

HFC0500+MP6902

Customer Support Test Report

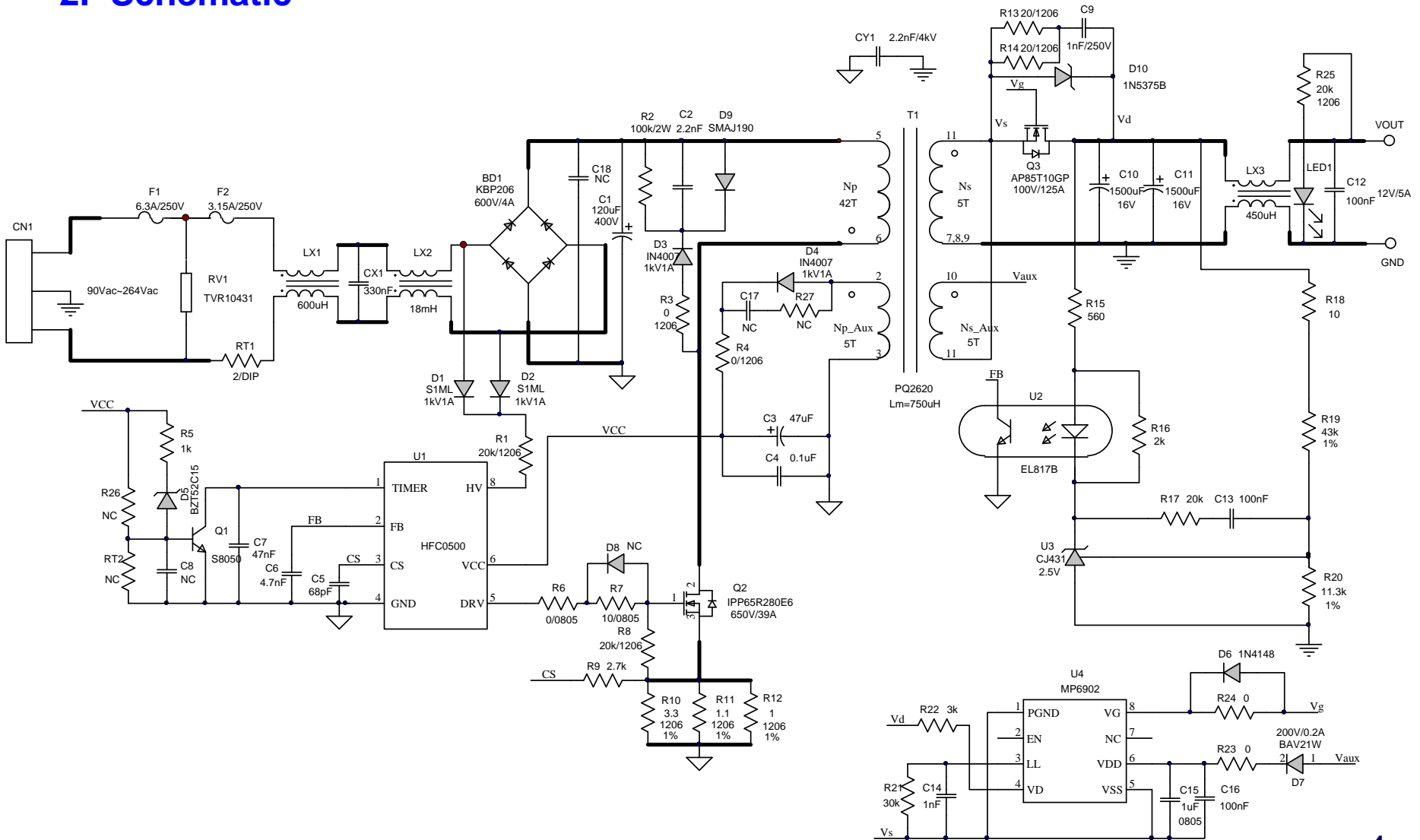
AE	John Liu
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Date	2014-07-10

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1. Specification

Description	Parameter	Units	Comment
Input voltage	90~264	V _{AC}	
Input frequency	47~53	Hz	
Output voltage	12	V	
Output current	5	A	

2. Schematic



4. Bill of Materials (Main Board)

Qty	RefDes	Value	Description	Package	Manufacturer	Manufacturer_PN
1	BD1	KBP206	Diode;600V;2A	DIP	Bangdayuan	KBP206
1	C1	120uF	Electrolytic Capacitor;400V;	DIP	Jianghai	CD267-400V120
1	C2	2.2nF	Ceramic Capacitor;630V	1206	muRata	
1	C3	47uF	Electrolytic Capacitor;25V;	DIP	Jianghai	CD286-25V47
3	C4,C13,C16	100nF	Ceramic Capacitor;50V;X7R;	0603	muRata	GRM188R71H104KA93D
1	C5	68pF	Ceramic Capacitor;50V;C0G;	0603	TDK	C1608COG1H680J
1	C6	4.7nF	Ceramic Capacitor;50V;X7R;	0603	TDK	C1608X7R1H471K
1	C7	47nF	Ceramic Capacitor;50V;X7R;	0603	muRata	GRM188R71H473KA61D
0	C8,C17,C18	NC				
1	C9	1nF	Capacitor;250V;X7R;	0805	TDK	C2012X7R2E102K
2	C10,C11	1500uF	Electrolytic Capacitor;16V	DIP	Any	Any
1	C12	100nF	Ceramic Capacitor;25V;X7R;	0805	muRata	GRM21BR71E104KA01L
1	C14	1nF	Ceramic Capacitor;25V;C0G;	0603	muRata	GRM1885C1E102JA01D
1	C15	1uF	Ceramic Capacitor;50V;X7R;	0805	muRata	GRM21BR71H105KA12L
1	CN1		Connector	DIP	Any	Any
1	CX1	330nF	Capacitor;275V;10%	DIP	Carli	PX334K3ID49L270D9R
1	CY1	2.2nF	Capacitor;4kV;20%	DIP	Hongke	JN12E222MY02N
2	D1,D2	S1ML	Diode;1000V;1A	SMA	Taiwan Semiconductor	S1ML
2	D3,D4	1N4007	Diode;1000V;1A	DO-41	Diodes	1N4007
1	D5	BZT52C16	Zener Diode;16V;5mA/500mW;	SOD-123	Diodes	BZT52C16

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Qty	RefDes	Value	Description	Package	Manufacturer	Manufacturer_PN
1	D6	1N4148	Schottky Diode;40V;0.5A	SOD-123	Diodes	B0540W
1	D7	BAV21W	Diode;200V;0.2A;	SOD-123	Diodes	BAV21W-7-F
1	D8	NC				
1	D9	SMAJ190A	Diode;190V;1mA	DO-214AC	Brightking	SMAJ190A
1	D10	1N5375B	Zener Diode;82V;0.015A	DIP	Bangdayuan	1N5375B
1	F1		Fuse;250V;6.3A	DIP	Any	Any
1	F2	SS-5-3.15A	Fuse;250V;3.15A	DIP	Cooper Bussmann	SS-5-3.15A
1	LED1	F3D02R-4A	LED;Red	DIP	Any	F3D02R-4A
1	LX1	600uH	600uH/2A	DIP	Any	Any
1	LX2	18mH	18mH/2A	DIP	Any	Any
1	LX3	450uH	450uH/6A	DIP	Any	Any
1	Q1	S8050	Transistor;25V;0.5A;	SOT-23	Changdian	S8050
1	Q2	IPP65R280E6	Mosfet;650V;0.28ohm/10V;	TO220		IPP65R280E6
1	Q3	AP85T10GP	N-Channel Mosfet;100V;8mohm;	TO-220	APEC	AP85T10GP
3	R1,R8,R25	20kΩ	Film Resistor;5%;	1206	Yageo	RC1206JR-0720KL
1	R2	100kΩ	Resistor;5%;2W	DIP	Any	Any
2	R3,R4	0Ω	Film Resistor;5%	1206	Yageo	RC1206JR-070RL
1	R5	1kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-071KL
3	R6,R23,R24	0Ω	Film Resistor;5%;	0805	Yageo	RC0805JR-070RL
1	R7	10Ω	Film Resistor;1%;	0805	Yageo	RC0805FR-0710RL
1	R9	2.7kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-072K7L

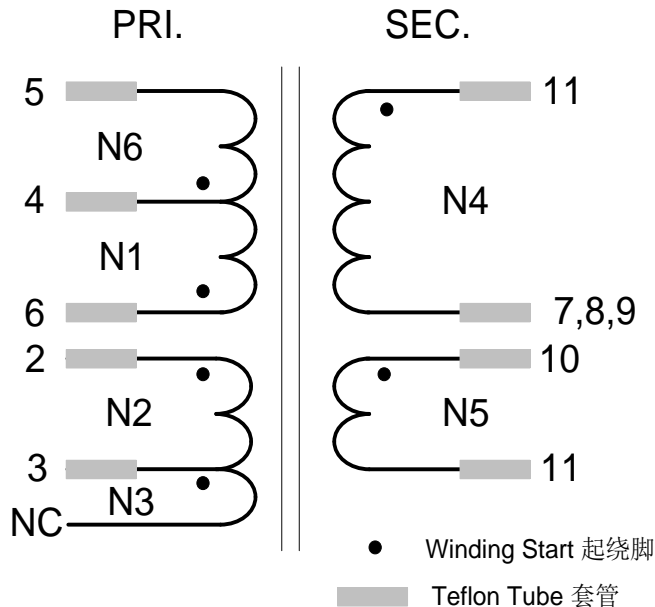
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Qty	RefDes	Value	Description	Package	Manufacturer	Manufacturer_PN
1	R10	3.3Ω	Film Resistor;1%	1206	Royalohm	1206F330KT5E
1	R11	1.1Ω	Film Resistor;1%	1206	Yageo	RC1206FR-071R1L
1	R12	1Ω	Film Resistor;1%	1206	Royalohm	1206F100KT5E
2	R13,R14	20Ω	Film Resistor;5%	1206	Yageo	RC1206JR-0720RL
1	R15	560Ω	Film Resistor;1%	0603	Yageo	RC0603FR-07560RL
1	R16	2kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-072KL
1	R17	20kΩ	Film Resistor;1%;	0603	Yageo	RC0603FR-0720KL
1	R18	10Ω	Film Resistor;1%;	0603	Yageo	RC0603FR-0710RL
1	R19	43kΩ	Film Resistor;1%	0603	LION	RC0603FR-0743KL
1	R20	11.3kΩ	Film Resistor;1%	0603	Yageo	RC0603FR-0711K3L
1	R21	30kΩ	Film Resistor;5%;	0603	LIZ	CR0603JA0303G
1	R22	3kΩ	Film Resistor;5%	0603	Yageo	RC0603JR-073KL
0	R26,R27	NC				
1	RT1	2Ω	NTC Resistor	DIP	Xingshun	2D2-10
1	RT2	NC				
1	RV1	TVR10431	MOV; 430V/1mA;0.4W;	DIP	TKS	TVR10431
1	T1	750uH	PQ26/25; Np:Ns:Np_aux:Ns_axu=42:5:5:5	DIP	Any	Any
1	U1	HFC0500	Offline controller	SOIC8-7	MPS	HFC0500HS
1	U2	EL817B	Photocoupler;1-Channel	DIP	Sharp	EL817B
1	U3	CJ431	2.5V shut regulator	SOT-23	Changdian	CJ431
1	U4	MP6902DS	SR controller;	SOIC8	MPS	MP6902DS

5. Transformer Information

5.1 Winding Spec

- Primary inductance: **750uH(±5%)**
- Leakage inductance: **40uH(Max)**
- Core/Bobbin: **PQ26/25**
- Core material: **PC40**
- N1:N2:N3:N4:N5:N6=18:5:15:5:5:24



5.2 Winding Details

Winding Order	Pin Number		Wire Type (Φ)	Number of Wires	Number of Turns	Winding Type
	Start	Finish				
N1	6	4	0.32mm	2	18	
N2	2	3	0.2mm	1	5	Spread Out
N3	3	NC	0.2mm	1	15	Spread Out
N4	11	7,8,9	0.6mm(T.I.W)	4	5	
N5	10	11	0.2mm(T.I.W)	1	5	Spread Out
N6	4	5	0.32mm	2	24	

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_{AC}/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 average efficiency must be > **90%**.

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Input (V _{AC} /Hz)	I _{OUT} (A)	V _{OUT} (V)	P _{OUT} (W)	P _{IN} (W)	Efficiency(%)
115/60	5	12.01	60.05	66.750	89.96
	3.75	12.02	45.075	49.933	90.27
	2.50	12.04	30.10	33.066	91.03
	1.251	12.04	15.062	16.524	91.15
Average Efficiency (%)					90.60
230/50	5	12.01	60.05	66.096	90.85
	3.751	12.02	45.087	49.141	91.75
	2.50	12.03	30.075	33.067	90.95
	1.251	12.04	15.062	16.704	90.17
Average Efficiency (%)					90.93

Comment: Pass

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 < **75mW** at the maximum input voltage.

V _{AC} /Hz	90/60	115/60	230/50	264/50
P _{IN} (mW)	68.91	63.48	68.88	72.68

Comment: Pass

6.3 Stress

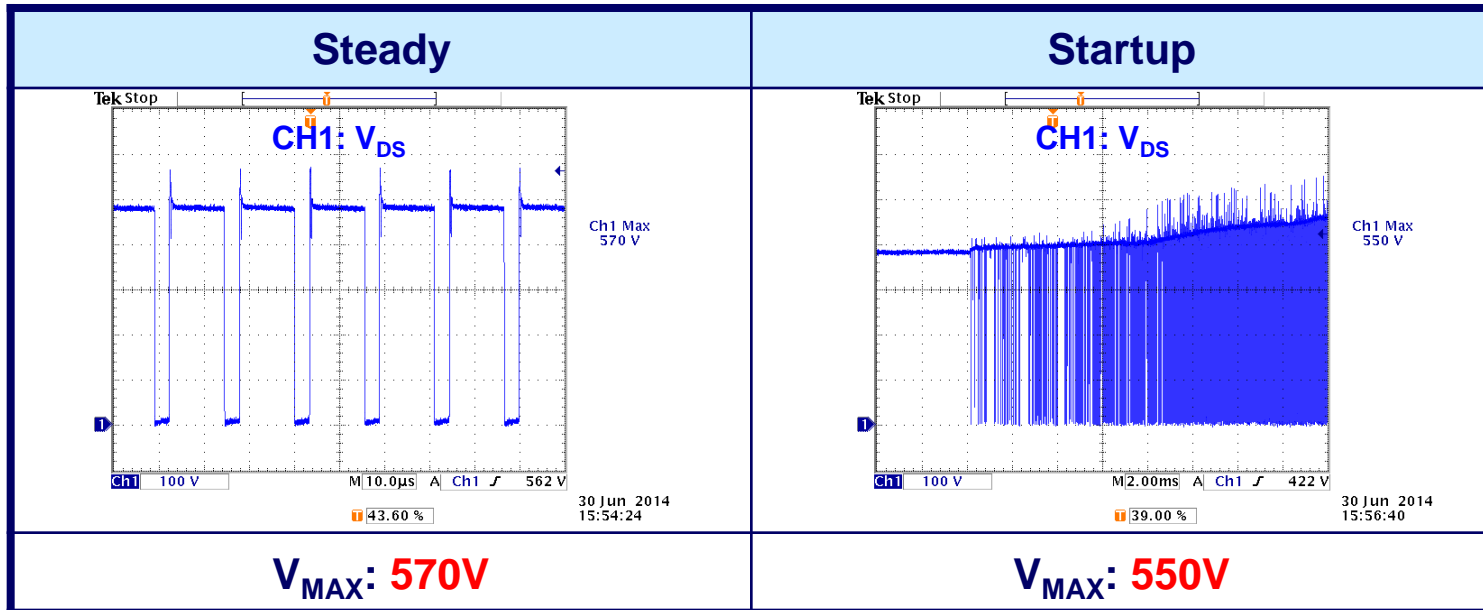
6.3.1 Mosfet V_{DS}

Test Conditions:

- The main input voltage was set to $264V_{AC}$.
- The electronic load was set to the maximum output current.

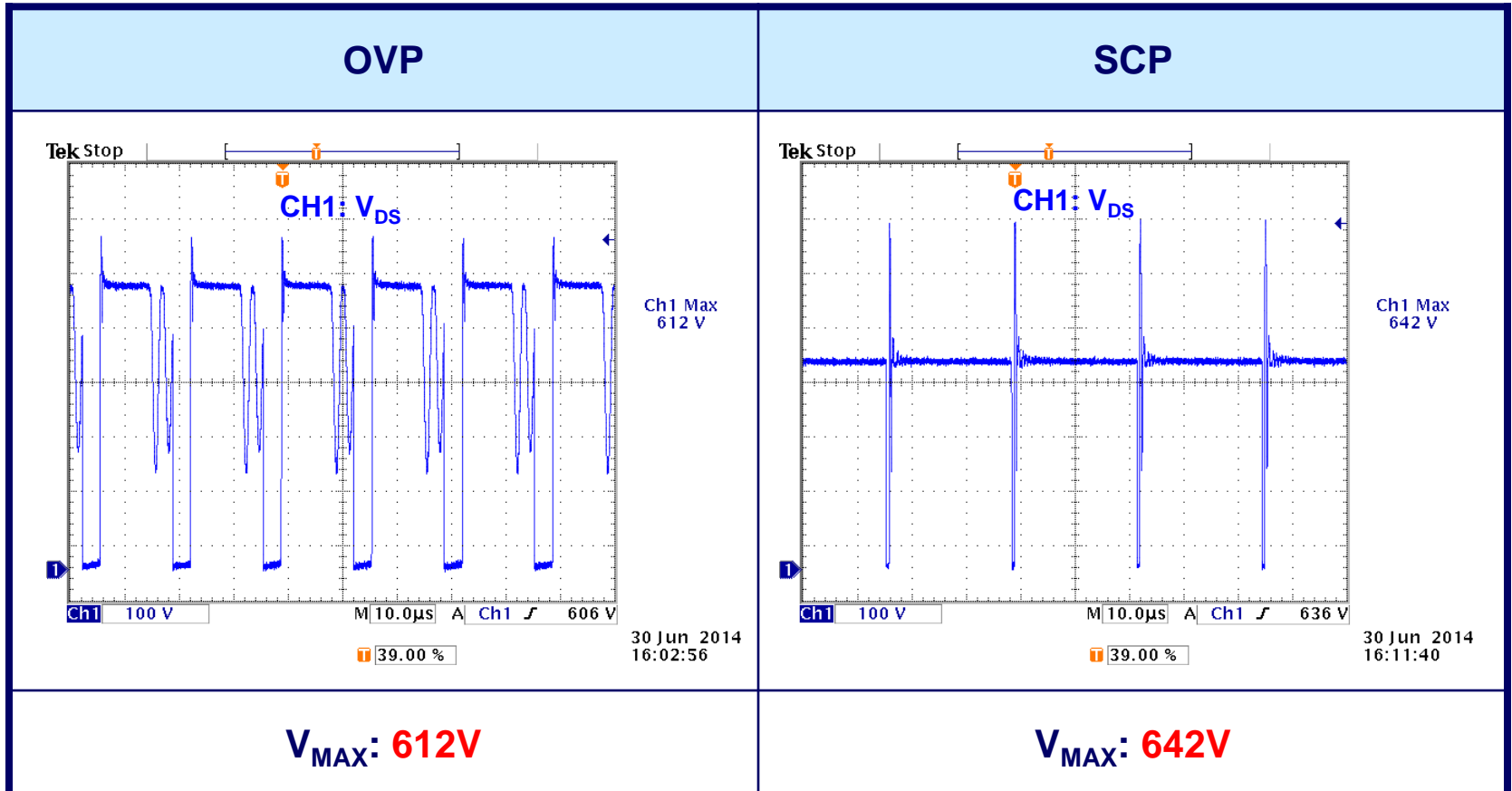
Criteria To Pass:

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



Comment: Pass

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Comment: Pass

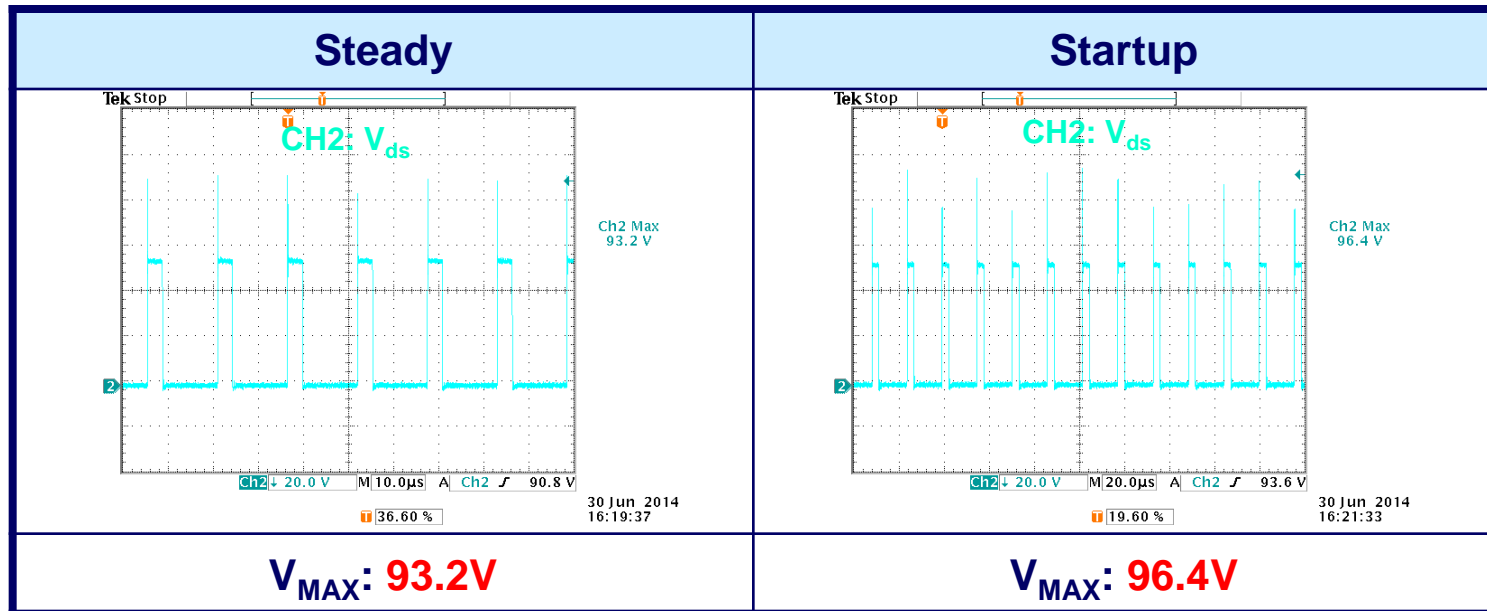
6.3.2 Output Mosfet V_{ds}

Test Conditions:

- The main input voltage was set to $264V_{AC}$.
- The electronic load was set to the maximum output current.

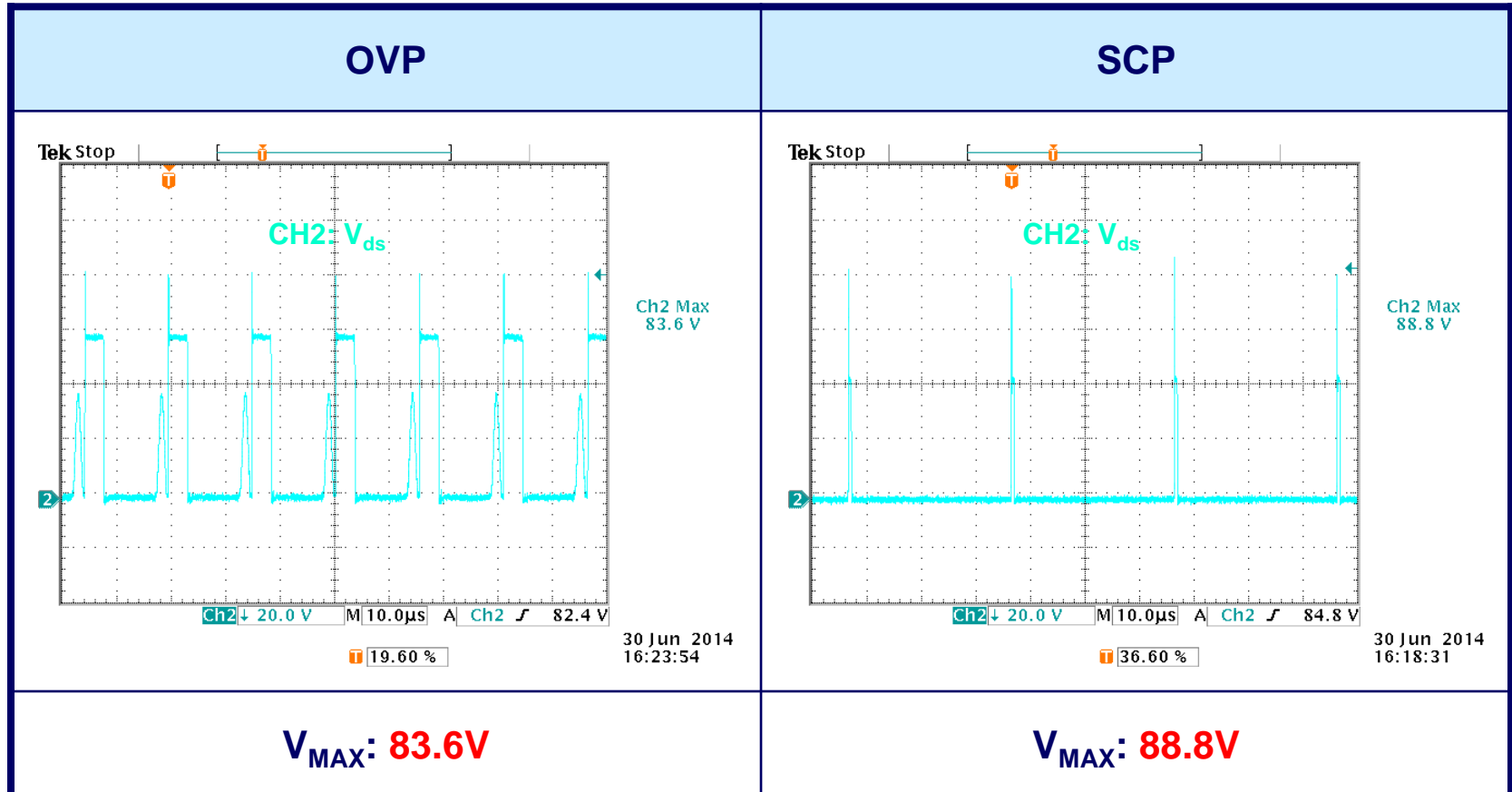
Criteria To Pass:

- The diode V_{ds} must be $< 100V$ at both startup and steady status.



Comment: Pass

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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 **< 1.5W** at the full input range.

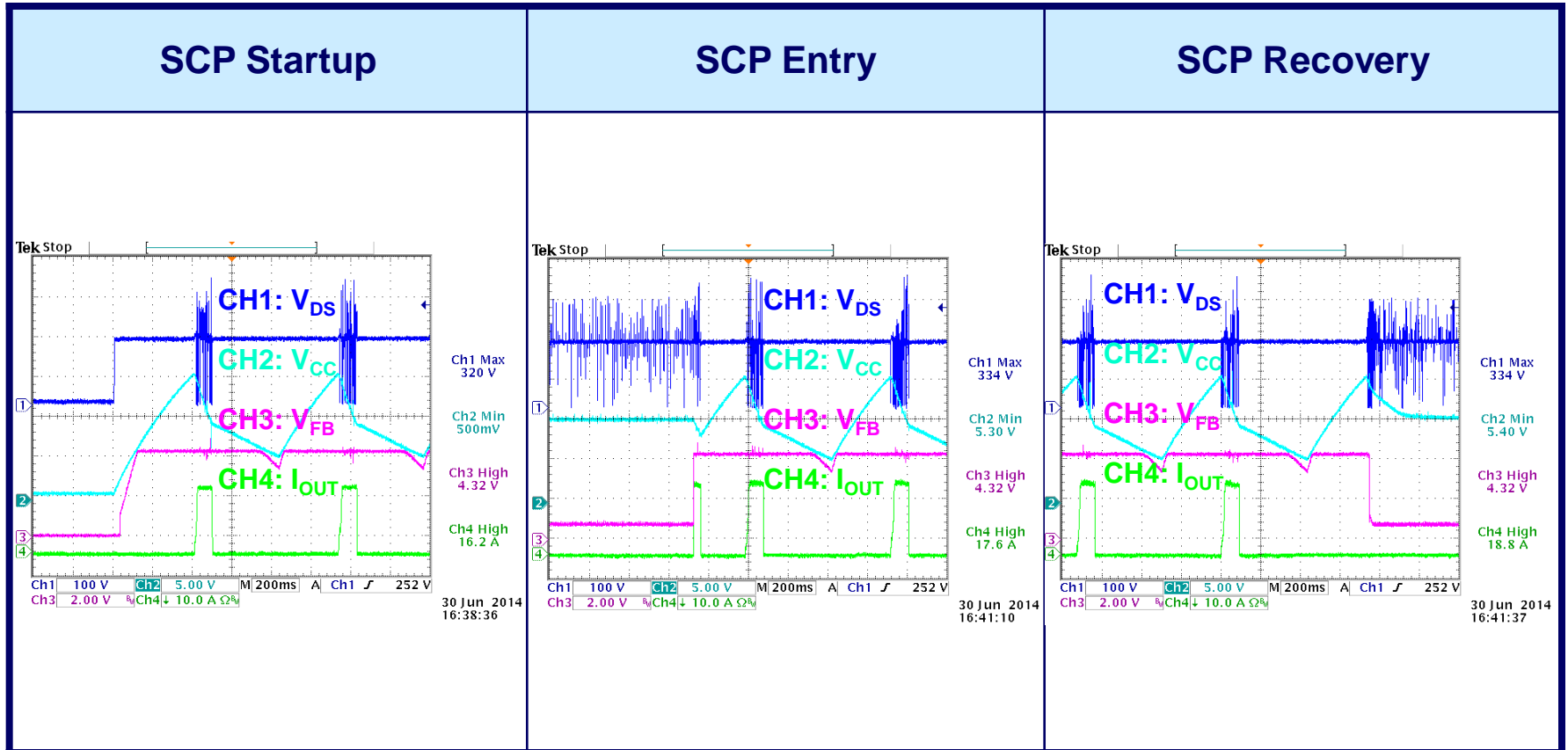
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V_{AC}/Hz	90/60	115/60	230/50	265/50
SCP	OK	OK	OK	OK
P_{IN}	1.392W	1.830W	282.29mW	364.4W

◆ Due to at low input voltage, SCP can't be triggered, OCP will protect the circuit instead. So the input power at low line is larger than high line.

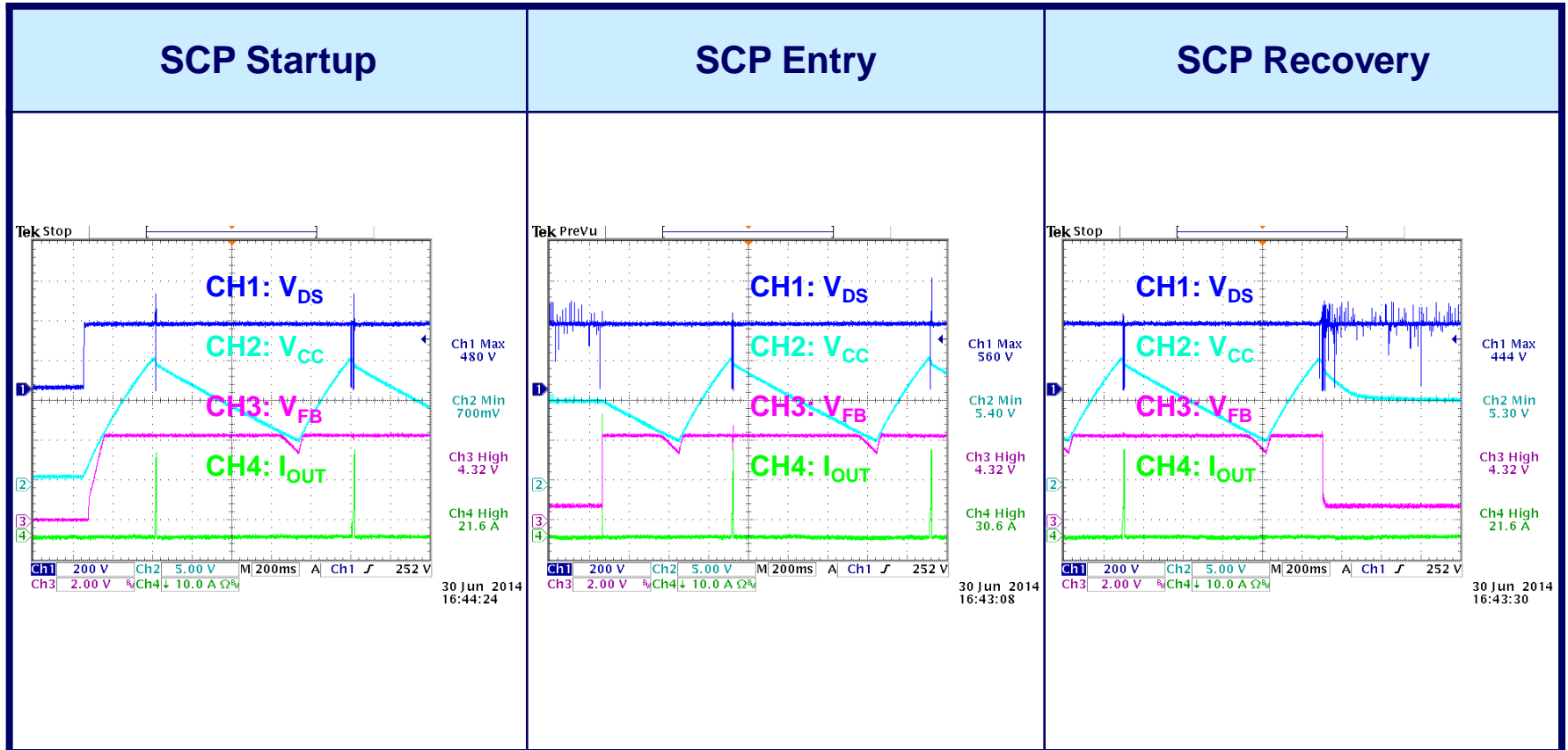
Comment: Pass

Output short circuit at 90V_{AC}(Worst input)



Comment: Pass

Output short circuit at 230V_{AC}(Typical input)



Comment: Pass

6.4.2 Over Current Protection (OCP)

Test Conditions:

- The load was increased from the maximum value to the an estimated over-current value in several steps.
- The test was repeated for different input voltages.

Criteria To Pass:

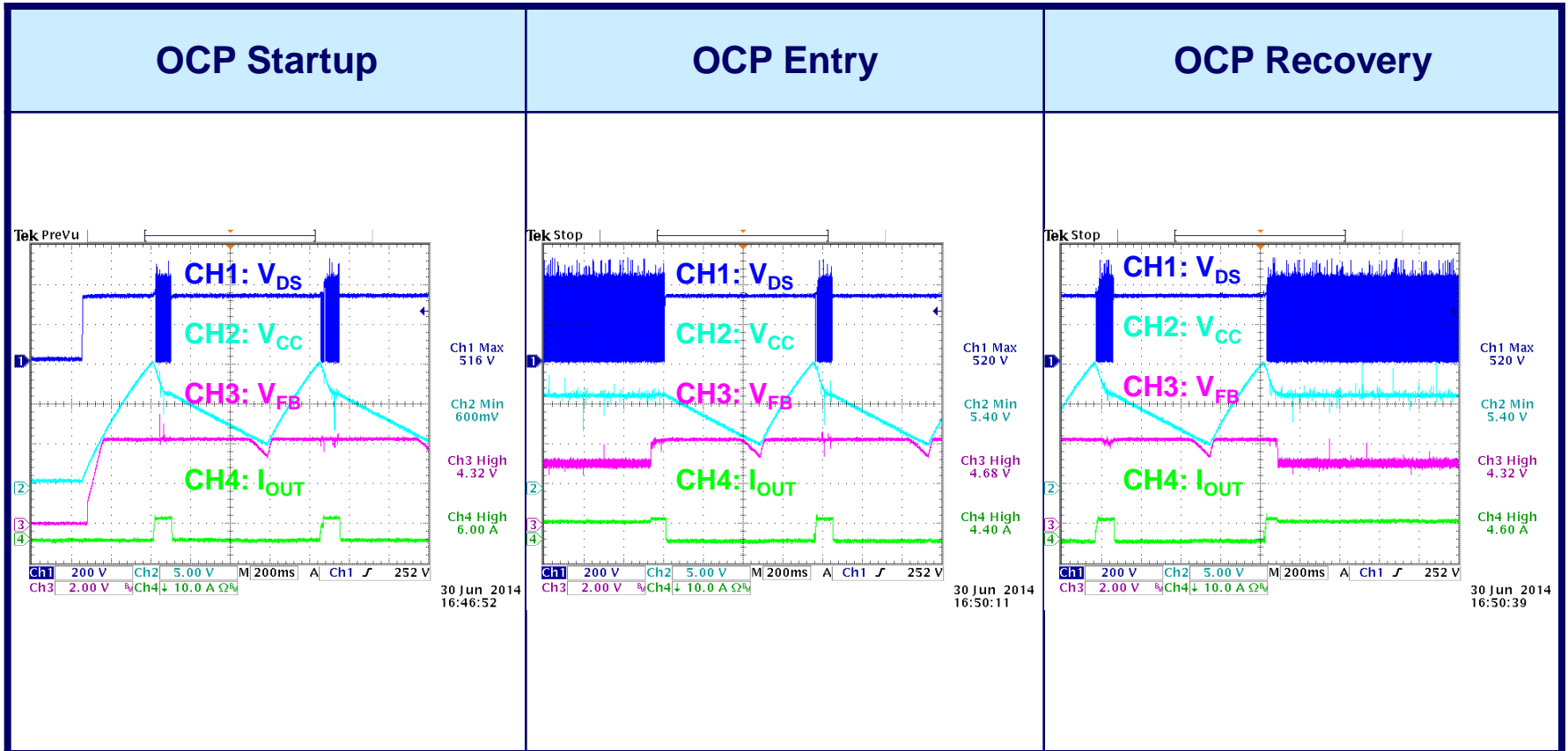
- The output power should be limited, just before the triggering of the over current protection, while the unit under any input conditions.

V_{AC}/Hz	90/60	115/60	230/50	265/50
OCP	5.68A	6.20A	5.69A	5.20A

Comment: Pass

...Continued

OCP at 230V_{AC}(Typical input)



Comment: Pass

6.4.3 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:

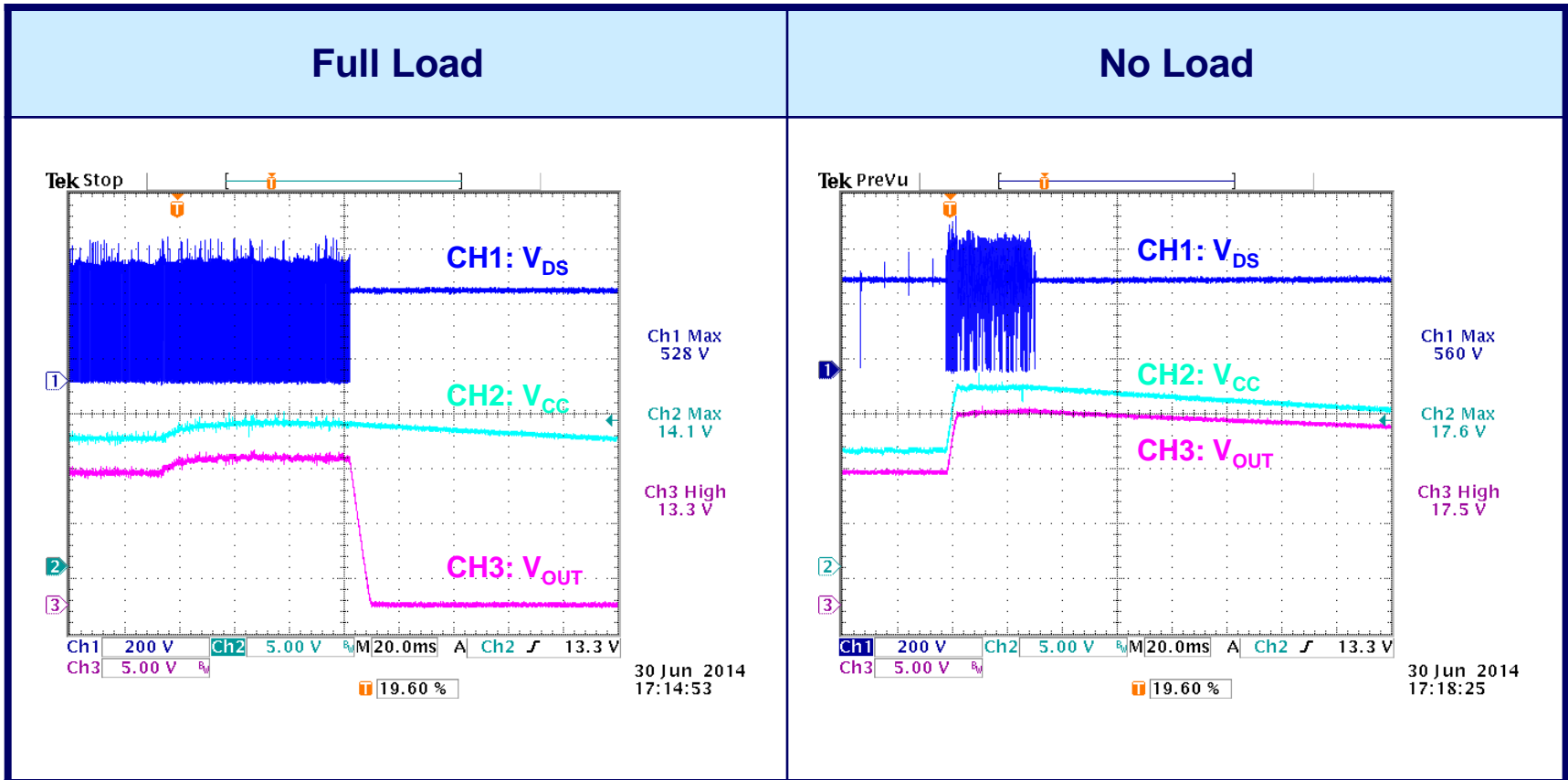
- The output voltage may not exceed **18V** or stabilize between **18V** and the rated voltage.
- At the moment OVP occurs, the primary side controller should be stay in latched mode or other protect mode.

Input (V _{AC} /Hz)	90/60	115/60	230/50	264/50
OVP Trip Point (V)	16.6	16.8	17.5	17.5

Comment: Pass

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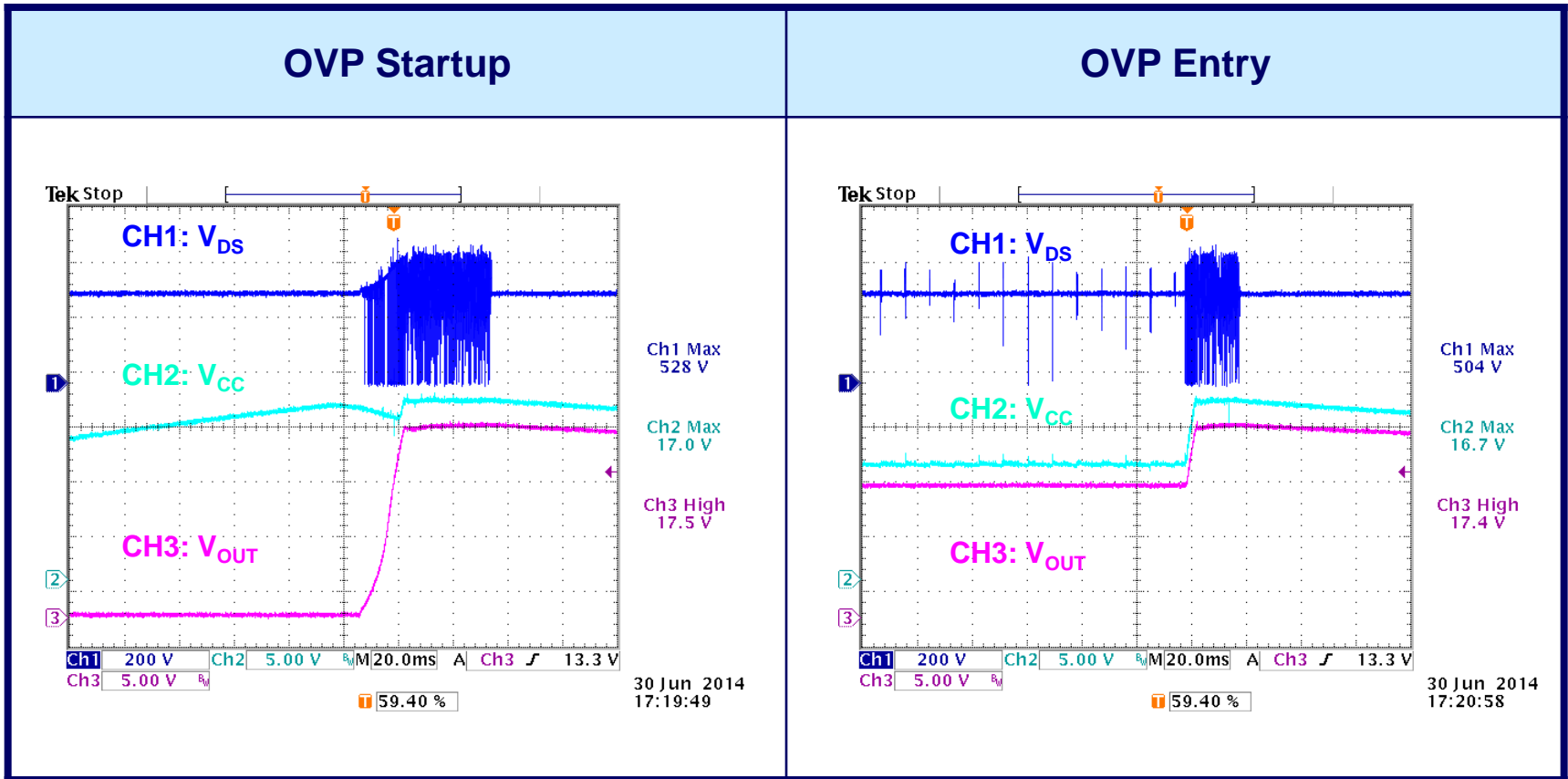
OVP at 230V_{AC}



Comment: Pass

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OVP at 230V_{AC}



Comment: Pass

6.5 Output and Timing

6.5.1 Load Regulation (*Optional, only for multiple output*)

Test Conditions:

- The output voltage deviation was measured while the load current on the output was increased from **0A** to **5A**.
- The measurement was repeated for different input voltages.

Criteria To Pass:

- The output voltage deviation must remain within **1%**.

Comment: Pass

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Output Input	No Load	¼ Load	½ Load	¾ Load	Full Load
115V _{AC}	12.05V	12.04V	12.04V	12.02V	12.01V
230V _{AC}	12.05V	12.04V	12.03V	12.02V	12.01V

Comment: Pass

6.5.2 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.

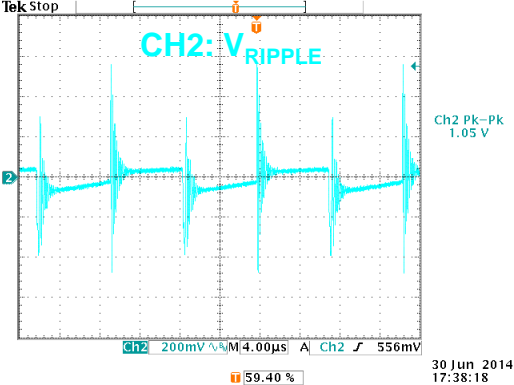
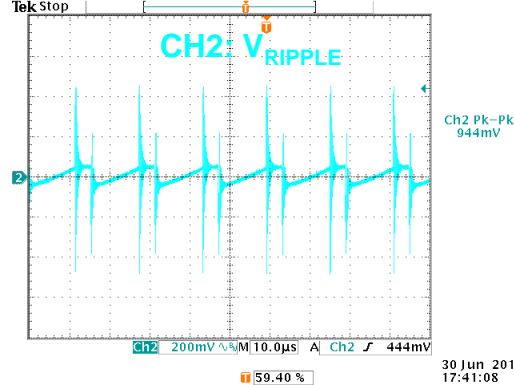
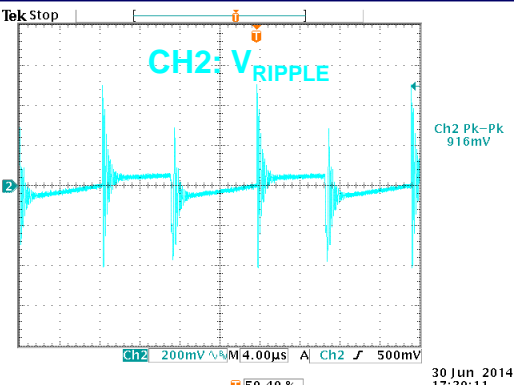
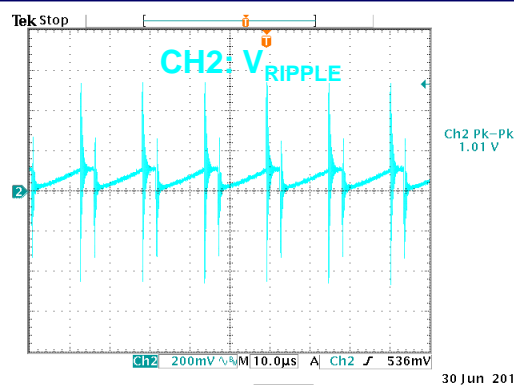
Criteria To Pass:

- The ripple of the output must remain within the specified limits (**120mV_{p-p}**) at a maximum load current of **5A**.

V _{AC} /Hz	90/60	115/60	230/50	264/50
Ripple (mV)	1050	916	944	1010

Comment: Not Good

...Continued

Input	Ripple waveform	Input	Ripple waveform
<p>90V_{AC}</p>	 <p>V_{P-P}: 1.05V</p>	<p>230V_{AC}</p>	 <p>V_{P-P}: 944mV</p>
<p>115V_{AC}</p>	 <p>V_{P-P}: 916mV</p>	<p>264V_{AC}</p>	 <p>V_{P-P}: 1.01V</p>

Comment: Not Good

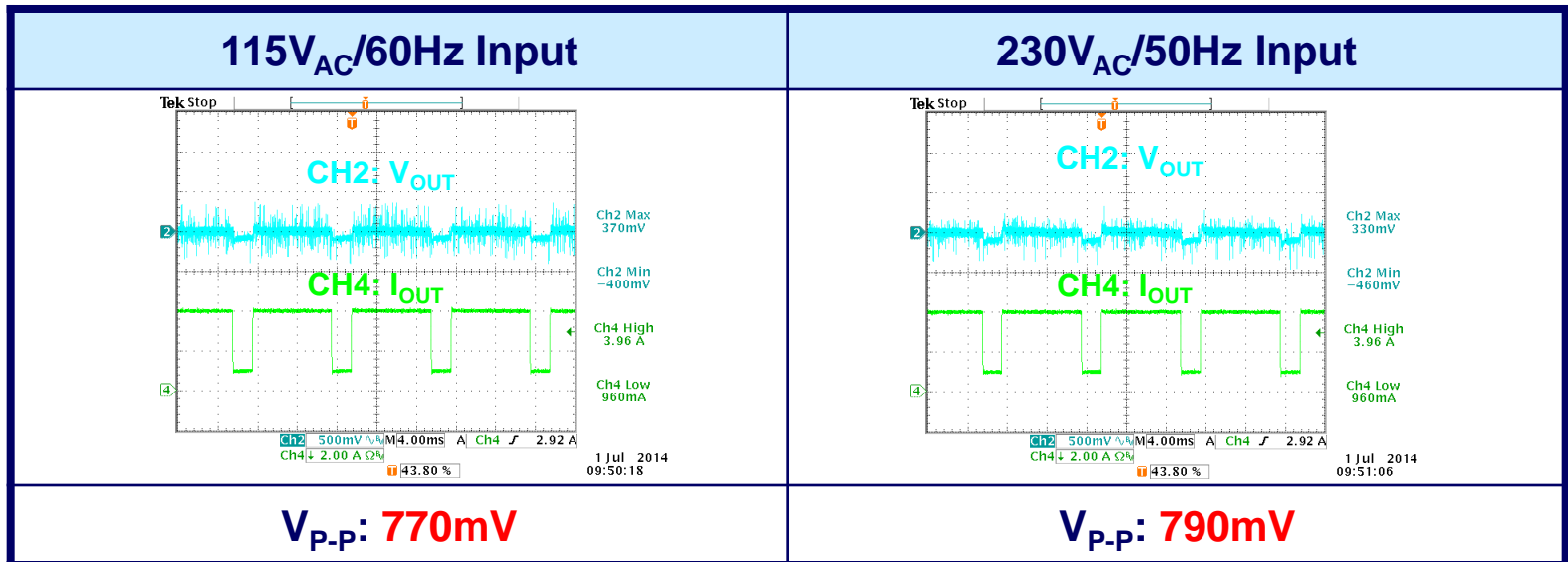
6.5.3 Transient Response

Test Conditions:

- The load of the unit changed from **1A** to **4A** at a slew rate of **0.1A/us**.
- The frequency of change was set to give the best readability of the deviation and setting time.

Criteria To Pass:

- The output was not allowed to have an overshoot or undershoot beyond the specified limits (**+0.6V** to **-0.6V**) after a load change.



Comment: Pass

6.5.4 Turn-on Delay and Output Rise Time

Test Conditions:

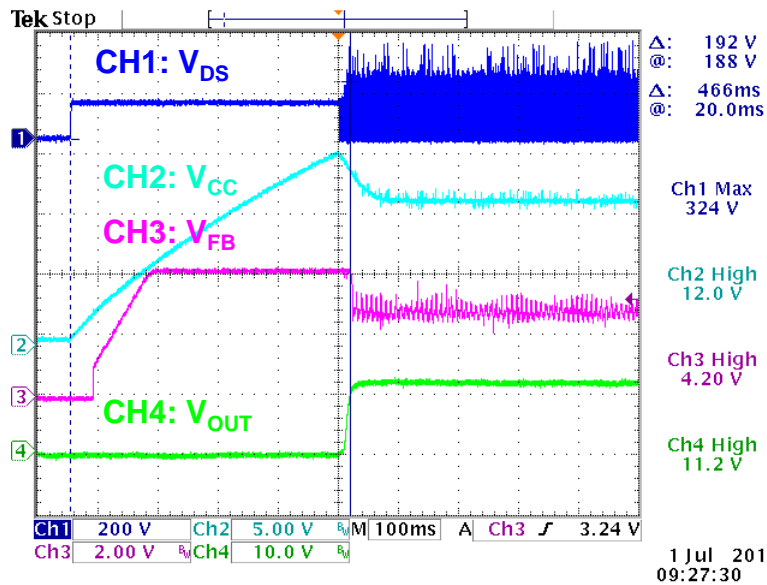
- The electronic load was set to CC mode and $V_{ON} = 0V$.
- The electronic load was set to the maximum output current.

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 **25mS**. 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.

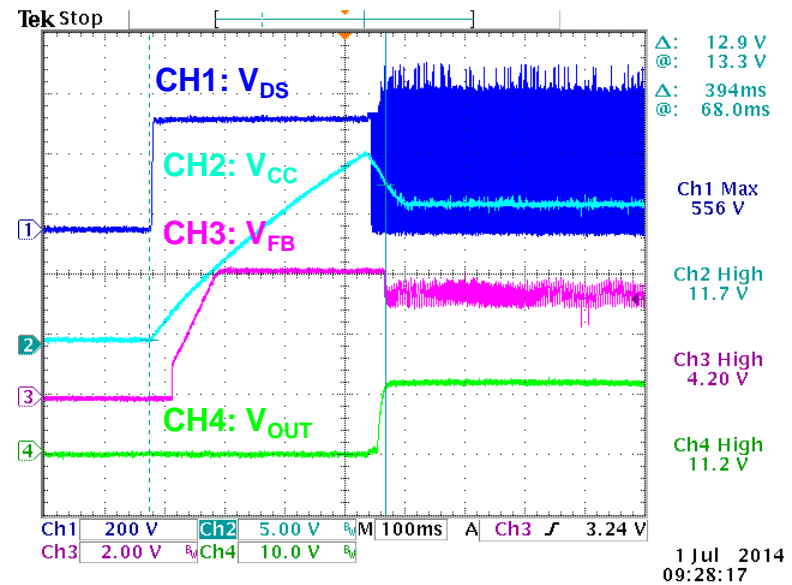
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90V_{AC}/60Hz Input



V_{OUT} Rise Time: **466ms**

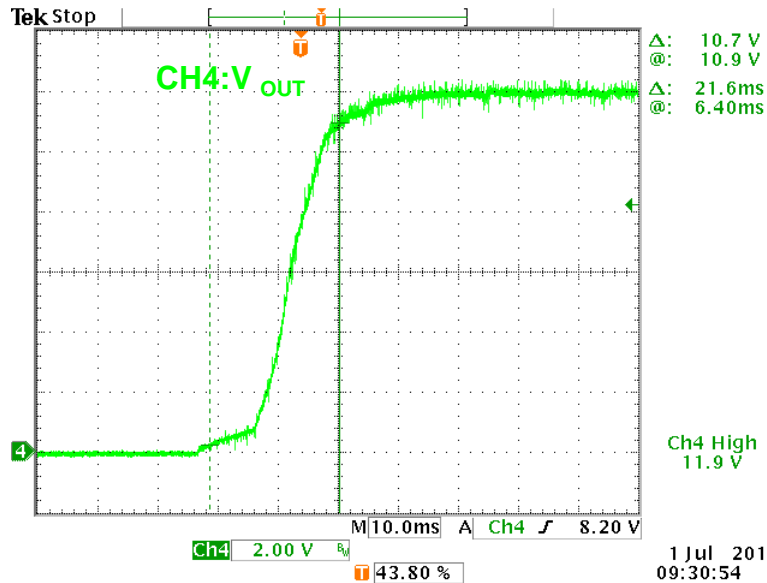
264V_{AC}/50Hz Input



V_{OUT} Rise Time: **394ms**

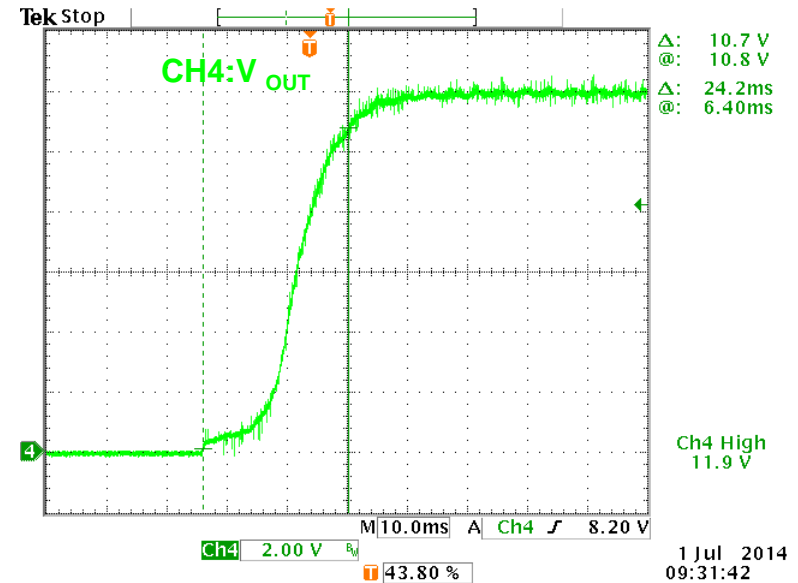
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90V_{AC}/60Hz Input



V_{OUT} Rise Time: **21.6ms**

265V_{AC}/50Hz Input



V_{OUT} Rise Time: **24.2ms**

Comment: Pass

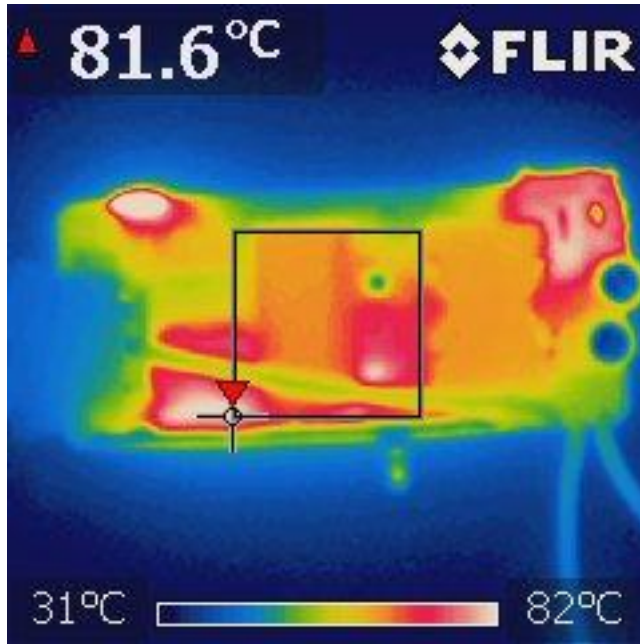
6.6 Thermal

6.6.1 Parts Thermal

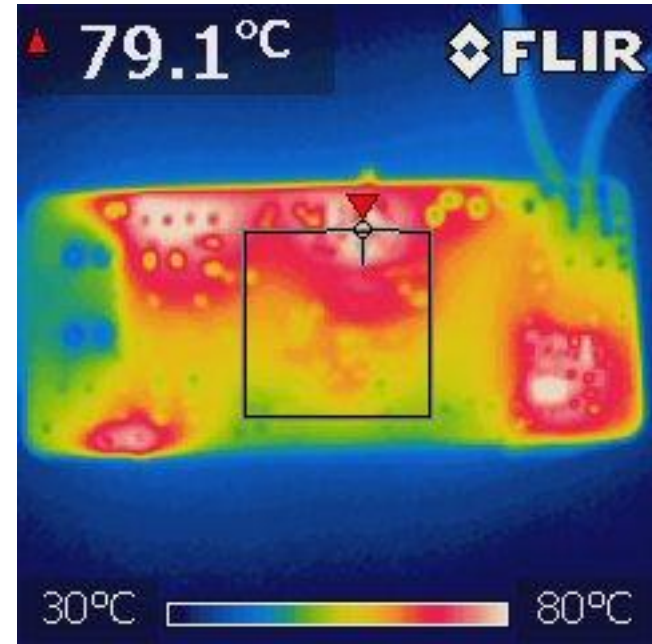
Test Conditions:

- 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

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Top



Bottom

Copper Thickness: 1 Oz

6.7 EMC and Safety

6.7.1 Conducted Emission

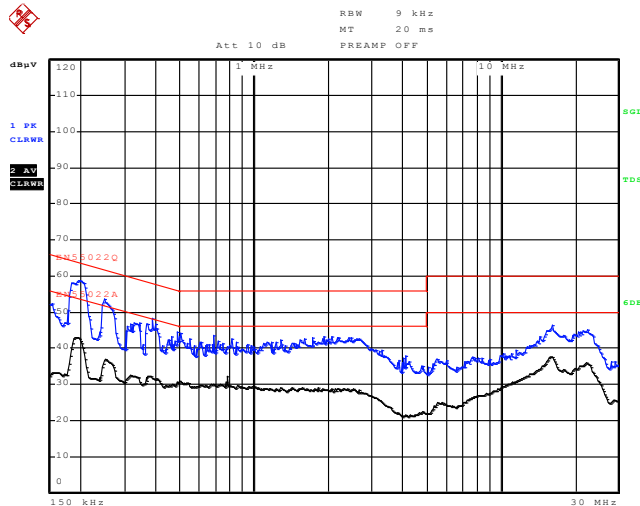
Test Conditions:

- The unit was subjected to 115V_{AC} or 230V_{AC} line and with maximum load.
- The test should include both L and N test.

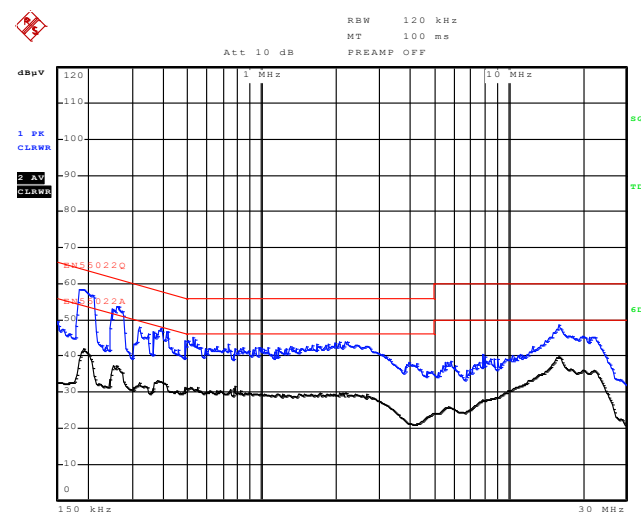
Criteria To Pass:

- CISPR22 Class B with -6dB margin.

L(115V_{AC})



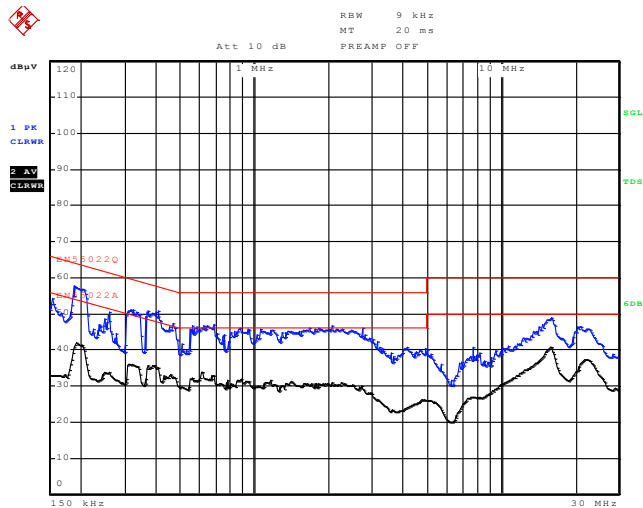
N(115V_{AC})



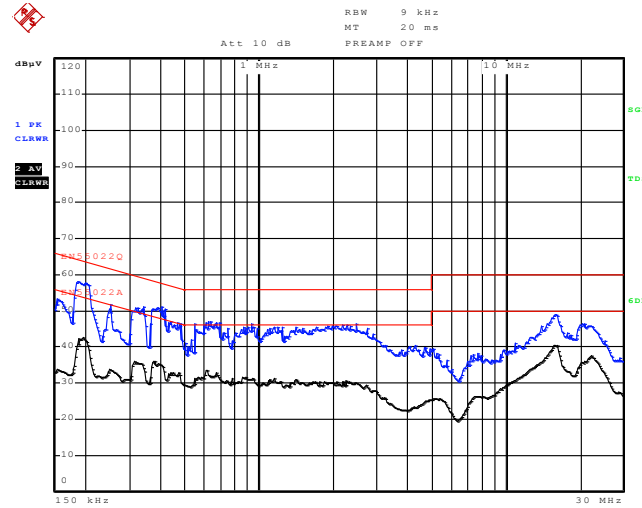
Comment: Pass

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L(230V_{AC})



N(230V_{AC})



Comment: Pass