Test Report: PMP22339 High-Voltage, 800-W SEPIC Converter Reference Design for Server Battery Backup Charging

TEXAS INSTRUMENTS

1 Description

This Discontinuous Conduction Mode (DCM), non-isolated, 800-W SEPIC converter battery charger provides an adjustable output voltage and current. The output voltage can be adjusted from 282 V to 400 V by setting an external DC voltage between 0 V to 3 V. The output charging current can be adjusted between 0 A to 2 A by adjusting the duty cycle of a PWM input. It operates over an input voltage range of 340 Vdc–420 Vdc. Independent voltage and current feedback loops are used to maintain regulation.

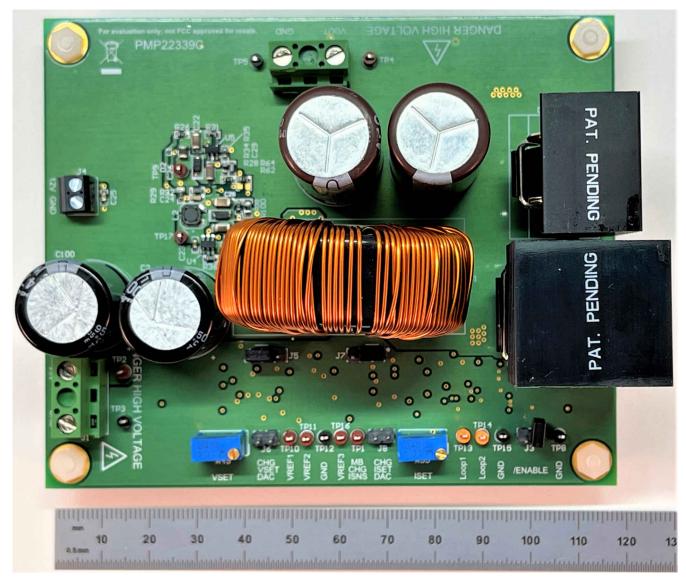


Figure 1-1. Top Photo

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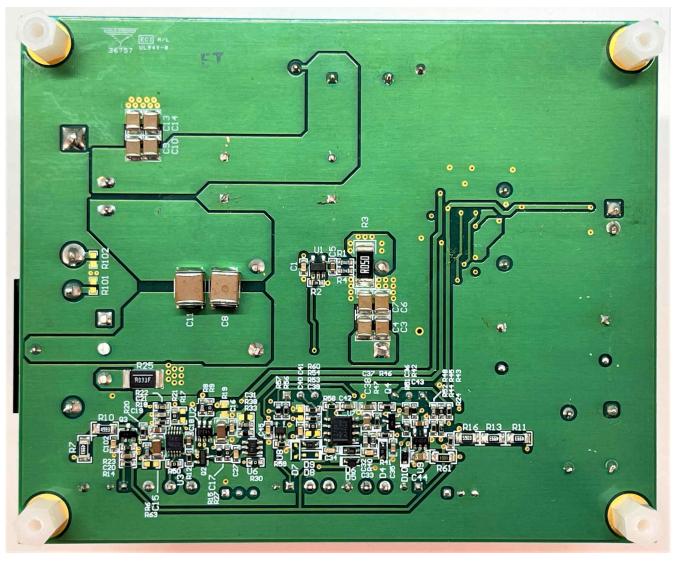


Figure 1-2. Bottom Photo



2 Test Prerequisites

2.1 Voltage and Current Requirements

Table 2-1. Voltage and Current Requirements

Table 2 1. Voltage and Garrent Requirements					
Parameter	Specifications				
Input voltage range	340 V–420 V, after > 335-V startup				
Output voltage	282 V–400 V, (CHG VSET DAC = 0 Vdc–3 Vdc)				
Output current	0 A–2 A, (CHG ISET DAC = 0% to 100%, 100 kHz, 2.5 V)				
Switching frequency	100 kHz				
Isolation	No				

2.2 Required Equipment

- Li-Ion batteries or load (active or resistive), 400 V, 2 A, 800 W minimum
- Input source power supply, adjustable, 0 V–500 V, 1000 W, 3 A minimum
- Oscilloscope and high-voltage probes
- Digital multimeters
- 12-V bias supplies, 100 mA minimum
- Function generator, adjustable frequency, amplitude and duty cycle

3 Testing and Results

3.1 Thermal Images

The following images show the operating temperature of the board with 400-Vdc input and 400 V at 2-A output at room temperature with approximately 200 LFM to 400 LFM of air flow.

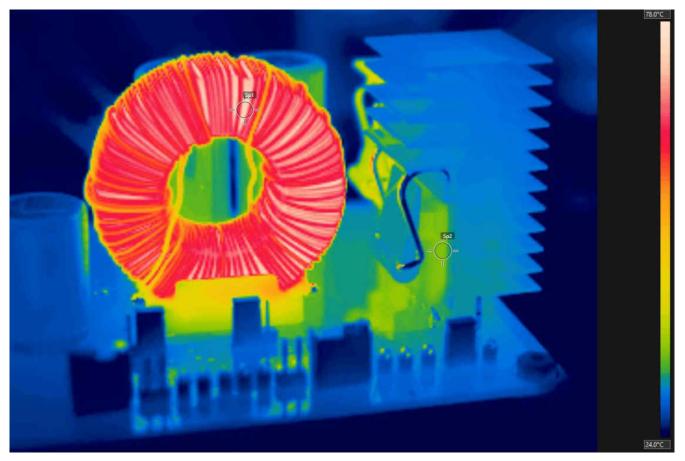


Figure 3-1. Front Thermal Image

Measurement Location	Temperature (°C)
Sp1	75.6
Sp2	37.1



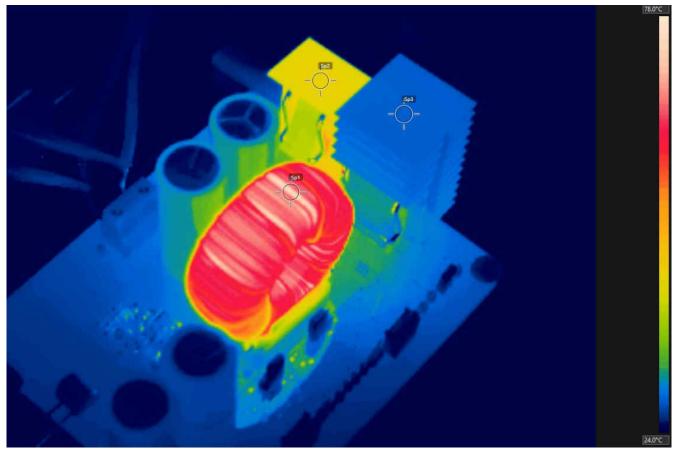


Figure 3-2. Top Thermal Image

Measurement Location	Temperature (°C)
Sp1	75.9
Sp2	47.6
Sp3	29.2



3.2 Efficiency and Power Dissipation Graph

This graph displays the efficiency and power dissipation of the converter at three different input and output voltage conditions.

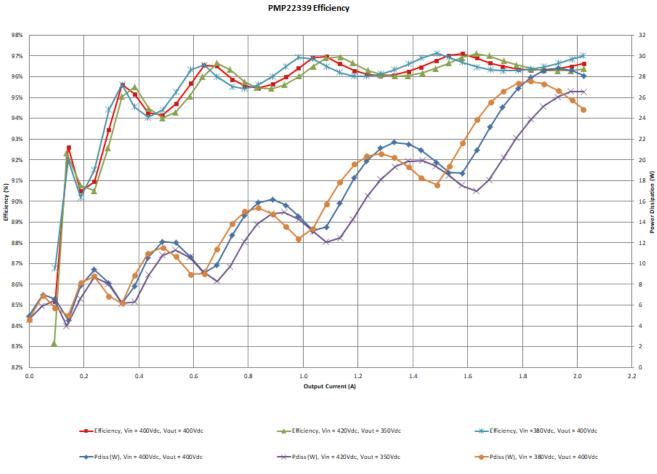


Figure 3-3. Efficiency and Power Dissipation Graph

3.3 Efficiency and Power Dissipation Data

400.111 0.0124 399.6 0.0000 4.968 0.0% 4.97 400.109 0.0178 399.6 0.0544 20.119 27.121 74.2% 7.00 400.108 0.1177 399.6 0.0544 20.119 27.121 74.2% 6.57 400.108 0.1173 399.6 0.1282 57.075 61.631 92.6% 4.56 400.107 0.260 399.6 0.2364 44.631 104.045 91.0% 9.41 400.105 0.2601 399.6 0.2363 135.569 11.777 95.6% 6.21 400.105 0.4037 399.5 0.4331 173.22 183.777 94.3% 10.57 400.108 0.5651 399.5 0.4332 194.602 20.704 94.1% 12.10 400.108 0.5651 399.5 0.6382 235.417 24.038 95.7% 10.62 400.105 0.7712 399.5 0.6382 235.417 24.038 95.5% 12	Vin	lin	Vout	lout	Ро	Pin	Efficiency, Vin = 400Vdc, Vout = 400Vdc	Pdiss (W), Vin = 400Vdc, Vout = 400Vdc
400.108 0.1107 399.6 0.0944 37.714 44.286 85.2% 6.57 400.108 0.1273 399.6 0.1428 57.075 61.631 92.6% 4.56 400.108 0.2073 399.6 0.1878 75.047 82.930 99.5% 7.88 400.107 0.2600 399.6 0.2388 94.631 104.045 91.0% 94.1 400.112 0.3543 399.6 0.3383 135.569 14.177 95.6% 6.21 400.109 0.4554 399.5 0.4381 173.222 183.797 94.3% 10.57 400.109 0.4561 399.5 0.4381 173.222 183.797 94.3% 10.57 400.108 0.5651 399.5 0.5382 214.082 226.083 94.7% 12.10 400.108 0.5611 39.5 0.4827 224.962 20.603 95.7% 10.62 400.105 0.7073 39.5 0.6837 273.157 283.013	400.111	0.0124	399.6	0.0000	0.000	4.968	0.0%	4.97
400.108 0.1540 399.6 0.1428 57.075 61.831 92.6% 4.56 400.107 0.2303 399.6 0.1878 75.47 82.930 90.5% 7.88 400.107 0.2600 399.6 0.2383 115.992 124.109 93.5% 6.12 400.112 0.343 399.6 0.2393 115.992 124.109 93.5% 6.21 400.105 0.4037 399.5 0.3381 155.768 161.529 95.2% 7.82 400.109 0.5166 399.5 0.4371 194.633 206.704 94.1% 10.57 400.108 0.6611 399.5 0.5382 254.402 28.033 94.7% 12.00 400.105 0.6149 399.5 0.5862 253.417 246.033 95.7% 10.62 400.106 0.6601 399.5 0.7863 313.98 328.574 95.5% 14.64 400.105 0.7712 399.5 0.7864 33.385 349.259	400.109	0.0678	399.6	0.0504	20.119	27.121	74.2%	7.00
400.108 0.2073 399.6 0.1878 75.047 82.930 90.5% 7.88 400.107 0.2600 399.6 0.2388 94.83 104.045 91.0% 9.41 400.112 0.543 399.6 0.2303 115.992 124.109 93.5% 8.12 400.112 0.543 399.6 0.3331 135.569 141.777 95.6% 6.21 400.109 0.4534 399.5 0.4336 173.232 183.797 94.3% 10.57 400.109 0.5166 399.5 0.4336 173.232 183.797 94.3% 10.20 400.108 0.5661 399.5 0.4582 225.083 94.7% 10.62 400.106 0.6149 399.5 0.6837 273.157 283.013 96.5% 9.11 400.105 0.7073 399.5 0.7868 313.395 349.259 95.5% 11.62 400.102 0.9229 399.5 0.8377 323.395 96.9% 13.13 <	400.108	0.1107	399.6	0.0944	37.714	44.286	85.2%	6.57
400.107 0.2600 399.6 0.2388 94.631 104.045 91.0% 9.41 400.106 0.3102 399.6 0.2903 115.92 124.109 93.5% 8.12 400.112 0.3534 399.6 0.3333 135.569 141.777 96.6% 6.21 400.105 0.4037 399.5 0.3347 153.714 161.529 95.2% 7.82 400.109 0.4594 399.5 0.4336 173.222 183.797 94.3% 10.57 400.108 0.6616 399.5 0.4582 226.083 94.7% 12.00 400.106 0.6149 399.5 0.6832 254.986 284.094 96.6% 9.11 400.105 0.77712 399.5 0.7858 313.395 328.574 95.5% 14.64 400.104 0.8212 399.5 0.7858 313.995 324.8259 95.5% 15.86 400.102 0.9733 399.5 0.8367 34.468 370.865 95.6% <td>400.108</td> <td>0.1540</td> <td>399.6</td> <td>0.1428</td> <td>57.075</td> <td>61.631</td> <td>92.6%</td> <td>4.56</td>	400.108	0.1540	399.6	0.1428	57.075	61.631	92.6%	4.56
400.106 0.3102 399.6 0.2903 115.992 124.109 93.5% 8.12 400.112 0.3543 399.6 0.3393 135.569 141.777 95.6% 6.21 400.109 0.4584 399.5 0.4381 173.232 183.797 94.3% 10.57 400.109 0.5166 399.5 0.4381 173.232 183.797 94.3% 10.57 400.108 0.5661 399.5 0.5382 254.402 266.03 94.7% 12.00 400.106 0.6601 399.5 0.6382 254.986 246.034 96.6% 9.11 400.105 0.77712 399.5 0.6837 273.157 283.013 96.5% 9.86 400.104 0.8212 399.5 0.7848 313.938 328.574 96.5% 11.64 400.102 0.9743 399.5 0.8361 333.935 349.259 95.5% 15.86 400.102 1.0169 399.5 0.8371 374.190 389.03<	400.108	0.2073	399.6	0.1878	75.047	82.930	90.5%	7.88
400.112 0.3543 399.6 0.3393 135.569 141.777 96.6% 6.21 400.105 0.4037 399.5 0.3847 153.714 161.529 95.2% 7.82 400.109 0.4594 399.5 0.4336 173.232 183.797 94.3% 10.57 400.108 0.5661 399.5 0.4336 173.232 183.797 94.3% 10.57 400.108 0.5661 399.5 0.5358 214.082 226.083 94.7% 12.00 400.106 0.6149 399.5 0.6832 254.986 284.094 96.6% 9.11 400.105 0.7712 399.5 0.7858 313.93 328.574 96.5% 12.75 400.104 0.8212 399.5 0.8879 324.9259 95.5% 15.86 400.102 0.9743 399.5 0.9367 374.190 389.803 96.0% 15.61 400.102 1.0743 399.5 0.9367 374.190 389.803 96.0%<	400.107	0.2600	399.6	0.2368	94.631	104.045	91.0%	9.41
400.105 0.4037 399.5 0.3847 153.714 161.529 95.2% 7.82 400.109 0.4594 399.5 0.4336 173.232 183.797 94.3% 10.57 400.109 0.5166 399.5 0.4358 174.063 206.704 94.1% 12.10 400.106 0.6651 399.5 0.5358 214.082 226.083 94.7% 12.00 400.106 0.6601 399.5 0.6382 235.417 246.038 95.7% 10.62 400.105 0.7712 399.5 0.6382 273.498 264.094 96.6% 9.11 400.105 0.7712 399.5 0.7858 313.938 328.574 95.5% 14.64 400.104 0.8272 399.5 0.8346 333.36 349.259 95.5% 16.18 400.102 0.9743 399.5 0.8372 374.190 389.803 96.0% 15.81 400.102 1.0768 399.5 1.3824 428.763 96.9%<	400.106	0.3102	399.6	0.2903	115.992	124.109	93.5%	8.12
400.109 0.4584 399.5 0.4336 173.232 183.797 94.3% 10.57 400.109 0.5166 399.5 0.4871 194.603 206.704 94.1% 12.10 400.108 0.5651 399.5 0.5358 214.082 226.083 94.7% 12.00 400.106 0.6149 399.5 0.6382 254.102 246.038 95.7% 10.62 400.105 0.7712 399.5 0.6382 254.986 264.094 96.6% 9.11 400.105 0.7712 399.5 0.7858 313.393 325.57 95.5% 14.64 400.104 0.8729 399.5 0.8346 333.395 39.850 96.5% 16.18 400.102 0.9269 39.5 0.8367 374.190 38.803 96.4% 14.57 400.102 0.9743 399.5 0.8821 392.30 406.88 96.4% 14.57 400.101 1.1682 393.823 496.5% 13.50 406.38 <td>400.112</td> <td>0.3543</td> <td>399.6</td> <td>0.3393</td> <td>135.569</td> <td>141.777</td> <td>95.6%</td> <td>6.21</td>	400.112	0.3543	399.6	0.3393	135.569	141.777	95.6%	6.21
400.109 0.5186 399.5 0.4871 194.603 206.704 94.1% 12.10 400.108 0.5681 399.5 0.5382 214.082 226.033 94.7% 12.00 400.106 0.6614 399.5 0.5882 235.417 246.038 95.7% 10.62 400.105 0.7703 399.5 0.6837 273.157 283.013 96.5% 9.86 400.104 0.8212 399.5 0.7404 295.809 308.561 95.9% 12.75 400.104 0.8212 399.5 0.8346 333.395 349.259 95.5% 15.86 400.102 0.9743 399.5 0.8346 333.395 349.259 95.5% 15.61 400.102 0.9743 399.5 0.9821 392.300 406.888 96.4% 14.57 400.101 1.168 399.5 1.0353 413.585 426.763 96.9% 13.18 400.101 1.162 399.5 1.1329 452.561 468.35	400.105	0.4037	399.5	0.3847	153.714	161.529	95.2%	7.82
400.108 0.5651 399.5 0.5358 214.082 226.083 94.7% 12.00 400.106 0.6149 399.5 0.5892 235.417 246.038 95.7% 10.62 400.106 0.6601 399.5 0.6382 254.986 640.94 96.6% 9.11 400.105 0.7712 399.5 0.6382 254.986 66.5% 9.86 400.105 0.7712 399.5 0.7858 313.938 328.574 95.5% 14.64 400.102 0.9289 399.5 0.8346 333.395 374.9259 95.5% 15.86 400.102 0.9743 399.5 0.8379 354.689 370.865 95.6% 16.18 400.102 1.0169 399.5 1.0353 413.585 426.763 96.9% 13.18 400.101 1.1162 399.5 1.1329 425.51 468.357 96.6% 15.80 400.099 1.2300 399.5 1.1829 455.347 96.6% 15.80 <td>400.109</td> <td>0.4594</td> <td>399.5</td> <td>0.4336</td> <td>173.232</td> <td>183.797</td> <td>94.3%</td> <td>10.57</td>	400.109	0.4594	399.5	0.4336	173.232	183.797	94.3%	10.57
400.106 0.8149 399.5 0.5892 235.417 246.038 95.7% 10.82 400.106 0.6601 399.5 0.6382 254.986 264.094 96.6% 9.11 400.105 0.7073 399.5 0.6837 273.157 283.013 96.5% 9.86 400.105 0.7712 399.5 0.7404 295.809 308.561 95.5% 14.64 400.104 0.8272 399.5 0.8346 333.395 349.259 95.5% 15.86 400.102 0.9269 399.5 0.8879 354.689 370.865 95.6% 16.18 400.102 0.9743 399.5 0.9867 374.190 389.803 96.0% 15.61 400.102 1.0169 399.5 1.0353 413.585 428.763 96.9% 13.18 400.101 1.162 399.5 1.3824 446.585 97.0% 13.50 400.099 1.2300 399.5 1.1822 452.51 488.357 96.6% </td <td>400.109</td> <td>0.5166</td> <td>399.5</td> <td>0.4871</td> <td>194.603</td> <td>206.704</td> <td>94.1%</td> <td>12.10</td>	400.109	0.5166	399.5	0.4871	194.603	206.704	94.1%	12.10
400.106 0.6601 399.5 0.6382 254.986 264.094 96.6% 9.11 400.105 0.7713 399.5 0.6837 273.157 283.013 96.5% 9.86 400.104 0.8212 399.5 0.7404 295.809 308.561 95.9% 12.75 400.104 0.8212 399.5 0.7404 295.809 308.561 95.9% 14.64 400.104 0.8212 399.5 0.8346 333.395 349.259 95.5% 15.86 400.102 0.9743 399.5 0.9367 374.190 398.803 96.0% 15.61 400.102 0.9743 399.5 0.9821 392.300 406.888 96.4% 14.57 400.101 1.1162 399.5 1.0841 433.082 446.585 97.0% 13.50 400.009 1.2300 399.5 1.1822 473.823 492.114 96.3% 18.29 400.099 1.2300 399.5 1.1822 473.823 492.1	400.108	0.5651	399.5	0.5358	214.082	226.083	94.7%	12.00
400.105 0.7073 399.5 0.6837 273.157 283.013 96.5% 95.9% 400.105 0.7712 399.5 0.7404 295.809 308.561 95.9% 12.75 400.104 0.8212 399.5 0.7858 313.938 328.574 95.5% 14.64 400.102 0.8269 399.5 0.8346 333.395 349.259 95.5% 16.18 400.102 0.9269 399.5 0.8879 554.689 370.865 95.6% 16.18 400.102 0.9743 399.5 0.9821 392.300 406.888 96.4% 14.57 400.101 1.0666 399.5 1.0353 413.585 426.763 96.9% 13.18 400.100 1.0706 399.5 1.0821 433.82 446.585 97.0% 13.50 400.100 1.1706 399.5 1.1329 452.51 488.357 96.6% 15.80 400.099 1.2310 399.5 1.2825 512.320 533.4	400.106	0.6149	399.5	0.5892	235.417	246.038	95.7%	10.62
400.105 0.7712 399.5 0.7404 295.809 308.561 95.9% 12.75 400.104 0.8212 399.5 0.7858 313.938 328.574 95.5% 14.64 400.104 0.8729 399.5 0.8346 333.395 349.259 95.5% 15.86 400.102 0.9269 399.5 0.8377 354.689 370.865 95.6% 16.18 400.102 0.9743 399.5 0.9827 374.190 389.803 96.0% 15.61 400.102 1.0168 399.5 1.0353 413.585 426.763 96.9% 13.18 400.101 1.1162 399.5 1.0841 433.082 446.585 97.0% 13.50 400.091 1.2300 399.5 1.1329 452.561 468.357 96.6% 16.82 400.099 1.2300 399.5 1.2317 492.015 51.839 96.1% 12.10 400.099 1.2302 399.5 1.2317 492.05 51.84	400.106	0.6601	399.5	0.6382	254.986	264.094	96.6%	9.11
400.104 0.8212 399.5 0.7858 313.938 328.574 95.5% 14.64 400.104 0.8729 399.5 0.8346 333.395 349.259 95.5% 15.86 400.102 0.9743 399.5 0.8377 374.190 389.803 96.0% 15.61 400.102 1.0743 399.5 0.9367 374.190 389.803 96.0% 15.61 400.102 1.0743 399.5 0.9821 392.300 406.868 96.4% 14.57 400.101 1.1669 399.5 1.0851 413.585 426.763 96.9% 13.18 400.101 1.1162 399.5 1.1329 452.561 468.357 96.6% 15.80 400.099 1.2300 399.5 1.2825 512.302 533.424 96.0% 21.10 400.099 1.3332 399.5 1.3846 553.476 96.1% 21.67 400.099 1.4362 399.5 1.4864 593.744 613.488 96.	400.105	0.7073	399.5	0.6837	273.157	283.013	96.5%	9.86
400.104 0.8729 399.5 0.8346 333.395 349.259 95.5% 15.86 400.102 0.9269 399.5 0.8879 354.689 370.865 95.6% 16.18 400.102 0.9743 399.5 0.9367 374.190 389.803 96.0% 15.61 400.102 1.0169 399.5 0.9821 392.300 406.888 96.4% 14.57 400.101 1.0666 399.5 1.0353 413.585 426.763 96.9% 13.18 400.101 1.1162 399.5 1.0841 433.082 446.585 97.0% 13.50 400.101 1.1706 399.5 1.1829 452.561 468.357 96.6% 15.80 400.099 1.2300 399.5 1.2817 492.005 511.899 96.1% 18.29 400.099 1.332 399.5 1.2825 512.320 533.424 96.0% 21.10 400.098 1.3834 399.5 1.3846 553.102 574.	400.105	0.7712	399.5	0.7404	295.809	308.561	95.9%	12.75
400.102 0.9269 399.5 0.8879 354.689 370.865 95.6% 16.18 400.102 0.9743 399.5 0.9367 374.190 389.803 96.0% 15.61 400.102 1.0169 399.5 0.9821 392.300 406.868 96.4% 14.57 400.100 1.0666 399.5 1.0353 413.585 426.763 96.9% 13.18 400.101 1.1162 399.5 1.0841 433.082 446.585 97.0% 13.50 400.100 1.1706 399.5 1.1329 452.561 468.357 96.6% 15.80 400.099 1.2300 399.5 1.2825 512.320 53.424 96.0% 21.10 400.099 1.3323 399.5 1.2825 512.320 53.424 96.0% 21.67 400.099 1.4324 399.5 1.3846 553.476 96.1% 21.67 400.099 1.4323 399.5 1.4288 571.165 592.095 96.5%	400.104	0.8212	399.5	0.7858	313.938	328.574	95.5%	14.64
400.102 0.9743 399.5 0.9367 374.190 389.803 96.0% 15.61 400.102 1.0169 399.5 0.9821 392.300 406.868 96.4% 14.57 400.100 1.0666 399.5 1.0353 413.585 426.763 96.9% 13.18 400.101 1.1162 399.5 1.0841 433.082 446.585 97.0% 13.50 400.009 1.2300 399.5 1.1329 452.561 468.357 96.6% 15.80 400.099 1.2300 399.5 1.2817 492.005 511.899 96.1% 19.89 400.099 1.332 399.5 1.2817 492.005 513.499 96.1% 21.67 400.099 1.3324 399.5 1.2817 592.095 96.5% 20.93 400.099 1.4362 399.5 1.4298 571.165 592.095 96.5% 20.93 400.099 1.4799 399.5 1.4298 571.165 592.095 96.5	400.104	0.8729	399.5	0.8346	333.395	349.259	95.5%	15.86
400.102 1.0169 399.5 0.9821 392.300 406.868 96.4% 14.57 400.100 1.0666 399.5 1.0353 413.585 426.763 96.9% 13.18 400.101 1.1162 399.5 1.0841 433.082 446.585 97.0% 13.50 400.099 1.2300 399.5 1.1329 452.561 468.357 96.6% 15.80 400.099 1.2300 399.5 1.2317 492.005 511.899 96.1% 19.89 400.099 1.3323 399.5 1.2325 512.320 533.424 96.0% 21.67 400.099 1.3323 399.5 1.3285 571.320 534.76 96.1% 21.67 400.099 1.4799 399.5 1.4298 571.165 592.095 96.5% 20.93 400.099 1.4799 399.5 1.4298 571.165 592.095 96.5% 20.93 400.091 1.5333 399.5 1.4298 571.165 592.	400.102	0.9269	399.5	0.8879	354.689	370.865	95.6%	16.18
400.1001.0666399.51.0353413.585426.76396.9%13.18400.1011.1162399.51.0841433.082446.58597.0%13.50400.1001.1706399.51.1329452.561468.35796.6%15.80400.0991.2300399.51.1862473.823492.11496.3%18.29400.0991.2794399.51.2317492.005511.89996.1%19.89400.0991.3332399.51.2825512.320533.42496.0%21.10400.0981.3834399.51.3313531.809553.47696.1%21.67400.0991.4362399.51.3466553.102574.61496.3%21.51400.0991.4799399.51.4298571.165592.09596.5%20.93400.0991.5333399.51.4864593.744613.48896.8%19.74400.0981.5762399.41.518611.846630.61497.0%18.77400.0971.6247399.51.6837652.601673.51196.9%20.91400.0861.7873399.51.6224672.043695.22296.7%23.18400.0961.7873399.51.6224670.032715.1496.5%25.07400.0951.8861399.51.7275690.032715.1496.3%25.07400.0951.8861399.51.7275690.03296.3%27.93 <td>400.102</td> <td>0.9743</td> <td>399.5</td> <td>0.9367</td> <td>374.190</td> <td>389.803</td> <td>96.0%</td> <td>15.61</td>	400.102	0.9743	399.5	0.9367	374.190	389.803	96.0%	15.61
400.1011.1162399.51.0841433.082446.58597.0%13.50400.1001.1706399.51.1329452.561468.35796.6%15.80400.0991.2300399.51.1862473.823492.11496.3%18.29400.0991.2794399.51.2317492.005511.89996.1%19.89400.0991.332399.51.2825512.320533.42496.0%21.10400.0981.3834399.51.3313531.809553.47696.1%21.67400.0991.4362399.51.4285571.165592.09596.5%20.93400.0991.4799399.51.4288571.165592.09596.5%20.93400.0991.5333399.51.4864593.744613.48896.8%19.74400.0981.5762399.41.5318611.846630.61497.0%18.77400.0971.6247399.51.6837652.601673.51196.9%20.91400.0981.7376399.51.6824672.043695.2296.7%23.18400.0961.7873399.51.7275690.032715.10496.5%25.07400.0951.8484399.51.7840712.646739.5396.3%25.07400.0951.8961399.51.8779750.155778.75396.3%26.89400.0951.9464399.51.8779750.155778.75396.3%<	400.102	1.0169	399.5	0.9821	392.300	406.868	96.4%	14.57
400.1001.1706399.51.1329452.561468.35796.6%15.80400.0991.2300399.51.1862473.823492.11496.3%18.29400.0991.2794399.51.2317492.005511.89996.1%19.89400.0991.332399.51.2825512.320533.42496.0%21.10400.0981.3834399.51.2825512.320533.42496.0%21.67400.0991.4362399.51.3846553.102574.61496.3%21.51400.0991.4799399.51.4298571.165592.09596.5%20.93400.0991.5333399.51.4864593.744613.48896.8%19.74400.0981.5762399.41.5318611.846630.61497.0%18.77400.0971.6247399.51.6337652.601673.51196.9%20.91400.0981.7376399.51.6824672.043695.22296.7%23.18400.0961.7873399.51.7275690.032715.10496.5%25.07400.0951.8484399.51.7840712.646739.53296.4%26.89400.0951.8464399.51.8779750.155778.75396.3%27.93400.0951.9464399.51.8779750.155778.75396.3%28.60400.0952.001399.51.9311771.40980.22696.4%<	400.100	1.0666	399.5	1.0353	413.585	426.763	96.9%	13.18
400.0991.2300399.51.1862473.823492.11496.3%18.29400.0991.2794399.51.2317492.005511.89996.1%19.89400.0991.332399.51.2825512.320533.42496.0%21.10400.0981.3834399.51.3313531.809553.47696.1%21.67400.0991.4362399.51.3846553.102574.61496.3%21.51400.0991.4799399.51.4298571.165592.09596.5%20.93400.0991.5333399.51.4864593.744613.48896.8%19.74400.0981.5762399.41.5318611.846630.61497.0%18.77400.0971.6247399.51.6337652.601673.51196.9%20.91400.0981.7376399.51.6824672.043695.22296.7%23.18400.0951.8484399.51.7275690.032715.10496.5%25.07400.0951.848439.51.7275690.032715.10496.5%25.07400.0951.848439.51.7840712.646739.53296.4%26.89400.0951.846439.51.879750.155778.75396.3%27.93400.0951.946439.51.8779750.155778.75396.3%28.62400.0952.048239.51.9777790.857819.47396.5%	400.101	1.1162	399.5	1.0841	433.082	446.585	97.0%	13.50
400.0991.2794399.51.2317492.005511.89996.1%19.89400.0991.3332399.51.2825512.320533.42496.0%21.10400.0981.3834399.51.3313531.809553.47696.1%21.67400.0991.4362399.51.3846553.102574.61496.3%21.51400.0991.4799399.51.4298571.165592.09596.5%20.93400.0991.5333399.51.4864593.744613.48896.8%19.74400.0981.5762399.41.5318611.846630.61497.0%18.77400.0971.6247399.51.5805631.328650.04297.1%18.71400.0981.7376399.51.6824672.043695.22296.7%23.18400.0961.7873399.51.7275690.032715.10496.5%25.07400.0951.8484399.51.7275690.032715.10496.3%27.93400.0951.848439.51.7275690.032715.10496.3%27.93400.0951.848439.51.7275690.032715.10496.3%27.93400.0951.846439.51.8779750.155778.75396.3%27.93400.0951.946439.51.8779750.155778.75396.3%28.60400.0952.048239.51.9797790.857819.47396.5% <td>400.100</td> <td>1.1706</td> <td>399.5</td> <td>1.1329</td> <td>452.561</td> <td>468.357</td> <td>96.6%</td> <td>15.80</td>	400.100	1.1706	399.5	1.1329	452.561	468.357	96.6%	15.80
400.0991.3332399.51.2825512.320533.42496.0%21.10400.0981.3834399.51.3313531.809553.47696.1%21.67400.0991.4362399.51.3846553.102574.61496.3%21.51400.0991.4799399.51.4298571.165592.09596.5%20.93400.0991.5333399.51.4298571.165592.09596.5%20.93400.0991.5333399.51.4864593.744613.48896.8%19.74400.0981.5762399.41.5318611.846630.61497.0%18.77400.0971.6247399.51.5805631.328650.04297.1%18.71400.0971.6834399.51.6337652.601673.51196.9%20.91400.0981.7376399.51.6824672.043695.22296.7%23.18400.0961.7873399.51.7275690.032715.10496.5%25.07400.0951.8484399.51.7275690.032715.10496.3%27.93400.0951.8484399.51.8292730.707758.63696.3%27.93400.0951.9464399.51.8779750.155778.75396.3%28.60400.0952.001399.51.9311771.40980.22696.4%28.82400.0962.0482399.51.9797790.857819.47396.5%	400.099	1.2300	399.5	1.1862	473.823	492.114	96.3%	18.29
400.0981.3834399.51.3313531.809553.47696.1%21.67400.0991.4362399.51.3846553.102574.61496.3%21.51400.0991.4799399.51.4298571.165592.09596.5%20.93400.0991.5333399.51.4864593.744613.48896.8%19.74400.0981.5762399.41.5318611.846630.61497.0%18.77400.0971.6247399.51.5805631.328650.04297.1%18.71400.0971.6834399.51.6337652.601673.51196.9%20.91400.0981.7376399.51.6824672.043695.22296.7%23.18400.0961.7873399.51.7275690.032715.10496.5%25.07400.0951.8484399.51.7275690.032715.10496.3%26.89400.0951.8961399.51.8292730.707758.63696.3%27.93400.0951.9464399.51.8779750.155778.75396.3%28.60400.0952.0011399.51.9311771.409800.22696.4%28.82400.0962.0482399.51.9797790.857819.47396.5%28.62	400.099	1.2794	399.5	1.2317	492.005	511.899	96.1%	19.89
400.0991.4362399.51.3846553.102574.61496.3%21.51400.0991.4799399.51.4298571.165592.09596.5%20.93400.0991.5333399.51.4864593.744613.48896.8%19.74400.0981.5762399.41.5318611.846630.61497.0%18.77400.0971.6247399.51.5805631.328650.04297.1%18.71400.0971.6834399.51.6337652.601673.51196.9%20.91400.0981.7376399.51.6824672.043695.22296.7%23.18400.0961.7873399.51.7275690.032715.10496.5%25.07400.0951.8484399.51.7840712.646739.53296.4%26.89400.0951.8961399.51.8292730.707758.63696.3%27.93400.0951.9464399.51.8779750.155778.75396.3%28.60400.0952.000139.51.9311771.409800.22696.4%28.82400.0962.048239.51.9797790.857819.47396.5%28.62	400.099	1.3332	399.5	1.2825	512.320	533.424	96.0%	21.10
400.0991.4799399.51.4298571.165592.09596.5%20.93400.0991.5333399.51.4864593.744613.48896.8%19.74400.0981.5762399.41.5318611.846630.61497.0%18.77400.0971.6247399.51.5805631.328650.04297.1%18.71400.0971.6834399.51.6337652.601673.51196.9%20.91400.0981.7376399.51.6824672.043695.22296.7%23.18400.0961.7873399.51.7275690.032715.10496.5%25.07400.0951.8484399.51.7275690.032715.10496.3%26.89400.0951.8961399.51.8292730.707758.63696.3%27.93400.0951.9464399.51.8779750.155778.75396.3%28.60400.0952.0011399.51.9311771.409800.22696.4%28.82400.0962.0482399.51.9797790.857819.47396.5%28.62	400.098	1.3834	399.5	1.3313	531.809	553.476	96.1%	21.67
400.0991.5333399.51.4864593.744613.48896.8%19.74400.0981.5762399.41.5318611.846630.61497.0%18.77400.0971.6247399.51.5805631.328650.04297.1%18.71400.0971.6834399.51.6337652.601673.51196.9%20.91400.0981.7376399.51.6824672.043695.22296.7%23.18400.0961.7873399.51.7275690.032715.10496.5%25.07400.0951.8484399.51.7275690.032715.10496.3%26.89400.0951.8961399.51.8292730.707758.63696.3%27.93400.0951.9464399.51.8779750.155778.75396.3%28.60400.0952.0001399.51.9311771.409800.22696.4%28.82400.0962.0482399.51.9797790.857819.47396.5%28.62	400.099	1.4362	399.5	1.3846	553.102	574.614	96.3%	21.51
400.0981.5762399.41.5318611.846630.61497.0%18.77400.0971.6247399.51.5805631.328650.04297.1%18.71400.0971.6834399.51.6337652.601673.51196.9%20.91400.0981.7376399.51.6824672.043695.22296.7%23.18400.0961.7873399.51.7275690.032715.10496.5%25.07400.0951.8484399.51.7275690.032715.10496.4%26.89400.0951.8961399.51.8292730.707758.63696.3%27.93400.0951.9464399.51.8779750.155778.75396.3%28.60400.0952.0001399.51.9311771.409800.22696.4%28.82400.0962.0482399.51.9797790.857819.47396.5%28.62	400.099	1.4799	399.5	1.4298	571.165	592.095	96.5%	20.93
400.0971.6247399.51.5805631.328650.04297.1%18.71400.0971.6834399.51.6337652.601673.51196.9%20.91400.0981.7376399.51.6824672.043695.22296.7%23.18400.0961.7873399.51.7275690.032715.10496.5%25.07400.0951.8484399.51.7240712.646739.53296.4%26.89400.0951.8961399.51.8292730.707758.63696.3%27.93400.0951.9464399.51.8779750.155778.75396.3%28.60400.0952.0001399.51.9311771.409800.22696.4%28.82400.0962.0482399.51.9797790.857819.47396.5%28.62	400.099	1.5333	399.5	1.4864	593.744	613.488	96.8%	19.74
400.0971.6834399.51.6337652.601673.51196.9%20.91400.0981.7376399.51.6824672.043695.22296.7%23.18400.0961.7873399.51.7275690.032715.10496.5%25.07400.0951.8484399.51.7840712.646739.53296.4%26.89400.0951.8961399.51.8292730.707758.63696.3%27.93400.0951.9464399.51.8779750.155778.75396.3%28.60400.0952.0001399.51.9311771.409800.22696.4%28.82400.0962.0482399.51.9797790.857819.47396.5%28.62	400.098	1.5762	399.4	1.5318	611.846	630.614	97.0%	18.77
400.0981.7376399.51.6824672.043695.22296.7%23.18400.0961.7873399.51.7275690.032715.10496.5%25.07400.0951.8484399.51.7840712.646739.53296.4%26.89400.0951.8961399.51.8292730.707758.63696.3%27.93400.0951.9464399.51.8779750.155778.75396.3%28.60400.0952.0001399.51.9311771.409800.22696.4%28.82400.0962.0482399.51.9797790.857819.47396.5%28.62	400.097	1.6247	399.5	1.5805	631.328	650.042	97.1%	18.71
400.0961.7873399.51.7275690.032715.10496.5%25.07400.0951.8484399.51.7840712.646739.53296.4%26.89400.0951.8961399.51.8292730.707758.63696.3%27.93400.0951.9464399.51.8779750.155778.75396.3%28.60400.0952.0001399.51.9311771.409800.22696.4%28.82400.0962.0482399.51.9797790.857819.47396.5%28.62	400.097	1.6834	399.5	1.6337	652.601	673.511	96.9%	20.91
400.0951.8484399.51.7840712.646739.53296.4%26.89400.0951.8961399.51.8292730.707758.63696.3%27.93400.0951.9464399.51.8779750.155778.75396.3%28.60400.0952.0001399.51.9311771.409800.22696.4%28.82400.0962.0482399.51.9797790.857819.47396.5%28.62	400.098	1.7376	399.5	1.6824	672.043	695.222	96.7%	23.18
400.0951.8484399.51.7840712.646739.53296.4%26.89400.0951.8961399.51.8292730.707758.63696.3%27.93400.0951.9464399.51.8779750.155778.75396.3%28.60400.0952.0001399.51.9311771.409800.22696.4%28.82400.0962.0482399.51.9797790.857819.47396.5%28.62	400.096	1.7873	399.5	1.7275	690.032	715.104	96.5%	25.07
400.095 1.8961 399.5 1.8292 730.707 758.636 96.3% 27.93 400.095 1.9464 399.5 1.8779 750.155 778.753 96.3% 28.60 400.095 2.0001 399.5 1.9311 771.409 800.226 96.4% 28.82 400.096 2.0482 399.5 1.9797 790.857 819.473 96.5% 28.62	400.095	1.8484	399.5	1.7840	712.646		96.4%	26.89
400.095 1.9464 399.5 1.8779 750.155 778.753 96.3% 28.60 400.095 2.0001 399.5 1.9311 771.409 800.226 96.4% 28.82 400.096 2.0482 399.5 1.9797 790.857 819.473 96.5% 28.62	400.095	1.8961	399.5	1.8292	730.707	758.636	96.3%	27.93
400.095 2.0001 399.5 1.9311 771.409 800.226 96.4% 28.82 400.096 2.0482 399.5 1.9797 790.857 819.473 96.5% 28.62	400.095	1.9464	399.5			778.753	96.3%	28.60
	400.095	2.0001	399.5	1.9311	771.409	800.226	96.4%	28.82
400.095 2.0900 399.3 2.0239 808.107 836.211 96.6% 28.10	400.096	2.0482	399.5	1.9797	790.857	819.473	96.5%	28.62
	400.095	2.0900	399.3	2.0239	808.107	836.211	96.6%	28.10

Figure 3-4. Efficiency and Power Dissipation at V_{IN} = 400 Vdc, V_{OUT} = 400 Vdc

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Vin	lin	Vout	lout	Ро	Pin	Efficiency, Vin = 420Vdc, Vout = 350Vdc	Pdiss (W), Vin = 420Vdc, Vout = 350Vdc
420.107	0.0110	349.9	0.0000	0.000	4.606	0.0%	4.61
420.108	0.0526	349.9	0.0462	16.171	22.100	73.2%	5.93
420.108	0.0919	349.9	0.0918	32.120	38.612	83.2%	6.49
420.106	0.1234	349.8	0.1368	47.864	51.852	92.3%	3.99
420.106	0.1717	349.8	0.1871	65.464	72.123	90.8%	6.66
420.106	0.2180	349.8	0.2369	82.891	91.578	90.5%	8.69
420.106	0.2588	349.8	0.2877	100.662	108.725	92.6%	8.06
420.111	0.2958	349.8	0.3376	118.110	124.261	95.1%	6.15
420.100	0.3367	349.8	0.3863	135.133	141.459	95.5%	6.33
420.108	0.3844	349.8	0.4361	152.548	161.472	94.5%	8.92
420.106	0.4311	349.8	0.4868	170.276	181.104	94.0%	10.83
420.106	0.4720	349.8	0.5346	186.998	198.304	94.3%	11.31
420.105	0.5127	349.8	0.5854	204.755	215.368	95.1%	10.61
420.105	0.5483	349.8	0.6322	221.105	230.349	96.0%	9.24
420.105	0.5907	349.8	0.6858	239.849	248.144	96.7%	8.30
420.104	0.6330	349.8	0.7325	256.199	265.939	96.3%	9.74
420.104	0.6817	349.8	0.7841	274.260	286.375	95.8%	12.11
420.102	0.7246	349.8	0.8309	290.604	304.393	95.5%	13.79
420.102	0.7717	349.8	0.8846	309.386	324.188	95.4%	14.80
420.100	0.8108	349.7	0.9311	325.652	340.616	95.6%	14.96
420.100	0.8539	349.8	0.9849	344.471	358.729	96.0%	14.26
420.100	0.8941	349.8	1.0364	362.491	375.603	96.5%	13.11
420.099	0.9304	349.7	1.0830	378.785	390.879	96.9%	12.09
420.098	0.9745	349.8	1.1348	396.889	409.365	97.0%	12.48
420.098	1.0176	349.7	1.1814	413.179	427.479	96.7%	14.30
420.097	1.0676	349.8	1.2350	431.946	448.491	96.3%	16.55
420.096	1.1101	349.8	1.2816	448.254	466.344	96.1%	18.09
420.095	1.1577	349.8	1.3353	467.018	486.357	96.0%	19.34
420.096	1.1978	349.7	1.3819	483.308	503.178	96.1%	19.87
420.095	1.2425	349.8	1.4354	502.036	521.951	96.2%	19.92
420.095	1.2800	349.8	1.4820	518.322	537.738	96.4%	19.42
420.095	1.3190	349.8	1.5314	535.624	554.101	96.7%	18.48
420.094	1.3555	349.8	1.5780	551.906	569.437	96.9%	17.53
420.094	1.3988	349.8	1.6315	570.622	587.619	97.1%	17.00
420.095	1.4400	349.8	1.6780	586.878	604.945	97.0%	18.07
420.093	1.4898	349.8	1.7316	605.630	625.838	96.8%	20.21
420.094	1.5331	349.8	1.7781	621.900	644.025	96.6%	22.13
420.094	1.5818	349.8	1.8315	640.576	664.513	96.4%	23.94
420.093	1.6217	349.8	1.8759	656.135	681.277	96.3%	25.14
420.094	1.6684	349.8	1.9294	674.828	700.881	96.3%	26.05
420.093	1.7084	349.8	1.9759	691.102	717.678	96.3%	26.58
420.091	1.7437	349.0	2.0228	705.962	732.517	96.4%	26.55

Figure 3-5. Efficiency and Power Dissipation at V_{IN} = 420 Vdc, V_{OUT} = 350 Vdc



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Vin	lin	Vout	lout	Ро	Pin	Efficiency, Vin =380Vdc, Vout = 400Vdc	Pdiss (W), Vin = 380Vdc, Vout = 400Vdc
380.099	0.0121	399.6	0.0000	0.000	4.611	0.0%	4.61
380.100	0.0714	399.6	0.0506	20.219	27.150	74.5%	6.93
380.098	0.1146	399.6	0.0946	37.803	43.555	86.8%	5.75
380.098	0.1635	399.6	0.1431	57.168	62.157	92.0%	4.99
380.098	0.2192	399.6	0.1881	75.151	83.320	90.2%	8.17
380.098	0.2724	399.6	0.2371	94.725	103.522	91.5%	8.80
380.098	0.3234	399.6	0.2905	116.075	122.937	94.4%	6.86
380.093	0.3732	399.6	0.3395	135.645	141.853	95.6%	6.21
380.099	0.4280	399.6	0.3849	153.810	162.664	94.6%	8.85
380.098	0.4849	399.6	0.4338	173.336	184.317	94.0%	10.98
380.097	0.5427	399.6	0.4873	194.708	206.270	94.4%	11.56
380.096	0.5916	399.6	0.5361	214.199	224.879	95.3%	10.68
380.096	0.6432	399.5	0.5895	235.528	244.488	96.3%	8.96
380.095	0.6950	399.5	0.6385	255.106	264.155	96.6%	9.05
380.093	0.7489	399.5	0.6840	273.279	284.650	96.0%	11.37
380.093	0.8151	399.5	0.7407	295.938	309.796	95.5%	13.86
380.091	0.8659	399.5	0.7861	314.080	329.116	95.4%	15.04
380.091	0.9180	399.5	0.8349	333.561	348.918	95.6%	15.36
380.091	0.9725	399.5	0.8883	354.872	369.634	96.0%	14.76
380.090	1.0207	399.5	0.9371	374.388	387.954	96.5%	13.57
380.090	1.0653	399.5	0.9825	392.509	404.917	96.9%	12.41
380.090	1.1238	399.5	1.0357	413.769	427.153	96.9%	13.38
380.089	1.1812	399.5	1.0845	433.261	448.969	96.5%	15.71
380.087	1.2382	399.5	1.1333	452.742	470.605	96.2%	17.86
380.088	1.2987	399.5	1.1867	474.062	493.635	96.0%	19.57
380.087	1.3486	399.5	1.2321	492.220	512.566	96.0%	20.35
380.088	1.4027	399.5	1.2831	512.572	533.165	96.1%	20.59
380.087	1.4532	399.5	1.3319	532.119	552.323	96.3%	20.20
380.087	1.5067	399.5	1.3852	553.380	572.685	96.6%	19.31
380.086	1.5516	399.5	1.4305	571.490	589,722	96.9%	18.23
380.087	1.6093	399.5	1.4870	594.086	611.659	97.1%	17.57
380.086	1.6618	399.5	1.5325	612.251	631.635	96.9%	19.38
380.086	1.7190	399.5	1.5812	631.692	653.353	96.7%	21.66
380.085	1.7809	399.5	1.6345	653.007	676.897	96.5%	23.89
380.084	1.8364	399.5	1.6832	672.475	697.994	96.3%	25.52
380.084	1.8867	399.5	1.7283	690.528	717.108	96.3%	26.58
380.084	1.9483	399.5	1.7850	713.145	740.518	96.3%	27.37
380.083	1.9963	399.5	1.8301	731.201	758.756	96.4%	27.56
380.083	2.0468	399.5	1.8789	750.663	777.969	96.5%	27.31
380.083	2.1010	399.5	1.9321	771.932	798.570	96.7%	26.64
380.083	2.1498	399.5	1.9807	791.345	817.099	96.8%	25.75
380.081	2.1450	398.7	2.0218	806.138	831.021	97.0%	24.88
300.001	2.1004	330.1	2.0210	000.100	001.021	ar.070	24.00

Figure 3-6. Efficiency and Power Dissipation at V_{IN} = 380 Vdc, V_{OUT} = 400 Vdc

Testing and Results

3.4 Current Regulation

This graph displays the measured output current versus CHG ISET DAC at an input voltage of 400 Vdc. A PWM signal is provided at J8 with a frequency of 100 kHz, an amplitude of 2.5 V, and a duty cycle varying between 0% and 100%. A constant resistance mode load of 200 Ω is used and V_{OUT} is allowed to vary with the current control.

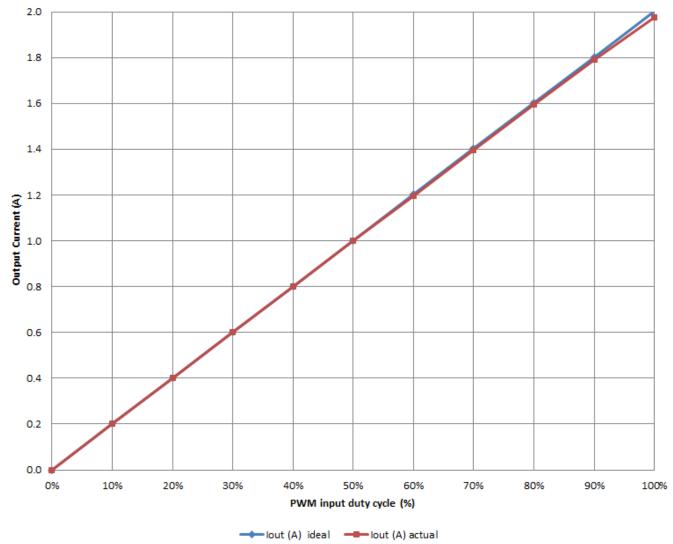


Figure 3-7. CHG ISET DAC Accuracy Curve

CHG ISET DAC input versus Output Current, Vin = 400V, Vout ~ 350V

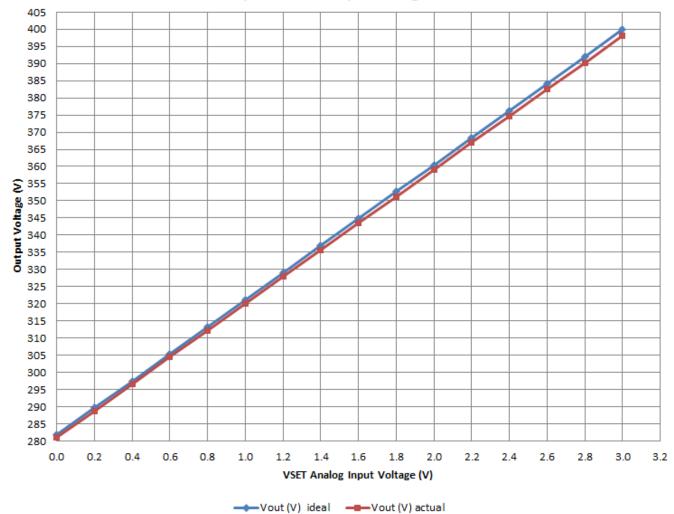


Duty Cycle	VREF3 TP14 (V)	lout (A) actual	lout (A) ideal	lout error (%)
0.999	1.9975	1.9754	2.0009	-1.3
0.900	1.7997	1.7923	1.8030	-0.6
0.800	1.5997	1.5944	1.6027	-0.5
0.700	1.3997	1.3961	1.4023	-0.4
0.600	1.1997	1.1976	1.2020	-0.4
0.500	0.9998	0.9988	1.0017	-0.3
0.400	0.7999	0.7997	0.8013	-0.2
0.300	0.6002	0.6004	0.6010	-0.1
0.200	0.4009	0.4004	0.4007	-0.1
0.100	0.2006	0.2013	0.2003	0.5
0.002	0.0039	0.0041	0.0032	27.0

Figure 3-8. CHG ISET DAC Accuracy Table

3.5 Voltage Regulation

This graph displays the measured output voltage versus CHG VSET DAC at an input voltage of 400 Vdc. A DC voltage ranging from 0 V–3 V is applied at J6 and a constant resistance mode load is used with the resistance equal to V_{OUT} ideal at each setpoint.



CHG VSET DAC input versus Output Voltage, Vin = 400V, lout ~ 1A

Figure 3-9. CHG VSET DAC Accuracy Curve



VDAC	VREF1 TP11 (V)	Vout (V) actual	Vout (V) ideal	Vout error (%)
0.000	1.762	281.0	281.7322	-0.3
0.200	1.811	288.8	289.6093	-0.3
0.400	1.861	296.6	297.4863	-0.3
0.600	1.910	304.4	305.3633	-0.3
0.800	1.959	312.2	313.2404	-0.3
1.000	2.008	320.0	321.1174	-0.3
1.200	2.057	327.8	328.9944	-0.4
1.400	2.106	335.7	336.8715	-0.4
1.600	2.156	343.5	344.7485	-0.4
1.800	2.205	351.3	352.6255	-0.4
2.000	2.254	359.1	360.5026	-0.4
2.200	2.303	366.9	368.3796	-0.4
2.400	2.352	374.7	376.2566	-0.4
2.600	2.401	382.5	384.1337	-0.4
2.800	2.450	390.3	392.0107	-0.4
3.000	2.500	398.1	399.8878	-0.5

Figure 3-10. CHG VSET DAC Accuracy Table



4 Waveforms

4.1 Start-up

The following figures show the output voltage start-up waveform (YELLOW), the ENABLE waveform (BLUE), and the output current waveform (RED) under two different output conditions.



Figure 4-1. V_{IN} = 400 V and V_{OUT} = 400 V at 2 A. Resistive Load (V_{OUT} : 100 V/DIV, ENABLE: 5 V/DIV, I_{OUT} : 2 A/DIV, 400 ms/DIV, BWL = 20 MHz)

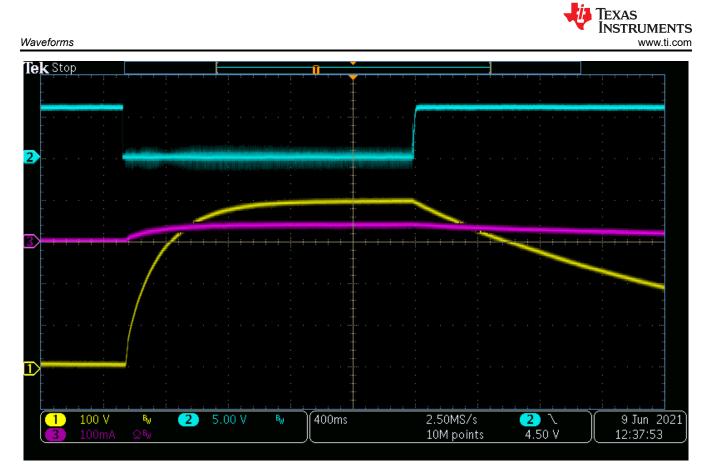


Figure 4-2. V_{IN} = 400 V and V_{OUT} = 400 V at 40 mA. Resistive Load (V_{OUT} : 100 V/DIV, ENABLE: 5 V/DIV, I_{OUT} : 100 mA/DIV, 400 ms/DIV, BWL = 20 MHz)



4.2 Switch Node

The following figures show the FET switch node voltage (YELLOW) at TP7 under various input and output conditions.



Figure 4-3. V_{IN} = 420 V and V_{OUT} = 350 V at 2 A. Resistive Load (V_{OUT}: 250 V/DIV, 2 μ s/DIV, BWL = 800 MHz)

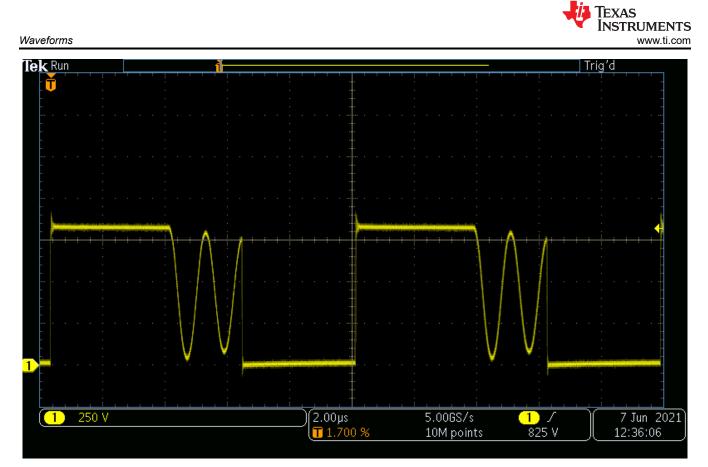


Figure 4-4. V_{IN} = 420 V and V_{OUT} = 400 V at 2 A. Resistive Load (V_{OUT}: 250 V/DIV, 2 μ s/DIV, BWL = 800 MHz)



Figure 4-5. V_{IN} = 400 V and V_{OUT} = 400 V at 2 A. Resistive Load (V_{OUT}: 250 V/DIV, 2 μ s/DIV, BWL = 800 MHz)



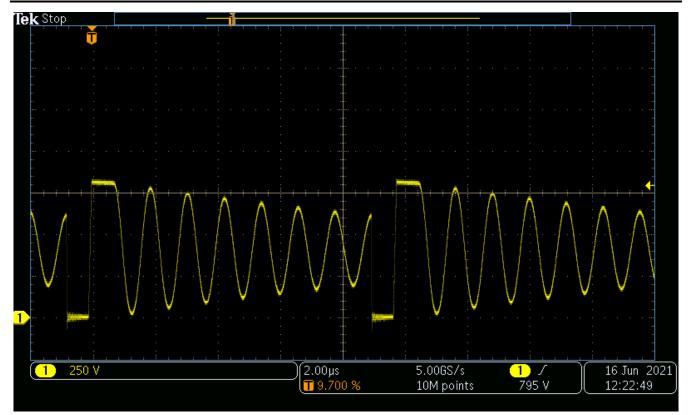


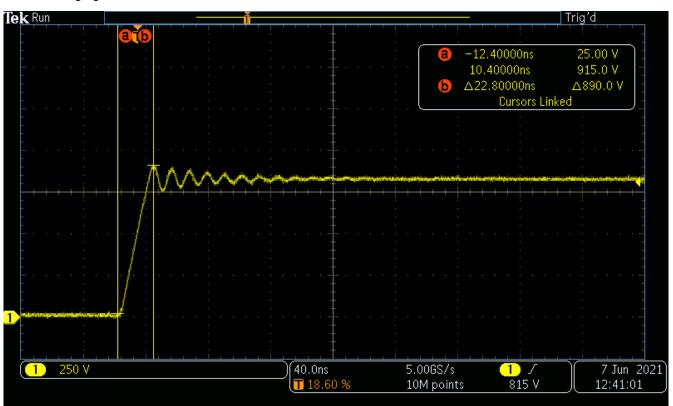
Figure 4-6. V_{IN} = 400 V and V_{OUT} = 400 V at 70 mA. Resistive Load (V_{OUT}: 250 V/DIV, 2 μ s/DIV, BWL = 800 MHz)



Figure 4-7. V_{IN} = 340 V and V_{OUT} = 400 V at 2 A. Resistive Load (V_{OUT}: 250 V/DIV, 2 μ s/DIV, BWL = 800 MHz)

Waveforms

Waveforms



The following figure shows the FET switch node rise time of 22.8 ns at TP7.

Figure 4-8. $V_{\rm IN}$ = 400 V and $V_{\rm OUT}$ = 400 V at 2 A. Resistive Load (V_{\rm OUT}: 250 V/DIV, 40 ns/DIV, BWL = 800 MHz)



4.3 Output Voltage Ripple

The output ripple voltage is shown in the following figure. The ripple was measured tip and barrel across ceramic output capacitors C10 and C14.

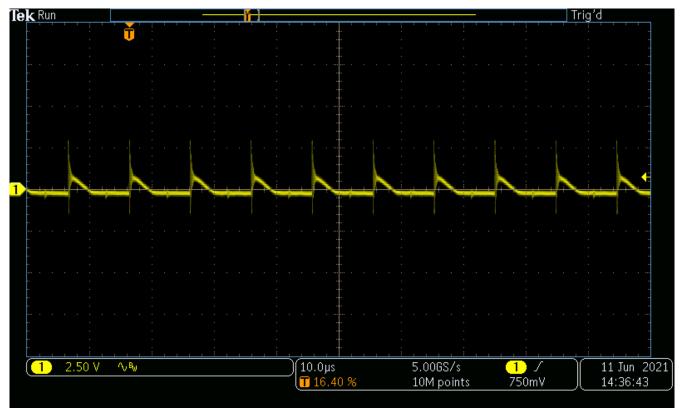


Figure 4-9. V_{IN} = 400 V and V_{OUT} = 400 V at 2 A. Resistive Load (V_{OUT}: 2.5 V/DIV, 10 µs/DIV, BWL = 20 MHz)



4.4 Current Loop to Voltage Loop Transition

The following figure shows the transition between the current loop control mode and the voltage loop control mode.

In the beginning state, the board is set to 1 A of output current and 400 V of output voltage. The resistive load is set to 270 Ω . In this state, the load is attempting to draw more current than the 1 A current limit allows. This means that the output voltage is limited to 270 V and the current loop is in control.

In the end state, the board output current setting is changed from 1 A to 2 A. The increased current limit is more than the current draw of the load. This allows the output voltage to rise up to the commanded 400 V and the voltage control loop takes over.

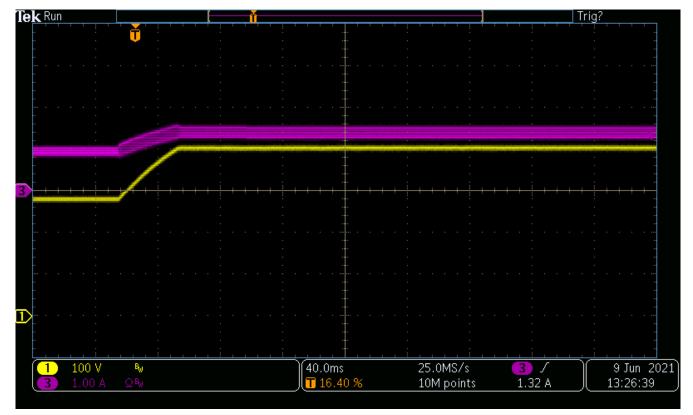


Figure 4-10. V_{IN} = 400 V, V_{OUT} = 400 V. Resistive Load = 270 Ω (V_{OUT}: 100 V/DIV, I_{OUT}: 1 A/DIV, 40 ms/DIV, BWL = 20 MHz)



4.5 Voltage Loop to Current Loop Transition

The following figure shows the transition between the voltage loop control mode and the current loop control mode.

In the beginning state, the board is set to 440 mA of output current and 282 V of output voltage. The resistive load is set to 800 Ω . In this state, the load is drawing less current than the 440 mA current limit. This means that the output voltage is regulated at 282 V and the voltage loop is in control.

In the end state, the board output voltage setting is changed from 282 V to 400 V. The current control loop limits the output current to 440 mA and the output voltage is limited to less than 400 V.

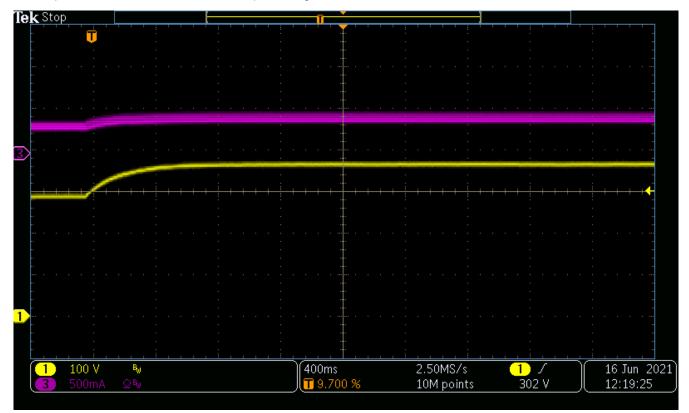


Figure 4-11. V_{IN} = 400 V, I_{OUT} = 0.44 A. Resistive Load = 800 Ω (V_{OUT}: 100 V/DIV, I_{OUT}: 500 mA/DIV, 400 ms/DIV, BWL = 20 MHz)



4.6 Bias Voltage Start-up

This board uses +18 V (BLUE), +12 V (RED), and -5 V (GREEN) bias rails to operate. The following figure shows the start-up behaviors of the +18 V, -5 V, and EN-drv (YELLOW) signals when the external 12-V bias is applied at J4. The start-up speed of the bias rails is determined by the start-up speed of the external 12-V bias.



Figure 4-12. (+18 V: 5 V/DIV, +12 V: 5 V/DIV, -5 V: 5 V/DIV, EN-drv: 5 V/DIV, 200 ms/DIV, BWL = 20 MHz)

4.7 Bias Voltage Switch Nodes

The +18-V and –5-V rails are converted from an external 12-V bias signal. The following figures show the switching behaviors of these bias converters.



Figure 4-13. +18 V Boost Converter Switch Node at TP9, V_{IN} = 400 V and V_{OUT} = 400 V at 2 A (5 V/DIV, 200 ns/DIV, BWL = 800 MHz)

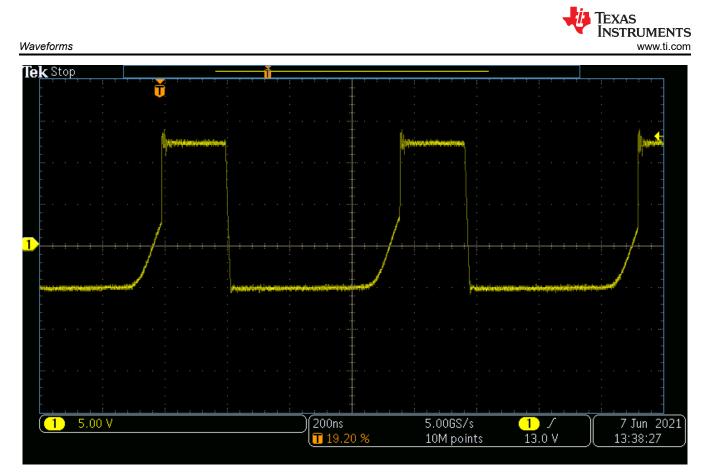


Figure 4-14. –5 V Inverting Buck-Boost Converter Switch Node at TP17, V_{IN} = 400 V and V_{OUT} = 400 V at 2 A (5 V/DIV, 200 ns/DIV, BWL = 800 MHz)

High-Voltage, 800-W SEPIC Converter Reference Design for Server Battery

Backup Charging



4.8 Output Current Sense Signal

The average of the MB CHG ISNS signal (on TP1) can be used to monitor the output current of the power supply. The following figures show the signal shape for varying output conditions.

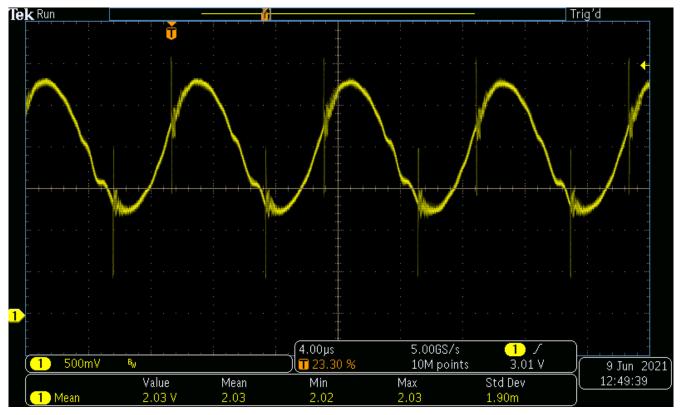


Figure 4-15. V_{IN} = 400 V, V_{OUT} = 400 V, I_{OUT} = 2 A. I_mean = 2.03 V (500 mV/DIV, 4 $\mu s/DIV$, BWL = 20 MHz)

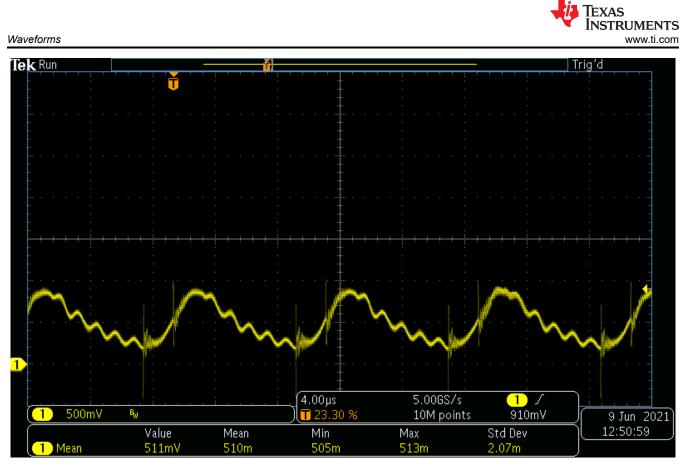
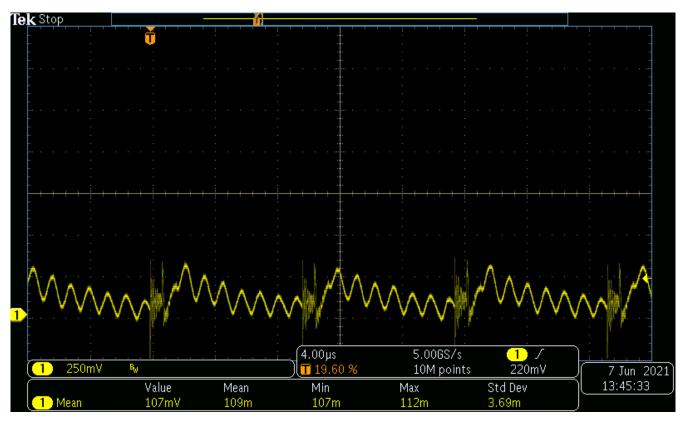


Figure 4-16. V_{IN} = 400 V, V_{OUT} = 400 V, I_{OUT} = 500 mA. I_mean = 511 mV (500 mV/DIV, 4 μ s/DIV, BWL = 20 MHz)





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