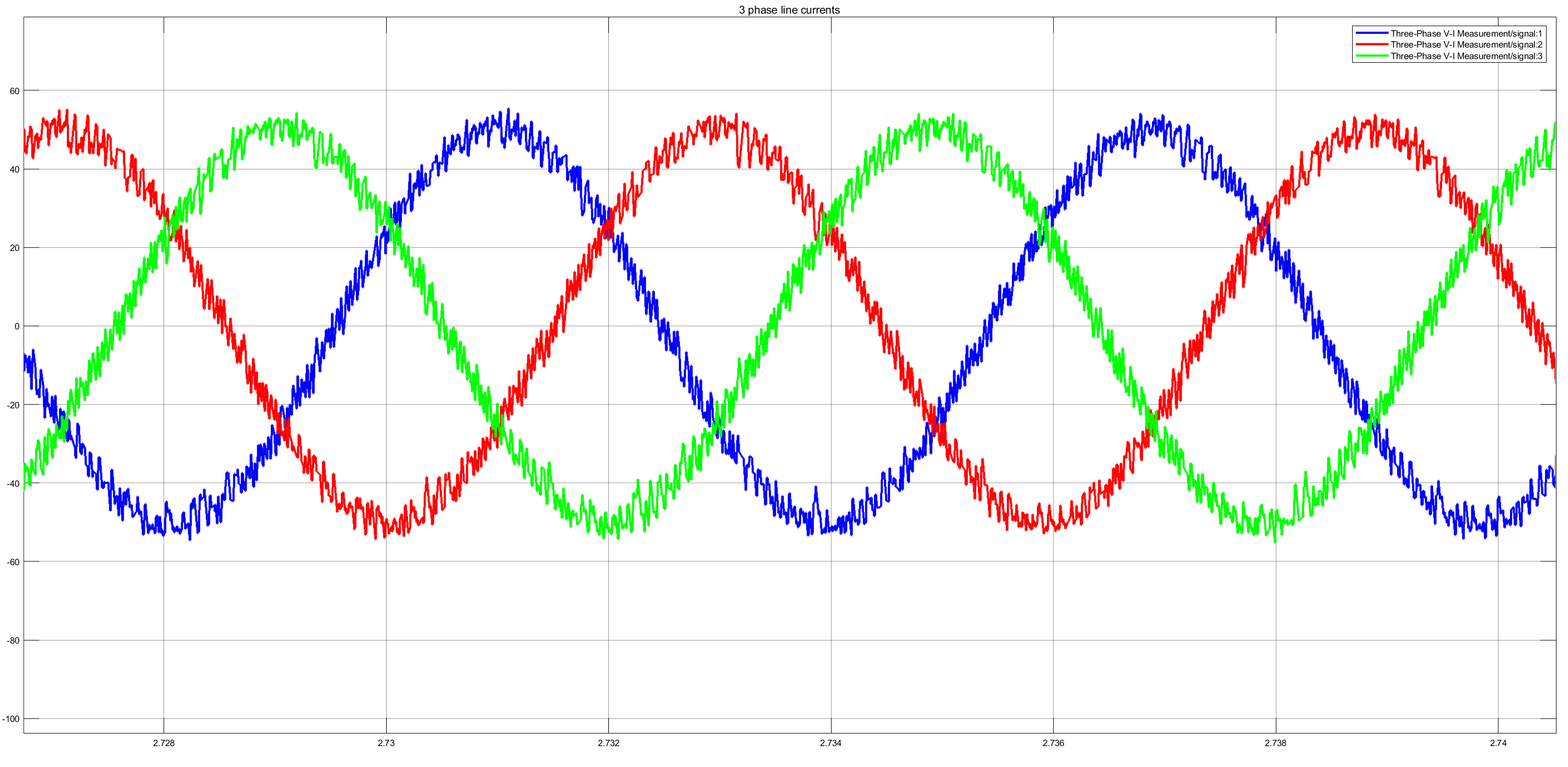
**PART C: SPACE VECTOR PWM (SVPWM)**











**PART D: COMPONENT SELECTION AND VERIFICATION**

1-)

IGBT: We have large current rating for motor.