ATAL Basic Faculty Development Program

On

"Recent Trends & Advances in Energy Storage System For E-Mobility"

"Permanent Magnet Synchronous Machines Simulation by Using Multiple Energy Storage Devices Used in EV "



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Classification of Vehicles

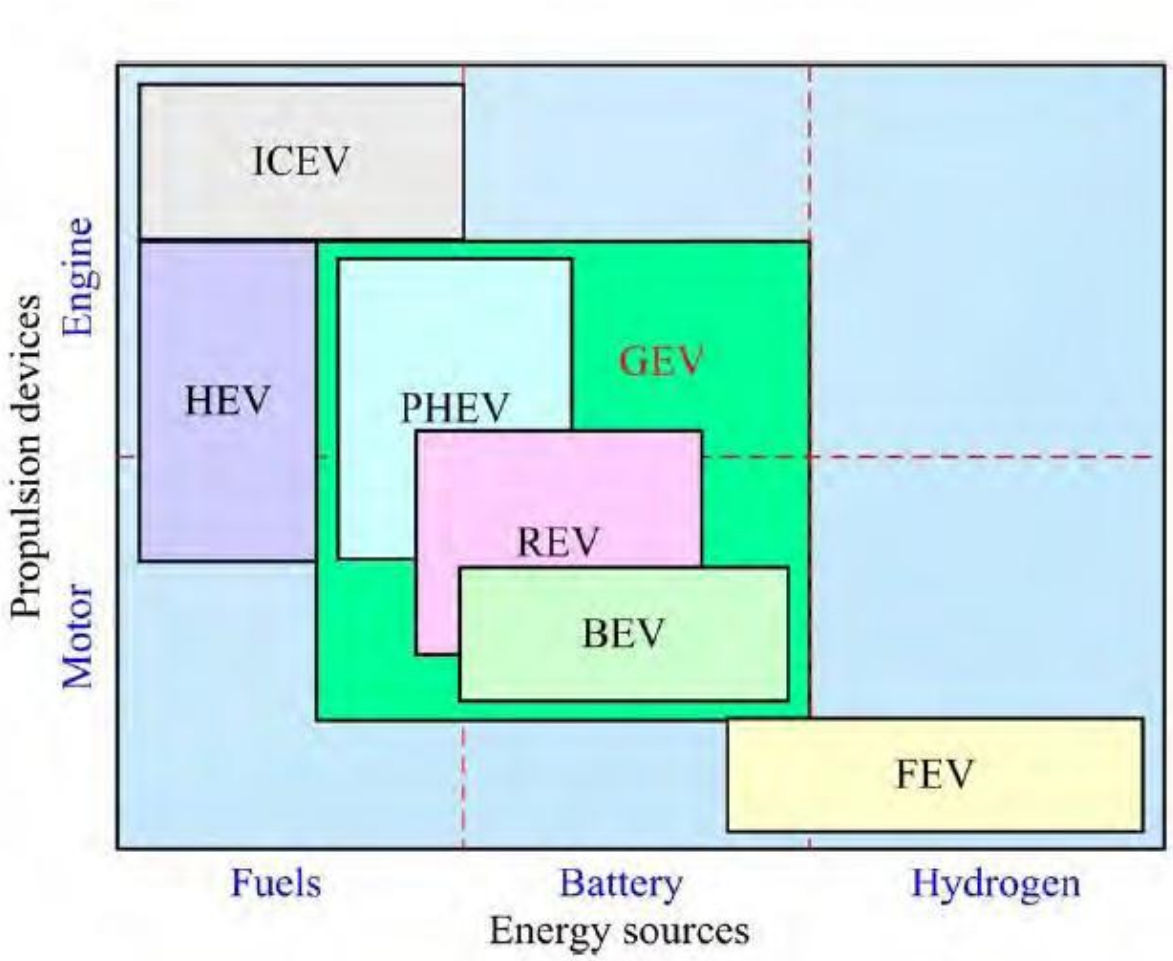


Figure 1. Classification of Véhicle

ICEV:- Internal Combustion Engine Vehicle

HEV:- Hybrid Electric Vehicle

PHEV:- Plug-In Hybrid Electric Vehicle

REV:- Range Extended Electric Vehicle

BEV:- Battery Electric Vehicle

FEV:- Fuel-Cell Electric Vehicle

Note:- It can be found that the PHEV, the REV, and the BEV can be directly fed by electricity from the power grid. These EVs are called GEVs (Gridable EV) which can be directly plugged into the power grid to absorb energy as loads or to deliver energy as resources.

Classification of Vehicles

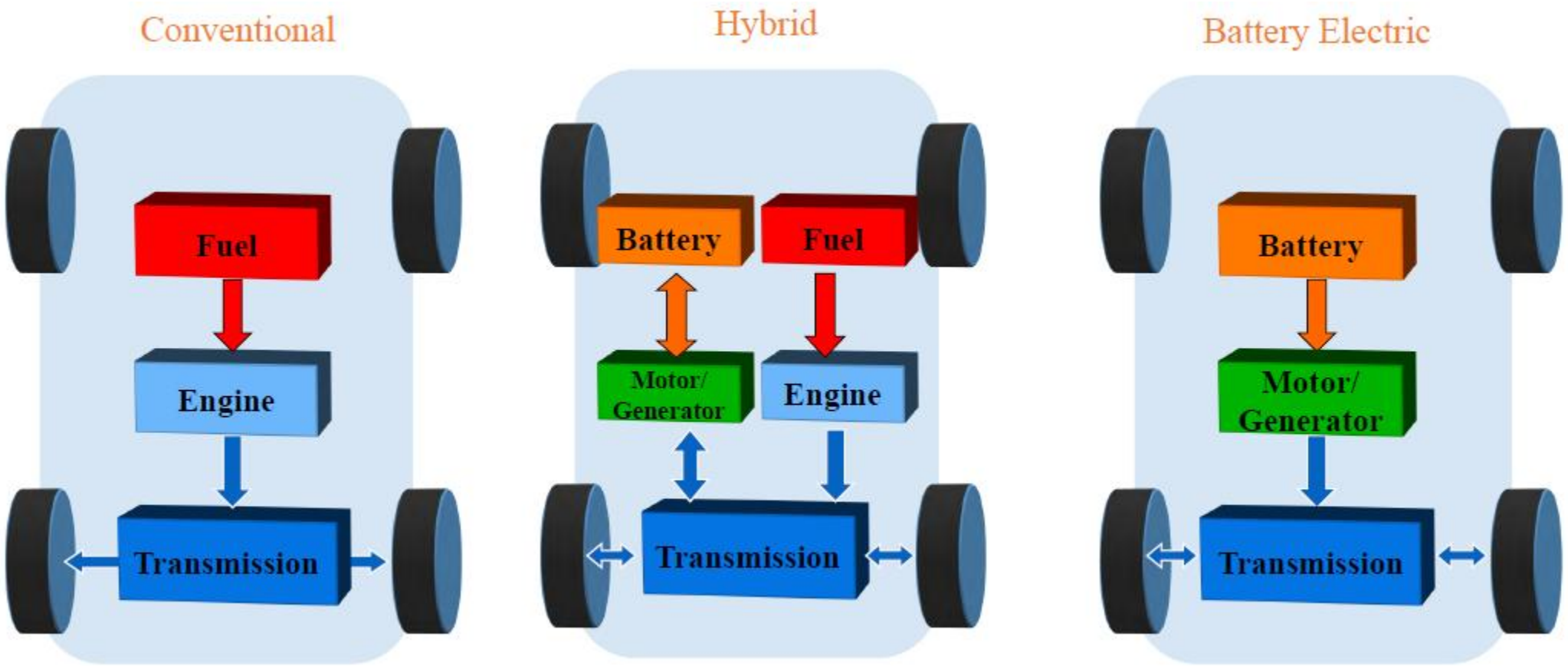


Figure 2. Classification of Vehicle

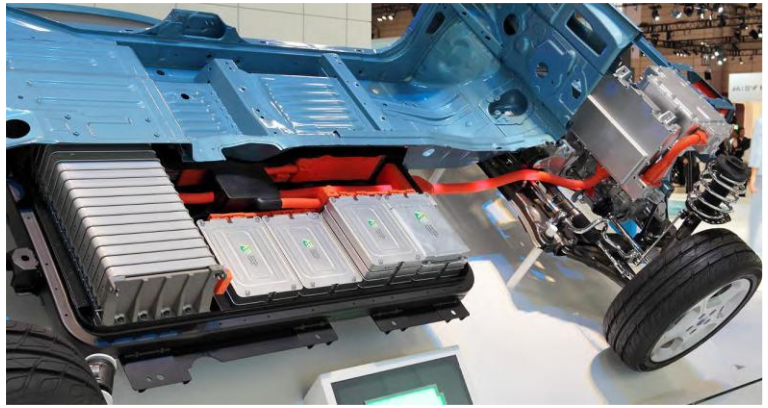
Types of Energy Sources for EVs

Energy storage systems are the core technology which provides on board electrical energy for the electric vehicles (EVs).



Currently **four viable energy sources** adopted in the EV market.

1. Electrochemical Batteries (Normally called as Batteries)
2. Ultra Capacitors (UCs)
3. Ultra Flywheels (UFs)
4. Fuel Cells





Types of Energy Sources for EVs

The **batteries** are electrochemical devices which store energy during charging and produce electricity during discharging.

- The **UCs** are essentially capacitors with ultra high capacitances.
- **UCs** store and produce electrical energy by **electrostatic means**.
- The **UFs** are essentially electric machines spinning at ultrahigh speed.
- **UFs** stores and produce electric energy by **electromechanical means**.
- **Fuel cells** are electrochemical generation devices which directly convert chemical fuels in to electricity.
- **All the above sources can operate in bidirectional mode except fuel cell.**

Types of Battery used in EVs

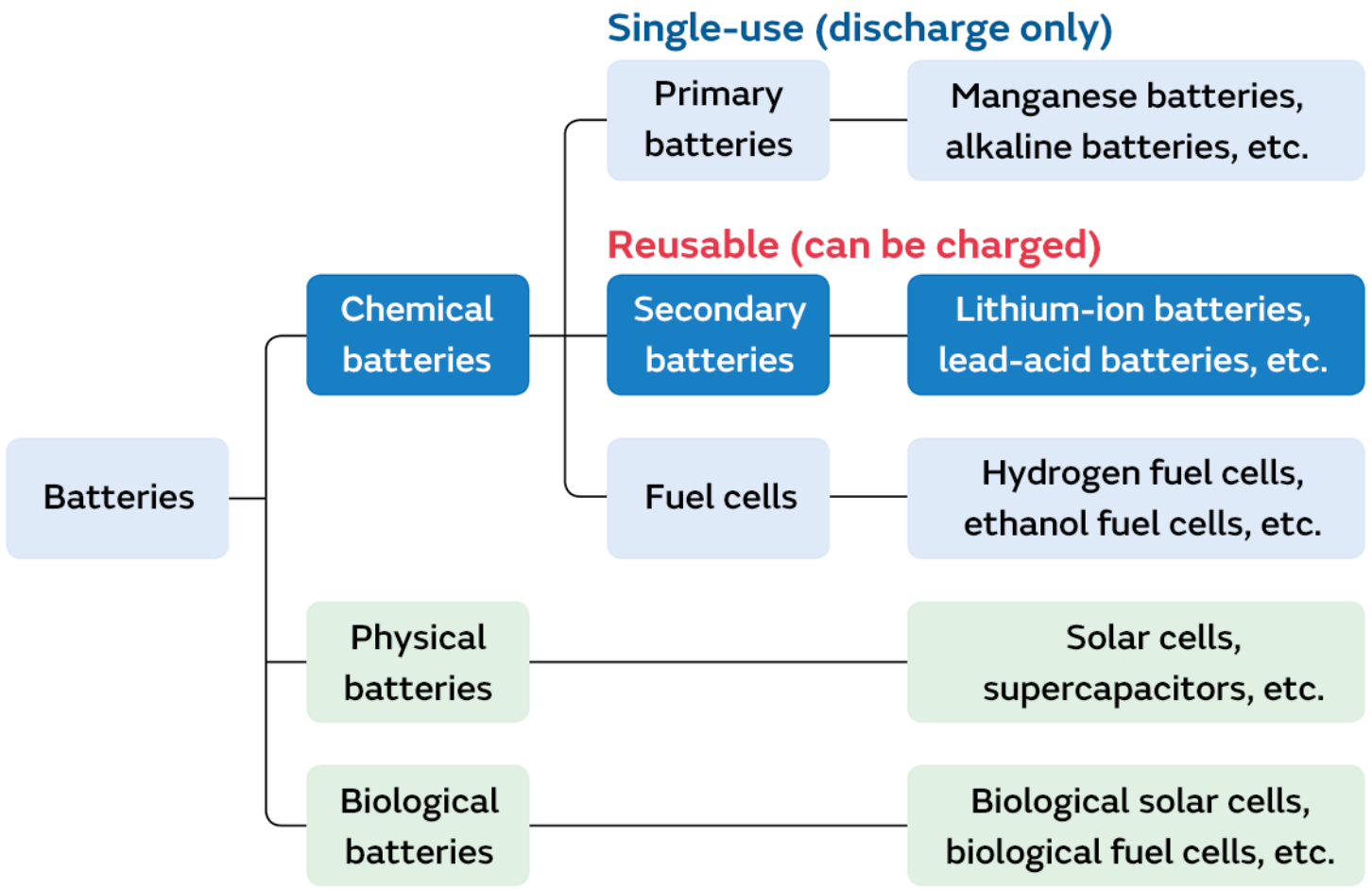


Figure 3. Types of Batteries

Types of Motors used in EVs

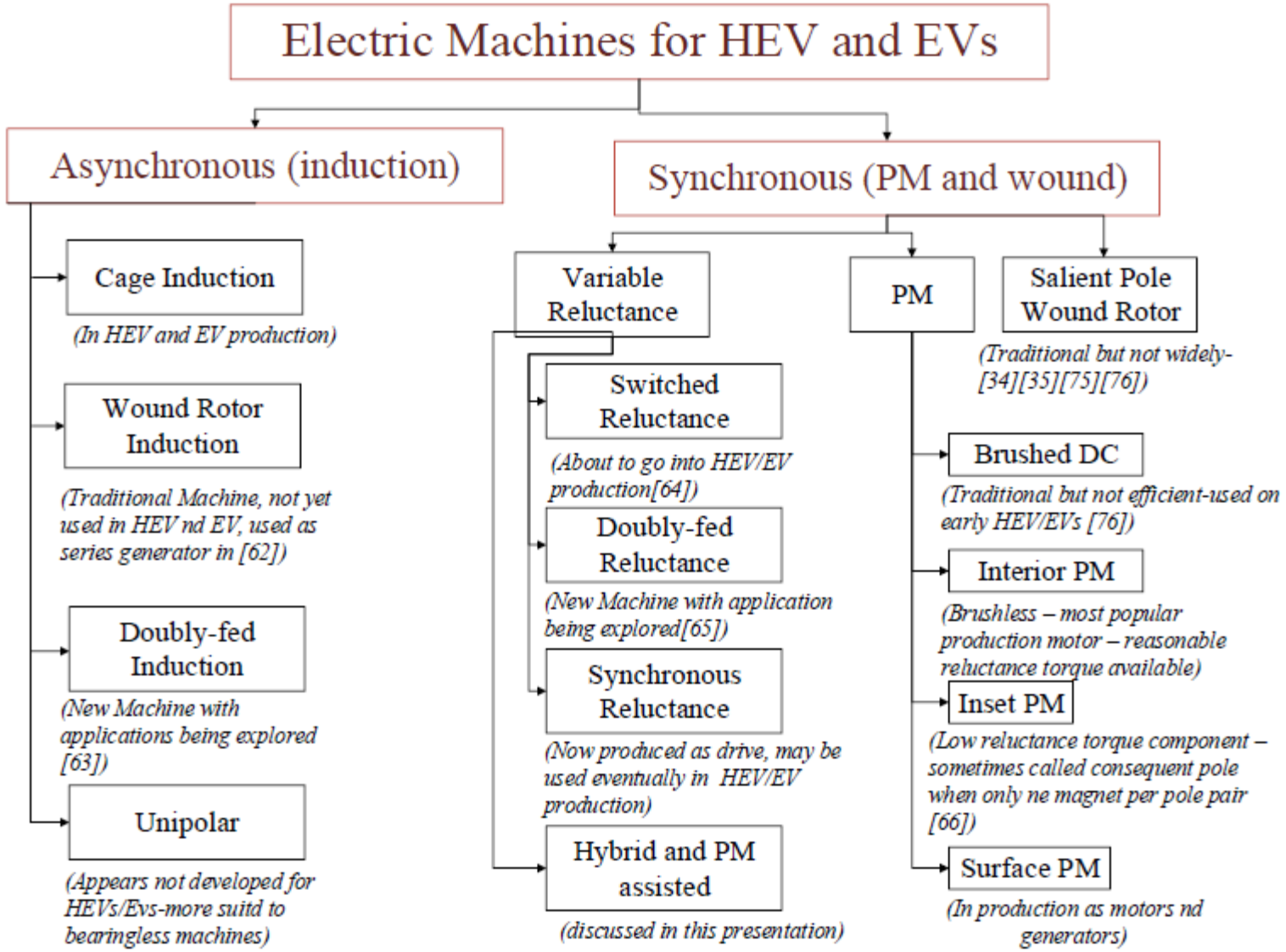


Figure 4. Types of Motors

Closed Loop System

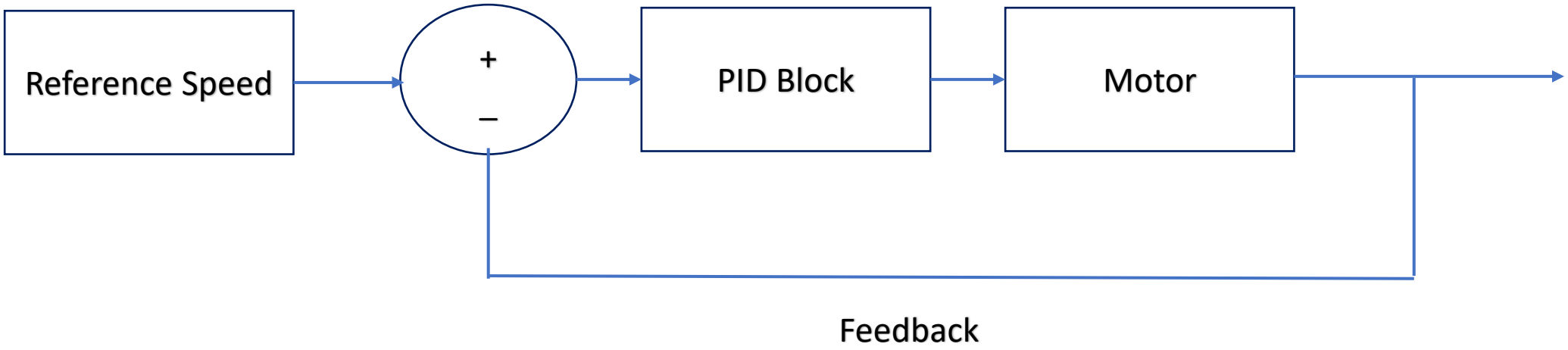
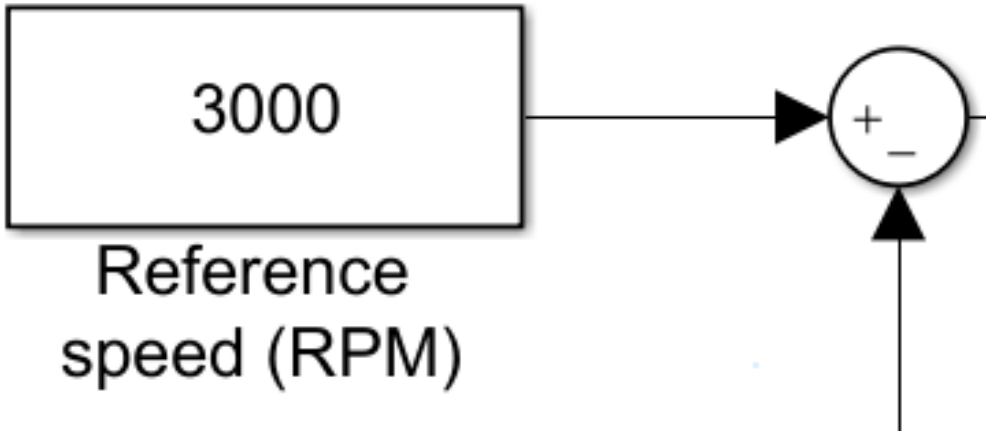


Figure 4. Closed loop System

MATLAB Simulation for PMSM Motor



PID Controller



Block Parameters: PID Controller

PID 1dof (mask) (link)

This block implements continuous- and discrete-time PID control algorithms and includes advanced features such as anti-windup, external reset, and signal tracking. You can tune the PID gains automatically using the 'Tune...' button (requires Simulink Control Design).

Controller: PID

Form: Parallel

Time domain:

- (•) Continuous-time
- ( ) Discrete-time

Discrete-time settings

Sample time (-1 for inherited): 1

Compensator formula

$$P + I\frac{1}{s} + D\frac{N}{1 + N\frac{1}{s}}$$

Main | Initialization | Output Saturation | Data Types | State Attributes

Controller parameters

Source: internal

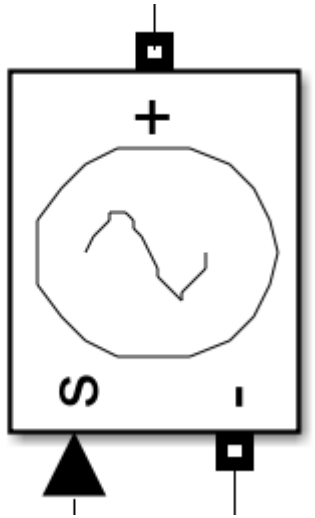
Proportional (P): 12

Integral (I): 0.07

Derivative (D): 0.16

OK | Cancel | Help | Apply

Controlled Voltage Source



Block Parameters: Controlled Voltage Source1

Controlled Voltage Source (mask) (link)

Converts the Simulink input signal into an equivalent voltage source. The generated voltage is driven by the input signal of the block.

You can initialize your circuit with a specific AC or DC voltage. If you want to start the simulation in steady-state, the block input must be connected to a signal starting as a sinusoidal or DC waveform corresponding to the initial values.

Parameters

Initialize

Source type: AC

Initial amplitude (V): 500

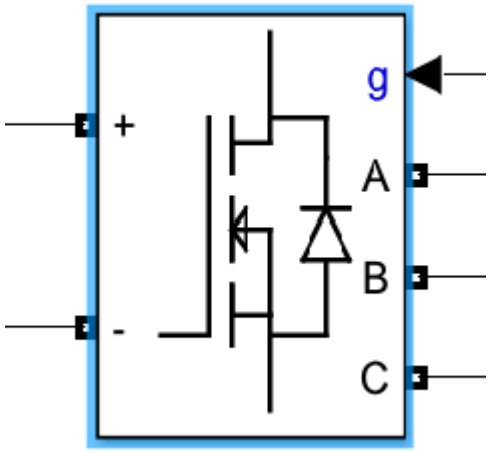
Initial phase (deg): 0

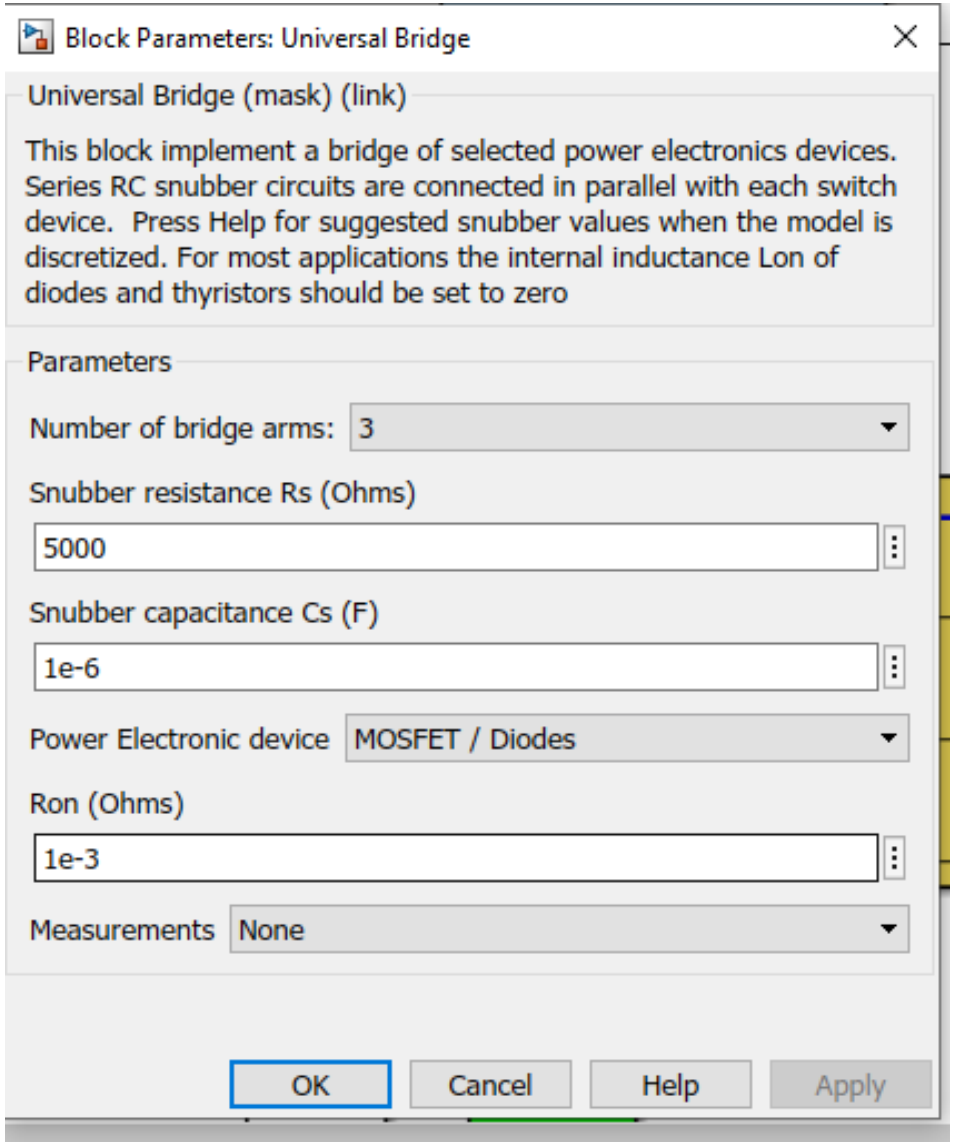
Initial frequency (Hz): 0

Measurements: None

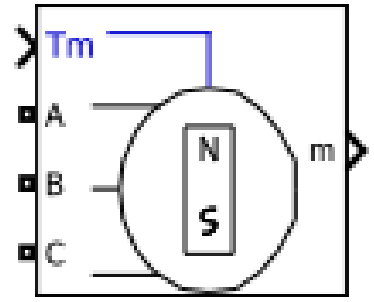
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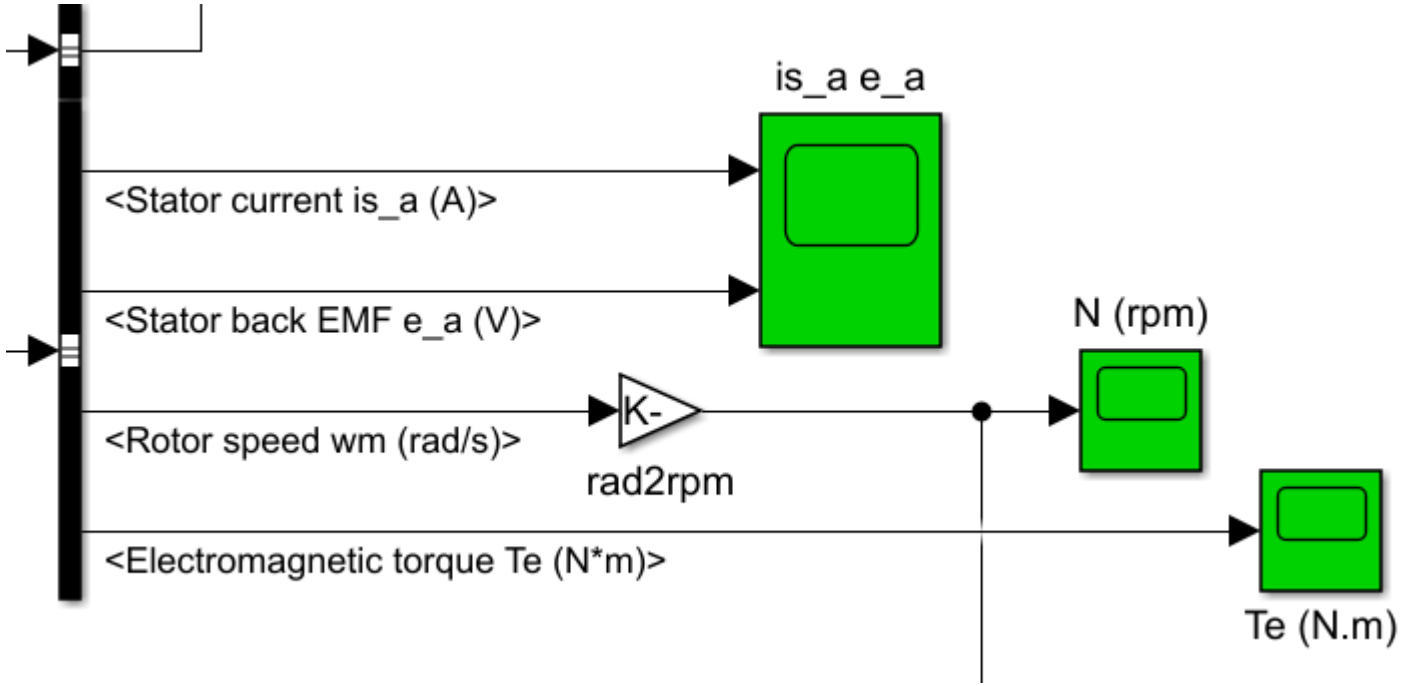
Universal Bridge





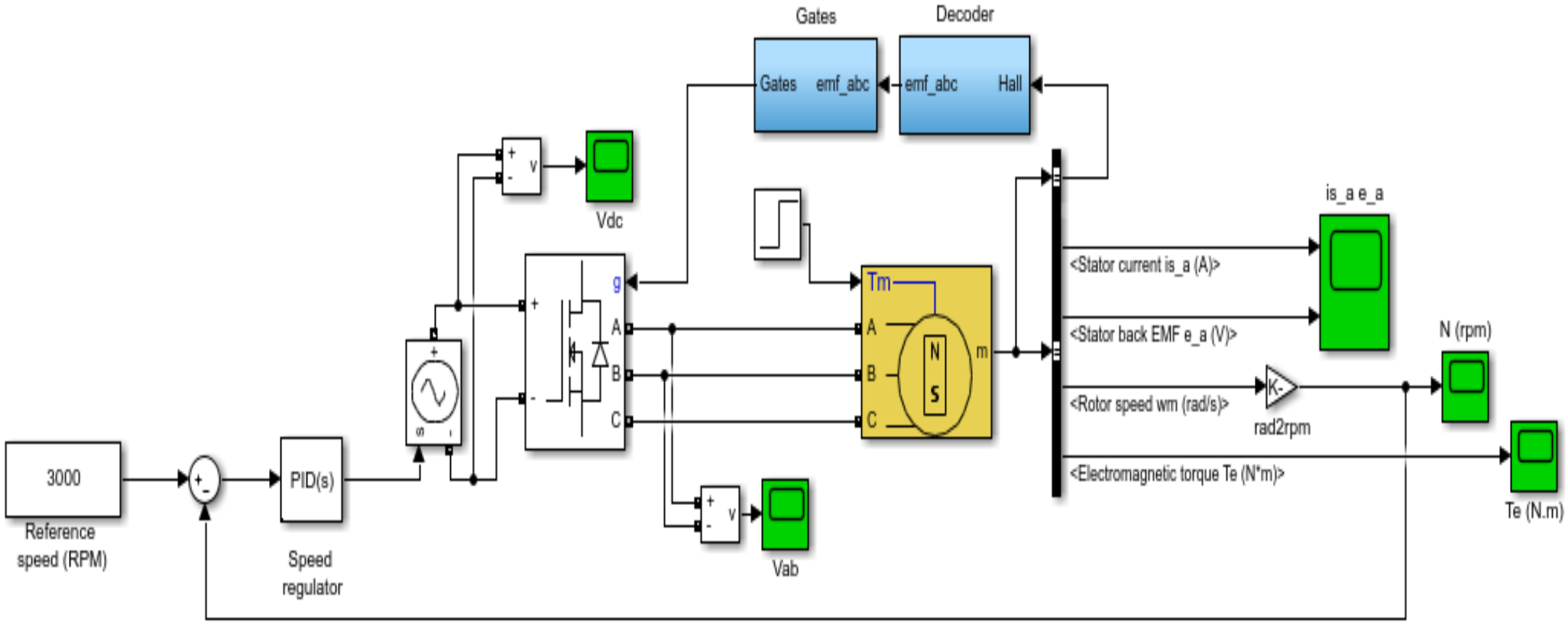
PMSM Simulation



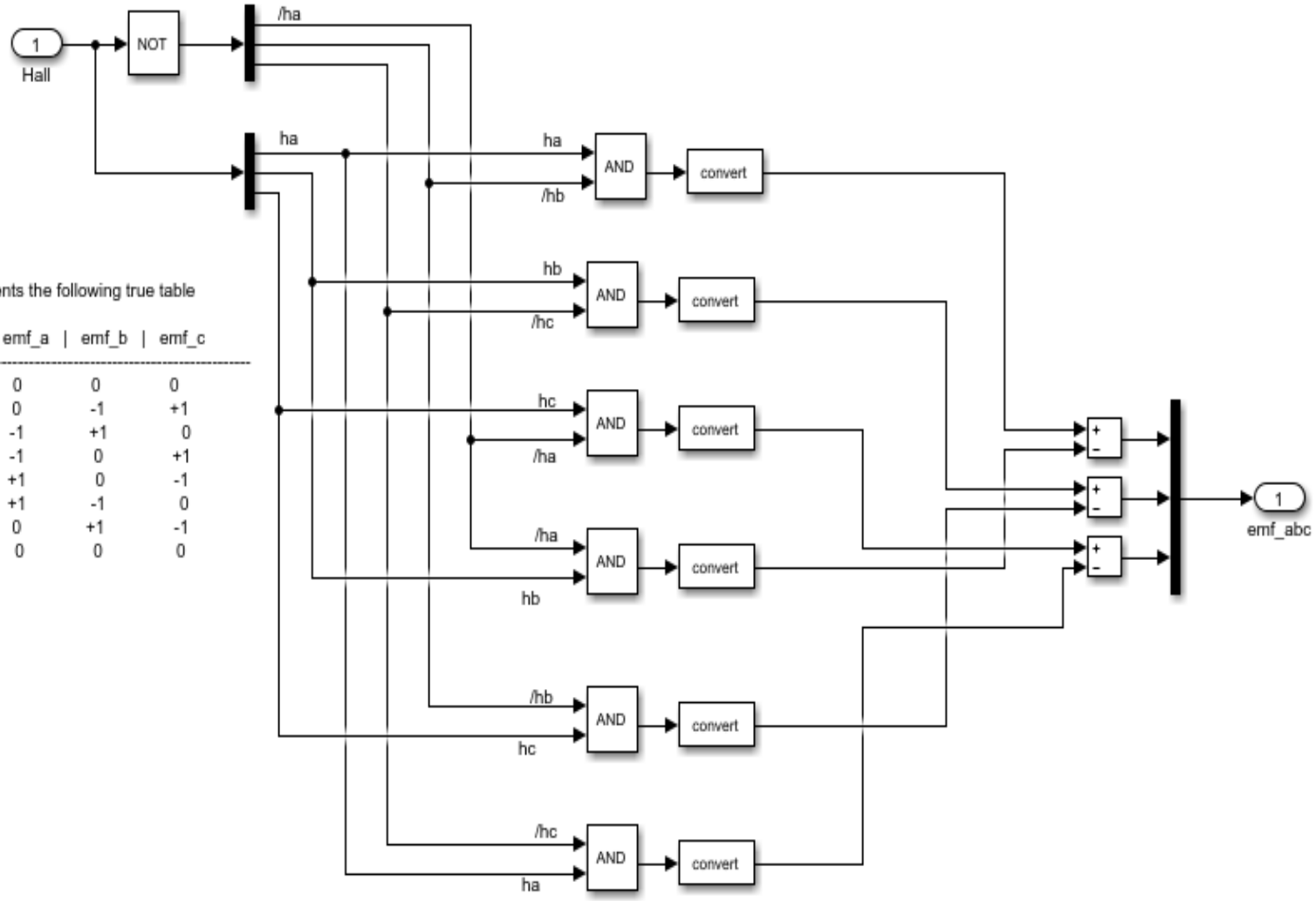


Simscape /Electrical/Specialized Power Systems/Fundamental Blocks/Machine

BLDC Motor fed by Six step Inverter

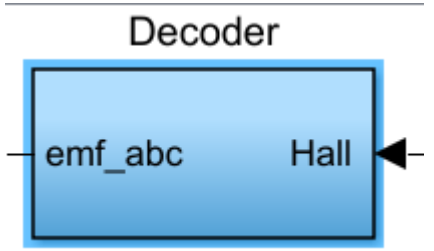


Decoder Block

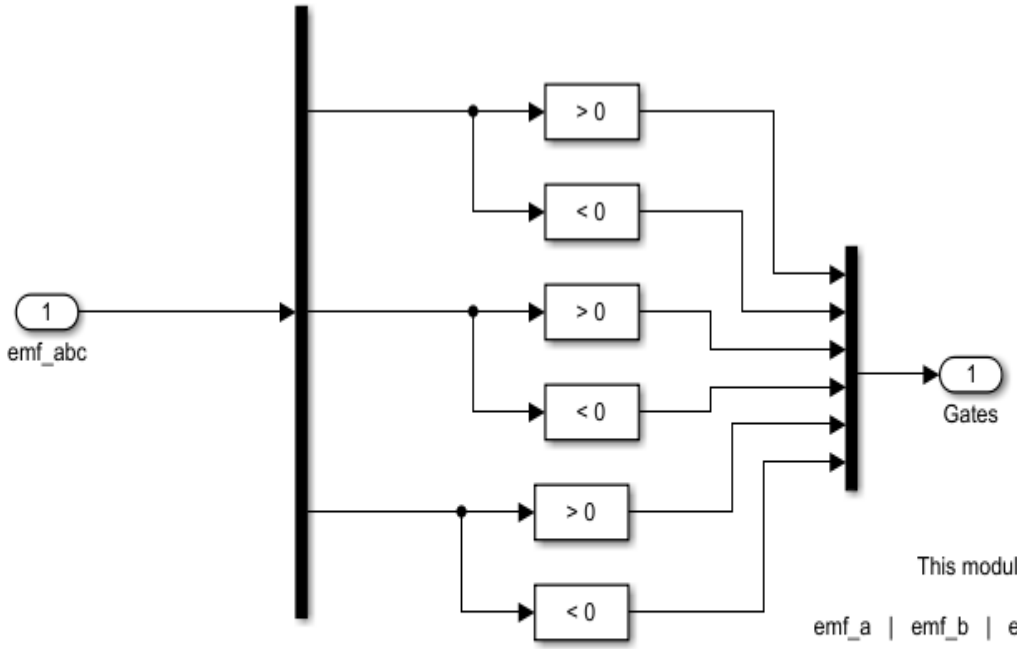


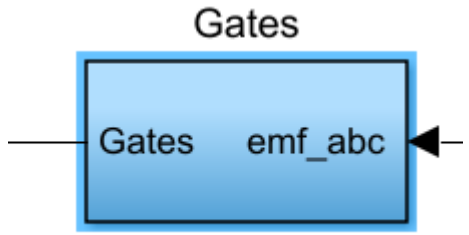
This module implements the following true table

ha	hb	hc	emf_a	emf_b	emf_c
0	0	0	0	0	0
0	0	1	0	-1	+1
0	1	0	-1	+1	0
0	1	1	-1	0	+1
1	0	0	+1	0	-1
1	0	1	+1	-1	0
1	1	0	0	+1	-1
1	1	1	0	0	0



Gate Block





This module implements the following true table

emf_a	emf_b	emf_c	Q1	Q2	Q3	Q4	Q5	Q6
0	0	0	0	0	0	0	0	0
0	-1	+1	0	0	0	1	1	0
-1	+1	0	0	1	1	0	0	0
-1	0	+1	0	1	0	0	1	0
+1	0	-1	1	0	0	0	0	1
+1	-1	0	1	0	0	1	0	0
0	+1	-1	0	0	1	0	0	1
0	0	0	0	0	0	0	0	0

Boost Converter Simulation

Check the all the voltages current and speed

How to change the color and axis properties of waveform

How to download CLEAR IMAGE

THANK YOU !