SIMULATION FOR MACHINES LAB 1

DT021A/3 Electrical Machine

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Model 1:

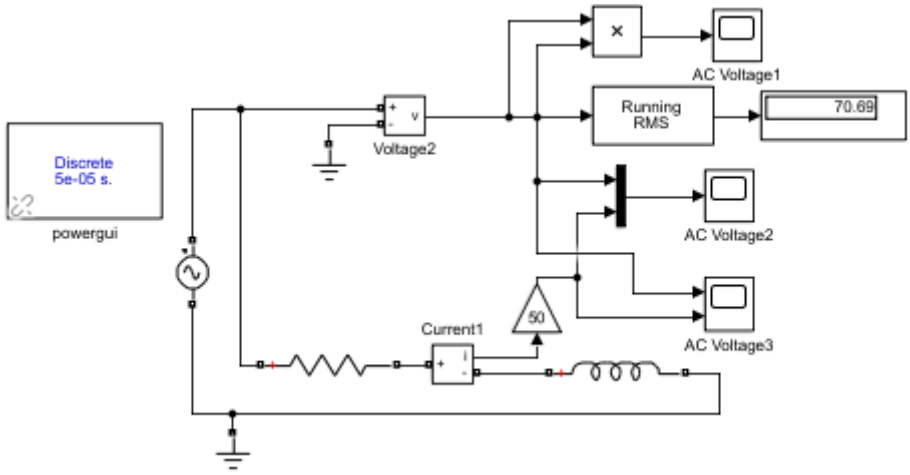

Figure 1 - Schematic diagram of the simple single-phase circuit

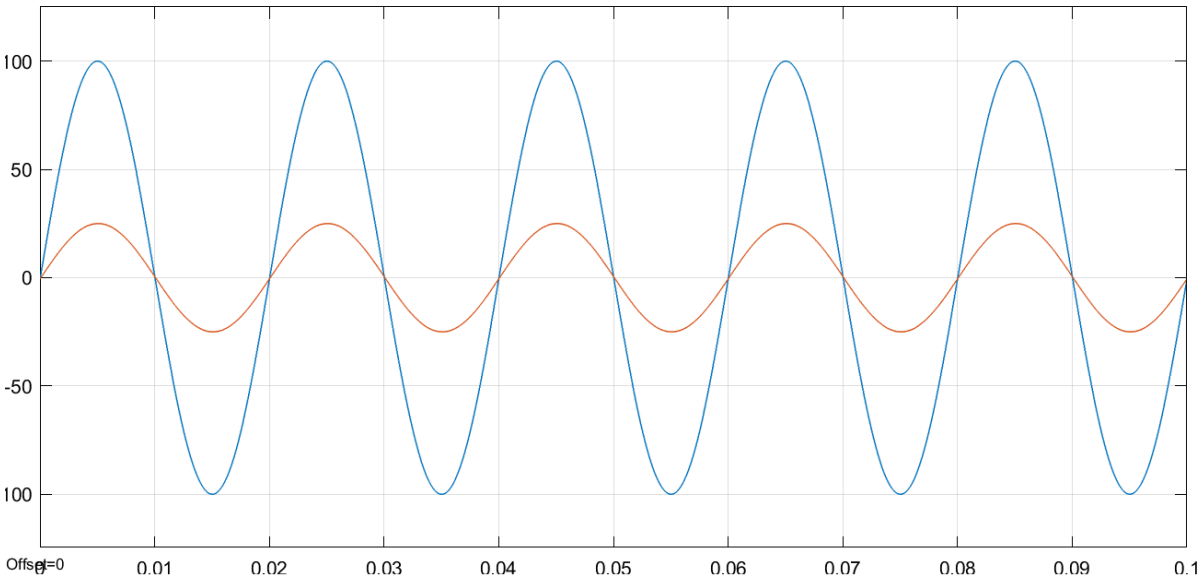

Figure 2 - Output voltage and current peak amplitude of single-phase circuit

The sinusoidal signal with a voltage amplitude of 100vpp is applied to the circuit with the frequency of 50Hz. The output current is in phase with output voltage.

The Vrms value of the AC signal is given by $\frac{1}{\sqrt{2}}$. The Block diagram shows the Vrms value of 70.69Vrms which satisfies the calculated value of 70.7Vrms.

$$Vrms = 100 * \frac{1}{\sqrt{2}} = 70.7$$

Simulation stop time is set to 0.1s to see the 5 number of cycles at the output. The following equation is used to have 5 cycles and figure 2 shows the 5 cycles.

$$p = \frac{1}{f} = \frac{1}{50Hz}\ 0.02s$$

$$Cycles = \frac{0.1s}{0.02s} = 5$$

To measure the power of the

Model 2:

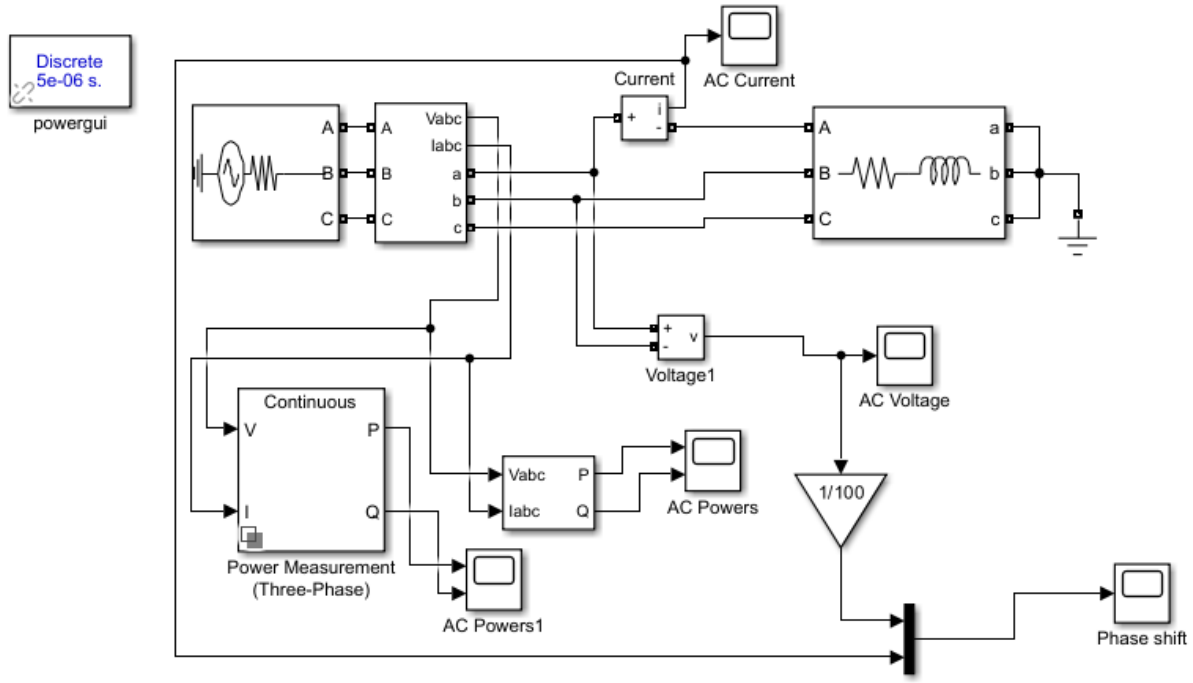

Figure 3 - Schematic diagram of the 3-phase circuit

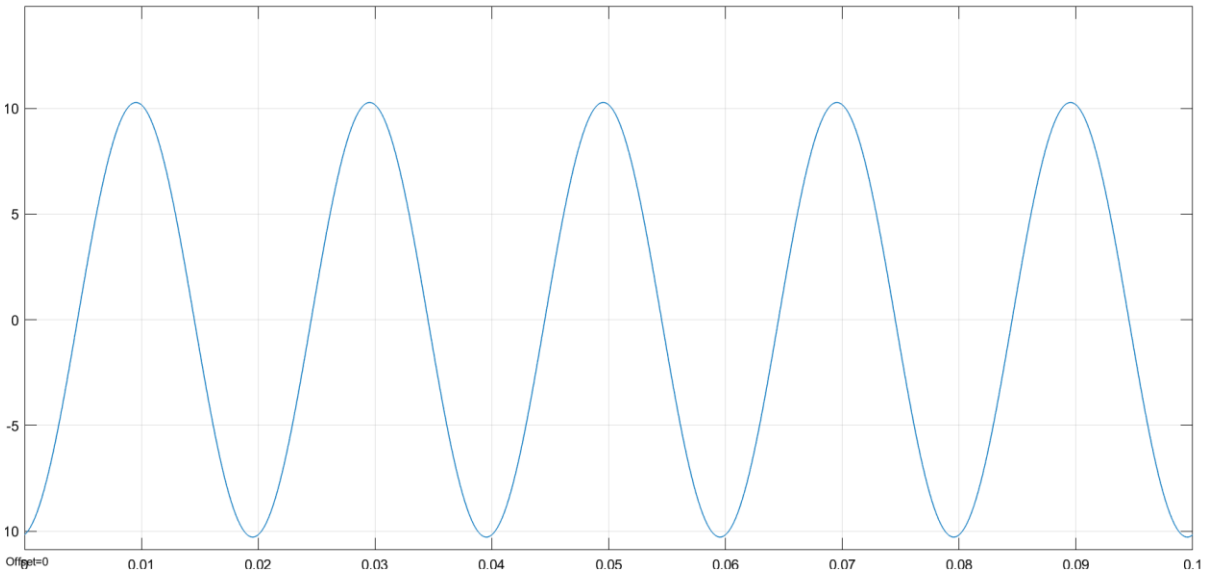

Figure 4 - Current Measurement for the 3-phase circuit

The AC current in phase 1 has amplitude from -10 to 10A and oscillates every 20ms.

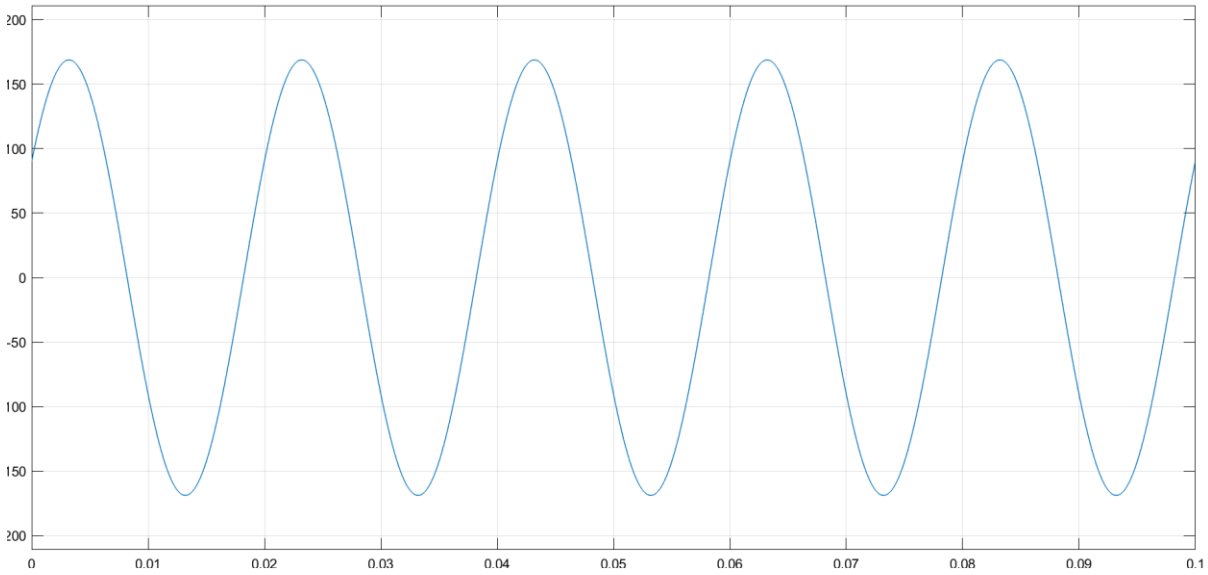

Figure 5 - Voltage Measurement

Peek amplitude is 168Vpp.

$$\Rightarrow V_{ab} = V - V\{Cos(-120^0) + jSin(-120^0)\}$$

$$= V - V\left\{-0.5 - j\frac{\sqrt{3}}{2}\right\}$$

$$= V\left[1 - \left\{-0.5 - j\frac{\sqrt{3}}{2}\right\}\right]$$

$$= V\left[1 + 0.5 + j\frac{\sqrt{3}}{2}\right]$$

$$= V\left[\frac{3}{2} + j\frac{\sqrt{3}}{2}\right] = \sqrt{3}.V\left[\frac{\sqrt{3}}{2} + j\frac{1}{2}\right] = \sqrt{3}V\angle 30^0$$

$$\Rightarrow V_{ab} = \sqrt{3}.V\angle 30^0$$

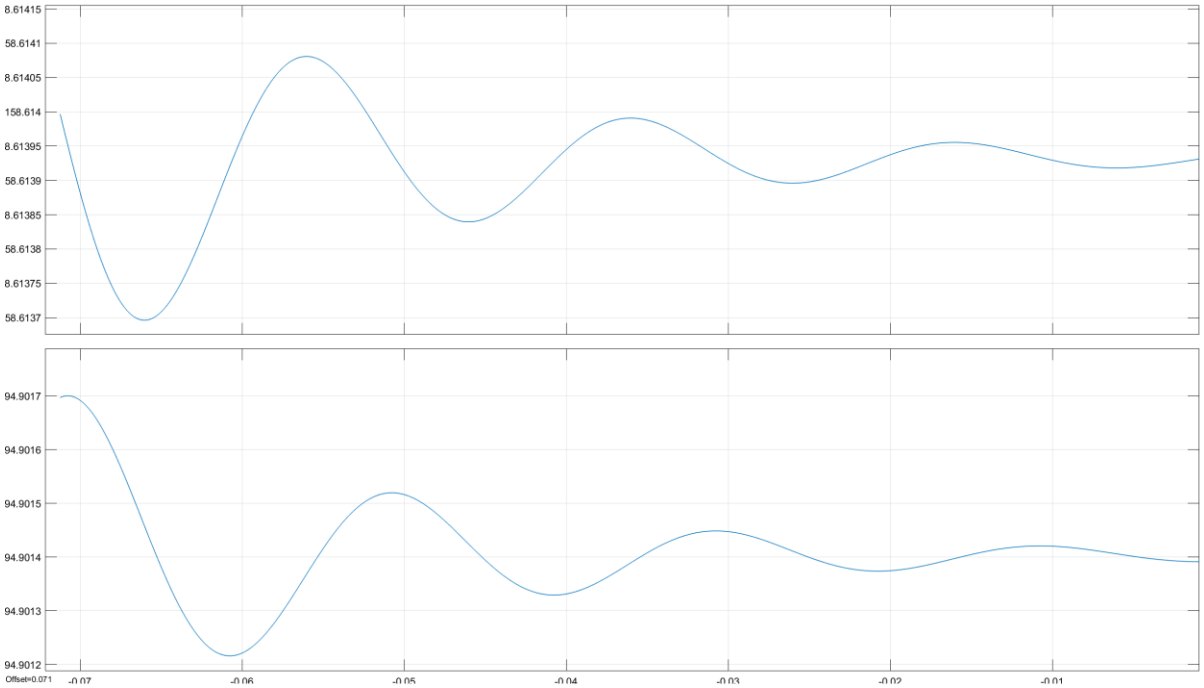

Figure 6 - AC power – Va & Ia

P = 3 Vp * Ip * cos0

P = 3 (168) * (10) * cos

P = 5.04kW

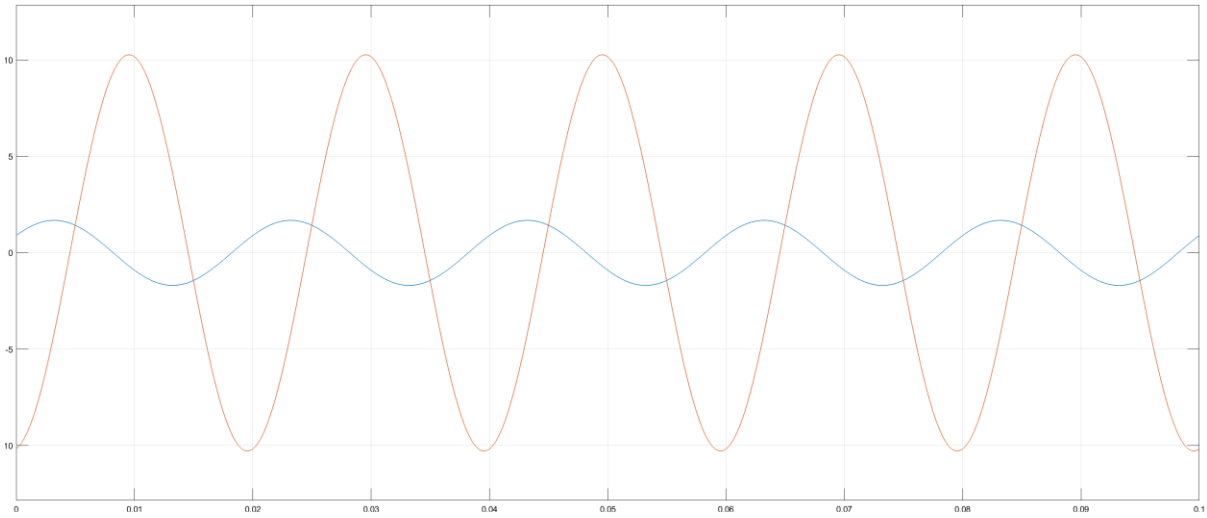

Figure 7 - Phase shift between current and voltage

The output voltage (168Vpp) has dropped due to the very small gain (1/100) and the voltage waveform is shifted by 90 degrees.

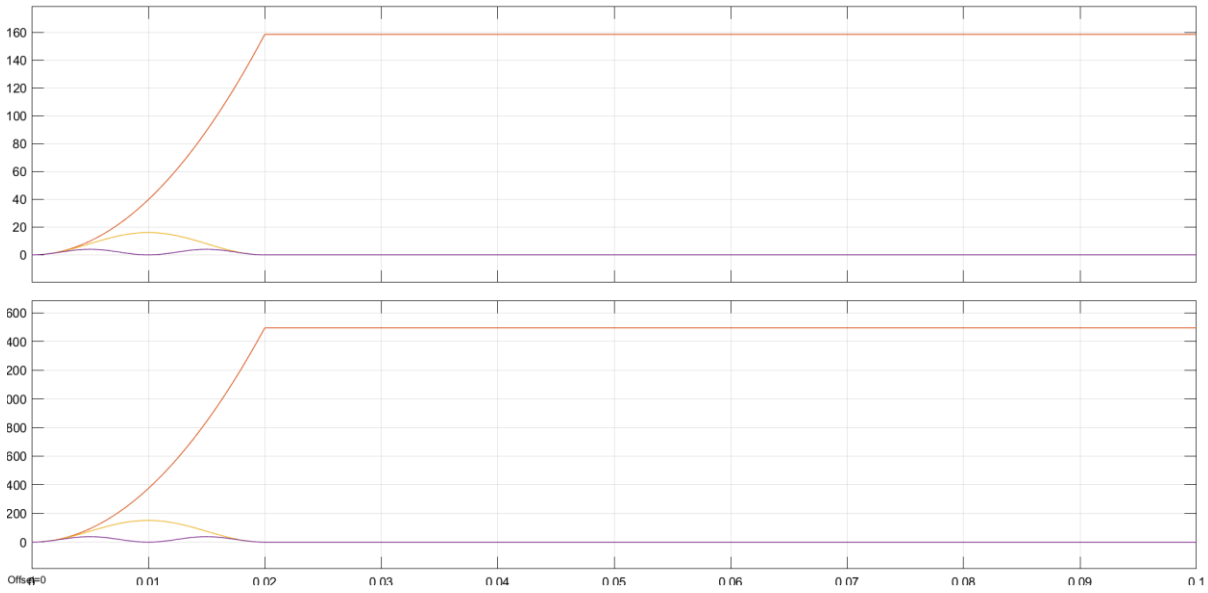

Figure 8 - Power Measurements when using the power block

$$Vrms = 125 * \frac{1}{\sqrt{2}} = 88.38$$

For the $\Delta - load$: $$I_A = \sqrt{3}\, I_{AB} \angle -30^0 = \frac{\sqrt{3}.E_{AB} \angle -30^0}{Z\Delta}.$$

For the $Y - load$: $$I_A = \frac{E_{AN}}{Z_y} = \frac{E_{AB} \angle -30^0}{\sqrt{3} Z_y}$$

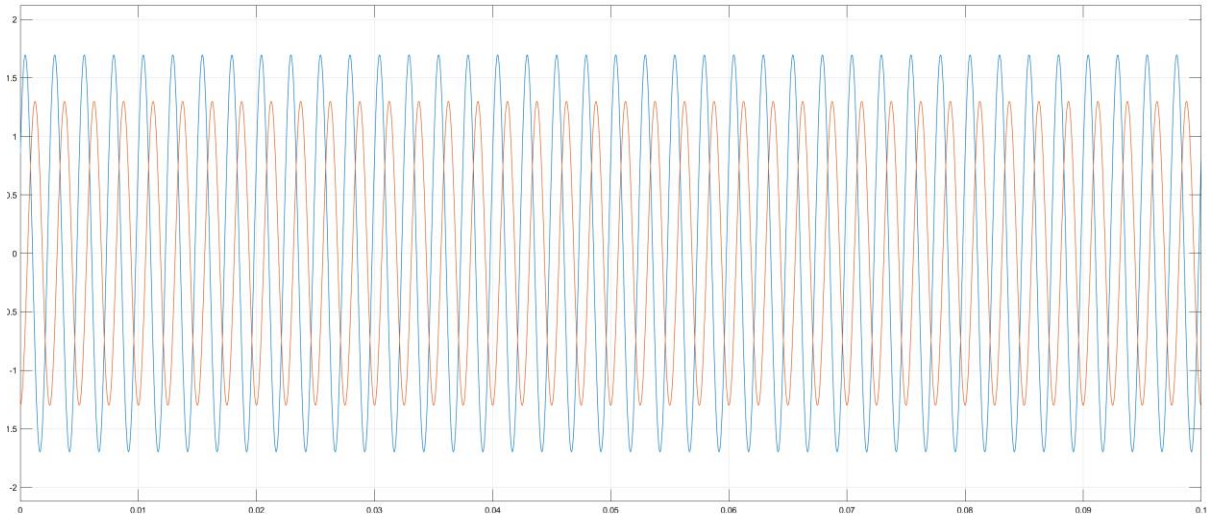

Figure 9 – increasing the frequency by 400Hz

The amplitude and phase stay the same only the cycles increase when increasing the frequency.

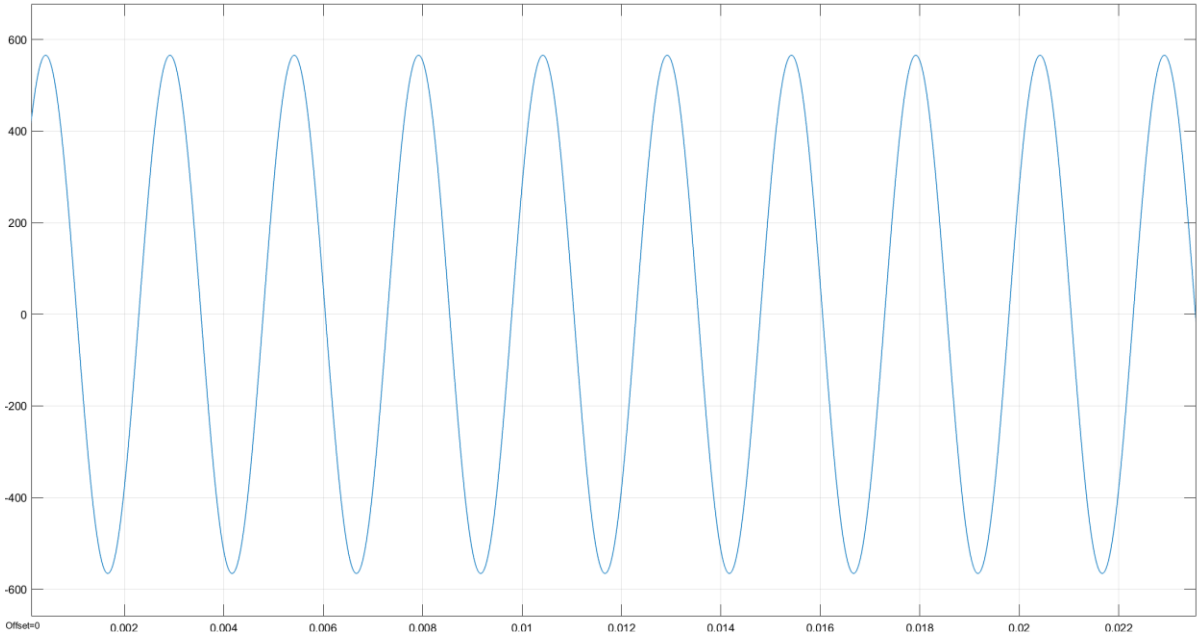

Figure 10 - The output voltage increases to 570v when the input volts increases to 400v

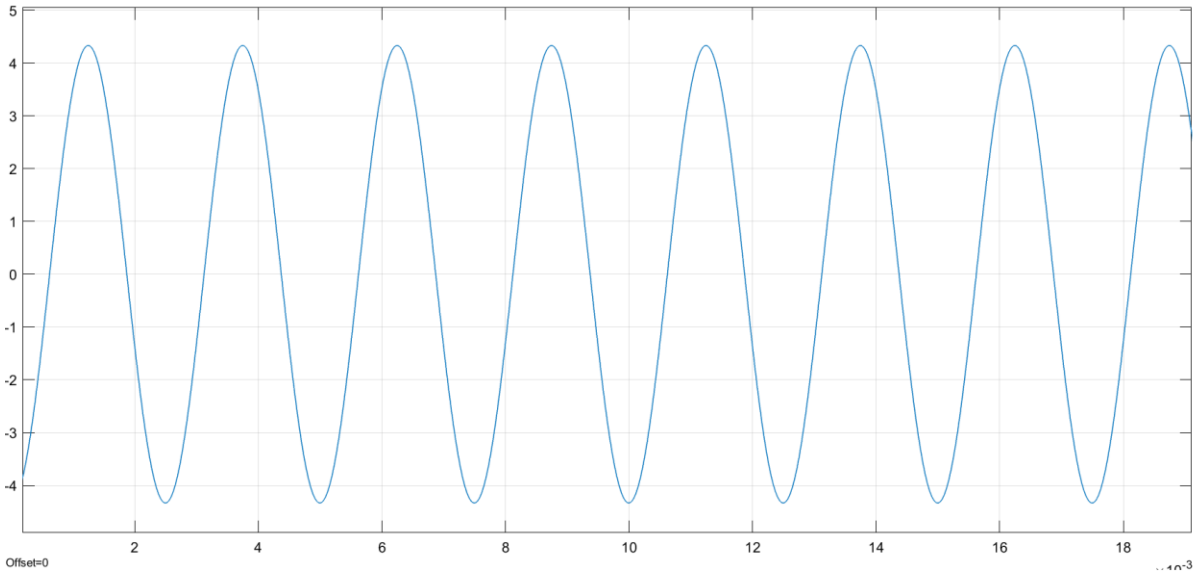

Figure 11 - Current decreases when applying 400v sinusoidal input

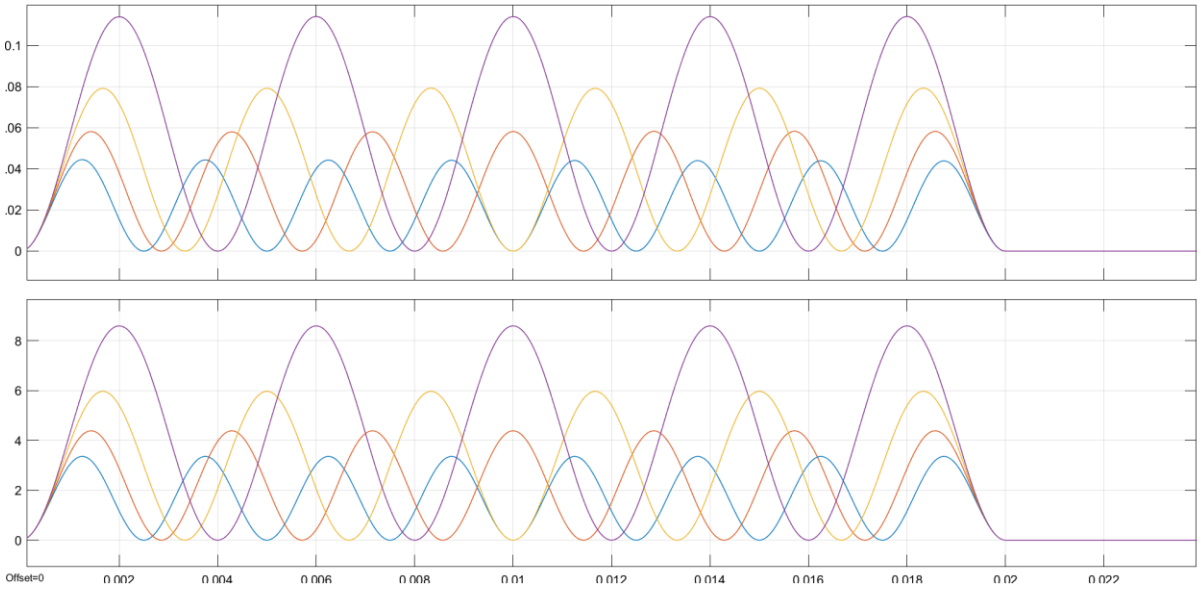

Figure 12 - 3 phase power measurements