

## ***HFC0400+MP2681***

# ***Customer Support Test Report***

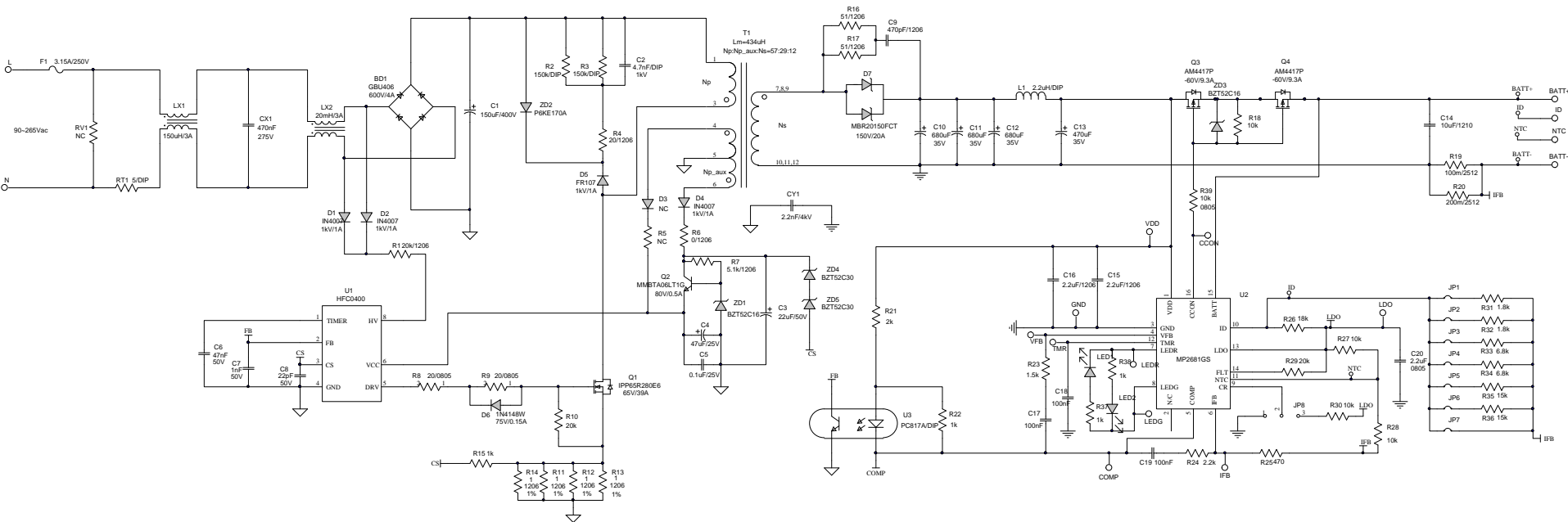
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<b>Date</b>	<b>2014-07-10</b>

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**1. Specification**

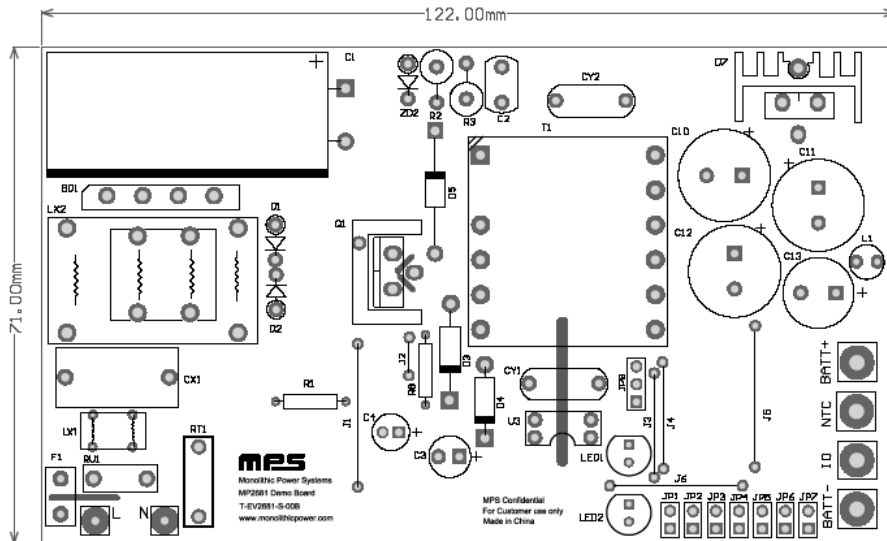
Description	Parameter	Units	Comment
Input voltage	180~265	V <sub>AC</sub>	
Input frequency	47~63	Hz	
Output voltage	12.5/16.7/20.87	V	
Output current	4	A	

## 2. Schematic

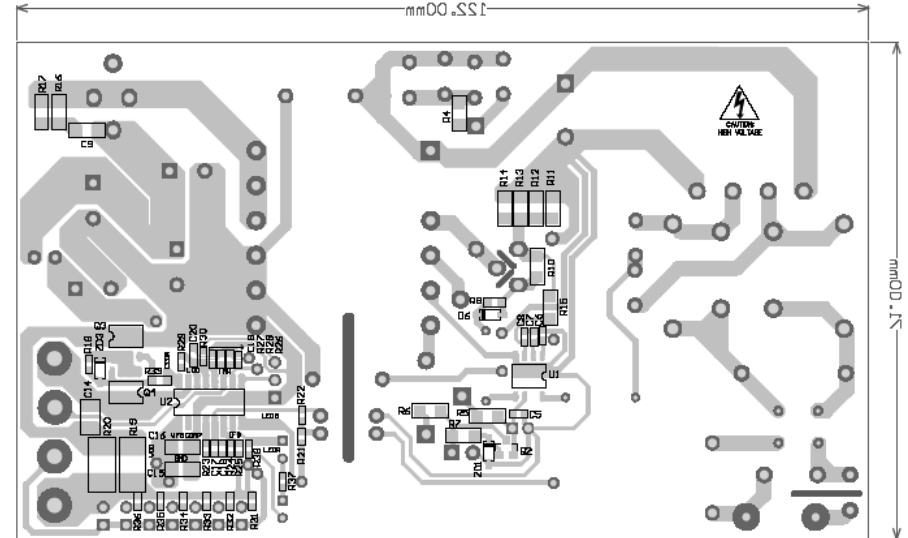


## 3. Circuit Board

### 3.1 PCB Layout



**TOP & TSK**



**BOT & BSK**

## 3.2 Board Photograph



**L\*W\*H=122mm\*71mm\*30mm**

## 4. Bill of Materials

Item	Qty	RefDes	Value	Description	Package	Manufacturer	Manufacturer_PN
1	1	BD1	GBU406	Diode;600V;4A	DIP	Diodes	GBU406
2	1	C1	150uF	Electrolytic Capacitor;400V;	DIP	Jianghai	CD267-400V150
3	1	C2	4.7nF	High Voltage Capacitor;1kV	DIP	Any	Any
4	1	C3	22uF	Capacitor;50V	DIP	Rubycon	50YXM22MEFC5*11
5	1	C4	47uF	Electrolytic Capacitor;25V;	DIP	Jianghai	CD28L-25V47
6	4	C5,C17,C18,C19	100nF	Ceramic Capacitor;50V;X7R;	0603	muRata	GRM188R71H104KA93D
7	1	C6	47nF	Ceramic Capacitor;50V;X7R;	0603	muRata	GRM188R71H473KA61D
8	1	C7	1nF	Ceramic Capacitor;50V;X7R;	0603	muRata	GRM188R71H102KA01D
9	1	C8	22pF	Ceramic Capacitor;50V;C0G;	0603	muRata	GRM1885C1H220JA01D
10	1	C9	470pF	Ceramic Capacitor;1000V;U2J;	1206	muRata	GRM31B7U3A471JW31L
11	3	C10,C11,C12	680uF	Electrolytic Capacitor;35V;	DIP	Jianghai	CD287-35V680
12	1	C13	470uF	Electrolytic Capacitor;35V;	DIP	Jianghai	CD263-35V470
13	1	C14	10uF	Ceramic Capacitor;50V;X7R	1210	Murata	GRM32ER71H106KA12L
14	2	C15,C16	2.2uF	Ceramic Capacitor;50V;X7R;	1206	muRata	GRM31CR71H225KA88L
15	1	C20	2.2uF	Ceramic Capacitor;16V;X7R;	0805	TDK	C2012X7R1C225K
16	1	CX1	470nF	Capacitor;275V;10%	DIP	Carli	PX474K3ID42L270D9R
17	1	CY1	2.2nF	Capacitor;4000V;20%	DIP	Hongke	JN12E222MY02N
18	4	D1,D2,D3,D4	1N4007	Diode;1000V;1A	DO-41	Diodes	1N4007

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Item	Qty	RefDes	Value	Description	Package	Manufacturer	Manufacturer_PN
29	1	D5	FR107	Diode;1000V;1A	DO-41	Diodes	FR107
20	1	D6	1N4148W	Diode;75V;0.15A;	SOD-123	Diodes	1N4148W
21	1	D7	MBR20150FCT	Diode;150V;20A	TO-220AB	Xutong	MBR20150FCT
22	1	F1	SS-5-3.15A	Fuse;250V;3.15A	DIP	Cooper Bussmann	SS-5-3.15A
23	1	L1	2.2uH	Inductor;2.2uH;20m;6.3A	DIP	Würth	7447462022
24	1	LED1	Green LED	LED;Green	DIP		F3D02HG-1A
25	1	LED2	Red LED	LED;Red	DIP		F3D02R-4A
26	1	LX1	150uH	Inductor;2A	DIP	Emei	TP4U150-00
27	1	LX2	20mH	Inductor;10mH;55mohm;5A	DIP	Würth	744825320
28	1	Q1	IPP65R280E6	Mosfet;650V;39A;0.28ohm;	TO-220	Infinon	IPP65R280E6
29	1	Q2	MMBTA06LT1G	Transistor;80V;0.5A;	SOT-23	Diodes	MMBTA06LT1G
30	2	Q3,Q4	AM4417P	P-Channel Mosfet;-60V;9.3A;	SO-8	Analog Power	AM4417P
31	2	R1,R10	20kΩ	Film Resistor;5%;	1206	LIZ	CR1206J40203G
32	2	R2,R3	150kΩ	Resistor;5%;1W	DIP	Any	Any
33	1	R4	20Ω	Film Resistor;5%;	1206	Royalohm	1206J0200T5E
34	1	R5	NC				
35	1	R6	0Ω	Film Resistor;1%	1206	Yageo	RC1206FR-070RL
36	1	R7	5.1kΩ	Film Resistor;5%;	1206	LIZ	CR06T05NJ5K1
37	2	R8,R9	20Ω	Film Resistor;5%;	0805	Yageo	RC0805JR-0720RL



...Continued

Item	Qty	RefDes	Value	Description	Package	Manufacturer	Manufacturer_PN
38	4	R11,R12,R13,R14	1Ω	Film Resistor;1%	1206	Yageo	RC1206FR-071RL
39	3	R15,R37,R38	1kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-071KL
40	2	R16,R17	51Ω	Film Resistor;5%;	1206	Yageo	RC1206JR-0751RL
41	1	R18	10kΩ	Film Resistor;5%;	0603	Yageo	RC0603JR-07100KL
42	1	R19	100mΩ	Sense Resistor;1%;2W;	2512	CYNTEC	RL-3264-9-R100-FN
43	1	R20	200mΩ	Sense Resistor;1%;1W	2512	CYNTEC	RL3264-6-R050-FN
44	1	R21	2kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-072KL
45	1	R22	1kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-071KL
46	1	R23	1.5kΩ	Film Resistor;1%;	0603	Yageo	RC0603FR-071K5L
47	1	R24	2.2kΩ	Film Resistor;1%;	0603	Yageo	RC0603FR-072K2L
48	1	R25	470Ω	Film Resistor;1%	0603	Yageo	RC0603FR-07470RL
49	1	R26	18kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-0718KL
50	4	R27,R28,R30,R39	10kΩ	Film Resistor;1%;	0603	Yageo	RC0603FR-0710KL
51	1	R29	20kΩ	Film Resistor;5%;	0603	Yageo	RC0603JR-0720KL
52	2	R31,R32	1.8kΩ	Film Resistor;5%;	0603	LIZ	CR0603JA0182G
53	2	R33,R34	6.8kΩ	Film Resistor;1%;	0603	Yageo	RC0603FR-076K8L
54	2	R35,R36	15kΩ	Film Resistor;1%;	0603	Yageo	RC0603FR-0715KL
55	1	RT1	5Ω	NTC Resistor;	DIP	Xingshun	5D2-10LC
56	1	RV1	NC				
57	1	T1	434uH	EER28;Np:Np_aux:Ns=57:29:12	DIP	Emei	FX0370

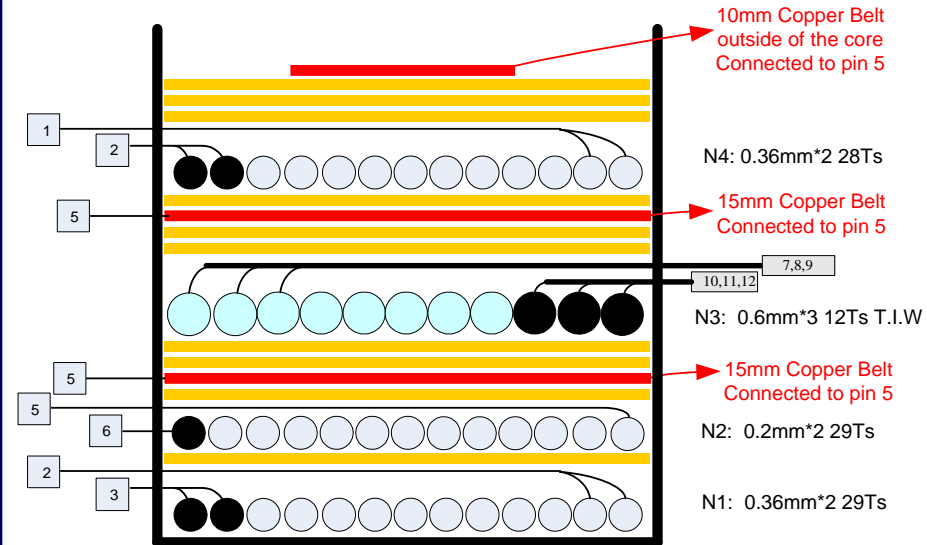
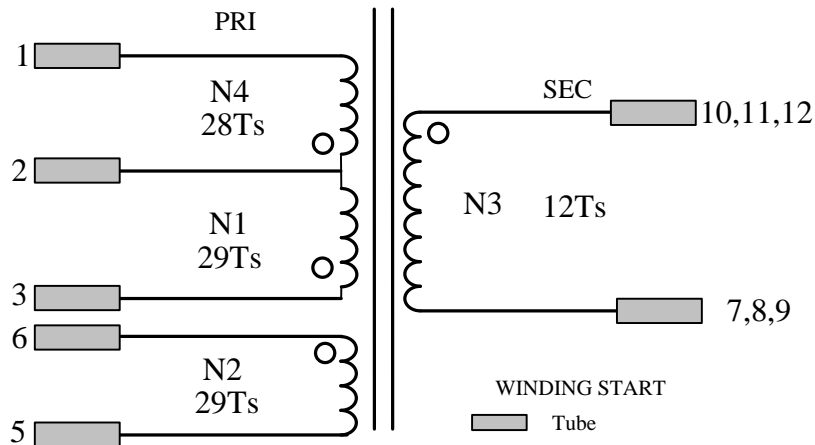
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Item	Qty	RefDes	Value	Description	Package	Manufacturer	Manufacturer_PN
58	1	U1	HFC0500	Flyback Ccontroller;	SOIC8-7A	MPS	HFC0500HS
59	1	U2	MP2681	CC/CV Controller;	SOIC16	MPS	MP2681GS
60	1	U3	PC817A	Photocoupler;1-Channel	DIP	Sharp	PC817A
61	2	ZD1,ZD3	BZT52C16	Zener Diode;16V;5mA/500mW;	SOD-123	Diodes	BZT52C16
62	1	ZD2	P6KE170CA	Diode;145V;1mA	DO-15	Brightking	P6KE170CA
63	2	ZD4,ZD5	BZT52C30	Zener Diode;30V;5mA/500mW;	SOD-123	Diodes	BZT52C30

## 5. Transformer Information

### 5.1 Winding Spec

- Primary inductance: **434uH(±5%)**
- Leakage inductance: **22uH(Max)**
- Core/Bobbin: **EER28**
- Core material: **PC40**
- N1:N2:N3:N4= **29:29:12:28**



## 5.2 Winding Details

Winding Order	Pin Number		Wire Type ( $\Phi$ )	Number of Wires	Number of Turns	Tube
	Start	Finish				
N1	3	2	0.36mm	2	29	matching with wire
N2	6	5	0.20mm	2	29	matching with wire
N3	10,11,12	7,8,9	0.6mm(T.I.W)	3	12	matching with wire
N4	2	1	0.36mm	2	28	matching with wire

## 6. Performance Data

### 6.1 Test Setup

#### 6.1.1 Test Equipment

- AC Source: **Chroma, Model 61601**
- Power Meter: **Yokogawa, Model WT210**
- E-Load: **Chroma, Model 63101**
- Oscilloscope: **Tektronix, Model TDS3014C**
- Current Probe/Amplifier: **Tektronix, Model TCP202**
- EMC Receiver: **Rohde & Schwarz, Model ESPI3+ESPI-B2**
- ... ..

*Note: Active mode efficiency at 115V<sub>AC</sub>/60Hz*

## 6.2 Efficiency

### 6.2.1 Active Mode Efficiency

#### Test Conditions:

- The unit was set to maximum load and well pre-heated until temperature stabilization was achieved.
- Temperature stabilization was established for every load step before recording any measurements.

#### Criteria To Pass:

- The efficiency must be > **75%** at the maximum continuous output load.

Input (V <sub>AC</sub> /Hz)	I <sub>OUT</sub> (A)	V <sub>OUT</sub> (V)	P <sub>OUT</sub> (W)	P <sub>IN</sub> (W)	Efficiency(%)
230/50	3.77	20.00	75.400	89.188	84.54
	3.77	16.70	62.959	74.702	84.28
	3.77	12.52	47.200	56.929	82.91
	Average Efficiency (%)				83.91

## 6.2.2 No-load Power Consumption

### Test Conditions:

- The unit was set to maximum load and well pre-heated.
- After 5 minutes the load was removed.
- The no-load input power measurements were recorded after stabilization of the input power reading.

### Criteria To Pass:

- The power consumption must be < **1W** at the maximum input voltage.

$V_{AC}/\text{Hz}$	220/50	240/50	265/50
$P_{IN}(\text{mW})$	161.9	177.83	184.2

**Comment: Pass**

## 6.3 Stress

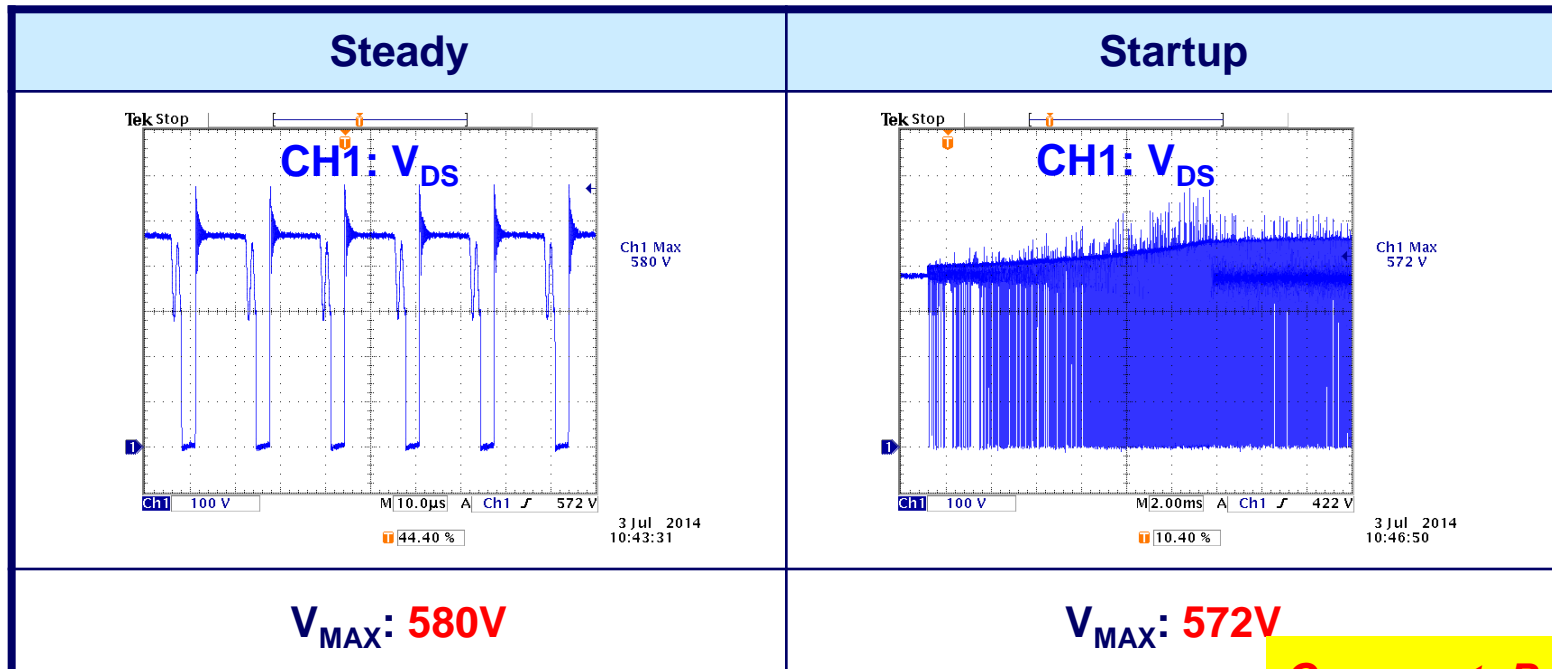
### 6.3.1 Mosfet $V_{DS}$

#### Test Conditions:

- The main input voltage was set to  $265V_{AC}$ .
- The electronic load was set to the maximum output current.

#### Criteria To Pass:

- The mosfet  $V_{DS}$  must be  $< 650V$  at both startup and steady status.

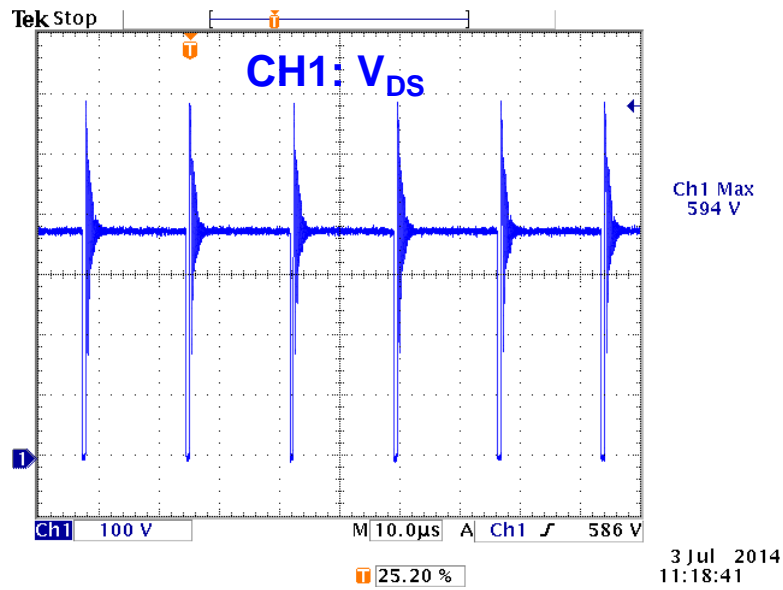


**Comment: Pass**



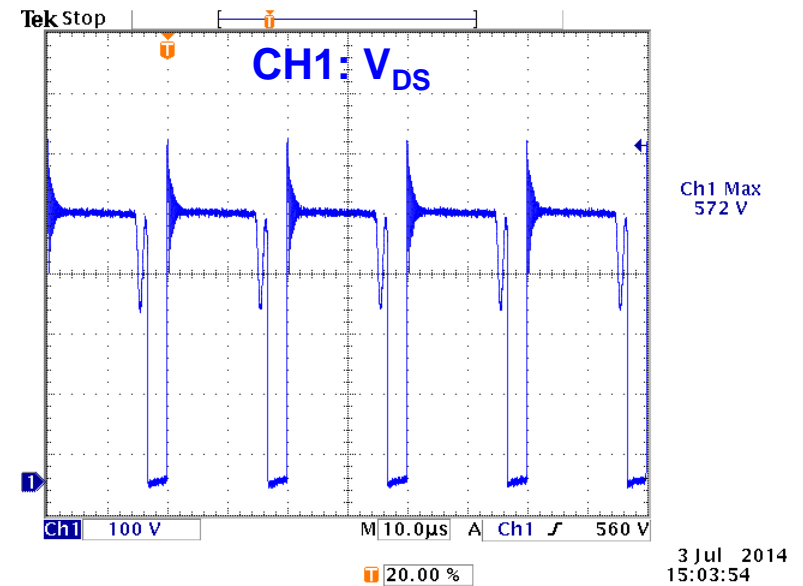
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## SCP



**V<sub>MAX</sub>: 594V**

## OVP



**V<sub>MAX</sub>: 572V**

**Comment: Pass**

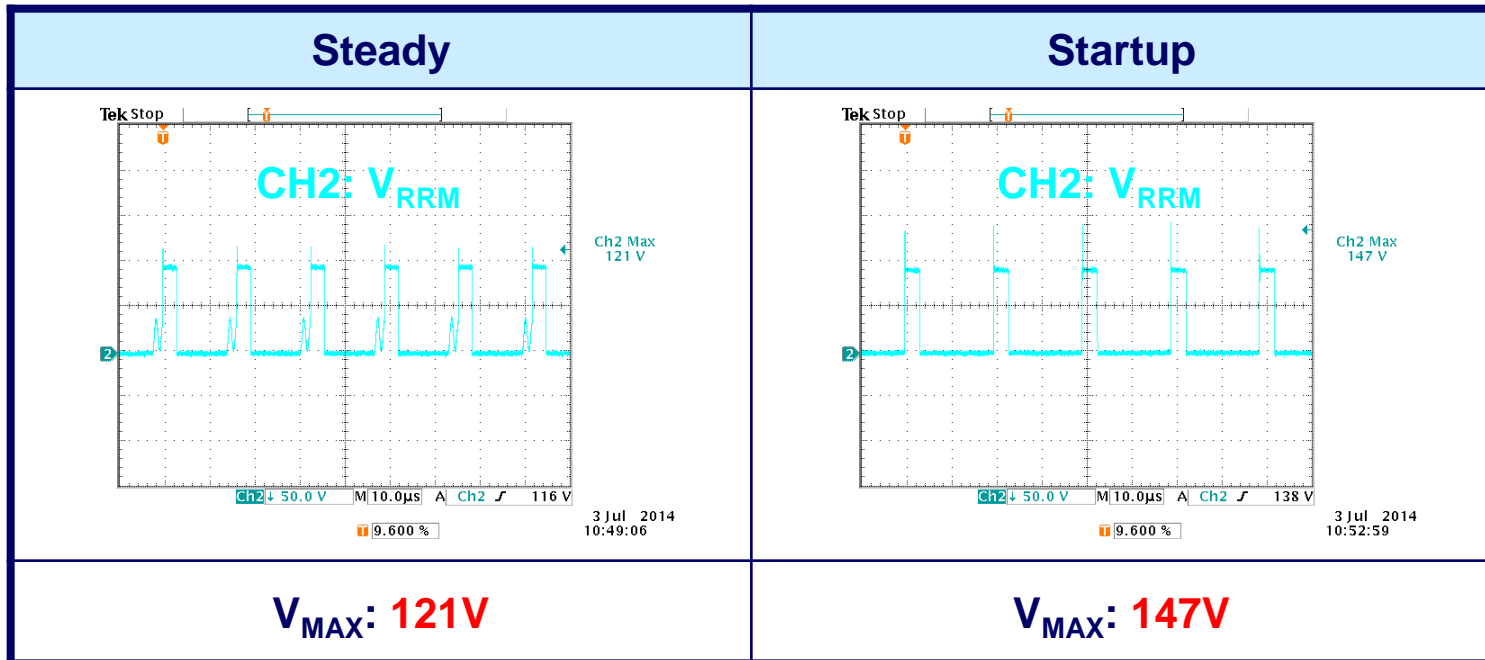
## 6.3.2 Output Diode $V_{RRM}$

Test Conditions:

- The main input voltage was set to  $265V_{AC}$ .
- The electronic load was set to the maximum output current.

Criteria To Pass:

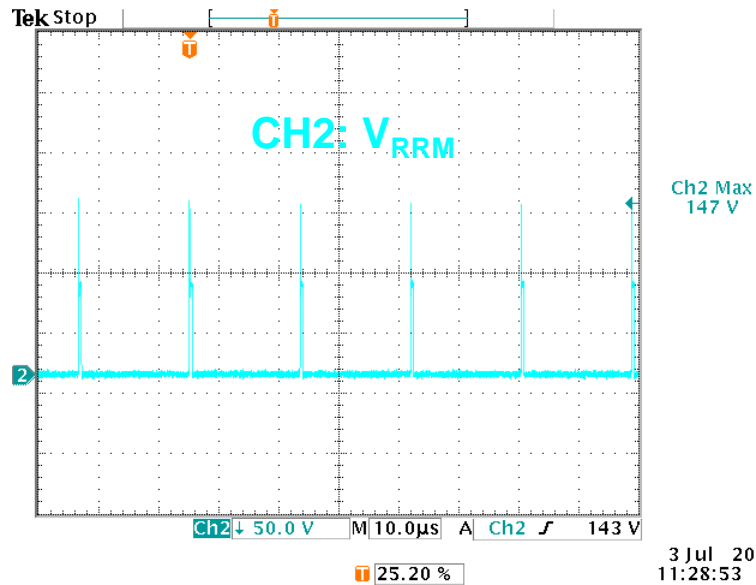
- The diode  $V_{RRM}$  must be  $< 150V$  at both startup and steady status.



**Comment: Pass**

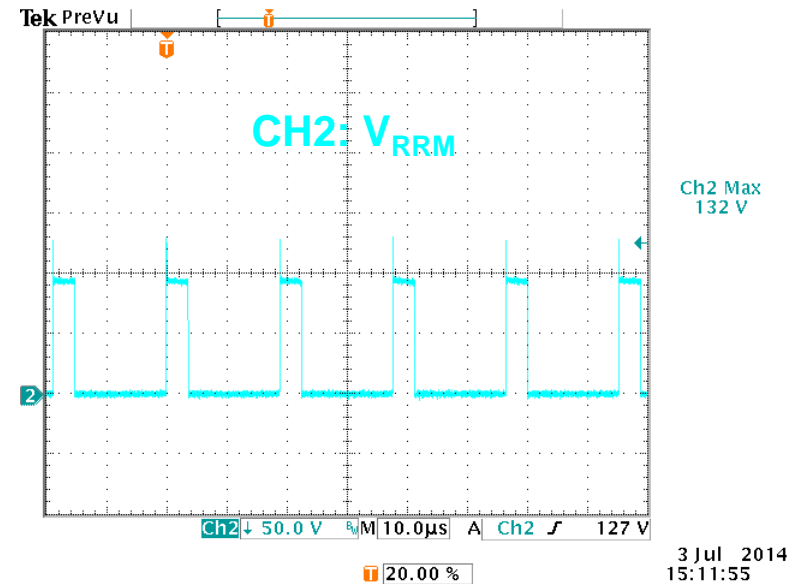
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## SCP



$V_{MAX}: 147V$

## OVP



$V_{MAX}: 132V$

**Comment: Pass**

## 6.4 Protection

### 6.4.1 Short Circuit Protection (SCP)

#### Test Conditions:

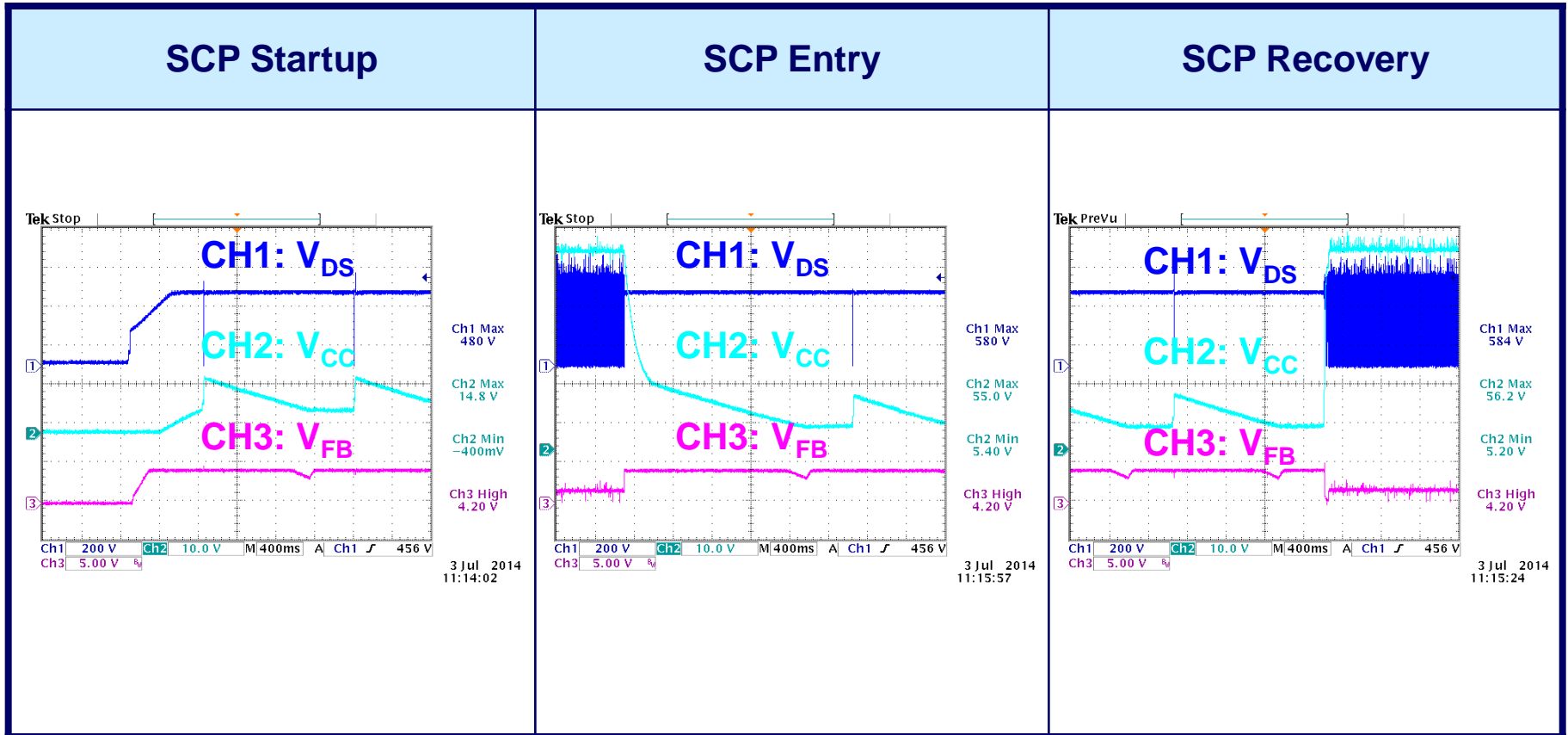
- The unit was switched on with no load on the output. A short circuit was applied manually to the output at the end of the cable. The mains voltage was adopted to obtain the worst-case condition.
- A short circuit was applied to the output at the end of the cable before startup of the unit. The unit was switched on with a short circuit at the output. The mains voltage was adopted to obtain the worse-case condition.

#### Criteria To Pass:

- The unit shall be capable of withstanding a continuous (at least 2 hours) short-circuit at the output without damage or overstress of the unit under any input conditions.
- After removal of the short circuit, the unit shall recover automatically.
- The input power consumption must be < **0.5W** at the full input range.

V <sub>AC</sub> /Hz	220/50	230/50	240/50	265/50
SCP	OK	OK	OK	OK
P <sub>IN</sub>	336.68mW	346.18mW	363.28mW	389.91mW

## Output short circuit at 230V<sub>AC</sub> (Typical input)



**Comment: Pass**

## 6.4.2 Output Over Voltage Protection (OVP)

### Test Conditions:

- An output over voltage was created by applying a short circuit across the opto LED.
- An AC input voltage was selected so that the worst-case condition occurred.
- There was full load or no load on the output.

### Criteria To Pass:

- The output voltage may not exceed **35V**.
- At the moment OVP occurs, the primary side controller should shut down and stay in a latched mode.

...Continued

Input		Input	
220V <sub>AC</sub>		230V <sub>AC</sub>	
	<b>V<sub>MAX</sub>: 24.5V</b>	<b>V<sub>MAX</sub>:</b>	<b>24.1V</b>
240V <sub>AC</sub>		265V <sub>AC</sub>	
	<b>V<sub>MAX</sub>: 24.4V</b>	<b>V<sub>MAX</sub>:</b>	<b>24.3V</b>

**Comment: Pass**

## 6.5 Output and Timing

### 6.5.1 Output Ripple

#### Test Conditions:

- The measurement was made with an oscilloscope having a full bandwidth.
- The output was shunted at the end of the output ceramic disk capacitor or electrolytic capacitor.
- There was full load on the output.

#### Criteria To Pass:

- The ripple of the output must remain within the specified limits (**500mV<sub>p-p</sub>**) at a maximum load current of **4A**.

V <sub>AC</sub> /Hz	220/50	230/50	240/50	265/50
Ripple (mV)	46.0	46.8	45.6	44.4

**Comment: Pass**



...Continued

Input	Ripple waveform	Input	Ripple waveform
<p><b>220V<sub>AC</sub></b></p>		<p><b>230V<sub>AC</sub></b></p>	
	<p><b>V<sub>P-P</sub>: 46.0mV</b></p>		<p><b>V<sub>P-P</sub>: 46.8mV</b></p>
<p><b>240V<sub>AC</sub></b></p>		<p><b>265V<sub>AC</sub></b></p>	
	<p><b>V<sub>P-P</sub>: 45.6mV</b></p>		<p><b>V<sub>P-P</sub>: 44.4mV</b></p>

**Comment: Pass**

## 6.5.2 Turn-on Delay and Output Rise Time

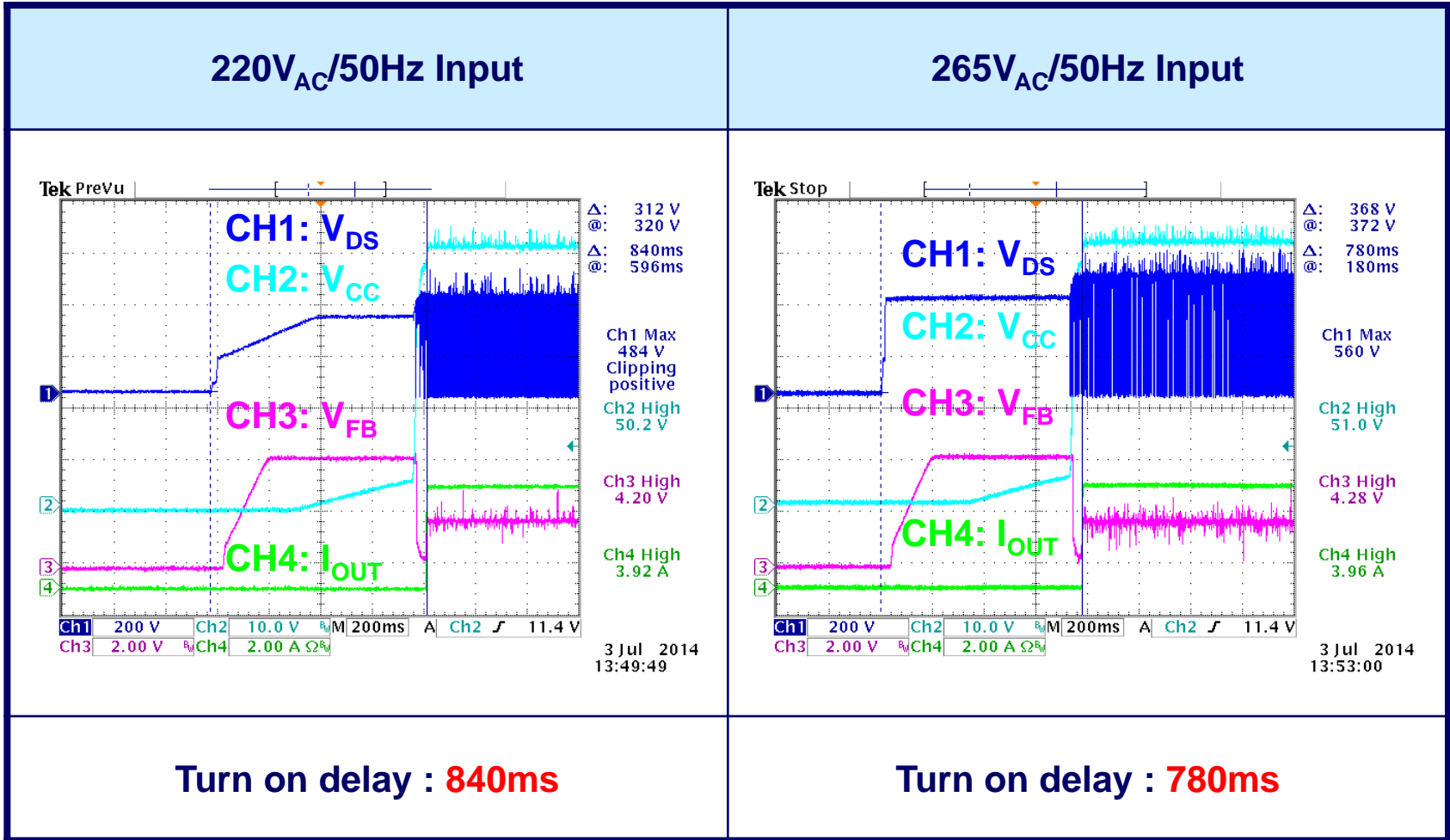
### Test Conditions:

- The electronic load was set to CC mode and  $V_{ON} = 0V$ .
- The electronic load was set to the maximum output current.

### Criteria To Pass:

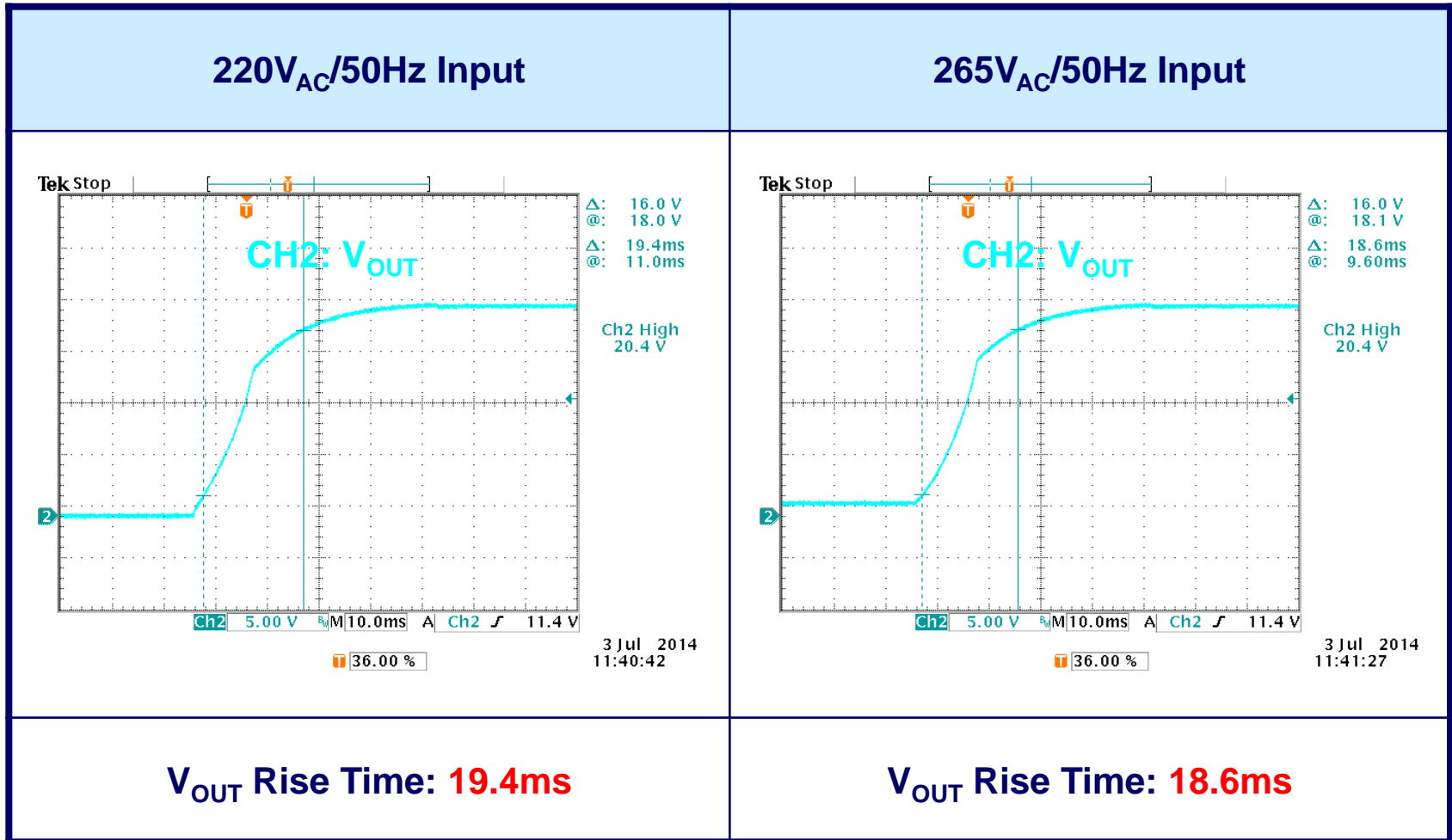
- Turn on delay: **1** Seconds maximum after the AC mains voltage was applied to the time when the output was within regulation.
- Output rise time: The output voltage shall rise from 10% of the maximum to the regulation limit within **50mS**. There must be a smooth and continuous ramp-up of the output voltage. No voltage with a negative polarity shall be present at the output during startup.

...Continued



**Comment: Pass**

...Continued



**Comment: Pass**

## 6.6 Thermal

### 6.6.1 Parts Thermal

#### Test Conditions:

- The input voltage was set to minimum input.
- The electronic load was set to the maximum output current.
- The unit was covered, and the data was recorded until temperature stabilization was achieved. Ta=30°C

#### Criteria To Pass:

- The  $\Delta$  temperature must be < 65°C.

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RefDes	Description	Temperature (°C)	Temperature Rise (°C)
BD1	Input Rectifier	54.6	24.6
C10,C11,C12	Output Capacitor	70.0	40
D7	Secondary Diode	93.8	63.8
Q1	Primary MOS	94.8	64.8
Q3,Q4	Secondary MOS	82.0	52.0
R19,R20	Sensing Resistor	80.0	50.0
T1	Transformer	91.9	61.9
U1	Primary Side Controller	68.0	38.0
U2	Secondary Side Controller	60.0	30.0

**Comment: Pass**

### 6.7 EMC and Safety

#### 6.7.1 Conducted Emission

##### Test Conditions:

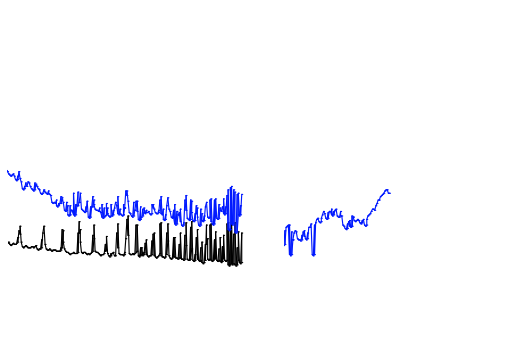
- The unit was subjected to 230V<sub>AC</sub> line and with maximum load.
- The test should include both L and N test.

##### Criteria To Pass:

- CISPR22 Class B with -8dB margin.

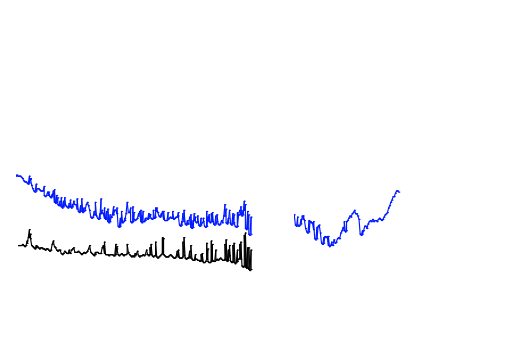
L (230V<sub>AC</sub>)

∨



N (230V<sub>AC</sub>)

∨



**Comment: Pass**