



**Texas Instruments**

**PMP4372 Test Procedure**

**China Power Reference Design**

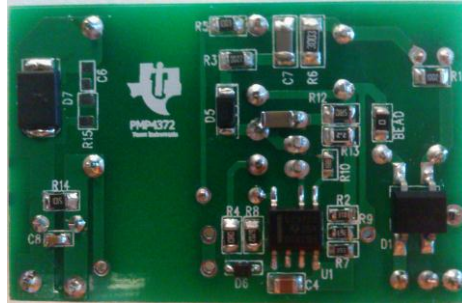
**REV A**

**28/05/2013**

# **1 GENERAL**

## **1.1 PURPOSE**

To provide detailed data for evaluating and verifying the PMP4372, which uses TI new Primary Side Controller UCC28720 and bipolar transistor for 5V1.5A adapter with size 43mmx28mmx16mm. The below photo shows this demo board.



## **1.2 REFERENCE DOCUMENTATION**

Schematic PMP4372\_SCH.PDF

Assembly PMP4372\_PCB.PDF

BOM

Promotion tools

## **1.3 TEST EQUIPMENTS**

Power-meter: YOKOGAWA WT210

Multi-meter(current): Fluke 8845A

Multi-meter(voltage): Fluke 187

AC Source: Chroma 61530

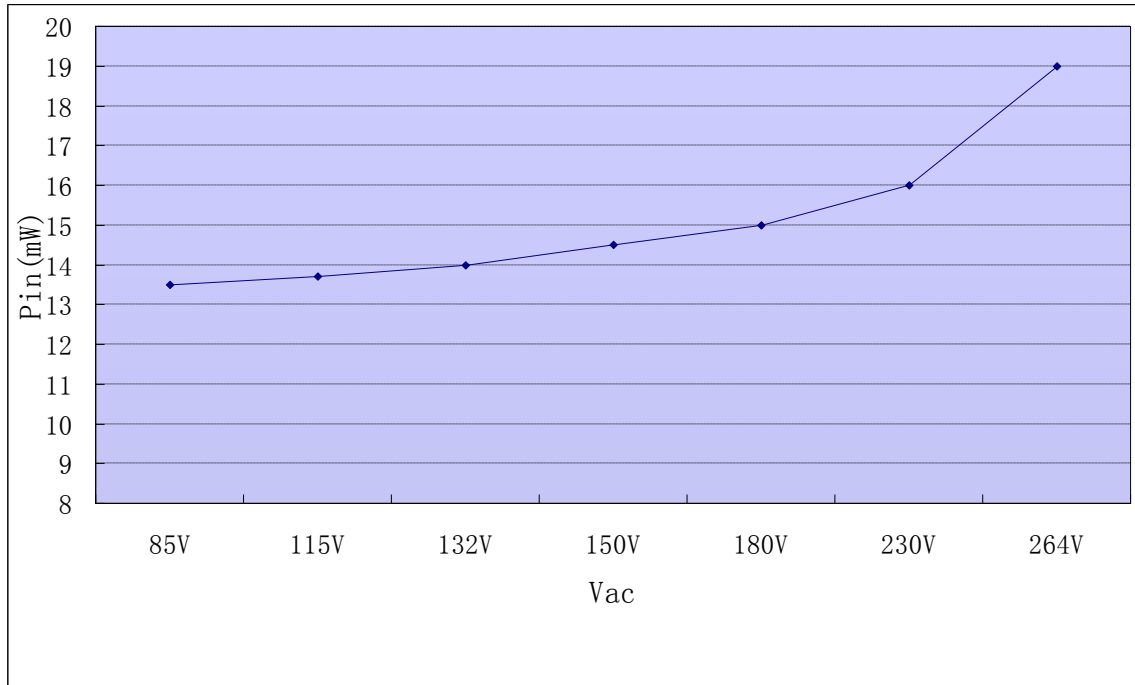
Electronic load: Chroma 63110A module

Testing demoboard

# **2 INPUT CHARACTERISTICS**

**Otherwise Specified, the test is under the condition with 50cm cable**

## 2.1 STANDBY POWER



## 2.2 EFFICIENCY DATA

Notes: efficiency test is based USB port

85v			
Pi (w)	Io (A)	Vo (V)	efficiency
0.714	0.1	5.005	0.701
1.332	0.2	5.017	0.753
1.96	0.3	5.033	0.77
2.439	0.375	5.042	0.775
2.594	0.4	5.047	0.778
3.24	0.5	5.058	0.781
3.895	0.6	5.071	0.781
4.56	0.7	5.086	0.781
4.894	0.75	5.093	0.78
5.232	0.8	5.101	0.78
5.903	0.9	5.114	0.78
6.57	1	5.131	0.781
7.245	1.1	5.143	0.781
7.408	1.125	5.147	0.782
7.928	1.2	5.153	0.78
8.61	1.3	5.165	0.78
9.3	1.4	5.177	0.779
9.965	1.5	5.168	0.778

115v			
Pi (w)	Io (A)	Vo (V)	efficiency
0.708	0.1	5.01	0.708
1.311	0.2	5.025	0.767
1.923	0.3	5.039	0.786
2.386	0.375	5.049	0.794
2.54	0.4	5.056	0.796
3.173	0.5	5.069	0.799
3.808	0.6	5.084	0.801
4.452	0.7	5.095	0.801
4.778	0.75	5.102	0.801
5.098	0.8	5.11	0.802
5.748	0.9	5.126	0.803
6.398	1	5.138	0.803
7.045	1.1	5.152	0.804
7.204	1.125	5.155	0.805
7.712	1.2	5.173	0.805
8.355	1.3	5.174	0.805
9.02	1.4	5.184	0.805
9.685	1.5	5.192	0.804

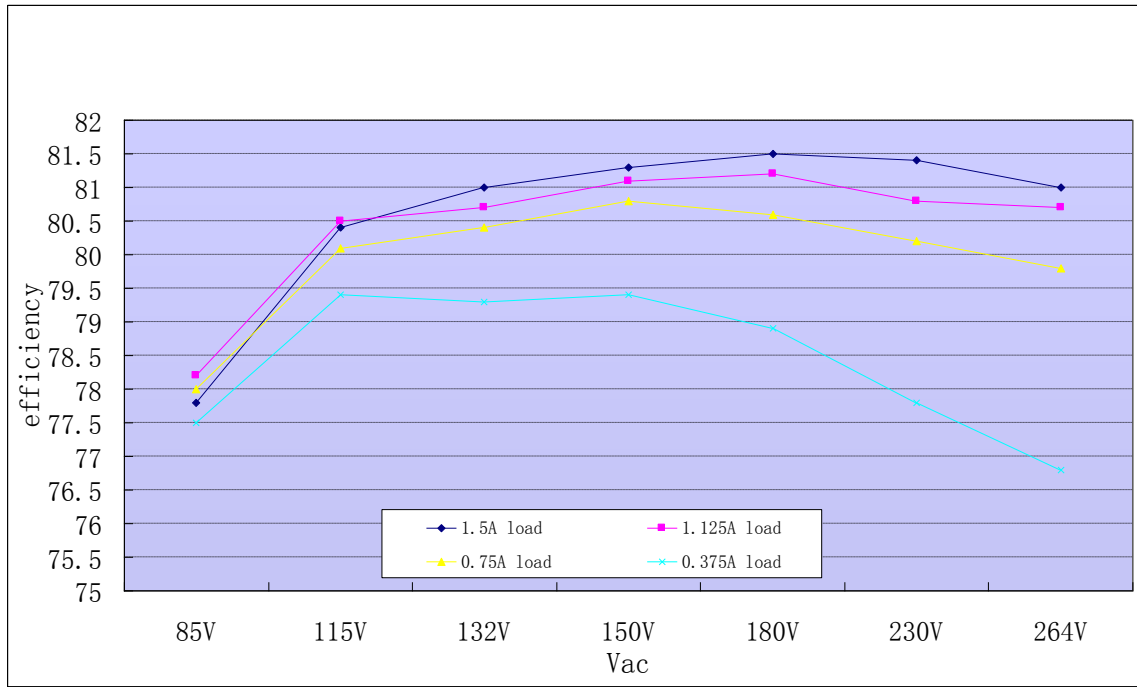
132v			
Pi (w)	Io(A)	Vo(V)	efficiency
0.713	0.1	5.01	0.703
1.311	0.2	5.022	0.766
1.922	0.3	5.034	0.786
2.385	0.375	5.046	0.793
2.543	0.4	5.05	0.794
3.167	0.5	5.064	0.799
3.804	0.6	5.075	0.8
4.441	0.7	5.089	0.802
4.758	0.75	5.098	0.804
5.08	0.8	5.105	0.804
5.73	0.9	5.121	0.804
6.37	1	5.134	0.806
7.017	1.1	5.147	0.807
7.175	1.125	5.15	0.807
7.672	1.2	5.168	0.808
8.32	1.3	5.174	0.808
8.975	1.4	5.183	0.808
9.625	1.5	5.198	0.81
180v			
Pi (w)	Io(A)	Vo(V)	efficiency
0.738	0.1	5.009	0.679
1.329	0.2	5.019	0.755
1.936	0.3	5.033	0.78
2.397	0.375	5.043	0.789
2.55	0.4	5.049	0.792
3.174	0.5	5.064	0.798
3.799	0.6	5.079	0.802
4.432	0.7	5.093	0.804
4.744	0.75	5.1	0.806
5.065	0.8	5.108	0.807
5.698	0.9	5.119	0.809
6.34	1	5.135	0.81
6.985	1.1	5.149	0.811
7.137	1.125	5.153	0.812
7.617	1.2	5.162	0.813
8.261	1.3	5.174	0.814
8.925	1.4	5.19	0.814
9.572	1.5	5.202	0.815

150v			
Pi (w)	Io(A)	Vo(V)	efficiency
0.72	0.1	5.014	0.696
1.316	0.2	5.028	0.764
1.924	0.3	5.04	0.786
2.385	0.375	5.053	0.794
2.541	0.4	5.058	0.796
3.162	0.5	5.074	0.802
3.787	0.6	5.089	0.806
4.422	0.7	5.099	0.807
4.741	0.75	5.107	0.808
5.061	0.8	5.113	0.808
5.7	0.9	5.128	0.81
6.348	1	5.142	0.81
6.989	1.1	5.152	0.811
7.151	1.125	5.154	0.811
7.639	1.2	5.167	0.812
8.291	1.3	5.182	0.813
8.939	1.4	5.19	0.813
9.59	1.5	5.199	0.813

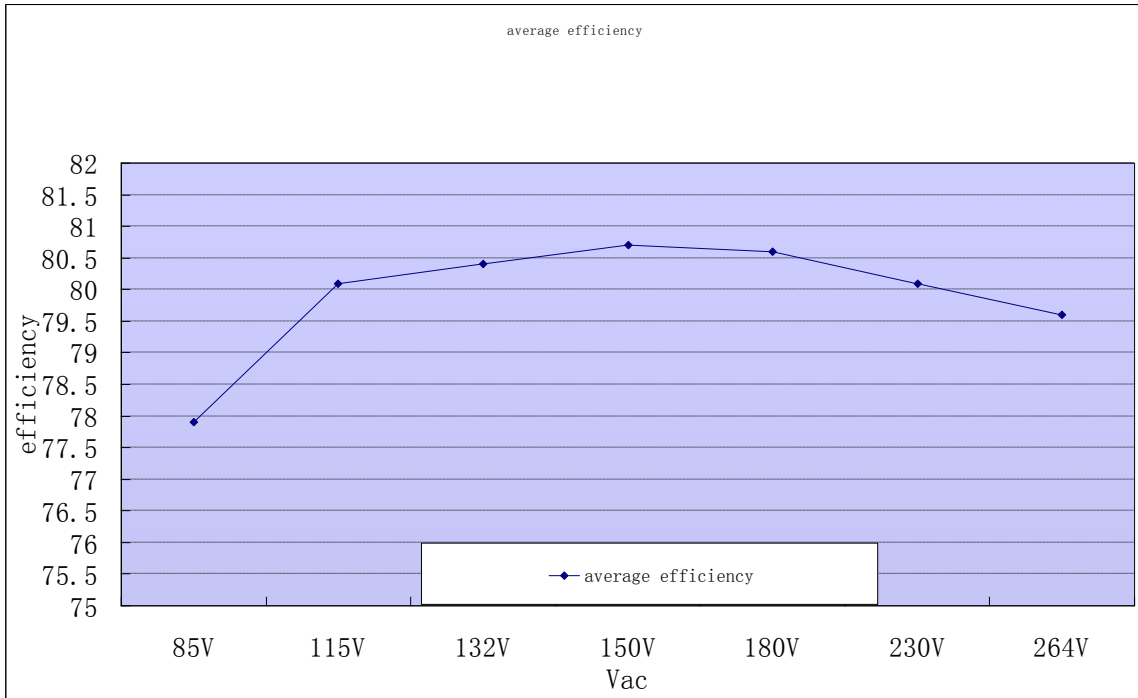
230v			
Pi (w)	Io (A)	Vo (V)	efficiency
0.783	0.1	5.008	0.64
1.369	0.2	5.017	0.733
1.972	0.3	5.03	0.765
2.428	0.375	5.04	0.778
2.586	0.4	5.046	0.781
3.198	0.5	5.062	0.791
3.822	0.6	5.075	0.797
4.451	0.7	5.091	0.801
4.766	0.75	5.099	0.802
5.091	0.8	5.107	0.803
5.727	0.9	5.117	0.804
6.364	1	5.13	0.806
7.007	1.1	5.146	0.808
7.168	1.125	5.149	0.808
7.64	1.2	5.161	0.811
8.282	1.3	5.173	0.812
8.93	1.4	5.186	0.813
9.585	1.5	5.2	0.814

264v			
Pi (w)	Io (A)	Vo (V)	efficiency
0.82	0.1	5.012	0.611
1.405	0.2	5.023	0.715
2.005	0.3	5.036	0.754
2.464	0.375	5.046	0.768
2.609	0.4	5.052	0.775
3.223	0.5	5.07	0.787
3.852	0.6	5.087	0.792
4.484	0.7	5.101	0.796
4.8	0.75	5.109	0.798
5.12	0.8	5.116	0.799
5.75	0.9	5.127	0.802
6.387	1	5.138	0.804
7.03	1.1	5.15	0.806
7.192	1.125	5.156	0.807
7.676	1.2	5.167	0.808
8.323	1.3	5.178	0.809
8.983	1.4	5.189	0.809
9.634	1.5	5.2	0.81

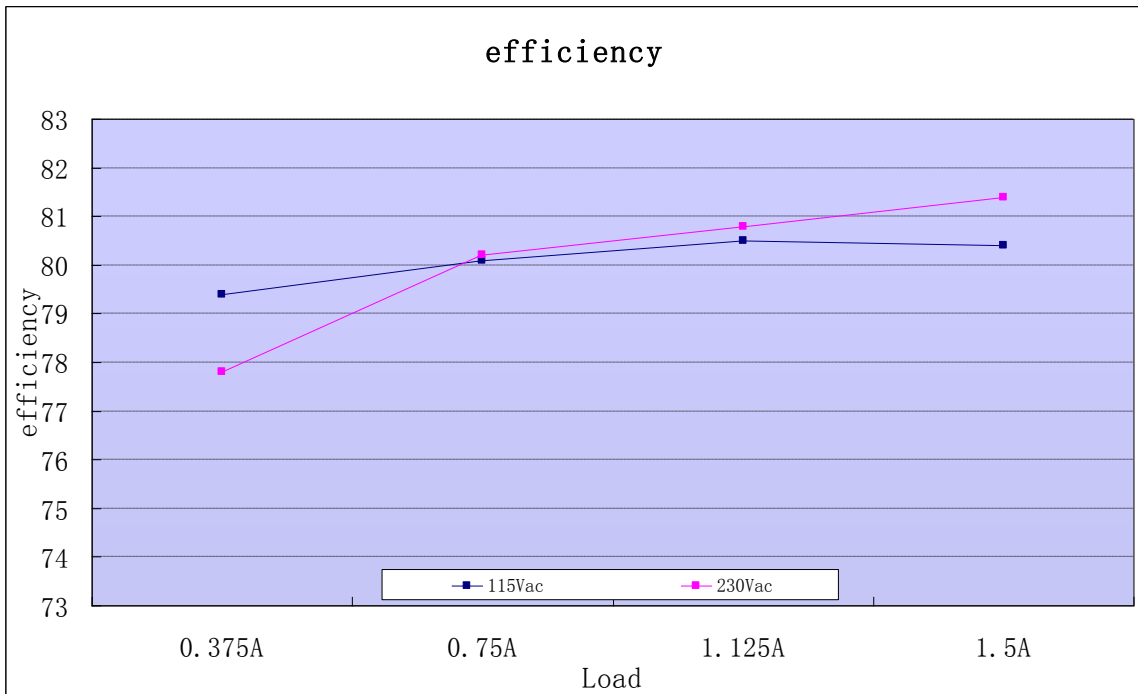
### 2.2.1 Load and input voltage Vs efficiency curve



### 2.2.2 Average efficiency curve at 0.375A, 0.75A, 1.125A AND 1.5A



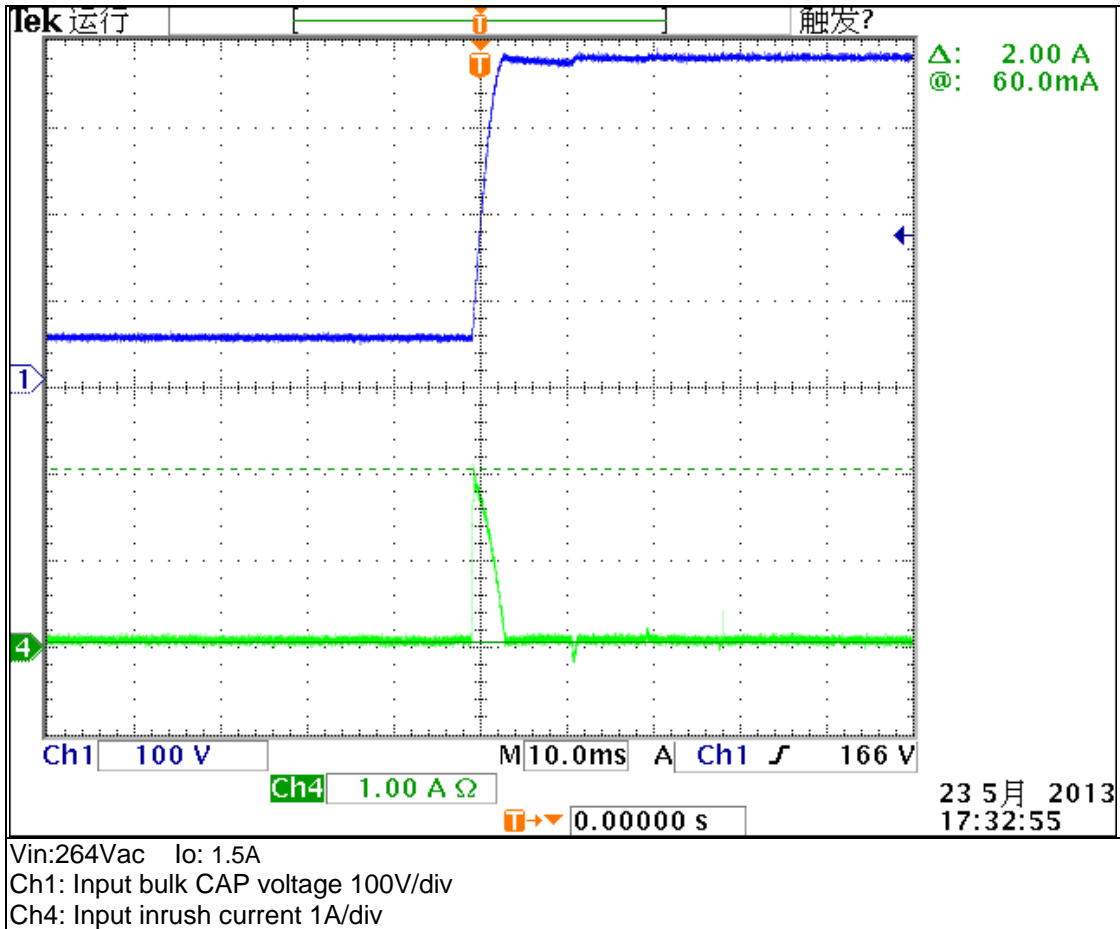
### 2.2.3 Efficiency Vs load curve



### 2.3 INPUT CURRENT

Vin(Vac)	Freq(Hz)	Iin(Arms)	Pass/Fail
85	60	<b>0.188</b>	

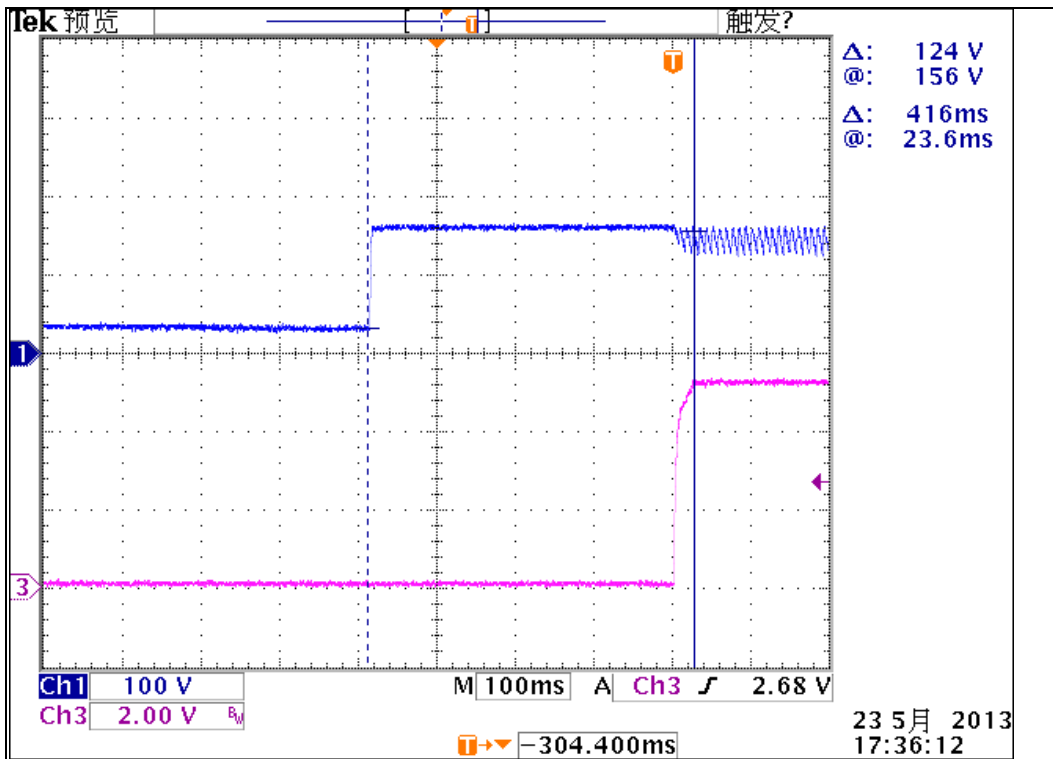
### 2.4 INPUT INRUSH CURRENT



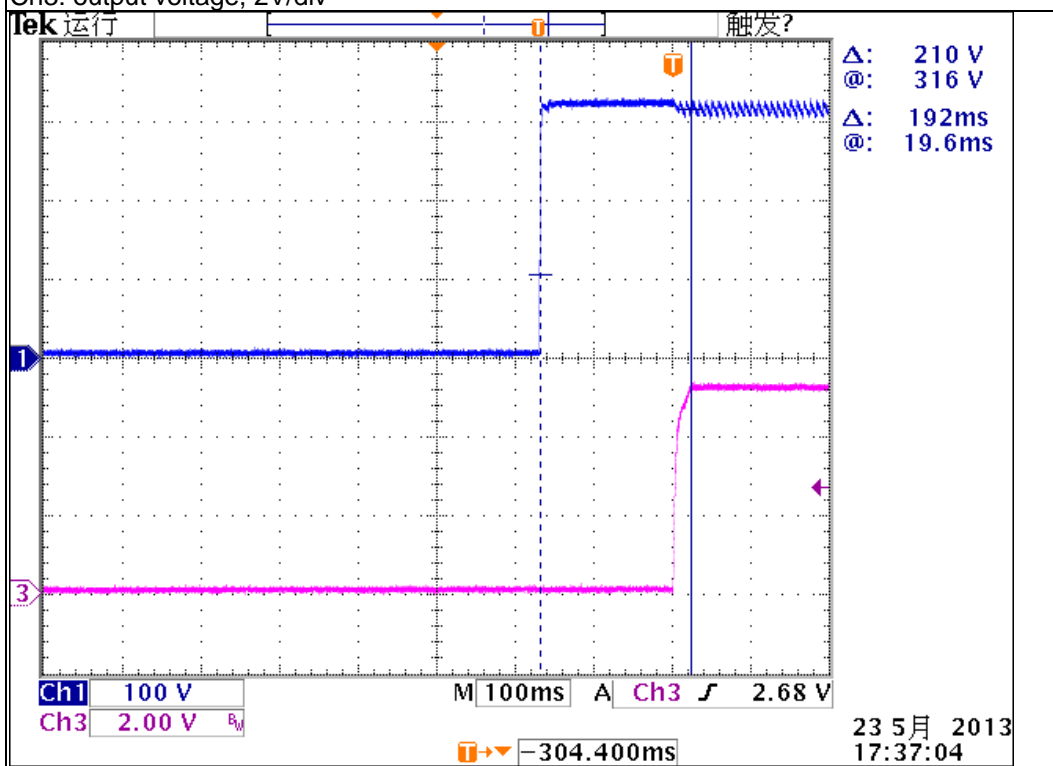
## 3 OUTPUT CHARACTERISTICS

### 3.1 STARTUP TIME

Input voltage	Output current	Startup time	Pass/Fail
115Vac	1.5A	<b>416mS</b>	
230Vac	1.5A	<b>192mS</b>	



Vin:115Vac Io: 1.5A  
 Ch1: MOSFET's drain voltage, 100V/div  
 Ch3: output voltage, 2V/div

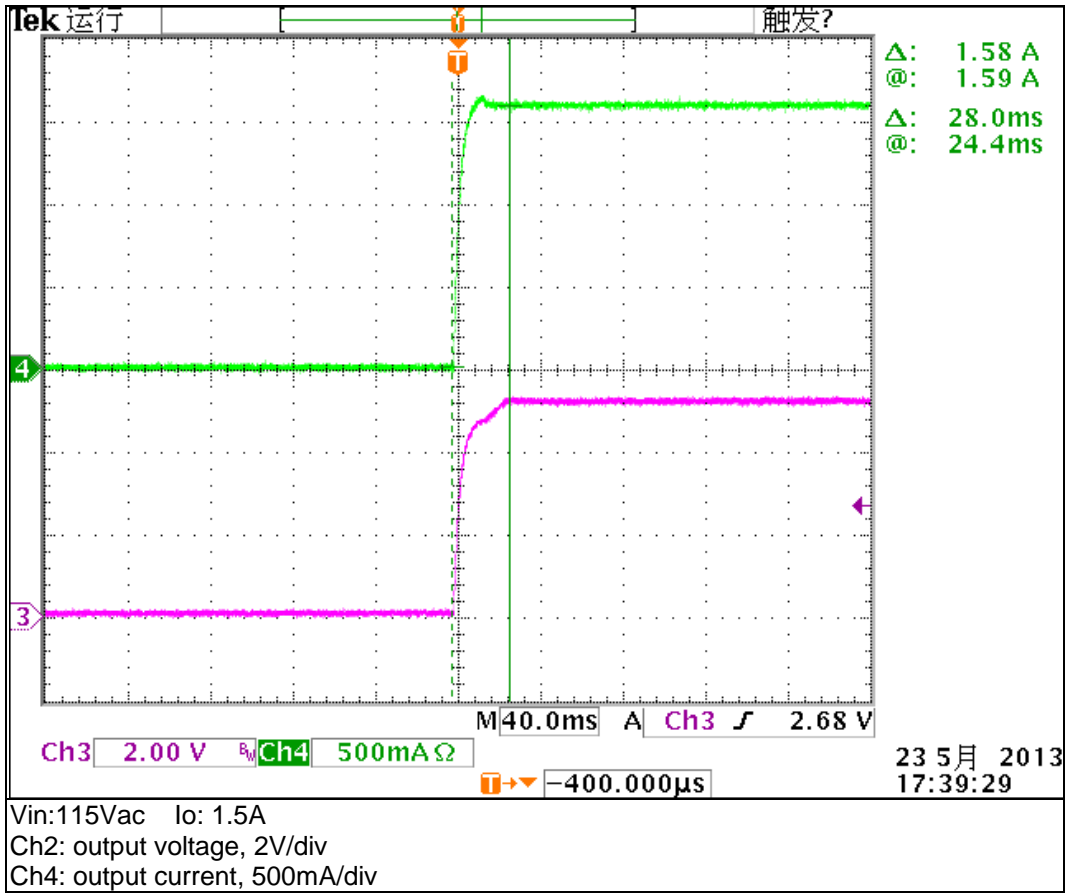


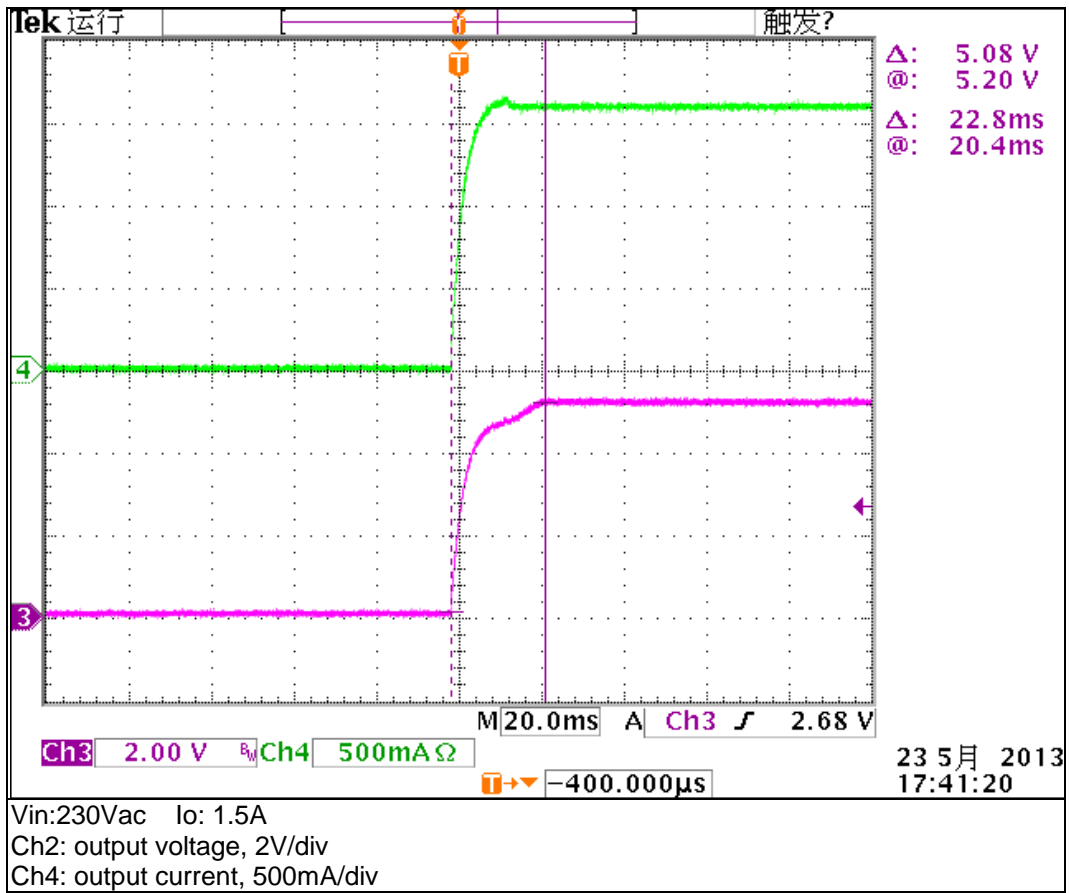
Vin:230Vac Io: 1.5A  
 Ch1: MOSFET's drain voltage, 100V/div  
 Ch3: output voltage, 2V/div



### 3.2 OUTPUT VOLTAGE RISE TIME

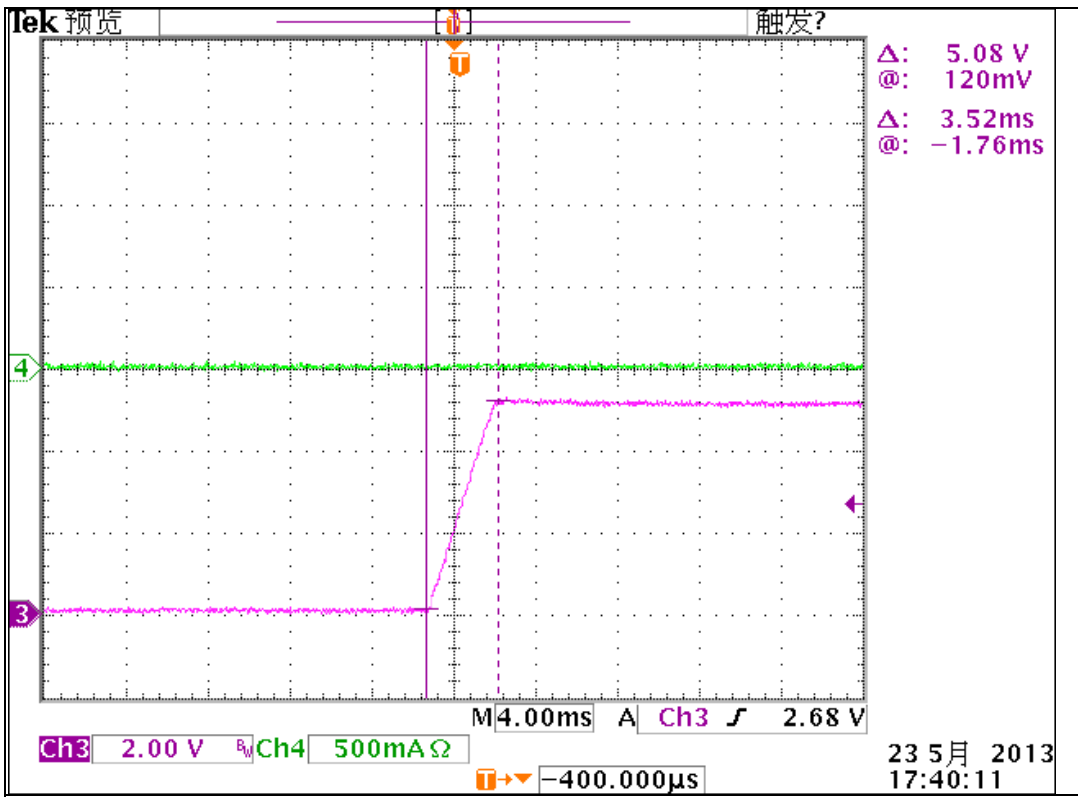
Input voltage	Output current	Startup time	Pass/Fail
115Vac	1.5A	<b>28mS</b>	
230Vac	1.5A	<b>22.8mS</b>	



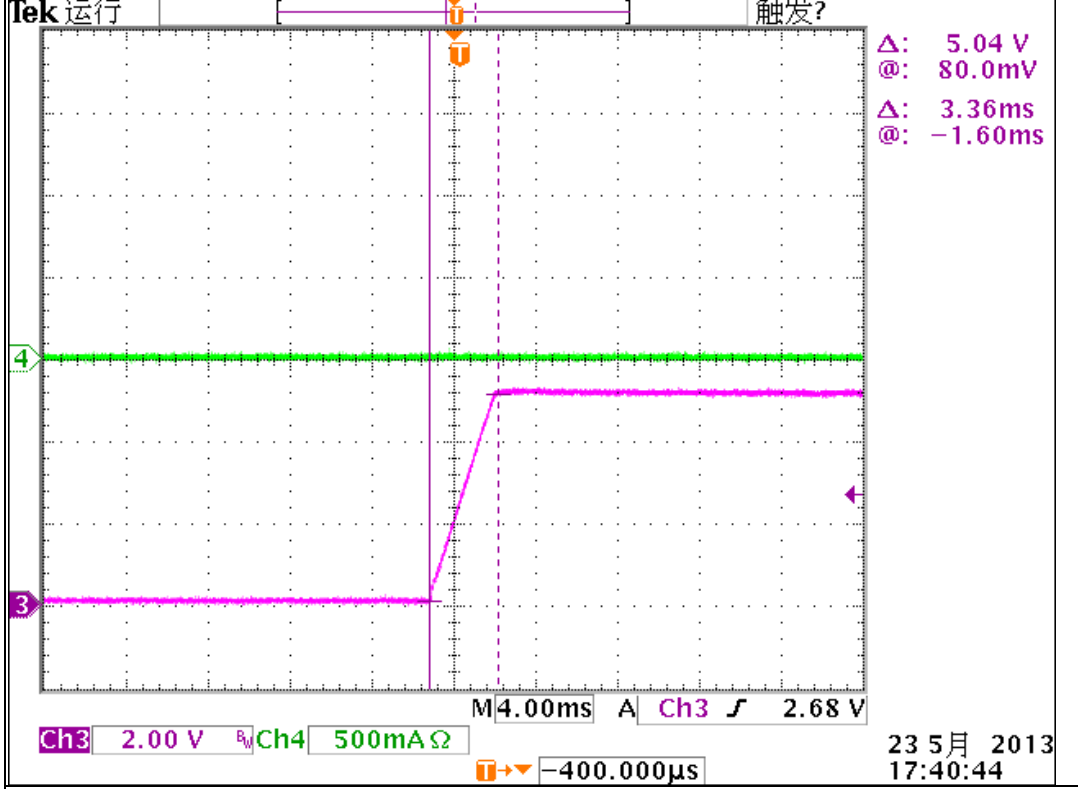


### 3.3 OUTPUT VOLTAGE OVERSHOOT

Input voltage	Output current	overshoot voltage	Pass/Fail
115Vac	0A	<1%	
230Vac	0A	<1%	



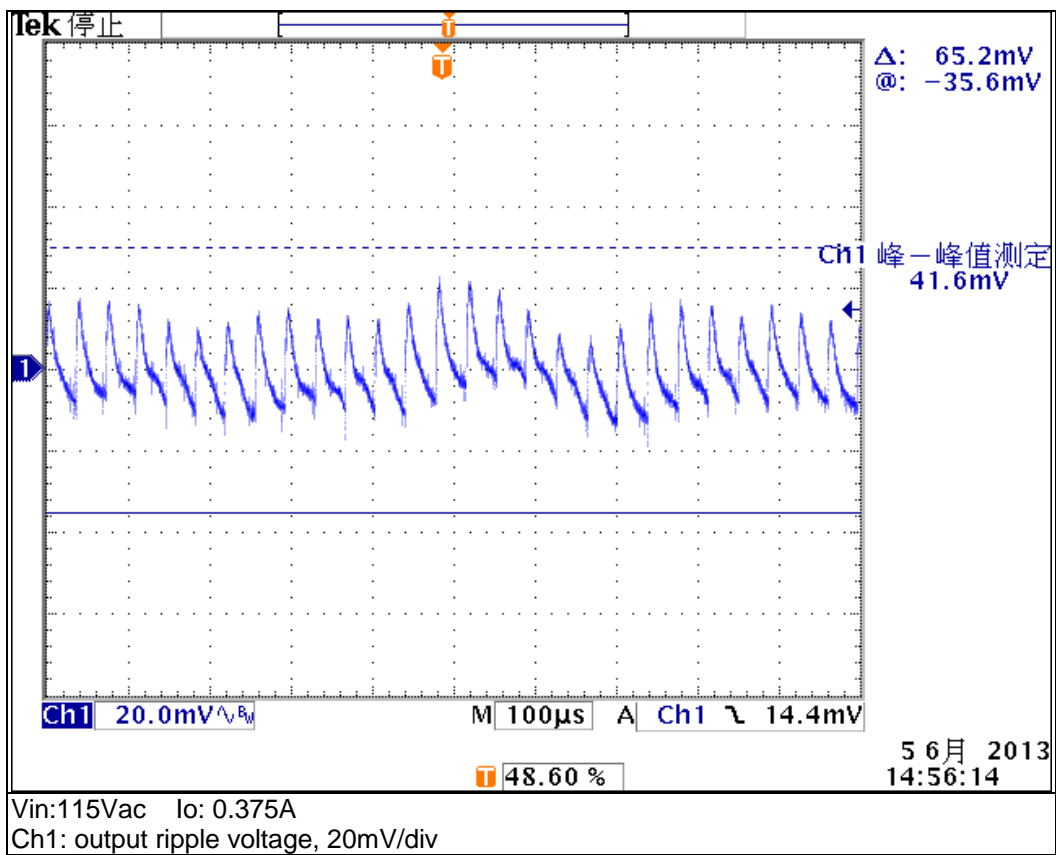
Vin:115Vac Io: 0A  
 Ch3: voltage, 2V/div

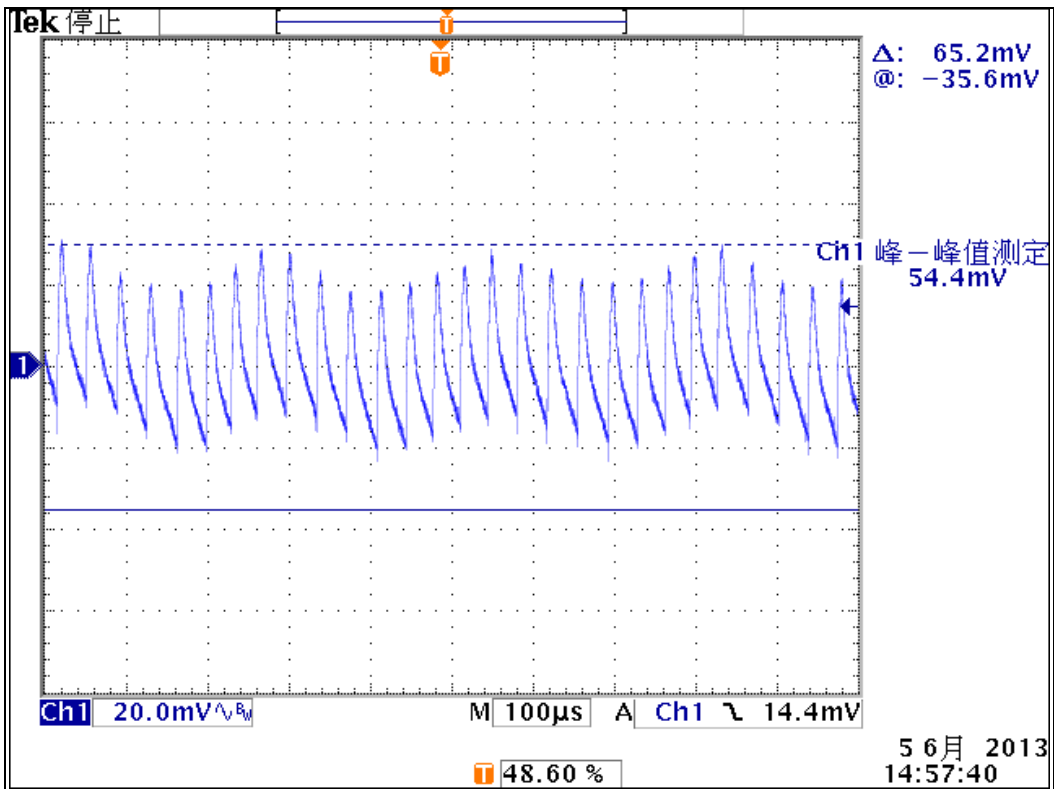


Vin:230Vac Io: 0A  
 Ch3: output voltage, 2V/div

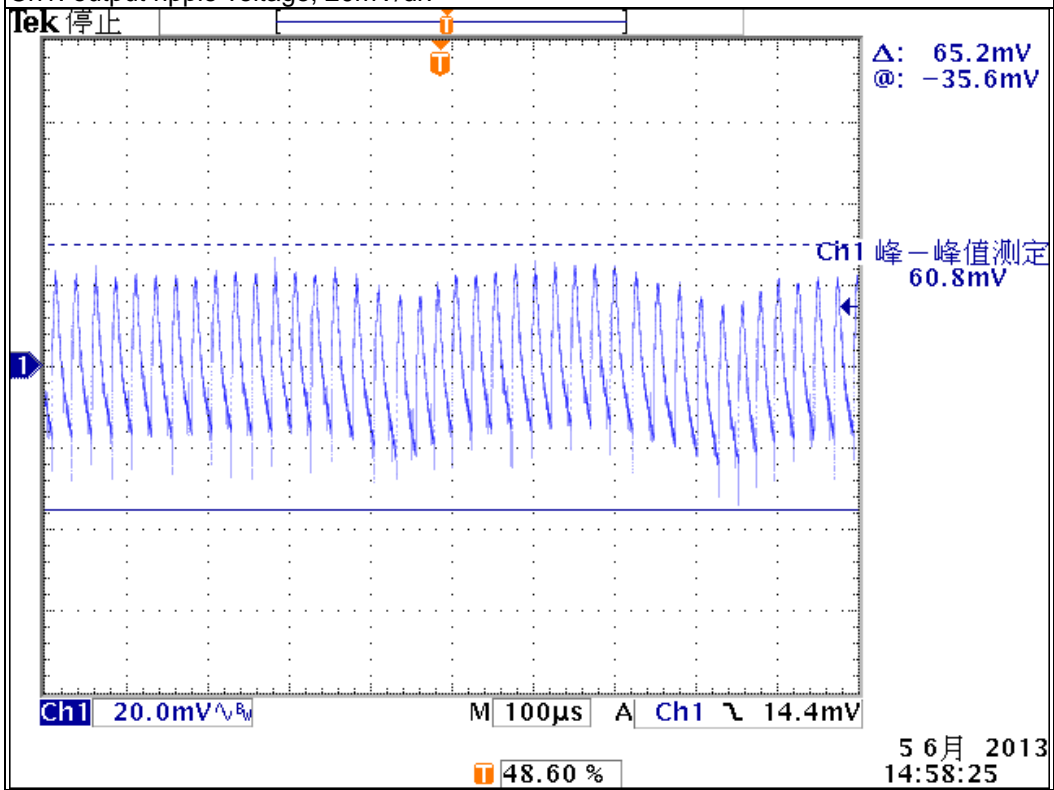
### 3.4 RIPPLE VOLTAGE

Input voltage	Output current	Ripple voltage	Pass/Fail
115Vac	0.375A	41.6mV	
115Vac	0.75A	54.4mV	
115Vac	1.125A	60.8mV	
115Vac	1.5A	64mV	
230Vac	0.375A	34.4mV	
230Vac	0.75A	60.8mV	
230Vac	1.125A	62.4mV	
230Vac	1.5A	58.4mV	

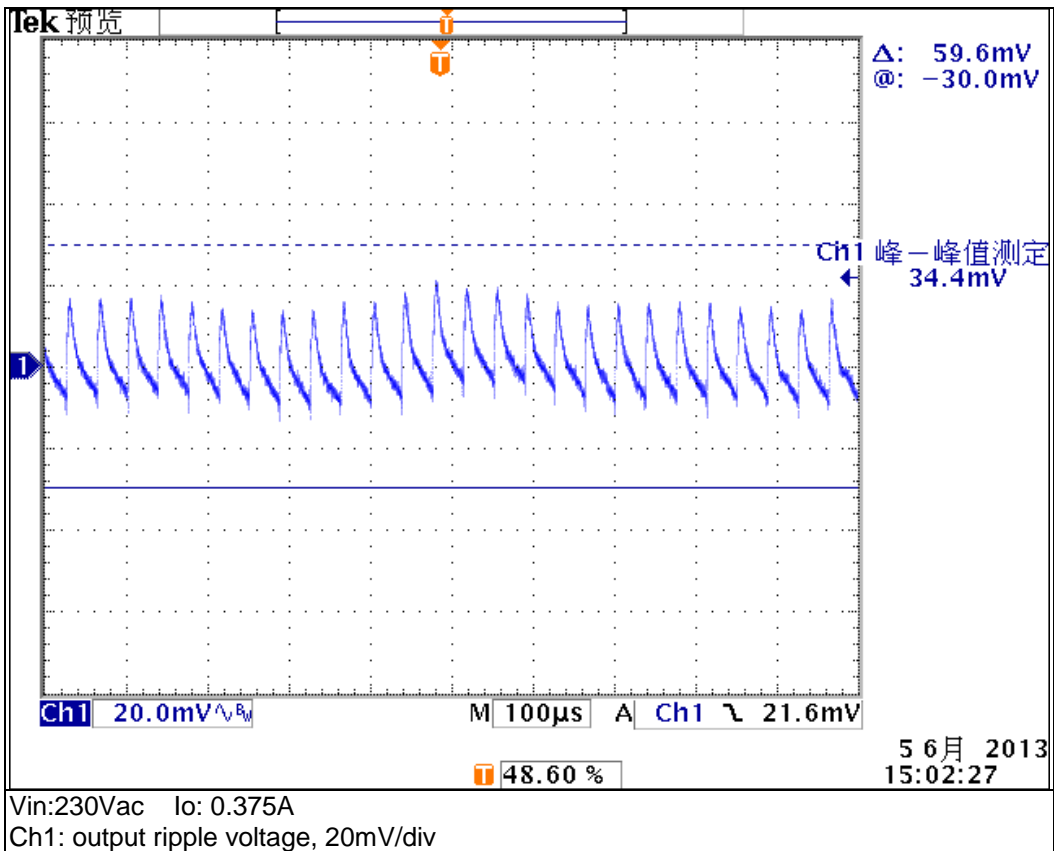
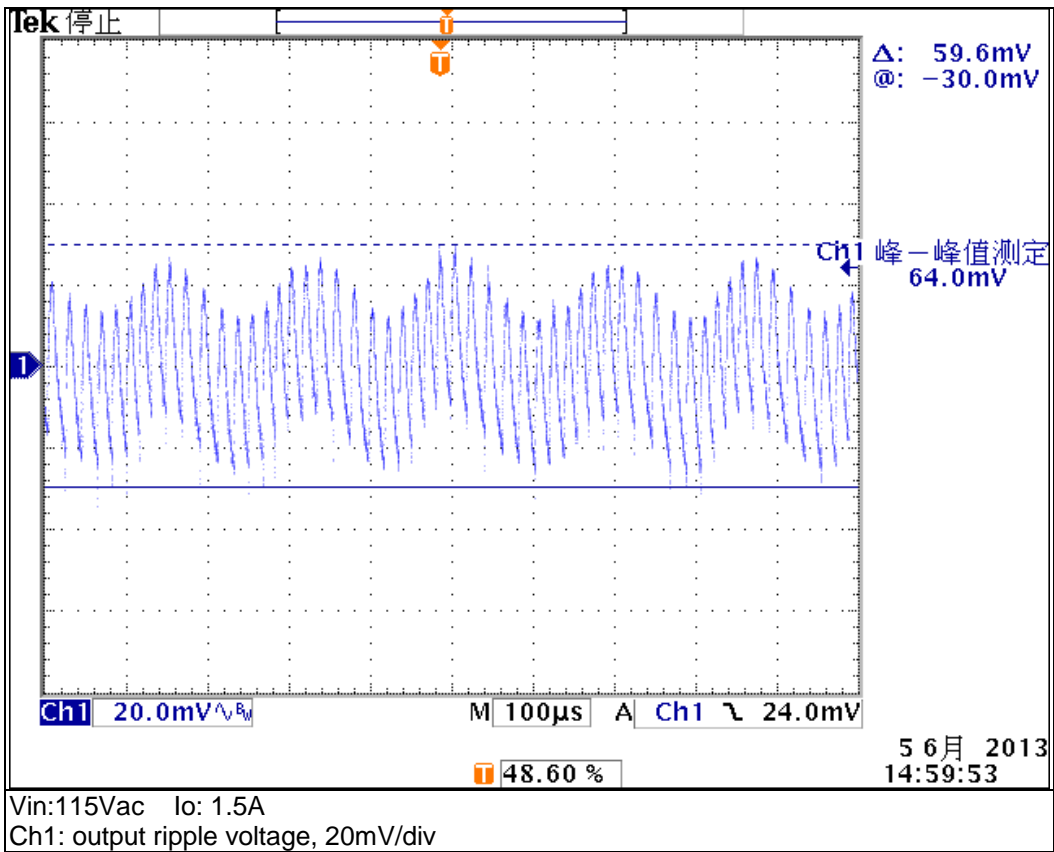


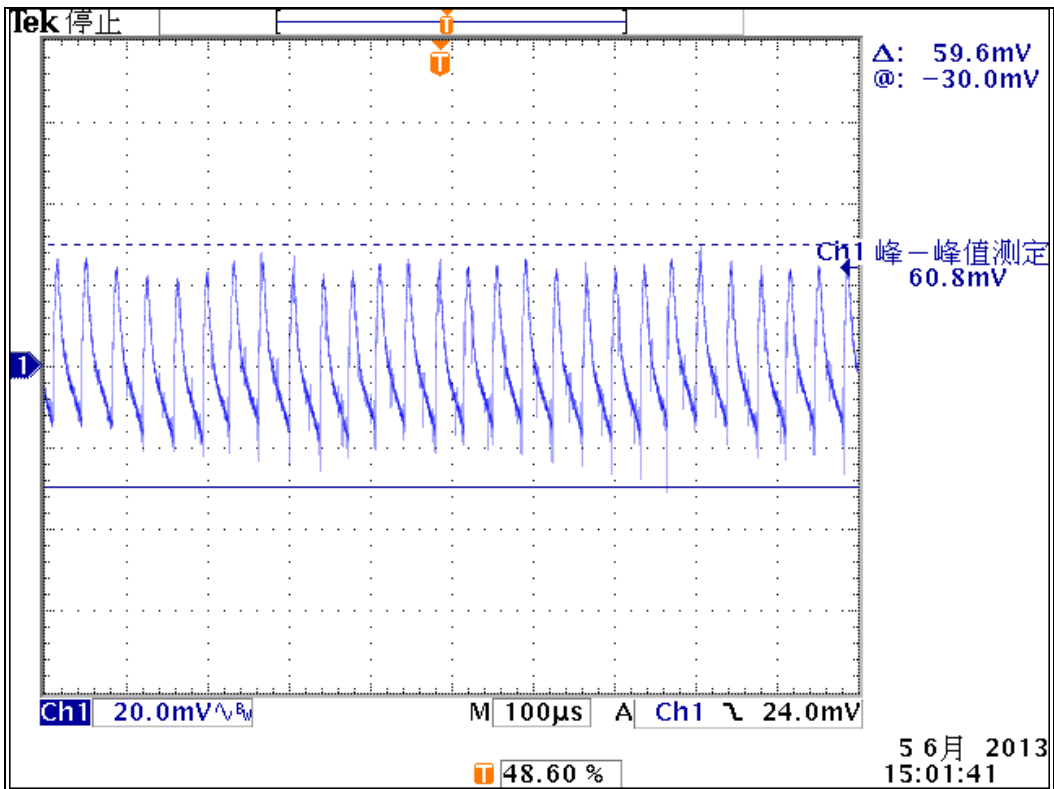


Vin:115Vac Io: 0.75A  
Ch1: output ripple voltage, 20mV/div

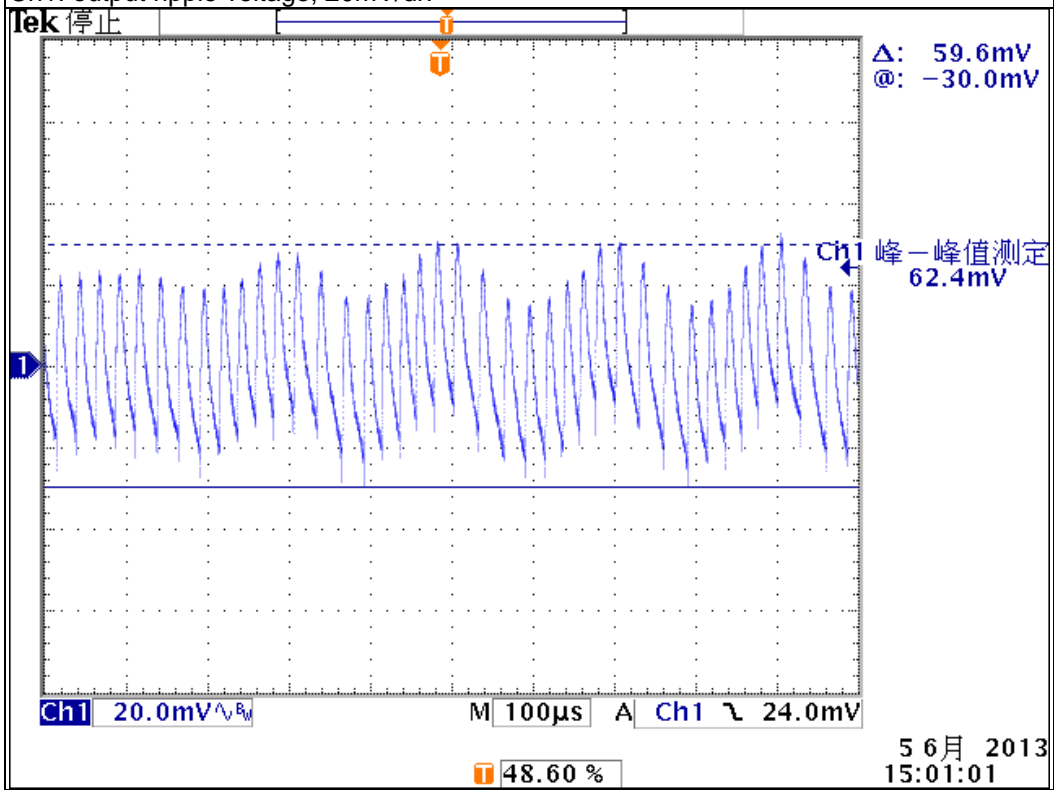


Vin:115Vac Io: 1.125A  
Ch1: output ripple voltage, 20mV/div

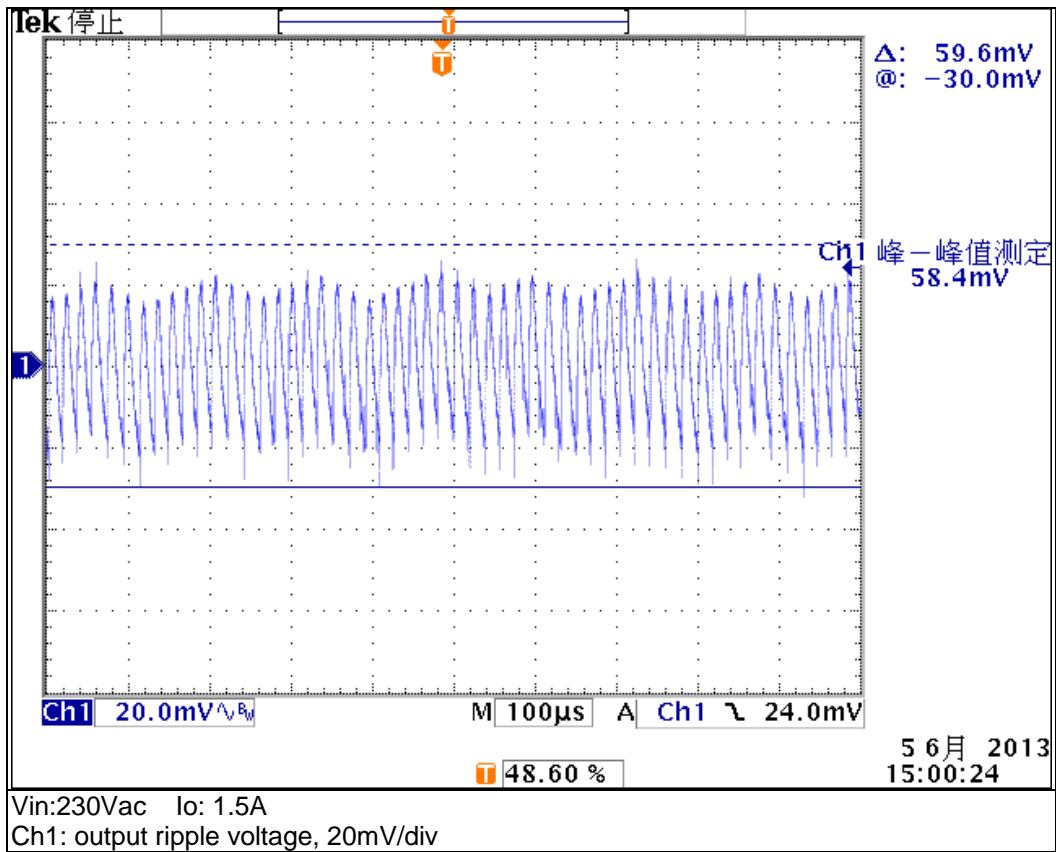




Vin:230Vac Io: 0.75A  
Ch1: output ripple voltage, 20mV/div



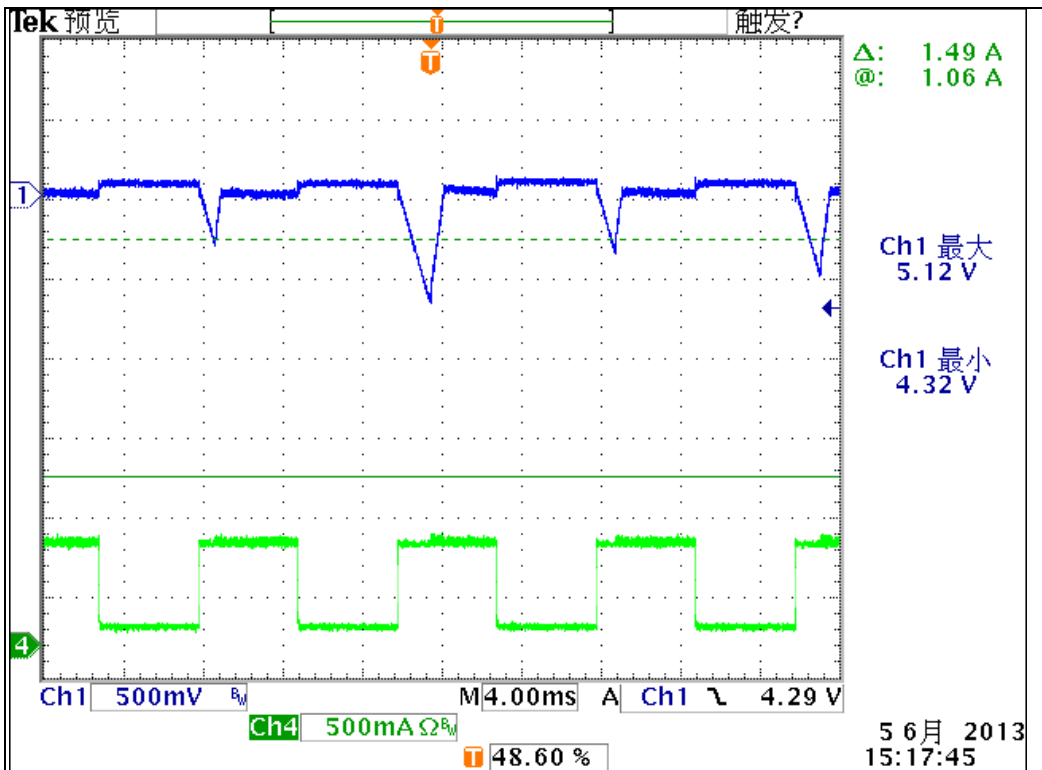
Vin:230Vac Io: 1.125A  
Ch1: output ripple voltage, 20mV/div



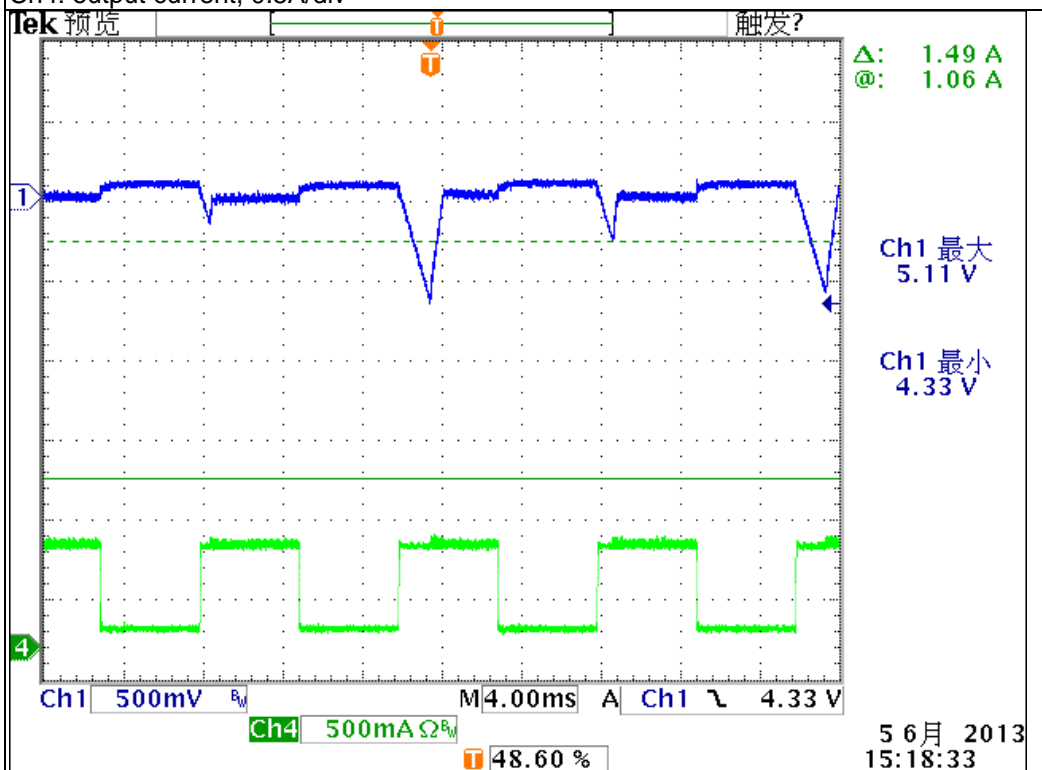
### 3.5 DYNAMIC RESPONSE

Input voltage	Output current	Max voltage	Min voltage
115Vac	0-0.5A	5.12V	4.32V
230Vac	0-0.5A	5.11V	4.33V





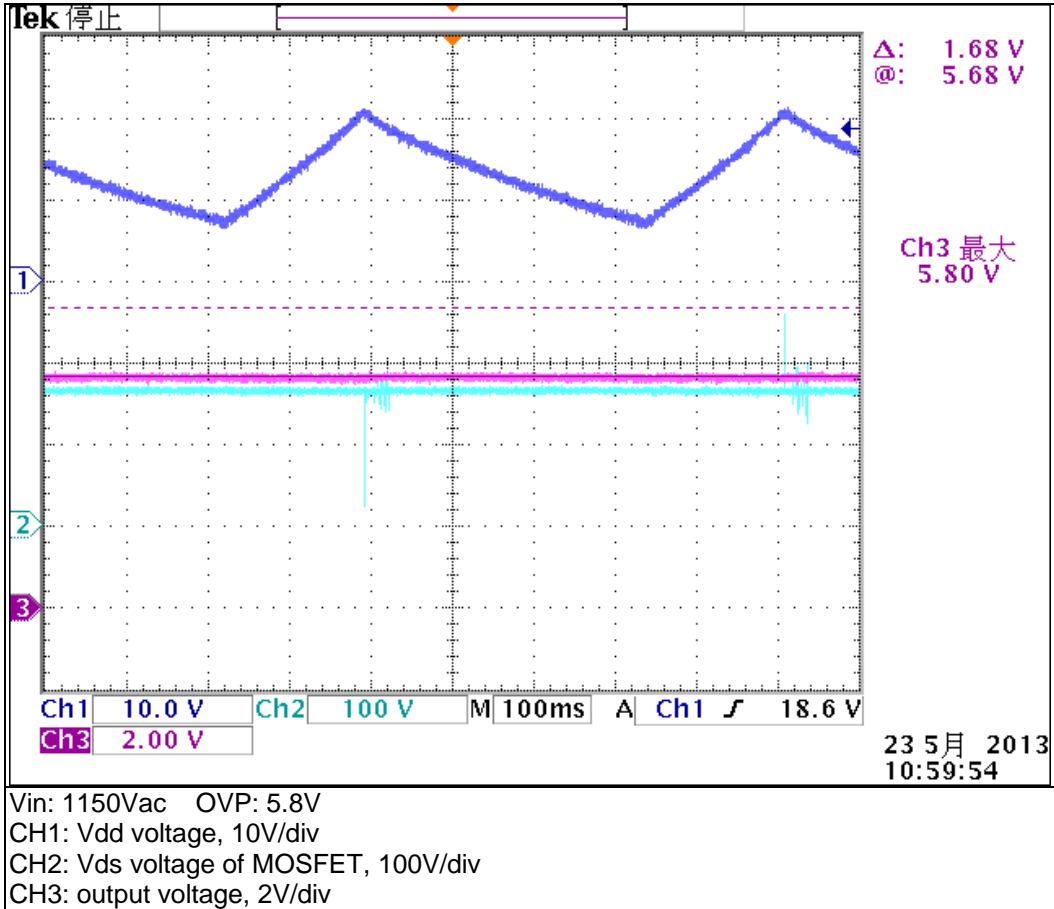
Vin:115Vac test condition: 0-0.5A, 0.25A/us, 10ms cycle, 100cm cable  
Ch1: output voltage, 0.5V/div  
Ch4: output current, 0.5A/div



Vin:230Vac test condition: 0-0.5A, 0.25A/us, 10ms cycle, 100cm cable  
Ch1: output voltage, 0.5V/div  
Ch4: output current, 0.5A/div

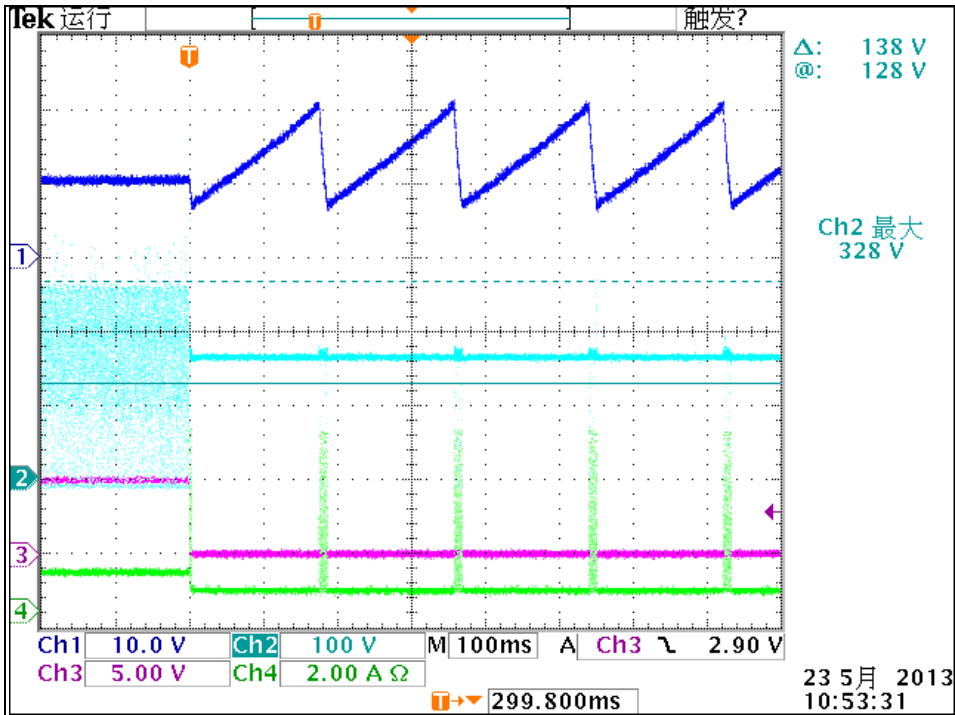
### 3.6 OUTPUT VOLTAGE PROTECTION

CONDITIONS	Protection voltage (V)	Pass/Fail
Vin (Vac)		
115&230	5.8	

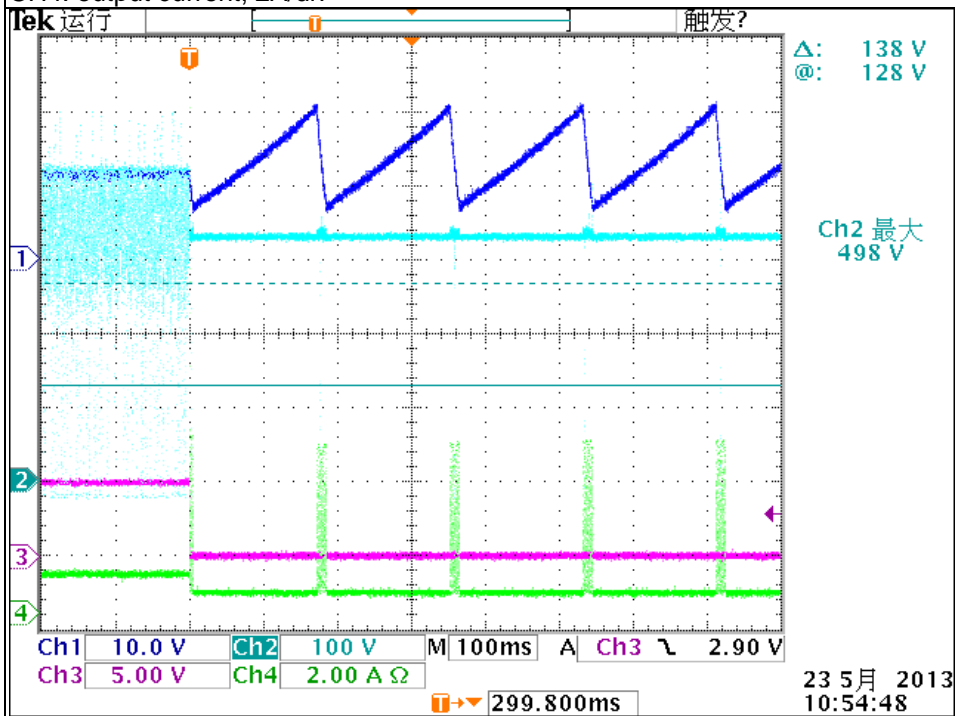


### 3.7 OUTPUT SHORT PROTECTION

Input voltage	Output short protection
115&230Vac	<b>Hiccup up mode</b>

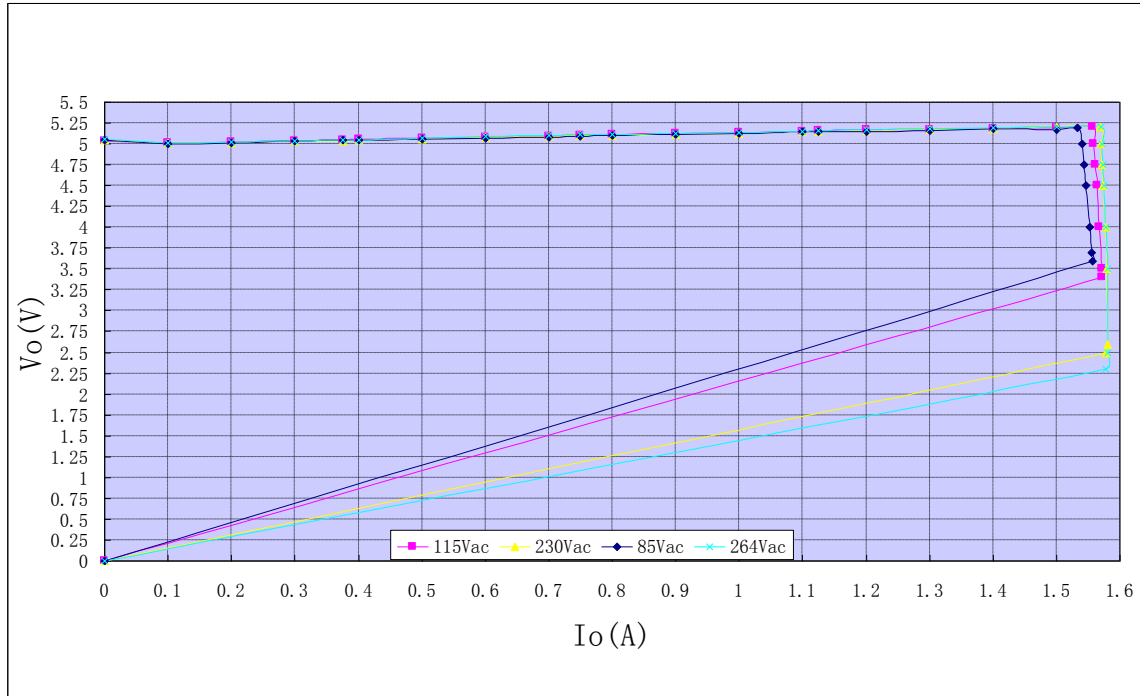


Vin:115Vac  
CH1: Vdd, 10V/div  
CH2: Vds of MOSFET, 100V/div  
CH3: output voltage, 5V/div  
CH4: output current, 2A/div

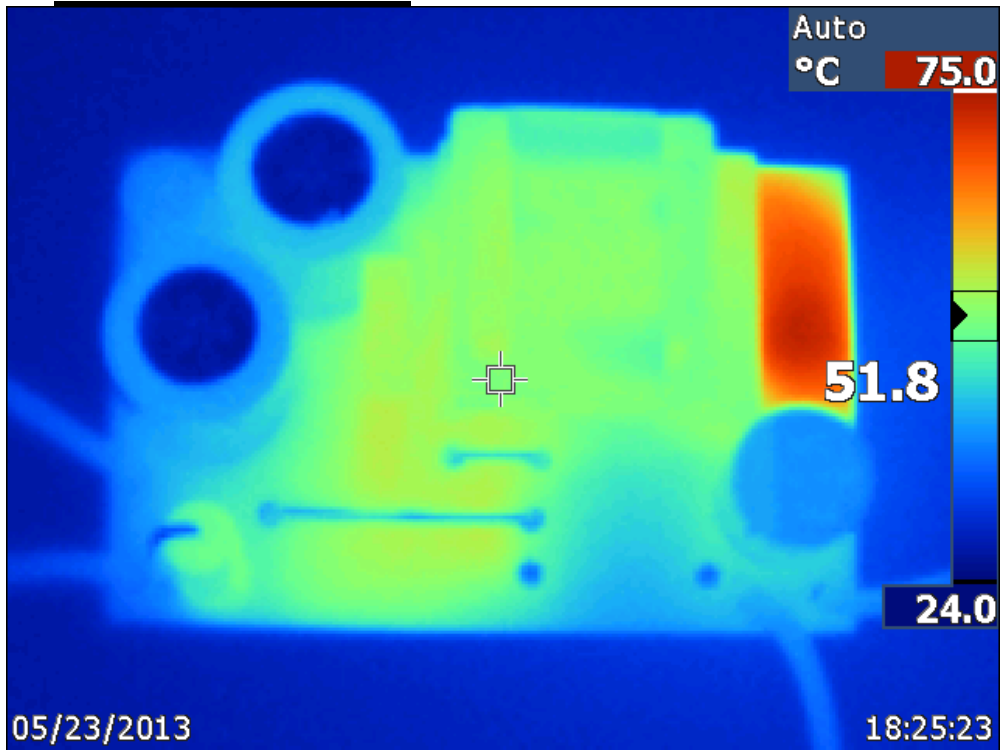


Vin:230Vac  
CH1: Vdd, 10V/div  
CH2: Vds of MOSFET, 100V/div  
CH3: output voltage, 5V/div  
CH4: output current, 2A/div

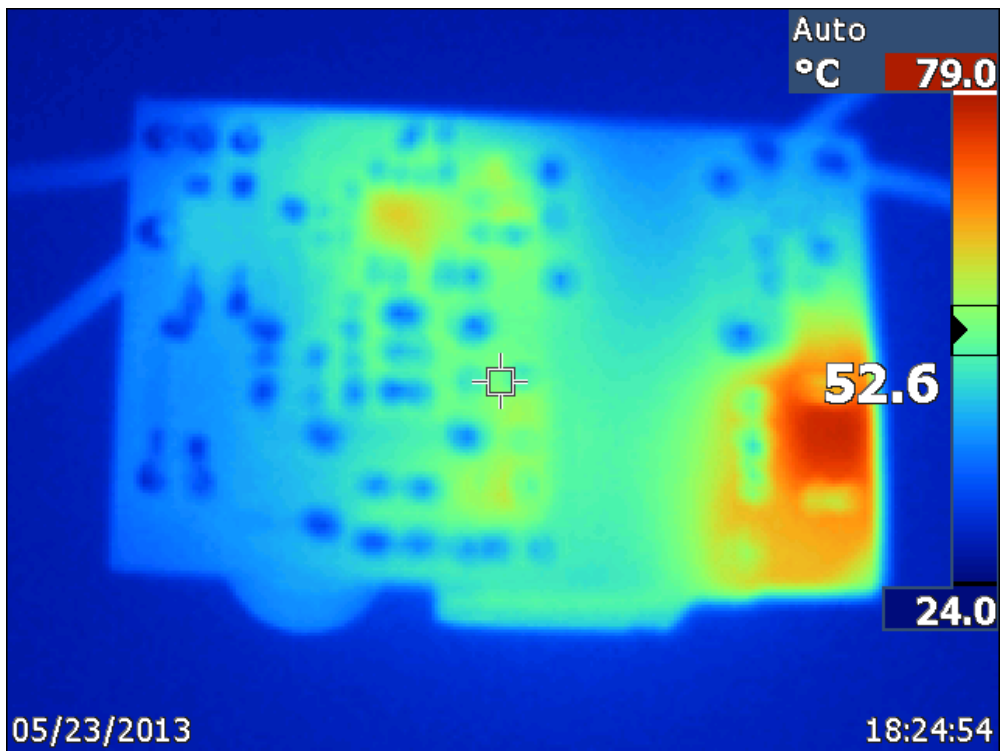
## 4 IV CURVE



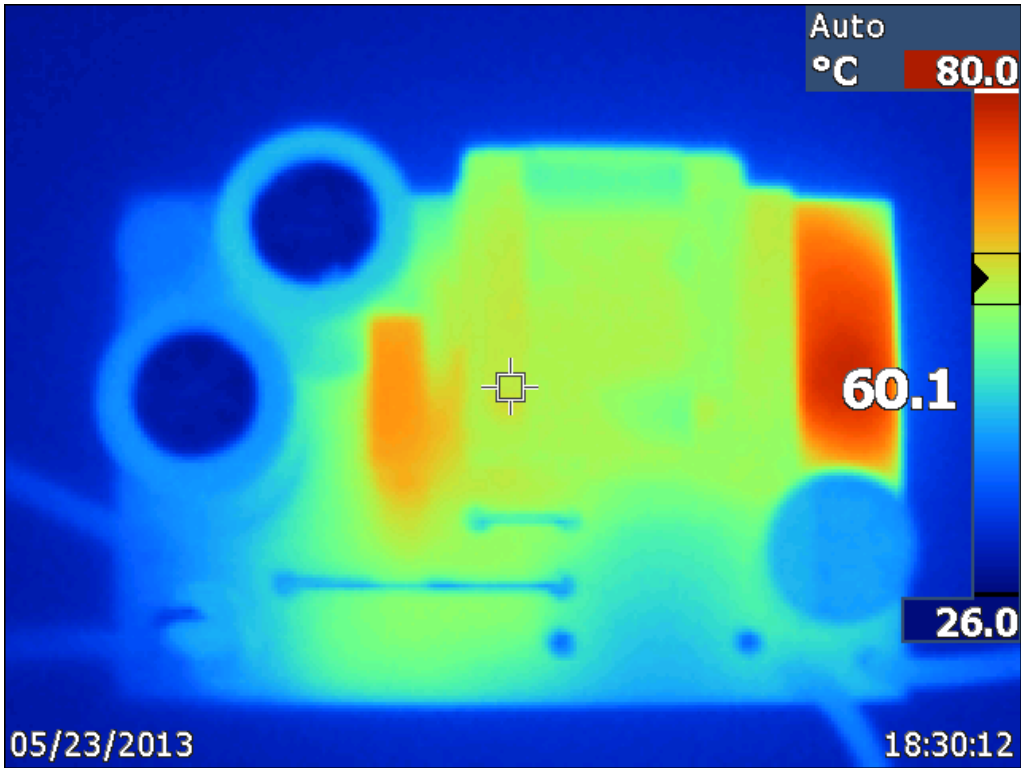
## 5 THERMAL IMAGE



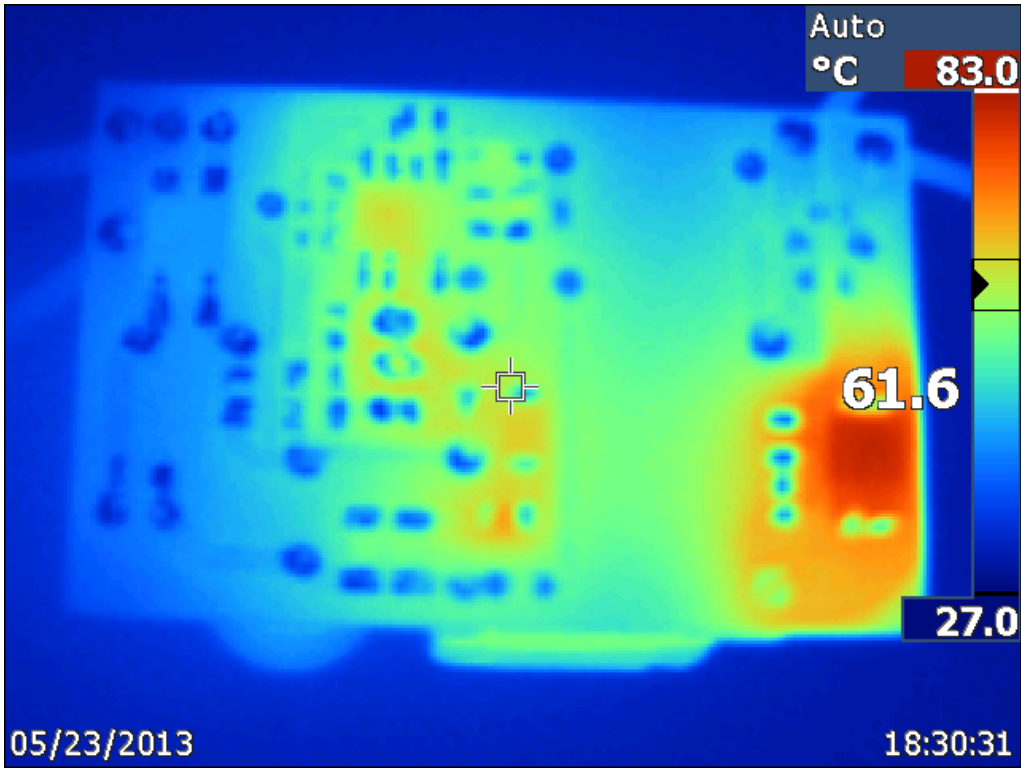
Component side, 115Vac and 1.5A load,  $T_a=25^\circ\text{C}$



Soldering side, 115Vac and 1.5A load,  $T_a=25^\circ\text{C}$

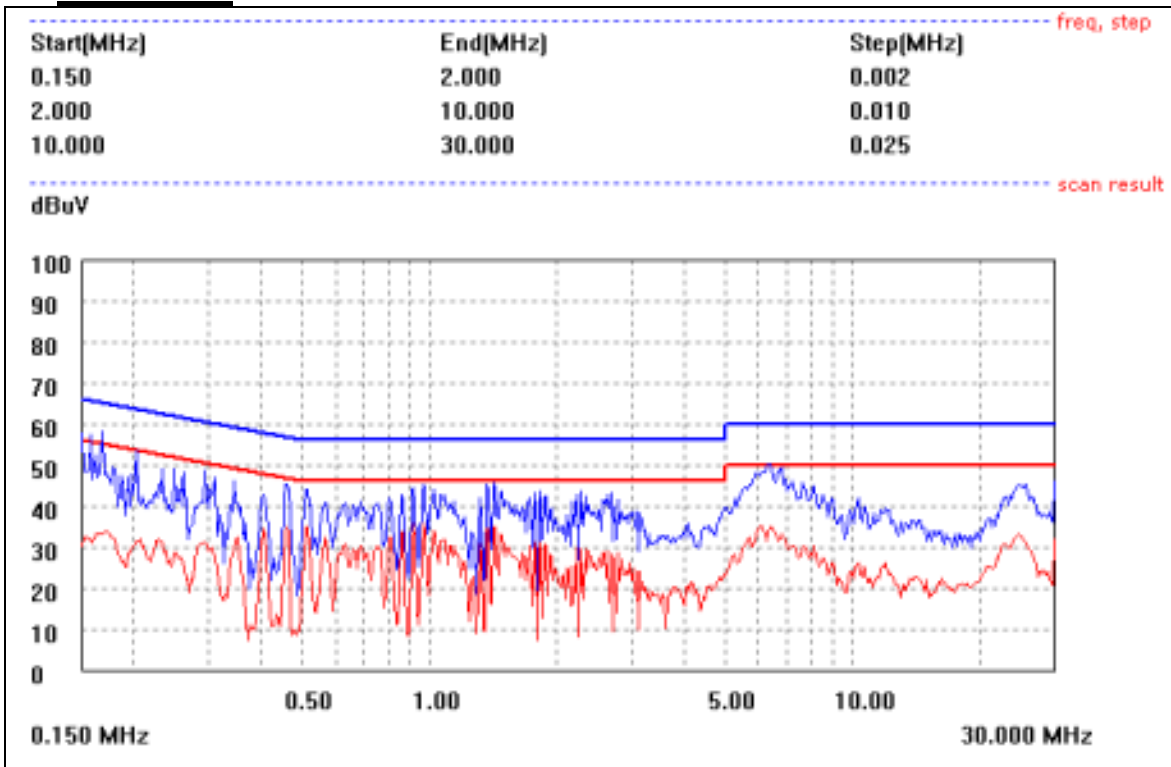


Component side, 230Vac and 1.5A load,  $T_a=25^\circ\text{C}$

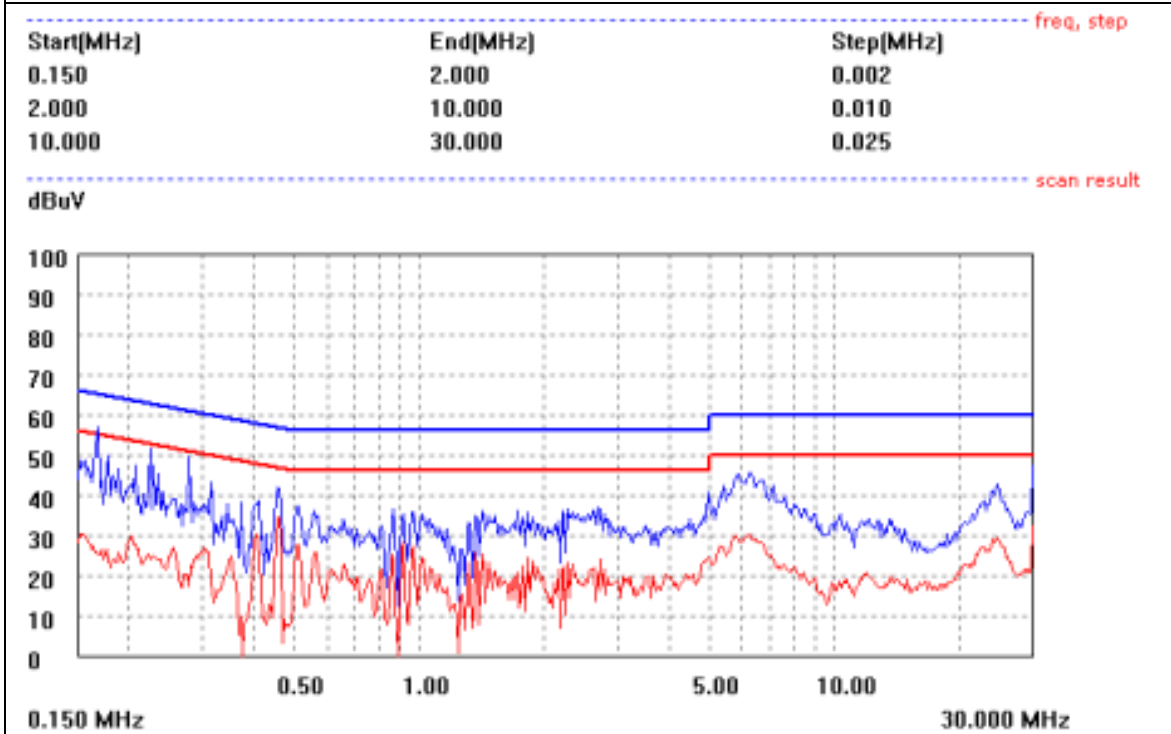


Soldering side, 230Vac and 1.5A load,  $T_a=25^\circ\text{C}$

## 6 EMI Test



Vin: 230Vac, Line, Io: 1.5A  
Test condition: 30cm cable with 3.4R load resistor



Vin: 230Vac, Neutral, Io: 1.5A  
Test condition: 30cm cable with 3.4R load resistor

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)