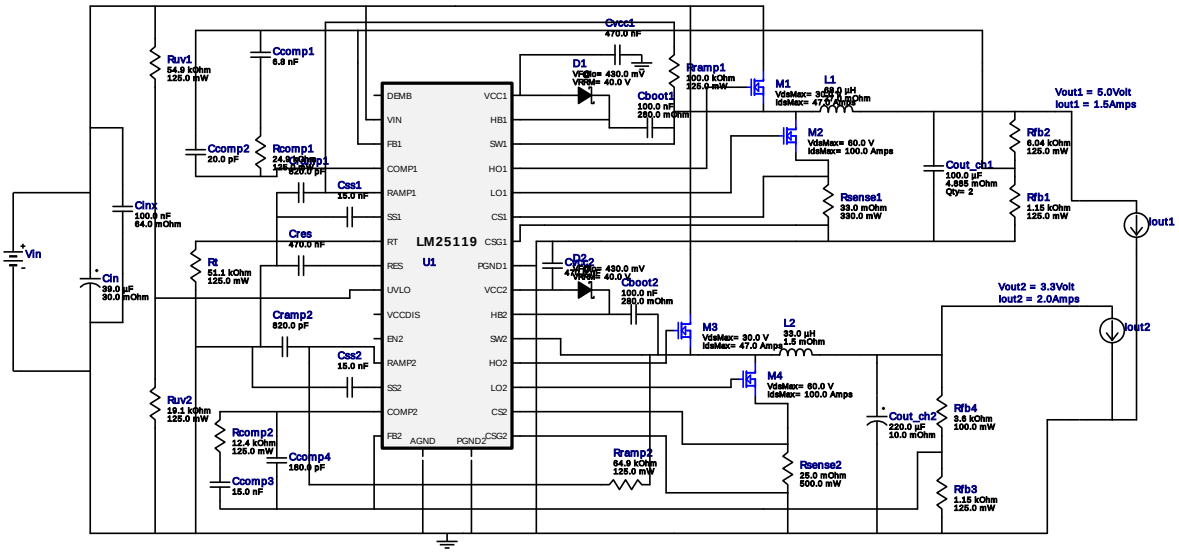
WEBENCH® Design Report

VinMin = 6.0V
VinMax = 22.0V
Vout = 5.0V
Iout = 1.5A

Device = LM25119PSQ/NOPB
Topology = Buck
Created = 4/12/16 7:34:32 AM
BOM Cost = $10.43
BOM Count = 40
Total Pd = 0.74W

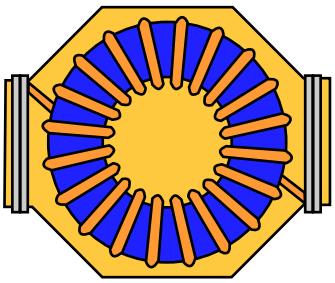
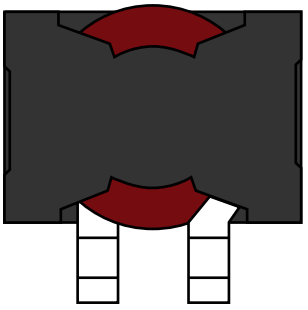
Design : 4116161/29 LM25119PSQ/NOPB
LM25119PSQ/NOPB 6.0V-22.0V to 3.30V @ 2.0A



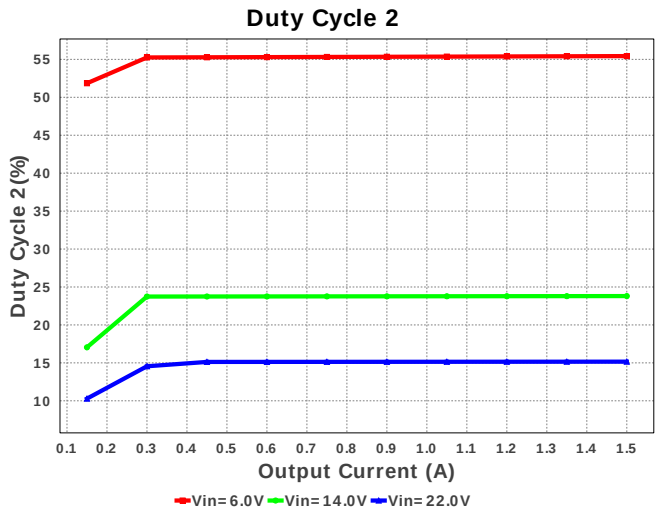
1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application.View WEBENCH(R) Disclaimer.

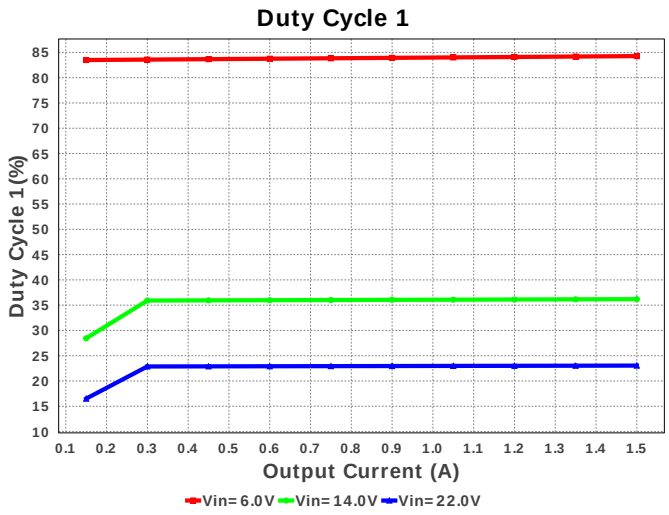
Electrical BOM

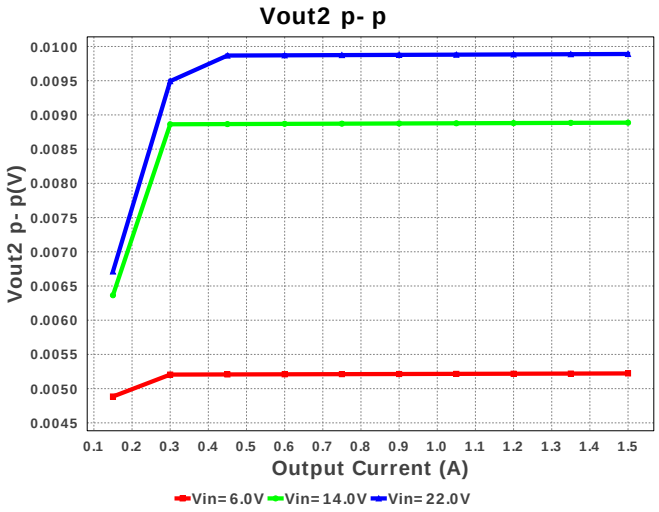
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot1	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
2.	Cboot2	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
3.	Ccomp1	Yageo America	CC0805KRX7R9BB682 Series= X7R	Cap= 6.8 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
4.	Ccomp2	Samsung Electro-Mechanics	CL21C200JBANNNC Series= C0G/NP0	Cap= 20.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
5.	Ccomp3	Yageo America	CC0805KRX7R9BB153 Series= X7R	Cap= 15.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
6.	Ccomp4	Kemet	C0805C181K5GACTU Series= C0G/NP0	Cap= 180.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
7.	Cin	Panasonic	35SVPF39M Series= SVPF	Cap= 39.0 uF ESR= 30.0 mOhm VDC= 35.0 V IRMS= 2.8 A	1	$0.50	CAPSMT_62_E7 106 mm²
8.	Cinx	Kemet	C0805C104K5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm²

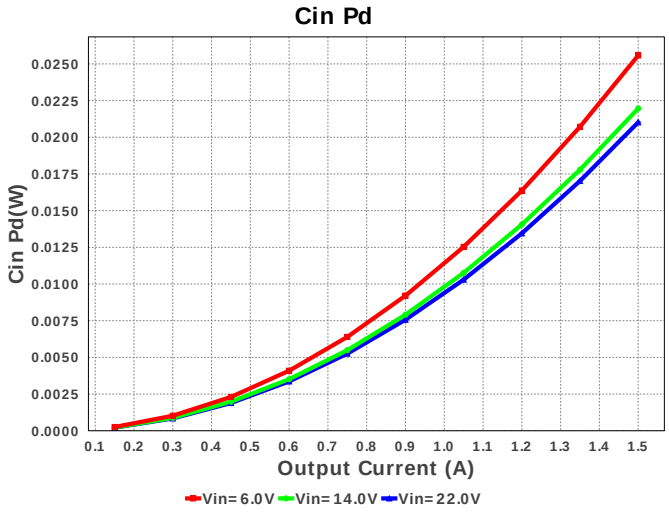
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	Cout_ch1	MuRata	GRM31CR60J107ME39L Series= X5R	Cap= 100.0 uF ESR= 4.885 mOhm VDC= 6.3 V IRMS= 4.4118 A	2	$0.20	 1206_190 11 mm²
10.	Cout_ch2	Panasonic	6SVPE220M Series= SVPE	Cap= 220.0 uF ESR= 10.0 mOhm VDC= 6.3 V IRMS= 3.9 A	1	$0.41	 CAPSMT_62_F61 74 mm²
11.	Cramp1	Yageo America	CC0805KRX7R9BB821 Series= X7R	Cap= 820.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	 0805 7 mm²
12.	Cramp2	Yageo America	CC0805KRX7R9BB821 Series= X7R	Cap= 820.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	 0805 7 mm²
13.	Cres	Taiyo Yuden	EMK212B7474KD-T Series= X7R	Cap= 470.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.02	 0805 7 mm²
14.	Css1	Yageo America	CC0805KRX7R9BB153 Series= X7R	Cap= 15.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	 0805 7 mm²
15.	Css2	Yageo America	CC0805KRX7R9BB153 Series= X7R	Cap= 15.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	 0805 7 mm²
16.	Cvcc1	MuRata	GRM155R61A474KE15D Series= X5R	Cap= 470.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	 0402 3 mm²
17.	Cvcc2	MuRata	GRM155R61A474KE15D Series= X5R	Cap= 470.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	 0402 3 mm²
18.	D1	ON Semiconductor	MBRS2040LT3G	VF@Io= 430.0 mV VRRM= 40.0 V	1	$0.12	 SMB 44 mm²
19.	D2	ON Semiconductor	MBRS2040LT3G	VF@Io= 430.0 mV VRRM= 40.0 V	1	$0.12	 SMB 44 mm²
20.	L1	Bourns	PM2110-680K-RC	L= 68.0 µH DCR= 27.0 mOhm	1	$1.21	 PM2110 890 mm²
21.	L2	Coilcraft	SER2915L-333KL	L= 33.0 µH DCR= 1.5 mOhm	1	$1.88	 SER2915L 652 mm²
22.	M1	Texas Instruments	CSD17308Q3	VdsMax= 30.0 V IdsMax= 47.0 Amps	1	$0.34	 TRANS_NexFET_Q3 18 mm²

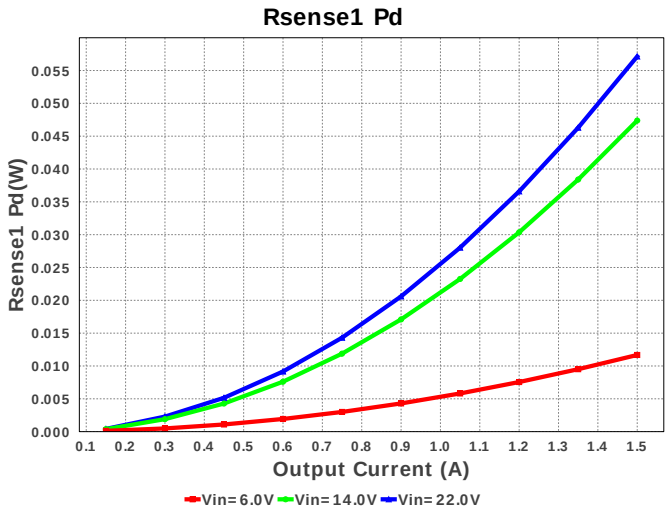
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
23.	M2	Texas Instruments	CSD18531Q5A	VdsMax= 60.0 V IdsMax= 100.0 Amps	1	$0.90	 TRANS_NexFET_Q5A 55 mm^2
24.	M3	Texas Instruments	CSD17308Q3	VdsMax= 30.0 V IdsMax= 47.0 Amps	1	$0.34	 TRANS_NexFET_Q3 18 mm^2
25.	M4	Texas Instruments	CSD18532Q5B	VdsMax= 60.0 V IdsMax= 100.0 Amps	1	$1.14	 TRANS_NexFET_Q5B 58 mm^2
26.	Rcomp1	Panasonic	ERJ-6ENF2492V Series= ERJ-6E	Res= 24.9 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
27.	Rcomp2	Panasonic	ERJ-6ENF1242V Series= ERJ-6E	Res= 12.4 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
28.	Rfb1	Panasonic	ERJ-6ENF1151V Series= ERJ-6E	Res= 1.15 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
29.	Rfb2	Panasonic	ERJ-6ENF6041V Series= ERJ-6E	Res= 6.04 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
30.	Rfb3	Panasonic	ERJ-6ENF1151V Series= ERJ-6E	Res= 1.15 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
31.	Rfb4	Susumu Co Ltd	RR1220P-362-D Series= RR12	Res= 3.6 kOhm Power= 100.0 mW Tolerance= 0.5%	1	$0.01	 0805 7 mm^2
32.	Rramp1	Panasonic	ERJ-6ENF1003V Series= ERJ-6E	Res= 100.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
33.	Rramp2	Panasonic	ERJ-6ENF6492V Series= ERJ-6E	Res= 64.9 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
34.	Rsense1	Panasonic	ERJ-L14KF33MU Series= ERJ-L14	Res= 33.0 mOhm Power= 330.0 mW Tolerance= 1.0%	1	$0.11	 1210 15 mm^2
35.	Rsense2	Stackpole Electronics Inc	CSR1206FK25L0 Series= ?	Res= 25.0 mOhm Power= 500.0 mW Tolerance= 1.0%	1	$0.10	 1206 11 mm^2
36.	Rt	Panasonic	ERJ-6ENF5112V Series= ERJ-6E	Res= 51.1 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
37.	Ruv1	Panasonic	ERJ-6ENF5492V Series= ERJ-6E	Res= 54.9 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
38.	Ruv2	Panasonic	ERJ-6ENF1912V Series= ERJ-6E	Res= 19.1 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
39.	U1	Texas Instruments	LM25119PSQ/NOPB	Switcher	1	$2.60	 SQA32A 49 mm^2

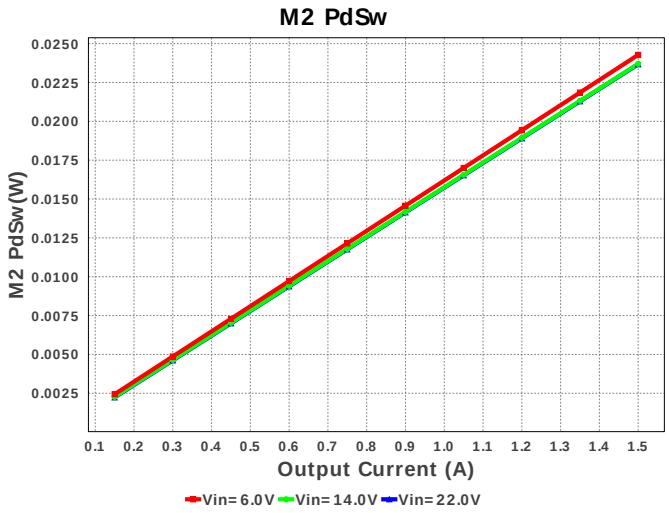


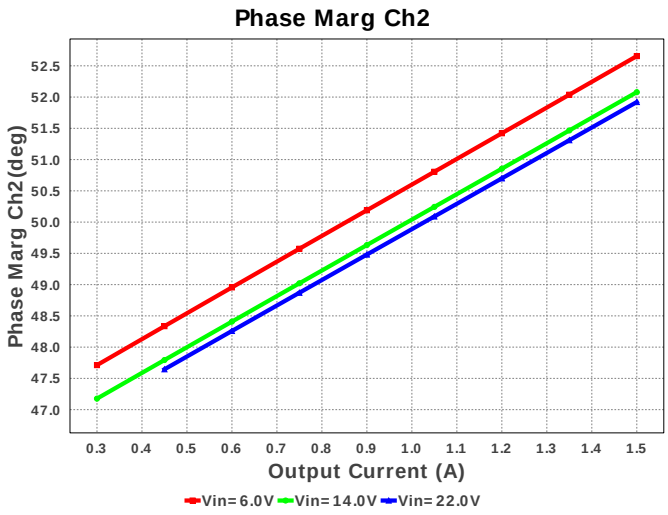


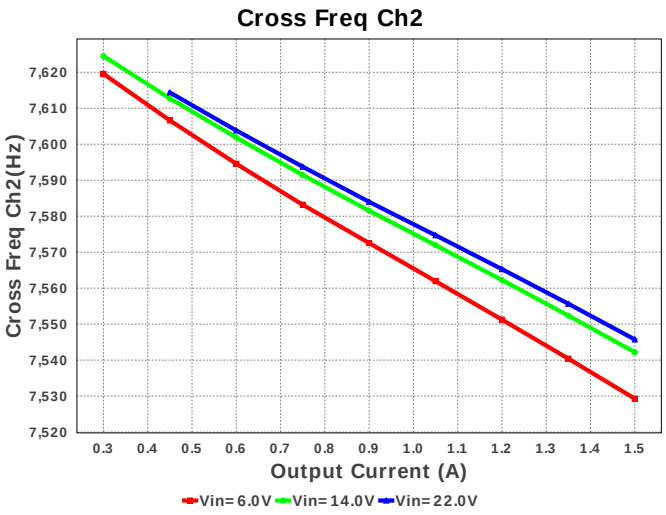


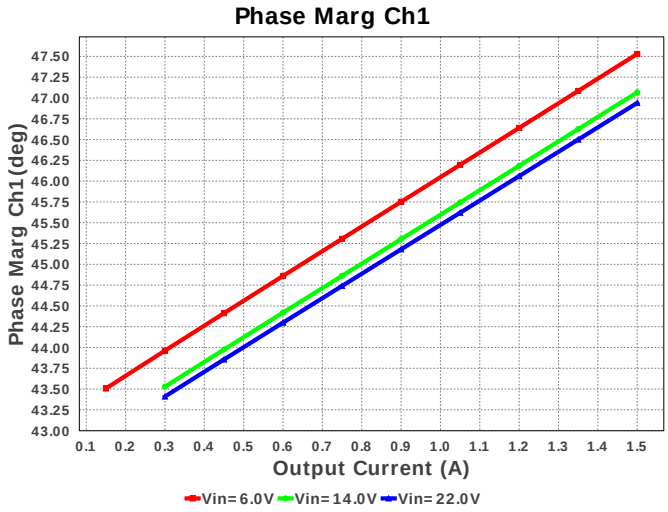


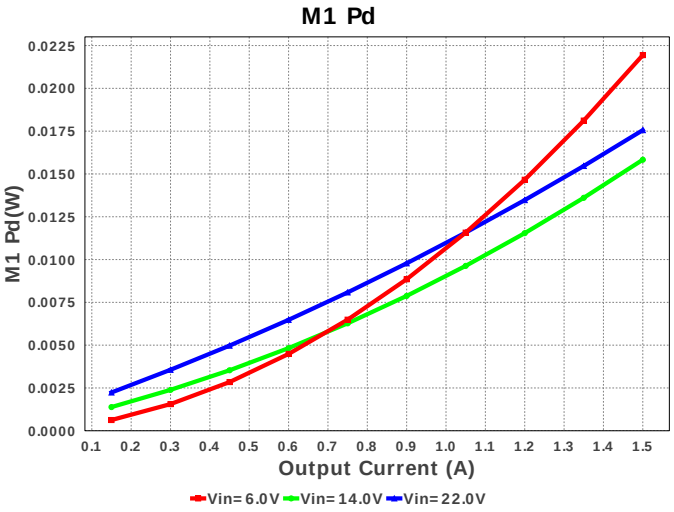


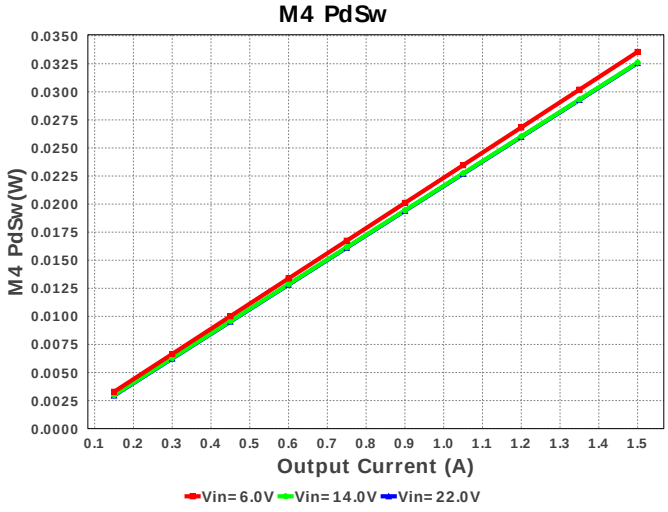


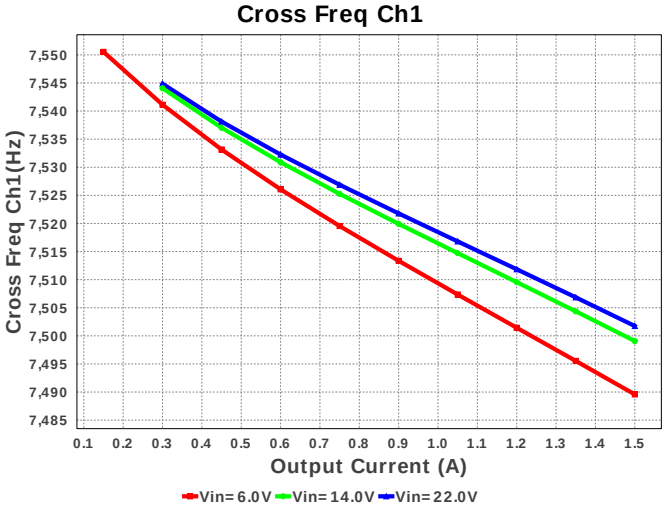


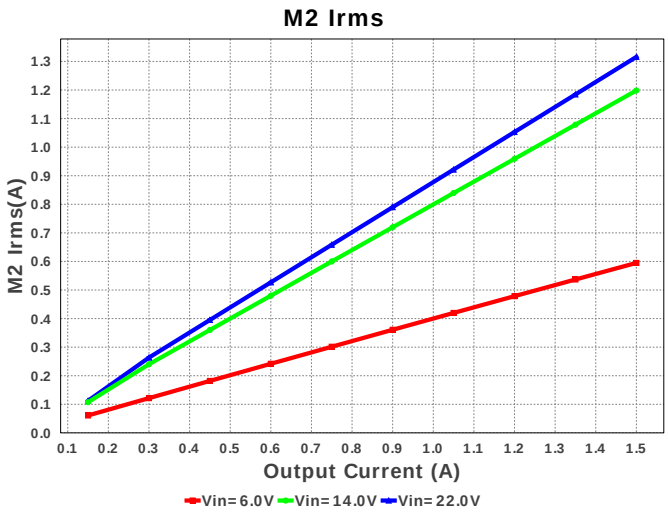


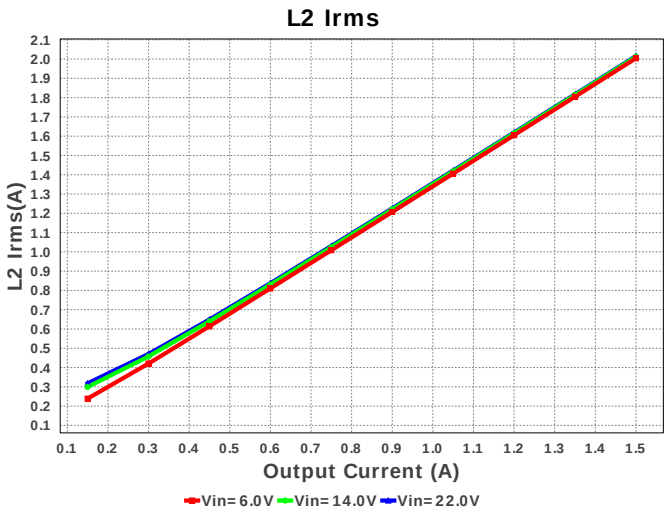


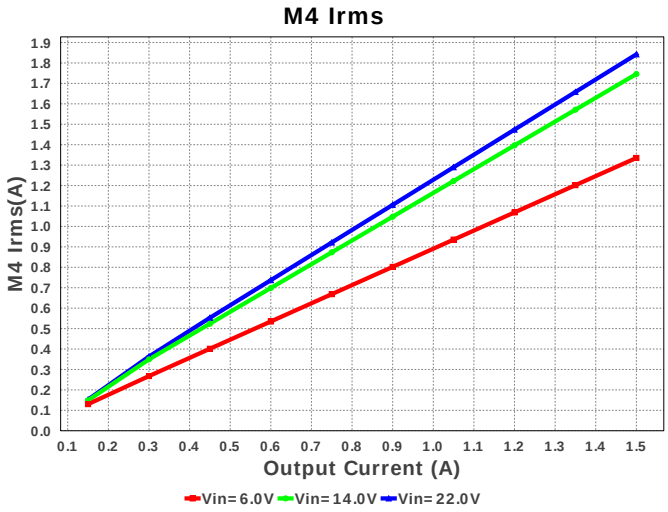


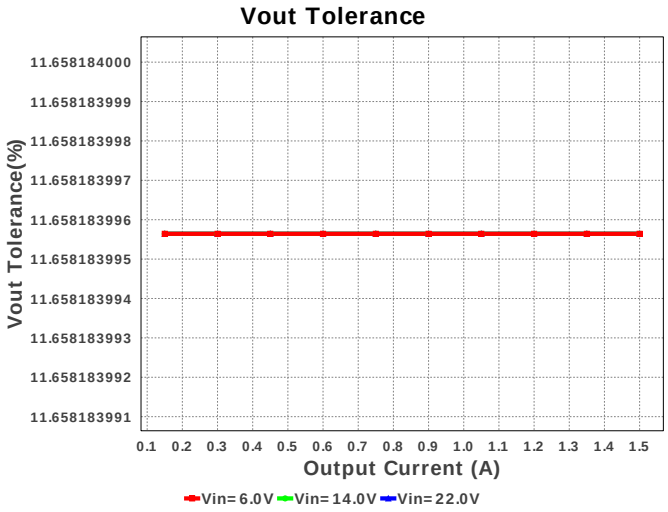


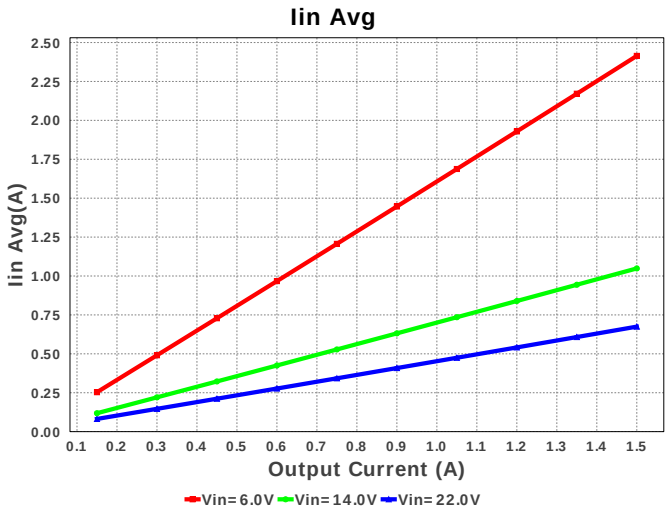


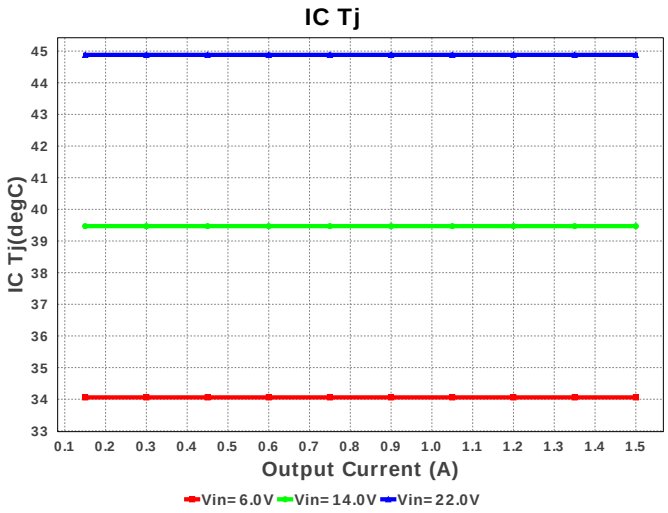




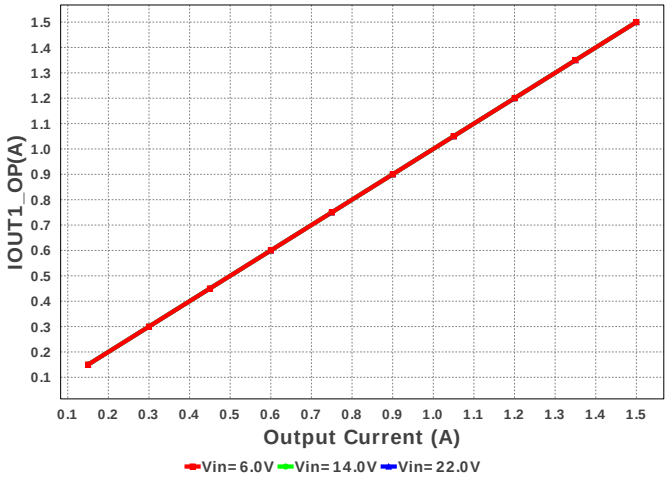




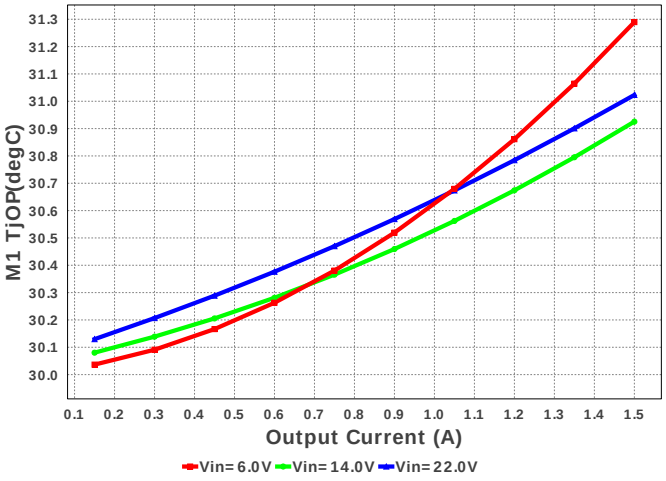




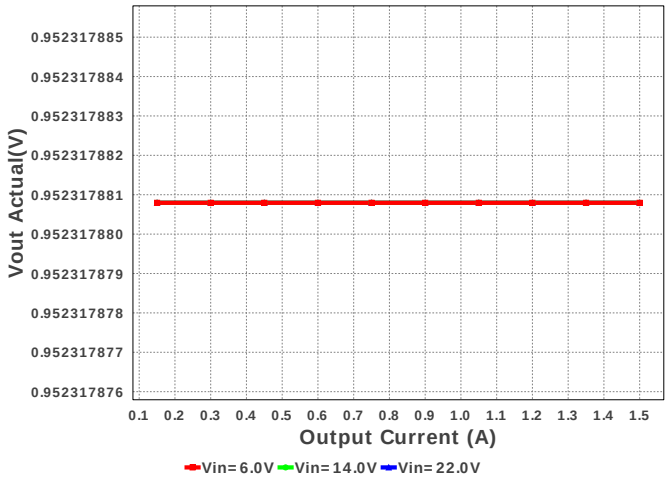
IOUT1_OP



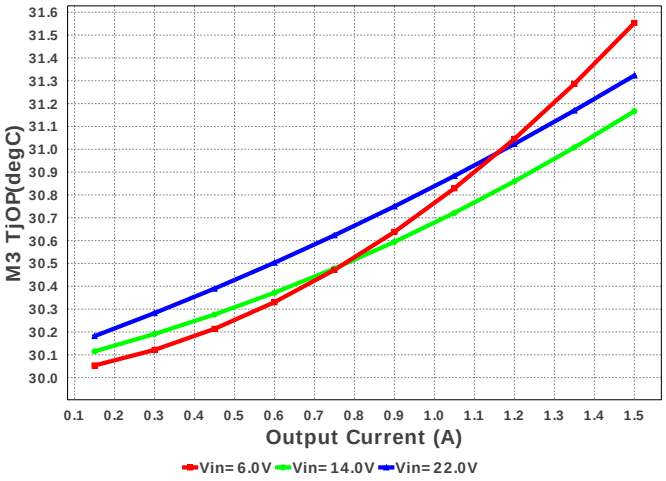
M1 TjOP



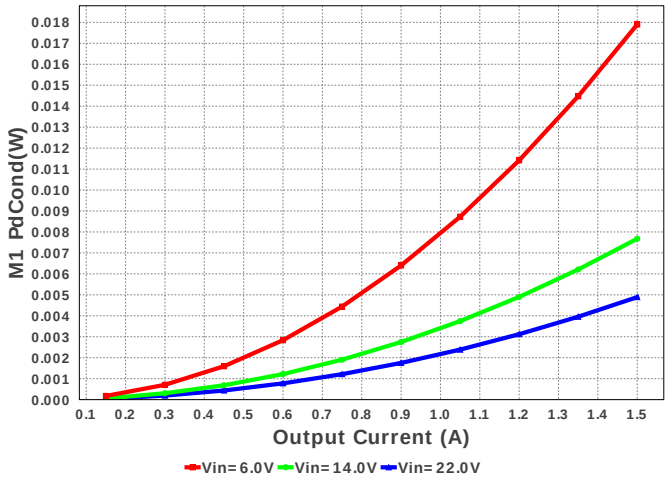
Vout Actual



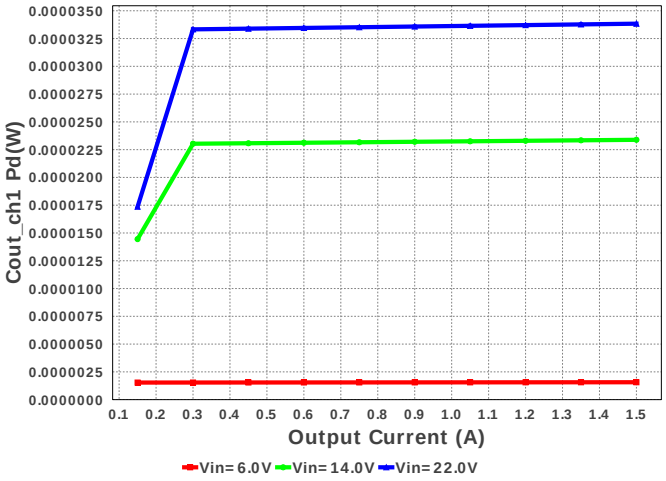
M3 TjOP

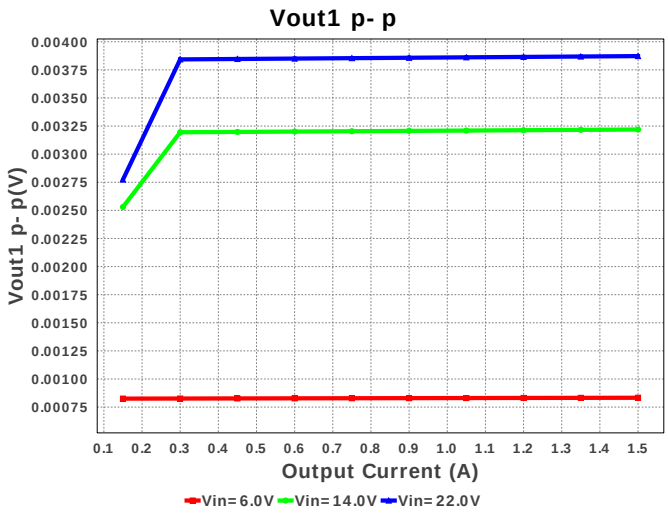


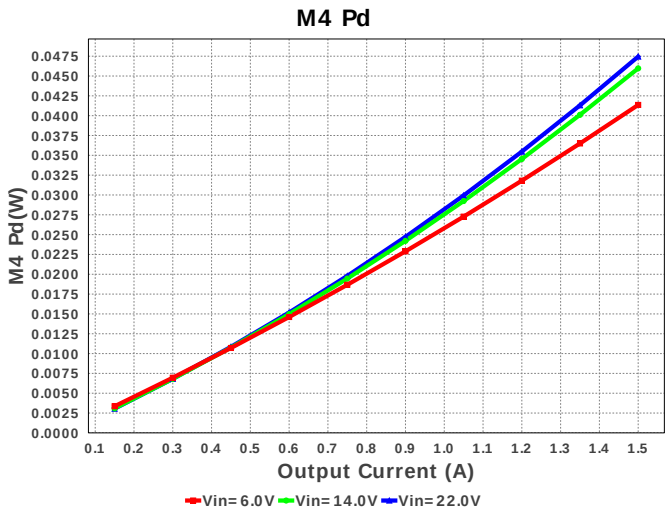
M1 PdCond

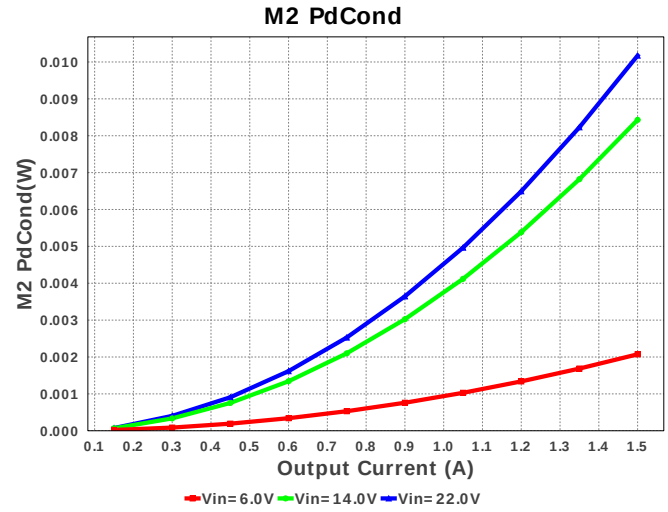


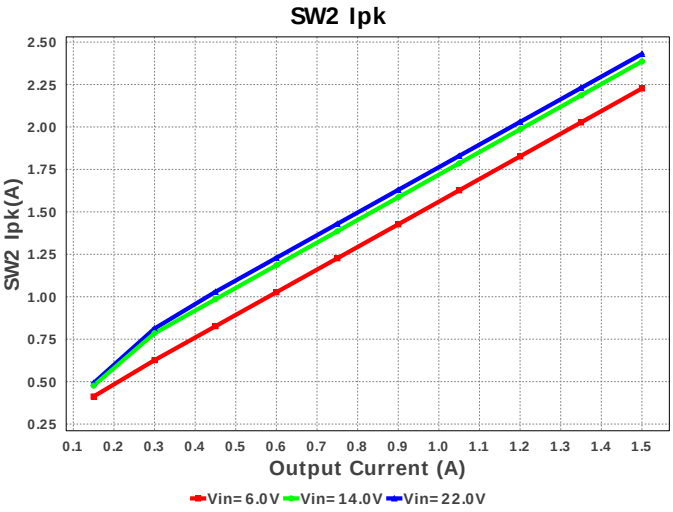
Cout_ch1 Pd

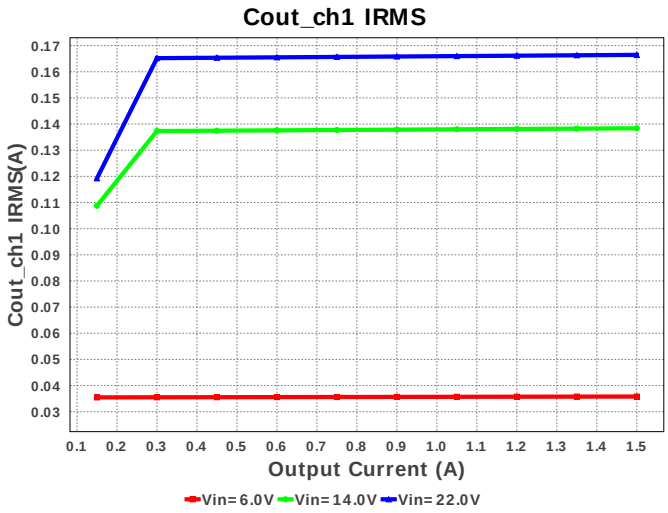


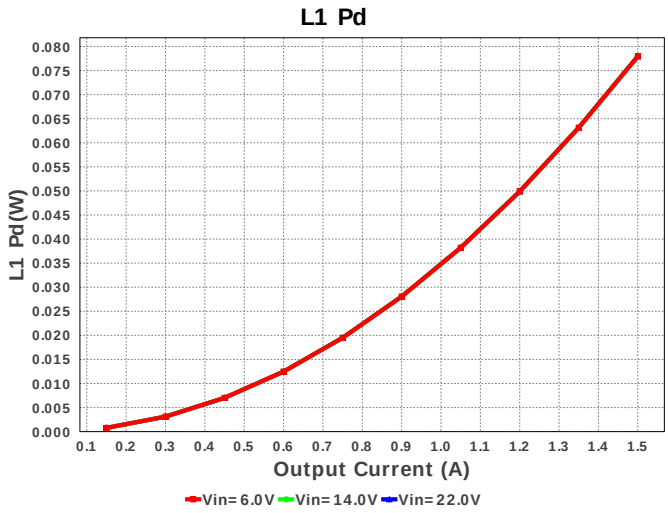




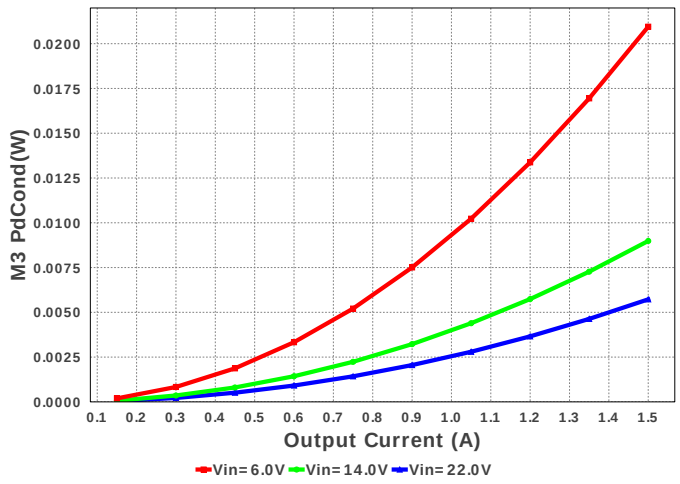




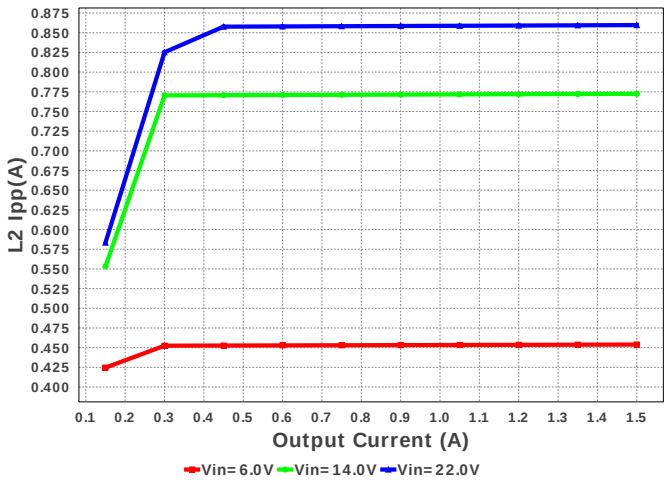




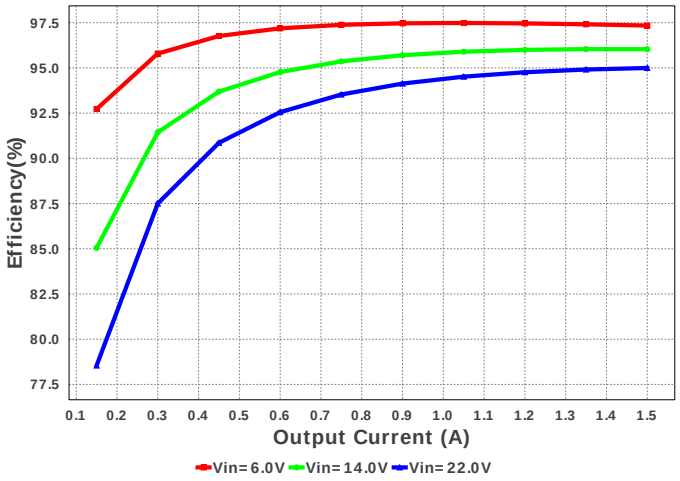
M3 PdCond



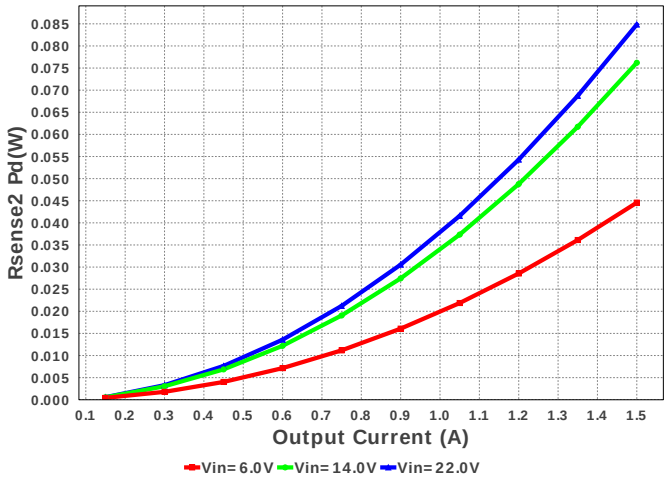
L2 Ipp



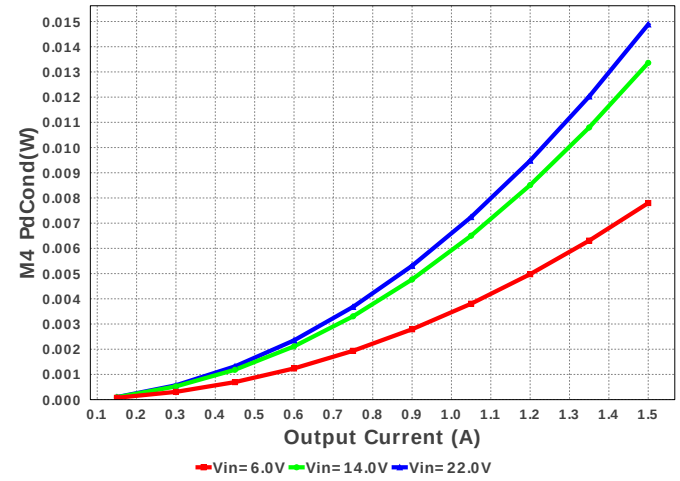
Efficiency



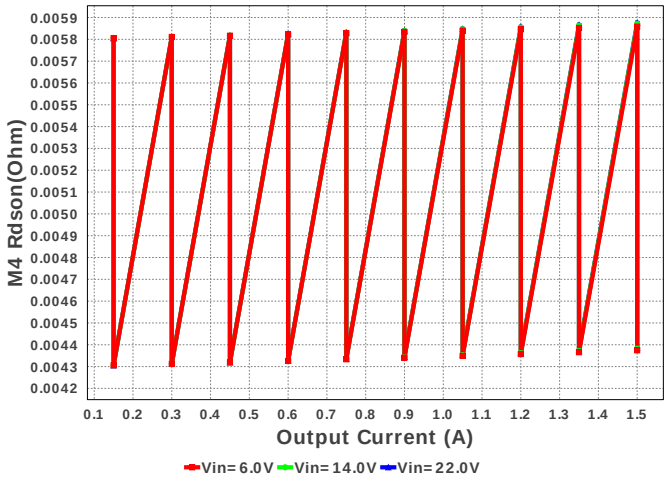
Rsense2 Pd

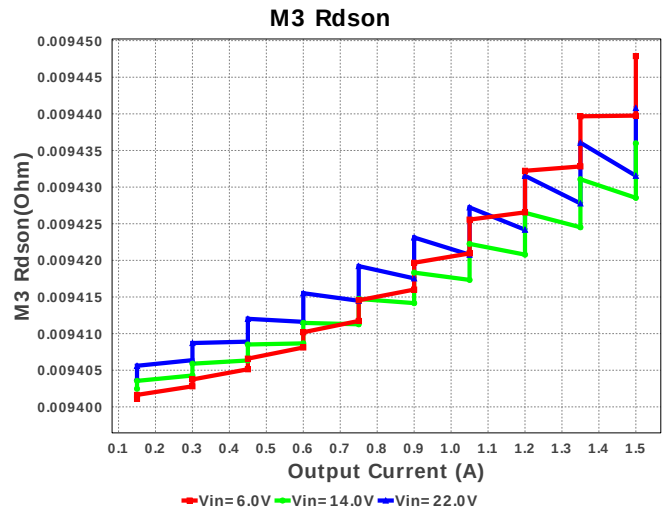


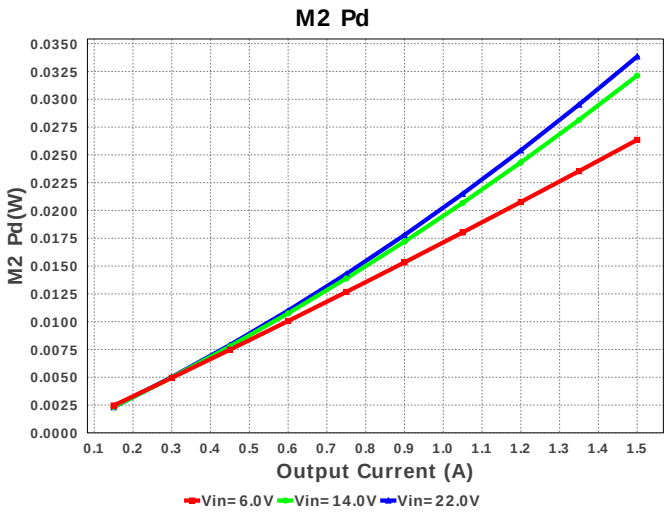
M4 PdCond

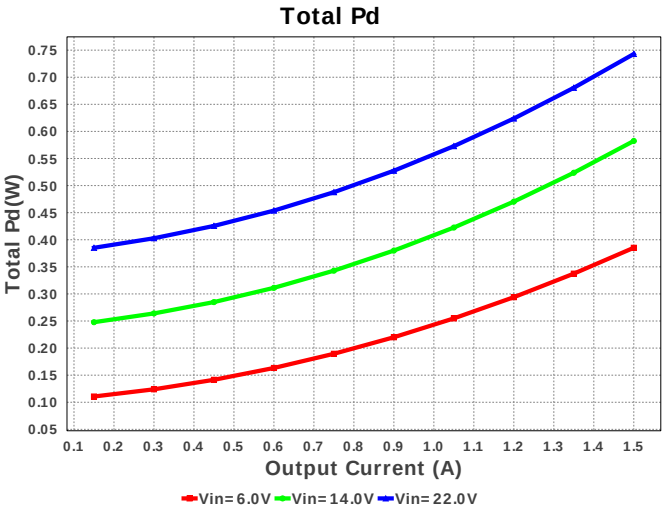


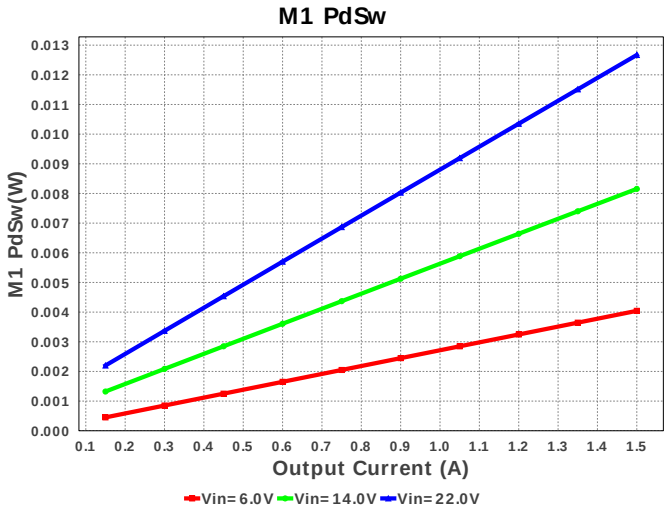
M4 Rdson

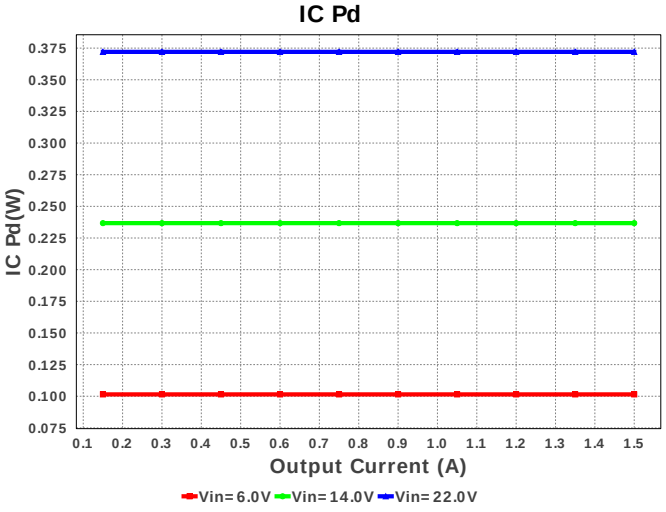


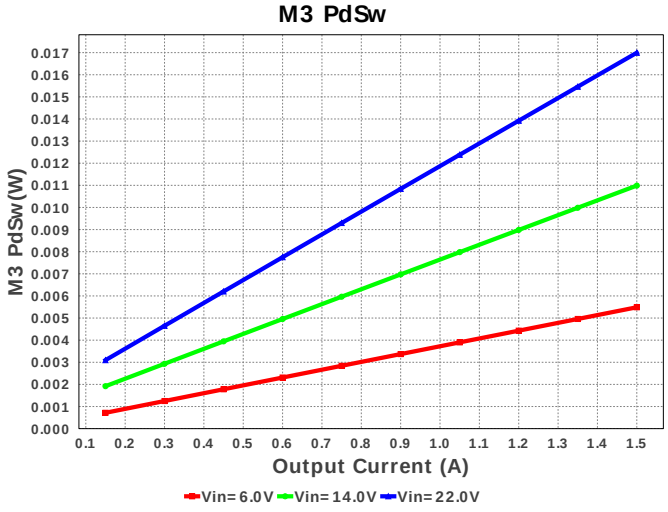


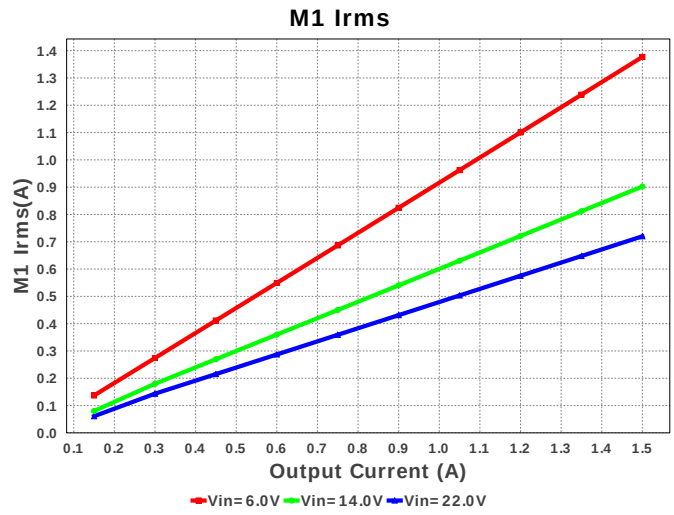


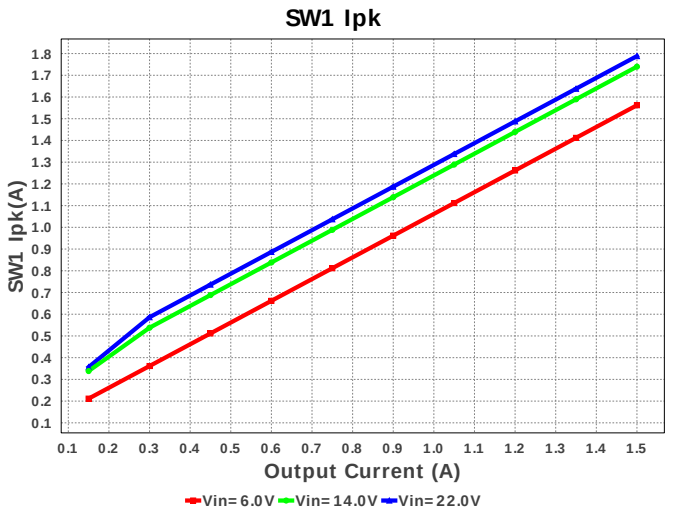


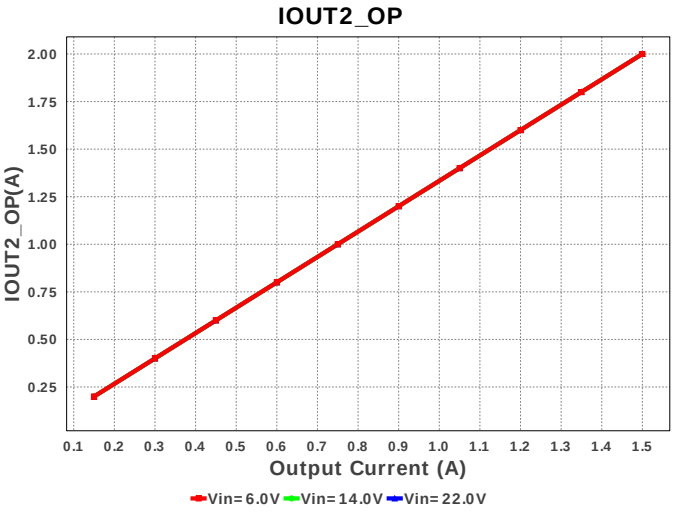


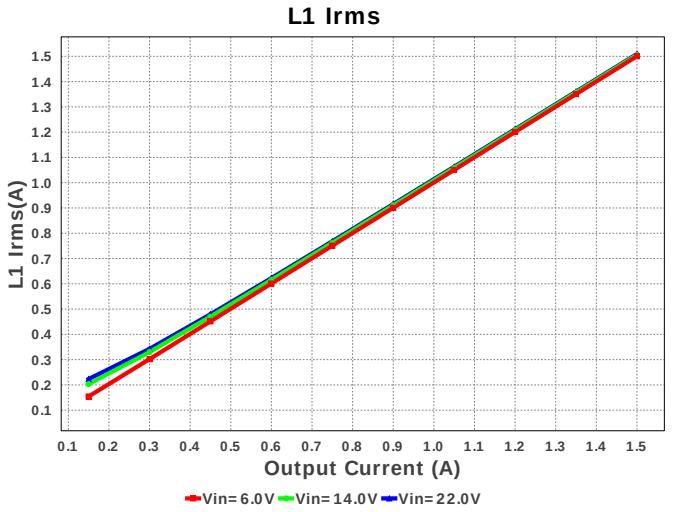


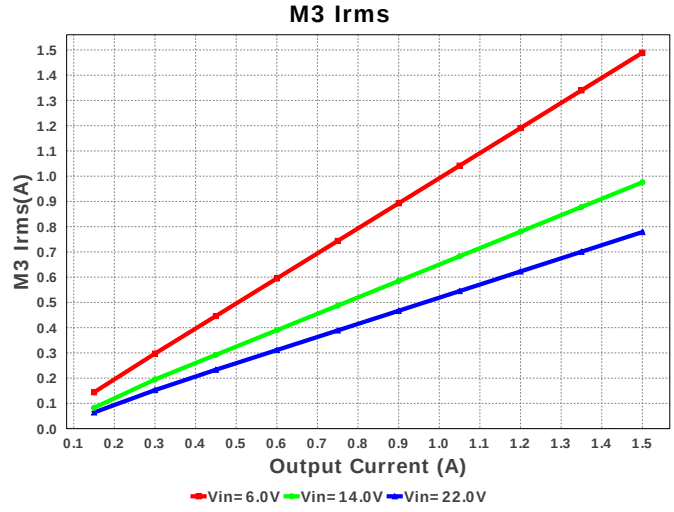


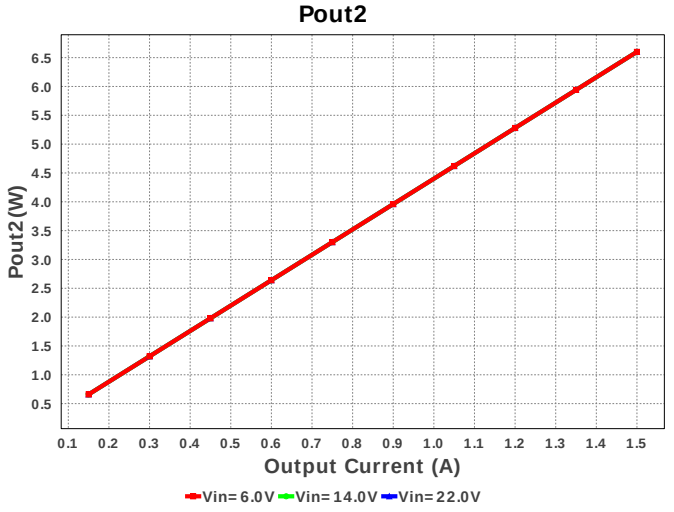


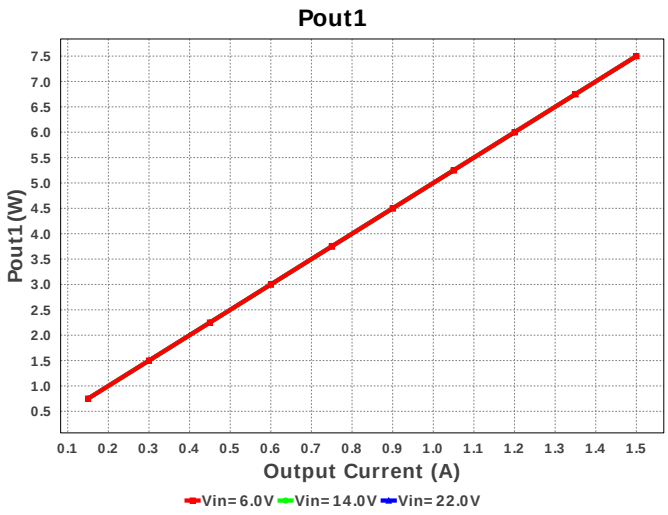


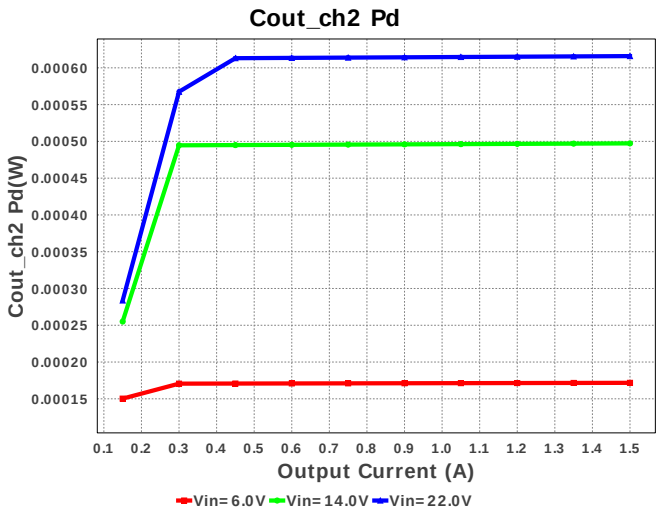


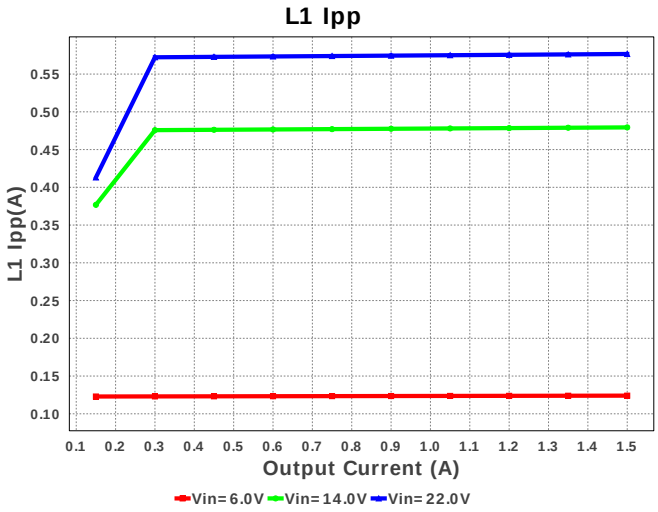


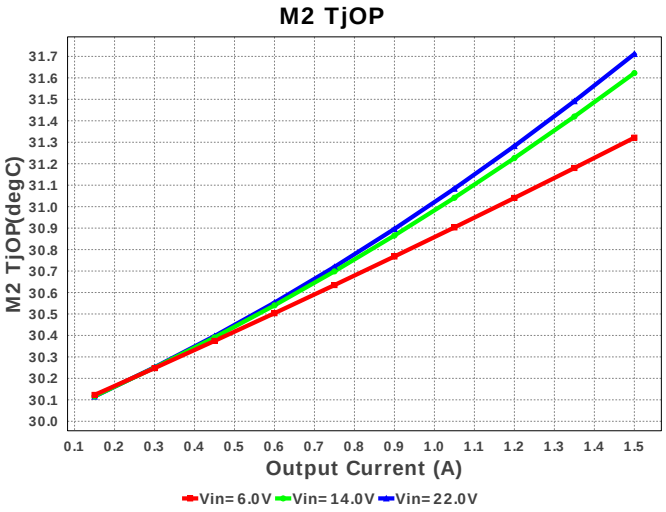


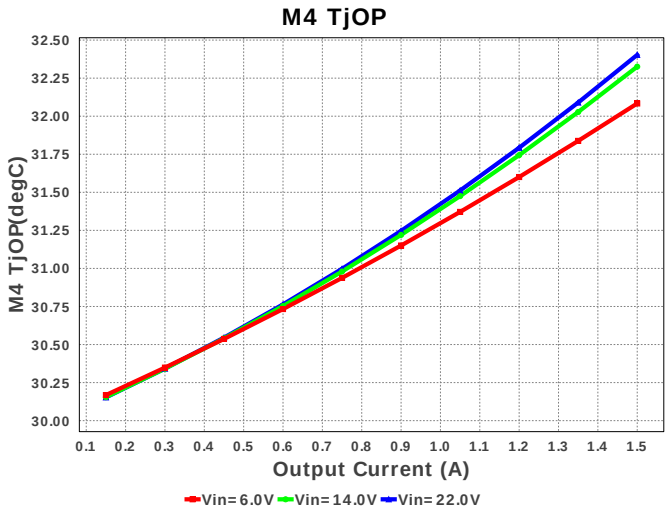


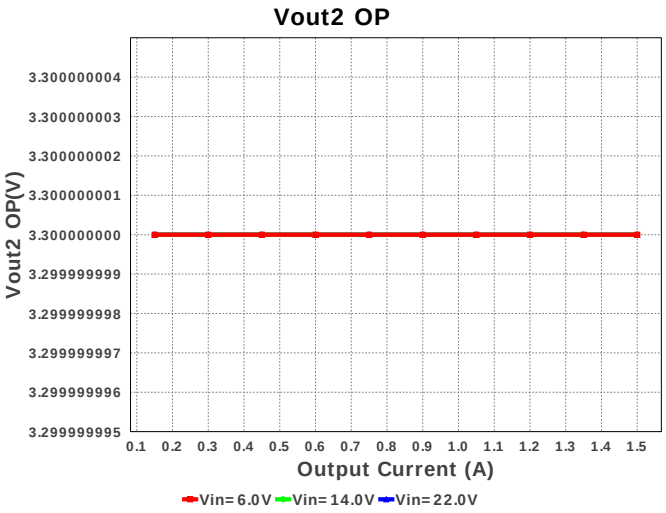


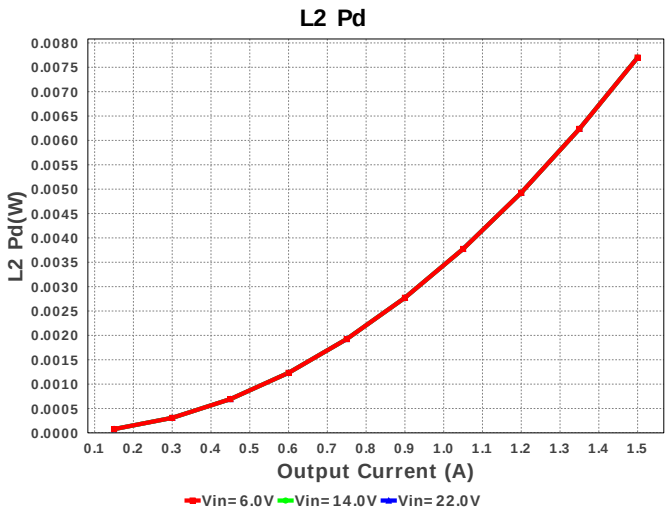


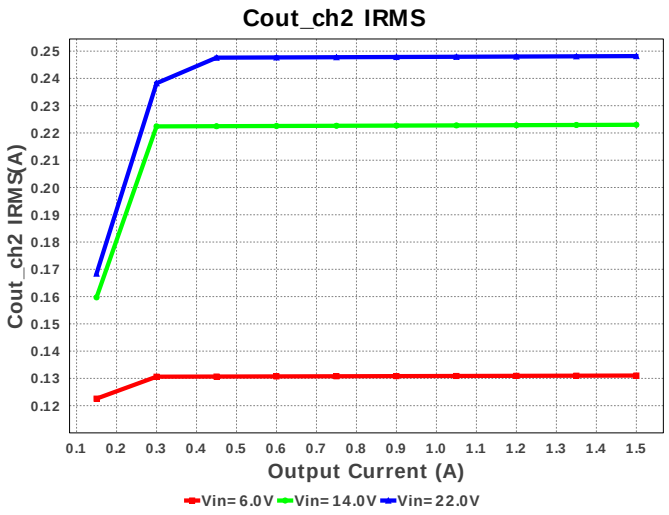


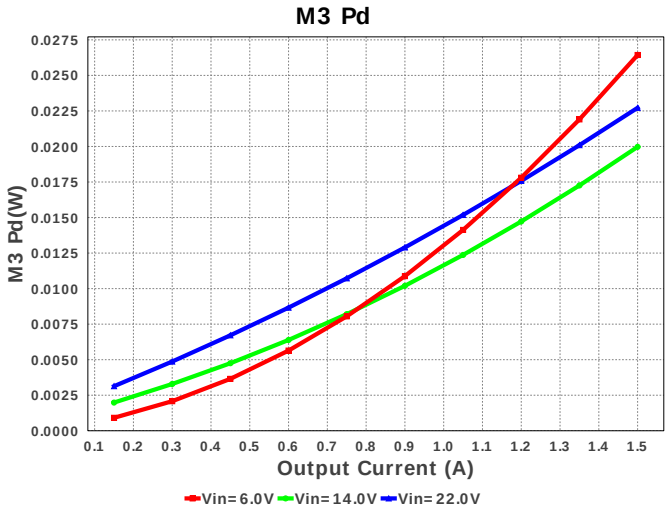


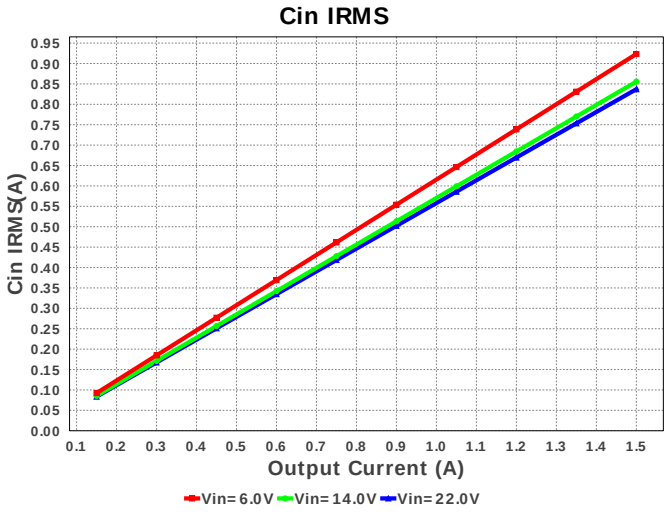












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	837.203 mA	Current	Input capacitor RMS ripple current
2.	Cout_ch1 IRMS	166.495 mA	Current	Output Channel 1 Capacitor RMS ripple current
3.	Cout_ch2 IRMS	248.449 mA	Current	Output Channel 2 Capacitor RMS ripple current
4.	Iin Avg	675.19 mA	Current	Average input current
5.	L1 Ipp	576.755 mA	Current	Peak-to-peak inductor ripple current
6.	L1 Irms	1.509 A	Current	Inductor ripple current
7.	L2Ipp	860.651 mA	Current	Channel 2 Inductor Peak to peak Current
8.	L2 Irms	2.015 A	Current	Inductor ripple current
9.	M1 Irms	720.176 mA	Current	MOSFET RMS ripple current
10.	M2 Irms	1.316 A	Current	MOSFET RMS ripple current
11.	M3 Irms	779.166 mA	Current	MOSFET RMS ripple current
12.	M4 Irms	1.842 A	Current	MOSFET RMS ripple current
13.	SW1 Ipk	1.788 A	Current	Peak switch current
14.	SW2 Ipk	2.43 A	Current	Peak switch current
15.	BOM Count	40	General	Total Design BOM count
16.	FootPrint	2.218 k mm^2	General	Total Foot Print Area of BOM components
17.	Frequency	99.908 kHz	General	Switching frequency
18.	IC Tolerance	12.0 mV	General	IC Feedback Tolerance
19.	Pout1	7.503 W	General	Channel 1 output Power
20.	Pout2	6.609 W	General	Channel 2 output Power
21.	Total BOM	$10.43	General	Total BOM Cost
22.	M3 TjOP	31.324 degC	Op_Point	M3 MOSFET junction temperature
23.	M4 TjOP	32.403 degC	Op_Point	M4 MOSFET junction temperature
24.	Vout Actual	952.318 mV	Op_Point	Vout Actual calculated based on selected voltage divider resistors
25.	Duty Cycle 1	23.051 %	Op_point	Duty cycle for Channel 1
26.	Duty Cycle 2	15.177 %	Op_point	Duty cycle for Channel 2
27.	Efficiency	94.999 %	Op_point	Steady state efficiency
28.	IC Tj	44.882 degC	Op_point	IC junction temperature
29.	IOUT1_OP	1.5 A	Op_point	Iout1 operating point
30.	IOUT2_OP	2.0 A	Op_point	Iout2 operating point
31.	M1 TjOP	31.024 degC	Op_point	M1 MOSFET junction temperature

#	Name	Value	Category	Description
32.	M2 TjOP	31.711 degC	Op_point	M2 MOSFET junction temperature
33.	VIN_OP	22.0 V	Op_point	Vin operating point
34.	Vout1 OP	5.002 V	Op_point	Operational Voltage 1
35.	Vout1 p-p	3.873 mV	Op_point	Peak-to-peak output1 ripple voltage
36.	Vout2 OP	3.304 V	Op_point	Operational Voltage 2
37.	Vout2 p-p	9.901 mV	Op_point	Peak-to-peak output2 ripple voltage
38.	Cin Pd	21.027 mW	Power	Input capacitor power dissipation
39.	Cout_ch1 Pd	33.854 µW	Power	Ouput channel 1 capacitor power dissipation
40.	Cout_ch2 Pd	617.267 µW	Power	Ouput channel 2 capacitor power dissipation
41.	IC Pd	372.038 mW	Power	IC power dissipation
42.	L1 Pd	77.961 mW	Power	Inductor power dissipation
43.	L2 Pd	7.7 mW	Power	Inductor power dissipation
44.	M1 Pd	17.567 mW	Power	M1 MOSFET total power dissipation
45.	M1 PdCond	4.892 mW	Power	M1 MOSFET conduction losses
46.	M1 PdSw	12.676 mW	Power	M1 MOSFET switching losses
47.	M2 Pd	33.843 mW	Power	M2 MOSFET total power dissipation
48.	M2 PdCond	10.172 mW	Power	M2 MOSFET conduction losses
49.	M2 PdSw	23.671 mW	Power	M2 MOSFET switching losses
50.	M3 Pd	22.736 mW	Power	M3 MOSFET total power dissipation
51.	M3 PdCond	5.732 mW	Power	M3 MOSFET conduction losses
52.	M3 PdSw	17.005 mW	Power	M3 MOSFET switching losses
53.	M1 Rdson	9.432 mOhm	Power	Drain-Source On-resistance
54.	M3 Rdson	9.441 mOhm	Power	Drain-Source On-resistance
55.	M4 Pd	47.447 mW	Power	M4 MOSFET total power dissipation
56.	M4 PdCond	14.881 mW	Power	M4 MOSFET conduction losses
57.	M4 PdSw	32.566 mW	Power	M4 MOSFET switching losses
58.	M2 Rdson	5.875 mOhm	Power	Drain-Source On-resistance
59.	M4 Rdson	4.386 mOhm	Power	Drain-Source On-resistance
60.	Rsense1 Pd	57.134 mW	Power	Current Limit Sense Resistor Power Dissipation
61.	Rsense2 Pd	84.823 mW	Power	Current Limit Sense Resistor Power Dissipation
62.	Total Pd	742.928 mW	Power	Total Power Dissipation
63.	Cross Freq Ch1	7.502 kHz		Bode plot crossover frequency
64.	Cross Freq Ch2	7.546 kHz		Bode plot crossover frequency
65.	Phase Marg Ch1	46.938 deg		Bode Plot Phase Margin
66.	Phase Marg Ch2	51.91 deg		Bode Plot Phase Margin
67.	Vout Tolerance	11.658 %		Vout Tolerance based on IC Tolerance and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	1.5	Maximum Output Current
2.	Iout1	1.5	Output Current #1
3.	Iout2	2.0	Output Current #2
4.	VinMax	22.0	Maximum input voltage
5.	VinMin	6.0	Minimum input voltage
6.	VinTyp	8.0	Typical input voltage
7.	Vout	5.0	Output Voltage
8.	Vout1	5.0	Output Voltage #1
9.	Vout2	3.3	Output Voltage #2
10.	base_pn	LM25119	Base Product Number
11.	source	DC	Input Source Type
12.	Ta	30.0	Ambient temperature

Design Assistance

1. Outline The LM5119 is a dual synchronous buck controller intended for step-down regulator applications from a high voltage or widely varying input supply. The control method is based upon current mode control utilizing an emulated current ramp. Current mode control provides inherent line feed-forward, cycle-by-cycle current limiting and ease of loop compensation. The use of an emulated control ramp reduces noise sensitivity of the pulse-width modulation circuit, allowing reliable control of very small duty cycles necessary in high input voltage applications. Sequencing the 2 outputs The LM(2)5119 contains an enable function allowing shutdown control of channel2, independent of channel1. If the EN2 pin is pulled below 2.0V, channel2 enters shutdown mode. If the EN2 input is greater than 2.5V, channel2 returns to normal operation. Diode Emulation A fully synchronous buck regulator implemented with a freewheel MOSFET rather than a diode has the capability to sink current from the output in certain conditions such as light load, over-voltage or pre-bias startup. The LM(2)5119 provides a diode emulation feature that can be enabled to prevent reverse (drain to source) current flow in the low side free-wheel MOSFET.

2. **LM25119** Product Folder : http://www.ti.com/product/LM25119 : contains the data sheet and other resources.