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Aim: To model and simulate Buck, Boost and Buck-Boost converters.

Apparatus required:

1) MATLAB simulink library
2) Mosfet Switch Block
3) series RLC Branch
4) Pulse Gate Generator
5) voltage measurement
6) Current measurement
7) Scope
8) Powergui

Buck converter

A buck converter or step-down converter is a DC-to-DC converter which steps down voltage from its input to its output.

$V_{oavg} = DV_s$ $\quad \Delta I_L = \frac{D(1-D)TV_s}{L}$

$\Delta V_c = \frac{D(1-D)V_s}{8LCF^2}$

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Parameter	Rated value
Input voltage (V_s)	20V
Output voltage (V_o)	8V
Switching frequency	2.5KHz
Duty cycle	40%
Inductor	960 e^{-6} H
Capacitor	1250 μF
Resistor	2Ω

Time Period = $\frac{1}{\text{Frequency}} = \frac{1}{25\,000} = 40\mu s$

Pulse width = % Duty Cycle = 40%

$$L = \frac{D(1-D)TV_s}{\Delta I_L} = \frac{0.4 \times 0.6 \times 20}{0.2 \times 25 \times 10^3}$$

$$L = 960e^{-6}\,H$$

$$\Delta V_c = \frac{D(1-D)V_s}{8LCF^2}$$

$$0.8 = \frac{0.4 \times 0.6 \times 20}{8 \times 960 \times 10^{-6} \times C \times 625 \times 10^3}$$

$C = 1250\,\mu F$

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Boost Converter

A boost converter is a DC-to-DC power converter that steps up voltage from its input to its output.

$V_{in} = 20V$ $\quad F = 25KHz$

$\delta = 0.6$ $\quad R = 10\Omega$

$V_o = \frac{V_s}{1-D} = \frac{20}{0.4} = 50V$ $\quad I = 5A$

$\Delta V = 10\%$ $\quad \Delta V_c = 5V$ $\quad \Delta I = 5\%$ $\quad \Delta I = 0.25$

$$\Delta I_L = \frac{DTV_s}{L} \Rightarrow \frac{0.6 \times 20}{25 \times 10^3 \times L} = 0.25$$

$$\boxed{L = 1.92\,mH}$$

$$\Delta V_c = \frac{V_o DT}{RC} \qquad 5 = \frac{50 \times 0.6 \times 1}{25 \times 10^3 \times 10 \times C}$$

$$\boxed{C = 24\mu F}$$

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Buck-Boost Converter

The buck-boost converter is a type of DC-DC converter that has an output volty magnitude that is either greater than or less than i/p volty

$V_s = 12V$

$D = 0.6$

$V_o = \frac{DV_s}{1-D} = 18V$

$F = 25KHz$

$R = 2\Omega$

$I = 9\Omega$

$\Delta V_o = 10\%$ $\Delta V = 1.8V$ $\Delta I = 5\%$ $\Delta I_L = 0.45$

$$\Delta I_L = \frac{DTV_s}{L}$$

$$0.45 = \frac{0.6 \times 1 \times 12}{25 \times 10^3 \times L}$$

$$\boxed{L = 640\mu H}$$

$$V_c = \frac{I_o DT}{C}$$

$$1.8 = \frac{9 \times 0.6 \times 1}{C \times 25 \times 10^3}$$

$$\boxed{C = 120\mu f}$$

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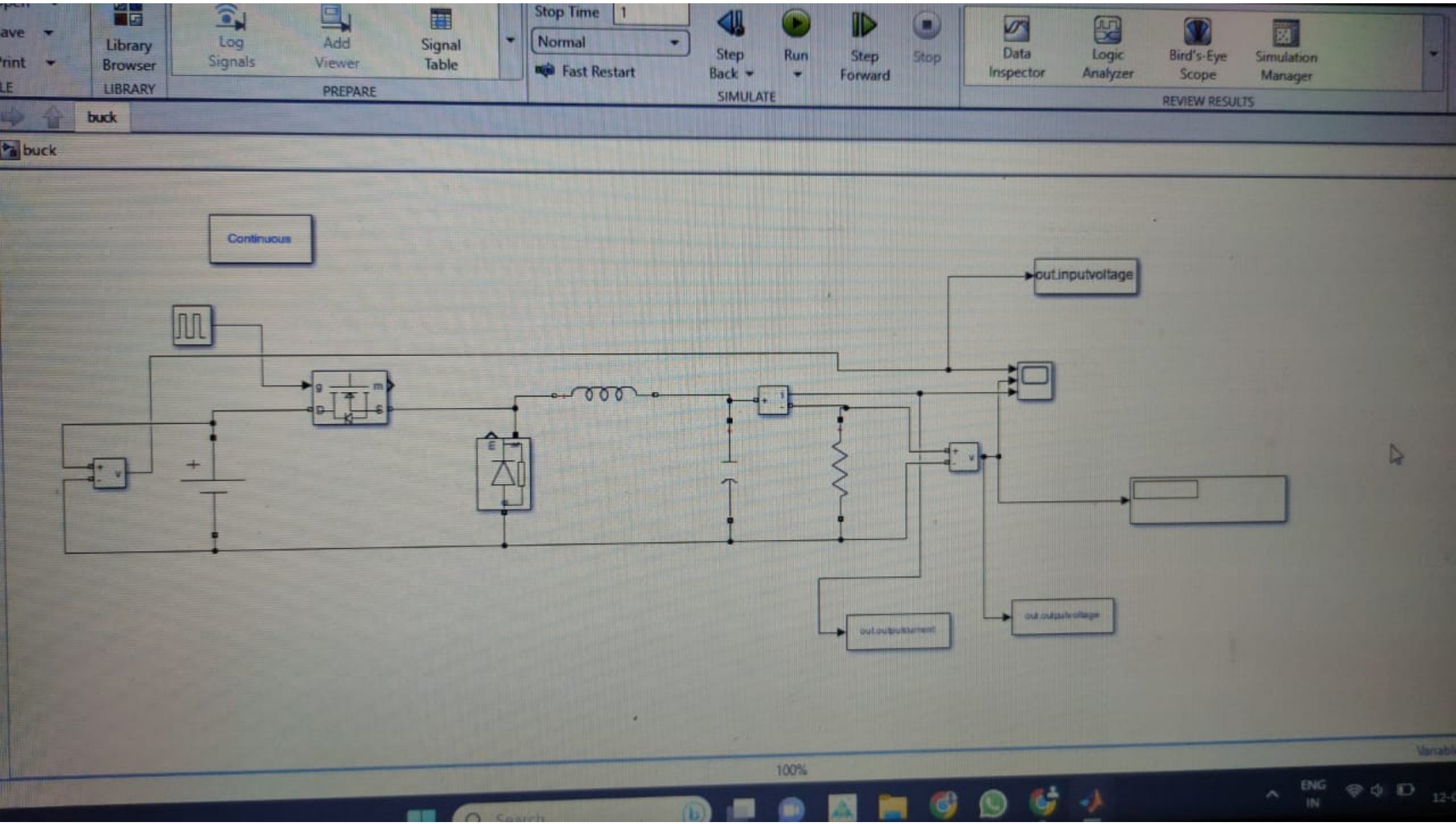
Library Browser
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Log Signals
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Signal Table
PREPARE
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1
Normal
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SIMULATE
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Logic Analyzer
Bird's-Eye Scope
Simulation Manager
REVIEW RESULTS
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out.inputvoltage
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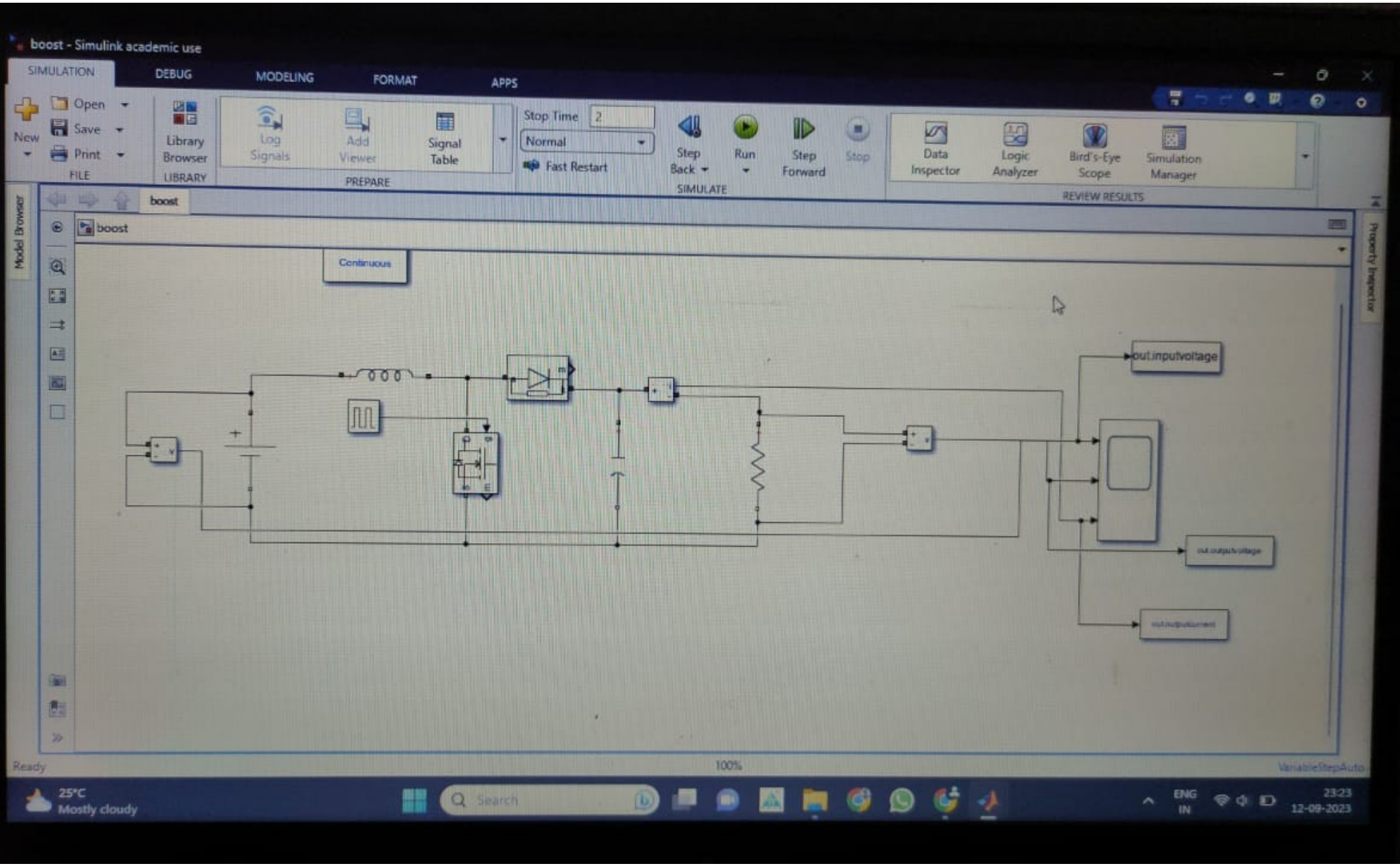
boost - Simulink academic use
SIMULATION
DEBUG
MODELING
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Bird's-Eye Scope
Simulation Manager
REVIEW RESULTS
Model Browser
boost
Continuous
out.inputvoltage
Property Inspector
Ready
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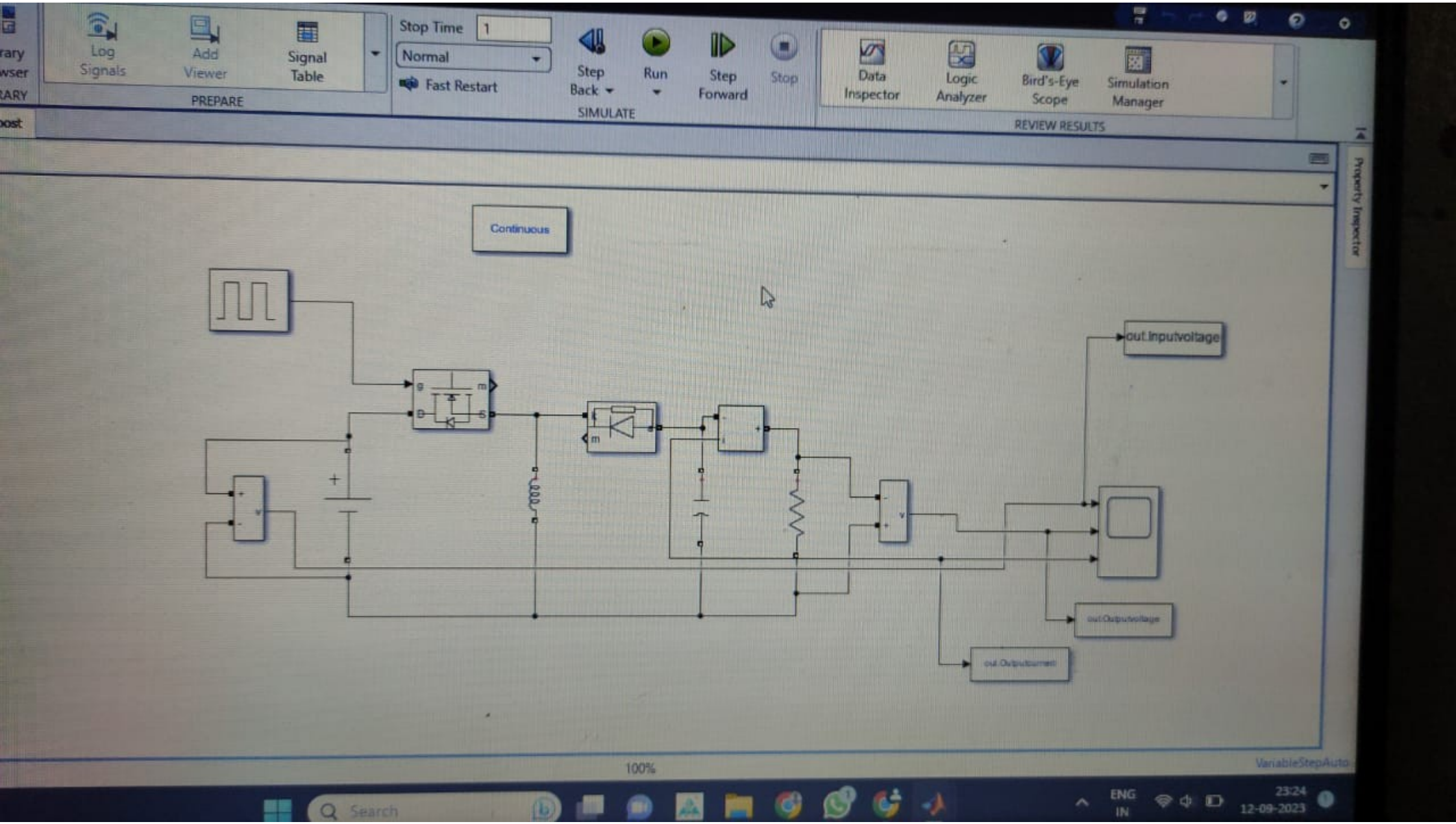
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Logic Analyzer
Bird's-Eye Scope
Simulation Manager
REVIEW RESULTS
Continuous
out.Inputvoltage
100%
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Search
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