Initial Design

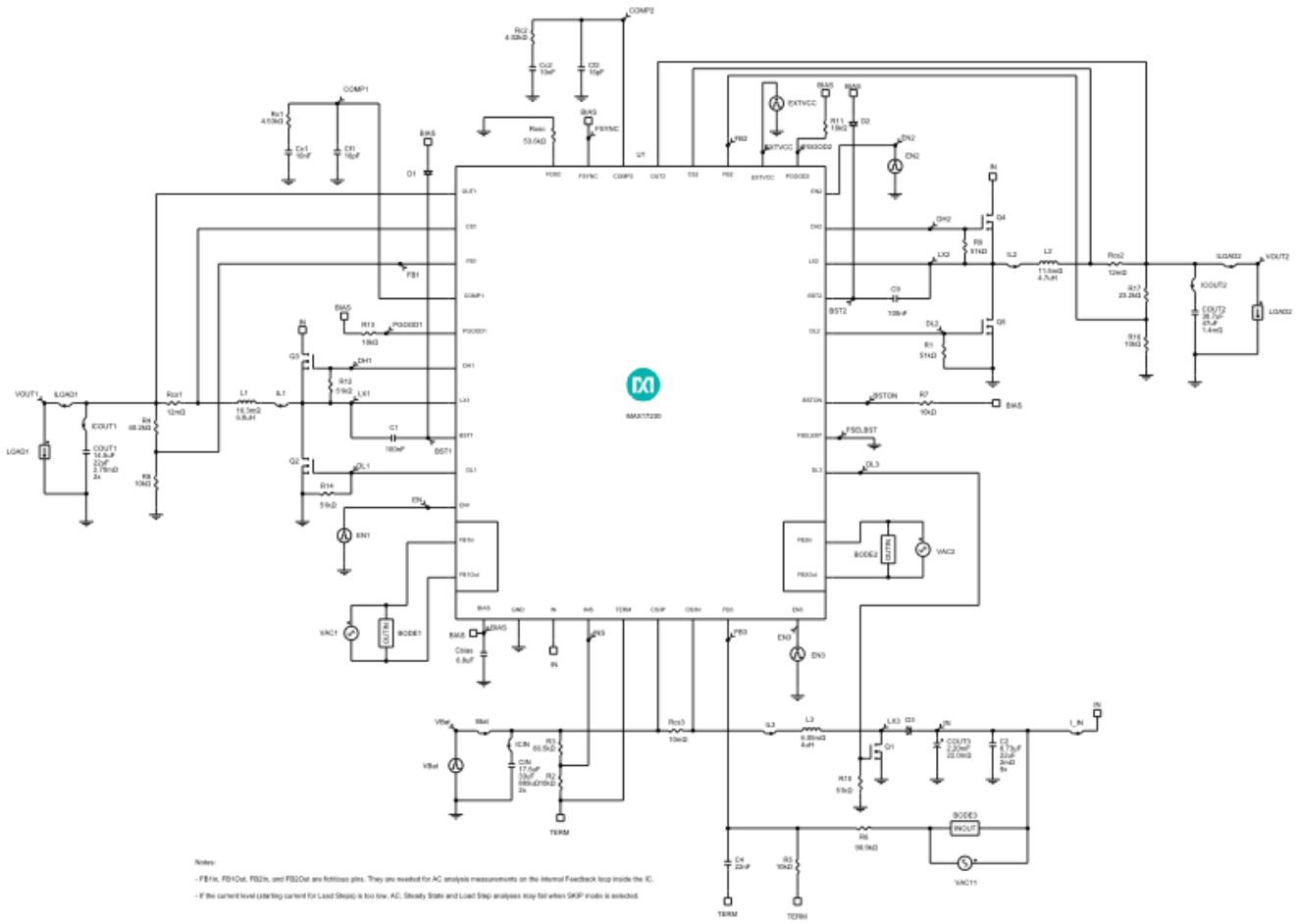
1.0

Design Requirements

Parameter	Value
Output Configuration	Adjustable Output Voltage
Minimum Input Voltage	7.5V
Maximum Input Voltage	14V
Nominal Input Voltage	12V
Input Voltage Ripple	0.5%
Output 1 Voltage	5V
Output 1 Current	3
Output 2 Voltage	3.3
Output 2 Current	3
Output 1 Voltage Rippple	1%
Load 1 Start Current	1.5A
Load 1 Step Current	3A
Load 1 Step Edge Rate	1A/us
Output 1 Voltage Load Step Over/Undershoot	5%
Output 2 Voltage Rippple	1%
Load 2 Step Current	3A
Load 2 Start Current	1.5A
Load 2 Step Edge Rate	1A/us
Output 2 Voltage Load Step Over/Undershoot	5%
Performance Priority	Balance Efficiency and Size
BOM Priority	Cost
Preboost Output Voltage	12V
Preboost Turn ON Threshold	8.8V

Parameter	Value
Preboost Inductor Current ratio (LIR)	0.3
Preboost Peak Current Limit	11.93A
Mode	PWM
Switching Frequency	600000Hz
Ambient Temperature	25°C
Inductor 1 Current Ratio (LIR 1)	0.3
Inductor 2 Current Ratio (LIR 2)	0.3
Peak Current Limit Output 1	5.175A
Peak Current Limit Output 2	5.175A

Schematic



BOM

Ref	Qty	Part Number	Manufacturer	Description
U1	1	MAX17230	Maxim Integrated	2V - 36V, Synchronous Dual Buck Controller with Integrated Boost and 20µA Quiescent Current
C1	1	06035C104KAT2A	AVX	Cap Ceramic 0.1uF 50V X7R 10% Pad SMD 0603 125°C T/R
C2	9	GRM32ER71E226ME15	Murata	Cap Ceramic 22uF 25V 1210 125C
C4	1	06035C223JAT2A	AVX	Cap Ceramic 0.022uF 50V X7R 5% Pad SMD 0603 125°C T/R
C9	1	06035C104KAT2A	AVX	Cap Ceramic 0.1uF 50V X7R 10% Pad SMD 0603 125°C T/R
CIN	2	C4532X5R1C336M250KA	TDK	Cap Ceramic 33uF 16V 1812 85C
COUT1	2	GRM31CC81A226ME19L	Murata	Cap Ceramic 22uF 10V X6S 20% SMD 1206 105C Embossed T/R
COUT2	1	GRM32EE70J476ME20L	Murata	Cap Ceramic 47uF 6.3V 1210 125C
COUT3	1	EEUTP1E222	Panasonic	Cap Aluminum Lytic 2200uF 25V 20% (16 X 25mm) Radial 7.5mm 0.022 Ohm 2300mA 2000h 135C Bulk
Cbias	1	C2012X5R1E685K125AC	TDK	Cap Ceramic 6.8uF 25V X5R 10% Pad SMD 0805 85°C T/R
Cc1	1	06035C103JAT2A	AVX	Cap Ceramic 0.01uF 50V X7R 5% Pad SMD 0603 125°C T/R
Cc2	1	06035C103JAT2A	AVX	Cap Ceramic 0.01uF 50V X7R 5% Pad SMD 0603 125°C T/R
Cf1	1	06035A160JAT2A	AVX	Cap Ceramic 16pF 50V C0G 5% Pad SMD 0603 125°C T/R
Cf2	1	C0603X7R500-160JNP	Venkel	Cap Ceramic 16pF 50V X7R 5% Pad SMD 0603 125°C T/R
D1	1	MBR0520L	ON Semiconductor	Diode Schottky 20V 0.5A 2-Pin SOD-123 T/R
D2	1	MBR0520L	ON Semiconductor	Diode Schottky 20V 0.5A 2-Pin SOD-123 T/R
D3	1	V15P45S-M3/86A	Vishay	Diode Schottky 45V 15A 3-Pin(2+Tab) SMPC T/R
L1	1	MSS1048-682NLB	Coilcraft	Inductor 6.8uH 30% 14.67mOhm 5.6A Isat 6.01A Irms
L2	1	MSS1048-472NLB	Coilcraft	Inductor 4.7uH 30% 10.35mOhm 6A Isat 6.9A Irms
L3	1	SER1360-402KLB	Coilcraft	Inductor 4uH 10% 5.5mOhm 13.5A Isat 9.4A Irms
Q1	1	FDMS0310AS	Fairchild Semiconductor	Trans MOSFET N-CH 30VDS 5.2mOhm@4.5V 5mOhm@6V 13nC 5.8nC 1.72nF 0.655nF 150°C 22A 41W 3°C/W 1.1mm 32.5mm^2 PQFN 5x6 8L (Power 56)
Q2	1	FDMS0310AS	Fairchild Semiconductor	Trans MOSFET N-CH 30VDS 5.2mOhm@4.5V 5mOhm@6V 13nC 5.8nC 1.72nF 0.655nF 150°C 22A 41W 3°C/W 1.1mm 32.5mm^2 PQFN

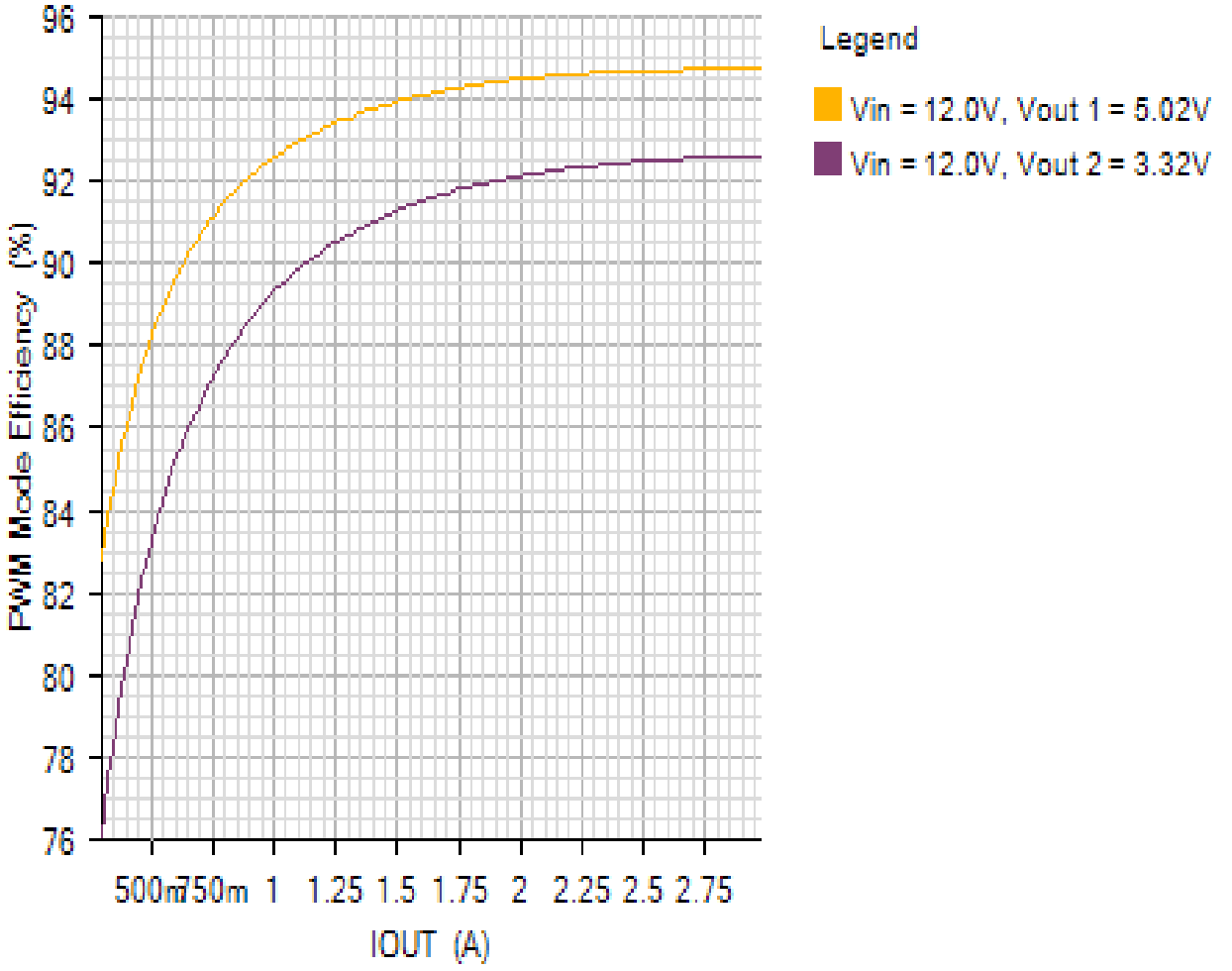
				5x6 8L (Power 56)
Q3	1	FDMS0310AS	Fairchild Semiconductor	Trans MOSFET N-CH 30VDS 5.2mOhm@4.5V 5mOhm@6V 13nC 5.8nC 1.72nF 0.655nF 150°C 22A 41W 3°C/W 1.1mm 32.5mm^2 PQFN 5x6 8L (Power 56)
Q4	1	FDMS0310AS	Fairchild Semiconductor	Trans MOSFET N-CH 30VDS 5.2mOhm@4.5V 5mOhm@6V 13nC 5.8nC 1.72nF 0.655nF 150°C 22A 41W 3°C/W 1.1mm 32.5mm^2 PQFN 5x6 8L (Power 56)
Q5	1	FDMS0310AS	Fairchild Semiconductor	Trans MOSFET N-CH 30VDS 5.2mOhm@4.5V 5mOhm@6V 13nC 5.8nC 1.72nF 0.655nF 150°C 22A 41W 3°C/W 1.1mm 32.5mm^2 PQFN 5x6 8L (Power 56)
R1	1	ERJ2GEJ513X	Panasonic	Res Thick Film 0402 51K Ohm 5% 0.1W(1/10W) ±200ppm/°C Pad SMD Automotive T/R
R2	1	ERJ2RKF1002X	Panasonic	Res Thick Film 0402 10K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R3	1	ERJ3EKF6652V	Panasonic	Res Thick Film 0603 66.5K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R4	1	ERJ3EKF4022V	Panasonic	Res Thick Film 0603 40.2K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R5	1	ERJ3EKF1002V	Panasonic	Res Thick Film 0603 10K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R6	1	ERJ3EKF9092V	Panasonic	Res Thick Film 0603 90.9K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R7	1	ERJ3GEYJ103V	Panasonic	Res Thick Film 0603 10K Ohm 5% 0.1W(1/10W) ±200ppm/°C Pad SMD Automotive T/R
R8	1	ERJ3EKF1002V	Panasonic	Res Thick Film 0603 10K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R9	1	ERJ2GEJ513X	Panasonic	Res Thick Film 0402 51K Ohm 5% 0.1W(1/10W) ±200ppm/°C Pad SMD Automotive T/R
R10	1	ERJ2GEJ513X	Panasonic	Res Thick Film 0402 51K Ohm 5% 0.1W(1/10W) ±200ppm/°C Pad SMD Automotive T/R
R11	1	ERJ3GEYJ103V	Panasonic	Res Thick Film 0603 10K Ohm 5% 0.1W(1/10W) ±200ppm/°C Pad SMD Automotive T/R
R12	1	ERJ2GEJ513X	Panasonic	Res Thick Film 0402 51K Ohm 5% 0.1W(1/10W) ±200ppm/°C Pad SMD Automotive T/R
R13	1	ERJ3GEYJ103V	Panasonic	Res Thick Film 0603 10K Ohm 5% 0.1W(1/10W) ±200ppm/°C Pad SMD Automotive T/R

R14	1	ERJ2GEJ513X	Panasonic	Res Thick Film 0402 51K Ohm 5% 0.1W(1/10W) ±200ppm/°C Pad SMD Automotive T/R
R16	1	ERJ3EKF1002V	Panasonic	Res Thick Film 0603 10K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R17	1	ERJ3EKF2322V	Panasonic	Res Thick Film 0603 23.2K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
Rc1	1	ERJ3EKF4531V	Panasonic	Res Thick Film 0603 4.53K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
Rc2	1	ERJ3EKF4021V	Panasonic	Res Thick Film 0603 4.02K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
Rcs1	1	NCSS12AFR012TRF	NIC Components	Res Metal Strip 1206 0.012 Ohm 1% 0.25W(1/4W) ±75ppm/°C Pad SMD T/R
Rcs2	1	NCSS12AFR012TRF	NIC Components	Res Metal Strip 1206 0.012 Ohm 1% 0.25W(1/4W) ±75ppm/°C Pad SMD T/R
Rcs3	1	ERJ6BWFR010V	Panasonic	Res Thick Film 0805 0.01 Ohm 1% 0.5W(1/2W) ±300ppm/°C Pad SMD Automotive T/R
Rosc	1	ERJ3EKF5362V	Panasonic	Res Thick Film 0603 53.6K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R

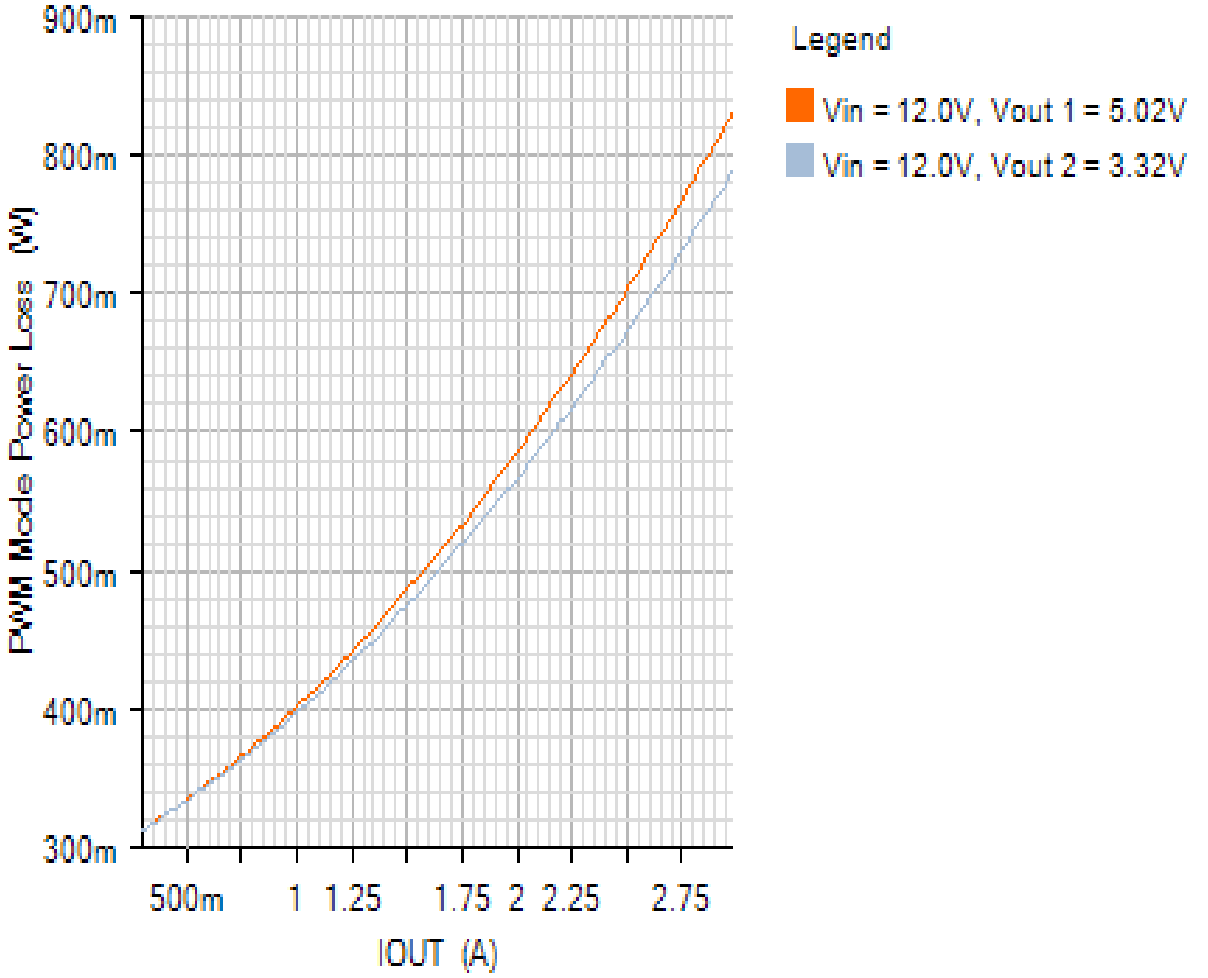
Simulation Results

Efficiency - Thu Nov 15 2018 14:37:25

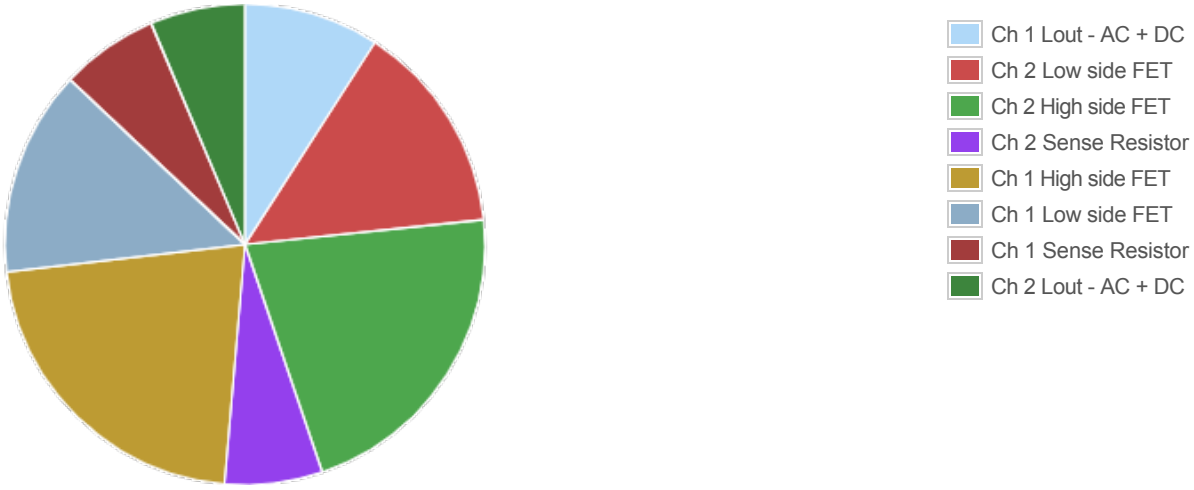
EFFICIENCY_PLOT Default



POWER_LOSS_PLOT Default



Losses

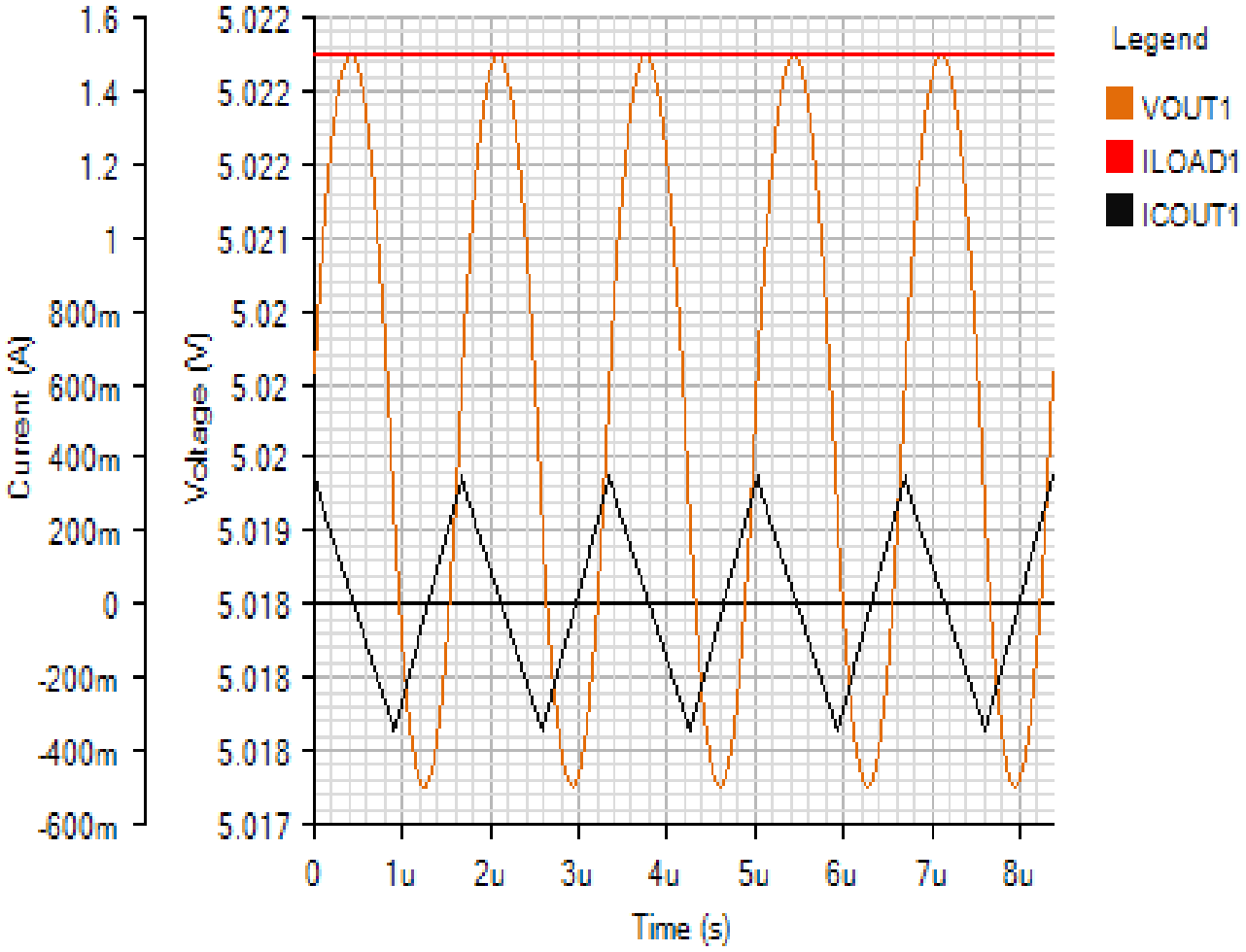


Component	Loss (W)	% of total

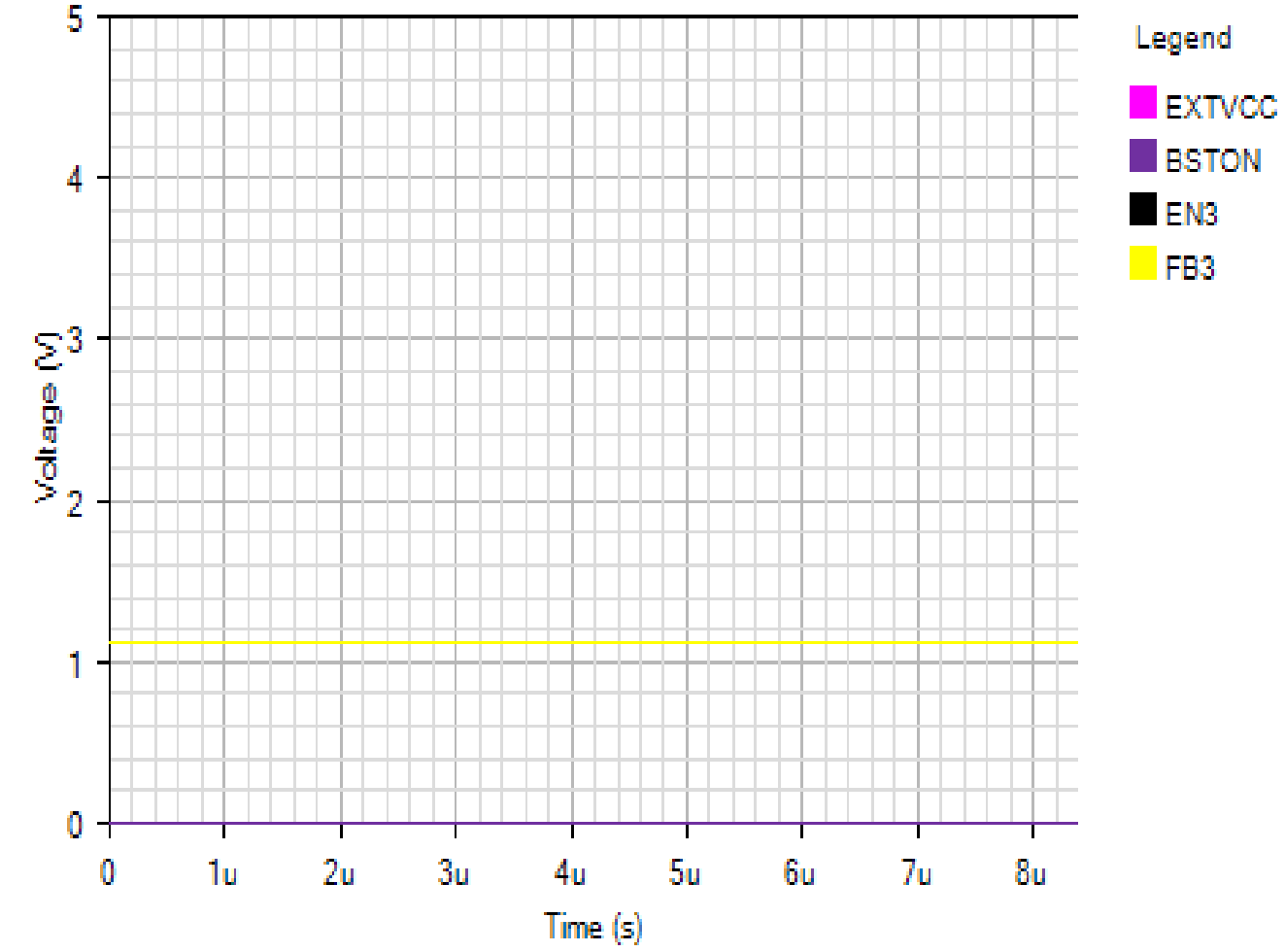
Component	Loss (W)	% of total
Ch 1 Lout - AC + DC	0.147555	9.1
Ch 2 Low side FET	0.230839	14.3
Ch 2 High side FET	0.3466	21.4
Ch 2 Sense Resistor	0.106789	6.6
Ch 1 High side FET	0.353242	21.8
Ch 1 Low side FET	0.224123	13.8
Ch 1 Sense Resistor	0.106572	6.6
Ch 2 Lout - AC + DC	0.103729	6.4
Total	1.619448	100

Steady State - Thu Nov 15 2018 14:37:25

OUTPUT1 Default



IC3 Default



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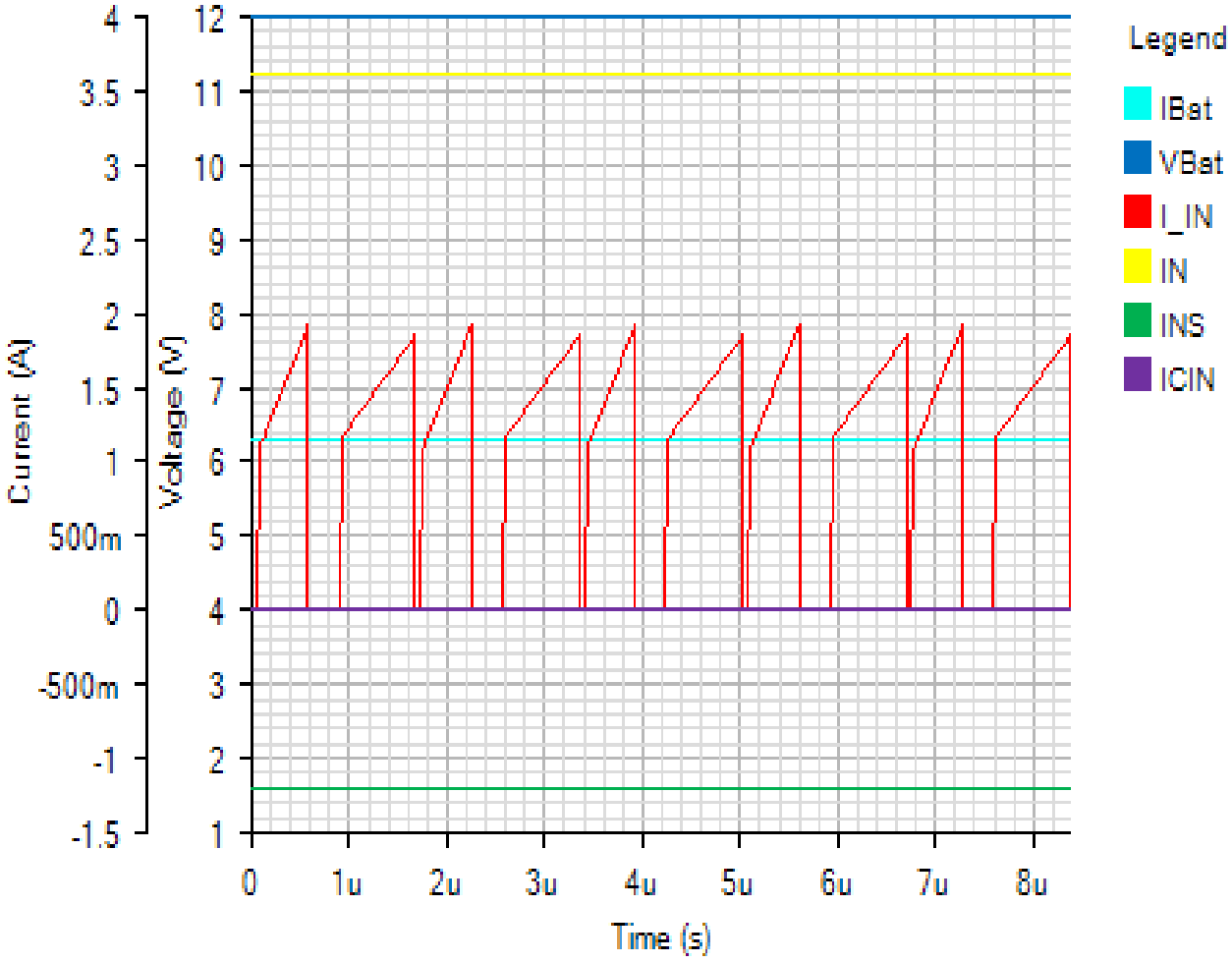

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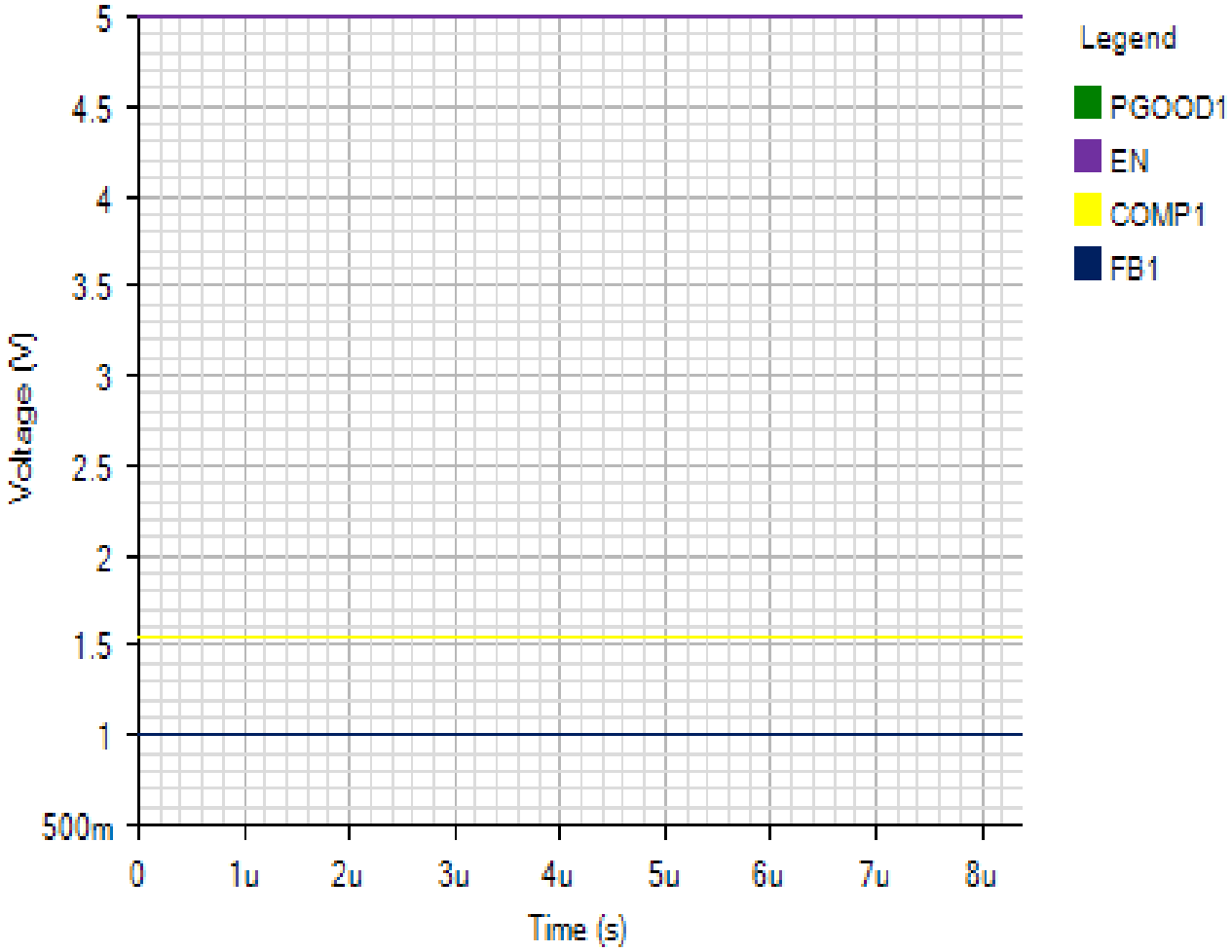
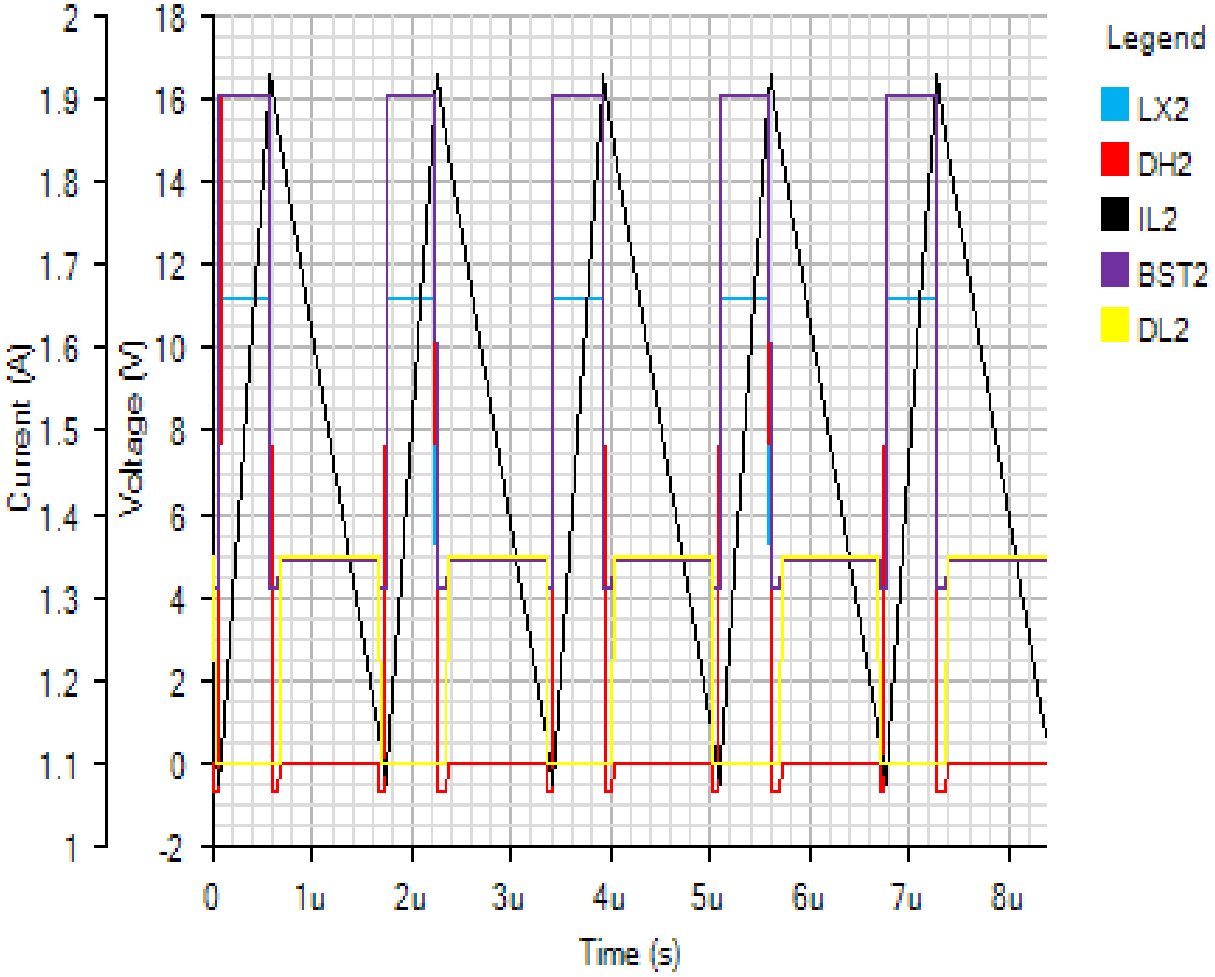
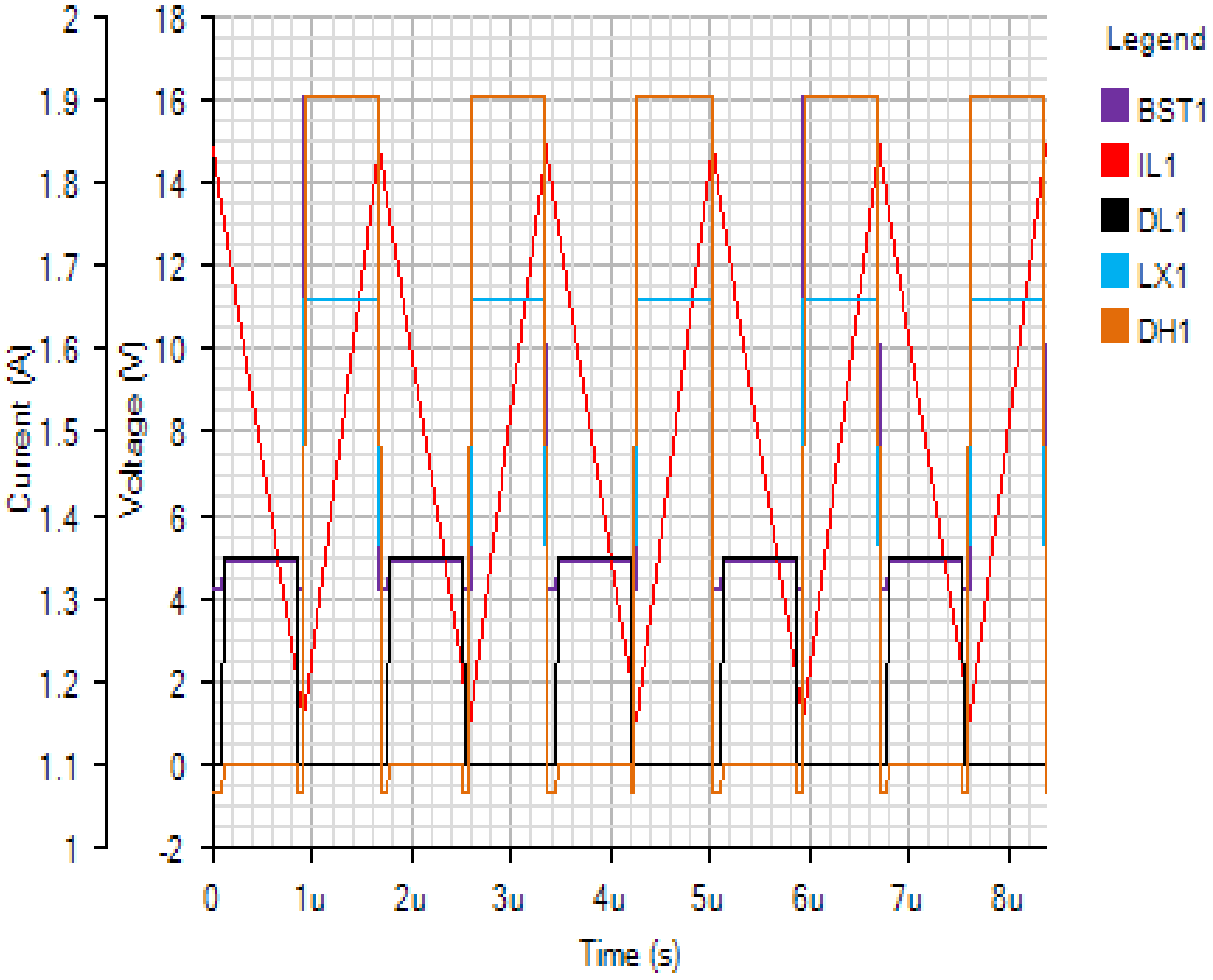


SWITCHING2 Default



SWITCHING1 Default



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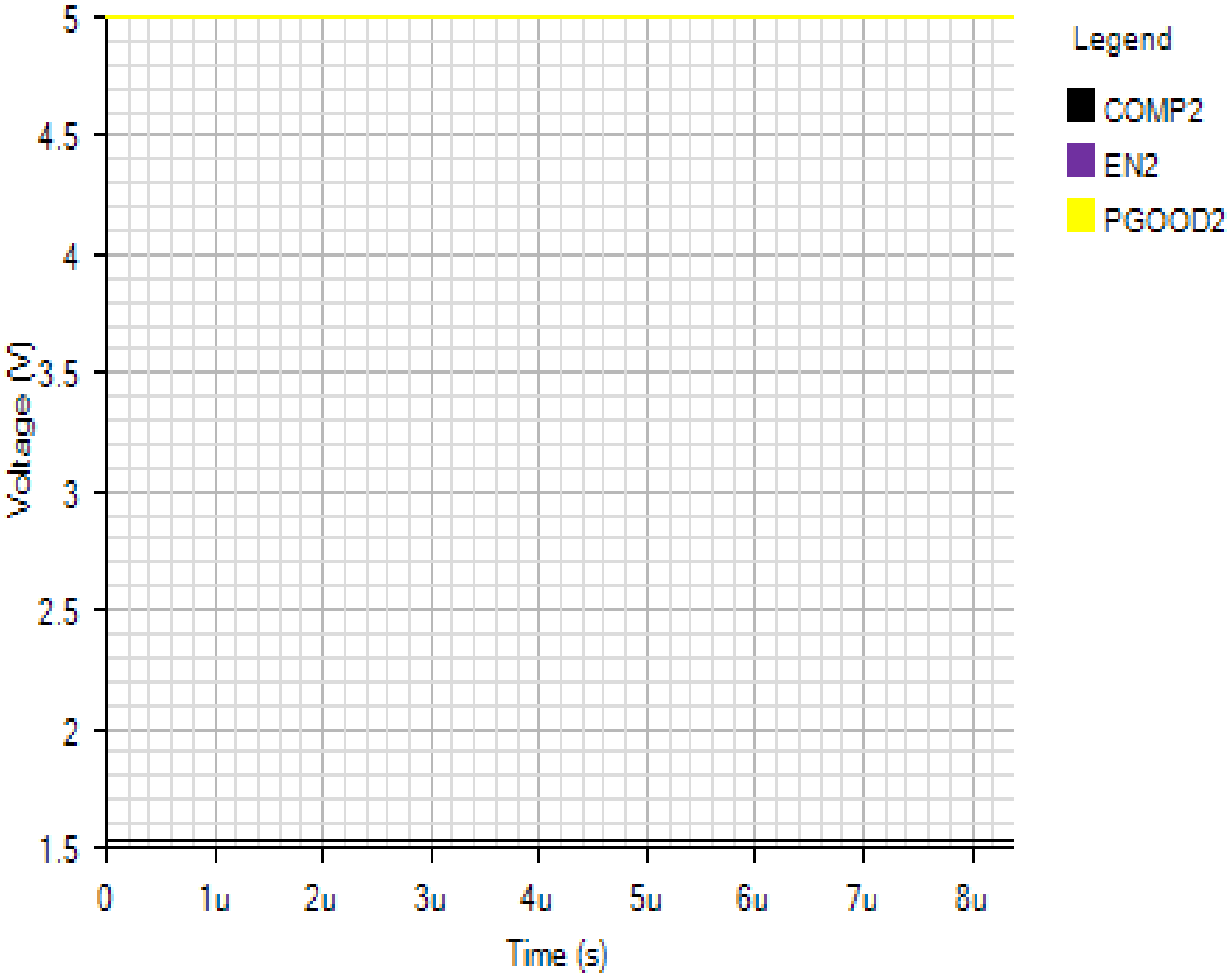
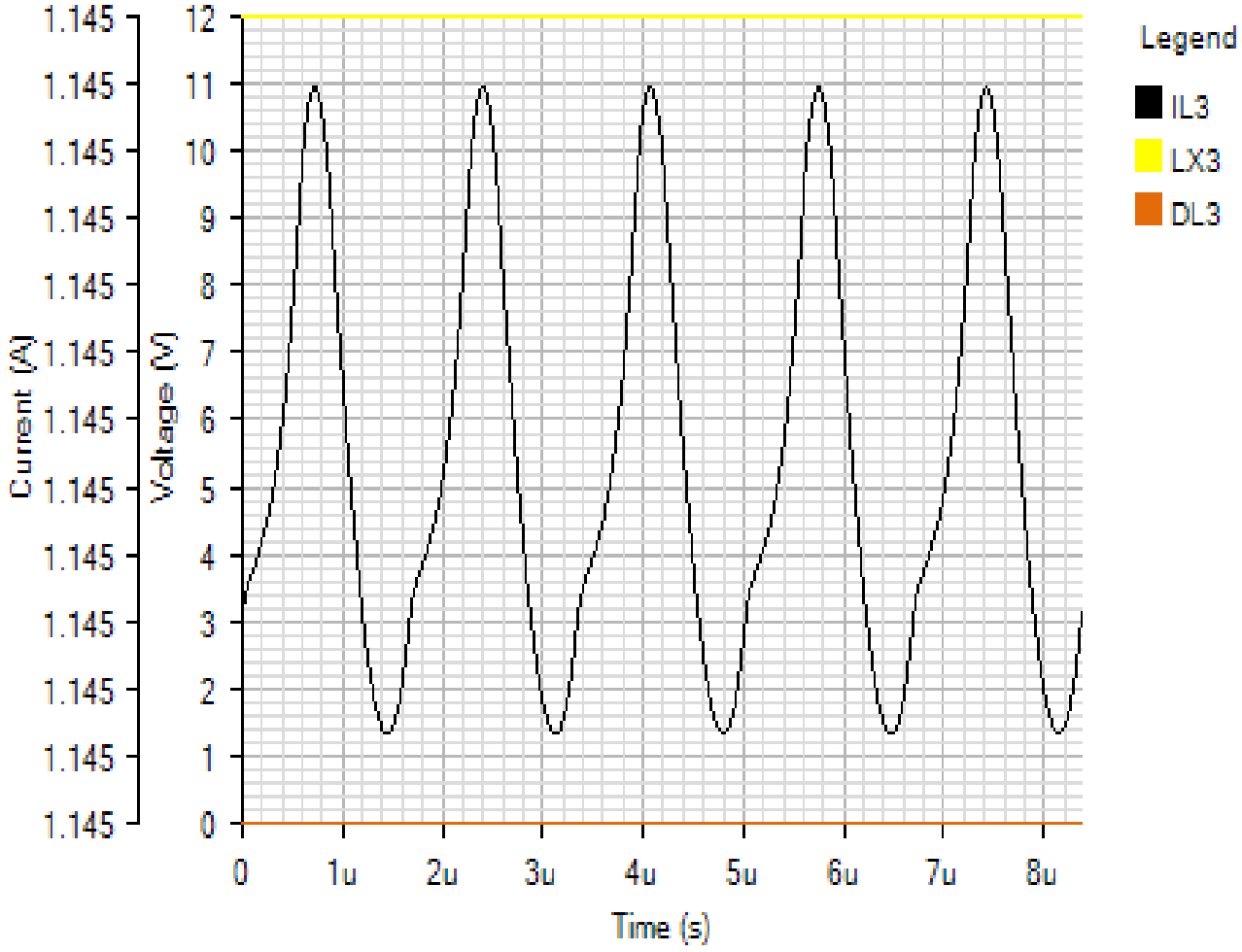
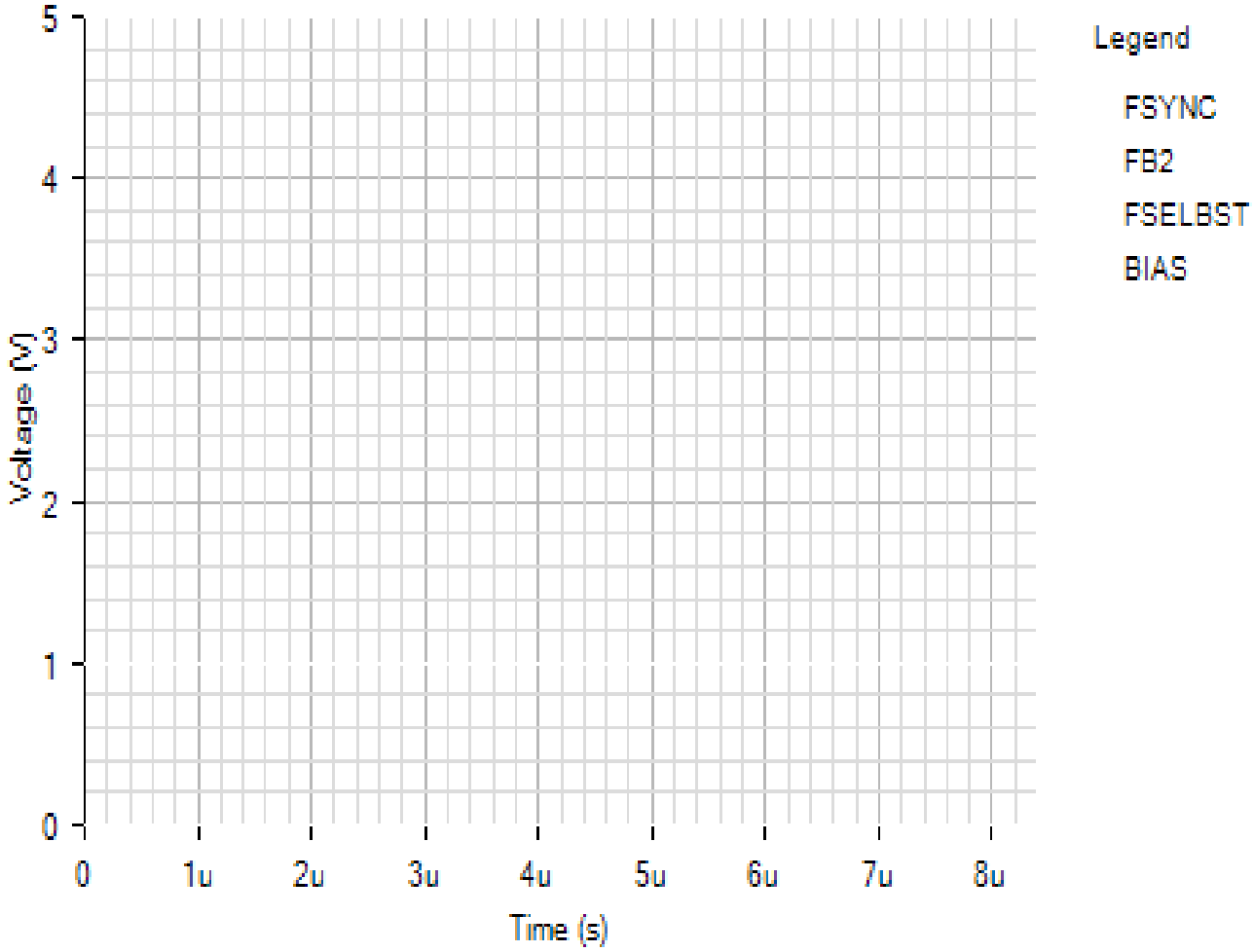


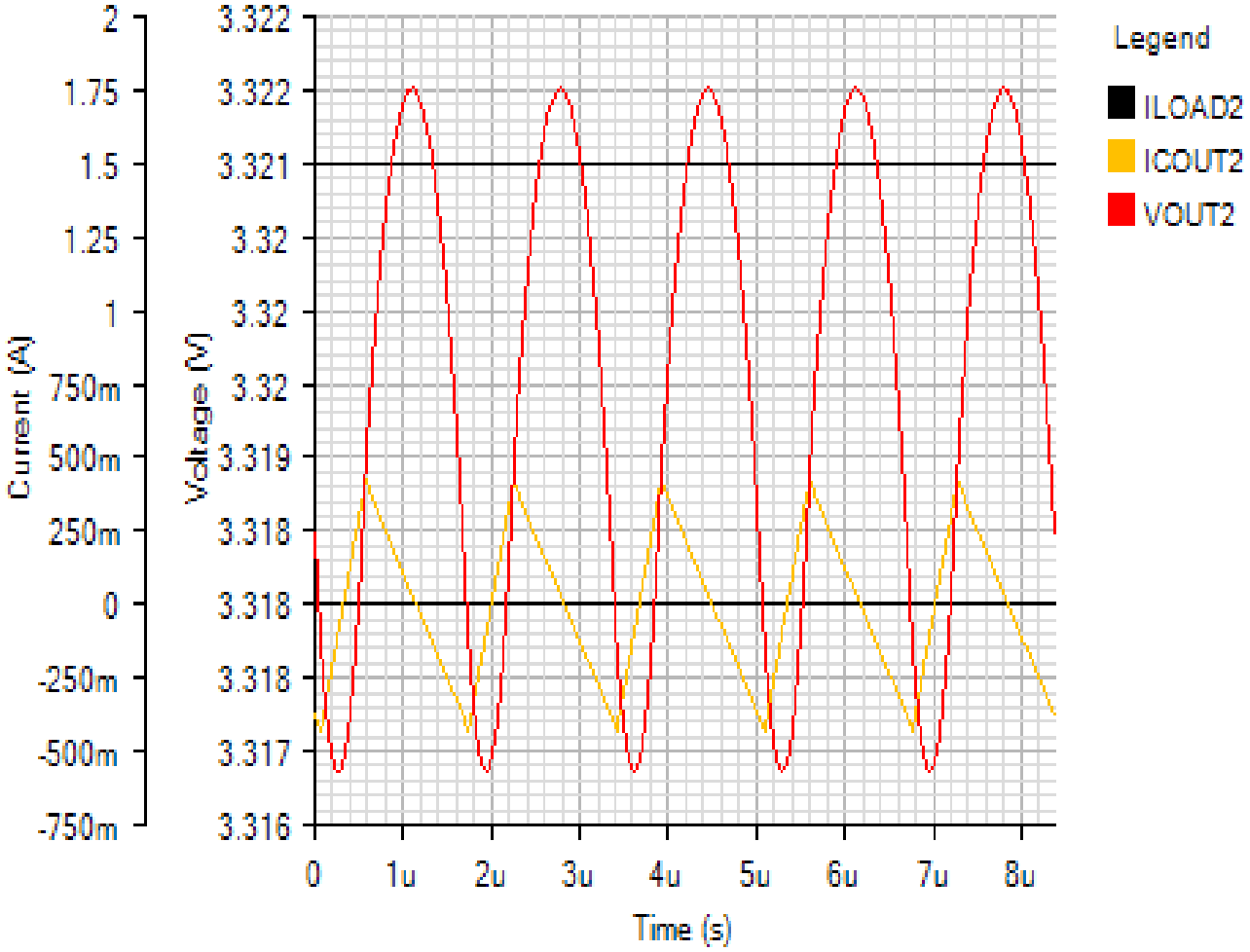
SWITCHING3 Default



WEBSIM_VOLTAGE_ Default

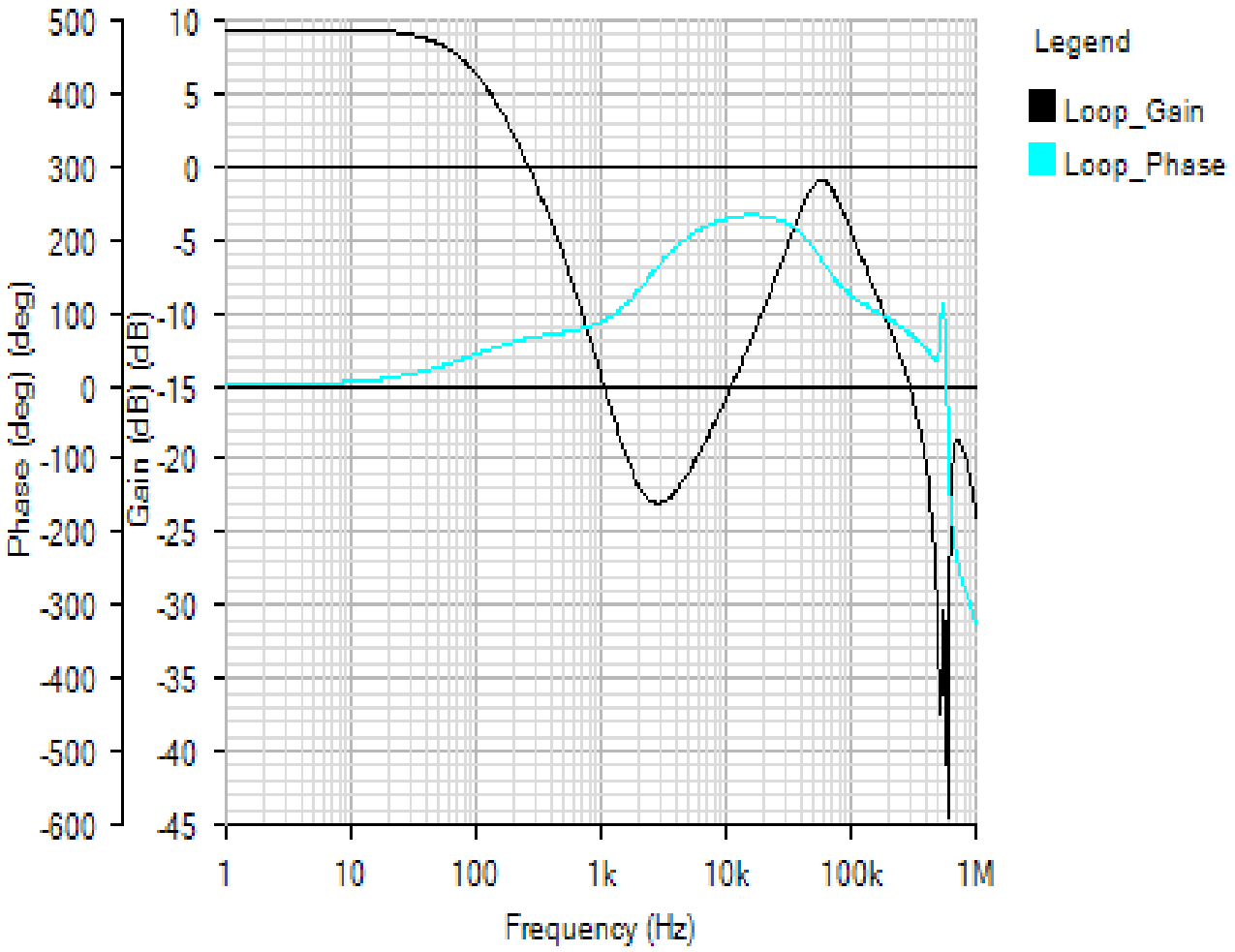


OUTPUT2 Default

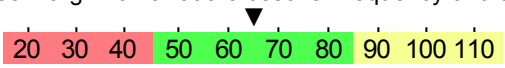


PreBoost AC - Thu Nov 15 2018 14:37:25

BODE Default

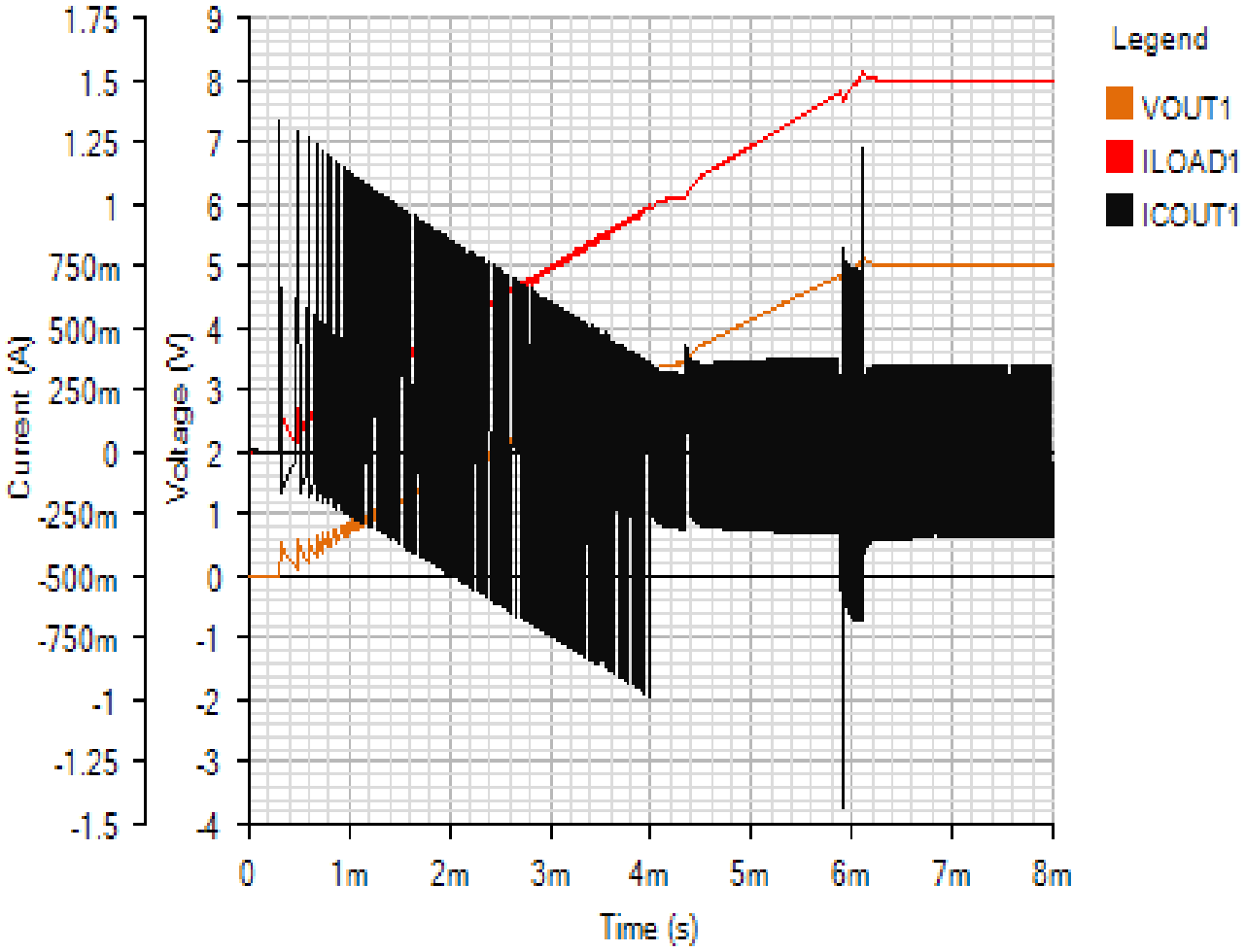


Phase Margin: 64.9° at a crossover frequency of 0.3kHz

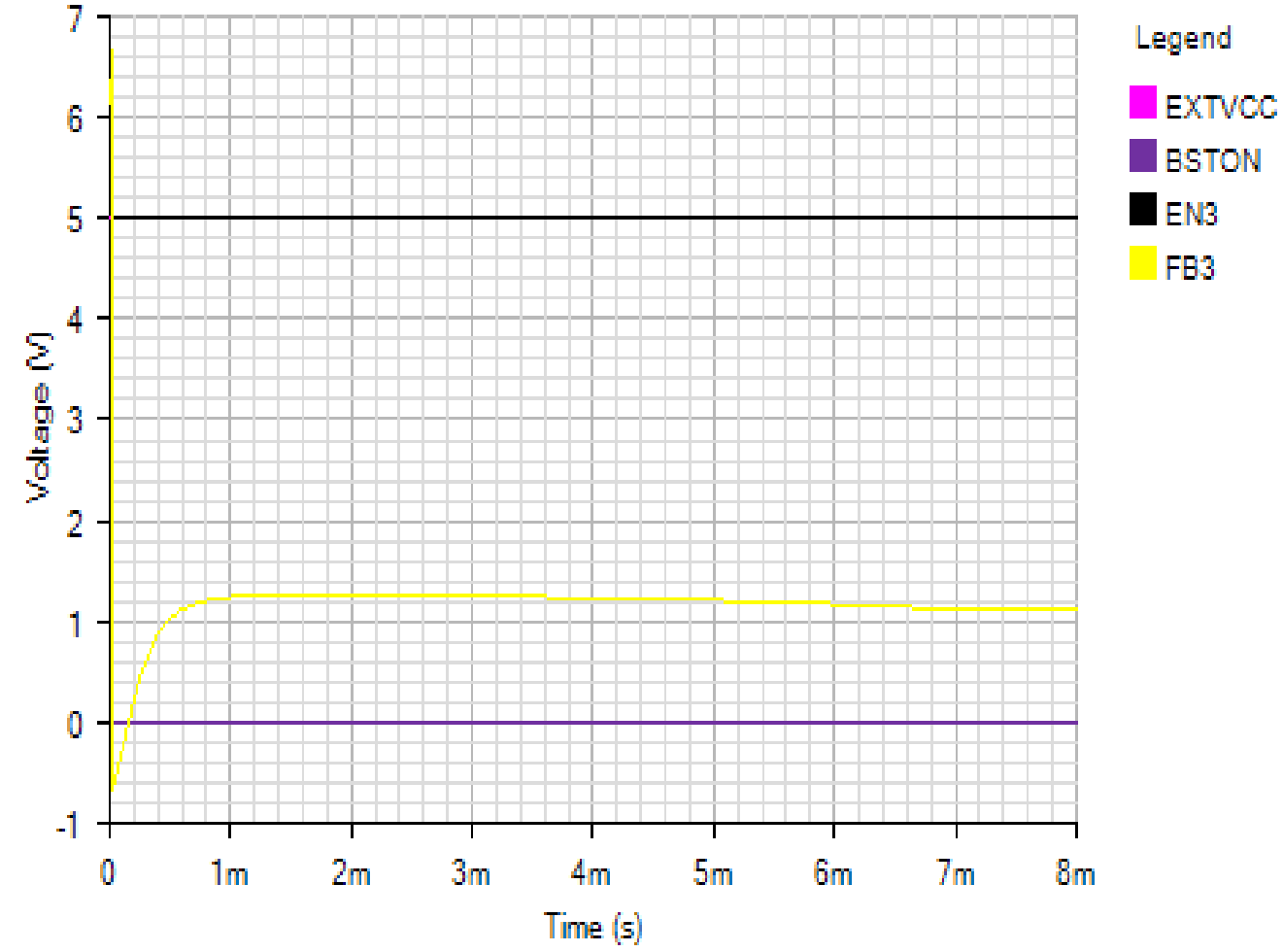


Start Up - Thu Nov 15 2018 14:37:25

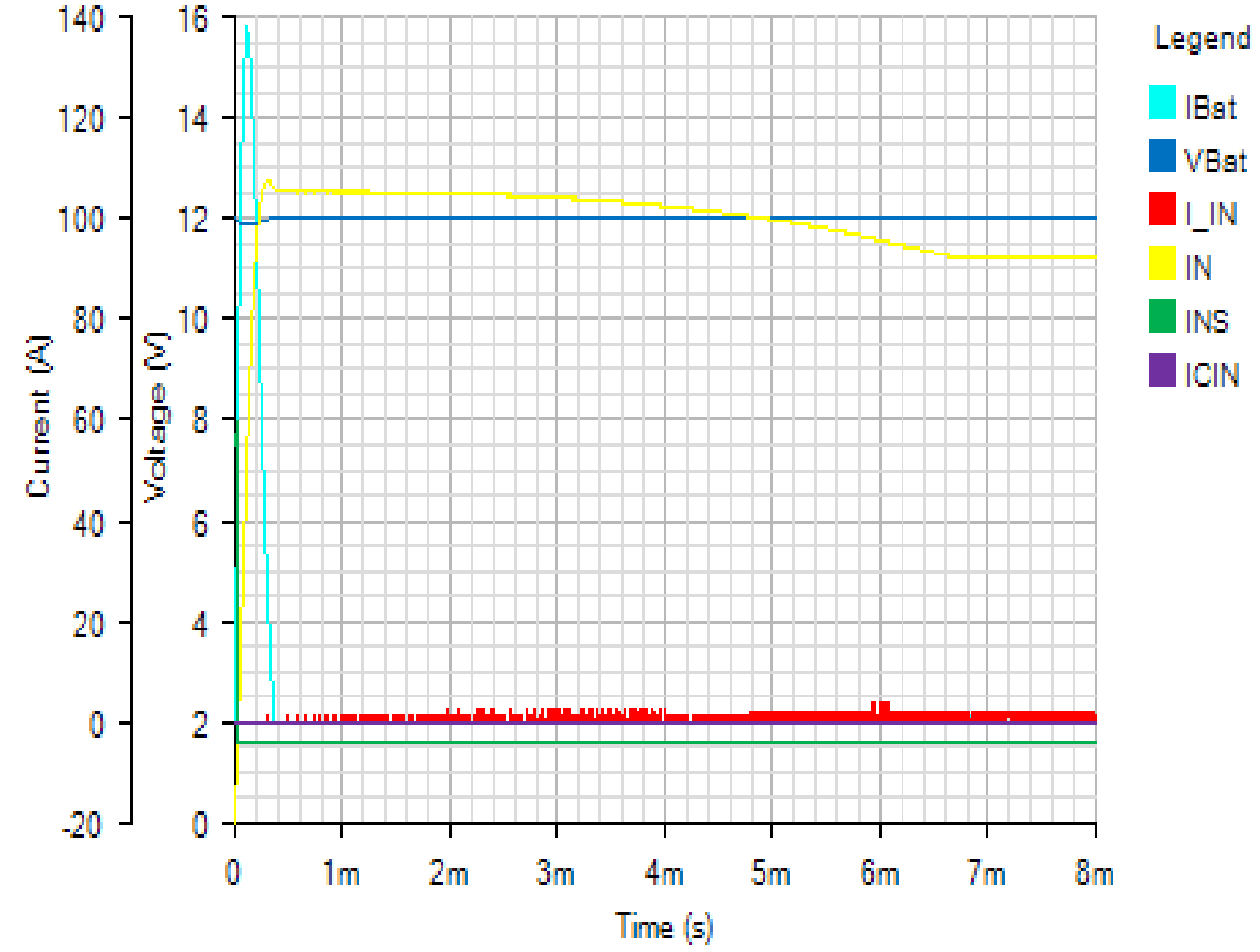
OUTPUT1 Default



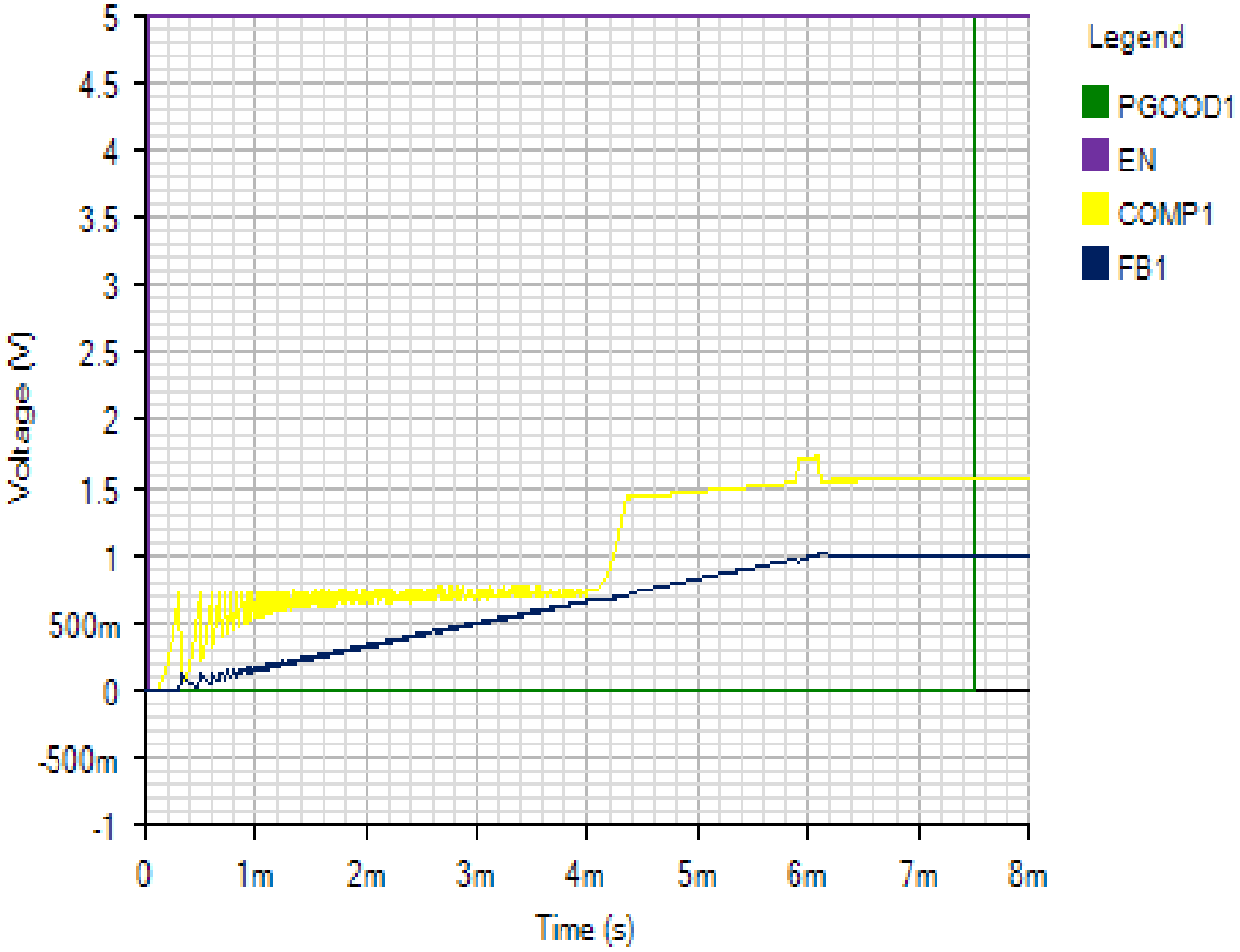
IC3 Default



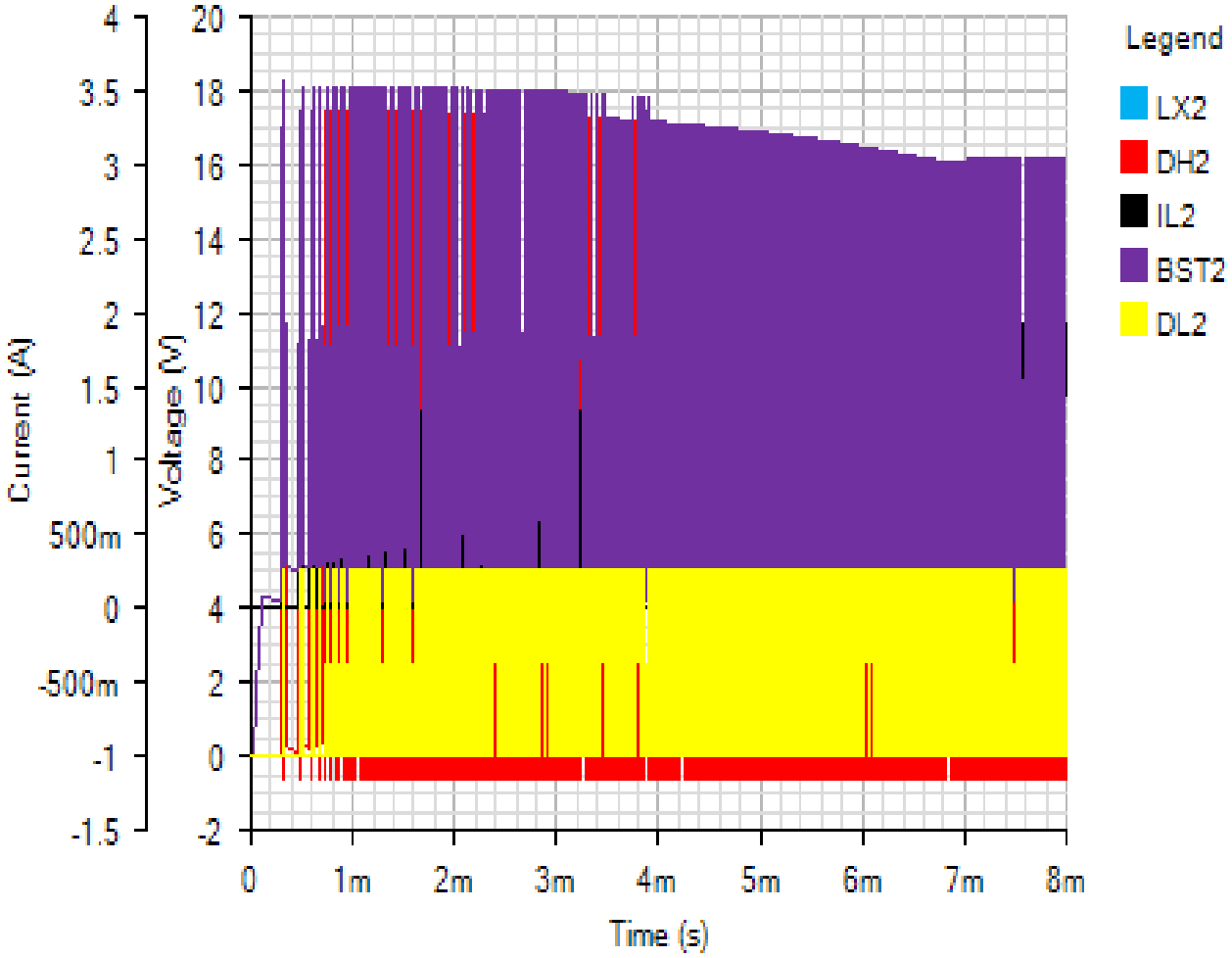
INPUT Default



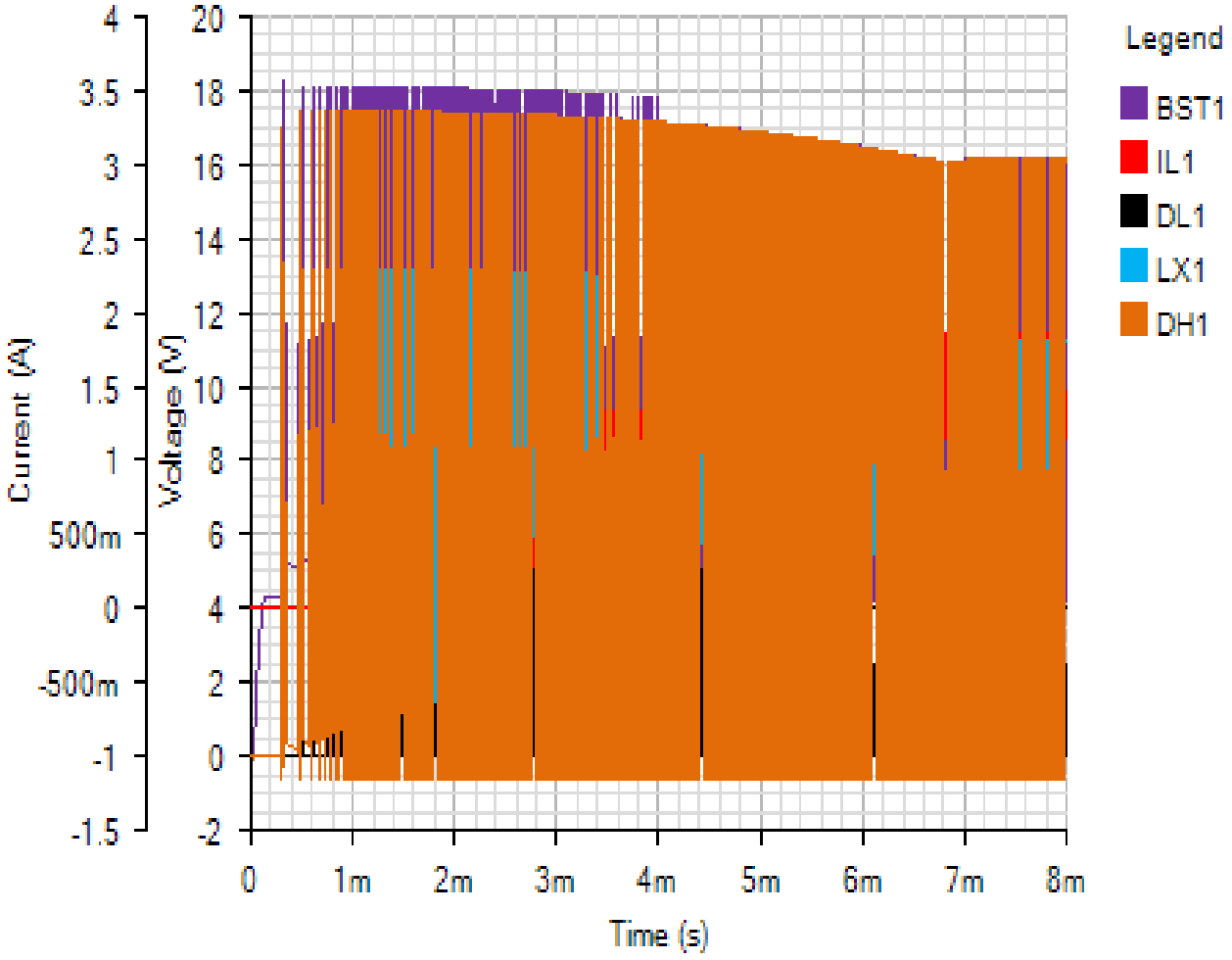
IC1 Default



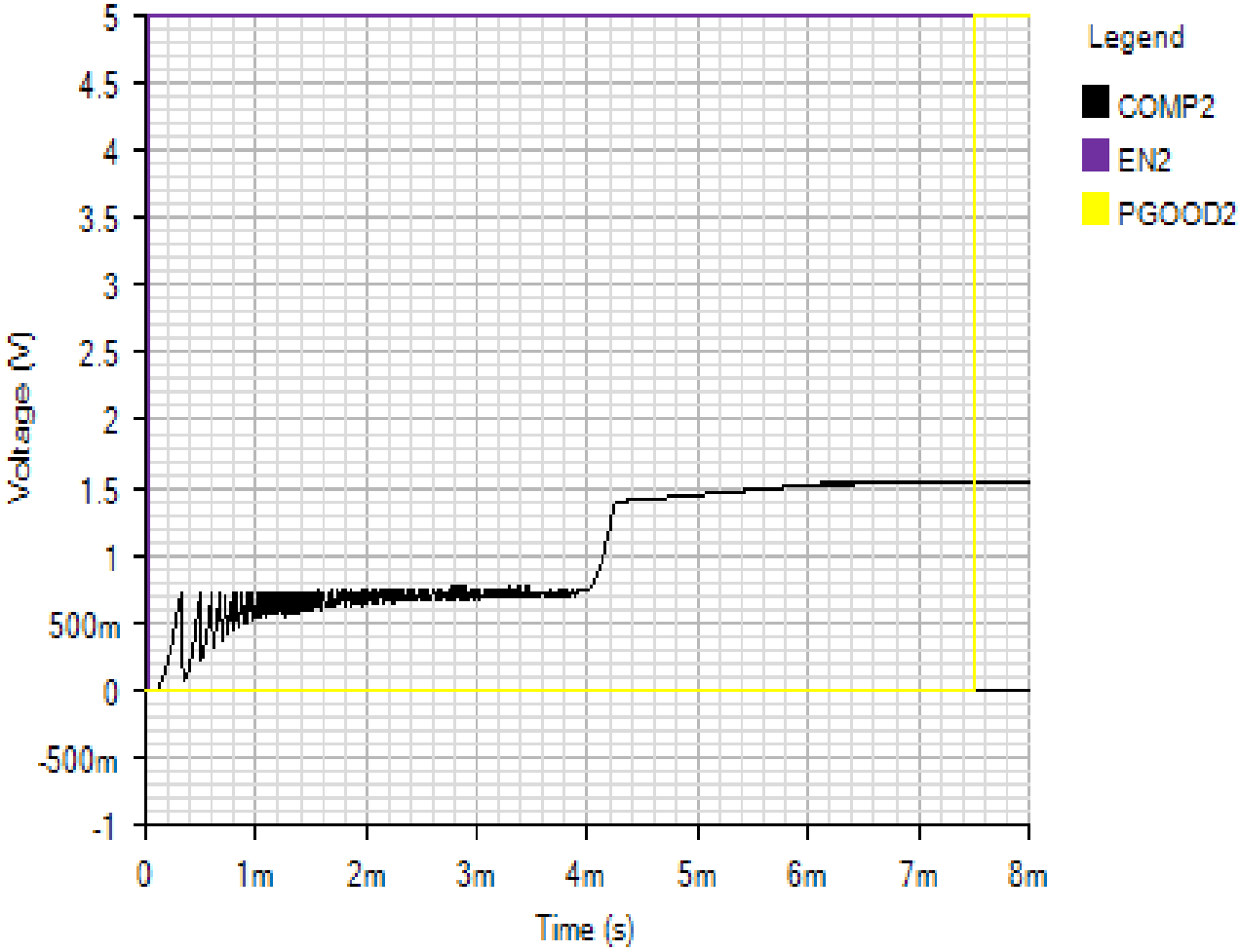
SWITCHING2 Default



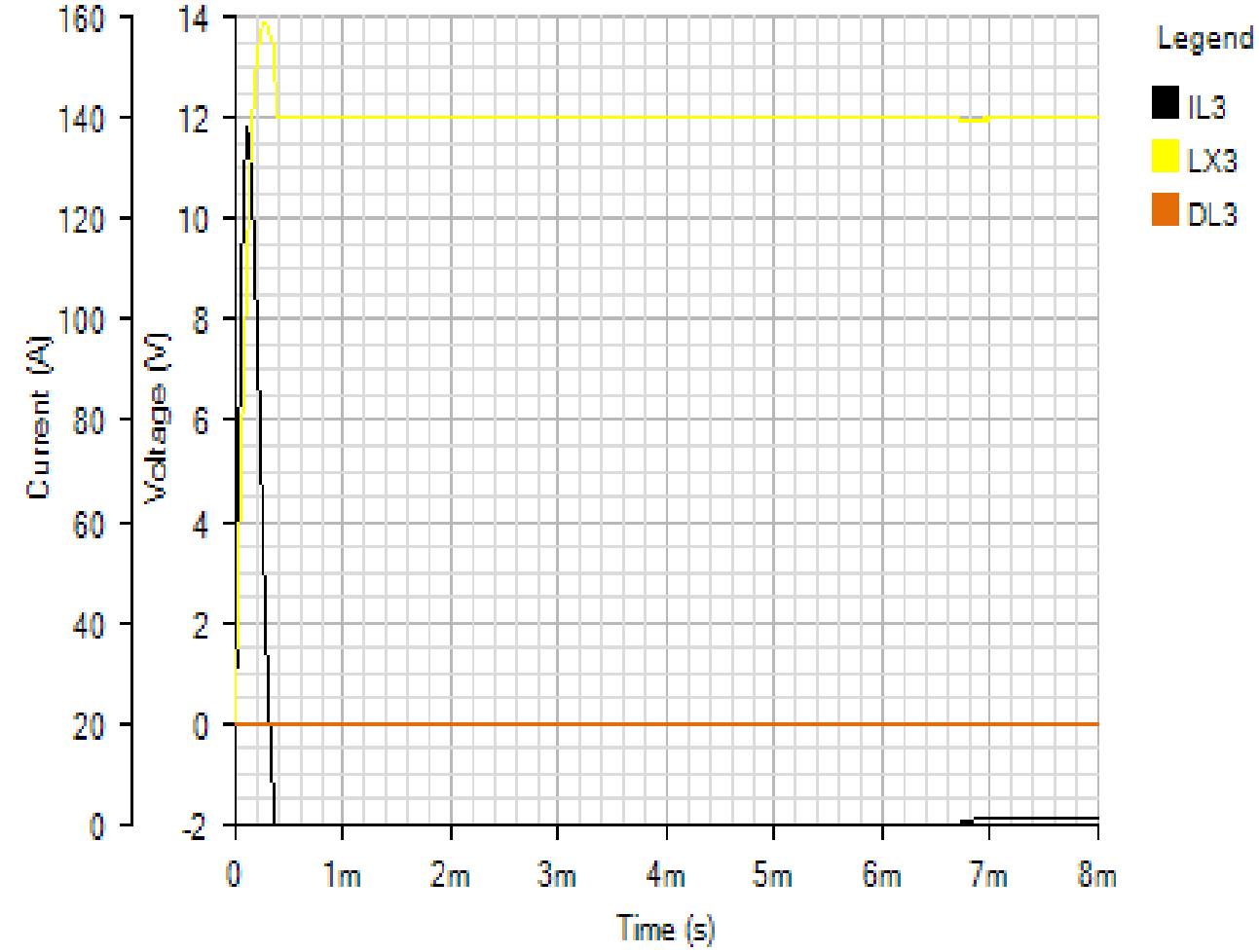
SWITCHING1 Default



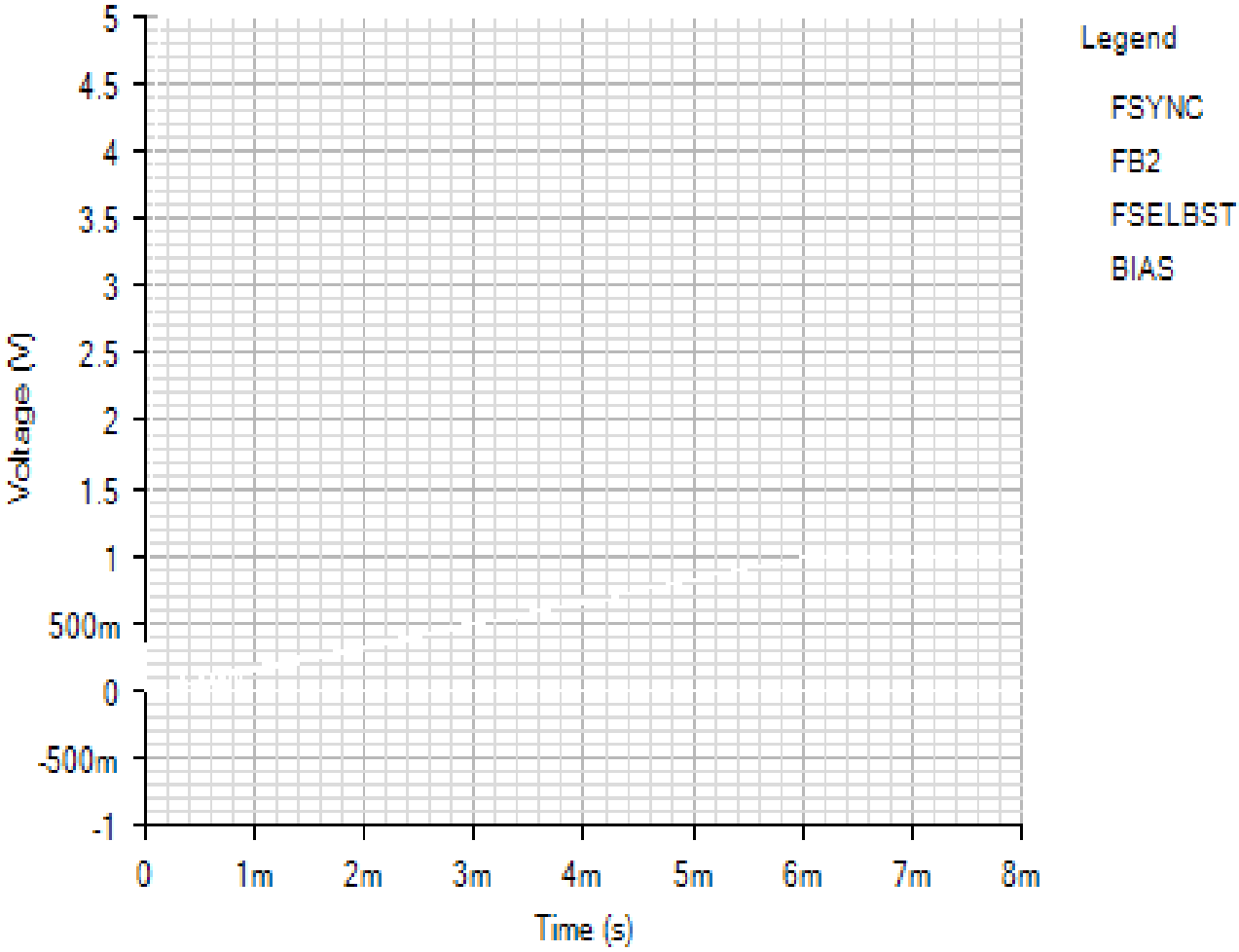
IC2 Default



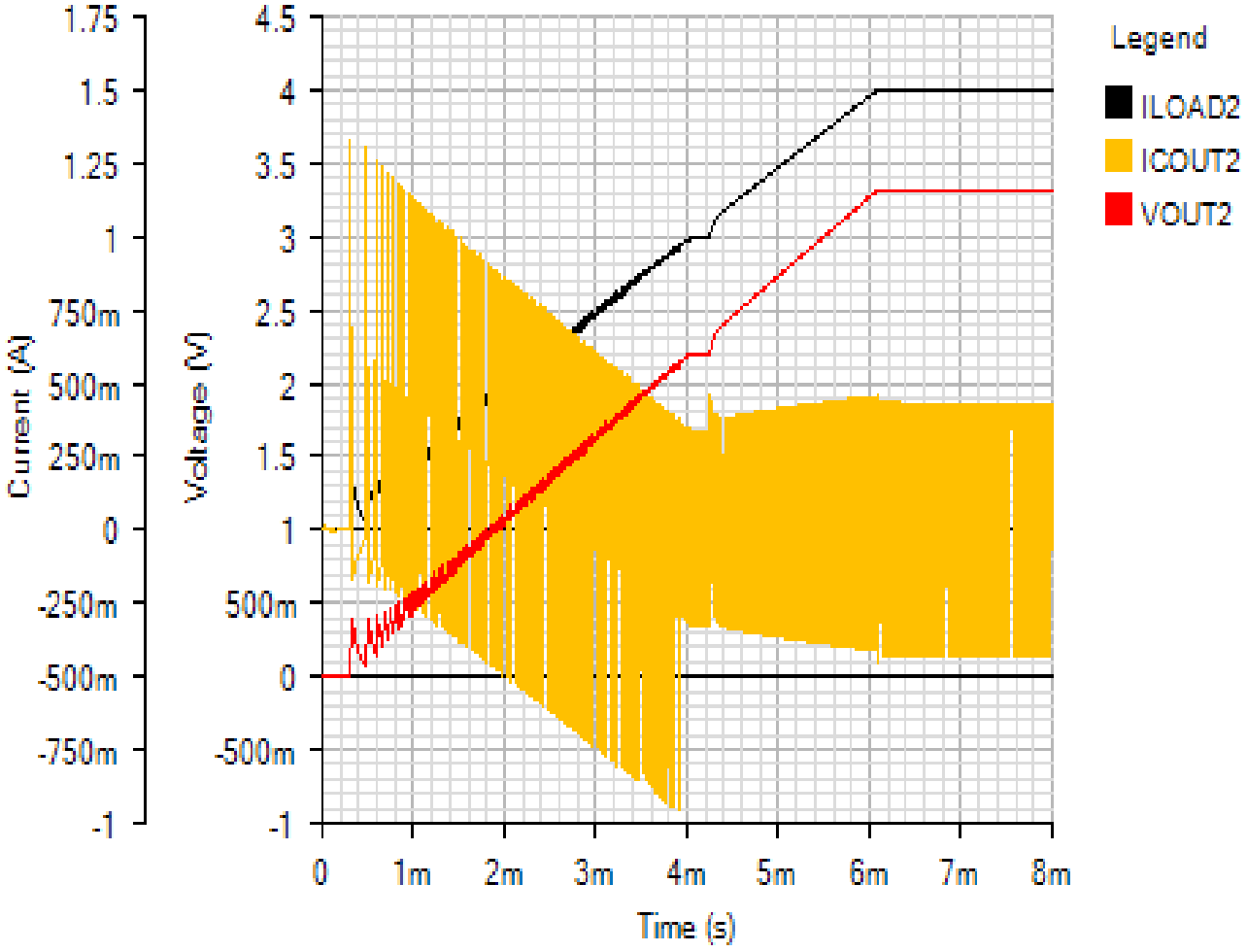
SWITCHING3 Default



WEBSIM_VOLTAGE_ Default

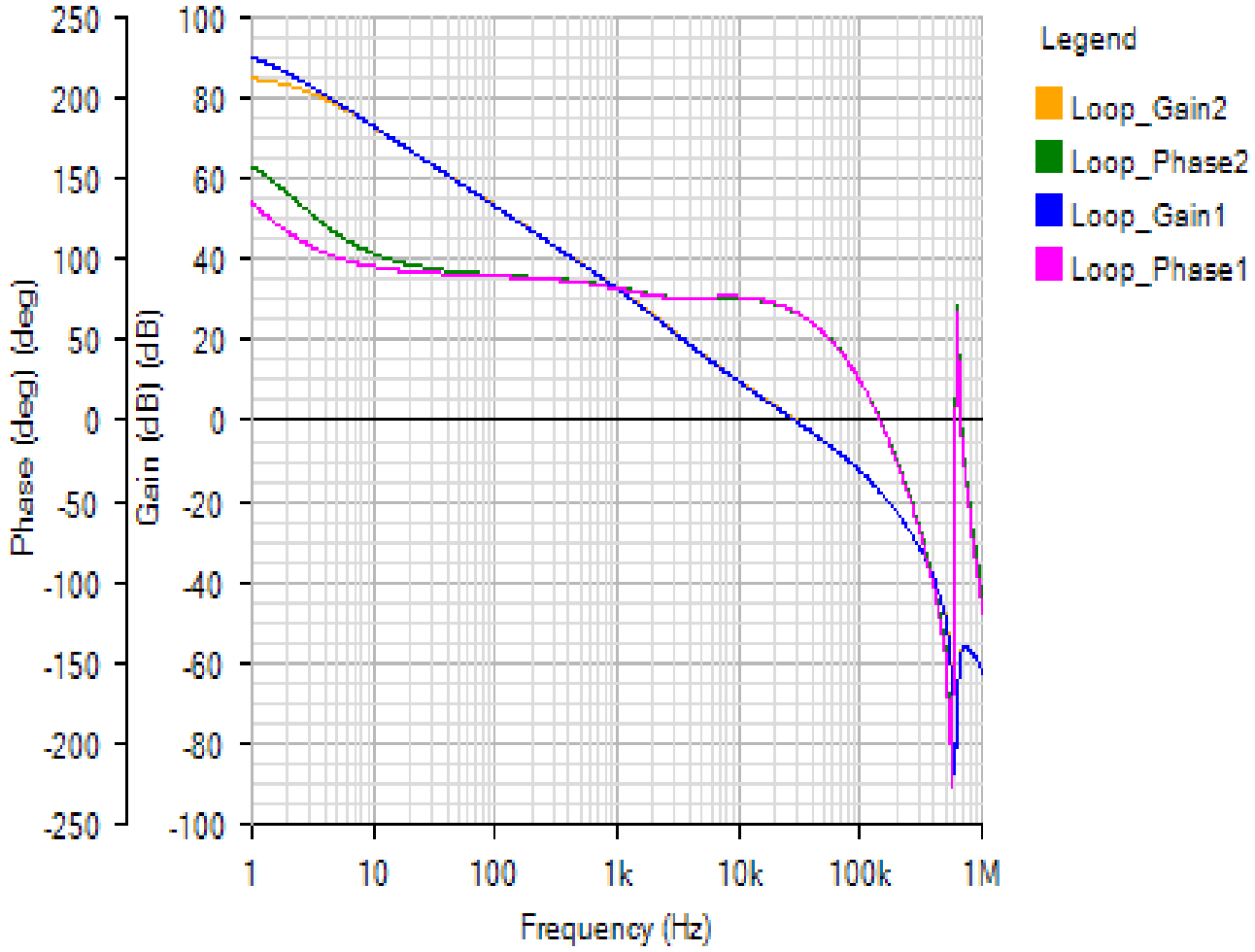


OUTPUT2 Default

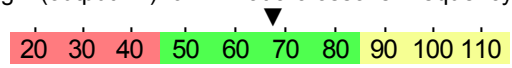


AC Loop - Thu Nov 15 2018 14:37:25

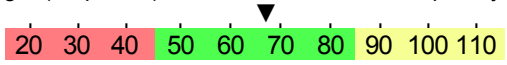
BODE Default



Phase Margin (output #1): 67.41° at a crossover frequency of 29.3kHz

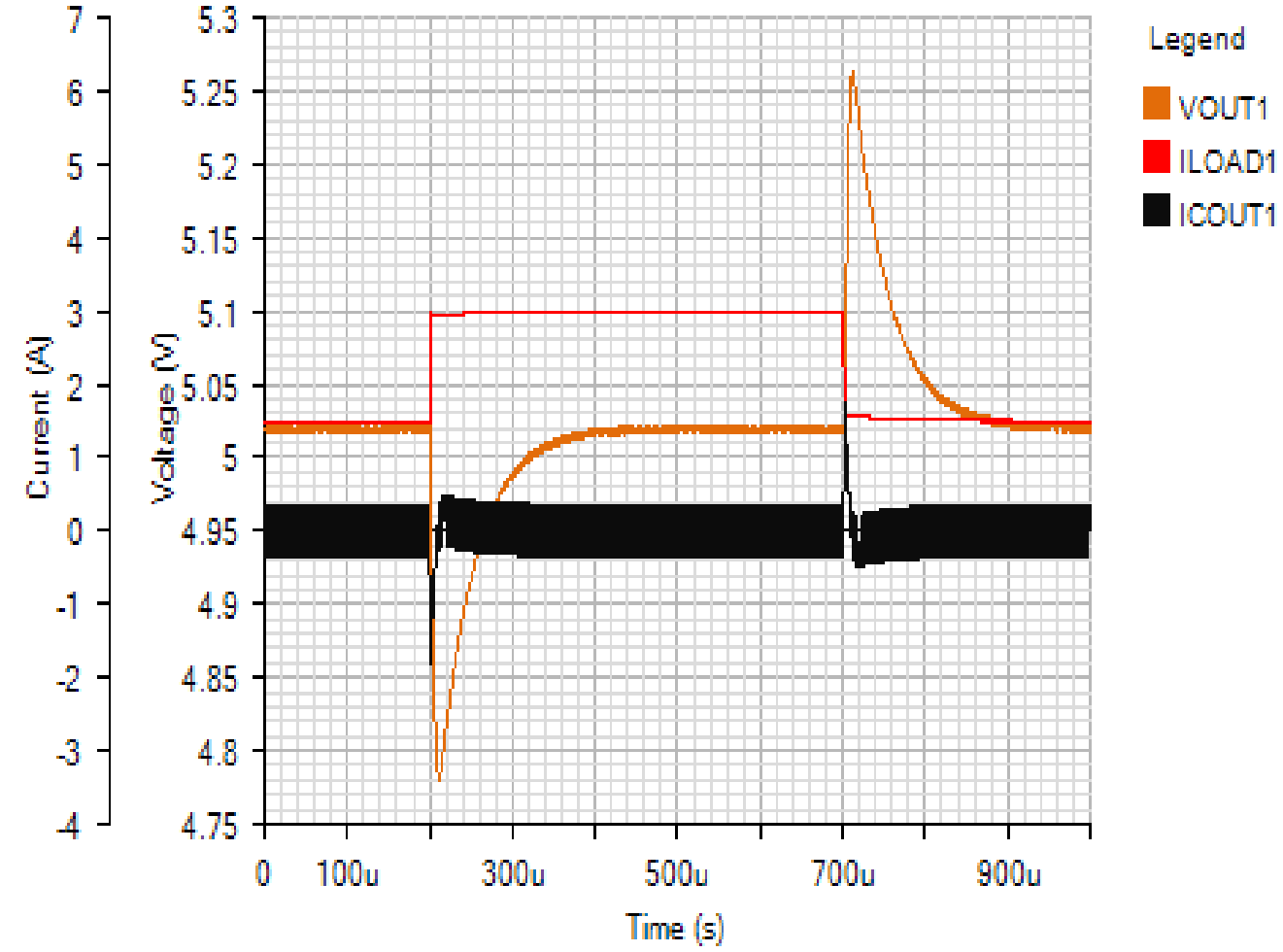


Phase Margin (output #2): 67.1° at a crossover frequency of 29.5kHz

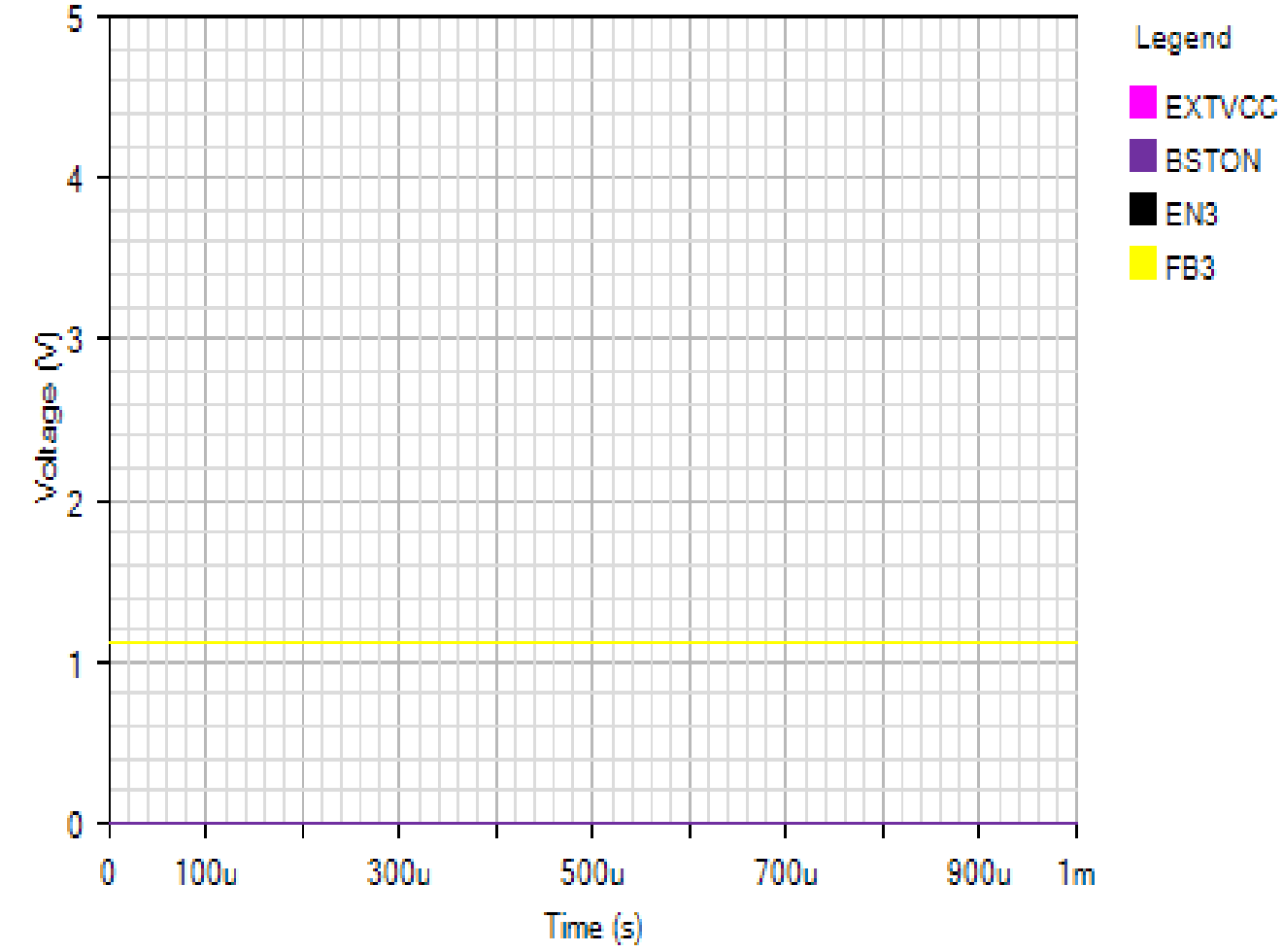


Load Step - Thu Nov 15 2018 14:37:25

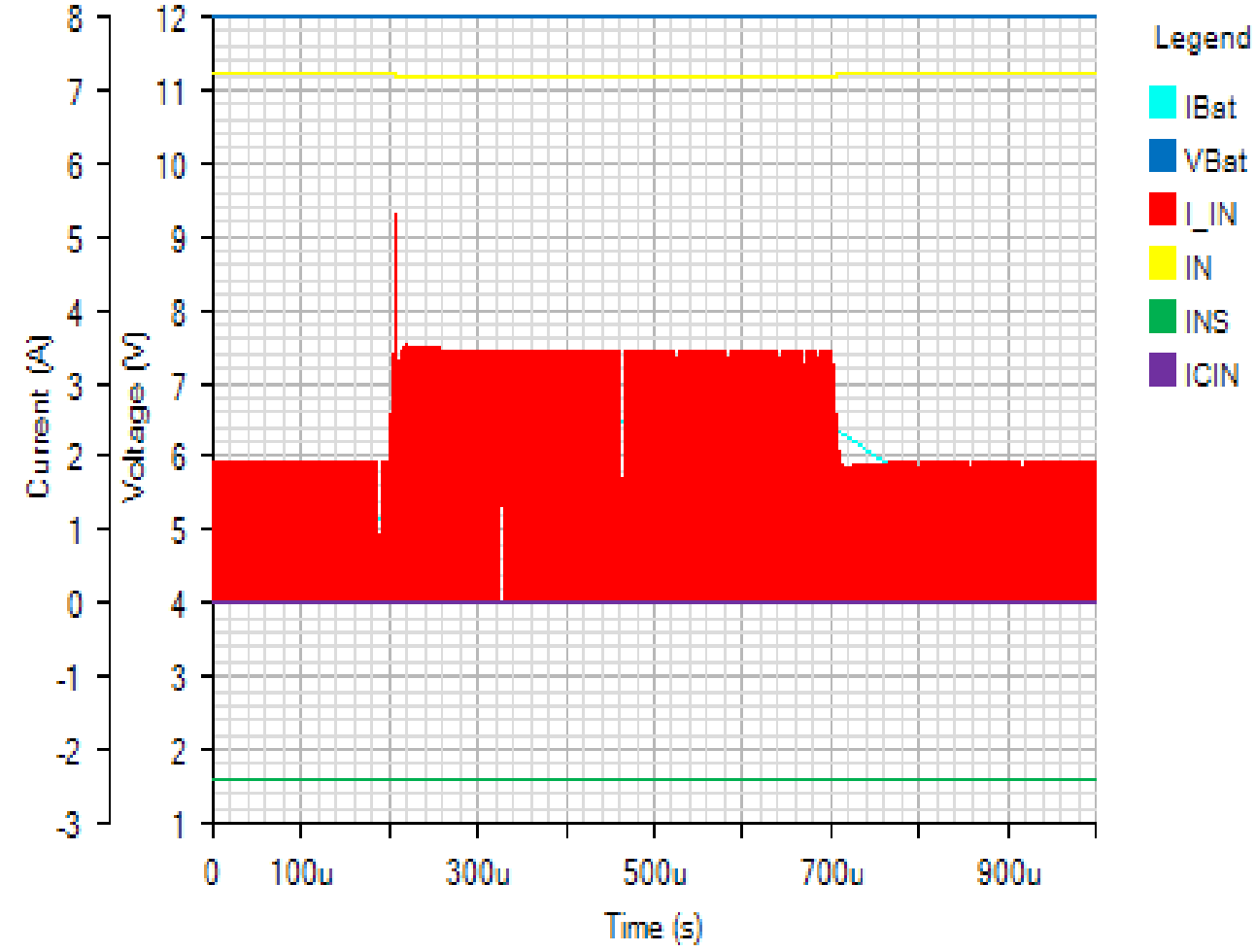
OUTPUT1 Default



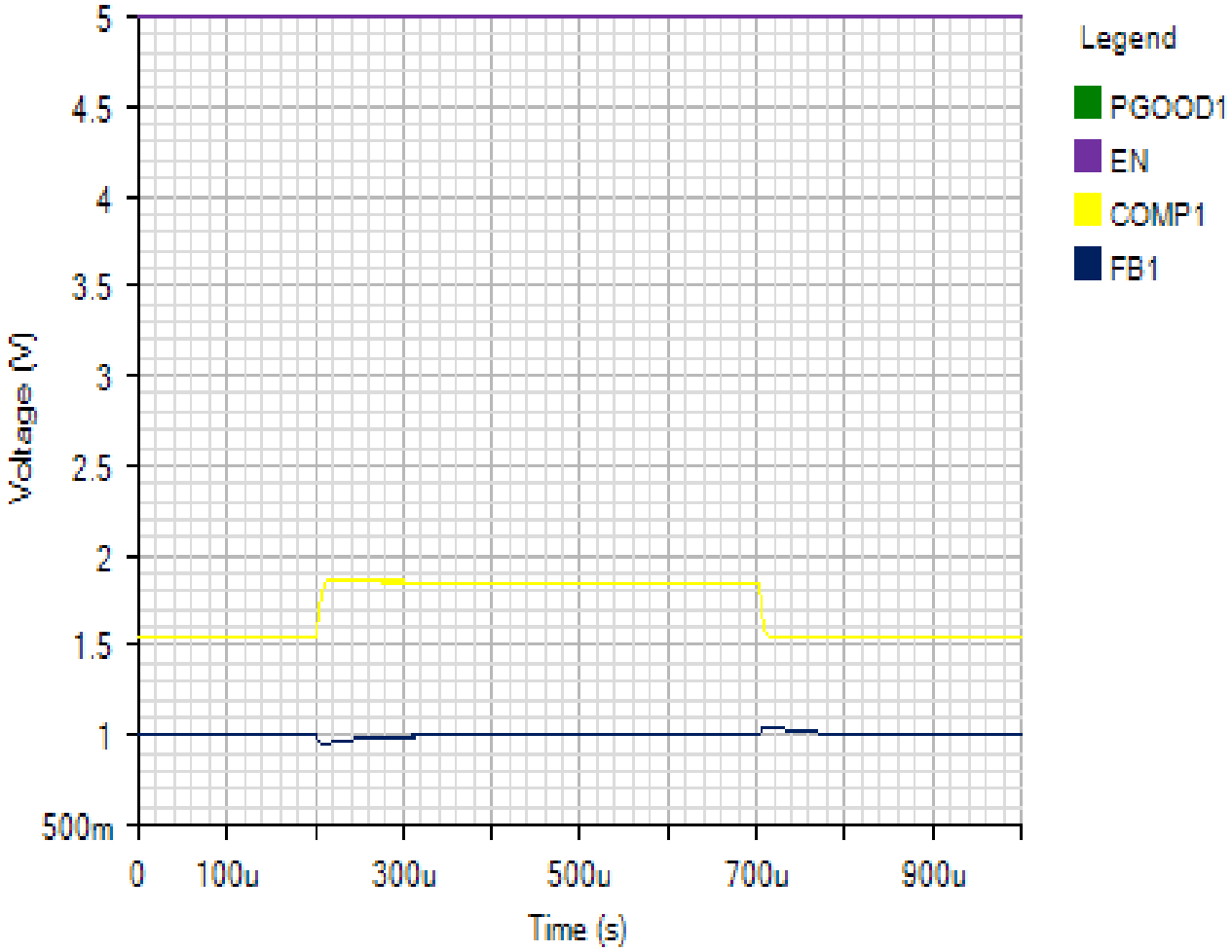
IC3 Default



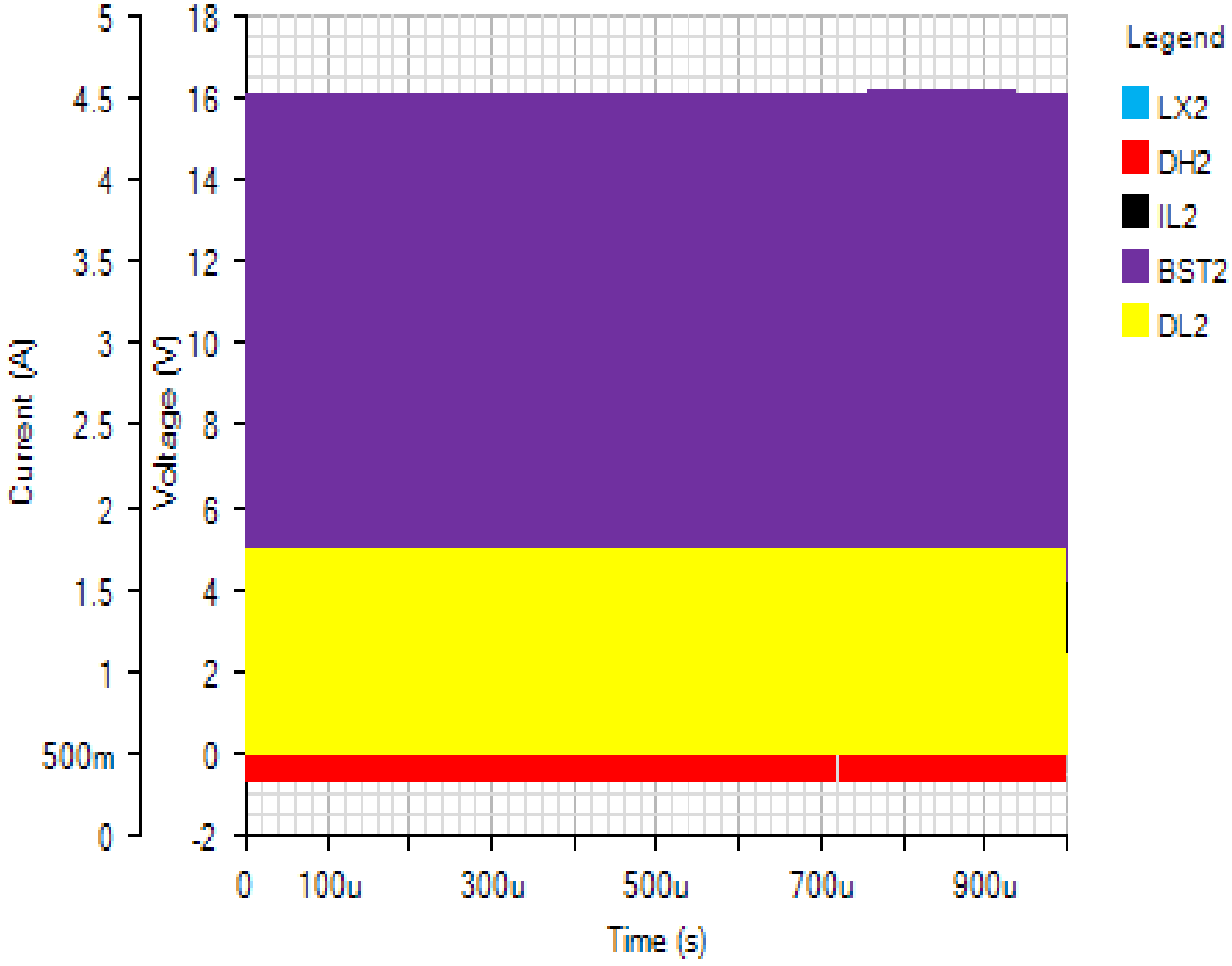
INPUT Default



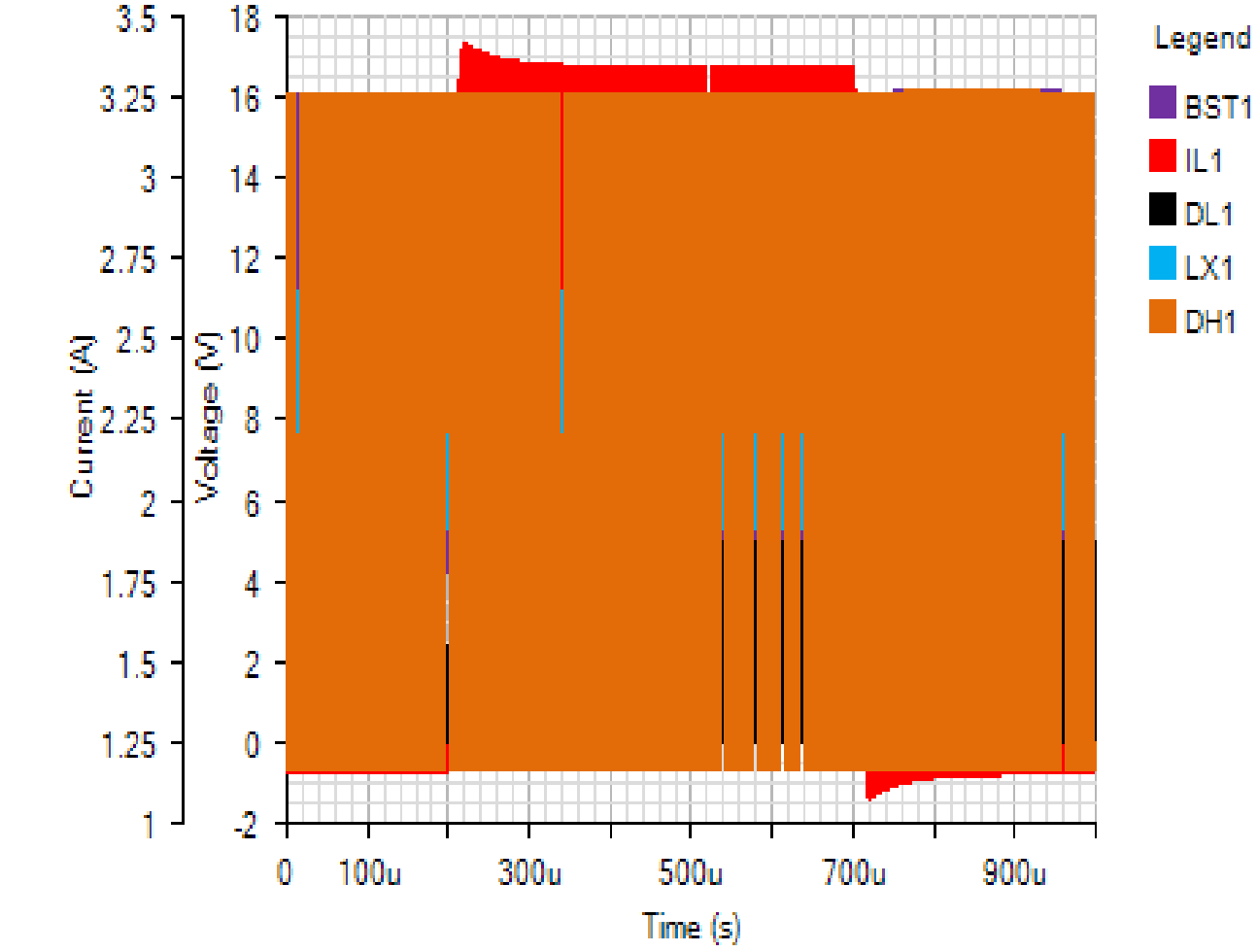
IC1 Default



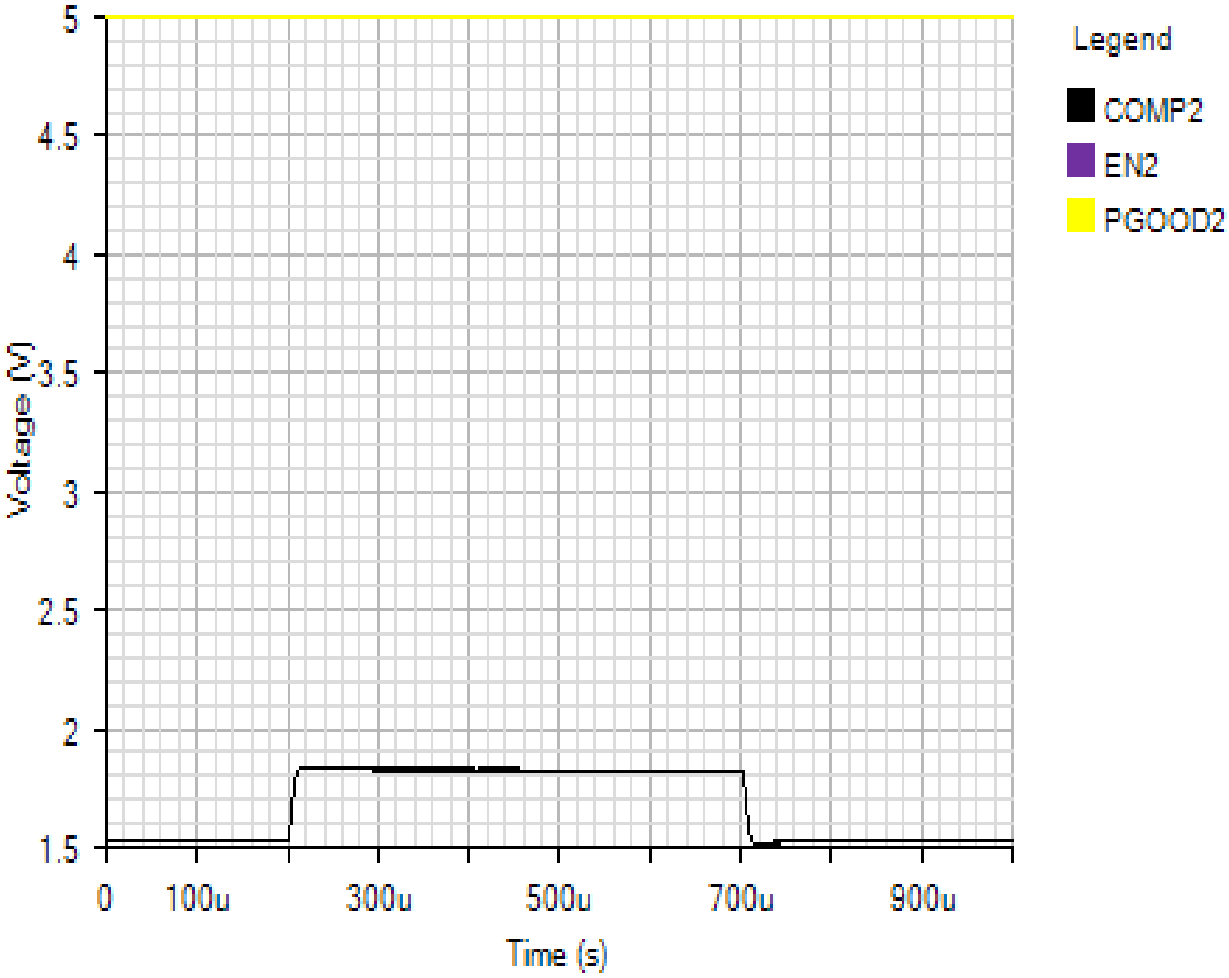
SWITCHING2 Default



SWITCHING1 Default



IC2 Default



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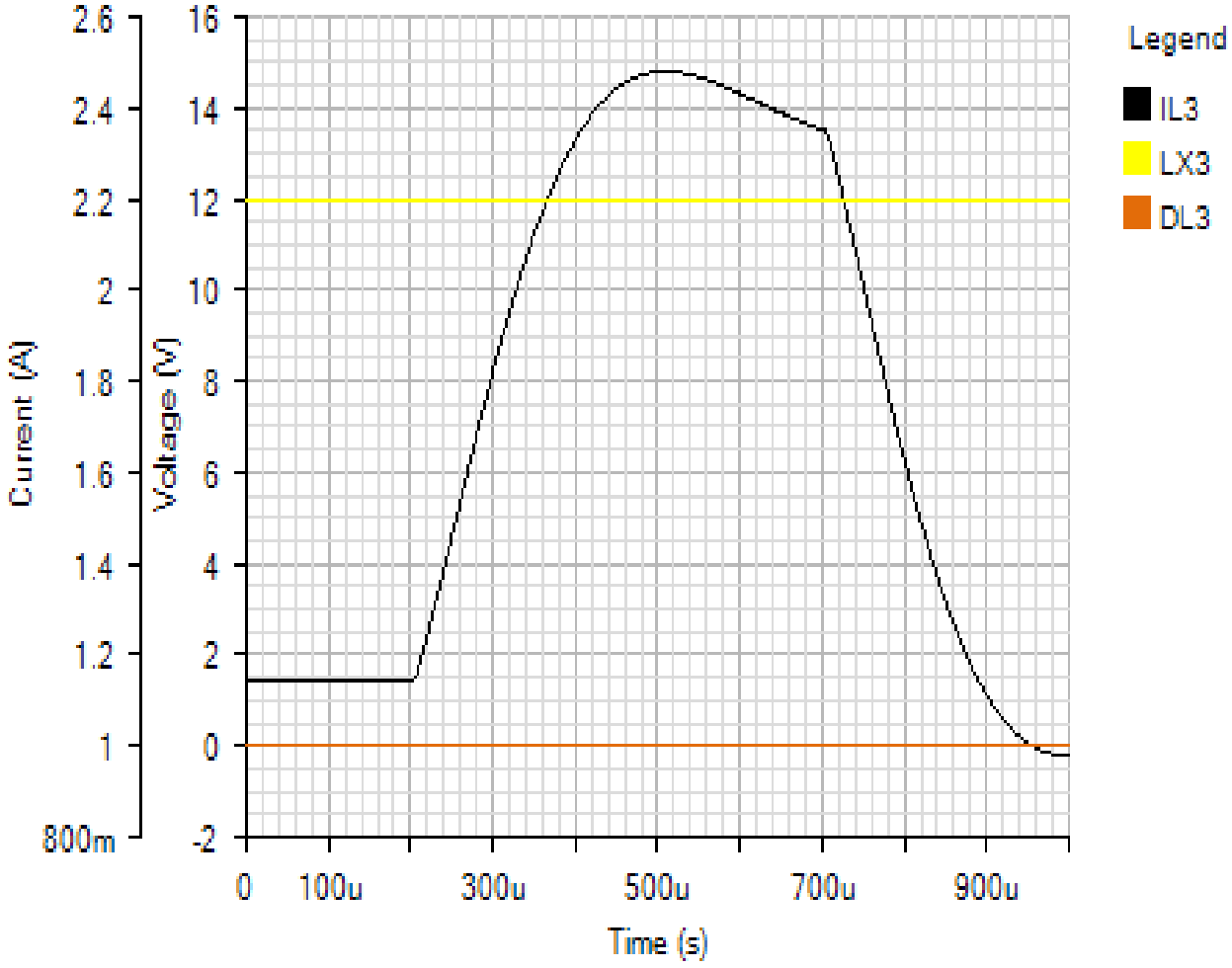

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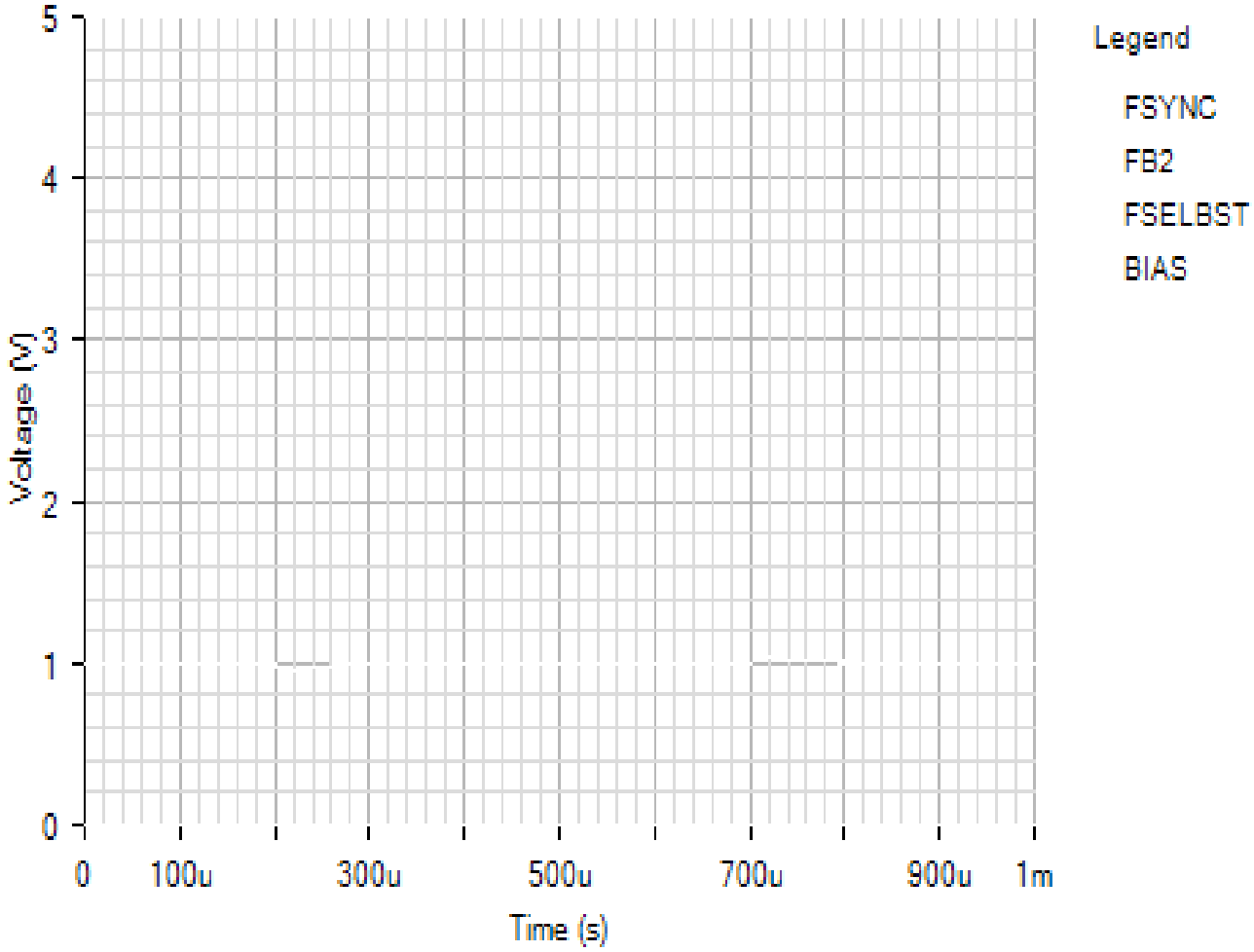

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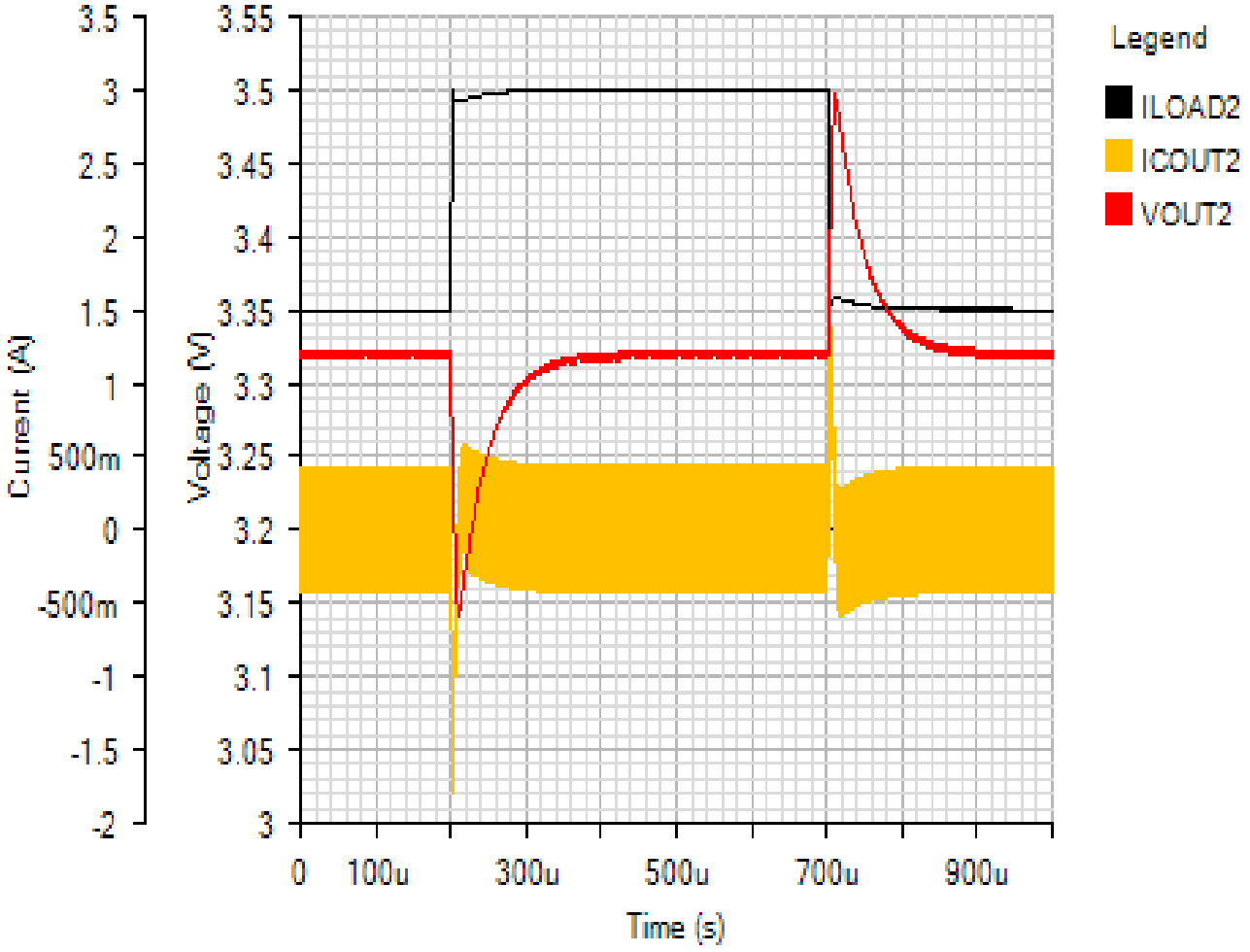
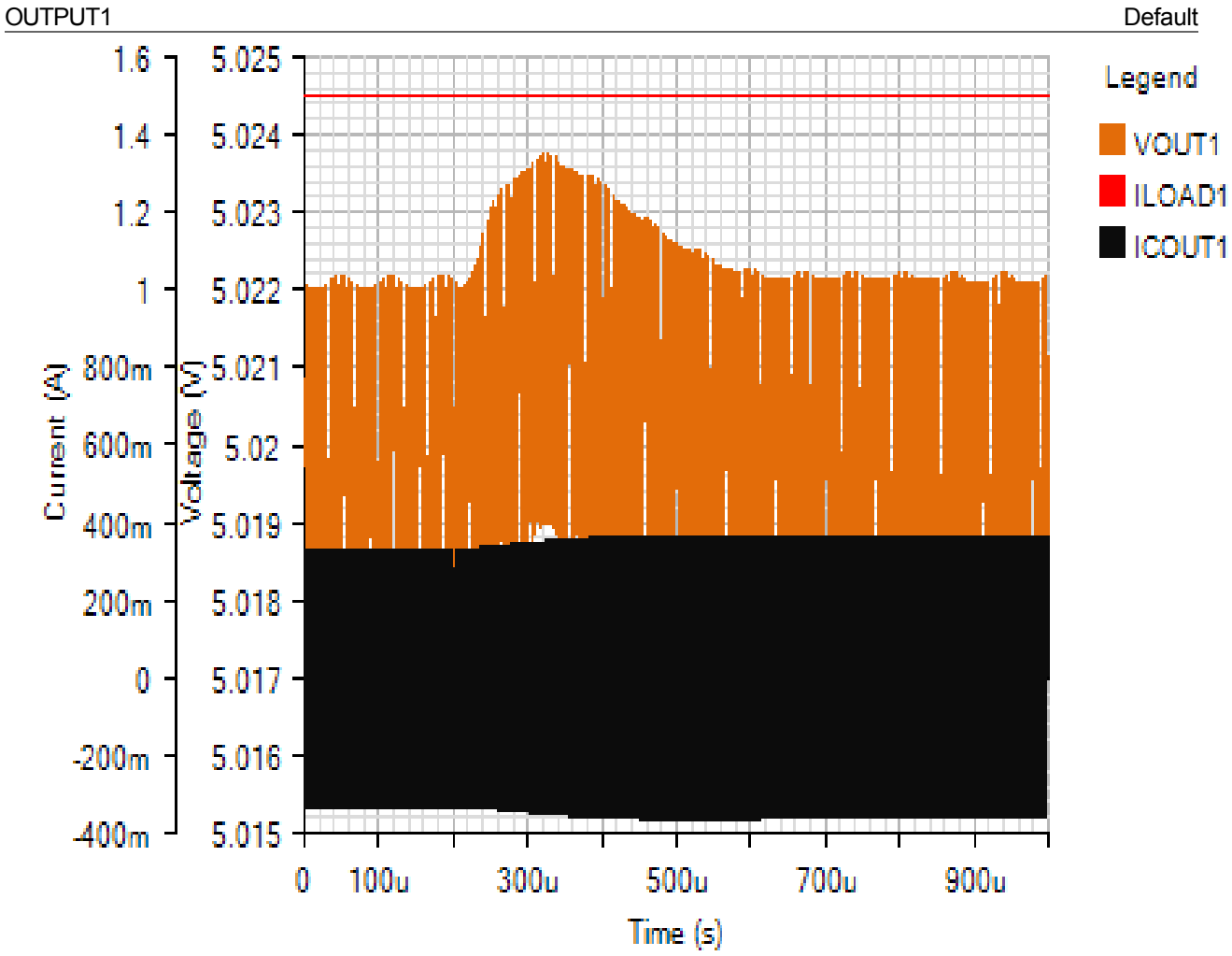


Line Transient - Thu Nov 15 2018 14:37:25



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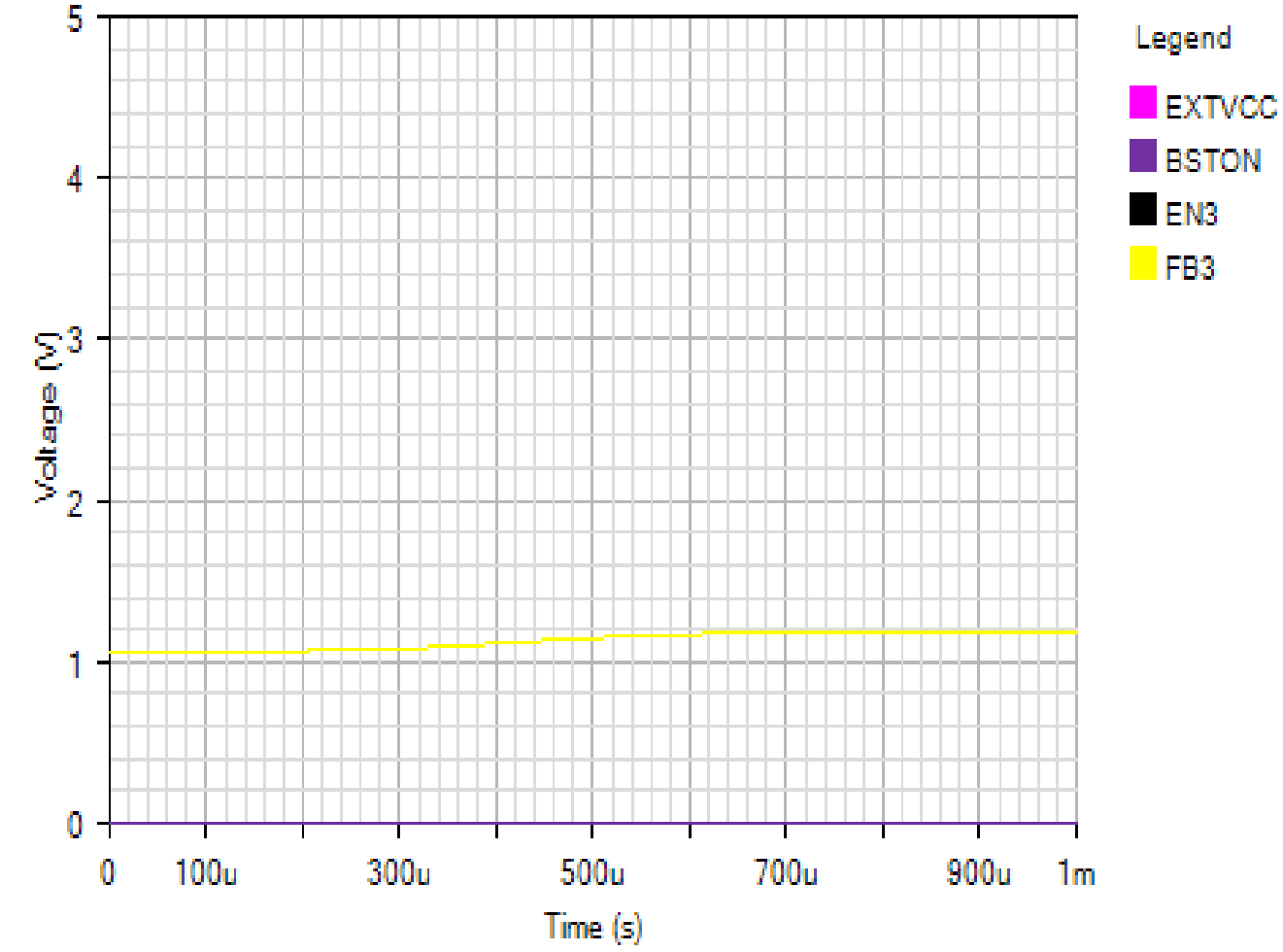

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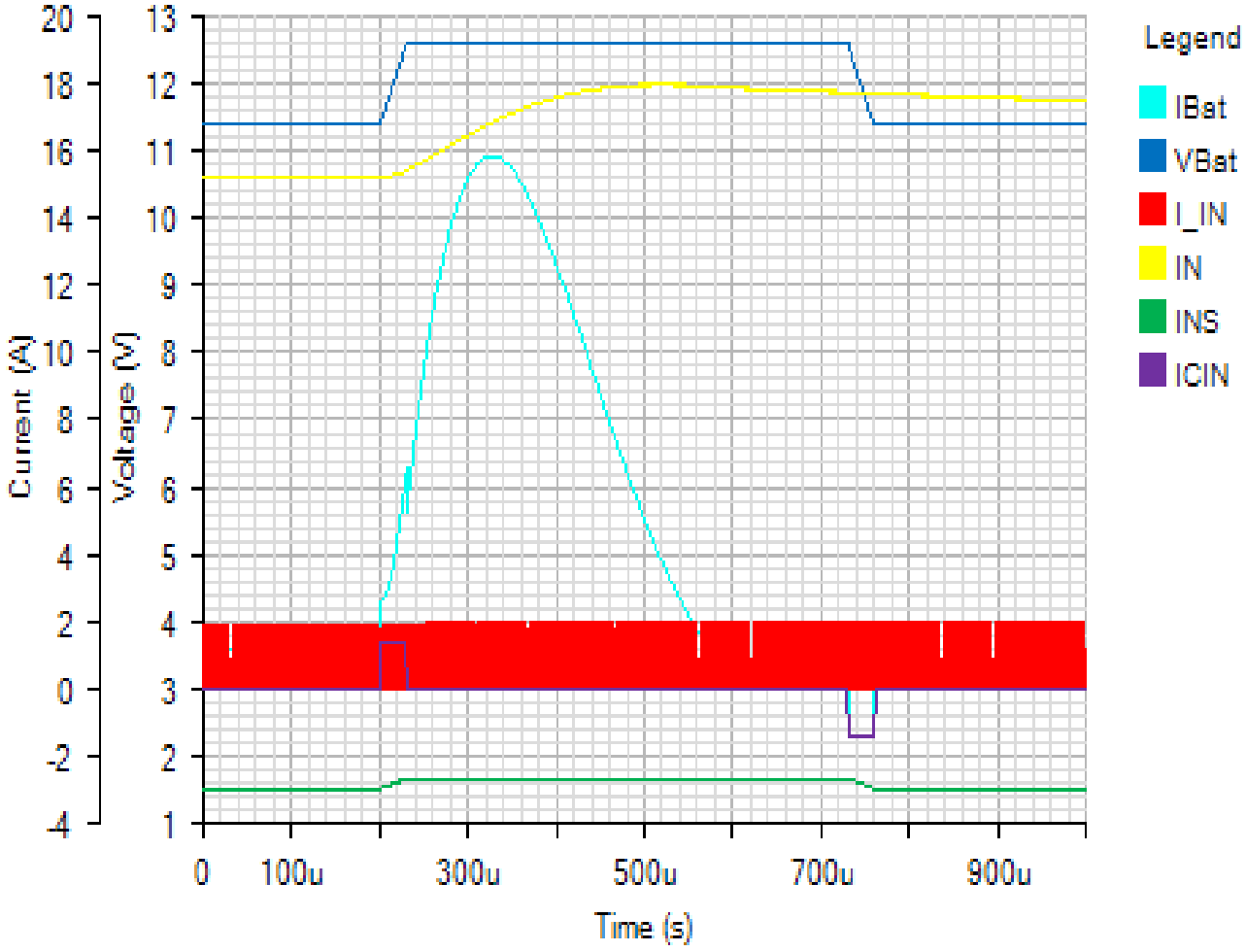

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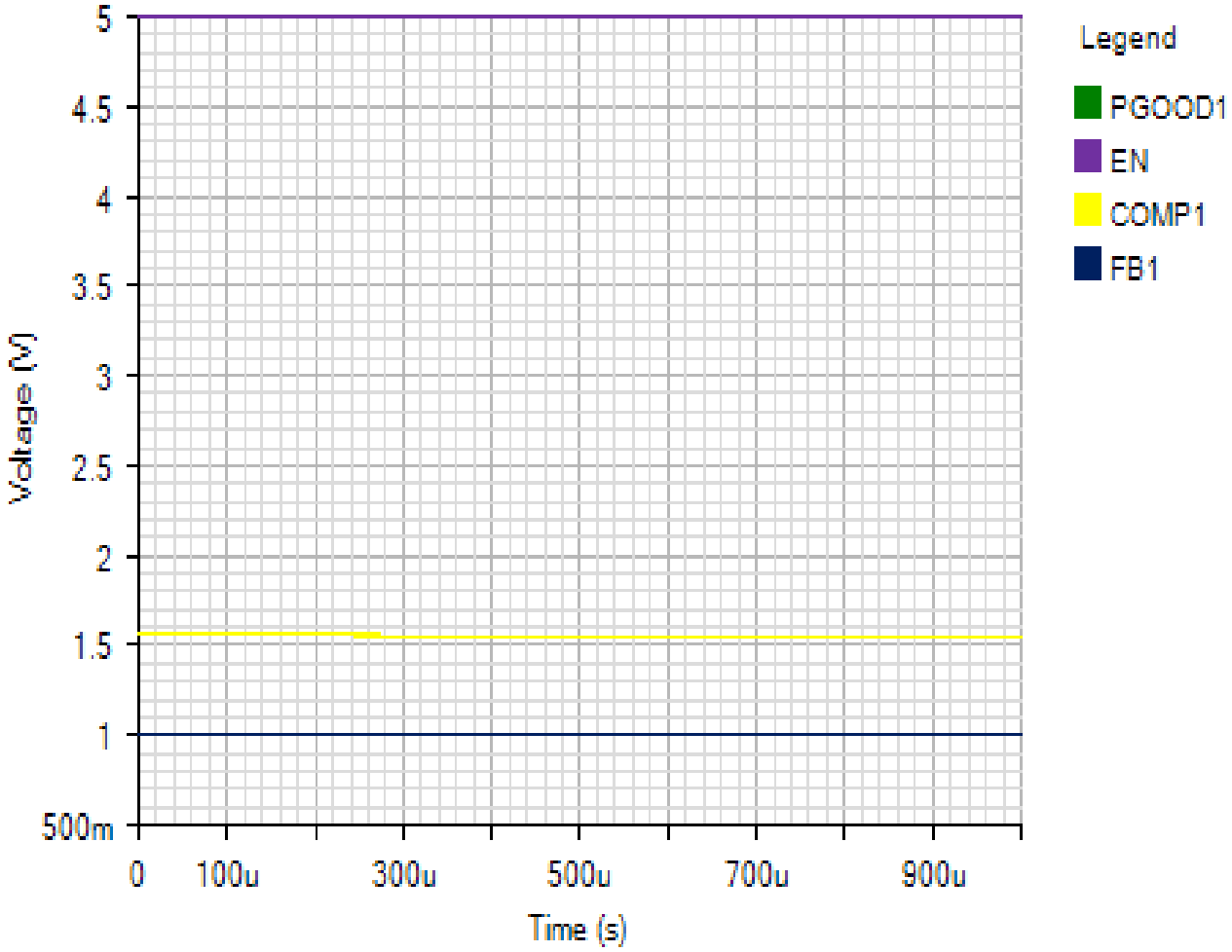

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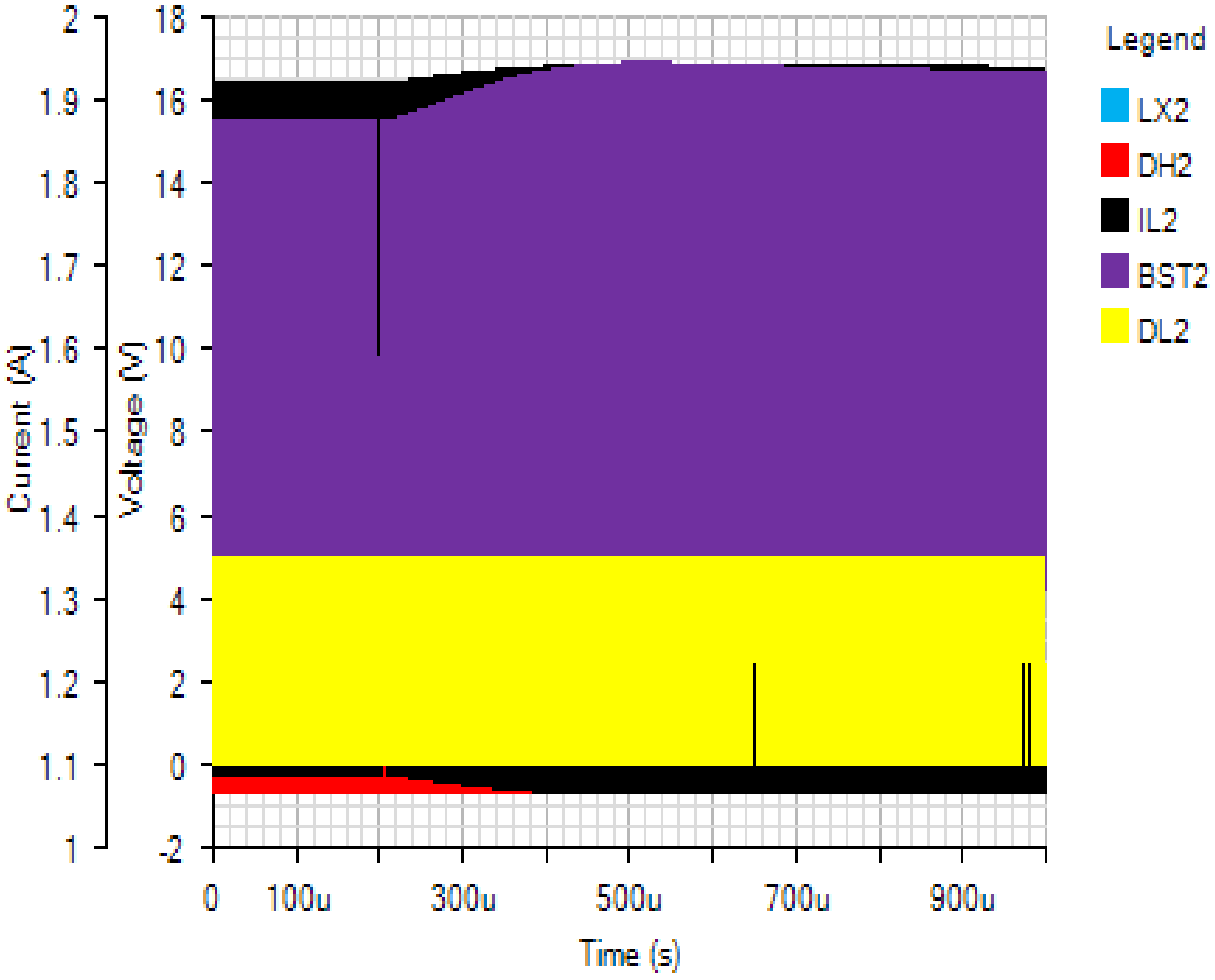

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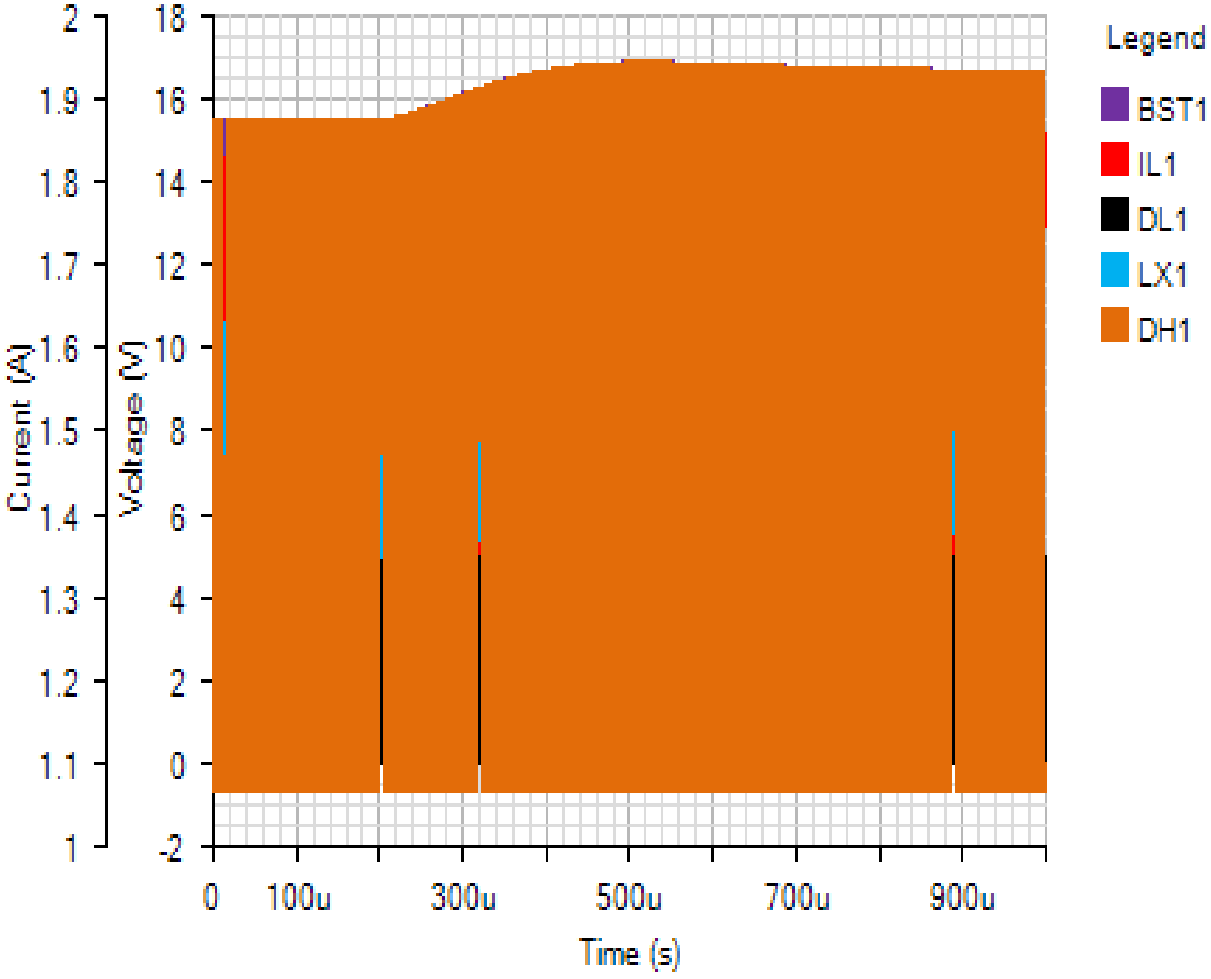

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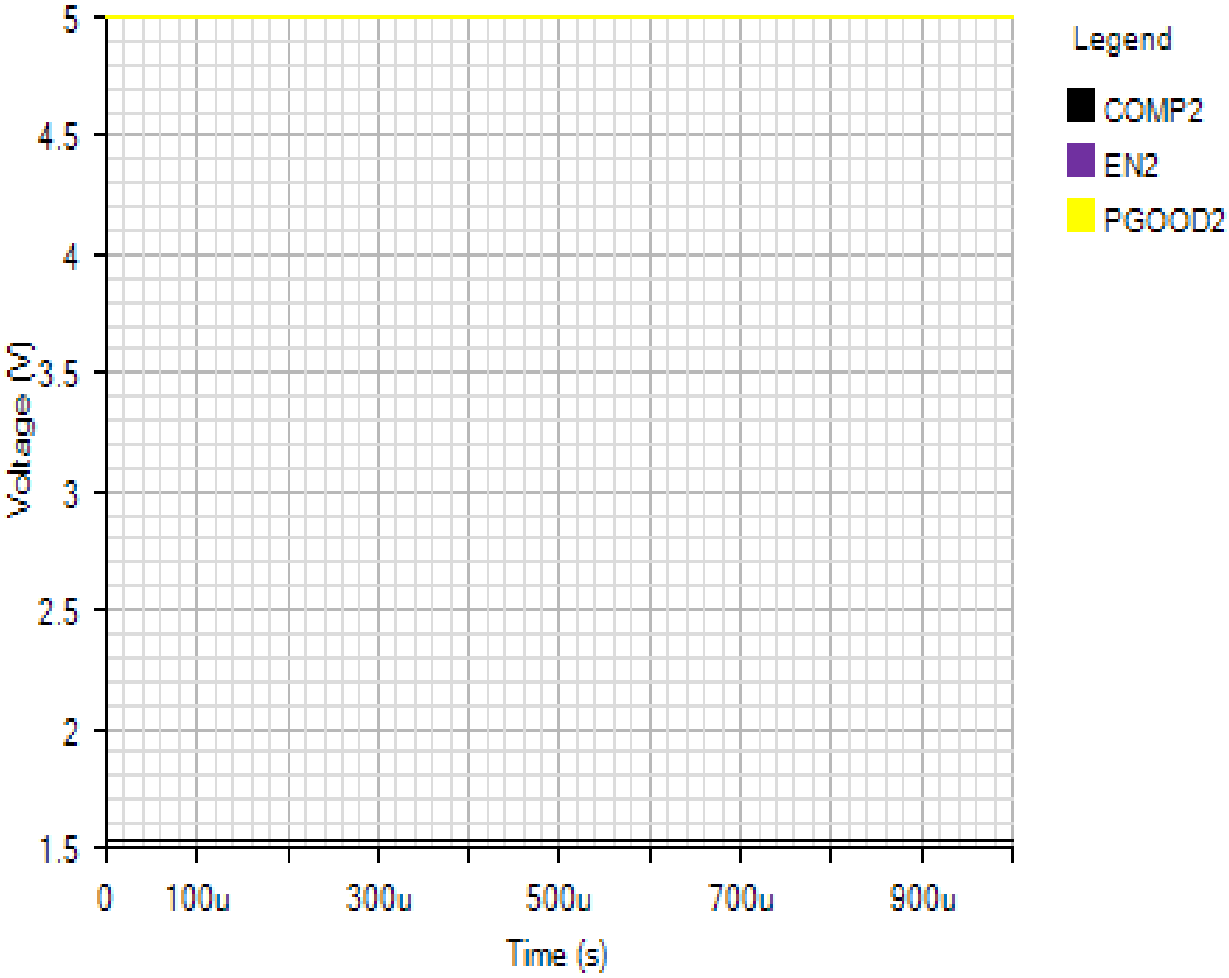

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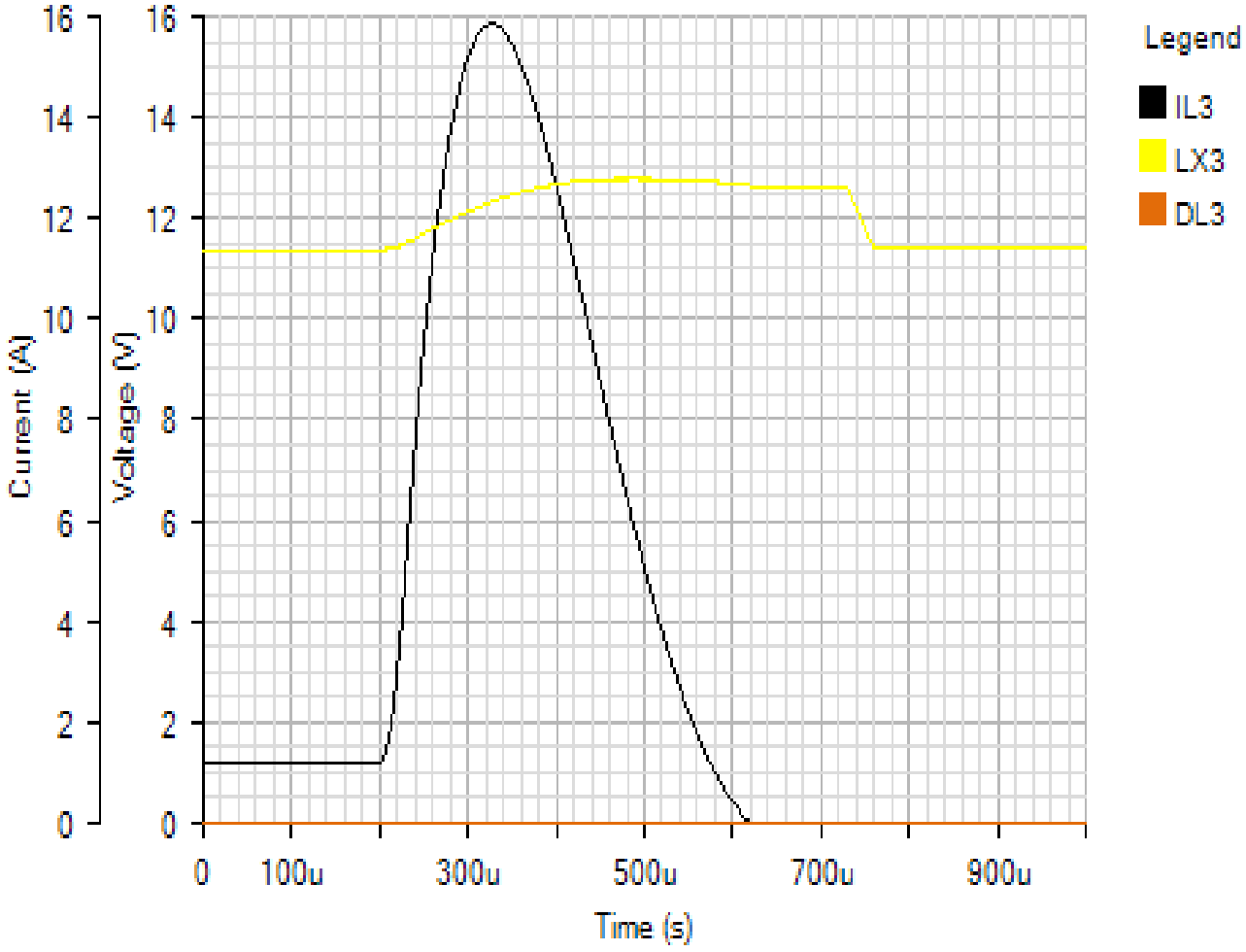

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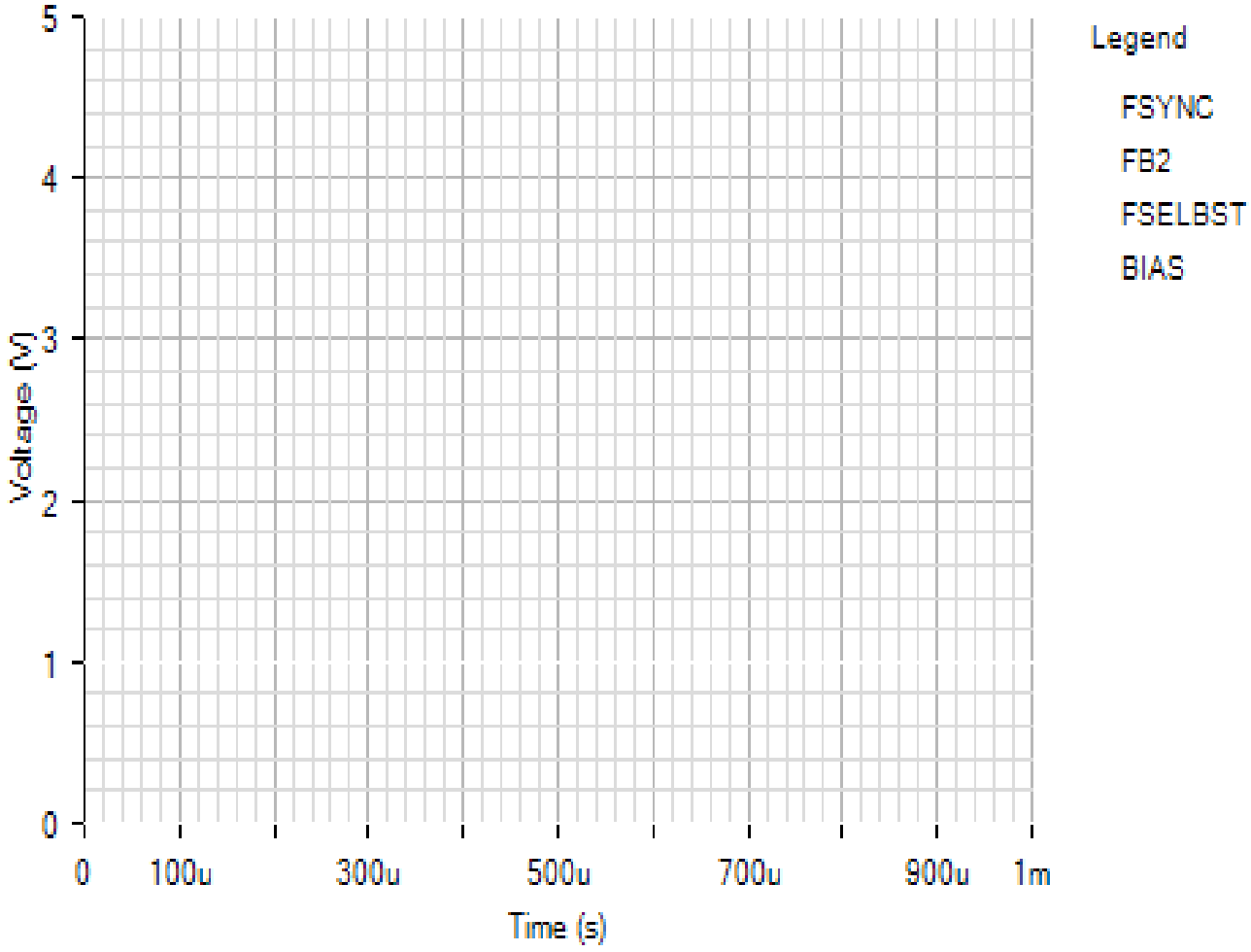

OUTPUT2 Default