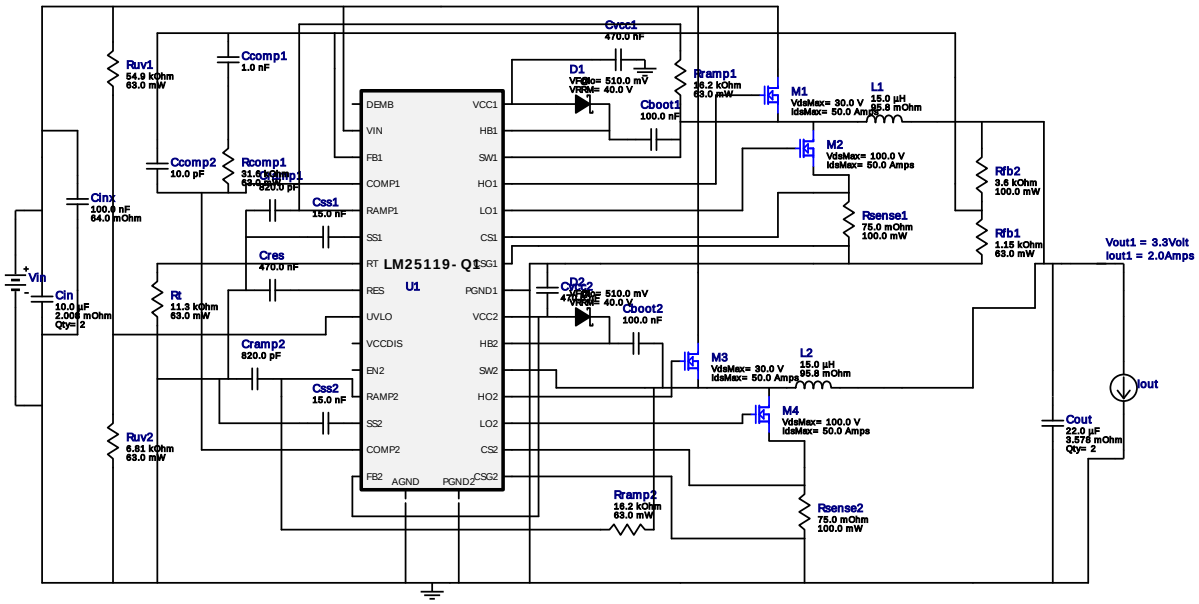
WEBENCH® Design Report

VinMin = 14.0V
VinMax = 22.0V
Vout = 3.3V
Iout = 2.0A

Device = LM25119QPSQ/NOPB
Topology = Buck
Created = 7/21/16 3:41:32 AM
BOM Cost = $6.51
BOM Count = 35
Total Pd = 1.34W

Design : 4372614/5 LM25119QPSQ/NOPB
LM25119QPSQ/NOPB 14.0V-22.0V to 3.30V @ 2.0A



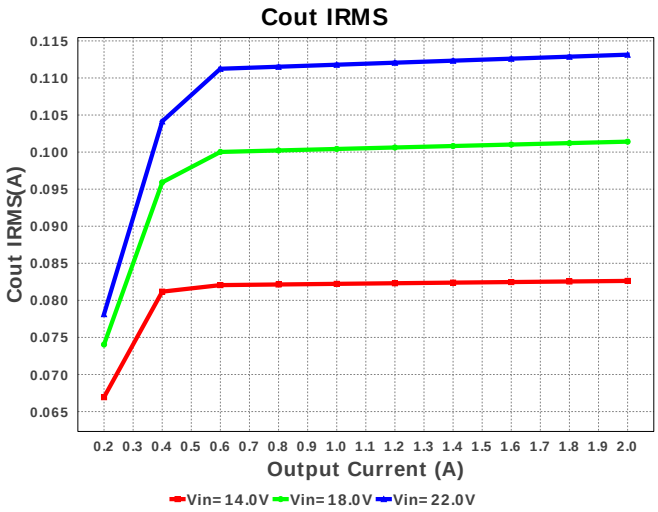
1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific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

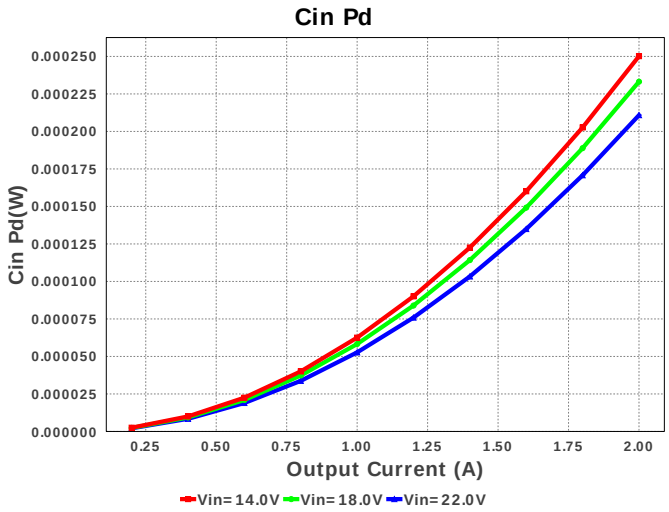
Electrical BOM

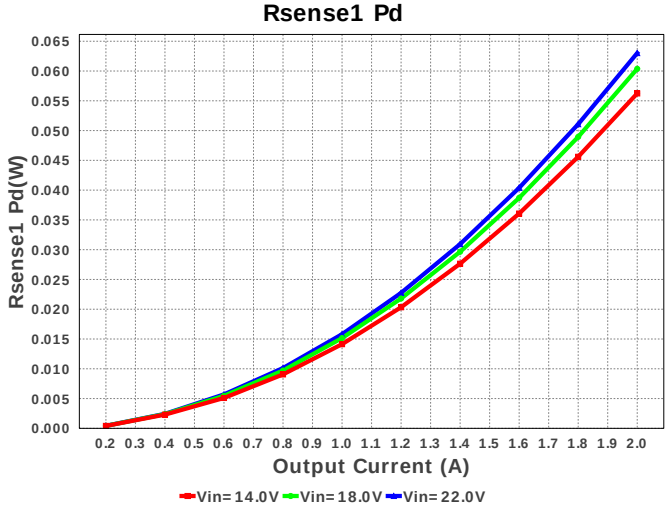
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot1	MuRata	GRM155R61A104KA01D Series= X5R	Cap= 100.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
2.	Cboot2	MuRata	GRM155R61A104KA01D Series= X5R	Cap= 100.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
3.	Ccomp1	Samsung Electro-Mechanics	CL21C102JBCNFNC Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
4.	Ccomp2	Kemet	C0805C100K5GACTU Series= C0G/NP0	Cap= 10.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
5.	Cin	MuRata	GRM32ER7YA106KA12L Series= X7R	Cap= 10.0 uF ESR= 2.008 mOhm VDC= 35.0 V IRMS= 4.6772 A	2	$0.22	1210_280 15 mm^2
6.	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 mm^2
7.	Cout	MuRata	GRM21BC80G226ME39L Series= X6S	Cap= 22.0 uF ESR= 3.578 mOhm VDC= 4.0 V IRMS= 3.29633 A	2	$0.04	0805 7 mm^2
8.	Cramp1	Yageo America	CC0805KRX7R9BB821 Series= X7R	Cap= 820.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2

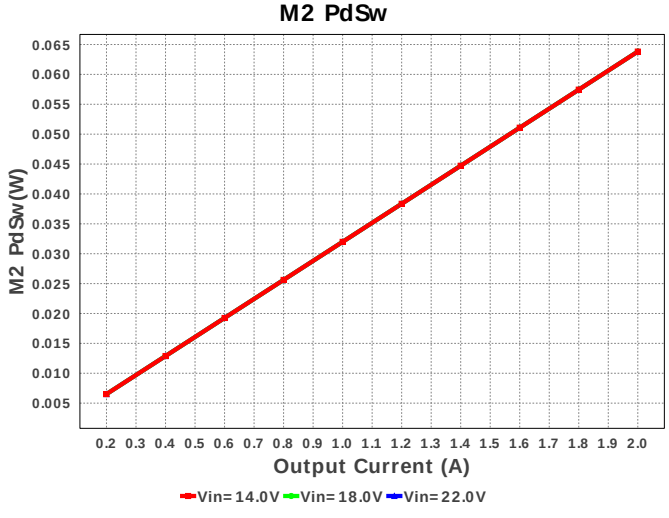
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	Cramp2	Yageo America	CC0805KRX7R9BB821 Series= X7R	Cap= 820.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	 0805 7 mm²
10.	Cres	MuRata	GRM155C80J474KE19D Series= X6S	Cap= 470.0 nF VDC= 6.3 V IRMS= 0.0 A	1	$0.01	 0402 3 mm²
11.	Css1	Yageo America	CC0805KRX7R9BB153 Series= X7R	Cap= 15.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	 0805 7 mm²
12.	Css2	Yageo America	CC0805KRX7R9BB153 Series= X7R	Cap= 15.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	 0805 7 mm²
13.	Cvcc1	MuRata	GRM155R61A474KE15D Series= X5R	Cap= 470.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	 0402 3 mm²
14.	Cvcc2	MuRata	GRM155R61A474KE15D Series= X5R	Cap= 470.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	 0402 3 mm²
15.	D1	ON Semiconductor	MBR0540T1G	VF@Io= 510.0 mV VRRM= 40.0 V	1	$0.06	 SOD-123 13 mm²
16.	D2	ON Semiconductor	MBR0540T1G	VF@Io= 510.0 mV VRRM= 40.0 V	1	$0.06	 SOD-123 13 mm²
17.	L1	Bourns	SRN6045-150M	L= 15.0 µH DCR= 95.8 mOhm	1	$0.16	 SRN6045 64 mm²
18.	L2	Bourns	SRN6045-150M	L= 15.0 µH DCR= 95.8 mOhm	1	$0.16	 SRN6045 64 mm²
19.	M1	Texas Instruments	CSD17308Q3	VdsMax= 30.0 V IdsMax= 50.0 Amps	1	$0.34	 TRANS_NexFET_Q3 18 mm²
20.	M2	Texas Instruments	CSD19537Q3	VdsMax= 100.0 V IdsMax= 50.0 Amps	1	$0.75	 TRANS_NexFET_Q3 18 mm²
21.	M3	Texas Instruments	CSD17308Q3	VdsMax= 30.0 V IdsMax= 50.0 Amps	1	$0.34	 TRANS_NexFET_Q3 18 mm²
22.	M4	Texas Instruments	CSD19537Q3	VdsMax= 100.0 V IdsMax= 50.0 Amps	1	$0.75	 TRANS_NexFET_Q3 18 mm²
23.	Rcomp1	Vishay-Dale	CRCW040231K6FKED Series= CRCW..e3	Res= 31.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
24.	Rfb1	Vishay-Dale	CRCW04021K15FKED Series= CRCW..e3	Res= 1.15 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
25.	Rfb2	Yageo America	RC0603FR-073K6L Series= ?	Res= 3.6 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	 0603 5 mm²
26.	Rramp1	Vishay-Dale	CRCW040216K2FKED Series= CRCW..e3	Res= 16.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²
27.	Rramp2	Vishay-Dale	CRCW040216K2FKED Series= CRCW..e3	Res= 16.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm²

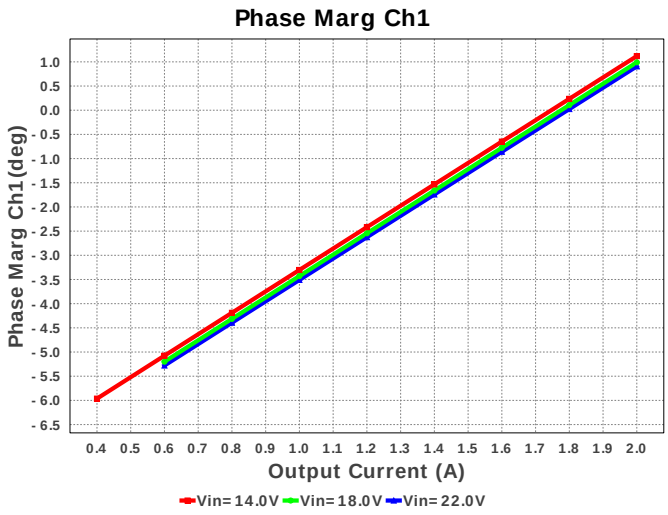
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
28.	Rsense1	Panasonic	ERJ-L03UF75MV Series= ERJ-L03	Res= 75.0 mOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.09	0603 5 mm²
29.	Rsense2	Panasonic	ERJ-L03UF75MV Series= ERJ-L03	Res= 75.0 mOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.09	0603 5 mm²
30.	Rt	Vishay-Dale	CRCW040211K3FKED Series= CRCW..e3	Res= 11.3 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
31.	Ruv1	Vishay-Dale	CRCW040254K9FKED Series= CRCW..e3	Res= 54.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
32.	Ruv2	Vishay-Dale	CRCW04026K81FKED Series= CRCW..e3	Res= 6.81 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
33.	U1	Texas Instruments	LM25119QPSQ/NOPB	Switcher	1	$2.99	SQA32A 49 mm²

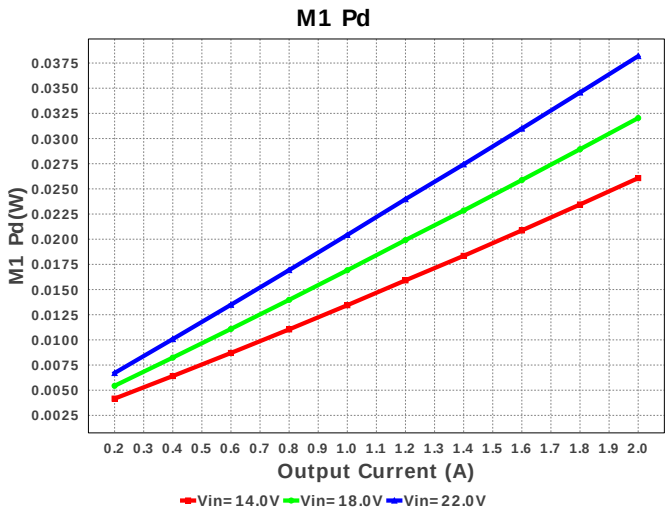


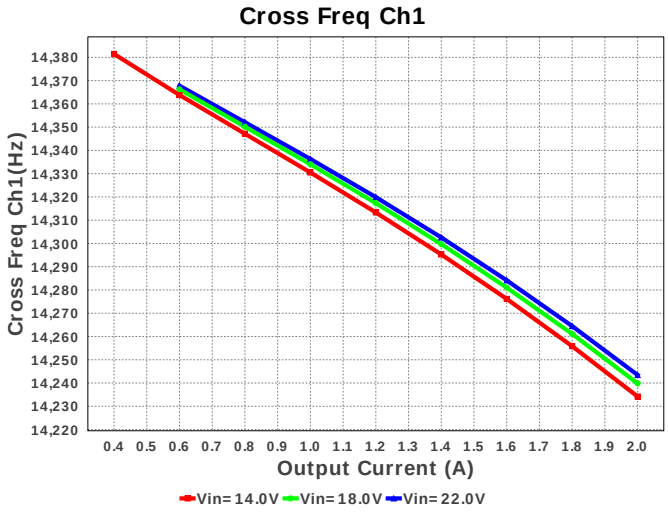


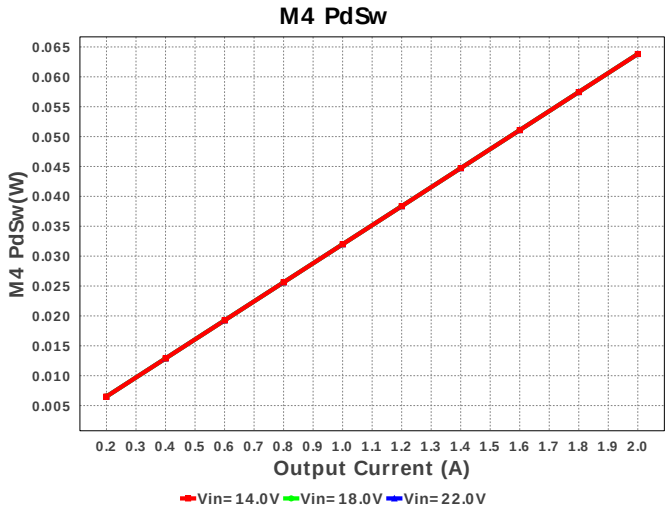


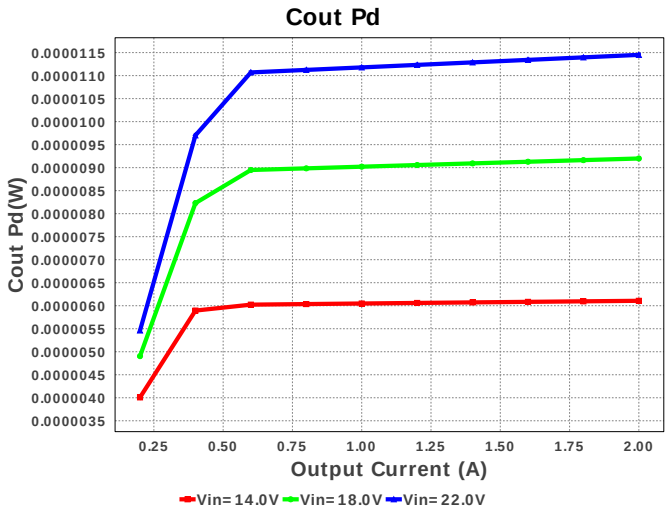


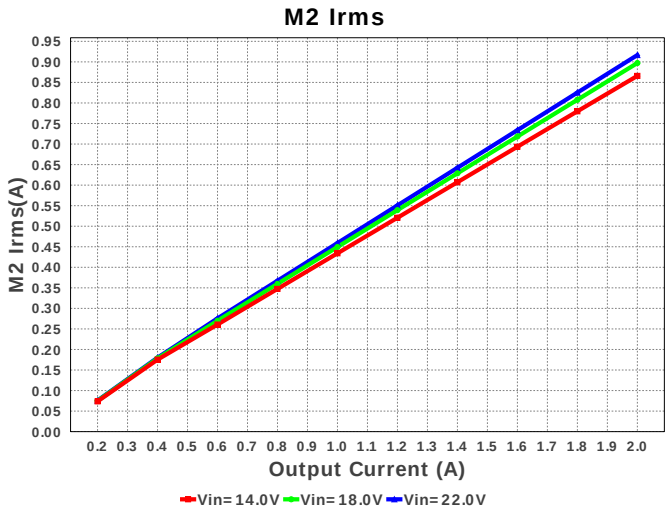




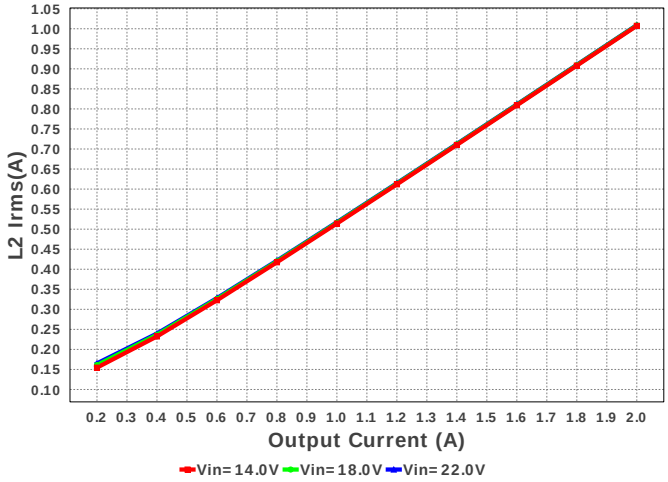




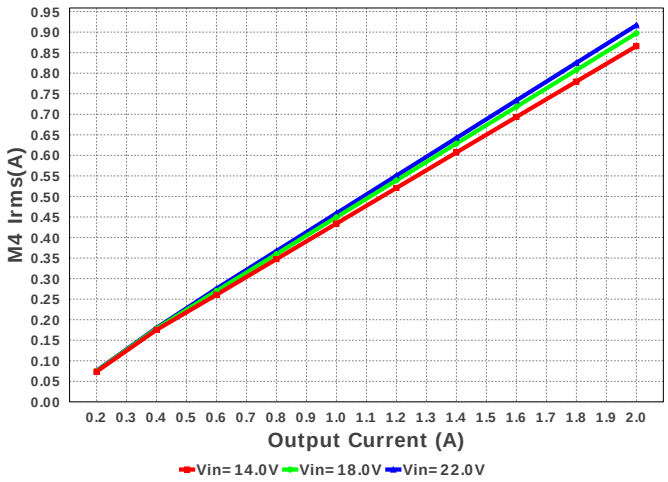




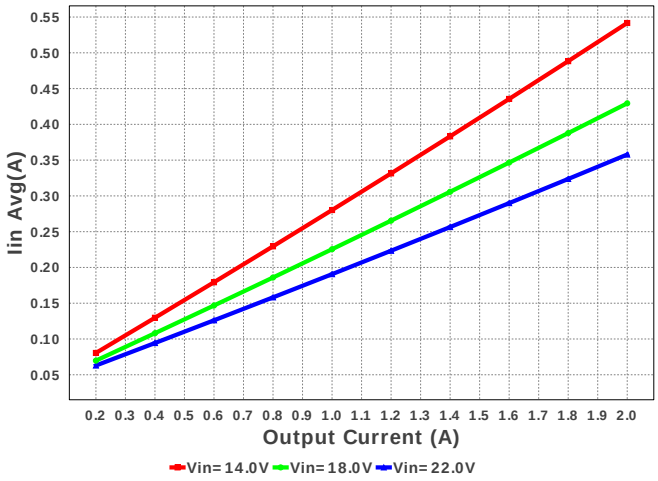
L2 Irms



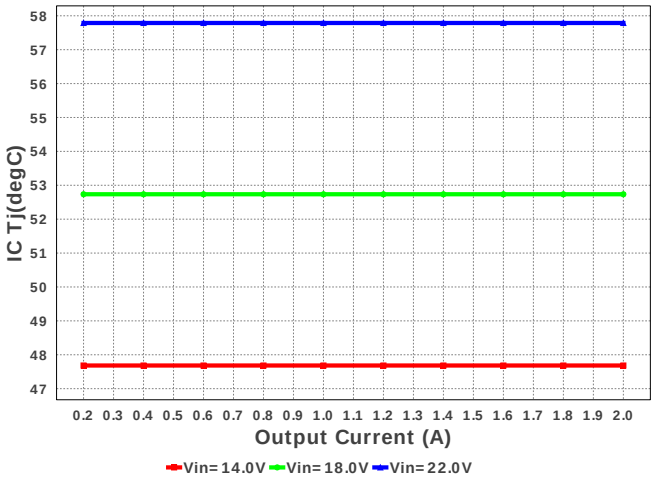
M4 Irms



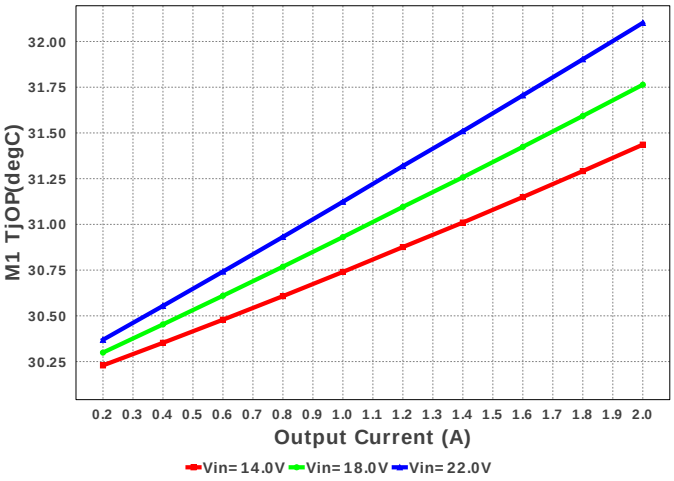
Iin Avg



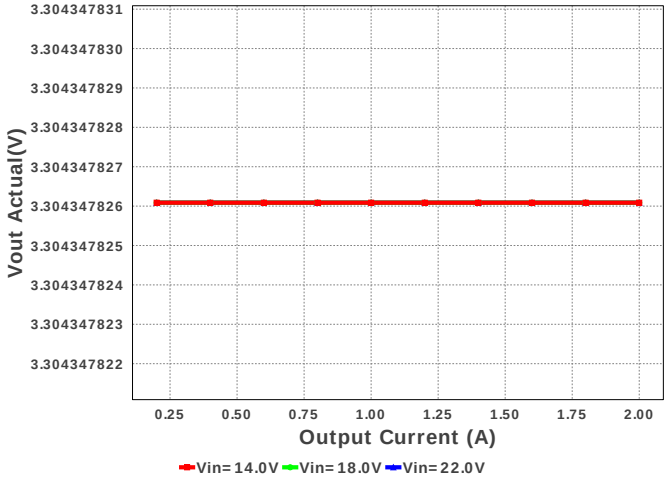
IC Tj

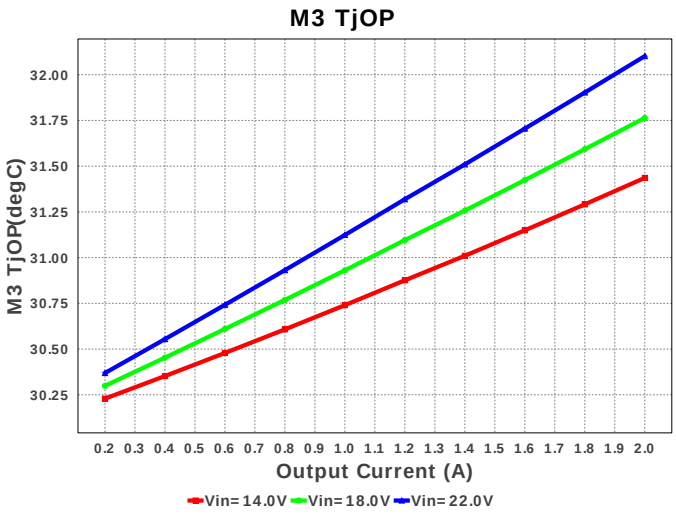


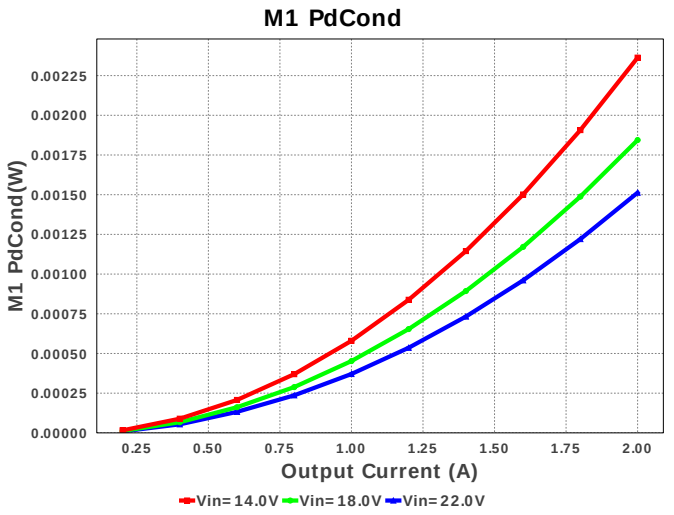
M1 TjOP

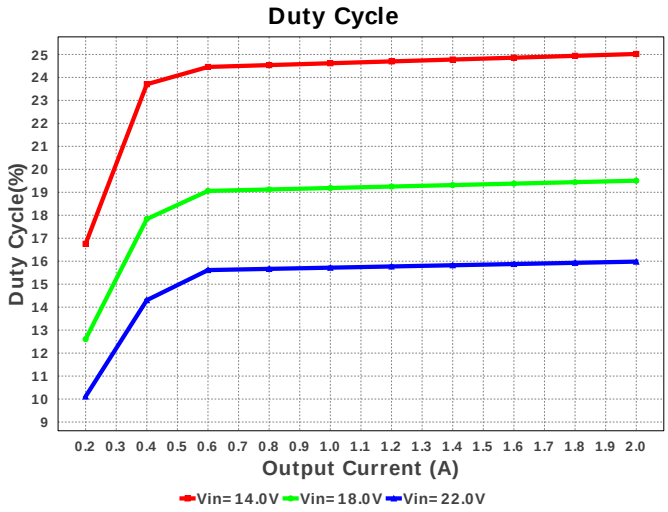


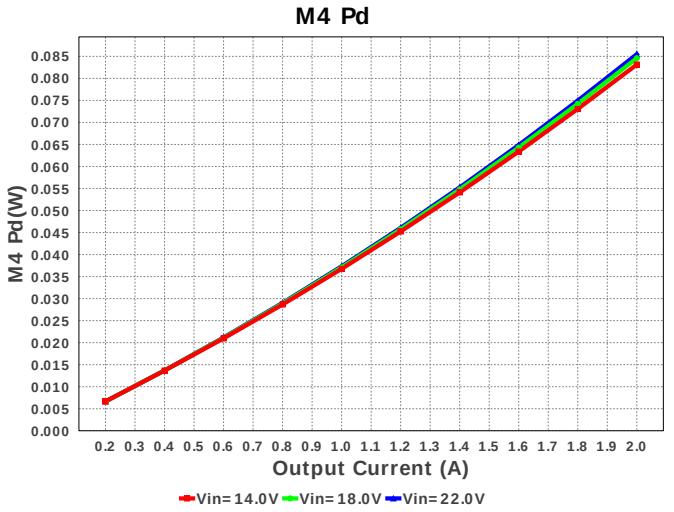
Vout Actual

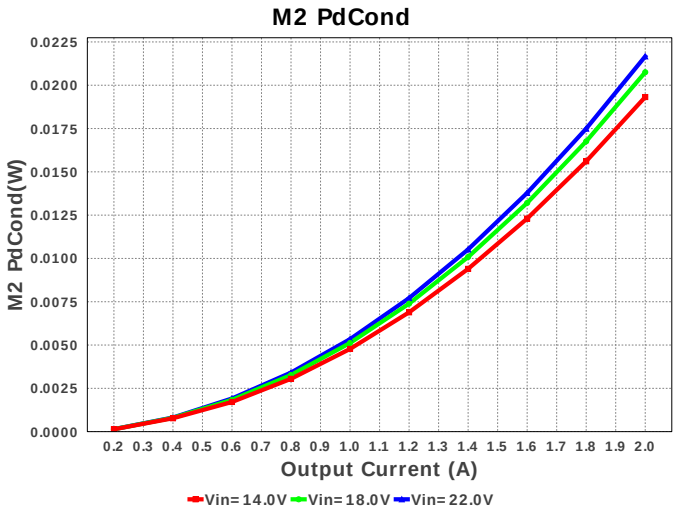


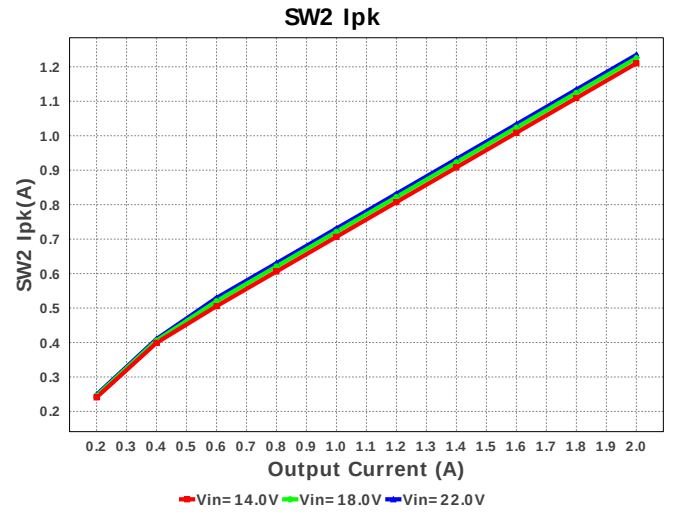


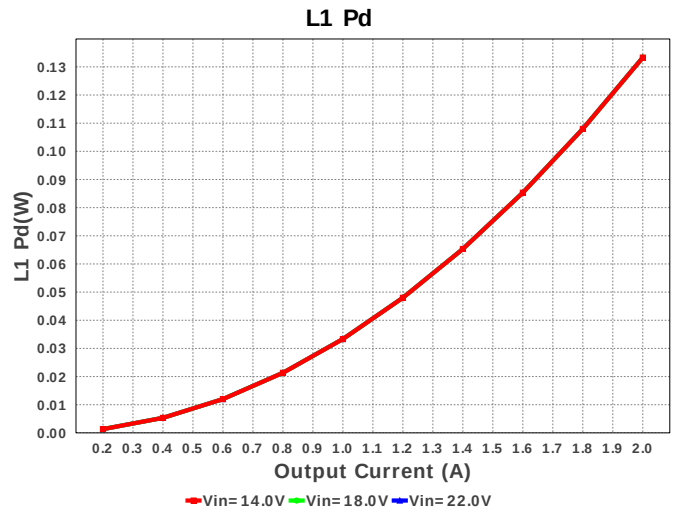


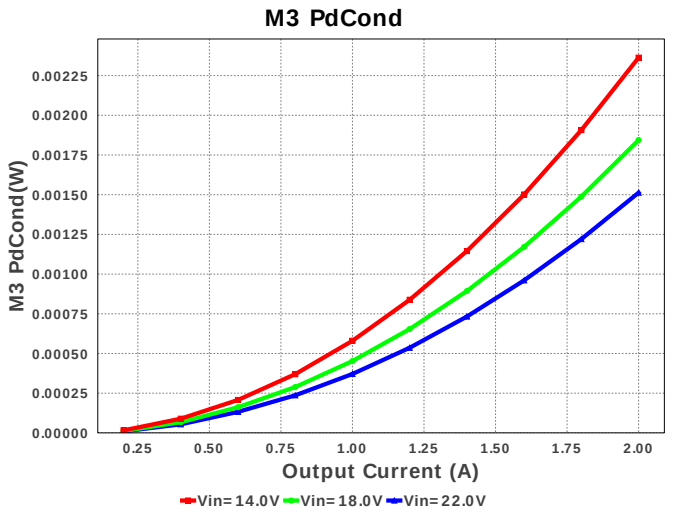


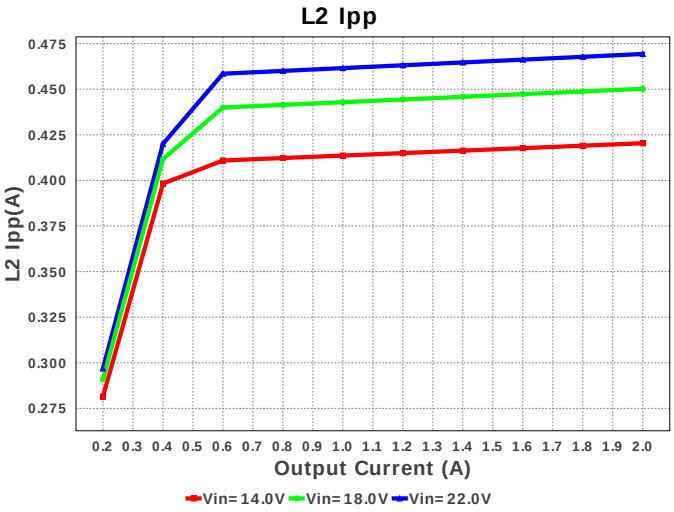


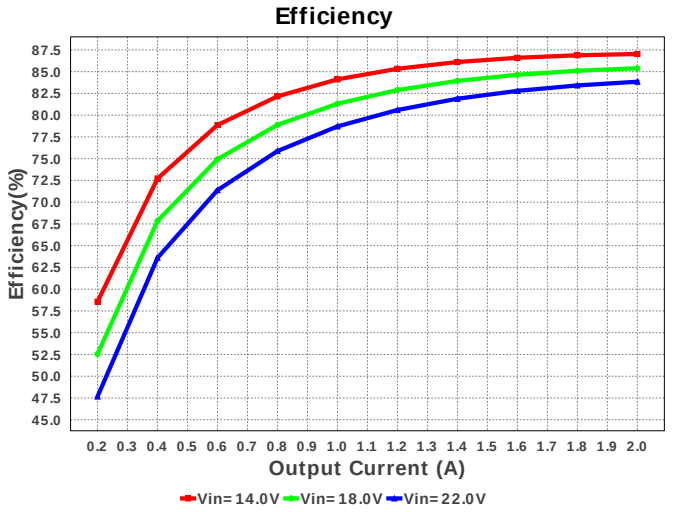


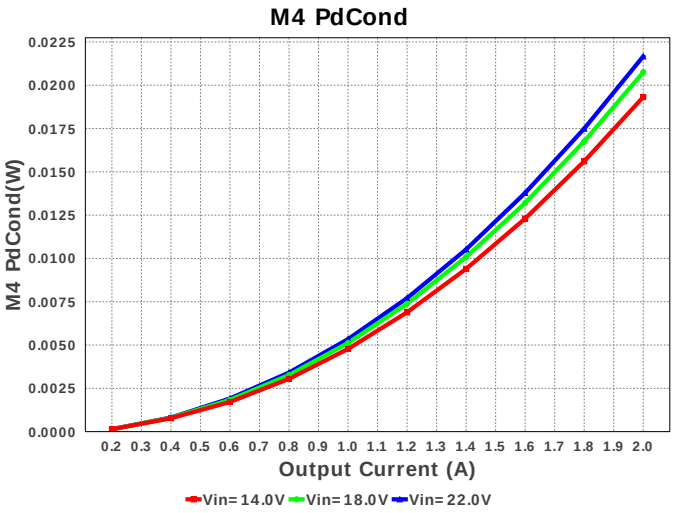


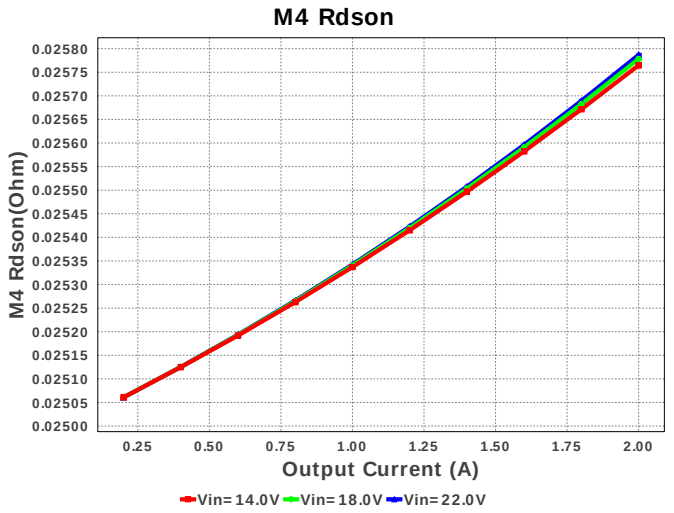


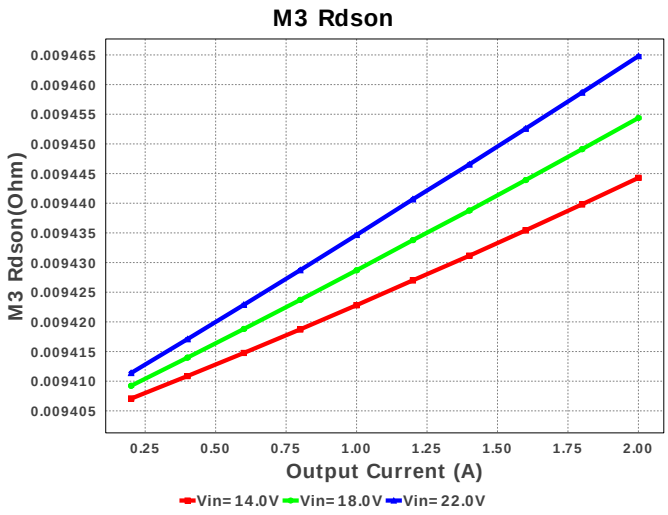


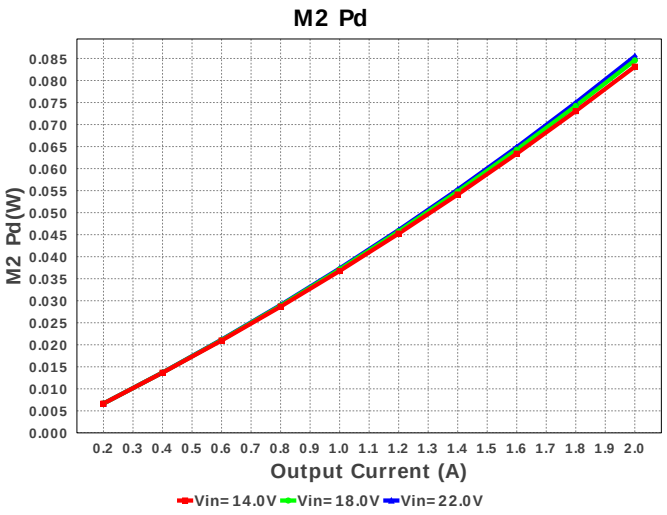


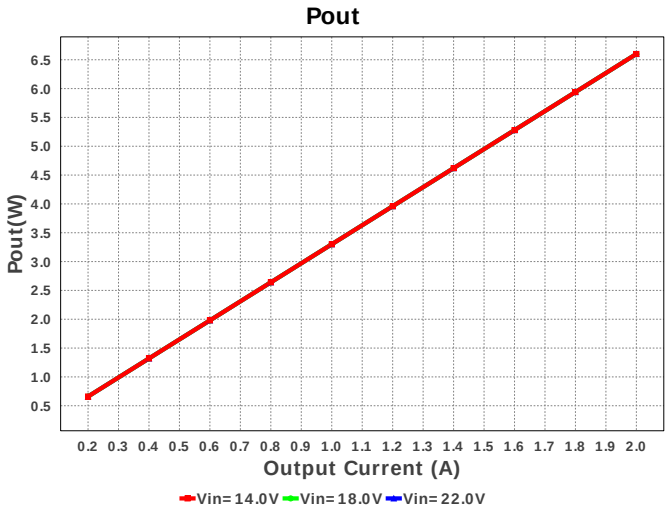


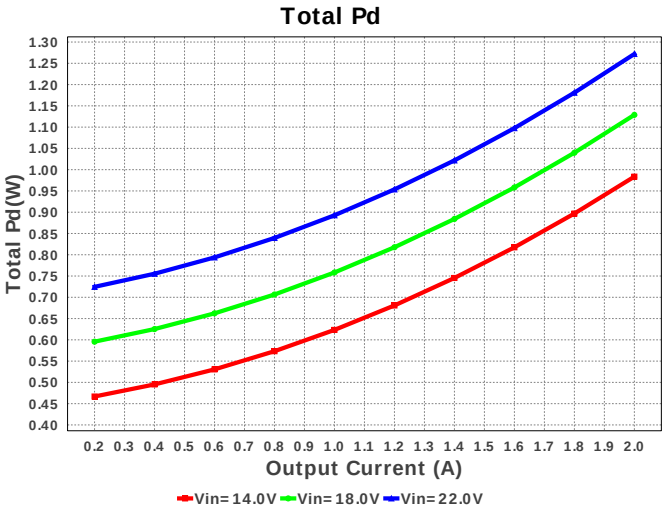


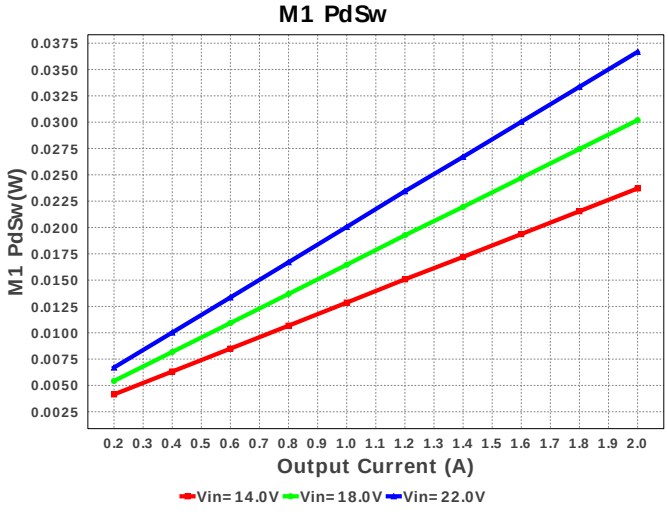


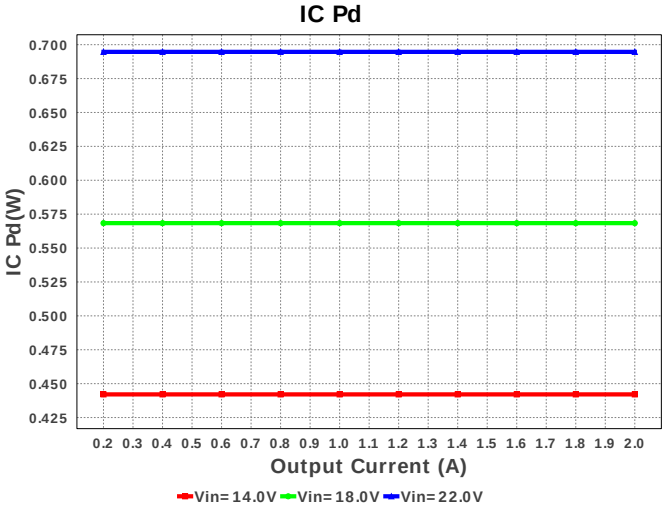


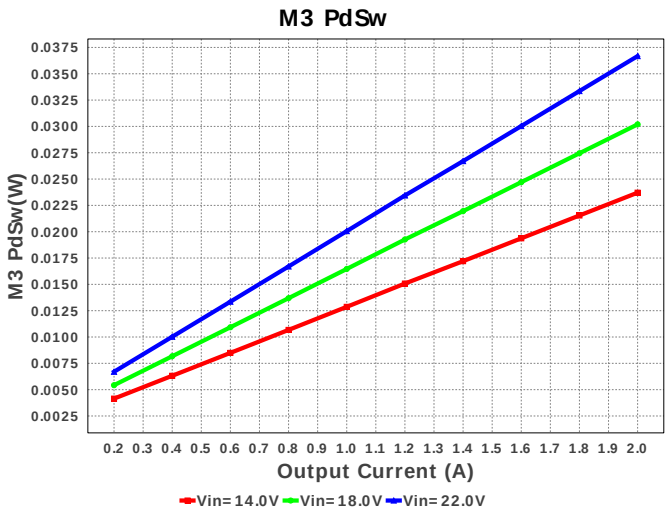


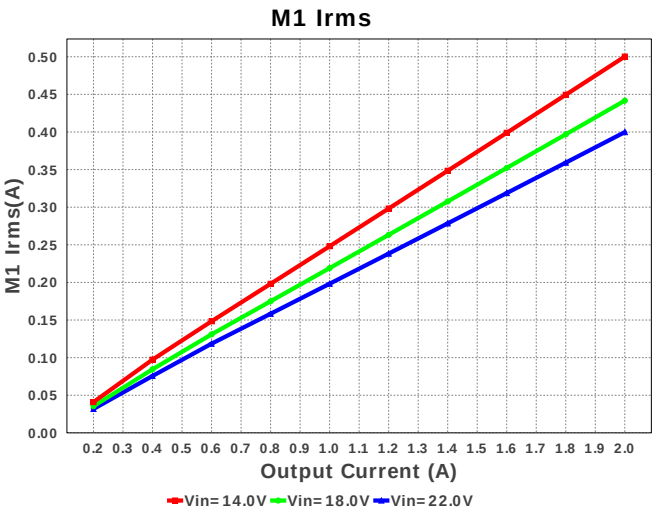


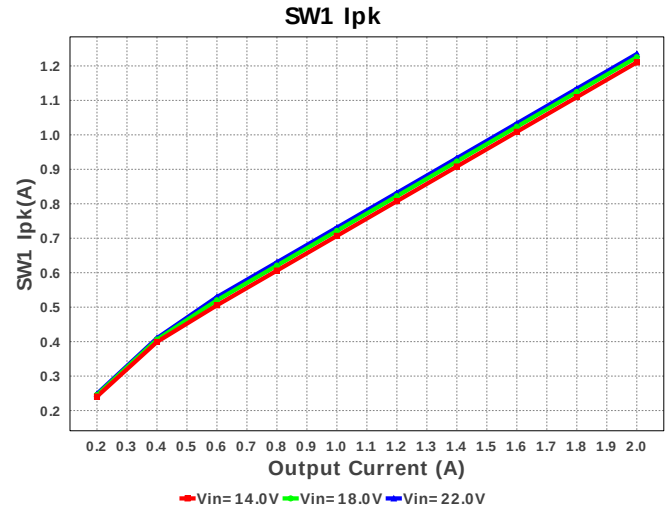


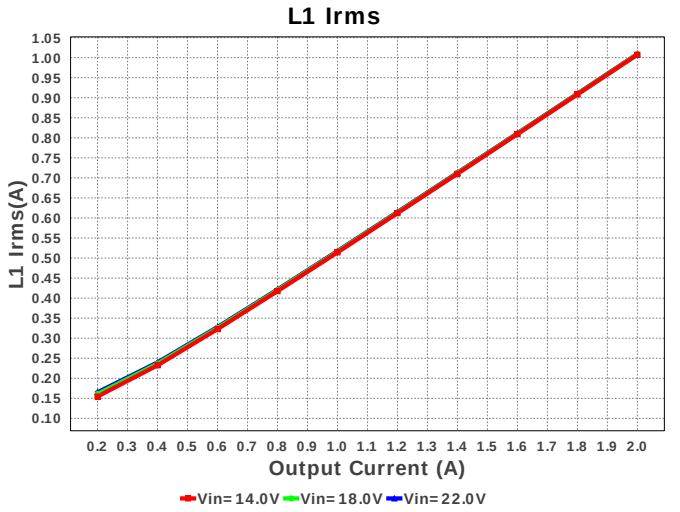


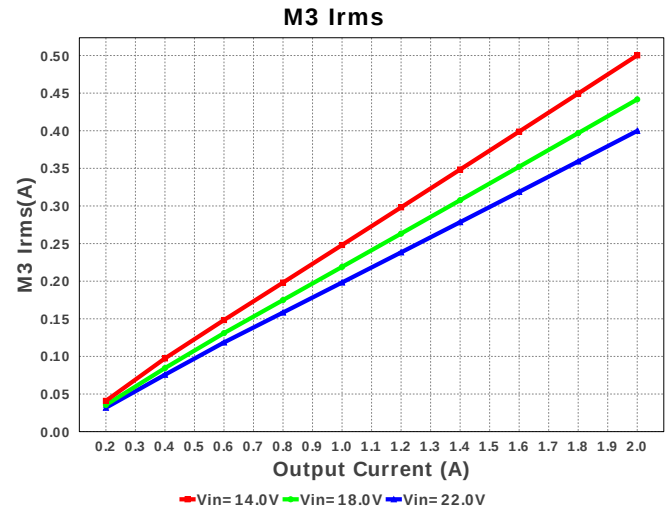


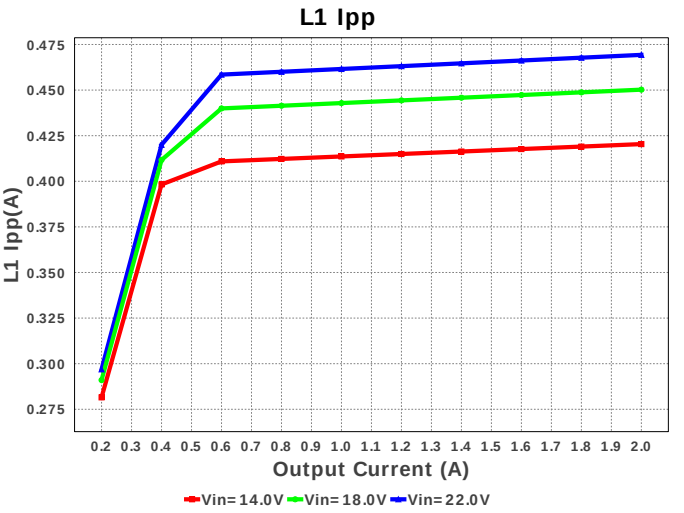


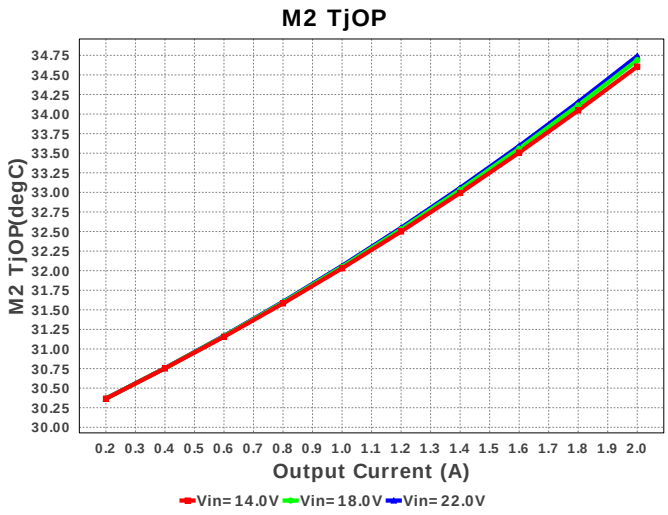


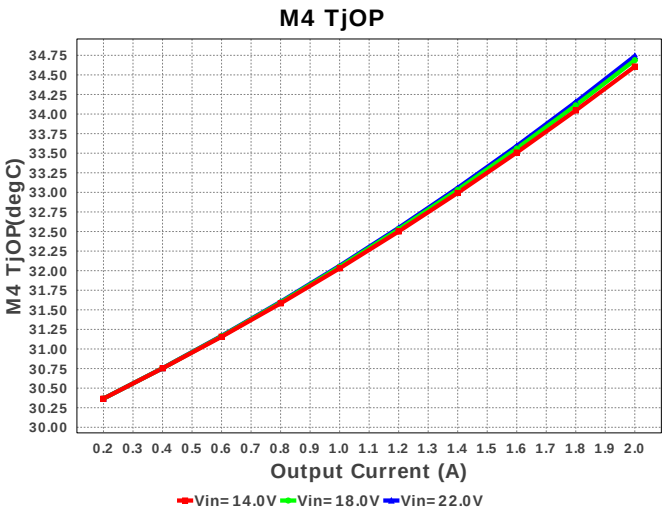


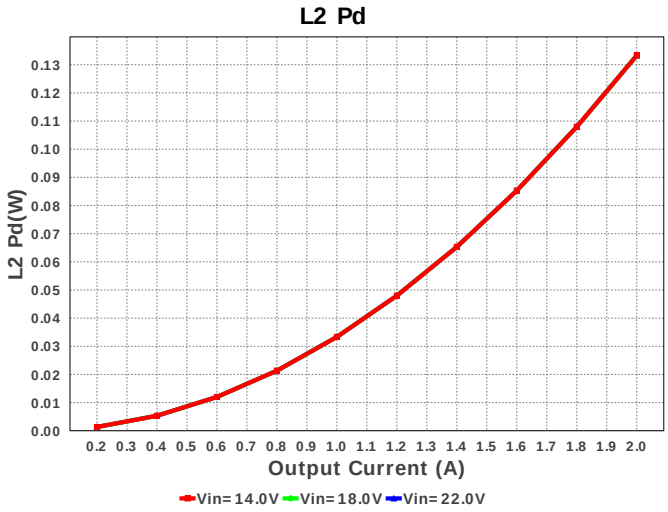


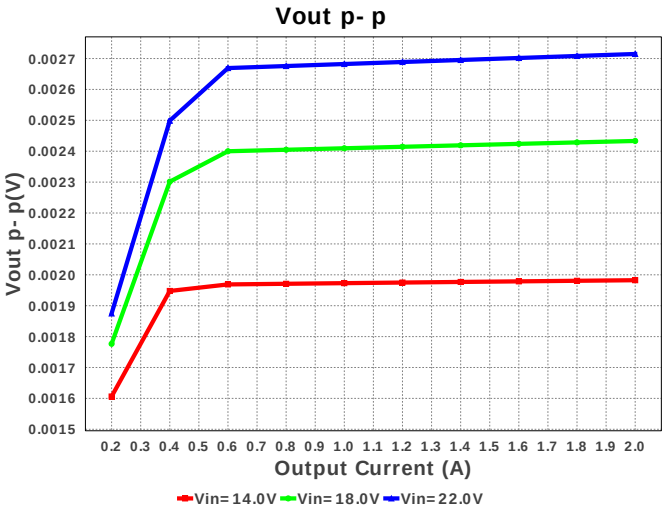


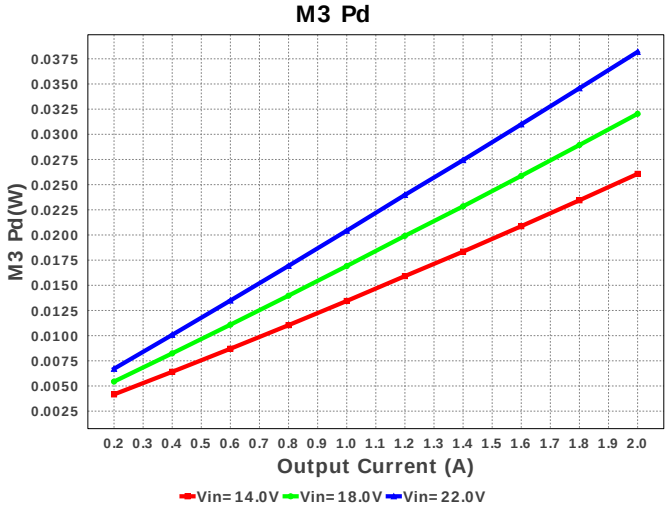


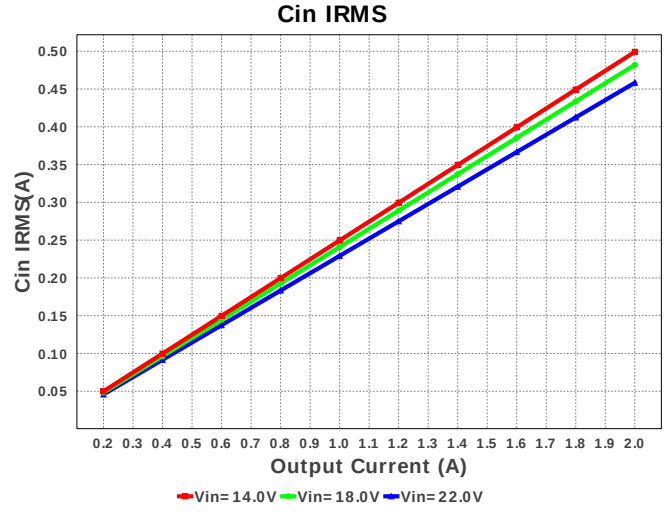












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	458.344 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	113.142 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	360.88 mA	Current	Average input current
4.	L1 Ipp	469.773 mA	Current	Peak-to-peak inductor ripple current
5.	L1 Irms	1.009 A	Current	Inductor ripple current
6.	L2Ipp	469.306 mA	Current	Channel 2 Inductor Peak to peak Current
7.	L2 Irms	1.009 A	Current	Inductor ripple current
8.	M1 Irms	400.026 mA	Current	MOSFET RMS ripple current
9.	M2 Irms	916.504 mA	Current	MOSFET RMS ripple current
10.	M3 Irms	399.781 mA	Current	MOSFET RMS ripple current
11.	M4 Irms	916.611 mA	Current	MOSFET RMS ripple current

#	Name	Value	Category	Description
12.	SW1 Ipk	1.235 A	Current	Peak switch current
13.	SW2 Ipk	1.235 A	Current	Peak switch current
14.	BOM Count	35	General	Total Design BOM count
15.	FootPrint	417.0 mm^2	General	Total Foot Print Area of BOM components
16.	Frequency	424.559 kHz	General	Switching frequency
17.	IC Tolerance	12.0 mV	General	IC Feedback Tolerance
18.	Pout	6.609 W	General	Total output power
19.	Total BOM	$6.51	General	Total BOM Cost
20.	M3 TjOP	32.104 degC	Op_Point	M3 MOSFET junction temperature
21.	M4 TjOP	34.74 degC	Op_Point	M4 MOSFET junction temperature
22.	Vout Actual	3.304 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
23.	Vout OP	3.304 V	Op_Point	Operational Output Voltage
24.	Duty Cycle	16.002 %	Op_point	Duty cycle
25.	Efficiency	83.185 %	Op_point	Steady state efficiency
26.	IC Tj	57.788 degC	Op_point	IC junction temperature
27.	IOUT_OP	2.0 A	Op_point	Iout operating point
28.	M1 TjOP	32.104 degC	Op_point	M1 MOSFET junction temperature
29.	M2 TjOP	34.74 degC	Op_point	M2 MOSFET junction temperature
30.	VIN_OP	22.0 V	Op_point	Vin operating point
31.	Vout p-p	2.715 mV	Op_point	Peak-to-peak output ripple voltage
32.	Cin Pd	210.919 µW	Power	Input capacitor power dissipation
33.	Cout Pd	11.451 µW	Power	Output capacitor power dissipation
34.	IC Pd	694.693 mW	Power	IC power dissipation
35.	L1 Pd	133.308 mW	Power	Inductor power dissipation
36.	L2 Pd	133.308 mW	Power	Inductor power dissipation
37.	M1 Pd	38.239 mW	Power	M1 MOSFET total power dissipation
38.	M1 PdCond	1.515 mW	Power	M1 MOSFET conduction losses
39.	M1 PdSw	36.724 mW	Power	M1 MOSFET switching losses
40.	M2 Pd	85.48 mW	Power	M2 MOSFET total power dissipation
41.	M2 PdCond	21.66 mW	Power	M2 MOSFET conduction losses
42.	M2 PdSw	63.82 mW	Power	M2 MOSFET switching losses
43.	M3 Pd	38.233 mW	Power	M3 MOSFET total power dissipation
44.	M3 PdCond	1.513 mW	Power	M3 MOSFET conduction losses
45.	M3 PdSw	36.721 mW	Power	M3 MOSFET switching losses
46.	M1 Rdson	9.465 mOhm	Power	Drain-Source On-resistance
47.	M3 Rdson	9.465 mOhm	Power	Drain-Source On-resistance
48.	M4 Pd	85.485 mW	Power	M4 MOSFET total power dissipation
49.	M4 PdCond	21.665 mW	Power	M4 MOSFET conduction losses
50.	M4 PdSw	63.82 mW	Power	M4 MOSFET switching losses
51.	M2 Rdson	25.787 mOhm	Power	Drain-Source On-resistance
52.	M4 Rdson	25.787 mOhm	Power	Drain-Source On-resistance
53.	Rsense1 Pd	62.998 mW	Power	Current Limit Sense Resistor Power Dissipation
54.	Rsense2 Pd	63.013 mW	Power	Current Limit Sense Resistor Power Dissipation
55.	Total Pd	1.335 W	Power	Total Power Dissipation
56.	Cross Freq Ch1	38.307 kHz		Bode plot crossover frequency
57.	Phase Marg Ch1	56.165 deg		Bode Plot Phase Margin
58.	Vout Tolerance	3.054 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	VinMax	22.0	Maximum input voltage
3.	VinMin	14.0	Minimum input voltage
4.	Vout	3.3	Output Voltage
5.	base_pn	LM25119-Q1	Base Product Number
6.	source	DC	Input Source Type
7.	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. Interleaved Operation Interleaved operation can offer many advantages in single output, high current applications. The output power path is split between two identical channels reducing the current in each channel by one-half. Ripple current reduction in the output capacitors is reduced significantly since each channel operates 180 degrees out of phase from the other. 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-Q1** Product Folder : http://www.ti.com/product/LM25119Q : contains the data sheet and other resources.