

**Preliminary Test Data  
For PMP10649  
4/2/2015**



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## Table of Contents

1. Design Specifications .....	3
2. Circuit Description.....	3
3. PMP10649 Board Photos .....	3
4. Efficiency .....	4
4.1 Efficiency Chart .....	4
4.2 Efficiency Data.....	5
5 Output Voltage Regulation .....	8
5.1 Line Regulation.....	8
5.2 Load Regulation .....	9
6 Thermal Images.....	9
7 Waveform .....	12
7.1 Switching Waveform .....	12

## 1. Design Specifications

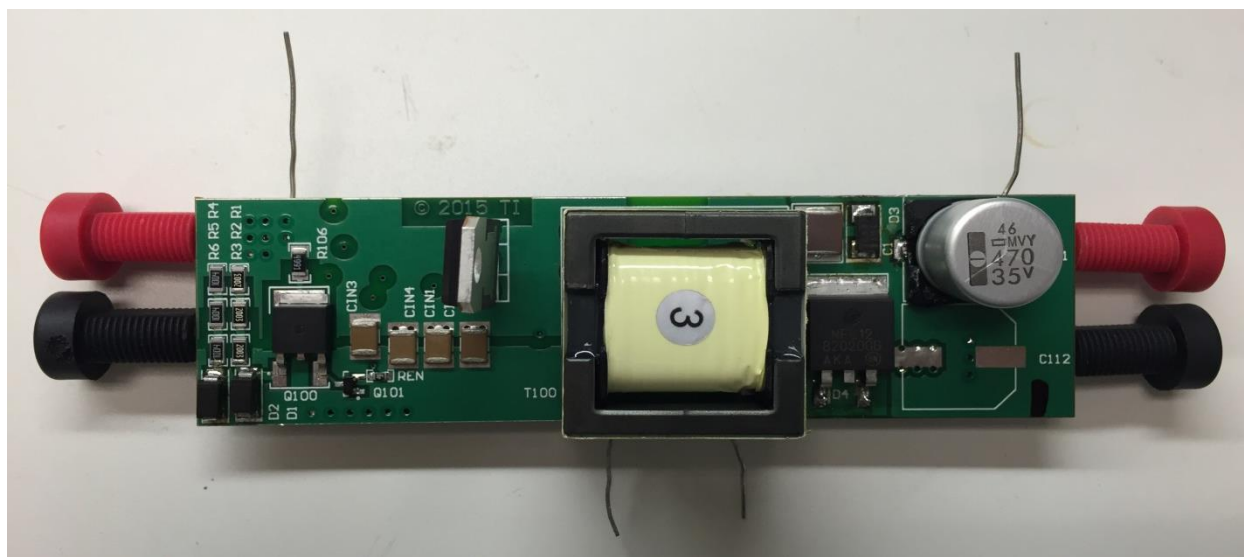
Vin Minimum	49VDC
Vin Maximum	450VDC
Vout	+15VDC @ 2A
Nominal Switching Frequency	≈ 80KHz

## 2. Circuit Description

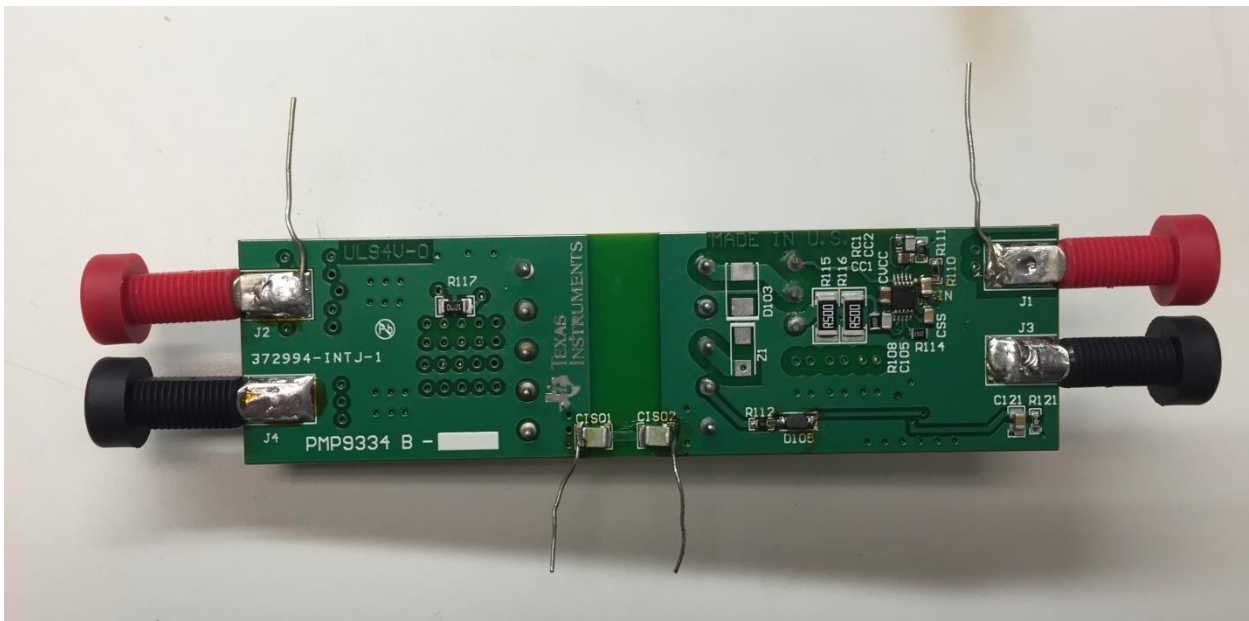
PMP10649 is an isolated Flyback converter using the LM5022 regulator IC. The design accepts an input voltage of 49Vin to 450Vin and provides one isolated outputs of +15Vout, capable of supplying 2A current at Vin higher than 100V. The nominal switching frequency of the design is 80KHz. The board is a 4-layer PCB with 1oz copper on both the top and bottom layer, 0.5oz copper on the internal layers. The design regulates the primary side voltage from the auxiliary windings to 17V. A zener diode of 18V is placed at the output to clamp the output voltage, a lower output voltage could be achieved using a smaller zener.

## 3. PMP10649 Board Photos

Board Dimensions: 101.6mm x 28mm



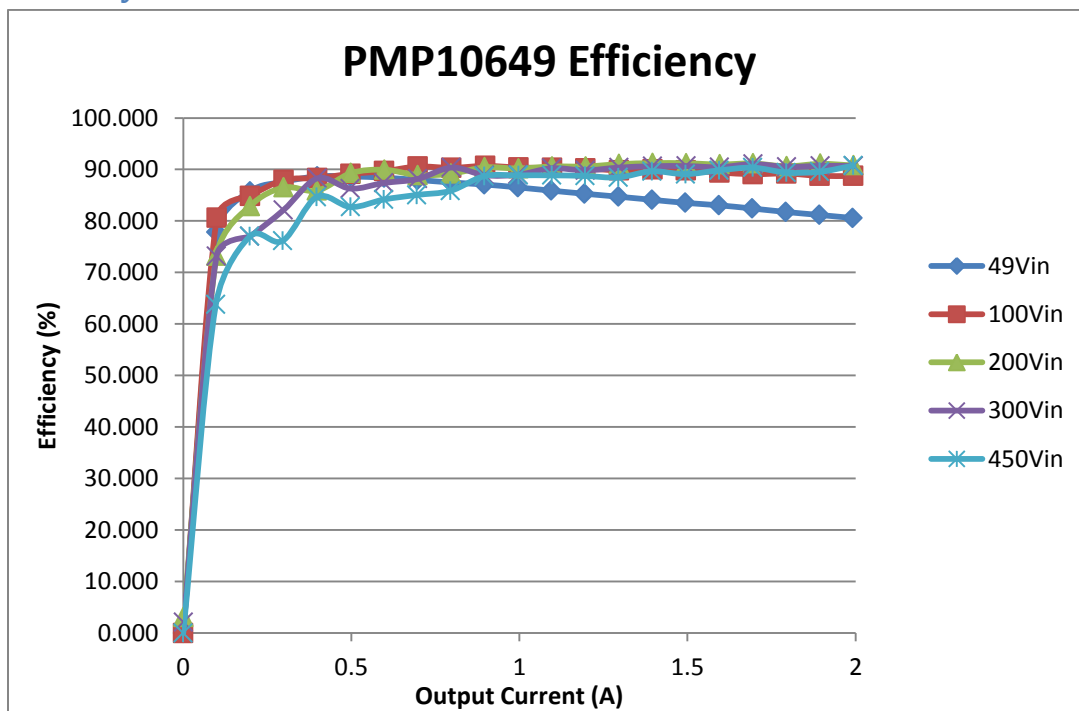
Board Photo (Top)



Board Photo (Bottom)

## 4. Efficiency

### 4.1 Efficiency Chart



## 4.2 Efficiency Data

Vin(V)	Iin(A)	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Efficiency(%)
49.026	0.011	0.539286	18.758	0	0	0.539286	0.000
49.027	0.046	2.255242	17.732	0.099	1.755468	0.499774	77.839
49.027	0.083	4.069241	17.529	0.199	3.488271	0.58097	85.723
49.027	0.121	5.932267	17.379	0.299	5.196321	0.735946	87.594
49.027	0.158	7.746266	17.213	0.399	6.867987	0.878279	88.662
49.026	0.195	9.56007	17.018	0.498	8.474964	1.085106	88.650
49.028	0.231	11.32547	16.742	0.598	10.01172	1.313752	88.400
49.027	0.264	12.94313	16.336	0.697	11.38619	1.556936	87.971
49.027	0.295	14.46297	15.873	0.797	12.65078	1.812184	87.470
49.025	0.323	15.83508	15.39	0.896	13.78944	2.045635	87.082
49.027	0.35	17.15945	14.905	0.996	14.84538	2.31407	86.514
49.026	0.375	18.38475	14.42	1.095	15.7899	2.59485	85.886
49.025	0.398	19.51195	13.937	1.194	16.64078	2.871172	85.285
49.027	0.419	20.54231	13.449	1.294	17.40301	3.139307	84.718
49.027	0.438	21.47383	12.957	1.394	18.06206	3.411768	84.112
49.027	0.454	22.25826	12.451	1.493	18.58934	3.668915	83.517
49.027	0.467	22.89561	11.936	1.593	19.01405	3.881561	83.047
49.029	0.478	23.43586	11.417	1.692	19.31756	4.118298	82.427
49.027	0.487	23.87615	10.892	1.792	19.51846	4.357685	81.749
49.025	0.493	24.16933	10.369	1.892	19.61815	4.551177	81.170
49.028	0.497	24.36692	9.862	1.991	19.63524	4.731674	80.582

Vin(V)	Iin(A)	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Efficiency(%)
100.041	0.006	0.600246	18.805	0	0	0.600246	0.000
100.041	0.022	2.200902	17.739	0.1	1.7739	0.427002	80.599
100.04	0.041	4.10164	17.49	0.199	3.48051	0.62113	84.857
100.041	0.059	5.902419	17.36	0.299	5.19064	0.711779	87.941
100.04	0.078	7.80312	17.273	0.399	6.891927	0.911193	88.323
100.04	0.096	9.60384	17.191	0.498	8.561118	1.042722	89.143
100.039	0.114	11.40445	17.104	0.598	10.22819	1.176254	89.686
100.038	0.131	13.10498	17.004	0.698	11.86879	1.236186	90.567
100.039	0.149	14.90581	16.871	0.798	13.46306	1.442753	90.321
100.039	0.165	16.50644	16.67	0.898	14.96966	1.536775	90.690
100.04	0.181	18.10724	16.417	0.997	16.36775	1.739491	90.393
100.04	0.196	19.60784	16.137	1.097	17.70229	1.905551	90.282
100.04	0.21	21.0084	15.841	1.196	18.94584	2.062564	90.182
100.041	0.224	22.40918	15.534	1.296	20.13206	2.27712	89.838
100.039	0.236	23.6092	15.219	1.396	21.24572	2.36348	89.989

100.039	0.248	24.80967	14.902	1.495	22.27849	2.531182	89.798
100.039	0.26	26.01014	14.58	1.595	23.2551	2.75504	89.408
100.039	0.271	27.11057	14.256	1.694	24.14966	2.960905	89.078
100.039	0.28	28.01092	13.93	1.794	24.99042	3.0205	89.217
100.038	0.29	29.01102	13.603	1.893	25.75048	3.260541	88.761
100.039	0.298	29.81162	13.273	1.993	26.45309	3.358533	88.734

Vin(V)	Iin(A)	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Efficiency(%)
200.036	0.012	2.400432	17.751	0.099	1.757349	0.643083	73.210
200.036	0.021	4.200756	17.492	0.199	3.480908	0.719848	82.864
200.035	0.03	6.00105	17.36	0.299	5.19064	0.81041	86.496
200.036	0.04	8.00144	17.266	0.398	6.871868	1.129572	85.883
200.036	0.048	9.601728	17.181	0.499	8.573319	1.028409	89.289
200.035	0.057	11.402	17.119	0.599	10.25428	1.147714	89.934
200.035	0.067	13.40235	17.072	0.698	11.91626	1.486089	88.912
200.036	0.076	15.20274	17.01	0.797	13.55697	1.645766	89.175
200.035	0.084	16.80294	16.935	0.897	15.1907	1.612245	90.405
200.035	0.093	18.60326	16.831	0.997	16.78051	1.822748	90.202
200.035	0.101	20.20354	16.682	1.097	18.30015	1.903381	90.579
200.035	0.109	21.80382	16.5	1.197	19.7505	2.053315	90.583
200.034	0.116	23.20394	16.298	1.296	21.12221	2.081736	91.029
200.035	0.123	24.60431	16.081	1.396	22.44908	2.155229	91.240
200.034	0.13	26.00442	15.854	1.496	23.71758	2.286836	91.206
200.034	0.137	27.40466	15.621	1.596	24.93112	2.473542	90.974
200.035	0.143	28.60501	15.385	1.695	26.07758	2.52743	91.164
200.034	0.15	30.0051	15.146	1.795	27.18707	2.81803	90.608
200.035	0.155	31.00543	14.904	1.895	28.24308	2.762345	91.091
200.035	0.161	32.20564	14.662	1.994	29.23603	2.969607	90.779

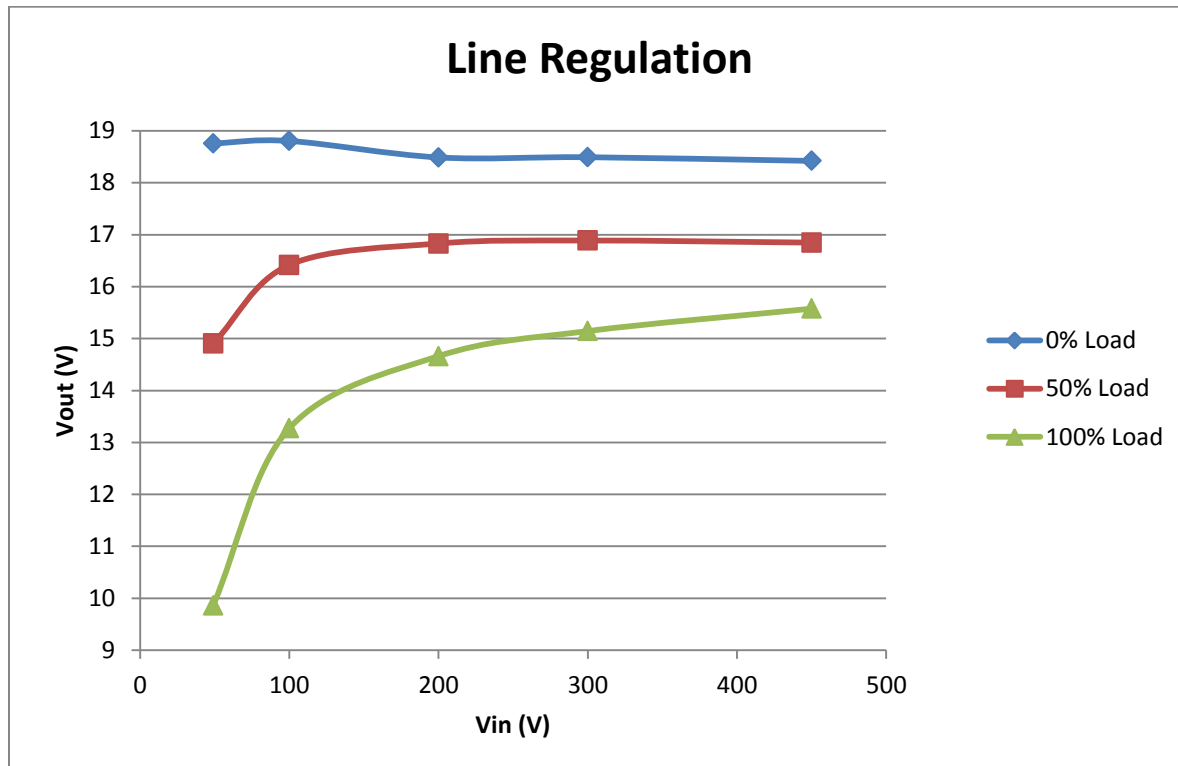
Vin(V)	Iin(A)	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Efficiency(%)
300.063	0.003	0.900189	18.492	0.001	0.018492	0.881697	2.054
300.064	0.008	2.400512	17.741	0.099	1.756359	0.644153	73.166
300.063	0.015	4.500945	17.502	0.198	3.465396	1.035549	76.993
300.063	0.021	6.301323	17.362	0.298	5.173876	1.127447	82.108
300.064	0.026	7.801664	17.261	0.399	6.887139	0.914525	88.278
300.063	0.033	9.902079	17.193	0.497	8.544921	1.357158	86.294
300.065	0.039	11.70254	17.127	0.597	10.22482	1.477716	87.373
300.063	0.045	13.50284	17.056	0.698	11.90509	1.597747	88.167
300.063	0.05	15.00315	16.991	0.798	13.55882	1.444332	90.373

300.063	0.057	17.10359	16.949	0.897	15.20325	1.900338	88.889
300.063	0.063	18.90397	16.888	0.996	16.82045	2.083521	88.978
300.063	0.068	20.40428	16.798	1.096	18.41061	1.993676	90.229
300.063	0.074	22.20466	16.677	1.196	19.94569	2.25897	89.827
300.063	0.079	23.70498	16.53	1.296	21.42288	2.282097	90.373
300.063	0.084	25.20529	16.364	1.396	22.84414	2.361148	90.632
300.062	0.089	26.70552	16.184	1.496	24.21126	2.494254	90.660
300.064	0.094	28.20602	15.994	1.595	25.51043	2.695586	90.443
300.064	0.098	29.40627	15.794	1.695	26.77083	2.635442	91.038
300.063	0.103	30.90649	15.584	1.795	27.97328	2.933209	90.509
300.064	0.107	32.10685	15.367	1.895	29.12047	2.986383	90.699
300.062	0.111	33.30688	15.145	1.994	30.19913	3.107752	90.669

Vin(V)	Iin(A)	Pin(W)	Vout(V)	Iout(A)	Pout(W)	Losses(W)	Efficiency(%)
450.102	0.003	1.350306	18.421	0	0	1.350306	0.000
450.101	0.006	2.700606	17.765	0.097	1.723205	0.977401	63.808
450.11	0.01	4.5011	17.505	0.198	3.46599	1.03511	77.003
450.101	0.015	6.751515	17.372	0.296	5.142112	1.609403	76.162
450.103	0.018	8.101854	17.276	0.397	6.858572	1.243282	84.654
450.103	0.023	10.35237	17.194	0.498	8.562612	1.789757	82.712
450.101	0.027	12.15273	17.134	0.597	10.229	1.923729	84.170
450.104	0.031	13.95322	17.076	0.695	11.86782	2.085404	85.054
450.103	0.035	15.75361	17.012	0.795	13.52454	2.229065	85.850
450.104	0.038	17.10395	16.934	0.896	15.17286	1.931088	88.710
450.105	0.042	18.90441	16.848	0.997	16.79746	2.106954	88.855
450.104	0.046	20.70478	16.786	1.096	18.39746	2.307328	88.856
450.104	0.05	22.5052	16.714	1.195	19.97323	2.53197	88.749
450.104	0.054	24.30562	16.615	1.294	21.49981	2.805806	88.456
450.105	0.057	25.65599	16.499	1.394	22.99961	2.656379	89.646
450.104	0.061	27.45634	16.373	1.494	24.46126	2.995082	89.091
450.105	0.064	28.80672	16.234	1.594	25.877	2.929724	89.830
450.104	0.067	30.15697	16.085	1.694	27.24799	2.908978	90.354
450.104	0.071	31.95738	15.926	1.794	28.57124	3.38614	89.404
450.103	0.074	33.30762	15.755	1.893	29.82422	3.483407	89.542
450.104	0.076	34.2079	15.576	1.993	31.04297	3.164936	90.748

## 5 Output Voltage Regulation

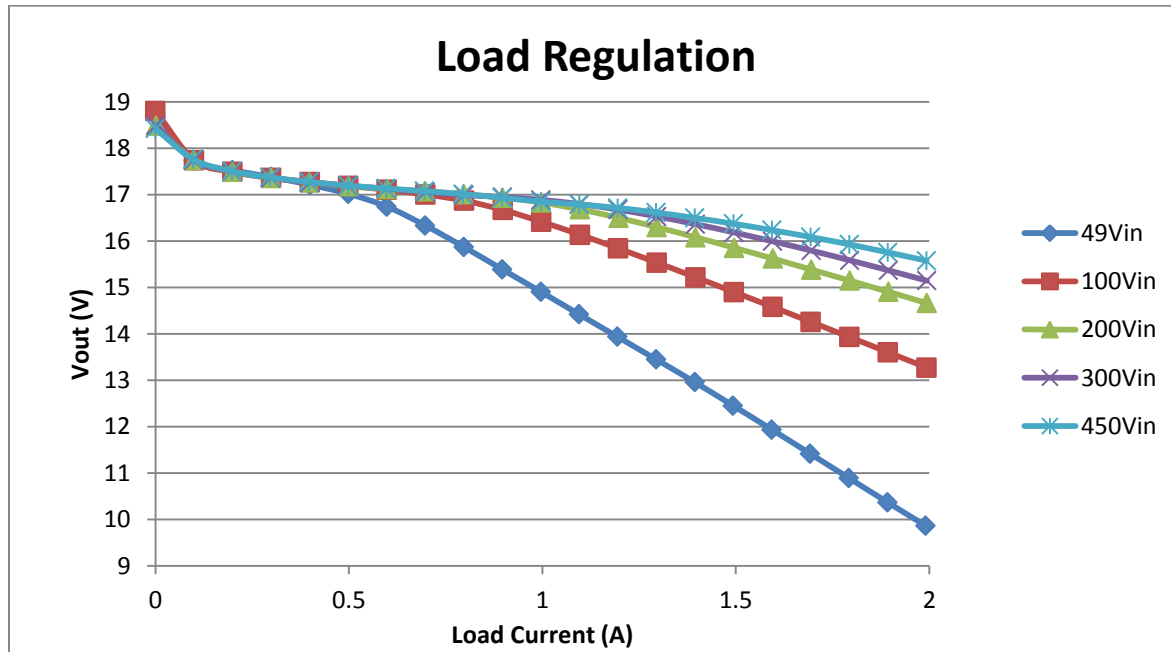
### 5.1 Line Regulation



Line Regulation at 0% Load			Line Regulation at 50% Load			Line Regulation at 100% Load		
Vin	Vout		Vin	Vout		Vin	Vout	
49	18.758		49	14.905		49	9.862	
100	18.805		100	16.417		100	13.273	
200	18.488		200	16.831		200	14.662	
300	18.492		300	16.888		300	15.145	
450	18.421		450	16.848		450	15.575	

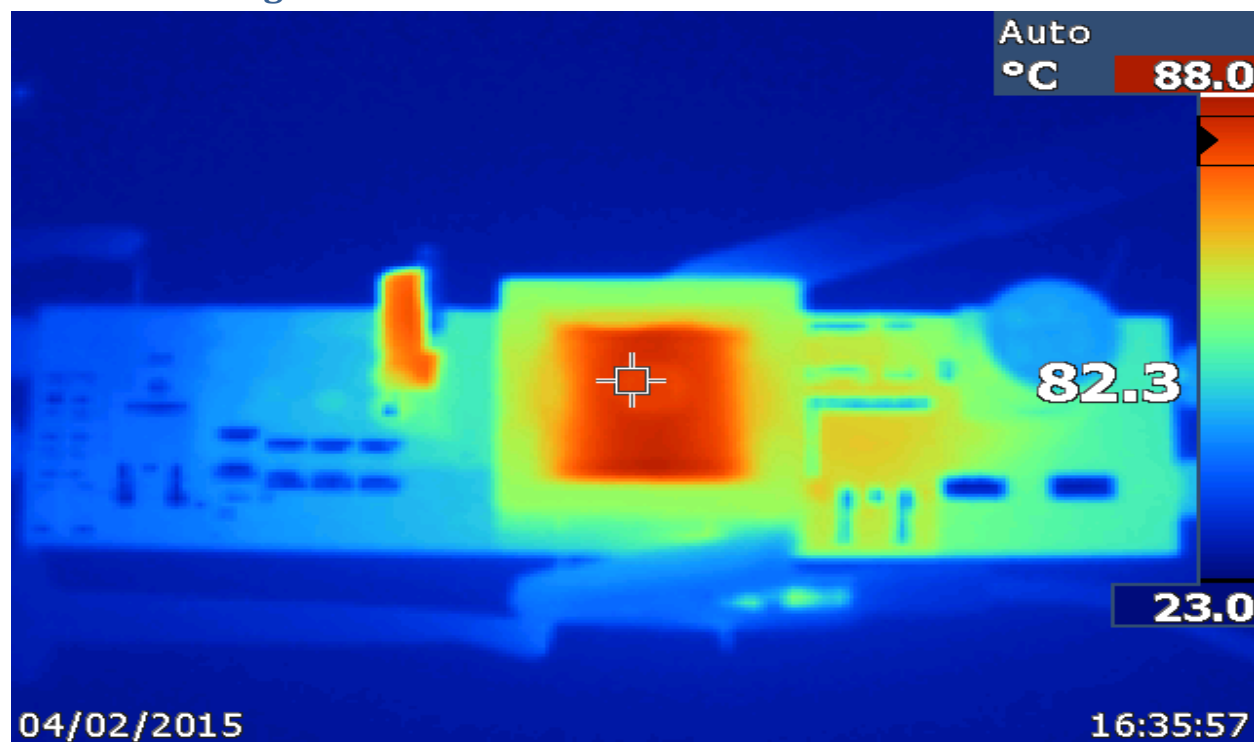


## 5.2 Load Regulation

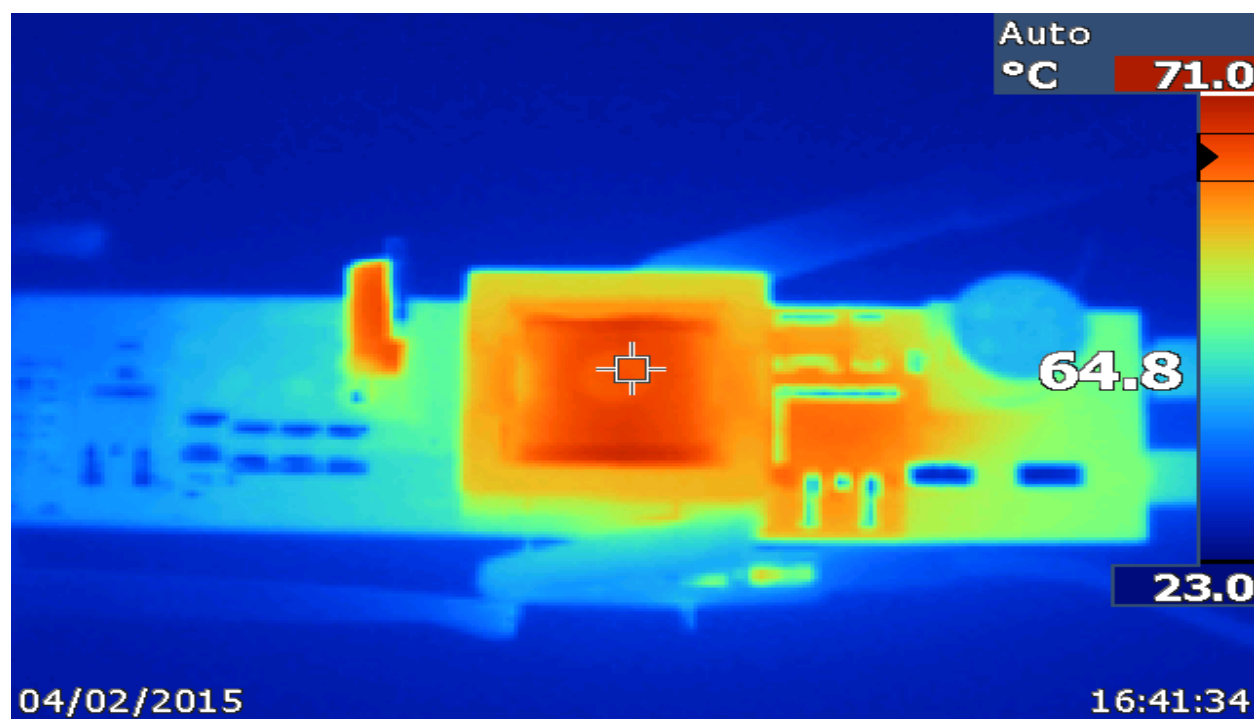


% of Load	49Vin	100Vin	200Vin	300Vin	450Vin
0	18.758	18.805	18.488	18.492	18.421
5	17.732	17.739	17.751	17.741	17.765
10	17.529	17.49	17.492	17.502	17.505
15	17.379	17.36	17.36	17.362	17.372
20	17.213	17.273	17.266	17.261	17.276
25	17.018	17.191	17.181	17.193	17.194
30	16.742	17.104	17.119	17.127	17.134
35	16.336	17.004	17.072	17.056	17.076
40	15.873	16.871	17.01	16.991	17.012
45	15.39	16.67	16.935	16.949	16.934
50	14.905	16.417	16.831	16.888	16.848
55	14.42	16.137	16.682	16.798	16.786
60	13.937	15.841	16.5	16.677	16.714
65	13.449	15.534	16.298	16.53	16.615
70	12.957	15.219	16.081	16.364	16.499
75	12.451	14.902	15.854	16.184	16.373
80	11.936	14.58	15.621	15.994	16.234
85	11.417	14.256	15.385	15.794	16.085
90	10.892	13.93	15.146	15.584	15.926
95	10.369	13.603	14.904	15.367	15.755
100	9.862	13.273	14.662	15.145	15.576

## 6 Thermal Images



Thermal image was taken at 49Vin, 2A load when the board reaches equilibrium.



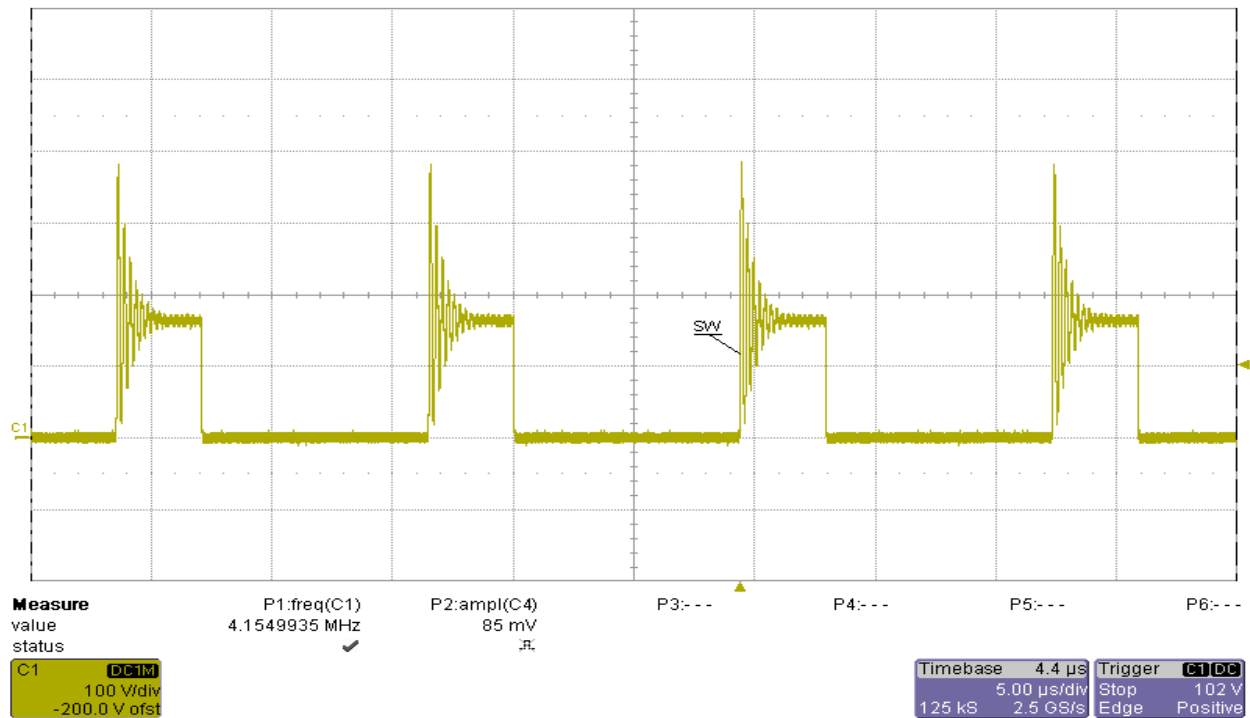
Thermal image was taken at 200Vin, 2A load when the board reaches equilibrium.



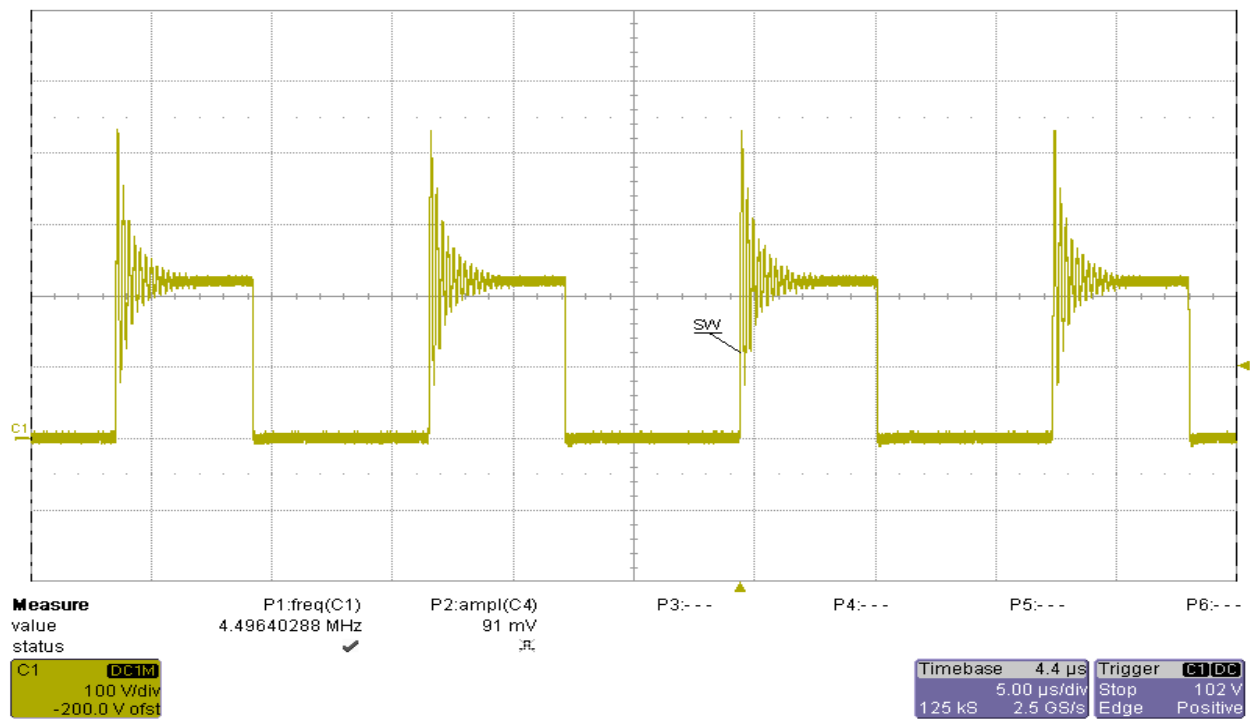
Thermal image was taken at 450Vin, 2A load when the board reaches equilibrium.

## 7 Waveform

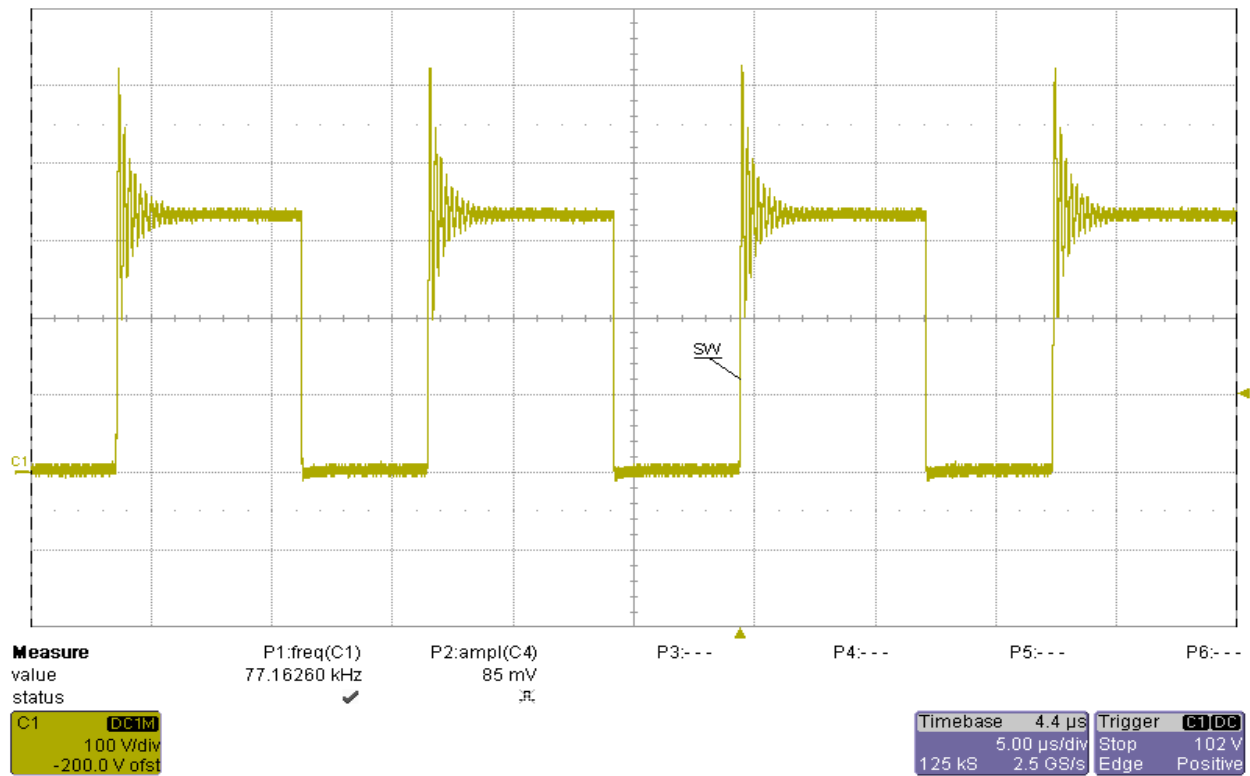
### 7.1 Switching Waveform



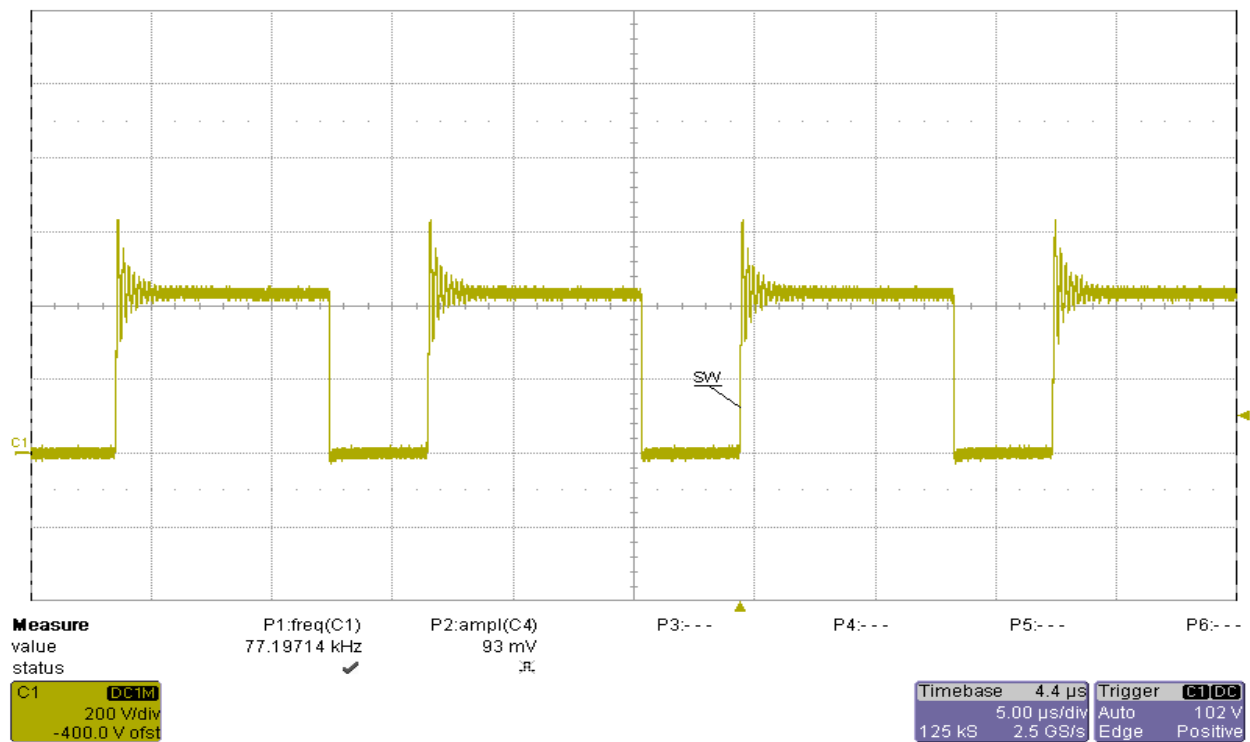
49Vin, 1.5A load. Ch1 measures primary switching waveform.



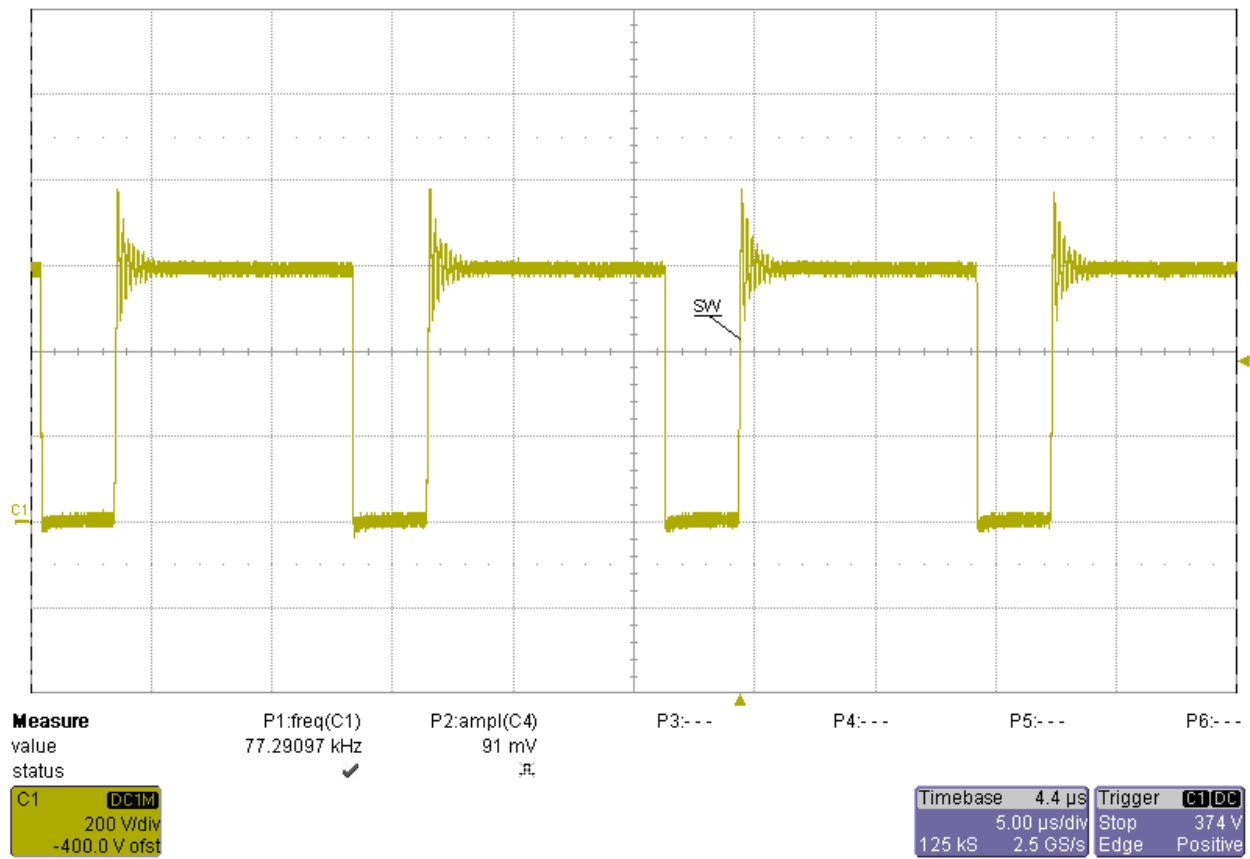
100Vin, 2A load. Ch1 measures primary switching waveform.



200Vin, 2A load. Ch1 measures primary switching waveform.



300Vin, 2A load. Ch1 measures primary switching waveform.



450Vin, 2A load. Ch1 measures primary switching waveform.