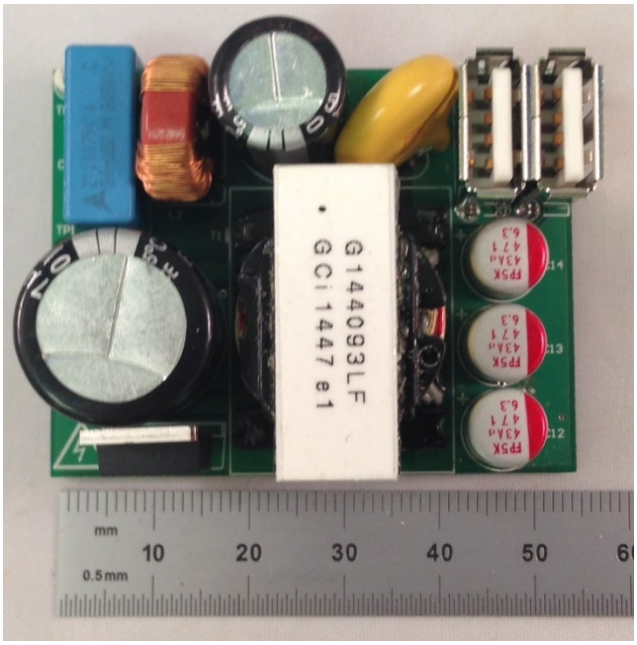
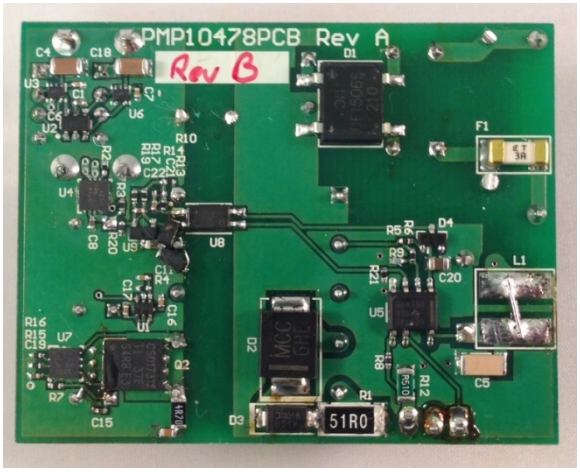
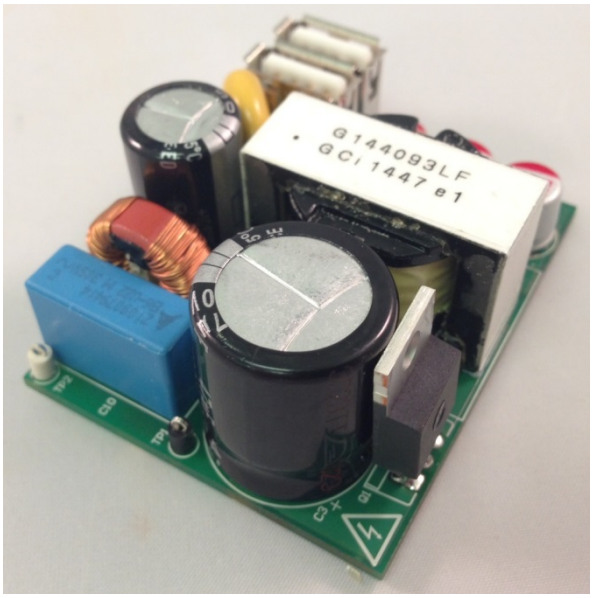
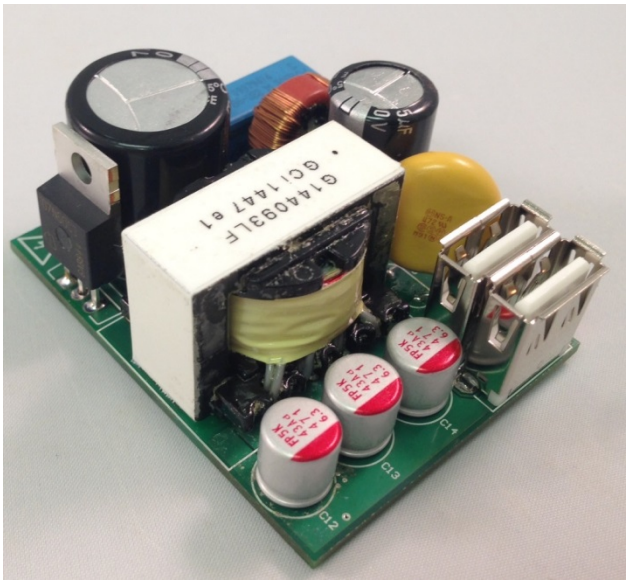
# 1 Photos

The photographs below show the PMP10478 Rev B prototype assembly. This circuit was built using a PMP10478 Rev A PCB.



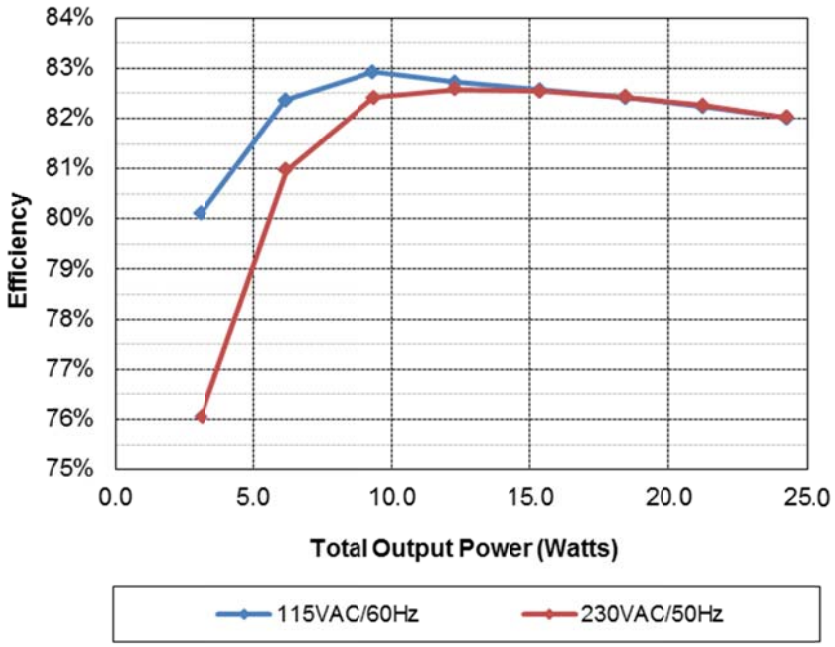

# 2 Standby Power

With no load attached to the output of the supply, the unit draws 76mW of input power with an 115VAC/60Hz input, and 136mW with a 230VAC/50Hz input.

# 3 Efficiency

## 3.1 Total Efficiency

The efficiency measurements below were measured from the AC input to the USB port outputs.




**115VAC/60Hz**

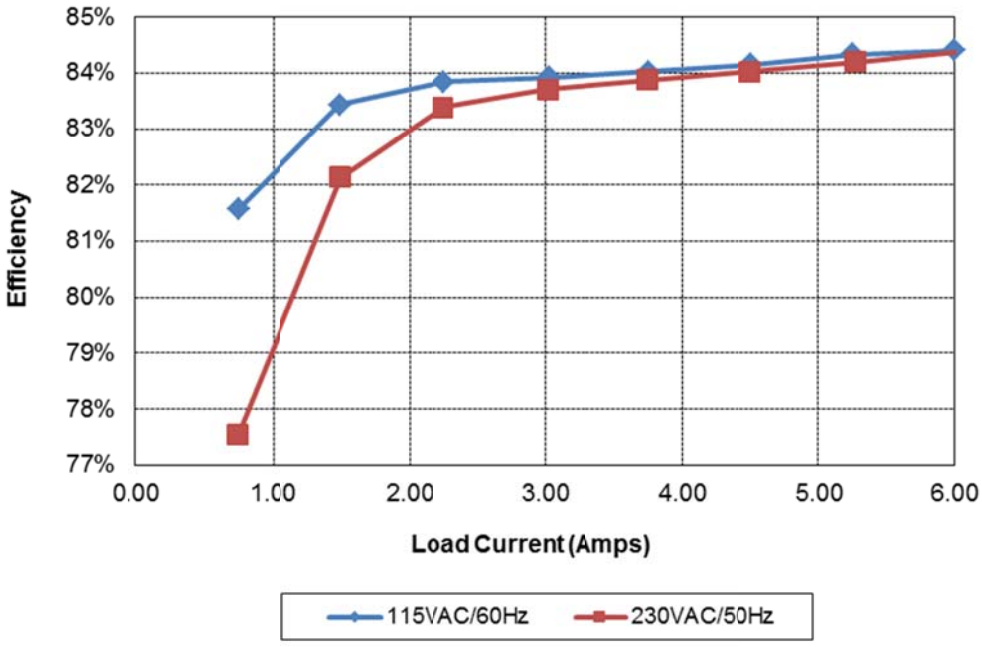
| J1 Port | | J2 Port | | | | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Iout | Vout | Iout | Vout | Vin | Iin | Pin | PF | Pout | Losses | Efficiency |
| 0.000 | 4.95 | 0.000 | 4.98 | 115.0 | 0.0088 | 0.076 | | | | |
| 0.311 | 4.97 | 0.309 | 4.97 | 115.0 | 0.0967 | 3.847 | 0.340 | 3.08 | 0.77 | 80.1% |
| 0.626 | 4.95 | 0.618 | 4.96 | 115.0 | 0.1725 | 7.480 | 0.380 | 6.16 | 1.32 | 82.4% |
| 0.938 | 4.94 | 0.951 | 4.94 | 115.0 | 0.2422 | 11.254 | 0.410 | 9.33 | 1.92 | 82.9% |
| 1.249 | 4.92 | 1.248 | 4.92 | 114.9 | 0.3020 | 14.852 | 0.440 | 12.29 | 2.57 | 82.7% |
| 1.562 | 4.90 | 1.574 | 4.91 | 114.9 | 0.3609 | 18.63 | 0.460 | 15.38 | 3.25 | 82.6% |
| 1.877 | 4.88 | 1.897 | 4.89 | 114.9 | 0.4175 | 22.37 | 0.470 | 18.44 | 3.93 | 82.4% |
| 2.186 | 4.87 | 2.179 | 4.87 | 114.9 | 0.4688 | 25.85 | 0.490 | 21.26 | 4.59 | 82.2% |
| 2.497 | 4.85 | 2.511 | 4.85 | 114.9 | 0.5231 | 29.62 | 0.500 | 24.29 | 5.33 | 82.0% |

| 230VAC/50Hz | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| J1 Port | | J2 Port | | | | | | Total | | |
| Iout | Vout | Iout | Vout | Vin | Iin | Pin | PF | Pout | Losses | Efficiency |
| 0.000 | 4.94 | 0.000 | 4.94 | 233.3 | 0.0139 | 0.136 | | | | |
| 0.310 | 4.97 | 0.315 | 4.97 | 230.0 | 0.0650 | 4.085 | 0.273 | 3.11 | 0.98 | 76.0% |
| 0.624 | 4.95 | 0.622 | 4.96 | 230.0 | 0.1079 | 7.625 | 0.307 | 6.17 | 1.45 | 81.0% |
| 0.938 | 4.94 | 0.956 | 4.94 | 230.0 | 0.1520 | 11.350 | 0.324 | 9.35 | 2.00 | 82.4% |
| 1.250 | 4.92 | 1.249 | 4.92 | 230.0 | 0.1930 | 14.888 | 0.335 | 12.30 | 2.59 | 82.6% |
| 1.562 | 4.90 | 1.578 | 4.91 | 230.0 | 0.2358 | 18.66 | 0.340 | 15.40 | 3.26 | 82.5% |
| 1.875 | 4.88 | 1.896 | 4.89 | 230.0 | 0.2764 | 22.35 | 0.352 | 18.42 | 3.93 | 82.4% |
| 2.188 | 4.87 | 2.177 | 4.87 | 230.0 | 0.3133 | 25.84 | 0.359 | 21.26 | 4.58 | 82.3% |
| 2.501 | 4.85 | 2.508 | 4.84 | 230.0 | 0.3517 | 29.59 | 0.366 | 24.27 | 5.32 | 82.0% |

| Vin | Pout | Load | Efficiency | Avg. Eff. |
|---|---|---|---|---|
| **115VAC/60Hz** | 6.161 | 25% | 82.4% | **82.4%** |
| | 12.285 | 50% | 82.7% | |
| | 18.436 | 75% | 82.4% | |
| | 24.289 | 100% | 82.0% | |
| **230VAC/50Hz** | 6.174 | 25% | 81.0% | **82.0%** |
| | 12.295 | 50% | 82.6% | |
| | 18.421 | 75% | 82.4% | |
| | 24.269 | 100% | 82.0% | |

## *3.2 AC/DC Only Efficiency*

The efficiency measurements below were measured from the AC input to before the USB switches.



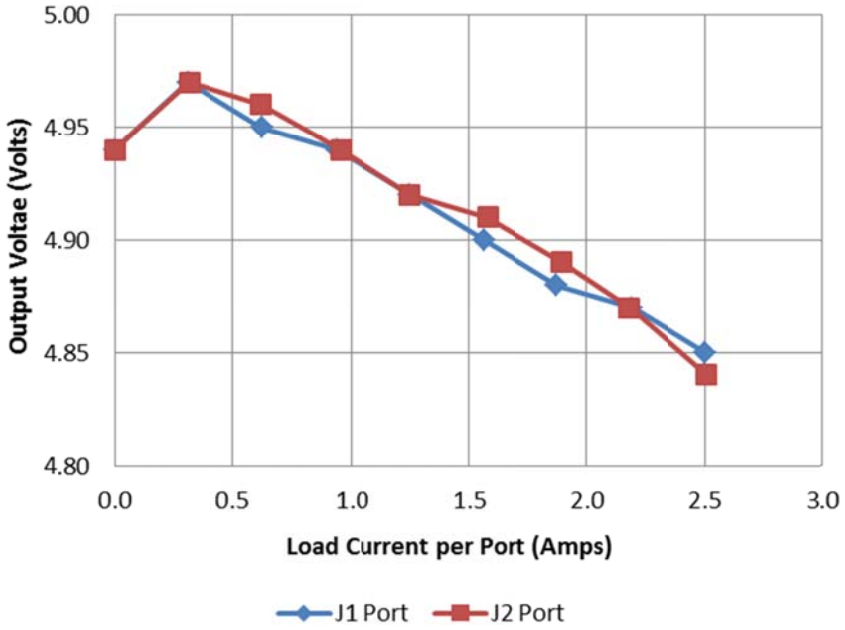
| 115VAC/60Hz | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Iout | Vout | Vin | Iin | Pin | PF | Pout | Losses | Efficiency |
| 0.000 | 4.98 | 115.0 | 0.0088 | 0.076 | | 0.00 | 0.08 | |
| 0.752 | 4.98 | 115.0 | 0.1148 | 4.591 | 0.348 | 3.74 | 0.85 | 81.6% |
| 1.496 | 4.98 | 115.0 | 0.2047 | 8.930 | 0.380 | 7.45 | 1.48 | 83.4% |
| 2.259 | 4.98 | 114.9 | 0.2836 | 13.417 | 0.412 | 11.25 | 2.17 | 83.8% |
| 3.027 | 4.98 | 114.9 | 0.355 | 17.961 | 0.440 | 15.07 | 2.89 | 83.9% |
| 3.761 | 4.98 | 114.9 | 0.420 | 22.29 | 0.463 | 18.73 | 3.56 | 84.0% |
| 4.51 | 4.98 | 114.9 | 0.483 | 26.69 | 0.481 | 22.46 | 4.23 | 84.2% |
| 5.25 | 4.98 | 114.9 | 0.544 | 31.00 | 0.496 | 26.15 | 4.86 | 84.3% |
| 6.00 | 4.98 | 114.9 | 0.605 | 35.40 | 0.509 | 29.88 | 5.52 | 84.4% |

| 230VAC/50Hz | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Iout | Vout | Vin | Iin | Pin | PF | Pout | Losses | Efficiency |
| 0.000 | 4.98 | 233.3 | 0.0139 | 0.136 | | 0.00 | 0.14 | |
| 0.743 | 4.98 | 230.0 | 0.0734 | 4.772 | 0.273 | 3.70 | 1.07 | 77.5% |
| 1.500 | 4.98 | 230.0 | 0.1254 | 9.094 | 0.307 | 7.47 | 1.62 | 82.1% |
| 2.251 | 4.98 | 230.0 | 0.1765 | 13.443 | 0.331 | 11.21 | 2.23 | 83.4% |
| 3.017 | 4.98 | 230.0 | 0.2277 | 17.950 | 0.343 | 15.02 | 2.93 | 83.7% |
| 3.751 | 4.98 | 230.0 | 0.2752 | 22.27 | 0.352 | 18.68 | 3.59 | 83.9% |
| 4.50 | 4.98 | 230.0 | 0.3215 | 26.67 | 0.361 | 22.41 | 4.26 | 84.0% |
| 5.27 | 4.98 | 230.0 | 0.3664 | 31.17 | 0.370 | 26.24 | 4.93 | 84.2% |
| 6.01 | 4.98 | 230.0 | 0.4067 | 35.47 | 0.379 | 29.93 | 5.54 | 84.4% |

| Vin | Pin | Vout | Iout | Load | Efficiency | Avg. Eff. |
|---|---|---|---|---|---|---|
| **115VAC/60Hz** | 8.93 | 4.98 | 1.496 | 25% | 83.43% | **83.98%** |
| | 17.96 | 4.98 | 3.027 | 50% | 83.93% | |
| | 26.69 | 4.98 | 4.510 | 75% | 84.15% | |
| | 35.40 | 4.98 | 6.000 | 100% | 84.41% | |
| **230VAC/50Hz** | 9.09 | 4.98 | 1.500 | 25% | 82.14% | **83.56%** |
| | 17.95 | 4.98 | 3.017 | 50% | 83.70% | |
| | 26.67 | 4.98 | 4.500 | 75% | 84.03% | |
| | 35.47 | 4.98 | 6.010 | 100% | 84.38% | |

# 4 Regulation

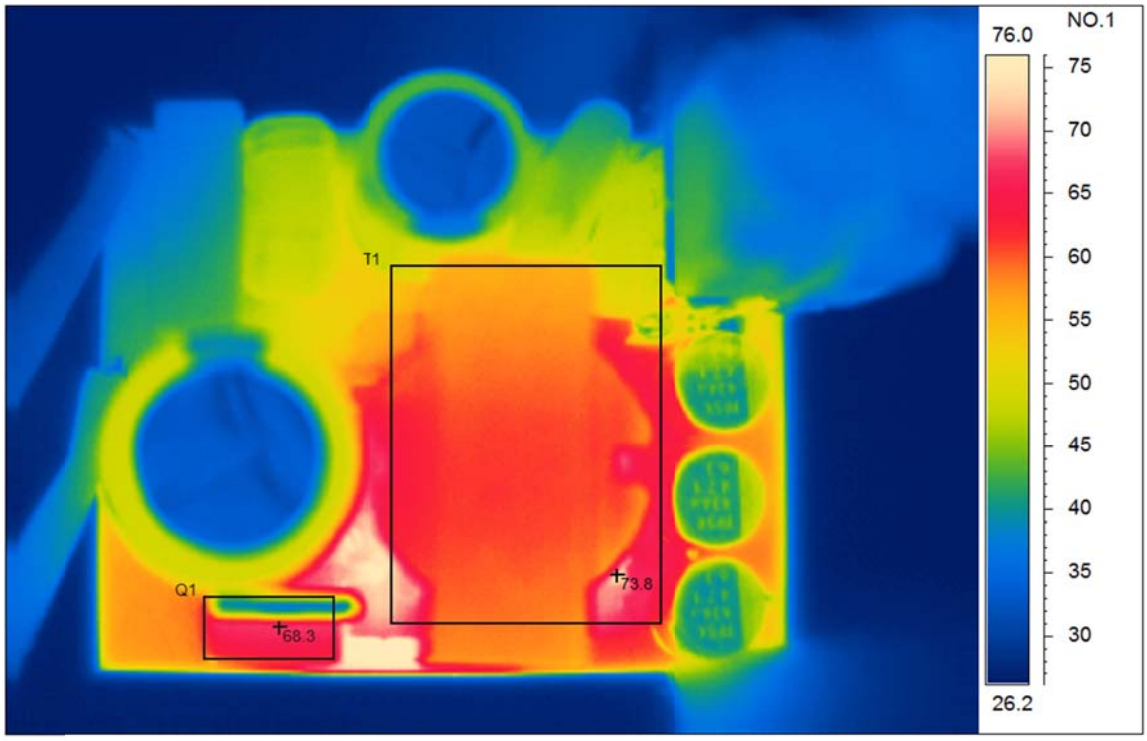
Data taken from efficiency tables, above.

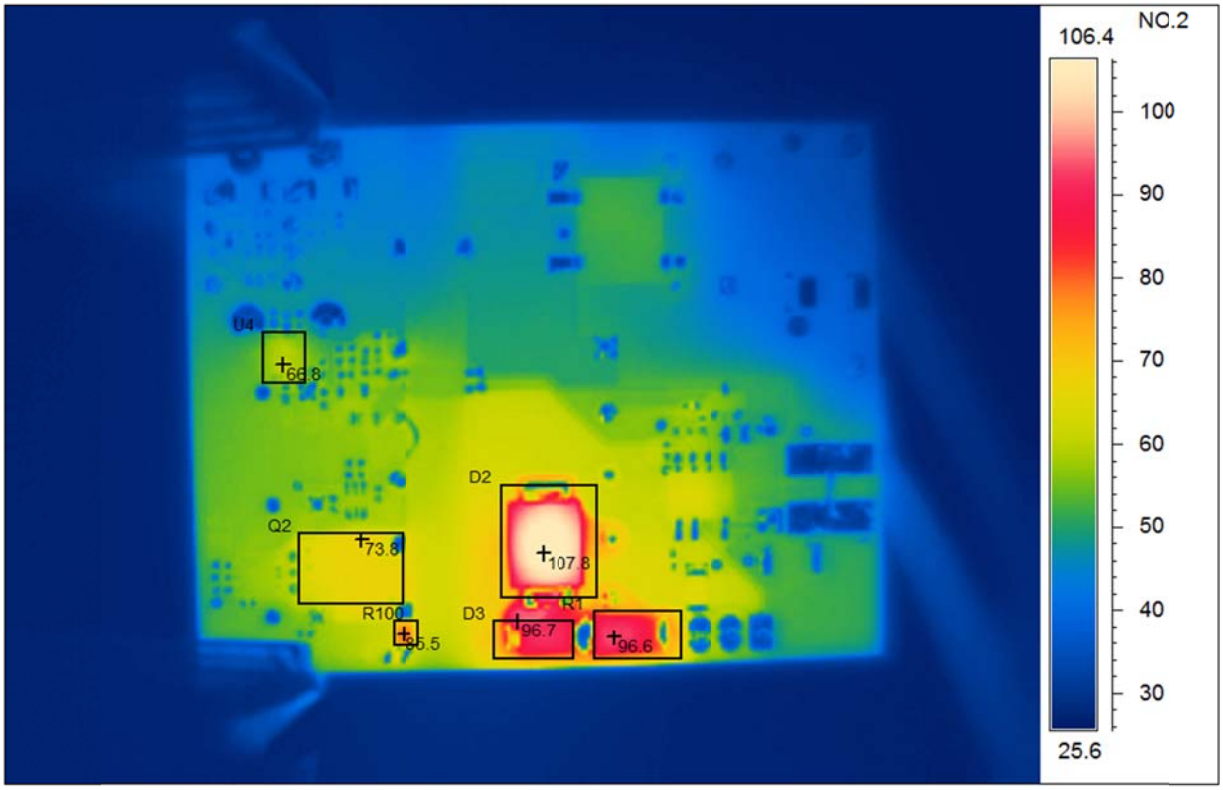



# 5 Thermal Images

The thermal images below show the assembly with both ports loaded with 2.5A each. The ambient temperature was 25ºC.

## *5.1 115VAC/60Hz*





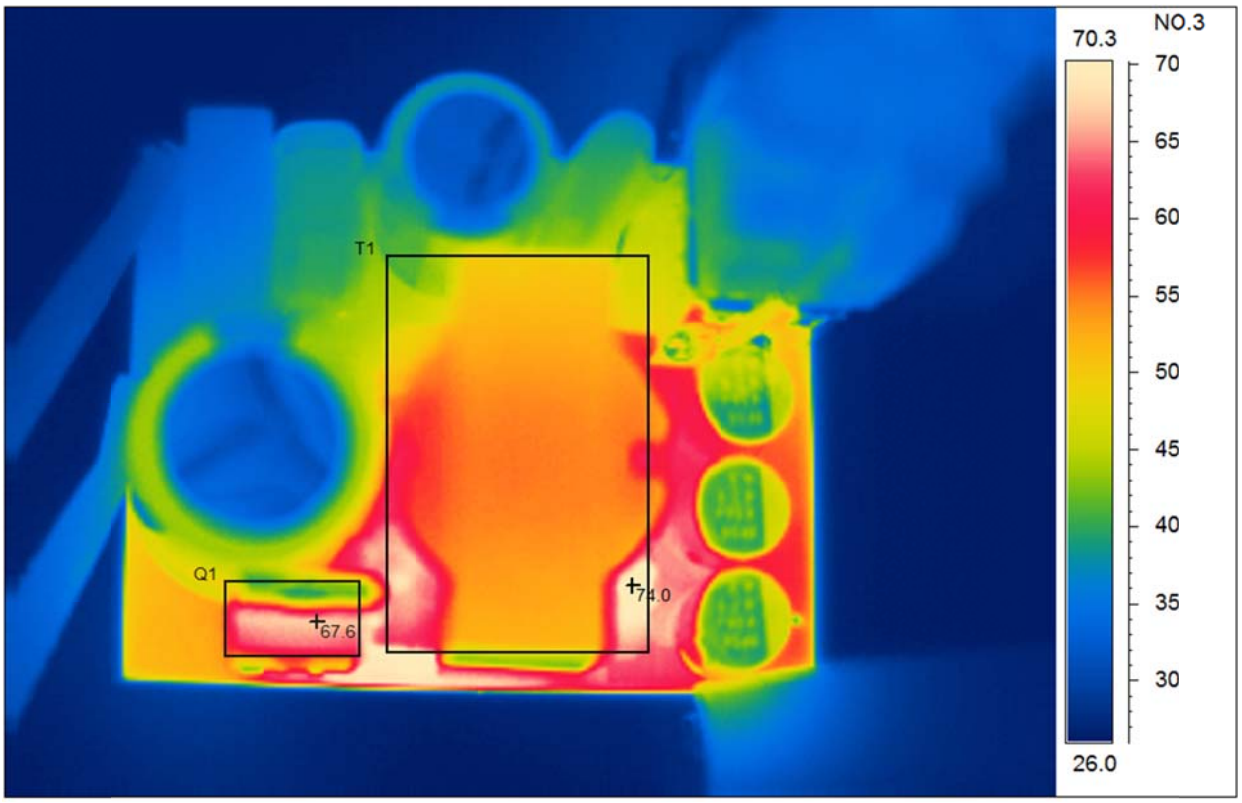

NO.1

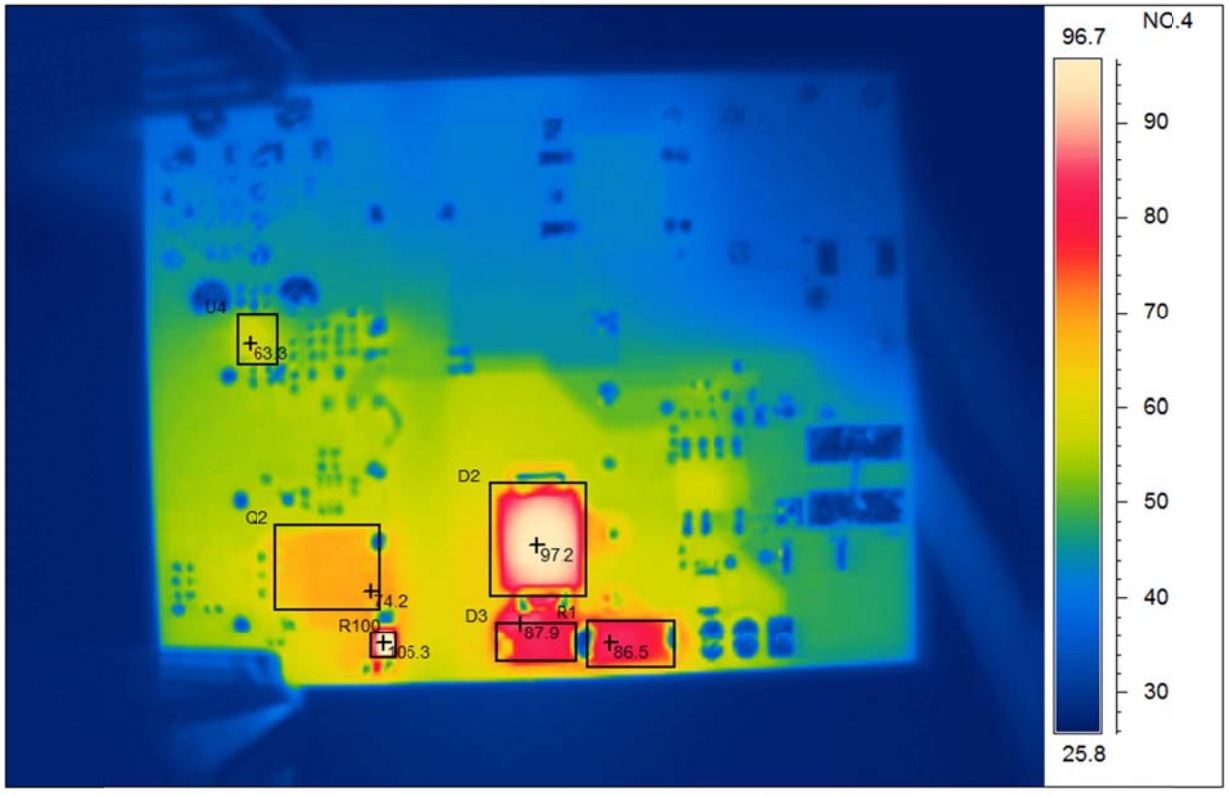
| Area analysis | Value |
|---|---|
| T1Max | 73.8°C |
| Q1 Max | 68.3°C |

NO.2

| Area analysis | Value |
|---|---|
| Q2Max | 73.8°C |
| R100Max | 85.5°C |
| D2Max | 107.8°C |
| D3Max | 96.7°C |
| R1Max | 96.6°C |
| U4 Max | 66.8°C |

### 5.2 230VAC/50Hz



| Area analysis | Value |
|---|---|
| T1Max | 74.0°C |
| Q1 Max | 67.6°C |

NO.3

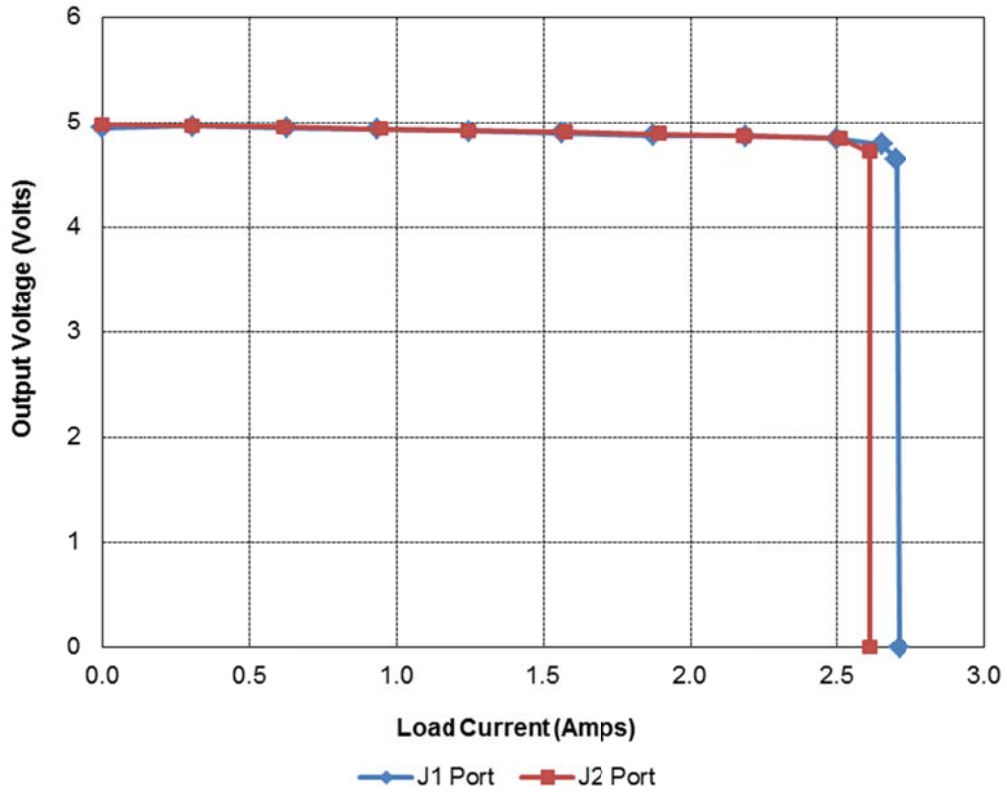
| Area analysis | Value |
|---|---|
| Q2Max | 74.2°C |
| R100Max | 105.3°C |
| D2Max | 97.2°C |
| D3Max | 87.9°C |
| R1Max | 86.5°C |
| U4 Max | 63.3°C |

NO.4

# 6 Current Limit

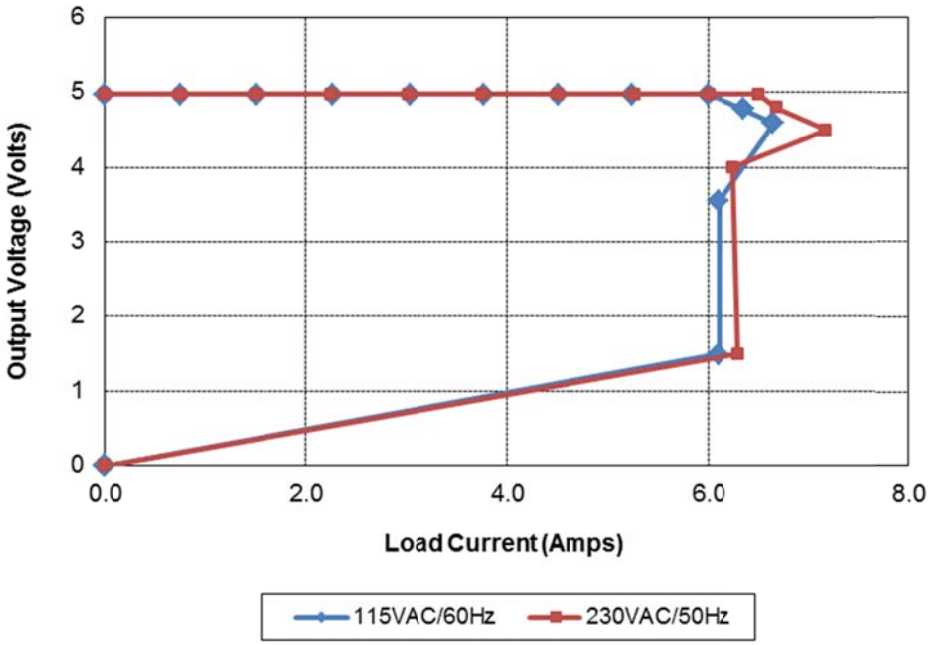
## *6.1 At USB Ports*

The plot below shows the output voltages on each port versus output current as the load is increased into current limit.



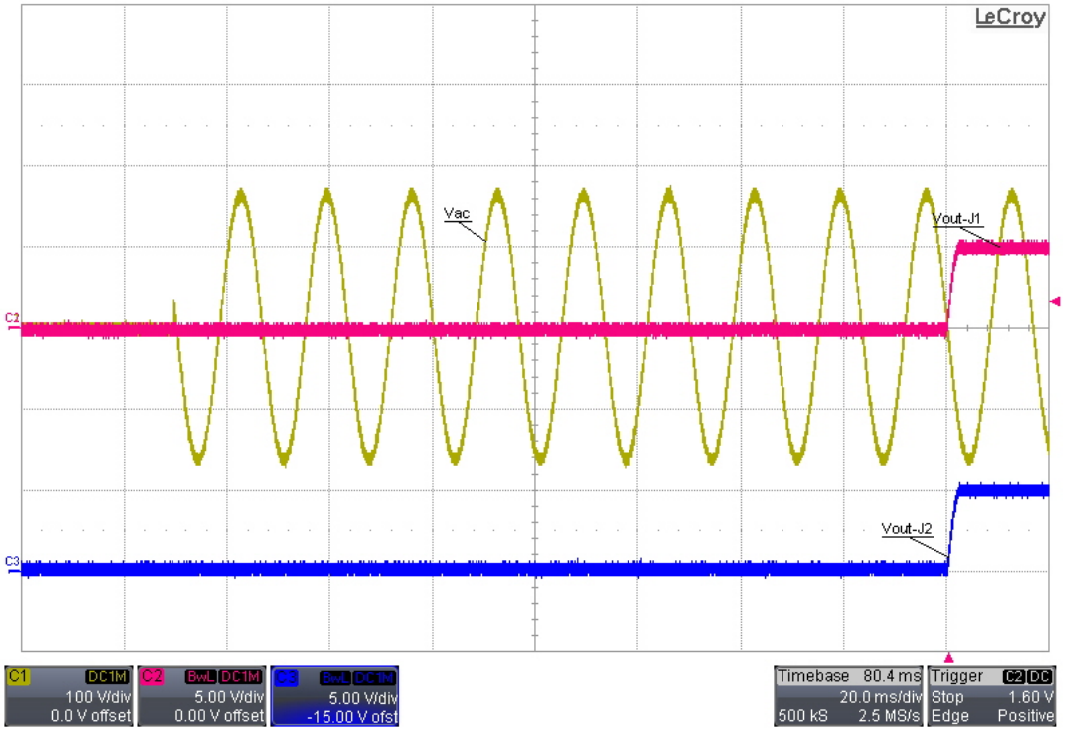
### 6.2 AC/DC Only

The load was applied before the USB switches.

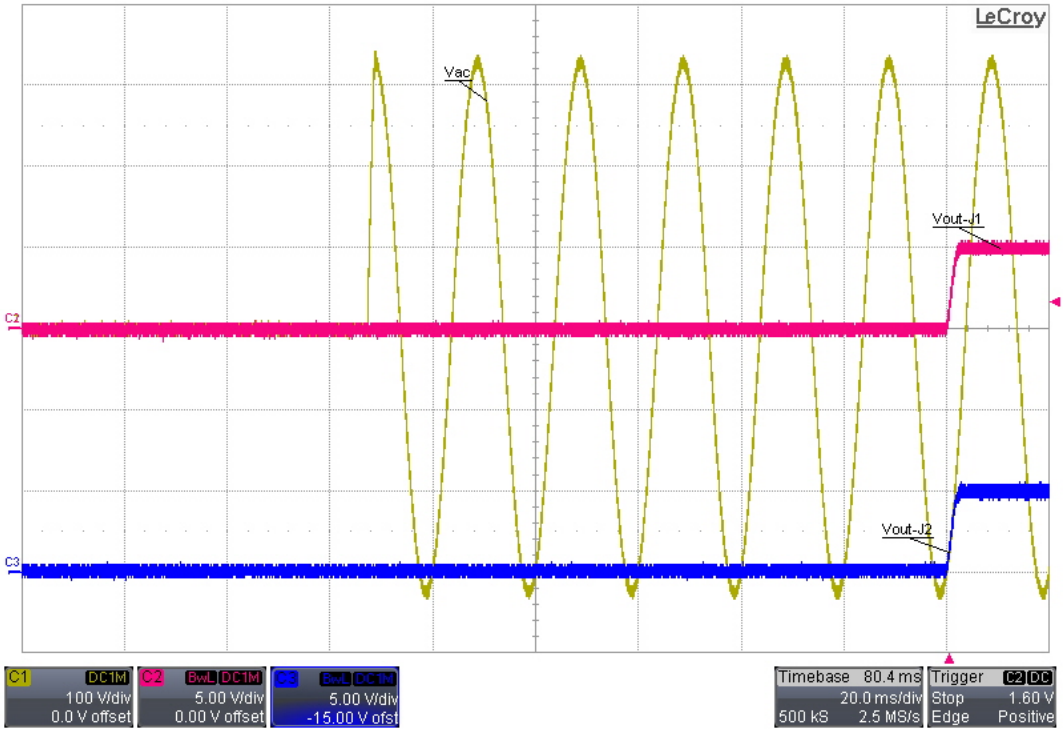



## 7 Startup

### 7.1 115VAC/60Hz – No Load



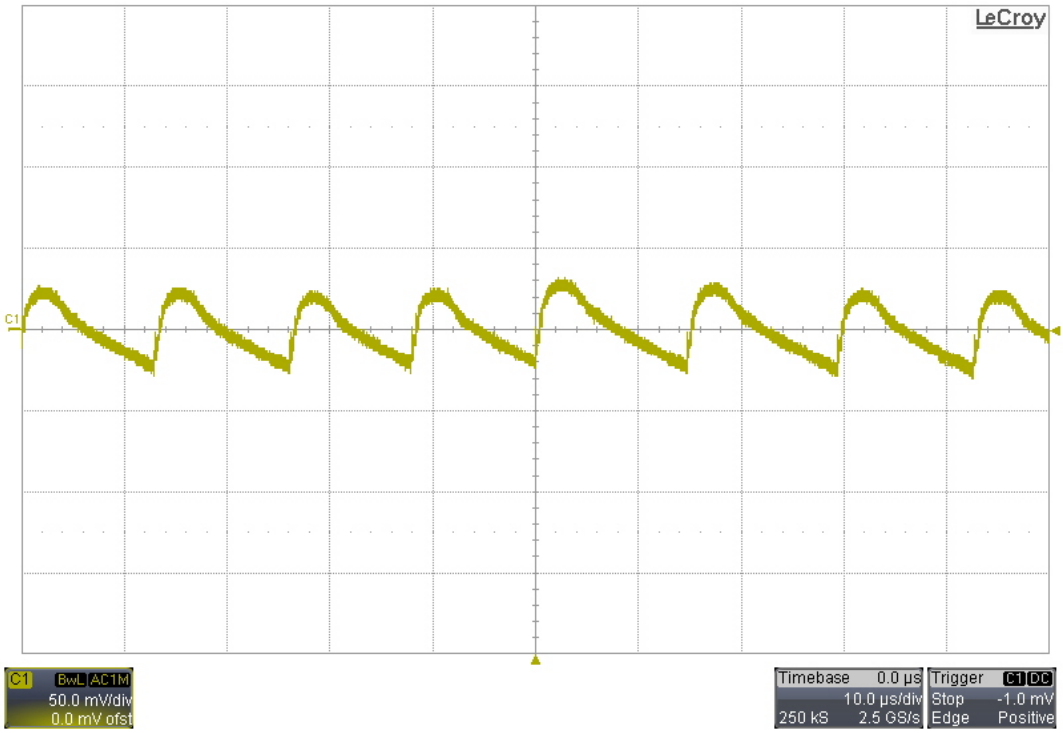
### 7.2 230VAC/50Hz – No Load



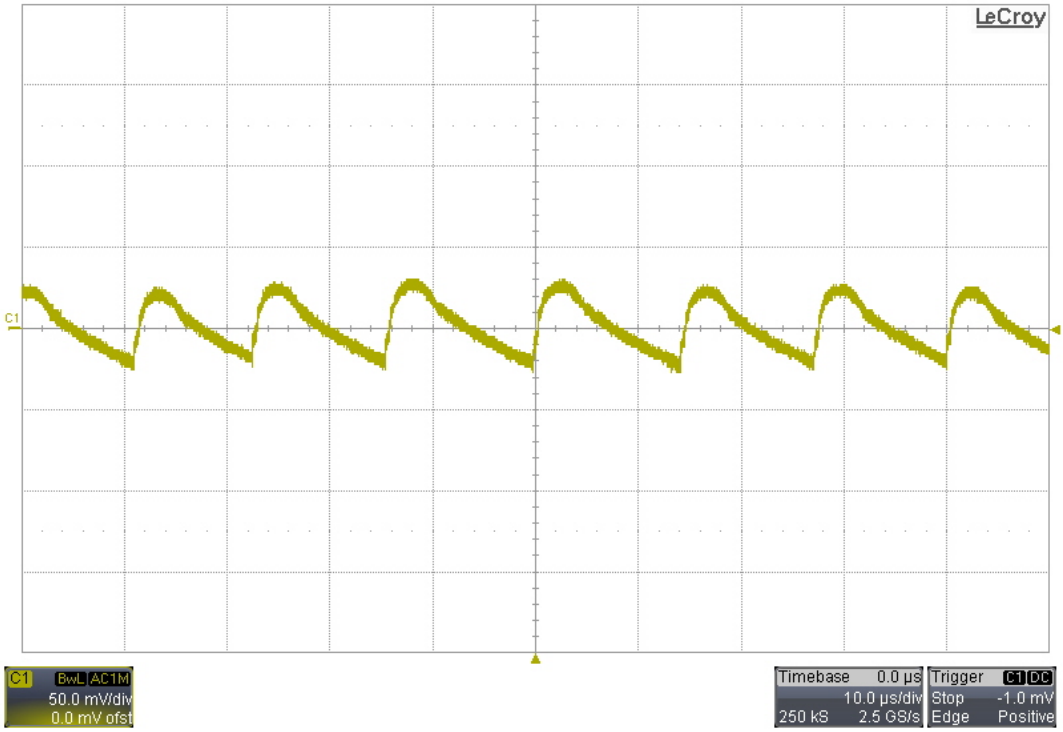

## 8 Output Ripple Voltage

Each port was loaded with 2.5A.

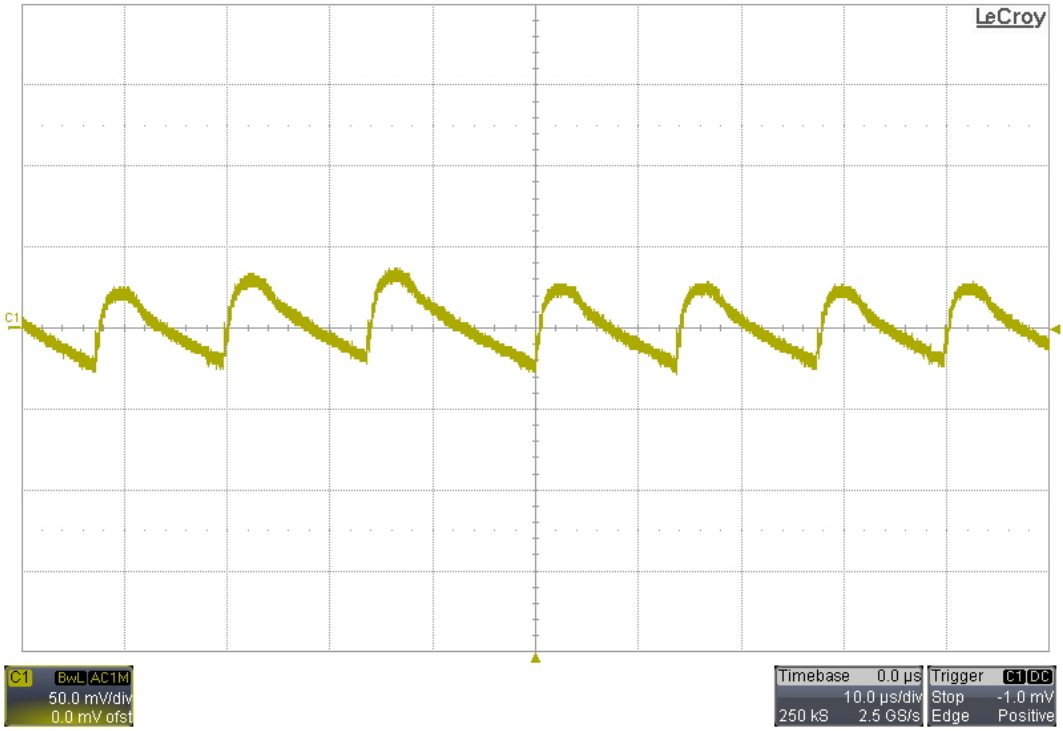
### 8.1 115VAC/60Hz – Measured on J1



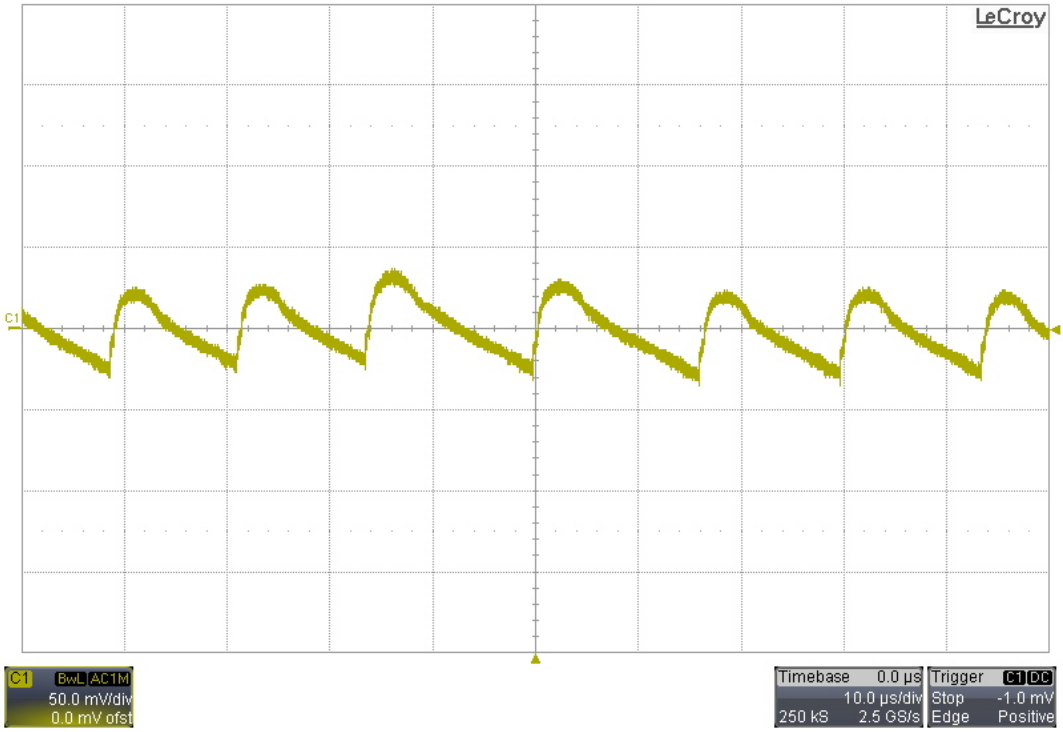
### 8.2 115VAC/60Hz – Measured on J2



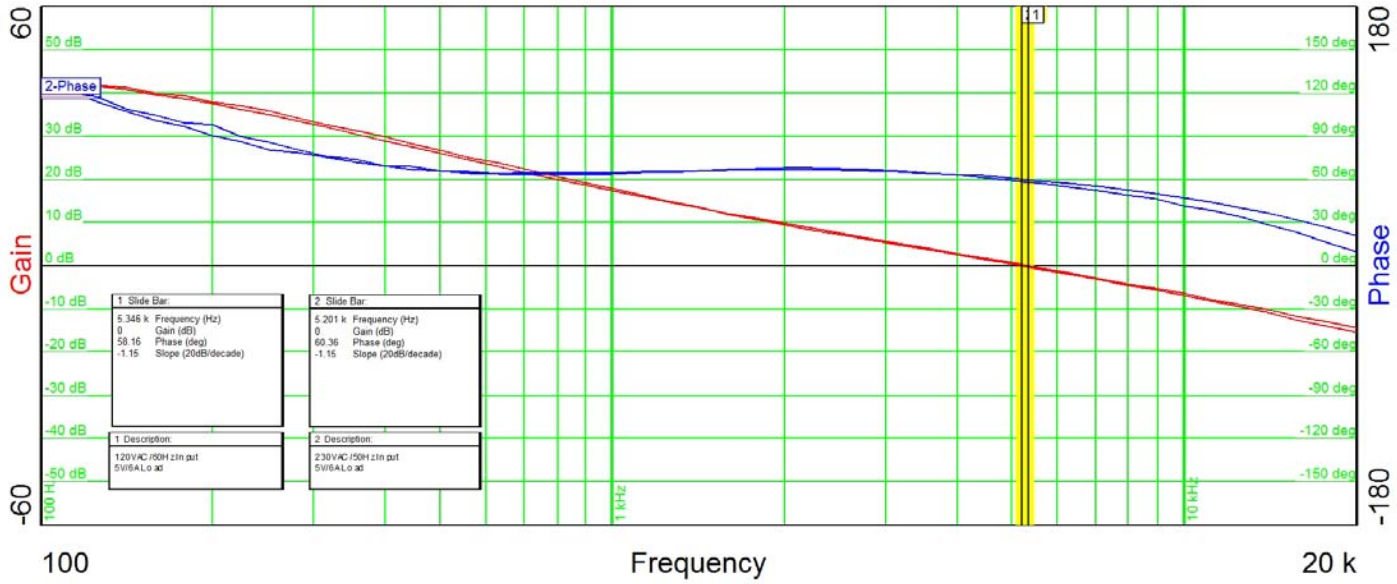

### 8.3 230VAC/50Hz – Measured on J1



### 8.4 230VAC/50Hz – Measured on J2

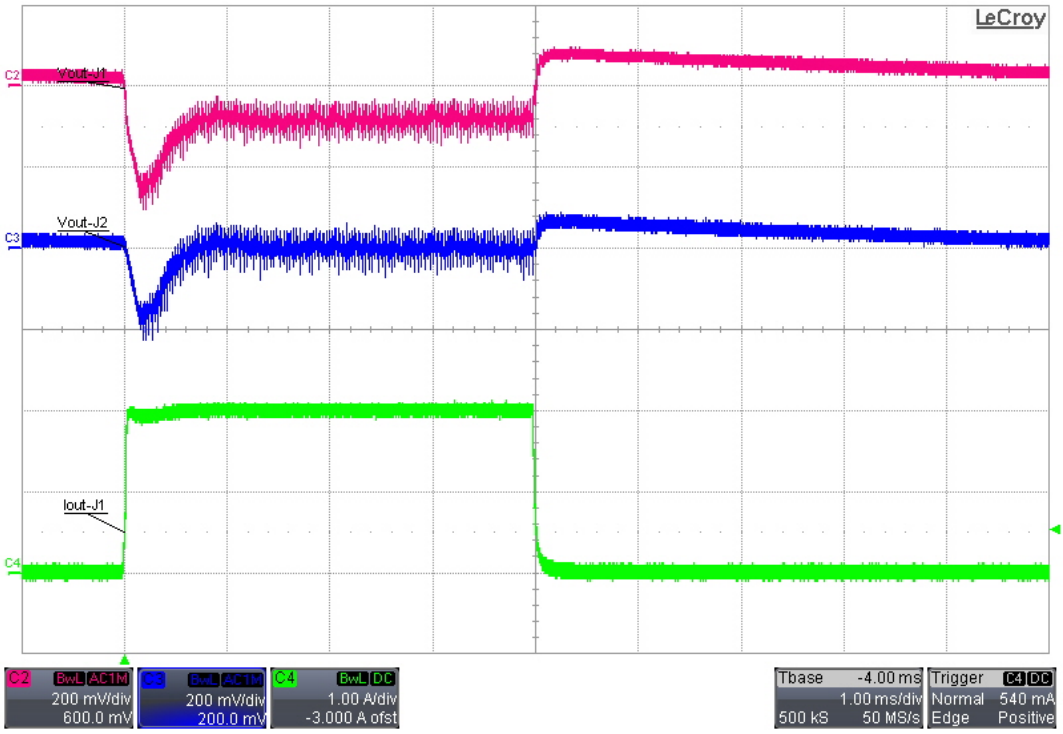



## 9 Loop Response

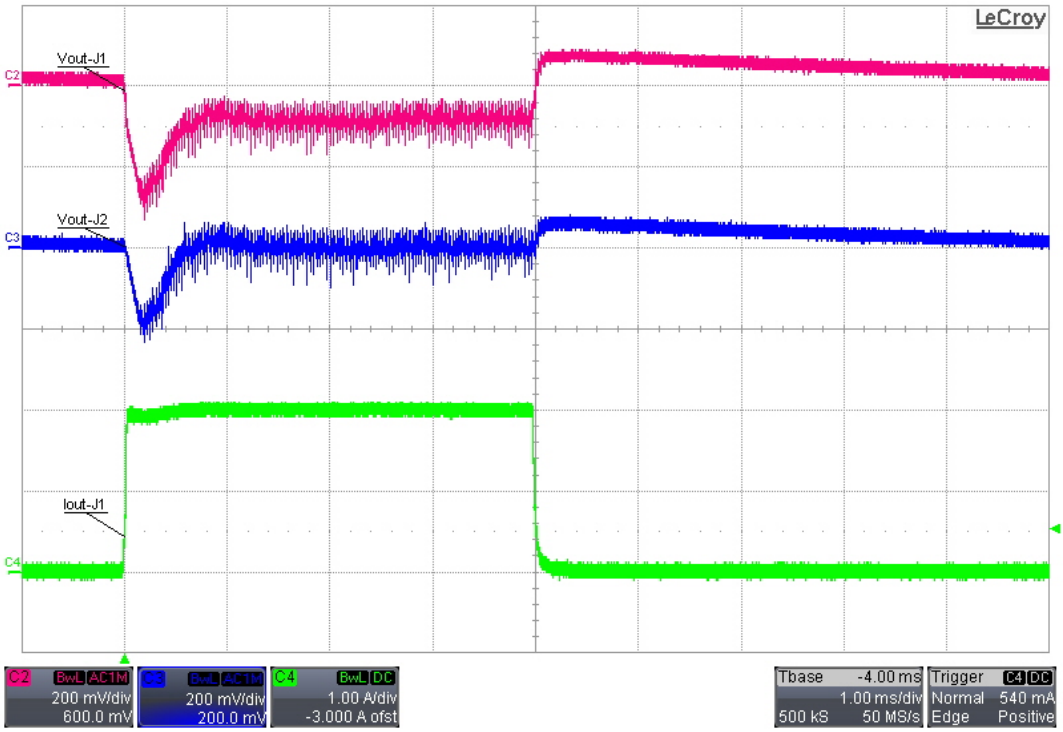


# 10 Load Transients

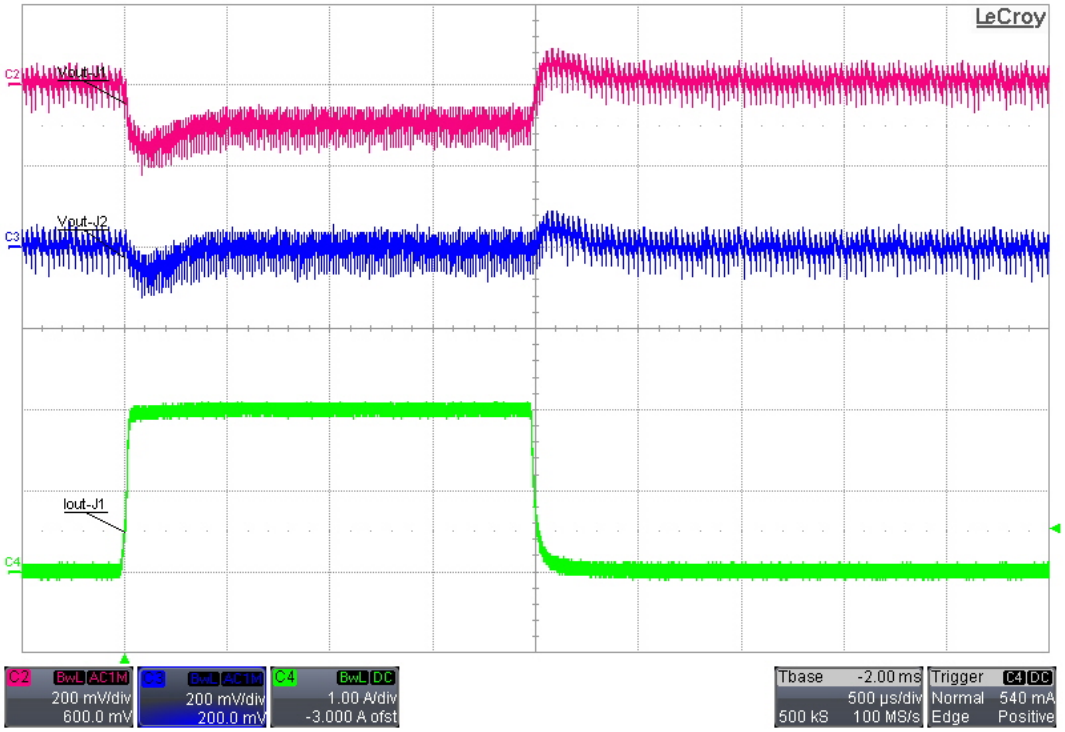
## 10.1 0A on J2; 0A to 2A Transient on J1; 115VAC/60Hz Input



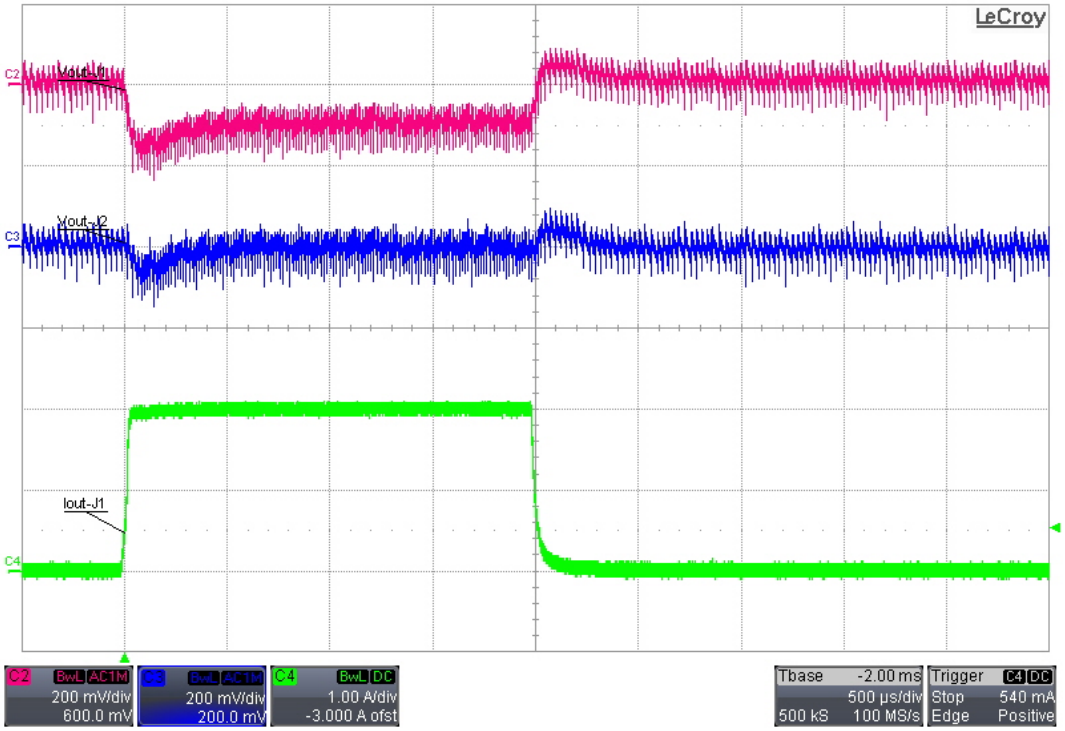

## 10.2 0A on J2; 0A to 2A Transient on J1; 230VAC/50Hz Input



### 10.3 2.5A on J2; 0A to 2A Transient on J1; 115VAC/60Hz Input



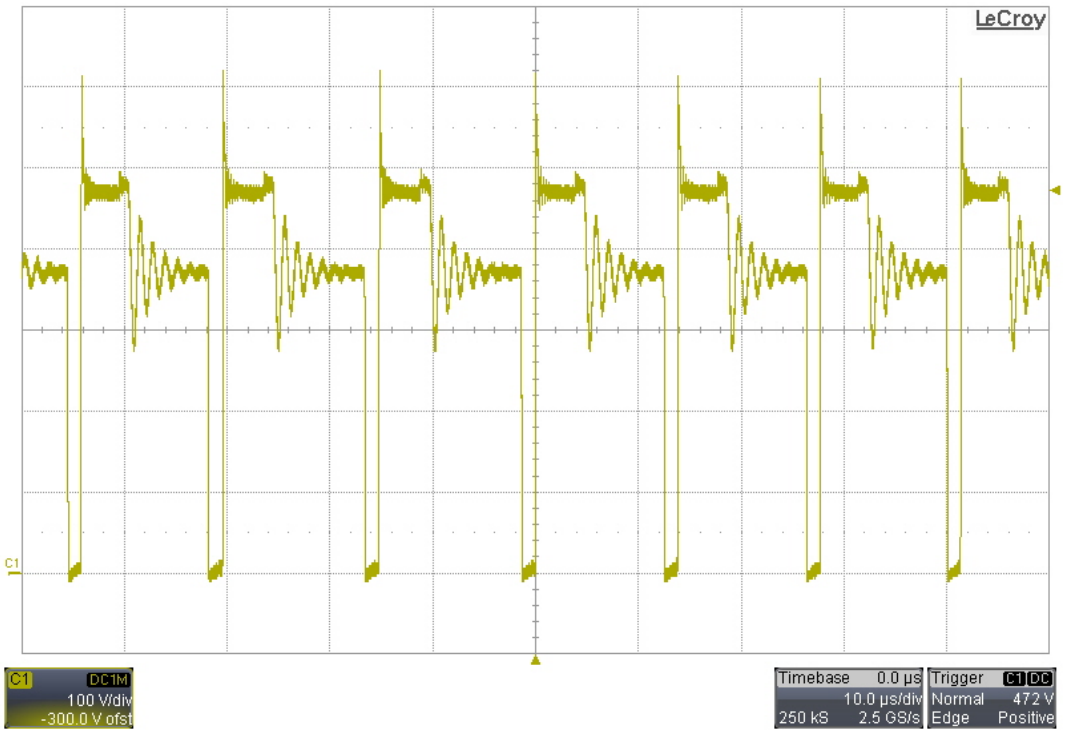

### 10.4 2.5A on J2; 0A to 2A Transient on J1; 230VAC/50Hz Input



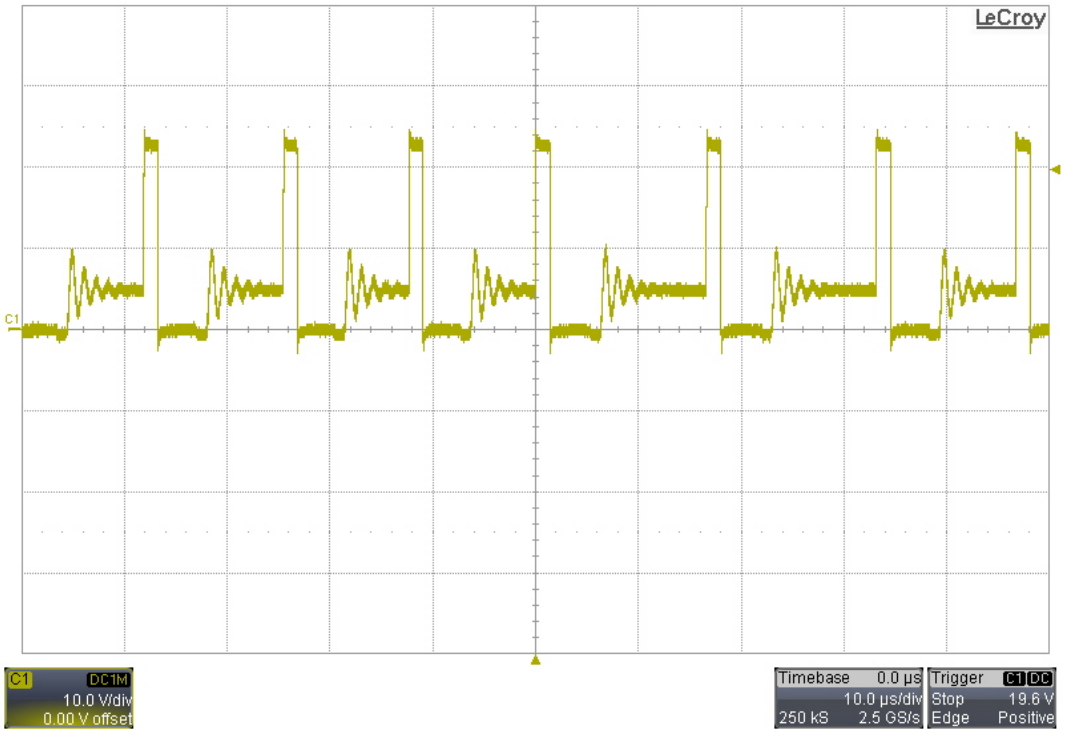
# 11 Switching Waveforms

The input was 265VAC/50Hz, and each port was loaded with 2.5A.

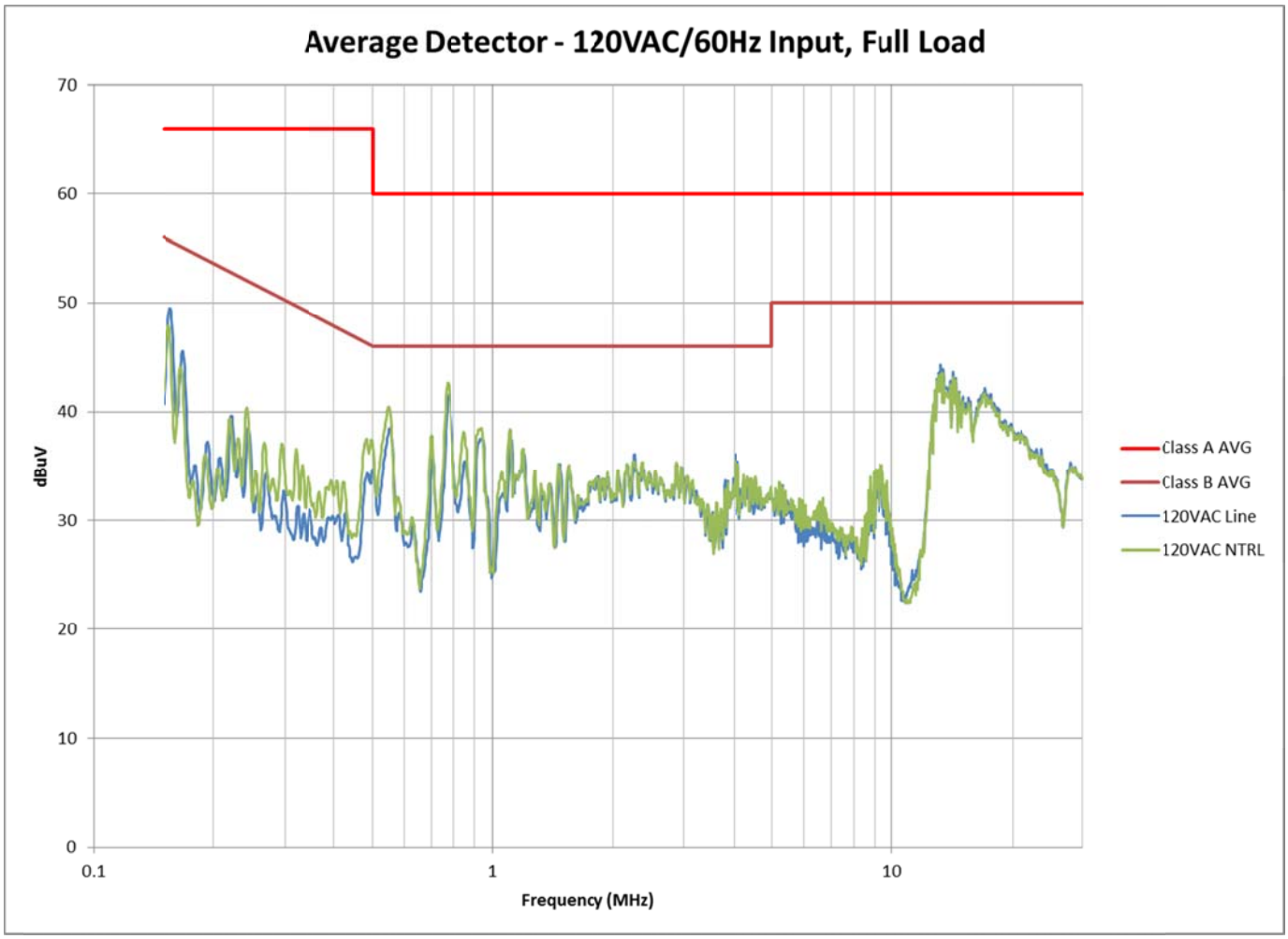
## *11.1 Drain of Primary FET – Q1*

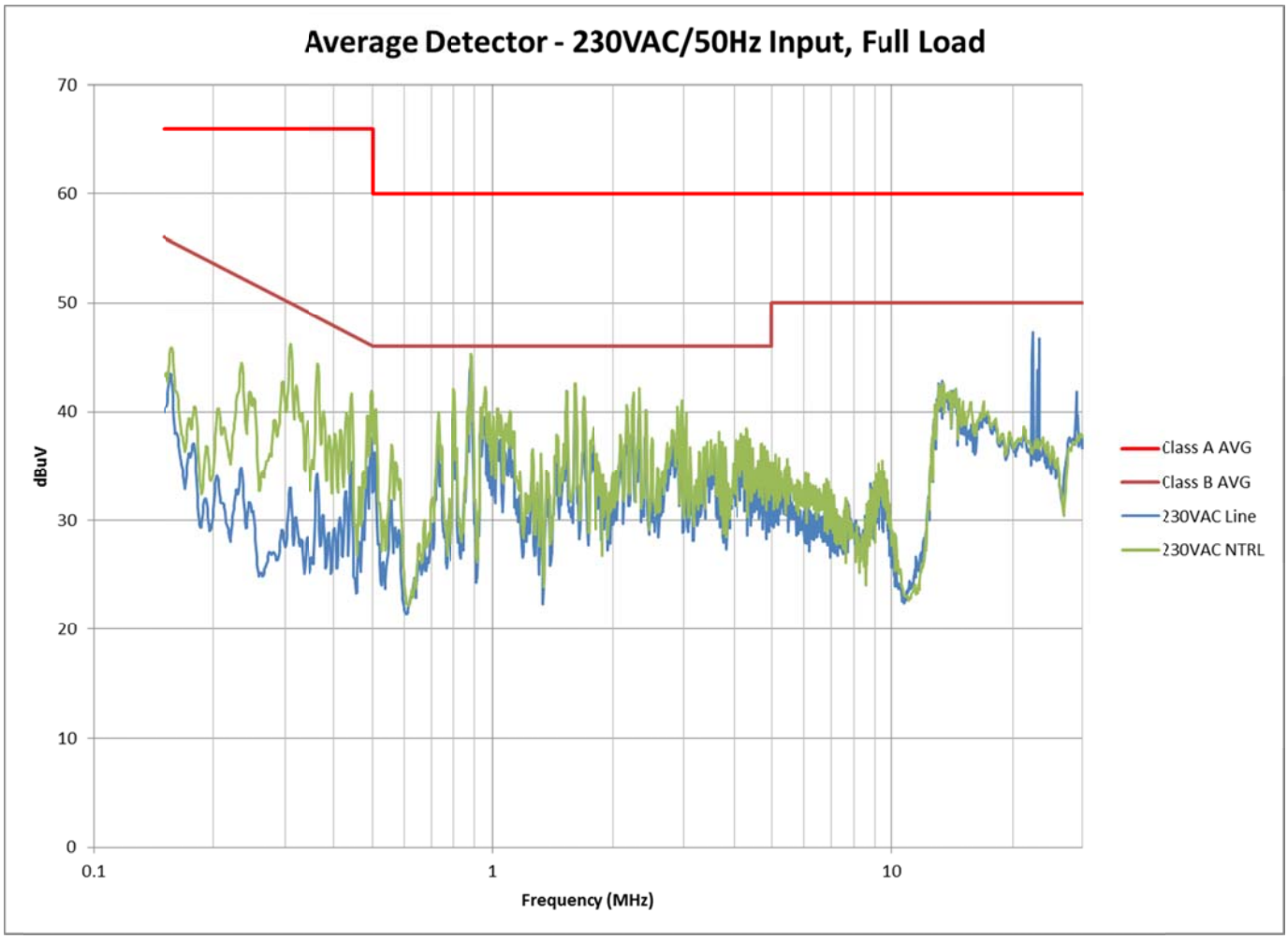



## *11.2 Drain of Sync FET – Q2*



## 12 Conducted Emissions




Average Detector - 230VAC/50Hz Input, Full Load
70
60
50
40
30
20
10
0
dBuV
0.1
1
10
Frequency (MHz)
Class A AVG
Class B AVG
230VAC Line
230VAC NTRL

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