LTspice IV

D.C. Motor

Simplified SPICE Model

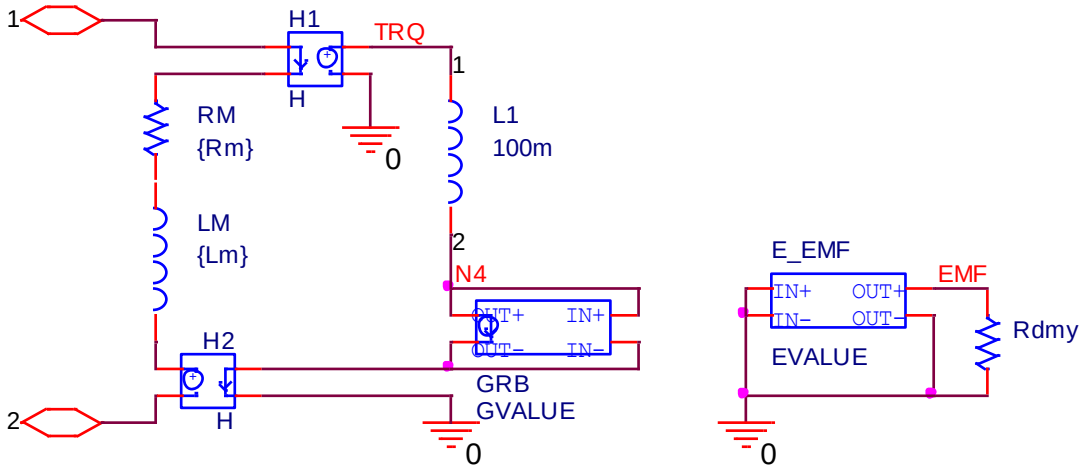
Contents

1. Benefit of the Model

- The model enables circuit designer to use D.C. Motor as load in their design which include: Back EMF, Torque(N·m) and Speed (rpm) characteristics.

- The model can be easily adjusted to your own D.C. Motor specifications by editing a few parameters that are provided in the spec-sheet.

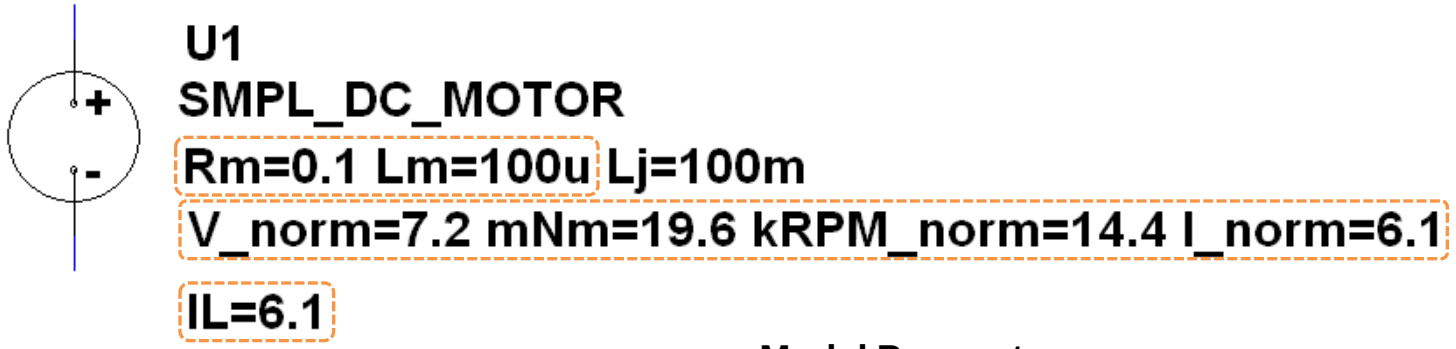
2. Model Feature



Equivalent circuit of the D.C. Motor model

- This *D.C. Motor Simplified SPICE Model* is for users who require the model of D.C. Motor as a part of their system.
- Perform electrical (voltage and current) and mechanical (speed and torque) characteristics at current load (Ampere) conditions.

3. Parameter Settings



D.C. Motor model and Parameters with Default Value

Model Parameters:

If there is no measurement data, the default value will be used:

Rm: motor winding resistance [Ω]
Lm: motor winding inductance [H]

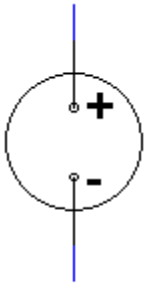
Data is given by D.C. motor spec-sheet:

V_norm: normal voltage [V]
mNm: normal load [mN·m]
kRPM_norm: speed at normal load [kr/min]
I_norm: current at normal load [A]

Load Condition:

IL: load current [A]

4. D.C. Motor Specification (Example)

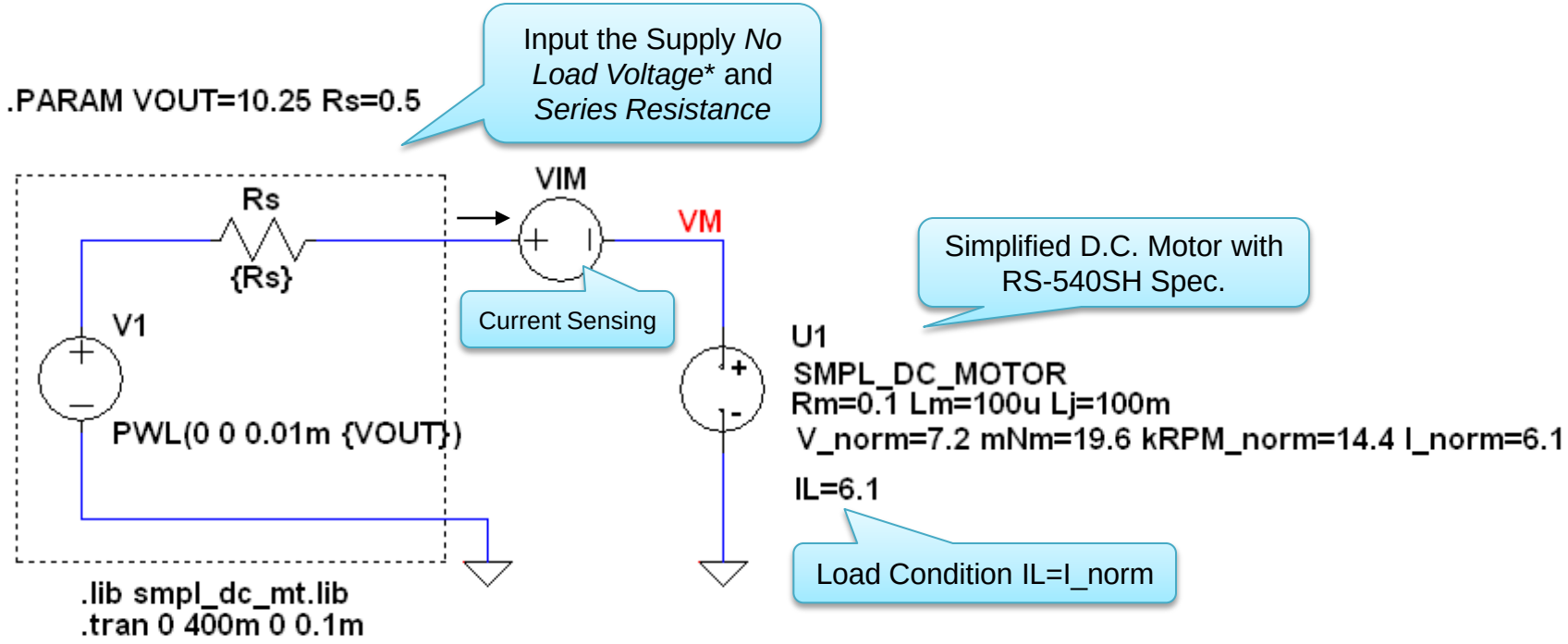



```
U1
SMPL_DC_MOTOR
Rm=0.1 Lm=100u Lj=100m
V_norm=7.2 mNm=19.6 kRPM_norm=14.4 I_norm=6.1
IL=6.1
```

D.C. Motor Specification Parameters are input

5. Motor Start Up Simulation at Normal Load (1/2)

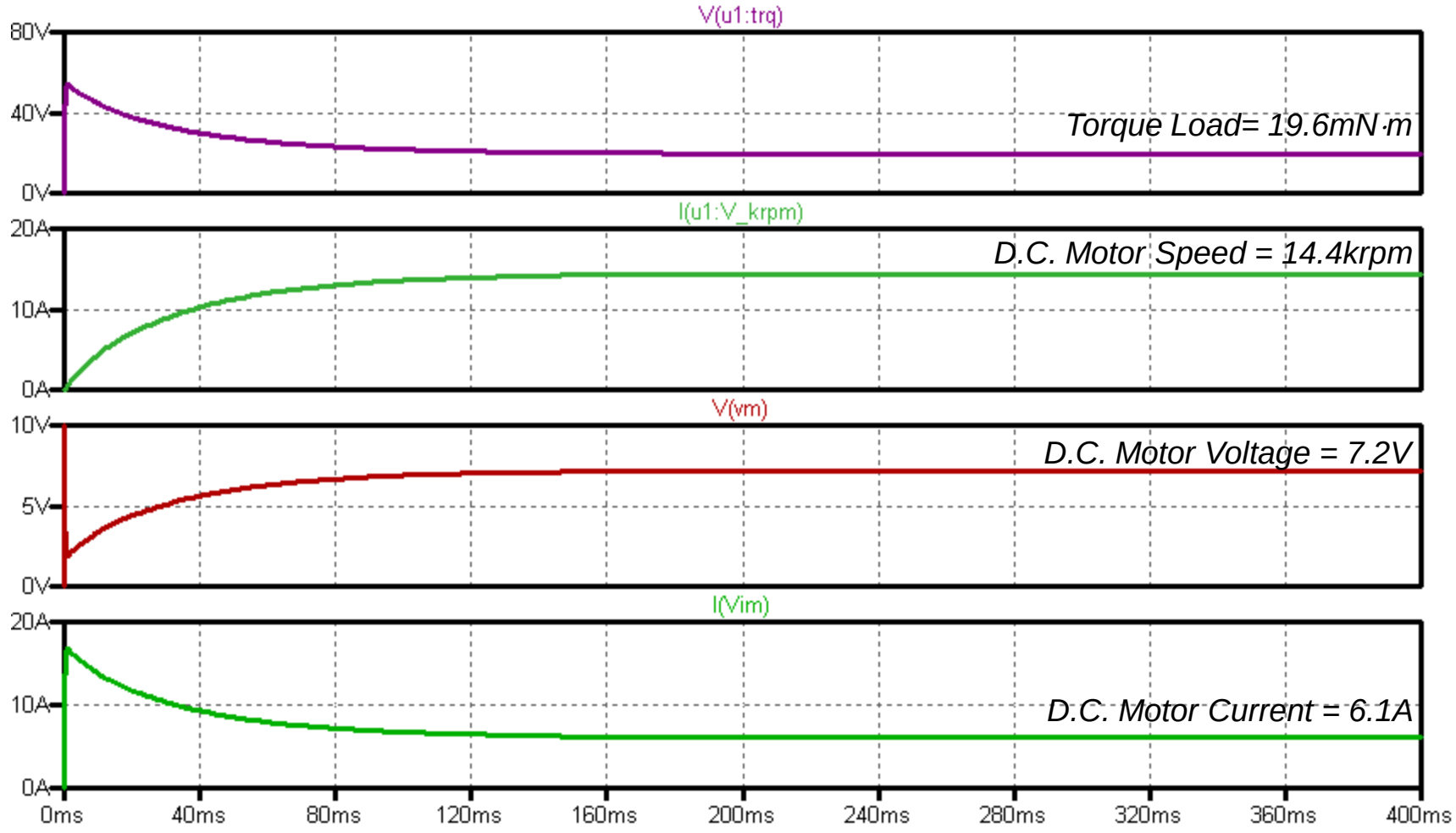
Simulation Circuit and Setting



*No Load Voltage is adjusted until the D.C. motor voltage (VM) equals to the normal voltage (7.2V).

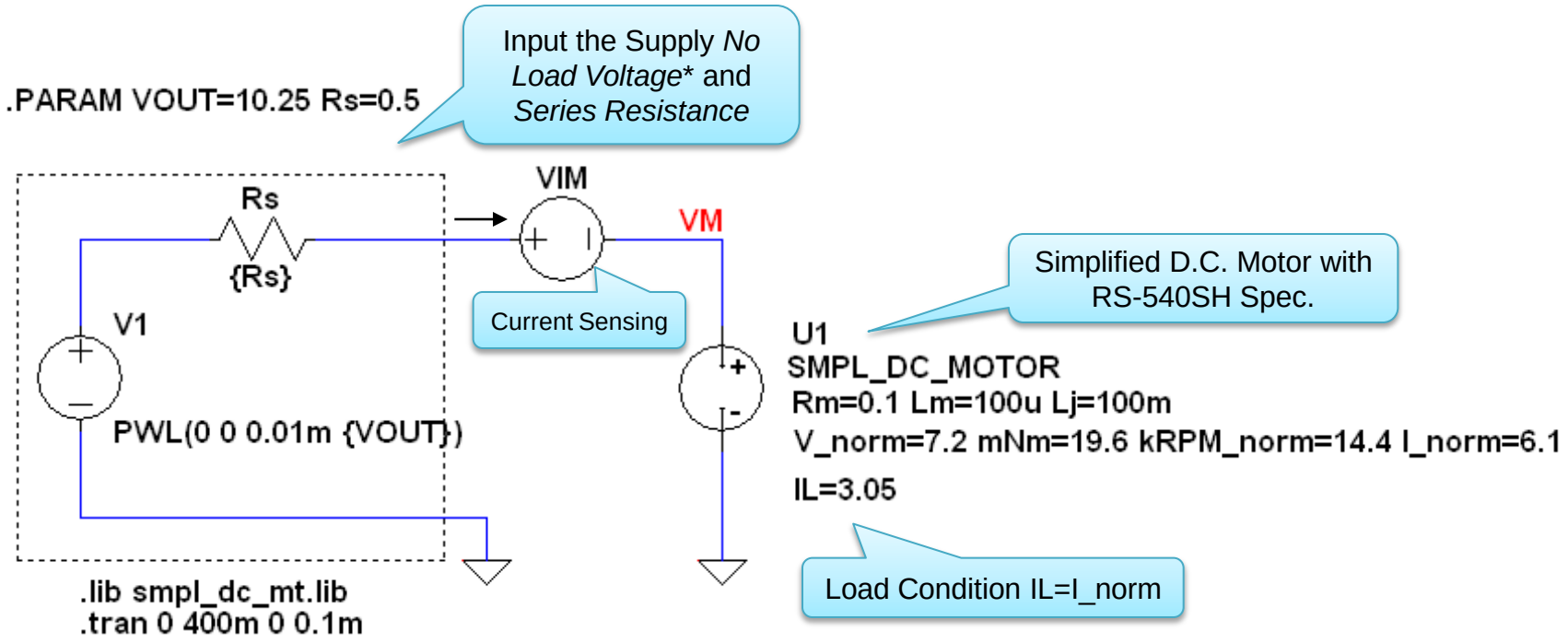
*Analysis directives:
.TRAN 0 400m 0 0.1m
.PROBE V(*) I(*) W(alias(*)) D(alias(*)) NOISE(alias(*))

5. Motor Start Up Simulation at Normal Load (2/2)



6. Motor Start Up Simulation at Half of Normal Load (1/2)

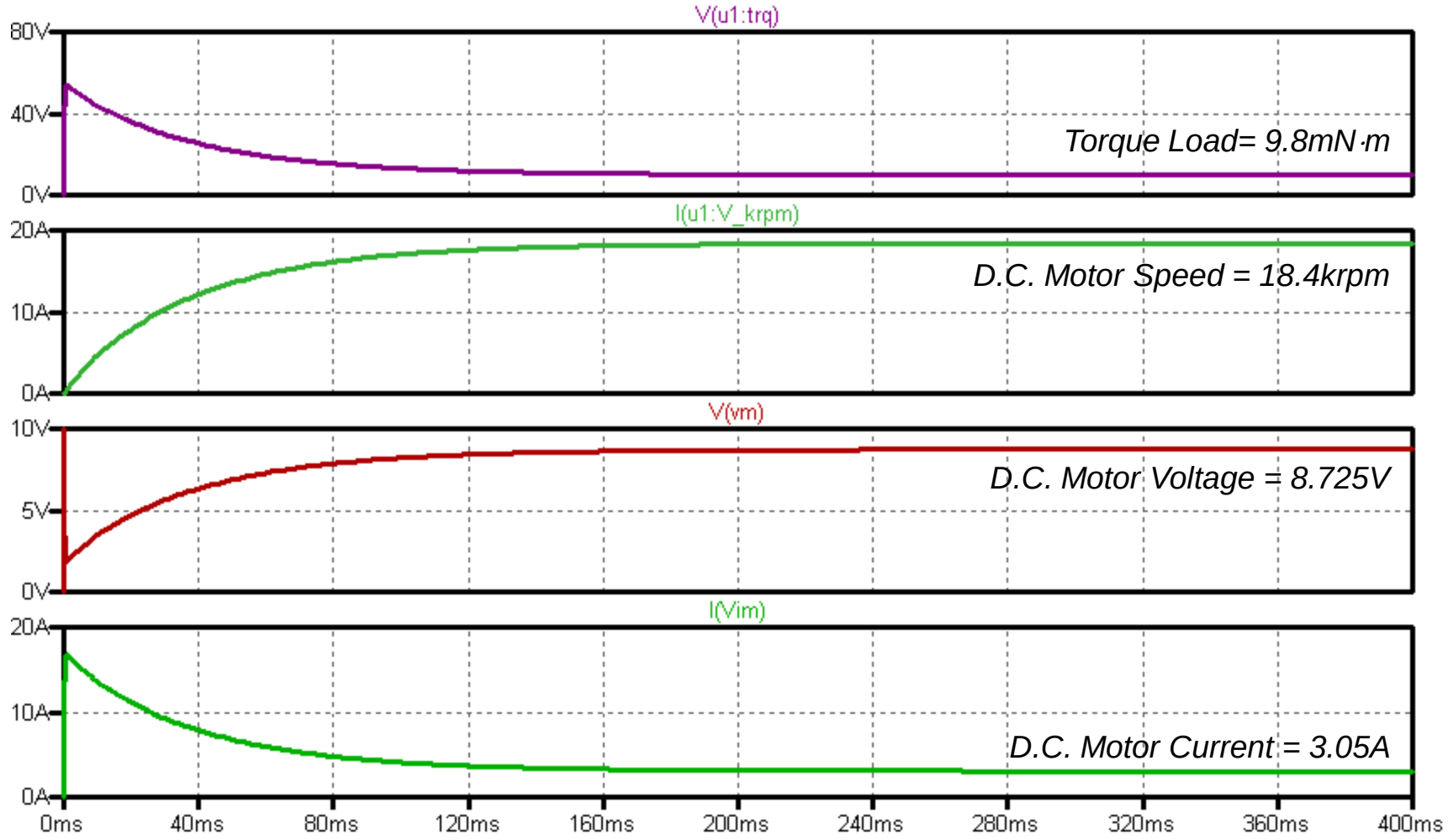
Simulation Circuit and Setting



*No Load Voltage is adjusted until the D.C. motor voltage (VM) equals to the normal voltage (7.2V).

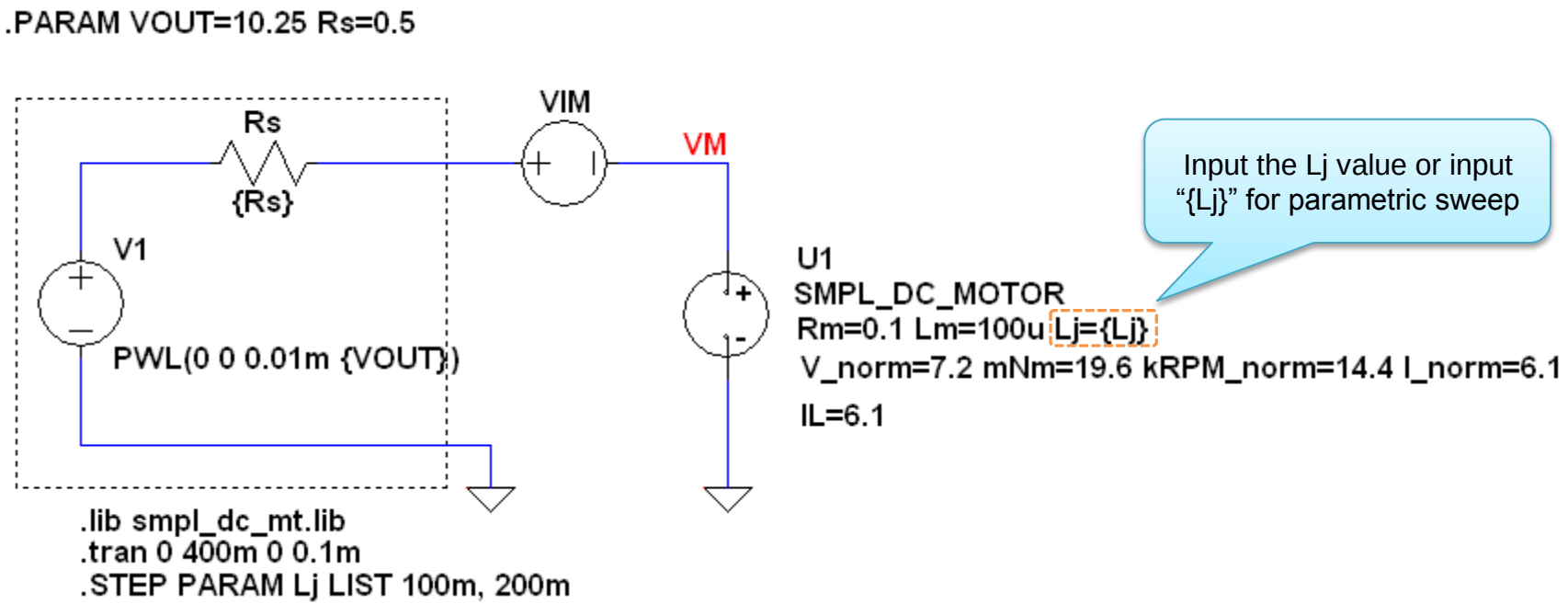
*Analysis directives:
.TRAN 0 400m 0 0.1m
.PROBE V(*) I(*) W(alias(*)) D(alias(*)) NOISE(alias(*))

6. Motor Start Up Simulation at Half of Normal Load (2/2)



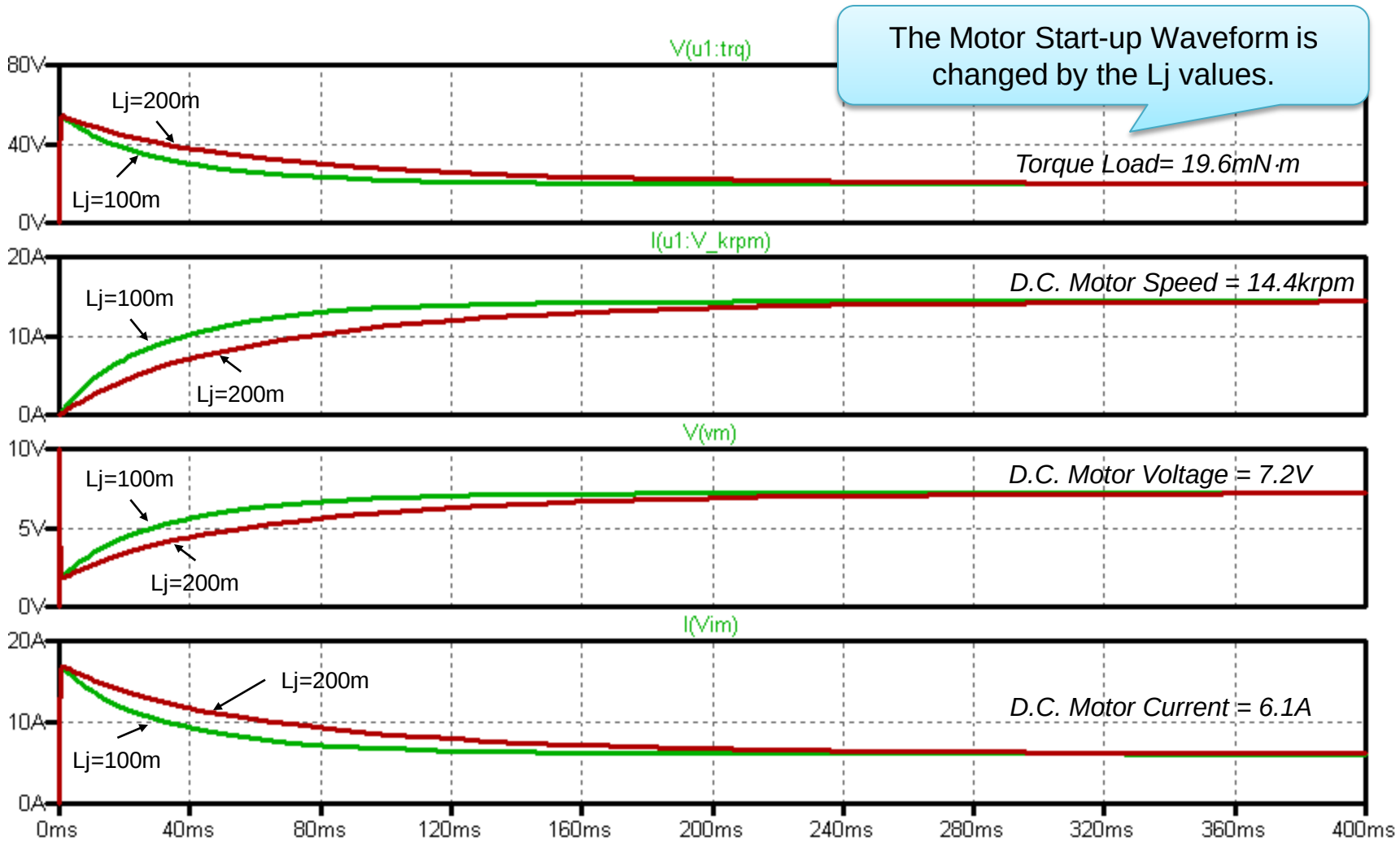
7. Lj of the Motor Model (1/2)

Simulation Circuit and Setting



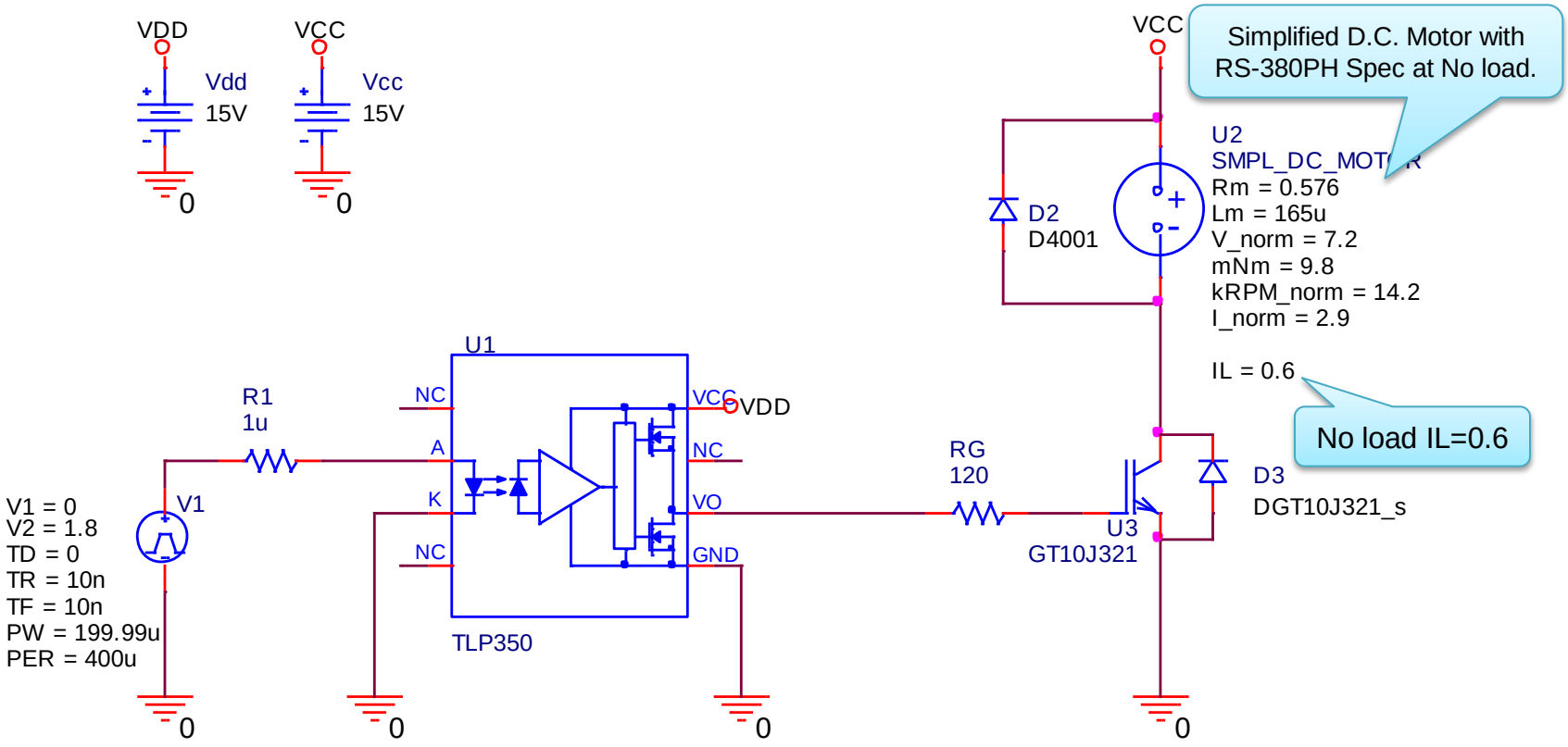
*Analysis directives:
.TRAN 0 400m 0 0.1m
.STEP PARAM Lj LIST 100m, 200m

7. Lj of the Motor Model (2/2)



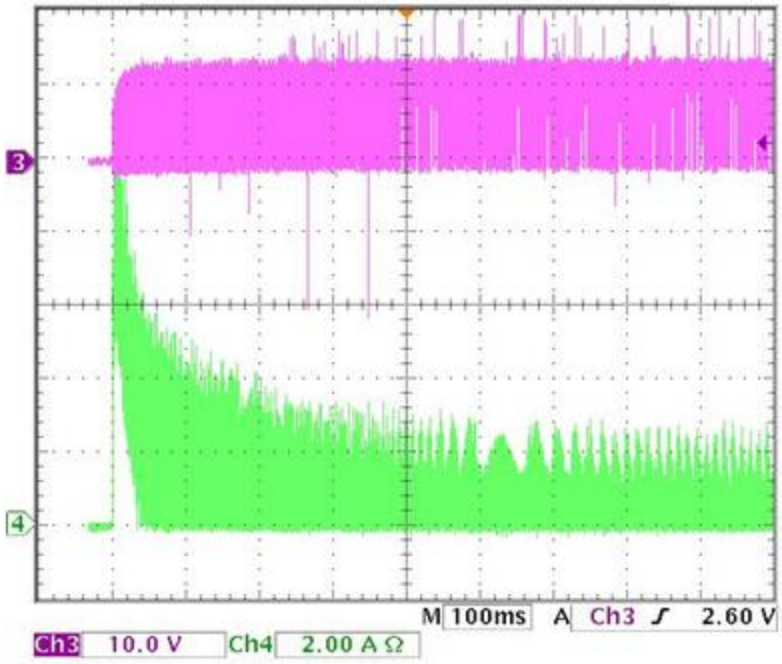
8. Application Example (1/3)

Simulation Circuit and Setting

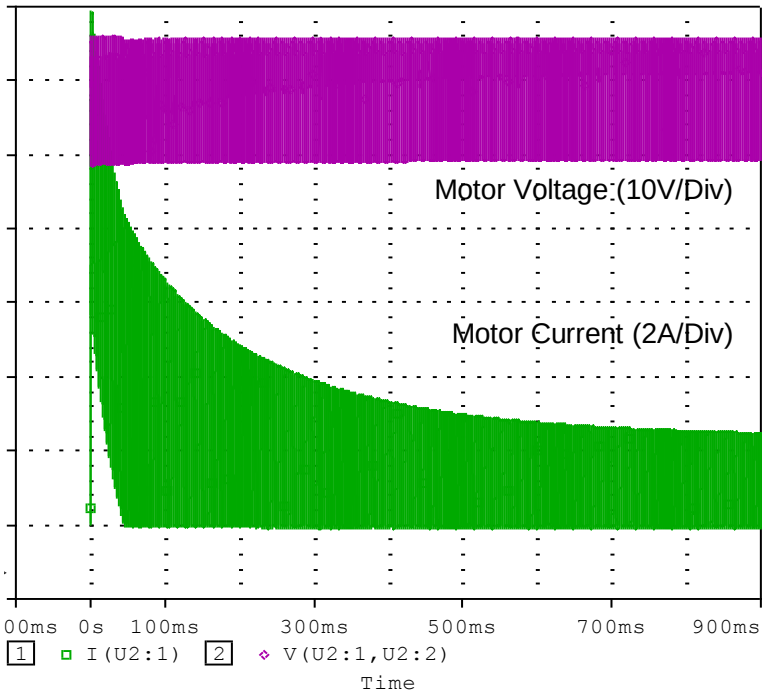


8. Application Example (2/3)

Measurement

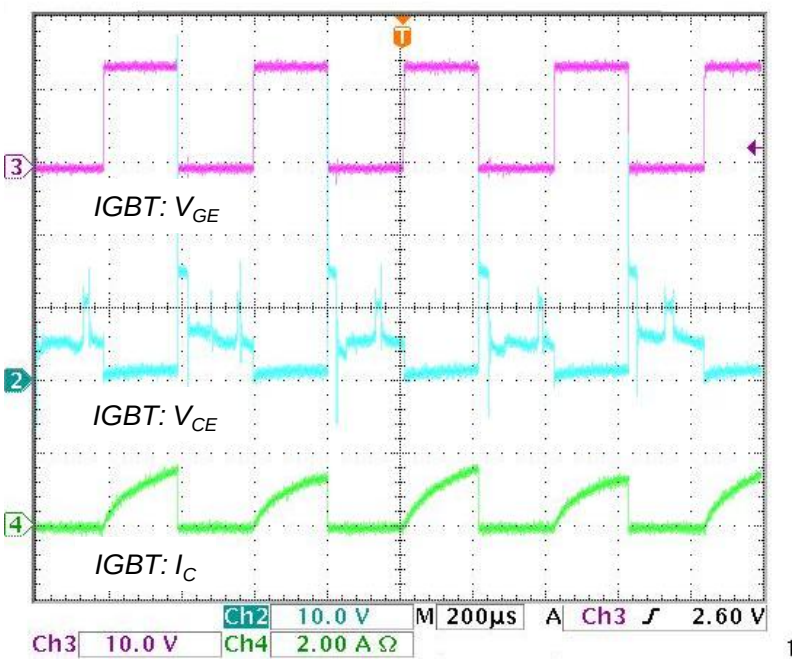


Simulation

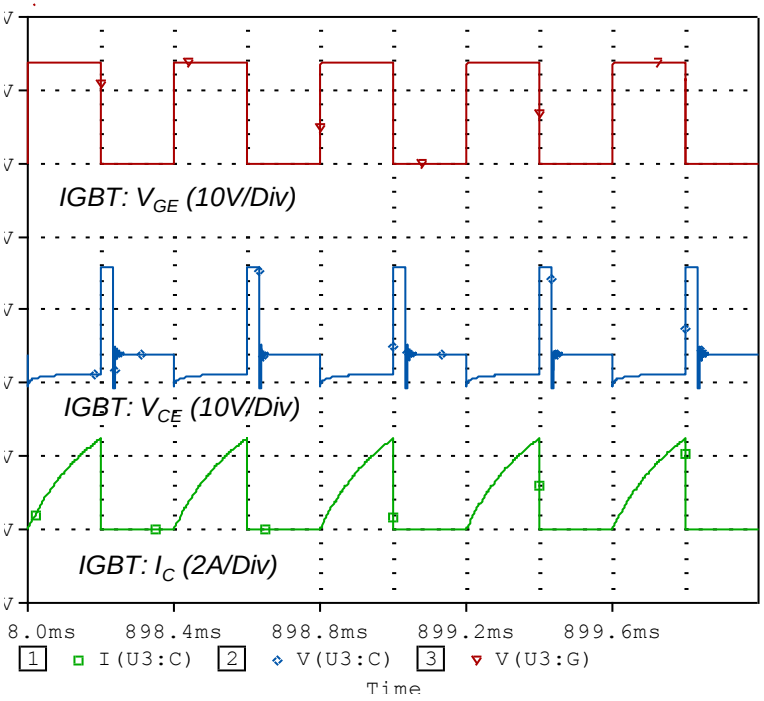


8. Application Example (3/3)

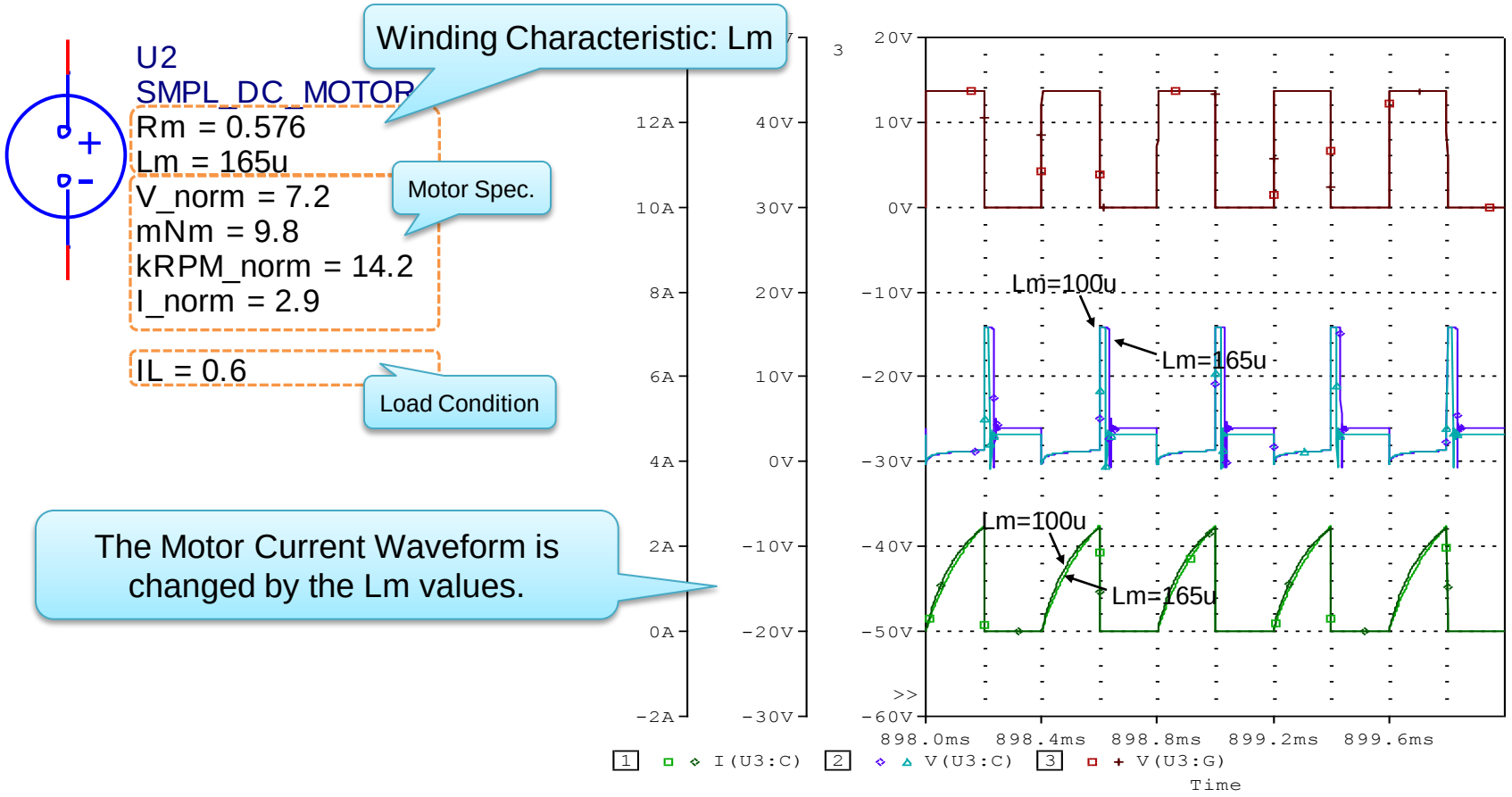
Measurement



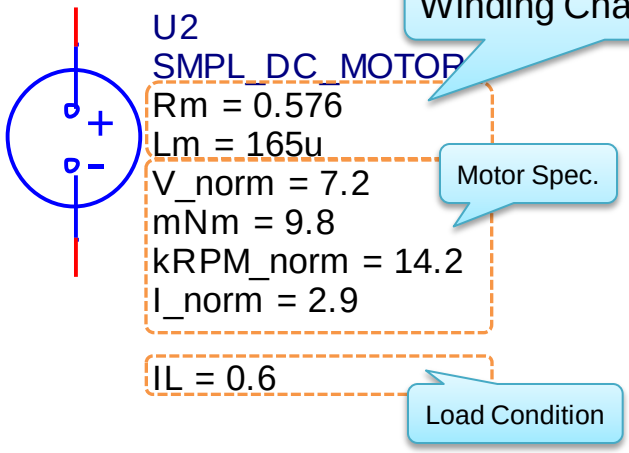
Simulation



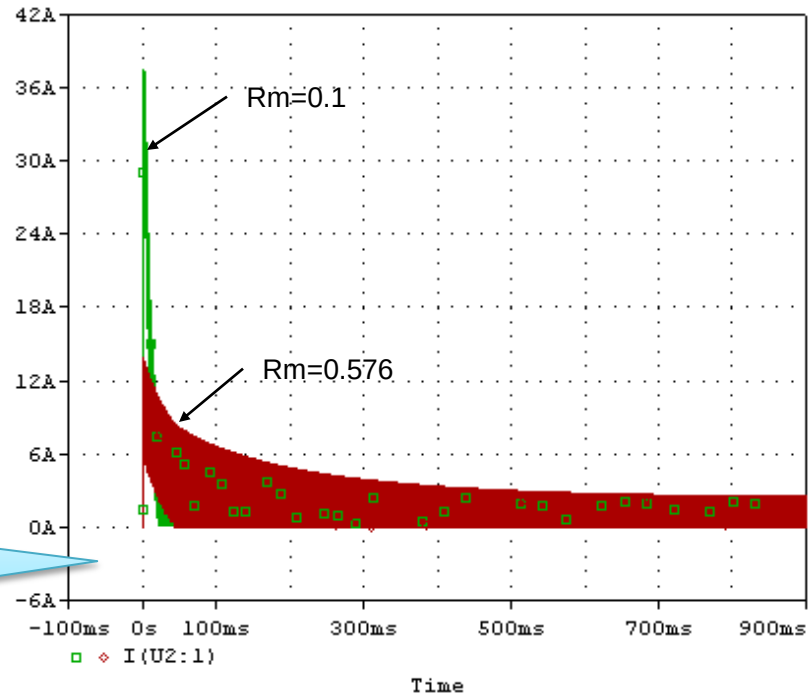
9. Winding Characteristic Parameters: Lm



10. Winding Characteristic Parameters: Rm



The Motor Start-up is Current changed by the Rm values.



Simulation Index

Simulations	Folder name
1. Motor Start Up Simulation at Normal Load.....	Normal
2. Motor Start Up Simulation at Haft of Normal Load.....	Half
3. Lj of the Motor Model.....	Lj