

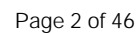
Initial Design

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 Ripple	1%
Output 1 Load Step Start Current	1.5A
Output 1 Load Step Current	3A
Output 1 Load Step Edge Rate	1A/us
Output 1 Voltage Load Step Over/Undershoot	5%
Output 2 Voltage Ripple	1%
Output 2 Load Step Current	3A
Output 2 Load Step Start Current	1.5A
Output 2 Load 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

Schematic



BOM

Ref	Qty	Part Number	Manufacturer	Description
U1	1	MAX16931	User-Defined	IC
C1	1	VJ0603Y104KXAAC	Vishay	Cap Ceramic 0.1uF 50V X7R 10% Pad SMD 0603 150°C T/R
C2	9	GRM32ER71E226ME15	Murata	Cap Ceramic 22uF 25V 1210 125C
C4	1	VJ0603Y223JXACW1BC	Vishay	Cap Ceramic 0.022uF 50V X7R 5% Pad SMD 0603 125°C T/R
C9	1	VJ0603Y104KXAAC	Vishay	Cap Ceramic 0.1uF 50V X7R 10% Pad SMD 0603 150°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	04023C685KAT2A	AVX	Cap Ceramic 6.8uF 25V X7R 10% Pad SMD 0402 125°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	NMC0402NPO180J50TRPF	NIC Components	Cap Ceramic 18pF 50V C0G 5% Pad SMD 0402 125°C T/R
Cf2	1	NMC0402NPO120J50TRPF	NIC Components	Cap Ceramic 12pF 50V C0G 5% Pad SMD 0402 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

Q3	1	FDMS0310AS	Fairchild Semiconductor	PQFN 5x6 8L (Power 56) 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
Q4	1	FDMS0310AS	Fairchild Semiconductor	PQFN 5x6 8L (Power 56) 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
Q5	1	FDMS0310AS	Fairchild Semiconductor	PQFN 5x6 8L (Power 56) 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
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	ERJ2RKF6652X	Panasonic	Res Thick Film 0402 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	ERJ2RKF1002X	Panasonic	Res Thick Film 0402 10K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R6	1	ERJ2RKF9092X	Panasonic	Res Thick Film 0402 90.9K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R7	1	ERJ2RKF1002X	Panasonic	Res Thick Film 0402 10K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R8	1	ERJ2RKF1002X	Panasonic	Res Thick Film 0402 10K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R9	1	ERJ3EKF5102V	Panasonic	Res Thick Film 0603 51K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R10	1	ERJ3EKF5102V	Panasonic	Res Thick Film 0603 51K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R11	1	ERJ2RKF1002X	Panasonic	Res Thick Film 0402 10K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R12	1	ERJ3EKF5102V	Panasonic	Res Thick Film 0603 51K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R13	1	ERJ2RKF1002X	Panasonic	Res Thick Film 0402 10K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R

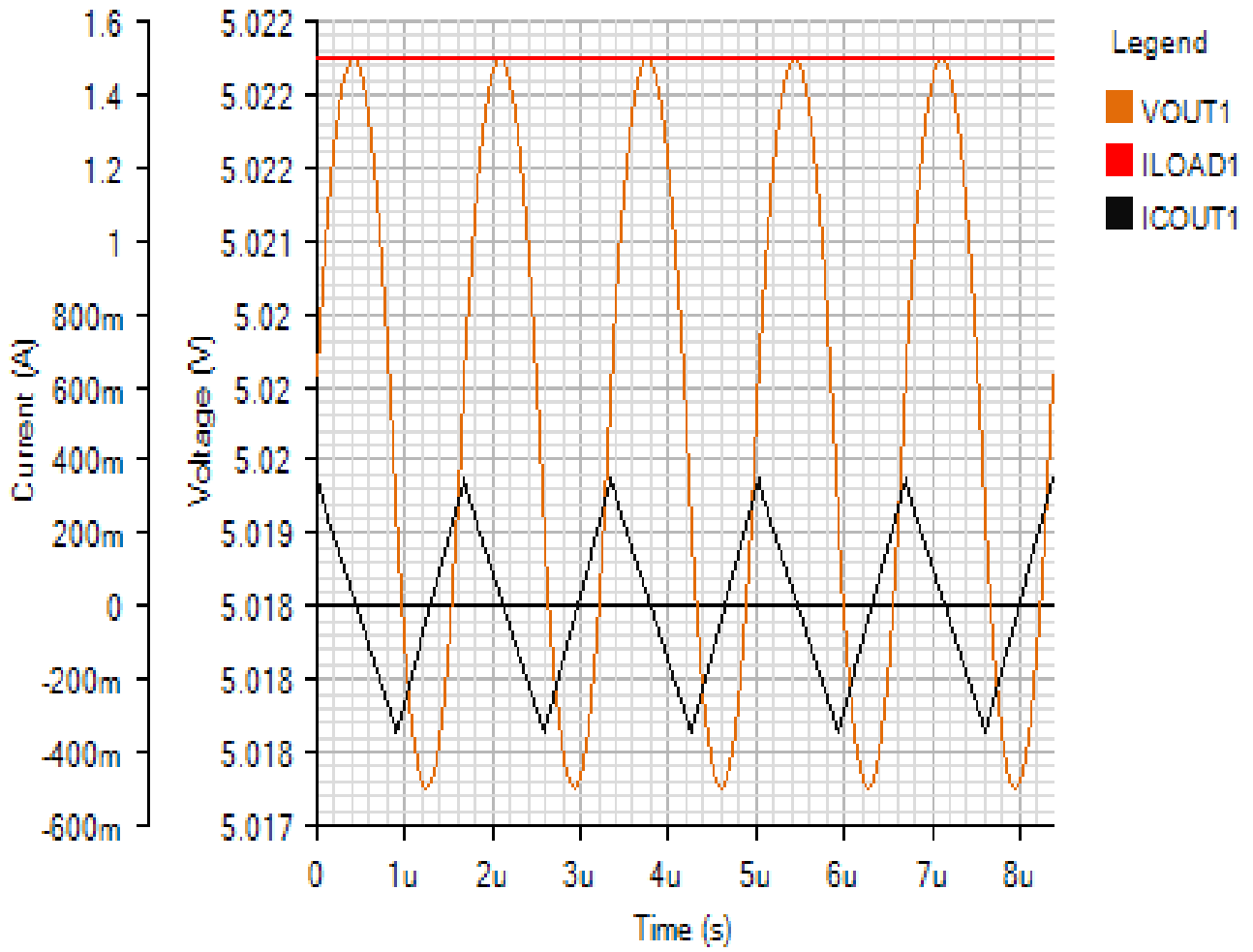
R14	1	ERJ2GEJ513X	Panasonic	Res Thick Film 0402 51K Ohm 5% 0.1W(1/10W) ±200ppm/°C Pad SMD Automotive T/R
R16	1	ERJ2RKF1002X	Panasonic	Res Thick Film 0402 10K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R17	1	ERJ2RKF2322X	Panasonic	Res Thick Film 0402 23.2K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD 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	SL1TTE9L10F	KOA Speer Electronics	Res Metal Plate 2512 0.0091 Ohm 1% 1W ±180ppm/°C J-Lead 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

Steady State - Mon Nov 19 2018 14:32:56

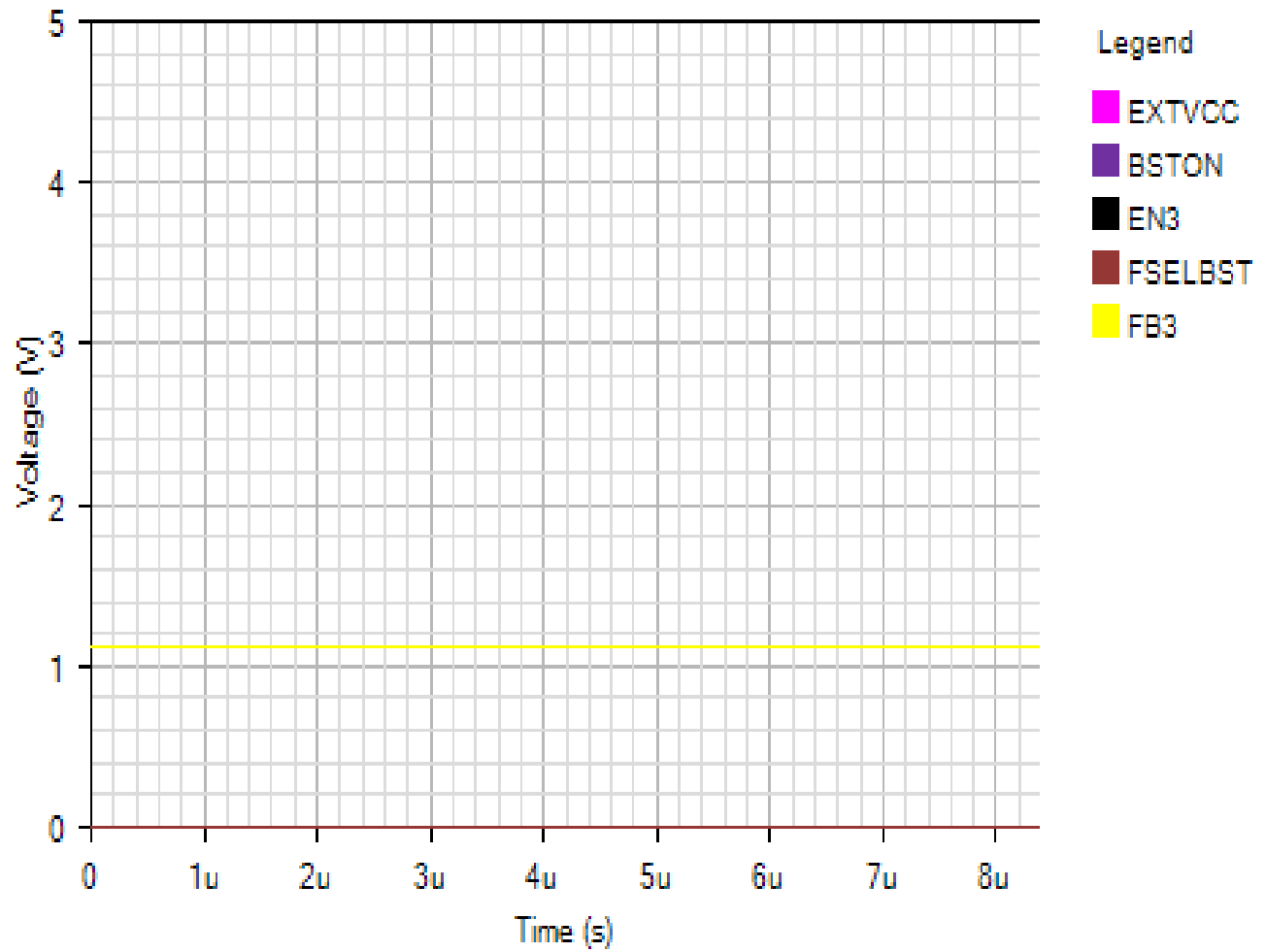
OUTPUT1

Default



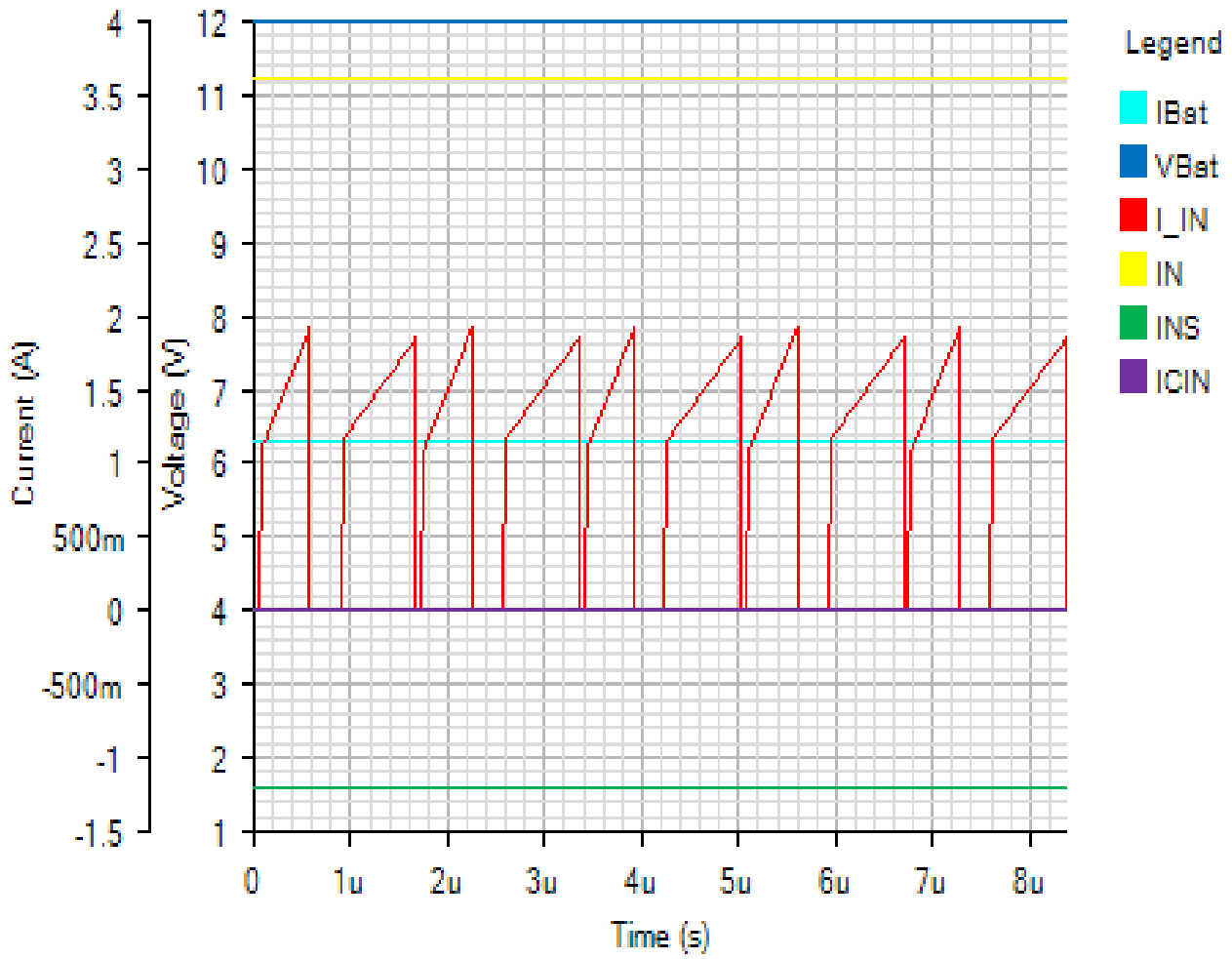
IC3

Default



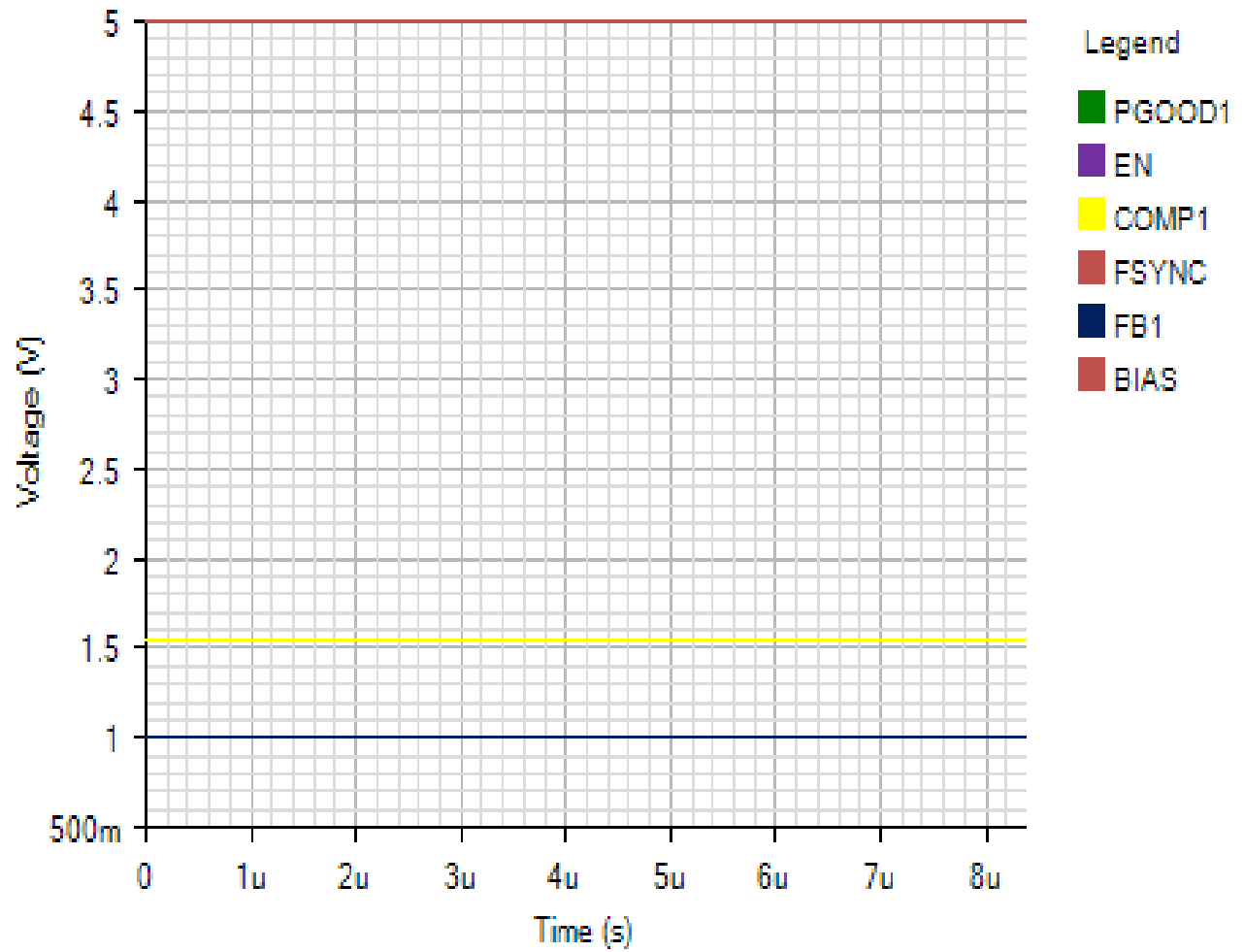
INPUT

Default



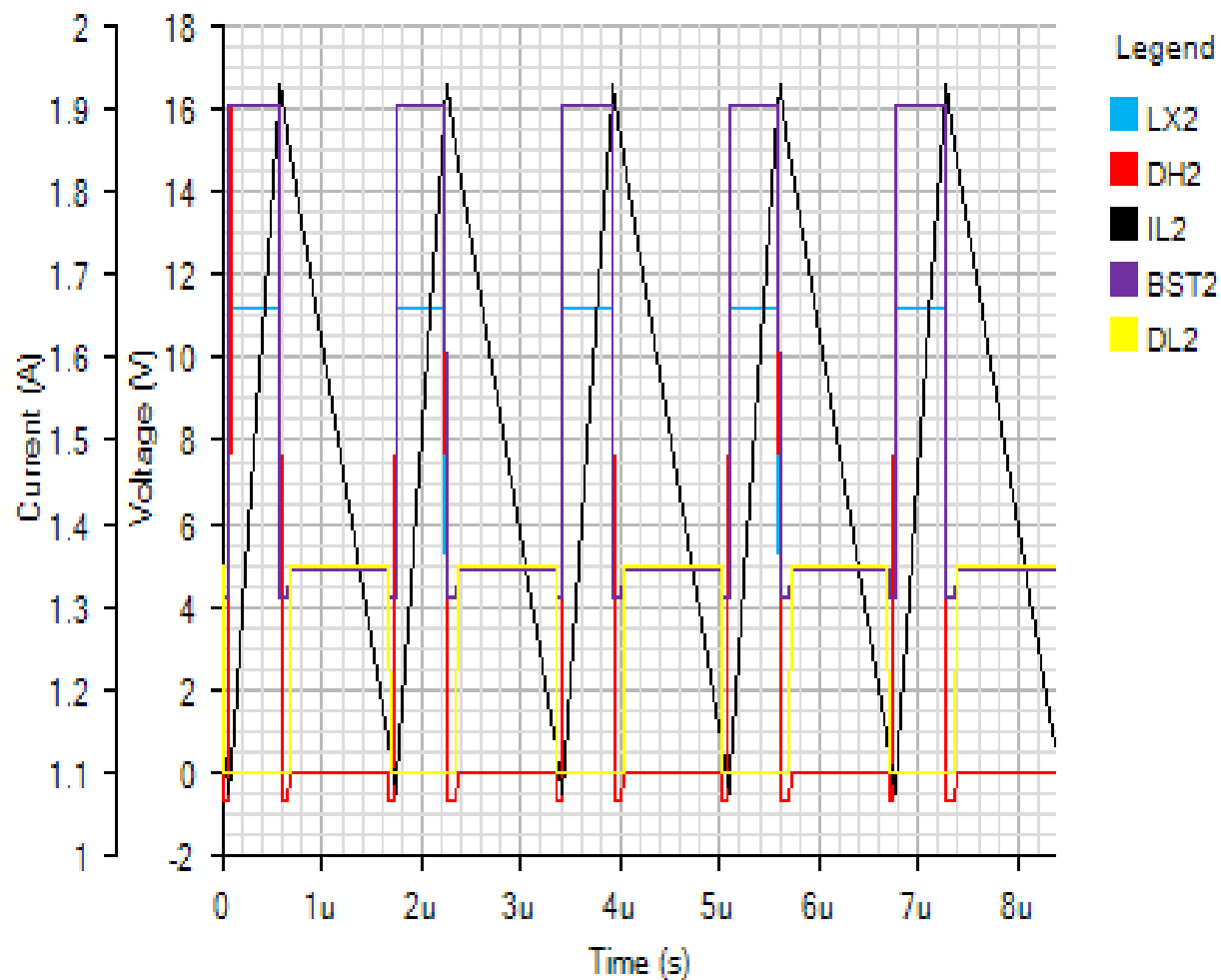
IC1

Default



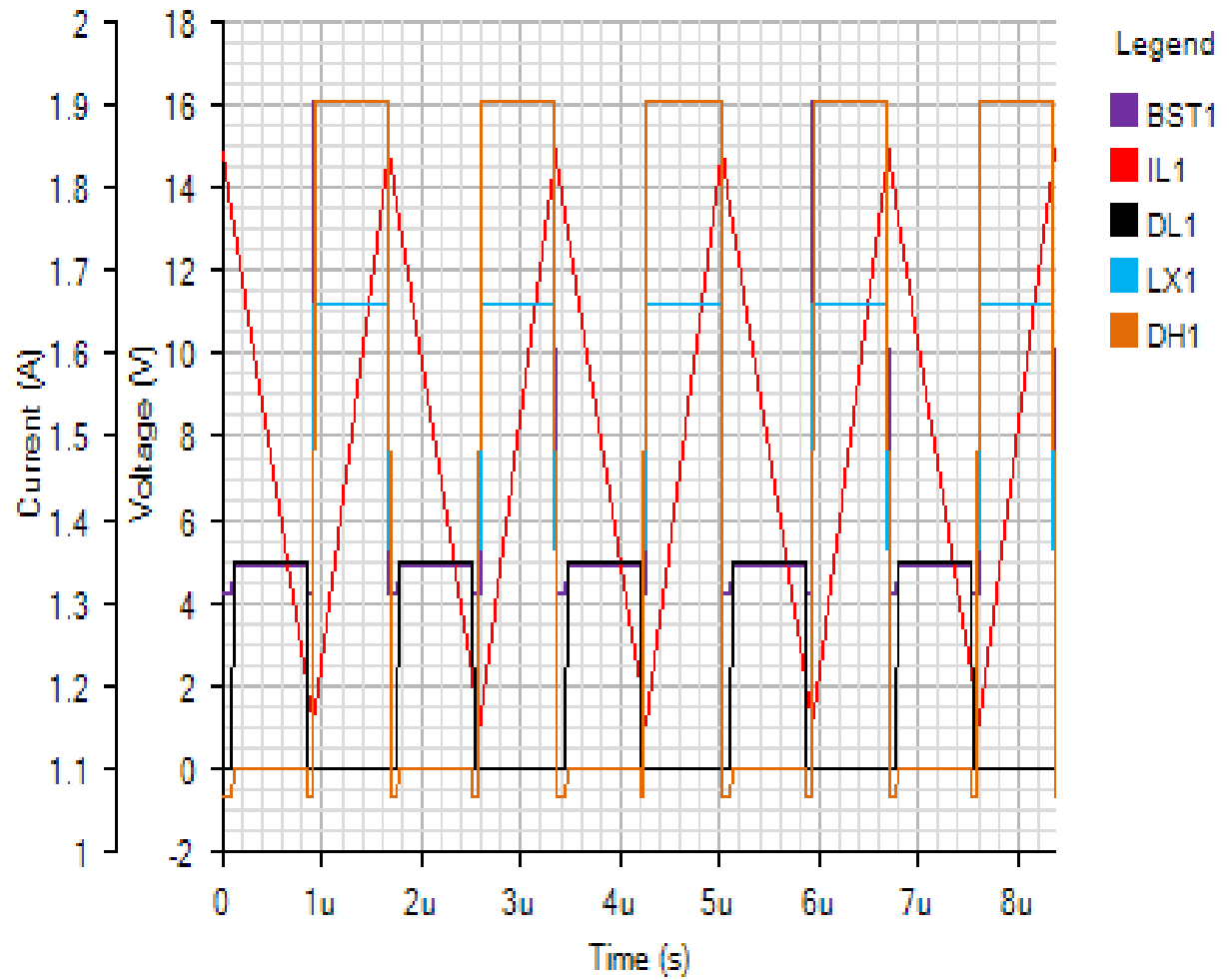
SWITCHING2

Default



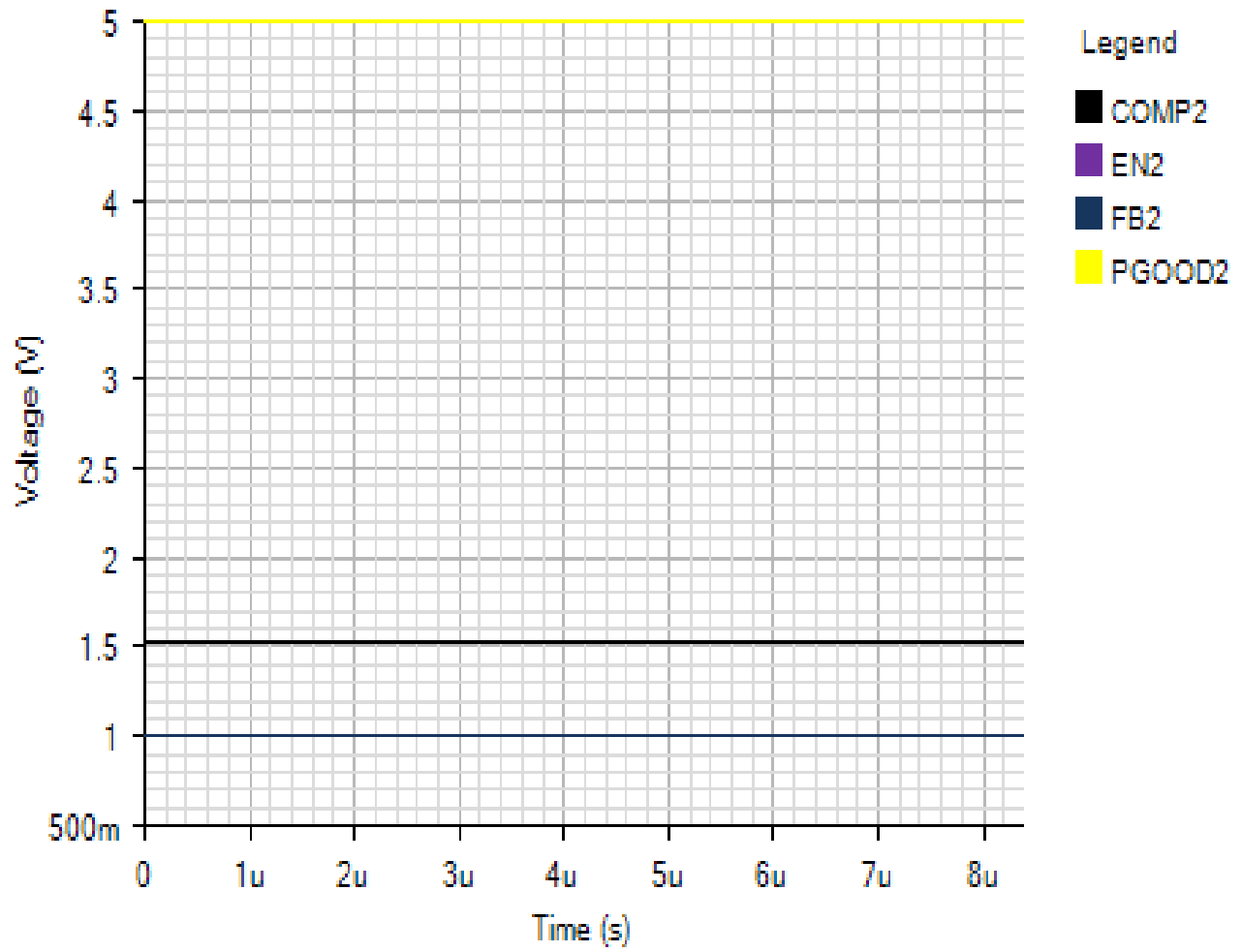
SWITCHING1

Default



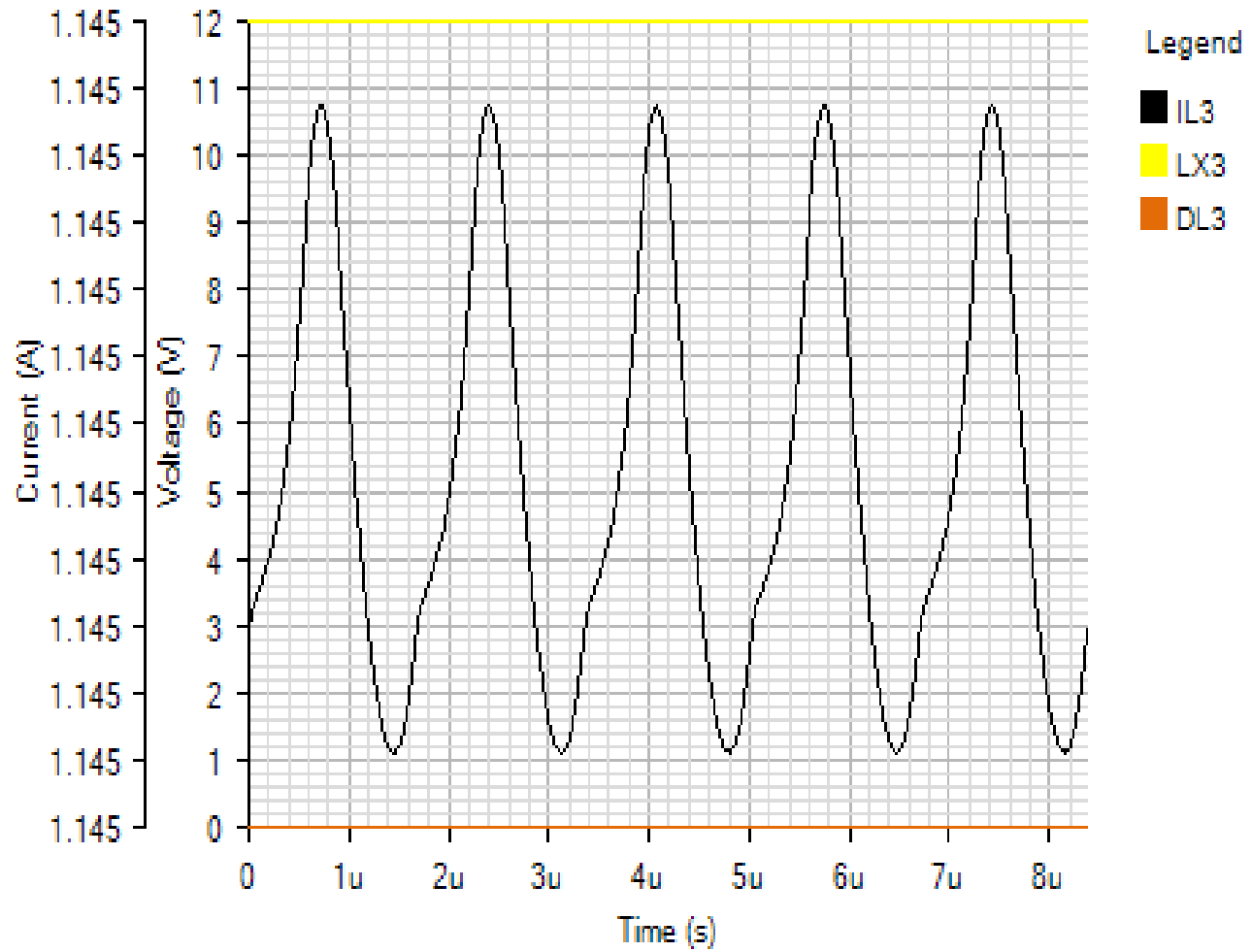
IC2

Default



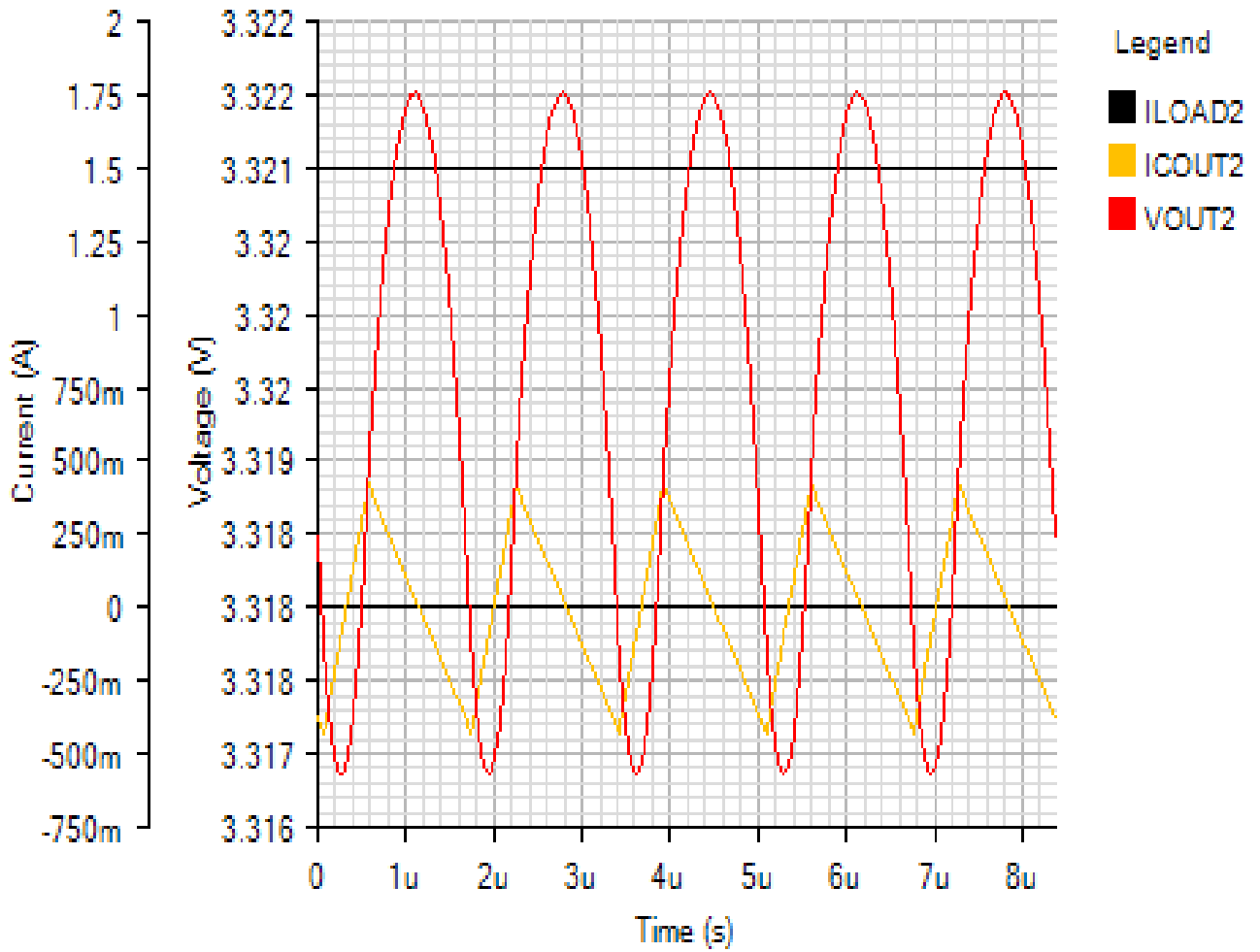
SWITCHING3

Default



OUTPUT2

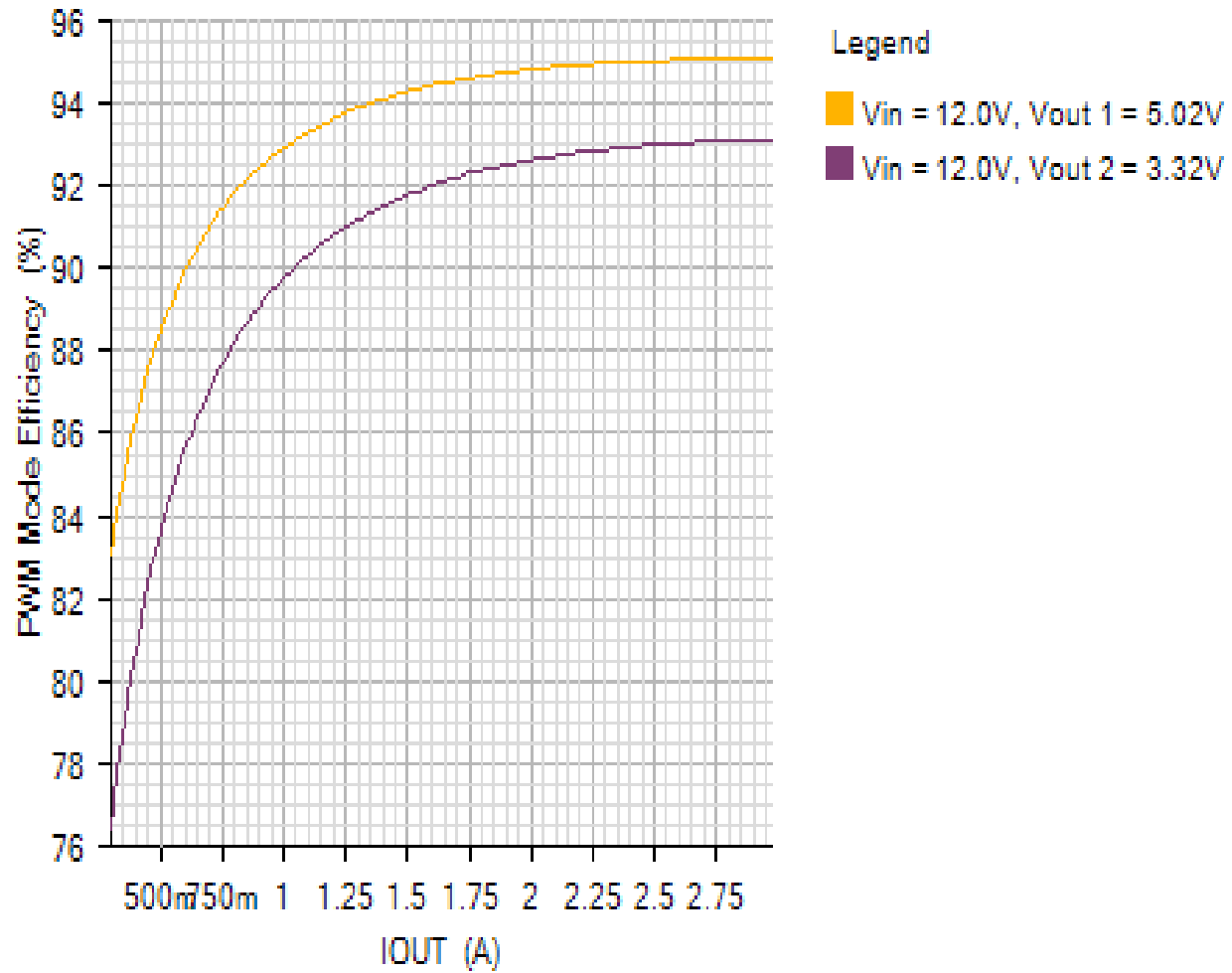
Default



Efficiency - Mon Nov 19 2018 14:32:56

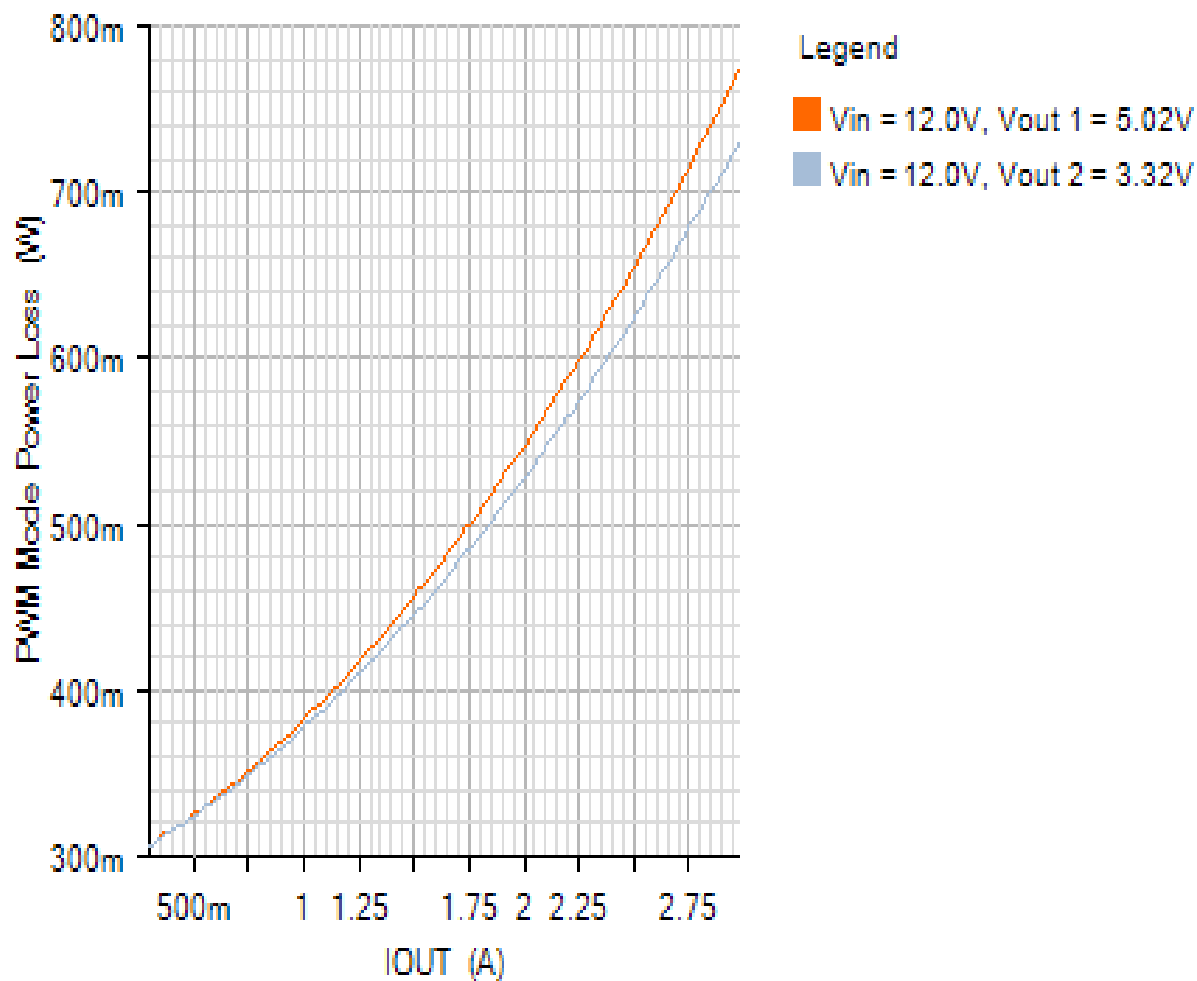
EFFICIENCY_PLOT

Default

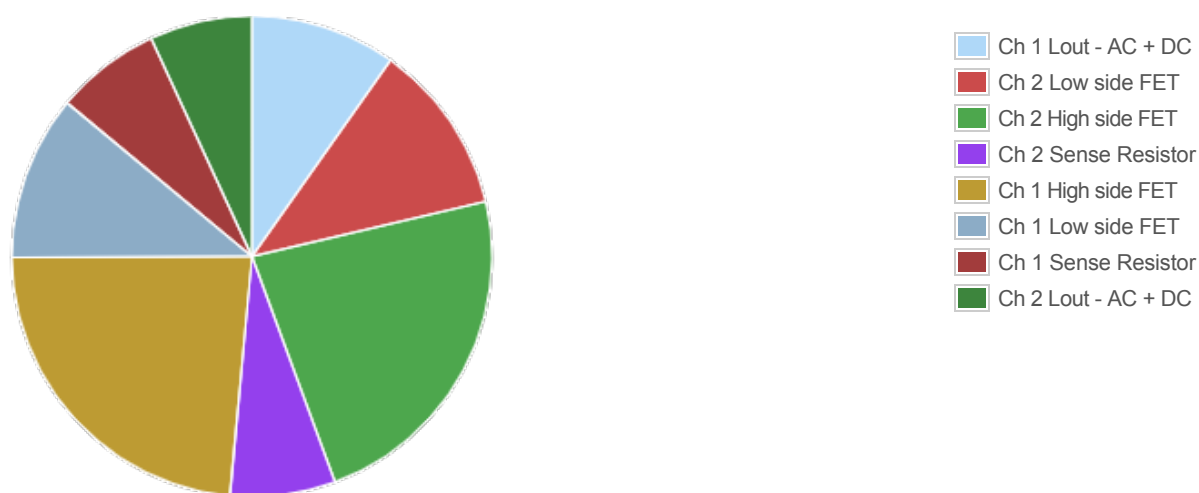


POWER_LOSS_PLOT

Default



Losses



Component

Loss (W)

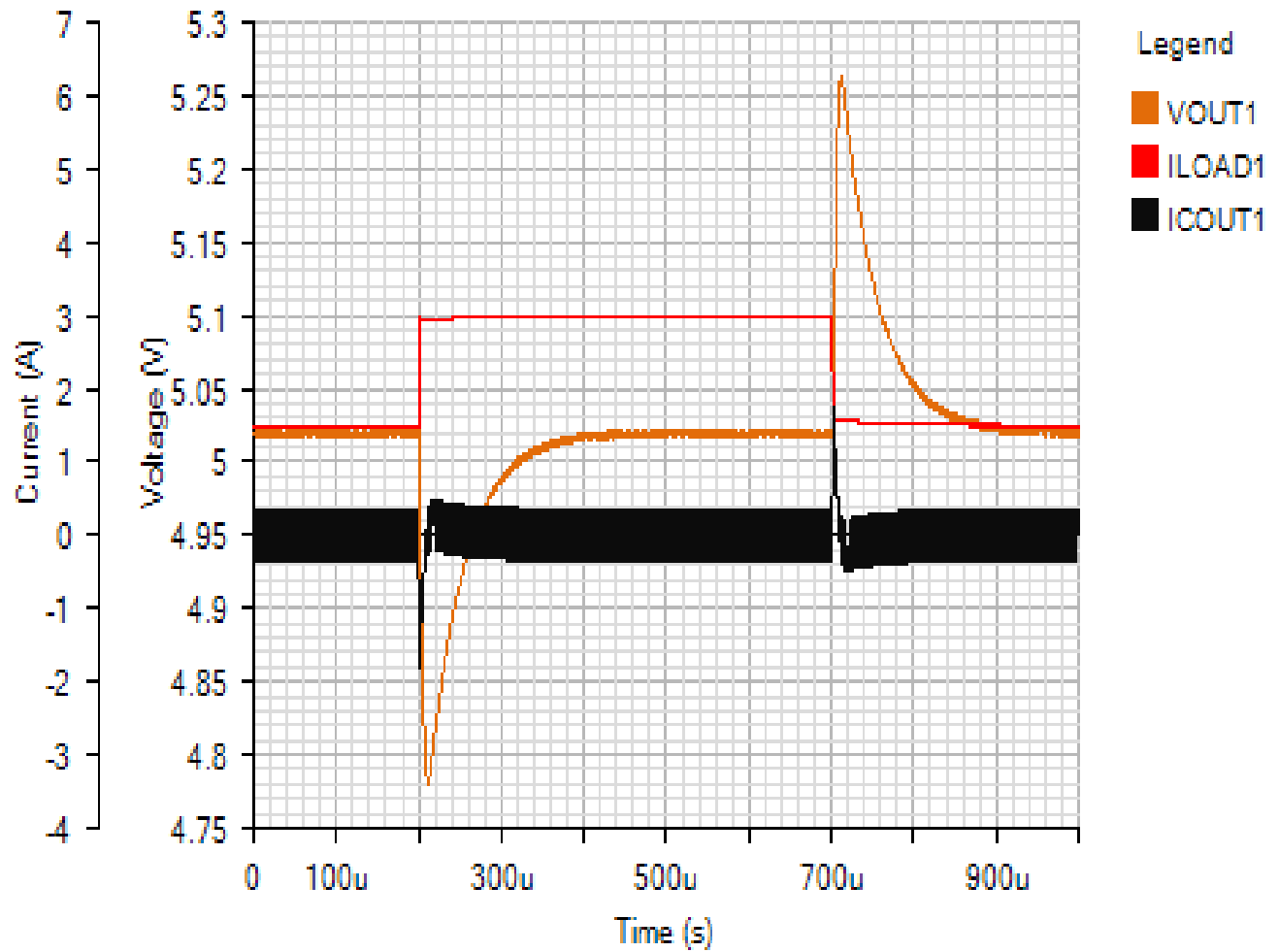
% of total

Component	Loss (W)	% of total
Ch 1 Lout - AC + DC	0.147555	9.8
Ch 2 Low side FET	0.173341	11.5
Ch 2 High side FET	0.3466	23
Ch 2 Sense Resistor	0.106789	7.1
Ch 1 High side FET	0.353242	23.5
Ch 1 Low side FET	0.166636	11.1
Ch 1 Sense Resistor	0.106572	7.1
Ch 2 Lout - AC + DC	0.103729	6.9
Total	1.504463	100

Load Step - Mon Nov 19 2018 14:32:56

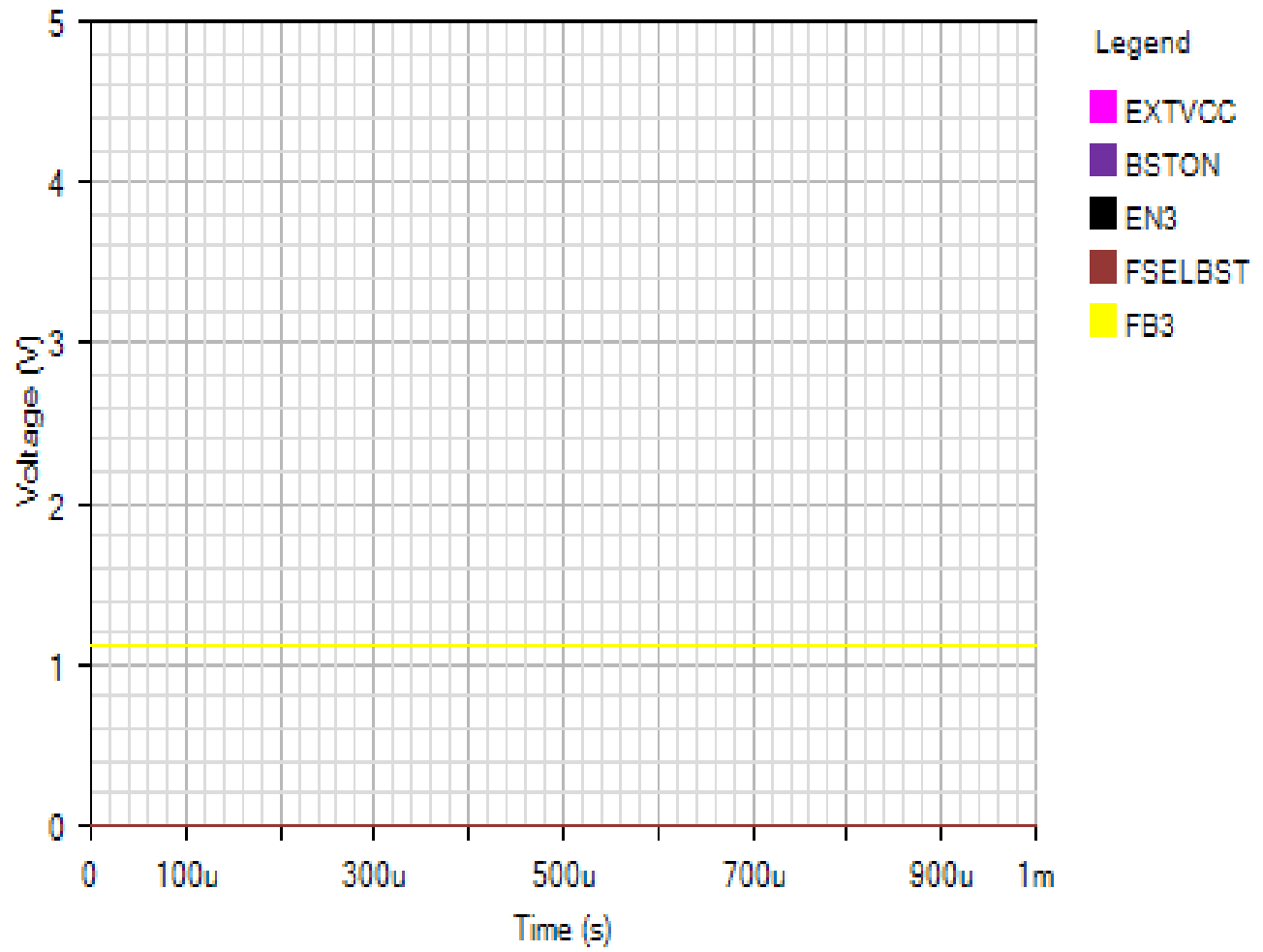
OUTPUT1

Default



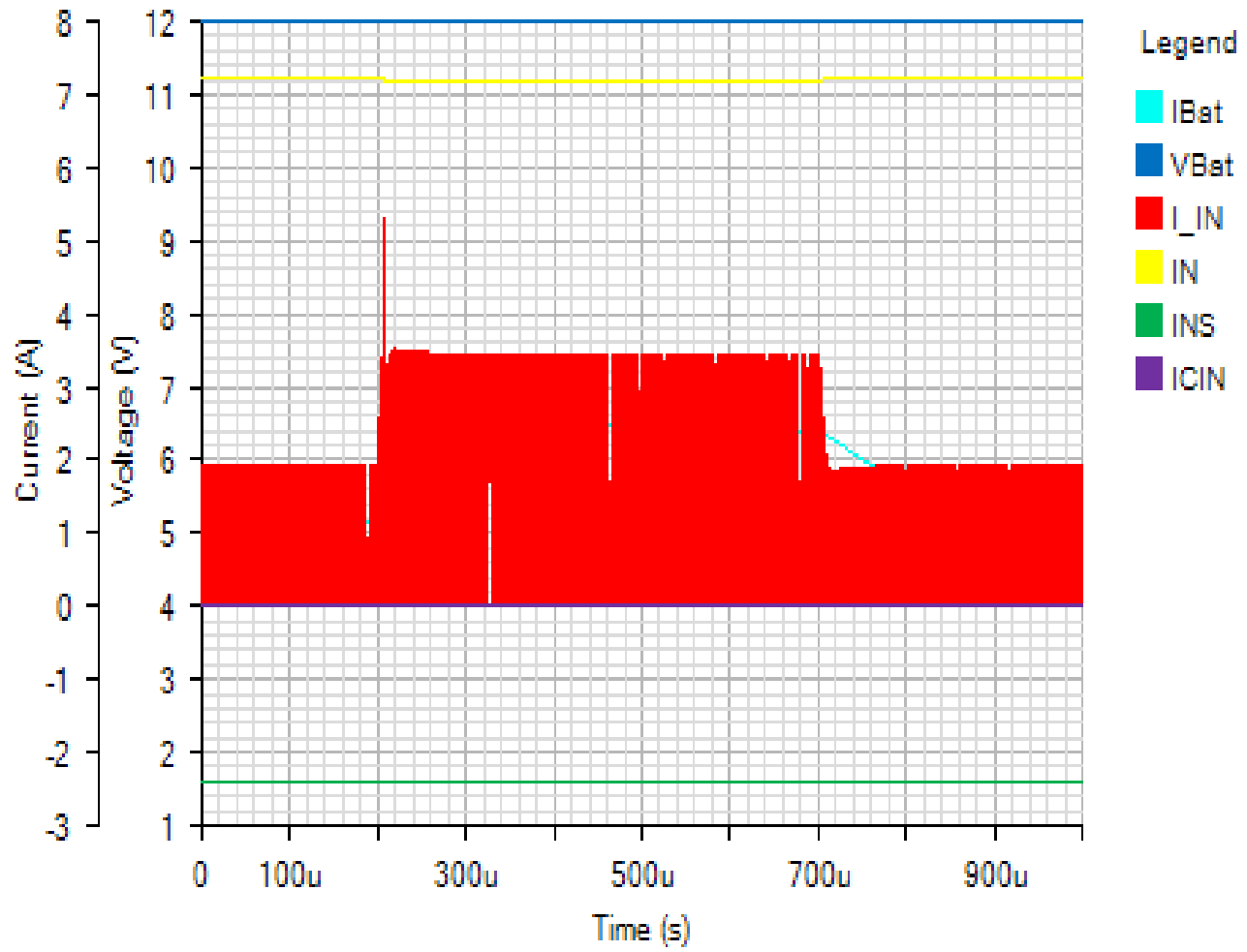
IC3

Default



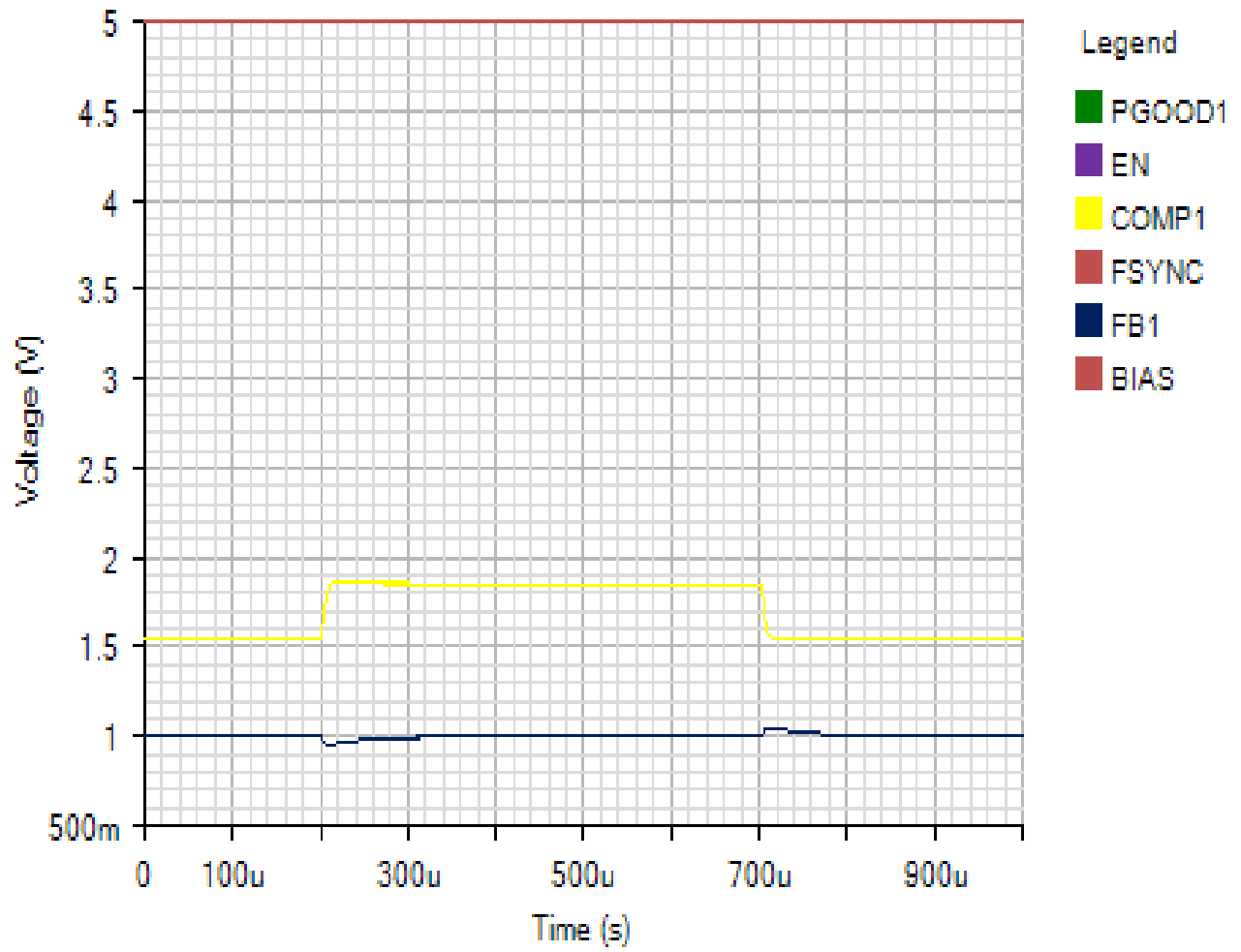
INPUT

Default



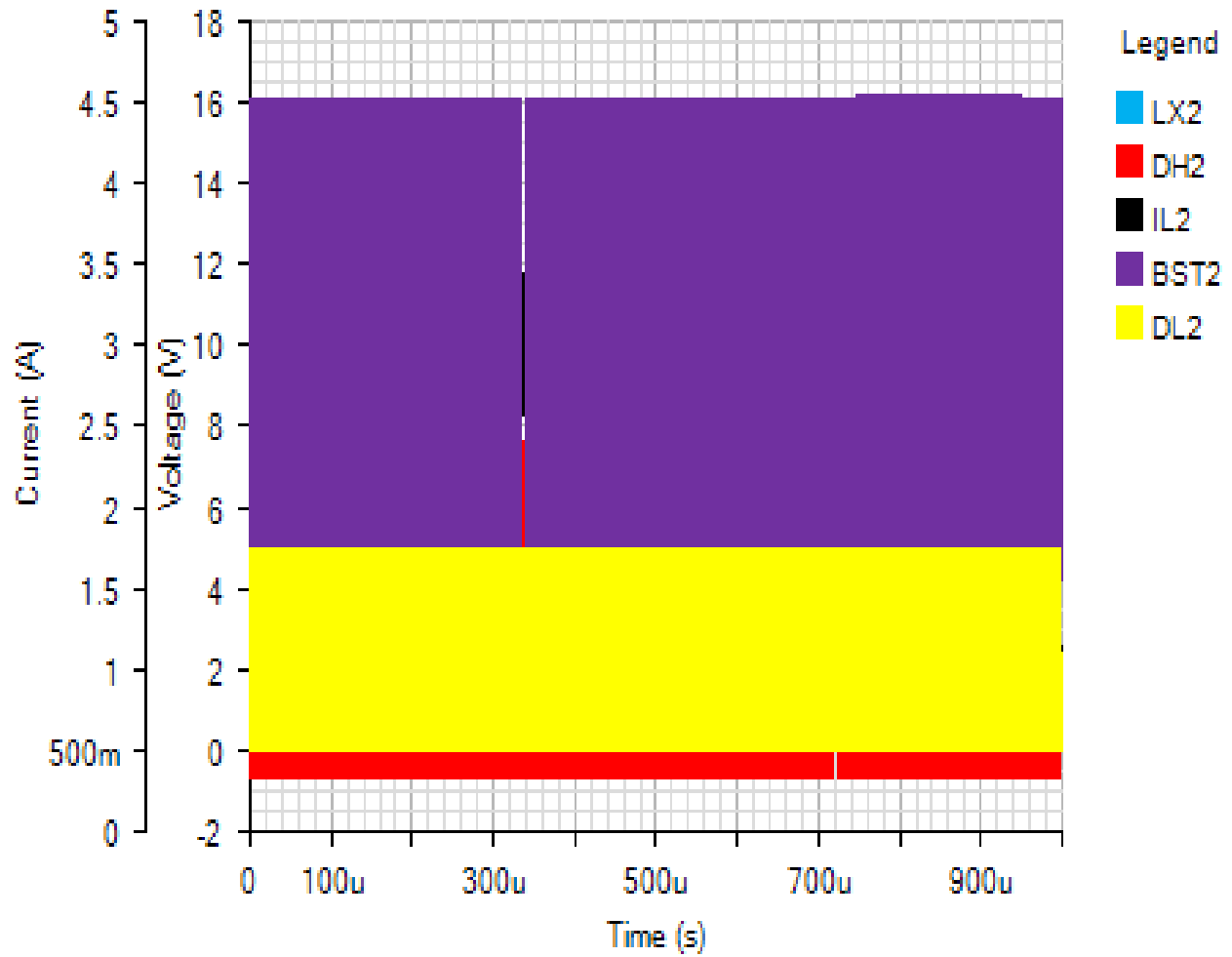
IC1

Default



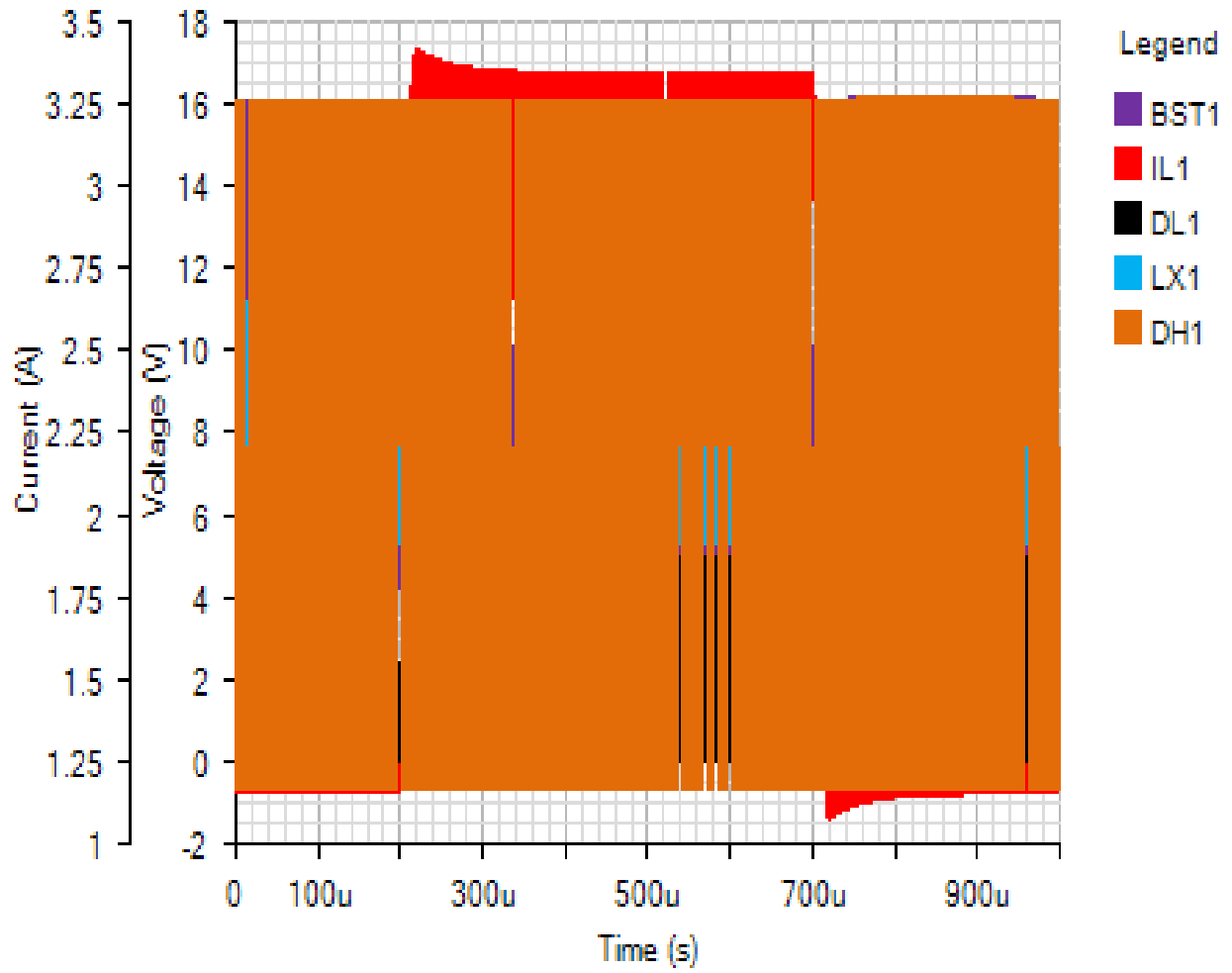
SWITCHING2

Default



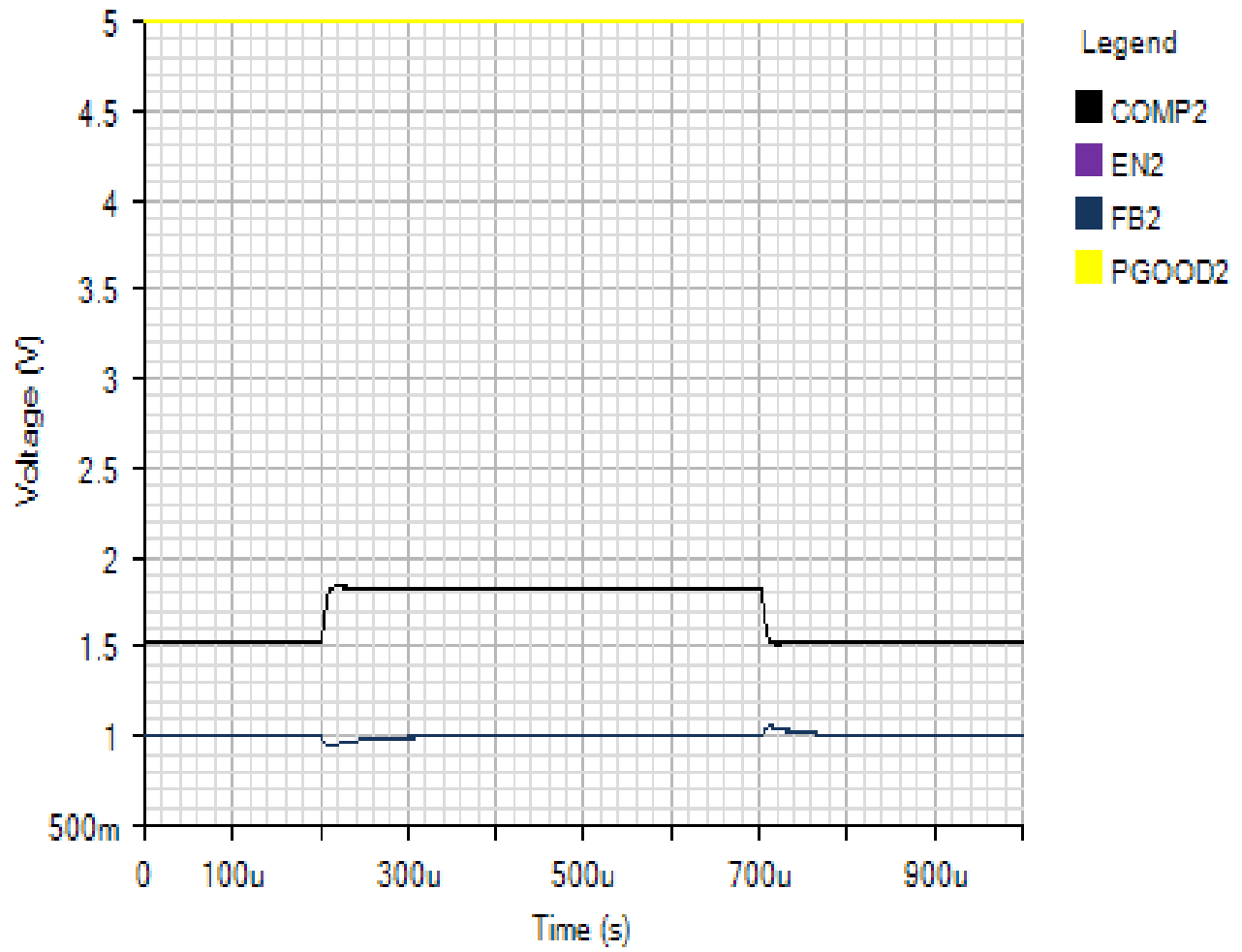
SWITCHING1

Default



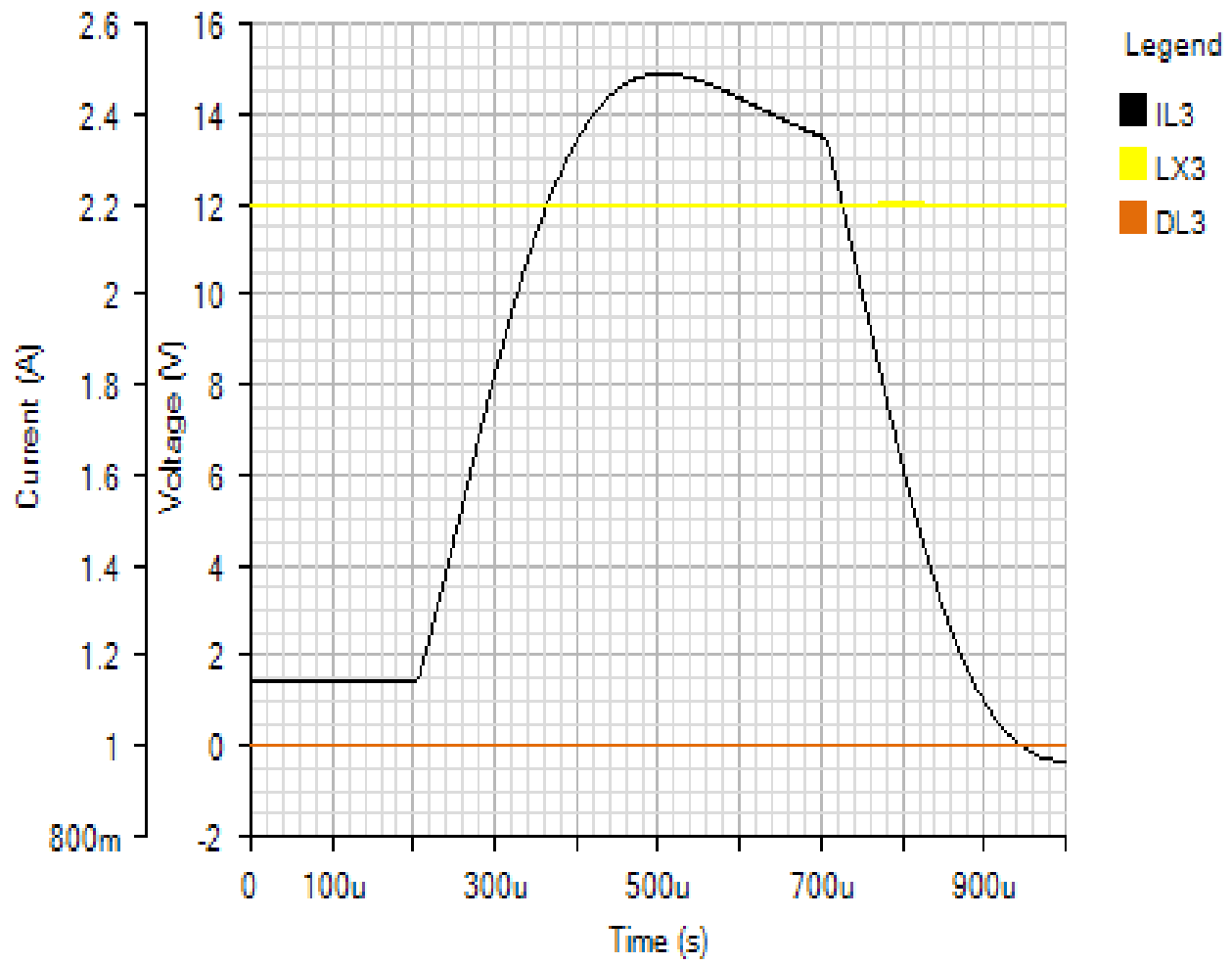
IC2

Default



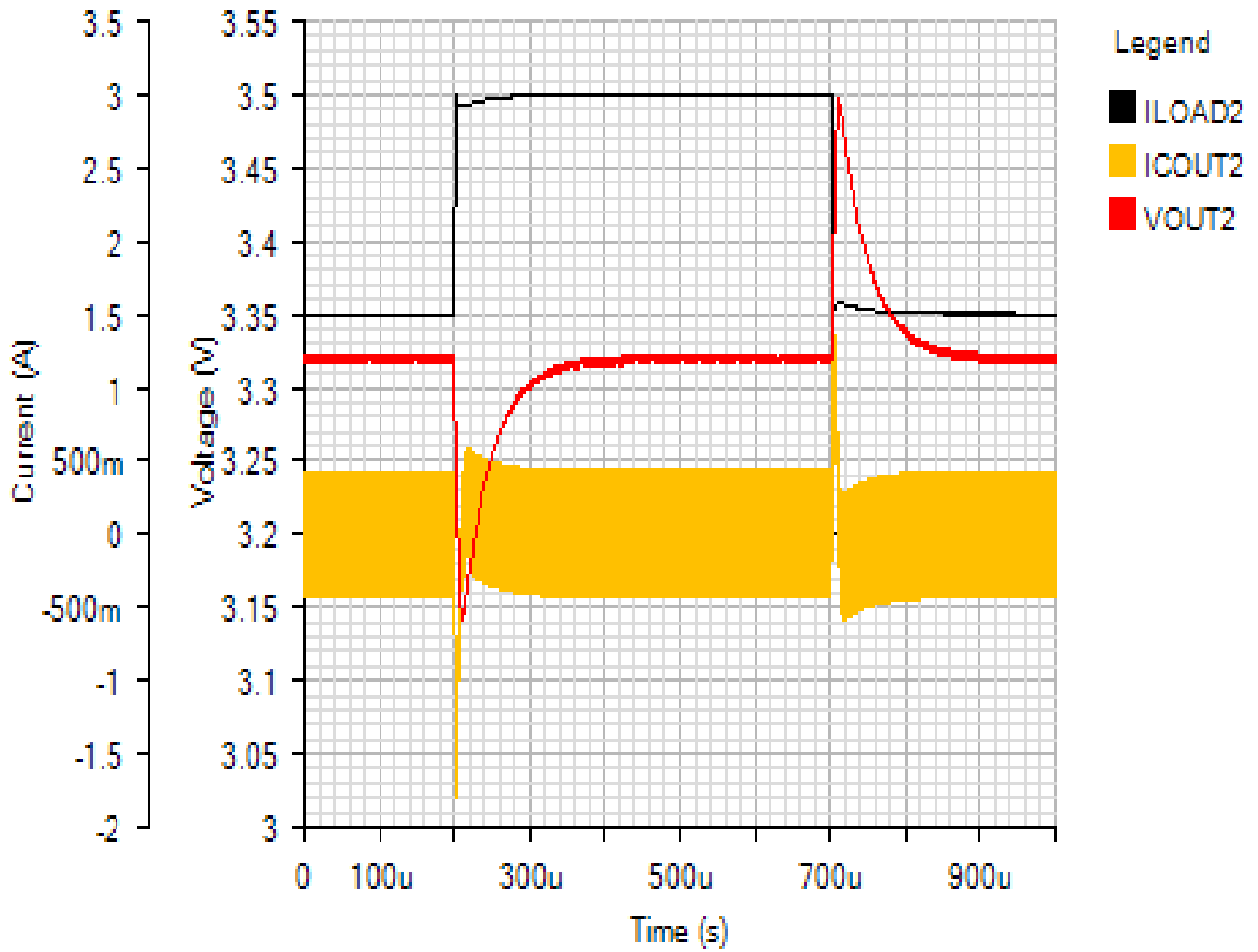
SWITCHING3

Default



OUTPUT2

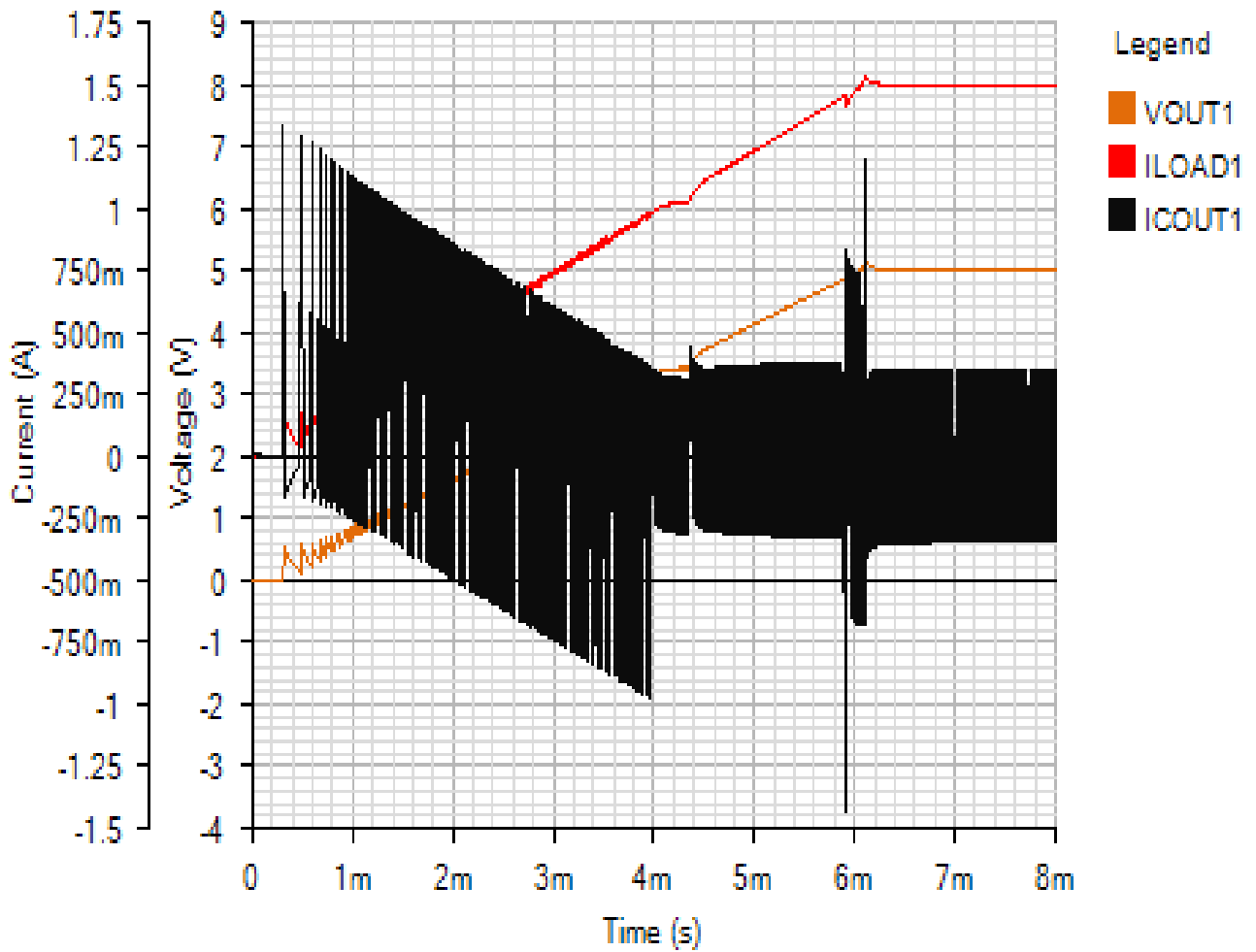
Default



Start Up - Mon Nov 19 2018 14:32:56

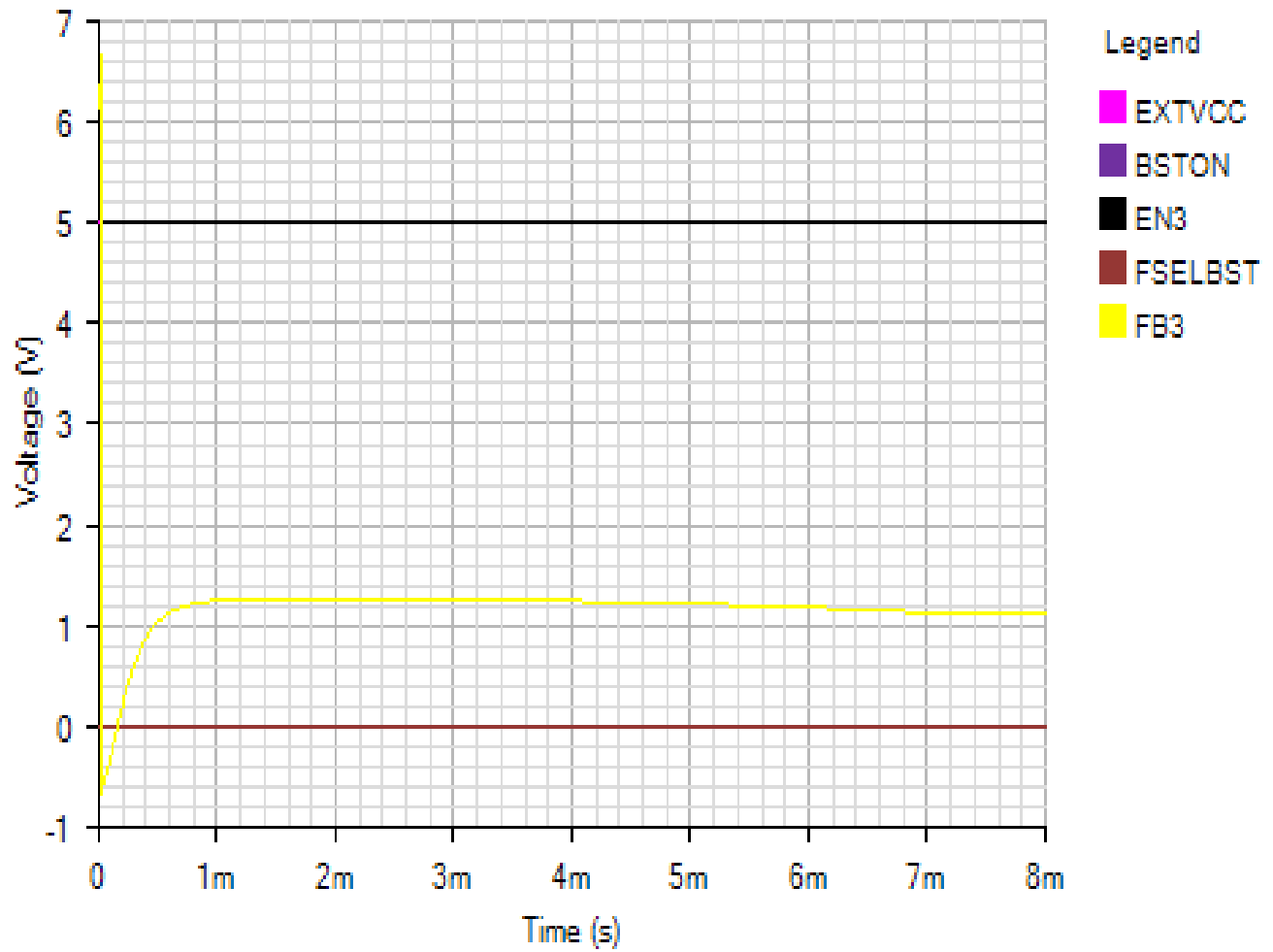
OUTPUT1

Default



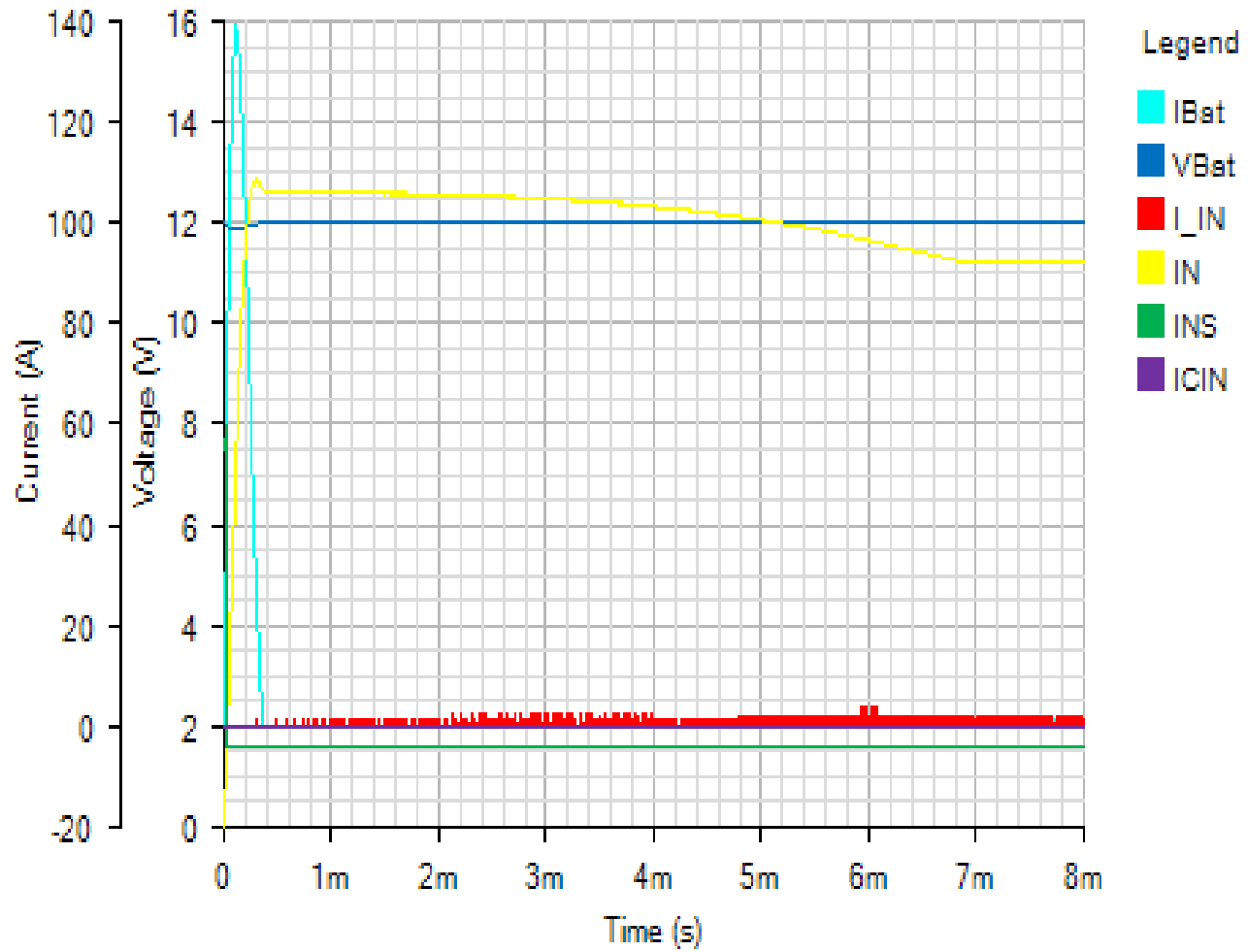
IC3

Default



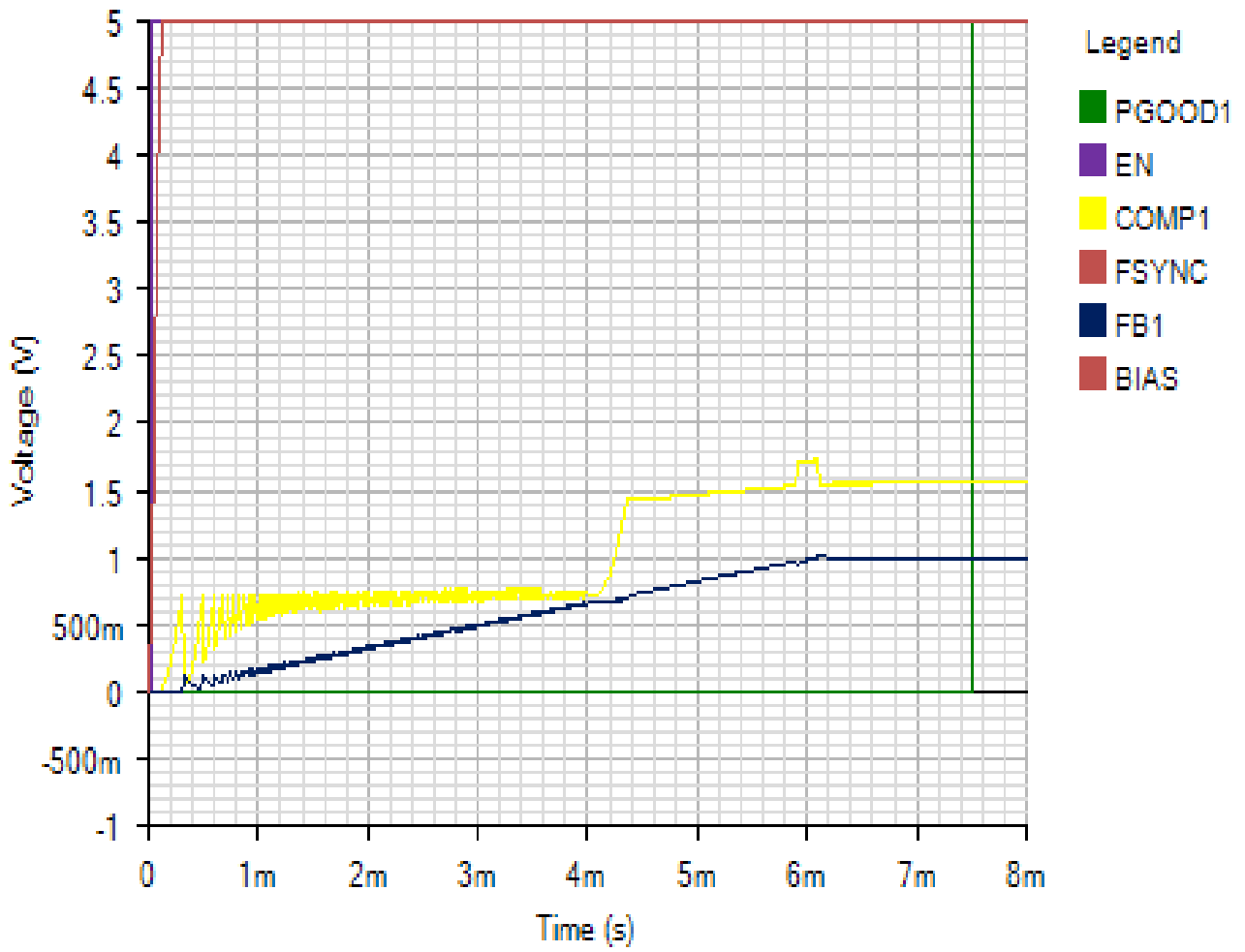
INPUT

Default



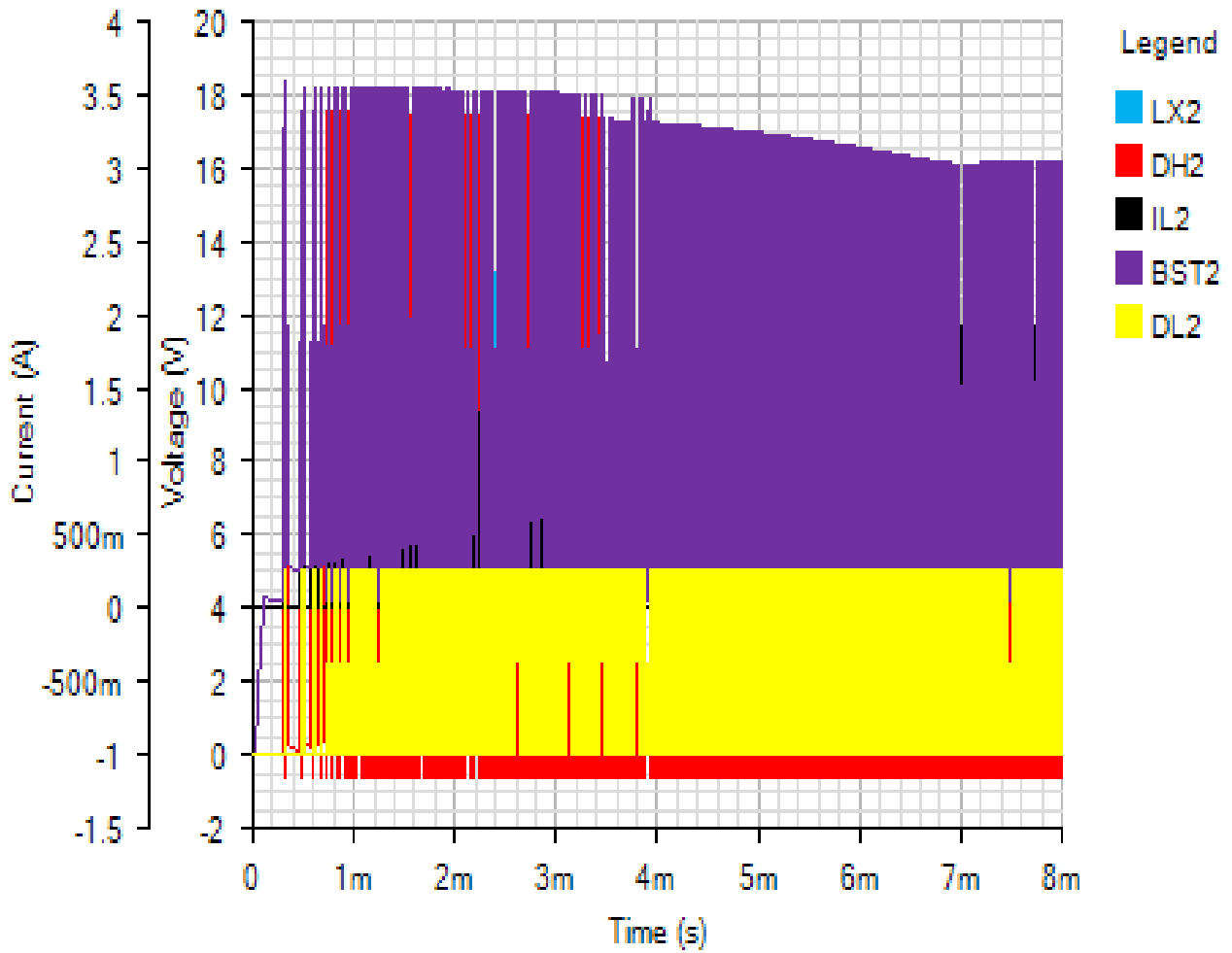
IC1

Default



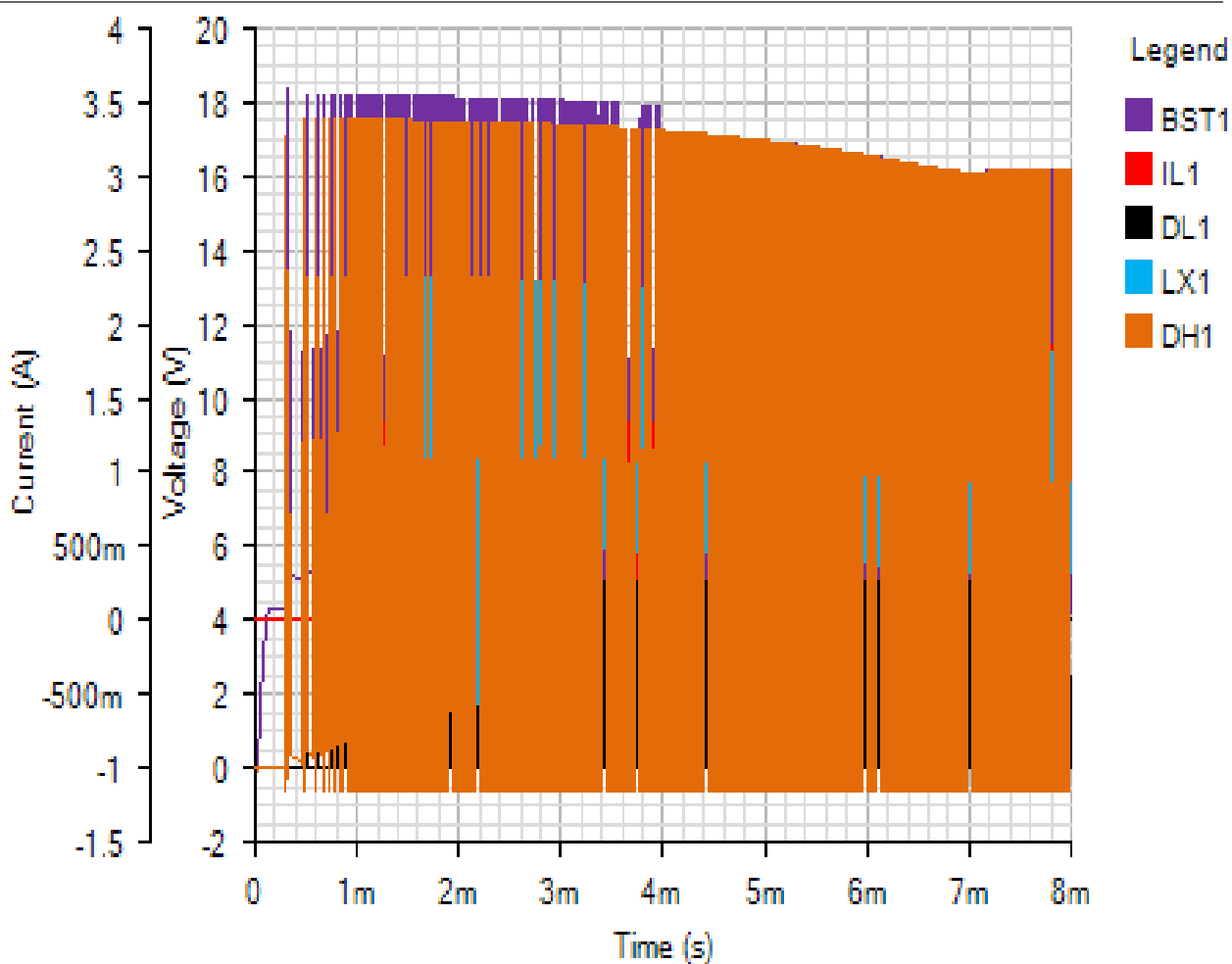
SWITCHING2

Default



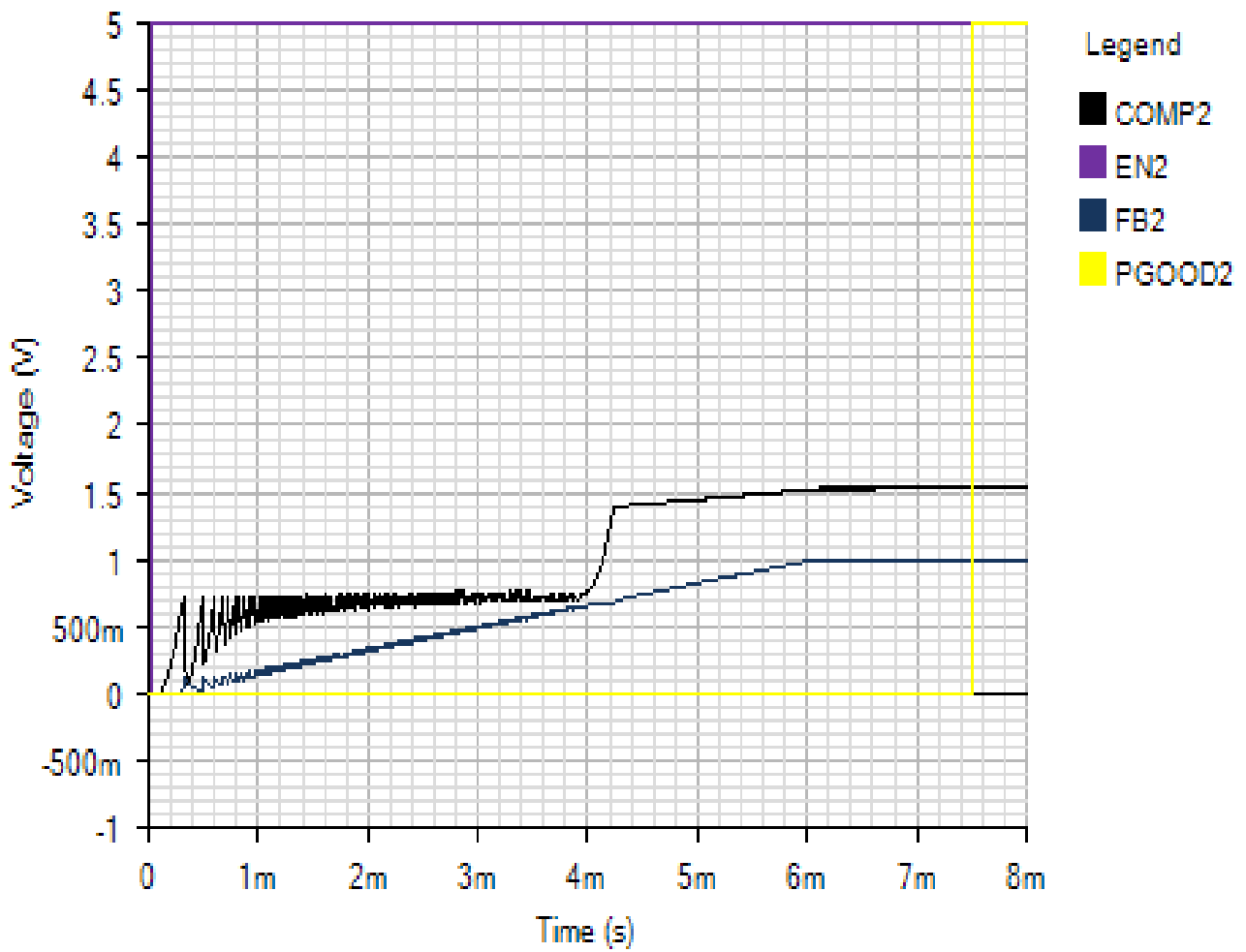
SWITCHING1

Default



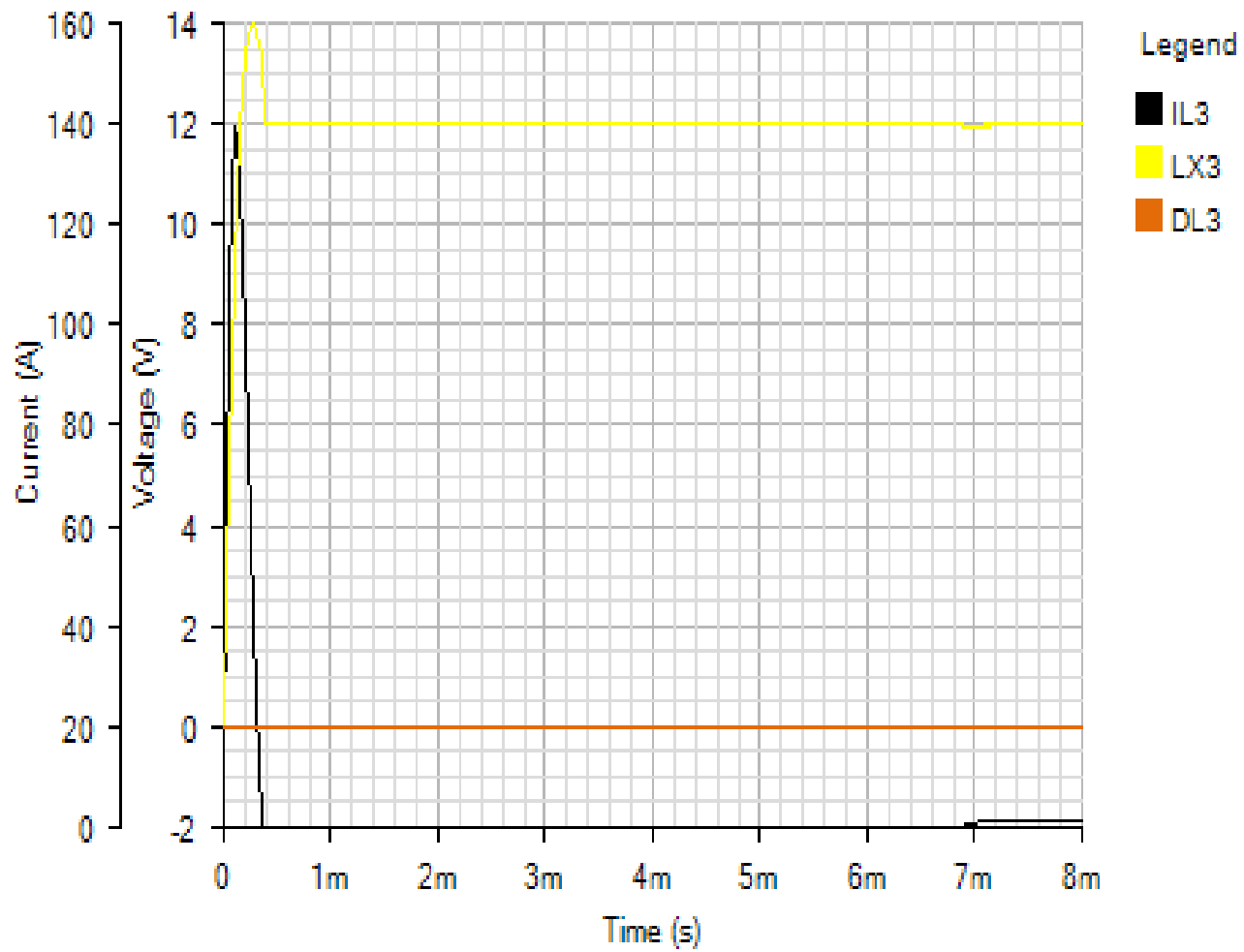
IC2

Default



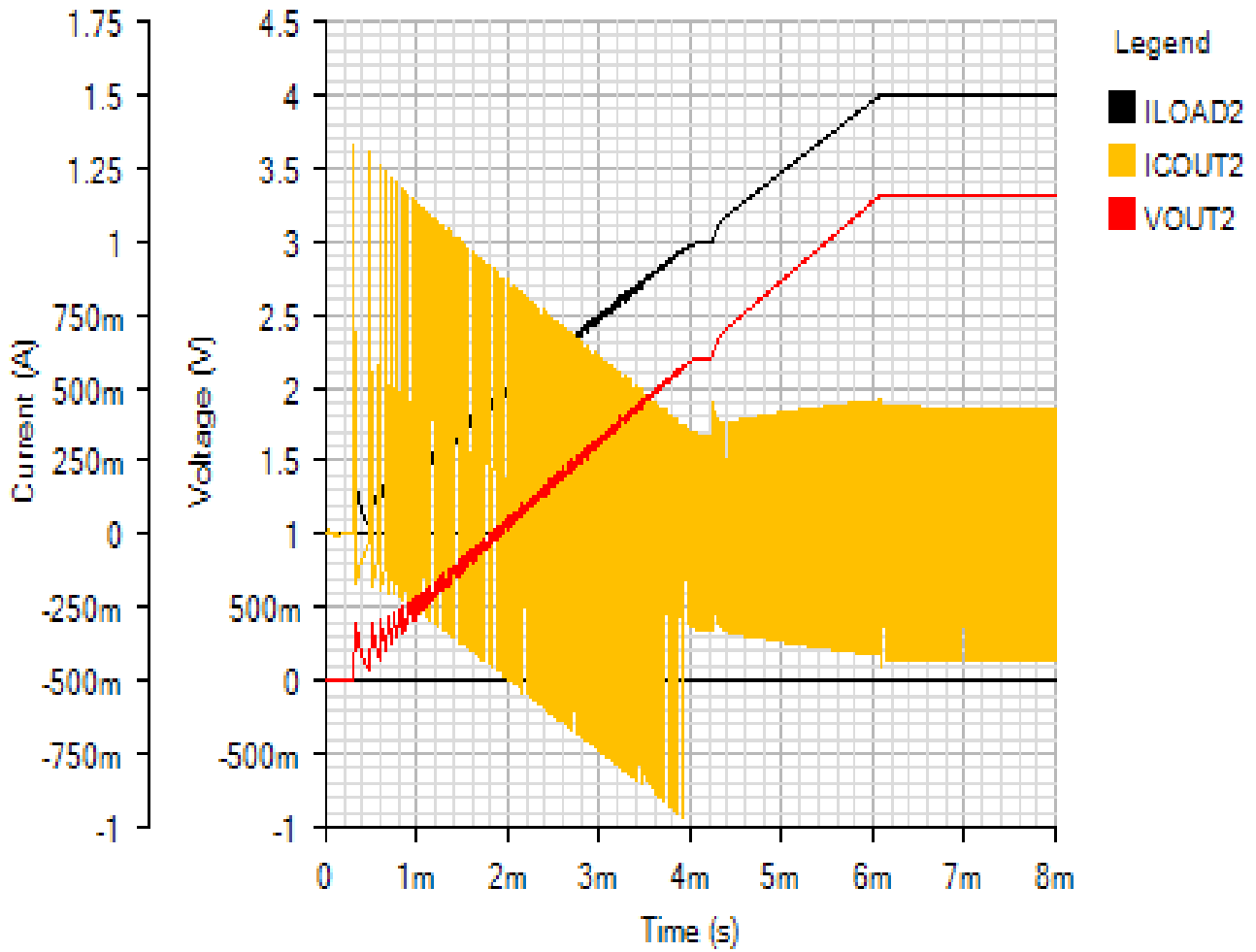
SWITCHING3

Default



OUTPUT2

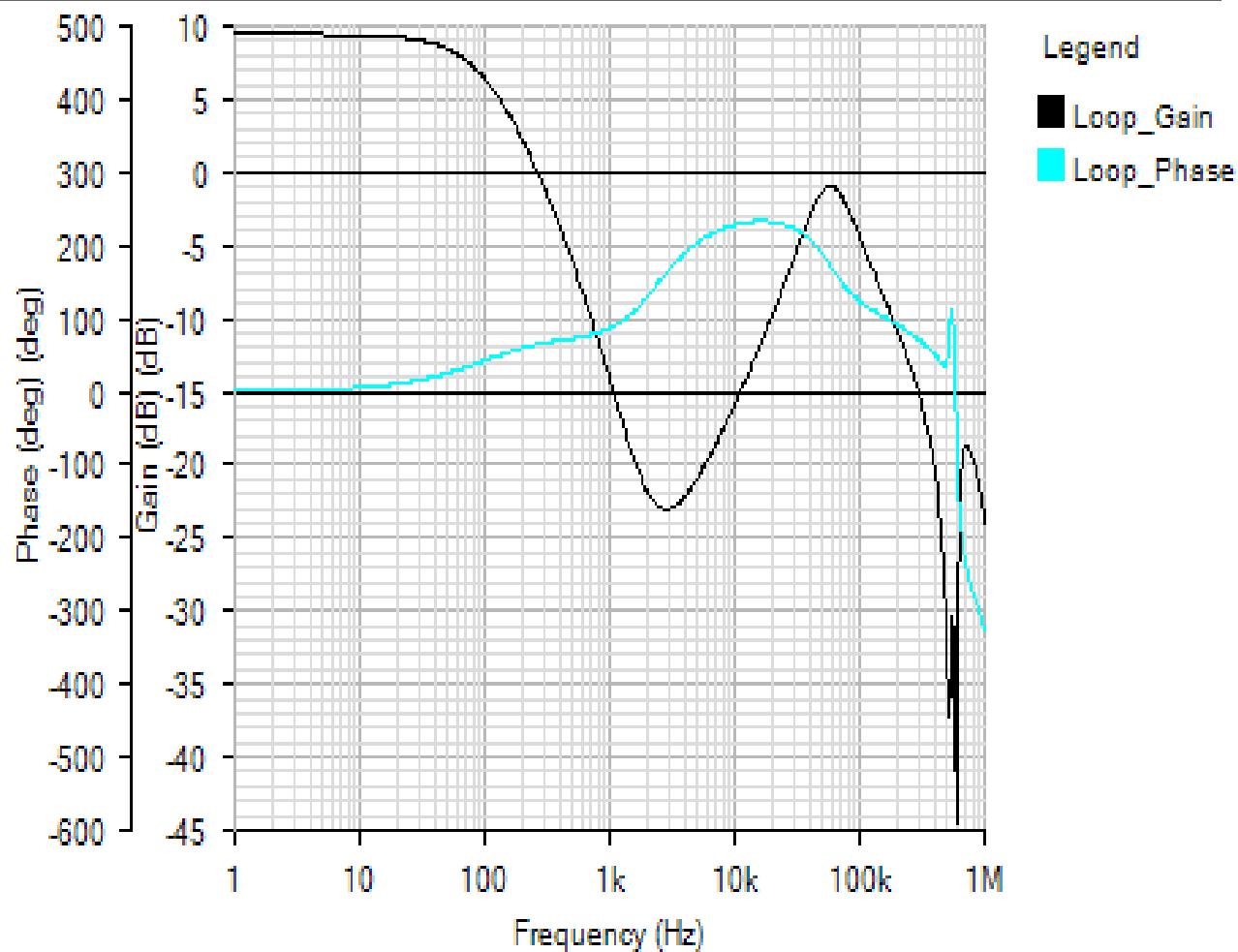
Default



PreBoost AC - Mon Nov 19 2018 14:32:56

BODE

Default



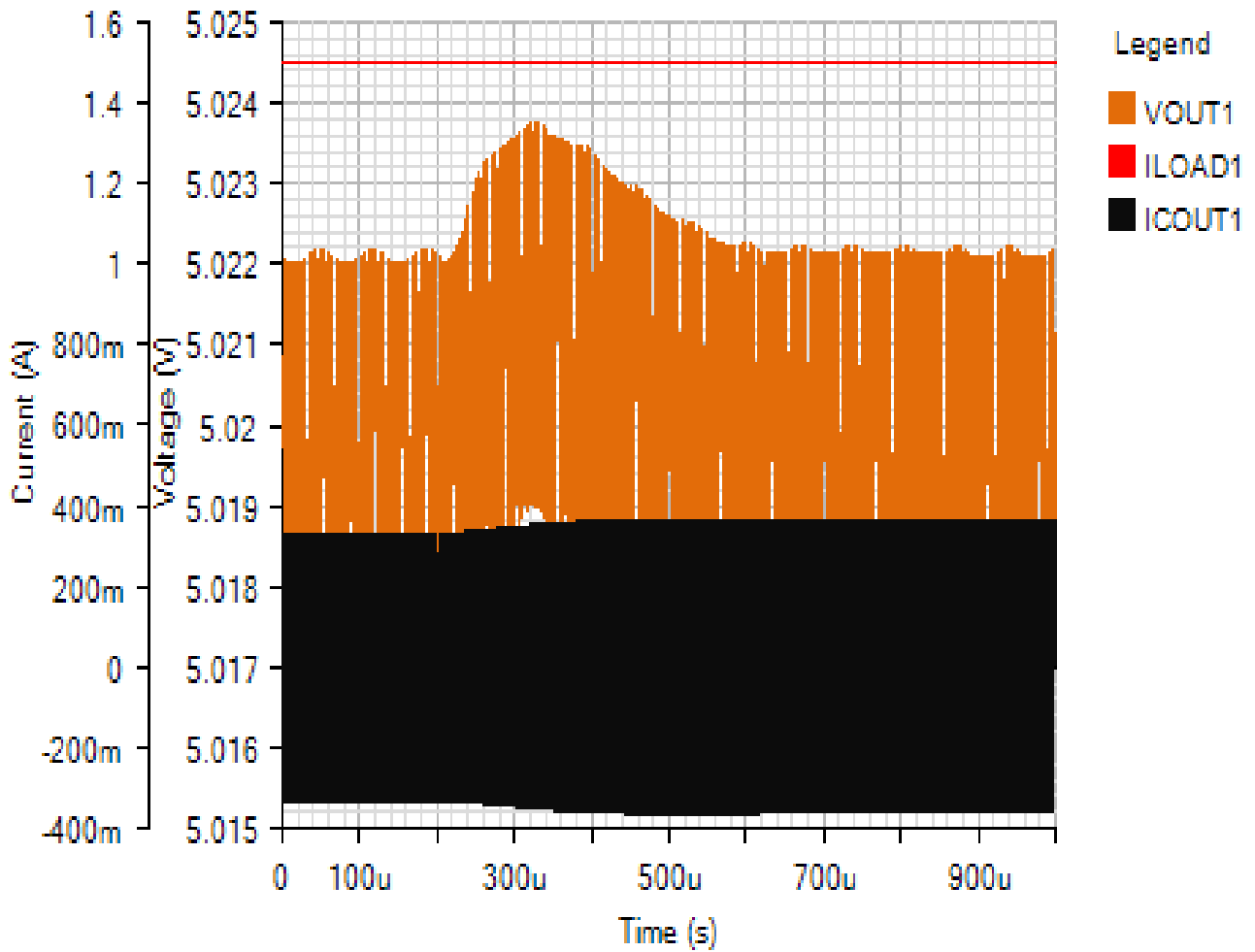
Phase Margin: 64.77° at a crossover frequency of 0.3kHz



Line Transient - Mon Nov 19 2018 14:32:56

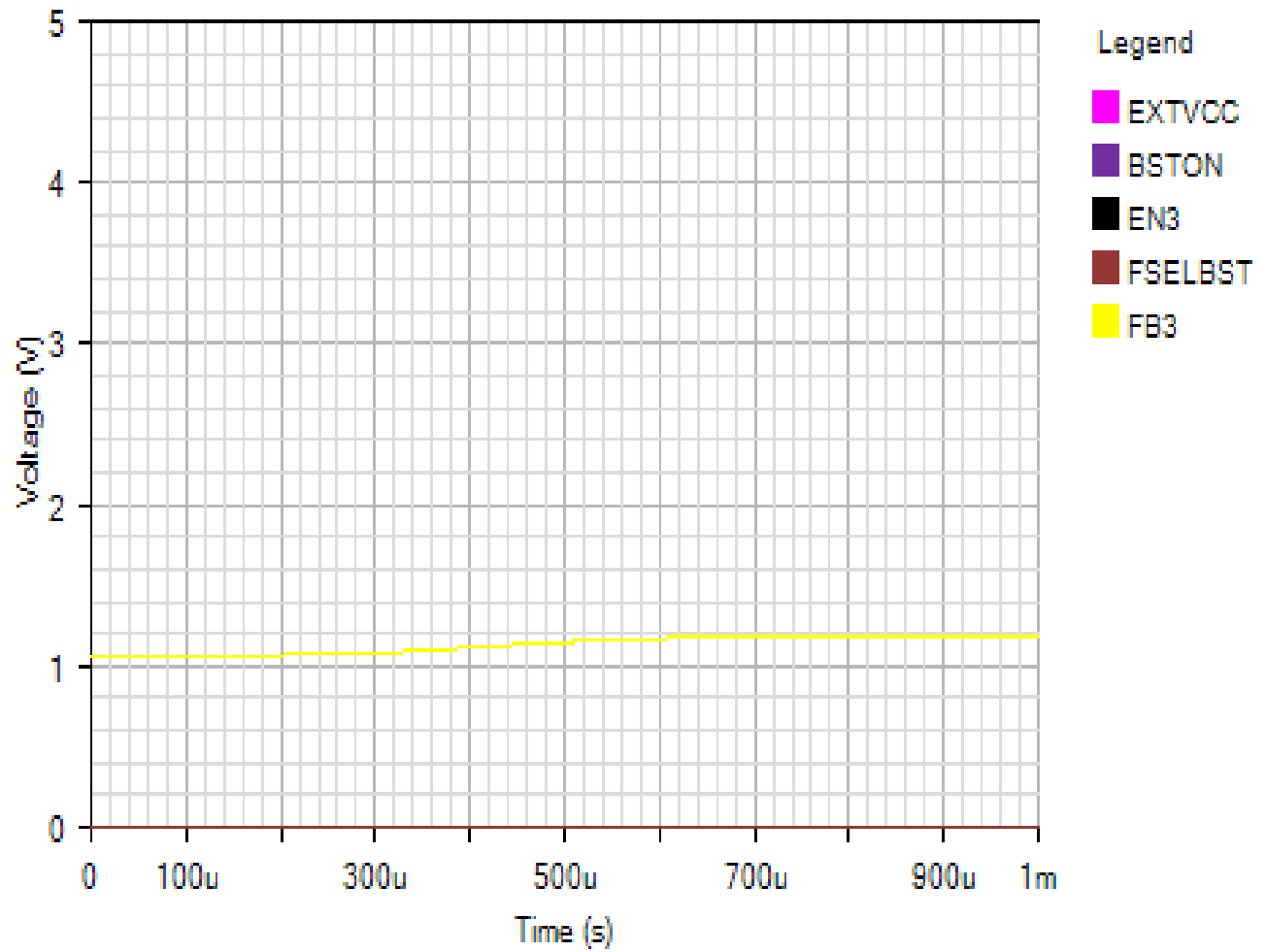
OUTPUT1

Default



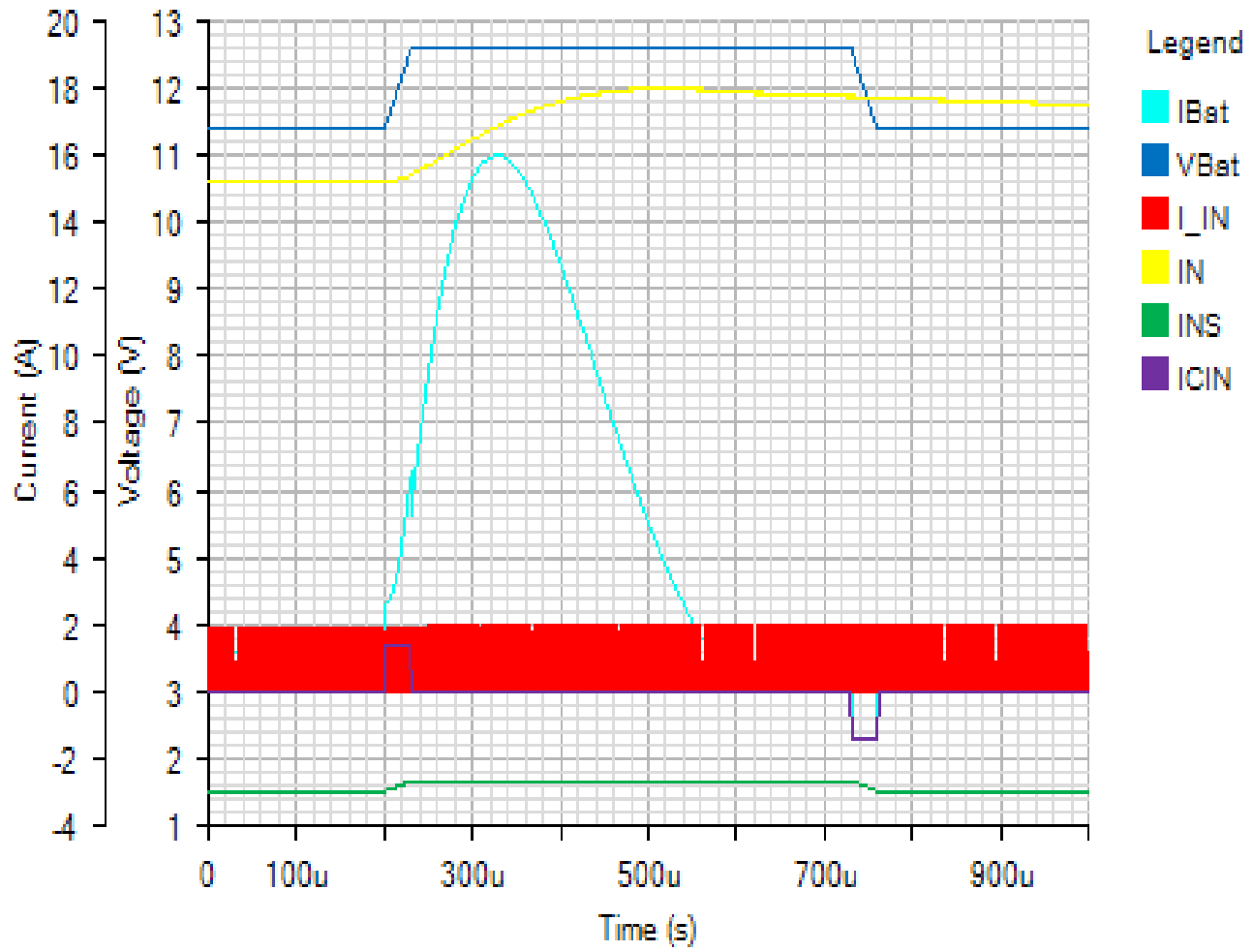
IC3

Default



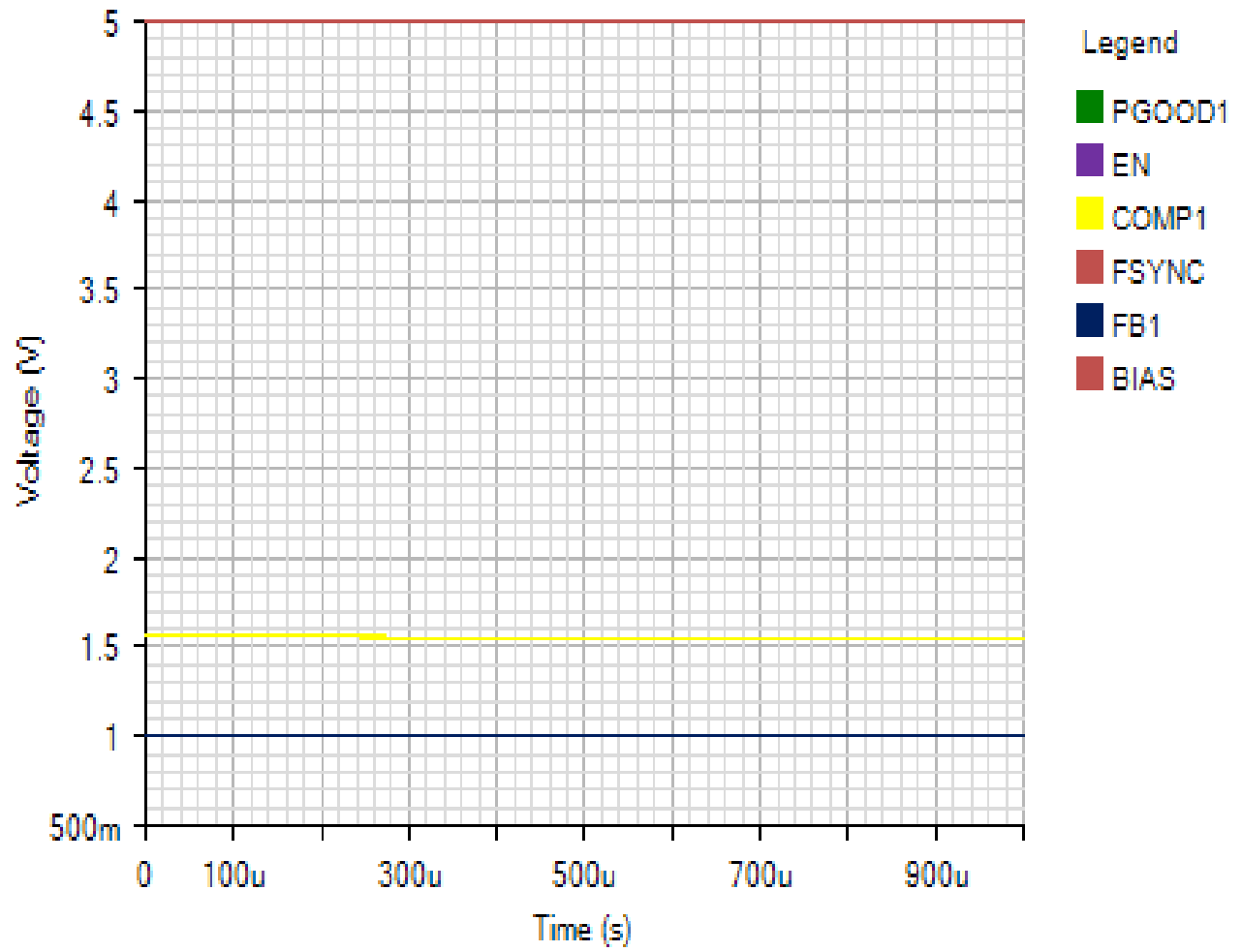
INPUT

Default



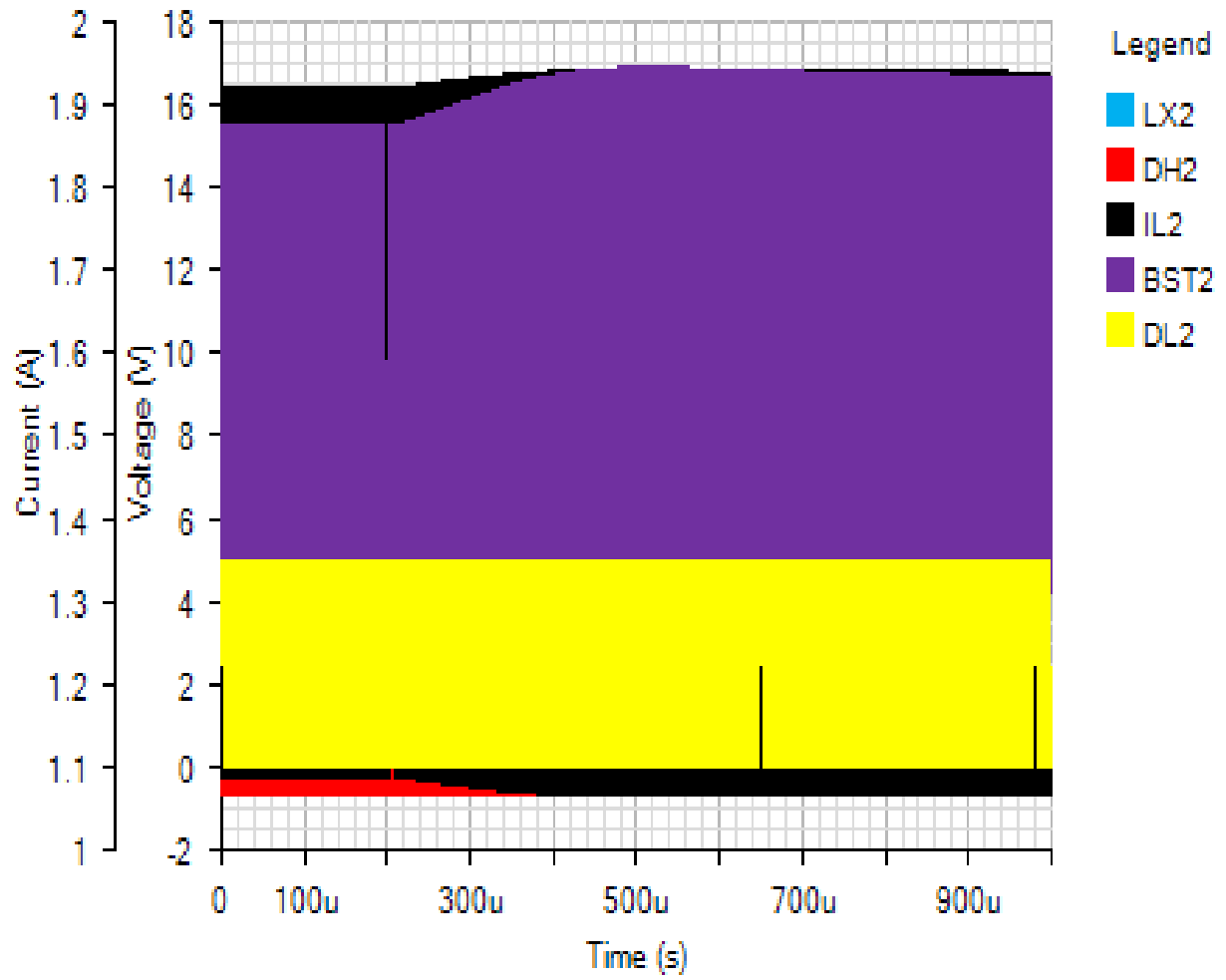
IC1

Default



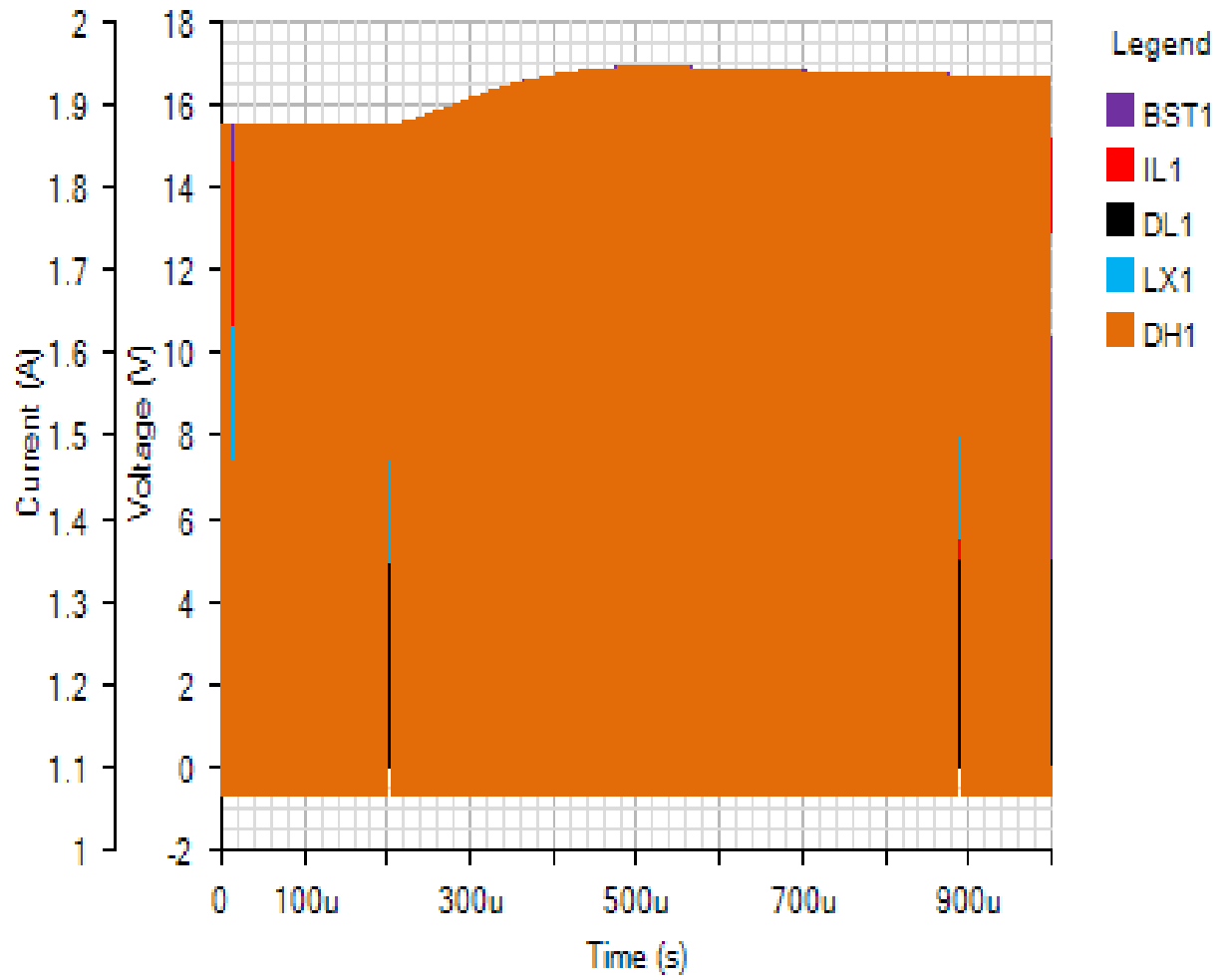
SWITCHING2

Default



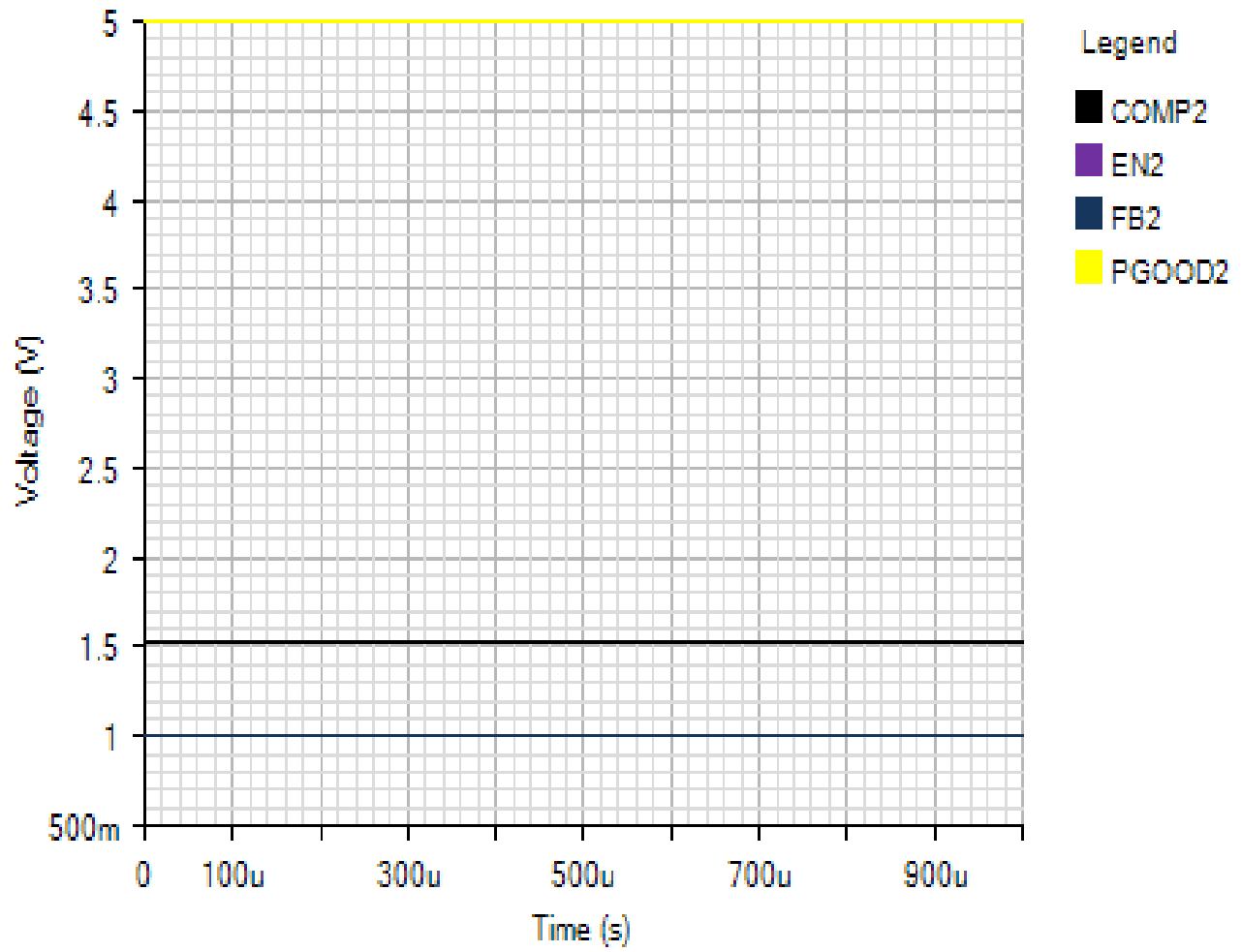
SWITCHING1

Default



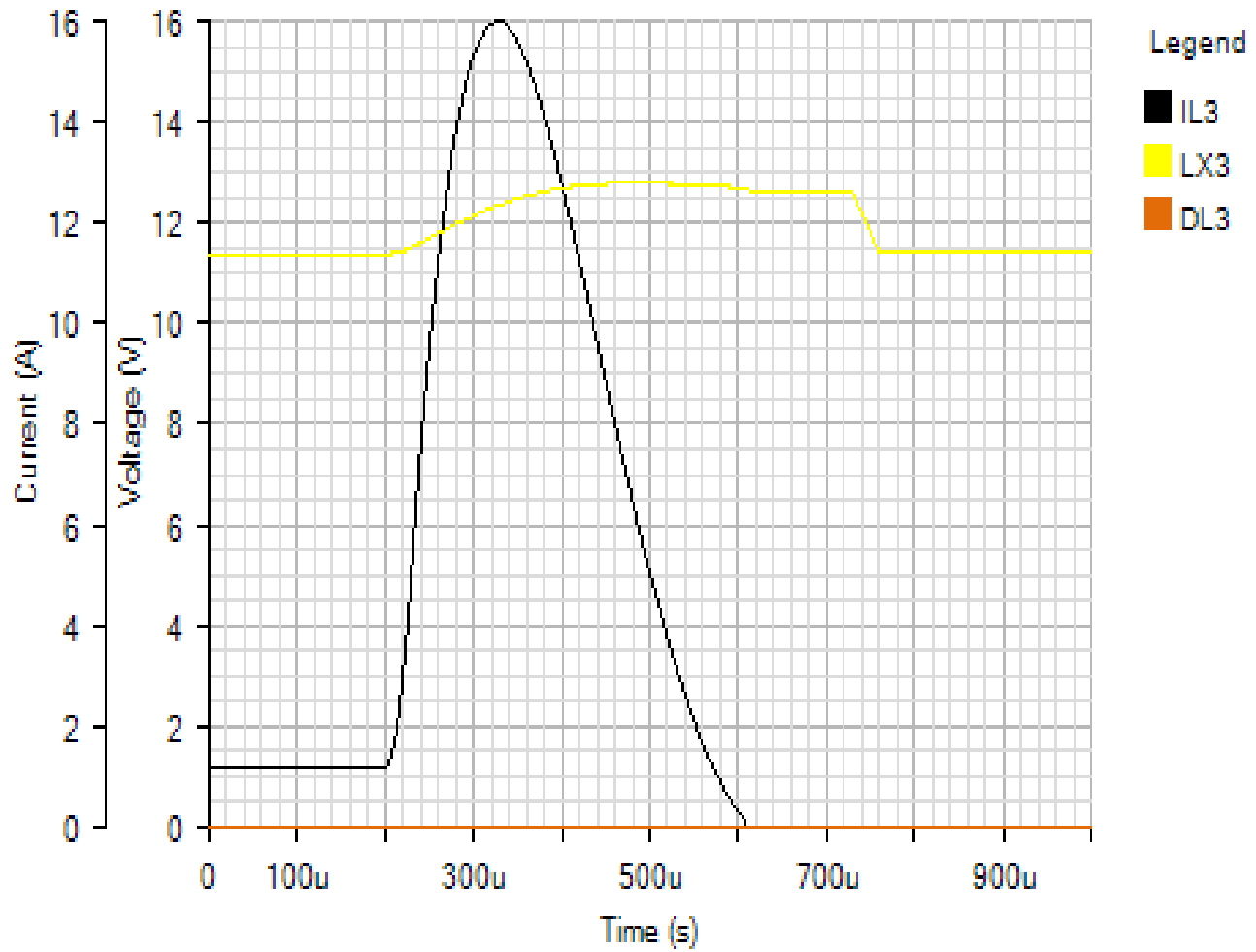
IC2

Default



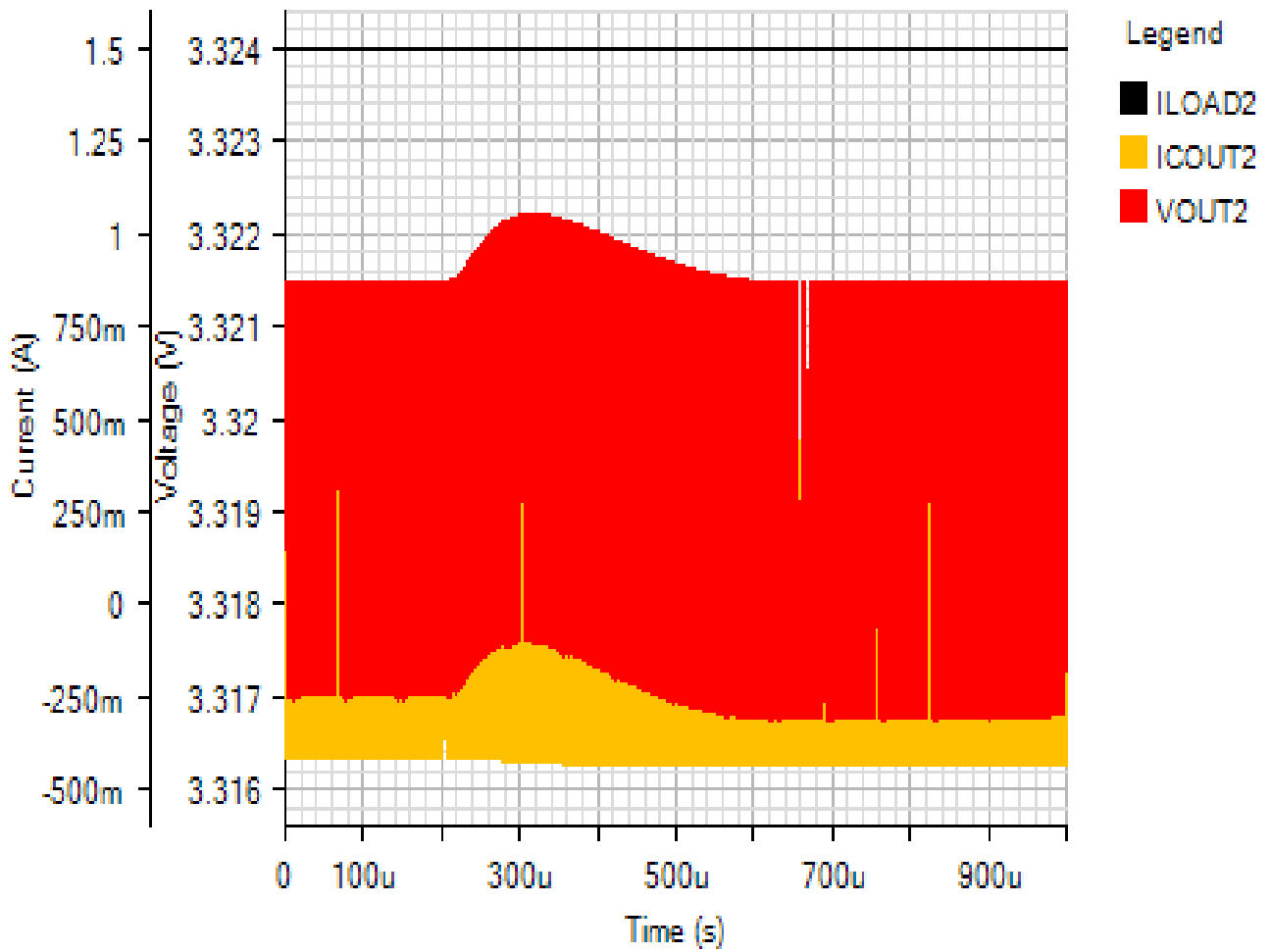
SWITCHING3

Default



OUTPUT2

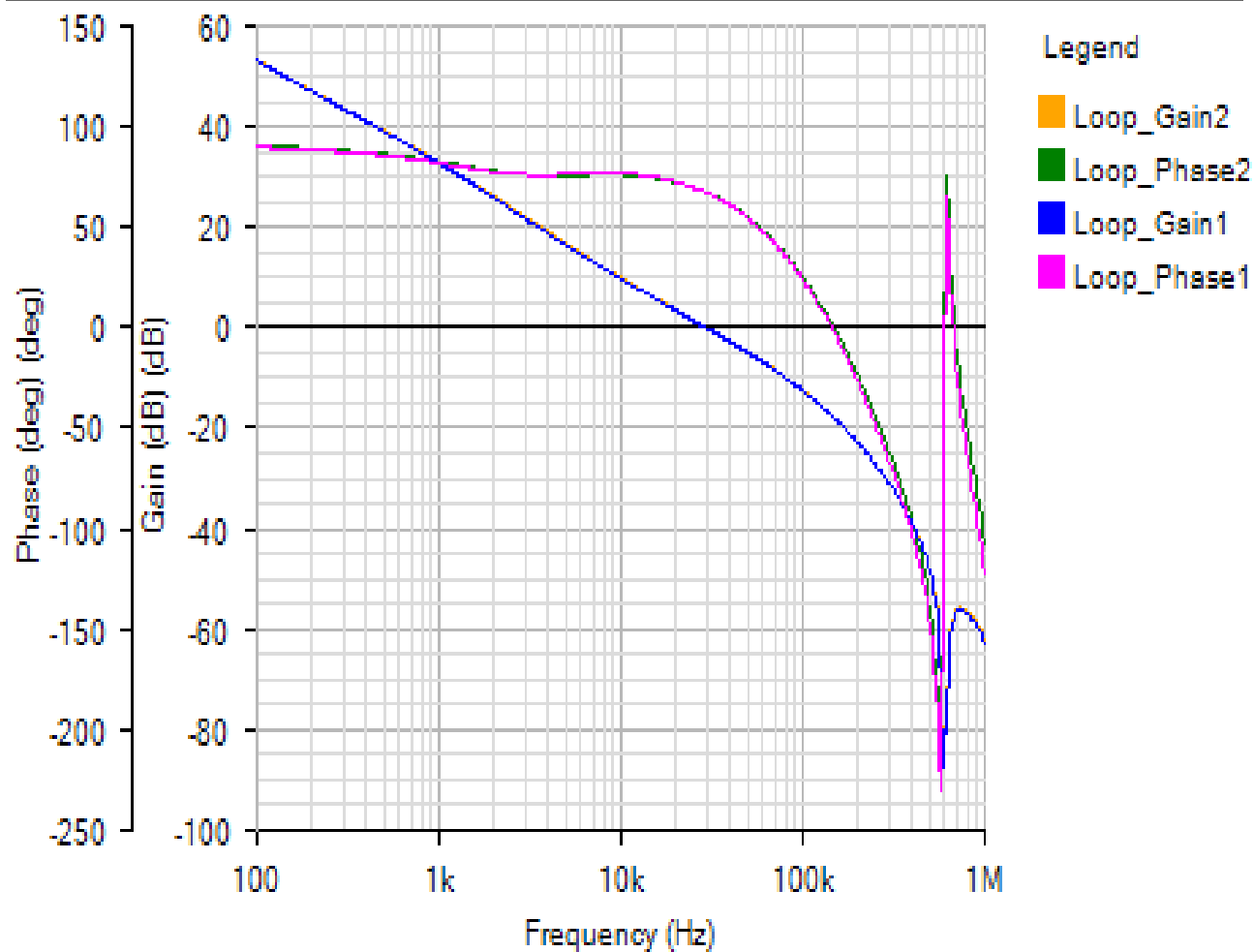
Default



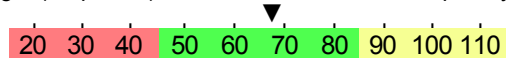
AC Loop - Mon Nov 19 2018 14:32:56

BODE

Default



Phase Margin (output #1): 67.32° at a crossover frequency of 29.3kHz



Phase Margin (output #2): 67.26° at a crossover frequency of 29.6kHz

