Texas Instruments

PMP4390 Test Procedure

China Power Reference Design

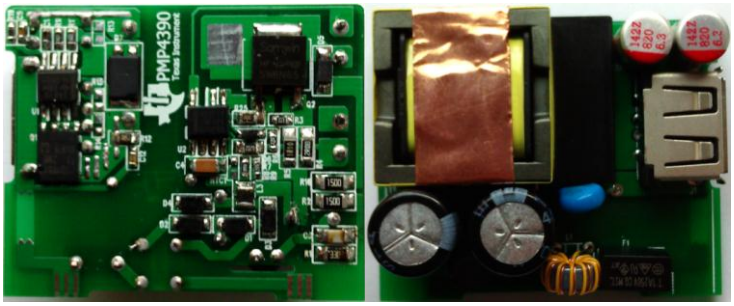
REV A

12/09/2013

1 GENERAL

1.1 PURPOSE

To provide detailed data for evaluating and verifying the PMP4390, which uses TI new Primary Side Controller UCC28713 and synchronous rectified controller UCC24610 for 5.5V3A adapter with small form factor: 44mmx35mmx15mm. The below photo shows this demo board.



1.2 REFERENCE DOCUMENTATION

Schematic PMP4390_SCH.PDF
Assembly PMP4390_PCB.PDF
BOM
Gerber files
Promotion tools

1.3 TEST EQUIPMENTS

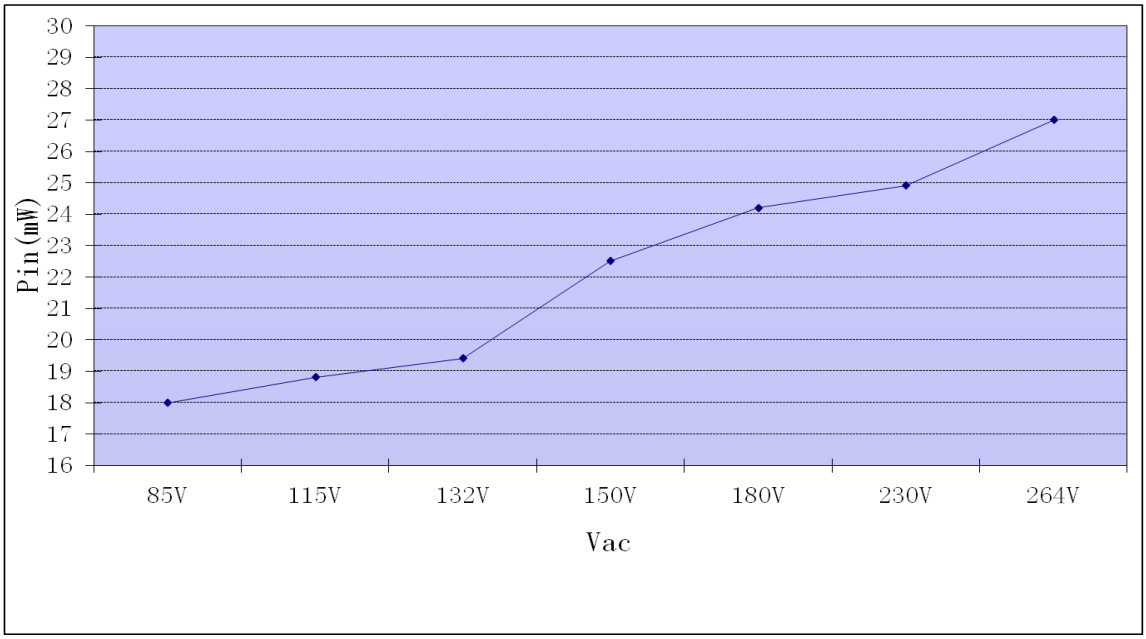
Power-meter: YOKOGAWA WT210
Multi-meter(current): Fluke 8845A
Multi-meter(voltage): Fluke 187
AC Source: Chroma 61530
Electronic load: Chroma 63105A module
Testing demoboard

2 INPUT CHARACTERISTICS

Efficiency is tested on USB-end

Otherwise Specified, the test is under the condition with 100cm cable

2.1 STANDBY POWER



2.2 EFFICIENCY DATA

Notes: efficiency test is based on USB port

85v			
Pi(w)	Io(A)	Vo(V)	efficiency
1.025	0.15	5.197	0.761
1.902	0.3	5.206	0.821
2.339	0.375	5.211	0.835
4.604	0.75	5.246	0.855
6.9	1.125	5.276	0.86
9.28	1.5	5.311	0.858
11.74	1.875	5.35	0.854
14.25	2.25	5.402	0.853
16.81	2.625	5.442	0.85
19.35	3	5.476	0.849

115v			
Pi(w)	Io(A)	Vo(V)	efficiency
1.038	0.15	5.195	0.751
1.925	0.3	5.203	0.811
2.361	0.375	5.209	0.827
4.598	0.75	5.243	0.855
6.882	1.125	5.279	0.863
9.219	1.5	5.31	0.864
11.62	1.875	5.353	0.864
14.05	2.25	5.394	0.864
16.53	2.625	5.436	0.863
18.99	3	5.461	0.863

132v			
Pi(w)	Io(A)	Vo(V)	efficiency
1.052	0.15	5.2	0.741
1.946	0.3	5.202	0.802
2.378	0.375	5.21	0.822
4.602	0.75	5.244	0.855
6.87	1.125	5.281	0.865
9.2	1.5	5.312	0.866
11.58	1.875	5.347	0.866

150v			
Pi(w)	Io(A)	Vo(V)	efficiency
1.085	0.15	5.205	0.72
1.976	0.3	5.203	0.79
2.406	0.375	5.209	0.812
4.627	0.75	5.242	0.85
6.899	1.125	5.279	0.861
9.213	1.5	5.312	0.865
11.58	1.875	5.346	0.866

14	2.25	5.394	0.867
16.44	2.625	5.438	0.868
18.86	3	5.463	0.869

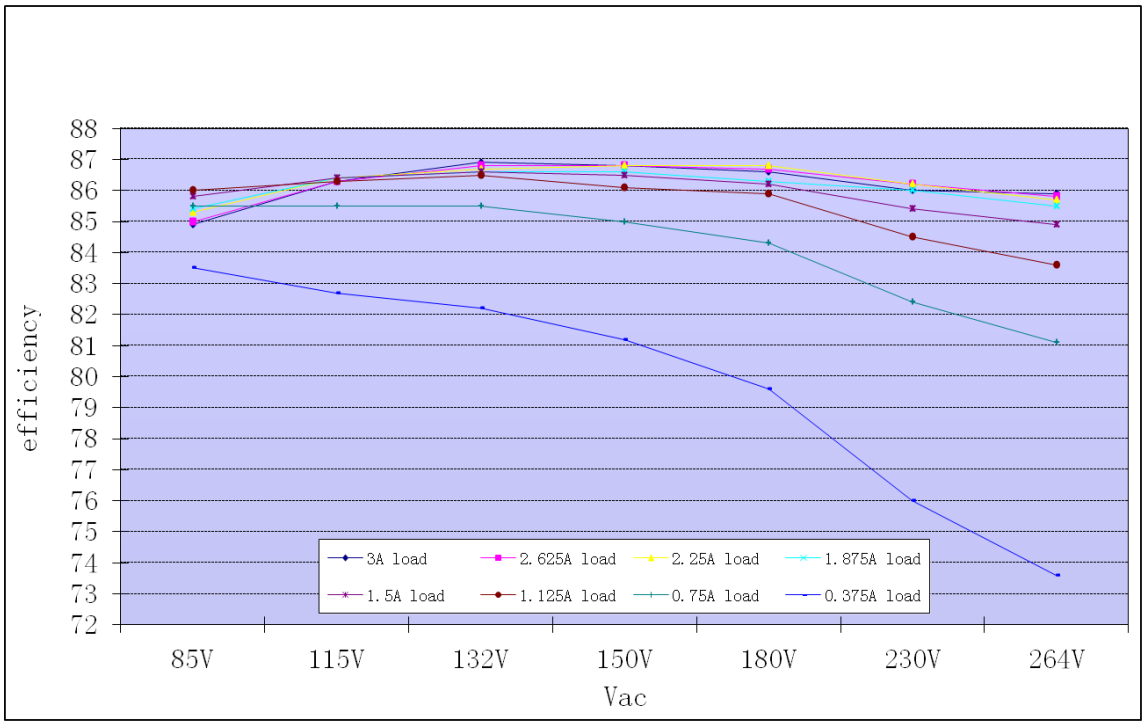
13.99	2.25	5.394	0.868
16.43	2.625	5.434	0.868
18.88	3	5.465	0.868

180v			
Pi(w)	Io(A)	Vo(V)	efficiency
1.133	0.15	5.203	0.689
2.026	0.3	5.202	0.77
2.455	0.375	5.209	0.796
4.665	0.75	5.242	0.843
6.916	1.125	5.28	0.859
9.25	1.5	5.315	0.862
11.62	1.875	5.348	0.863
13.99	2.25	5.395	0.868
16.46	2.625	5.434	0.867
18.93	3	5.467	0.866

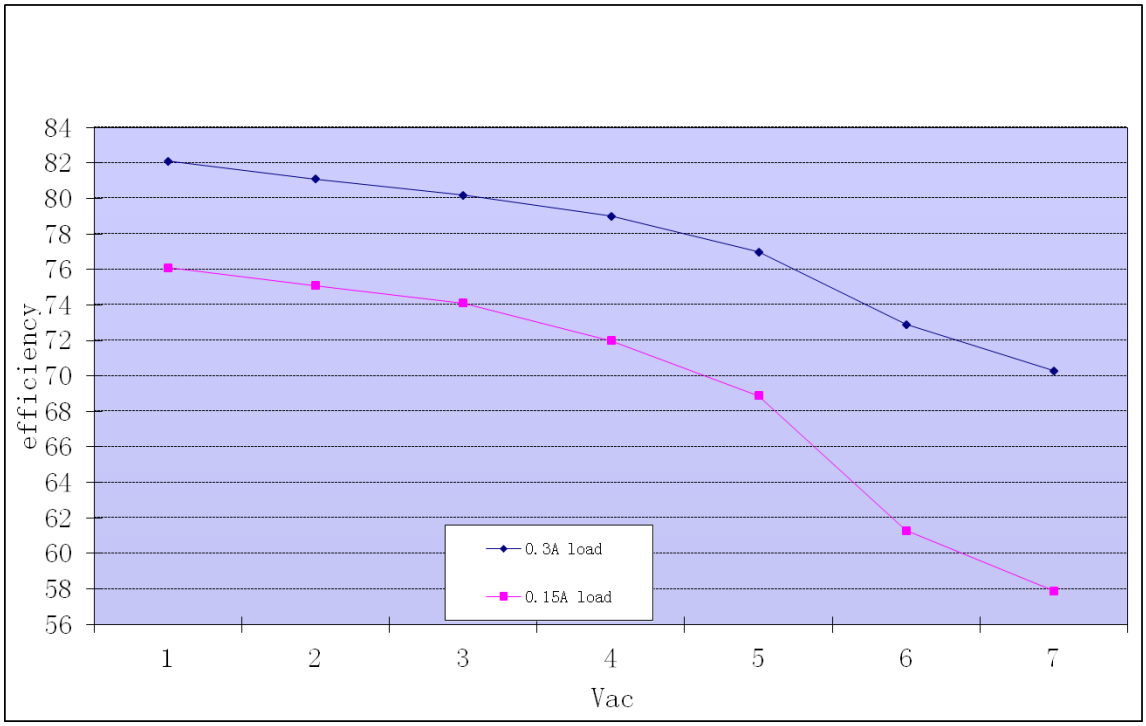
230v			
Pi(w)	Io(A)	Vo(V)	efficiency
1.27	0.15	5.193	0.613
2.14	0.3	5.2	0.729
2.57	0.375	5.206	0.76
4.766	0.75	5.236	0.824
7.027	1.125	5.275	0.845
9.328	1.5	5.312	0.854
11.66	1.875	5.348	0.86
14.05	2.25	5.383	0.862
16.54	2.625	5.433	0.862
19	3	5.448	0.86

264v			
Pi(w)	Io(A)	Vo(V)	efficiency
1.345	0.15	5.192	0.579
2.219	0.3	5.2	0.703
2.654	0.375	5.207	0.736
4.846	0.75	5.237	0.811
7.099	1.125	5.274	0.836
9.388	1.5	5.312	0.849
11.73	1.875	5.348	0.855
14.14	2.25	5.383	0.857
16.62	2.625	5.432	0.858
19.1	3	5.469	0.859

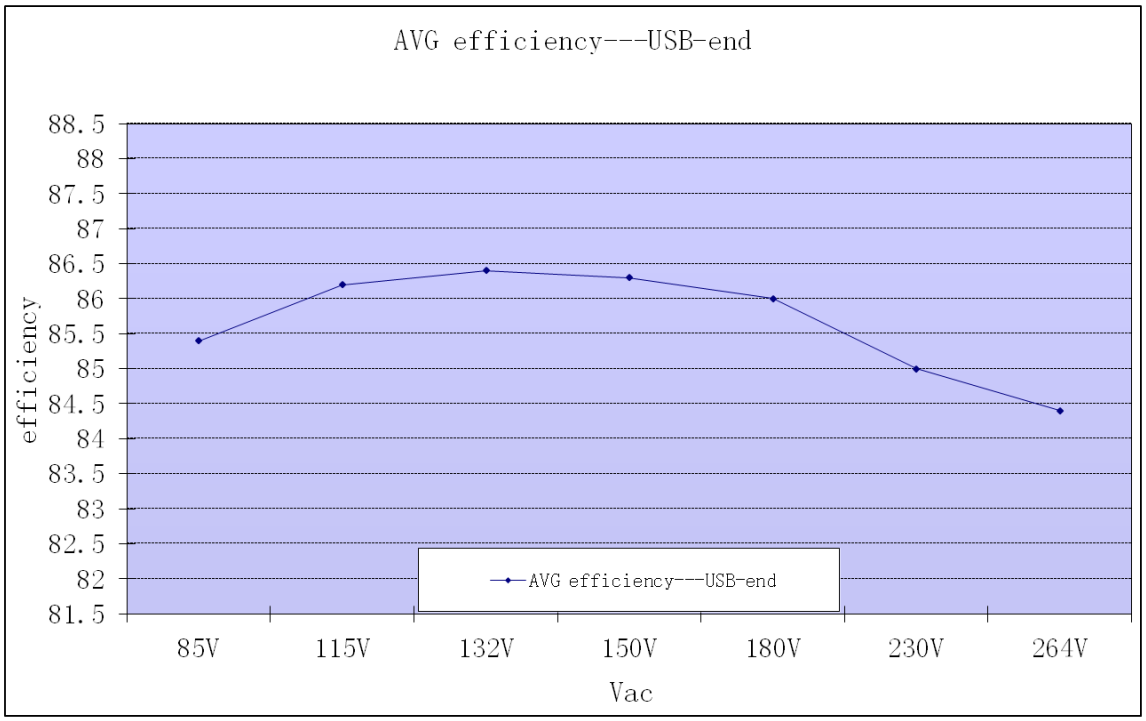
2.2.1 Load and input voltage Vs efficiency curve tested at USB-end



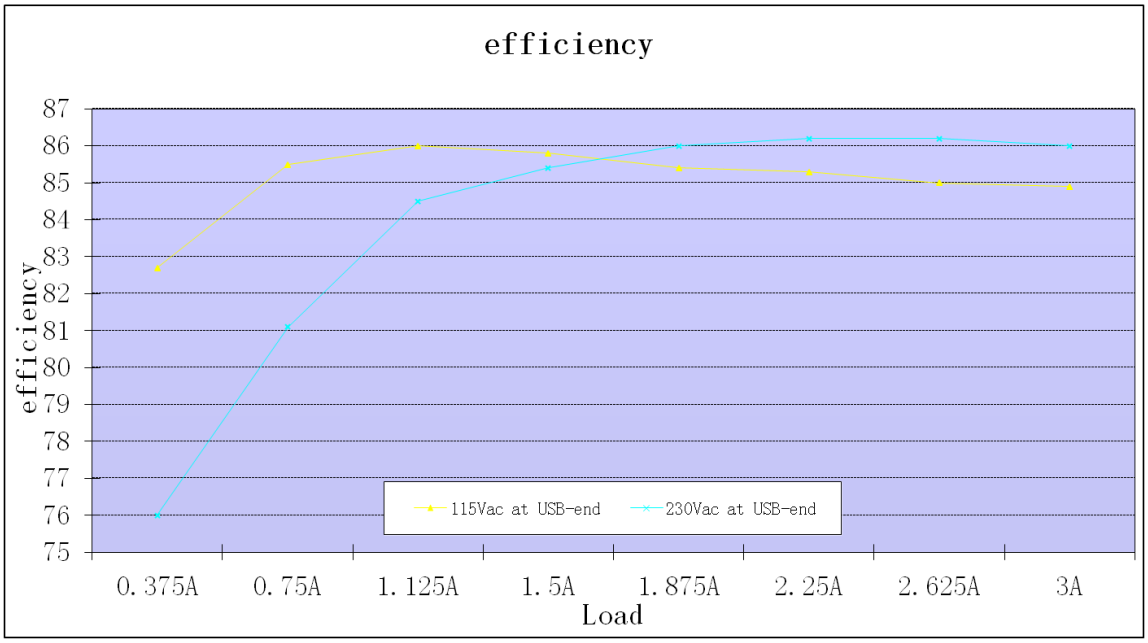
2.2.2 efficiency curve at 5% and 10% of full load



2.2.3 Average efficiency curve at 0.75A,1.5A,2.25A,3A



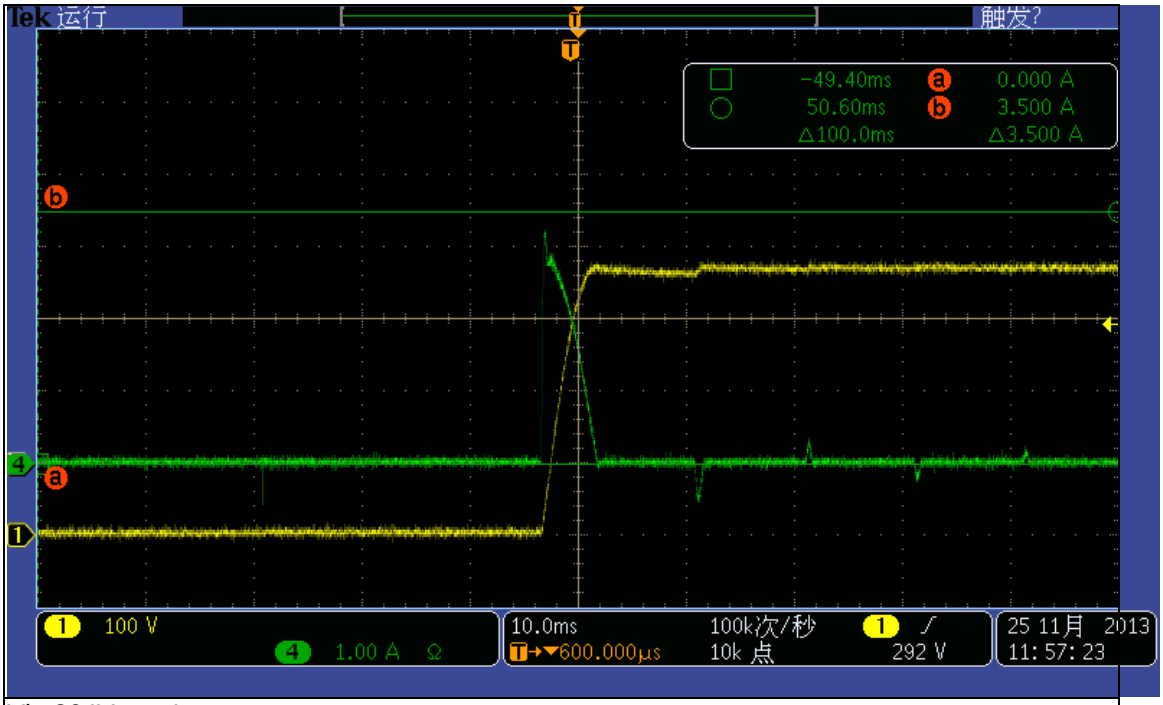
2.2.5 Efficiency Vs load curve



2.3 INPUT CURRENT

Vin(Vac)	Freq(Hz)	Iin(Arms)	Pass/Fail
85	60	**0.36**	

2.4 INPUT INRUSH CURRENT

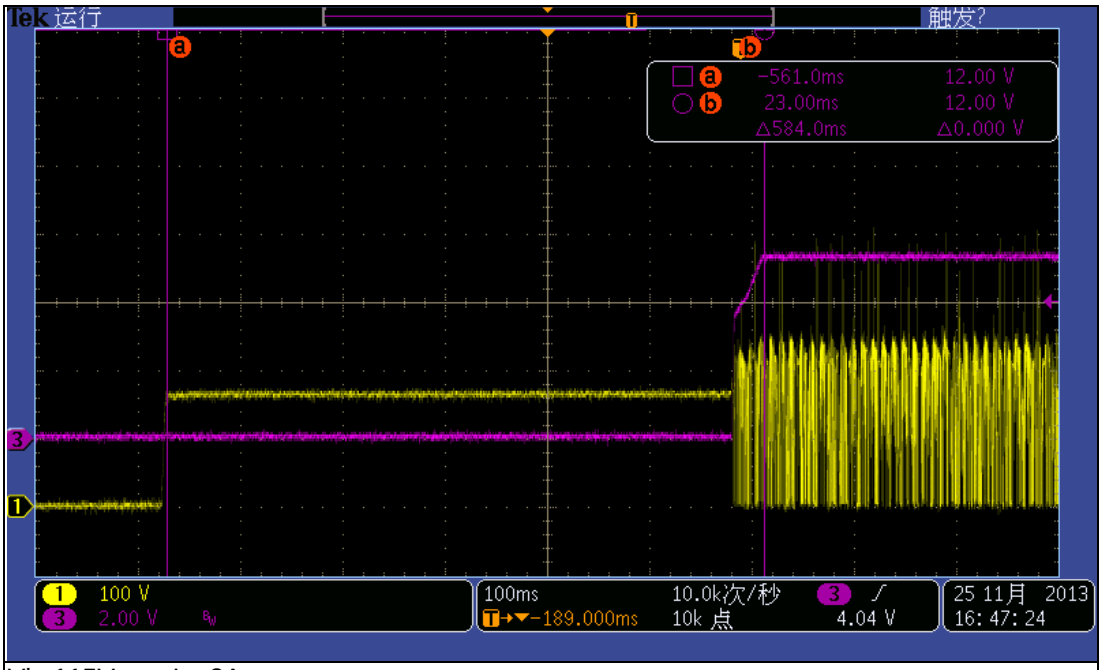


Vin:264Vac Io: 3A
Ch1: Input bulk CAP voltage 100V/div
Ch4: Input inrush current 1A/div

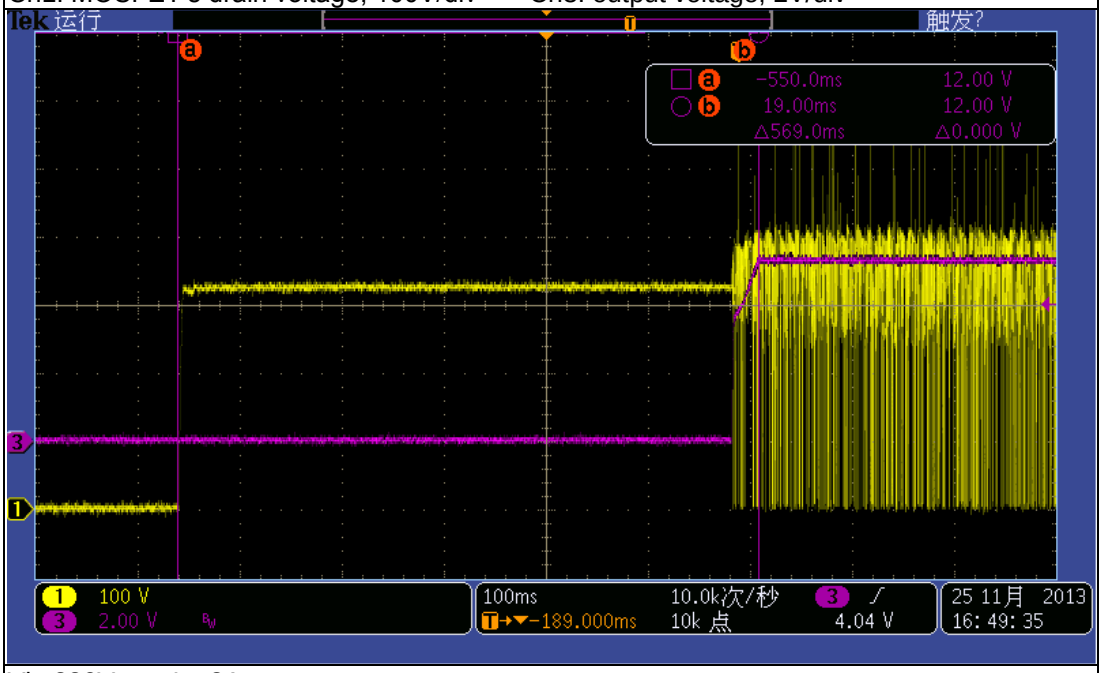
3 OUTPUT CHARACTERISTICS

3.1 STARTUP TIME

Input voltage	Output current	Startup time	Pass/Fail
115Vac	3A	**584mS**	
230Vac	3A	**569mS**	



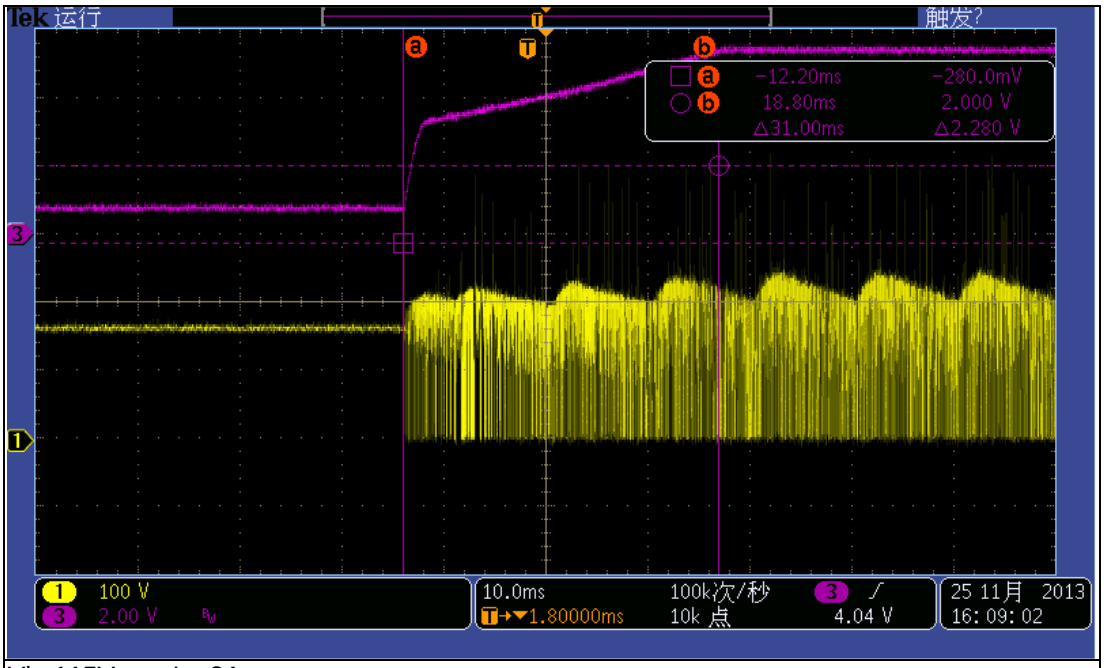
Vin:115Vac Io: 3A
Ch1: MOSFET's drain voltage, 100V/div Ch3: output voltage, 2V/div



Vin:230Vac Io: 3A
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	3A	**31mS**	
230Vac	3A	**27.3mS**	

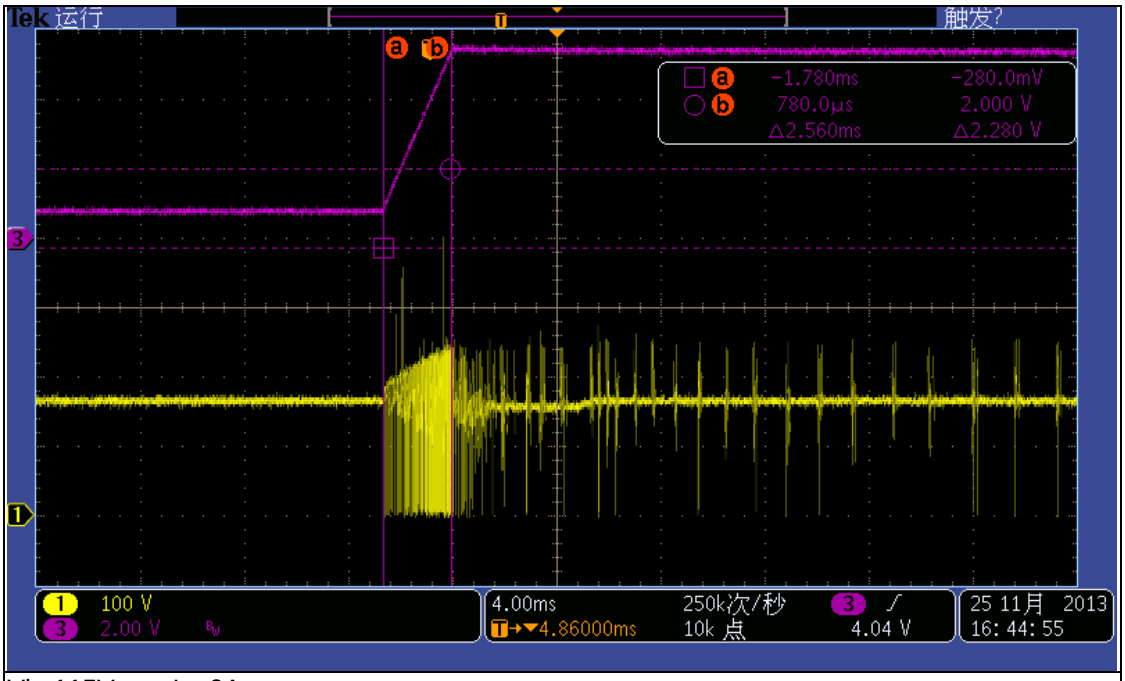


Vin:115Vac Io: 3A
Ch1: MOSFET's drain voltage, 100V/div Ch3: output voltage, 2V/div

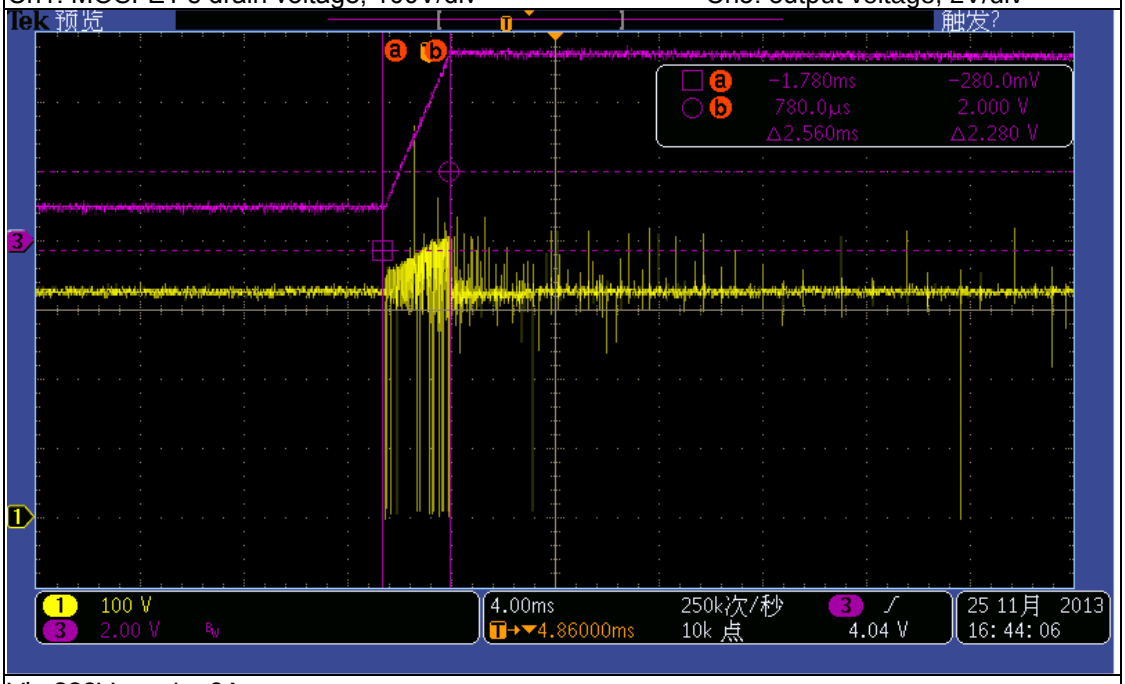
Vin:230Vac Io: 3A
Ch1: MOSFET's drain voltage, 100V/div Ch3: output voltage, 2V/div

3.3 OUTPUT VOLTAGE OVERSHOOT

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



Vin:115Vac Io: 0A
Ch1: MOSFET's drain voltage, 100V/div Ch3: output voltage, 2V/div

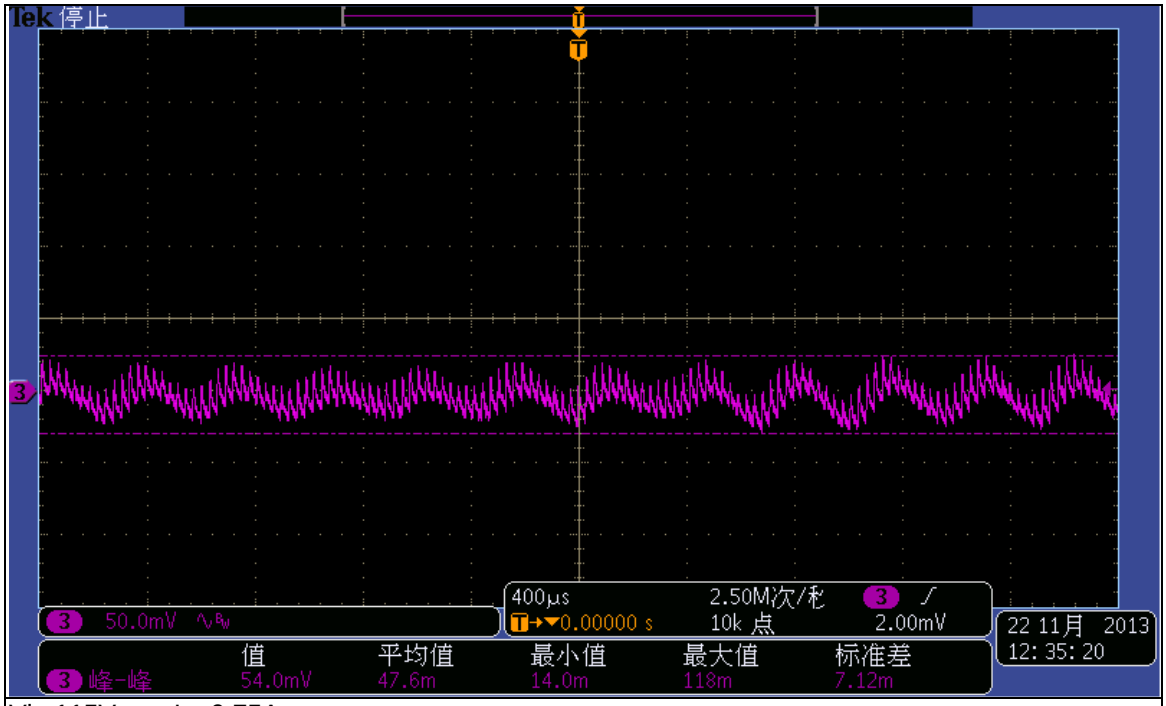


Vin:230Vac Io: 0A
Ch1: MOSFET's drain voltage, 100V/div Ch3: output voltage, 2V/div

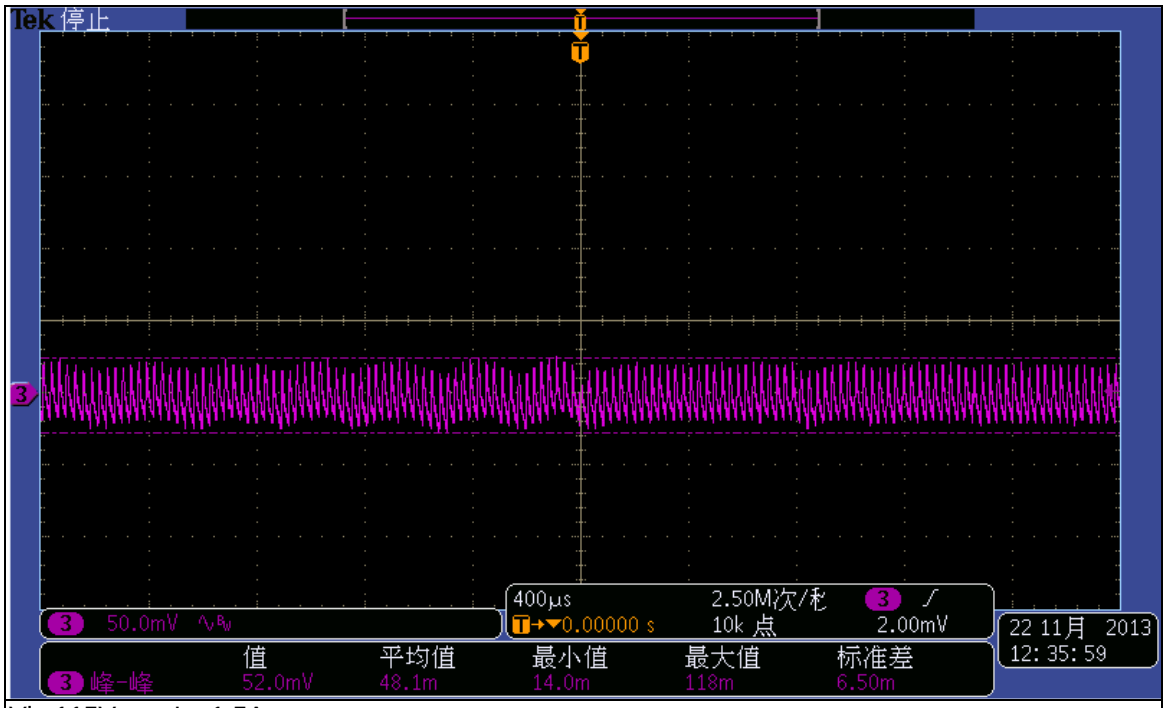
3.4 RIPPLE VOLTAGE

Input voltage	Output current	Ripple voltage	Pass/Fail
115Vac	0.75A	**54mV**	
115Vac	1.5A	**52mV**	

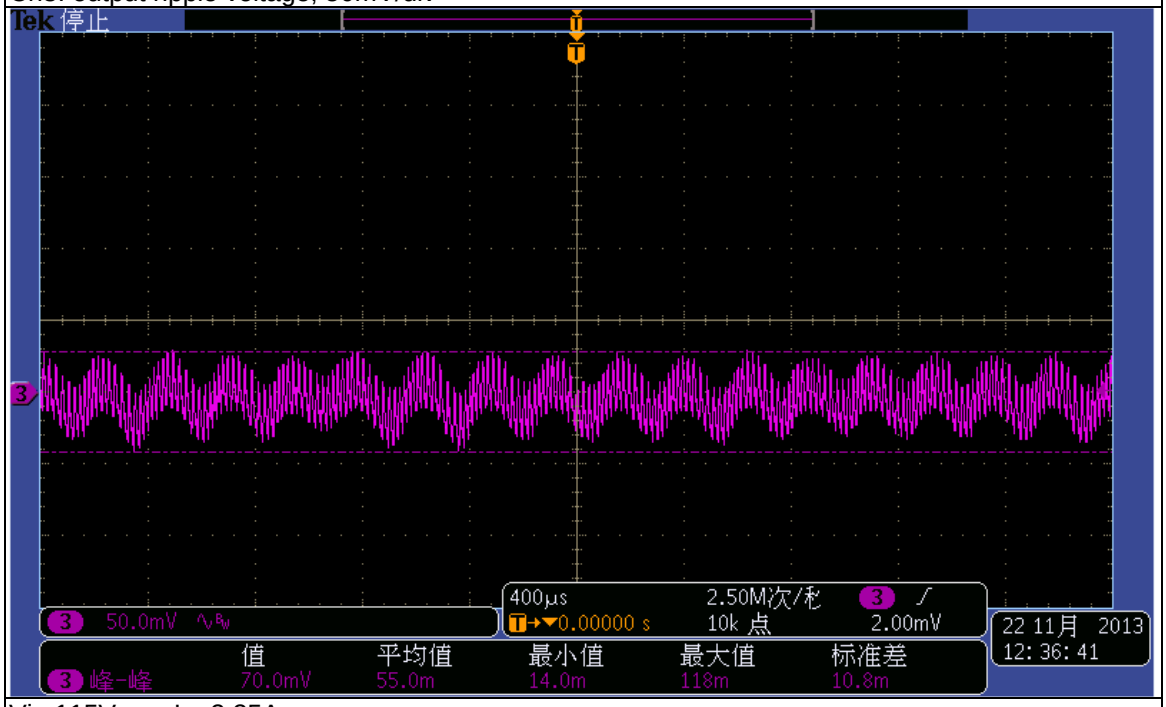
115Vac	2.25A	**70mV**	
115Vac	3A	**62mV**	
230Vac	0.75A	**36mV**	
230Vac	1.5A	**58mV**	
230Vac	2.25A	**58mV**	
230Vac	3A	**66mV**	



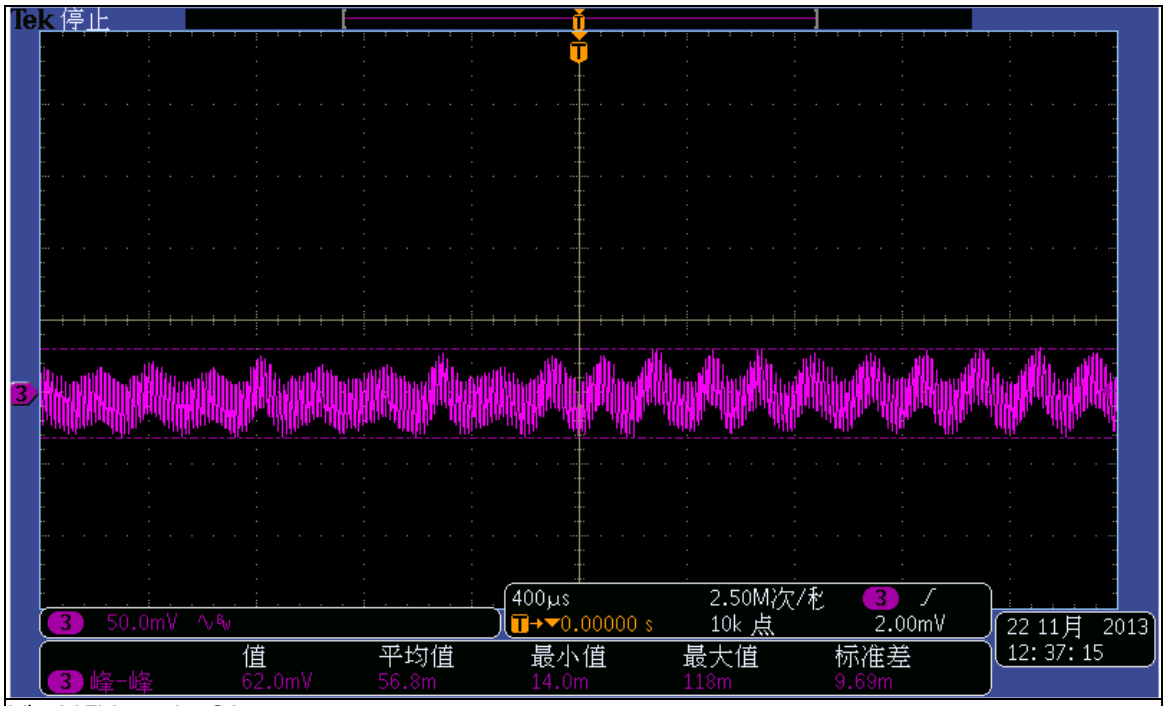
Vin:115Vac Io: 0.75A
Ch3: output ripple voltage, 50mV/div



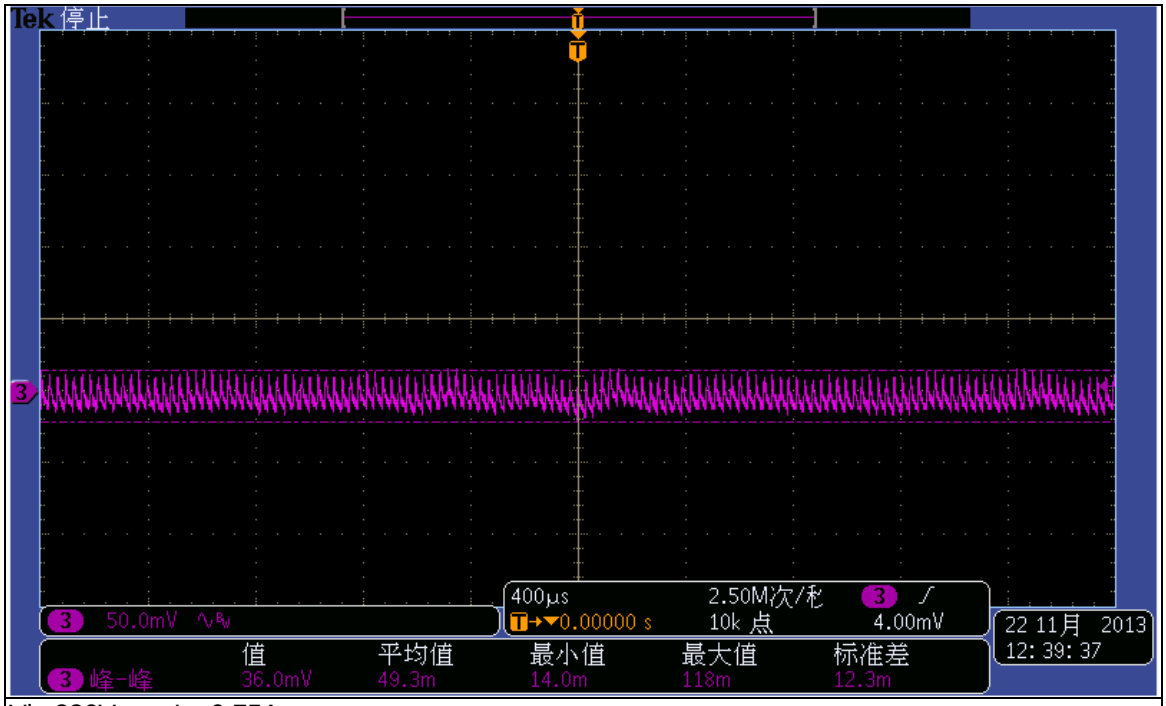
Vin:115Vac Io: 1.5A
Ch3: output ripple voltage, 50mV/div



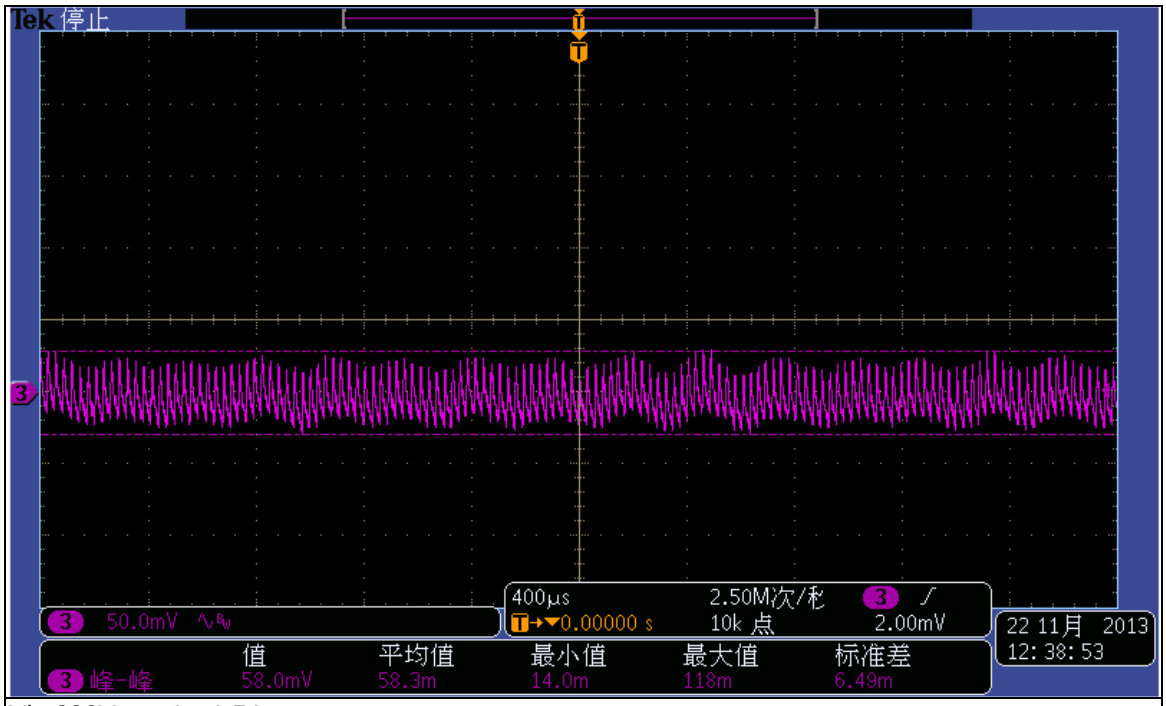
Vin:115Vac Io: 2.25A
Ch3: output ripple voltage, 50mV/div



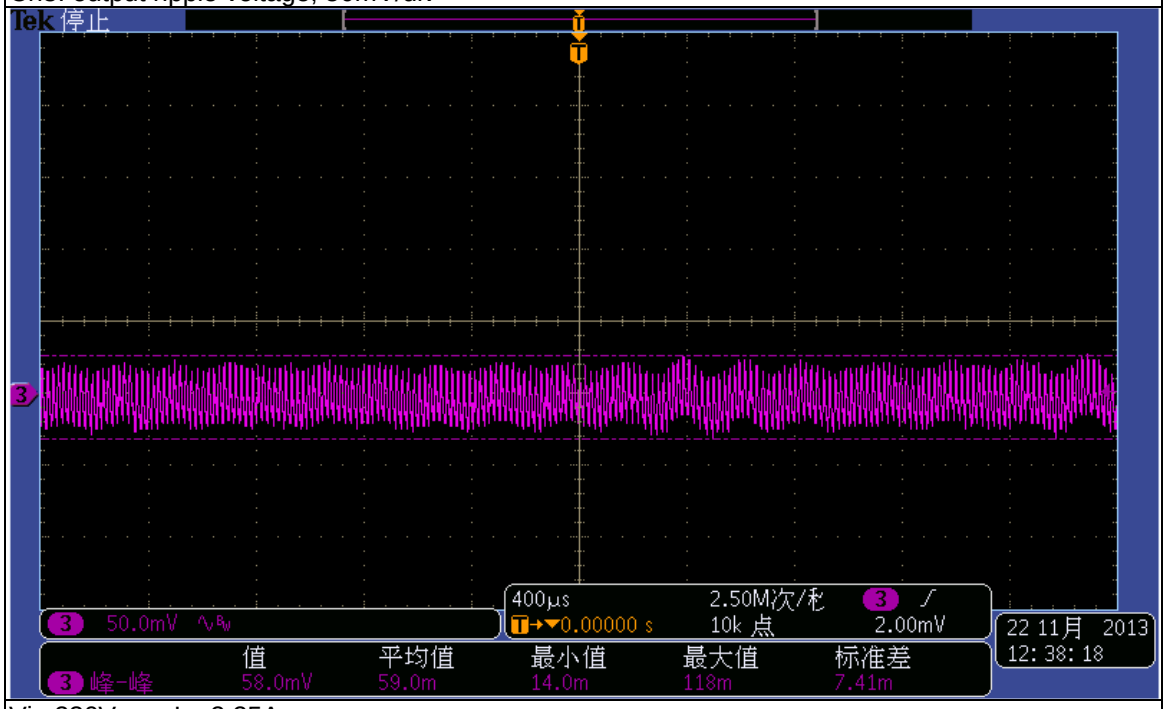
Vin:115Vac Io: 3A
Ch3: output ripple voltage, 50mV/div



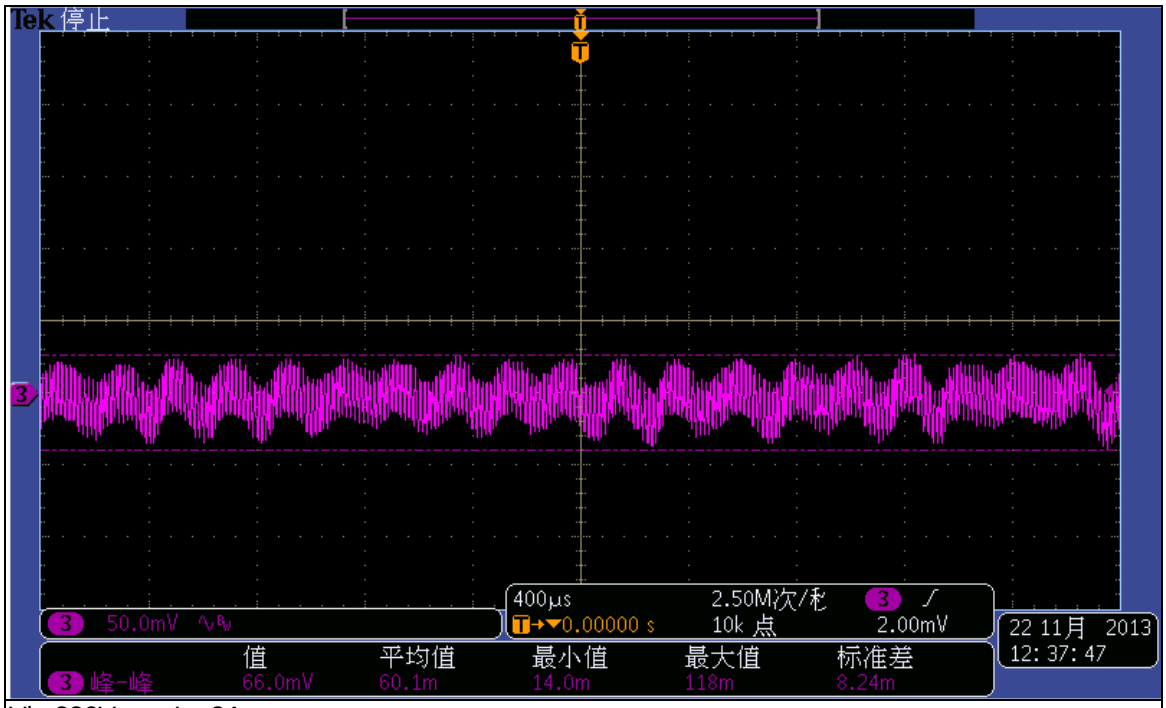
Vin:230Vac Io: 0.75A
Ch3: output ripple voltage, 50mV/div



Vin:230Vac Io: 1.5A
Ch3: output ripple voltage, 50mV/div



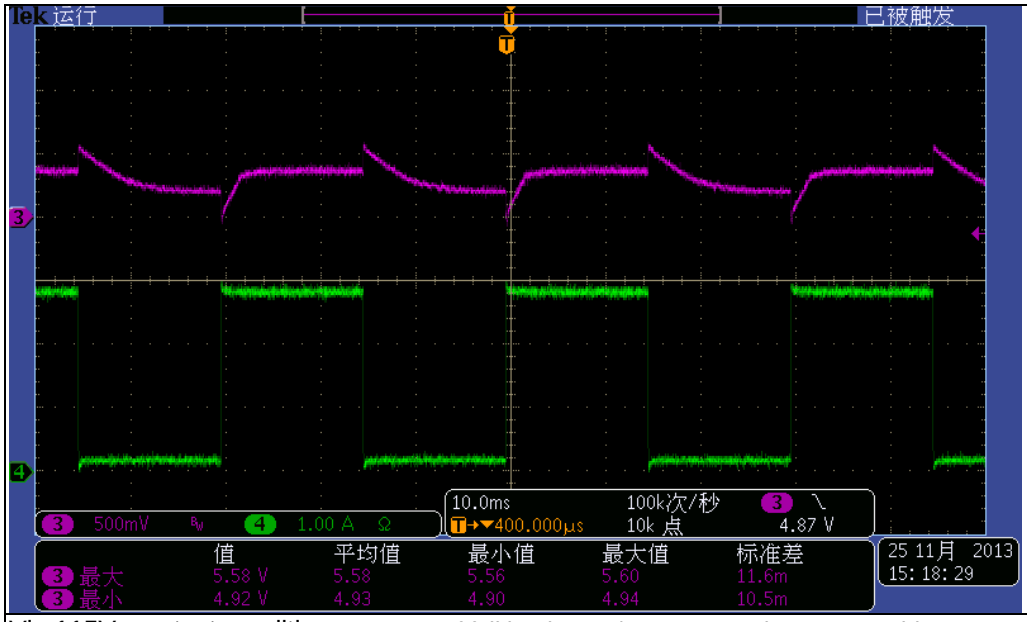
Vin:230Vac Io: 2.25A
Ch3: output ripple voltage, 50mV/div



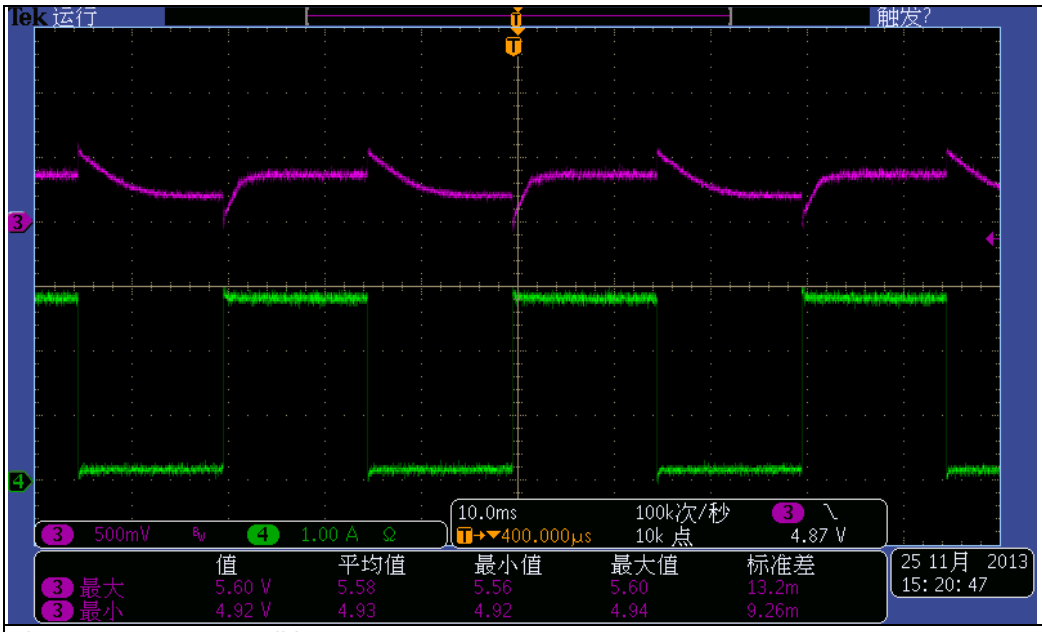
Vin:230Vac Io: 3A
Ch3: output ripple voltage, 50mV/div

3.5 DYNAMIC RESPONSE

Input voltage	Output current	Max voltage	Min voltage
115Vac	5%-95% of full load	**5.58V**	**4.92V**
230Vac	5%-95% of full load	**5.6V**	**4.92V**



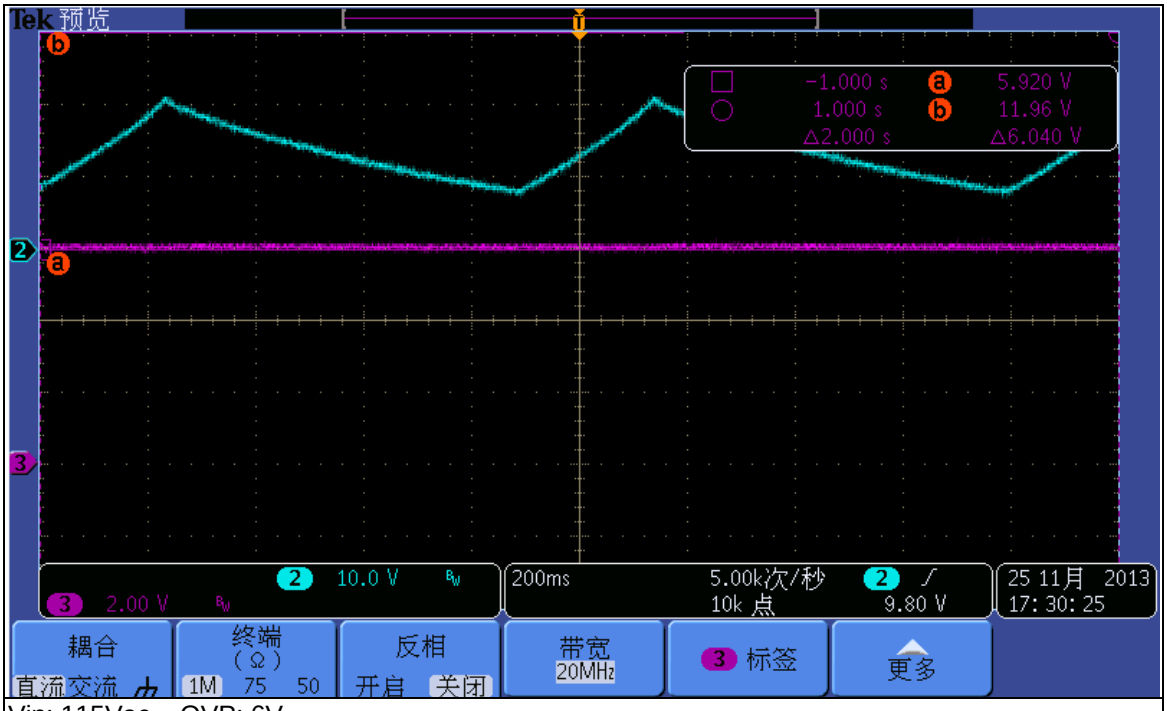
Vin:115Vac test condition: 5%-95% of full load, 0.1A/us, 30ms cycle, 100cm cable
Ch3: output voltage Ch4: output current



Vin:230Vac test condition: 5%-95% of full load, 0.1A/us, 30ms cycle, 100cm cable
Ch3: output voltage Ch4: output current

3.6 OUTPUT VOLTAGE PROTECTION

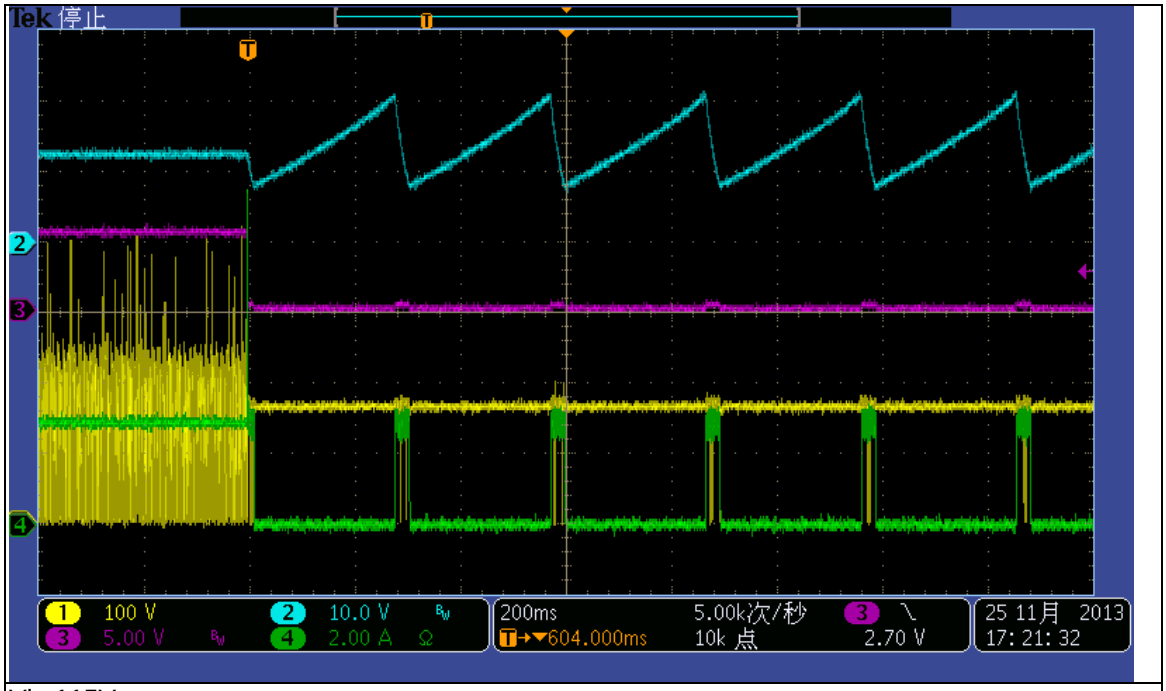
CONDITIONS Vin (Vac)	Protection voltage（V）	Pass/Fail
115&230	6	



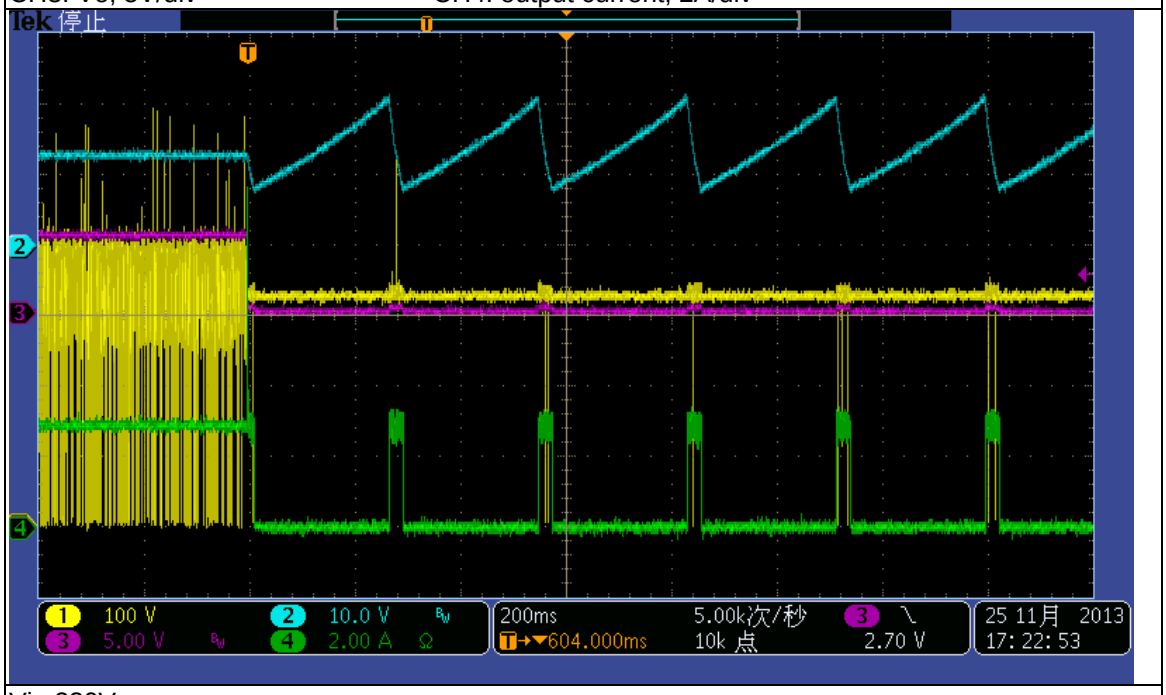
Vin: 115Vac OVP: 6V
CH2: Vdd voltage, 10V/div
CH3: Vo, 2V/div

3.7 OUTPUT SHORT PROTECTION

Input voltage	Output short protection
115&230Vac	**Hiccup up mode**

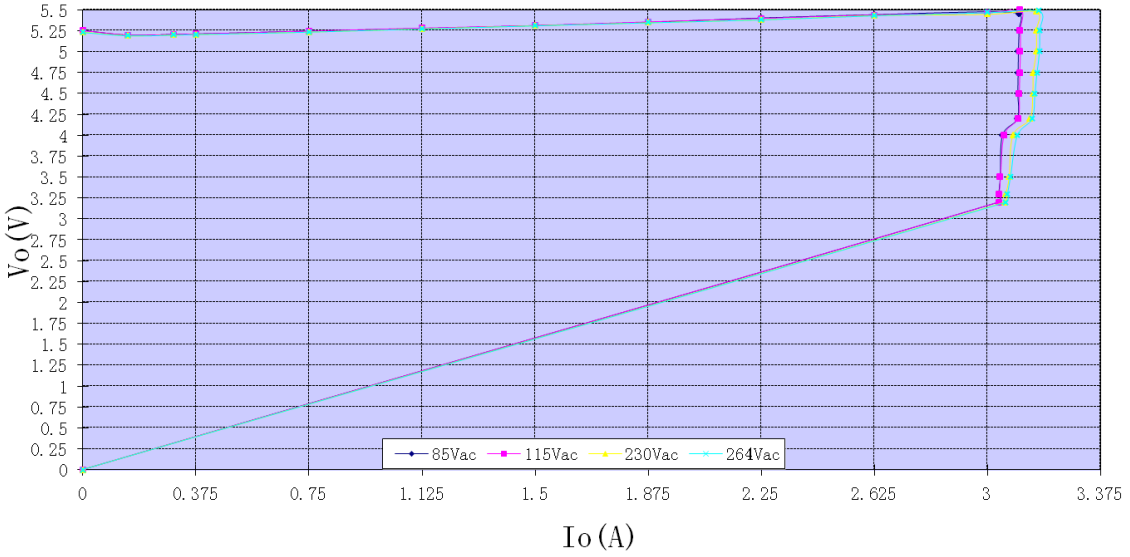


Vin:115Vac
CH1: Vds of MOSFET, 100V/div CH2: Vdd, 10V/div
CH3: Vo, 5V/div CH4: output current, 2A/div



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

4 IV CURVE



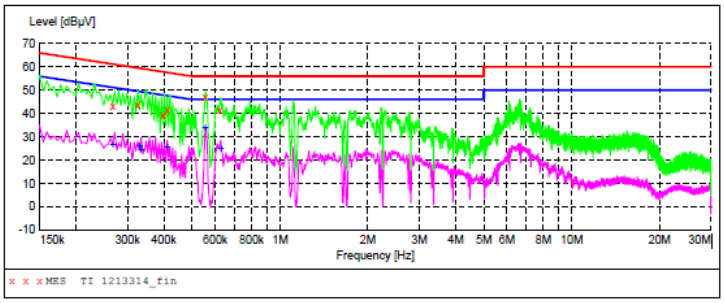
5 THERMAL TEST

5.1. Thermal test with case at Ta=25° C

Temp record						
			90VAC 60Hz ,Ambient:25℃		264VAC 50Hz,Ambient:25℃	
Thermal Coupler Channel	Name	Pos	test Time	CC	test Time	CC
			2 hrs	3A	2 hrs	3A
108	Input cap	C1	72° C		66.9° C	
101	Input cap	C2	74.7° C		69.5° C	
116	Schonounous MOSFET	Q1	66.6° C		69.7° C	
109	Transformer	T1 Core	75.1° C		75.6° C	
102	Transformer	T1 Winding	76.1° C		75.5° C	
111	Power Switch	Q2	71.1° C		81.6° C	
106	Output cap	C13	51.7° C		51.3° C	
114	Output cap	C14	48.6° C		48.8° C	
74	Output rectifier	D7	74° C		73.5° C	
113	Rect. bridge diode	D1	83.9° C		78° C	
115	UCC28713	U2	72.8° C		74.6° C	
117	UCC24610	U1	65.2° C		67.9° C	
107	Top of shell	TP1	50.4°C		51.5°C	
104	Front of shell	TP2	48.7°C		45.3°C	
110	Rear of shell	TP3	41.2°C		33.2°C	
105	Side of shell	TP4	52.5°C		53.2°C	

6 EMI Test

6.1 Conduction emission



MEASUREMENT RESULT: "TI 1213314_fin"

12/13/2013 1:18PM

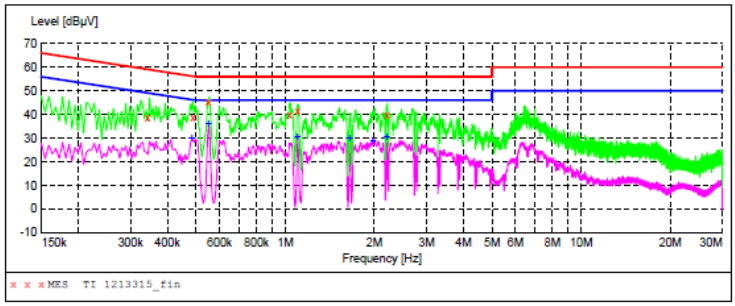
Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.267000	43.10	10.6	61	18.1	QP	L1	GND
0.325500	44.00	10.6	60	15.6	QP	L1	GND
0.397500	39.50	10.5	58	18.4	QP	L1	GND
0.411000	41.30	10.4	58	16.3	QP	L1	GND
0.555000	46.90	10.3	56	9.1	QP	L1	GND
0.622500	41.30	10.3	56	14.7	QP	L1	GND

MEASUREMENT RESULT: "TI 1213314_fin2"

12/13/2013 1:18PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.267000	26.90	10.6	51	24.3	AV	L1	GND
0.330000	26.20	10.6	50	23.3	AV	L1	GND
0.334500	24.80	10.6	49	24.5	AV	L1	GND
0.411000	25.90	10.4	48	21.7	AV	L1	GND
0.555000	34.30	10.3	46	11.7	AV	L1	GND
0.627000	25.40	10.3	46	20.6	AV	L1	GND

Vin: 230Vac, Line, Io: 3A Test condition: 1.5m cable with 1.77R load resistor



MEASUREMENT RESULT: "TI 1213315_fin"

12/13/2013 1:21PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.343500	38.90	10.6	59	20.2	QP	N	GND
0.487500	38.80	10.4	56	17.4	QP	N	GND
0.550500	45.30	10.3	56	10.7	QP	N	GND
1.036500	39.70	10.3	56	16.3	QP	N	GND
1.104000	41.50	10.3	56	14.5	QP	N	GND
2.211000	39.90	10.3	56	16.1	QP	N	GND

MEASUREMENT RESULT: "TI 1213315_fin2"

12/13/2013 1:21PM

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.483000	30.20	10.4	46	16.1	AV	N	GND
0.550500	36.30	10.3	46	9.7	AV	N	GND
1.099500	31.20	10.3	46	14.8	AV	N	GND
1.653000	30.10	10.3	46	15.9	AV	N	GND
1.981500	29.10	10.3	46	16.9	AV	N	GND
2.202000	31.20	10.3	46	14.8	AV	N	GND

Vin:230Vac, Neutral, Io: 3A Test condition: 1.5m cable with 1.77R load resistor

6.2 Radiation emission

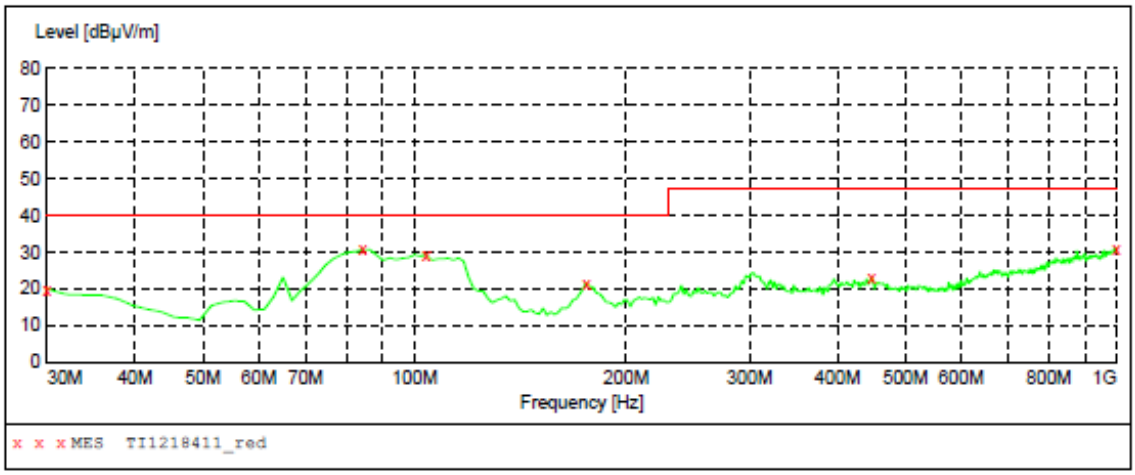
SHENZHEN HUATONGWEI INTERNATIONAL INSPECTION CO.,LTD

RADIATED EMISSION TEST EN 55022 CLASS B

```
EUT:                  PMP4390-3
Manufacturer:         TI
Operating Condition:  FULL LOAD
Test Site:            3M CHAMBER
Operator:             MINGHUA.FAN
Test Specification:   AC 230V/50Hz
Comment:
Start of Test:        12/18/2013 / 9:36:28AM
```

SWEEP TABLE: "test (30M-1G)"

Short Description: Field Strength



MEASUREMENT RESULT: "TI1218411_red"

12/18/2013 9:38AM

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
30.000000	19.90	-10.0	40.0	20.1	---	100.0	155.00	HORIZONTAL
84.428858	30.70	-19.7	40.0	9.3	---	300.0	192.00	HORIZONTAL
103.867735	29.30	-18.3	40.0	10.7	---	300.0	26.00	HORIZONTAL
175.791583	21.60	-21.0	40.0	18.4	---	300.0	329.00	HORIZONTAL
447.935872	23.10	-12.7	47.0	23.9	---	100.0	184.00	HORIZONTAL
1000.000000	31.00	-2.9	47.0	16.0	---	100.0	279.00	HORIZONTAL

Vin: 230Vac, Horizontal, Io: 3A Test condition: 1.5m cable with 1.77R load resistor

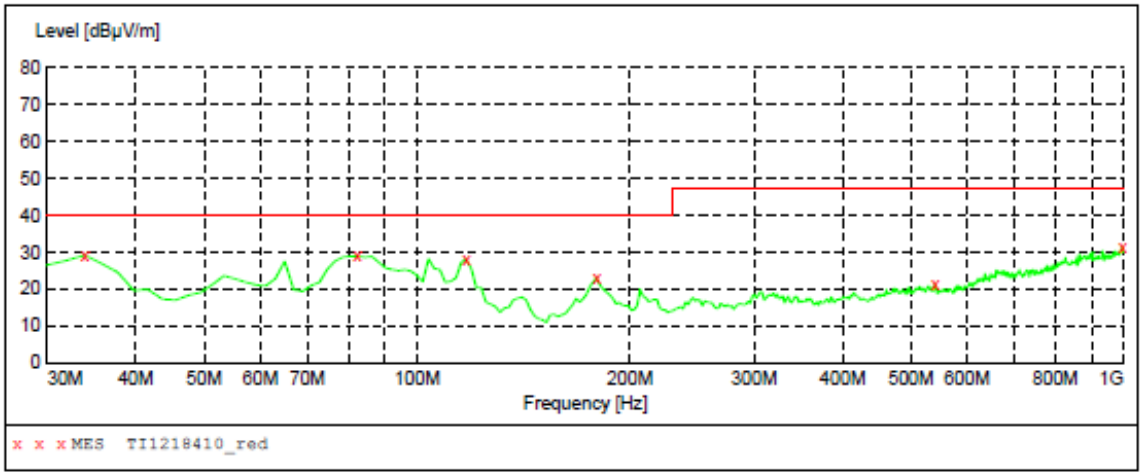
SHENZHEN HUATONGWEI INTERNATIONAL INSPECTION CO.,LTD

RADIATED EMISSION TEST EN 55022 CLASS B

```
EUT:                    PMP4390-3
Manufacturer:           TI
Operating Condition:    FULL LOAD
Test Site:              3M CHAMBER
Operator:               MINGHUA.FAN
Test Specification:     AC 230V/50Hz
Comment:
Start of Test:          12/18/2013 / 9:34:40AM
```

SWEEP TABLE: "test (30M-1G)"

Short Description: Field Strength



MEASUREMENT RESULT: "TI1218410_red"

12/18/2013 9:36AM

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
33.887776	29.20	-12.0	40.0	10.8	---	100.0	90.00	VERTICAL
82.484970	28.90	-19.9	40.0	11.1	---	100.0	149.00	VERTICAL
117.474950	28.20	-18.0	40.0	11.8	---	100.0	107.00	VERTICAL
179.679359	23.00	-20.5	40.0	17.0	---	100.0	287.00	VERTICAL
541.242485	21.20	-11.6	47.0	25.8	---	100.0	299.00	VERTICAL
996.112224	31.40	-3.0	47.0	15.6	---	100.0	310.00	VERTICAL

Vin:230Vac, Vertical, Io: 3A Test condition: 1.5m cable with 1.77R load resistor

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