

### TIDA-00595

Synchronous DC/DC Converter with Inductor on top of IC for Small Footprint

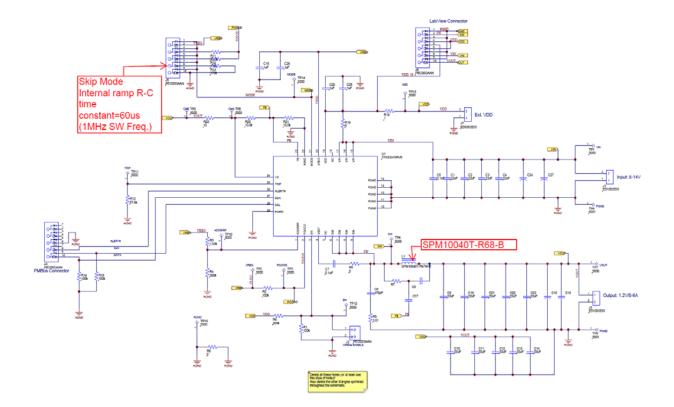
### Description

The TPS53515 Inductor-On-Top Step-Down Buck Converter reference design enables reduction of X-Y area while enabling >87% efficiency with 2.6W of power loss @12A load and 12mV of output voltage ripple with only 10x22uF ceramic output caps. This power reference design supports a 12V input and a 1.2V output at 12A and switches at 1MHz.

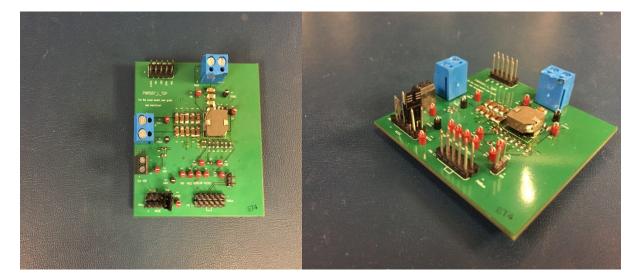
# TPS53515EVM Set up

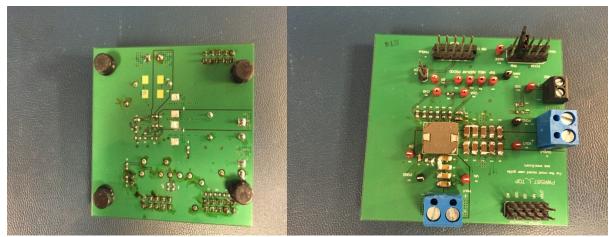
- **VIN**=12V
- **VOUT**=1.2V
- IOUT=E-Load Dynamic: 5A to 10A at ~2.5A/µs & Static=5A
- IOUT\_Max=12A
- COUT=10x22µF\_Ceramic, 6.3V
- Inductor=SPM10040T-R68-B
- FREQ=1MHz
- Temperature=25°C

## **TPS53515 EVM Schematic**



## **TPS53515 L-TOP Pictures**

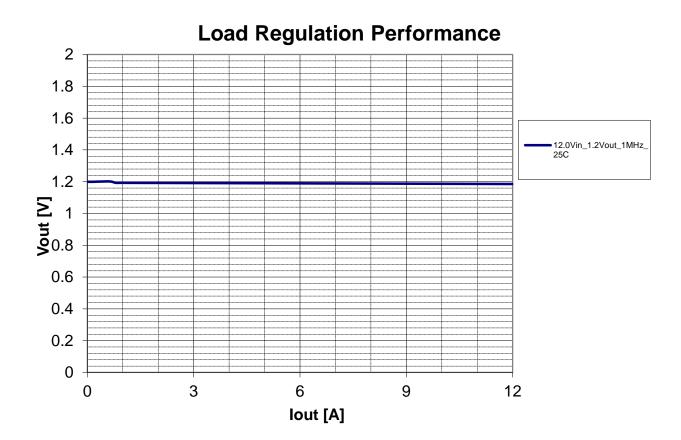


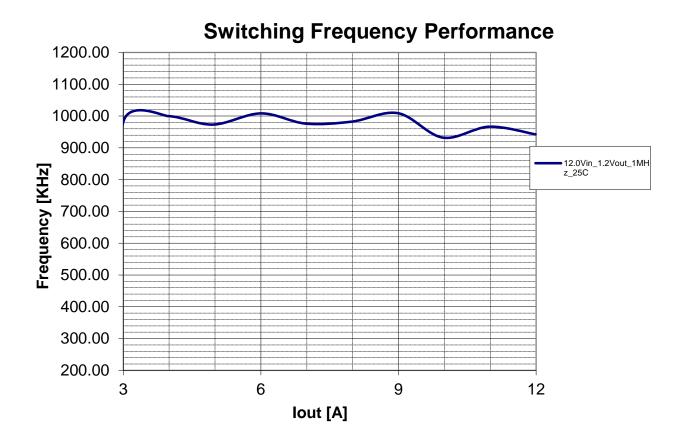


## **TPS53515 Efficiency Performance**

lout [A]







# **Vout Ripple Test**

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												VOUT	ripple	e=12mV
			0.0.0.0						0_0_1		0.0	0.0.0	0.0.0	<u><u><u>a</u></u> <u>a</u> <u>a</u></u>
VOUT			1222	2223			22	222				<b>Saa</b> a		
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FSW						, t								
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						-								
IOUT						· + ·								
C1 5.0V/div		MΩ <sup>B</sup> w:20.0M 1MΩ <sup>B</sup> w:2						A C1	 ∫ 6.9	v		5.0µs/div	/ 1.25GS/s	s 800ps/p
	Offset:1.2V	MΩ ᡛ <sub>W</sub> :20.0M 1MΩ <sup>B</sup> W:2 0Ω <sup>B</sup> W:1.0G		1.184V		· · · ·		ACI	<b>5</b> 6.9	×		5.0μs/div Stopped 236 544		s 800ps/p RL:62.5k
C1 5.0V/div C3 20.0mV	Offset:1.2V	1MΩ <sup>B</sup> W:2	0.0M	1.184V				ACI	<b>√</b> 6.9	v		Stopped 236 544		RL:62.5k
C1 5.0V/div C3 20.0mV	Offset:1.2V	1MΩ <sup>B</sup> W:2	0.0M	1.184V	St Dev	Count	Info		<b>5</b> 6.9	· · · · · · · · · · · · · · · · · · ·		Stopped 236 544	acqs	RL:62.5k
C1 5.0V/div C3 20.0mV C4 5.0A/div	Offset:1.2V 5 Value 1.188V	1MΩ <sup>B</sup> W:2 0Ω <sup>B</sup> W:1.0G Mean 1.1881409	0.0M	1.184V -12.0mV Max 1.188	1.94µ	616.0	Info		<b>√</b> 6.9	v		Stopped 236 544	acqs	RL:62.5k
C1 5.0V/div C3 20.0mV C4 5.0A/div	Offset:1.2V 5 Value	1MΩ <sup>B</sup> <sub>W</sub> :2 0Ω <sup>B</sup> <sub>W</sub> :1.0G Mean	0.0M	1.184V -12.0mV Max			Info		<b>√</b> 6.9	v		Stopped 236 544	acqs	RL:62.5k

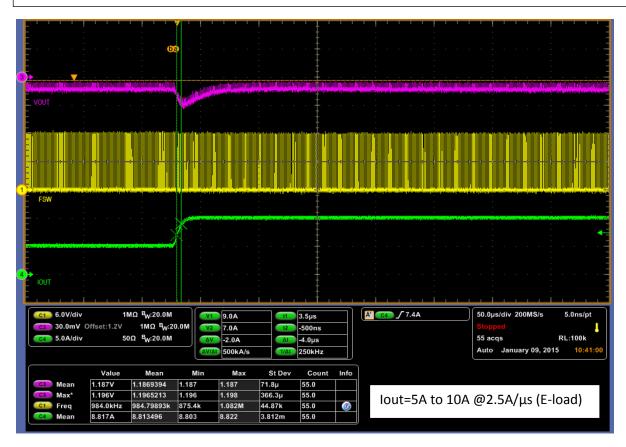
3												VOUT	ripple	⊨10m\	/
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4 IOUT							Ì								
C3 2	.0V/div 0.0mV( 0.0A/div	Offset:1.2V	MΩ <sup>B</sup> W:20.0M 1MΩ <sup>B</sup> W:20.0M 0Ω <sup>B</sup> W:20.0M	0.0M	1.195V				A' C1	<b>∖</b> 4.92V		Stopped 978 acq		200ps RL:100	k l
												Auto J	lanuary 09,	2015 11	:14:07
<b>C3</b>	Mean	Value 1.188V	Mean 1.1882433	Min 1.188	Max 1.189	St Dev 145.5µ	Count 978.0	Info							
	Aax*	1.196V	1.19623	1.195	1.198	365.0µ	978.0								
	Freq Mean	914.0kHz 18.89mA	920.13056k 18.55595m	859.7k -2.37m	981.5k 49.16m	14.03k 6.009m	978.0 978.0	0							

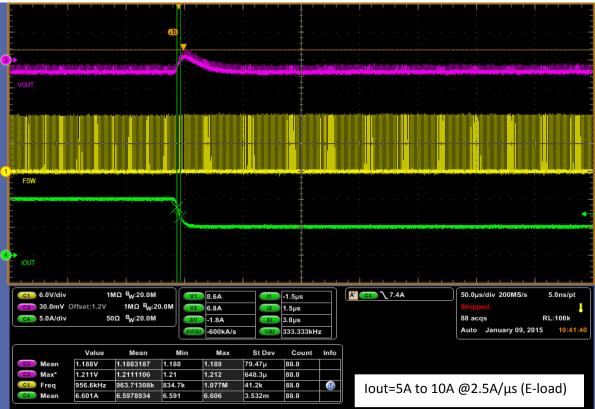
## **Under/Overshoot Measurements**

C3 Max*	1.212V -Hz	1.212	1.212 ?	1.212 ?	0.0	19.0 0.0	۲			-load)
C3 Mean	Value 1.188V	Mean 1.1877075	Min 1.188	Max 1.188	St Dev 36.58µ	Count 19.0	Info			
C3 30.0mV C4 5.0A/div		1ΜΩ <sup>B</sup> W:20 0Ω <sup>B</sup> W:1.0G	0.0M V2	1.212V 15.6mV					Stopped 329 acqs Auto January 09, 20	RL:250k 15 10:34
C1 6.0V/div		MΩ <sup>B</sup> W:20.0M	V1	1.196V				A C4 / 9.0A	100µs/div 250MS/s	4.0ns/pt
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IOUT										
						· + ·				
FSW										
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VOUT			▼ :							
	·					· ‡ ·		·	Overshoot=~1	6mV
						. ±			Overshoot=~1	6mV

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	C1 6.0		1N set:1.2V	1Ω <sup>B</sup> W:20.0M 1MΩ <sup>B</sup> W:20	0.0M V1	1.184V				A C4	9.0A 🖊 🦉		100µs/div 250MS/s	4.0ns/pt
	<b>C4</b> 5.0/			Ω <sup>B</sup> w:1.0G		1.168V -16.8mV							329 acqs	RL:250k
						-10.01114							Auto January 09, 20	
			Value	Mean	Min	Max	St Dev	Count	Info					
	C3 Me		.188V	1.1877075	1.188	1.188	36.58µ	19.0						
	C3 Ma:		.212V	1.212	1.212	1.212	0.0	19.0			lout=5A to	10A	@2.5A/μs (l	-load)
	C1 Fre		Hz .671A	? 7.6718685	? 7.671	? 7.674	0.0 813.6µ	0.0 19.0	۸			_0, (	C =, p. (	
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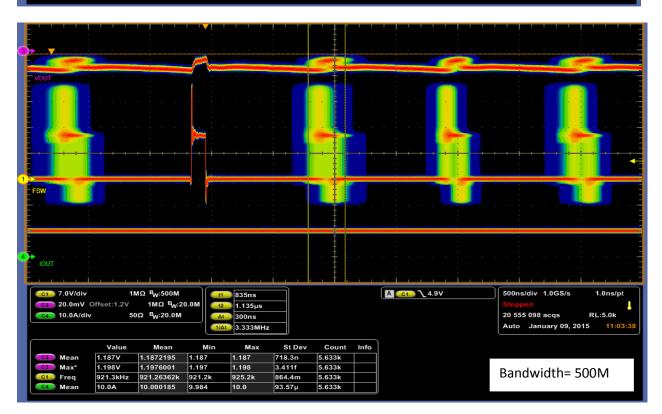
## **Transient Performance**





### **Jitter Performance**

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C1 6.0V/div		ΜΩ <sup>B</sup> W:20.0M	t1	) 1.005µs				A C1 \ 4.92V	500ns/div 1.0GS/s 1.0ns/pt
<b>C3</b> 20.0mV		1MΩ <sup>B</sup> W:2		1.085µs					Stopped
C4 10.0A/div	5	0Ω <sup>B</sup> W:20.0M	Δt	80.0ns					447 970 acqs RL:5.0k Auto January 09, 2015 <b>11:12:03</b>
				12.5MHz					Auto Salidary 03, 2013 11.12.03
	Value	Mean	Min	Max	St Dev	Count	Info		
C3 Mean	1.187V	1.1870762	1.187	1.187	14.96µ	120.0			
C3 Max*	1.198V 963.1kHz	1.1975664 963.07743k	1.197 963.0k	1.198 963.6k	162.3µ 35.59	120.0 120.0			Devel table 2014
C1 Freq	963.1kHz 10.01A	963.07743k 10.005214	963.0k 9.988	963.6k 10.01	35.59 3.351m	120.0			Bandwidth= 20M
		141000214		10.01					



# **IC Case and Inductor Temperature**

Vin=12V, Vout=1.2V, Fsw=1MHz, Ambient=25°C, Waiting time for each load= 10min.

Load (A)	Case Temp (°C)	Inductor(°C)
0	27.2	27
3	32.6	30
6	36.6	32.2
9	42.5	36
12	50	41.3

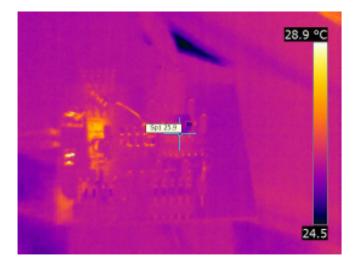


### Inspection Report

Report Date	2/2
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2/25/2015

Company	Texas Instruments Inc.
Address	
Thermographer	Benyam Gebru



#### Image and Object Parameters

Camera Model

FLIR T300

Customer		
Site Address		
Contact Person		

#### Text Comments

Due to the location of the IC, the measurement may not be accurate

Image Date	2/25/2015 10:46:53 PM
Image Name	IR_0385.jpg
Emissivity	0.98
Reflected apparent temperature	25.0 °C
Object Distance	0.2 m
Description	

12Vin\_1.2Vout\_1MHz\_0Aload



### Inspection Report

Report Date	2/25/

2/25/2015

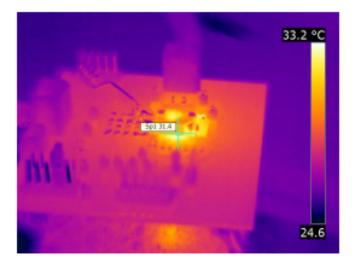
Company

Address

Thermographer

Benyam Gebru

Texas Instruments Inc.



#### Image and Object Parameters

Camera Model

FLIR T300

Customer Site Address Contact Person

#### Text Comments

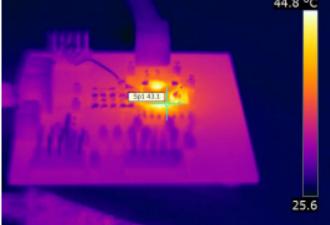
Due to the location of the IC, the measurement may not be accurate

Image Date	2/25/2015 11:03:35 PM				
Image Name	IR_0386.jpg				
Emissivity	0.98				
Reflected apparent temperature	25.0 °C				
Object Distance	0.2 m				
Description					
12Vin_1.2Vout_1MHz_6Aload					



### Inspection Report

Report Date	2/25/2015
Company Address	Texas Instruments Inc.
Thermographer	Benyam Gebru
	44.8 °C



Customer		
Site Address		
Contact Person		

Image and Object Parar	neters	Text Comments	
Camera Model	FLIR T300	Due to the location of the IC, the measurement may not be accurate	
Image Date	2/25/2015 11:14:10 PM		
Image Name	IR_0387.jpg		
Emissivity	0.98		
Reflected apparent temperature	25.0 °C		
Object Distance	0.2 m		

#### Description

12Vin\_1.2Vout\_1MHz\_12Aload

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