



ON Semiconductor®

Customer:	ON Semiconductor Customer
Board Info:	NCP1589A EVB
Power Rail:	2.5-3.3V at 8A
Date:	7/8/2011

Design Summary	
Design Name:	1589A 2.5V-3.3V 8A
	VR: NCP1589A
	Driver: Internal to 1589
	1 HS NTFFS4930
	1 LS NTFFS4939
L:	1x 3.3 µH
Input Cap:	MLCC 2 x 22.0uF
	Bulk 0 x 0.0uF
Output Cap:	MLCC 4 x 10.0uF
	Bulk 1 x 470.0uF

Design Notes:	Generic Reference Design
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Schematics and BOM

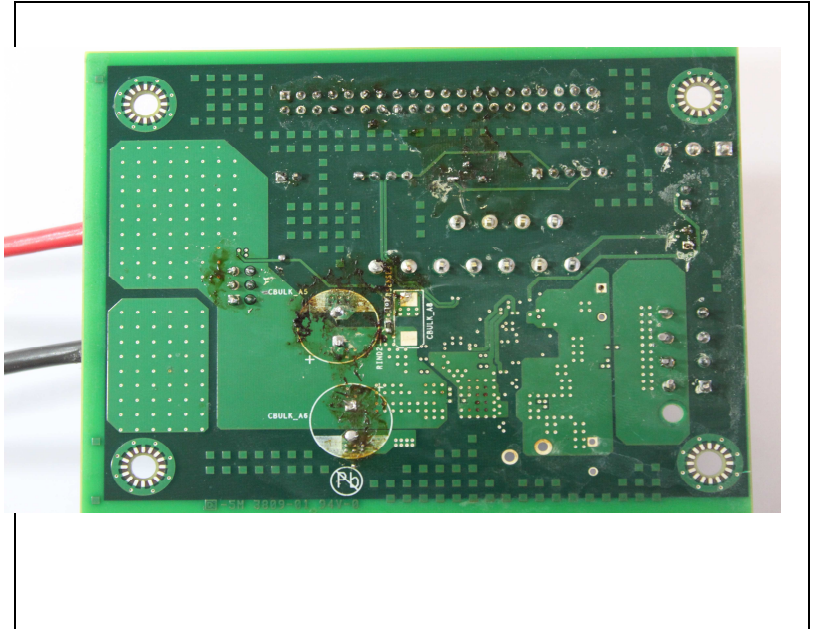
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BOM							
Functional Block	Name	RefDes	MFG	P/N	Qty	Value	Notes:
Voltage Regulator Controller	VRC	-	ON Semiconductor	NCP1589A	1	NCP1589A	
Driver	DHV	-	ON Semiconductor	Internal to 1589	0		
Control FET	QHS1	-	ON Semiconductor	NTTFS4930	1	15.0 mΩ	
Sync FET	QLS1	-	ON Semiconductor	NTTFS4939	1	4.1 mΩ	
Output Inductor	Lout	LOUT2	Cooper Bussmann	HCF1305-3R3	1	3.3 μH	
Cout	Cout_cer	COU15_6,7,8	TDK	C2012K390J106M	4	10 μF	
	Cout_bulk	CBULK_A5	Oscon	KSPEC270MY	1	470 μF	
Cin	Cin_cer	CIN_A3,4	muRata	GRM42-6X7R226K	2	22 μF	
	Cin_bulk	-	-	-	0		
Input Filter	C_pi	-	-	EMPTY	0	EMPTY	No Filter Required
	L_pi	-	-	EMPTY	0	EMPTY	No Filter Required
Snubber	Rsnub	RSNUB_2	-	-	1	1 Ω	
	Csnub	CSNUB_2	-	-	1	330 pF	
FET Drive	Rbst	RBST_2	-	-	1	1 Ω	
	Cbst	CBST_2	-	-	1	0.1 μF	
	Rbst2	RBST2_2	-	-	1	4.7 Ω	
	RHGate	RHGATE1	-	-	1	0 Ω	
Voltage Loop	Ch	CH_2	-	-	1	470p pF	
	Cf	CF_2	-	-	1	3.3 nF	
	Rf	RF_2	-	-	1	16.9 kΩ	
	Cfb1	CFB1_2	-	-	1	4.7 nF	
	Rfb1	RFB1_2	-	-	1	20.5 Ω	
	Rfb	RFB_2	-	-	1	3.01 kΩ	
	Ros1	ROS1_1	-	-	1	3.01 kΩ	
	Ros2	ROS2_1	see notes		1	1.42 kΩ	for 2.5 V out ; 963 Ω for 3.3V out
	Rfb2	RFB2_2	-	-	1	1.42 kΩ	for 2.5 V out ; 963 Ω for 3.3V out
	Rf1	RF1_1	-	-	0	kΩ	
Lossless Current sensing	Rf2	RF2_1	-	-	0	kΩ	
	CS	CCS1_1	-	-	0	μF	
	Rtherm	Rtherm_4	-	-	0	kΩ	
	RTC1	RTC1_1	-	-	0	kΩ	
Current Limit/Droop	RTC2	RTC2_1	-	-	0	kΩ	
	RQCP	RQCP_1V1	-	-	0	kΩ	
	RDRP	RDRP_1V1	-	-	0	kΩ	
	CDRP	CDRP_1V1	-	-	0	μF	
Transient Enhancement	RTRF	RTRF_1	-	-	0	kΩ	
	R10	R10	-	-	1	10 kΩ	
Enable	Q2	Q2	ON Semiconductor	ZN700ZLT1G	1	10 kΩ	
	R7	R7	-	-	1	10 kΩ	
Pgood	R8	R8	-	-	1	10 kΩ	
	R9	R9	-	-	1	3.01 kΩ	
Vcc	RVCC	RVCC2	-	-	1	2.21 Ω	
	CVCC	CVCC2	-	-	1	1 μF	
Auxiliary	RIND	RIND1	-	-	1	100 Ω	
	RSENSE	RSENSE1	-	-	1	0 Ω	
	RBODE	RBODE_1	-	-	1	10 Ω	

TOP

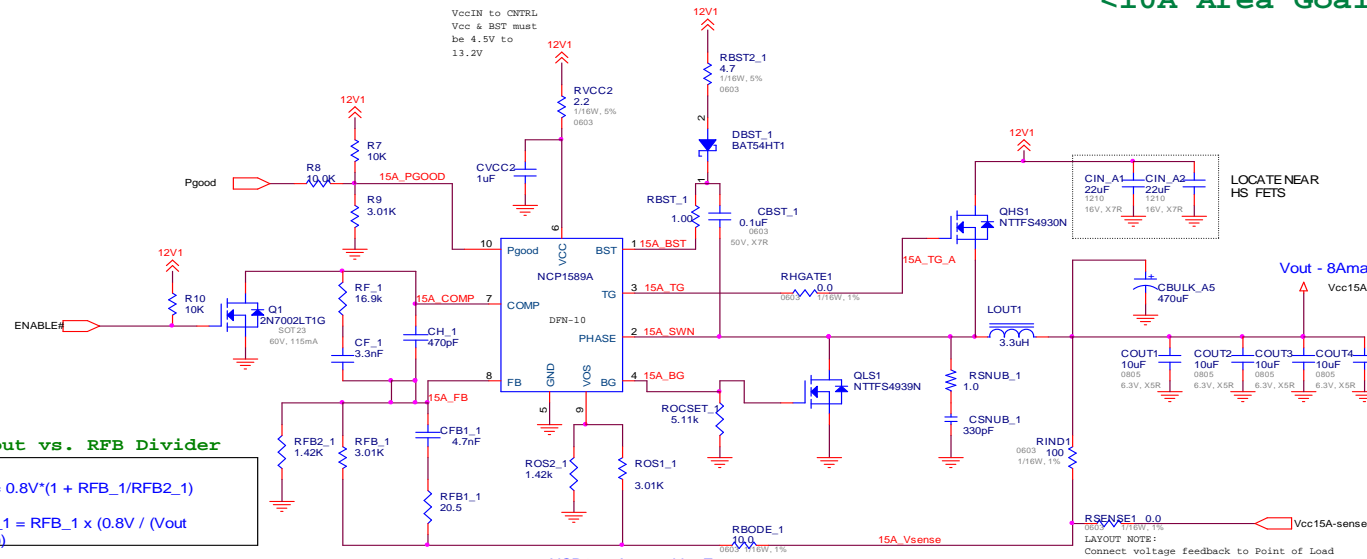


BOTTOM



NCP1589A 8A / 2.5-3.3V

CNTRL+FET+output filter Area:
 20-30A Area Goal = 1" x 1.5"
 10-20A Area Goal = 1" x 1"
 <10A Area Goal = 1" x 0.5"



Vout vs. RFB Divider

$$V_{out} = 0.8V \cdot (1 + R_{FB1} / R_{FB2_1})$$

$$R_{FB2_1} = R_{FB1} \times (0.8V / (V_{out} - 0.8V))$$

Vout	RFB_1	RFB2_1	ROS2_1
2.5V	3.01k	1.42kOhm	1.42kOhm
3.3V	3.01k	963 Ohm	963 Ohm

NCP1589A = 300khz Fsw

Vout	ROCSET_1
2.5V	2.7k
2.5V	2.7k

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Title NCP1589A - 8A		
Size	Document Number ONS252G	Rev A
Date:	Friday, July 08, 2011	Sheet 2 of 10

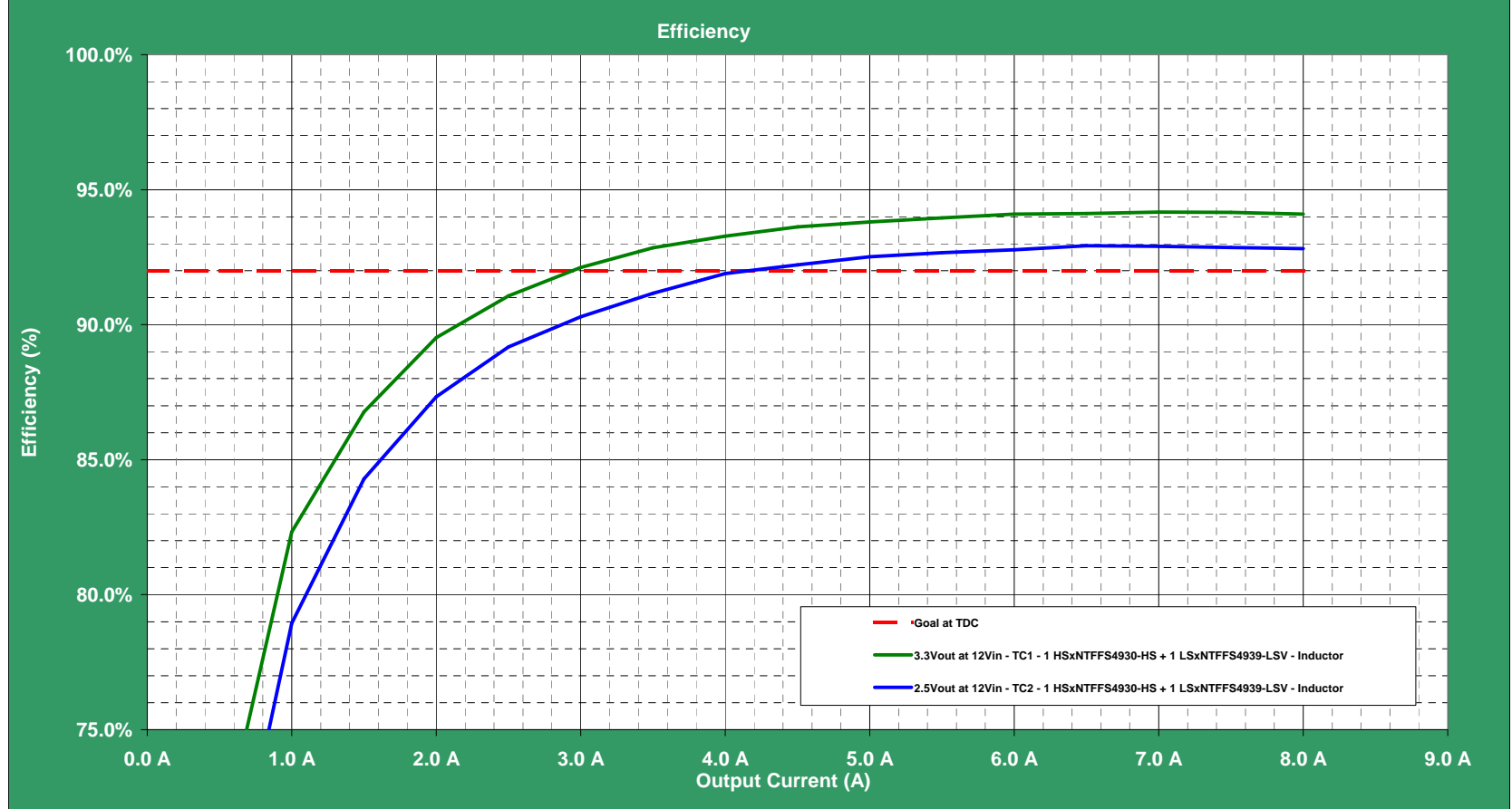
Parametric Input and Test Results Summary

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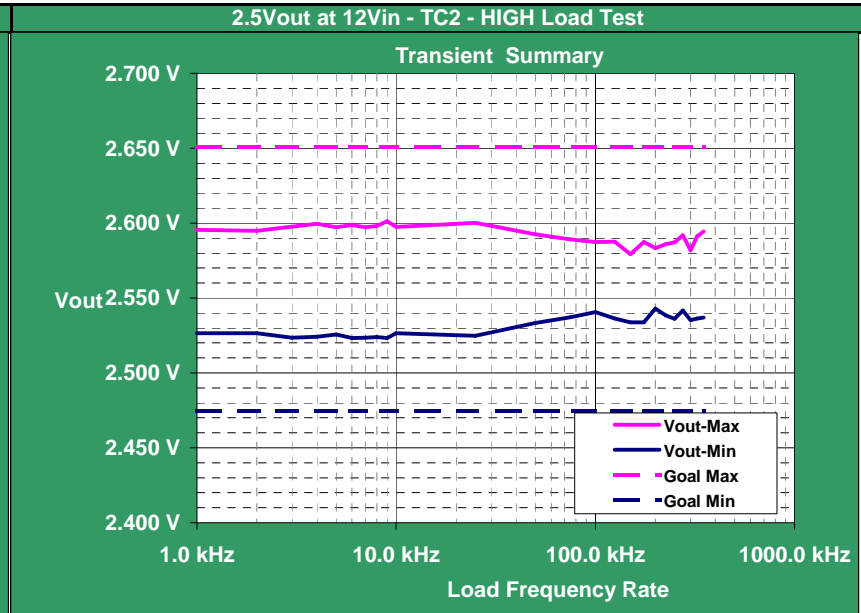
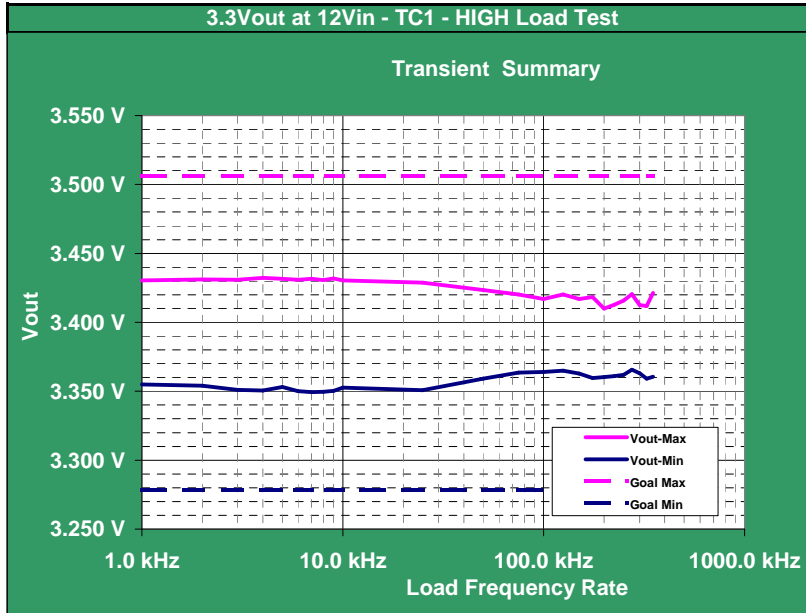
Design Operating Conditions						
Parameter	Spec	Comments				
Imax	8.0 A	1st order impact on inductor selection (Isat)				
TDC	6.0 A	1st order impact on inductor & FET selection				
IccDynamic	2.5 A	1st order impact on decoupling and transient tolerance				
di/dt	10 A/us	Impacts decoupling and transient tolerance				
DC Tolerance	+/- 2.00 %	Includes Ripple voltage				
AC Tolerance	+/- 3.00 %					
Overshoot Allow	0 mV					
Efficiency	92 %	at TDC				
OCP of Imax	180 %					
Load Line	0.00 mOhm					
Test Conditions						
Test Condition #1	Vout = 3.300V	Vin = 12.0V	Idyn = 2.5 A	TDC = 6.0 A	Imax = 8.0 A	Note: TC1 TC1 Label = 3.3Vout at 12Vin - TC1
Test Condition #2	Vout = 2.500V	Vin = 12.0V	Idyn = 2.5 A	TDC = 6.0 A	Imax = 8.0 A	Note: TC2 TC2 Label = 2.5Vout at 12Vin - TC2

Specifications & RESULTS									
Test Information		Test Condition #1 = 3.3Vout at 12Vin - TC1				Test Condition #2 = 2.5Vout at 12Vin - TC2			
Name	Parameters	Spec	Measured	Result	Comments	Spec	Measurement	Result	Comments
Efficiency	TDC	92 %	94.1 %	PASS		92 %	92.8 %	PASS	
	Max Efficiency	92 %	94.2 %	PASS		92 %	92.9 %	PASS	
Load Line	Average	0.00 mOhm	0.00 mOhm			0.00 mOhm	0.00 mOhm		
	TDC	300 kHz	298 kHz	PASS		300 kHz	299 kHz	PASS	
Ripple	Output MAX	66 mV	26.943 mV	PASS		50 mV	20.774 mV	PASS	
	Input MAX	480 mV	276.55 mV	PASS		480 mV	237.128 mV	PASS	
Transient	Min Droop	3.0 %	0.86 %	PASS		3.0 %	1.17 %	PASS	
	Max Overshoot	3.0 %	0.75 %	PASS		3.0 %	0.92 %	PASS	
Bode	Bandwidth	75.0 kHz	26.6 kHz	PASS		75.0 kHz	28.5 kHz	PASS	
	Phase Margin	45.00 °	46.90 °	PASS		45.00 °	46.55 °	PASS	
	Gain Margin	10 dB	18.7 dB	PASS		10 dB	18.5 dB	PASS	
DC Jitter	Max	50 ns	17.6 ns	PASS		50 ns	19.2 ns	PASS	
	Peak	24 V	21.7 V	PASS		24 V	22 V	PASS	
Startup	EN to Vout > 90%	5 ms	0 ms	PASS		5 ms	0 ms	PASS	
Shutdown	EN# to Vout < 10%	100 ms	0 ms	PASS		100 ms	0 ms	PASS	
OCP Setpoint	DC load	14 A	15.3 A	PASS		14 A	13.8 A	PASS	

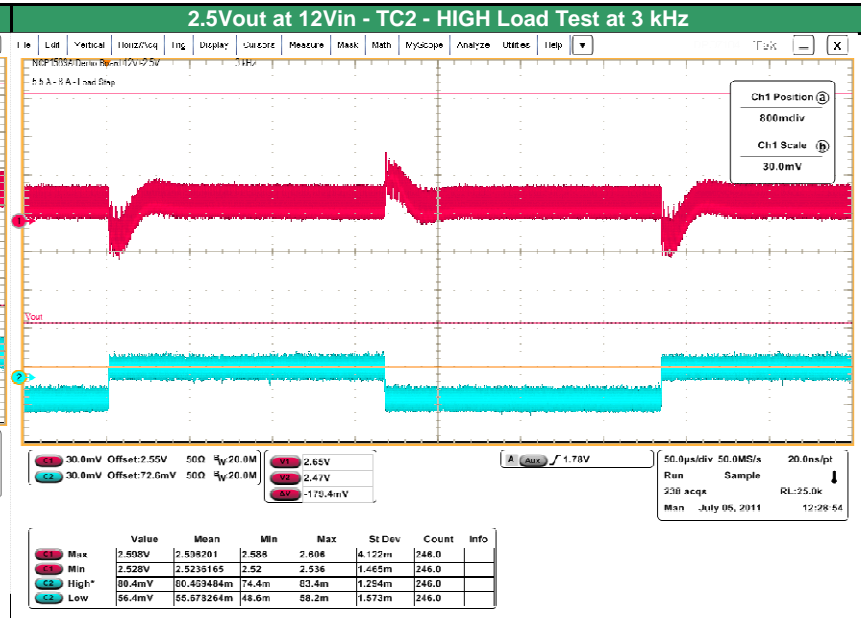
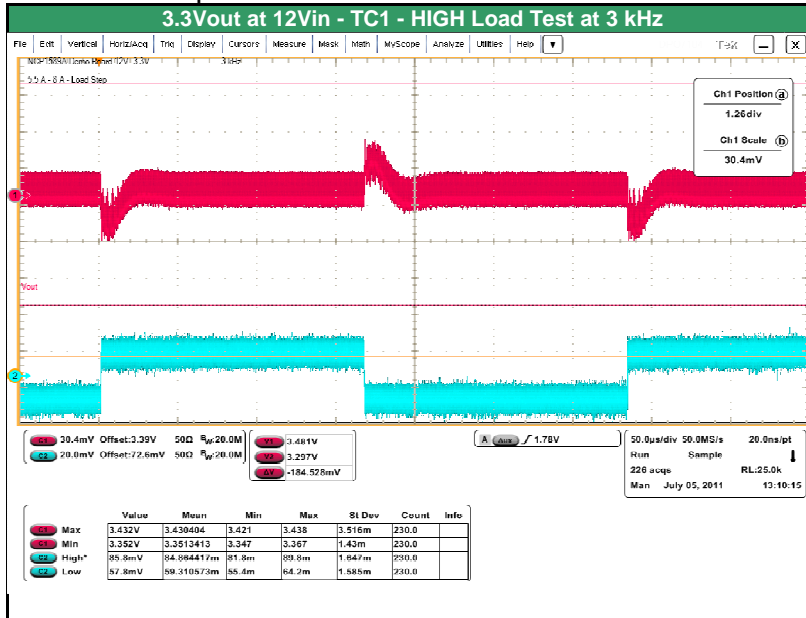
Parametric Input and Test Results Summary



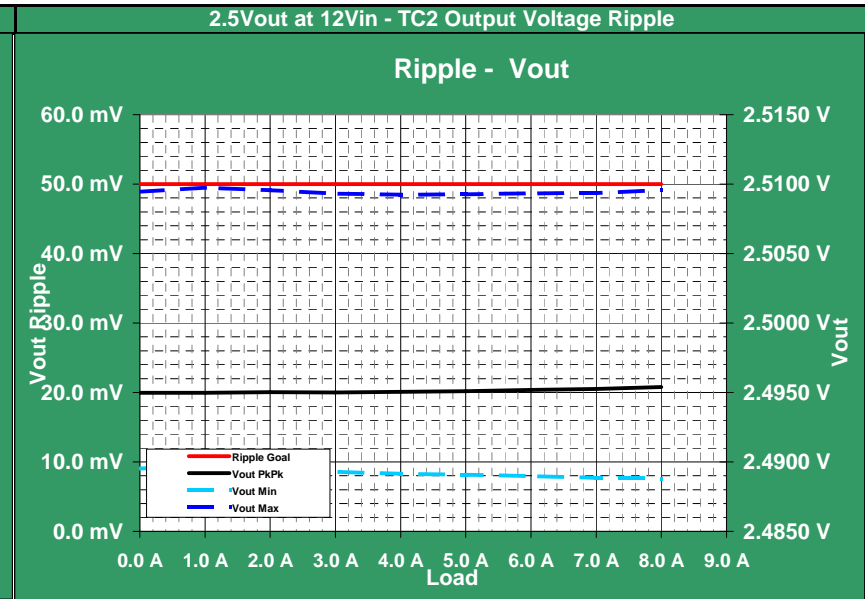
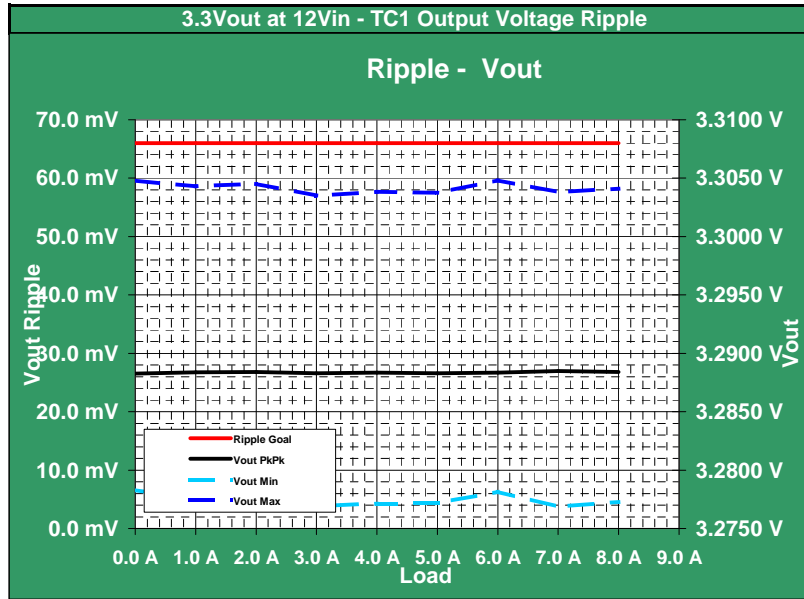
Parametric Input and Test Results Summary



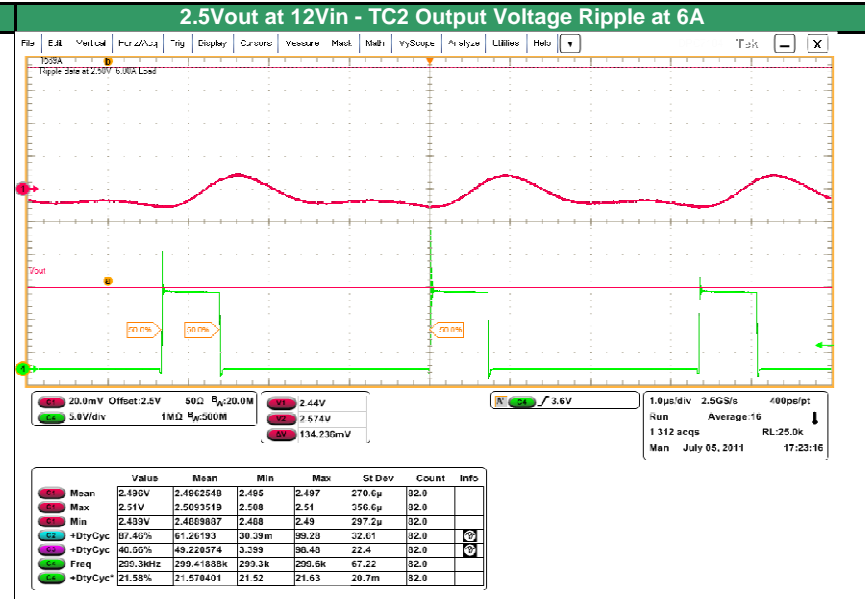
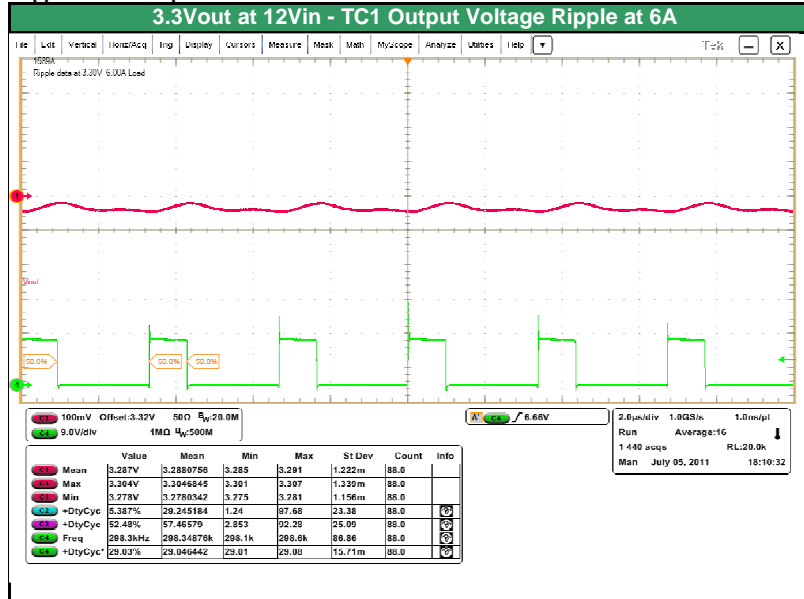
Transient Screen Captures:

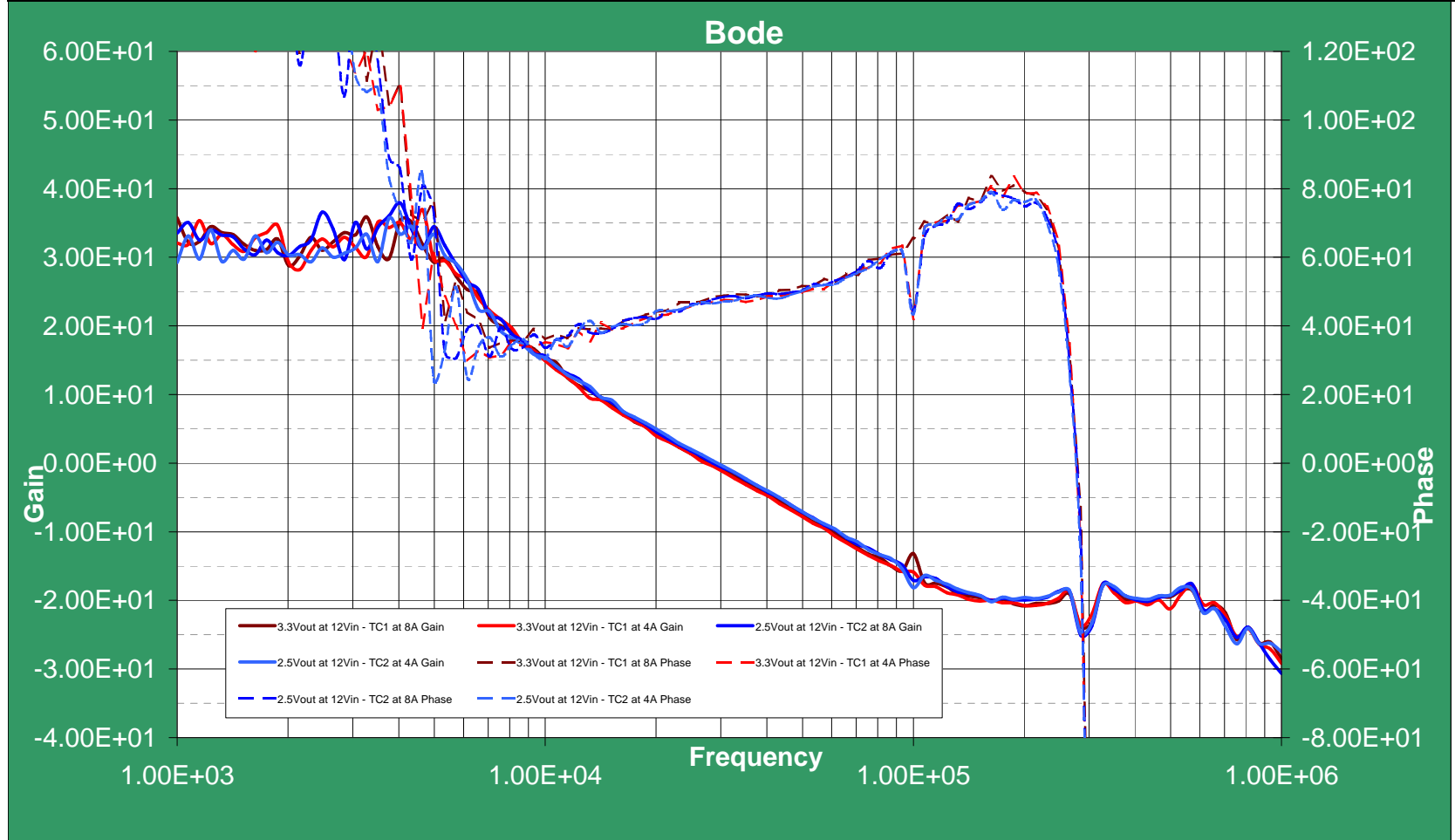


Parametric Input and Test Results Summary



Ripple Screen Captures:





Parametric Input and Test Results Summary

Thermals at 3.3Vout at 12Vin - TC1

Thermals at 2.5Vout at 12Vin - TC2

Ambient = 23.0 °C		Thermals @ 23°C Ambient					
Area	Component	No Airflow		Minimum Airflow		Measured Airflow	
		Temp	Rise	Temp	Rise	Temp	Rise
1	Inductor	43.6 °C	20.6 °C	34.6 °C	11.6 °C		
2	LS FET	42.1 °C	19.1 °C	34.0 °C	11.0 °C		
3	HS FET	44.2 °C	21.2 °C	35.9 °C	12.9 °C		
4	Controller/Driver	43.1 °C	20.1 °C	34.5 °C	11.5 °C		
5	Max Hot Spot	44.2 °C	21.2 °C	35.9 °C	12.9 °C		
Max Temp / Rise =		44.2 °C	21.2 °C	35.9 °C	12.9 °C		
Tsoak = 10 min						Airflow = 0 lfm	

Ambient = 23.0 °C		Thermals @ 23°C Ambient					
Area	Component	No Airflow		Minimum Airflow		Measured Airflow	
		Temp	Rise	Temp	Rise	Temp	Rise
1	Inductor	41.1 °C	18.1 °C	32.2 °C	9.2 °C		
2	LS FET	40.0 °C	17.0 °C	31.9 °C	8.9 °C		
3	HS FET	40.5 °C	17.5 °C	32.3 °C	9.3 °C		
4	Controller/Driver	40.9 °C	17.9 °C	32.4 °C	9.4 °C		
5	Max Hot Spot	41.1 °C	18.1 °C	32.4 °C	9.4 °C		
Max Temp / Rise =		41.1 °C	18.1 °C	32.4 °C	9.4 °C		
Tsoak = 10 min						Airflow = 0 lfm	

