

Initial Design

1.0

Design Requirements

Parameter	Value
Nominal Input Voltage	24V
Minimum Input Voltage	8V
Maximum Input Voltage	60V
Input Undervoltage Lockout Level 1	6V
Input Undervoltage Lockout Level 2	6V
Input Voltage Ripple	5%
Output Voltage1	5V
Output Current1	5A
Load Step Current1	5A
Load Step Start Current1	2.5A
Output Voltage Load Step Over/undershoot1	5%
Output Voltage2	3.3V
Output Current2	10A
Load Step Current2	10A
Load Step Start Current2	5A
Output Voltage Load Step Over/undershoot2	5%
Switching Frequency	253kHz
Mode of Operation	PWM
Current Sensing Scheme	Inductor DCR based
Phase	In-Phase
Buck1 Soft Start Time	5ms
Buck2 Soft Start Time	5ms
Performance Priority	Balance Efficiency and Size

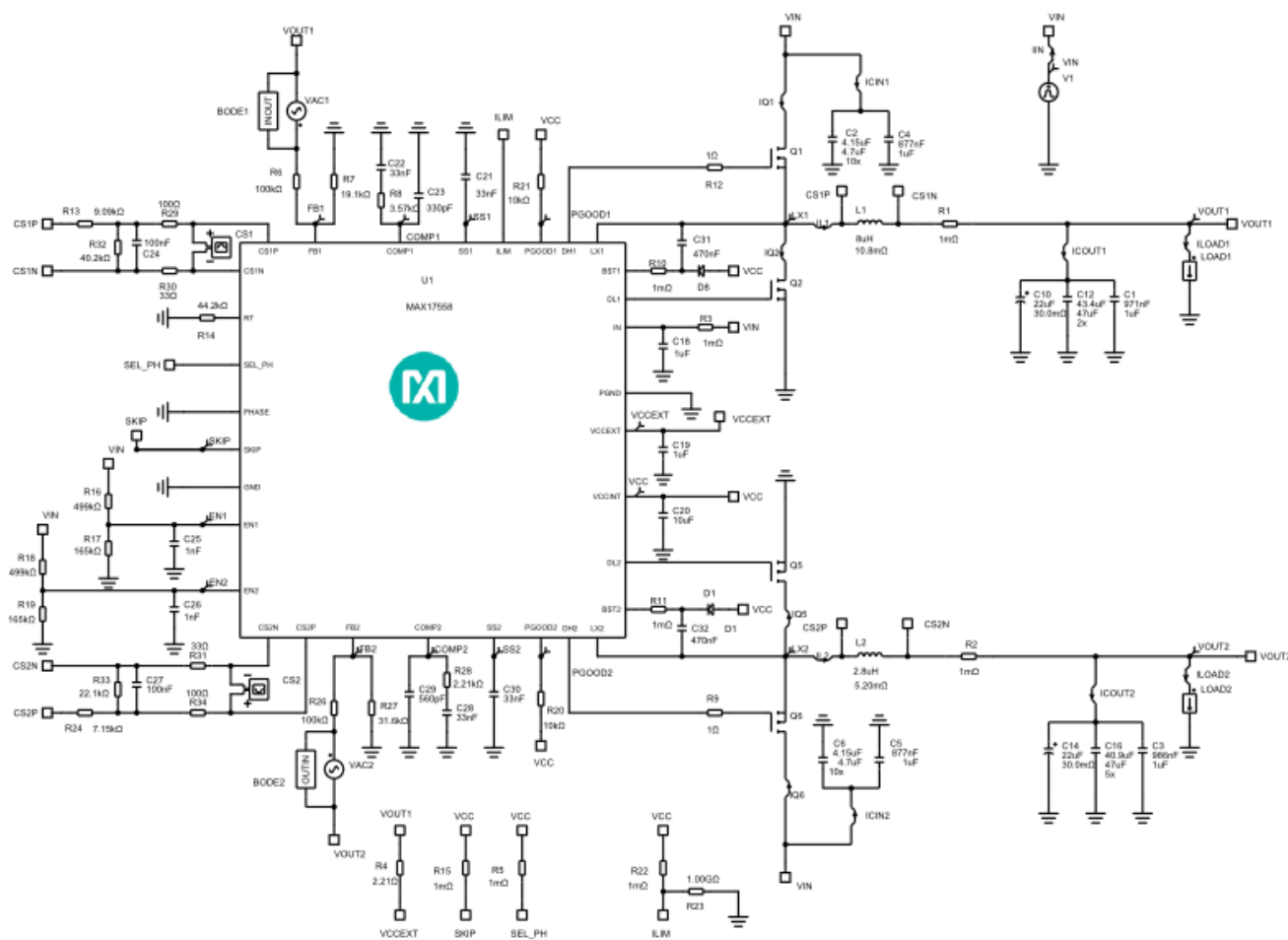
Parameter	Value
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BOM Priority	Cost
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Capacitor Type	Ceramic
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Ambient Temperature	25°C
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Schematic



BOM

Ref	Qty	Part Number	Manufacturer	Description
U1	1	MAX17558	User-Defined	IC
C1	1	C0805C105K8RAC	Kemet	Cap Ceramic 1uF 10V X7R 10% SMD 0805 125C Bulk
C2	10	C5750X7R2A475K230KA	TDK	Cap Ceramic 4.7uF 100V X7R 10% SMD 2220 125C Plastic T/R

C3	1	C0805C105K8RAC	Kemet	Cap Ceramic 1uF 10V X7R 10% SMD 0805 125C Bulk
C4	1	C3225X7R2A105K200AA	TDK	Cap Ceramic 1uF 100V X7R 10% SMD 1210 125C Plastic T/R
C5	1	C3225X7R2A105K200AA	TDK	Cap Ceramic 1uF 100V X7R 10% SMD 1210 125C Plastic T/R
C6	10	C5750X7R2A475K230KA	TDK	Cap Ceramic 4.7uF 100V X7R 10% SMD 2220 125C Plastic T/R
C10	1	ECASD41B226M030K00	Murata	Cap Aluminum 22uF 12.5V 20% (7.3 X 4.3 X 1.9mm) SMD 0.03 Ohm 1600mA 105C Embossed T/R
C12	2	C5750X7R1C476M230KB	TDK	Cap Ceramic 47uF 16V X7R 20% SMD 2220 125C Plastic T/R
C14	1	ECASD41B226M030K00	Murata	Cap Aluminum 22uF 12.5V 20% (7.3 X 4.3 X 1.9mm) SMD 0.03 Ohm 1600mA 105C Embossed T/R
C16	5	GRM32ER71A476ME15L	Murata	Cap Ceramic 47uF 10V X7R 20% SMD 1210 125C Embossed T/R
C18	1	C3225X7R2A105M200AA	TDK	Cap Ceramic 1uF 100V X7R 20% Pad SMD 1210 125°C T/R
C19	1	LMK212B7105KD-T	Taiyo Yuden	Cap Ceramic 1uF 10V X7R 10% Pad SMD 0805 125°C T/R
C20	1	C3216X7R1C106M160AC	TDK	Cap Ceramic 10uF 16V X7R 20% Pad SMD 1206 125°C T/R
C21	1	CC0603KRX7R8BB333	Yageo	Cap Ceramic 0.033uF 25V X7R 10% Pad SMD 0603 125°C T/R
C22	1	CC0603KRX7R8BB333	Yageo	Cap Ceramic 0.033uF 25V X7R 10% Pad SMD 0603 125°C T/R
C23	1	CC0402KRX7R9BB331	Yageo	Cap Ceramic 330pF 50V X7R 10% Pad SMD 0402 125°C T/R
C24	1	CC0402KRX7R8BB104	Yageo	Cap Ceramic 0.1uF 25V X7R 10% Pad SMD 0402 125°C T/R
C25	1	C1608X7R2A102K080AA	TDK	Cap Ceramic 0.001uF 100V X7R 10% Pad SMD 0603 125°C T/R
C26	1	C1608X7R2A102K080AA	TDK	Cap Ceramic 0.001uF 100V X7R 10% Pad SMD 0603 125°C T/R
C27	1	CC0402KRX7R8BB104	Yageo	Cap Ceramic 0.1uF 25V X7R 10% Pad SMD 0402 125°C T/R
C28	1	CC0603KRX7R8BB333	Yageo	Cap Ceramic 0.033uF 25V X7R 10% Pad SMD 0603 125°C T/R
C29	1	CL31B561KBCNNNC	Samsung Electro-Mechanics	Cap Ceramic 560pF 50V X7R 10% Pad SMD 1206 125°C T/R
C30	1	CC0603KRX7R8BB333	Yageo	Cap Ceramic 0.033uF 25V X7R 10% Pad SMD 0603 125°C T/R
C31	1	GCM188R71E474KA64D	Murata Manufacturing	Cap Ceramic 0.47uF 25V X7R 10% Pad SMD 0603 125°C Automotive T/R
C32	1	GCM188R71E474KA64D	Murata Manufacturing	Cap Ceramic 0.47uF 25V X7R 10% Pad SMD 0603 125°C Automotive T/R
D1	1	GL34B-E3/98	Vishay	Diode Switching 100V 0.5A 2-Pin DO-213AA T/R
D8	1	GL34B-E3/98	Vishay	Diode Switching 100V 0.5A 2-Pin DO-213AA T/R

L1	1	SER1360-802KLB	Coilcraft	Inductor 8uH 10% 9.83mOhm 9.5A Isat 7.6A Irms
L2	1	DO5040H-282MLB	Coilcraft	Inductor 2.8uH 20% 4.68mOhm 35A Isat 12.1A Irms
Q1	1	FDMS36101L_F085	Fairchild Semiconductor	Trans MOSFET N-CH 100VDS 28mOhm@4.5V 27mOhm@6V 35nC 17.25nC 3.95nF 0.229nF 175°C 38A 94W 1.6°C/W 1.1mm 32.6mm^2 PQFN 5x6 8L (Power 56)
Q2	1	FDMS36101L_F085	Fairchild Semiconductor	Trans MOSFET N-CH 100VDS 28mOhm@4.5V 27mOhm@6V 35nC 17.25nC 3.95nF 0.229nF 175°C 38A 94W 1.6°C/W 1.1mm 32.6mm^2 PQFN 5x6 8L (Power 56)
Q5	1	SiJ482DP	Vishay	Trans MOSFET N-CH 80VDS 9.5mOhm@4.5V 8.6mOhm@6V 24nC 13.5nC 2.43nF 1.18nF 150°C 60A 69.4W 1.8°C/W 1.14mm 43.3mm^2 PowerPak SO-8L
Q6	1	FDMS86103L	Fairchild Semiconductor	Trans MOSFET N-CH 100VDS 11mOhm@4.5V 10mOhm@6V 23nC 10.75nC 2.79nF 0.469nF 150°C 81A 104W 1.2°C/W 1.1mm 33.7mm^2 8-PQFN (5x6), Power56
R4	1	RC0603FR-072R21L	Yageo	Res Thick Film 0603 2.21 Ohm 1% 0.1W(1/10W) ±200ppm/°C Epoxy Pad SMD T/R
R6	1	CRCW0603100KFKEAHP	Vishay	Res Thick Film 0603 100K Ohm 1% 0.25W(1/4W) ±100ppm/°C Pad SMD Automotive T/R
R7	1	ERJ3EKF1912V	Panasonic	Res Thick Film 0603 19.1K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R8	1	ERJ3EKF3571V	Panasonic	Res Thick Film 0603 3.57K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R9	1	ERJ3RQF1R0V	Panasonic	Res Thick Film 0603 1 Ohm 1% 0.1W(1/10W) ±200ppm/°C Pad SMD Automotive T/R
R12	1	ERJ3RQF1R0V	Panasonic	Res Thick Film 0603 1 Ohm 1% 0.1W(1/10W) ±200ppm/°C Pad SMD Automotive T/R
R13	1	ERJ6ENF9091V	Panasonic	Res Thick Film 0805 9.09K Ohm 1% 0.125W(1/8W) ±100ppm/°C Pad SMD Automotive T/R
R14	1	ERJ3EKF4422V	Panasonic	Res Thick Film 0603 44.2K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R16	1	ERJ3EKF4993V	Panasonic	Res Thick Film 0603 499K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R17	1	ERJ3EKF1653V	Panasonic	Res Thick Film 0603 165K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
				Res Thick Film 0603 499K Ohm 1%

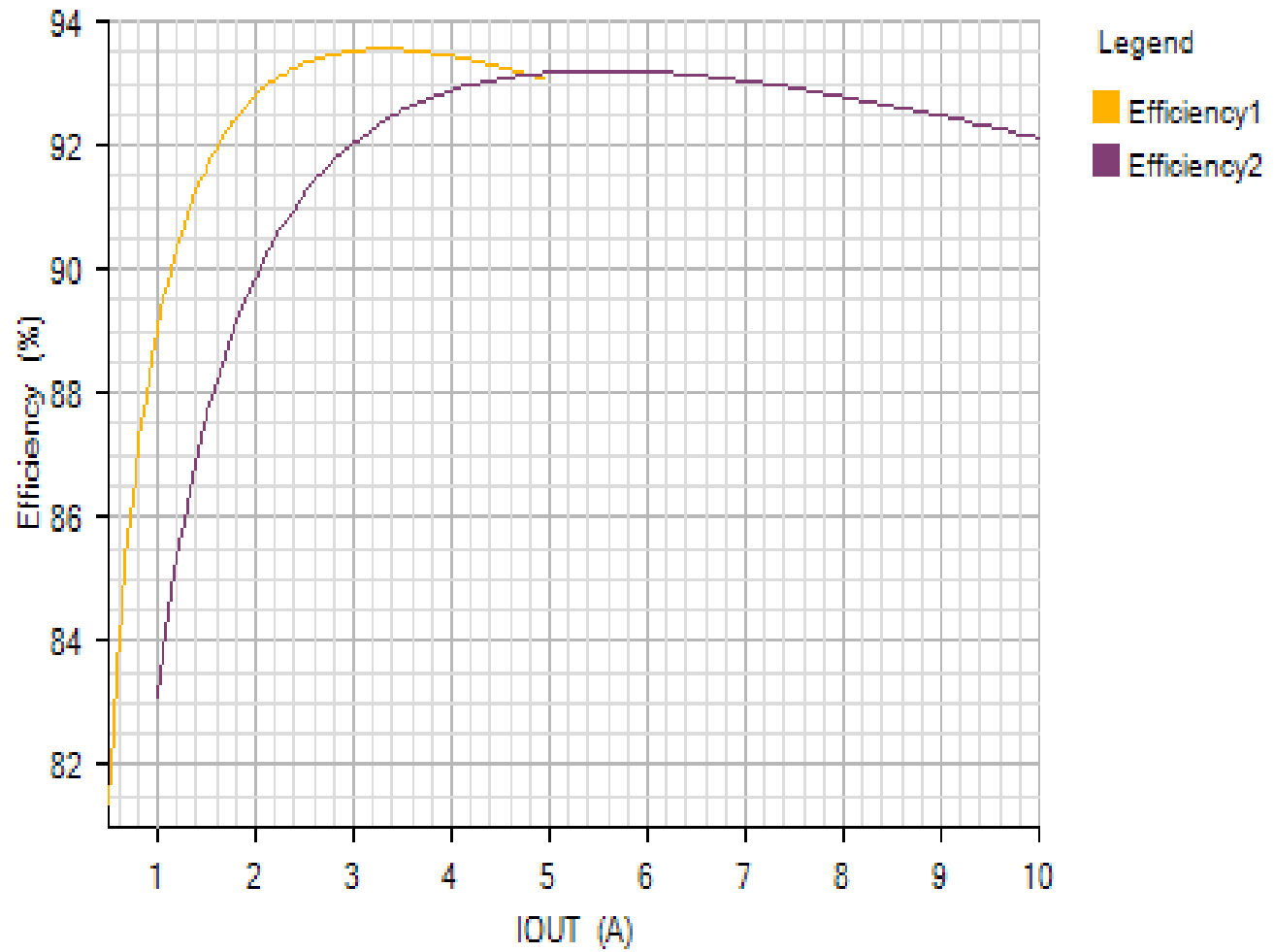
R18	1	ERJ3EKF4993V	Panasonic	0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R19	1	ERJ3EKF1653V	Panasonic	Res Thick Film 0603 165K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R20	1	ERJ3EKF1002V	Panasonic	Res Thick Film 0603 10K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R21	1	ERJ3EKF1002V	Panasonic	Res Thick Film 0603 10K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R24	1	ERJ3EKF7151V	Panasonic	Res Thick Film 0603 7.15K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R26	1	CRCW0603100KFKEAHP	Vishay	Res Thick Film 0603 100K Ohm 1% 0.25W(1/4W) ±100ppm/°C Pad SMD Automotive T/R
R27	1	ERJ3EKF3162V	Panasonic	Res Thick Film 0603 31.6K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R28	1	ERJ3EKF2211V	Panasonic	Res Thick Film 0603 2.21K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R29	1	CR0603-FX-1000ELF	Bourns	Res Thick Film 0603 100 Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD T/R
R30	1	ERJ3EKF33R0V	Panasonic	Res Thick Film 0603 33 Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R31	1	ERJ3EKF33R0V	Panasonic	Res Thick Film 0603 33 Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R32	1	ERJ3EKF4022V	Panasonic	Res Thick Film 0603 40.2K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R33	1	ERJ3EKF2212V	Panasonic	Res Thick Film 0603 22.1K Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD Automotive T/R
R34	1	CR0603-FX-1000ELF	Bourns	Res Thick Film 0603 100 Ohm 1% 0.1W(1/10W) ±100ppm/°C Pad SMD T/R

Simulation Results

Efficiency - Tue Nov 20 2018 09:29:25

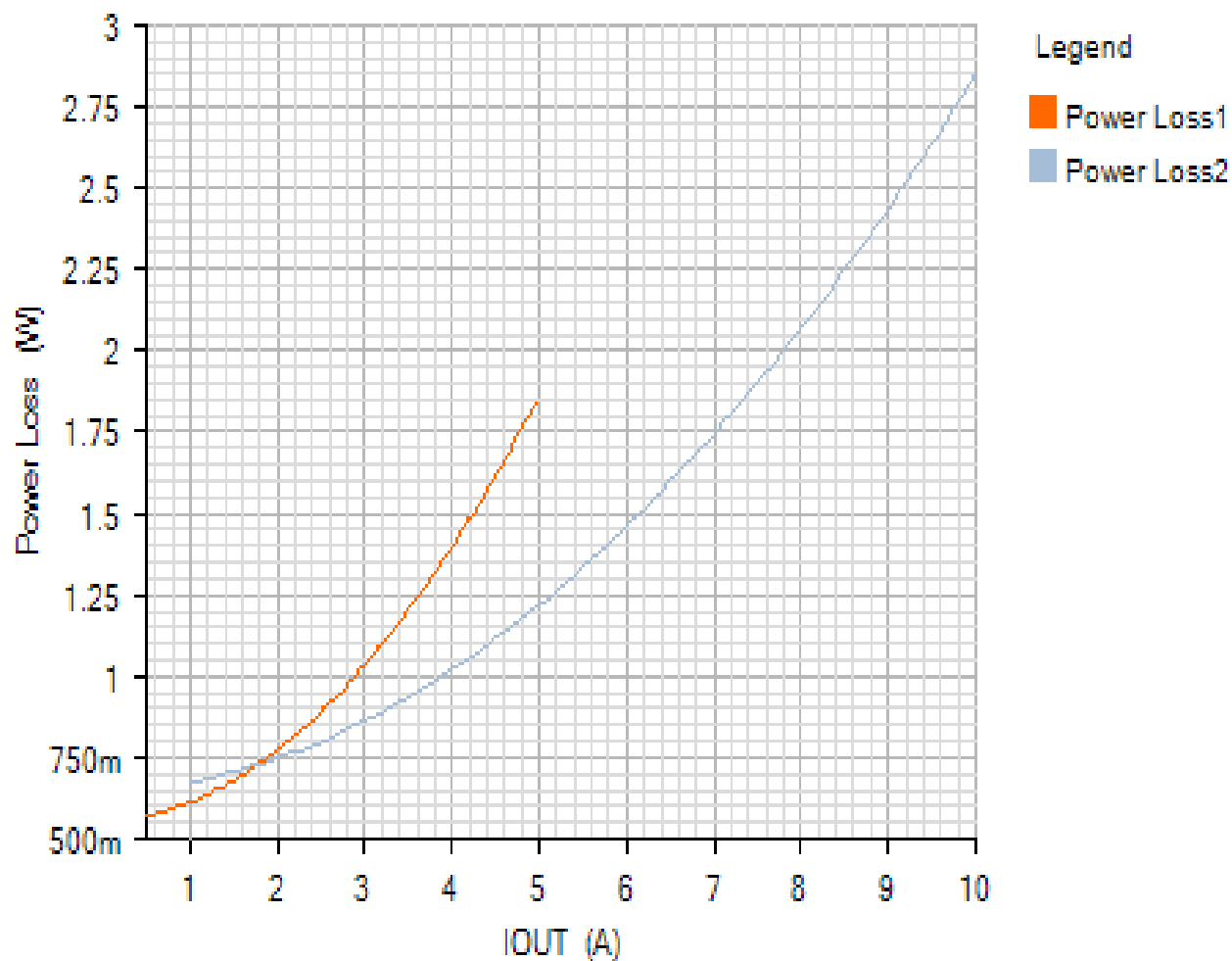
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Default

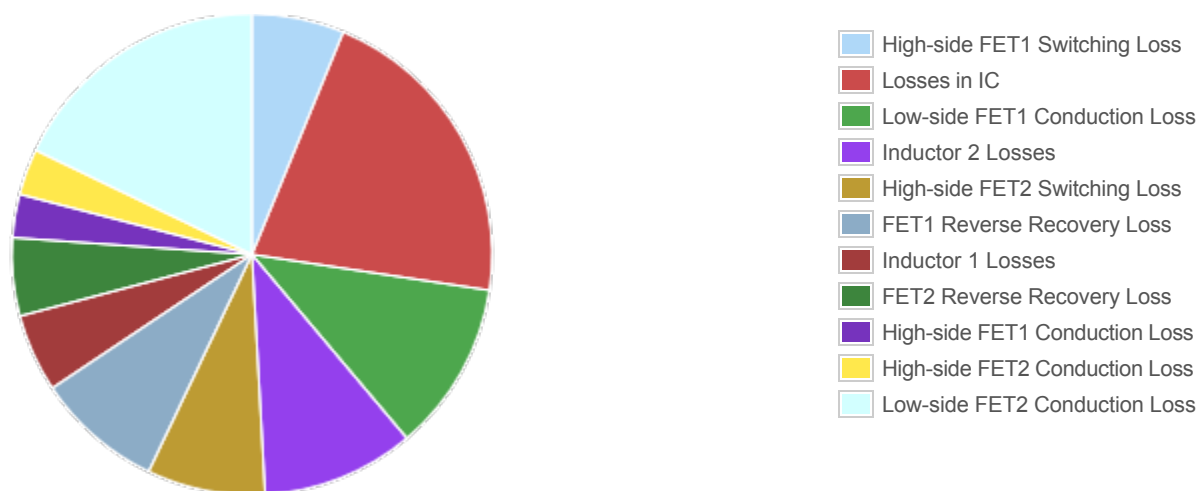


POWER_LOSS_PLOT

Default



Losses



Component

Loss (W)

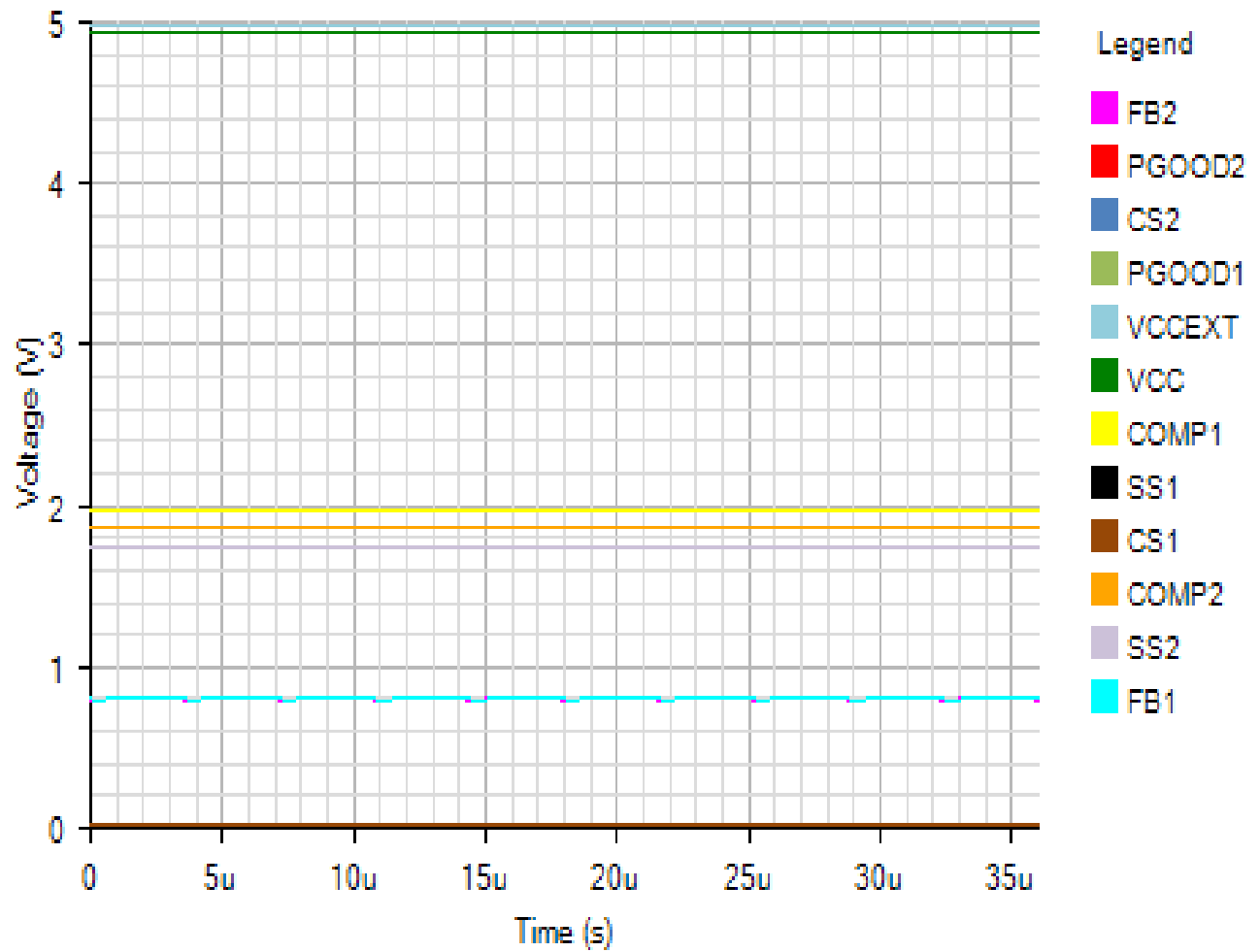
% of total

Component	Loss (W)	% of total
High-side FET1 Switching Loss	0.32	6.2
Losses in IC	1.09	21.2
Low-side FET1 Conduction Loss	0.59	11.5
Inductor 2 Losses	0.53	10.3
High-side FET2 Switching Loss	0.41	8
FET1 Reverse Recovery Loss	0.44	8.5
Inductor 1 Losses	0.27	5.2
FET2 Reverse Recovery Loss	0.27	5.2
High-side FET1 Conduction Loss	0.15	2.9
High-side FET2 Conduction Loss	0.16	3.1
Low-side FET2 Conduction Loss	0.92	17.9
Total	5.15	100

Steady State - Tue Nov 20 2018 09:29:25

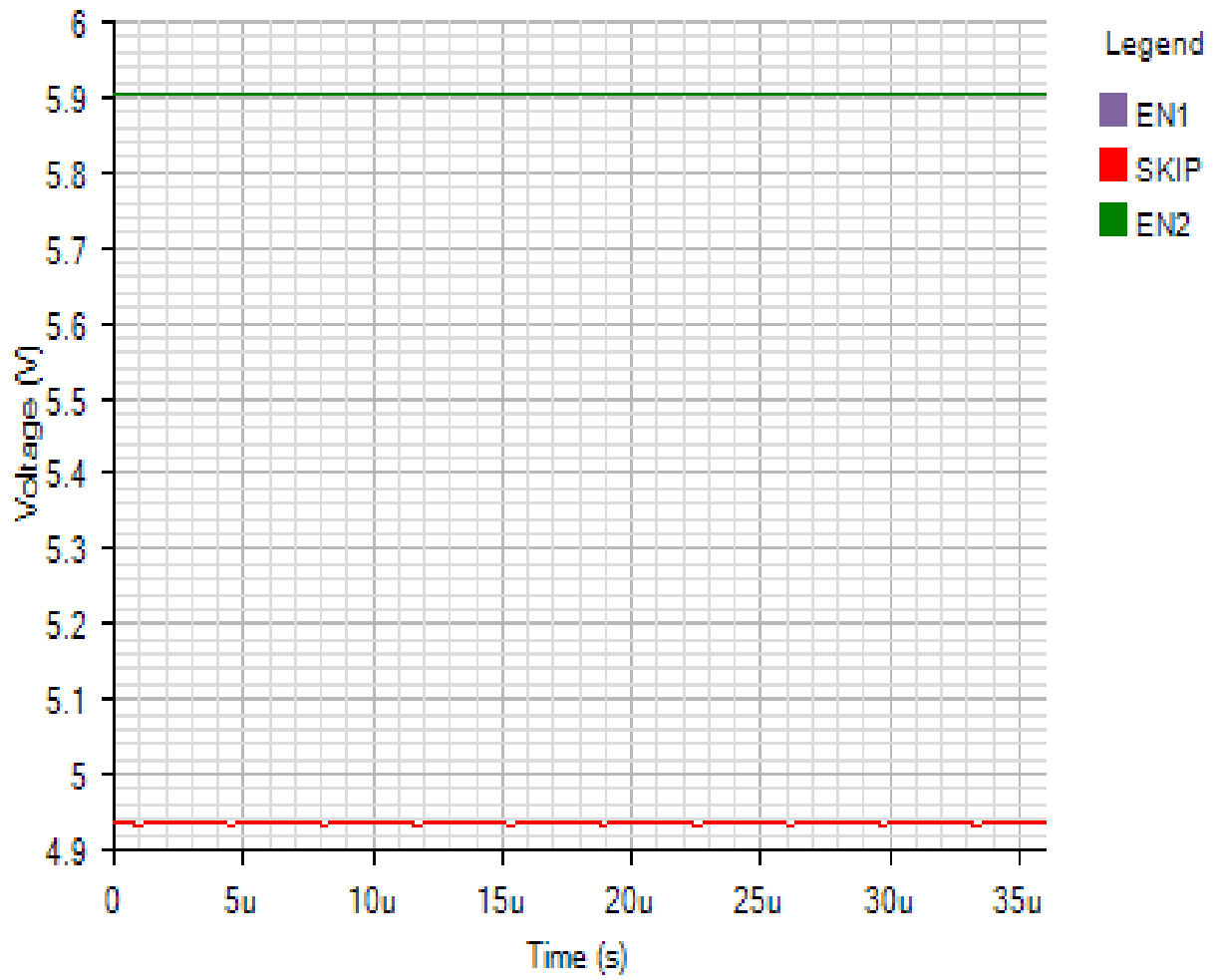
IC

Default



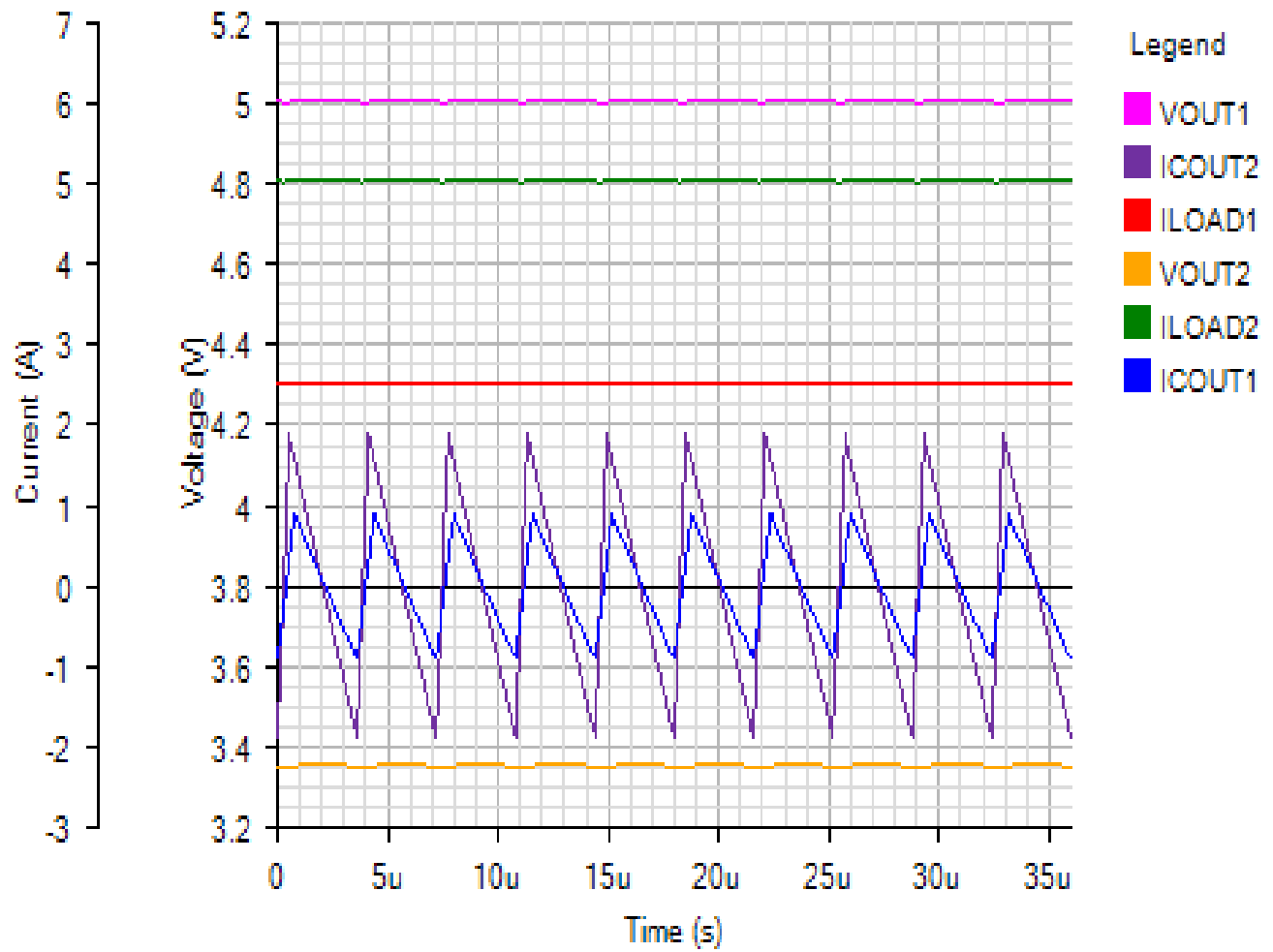
SIGNALS

Default



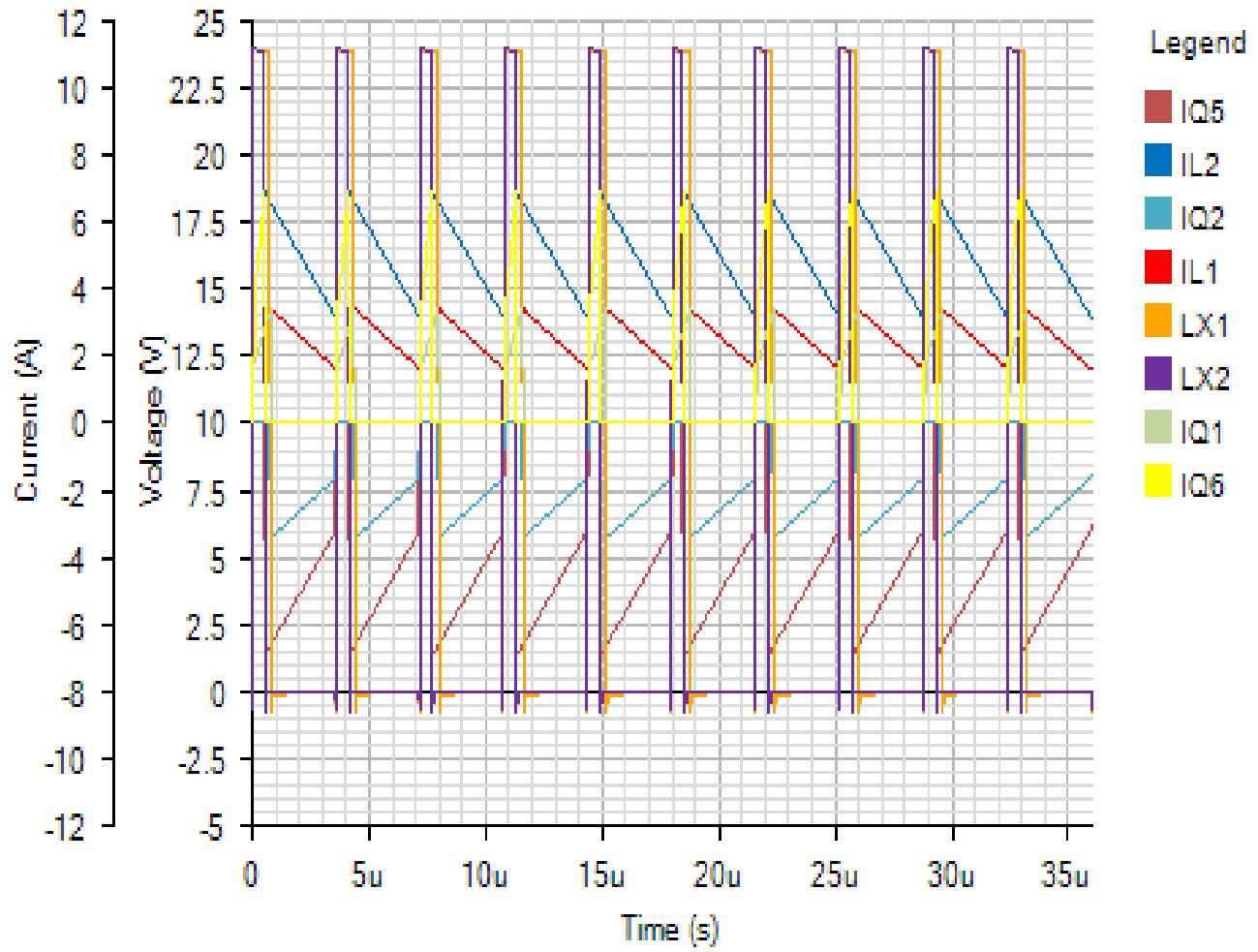
OUTPUT

Default



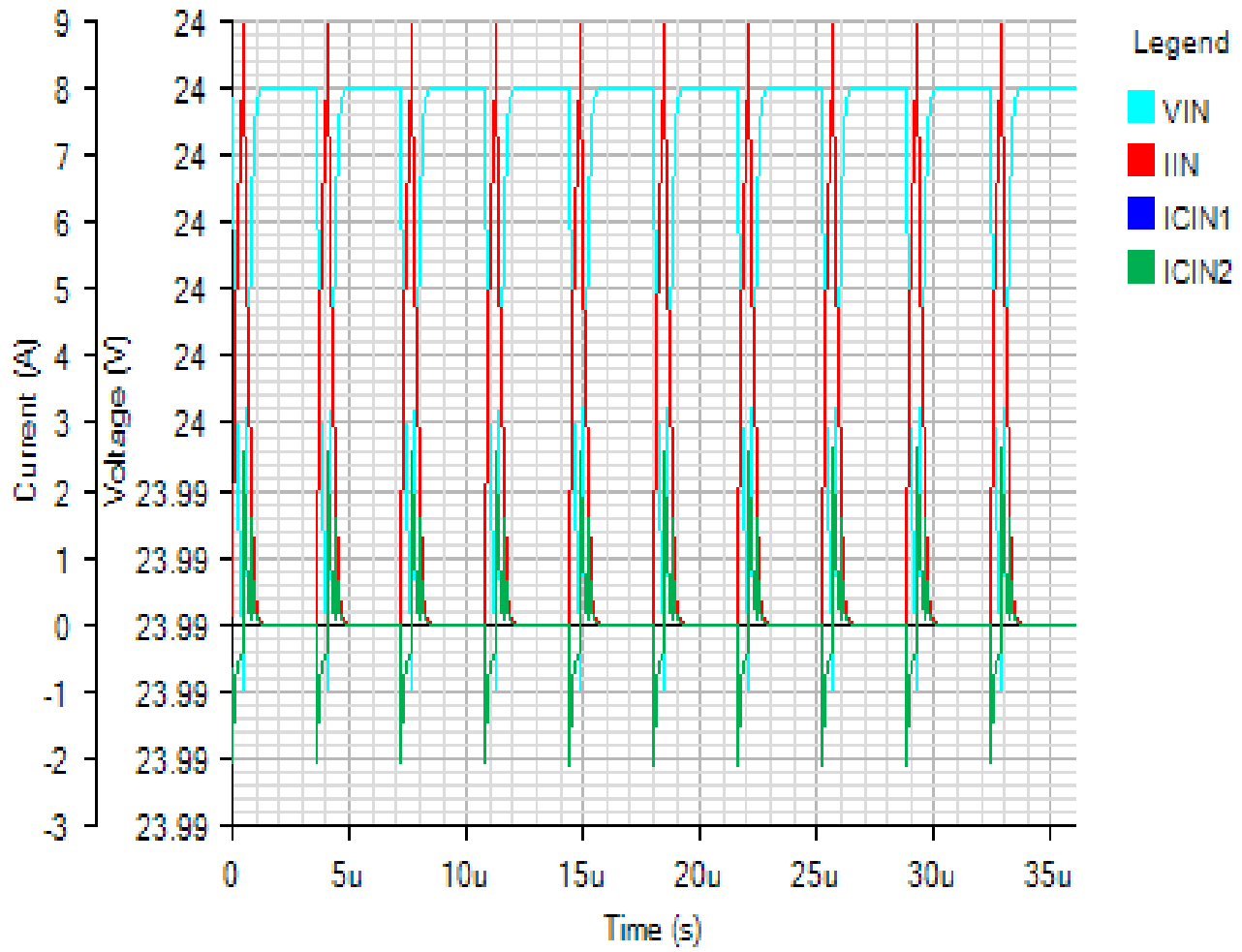
SWITCHING

Default



INPUT

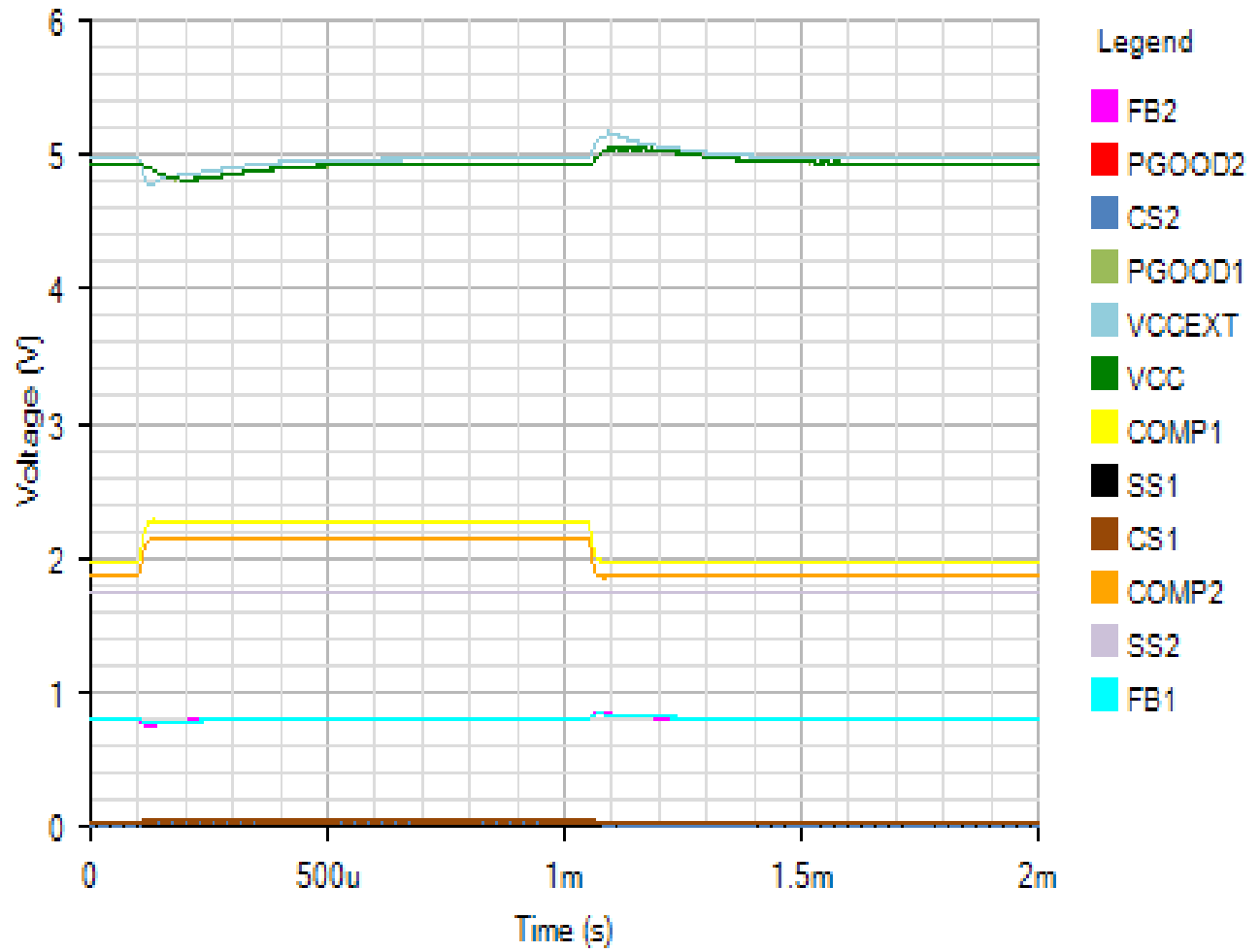
Default



Load Setp - Tue Nov 20 2018 09:29:25

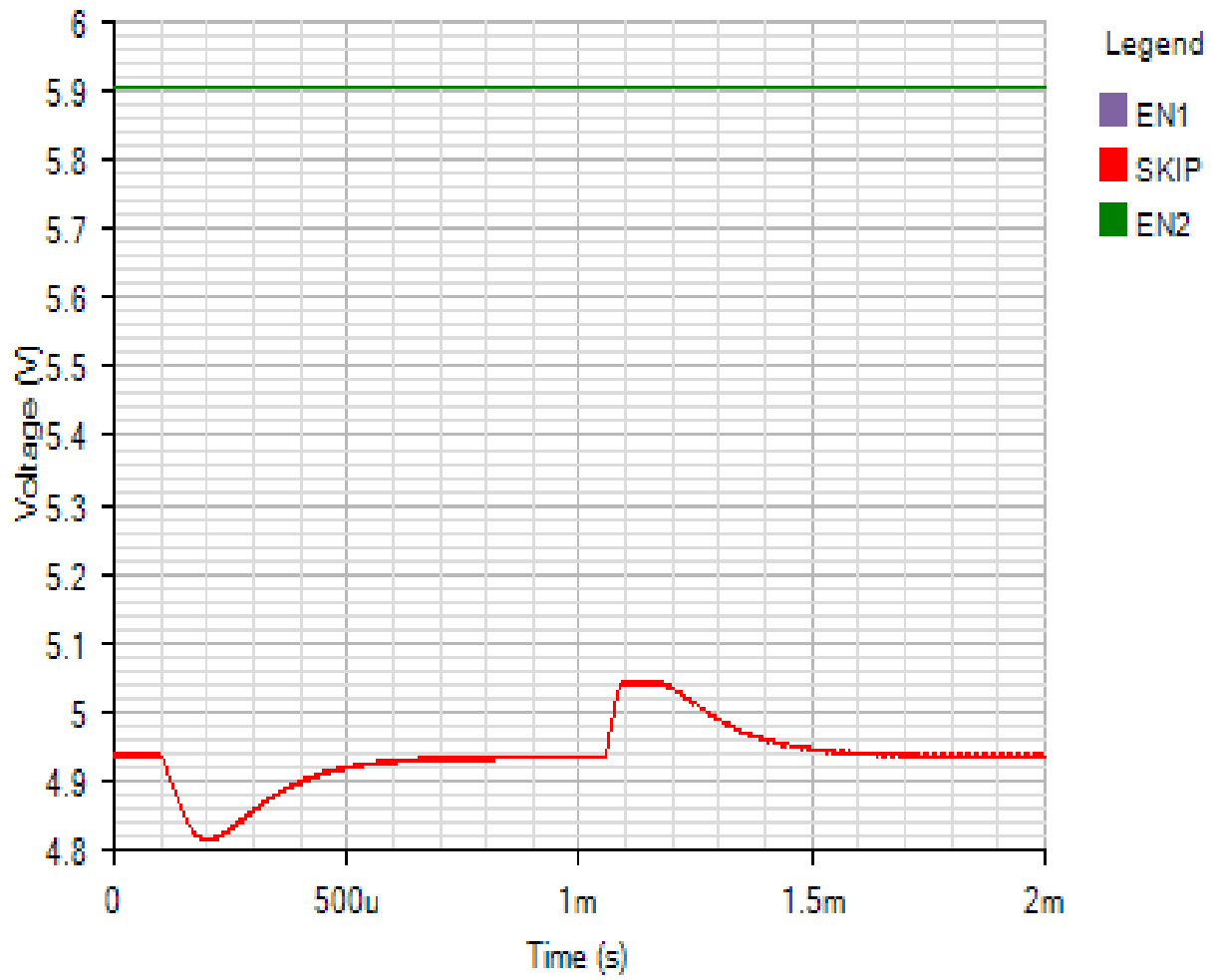
IC

Default



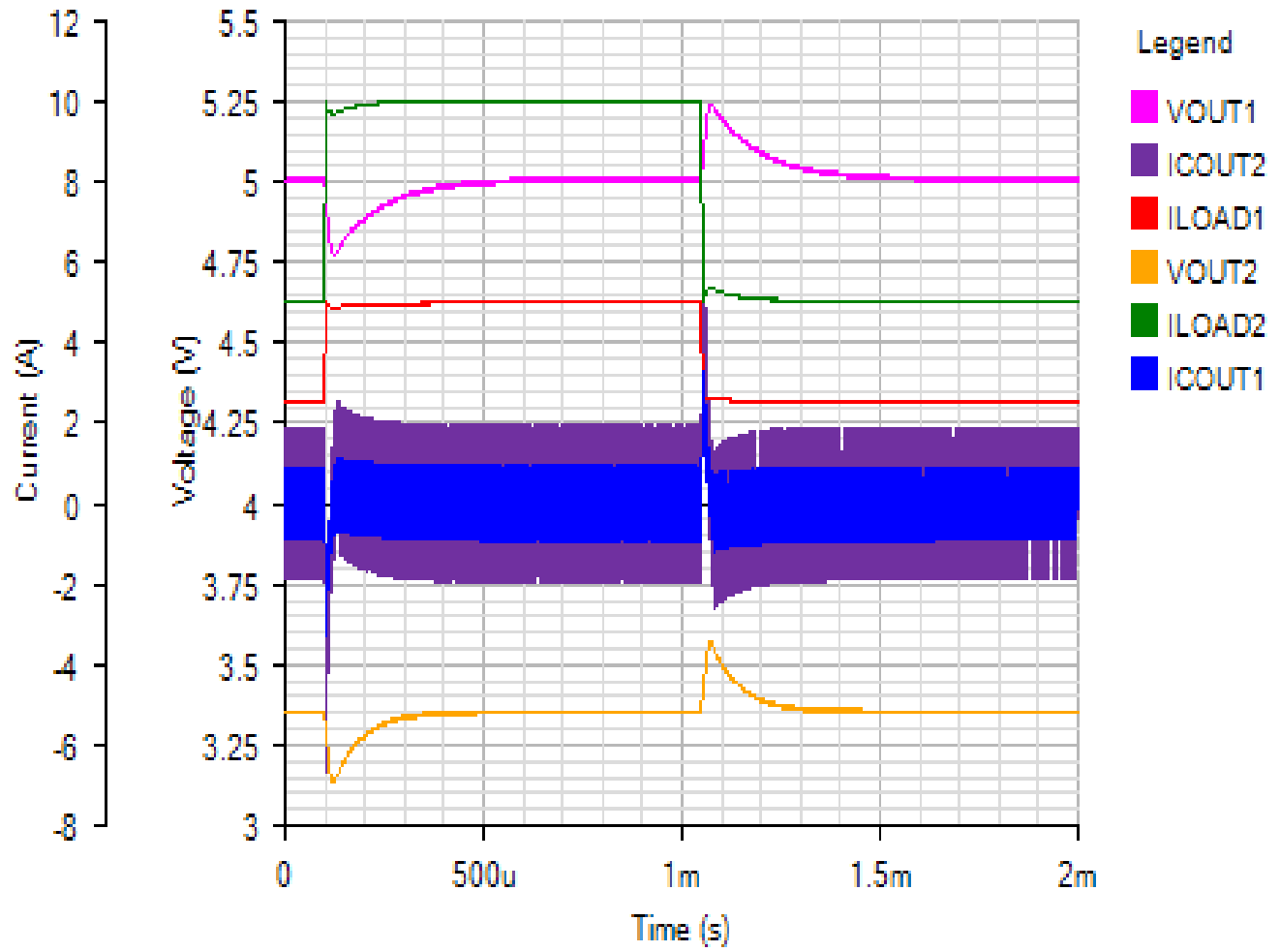
SIGNALS

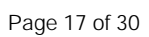
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OUTPUT

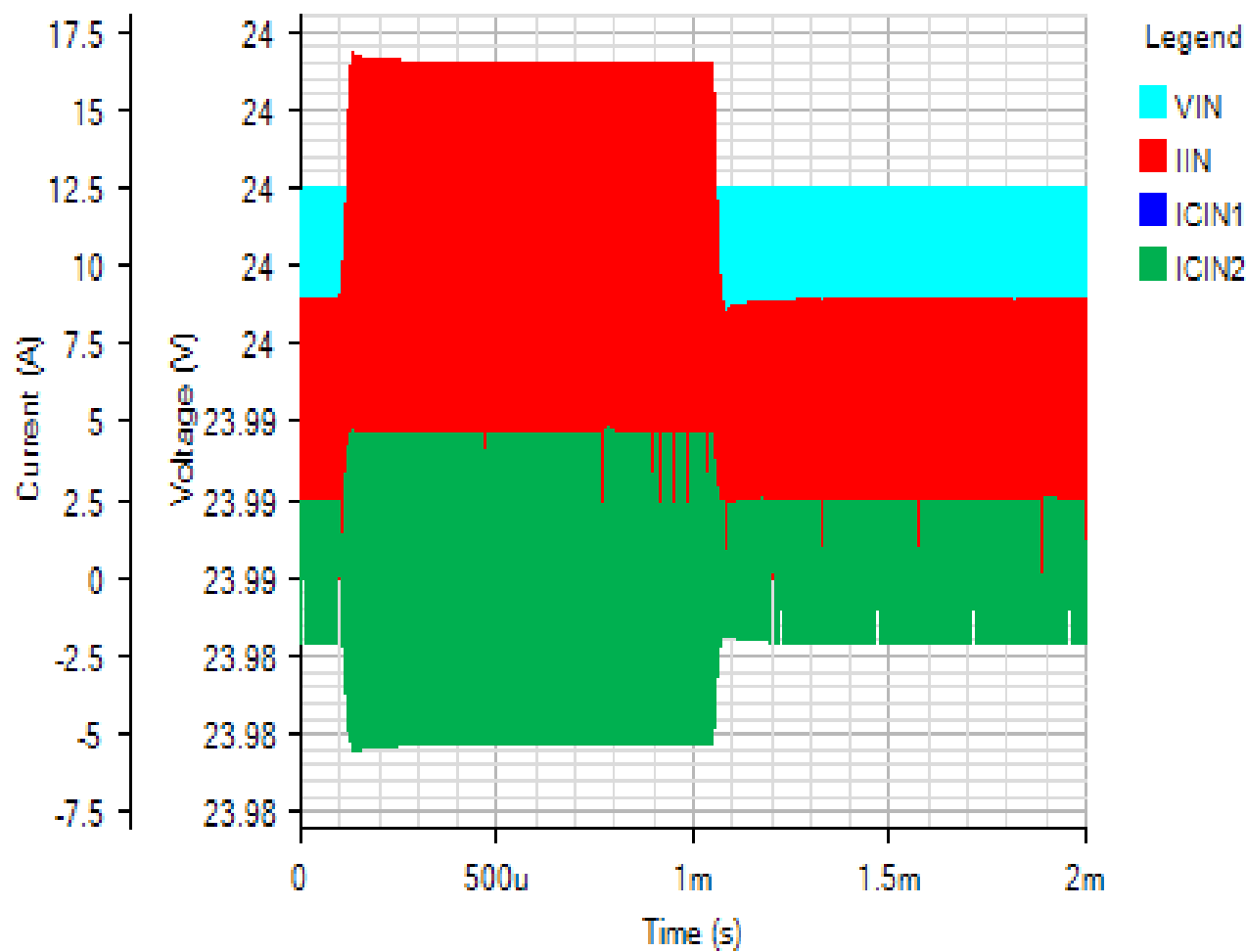
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INPUT

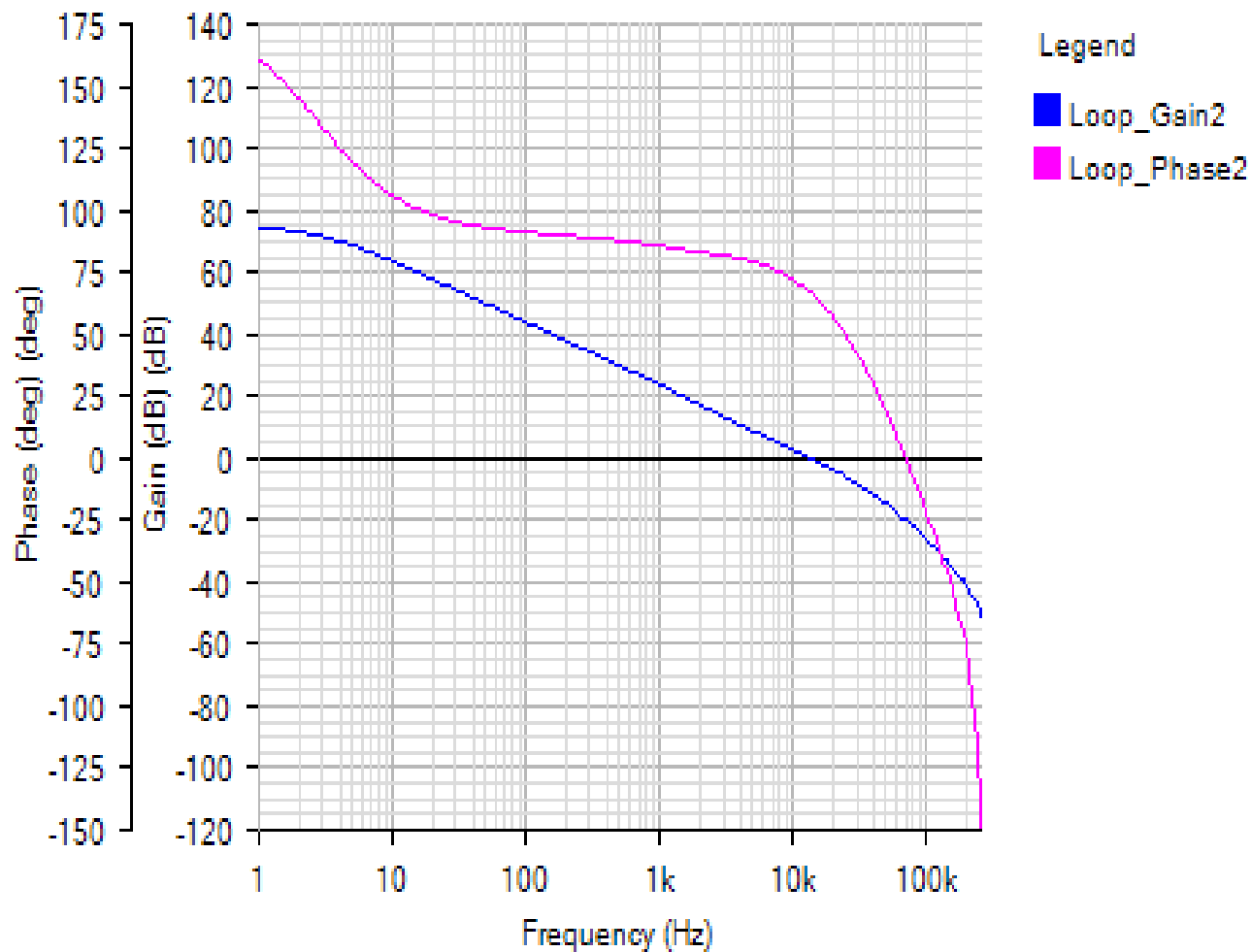
Default



AC Loop - Tue Nov 20 2018 09:29:25

BODE2

Default

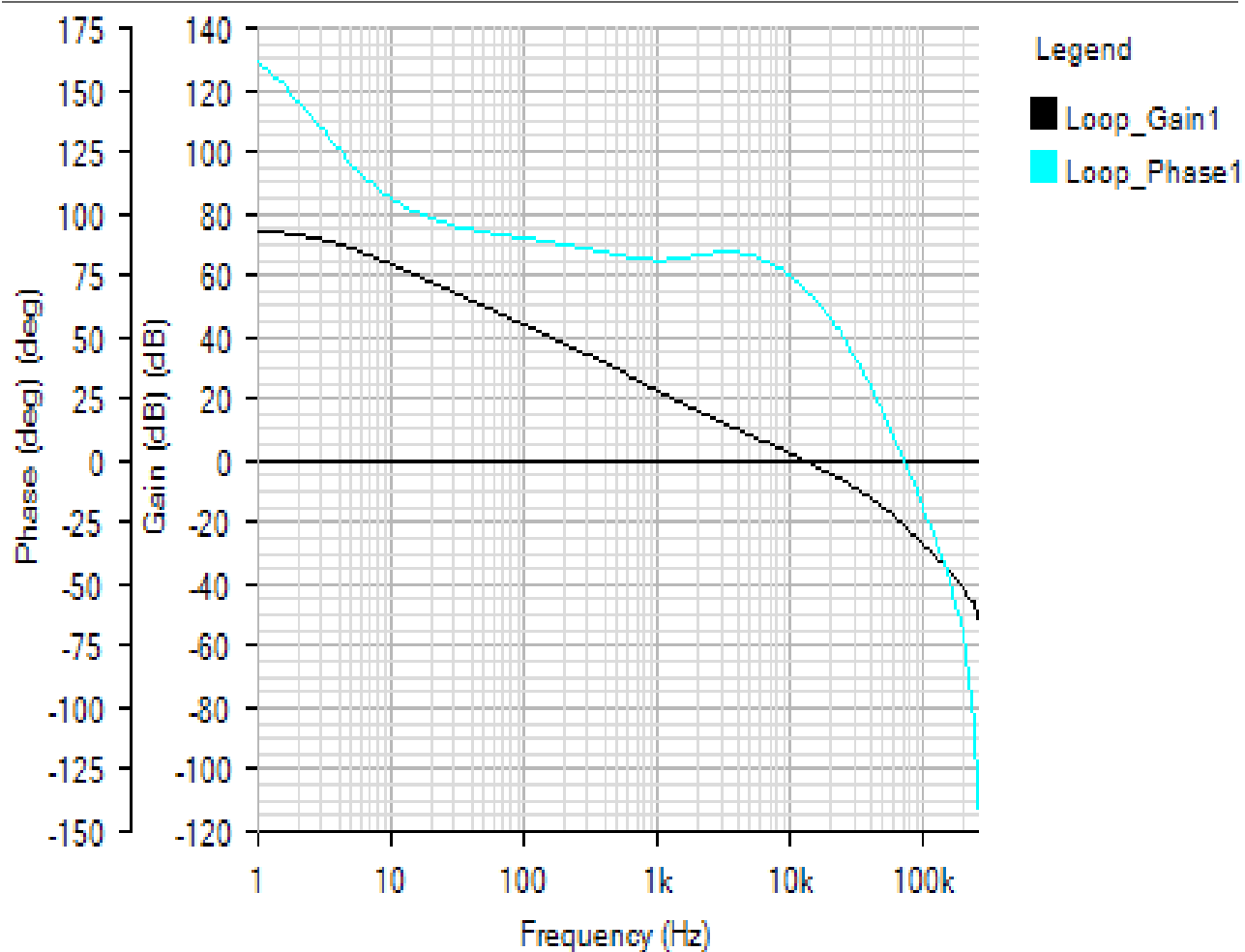


Phase Margin (output #2): 67.02° at a crossover frequency of 13.3kHz



BODE1

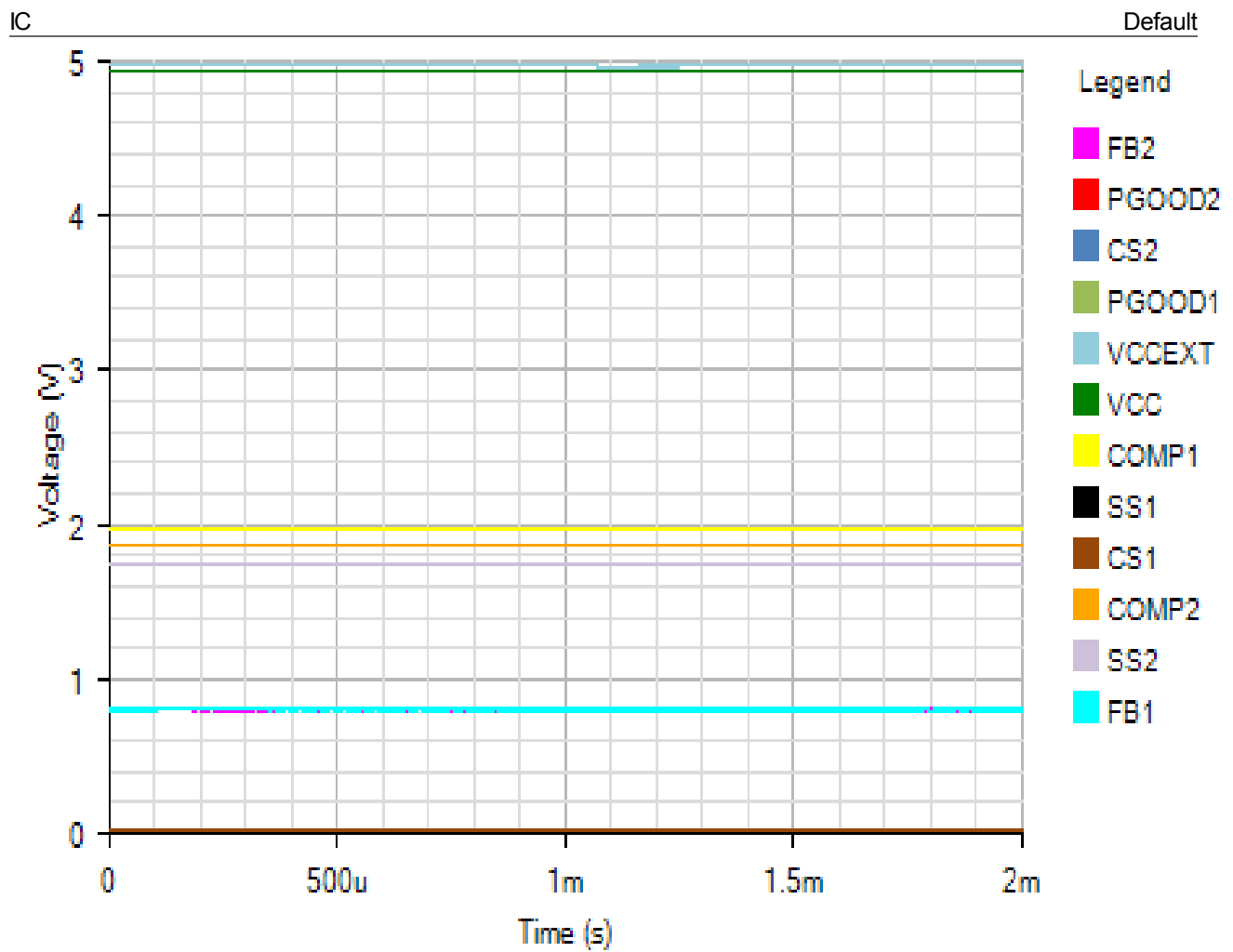
Default



Phase Margin (output #1): 69.45° at a crossover frequency of 13kHz

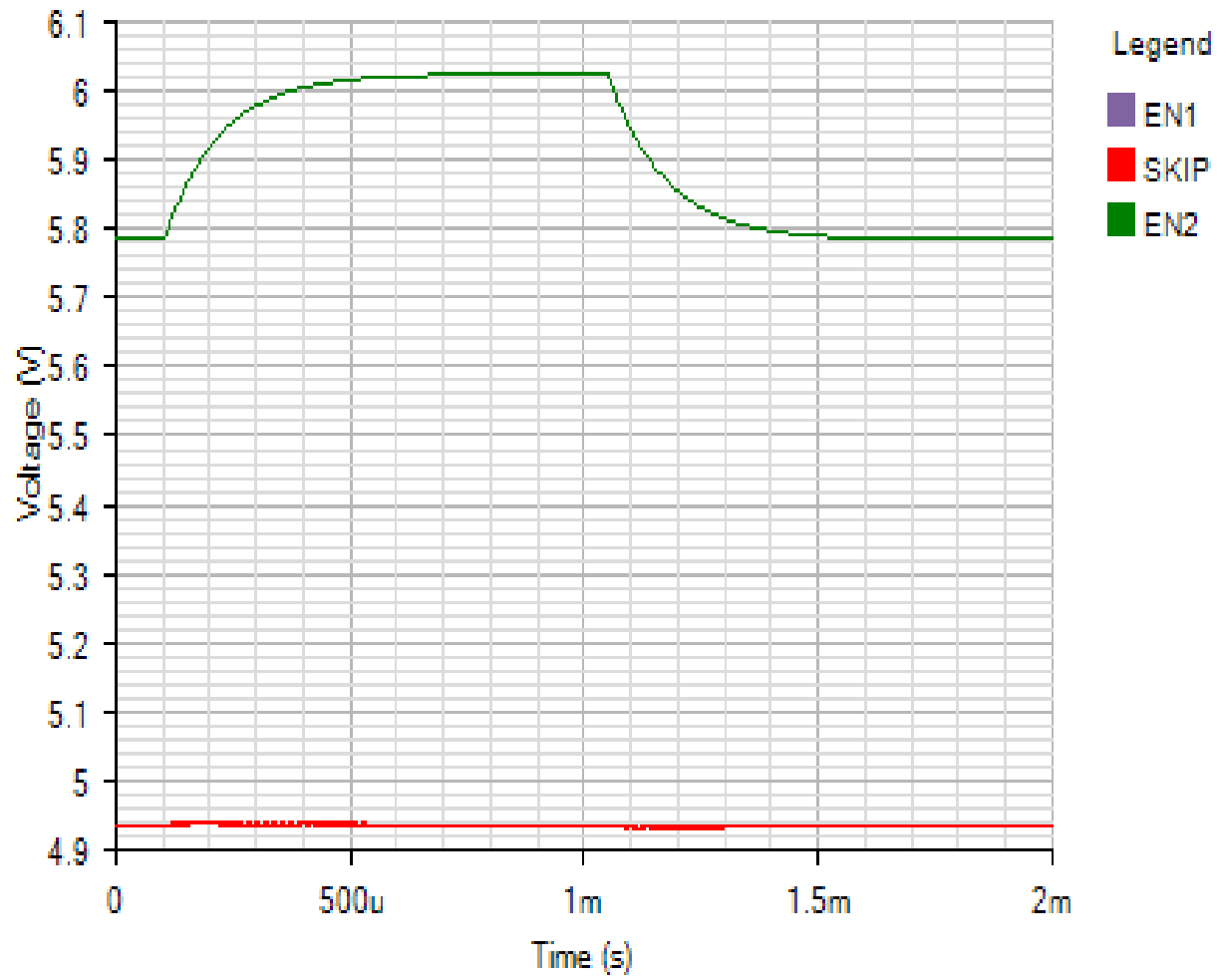


Line Transient - Tue Nov 20 2018 09:29:25



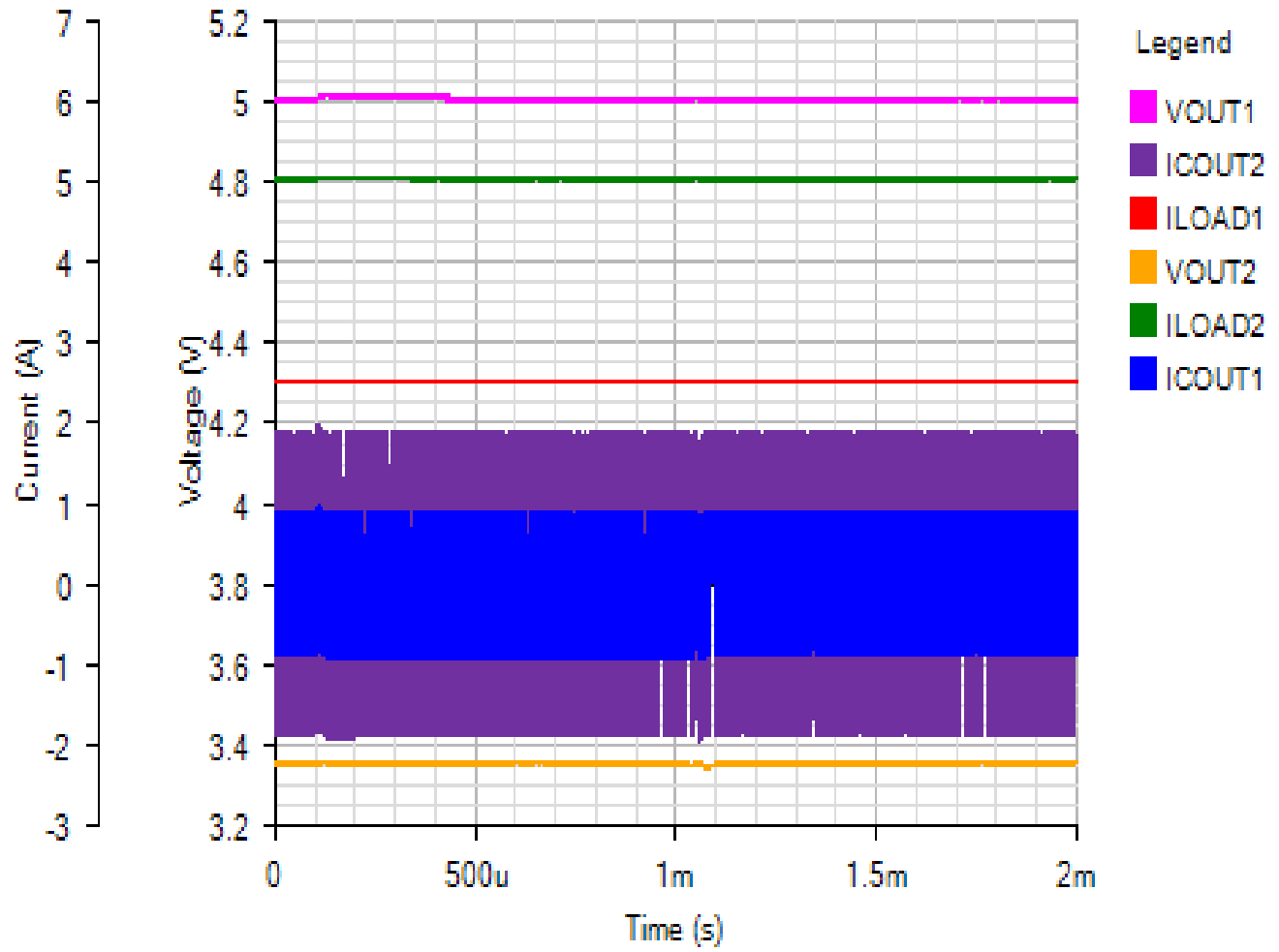
SIGNALS

Default



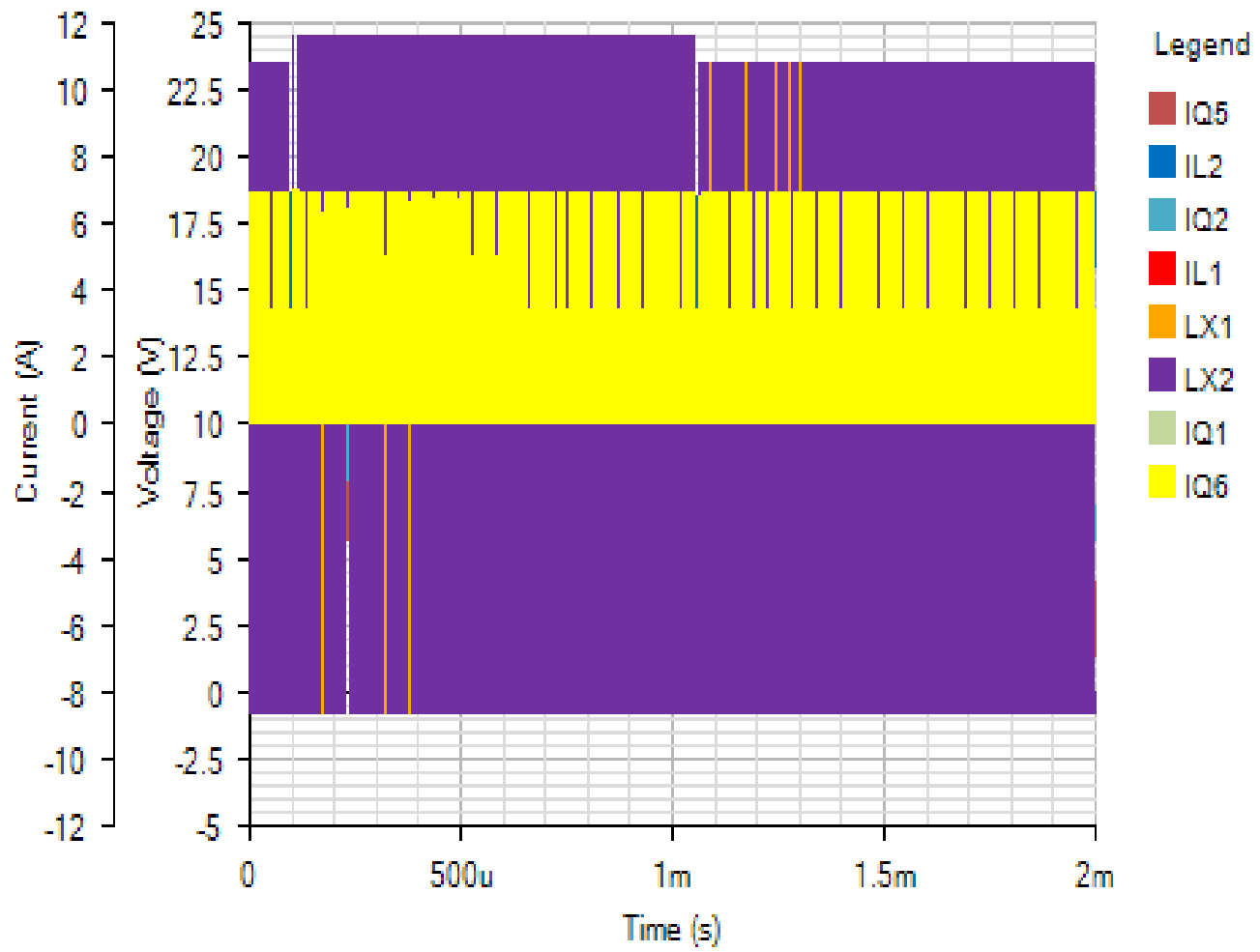
OUTPUT

Default



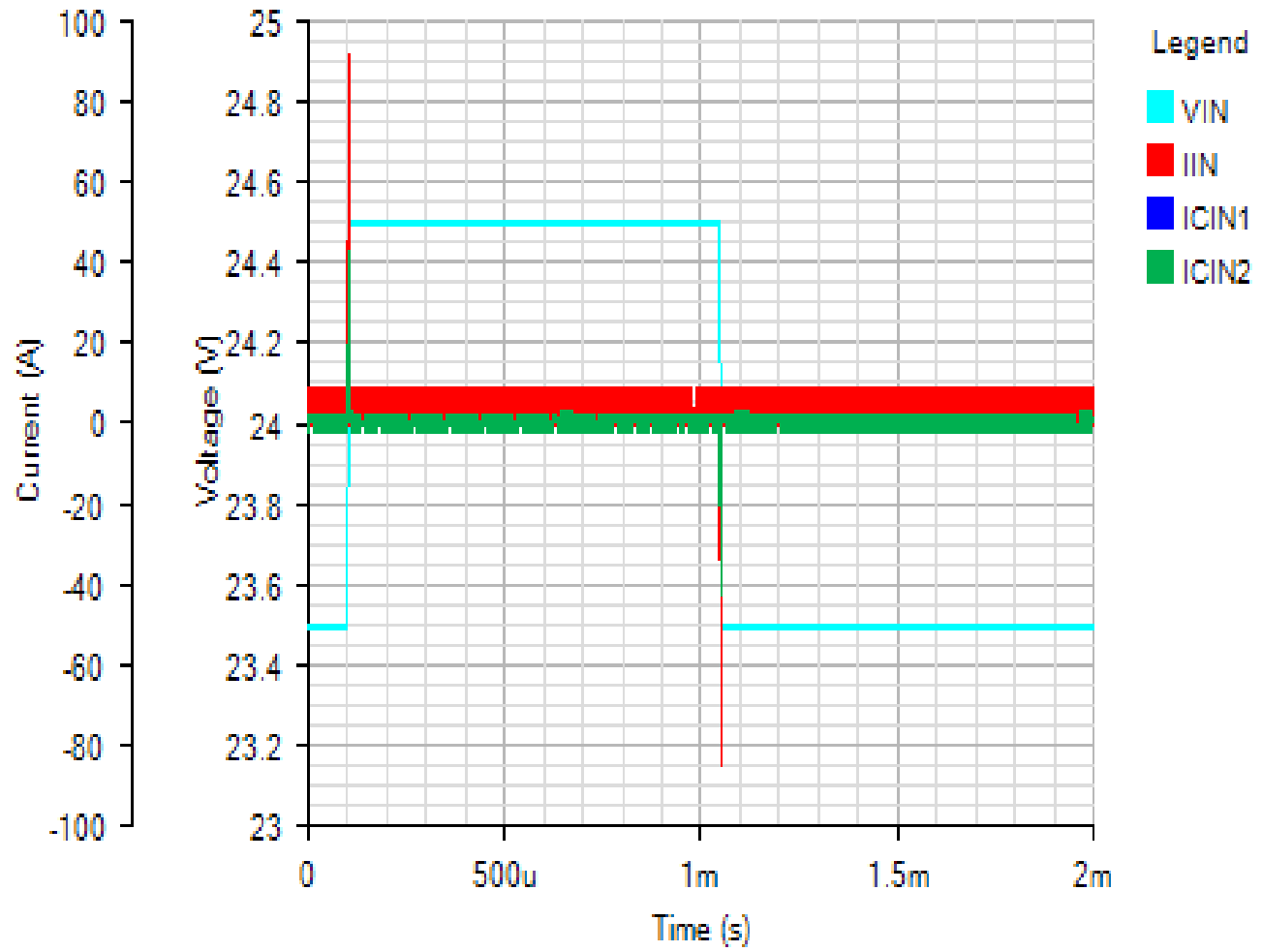
SWITCHING

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INPUT

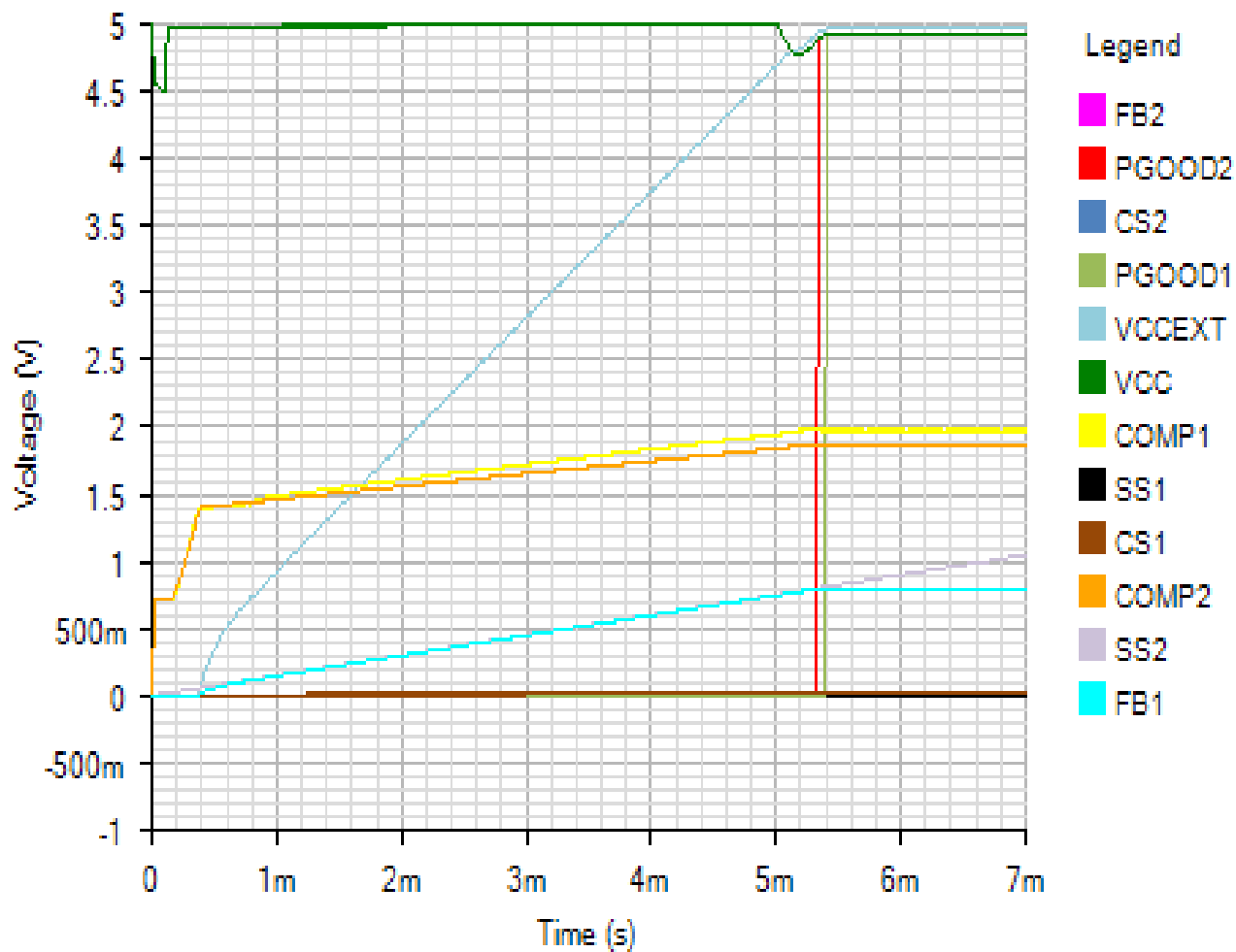
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Start Up - Tue Nov 20 2018 09:29:25

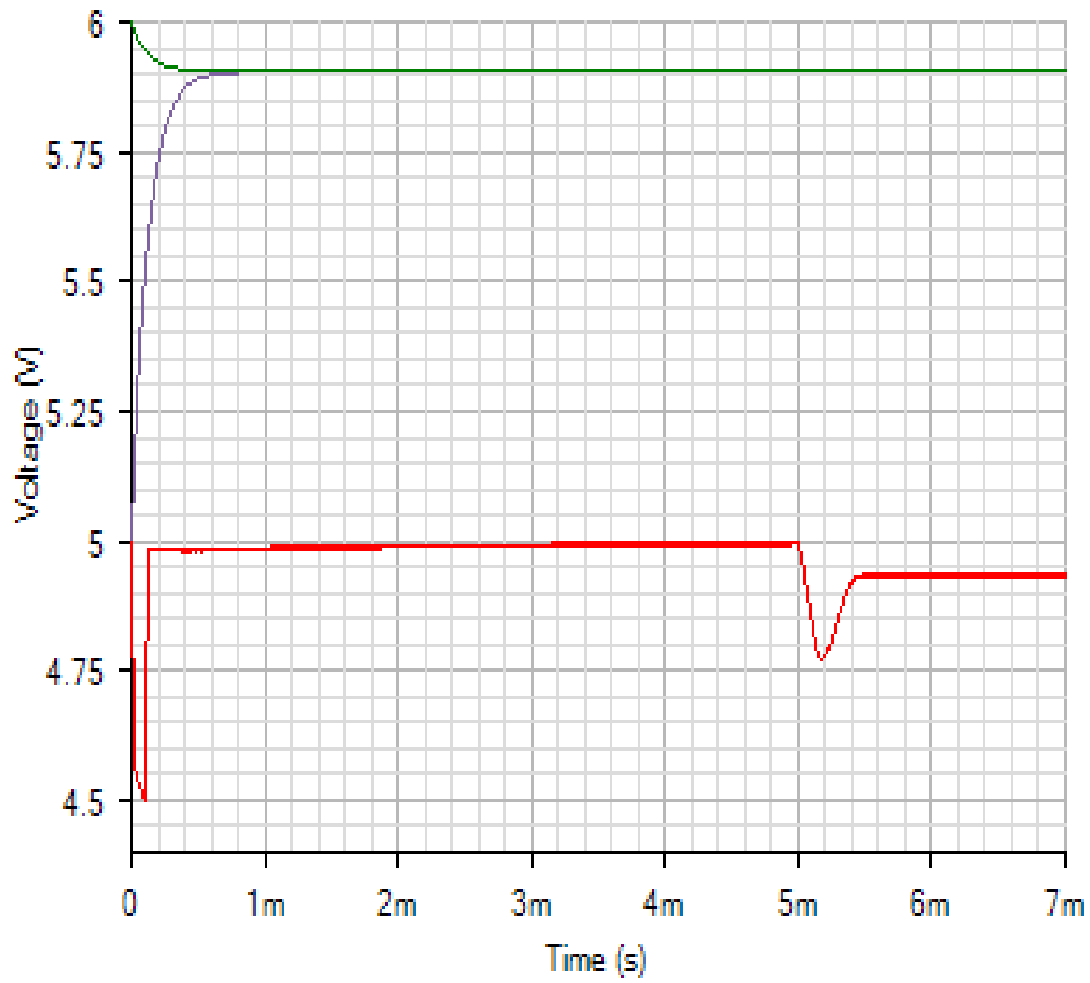
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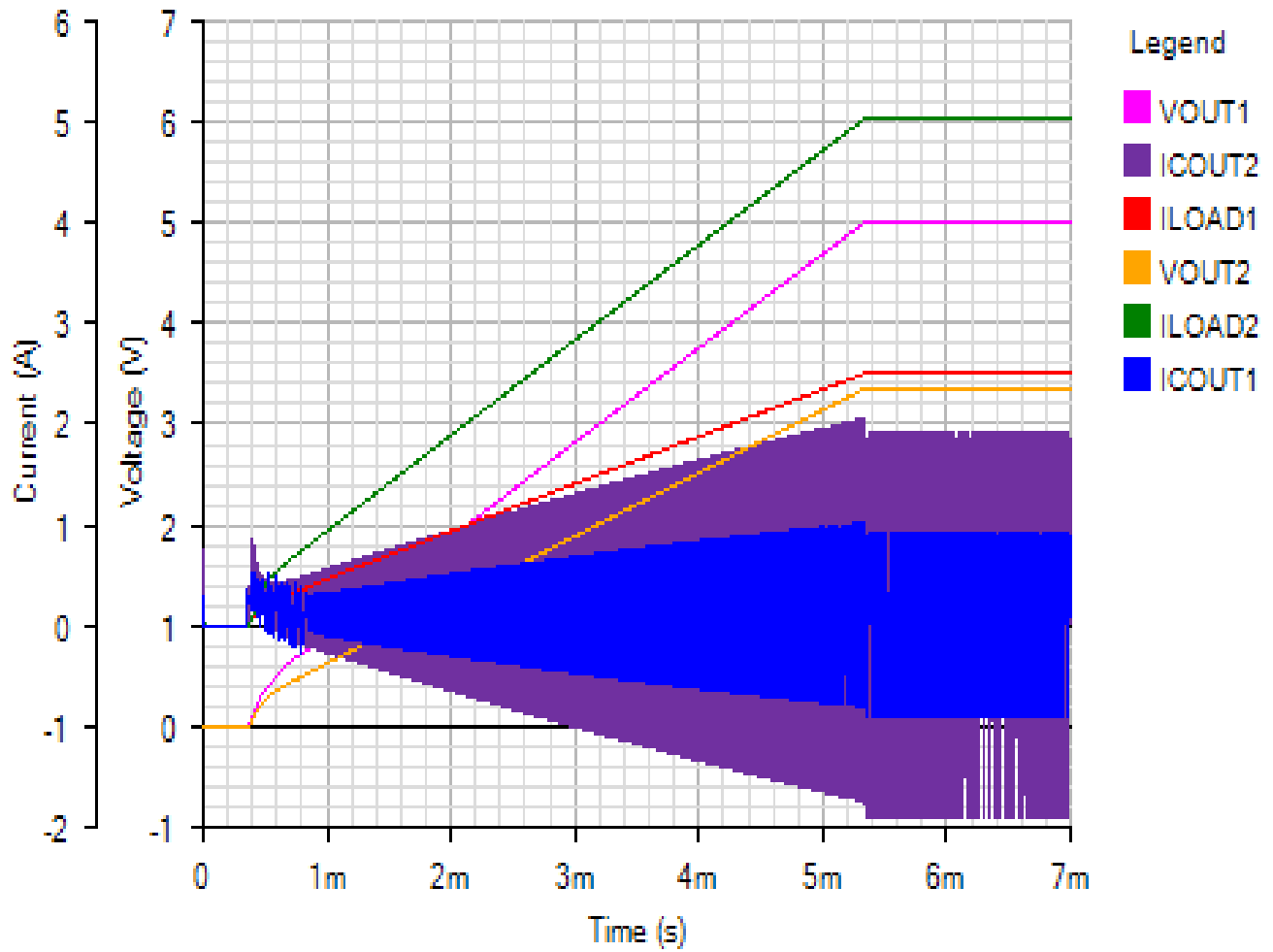
SIGNALS

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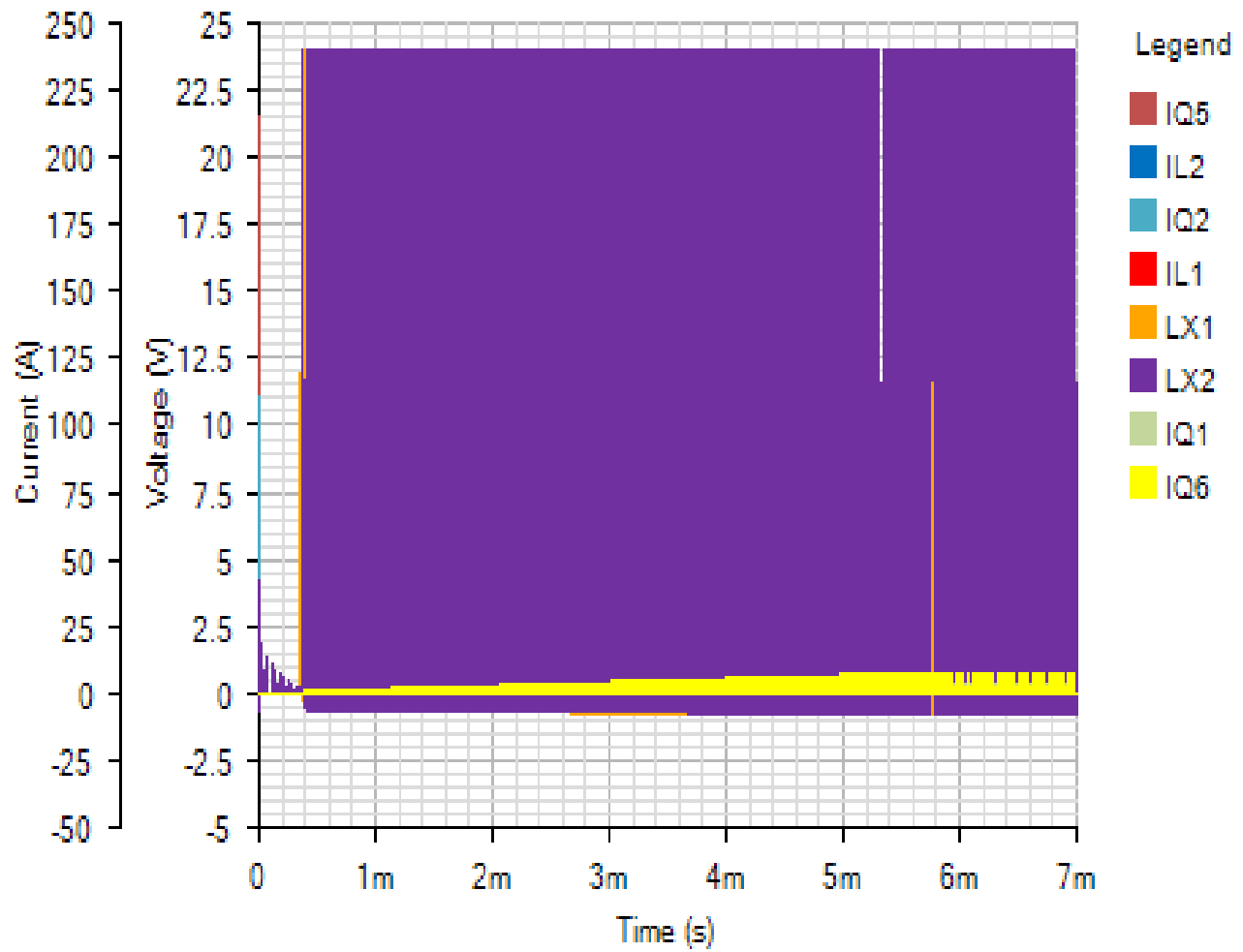
OUTPUT

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SWITCHING

Default



INPUT

Default

