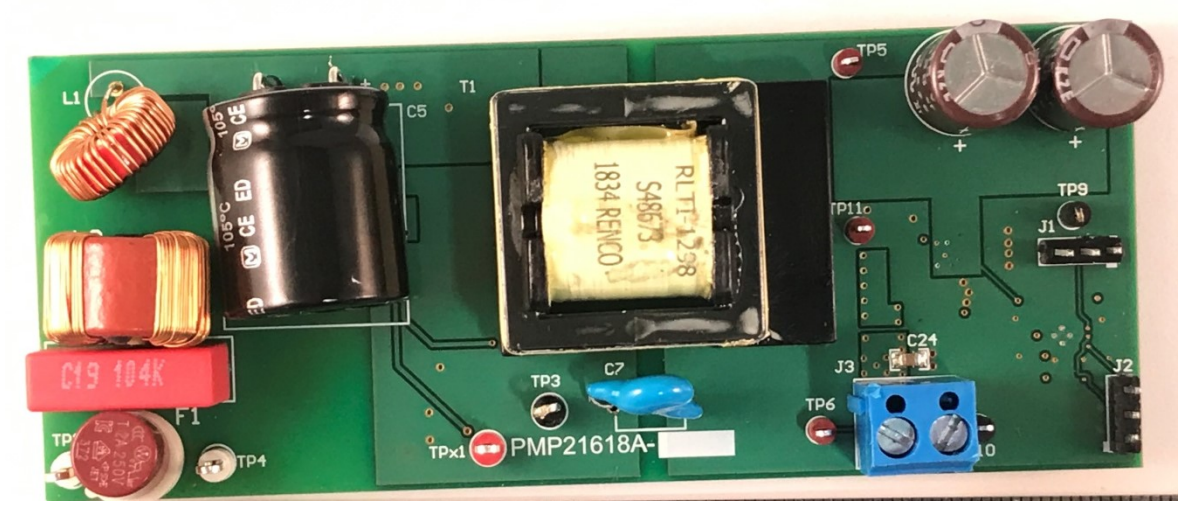
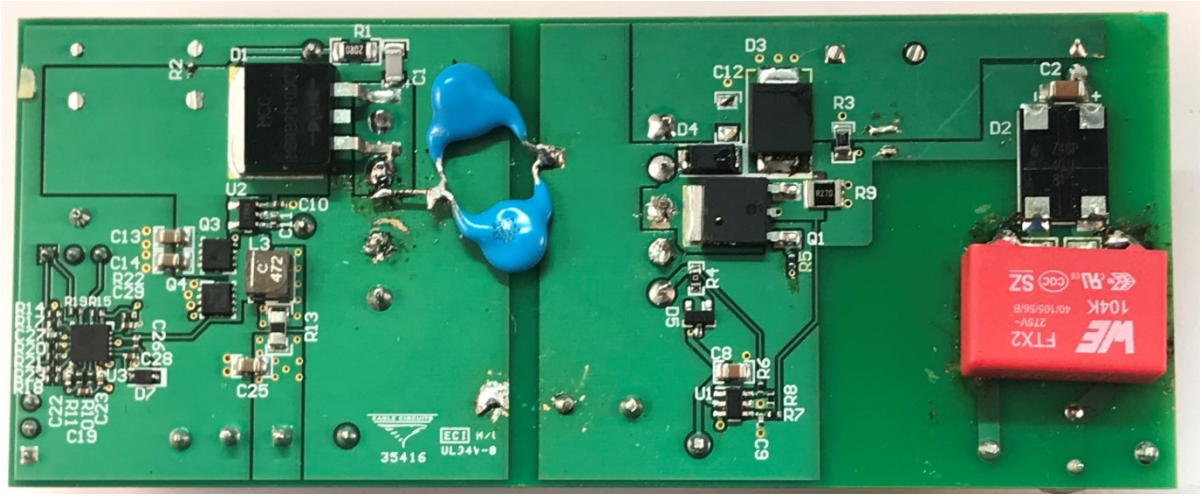
Test Report: PMP21618
Universal input reference design for 12-V lead acid battery charger

Description

PMP21618 is a universal input to 12-V lead acid battery charger at a charge current of 2.5 A. It utilizes the UCC28704 and a Primary side regulated (PSR) topology to provide a cost effective solution. On the secondary side, the BQ24725A is used to provide seamless transfer between the constant-voltage and constant-current modes.



Top of Board



Bottom of Board

1 Test Prerequisites

1.1 Voltage and Current Requirements

Table 1. Voltage and Current Requirements

PARAMETER	SPECIFICATIONS
Input Voltage Range	85 Vac – 265 Vac, 47 – 60 Hz
Output Voltage	10-14V
Output Current	2.5A
Switching Frequency	85 kHz

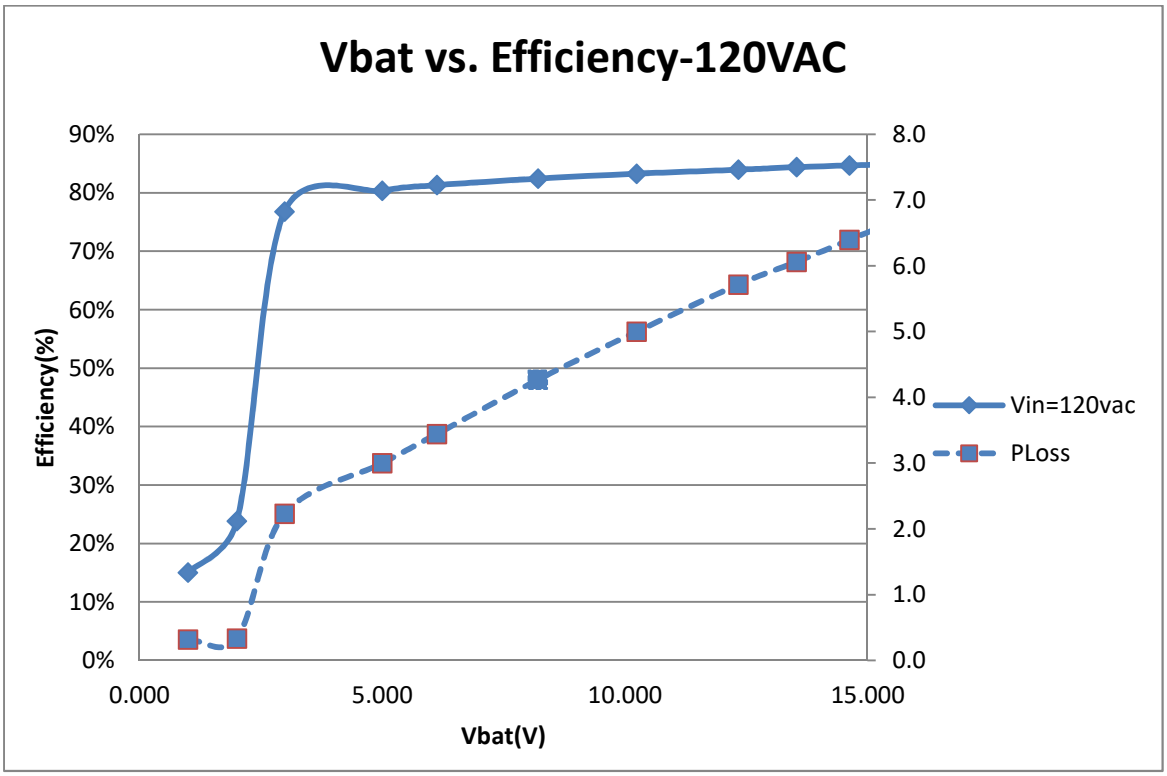
2 Testing and Results

NOTE: unless otherwise noted, the load was attached at the output of the fly-back circuit before the BQ24725A

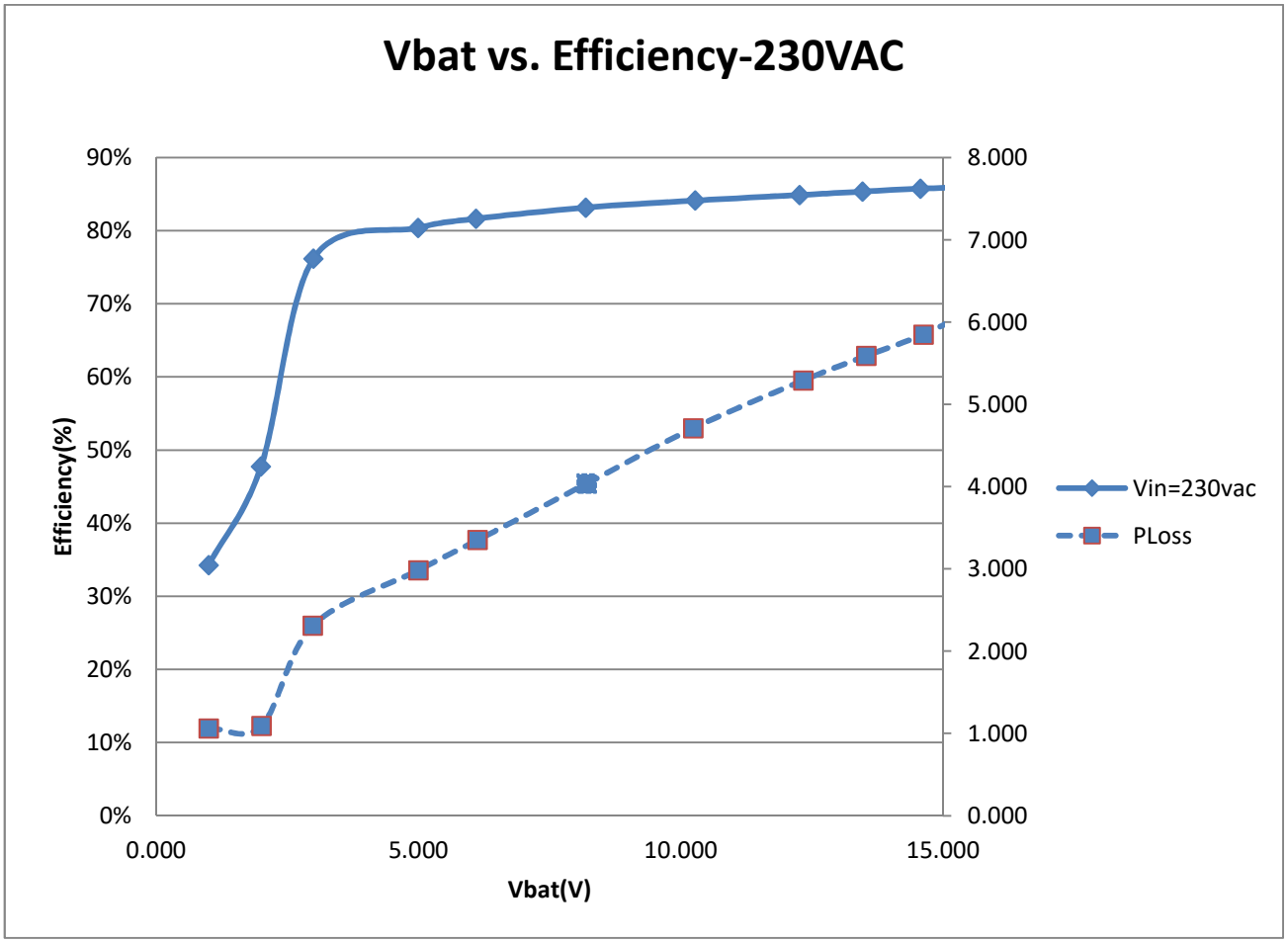
2.1 Efficiency Graphs

Battery voltage vs. efficiency

Note: a Cap Bank was attached to the output of the BQ24725A, in parallel with a constant voltage e-load to simulate a lead acid battery. The charging current was limited to 2.5A.



vin	Iin	Pin	vout_flbk	vbat	iout	Pout	Eff	Ploss
120	0.013	0.373	17.100	1.000	0.056	0.056	15.013%	0.317
120	0.015	0.438	17.110	2.008	0.052	0.104	23.839%	0.334
120	0.187	9.600	17.160	2.990	2.465	7.370	76.774%	2.230
120	0.271	15.250	17.280	5.001	2.450	12.252	80.344%	2.998
120	0.315	18.420	17.330	6.130	2.443	14.976	81.301%	3.444
120	0.394	24.250	17.440	8.210	2.434	19.983	82.405%	4.267
120	0.467	29.850	17.540	10.240	2.427	24.852	83.258%	4.998
120	0.540	35.590	17.630	12.340	2.421	29.875	83.943%	5.715
120	0.582	38.800	17.680	13.540	2.418	32.740	84.381%	6.060
120	0.621	41.740	17.730	14.630	2.416	35.346	84.682%	6.394
120	0.652	44.160	17.770	15.530	2.414	37.489	84.89%	6.671

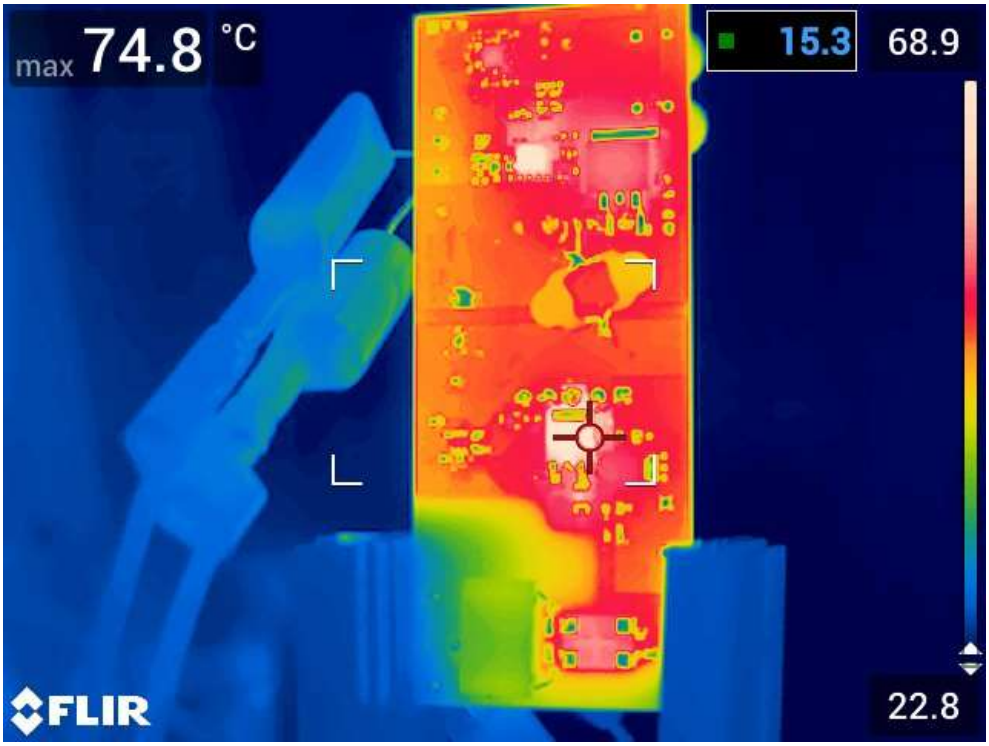


vin	Iin	Pin	vout_flbk	vbat	iout	Pout	Eff	Ploss
230	0.033	1.615	17.050	1.001	0.553	0.554	34.276%	1.061
230	0.039	2.090	17.040	2.000	0.499	0.998	47.751%	1.092
230	0.133	9.706	17.140	3.000	2.465	7.395	76.190%	2.311
230	0.194	15.220	17.260	4.994	2.450	12.235	80.390%	2.985
230	0.223	18.250	17.320	6.096	2.444	14.899	81.636%	3.351
230	0.275	23.980	17.430	8.190	2.435	19.943	83.164%	4.037
230	0.323	29.670	17.530	10.280	2.428	24.960	84.125%	4.710
230	0.367	35.010	17.630	12.270	2.422	29.718	84.884%	5.292
230	0.393	38.160	17.680	13.470	2.418	32.570	85.352%	5.590
230	0.417	41.050	17.730	14.570	2.416	35.201	85.752%	5.849
230	0.438	43.740	17.770	15.570	2.415	37.602	85.97%	6.138

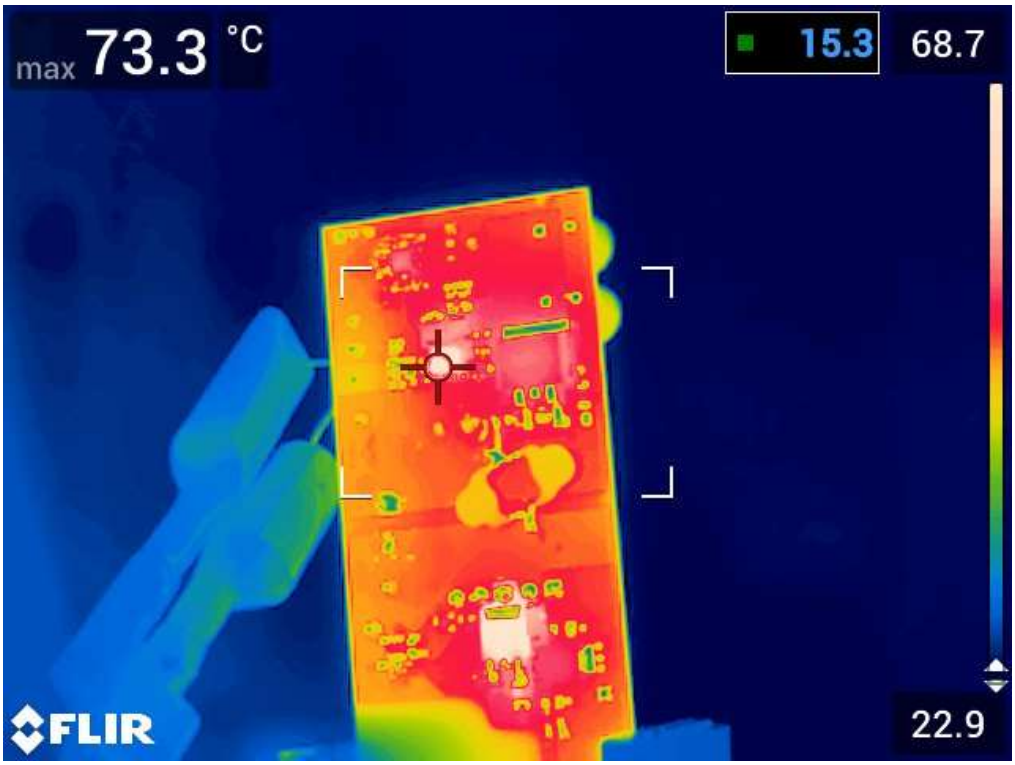
2.2 Thermal Images

The thermal images were taken below with 12Vout at 2.5A attached to the output of the battery charger. This was taken after 10minute soak.

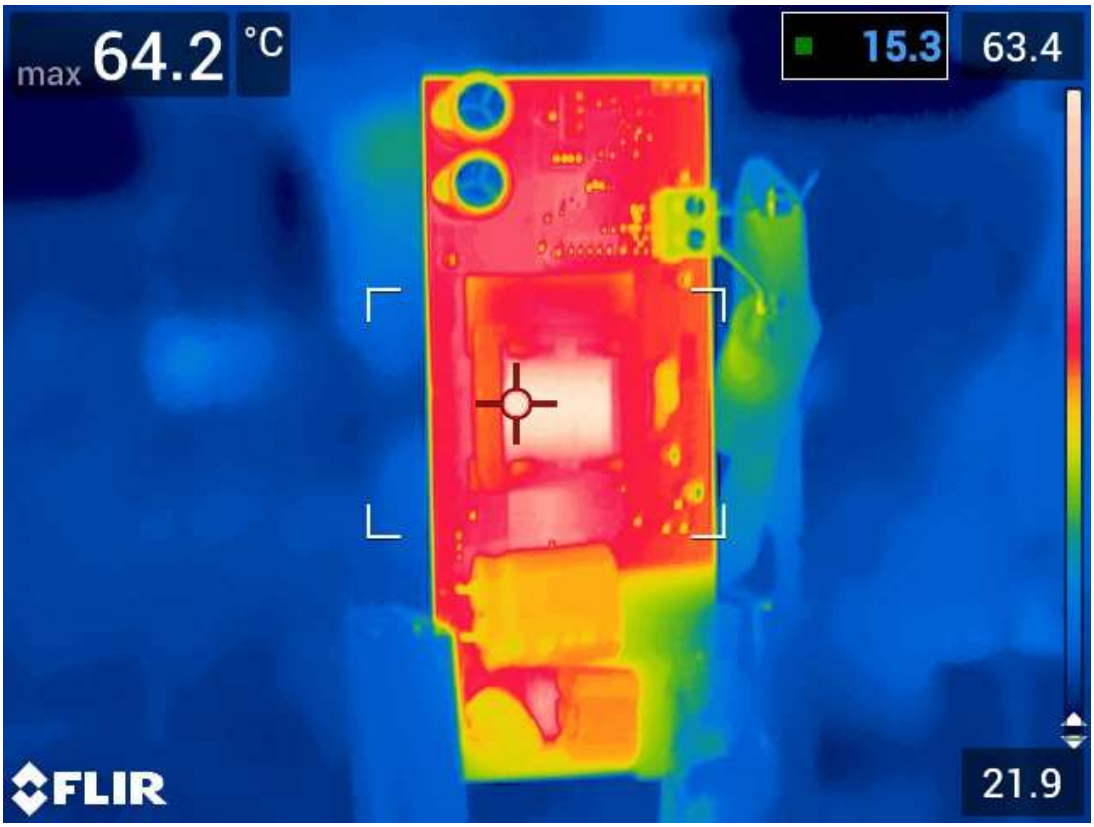
2.2.1: 85VAC



85VAC-Max temp on primary FET = 74.8C

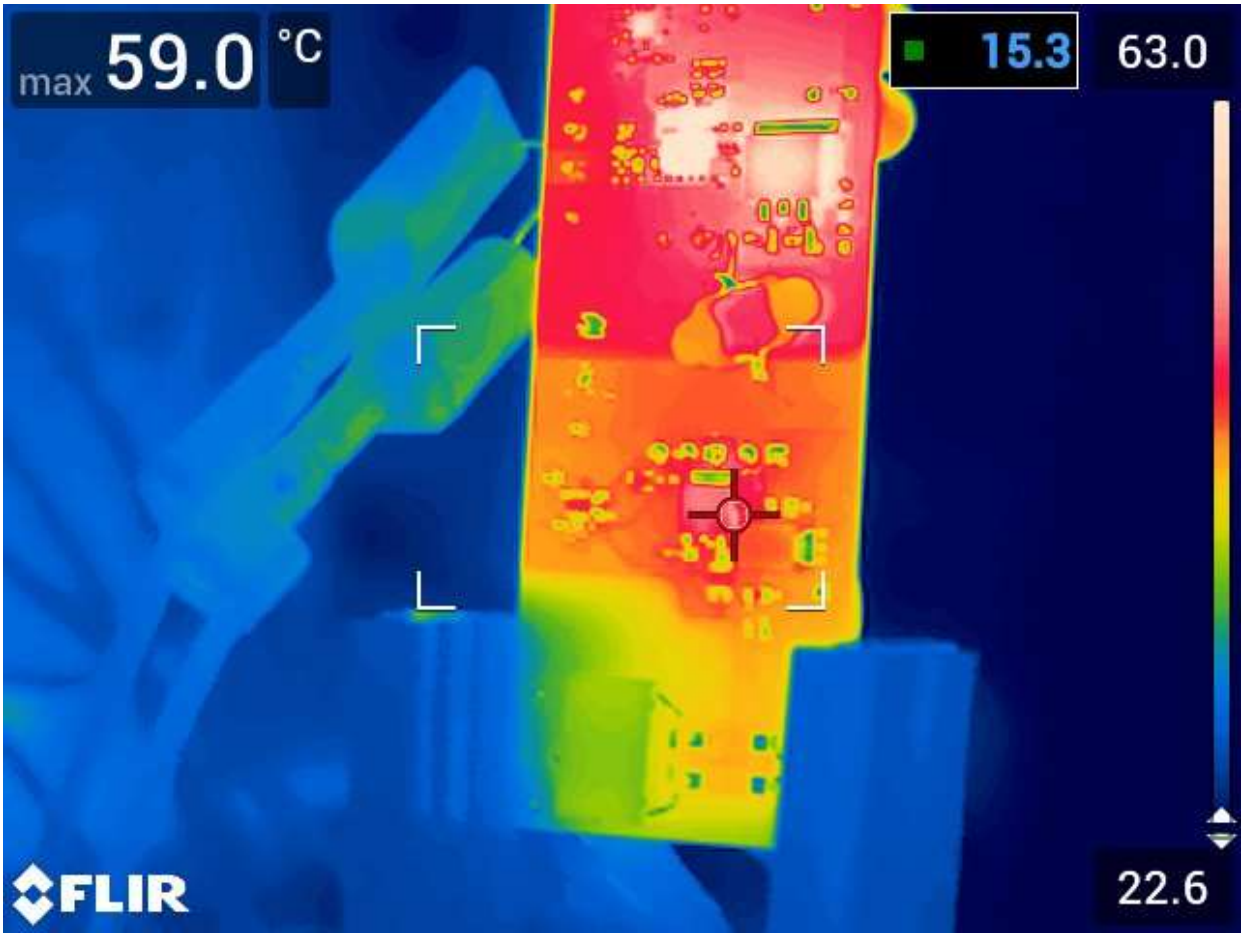


85VAC-Max temp on L3 = 73.3C

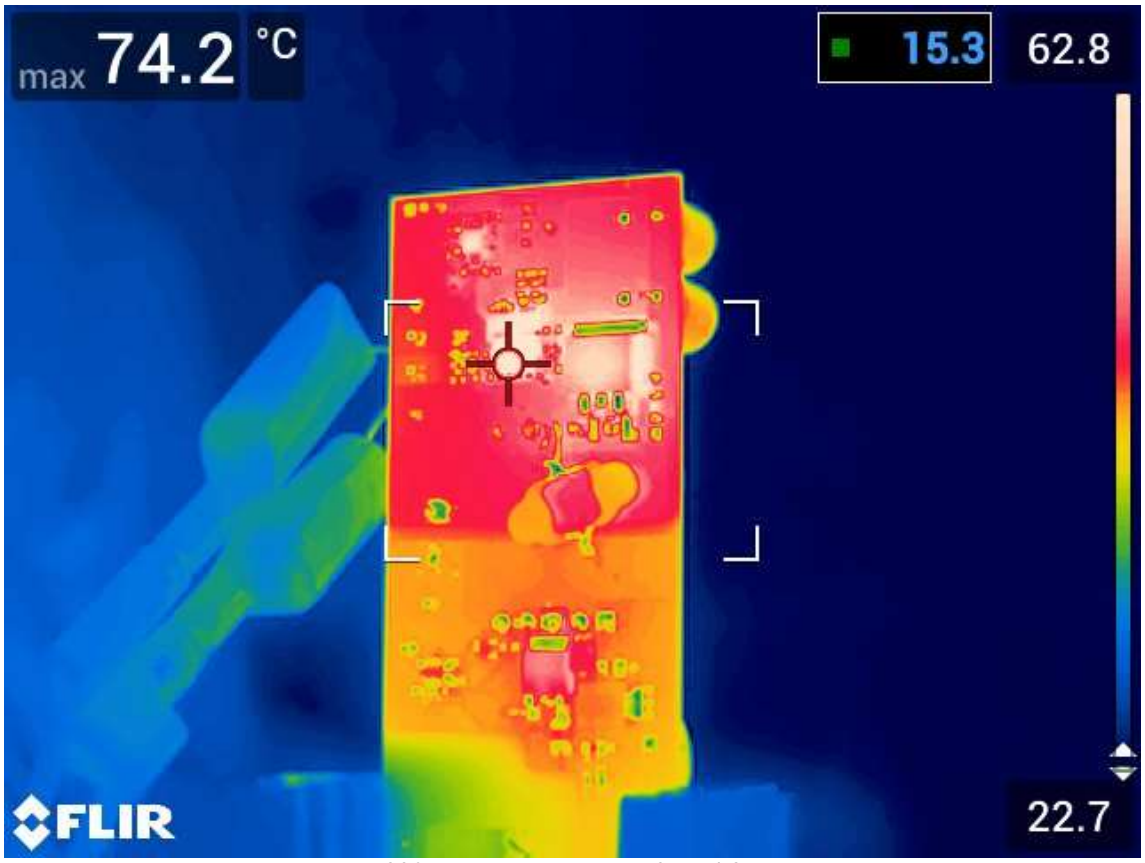


85VAC-Max temp on transformer = 64.2C

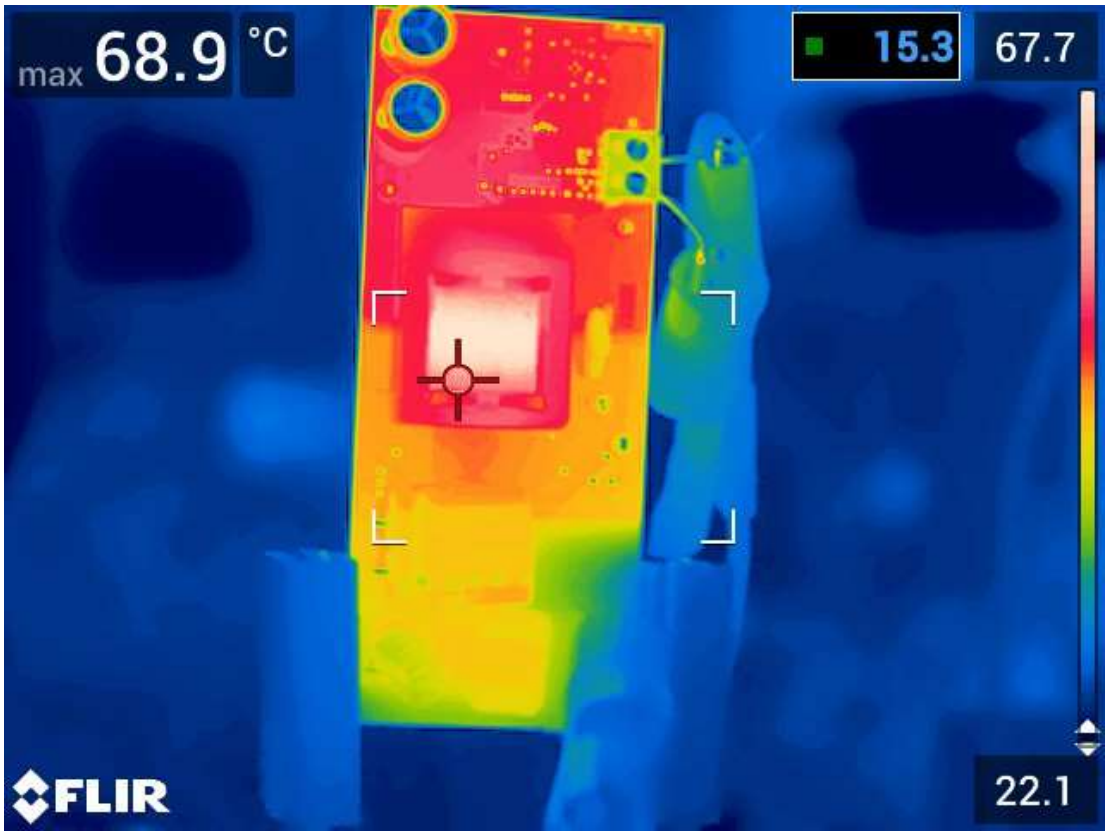
2.2.2: 230VAC:



230VAC-Max temp on primary FET = 59C



230VAC-Max temp on L3 = 74.2C

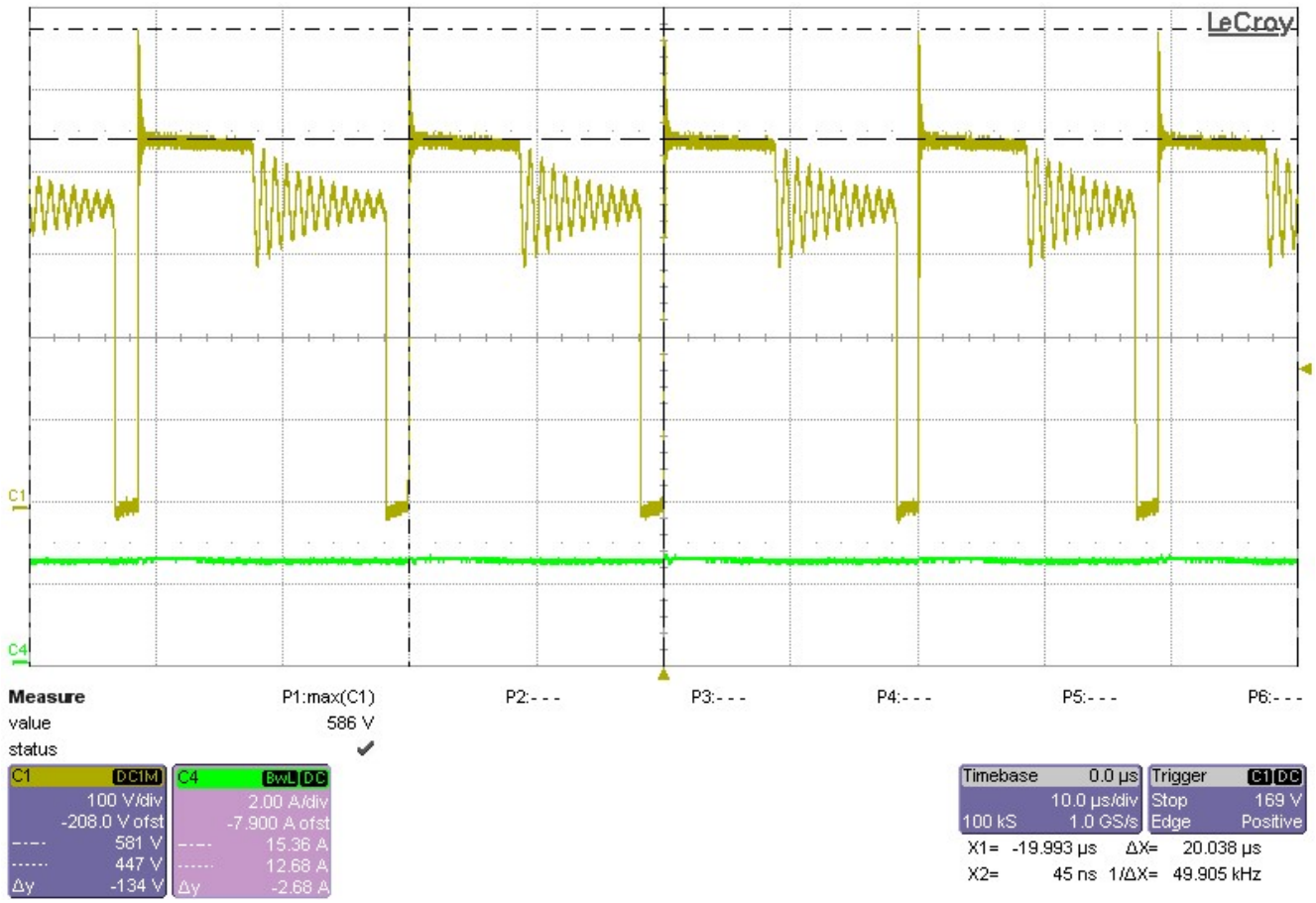


230VAC-Max temp on transformer = 68.9C

3 Waveforms

*3.1 Switching**

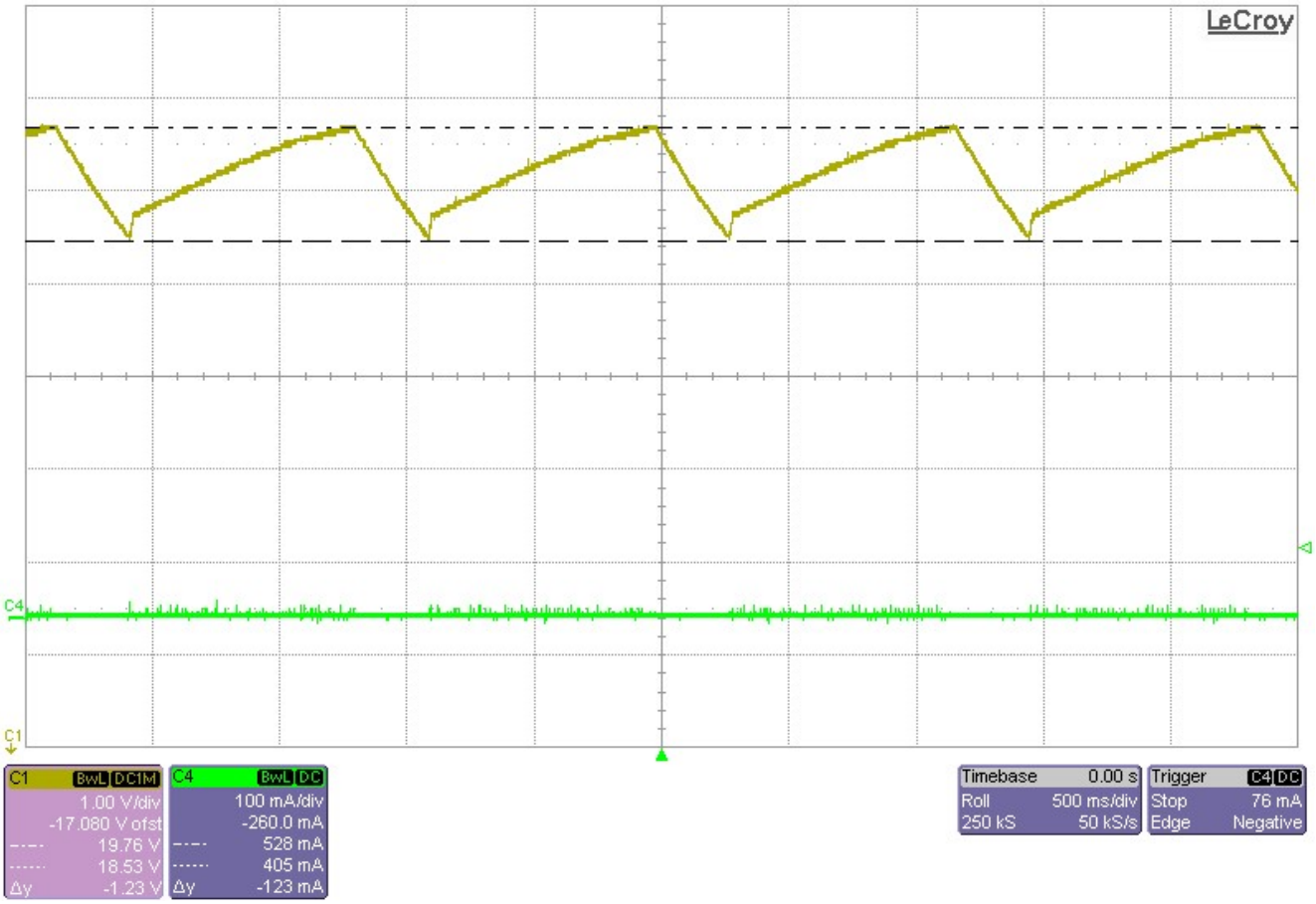
Channel 2 – Pink: Vsw_primary – (20V/Division)
Channel 4 - Green: 12V-Iout (2A/div)



265VAC 17Vout @ 2.5A; Vsw_primary_max= 586V;

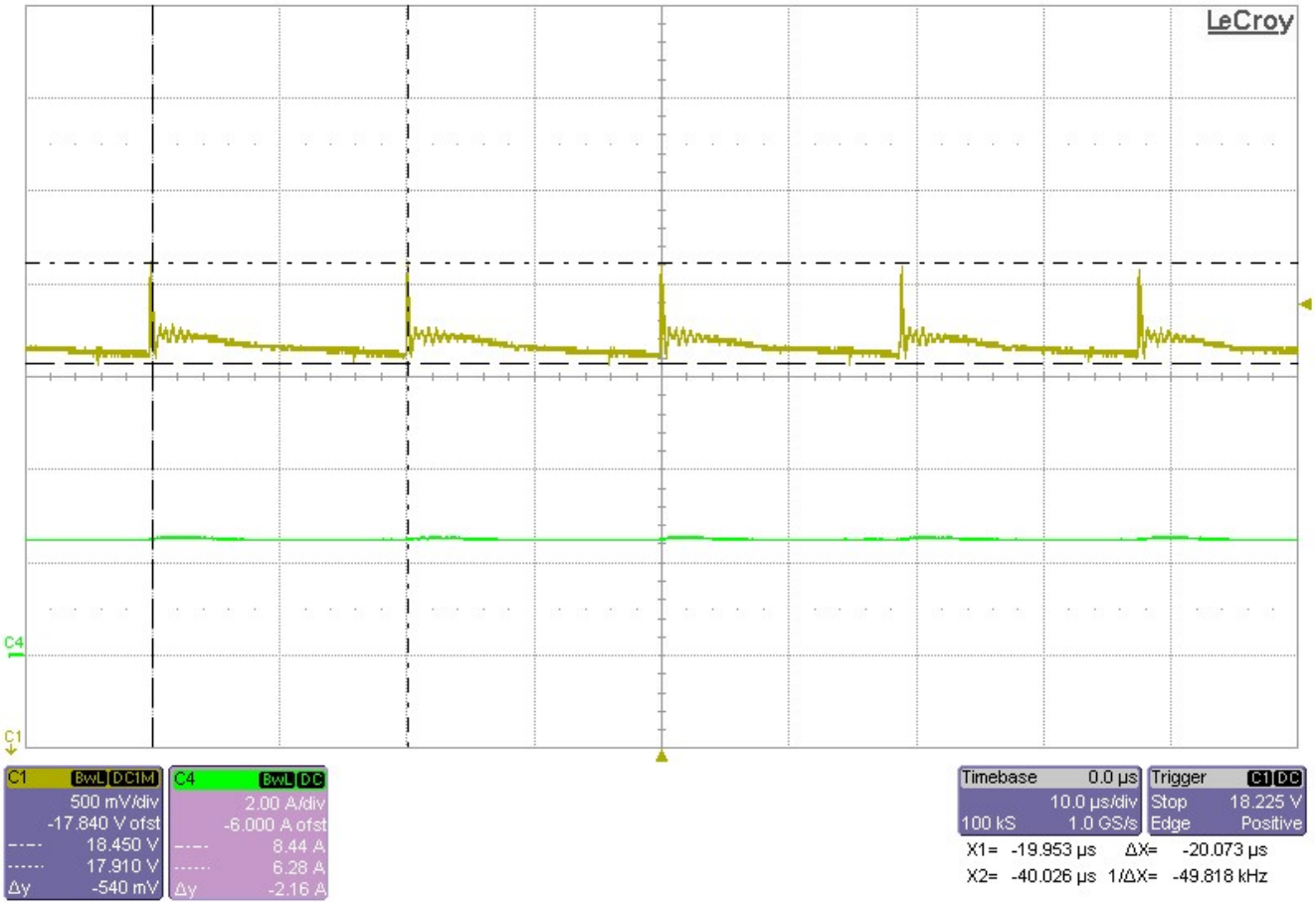
*3.2 Output Voltage Ripple**

Note: this is taken at the output of the flyback and not at the output of the battery charger.
Channel 1 – Yellow: 17Vout – (1V/Division)
Channel 4 - Green: Iout (100mA/div)



120Vac; No Load; Vout Min: 18.53V, VoutMax = 19.76V

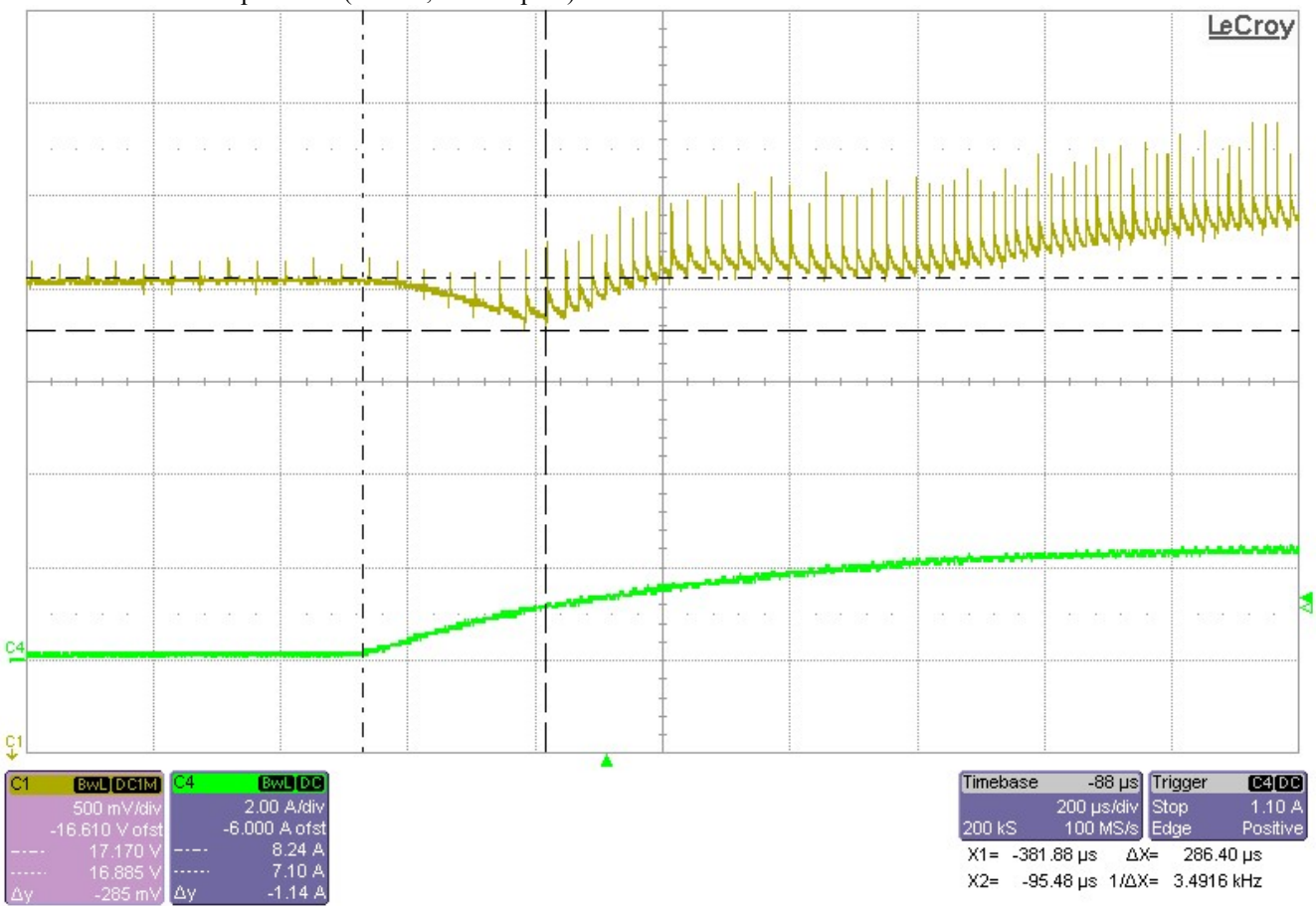
Channel 1 – Yellow: 17Vout – (1V/Division)
Channel 4 - Green: Iout (100mA/div)



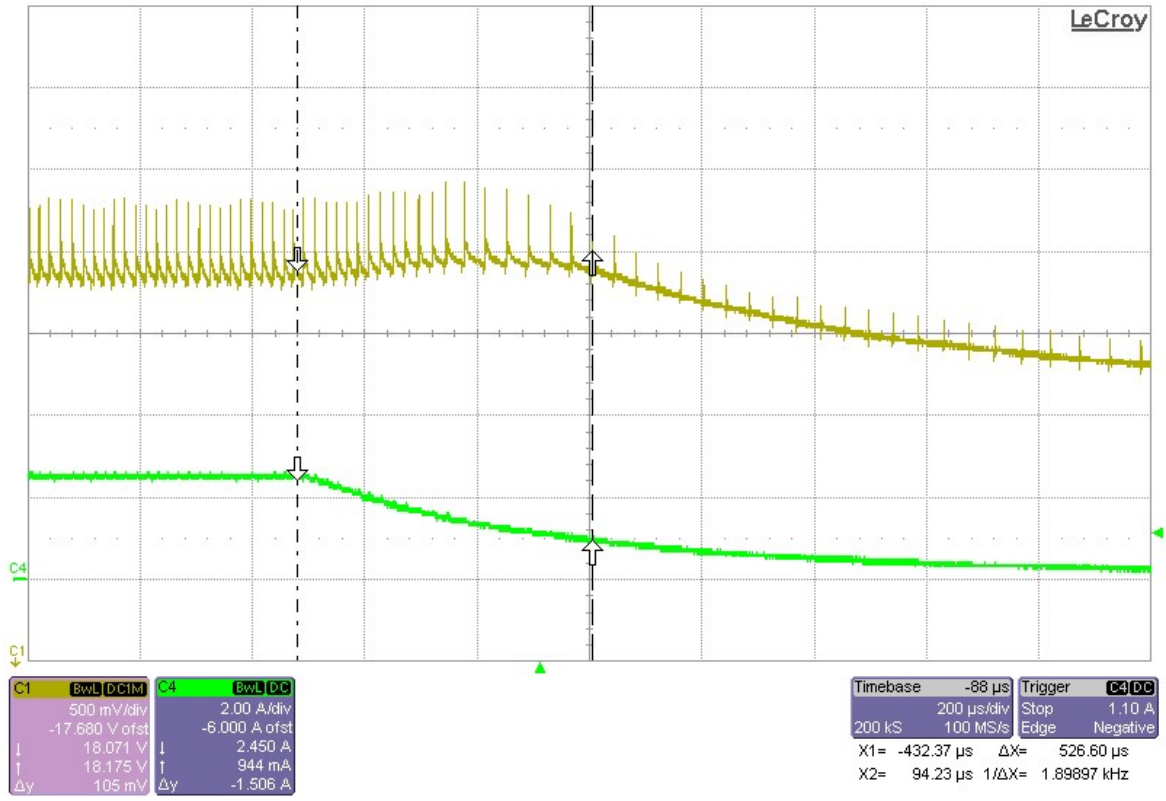
120Vac; 2.5A; Vout Min: 17.91V, VoutMax = 18.45V

*3.3 Load Transients**

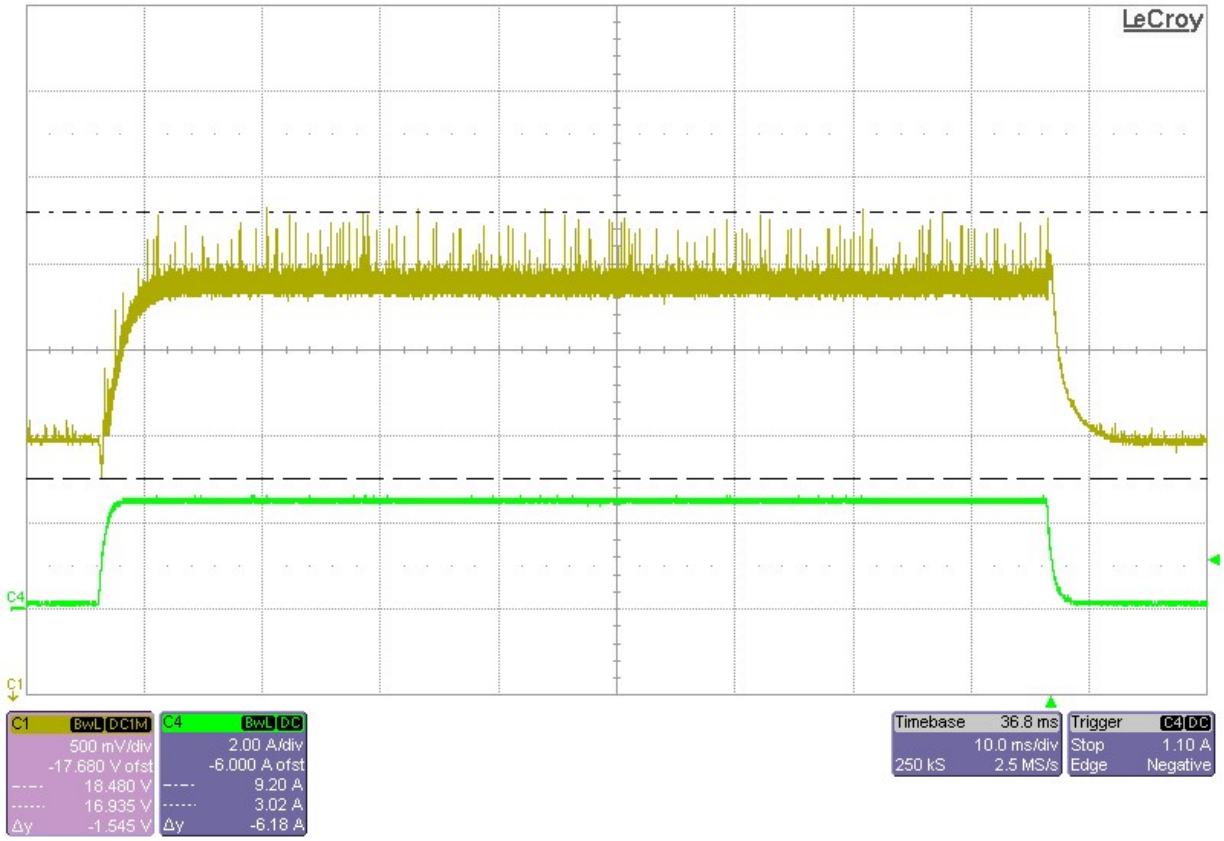
Channel 1 – Yellow: 17V Output Voltage (500mV/div)
Channel 4 – Green: Output Load (2A/div; DC coupled)



120VAC; Istep 100mA-2.5A; Vmin:16.885V



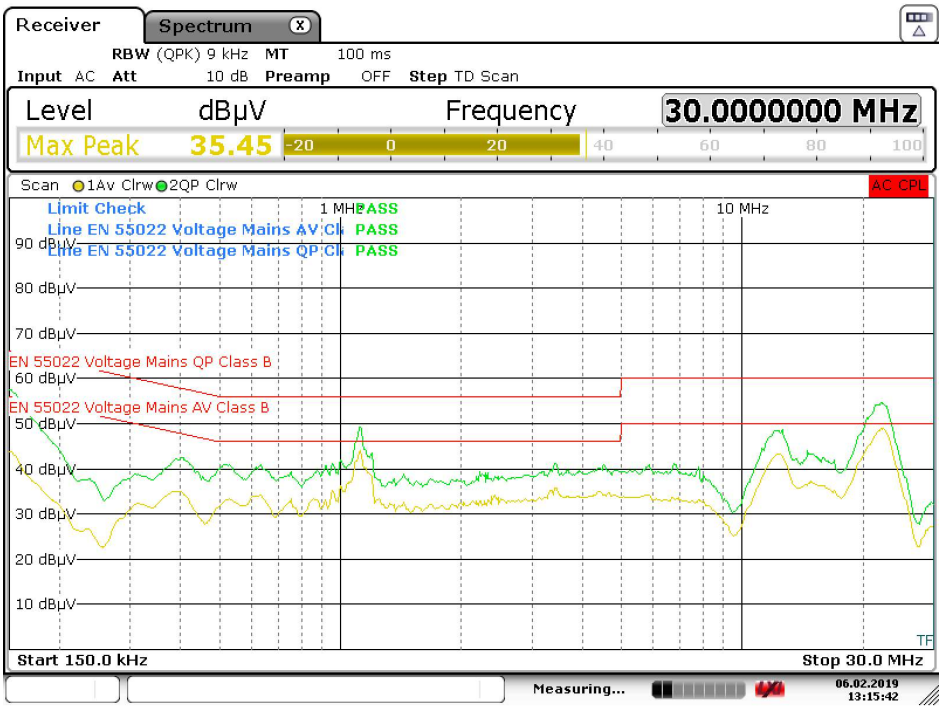
120VAC; Istep 2.5A-100mA; Vmax:18.175V



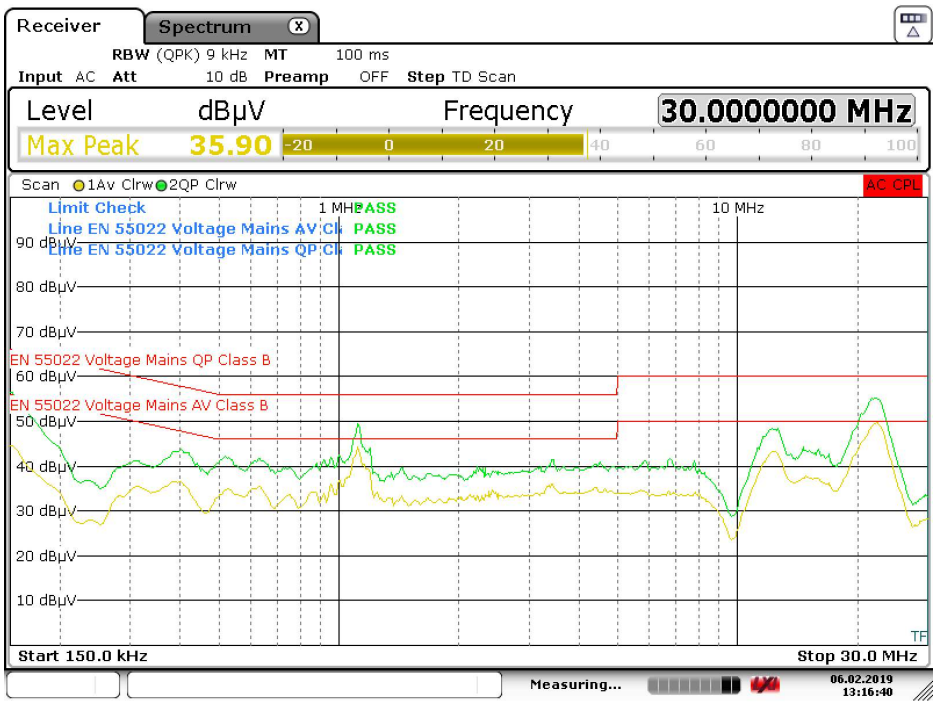
Vtransient= 1.545Vpp

3.4 EMI

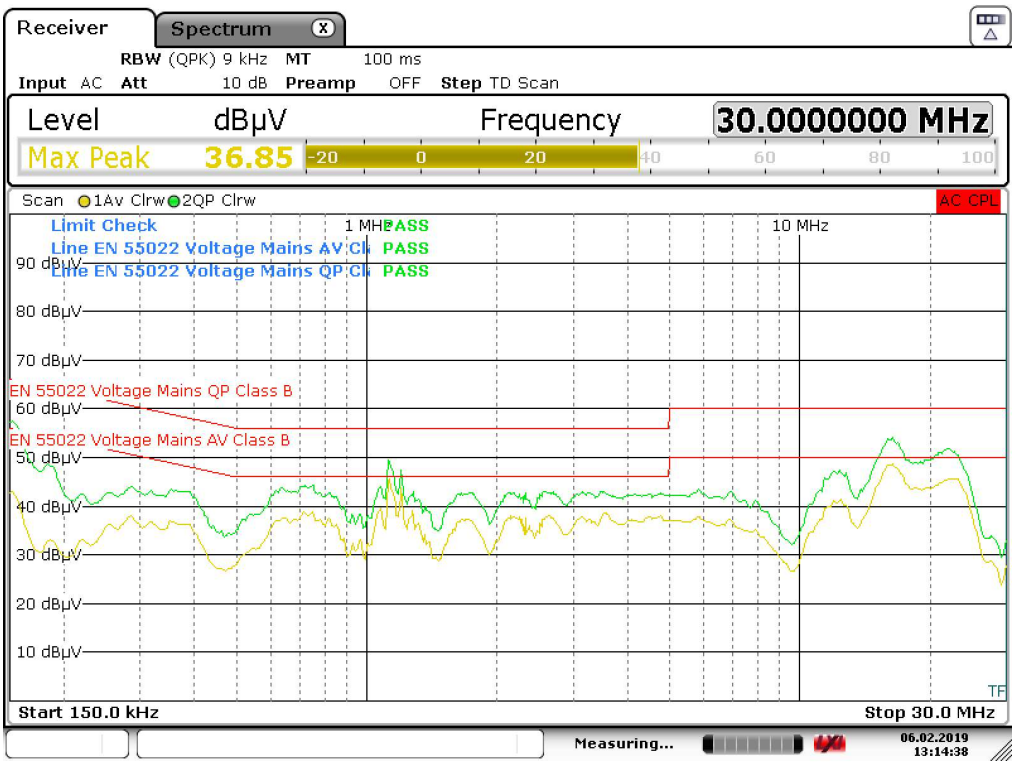
Below are the results for conducted EMI. These were taken at 12V @2.5A.



120Vac- LINE test

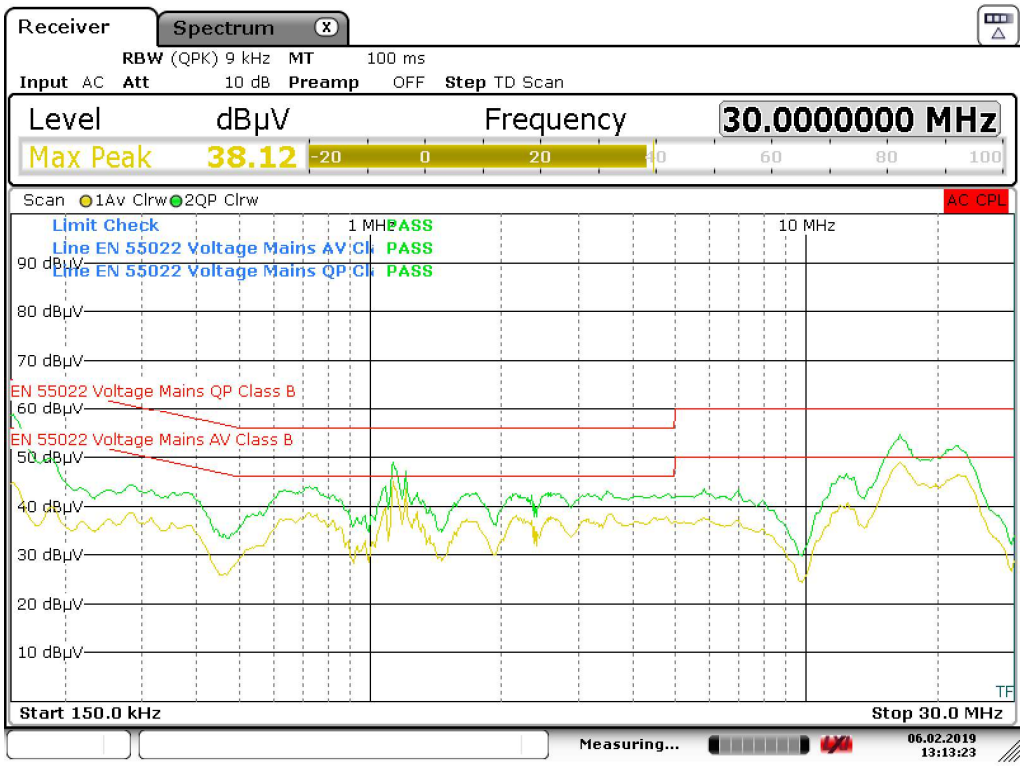


120Vac- NEUTRAL test



Date: 6.FEB.2019 13:14:38

230Vac- LINE test



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230Vac- LINE test

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265