Table on contents: Pages 1-4: 5V 2.5A off 7-42Vin TPS40200

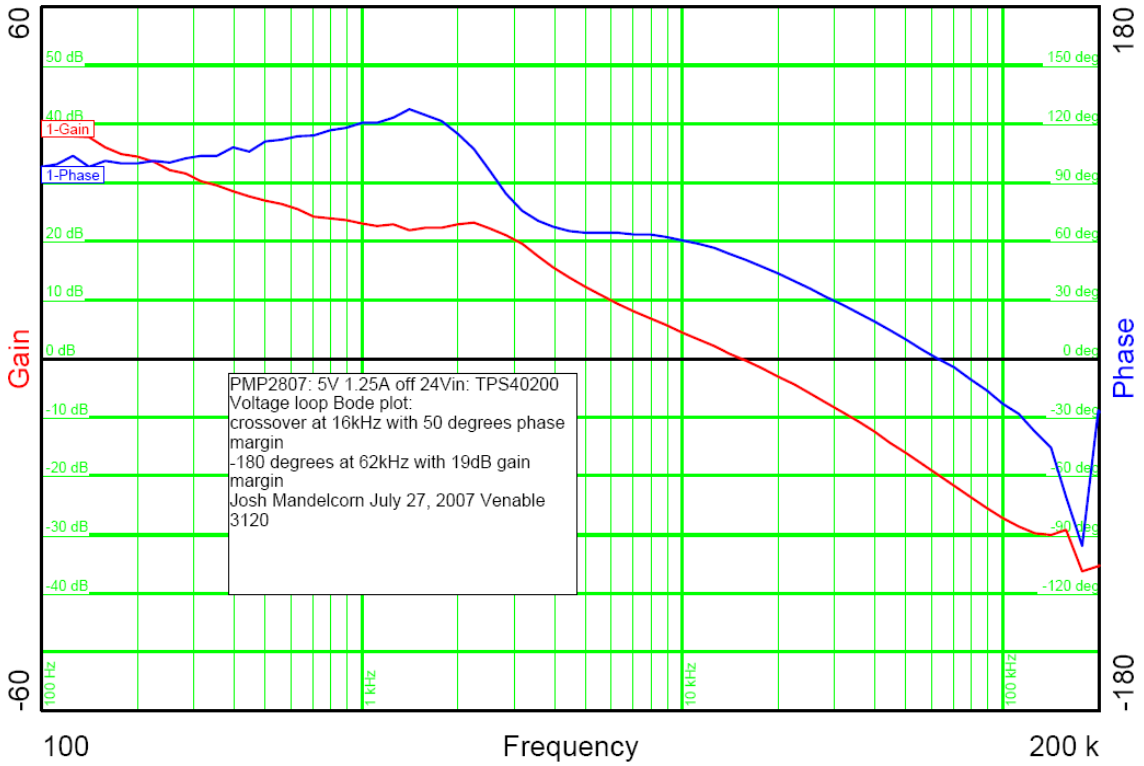
5V Regulation and efficiency: 5mA drawn by downstream added to I load

Vin Volts	Iin A	Vout Volts	Iout A	Efficiency %
7.00	2.029	5.02	2.523	89.2
11.99	1.210	5.01	2.523	87.1
24.01	0.6185	5.01	2.523	85.1
36.02	0.419	5.00	2.523	83.6
42.0	0.362	5.00	2.523	83.0
6.96	1.491	5.02	1.887	91.3
12.01	0.888	5.01	1.887	88.6
23.97	0.458	5.01	1.887	86.1
42.0	0.2695	5.00	1.887	83.4
6.98	0.970	5.02	1.254	93.0
11.93	0.5855	5.01	1.254	89.9
24.06	0.302	5.01	1.255	86.5
36.09	0.207	5.00	1.255	84.0
42.1	0.180	5.00	1.255	82.8
6.97	0.479	5.02	0.627	94.3
12.02	0.2879	5.01	0.627	90.8
42.0	0.0922	5.00	0.627	81.0
7.01	0.1873	5.02	0.246	94.1
12.01	0.1168	5.01	0.246	87.9
23.90	0.0643	5.01	0.246	80.2
41.9	0.04038	5.00	0.246	72.7
6.96	0.0078	5.02	0.005	46.2
12.03	0.0065	5.01	0.005	32.0
24.02	0.00569	5.00	0.005	18.3
36.07	0.00458	5.00	0.005	15.1
42.0	0.00442	5.00	0.005	13.5

5V 2.5A off 7-42Vin TPS40200 (continued)

Temperatures in degrees Celsius: Ambient in all cases 24-25 degrees C:
Measurements with IR scanner, except thermocouple pressed on Q1
07Vin 2.5Aout: Q1 =55; D1=47; L1=50; U1=??: 191kHz
12Vin 2.5Aout: Q1 =48; D1=55; L1=52; U1=??: 184.5kHz
24Vin 2.5Aout: Q1 =55; D1=64; L1=55; U1=42: 180.3kHz
36Vin 2.5Aout: Q1 =56; D1=67; L1=57; U1=45: 177.8kHz
42Vin 2.5Aout: Q1 =63.5; D1=67; L1=59; U1=48: 176.8kHz

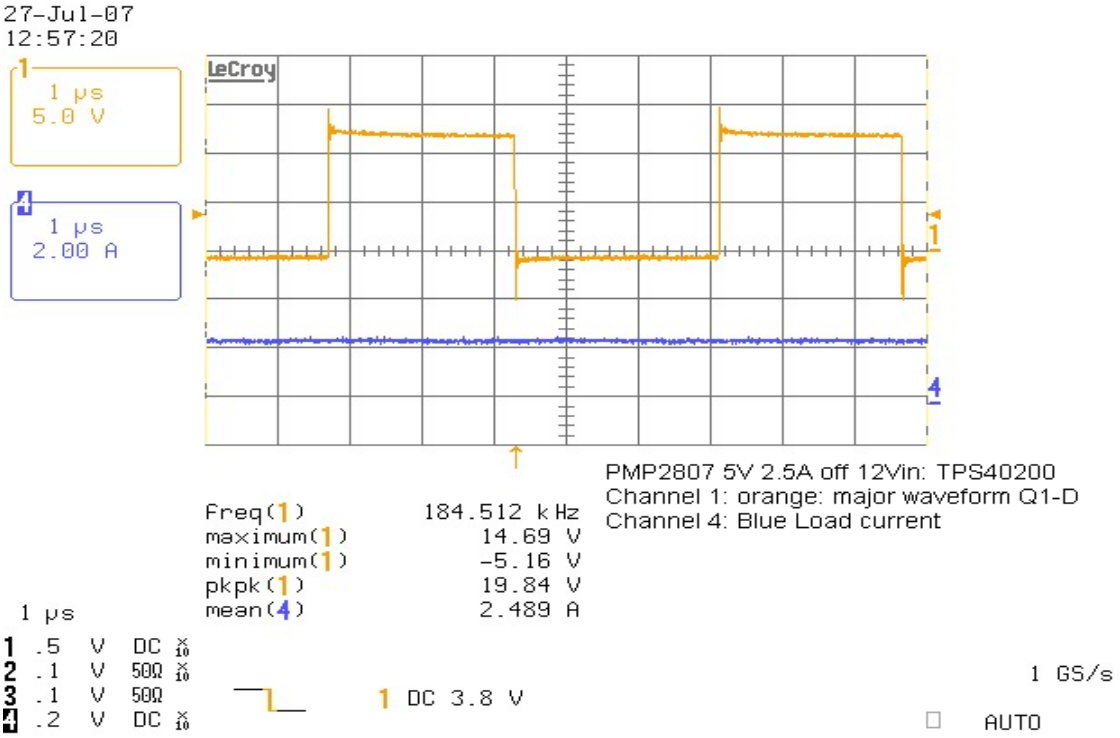
Bode Plots at ½ load:



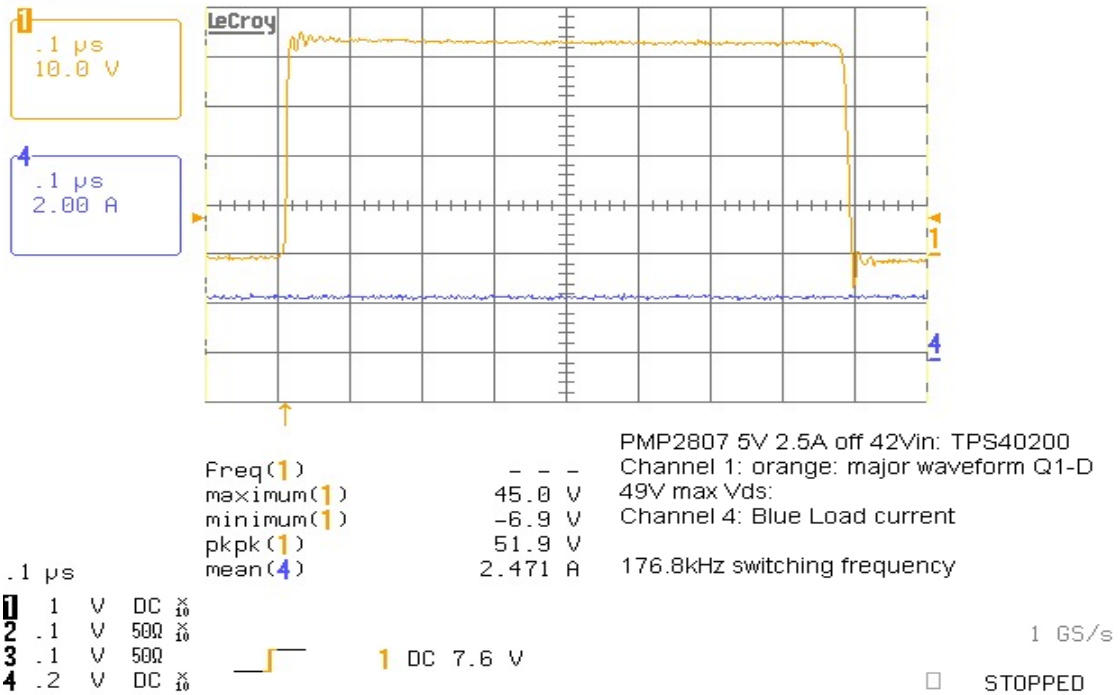
Qq

5V 2.5A off 7-42Vin TPS40200 (continued)

Main waveform: 12Vin



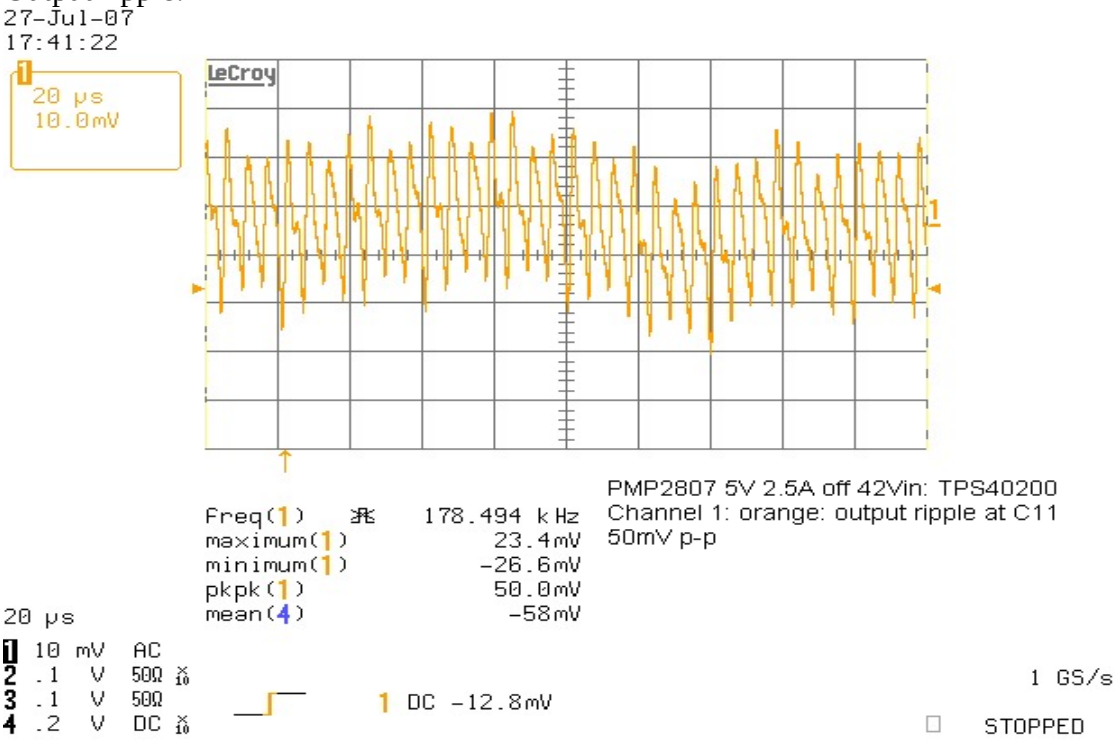
Main waveform: 42Vin:



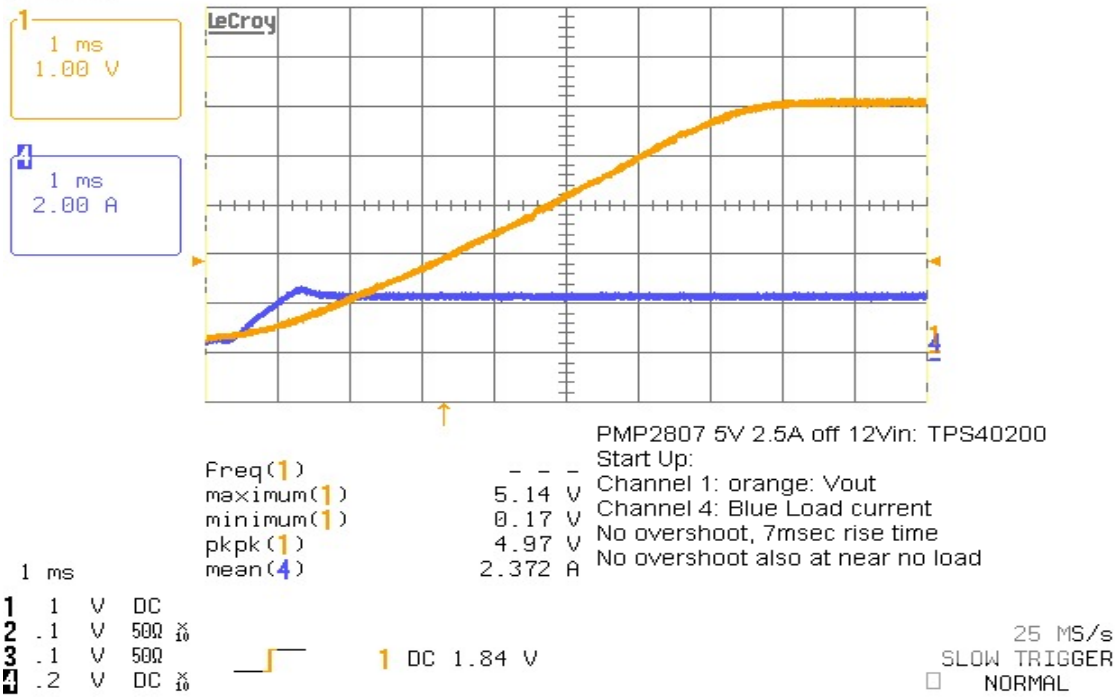
Qq

5V 2.5A off 7-42Vin TPS40200 (continued)

Output ripple:



Start Up:



3.3Vout off 4.4Vin: 1 Ampere switcher: TPS64203

Regulation, efficiency and ripple:

Vin Volts	Iin mA	Vout Volts	Iout mA	Efficiency %	Pp mV ripple	Freq. kHz
4.50	836	3.255	1006	87.0	75	272
4.40	854.5	3.255	1006	87.1	72	254
4.20	897	3.254	1006	86.9	~70	195
4.00	942	3.255	1006	86.9	~70	122
3.80	994	3.267	1006	87.0	~70	~50
3.758	1005	3.273	1006	87.2	68	burps
3.70	1008	3.234	1006	87.2	DC	zero
3.501	1008	2.979	1006	84.9	DC	zero
4.50	610	3.255	748	88.7	80	302
4.40	622	3.255	748	89.0	76	282
4.00	681	3.254	748	89.4	72	174
3.627	747.5	3.272	748	90.3	<70	burps
3.501	750	3.156	748	89.9	0	zero
4.50	405	3.256	501	89.5	85	323
4.38	414	3.256	501	90.0	77	301
4.006	448	3.254	501	90.8	75	210
3.497	503	3.276	501	93.3	50	Burps 3
4.49	200.7	3.268	251.7	91.3	53	465
4.40	205	3.267	251	90.9	51	443
4.01	220.6	3.264	251.6	92.8	52	335
3.499	246.6	3.266	251.6	95.2	42	100
4.50	84.8	3.281	105.3	90.5	37	520
4.40	86.2	3.280	105.3	91.1	40	522
4.002	92.8	3.273	105.3	92.8	32	464
3.505	102.3	3.272	105.3	96.1	26	240
4.40	38.7	3.284	46.7	90.1	35	310
4.50	0.38	3.292	0		32	pulsing
4.40	0.37	3.292	0		30	pulsing
4.02	0.39	3.292	0		22	pulsing
3.501	0.42	3.2915	0		12	??

3.3Vout off 4.4Vin: 1 Ampere switcher: TPS64203 (continued):

Note: Regulator is hysteretic with frequency varying with load and input voltage. Due to on resistance of switch (On Semi NTR4502P), an input of at least 3.76V is needed to achieve regulation of 3.26V on output at full 1.0A load. At ¾ load, 3.63V input is needed and at ½ load 3.5V is enough. At the point of just reaching regulation, the main switch starts to “burp” off, but overall ripple is not greater than when input is at full 4.4V.

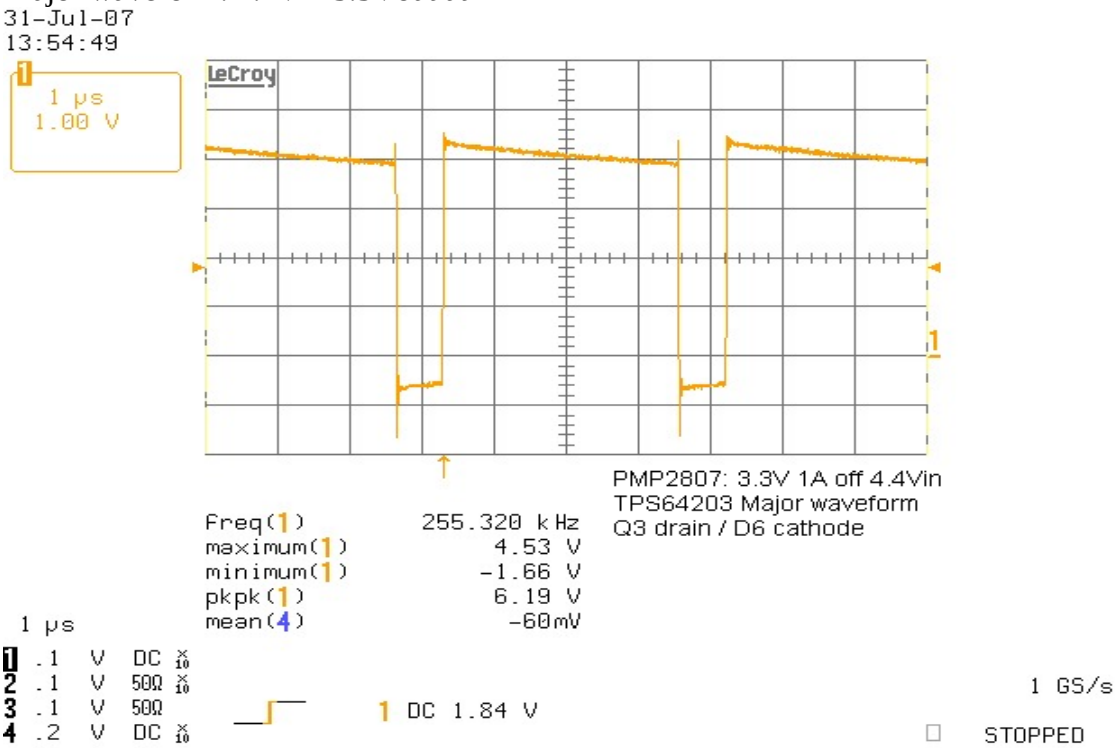
If regulation of 3.3V at 1.0A is needed when operating off battery only, then a lower Rds FET will be needed for the 3.3V. If only 500mA needed, then existing FET is OK.

Thermal:

At 4.4Vin and full 1.0A load: All temperatures in degrees Celsius:
Ambient = 25; L3=36; Q3=41: U4=31; no noticeable rise on D6

Worst case for switch (On Semi NTR4502P) is at 3.5Vin with it on constantly and having a drop of 414mV at 1.0A load and only -3.4V on gate drive. Dissipation is over 400mW and a temperature of 46 degrees C was read on the IR scanner on this part. Due to small size of SOT-23 part may be actually hotter. At higher Vin, and more gate voltage available the Vds drop is less and part is cooler.

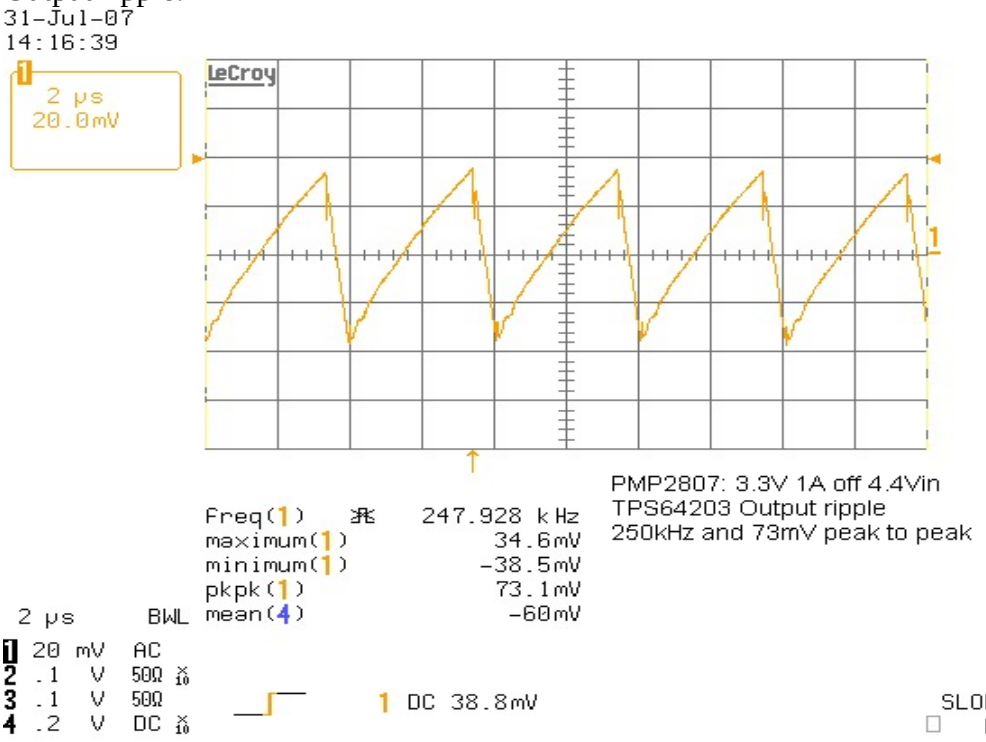
Major waveform: 4.4Vin 3.3Vout at 1A



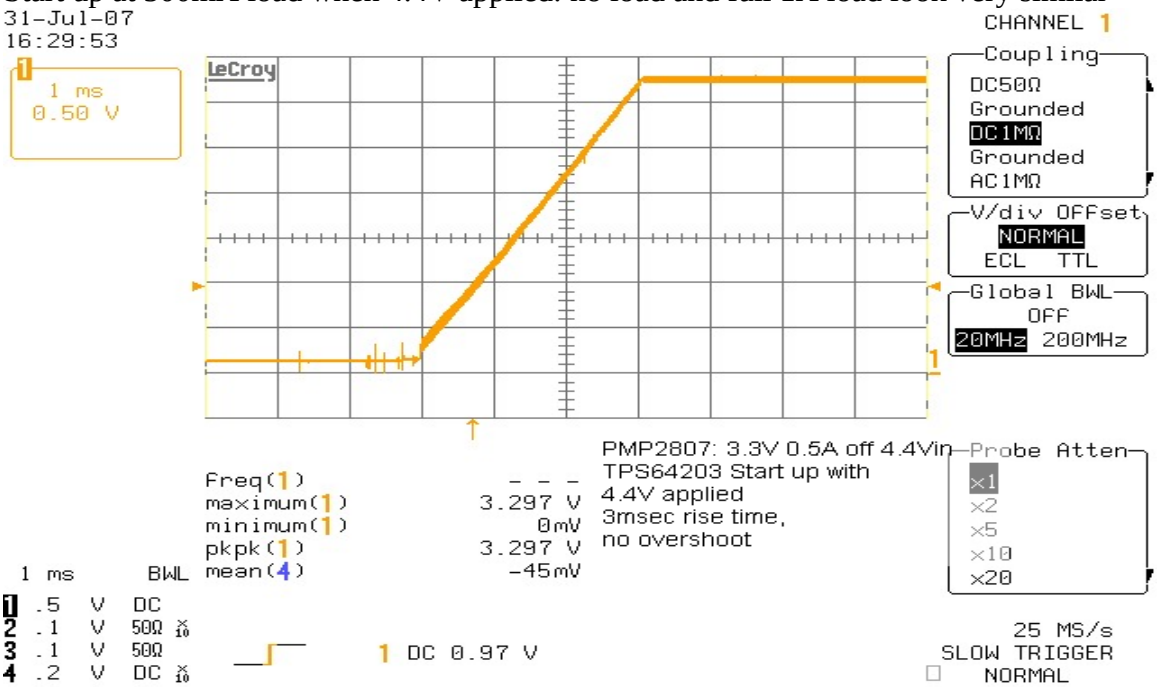
Qq

3.3Vout off 4.4Vin: 1 Ampere switcher: TPS64203 (continued):

Output ripple:



Start up at 500mA load when 4.4V applied: no load and full 1A load look very similar



qq

1.8V switcher off 3.5-4.4Vin: TPS64203

Regulation, efficiency and ripple:

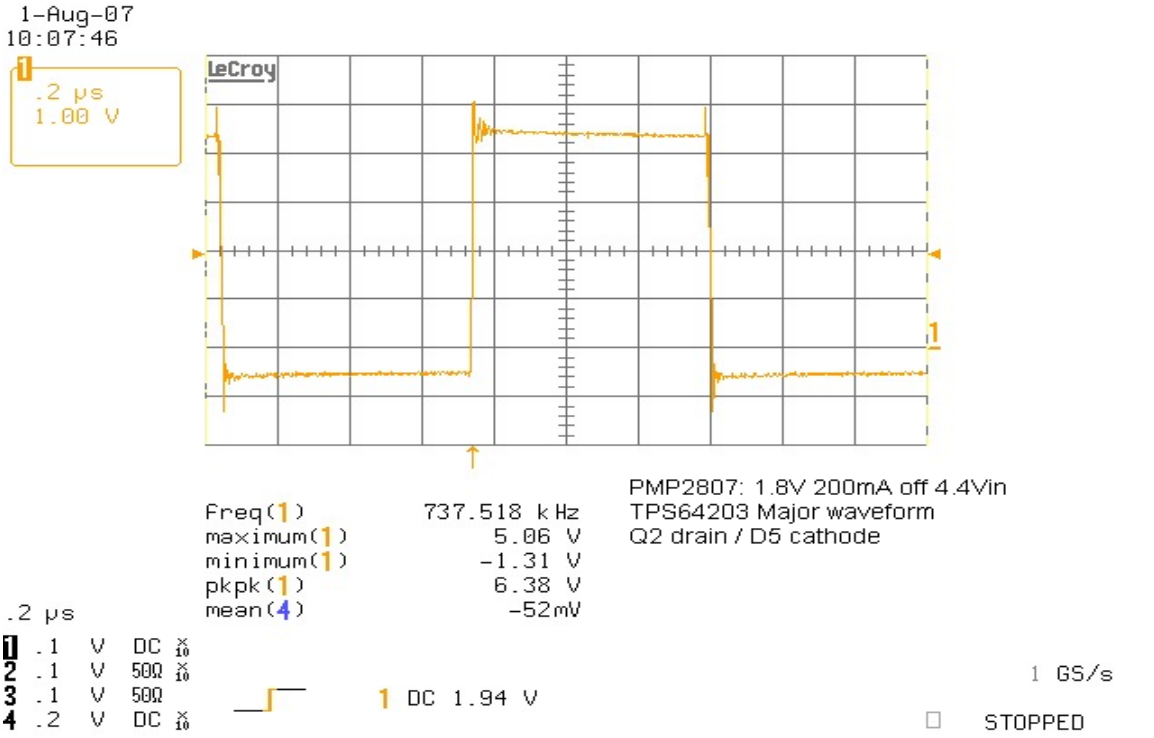
Vin Volts	Iin mA	Vout Volts	Iout mA	Efficiency %	Pp mV ripple	Freq. kHz
4.50	100.2	1.825	201.1	81.4	36	722
4.40	102.3	1.825	201.2	81.6	35	735
4.00	111.5	1.825	201.1	82.3	30	764
3.499	125.7	1.822	201.3	83.4	28	707
4.41	72.7	1.825	142.9	81.3	35	727
3.498	88.7	1.823	142.9	84.0	28	720
4.40	54.3	1.826	105.8	80.9	35	720
3.494	65.8	1.823	105.7	83.8	27	725
4.41	25.47	1.835	47.3	77.3	37	551
3.498	30.62	1.824	47.2	80.4	27	738
4.40	11.05	1.838	20.0	75.6	37	230
3.498	13.34	1.832	19.9	78.1	25	450
4.50	0.37	1.834	0		42	0.104
4.40	0.37	1.834	0		41	0.110
3.499	0.41	1.833	0		28	0.203

Conversion efficiency from 4.4V is 81.6% at full load. This is better than having a linear regulator of 1.8V off 3.3V. There the efficiency is 1.8V/3.3V times the 87% efficiency of the 3.3V off 4.4V or 47.5%. This translates into 317mW savings in terms of power off 4.4V.

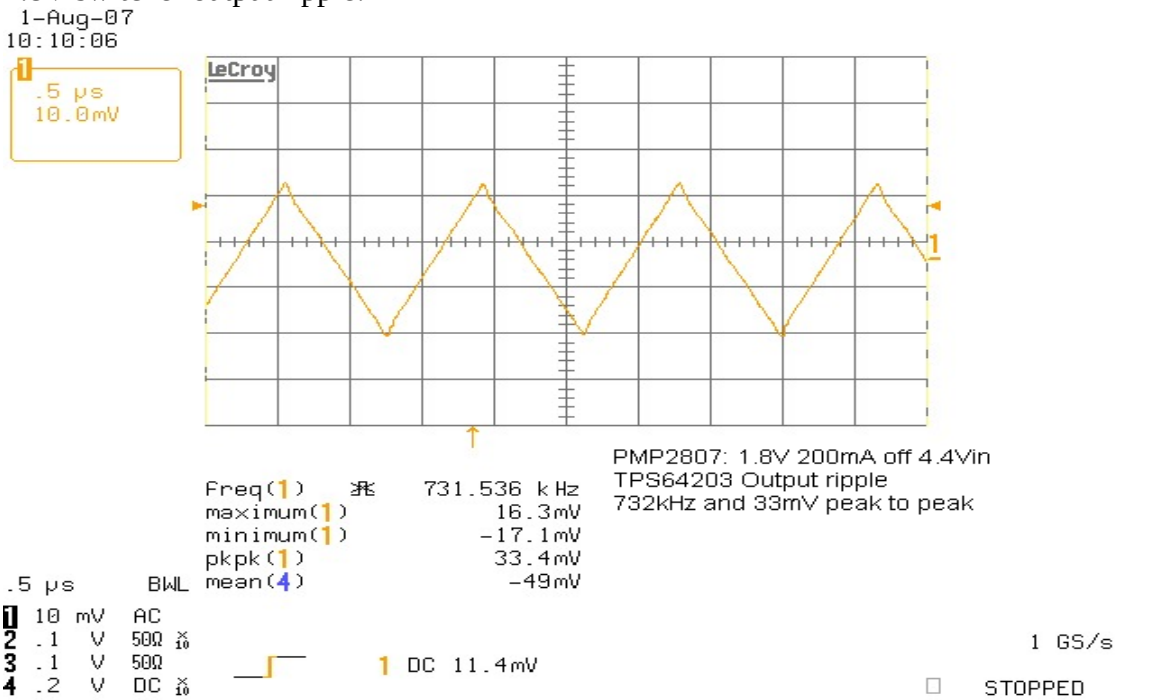
No significant temperature rise was seen at full load and 4.5V input. Less than 3 degrees Celsius rise was seen with IR scanner.

1.8V switcher off 3.5-4.4Vin: TPS64203 continued:

1.8V switcher main waveform:



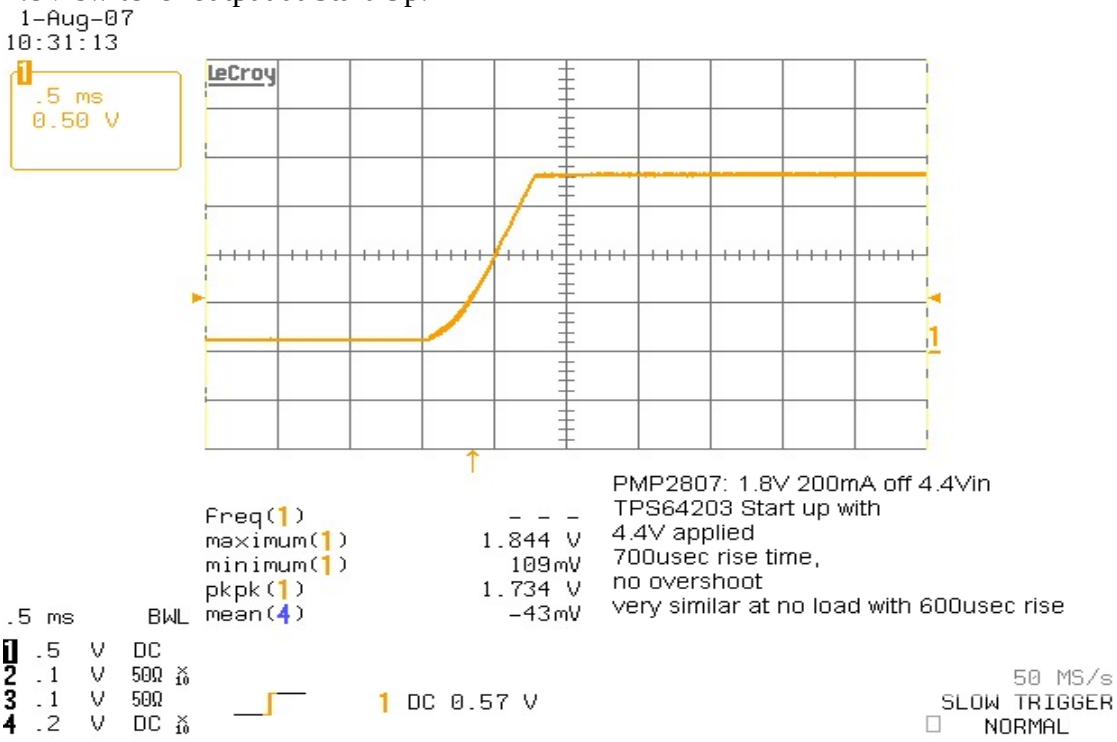
1.8V switcher output ripple:



Qq

1.8V switcher off 3.5-4.4Vin: TPS64203 continued:

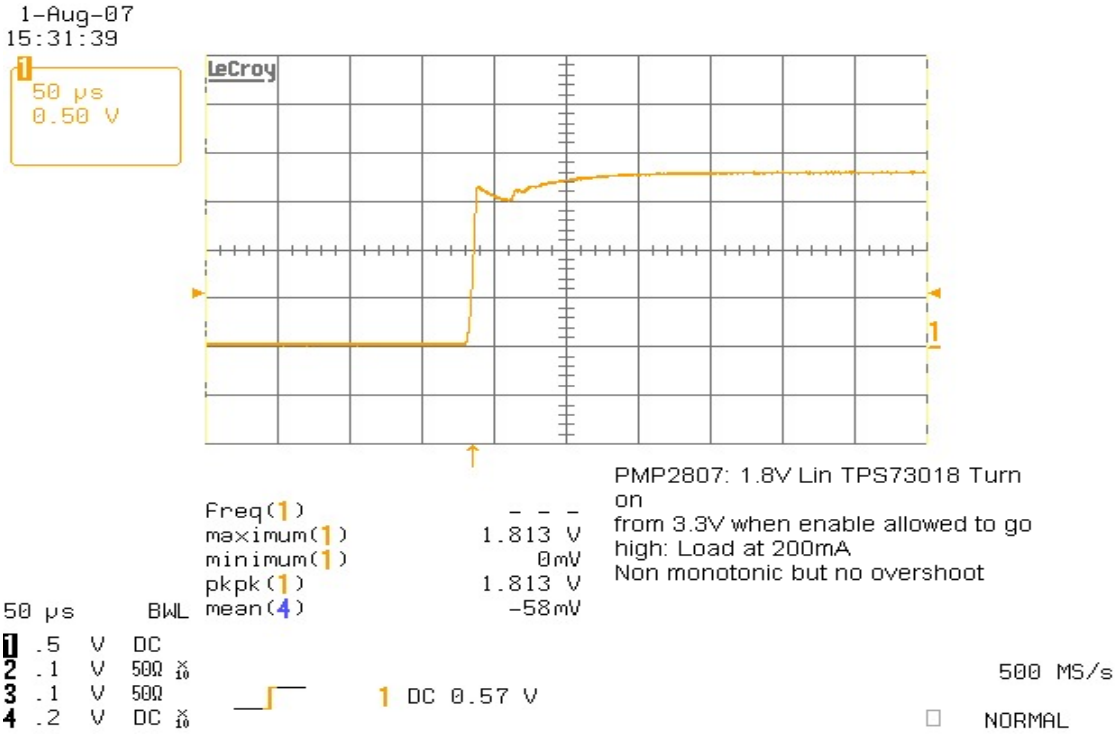
1.8V switcher output at Start Up:



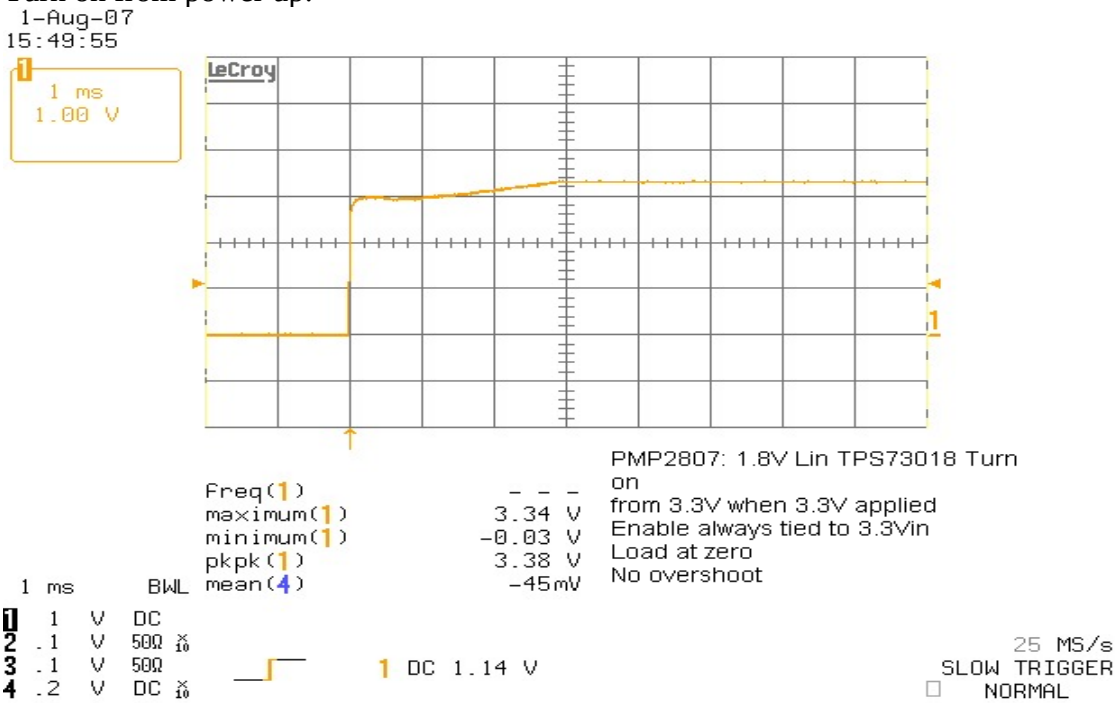
Qq

1.8V 200mA linear off 3.3V: TPS73018:

Turn on from enable:



Turn on from power up:

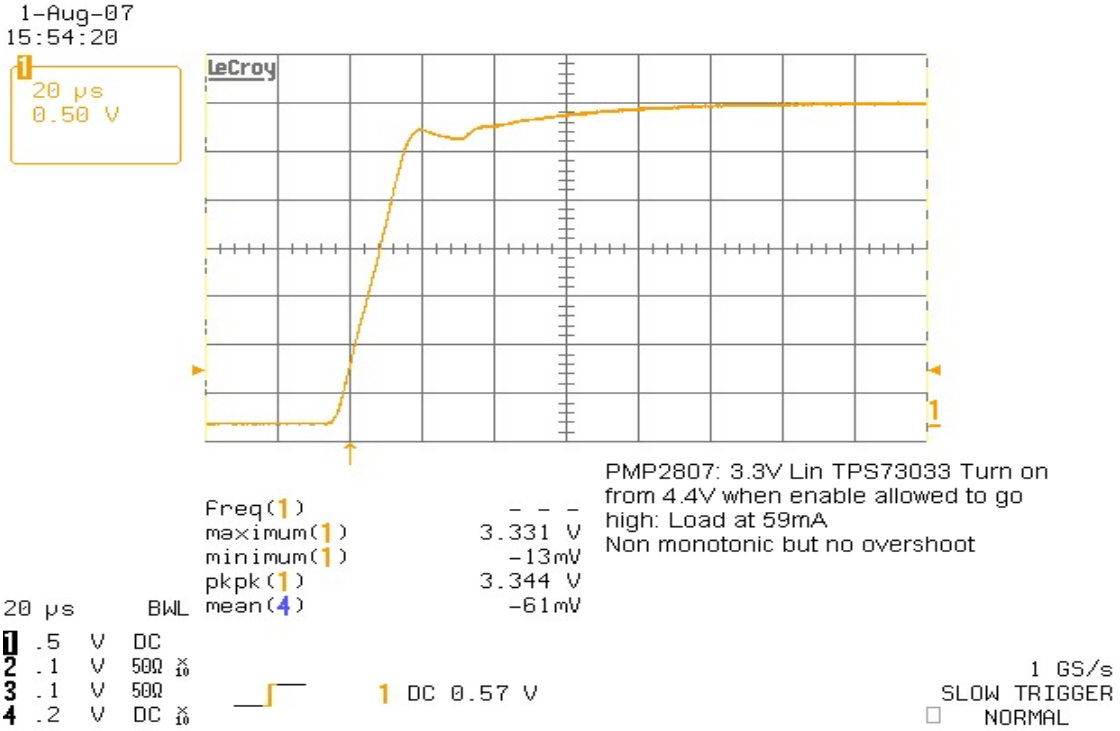


Qq

1.8V 200mA linear TPS73018 off 3.3V: continued:
At 25 degrees C ambient measure 36 degrees C on the TPS73018 at 201.4mA with 298mW internal dissipation.
Load regulation from 1.803V at no load to 1.792V at full 200mA load at 3.27Vin
At full load output drops 1% when input goes below 2.62V

3.3V 50mA linear off 4.4V: TPS73033:

Turn on from enable:



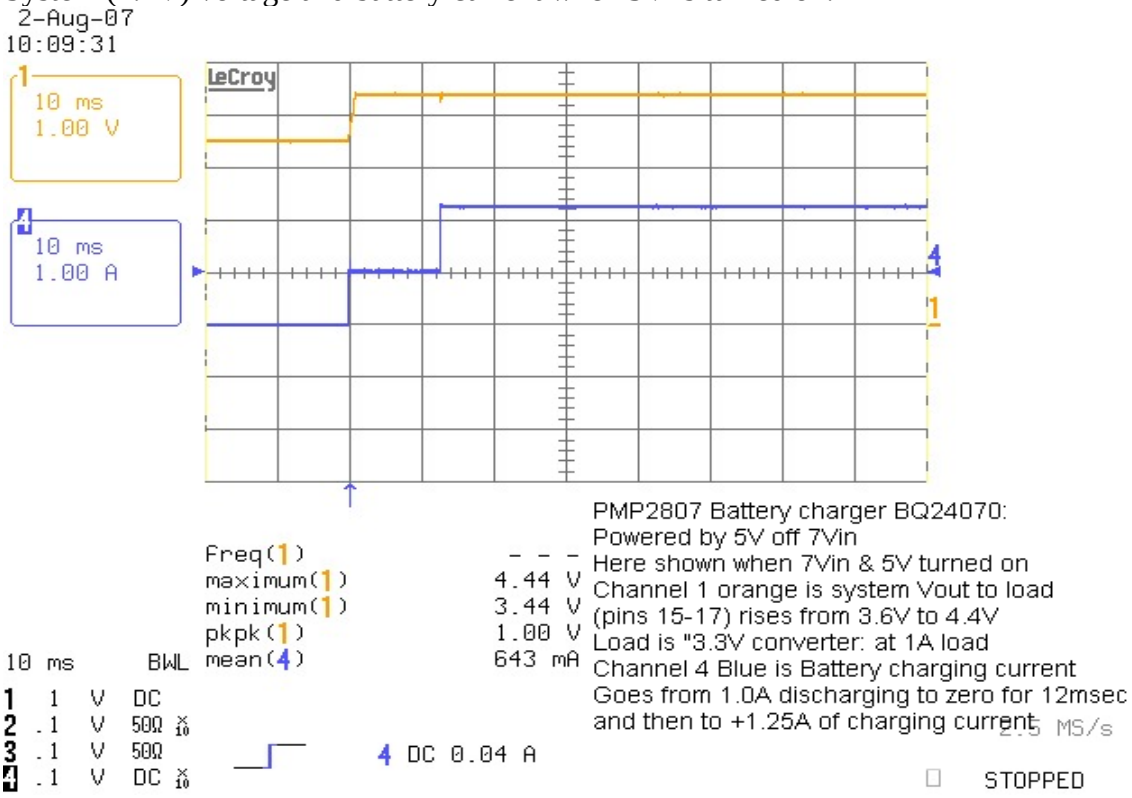
Qq

3.3V 50mA off 4.4V has only 55mW dissipation much less than 1.8V 200mA above:
Output regulation varies from 3.301V at no load to 3.297V at full load 58mA with 4.4Vin.
Drop out at 58mA load: When Vin = 3.322V Vout = 3.288V

Battery charging and backup with BQ24070:
Temp rise during charging: 5.02V into BQ24070, 4.03V at 1.243A to Battery;
854mA at 4.40V to system: Ambient 24 degrees C, BQ24070 at 64 degrees C.
When only Battery present and no 5V: 1.00A load off battery: Vbattery = 3.565V and Vsystem to load = 3.515V and 3.006V to the 3.3V at 1.00A.

Verified Power Good D4 is on whenever input 5V is available.
With Battery removed, the Alarm D3 (stat2) is on and green D2 blips every few seconds.
With Battery in and charging green D2 (stat1) is on.
When Battery fully charged and 5V still present, only power good D4 is on. Battery current is zero and 4.39V is delivered to system.

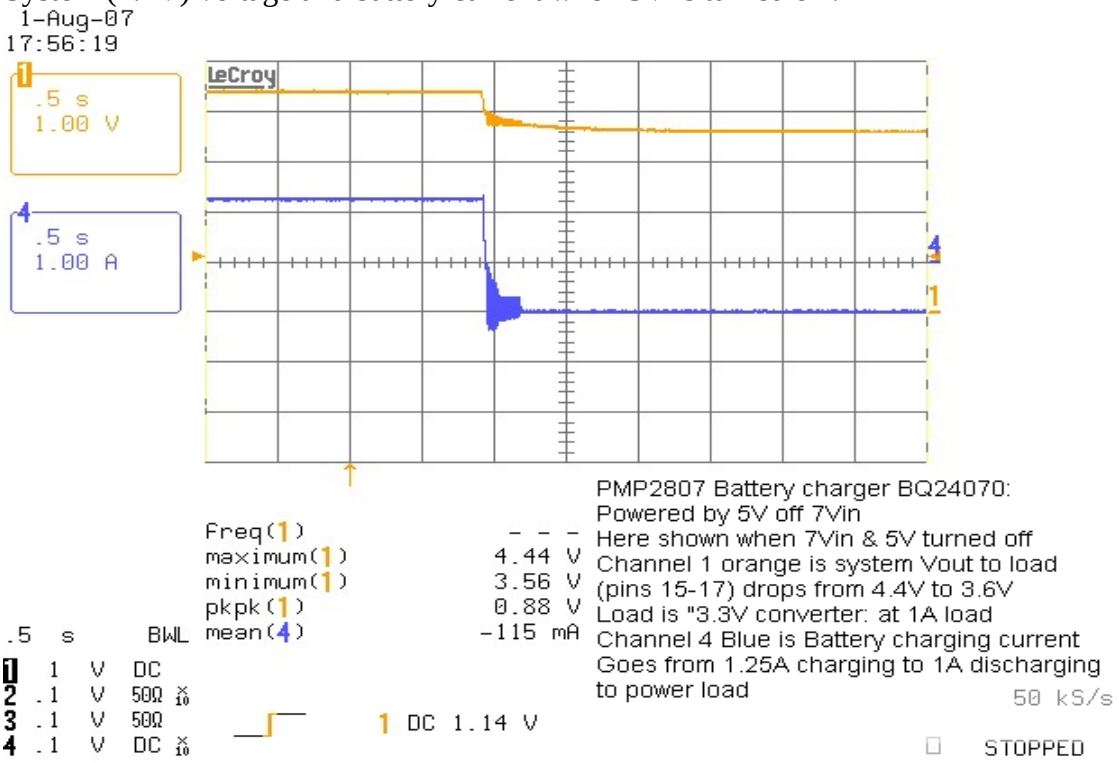
System (4.4V) voltage and battery current when 5V is turned on:



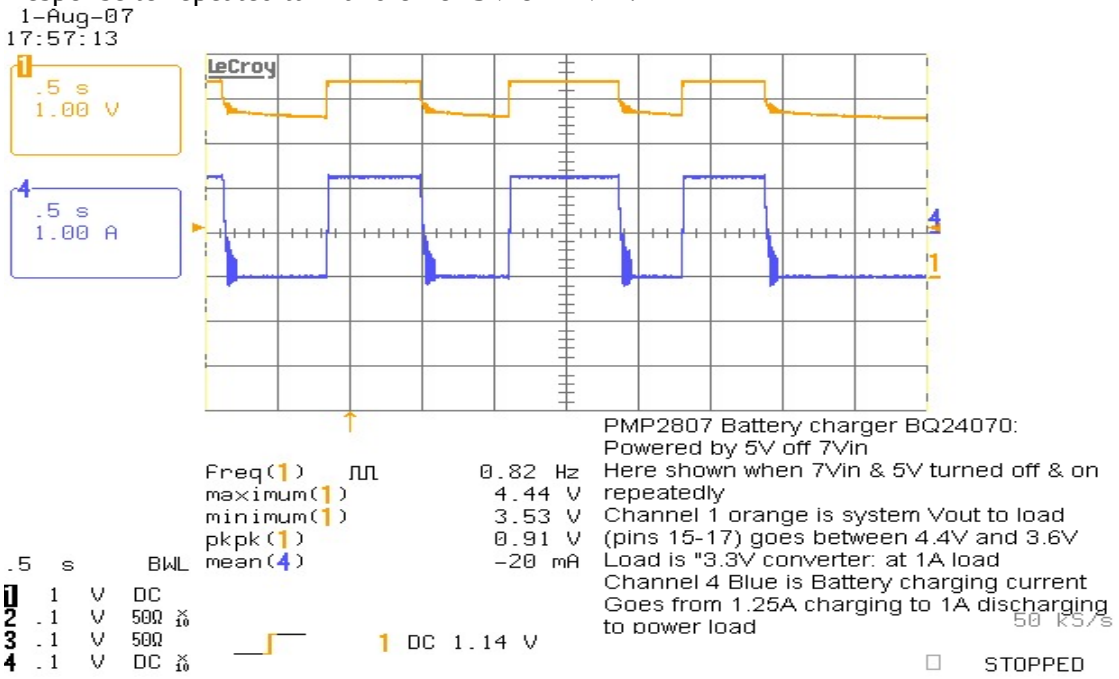
Qq

Battery charging and backup with BQ24070 continued:

System (4.4V) voltage and battery current when 5V is turned off:



Response to repeated turn and on of 5V off 7Vin:



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