An AC Method For Load Disconnect Detection "Current Pulse"

Thong Huynh

Austin Nov'01

thong_huynh@maximhq.com

OUTLINE:

- The Purpose
- The Concept
- System Considerations
- Current Pulse Worst Case Simulations
- Solving Input Step Problem
- Discrete Detection Implementation Examples
- Next Steps
- Summary

The Purpose

THE PURPOSE:

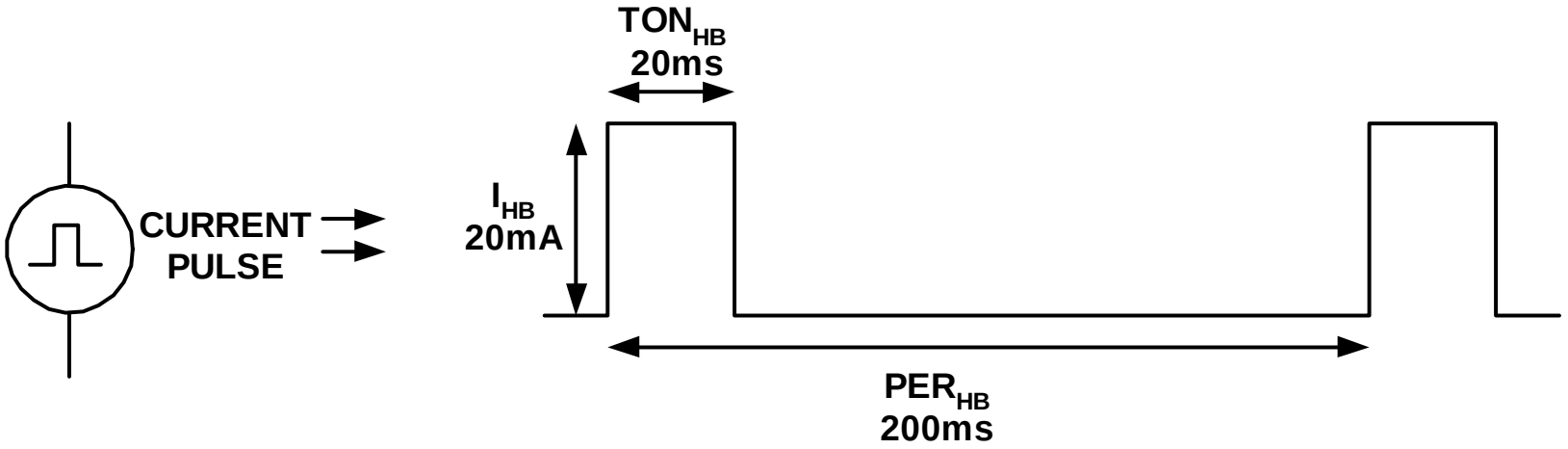
- To Reliably Detect A PD Disconnection From A Powered Port Using A Method That Is Different Than The Patented DC Detection Scheme.

THE CONCEPT:

- Introducing A Pulse Current (Current Pulse) At The PD Side During Normal Power Phase
- Pulse Current Is Detected At The PSE Side, Indicating That The PD Is Connected To The Port
- Pulse Current Not Detected Indicates PD Is No Longer Connected To The Port.

Current Pulse

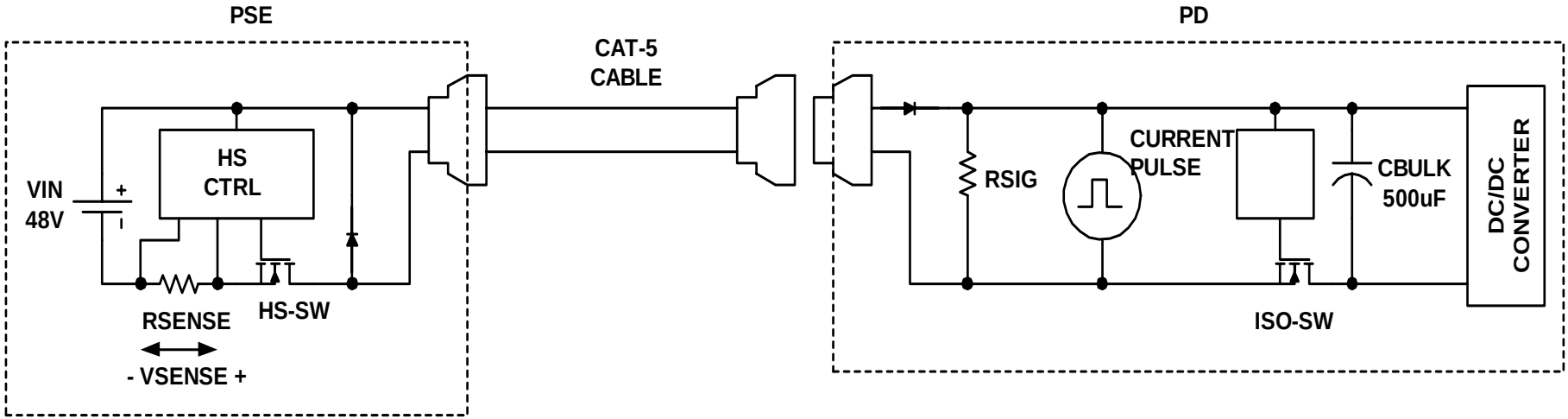
The Concept

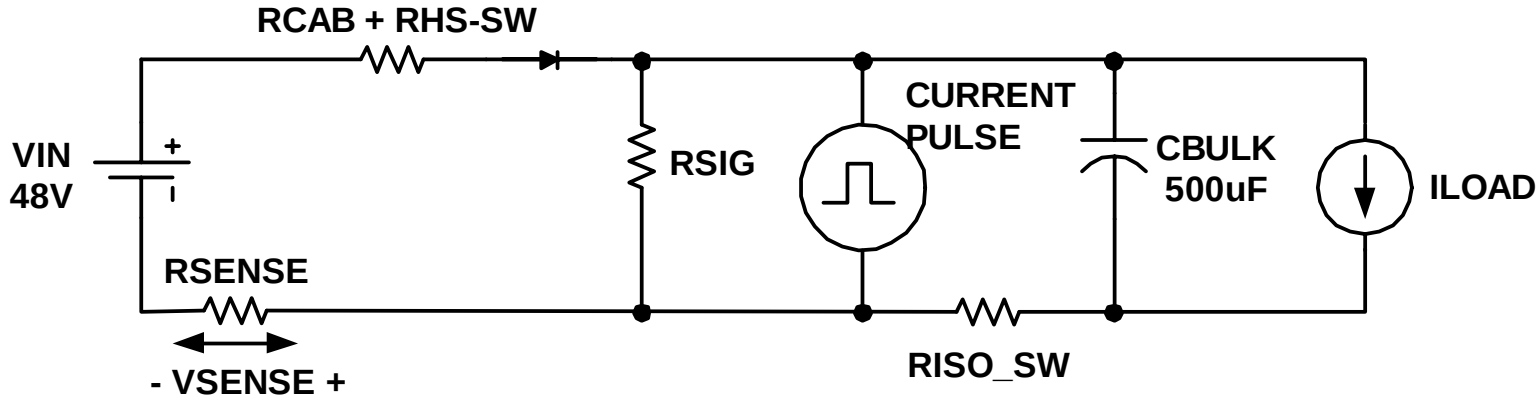


$$P_{HB} = I_{HB}.V_{IN}.\frac{T_{ON}}{PER_{HB}} = 20mA.48V.\frac{20ms}{200ms} = 96mW$$

Current Pulse

The Concept





SYSTEM CONSIDERATION:

- Detection Robustness:
  - Reliably Detecting The Current Pulse
  - Detecting Under Worst Case Condition
  - Detecting During An Input Voltage Step From 57V to 44V and Vice Versa.
  - Detecting During An Output Load Step From 350mA 0mA and Vice Versa. Detecting At Zero Load Current.
  - Immunity To System Noise (50/60Hz Power Line, Dc-Dc Converter Switching Frequency Noise, EMI, etc.)

SYSTEM CONSIDERATION (Cont.):

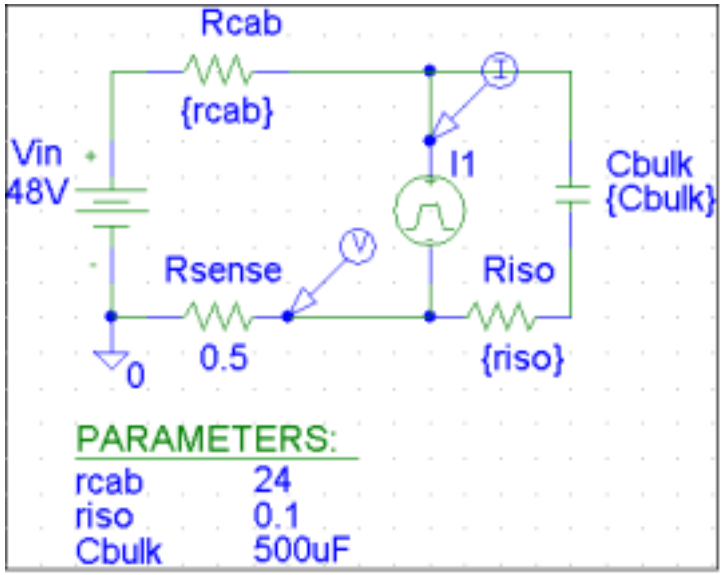
- Power Dissipation: 96mW at 48V
- Cost: Only A Small Fraction Of The PD Front End Cost (<5%).
- Ease Of Implementation: For Both Integrated and Discrete Solutions

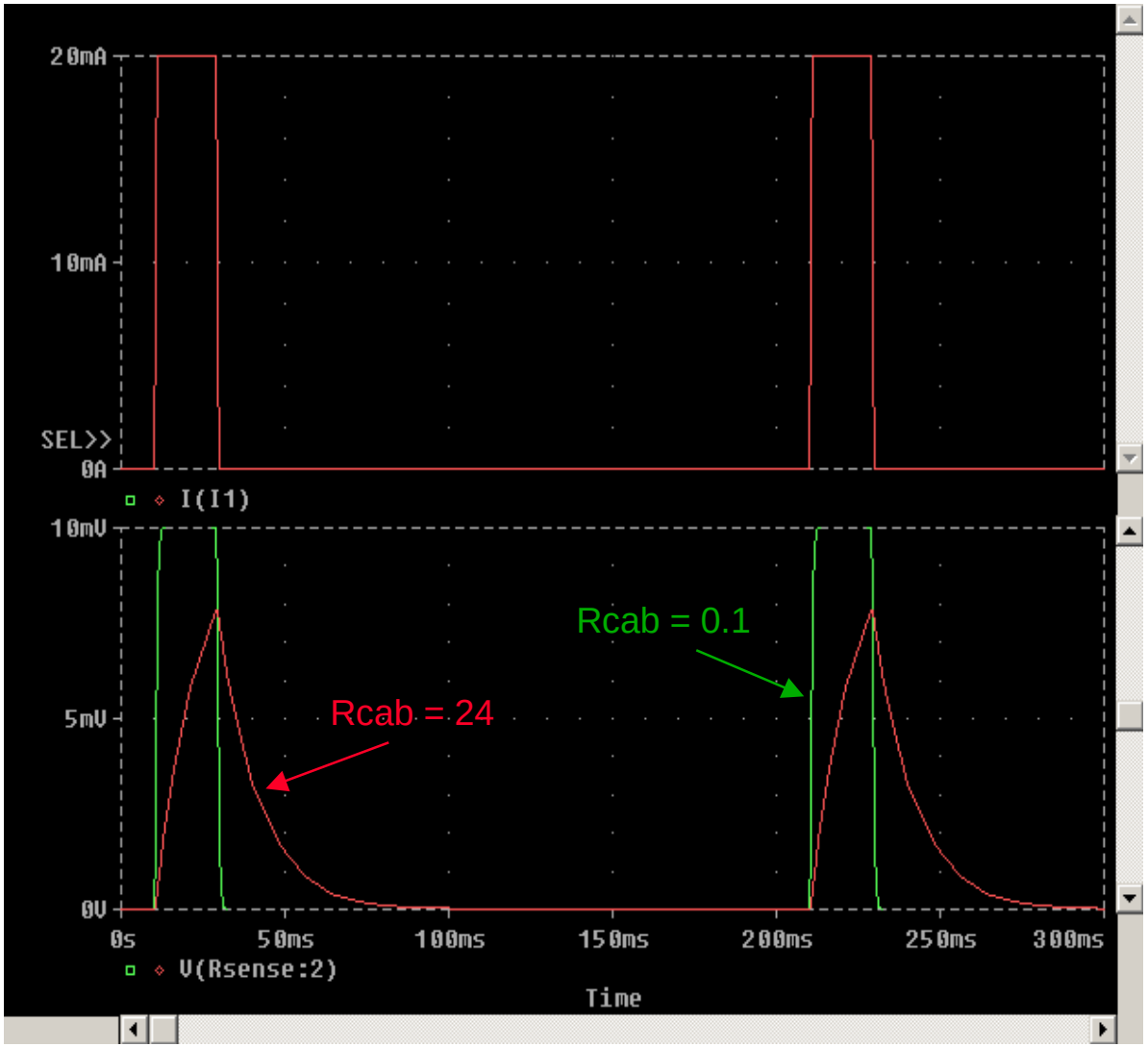
Current Pulse Worst Case Simulation

Current Pulse WORST CASE SIMULATION:

- Bulk Capacitor At 500uF And 0 Ohm ESR
- CAT-5 Cable Resistance At 20 Ohm
- ISO-SW At Minimum Resistance (100m Ohm)
- HS-SW At Maximum Resistance (4 Ohm)

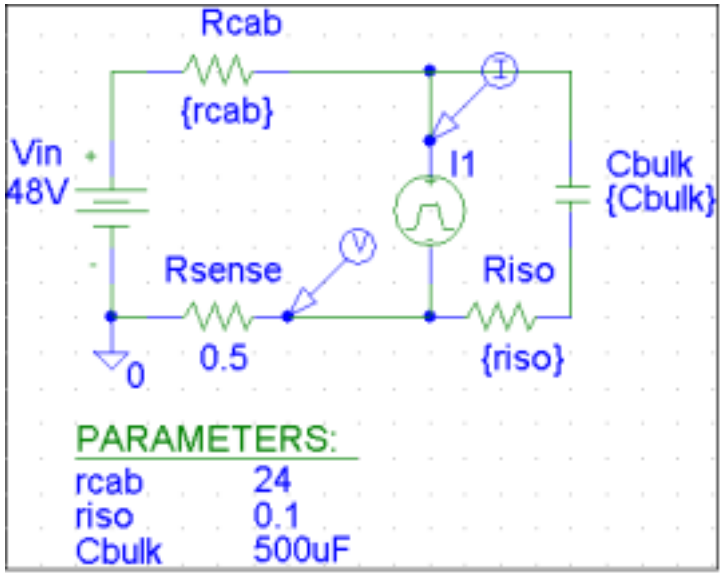
Current Pulse Worst Case Simulation

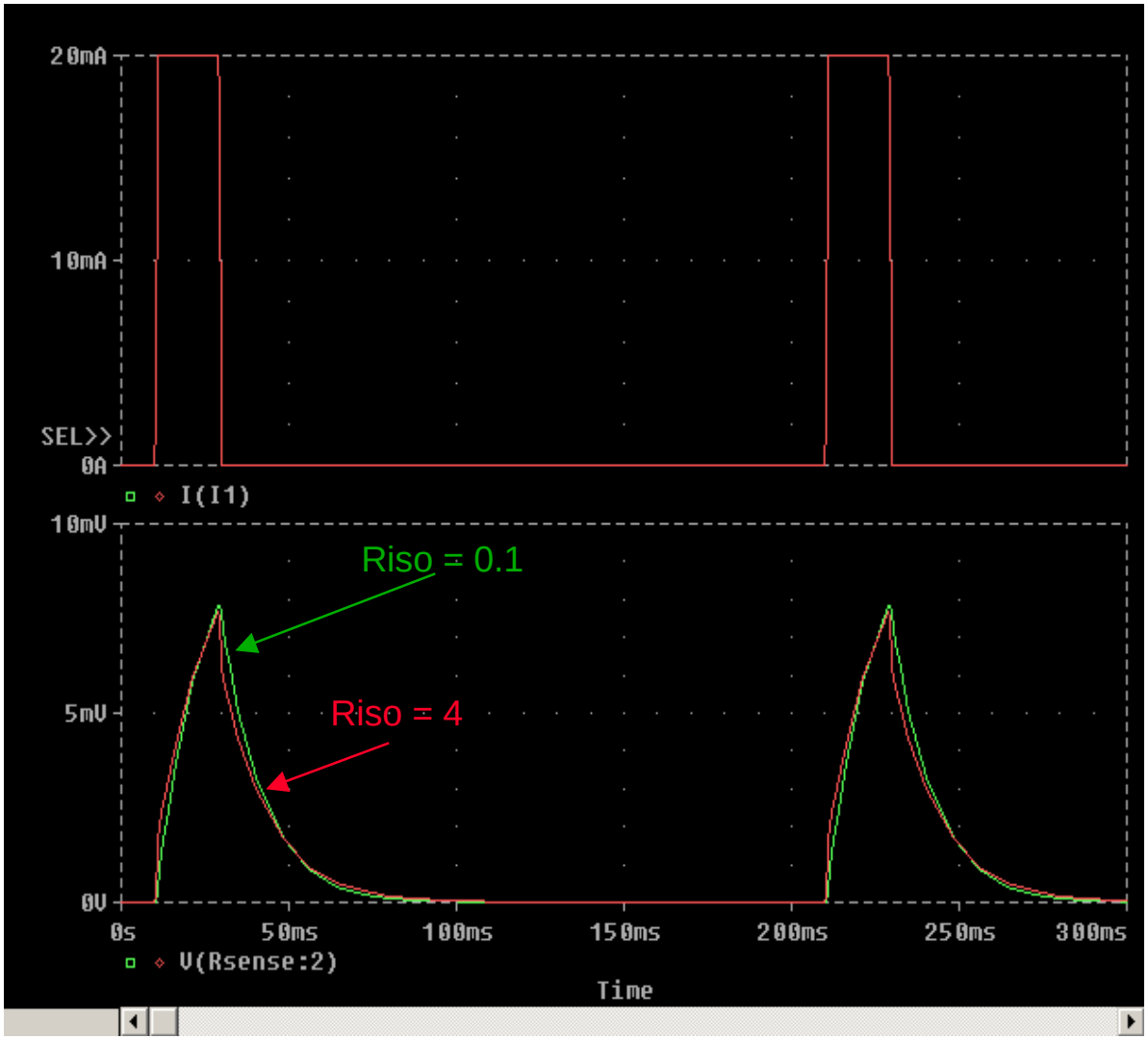




Current Pulse

Current Pulse Worst Case Simulation





Current Pulse

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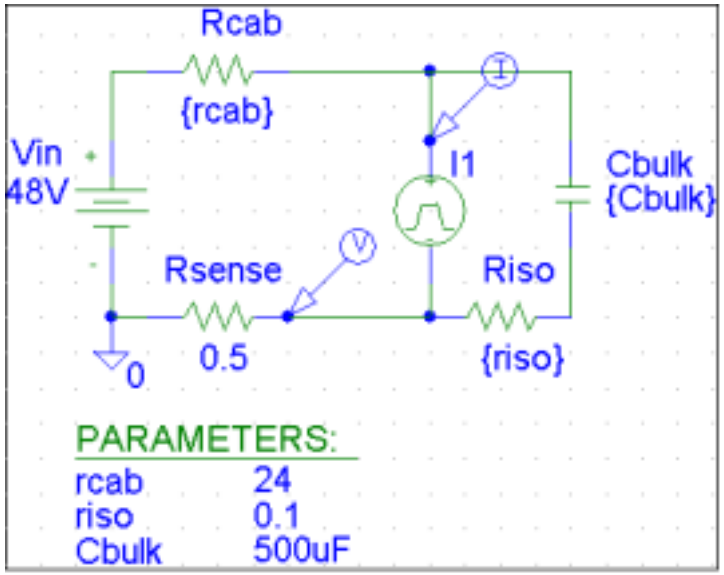

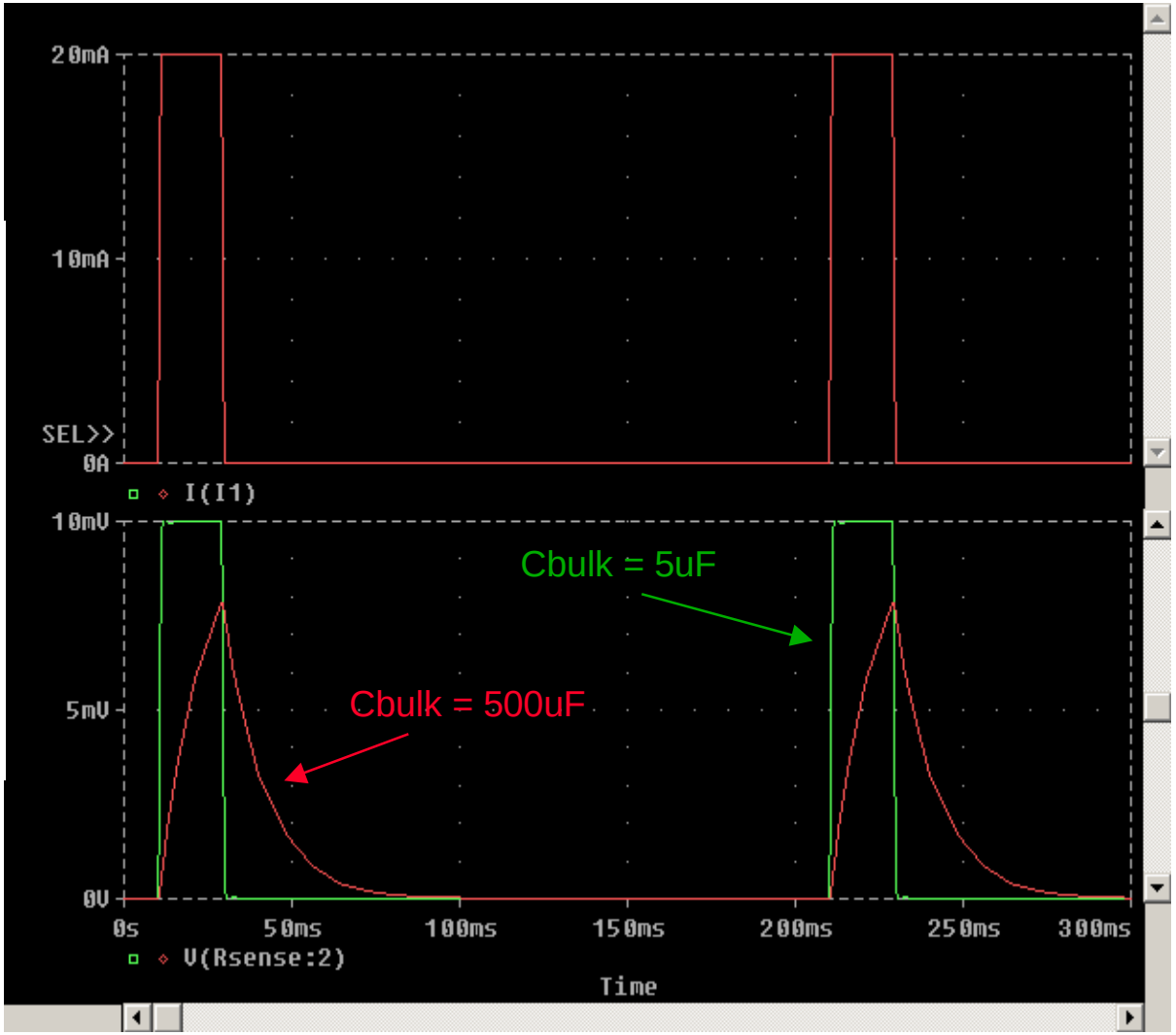

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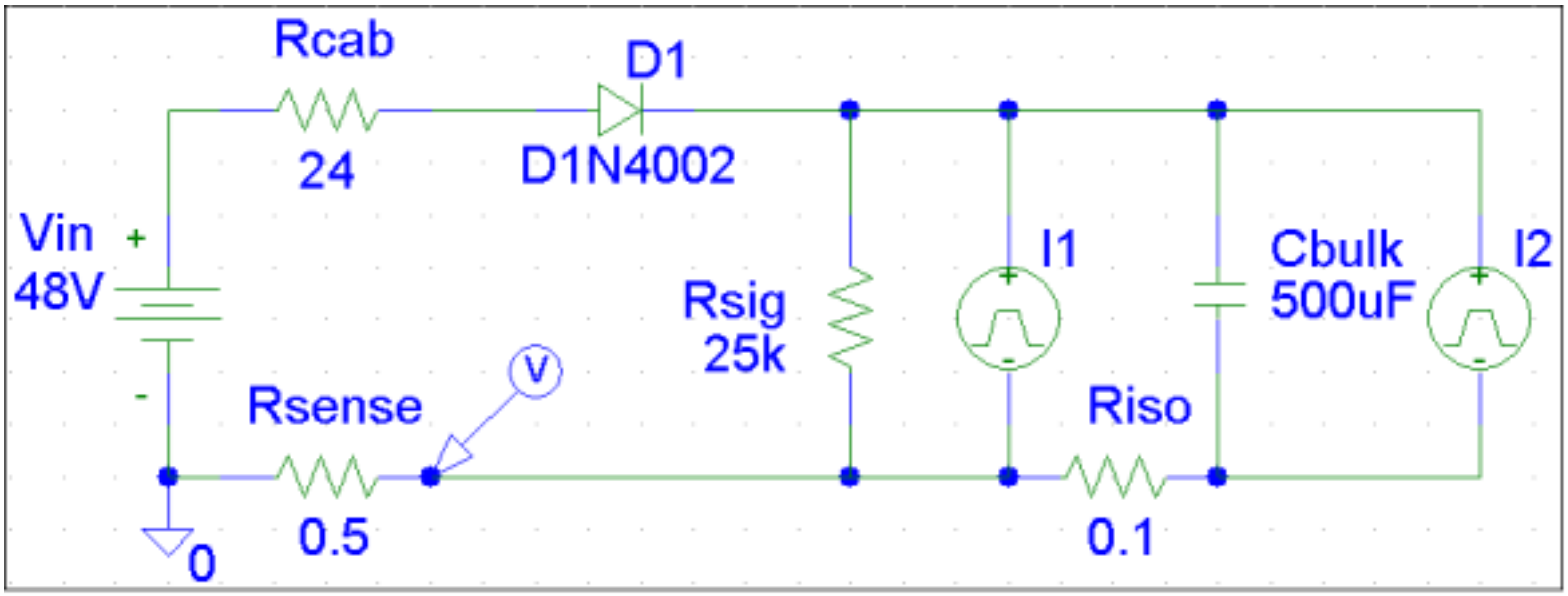

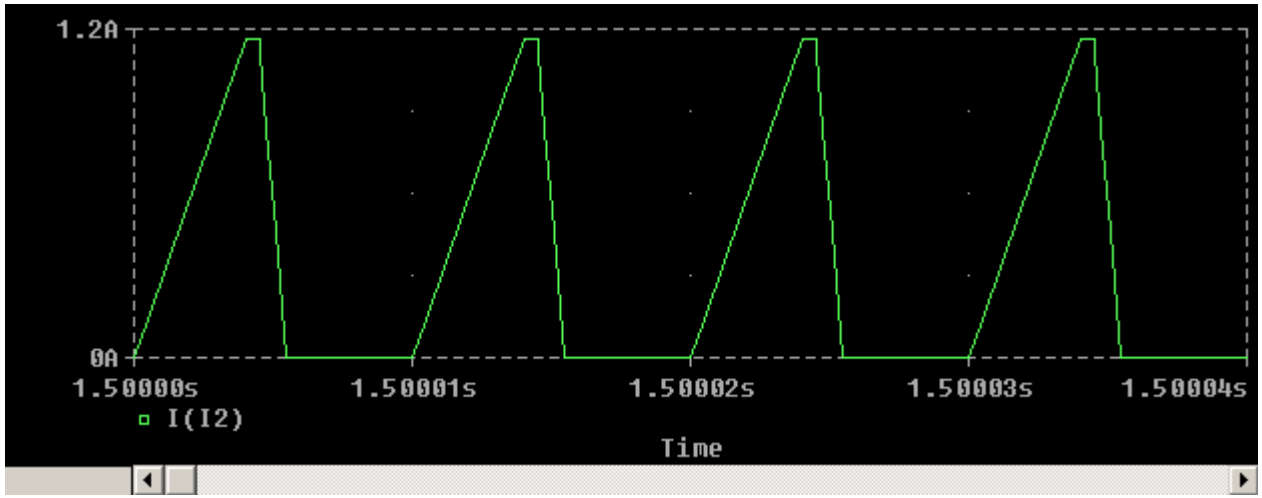

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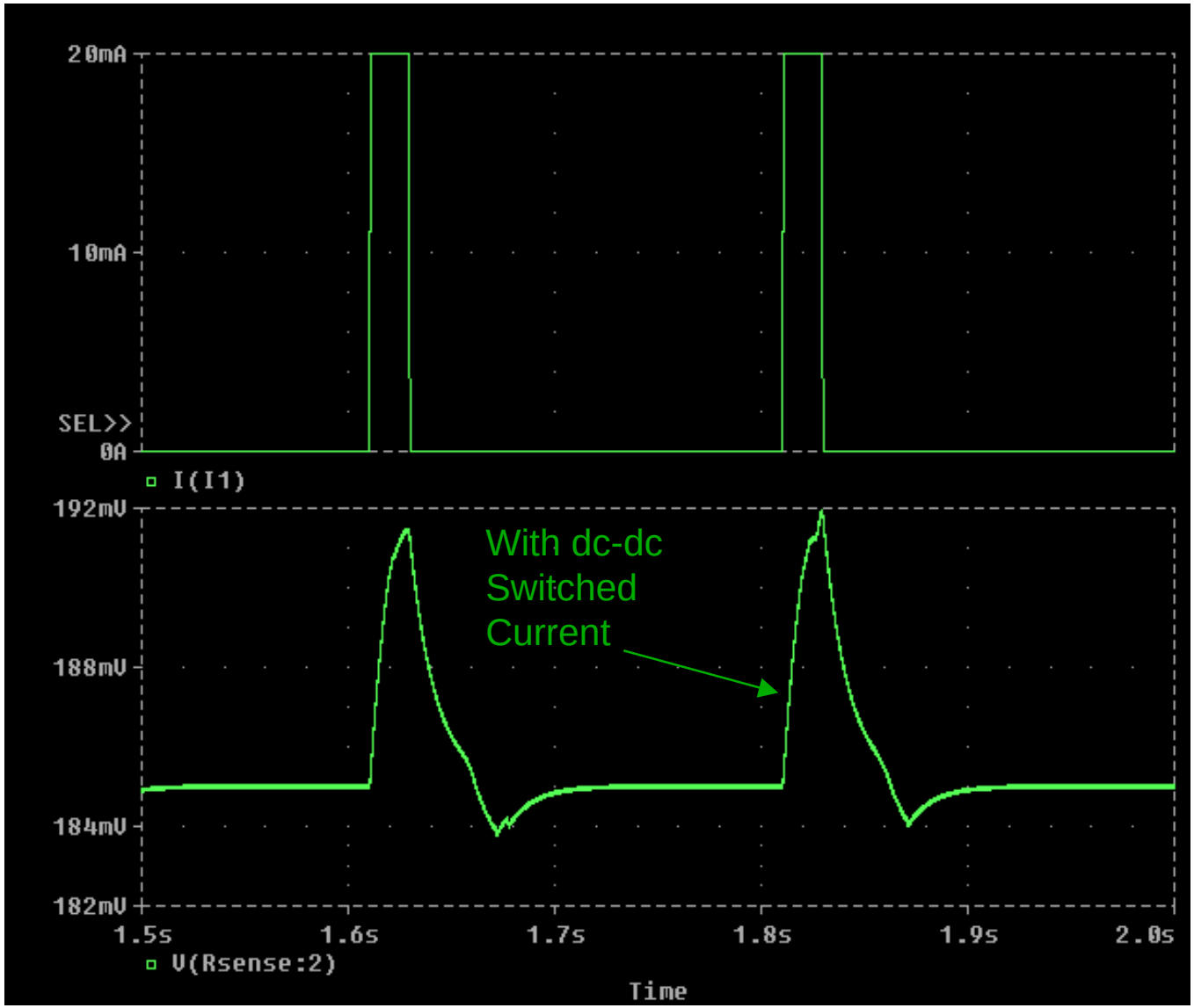

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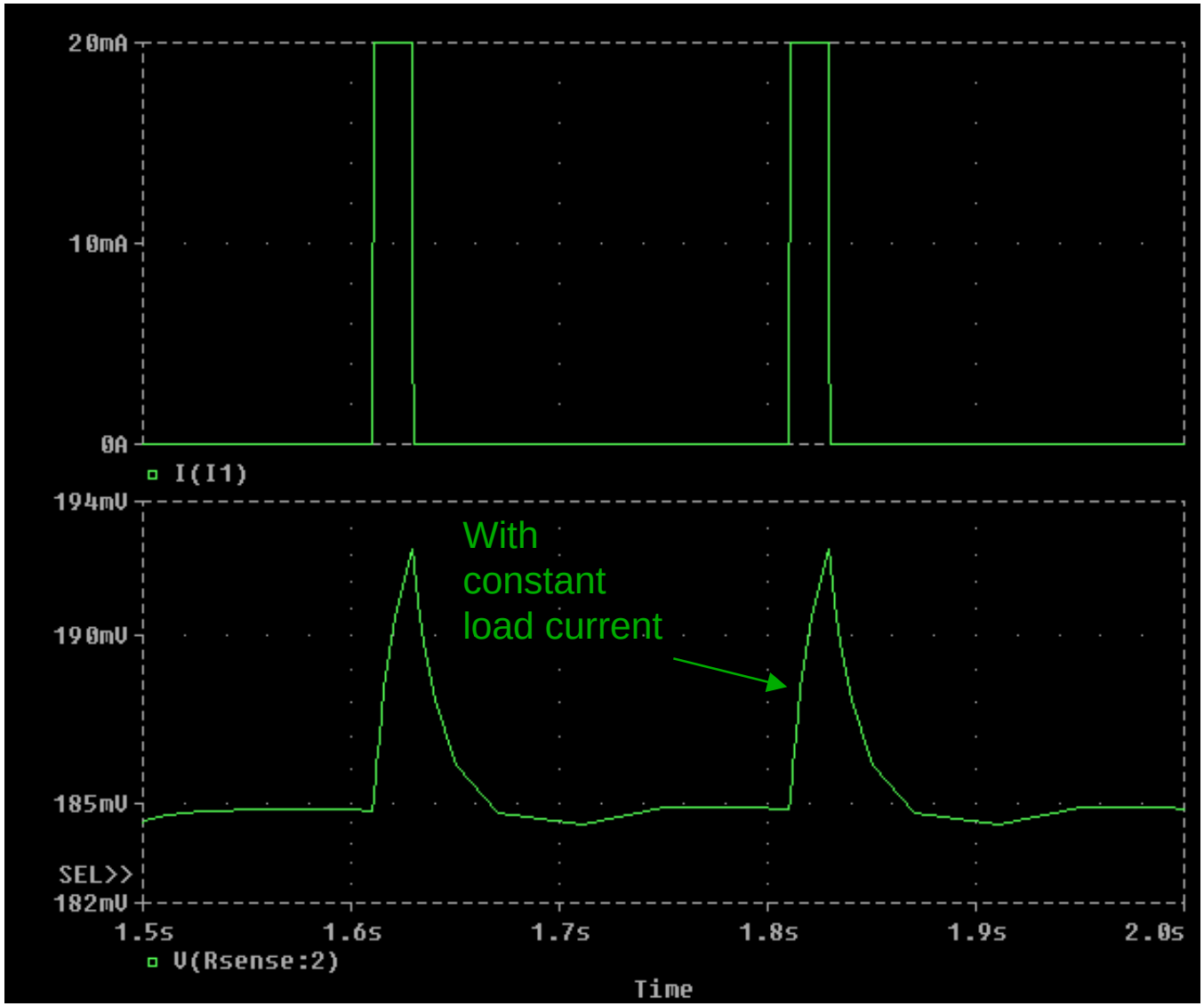
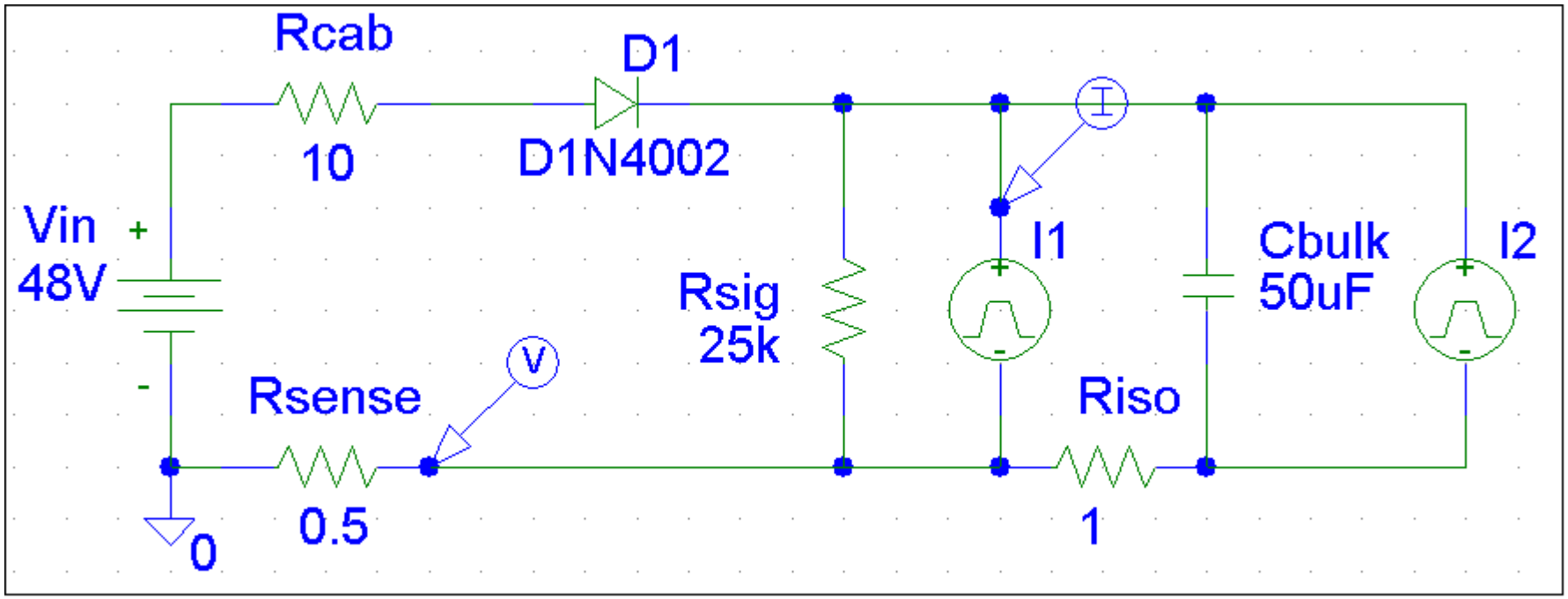
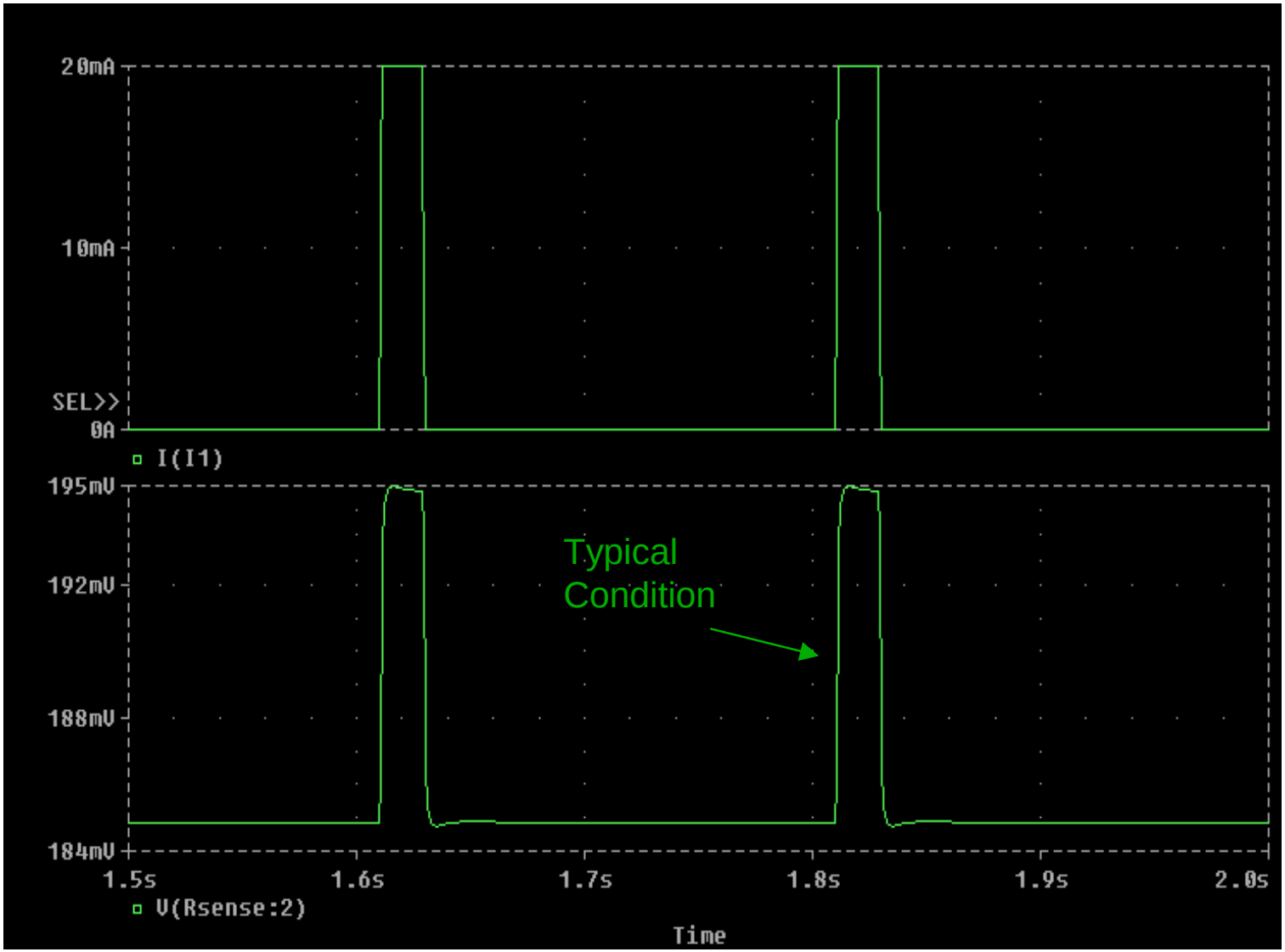


Current Pulse Worst Case Simulation

Typical Condition



Current Pulse Worst Case Simulation

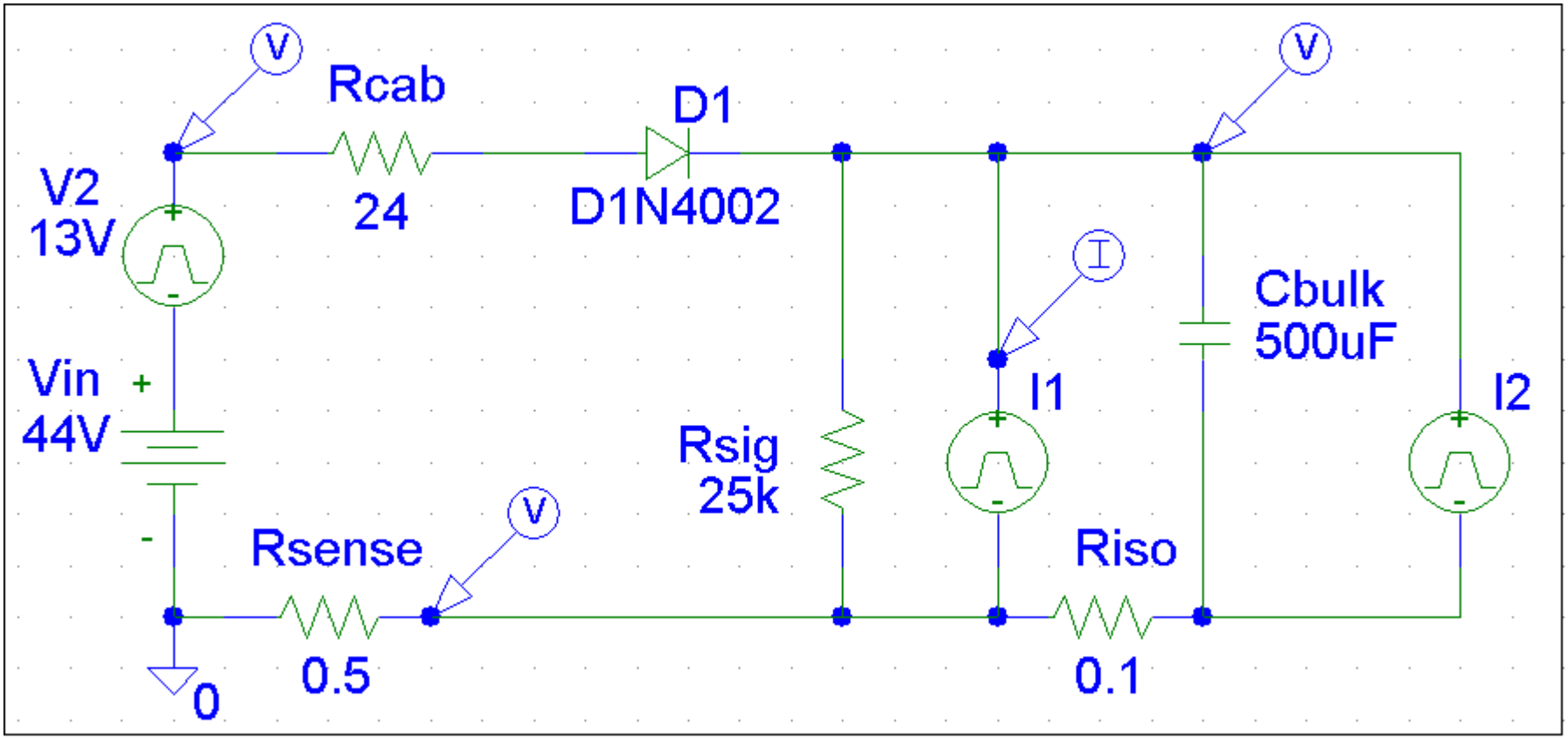


SOLVING INPUT VOLTAGE STEP PROBLEM

- When The Input Voltage,Vin, Steps From 57V To 44V, The Reverse Protection Diode On The PD Blocks Any Current Information (Including The Current Pulse) From The PD To The PSE Until The CBULK Voltage Discharges Down To Vin - Vdiode. The Problem Is Worst At Light Load.

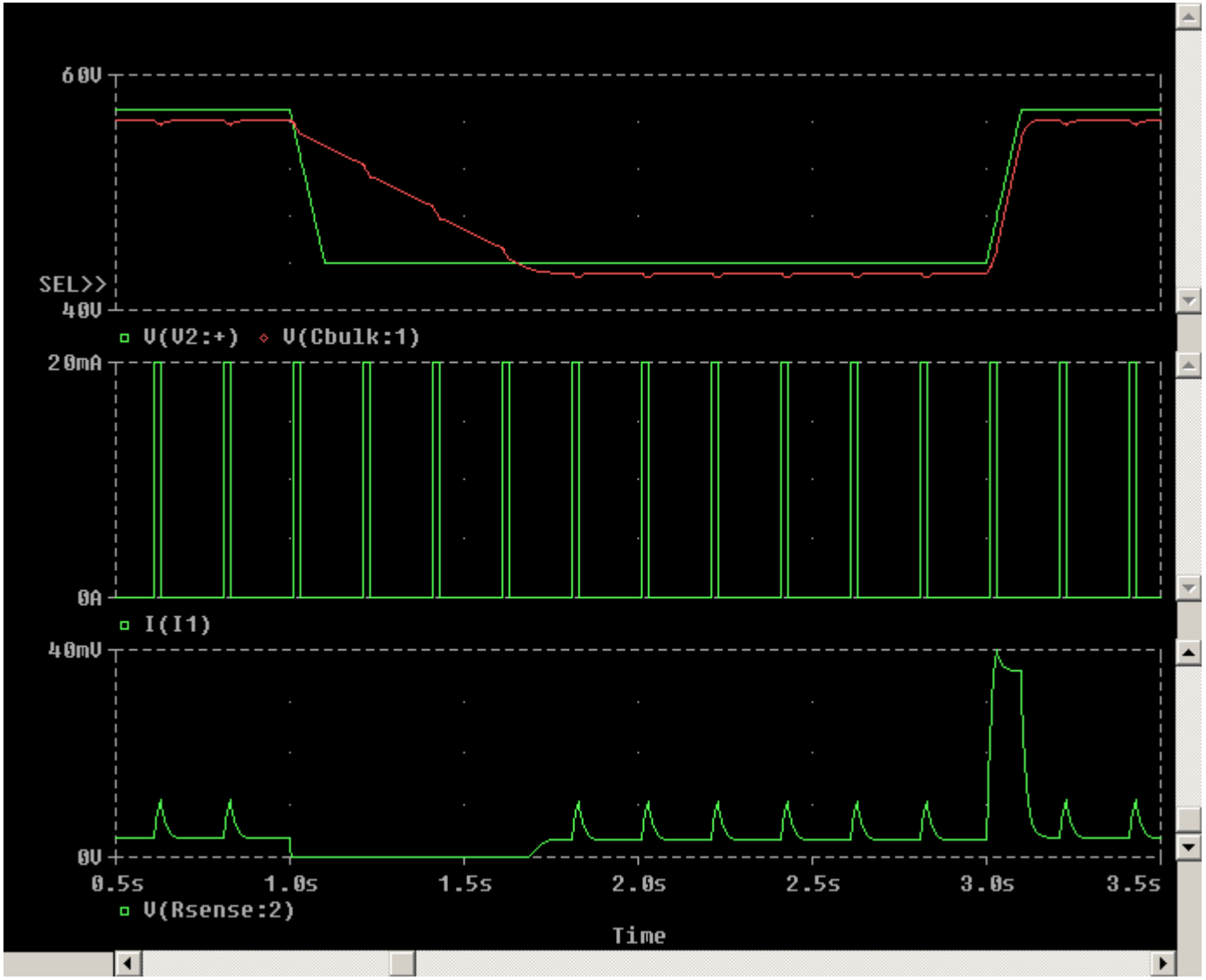
Current Pulse

Solving Input Voltage Step Problem



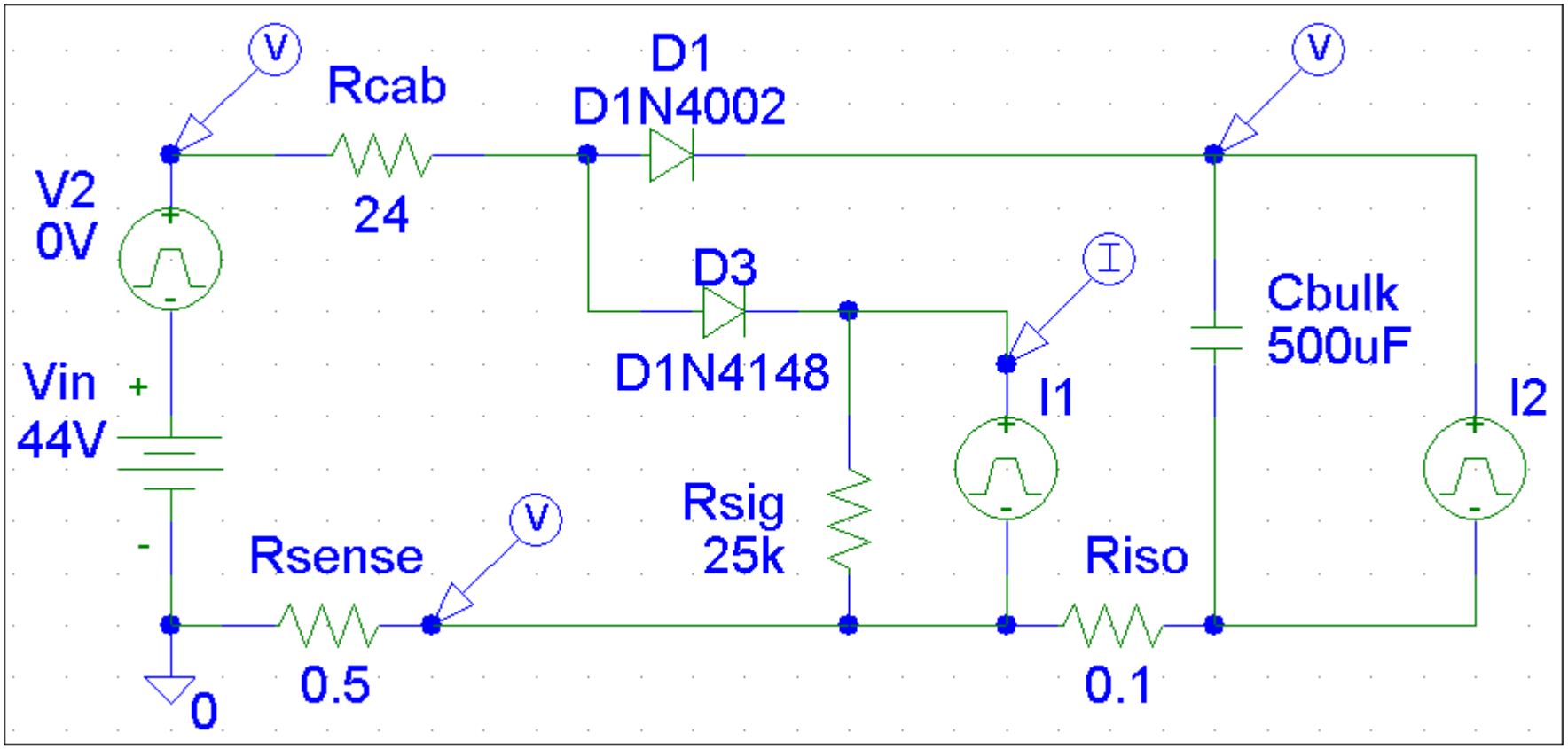
Current Pulse

Solving Input Voltage Step Problem



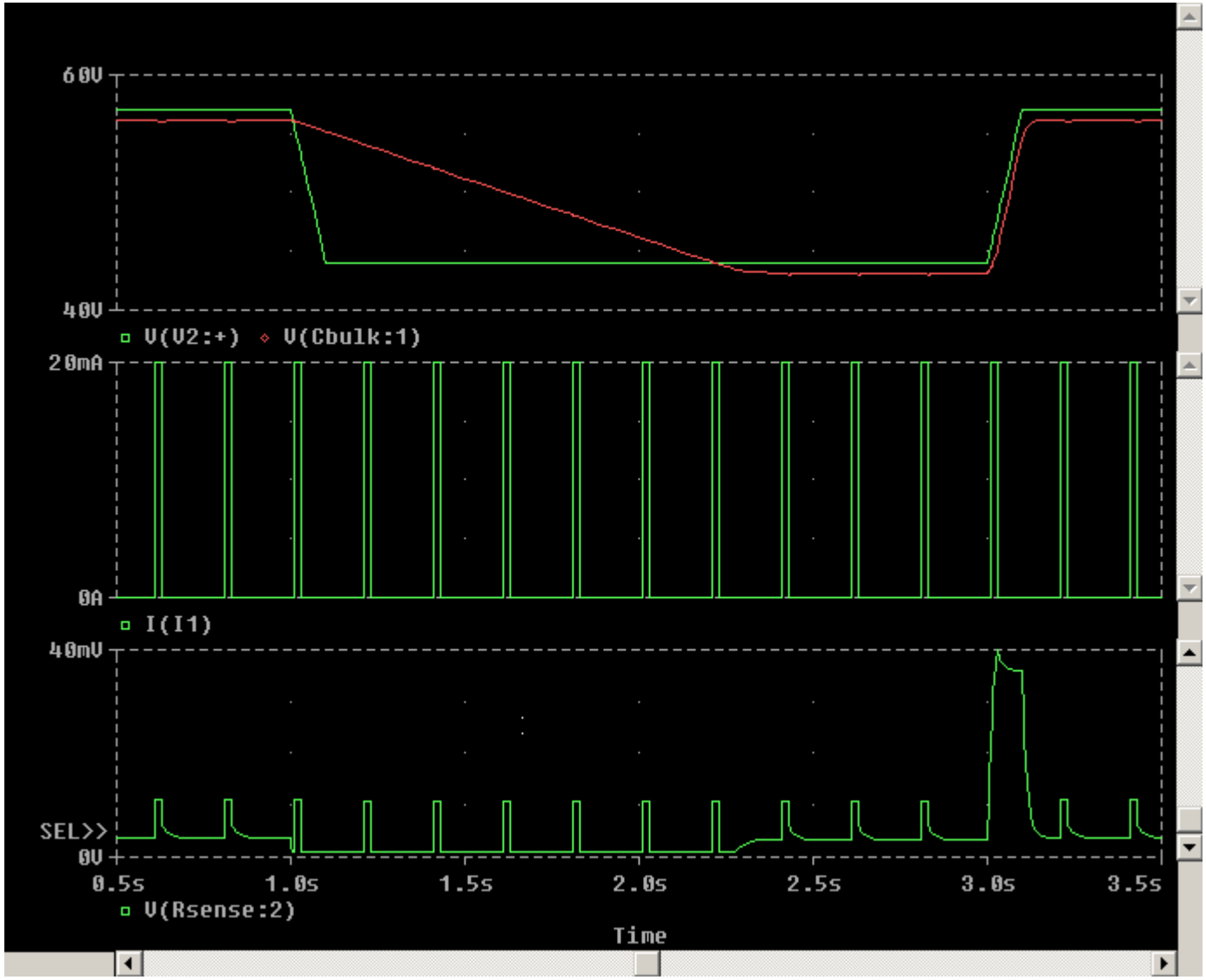
Current Pulse

Solving Input Voltage Step Problem



Current Pulse

Solving Input Voltage Step Problem



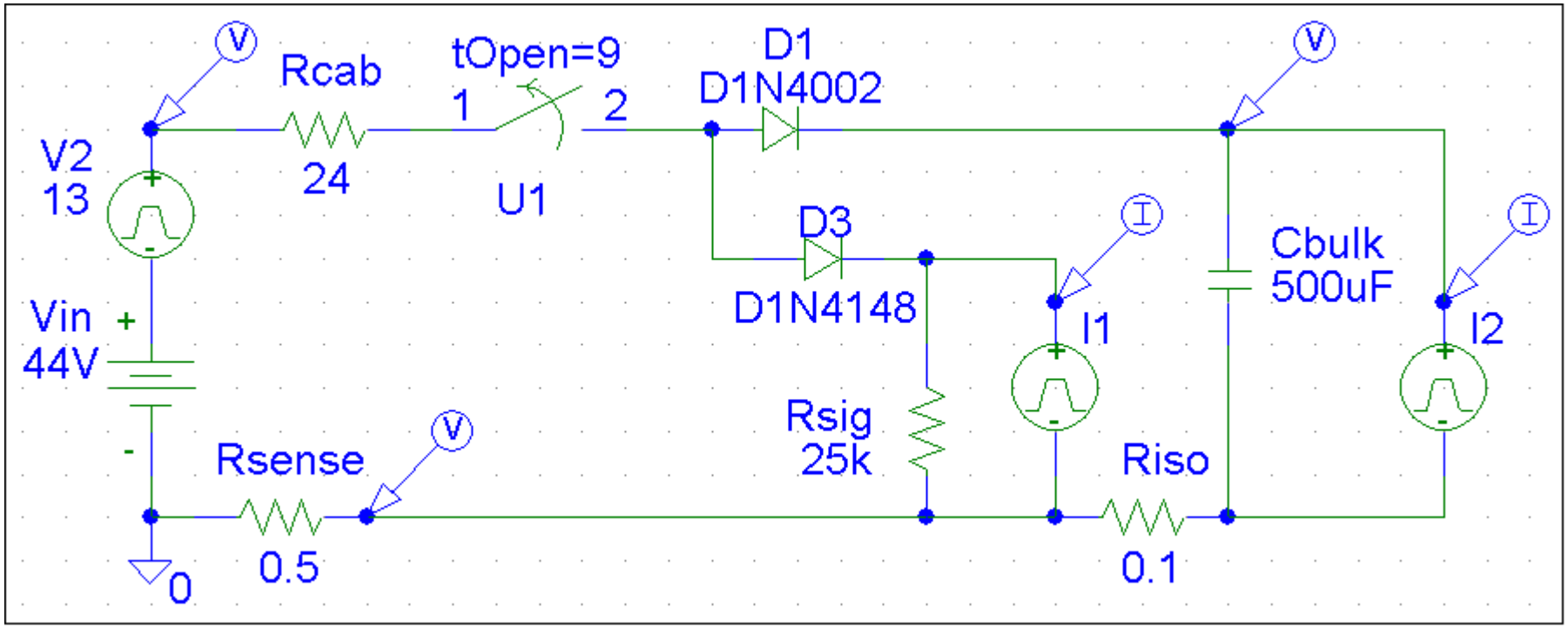
Discrete Detection Examples

Discrete Detection Implementation Examples:

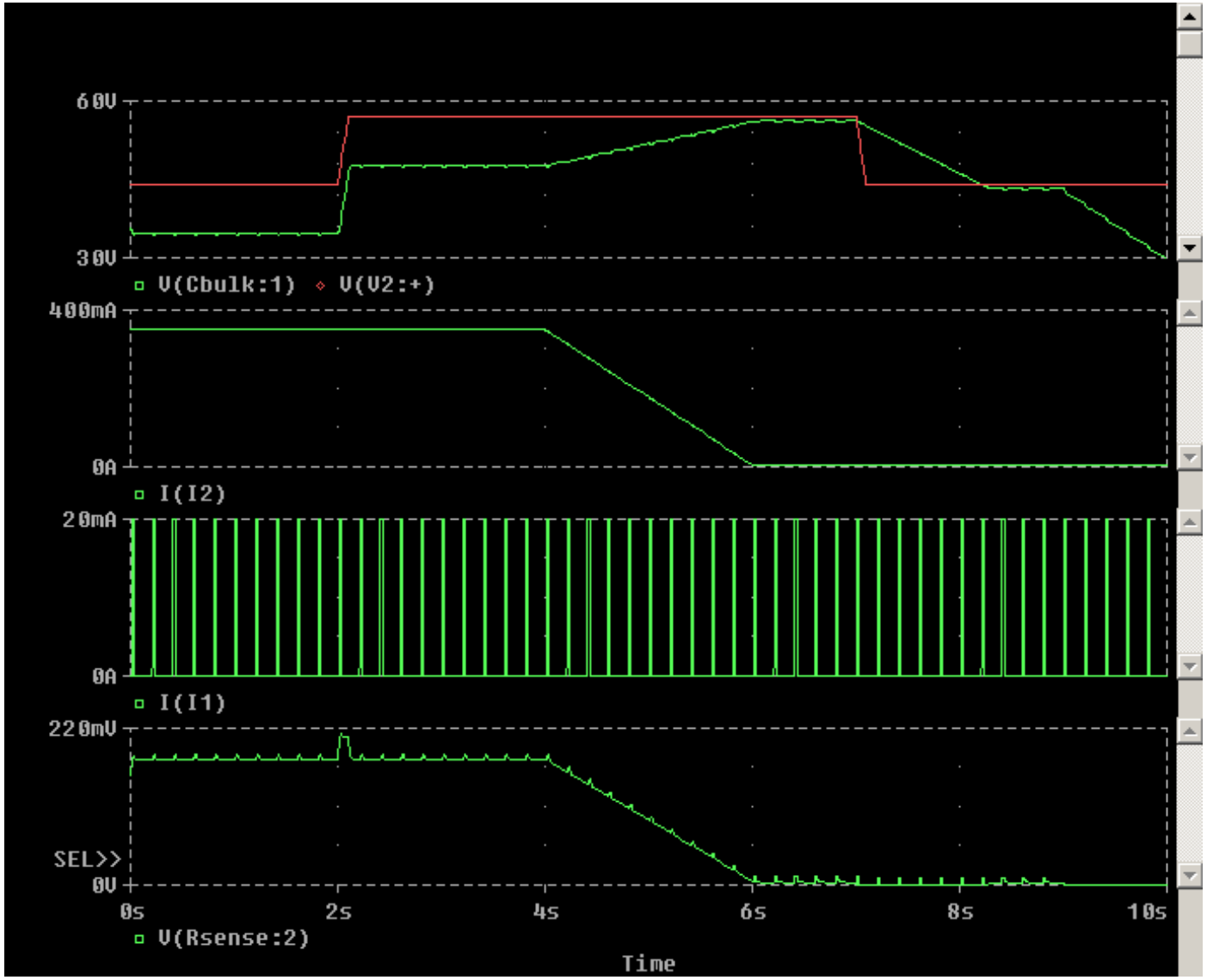
- Example 1: Use Band Pass Filter To Re-Condition Vrsense. Then Compare It With A Fixed DC Voltage Reference
- Example 2: Compare Vrsense With A Reference That Tracks Vrsense DC Offset

Current Pulse

Discrete Detection Examples

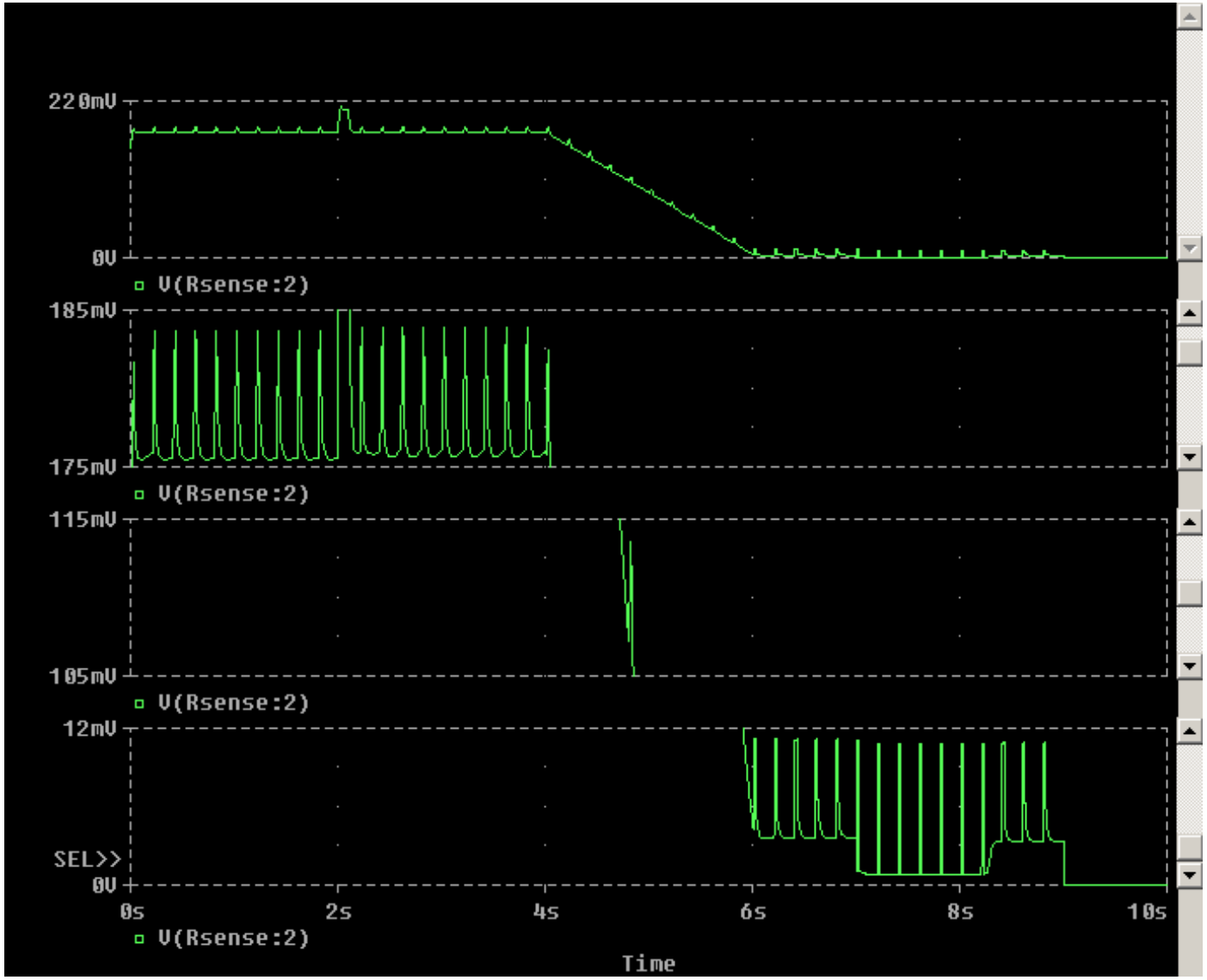


Current Pulse Discrete Detection Examples



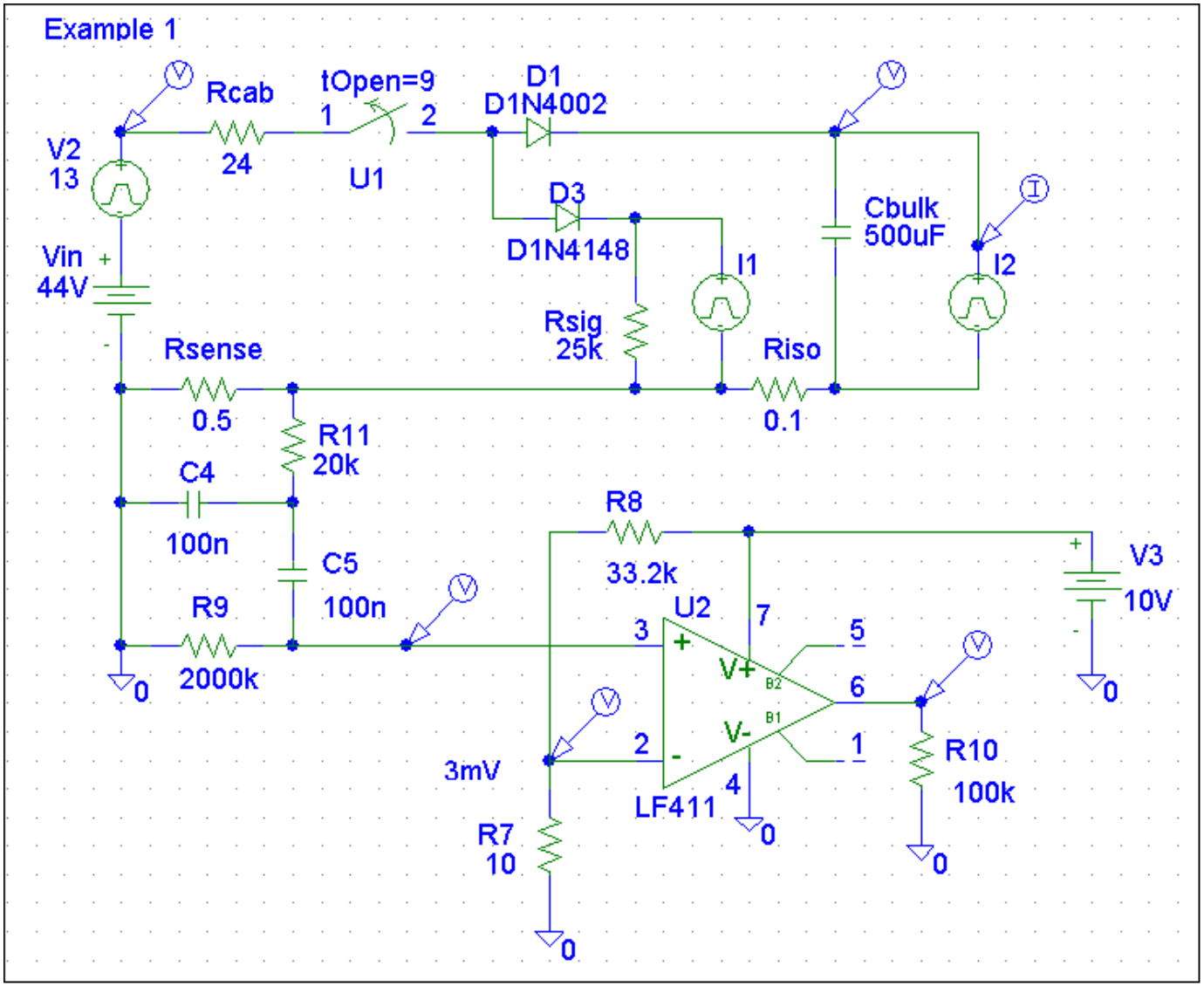
Current Pulse

Discrete Detection Examples



Current Pulse

Discrete Detection Example 1



Current Pulse

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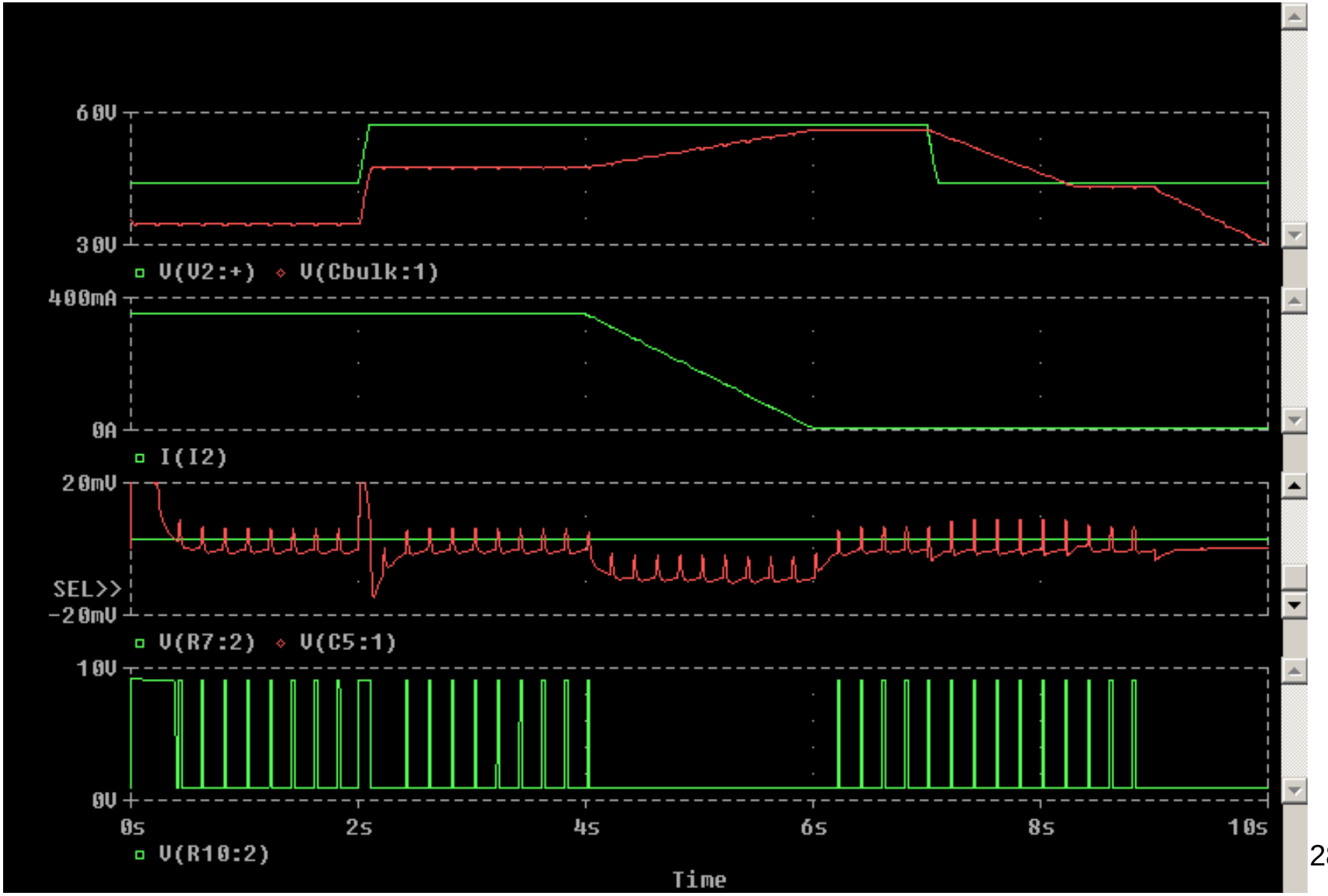

Current Pulse

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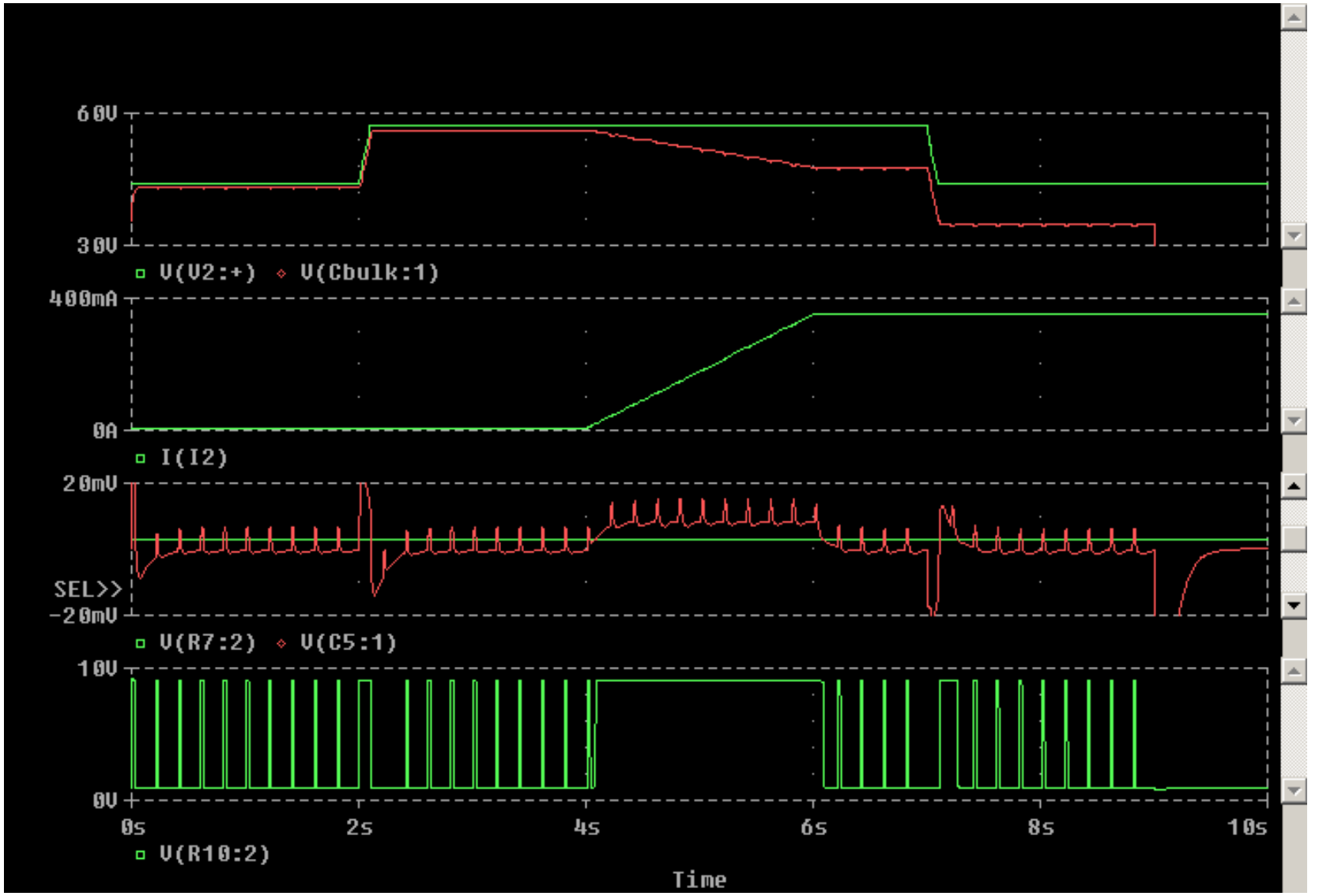
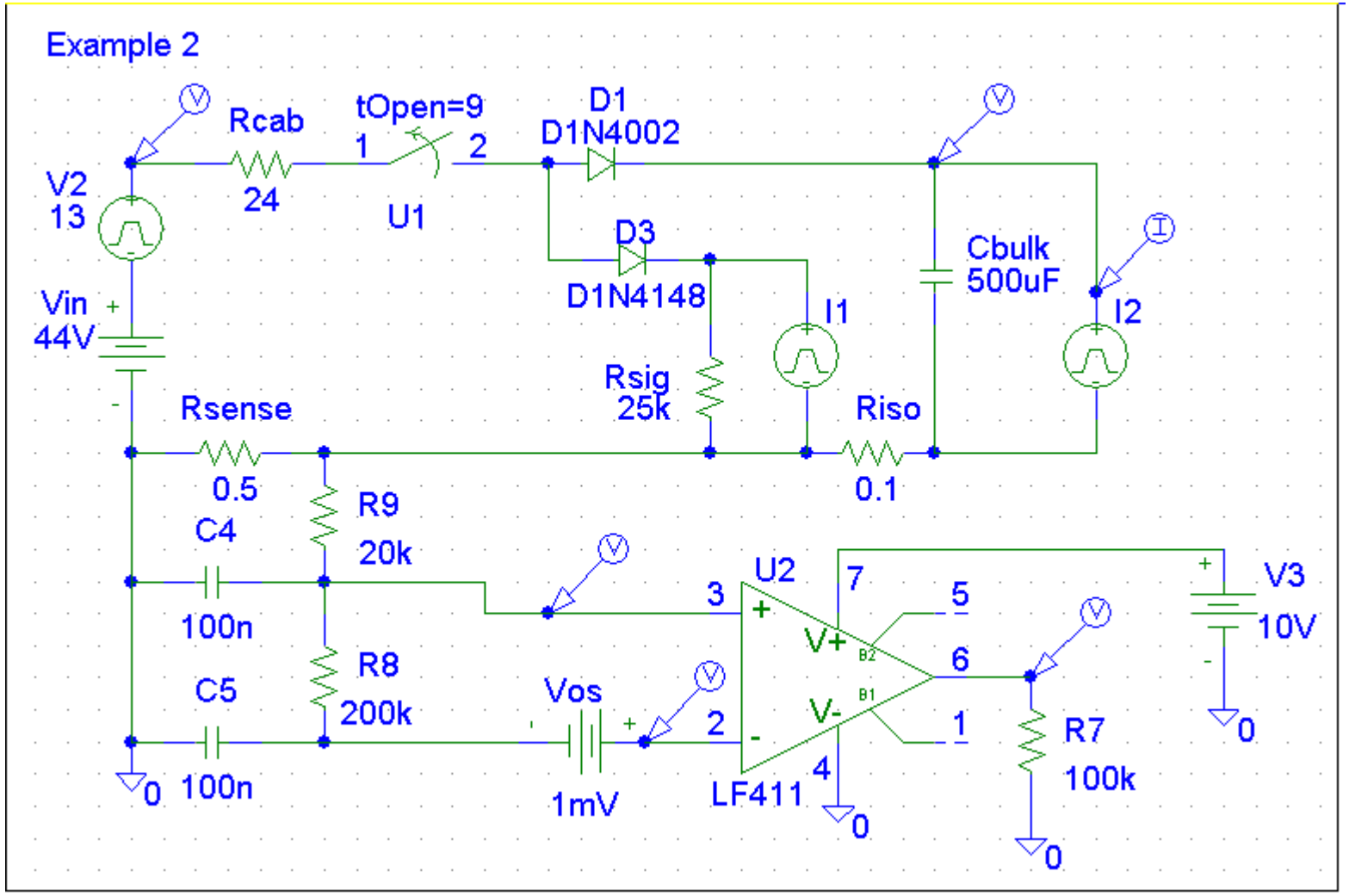
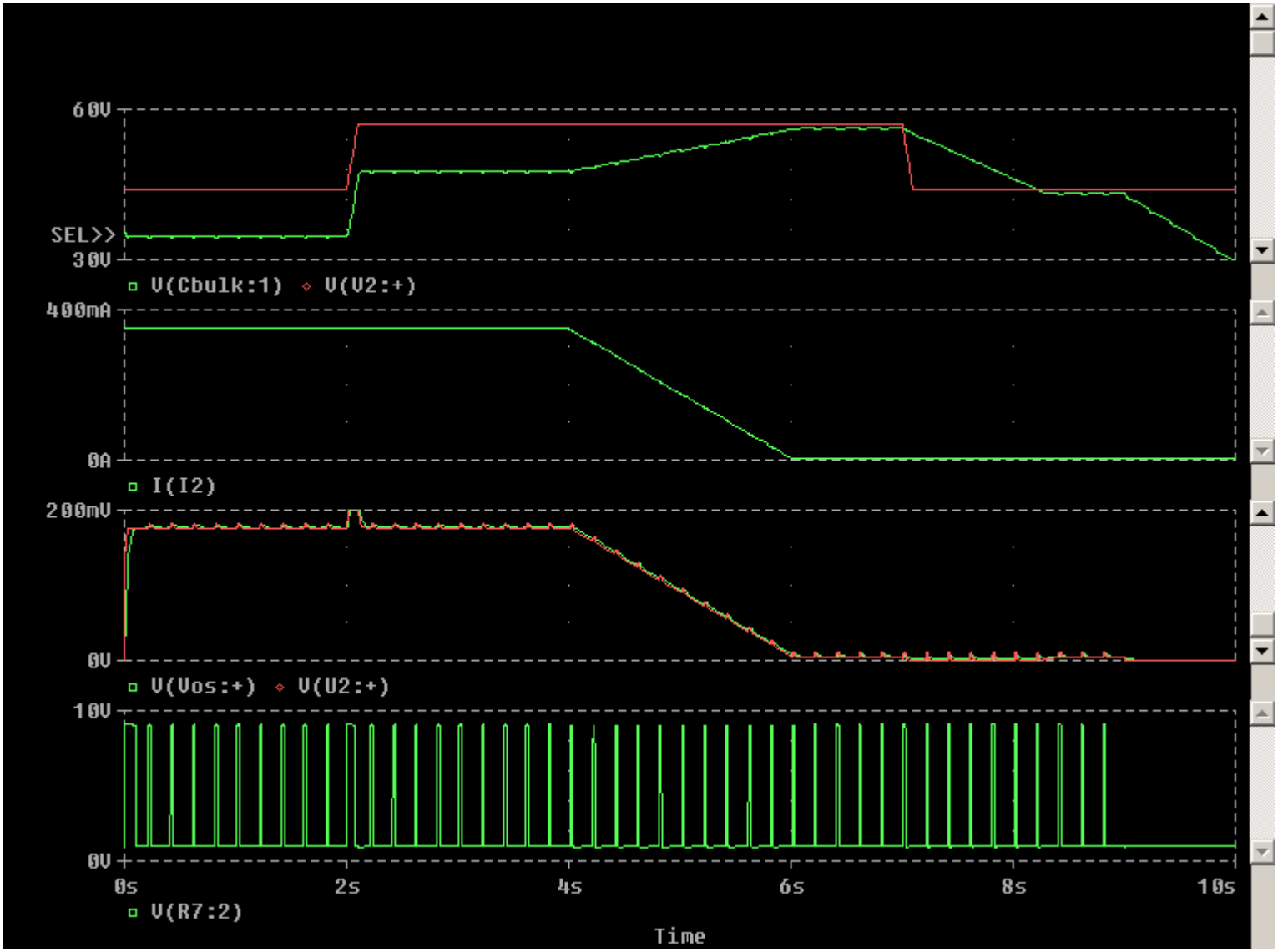


Current Pulse Discrete Detection Example 2



Current Pulse

Discrete Detection Example 2



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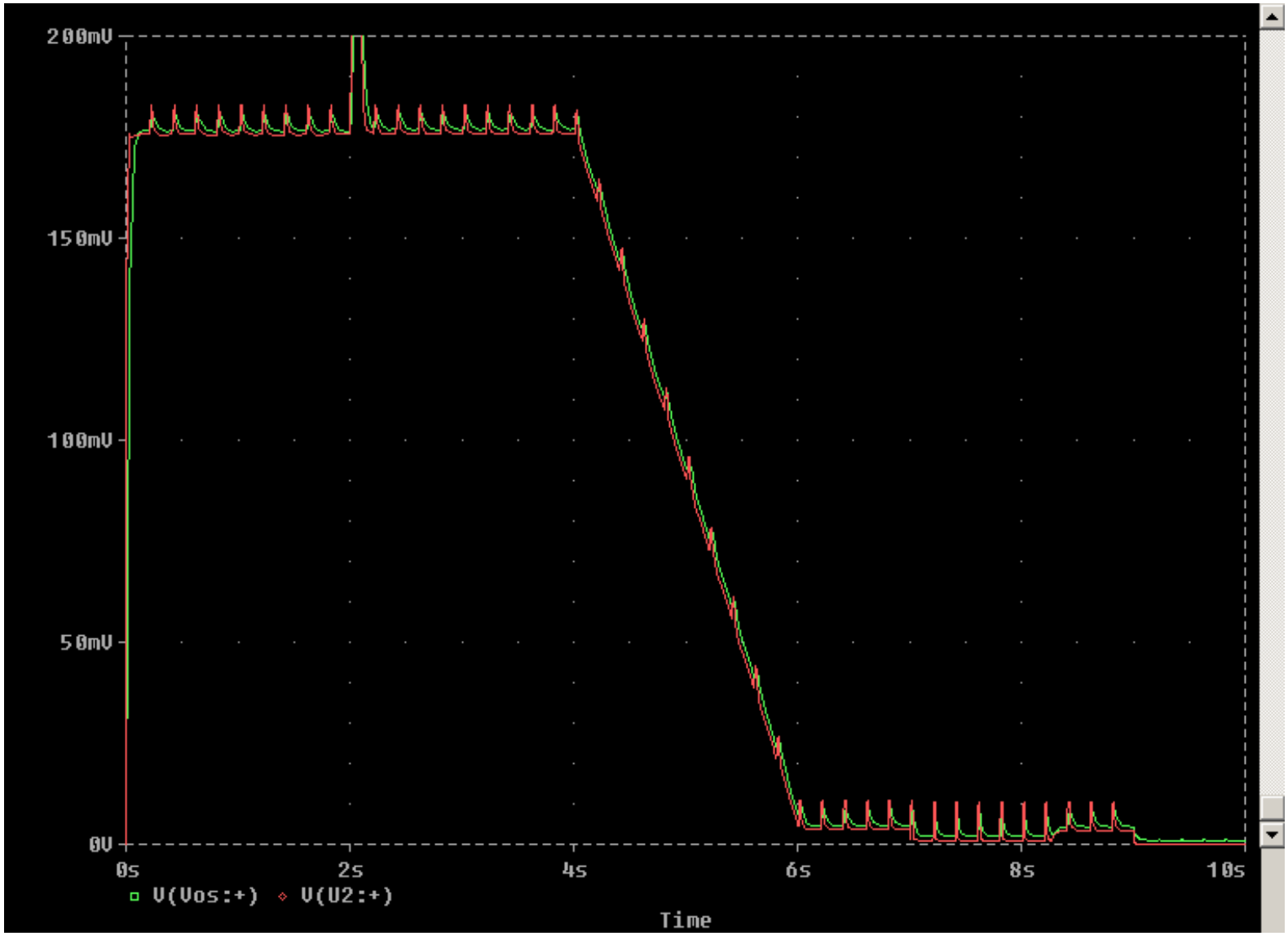
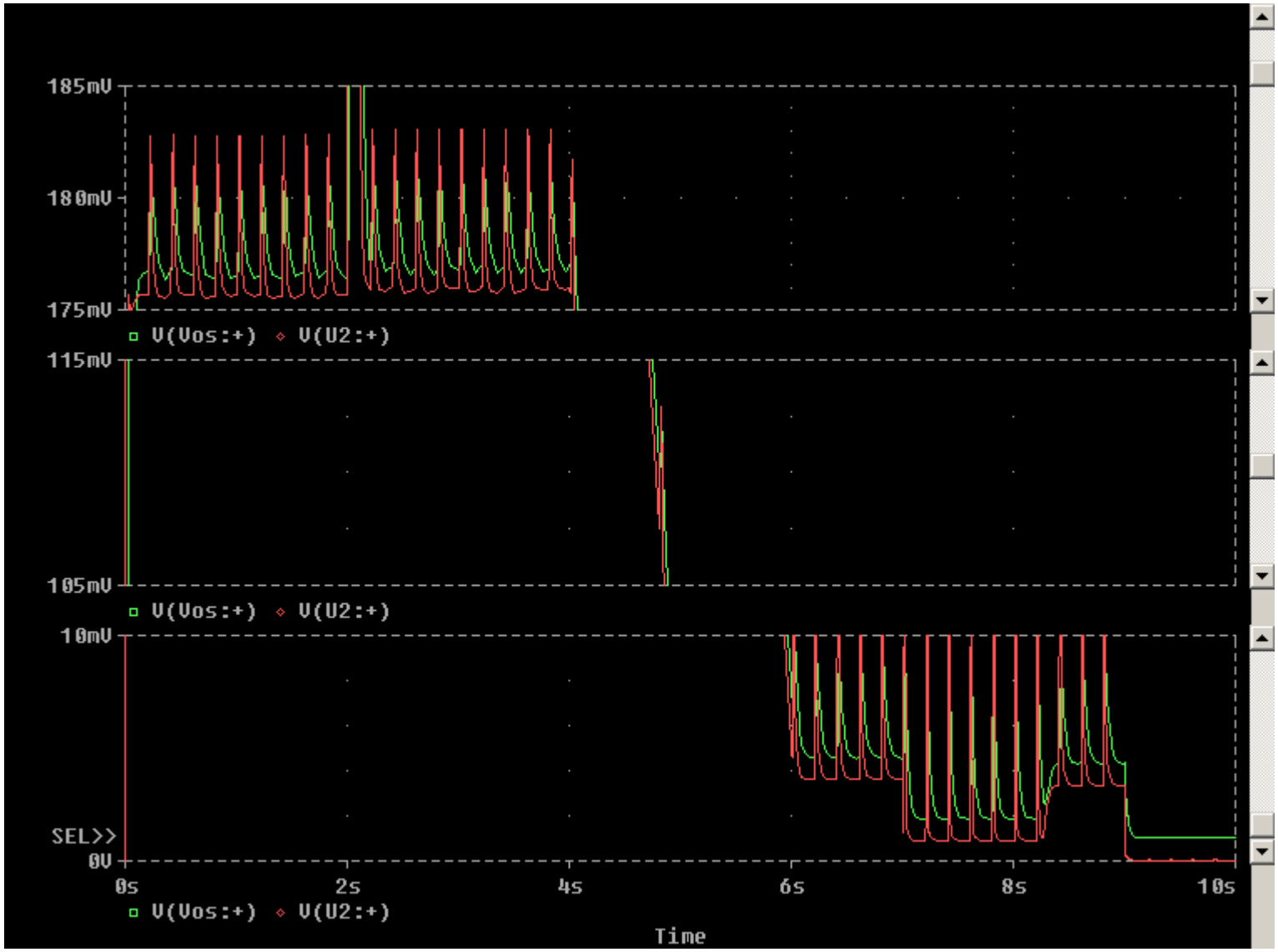


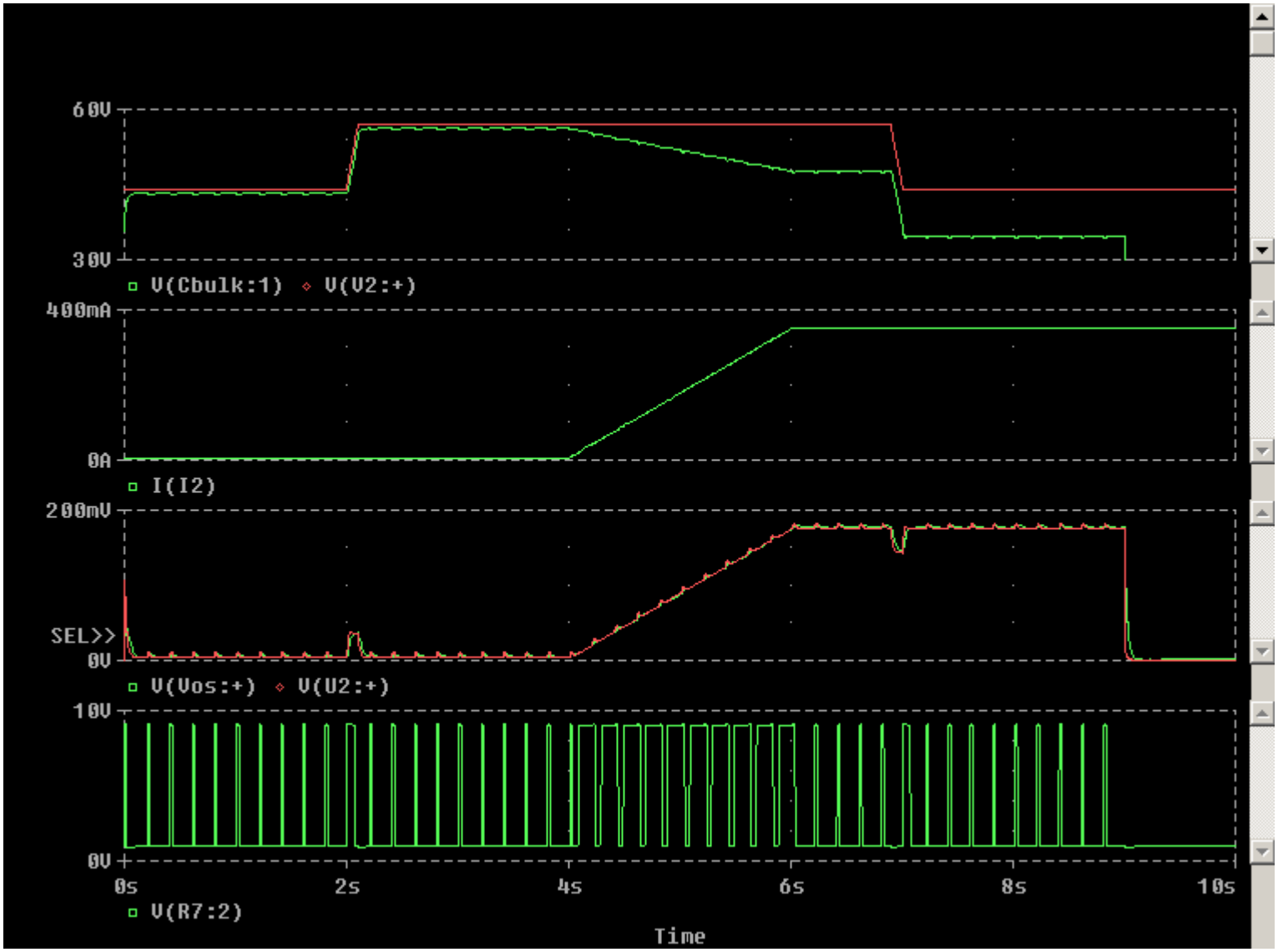
Current Pulse

Discrete Detection Example 2



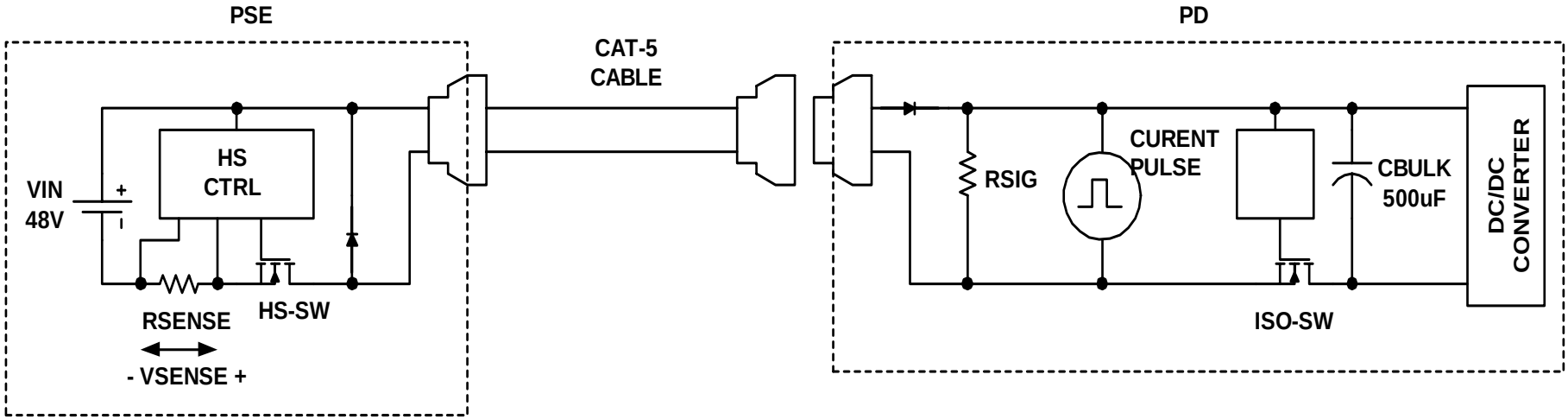
Current Pulse

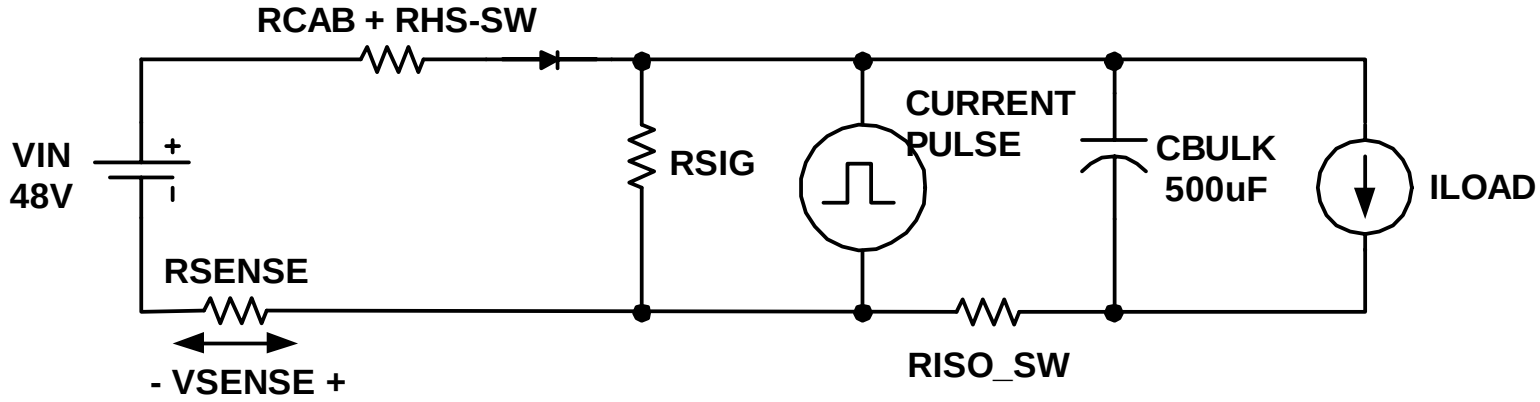
Discrete Detection Example 2



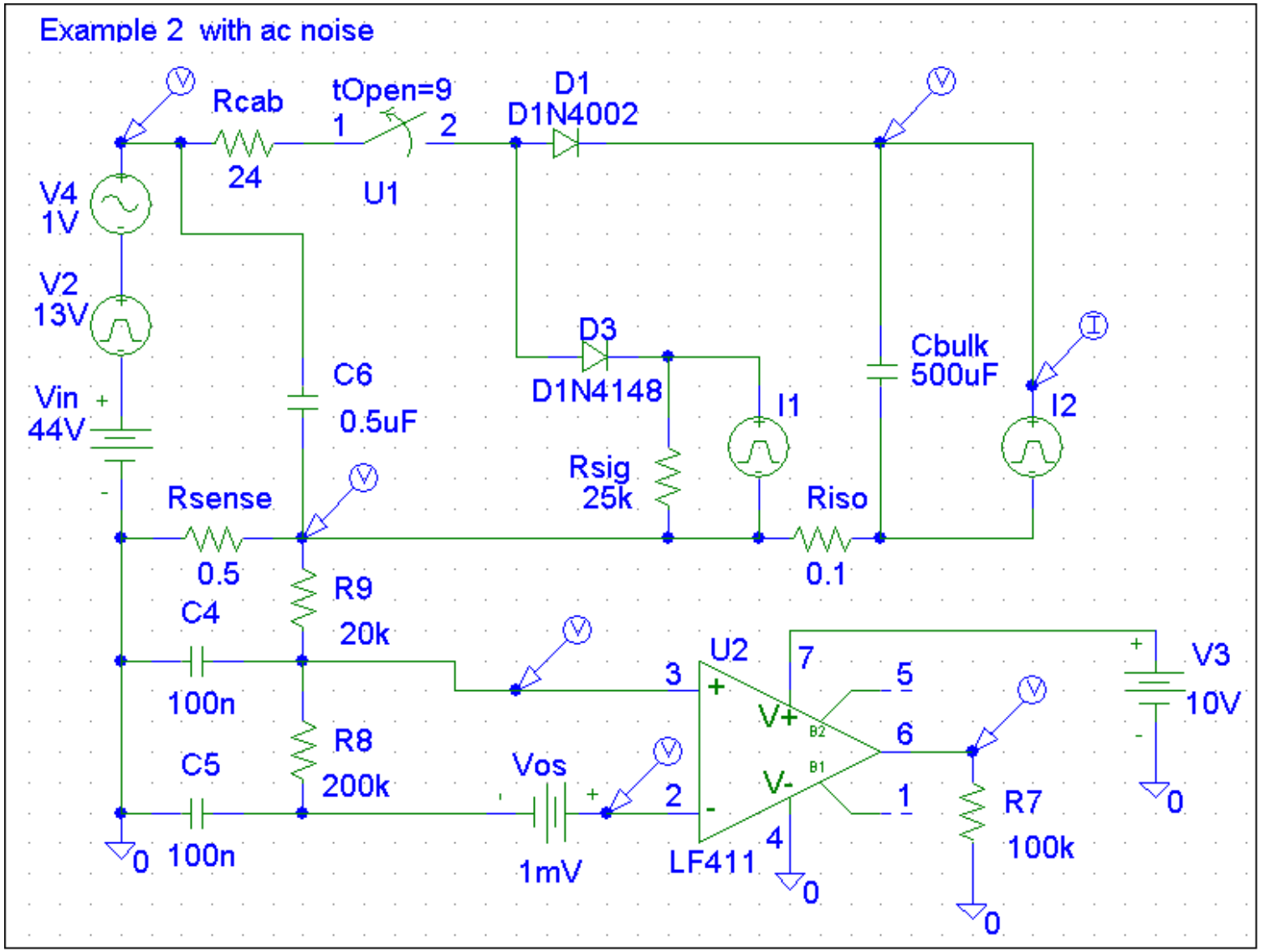
Current Pulse

The Concept



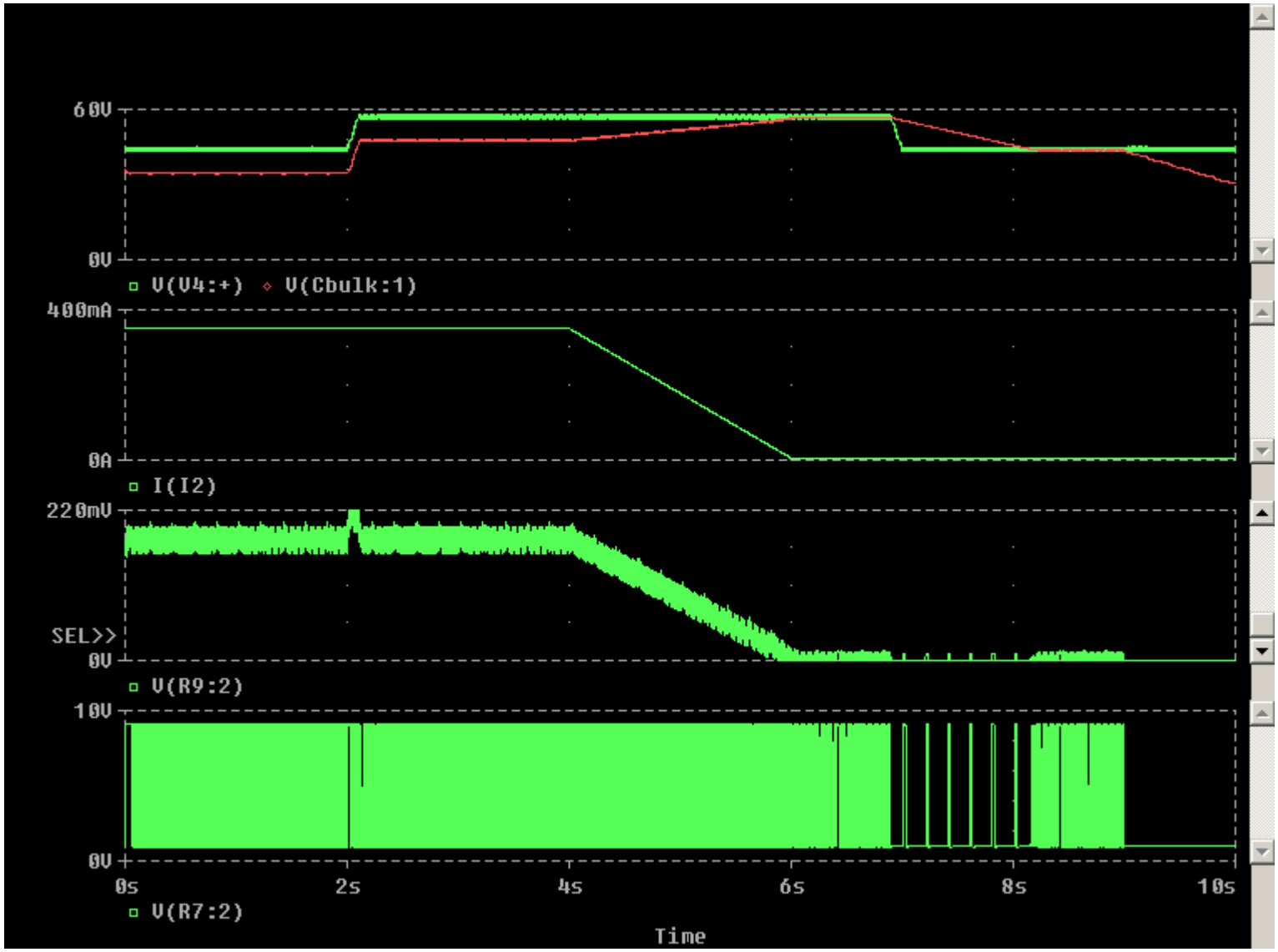


Discrete Detection Example 2 With 50Hz Noise



Current Pulse

Discrete Detection Example 2 With 50Hz Noise



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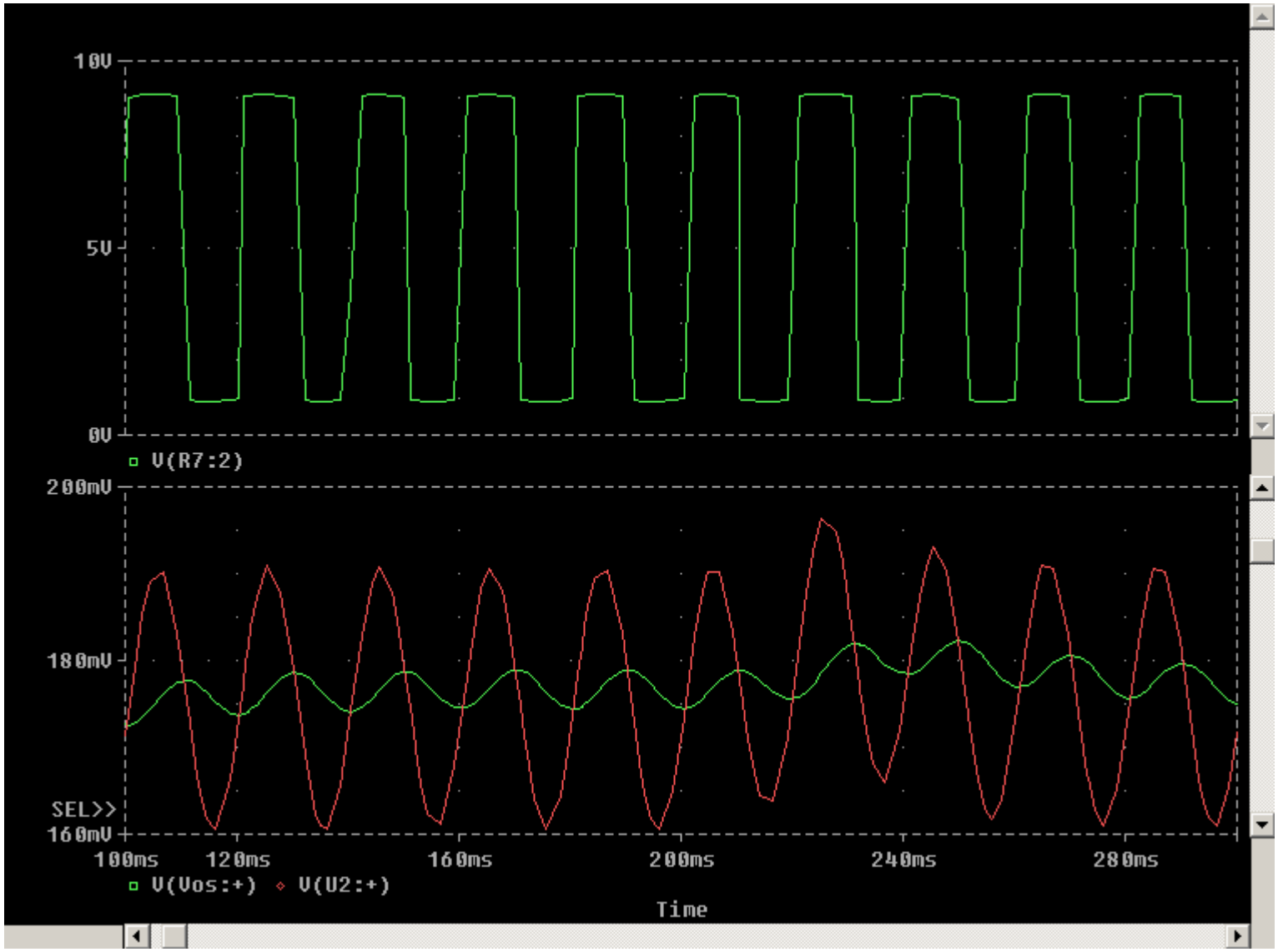

NEXT STEPS:

- Proof Of Concept Bread Board.
- System Test For Noise Immunity, EMI, etc.
- Address Any Other Concern(s).

Summary

SUMMARY:

- An AC Method Of Detecting A Load Disconnect Was Presented
- A Working Discrete Solution Simulation Results Were shown
- The Solution Also Solves Input Voltage Step Problem
- The Solution Also Works For Load Down To Zero Ampere, Saving Up To 450mW
- System Considerations Were Addressed