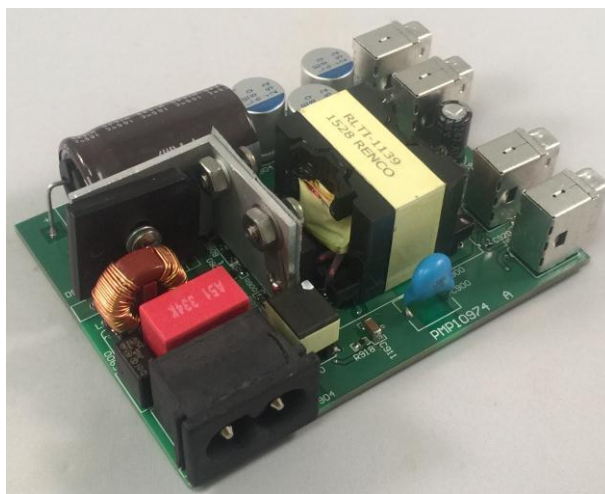
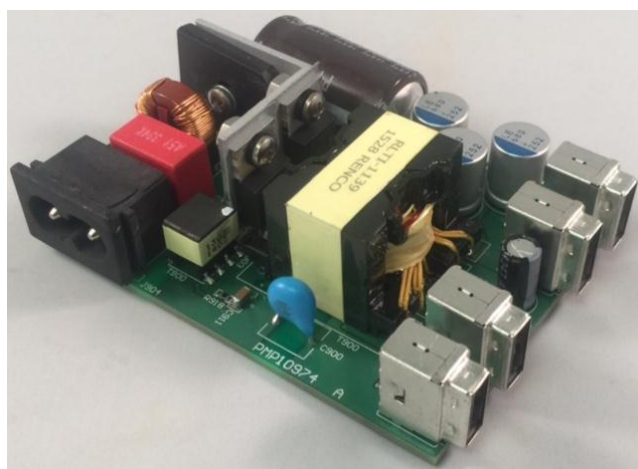
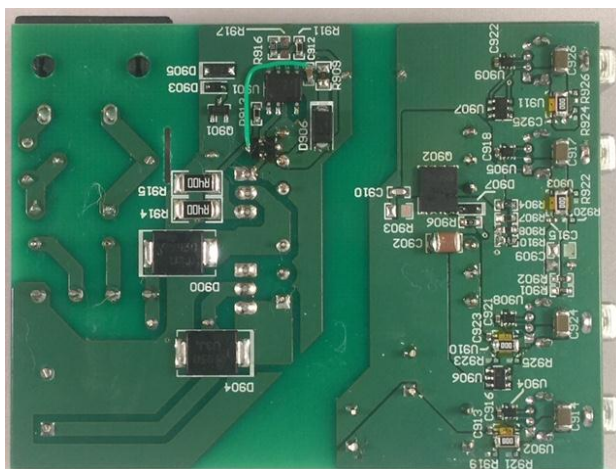


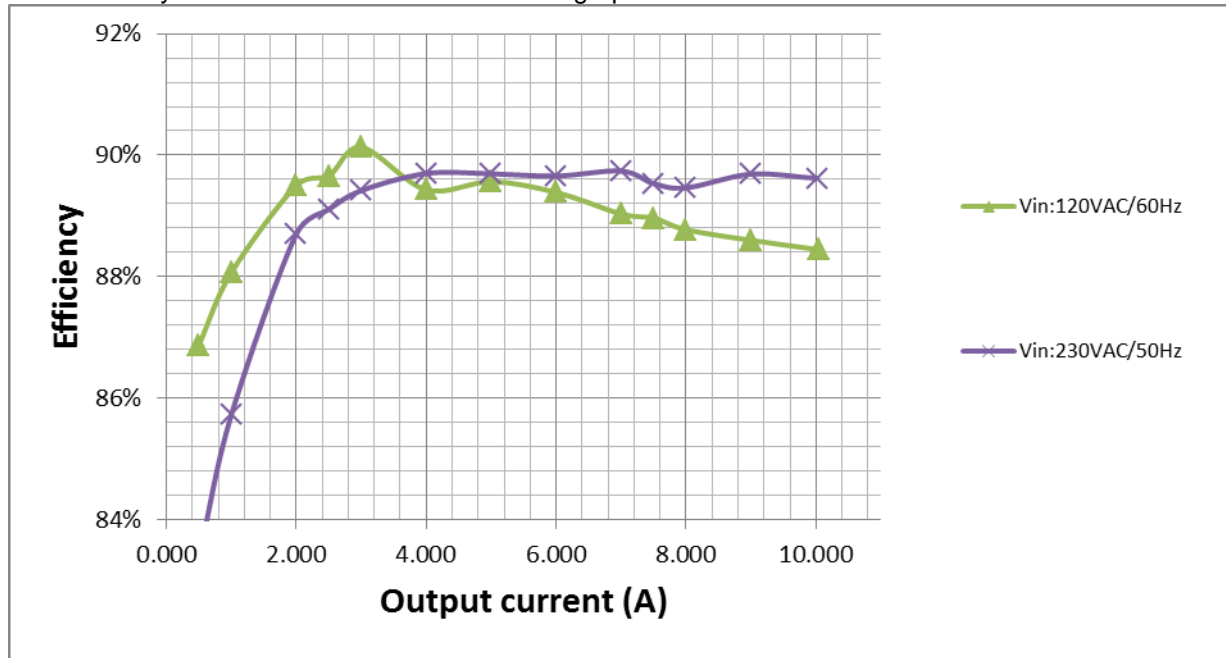
## 1 Photo

The photographs below show the PMP10974 Rev A assembly. This circuit was built on a PMP10974 Rev A PCB.



## 2 Converter Efficiency

The efficiency data are shown in the tables and graph below.



### $V_{IN}=120V_{AC}/60Hz$

Vin(AC)	Iin(A)	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Losses	Eff. (%)
119.97	0.858	59.210	5.216	10.040	52.369	6.841	88.45%
120.07	0.770	52.690	5.187	9.000	46.683	6.007	88.60%
120.17	0.686	46.500	5.16	8.000	41.280	5.220	88.77%
120.02	0.645	43.400	5.148	7.500	38.610	4.790	88.96%
120.06	0.604	40.380	5.136	7.000	35.952	4.428	89.03%
120.16	0.521	34.320	5.113	6.000	30.678	3.642	89.39%
120.27	0.439	28.410	5.089	5.000	25.445	2.965	89.56%
120.03	0.360	22.650	5.064	4.000	20.256	2.394	89.43%
120.1	0.276	16.801	5.046	3.001	15.143	1.658	90.13%
120.16	0.235	14.031	5.032	2.500	12.580	1.451	89.66%
120.21	0.193	11.220	5.021	2.000	10.042	1.178	89.50%
120.32	0.107	5.690	5.011	1.000	5.011	0.679	88.07%
120.39	0.060	2.884	5.011	0.500	2.506	0.379	86.88%
120.03	0.015	0.036	5.014	0.000	0.000	0.036	0.00%

**V<sub>IN</sub>=230V<sub>AC</sub>/50Hz**

Vin(AC)	Iin(A)	Pin(W)	Vo1(V)	Io1(A)	Pout(W)	Losses	Eff. (%)
230.0	0.521	58.330	5.217	10.020	52.274	6.056	89.62%
230.0	0.471	52.070	5.189	9.000	46.701	5.369	89.69%
230.1	0.423	46.160	5.162	8.000	41.296	4.864	89.46%
230.1	0.399	43.140	5.15	7.500	38.625	4.515	89.53%
230.1	0.373	40.070	5.137	7.000	35.959	4.111	89.74%
230.2	0.325	34.230	5.115	6.000	30.690	3.540	89.66%
230.2	0.276	28.380	5.091	5.000	25.455	2.925	89.69%
230.3	0.226	22.600	5.068	4.000	20.272	2.328	89.70%
230.3	0.176	16.933	5.047	3.000	15.141	1.792	89.42%
230.1	0.150	14.115	5.031	2.500	12.578	1.538	89.11%
230.1	0.125	11.314	5.018	2.000	10.036	1.278	88.70%
230.1	0.073	5.865	5.023	1.001	5.028	0.837	85.73%
230.2	0.045	3.013	5.024	0.500	2.512	0.501	83.37%
230.2	0.024	0.035	5.016	0.000	0.000	0.035	0.00%

**Average Efficiency**

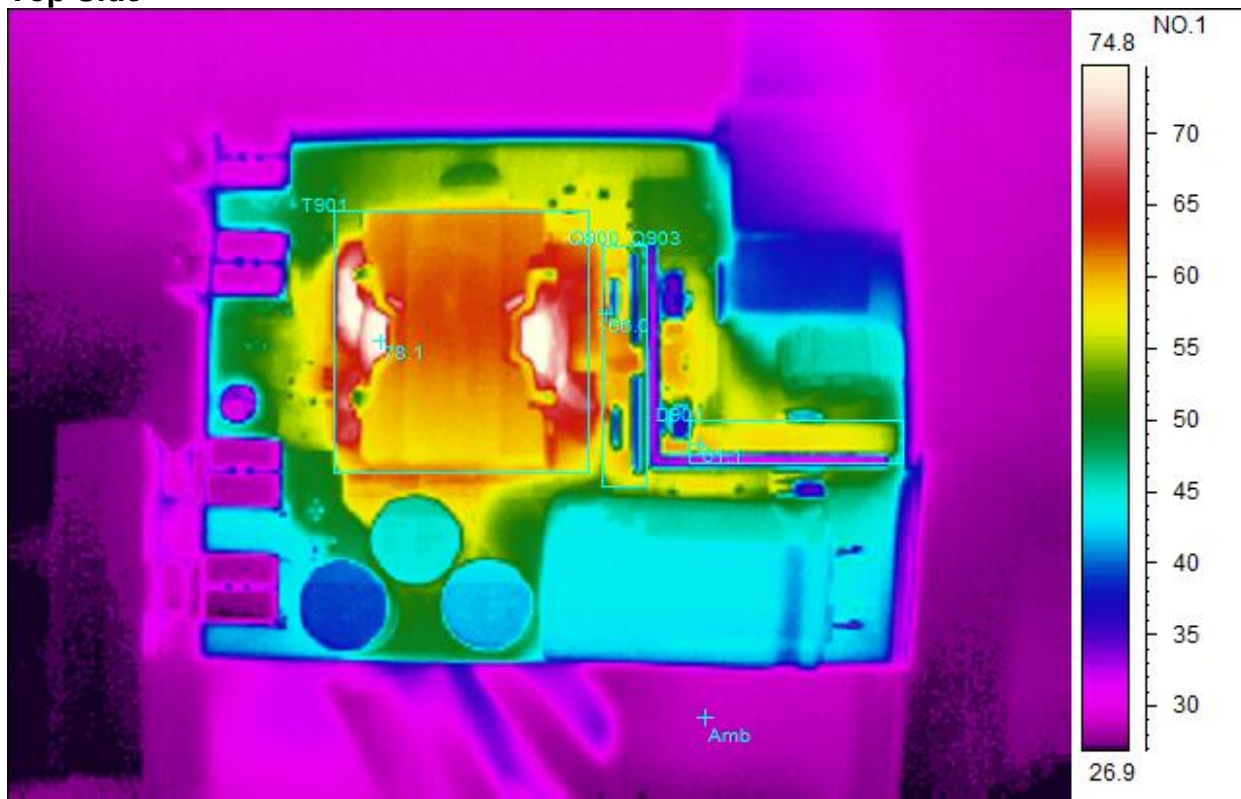
Vin	Pin(W)	Vout(V)	Iout(A)	Load	Avg Eff.
120VAC/60Hz	14.031	5.032	2.500	25%	89.16%
	28.410	5.089	5.000	50%	
	43.400	5.148	7.500	75%	
	59.210	5.216	10.040	100%	
230VAC/50Hz	14.115	5.031	2.500	25%	89.49%
	28.380	5.091	5.000	50%	
	43.140	5.15	7.500	75%	
	58.330	5.217	10.020	100%	

### 3 Thermal Images

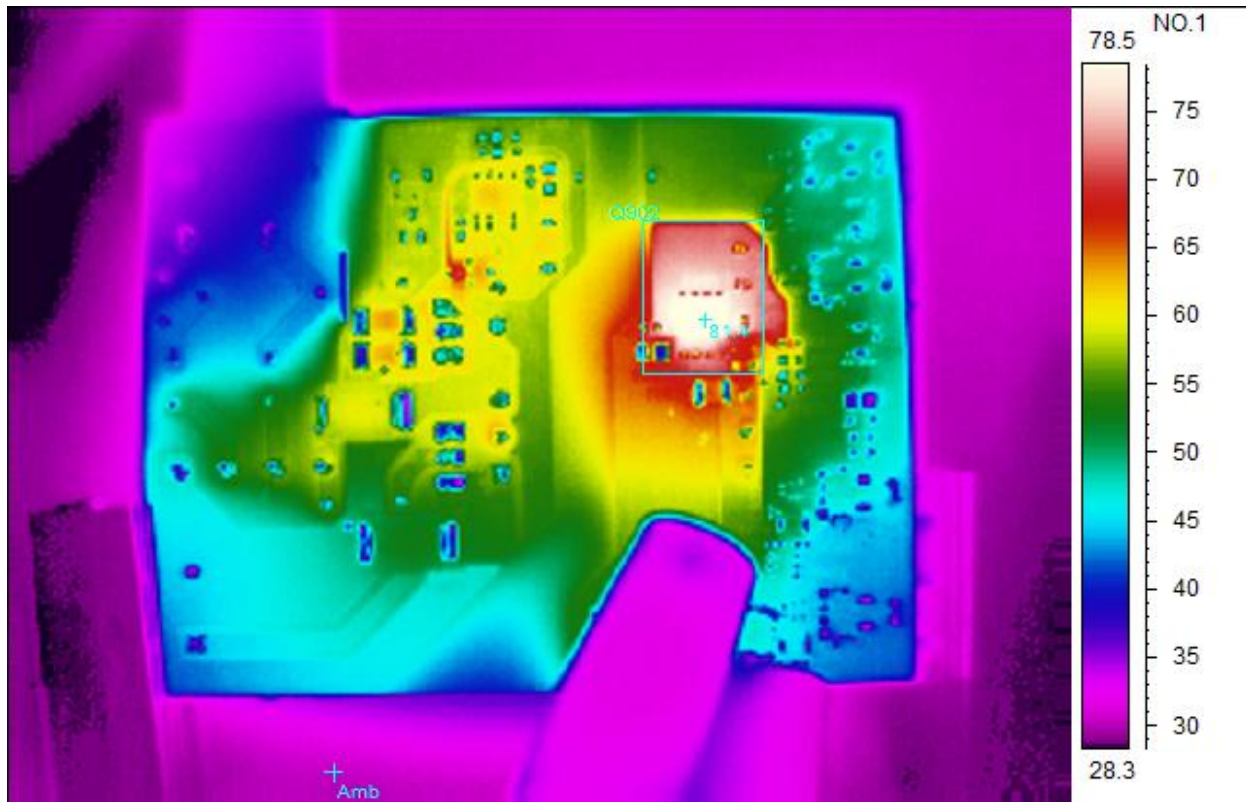
The thermal images below show a top view and bottom view of the board. The ambient temperature was 20°C with no forced air flow. The output was at 5V/50W full load.

**120V<sub>AC</sub>/60Hz**

**Top Side**

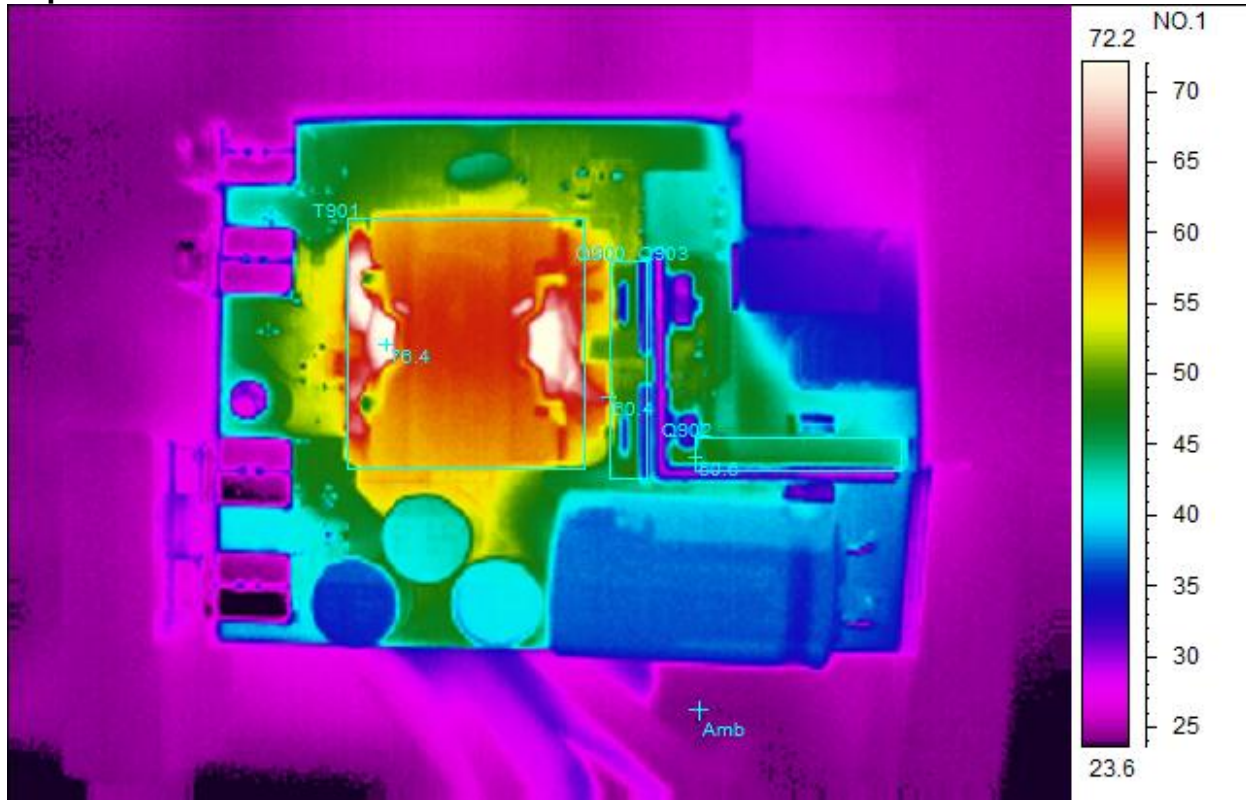


Spot analysis	Value
Amb Temperature	29.1°C
Area analysis	Value
T901Max	78.1°C
Q900, Q903Max	66.0°C
D901Max	61.1°C

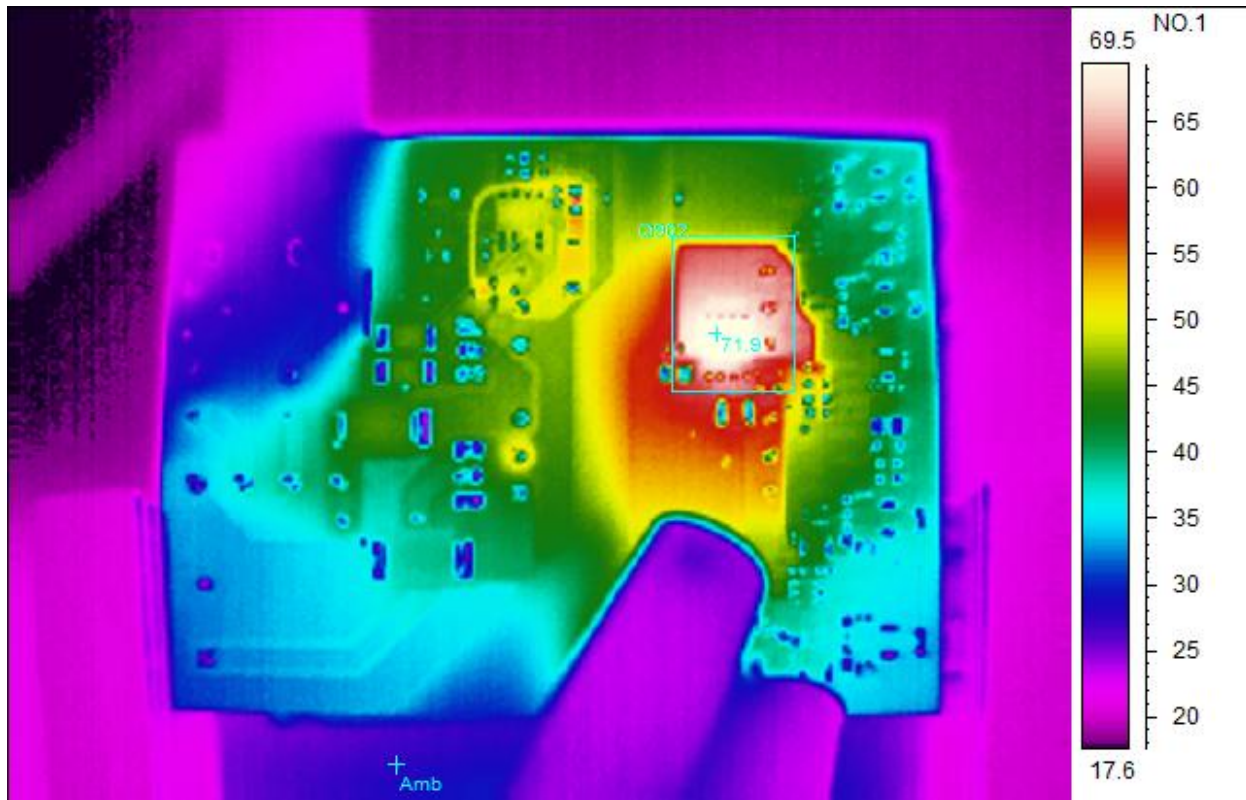
**120V<sub>AC</sub>/60Hz  
Bottom Side**

Spot analysis	Value
Amb Temperature	30.8°C
Area analysis	Value
Q902Max	81.4°C



**230V<sub>AC</sub>/50Hz  
Top Side**

Spot analysis	Value
Amb Temperature	24.3°C
Area analysis	Value
T901Max	76.4°C
Q900, Q903Max	60.4°C
Q902 Max	50.6°C

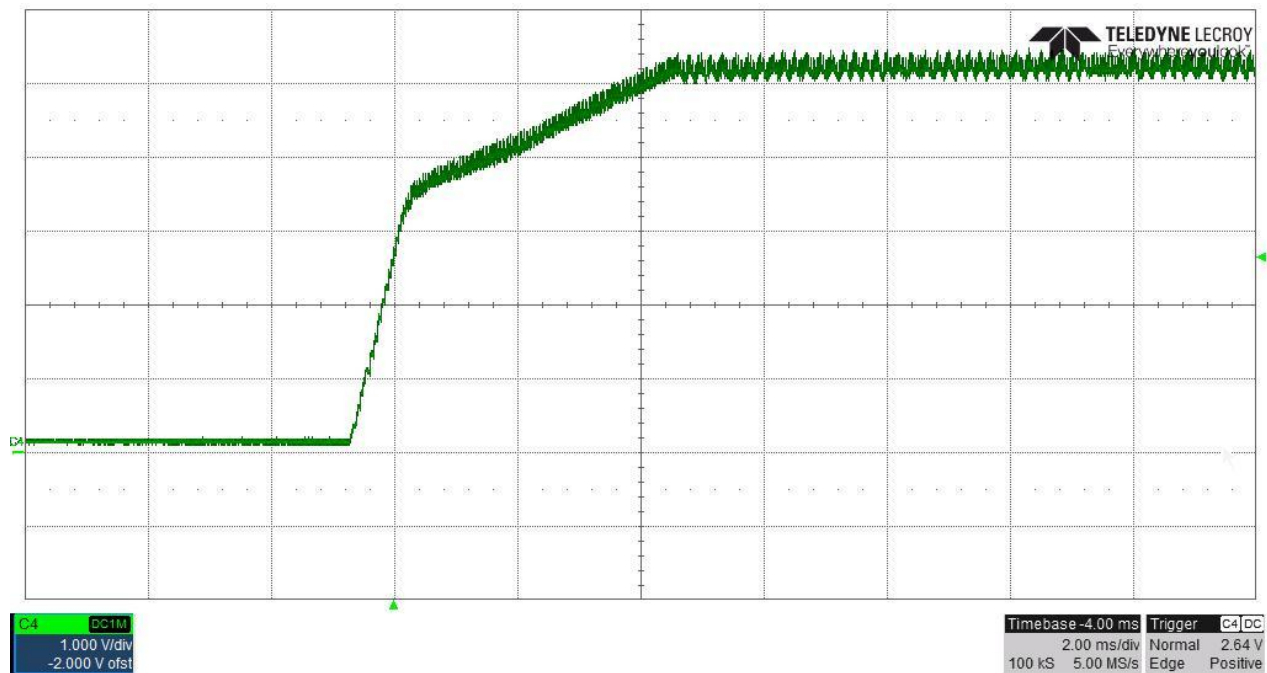
**230V<sub>AC</sub>/50Hz  
Bottom Side**

Spot analysis	Value
Amb Temperature	28.9°C
Area analysis	Value
Q902Max	71.9°C

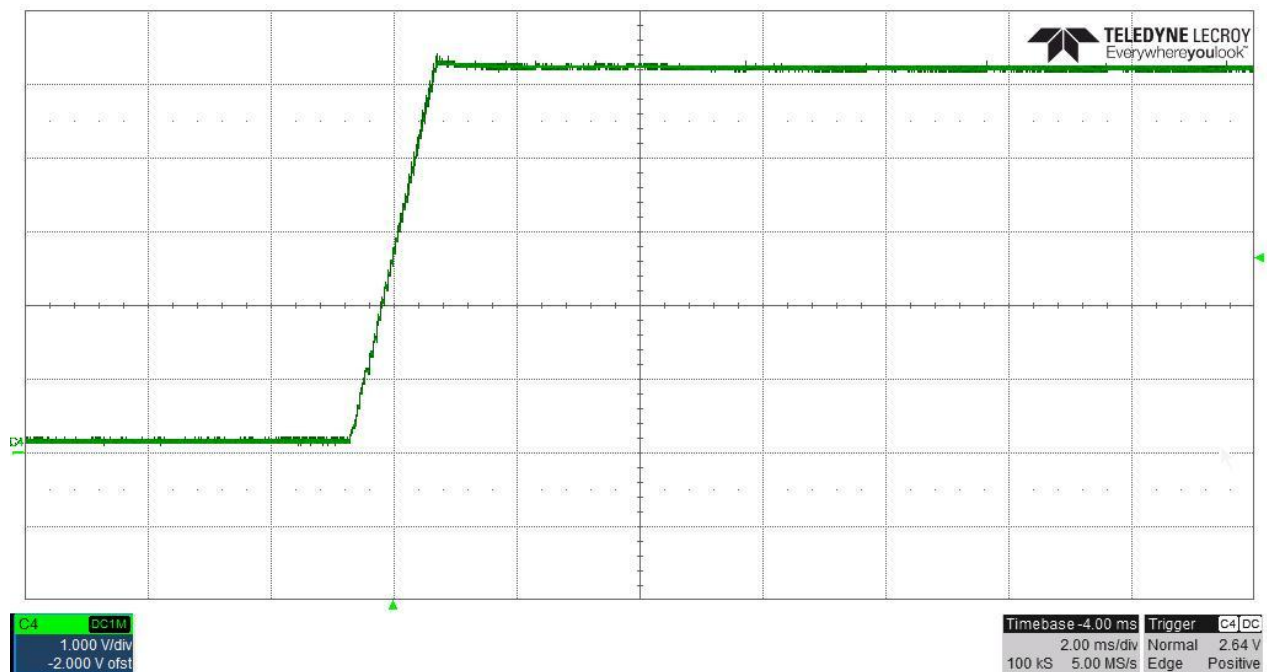
## 4 Startup

The output voltages at startup are shown in the images below.

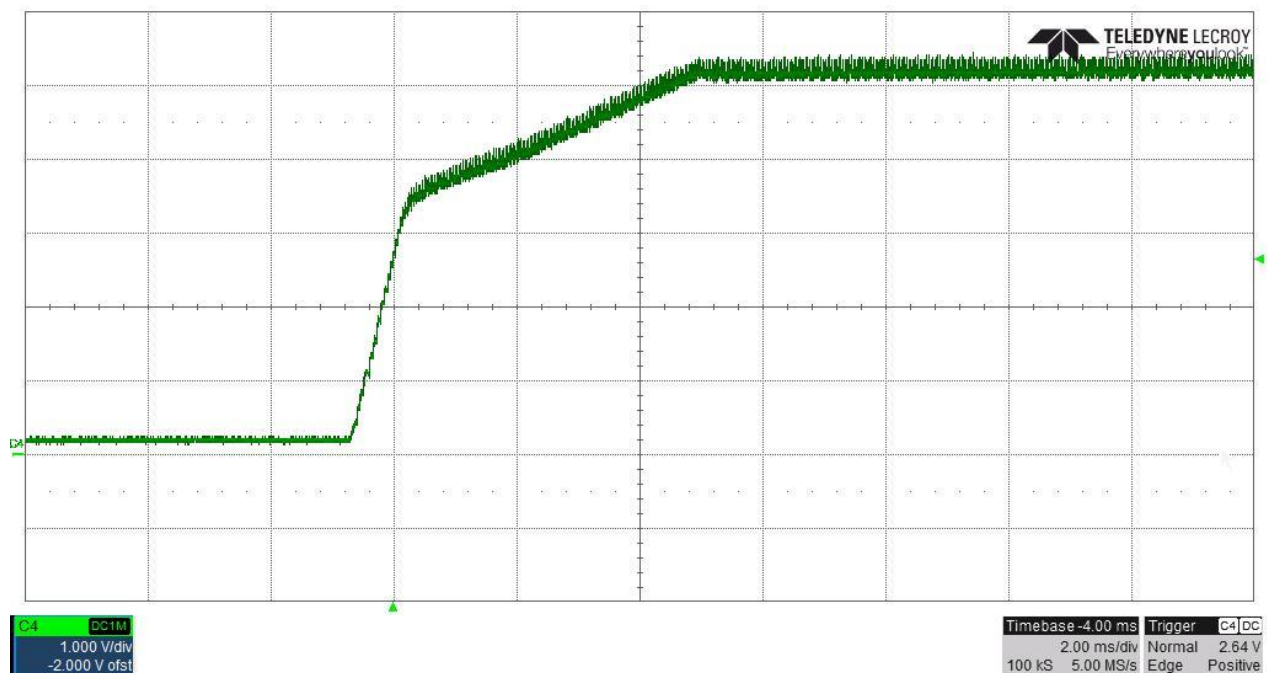
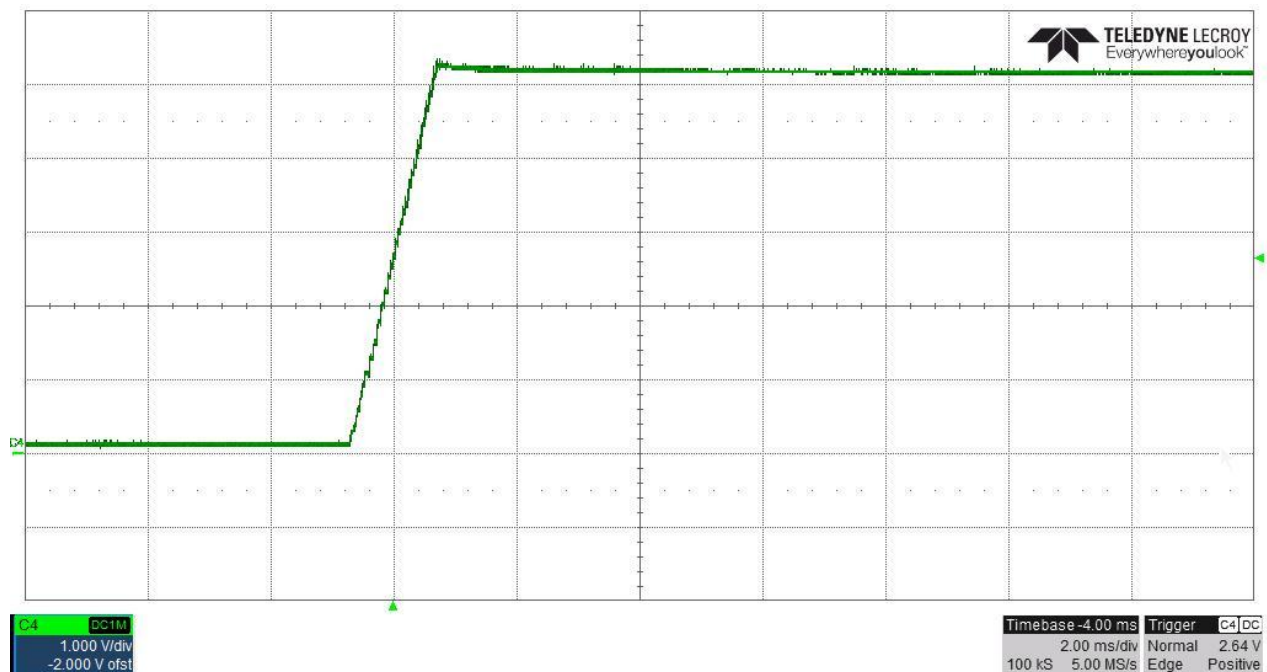
### 4.1 Startup @ 120V<sub>AC</sub>/60Hz: 5V/10A at C907.



### 4.2 Startup @ 120V<sub>AC</sub>/60Hz: no load.

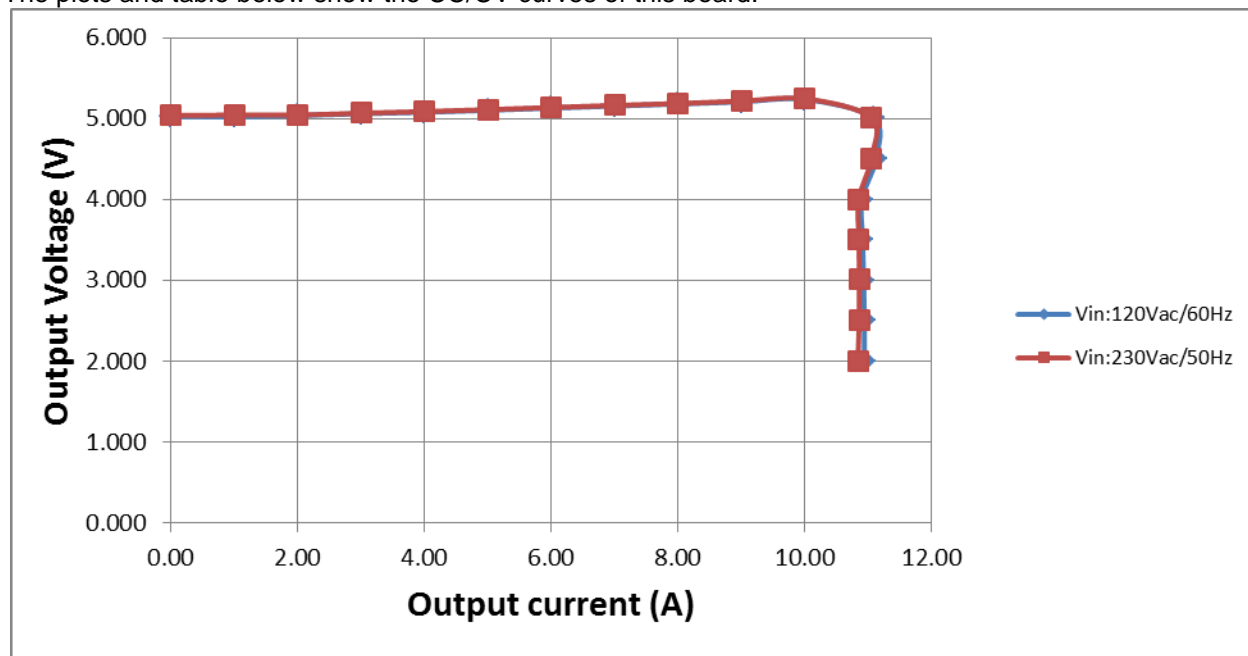




**4.3 Startup @ 230V<sub>AC</sub>/50Hz: 5V/10A at C907.****4.4 Startup @ 230V<sub>AC</sub>/50Hz: no load.**

## 5 Constant Current/ Constant Voltage

The plots and table below show the CC/CV curves of this board.

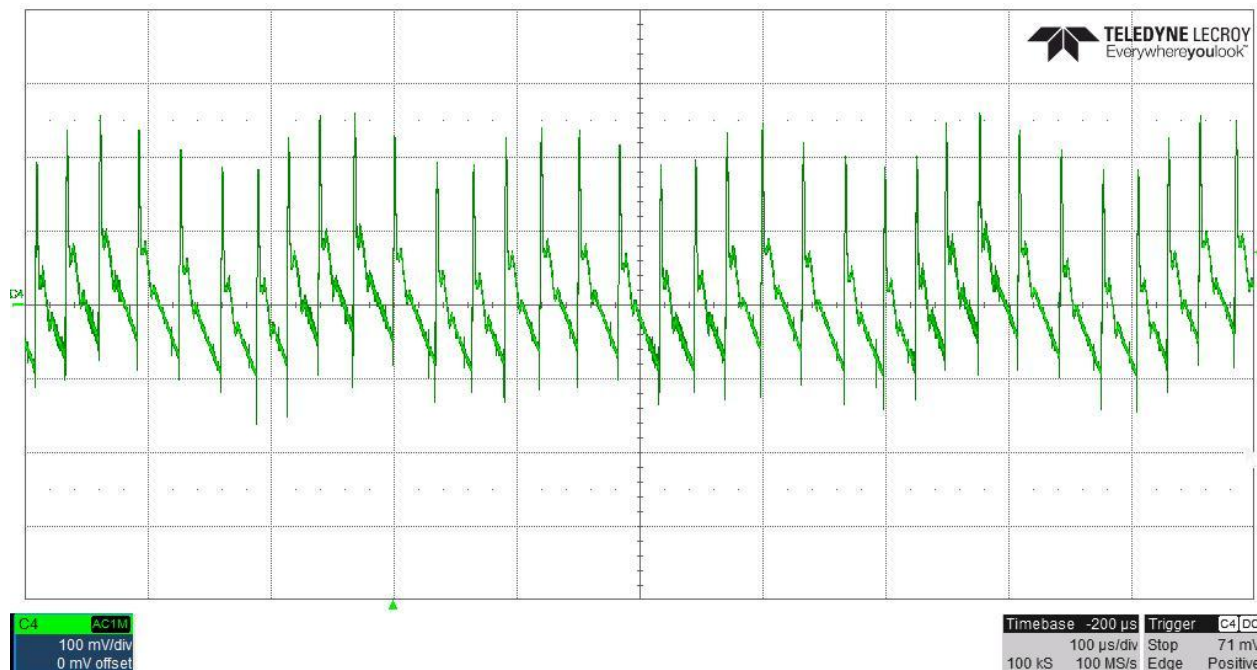


120VAC/60Hz		230VAC/50Hz	
Vout	Iout	Vout	Iout
5.027	0.000	5.037	0.000
5.021	1.000	5.044	1.000
5.037	2.000	5.044	2.000
5.060	3.000	5.067	3.000
5.078	4.000	5.087	4.000
5.103	5.000	5.111	5.000
5.130	6.000	5.137	6.000
5.155	7.000	5.163	7.000
5.180	8.000	5.186	8.000
5.207	9.000	5.217	9.000
5.238	10.000	5.246	10.000
5.006	11.082	5.010	11.048
4.502	11.118	4.507	11.048
4.003	10.896	4.001	10.848
3.500	10.908	3.500	10.850
2.998	10.924	3.018	10.856
2.498	10.936	2.503	10.854
2.001	10.936	2.000	10.834

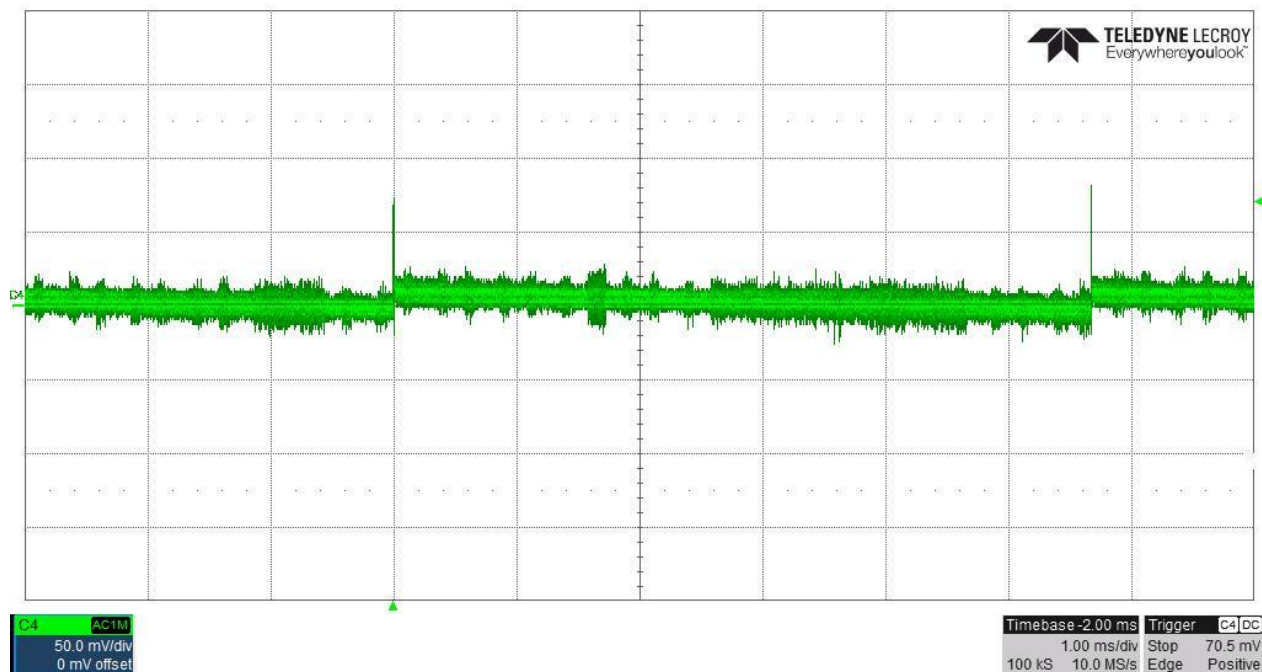
## 6 Output Ripple Voltages

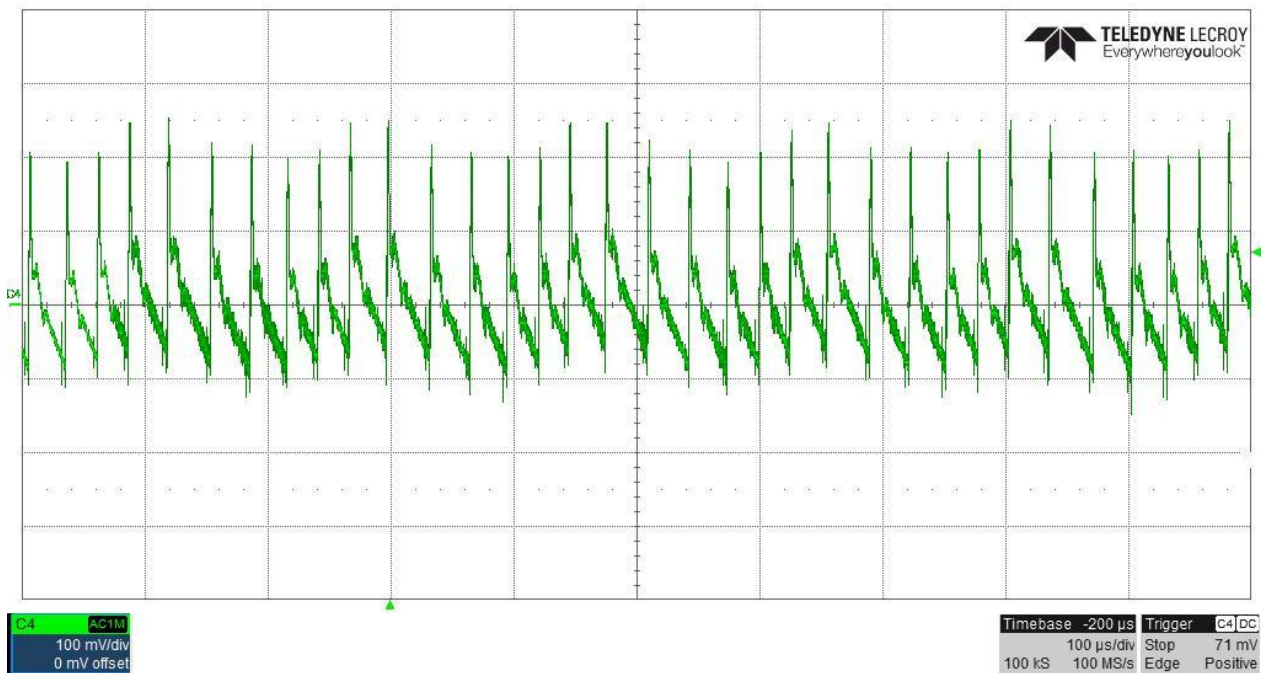
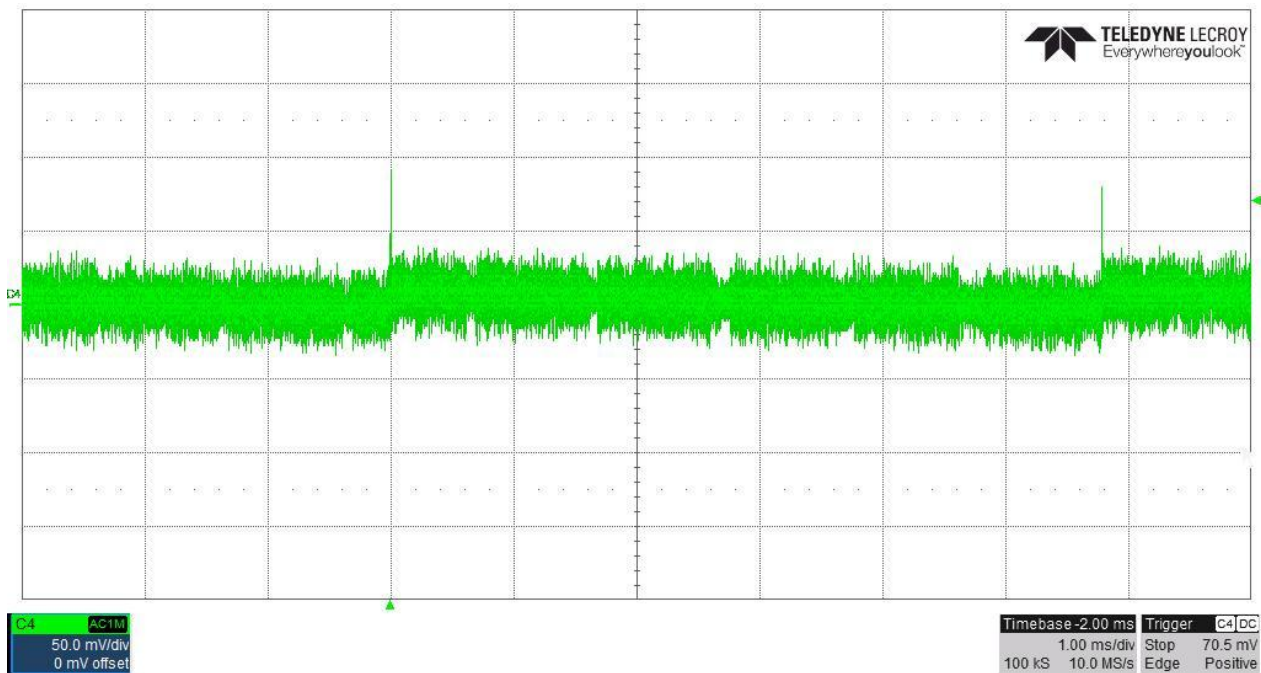
The output ripple voltage is shown in the plots below.

### 6.1 120V<sub>AC</sub>/60Hz: 5V/10A at C907.



### 6.2 120V<sub>AC</sub>/60Hz: no Load.



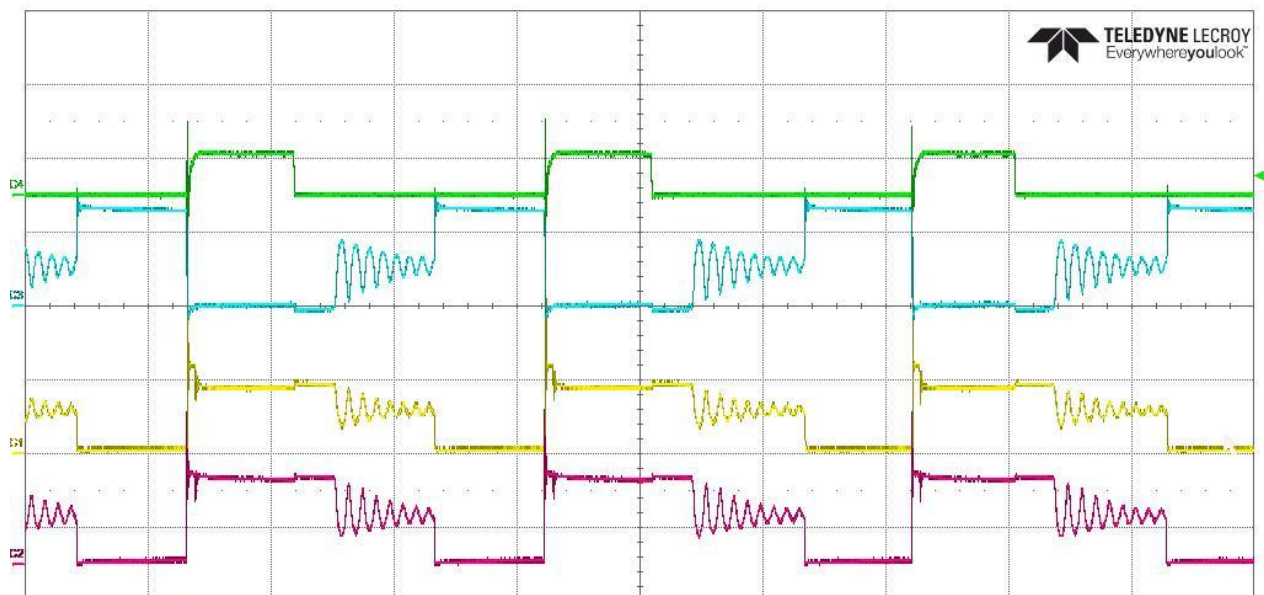
**6.3 230V<sub>AC</sub>/50Hz: 5V/10A at C907****6.4 230V<sub>AC</sub>/50Hz: no Load.**



## 7 Switching Waveforms

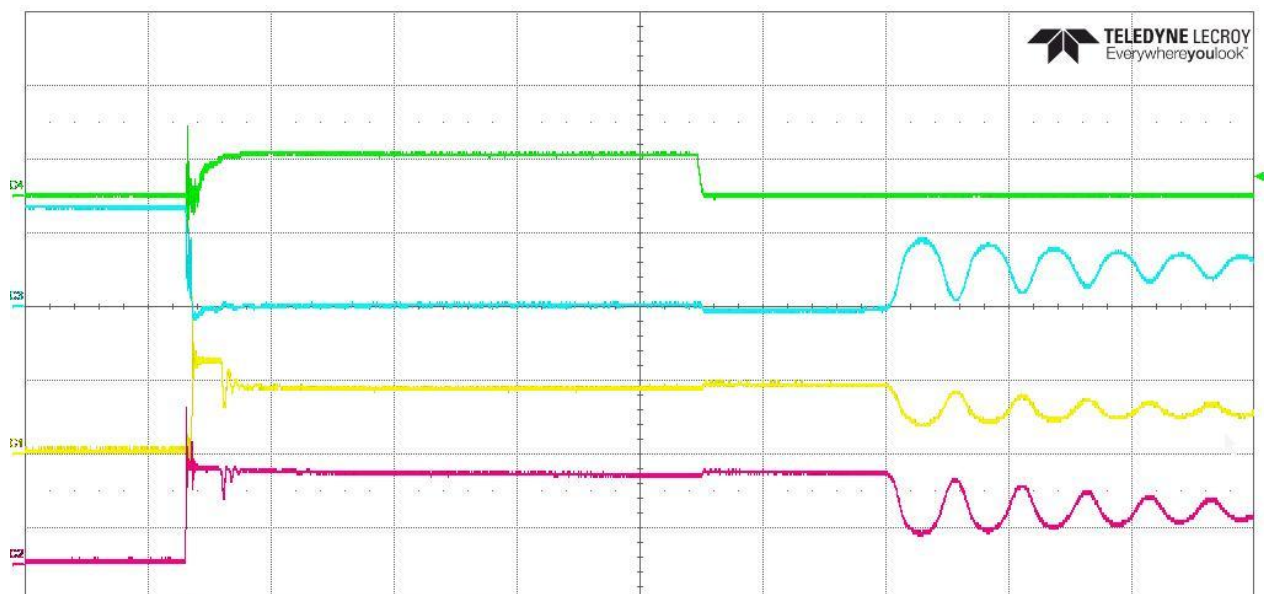
The images below show key switching waveforms of this board. The waveforms are measured with 5V/50W full load. CH1:  $V_{DS}$  (Q900), CH2:  $V_D$  to GND (Q903), CH3:  $V_{DS}$  (Q902), CH4:  $V_{GS}$  (Q902).

### 7.1 85V<sub>AC</sub>/60Hz



C1	DC	C2	DC1M	C3	BwL DC1M	C4	DC1M
100 V/div		100 V/div		10.0 V/div		10.0 V/div	
-200.0 V ofst		-350.0 V ofst		0.00 V offset		15.00 V offset	

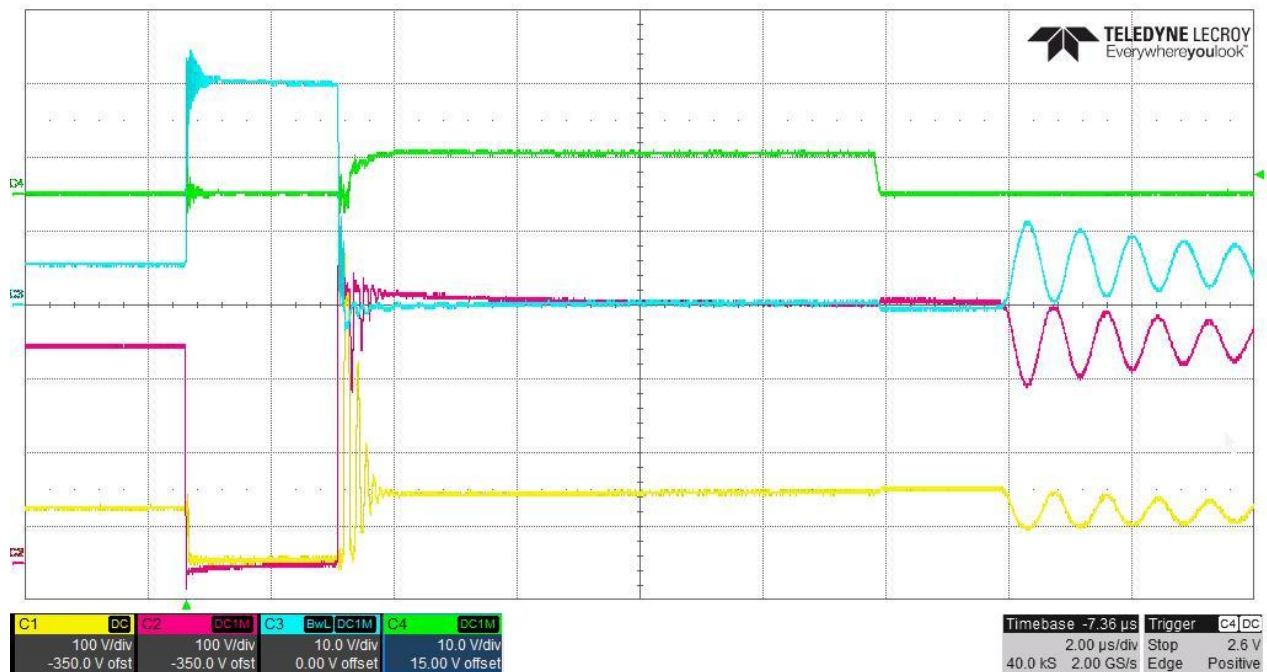
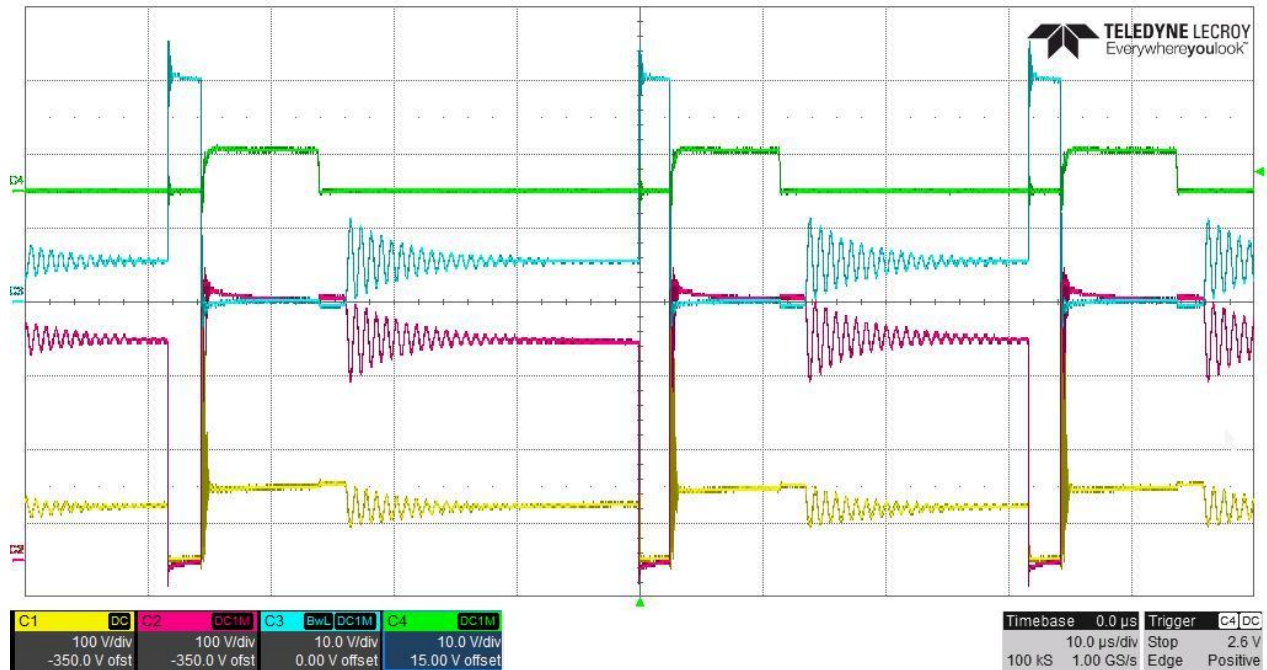
Timebase	-36.8 $\mu$ s	Trigger	C4 DC
10.0 $\mu$ s/div		Stop	2.6 V
100 kS	1.00 GS/s	Edge	Positive



C1	DC	C2	DC1M	C3	BwL DC1M	C4	DC1M
100 V/div		100 V/div		10.0 V/div		10.0 V/div	
-200.0 V ofst		-350.0 V ofst		0.00 V offset		15.00 V offset	

Timebase	-7.36 $\mu$ s	Trigger	C4 DC
2.00 $\mu$ s/div		Stop	2.6 V
40.0 kS	2.00 GS/s	Edge	Positive



**7.2 264V<sub>AC</sub>/50Hz**

## IMPORTANT NOTICE FOR TI REFERENCE DESIGNS

Texas Instruments Incorporated ("TI") reference designs are solely intended to assist designers ("Buyers") who are developing systems that incorporate TI semiconductor products (also referred to herein as "components"). Buyer understands and agrees that Buyer remains responsible for using its independent analysis, evaluation and judgment in designing Buyer's systems and products.

TI reference designs have been created using standard laboratory conditions and engineering practices. **TI has not conducted any testing other than that specifically described in the published documentation for a particular reference design.** TI may make corrections, enhancements, improvements and other changes to its reference designs.

Buyers are authorized to use TI reference designs with the TI component(s) identified in each particular reference design and to modify the reference design in the development of their end products. HOWEVER, NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY OTHER TI INTELLECTUAL PROPERTY RIGHT, AND NO LICENSE TO ANY THIRD PARTY TECHNOLOGY OR INTELLECTUAL PROPERTY RIGHT, IS GRANTED HEREIN, including but not limited to 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.

TI REFERENCE DESIGNS ARE PROVIDED "AS IS". TI MAKES NO WARRANTIES OR REPRESENTATIONS WITH REGARD TO THE REFERENCE DESIGNS OR USE OF THE REFERENCE DESIGNS, EXPRESS, IMPLIED OR STATUTORY, INCLUDING ACCURACY OR COMPLETENESS. TI DISCLAIMS ANY WARRANTY OF TITLE AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, QUIET ENJOYMENT, QUIET POSSESSION, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS WITH REGARD TO TI REFERENCE DESIGNS OR USE THEREOF. TI SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY BUYERS AGAINST ANY THIRD PARTY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON A COMBINATION OF COMPONENTS PROVIDED IN A TI REFERENCE DESIGN. IN NO EVENT SHALL TI BE LIABLE FOR ANY ACTUAL, SPECIAL, INCIDENTAL, CONSEQUENTIAL OR INDIRECT DAMAGES, HOWEVER CAUSED, ON ANY THEORY OF LIABILITY AND WHETHER OR NOT TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, ARISING IN ANY WAY OUT OF TI REFERENCE DESIGNS OR BUYER'S USE OF TI REFERENCE DESIGNS.

TI reserves 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 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 for TI components 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.

Reproduction of significant portions of TI information in TI data books, data sheets or reference designs 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.

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 that anticipate dangerous failures, monitor failures and their consequences, lessen the likelihood of dangerous failures 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 Buyer's 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 an agreement specifically governing such use.

Only those TI components that 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 that have **not** been so designated is solely at Buyer's risk, and 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.