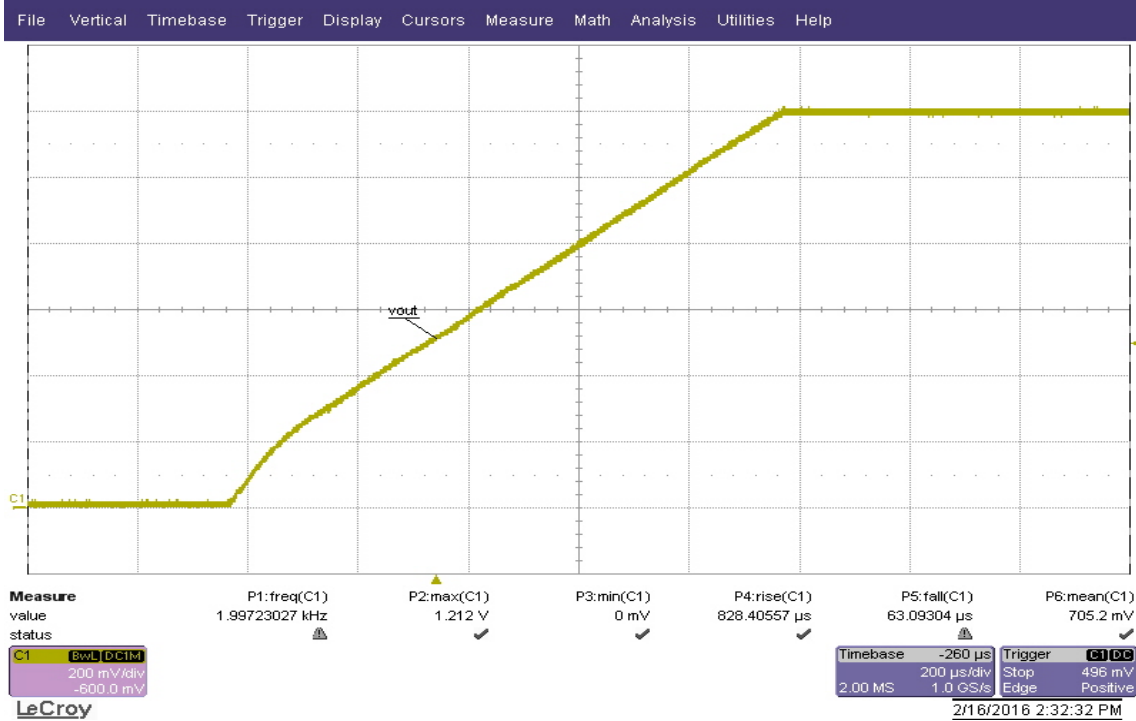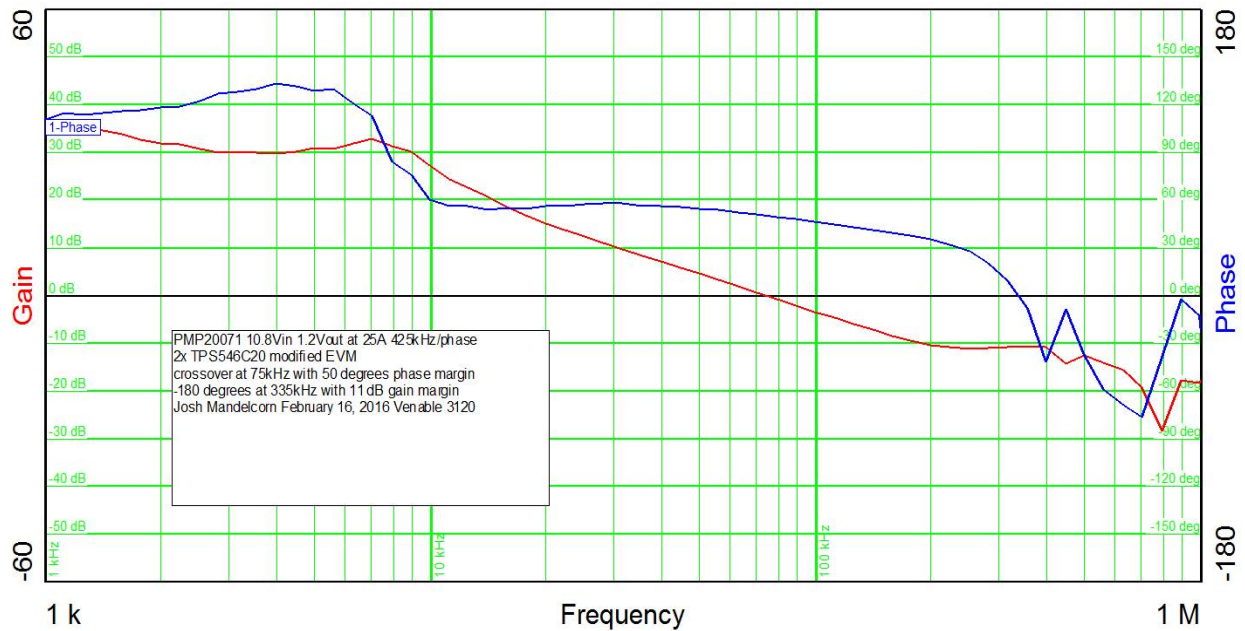# *Design PMP20071 Test Results*

PMP20071 2xTPS546C20 1200mV 50A Test Report:
TPS546C20 EVM modified for 1.2V 50A 425kHz per phase.
Modified to match PMP20071 output Ls & Cs and loop compensation
All testing at 10.8Vin unless otherwise mentioned

**Start up no load**: overshoot is less than the ripple: ~1.0 msec linear rise: target rise time 1 msec



## Bode Plot



PMP20071 10.8Vin 1.2Vout at 25A 425kHz/phase
2x TPS546C20 modified EVM
crossover at 75kHz with 50 degrees phase margin
-180 degrees at 335kHz with 11 dB gain margin
Josh Mandelcorn February 16, 2016 Venable 3120

q

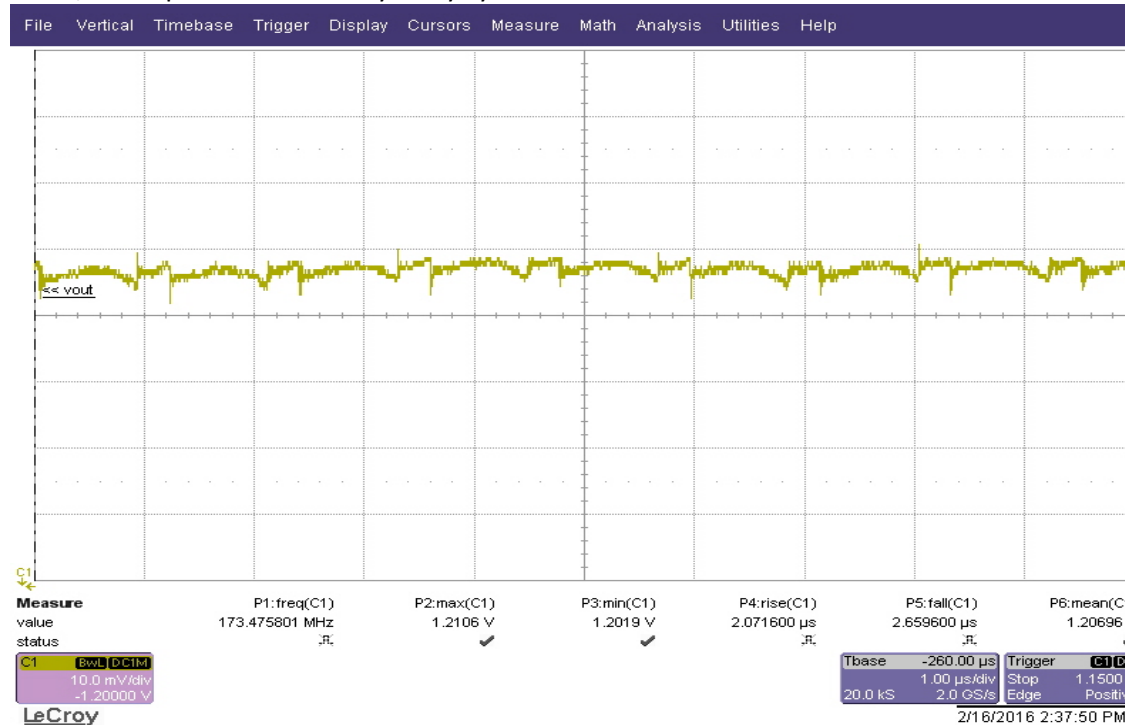## Output Ripple out full load: 12.5 mV p-p



Same, but expanded to show cycle by cycle detail

## Full Load Thermal images: with 1-2 M/sec fan

PMP20071 on mod EVM 10.8Vin 1.2V 50A 1-2 M/sec fan 10 minutes (emissivity set at 0.94)
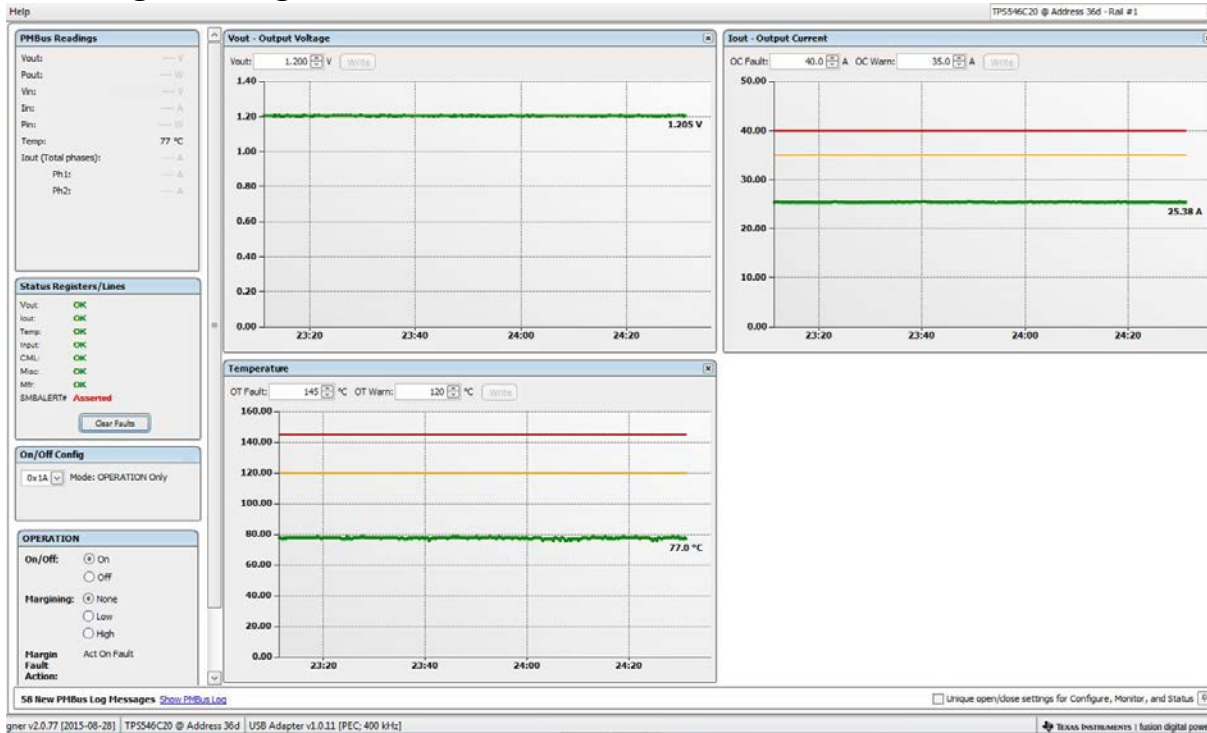master TPS546C20 at 45 deg. C, slave at 44, inductor tops at 41 & 39
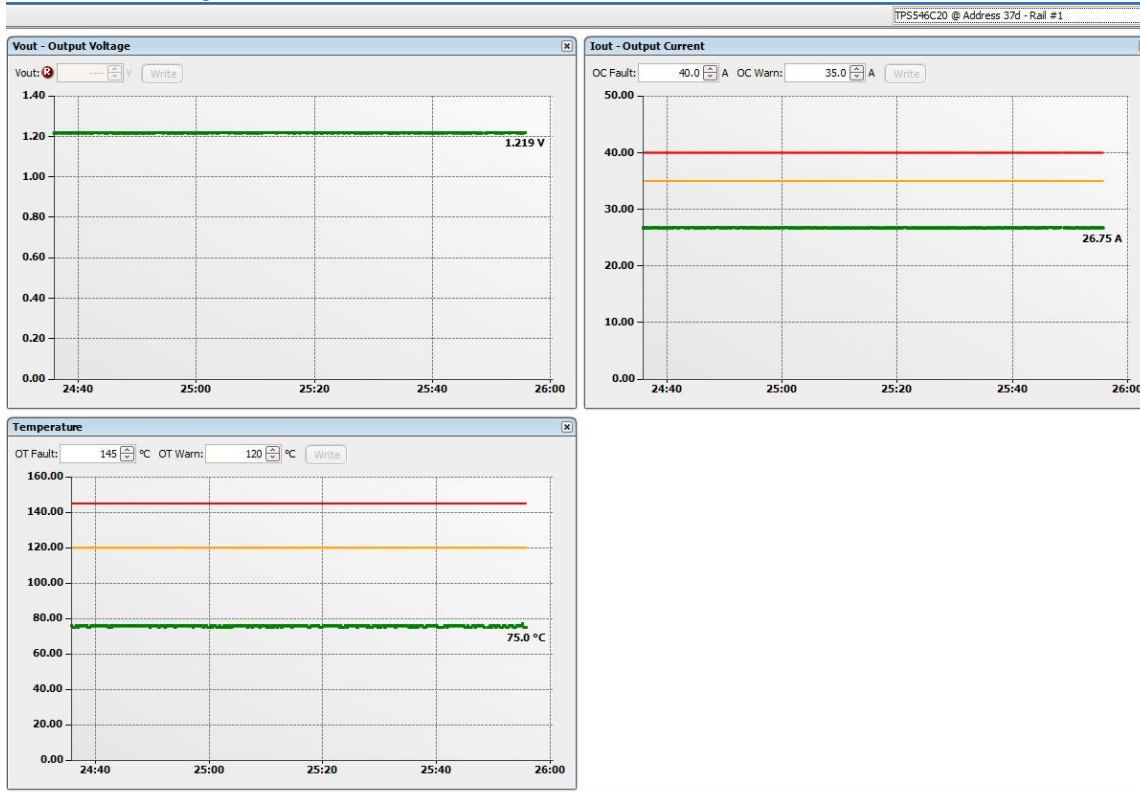


Q

## Full load with no fan:

PMP20071 on mod EVM 10.8Vin 1.2V 50A no fan 20+ minutes
master TPS546C20 at 74, slave at 73, inductor tops at 71 & 70

## GUI images during full load no fan run: 77 degrees on GUI vs. 74 on thermal camera


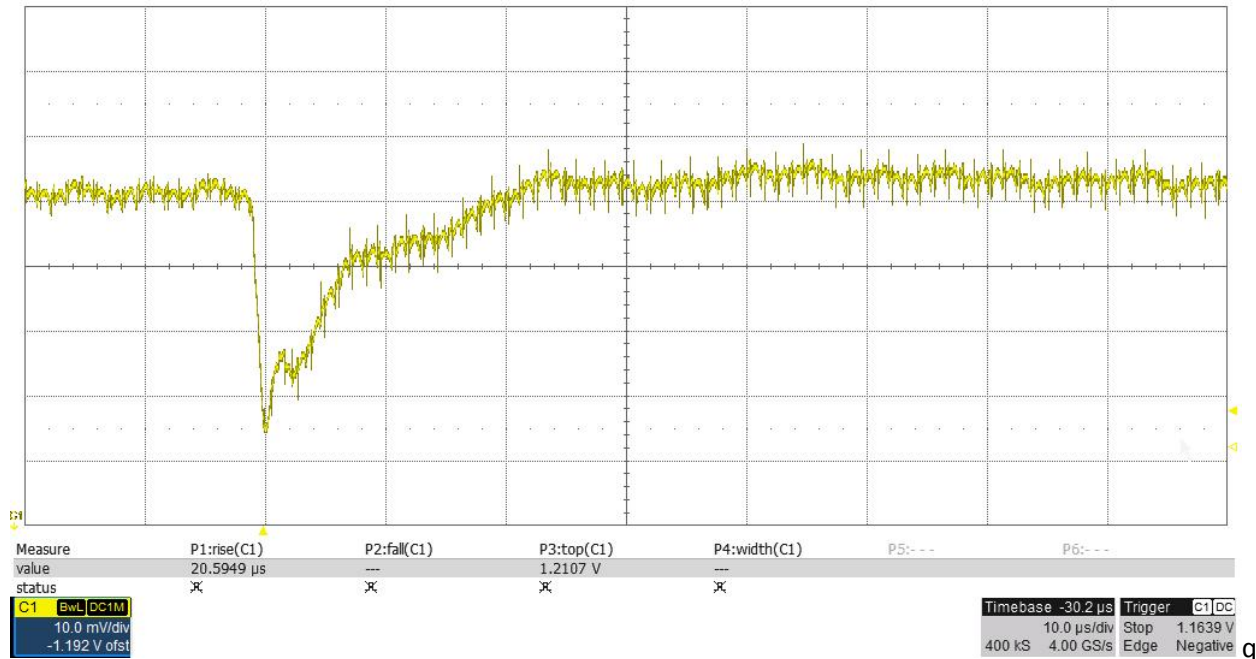
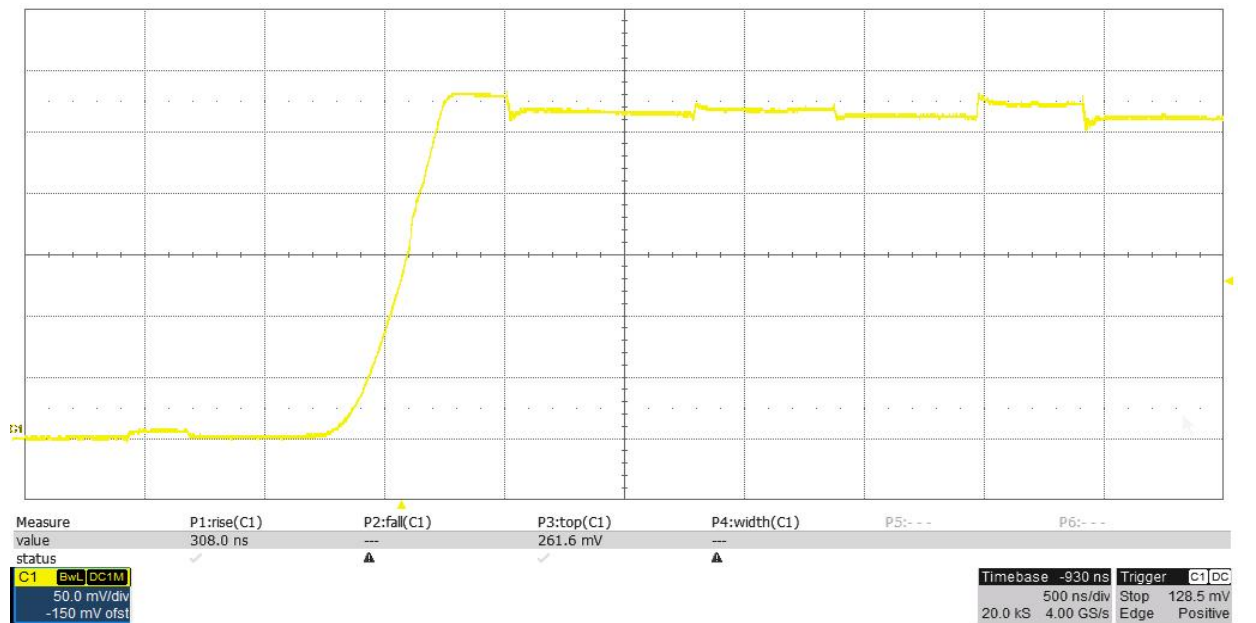slave GUI: 75 degrees on GUI vs. 73 on thermal camera



Q

## Step load response:

12V 1.2Vout and 25A static load 25A additional load applied in less than 500 nsec
Close in tip & barrel at C44 (ceramic output cap) 20 MHz BW      Max 35mV Vout dip



| Measure | P1:rise(C1) | P2:fall(C1) | P3:top(C1) | P4:width(C1) | P5:- - - | P6:- - - |
|---|---|---|---|---|---|---|
| value | 20.5949 µs | --- | 1.2107 V | --- | | |
| status | | | | | | |

Q

Waveform across 10 mOhm dynamic load tied to ground: 260mV increase in less than 500nsec
Close in tip & barrel at added 10mOhm tied to ground and source of CSD16322 (drain of CSD16322 to
Vout, gate has 1k to ground and is driven by Tektronix AFG3102 generator, with pulse of 1 msec wide
every 20 msec, pulse high 1.265V x2, pulse low 0V, "leading" and "trailing" each 1.00 usec)
20 MHz BW



| Measure | P1:rise(C1) | P2:fall(C1) | P3:top(C1) | P4:width(C1) | P5:- - - | P6:- - - |
|---|---|---|---|---|---|---|
| value | 308.0 ns | --- | 261.6 mV | --- | | |
| status | | | | | | |

Q

**Load dump response:** 12Vin 1.2V from 51A to 25A in less than 500 nsec
Close in tip & barrel at C44 (ceramic output cap)  20 MHz BW
34mV peak overshoot



| Measure | P1:rise(C1) | P2:fall(C1) | P3:top(C1) | P4:width(C1) | P5:- - - | P6:- - - |
|---|---|---|---|---|---|---|
| value | 857.3 ns | 17.6866 µs | 1.2377 V | 7.182250 µs | | |
| status | | | | | | |

C1  BwL DC1M
10.0 mV/div
−1.214 V ofst

Timebase −30.2 µs  Trigger  C1 DC
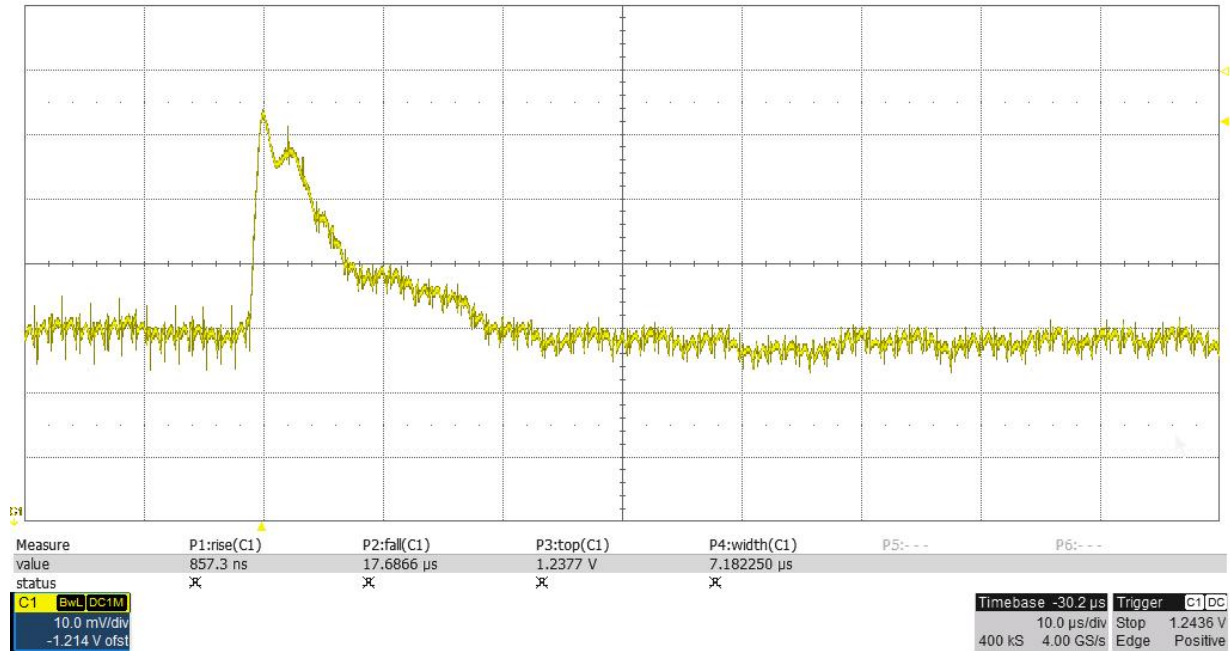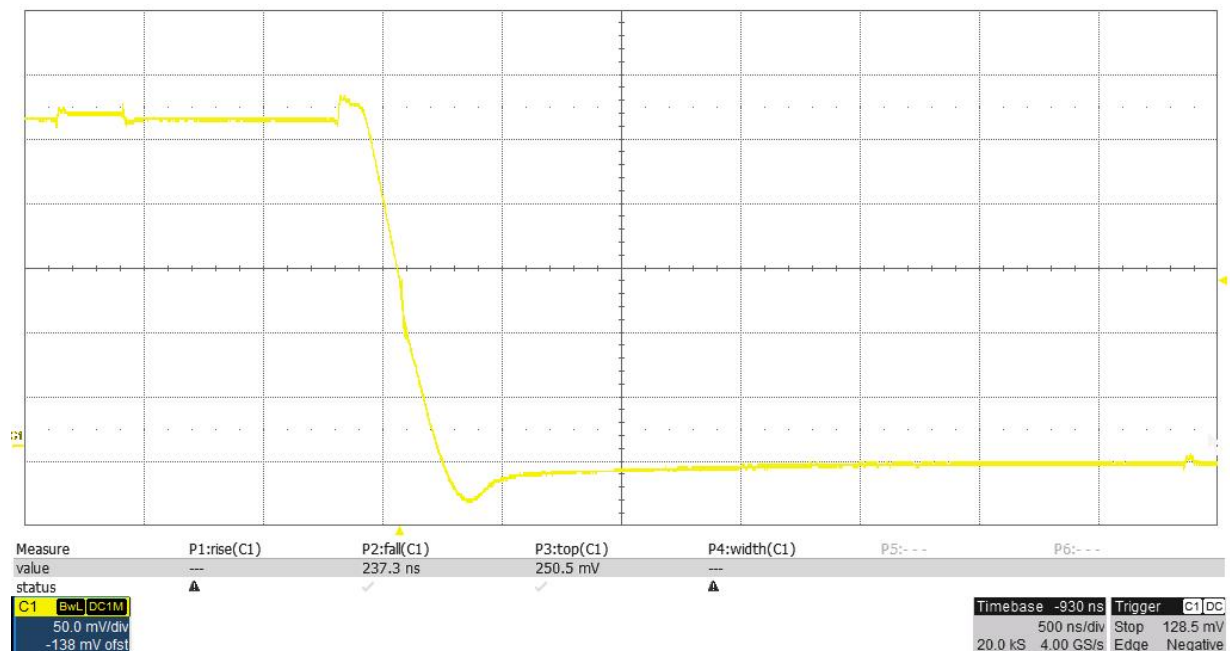10.0 µs/div  Stop  1.2436 V
400 kS  4.00 GS/s  Edge  Positive

Waveform across 10 mOhm dynamic load tied to ground: 260mV decrease in less than 500nsec
Close in tip & barrel at added 10mOhm tied to ground and source of CSD16322 (drain of CSD16322 to
Vout, gate has 1k to ground and is driven by Tektronix AFG3102 generator, with pulse of 1 msec wide
every 20 msec, pulse high 1.265V x2, pulse low 0V, "leading" and "trailing" each 1.00 usec)
20 MHz BW



| Measure | P1:rise(C1) | P2:fall(C1) | P3:top(C1) | P4:width(C1) | P5:- - - | P6:- - - |
|---|---|---|---|---|---|---|
| value | --- | 237.3 ns | 250.5 mV | --- | | |
| status | | | | | | |

C1  BwL DC1M
50.0 mV/div
−138 mV ofst

Timebase −930 ns  Trigger  C1 DC
500 ns/div  Stop  128.5 mV
20.0 kS  4.00 GS/s  Edge  Negative

Q

## Efficiency data: 10.8Vin

No fan

| Vin V | Iin A | Vout | Iout A | eff % | loss W |
|-------|-------|------|--------|-------|--------|
| 10.804 | 0.114 | 1.203 | 0.000 | N/A | 1.229 |
| 10.803 | 0.339 | 1.203 | 1.966 | 64.525 | 1.300 |
| 10.803 | 0.571 | 1.203 | 3.967 | 77.356 | 1.396 |
| 10.803 | 0.806 | 1.203 | 5.965 | 82.428 | 1.529 |
| 10.803 | 1.042 | 1.203 | 7.965 | 85.116 | 1.675 |
| 10.803 | 1.277 | 1.203 | 9.964 | 86.857 | 1.813 |
| 10.803 | 1.513 | 1.203 | 11.965 | 88.076 | 1.948 |
| 10.802 | 1.749 | 1.203 | 13.964 | 88.896 | 2.098 |
| 10.802 | 1.987 | 1.203 | 15.965 | 89.464 | 2.261 |
| 10.802 | 2.226 | 1.203 | 17.966 | 89.851 | 2.441 |
| 10.802 | 2.467 | 1.203 | 19.964 | 90.100 | 2.639 |
| 10.802 | 2.710 | 1.203 | 21.965 | 90.248 | 2.855 |
| 10.801 | 2.955 | 1.203 | 23.966 | 90.321 | 3.089 |
| 10.801 | 3.201 | 1.203 | 25.964 | 90.326 | 3.345 |
| 10.801 | 3.450 | 1.203 | 27.965 | 90.286 | 3.620 |
| 10.801 | 3.700 | 1.203 | 29.964 | 90.203 | 3.915 |
| 10.801 | 3.952 | 1.203 | 31.962 | 90.083 | 4.233 |
| 10.800 | 4.207 | 1.203 | 33.965 | 89.934 | 4.574 |
| 10.800 | 4.464 | 1.203 | 35.964 | 89.755 | 4.939 |
| 10.800 | 4.723 | 1.203 | 37.965 | 89.561 | 5.324 |
| 10.800 | 4.984 | 1.203 | 39.966 | 89.344 | 5.736 |
| 10.799 | 5.248 | 1.203 | 41.967 | 89.108 | 6.173 |
| 10.799 | 5.514 | 1.203 | 43.967 | 88.856 | 6.636 |
| 10.799 | 5.783 | 1.203 | 45.969 | 88.588 | 7.127 |
| 10.799 | 6.054 | 1.204 | 47.969 | 88.305 | 7.646 |
| 10.798 | 6.328 | 1.204 | 49.973 | 88.015 | 8.190 |

Q

Data taken with 30 second delay before each measurement or spread over 13 minutes for 26 points of data going from no load to full load. This is on our automatic efficiency tester using 4 HP / Agilent 34401A meters and two calibrated current shunts (0.9993 milli-ohms for output current and 3.998 milli-ohms for input current).

## Efficiency data continued: 10.8Vin

with ~1 Meter per second airflow

| Vin V | Iin A | Vout | Iout A | eff % | loss W |
|-------|-------|------|--------|-------|--------|
| 10.804 | 0.114 | 1.203 | 0.000 | N/A | 1.230 |
| 10.803 | 0.339 | 1.202 | 1.955 | 64.188 | 1.312 |
| 10.803 | 0.571 | 1.203 | 3.956 | 77.155 | 1.409 |
| 10.803 | 0.805 | 1.202 | 5.956 | 82.315 | 1.539 |
| 10.803 | 1.041 | 1.202 | 7.956 | 85.049 | 1.682 |
| 10.803 | 1.277 | 1.203 | 9.957 | 86.801 | 1.821 |
| 10.803 | 1.512 | 1.203 | 11.959 | 88.056 | 1.951 |
| 10.802 | 1.749 | 1.203 | 13.959 | 88.887 | 2.099 |
| 10.802 | 1.986 | 1.203 | 15.961 | 89.465 | 2.261 |
| 10.802 | 2.226 | 1.203 | 17.963 | 89.862 | 2.437 |
| 10.802 | 2.466 | 1.203 | 19.962 | 90.121 | 2.632 |
| 10.802 | 2.709 | 1.203 | 21.962 | 90.282 | 2.843 |
| 10.801 | 2.953 | 1.203 | 23.963 | 90.367 | 3.072 |
| 10.801 | 3.199 | 1.203 | 25.962 | 90.388 | 3.321 |
| 10.801 | 3.446 | 1.203 | 27.962 | 90.357 | 3.590 |
| 10.801 | 3.696 | 1.203 | 29.961 | 90.280 | 3.880 |
| 10.801 | 3.947 | 1.203 | 31.960 | 90.179 | 4.187 |
| 10.800 | 4.201 | 1.203 | 33.966 | 90.046 | 4.517 |
| 10.800 | 4.457 | 1.203 | 35.967 | 89.893 | 4.865 |
| 10.800 | 4.714 | 1.203 | 37.968 | 89.715 | 5.236 |
| 10.800 | 4.974 | 1.203 | 39.968 | 89.522 | 5.628 |
| 10.800 | 5.235 | 1.203 | 41.970 | 89.314 | 6.041 |
| 10.799 | 5.499 | 1.203 | 43.969 | 89.085 | 6.482 |
| 10.799 | 5.765 | 1.203 | 45.971 | 88.848 | 6.942 |
| 10.799 | 6.033 | 1.203 | 47.972 | 88.598 | 7.428 |
| 10.799 | 6.303 | 1.203 | 49.977 | 88.342 | 7.935 |

Q
Data taken with 30 second delay before each measurement or spread over 13 minutes for 26 points of data going from no load to full load. This is on our automatic efficiency tester using 4 HP / Agilent 34401A meters and two calibrated current shunts (0.9993 milli-ohms for output current and 3.998 milli-ohms for input current).
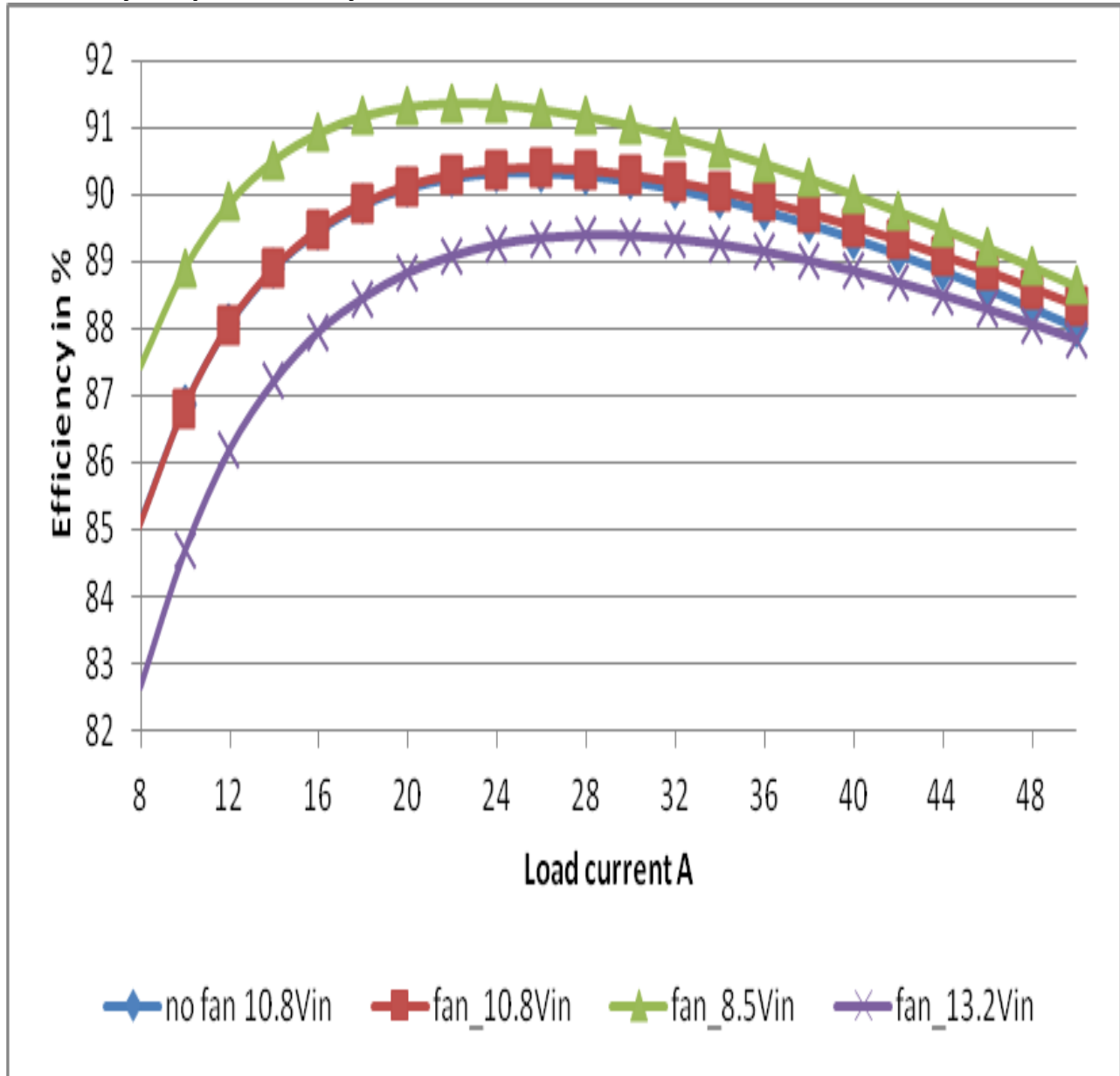
## Efficiency data continued: 13.2Vin

with ~1 Meter per second airflow

| Vin V | Iin A | Vout | Iout A | eff % | loss W |
|-------|-------|------|--------|-------|--------|
| 13.202 | 0.112 | 1.203 | 0.000 | N/A | 1.481 |
| 13.202 | 0.298 | 1.202 | 1.965 | 60.068 | 1.571 |
| 13.202 | 0.489 | 1.202 | 3.965 | 73.810 | 1.692 |
| 13.202 | 0.683 | 1.202 | 5.963 | 79.512 | 1.848 |
| 13.201 | 0.877 | 1.202 | 7.962 | 82.664 | 2.008 |
| 13.201 | 1.072 | 1.203 | 9.964 | 84.699 | 2.165 |
| 13.201 | 1.265 | 1.203 | 11.964 | 86.194 | 2.305 |
| 13.201 | 1.459 | 1.203 | 13.963 | 87.214 | 2.462 |
| 13.201 | 1.654 | 1.203 | 15.965 | 87.949 | 2.631 |
| 13.201 | 1.851 | 1.203 | 17.964 | 88.452 | 2.821 |
| 13.200 | 2.048 | 1.203 | 19.965 | 88.825 | 3.021 |
| 13.200 | 2.247 | 1.203 | 21.964 | 89.076 | 3.240 |
| 13.200 | 2.447 | 1.203 | 23.964 | 89.248 | 3.473 |
| 13.200 | 2.648 | 1.203 | 25.962 | 89.342 | 3.726 |
| 13.200 | 2.851 | 1.203 | 27.963 | 89.383 | 3.996 |
| 13.200 | 3.055 | 1.203 | 29.961 | 89.374 | 4.286 |
| 13.199 | 3.261 | 1.203 | 31.961 | 89.327 | 4.594 |
| 13.199 | 3.469 | 1.203 | 33.964 | 89.248 | 4.923 |
| 13.199 | 3.678 | 1.203 | 35.964 | 89.137 | 5.273 |
| 13.199 | 3.888 | 1.203 | 37.966 | 89.003 | 5.644 |
| 13.199 | 4.101 | 1.203 | 39.967 | 88.851 | 6.034 |
| 13.198 | 4.314 | 1.203 | 41.967 | 88.678 | 6.447 |
| 13.198 | 4.530 | 1.203 | 43.967 | 88.489 | 6.881 |
| 13.198 | 4.747 | 1.203 | 45.968 | 88.281 | 7.342 |
| 13.198 | 4.966 | 1.203 | 47.969 | 88.061 | 7.825 |
| 13.198 | 5.187 | 1.203 | 49.973 | 87.827 | 8.334 |

Q

Data taken with 30 second delay before each measurement or spread over 13 minutes for 26 points of data going from no load to full load. This is on our automatic efficiency tester using 4 HP / Agilent 34401A meters and two calibrated current shunts (0.9993 milli-ohms for output current and 3.998 milli-ohms for input current).

## Efficiency data continued: 8.5Vin

with ~1 Meter per second airflow

| Vin V | Iin A | Vout | Iout A | eff % | loss W |
|-------|-------|------|--------|-------|--------|
| 8.505 | 0.117 | 1.203 | 0.000 | N/A | 0.998 |
| 8.505 | 0.402 | 1.203 | 1.965 | 69.153 | 1.054 |
| 8.504 | 0.694 | 1.202 | 3.965 | 80.842 | 1.130 |
| 8.504 | 0.989 | 1.203 | 5.963 | 85.245 | 1.241 |
| 8.504 | 1.288 | 1.203 | 7.962 | 87.453 | 1.374 |
| 8.504 | 1.585 | 1.203 | 9.964 | 88.916 | 1.494 |
| 8.503 | 1.882 | 1.203 | 11.962 | 89.886 | 1.619 |
| 8.503 | 2.182 | 1.203 | 13.963 | 90.520 | 1.759 |
| 8.503 | 2.483 | 1.203 | 15.963 | 90.926 | 1.916 |
| 8.503 | 2.787 | 1.203 | 17.965 | 91.181 | 2.090 |
| 8.503 | 3.092 | 1.203 | 19.964 | 91.317 | 2.283 |
| 8.502 | 3.401 | 1.203 | 21.965 | 91.367 | 2.496 |
| 8.502 | 3.711 | 1.203 | 23.964 | 91.352 | 2.729 |
| 8.502 | 4.024 | 1.203 | 25.962 | 91.277 | 2.984 |
| 8.502 | 4.339 | 1.203 | 27.962 | 91.173 | 3.256 |
| 8.501 | 4.656 | 1.203 | 29.961 | 91.037 | 3.548 |
| 8.501 | 4.976 | 1.203 | 31.959 | 90.866 | 3.864 |
| 8.501 | 5.300 | 1.203 | 33.964 | 90.677 | 4.200 |
| 8.501 | 5.625 | 1.203 | 35.963 | 90.468 | 4.558 |
| 8.500 | 5.953 | 1.203 | 37.964 | 90.246 | 4.936 |
| 8.500 | 6.283 | 1.203 | 39.965 | 90.006 | 5.338 |
| 8.500 | 6.617 | 1.203 | 41.966 | 89.755 | 5.762 |
| 8.499 | 6.953 | 1.203 | 43.966 | 89.495 | 6.208 |
| 8.499 | 7.292 | 1.203 | 45.967 | 89.218 | 6.683 |
| 8.499 | 7.634 | 1.203 | 47.968 | 88.932 | 7.181 |
| 8.499 | 7.980 | 1.203 | 49.972 | 88.638 | 7.706 |

Q

Data taken with 30 second delay before each measurement or spread over 13 minutes for 26 points of data going from no load to full load. This is on our automatic efficiency tester using 4 HP / Agilent 34401A meters and two calibrated current shunts (0.9993 milli-ohms for output current and 3.998 milli-ohms for input current).

**Efficiency Graph summary of all 4 runs:**