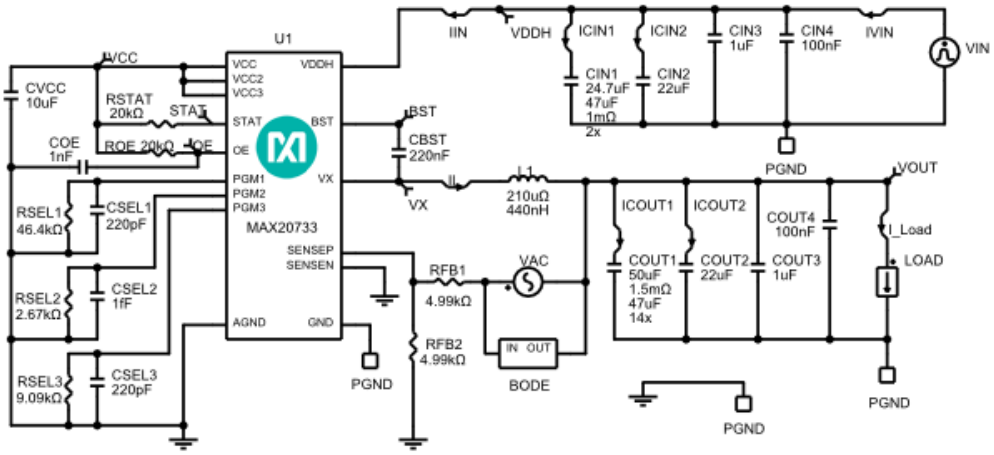
# Initial Design

1.0

## Design Requirements

| Parameter | Value |
|---|---|
| Minimum Input Voltage | 10V |
| Maximum Input Voltage | 14V |
| Nominal Input Voltage | 12V |
| Input Voltage Ripple | 1% |
| Output Voltage | 1.8V |
| Output Current | 20A |
| Output Voltage Ripple | 1% |
| Load Step Start Current | 10A |
| Load Step Current | 20A |
| Load Step Edge Rate | 5A/us |
| Output Voltage Load Step Over/Undershoot | 5% |
| Performance Priority | Balance Efficiency and Size |
| BOM Priority | Cost |
| Inductor Current Ratio (LIR) | 0.3 |
| Switching Frequency | 600 KHz |
| Reference Voltage value | 0.8984 V |
| Over Temerature Protection Value | 150 °C |
| Rgain value | 1.8 mOhm |
| STAT Blanking Time | 125 us |
| Soft Start Ramp Time | 1.5 ms |
| Ambient Temperature | 25°C |

## Schematic




Overtemperature Protection (OTP) and Overcurrent Protection (OCP) are not modeled in EE-Sim.

Increasing COUT1 will decrease the loop bandwidth and increase the phase margin. Decreasing COUT1 will have the opposite effect.

This note only applies to the online EE-Sim Design Tool: RSEL1, CSEL1, RSEL2, CSEL2, RSEL3 and CSEL3 are set to the proper values for the design requirements entered. To change any of the chip parameters that these components set, change the design requirements accordingly and create a new design.

## BOM

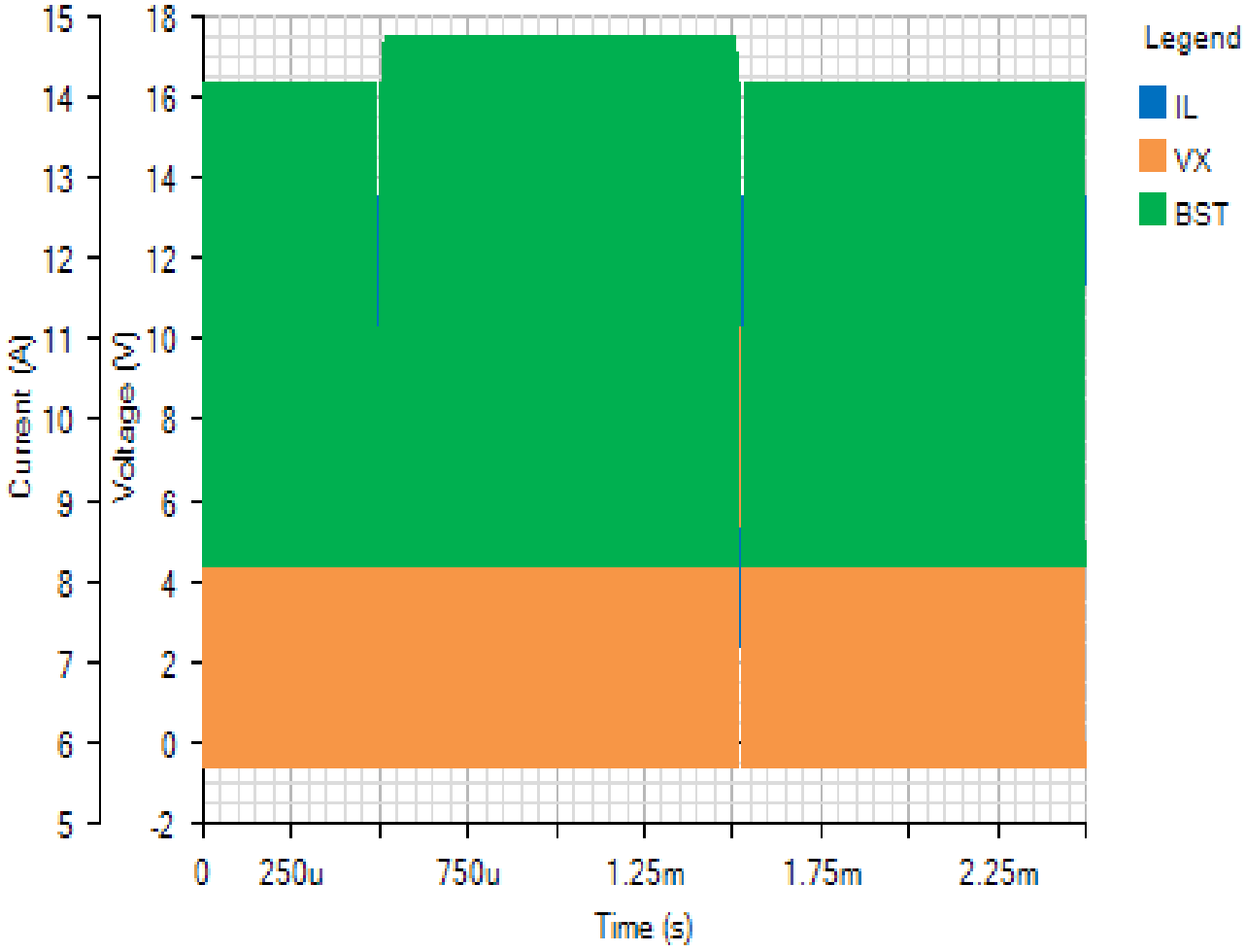
| Ref | Qty | Part Number | Manufacturer | Description |
|---|---|---|---|---|
| U1 | 1 | MAX20733 | Maxim Integrated | 4.5V to 16V High Efficiency Step-Down Switching Regulator upto 35A Maximum Load |
| CBST | 1 | 0805YC224KAT2A | AVX | Cap Ceramic 0.22uF 16V X7R 10% Pad SMD 0805 125°C T/R |
| CIN1 | 2 | C1210C476K4PAC | Kemet | Cap Ceramic 47uF 16V 1210 85C |
| CIN2 | 1 | GCM32ER71C226KE19L | Murata Manufacturing | Cap Ceramic 22uF 16V X7R 10% Pad SMD 1210 125°C Automotive T/R |
| CIN3 | 1 | CGA4J2X7R1C105K125AA | TDK | Cap Ceramic 1uF 16V X7R 10% Pad SMD 0805 125°C Automotive T/R |
| CIN4 | 1 | 0805YC104KAT2A | AVX | Cap Ceramic 0.1uF 16V X7R 10% Pad SMD 0805 125°C T/R |
| COE | 1 | C0603C102K8RACTU | KEMET Corporation | Cap Ceramic 0.001uF 10V X7R 10% Pad SMD 0603 125°C T/R |
| COUT1 | 14 | GRM32ER71A476ME15L | Murata | Cap Ceramic 47uF 10V X7R 20% SMD 1210 125C Embossed T/R |
| COUT2 | 1 | GCM32ER71A226KE12L | Murata Manufacturing | Cap Ceramic 22uF 10V X7R 10% Pad SMD 1210 125°C Automotive T/R |
| COUT3 | 1 | CC0603KRX7R6BB105 | Yageo | Cap Ceramic 1uF 10V X7R 10% Pad SMD 0603 125°C T/R |
| COUT4 | 1 | GCM155R71C104KA55D | Murata Manufacturing | Cap Ceramic 0.1uF 16V X7R 10% Pad SMD 0402 125°C Automotive T/R |
| CSEL1 | 1 | C0805C221K4RACTU | KEMET Corporation | Cap Ceramic 220pF 16V X7R 10% Pad SMD 0805 125°C T/R |
| CSEL3 | 1 | VJ0603A221KXQPW1BC | Vishay | Cap Ceramic 220pF 10V C0G 10% Pad SMD 0603 125°C T/R |

| | | | | |
|---|---|---|---|---|
| CVCC | 1 | GCJ31CR71A106KA13L | Murata Manufacturing | Cap Ceramic 10uF 10V X7R 10% Pad SMD 1206 Soft Termination 125°C Automotive T/R |
| L1 | 1 | SLC1480-441MLB | Coilcraft | Inductor 440nH 20% 0.18mOhm 32A Isat 55A Irms |
| RFB1 | 1 | ERJ2RKF4991X | Panasonic | Res Thick Film 0402 4.99K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R |
| RFB2 | 1 | ERJ2RKF4991X | Panasonic | Res Thick Film 0402 4.99K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R |
| ROE | 1 | ERJ3GEYJ203V | Panasonic | Res Thick Film 0603 20K Ohm 5% 0.1W(1/10W) ±200ppm/°C Pad SMD Automotive T/R |
| RSEL1 | 1 | ERJ2RKF4642X | Panasonic | Res Thick Film 0402 46.4K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R |
| RSEL2 | 1 | ERJ2RKF2671X | Panasonic | Res Thick Film 0402 2.67K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R |
| RSEL3 | 1 | ERJ2RKF9091X | Panasonic | Res Thick Film 0402 9.09K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R |
| RSTAT | 1 | ERJ2GEJ203X | Panasonic | Res Thick Film 0402 20K Ohm 5% 0.1W(1/10W) ±200ppm/°C Pad SMD Automotive T/R |

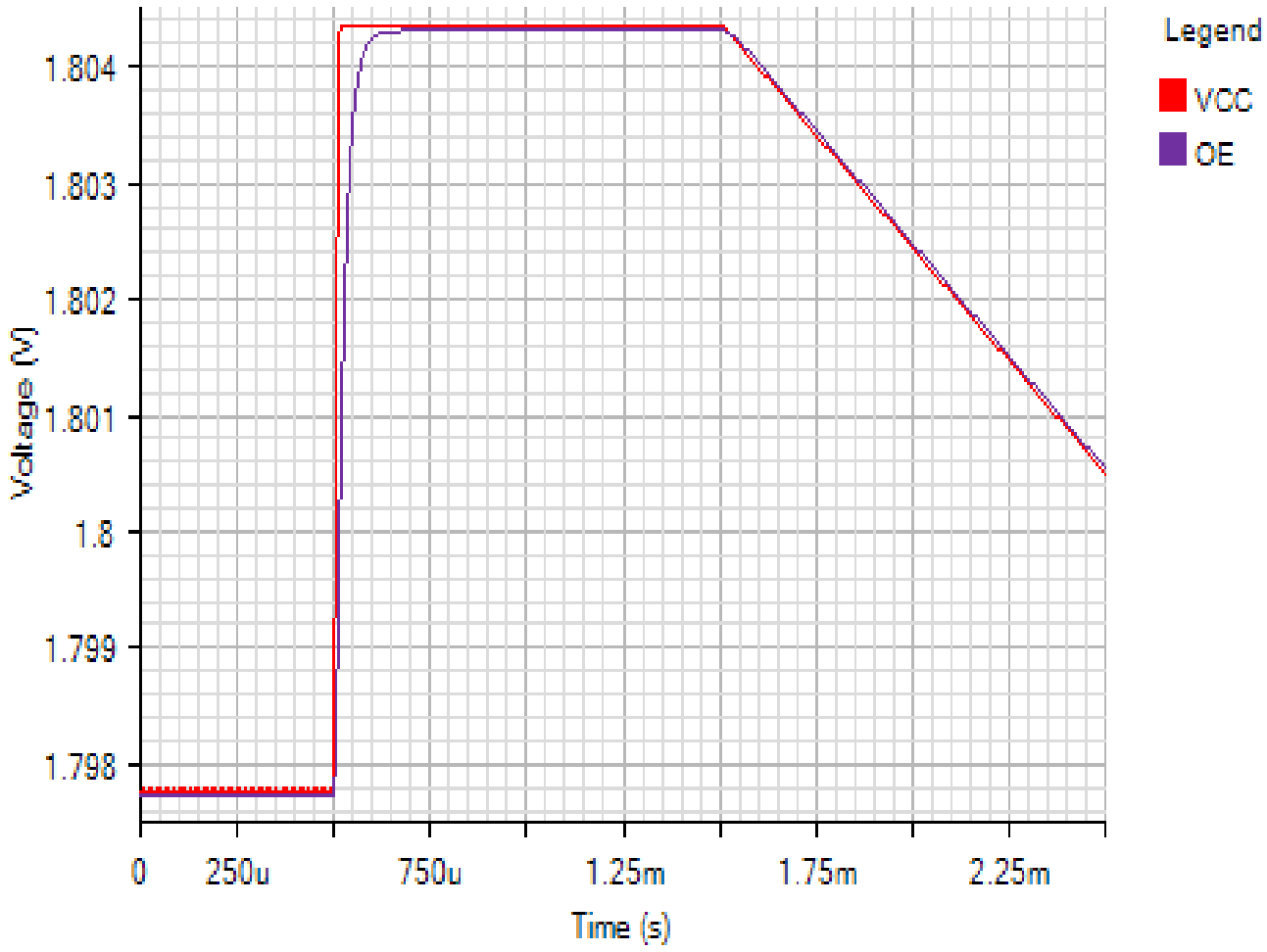
## Simulation Results

### Line Transient - Tue Nov 20 2018 14:06:21

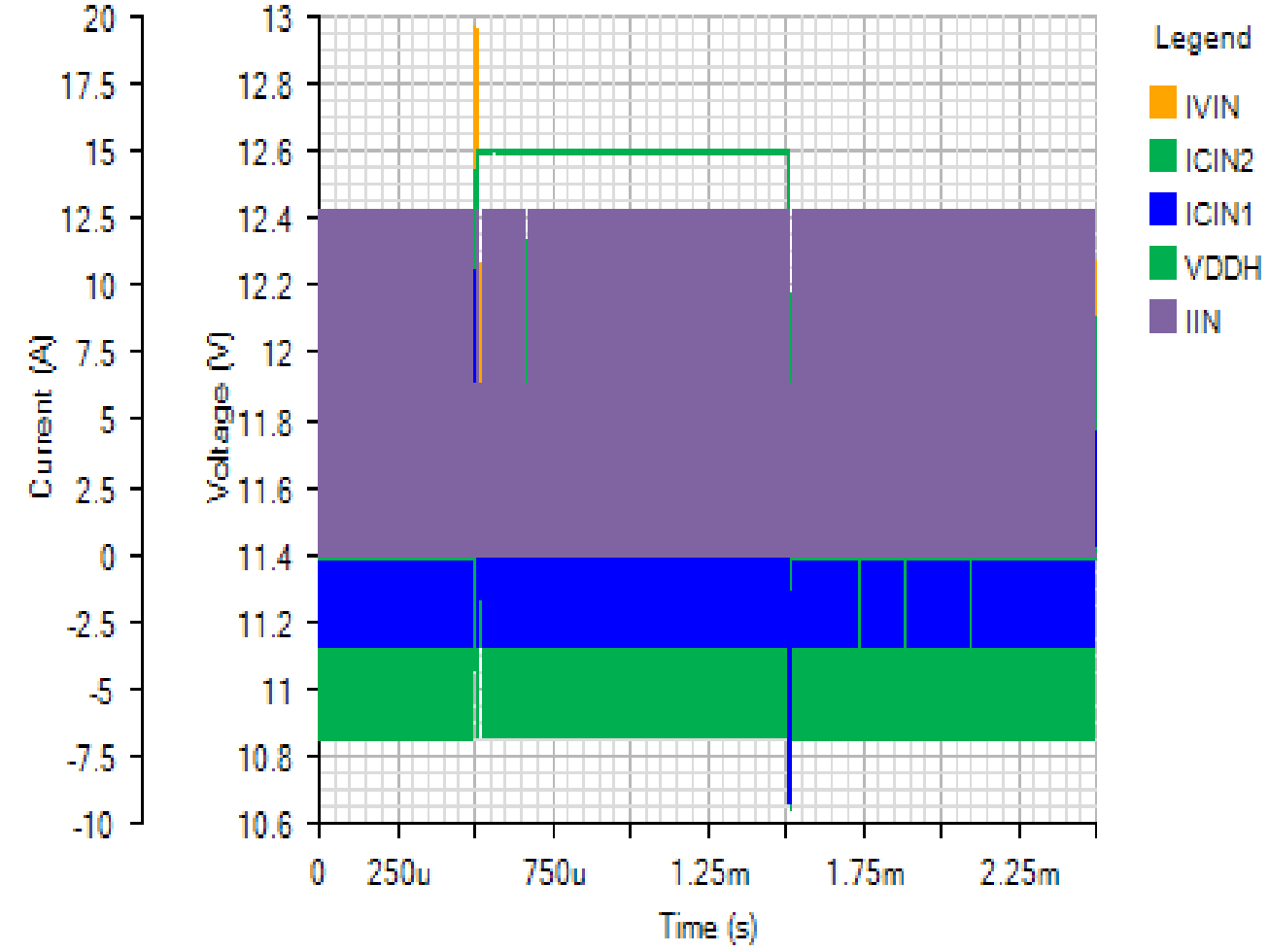
SWITCHING Default



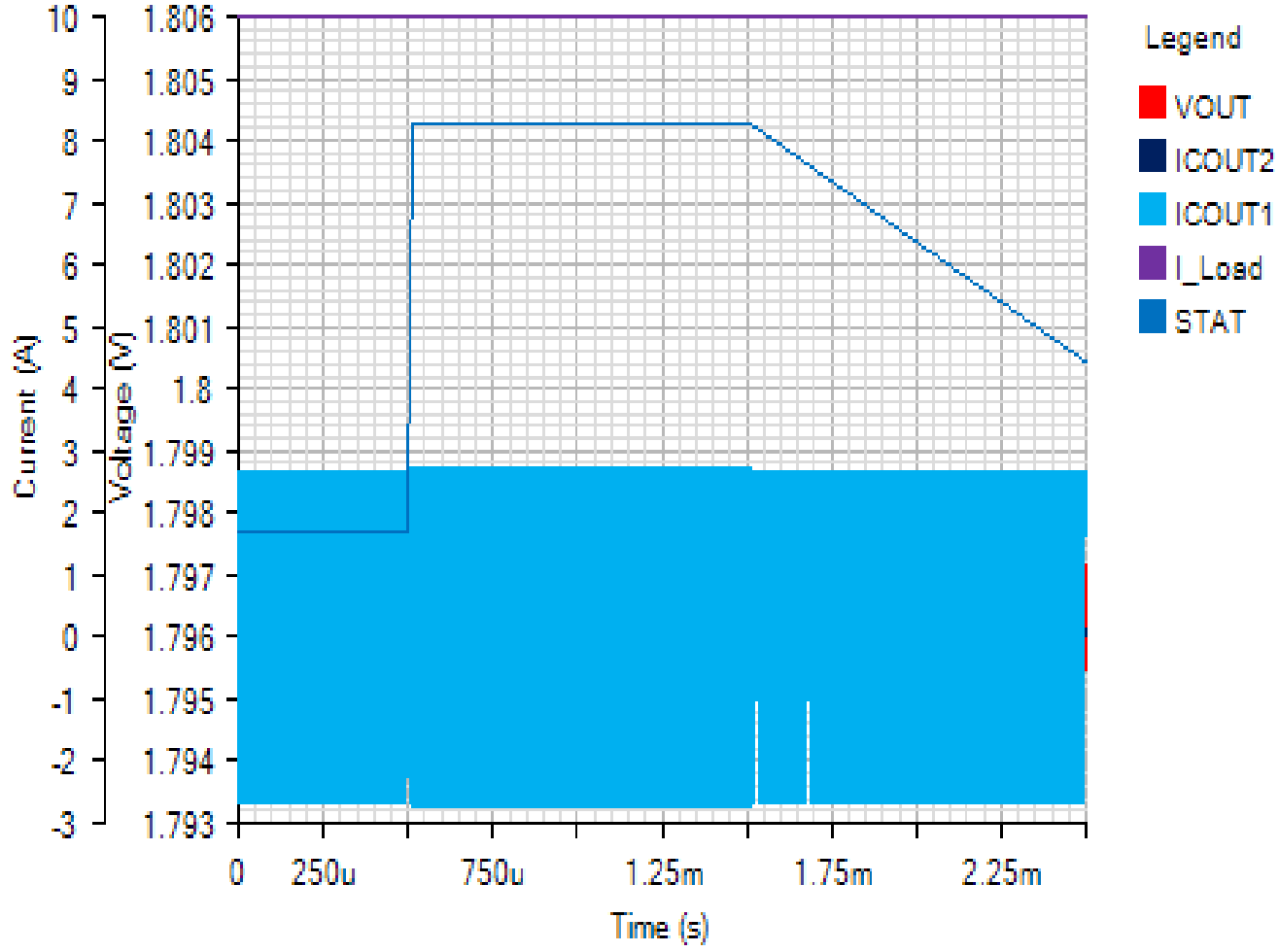
IC Default



INPUT Default

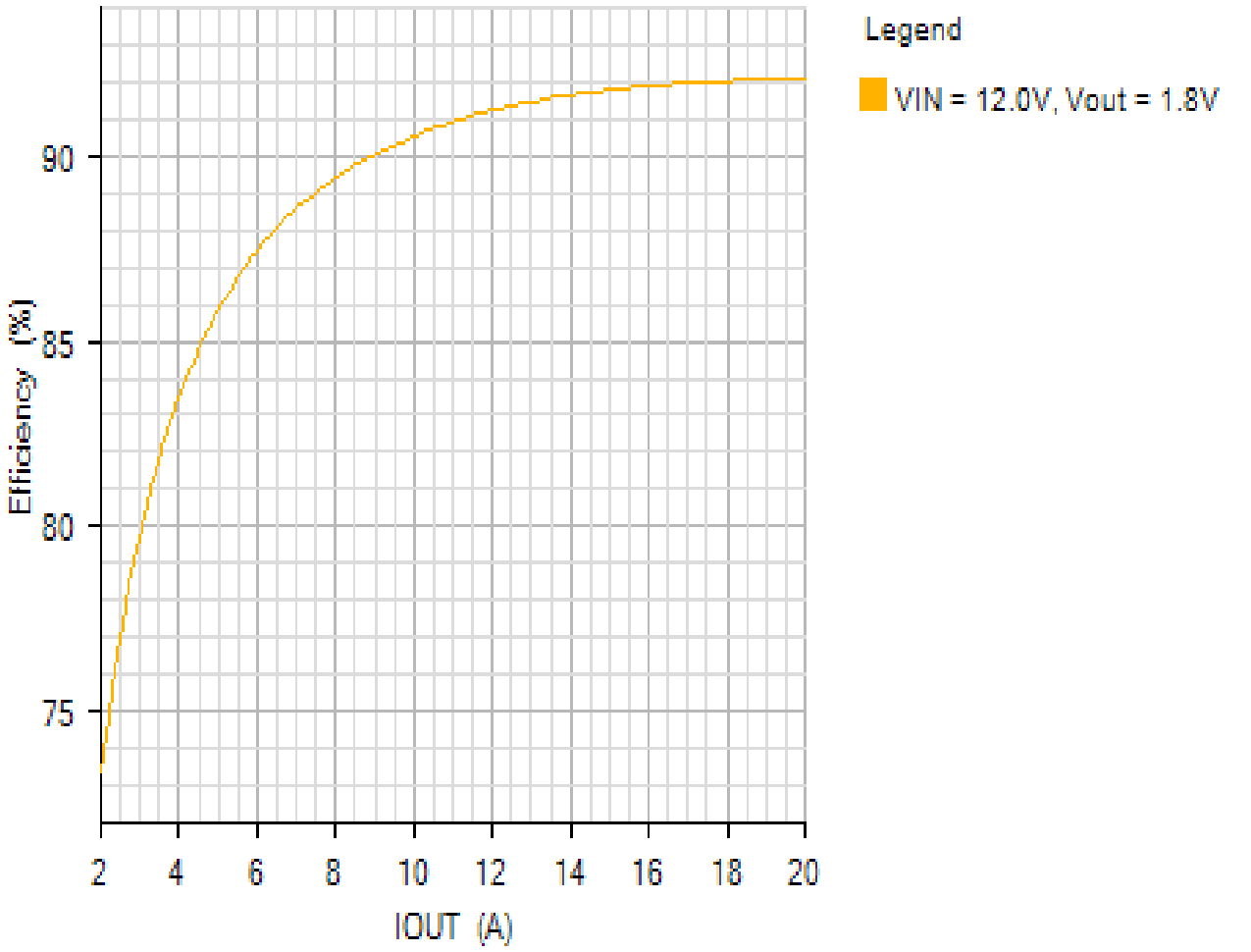


OUTPUT Default

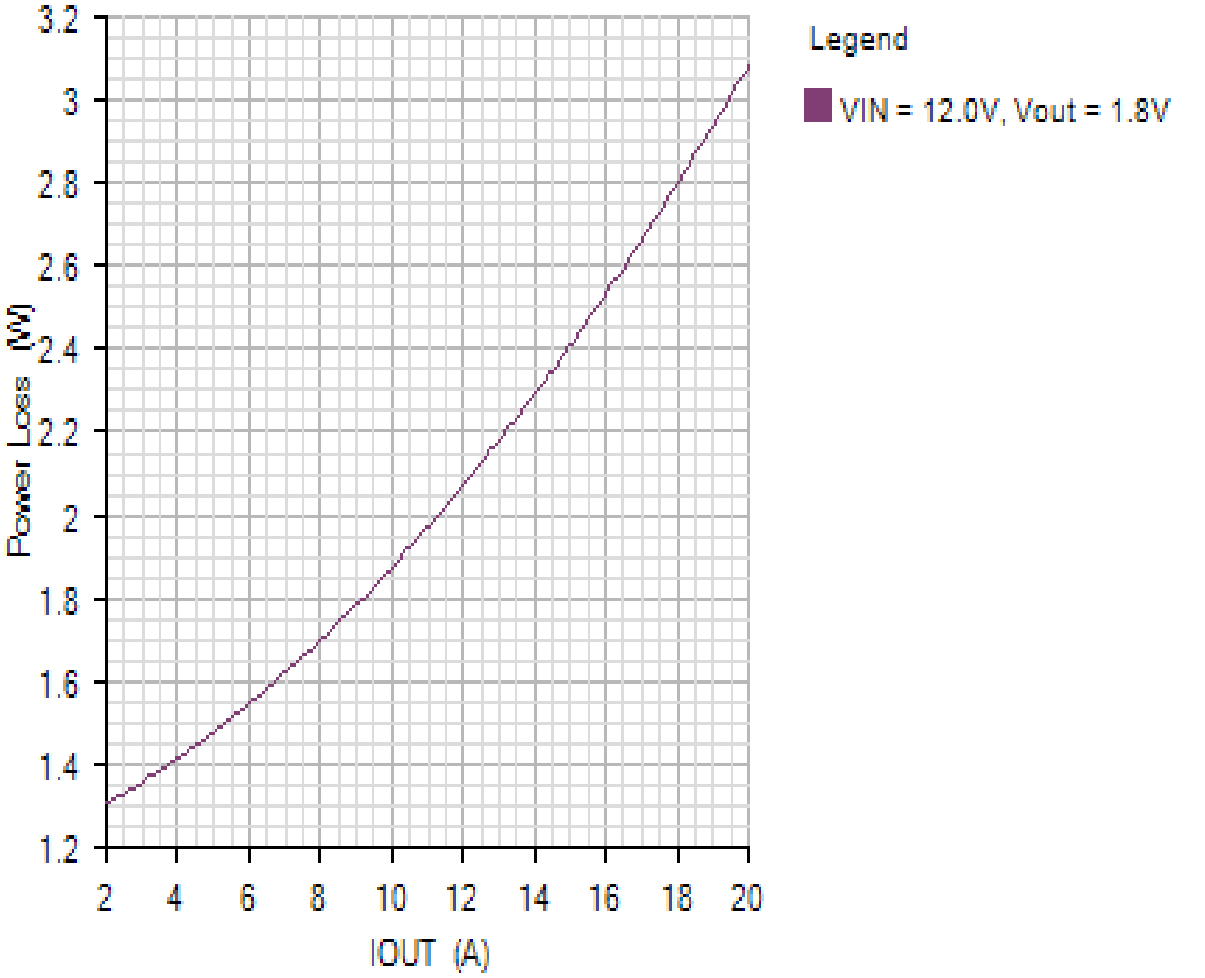


**Efficiency - Tue Nov 20 2018 14:06:21**

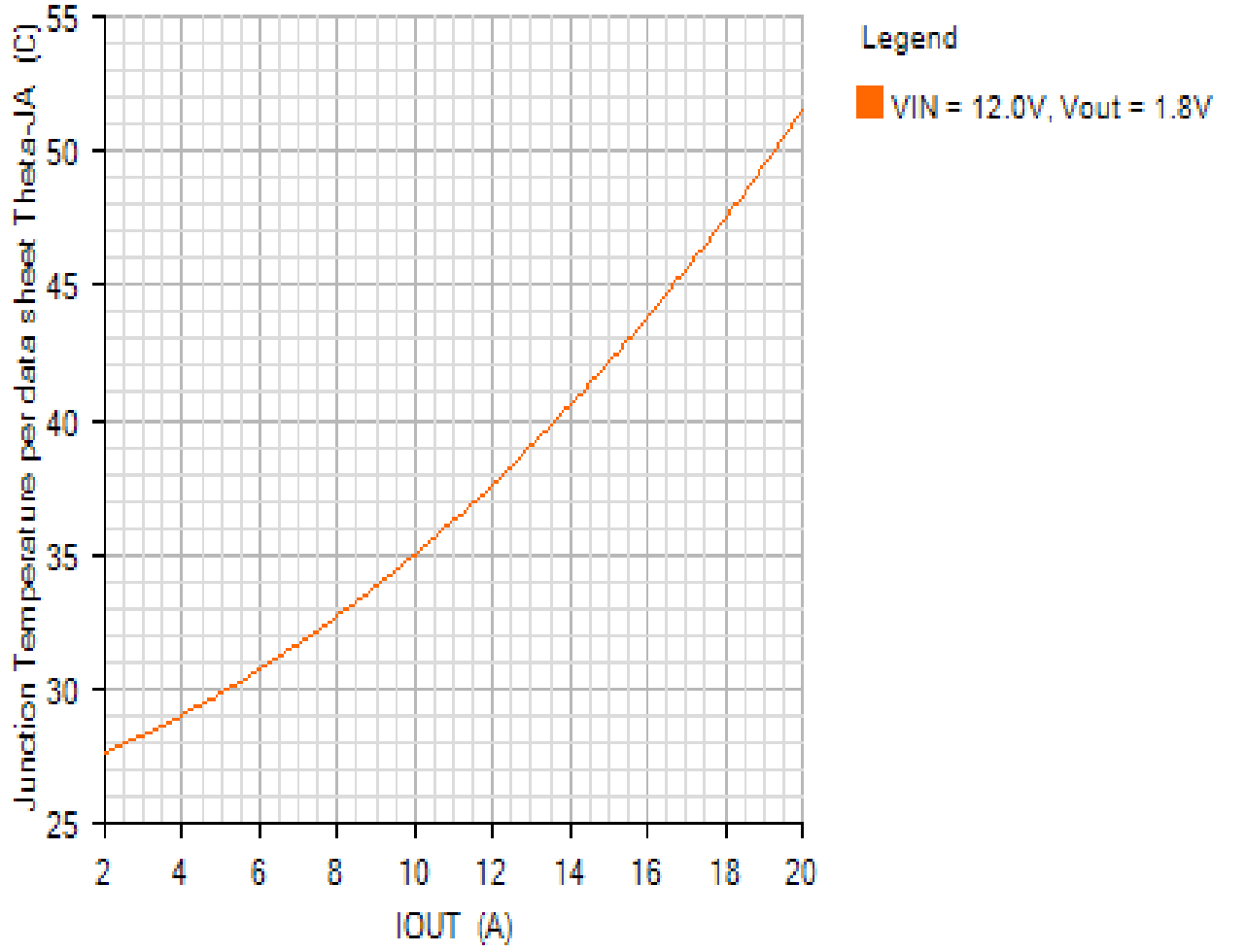
EFFICIENCY_PLOT Default



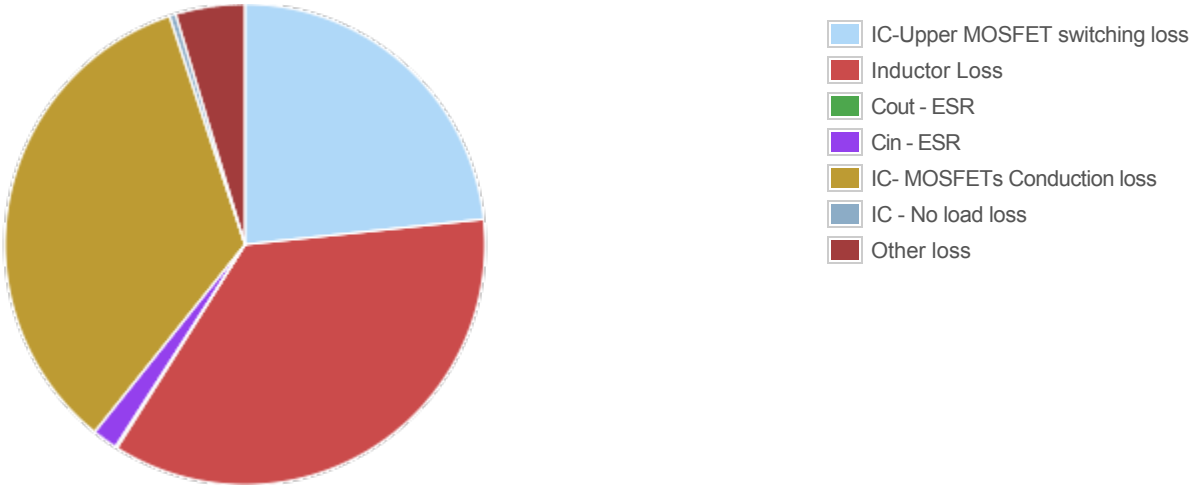
POWER_LOSS_PLOT Default



JUNCTION_TEMPERATURE_PLOT Default




Losses

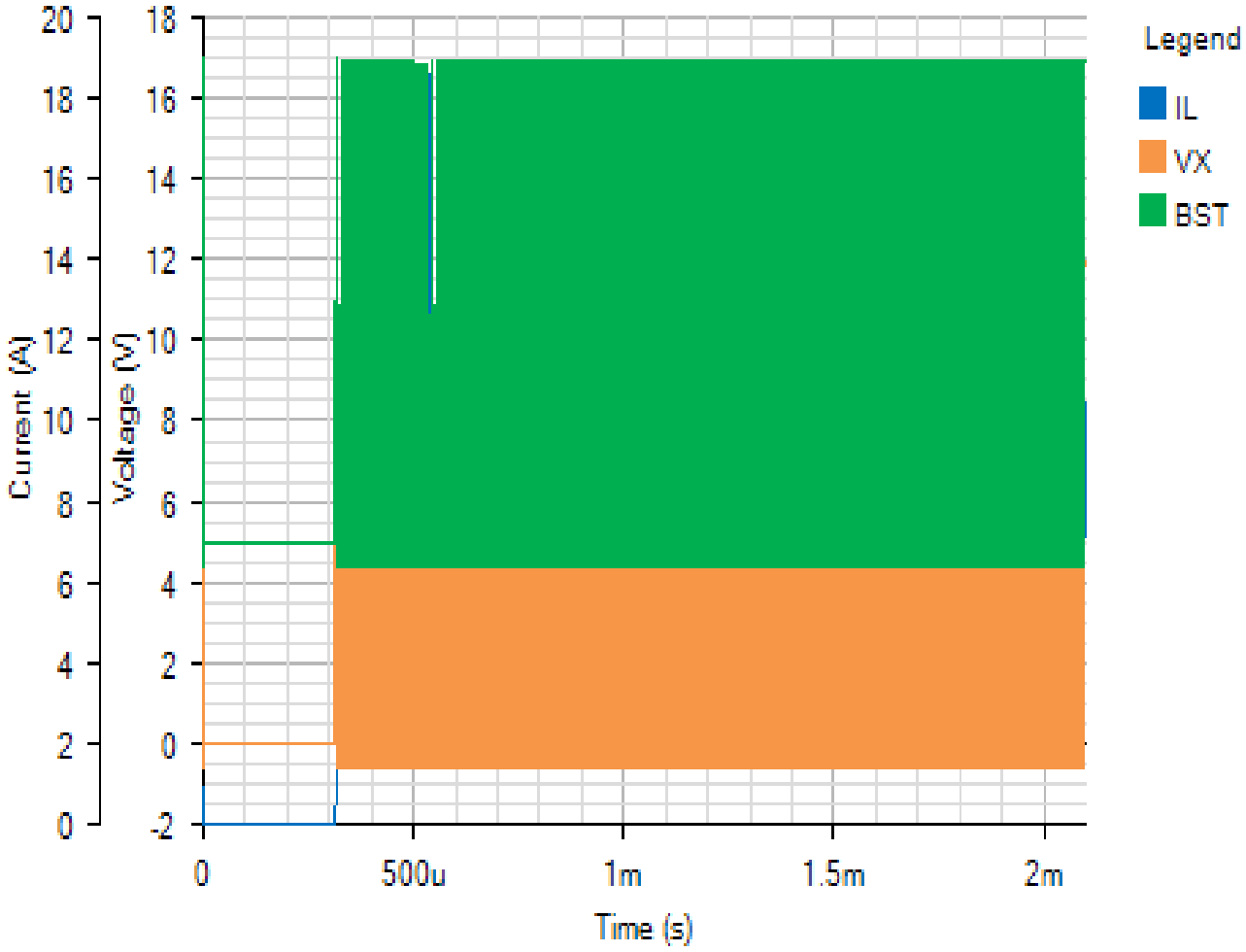



| Component | Loss (W) | % of total |
|---|---|---|

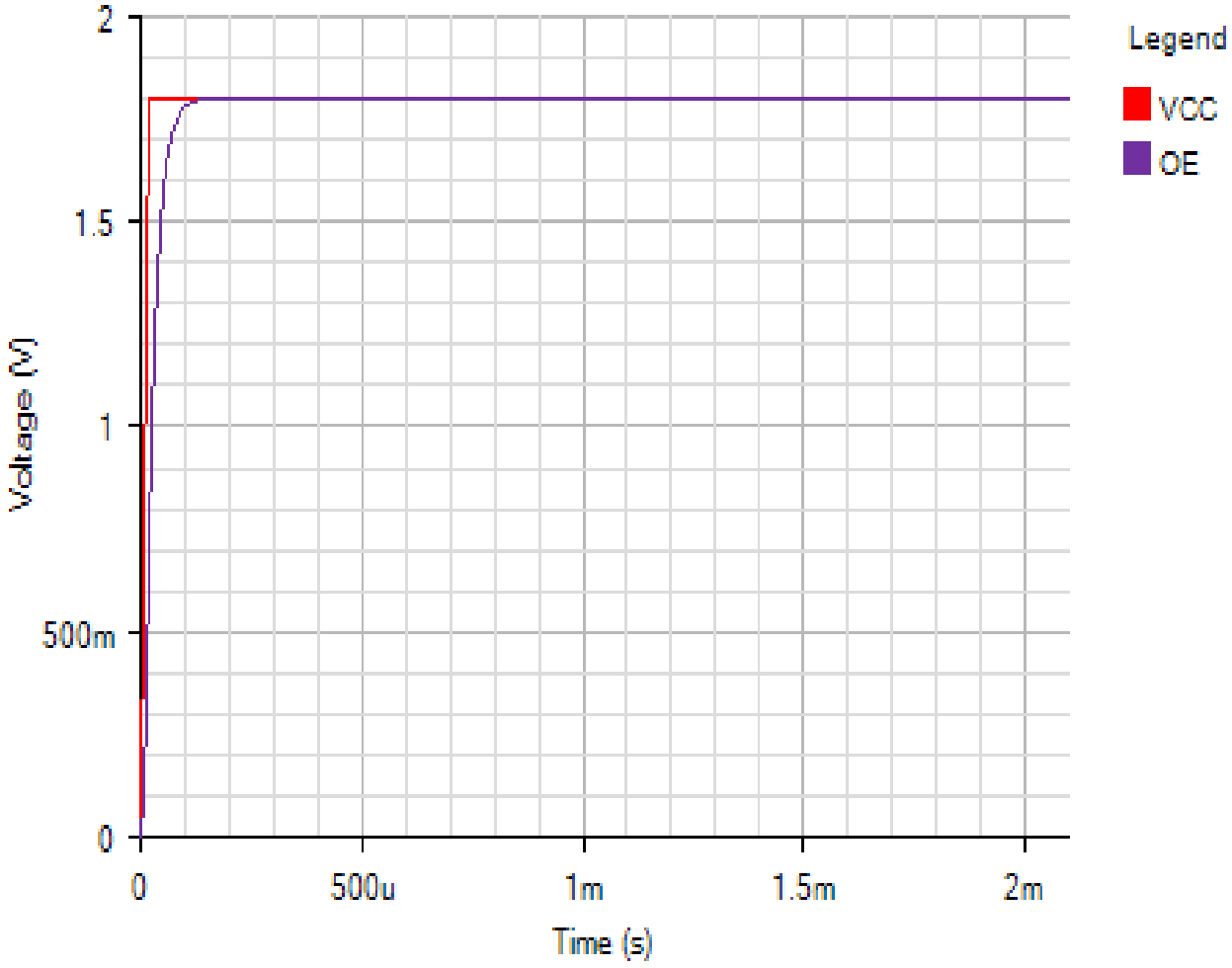
| Component | Loss (W) | % of total |
|---|---|---|
| IC-Upper MOSFET switching loss | 0.72 | 23.3 |
| Inductor Loss | 1.1 | 35.6 |
| Cout - ESR | 0.0041 | 0.1 |
| Cin - ESR | 0.0522 | 1.7 |
| IC- MOSFETs Conduction loss | 1.054 | 34.1 |
| IC - No load loss | 0.0132 | 0.4 |
| Other loss | 0.144 | 4.7 |
| Total | 3.0875 | 100 |

**Start Up - Tue Nov 20 2018 14:06:21**

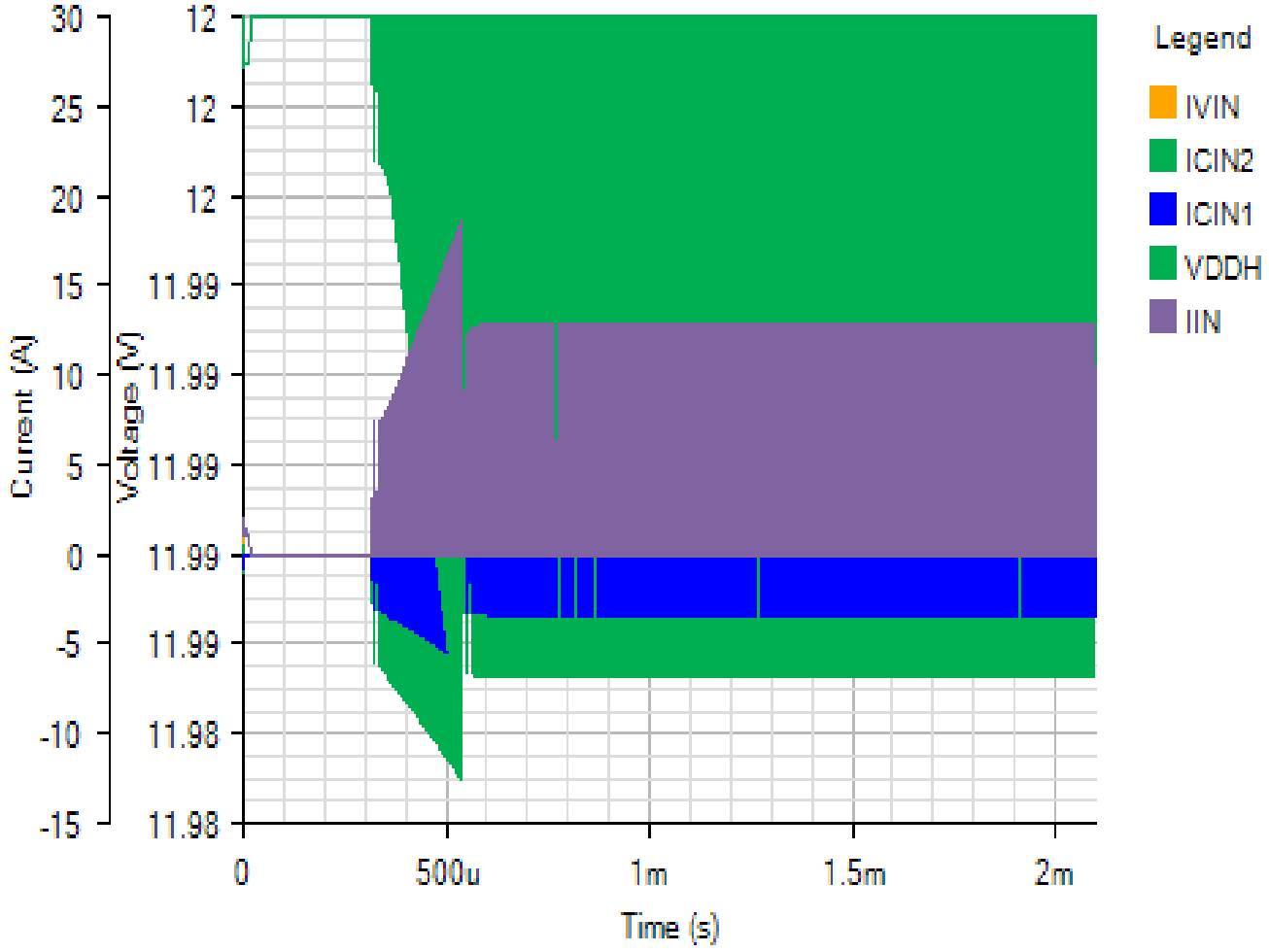
SWITCHING Default



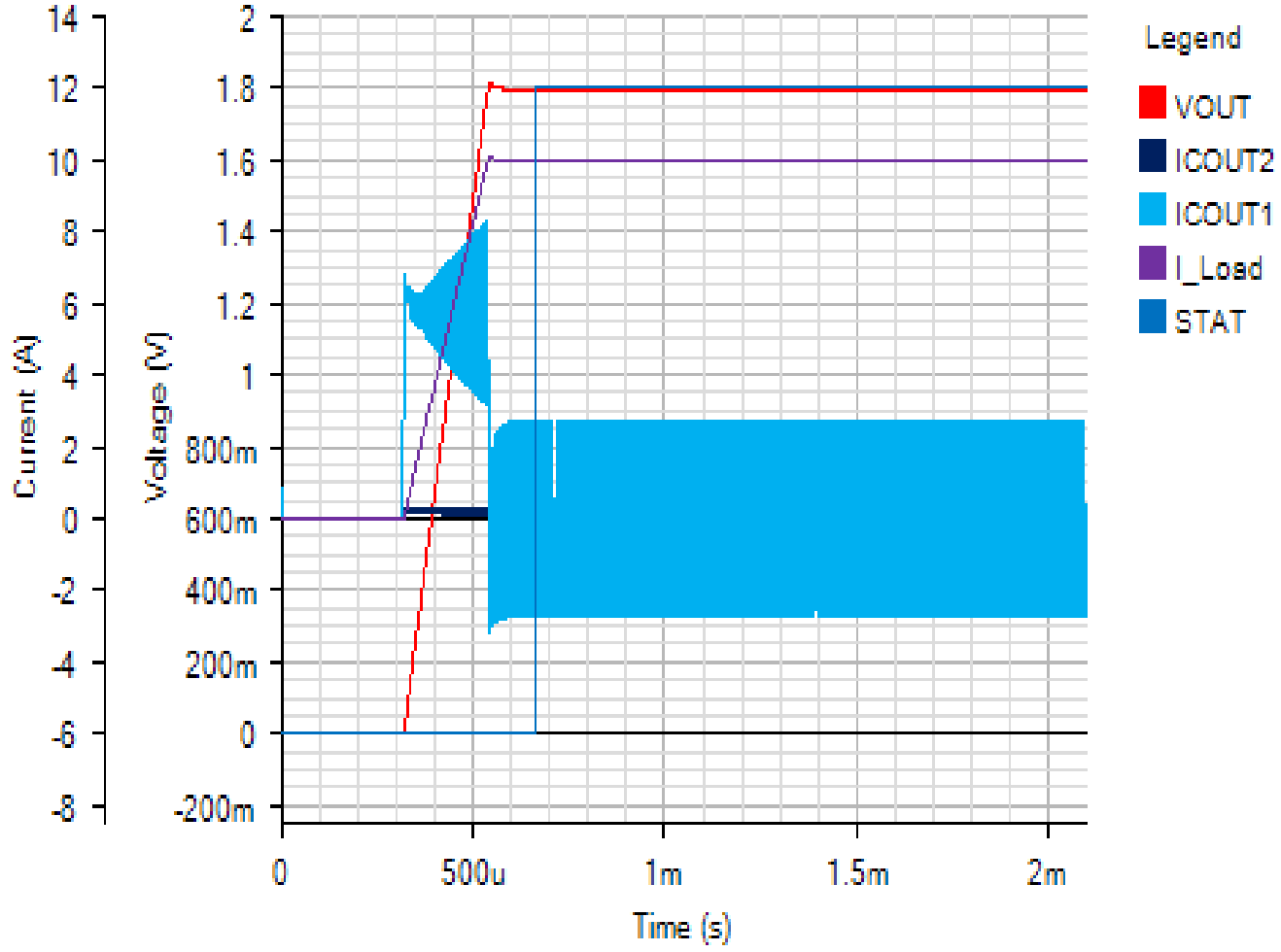
IC Default



INPUT Default

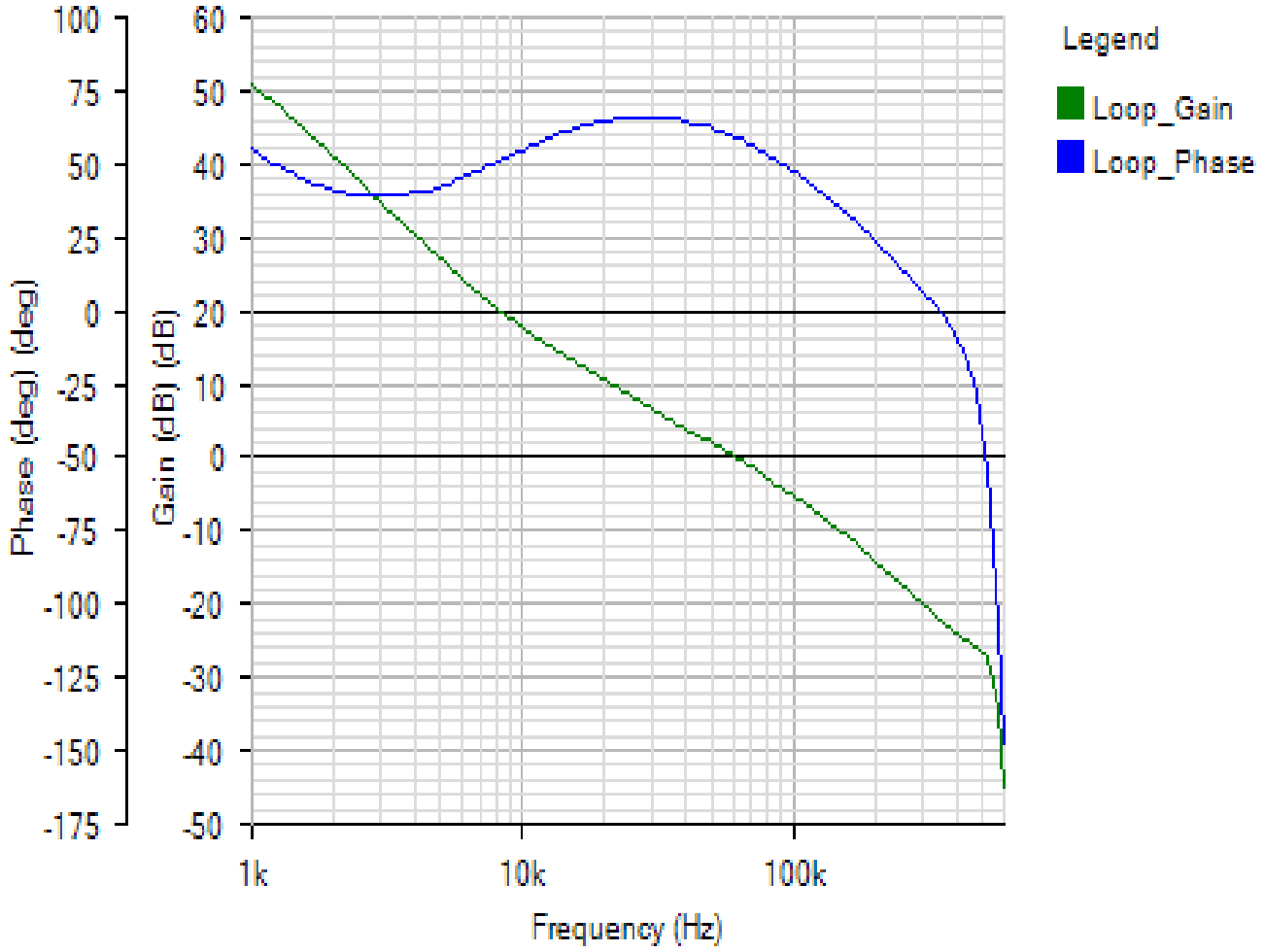


OUTPUT Default

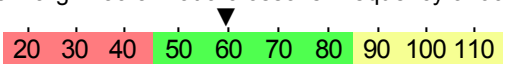


**AC Loop - Tue Nov 20 2018 14:06:21**

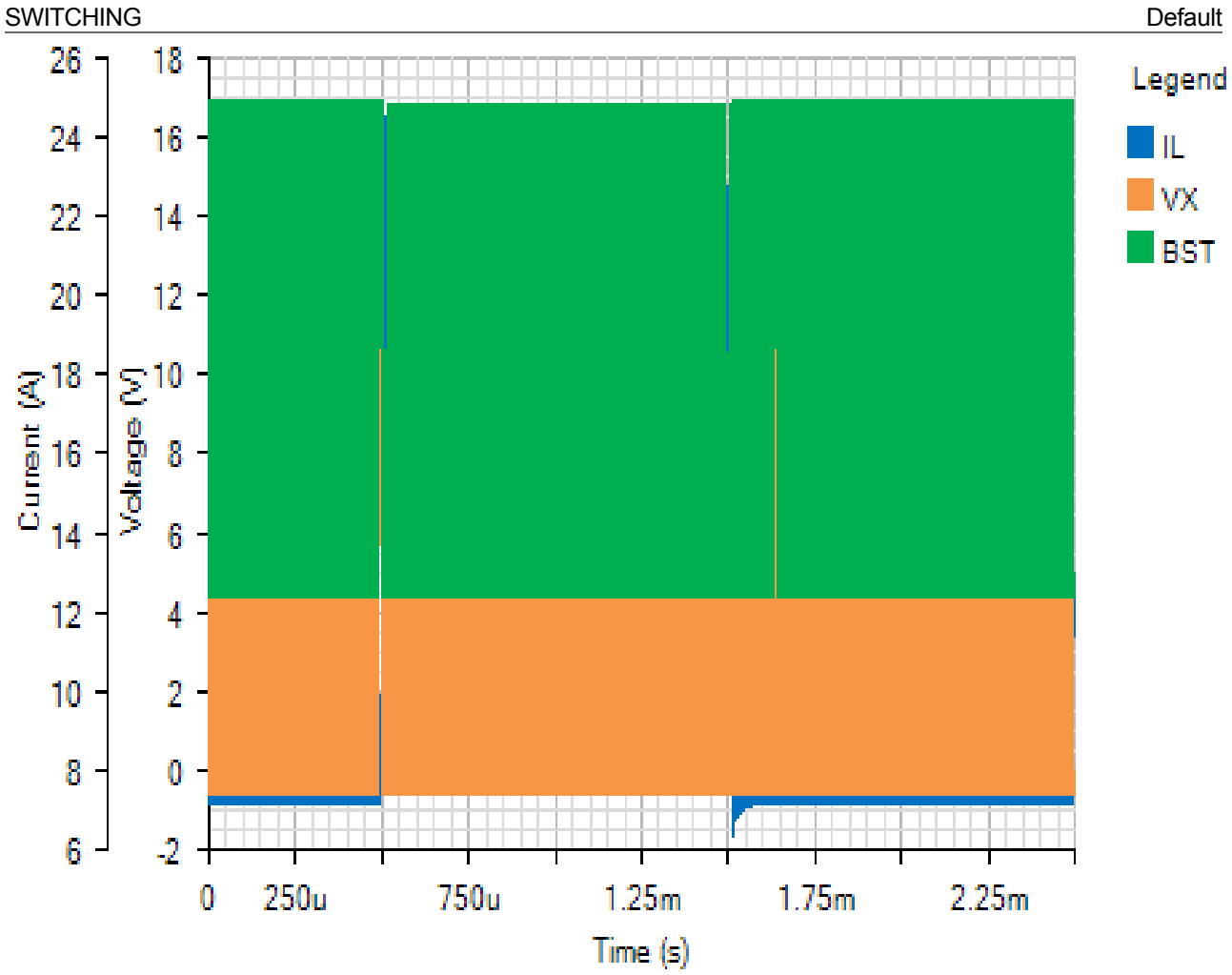
BODE Default




Phase Margin: 59.32° at a crossover frequency of 60.7kHz



**Load Step - Tue Nov 20 2018 14:06:21**



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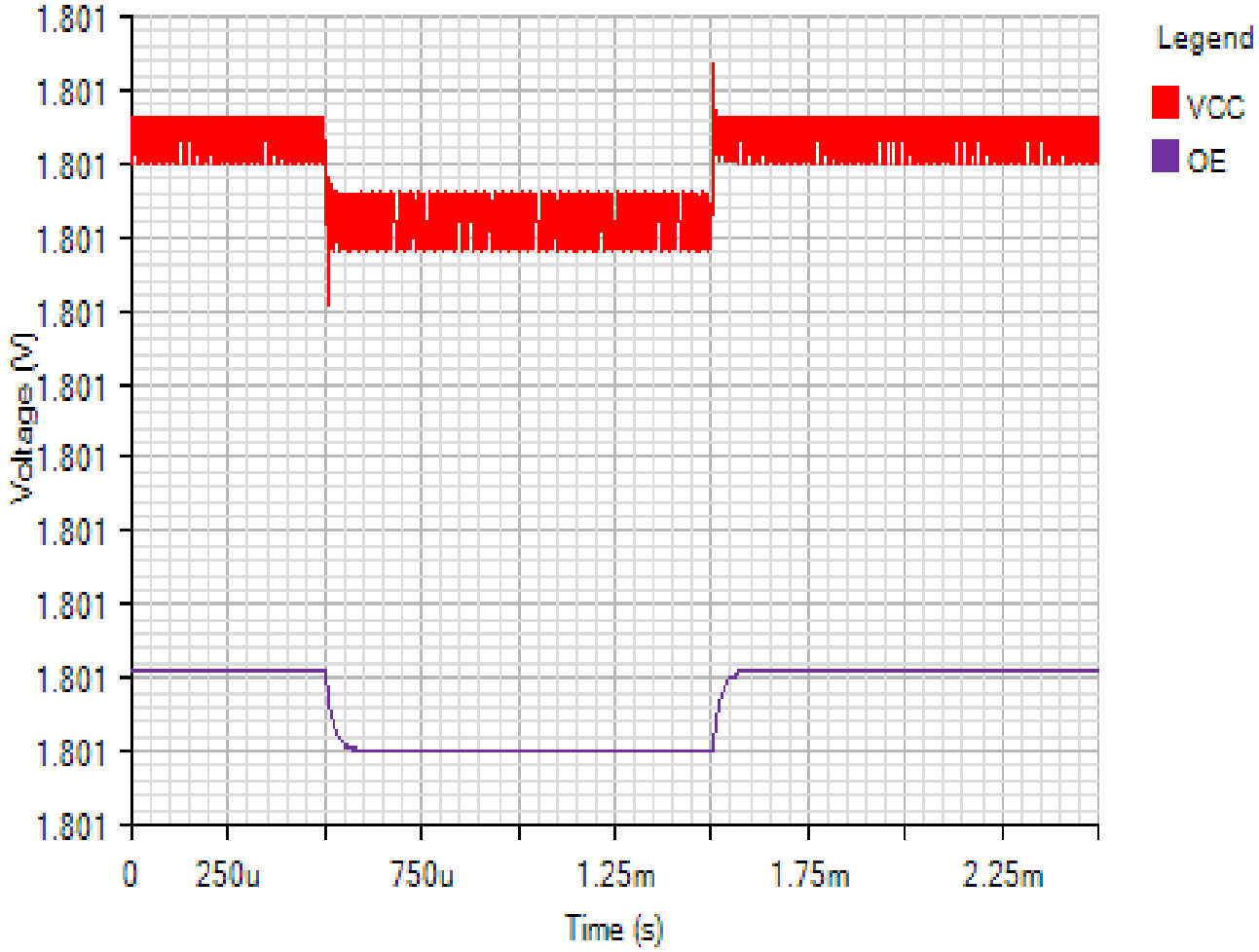

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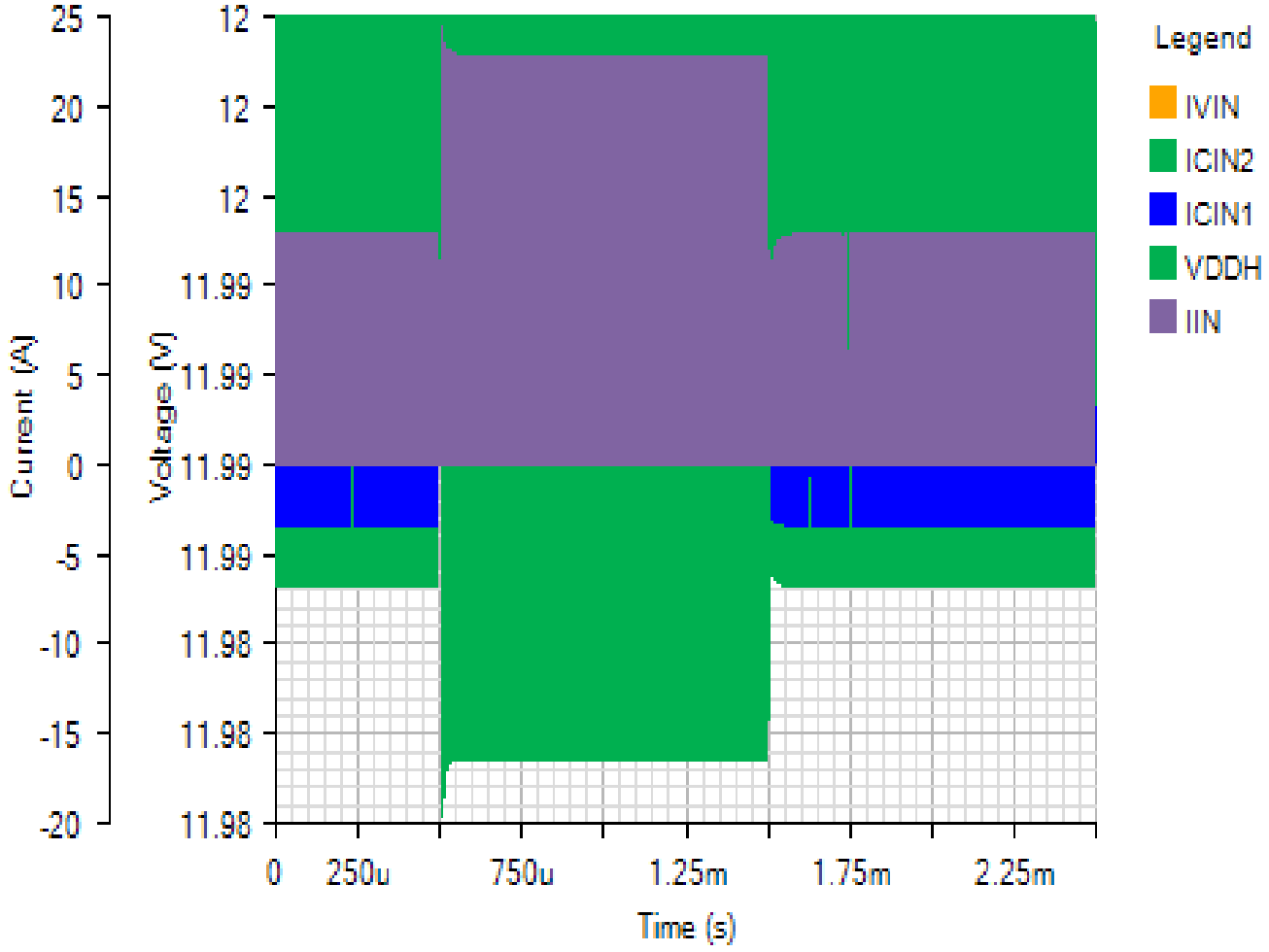
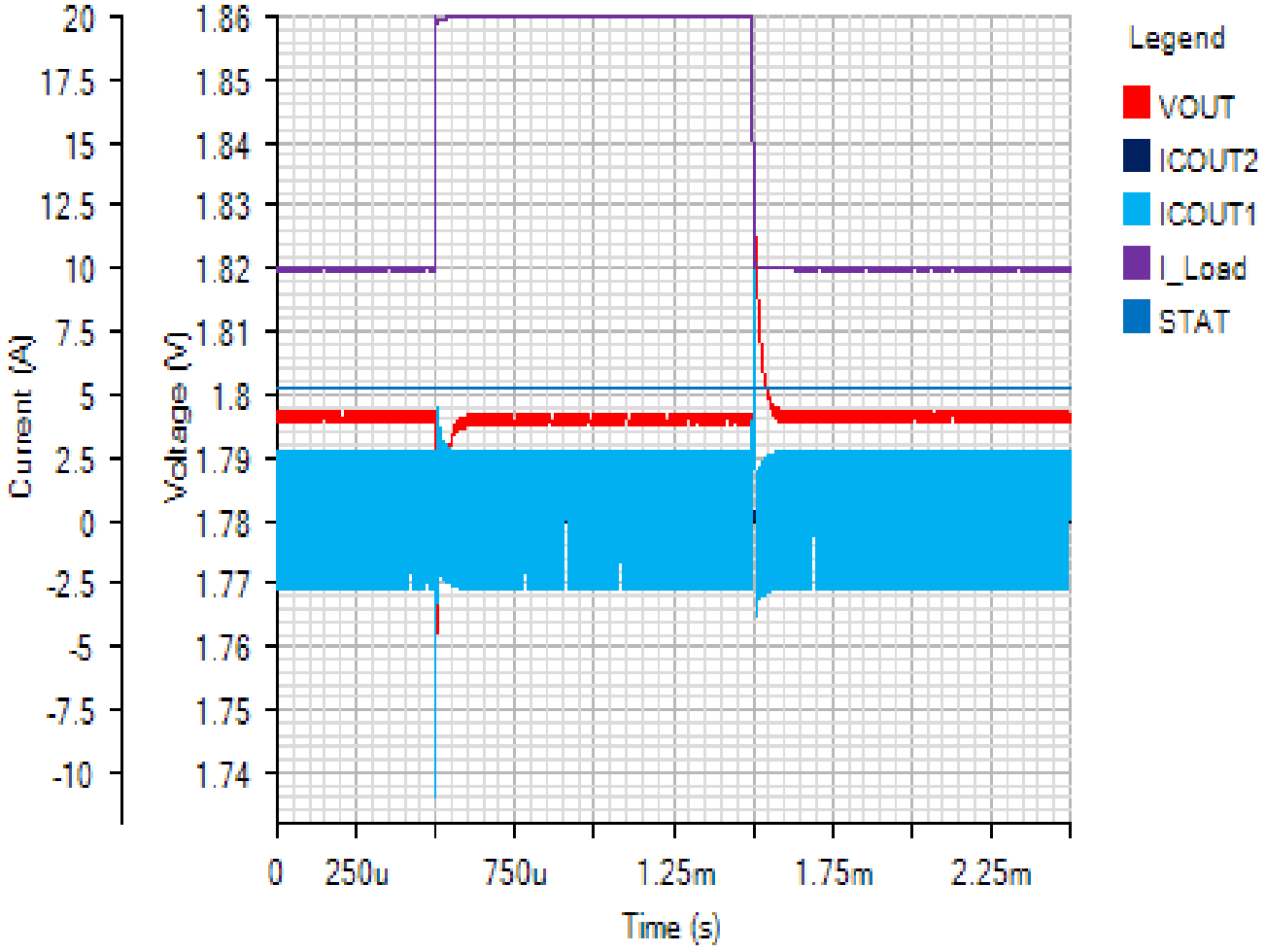
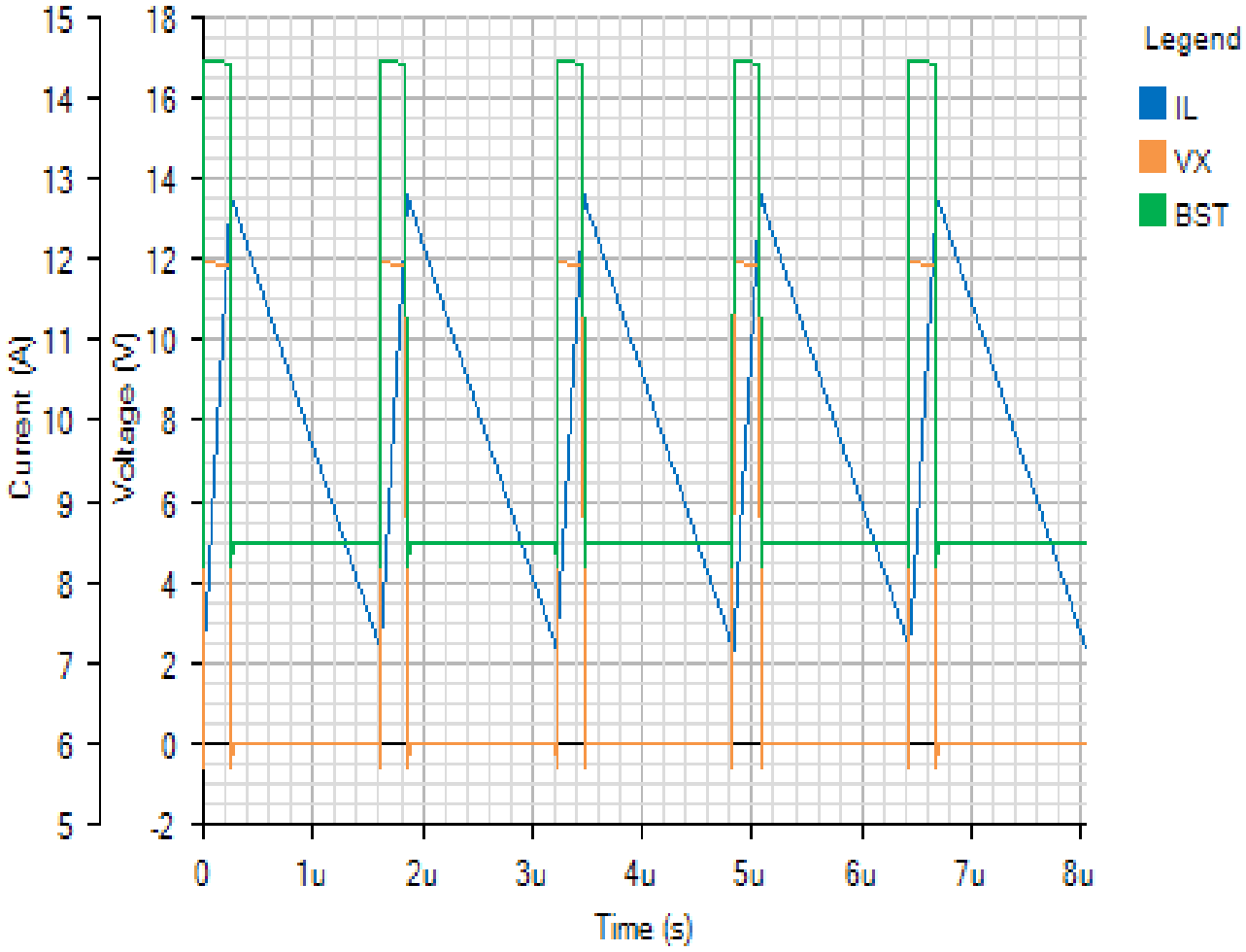


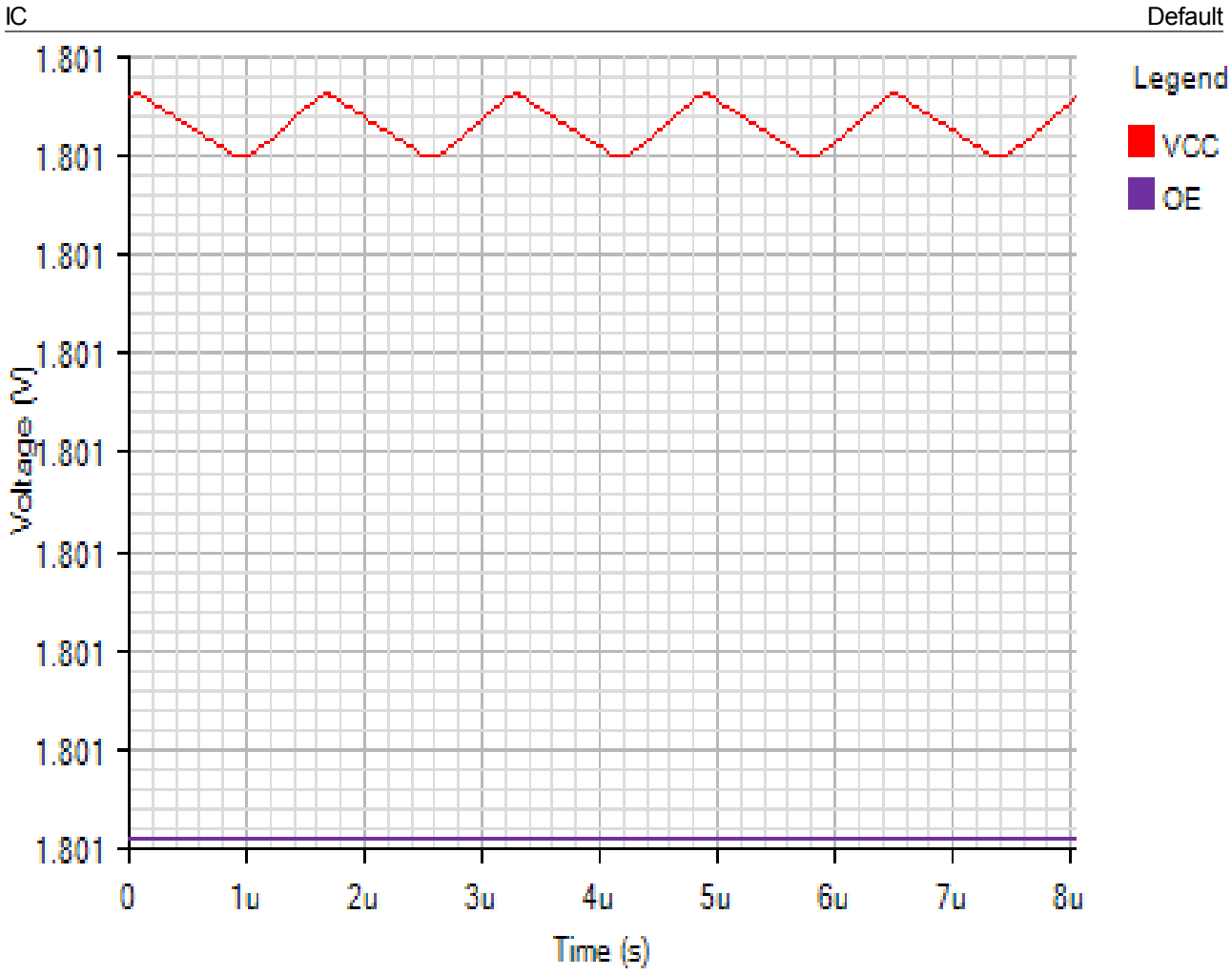
OUTPUT Default



**Steady State - Tue Nov 20 2018 14:06:21**

SWITCHING Default





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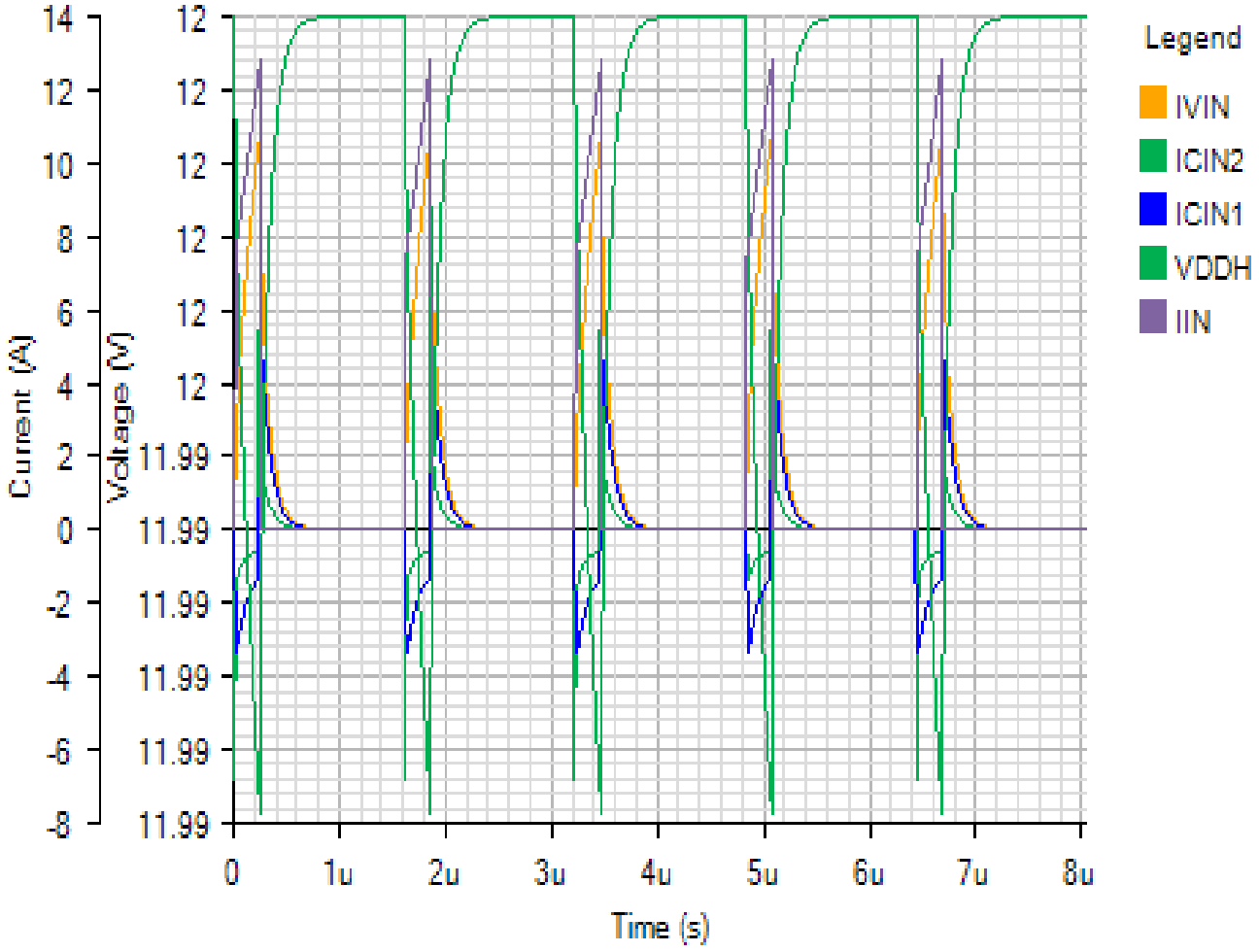

OUTPUT Default