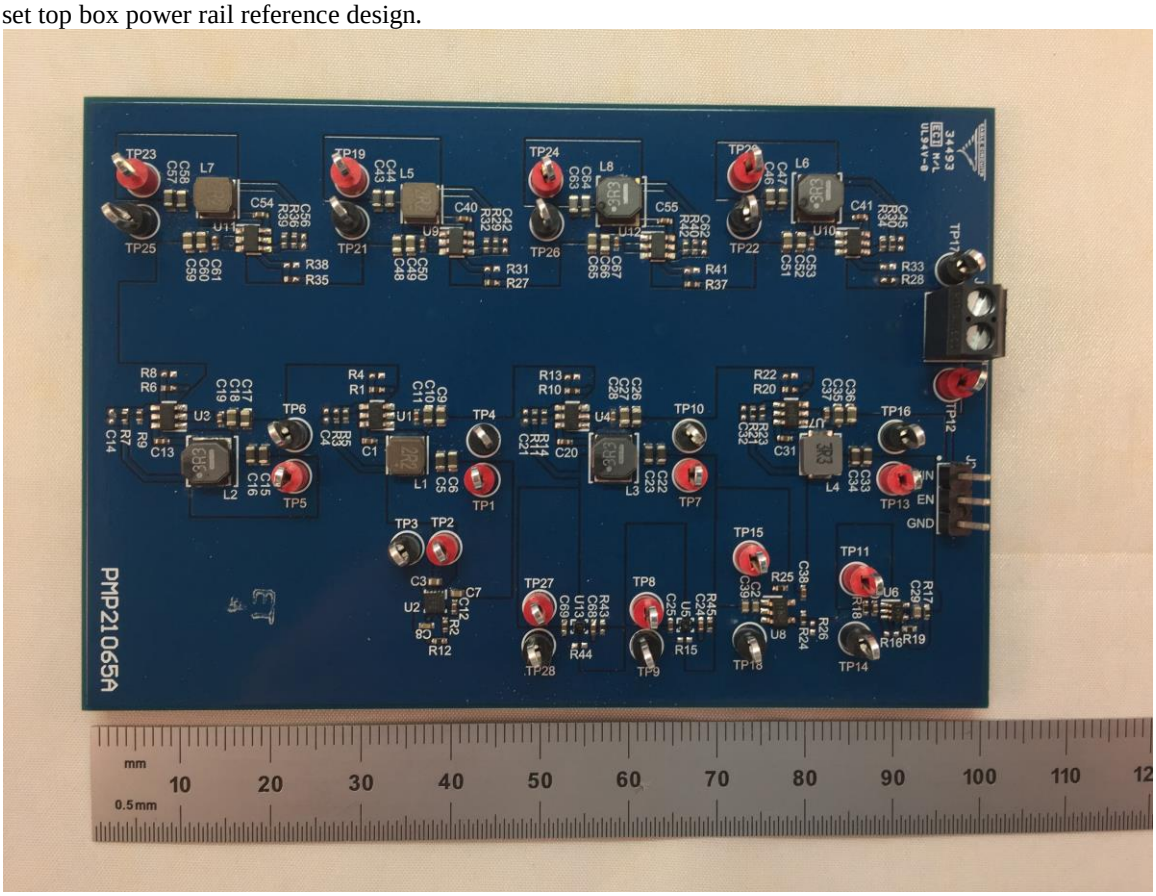
1 Board Photo

The image below shows PMP21065. It takes a 12V DC input and has multiple output rails. The PMP is a set top box power rail reference design.



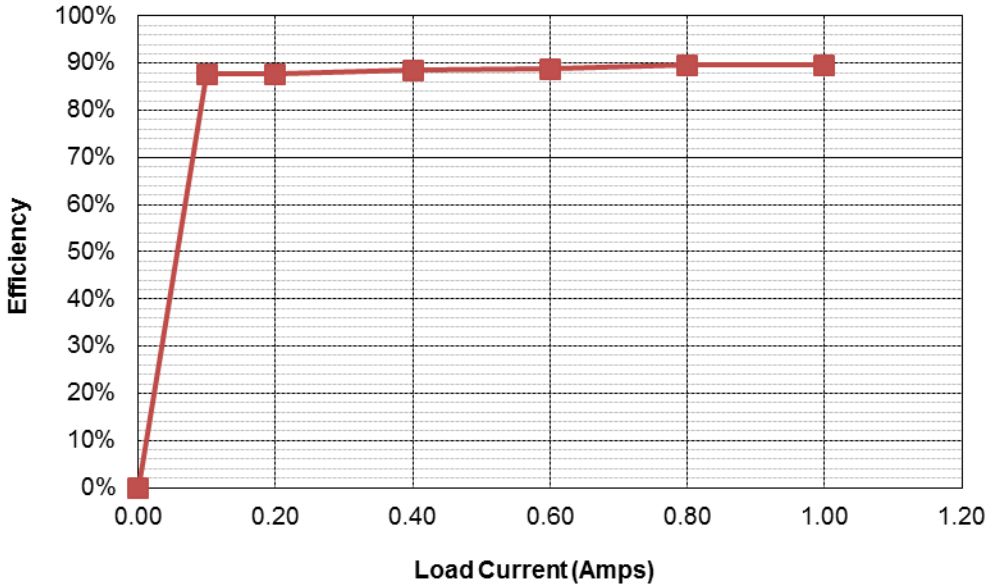
2 Standby Power

Vin	Standby Power
12V	108mW

3 Efficiency

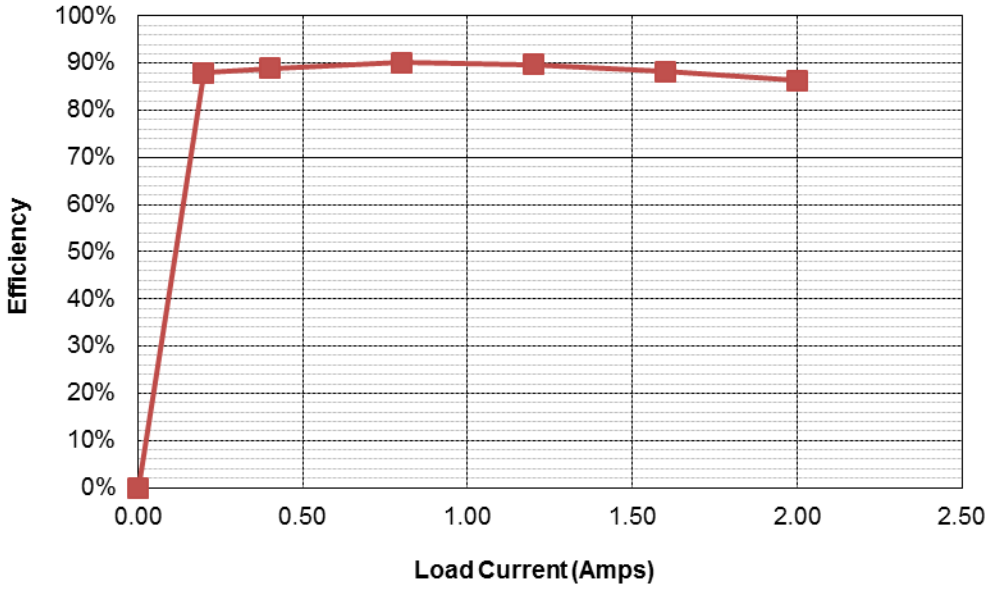
All the below efficiency tests were taken with a nominal 12V input. Each of the rails were independently loaded.

3.1 U10: WiFi 3.3Vout



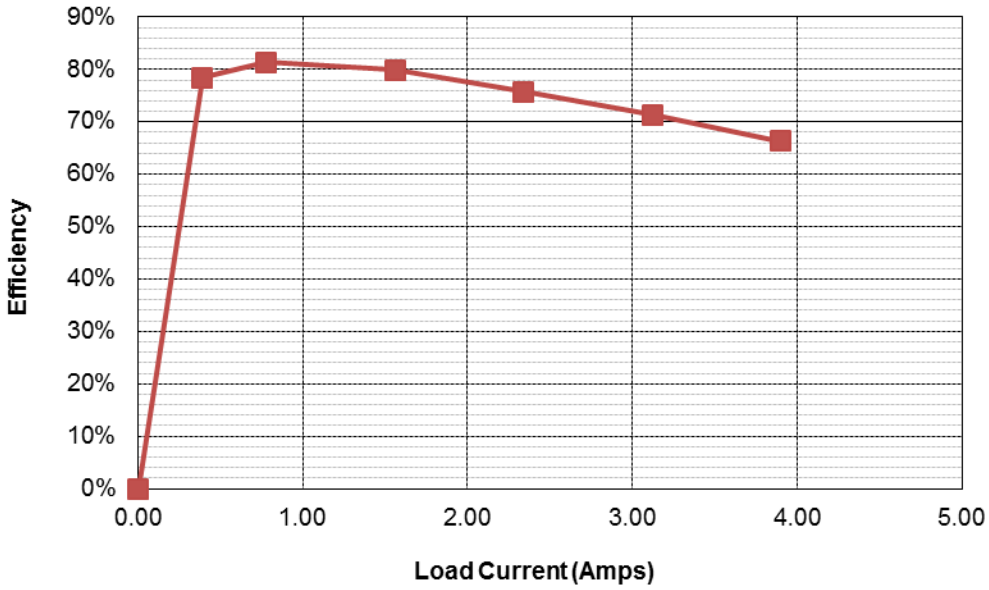
Iout	Vout	Vin	Iin	Pin	Pout	Losses	Efficiency
0.000	3.365	12.0	0.00800	0.0960	0.00	0.10	0.0%
0.100	3.365	12.0	0.0320	0.3840	0.34	0.05	87.6%
0.200	3.365	12.0	0.064	0.7680	0.67	0.10	87.6%
0.400	3.345	12.0	0.126	1.5120	1.34	0.17	88.5%
0.600	3.340	12.0	0.188	2.2560	2.00	0.25	88.8%
0.800	3.332	12.0	0.248	2.9760	2.67	0.31	89.6%
1.000	3.324	12.0	0.309	3.7080	3.32	0.38	89.6%

3.2 U12: Bluetooth 3.3Vout



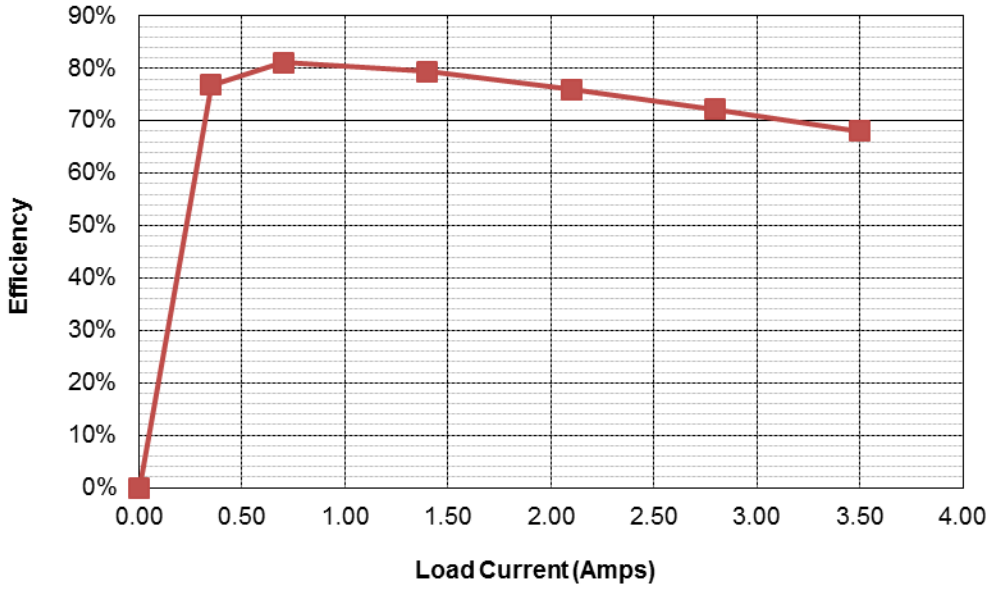
Iout	Vout	Vin	Iin	Pin	Pout	Losses	Efficiency
0.000	3.377	12.0	0.00800	0.0960	0.00	0.10	0.0%
0.200	3.378	12.0	0.0640	0.7680	0.68	0.09	88.0%
0.400	3.362	12.0	0.126	1.5120	1.34	0.17	88.9%
0.800	3.352	12.0	0.248	2.9760	2.68	0.29	90.1%
1.200	3.338	12.0	0.372	4.4640	4.01	0.46	89.7%
1.600	3.323	12.0	0.502	6.0240	5.32	0.71	88.3%
2.000	3.307	12.0	0.638	7.6560	6.61	1.04	86.4%

3.3 U9: Core 1 CPU 0.95Vout



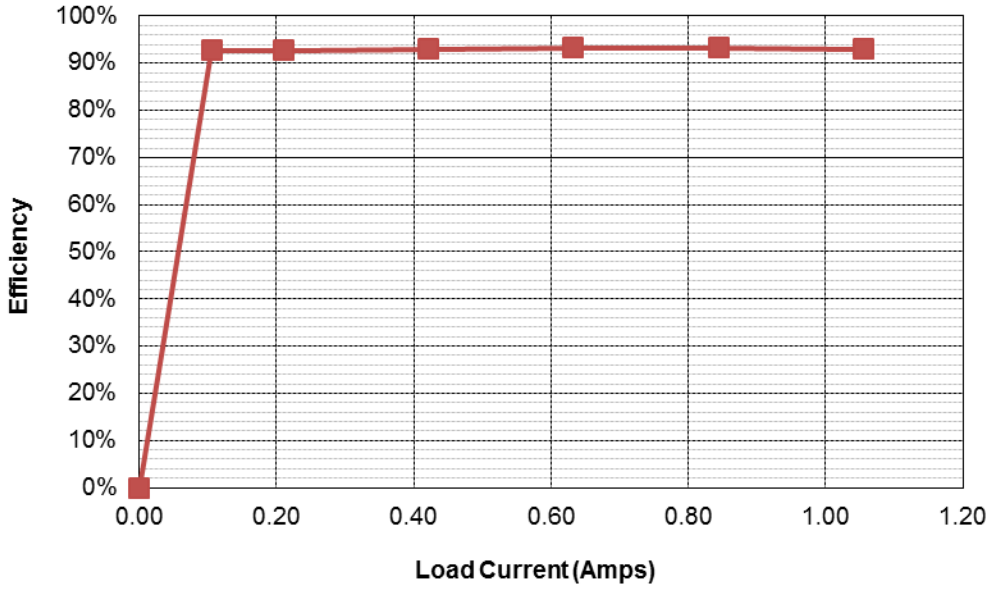
Iout	Vout	Vin	Iin	Pin	Pout	Losses	Efficiency
0.000	0.950	12.0	0.00900	0.1080	0.00	0.11	0.0%
0.390	0.941	12.0	0.0390	0.4680	0.37	0.10	78.4%
0.780	0.939	12.0	0.075	0.9000	0.73	0.17	81.4%
1.560	0.934	12.0	0.152	1.8240	1.46	0.37	79.9%
2.340	0.929	12.0	0.239	2.8680	2.17	0.69	75.8%
3.120	0.924	12.0	0.337	4.0440	2.88	1.16	71.3%
3.900	0.919	12.0	0.450	5.4000	3.58	1.82	66.4%

3.4 U11: Core 2 Set Top Box 0.95Vout



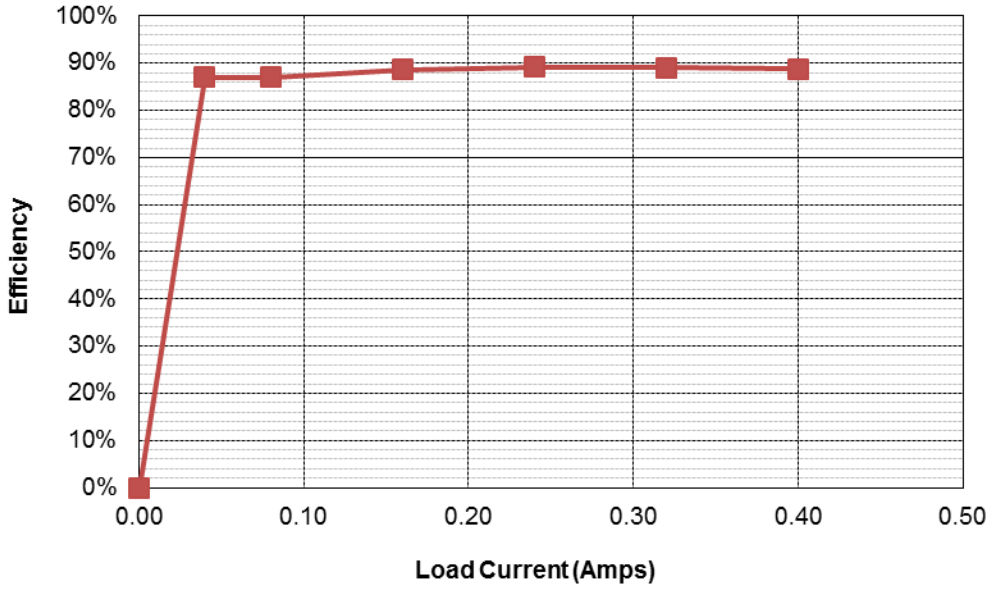
Iout	Vout	Vin	Iin	Pin	Pout	Losses	Efficiency
0.000	0.959	12.0	0.00900	0.1080	0.00	0.11	0.0%
0.350	0.949	12.0	0.0360	0.4320	0.33	0.10	76.9%
0.700	0.946	12.0	0.068	0.8160	0.66	0.15	81.2%
1.400	0.940	12.0	0.138	1.6560	1.32	0.34	79.5%
2.100	0.934	12.0	0.215	2.5800	1.96	0.62	76.0%
2.800	0.928	12.0	0.300	3.6000	2.60	1.00	72.2%
3.500	0.922	12.0	0.395	4.7400	3.23	1.51	68.1%

3.5 U7: HDMI/USB 5Vout



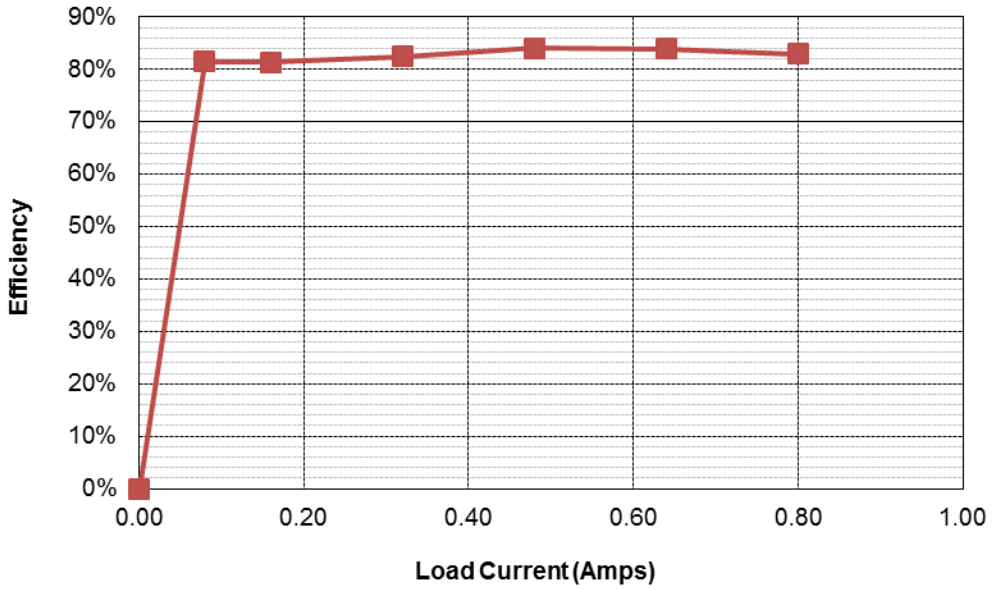
Iout	Vout	Vin	Iin	Pin	Pout	Losses	Efficiency
0.000	5.062	12.0	0.00900	0.1080	0.00	0.11	0.0%
0.106	5.060	12.0	0.0480	0.5760	0.53	0.04	92.7%
0.211	5.062	12.0	0.096	1.1520	1.07	0.08	92.7%
0.422	5.050	12.0	0.191	2.2920	2.13	0.16	93.0%
0.633	5.022	12.0	0.284	3.4080	3.18	0.23	93.3%
0.844	4.984	12.0	0.376	4.5120	4.21	0.31	93.2%
1.055	4.973	12.0	0.470	5.6400	5.25	0.39	93.0%

3.6 U4: Analog I/O 3.3Vout



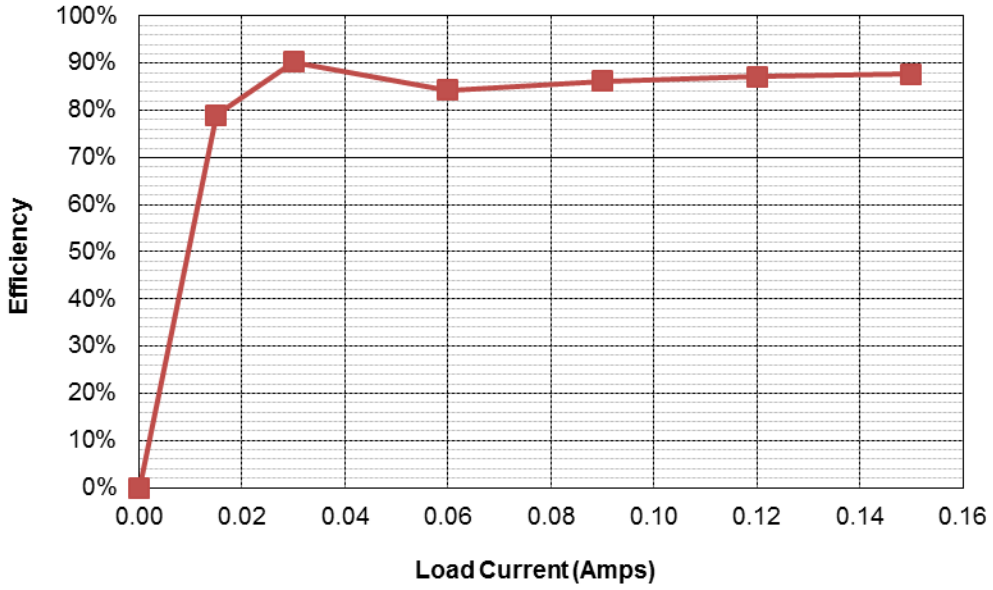
Iout	Vout	Vin	Iin	Pin	Pout	Losses	Efficiency
0.000	3.393	12.0	0.00900	0.1080	0.00	0.11	0.0%
0.040	3.393	12.0	0.0130	0.1560	0.14	0.02	87.0%
0.080	3.393	12.0	0.026	0.3120	0.27	0.04	87.0%
0.160	3.392	12.0	0.051	0.6120	0.54	0.07	88.7%
0.240	3.387	12.0	0.076	0.9120	0.81	0.10	89.1%
0.320	3.373	12.0	0.101	1.2120	1.08	0.13	89.1%
0.400	3.358	12.0	0.126	1.5120	1.34	0.17	88.8%

3.7 U1: DDR4 VDDQ 1.2Vout



Iout	Vout	Vin	Iin	Pin	Pout	Losses	Efficiency
0.000	1.223	12.0	0.00900	0.1080	0.00	0.11	0.0%
0.080	1.223	12.0	0.0100	0.1200	0.10	0.02	81.5%
0.160	1.220	12.0	0.020	0.2400	0.20	0.04	81.3%
0.320	1.206	12.0	0.039	0.4680	0.39	0.08	82.5%
0.480	1.198	12.0	0.057	0.6840	0.58	0.11	84.1%
0.640	1.196	12.0	0.076	0.9120	0.77	0.15	83.9%
0.800	1.194	12.0	0.096	1.1520	0.96	0.20	82.9%

3.8 U3: DDR4 VPP 2.5Vout

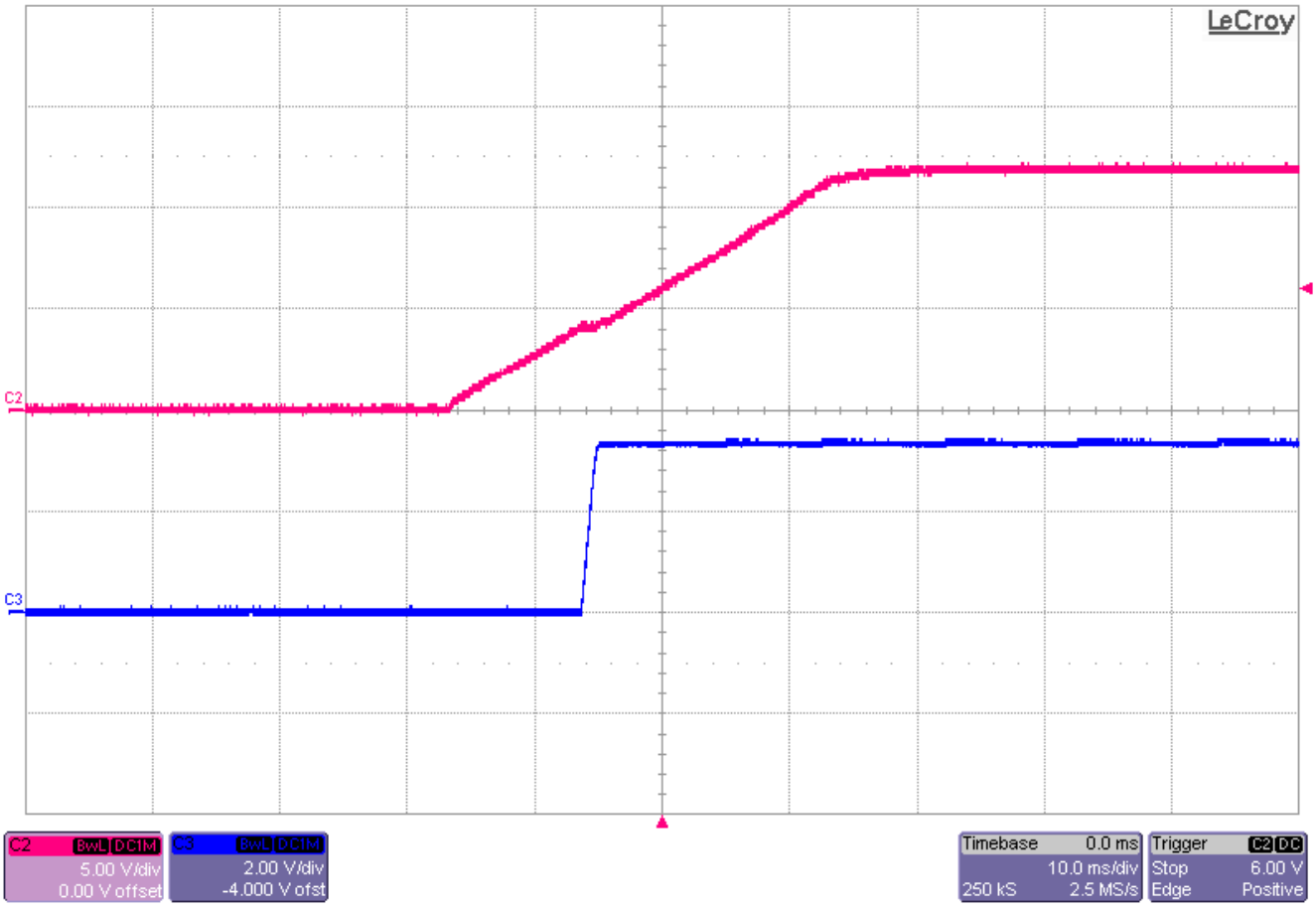


Iout	Vout	Vin	Iin	Pin	Pout	Losses	Efficiency
0.000	2.529	12.0	0.00900	0.1080	0.00	0.11	0.0%
0.015	2.530	12.0	0.0040	0.0480	0.04	0.01	79.1%
0.030	2.529	12.0	0.007	0.0840	0.08	0.01	90.3%
0.060	2.528	12.0	0.015	0.1800	0.15	0.03	84.3%
0.090	2.528	12.0	0.022	0.2640	0.23	0.04	86.2%
0.120	2.528	12.0	0.029	0.3480	0.30	0.04	87.2%
0.150	2.527	12.0	0.036	0.4320	0.38	0.05	87.7%

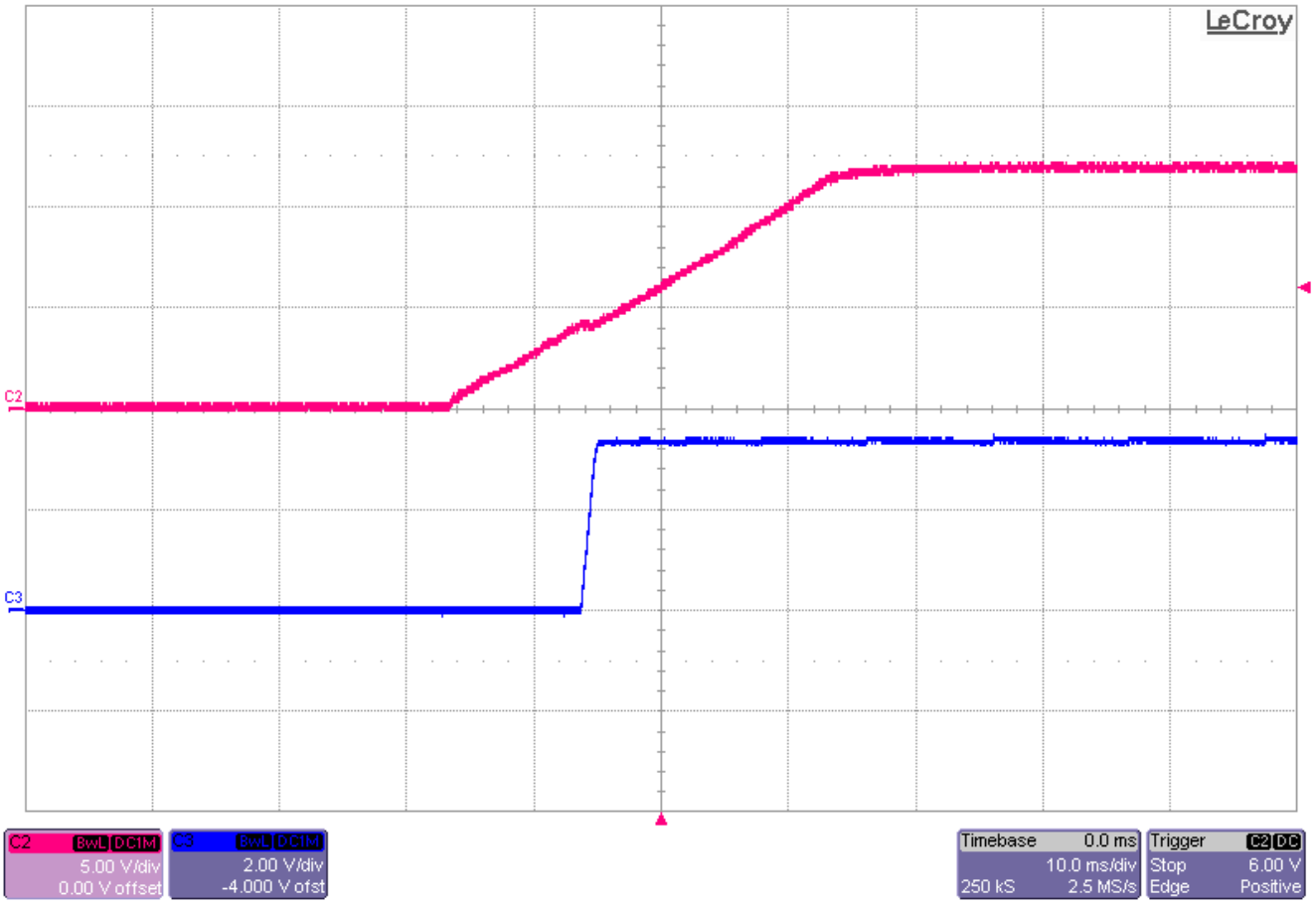
4 Startup

The following waveforms were taken with no load

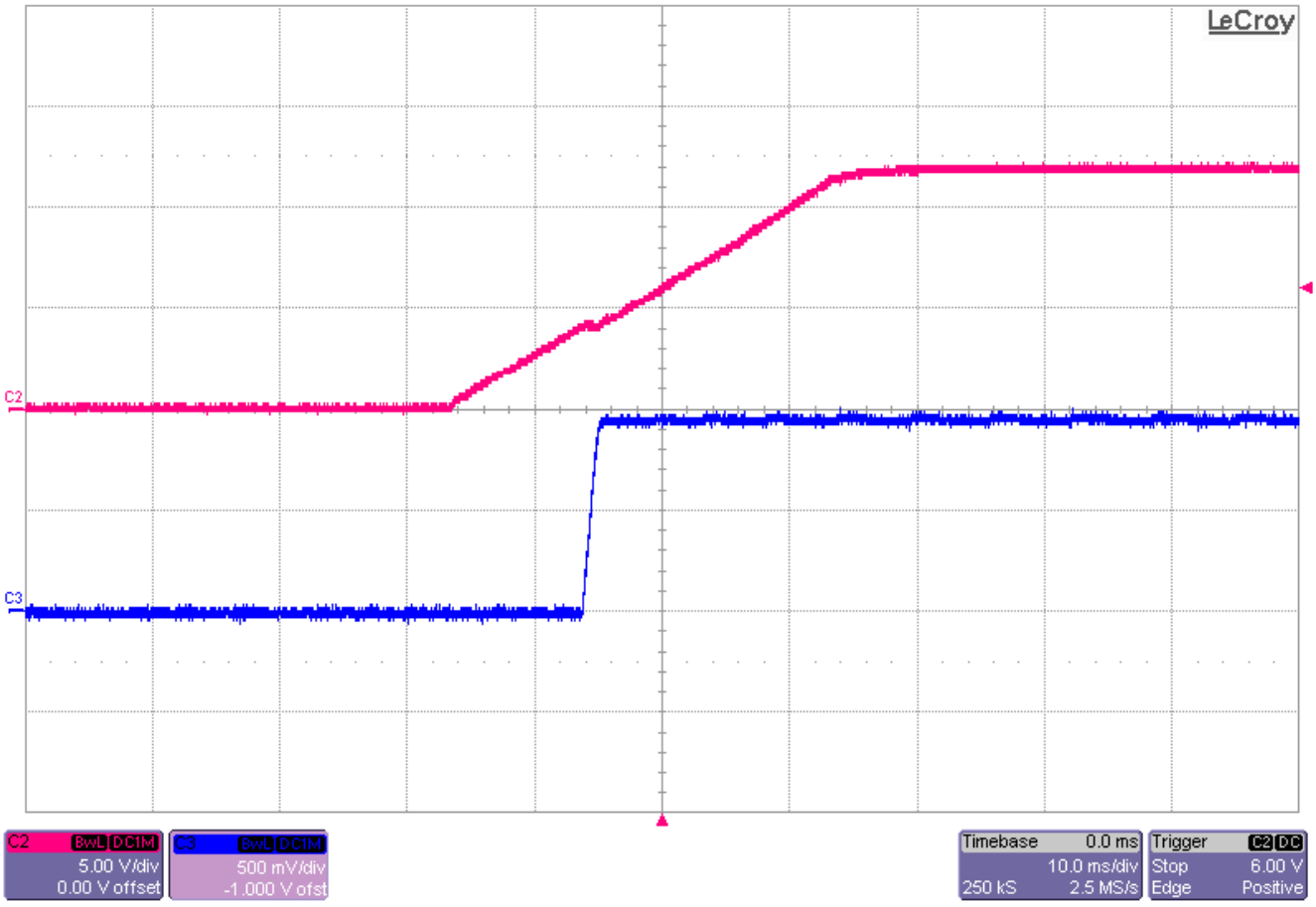
4.1 U10: WiFi



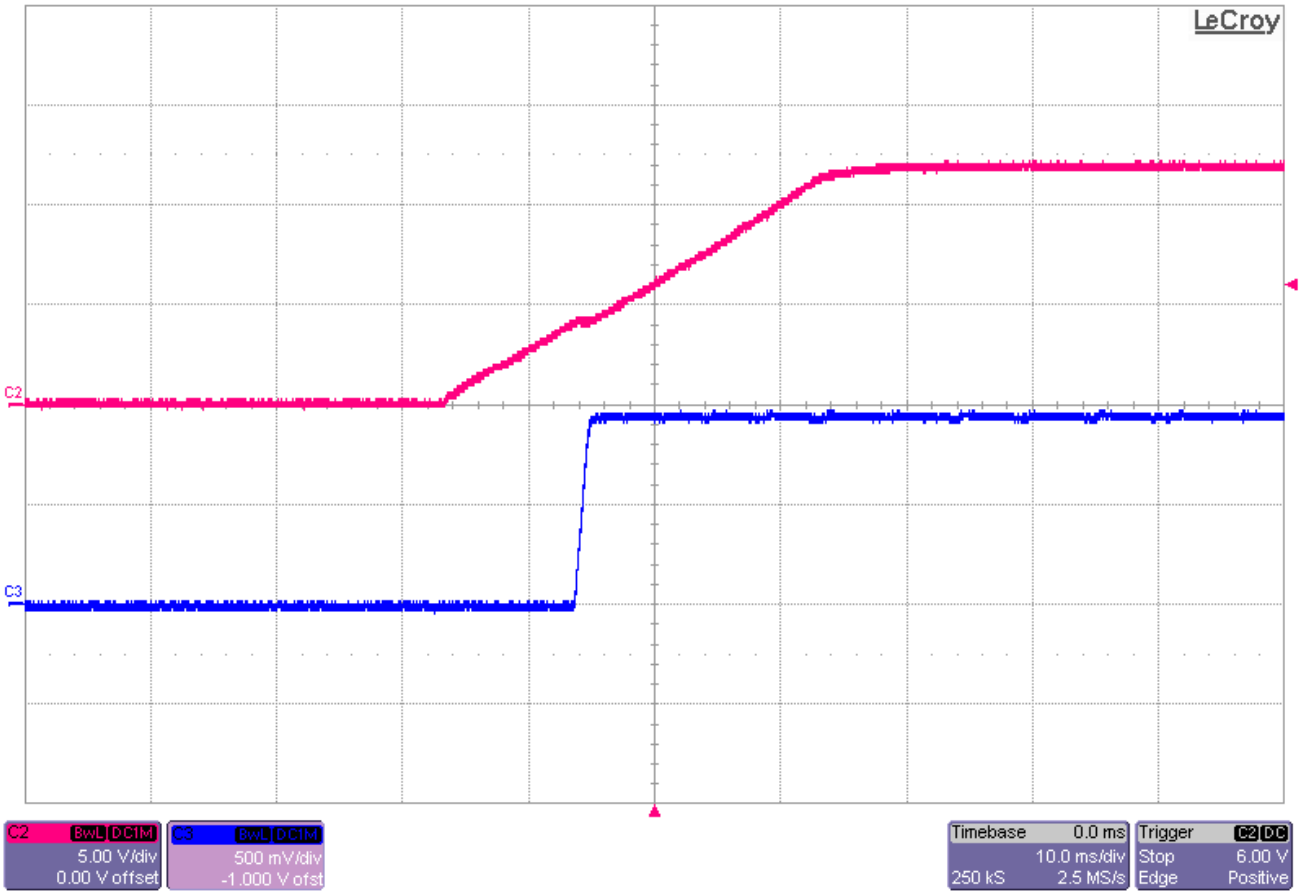
4.2 U12: Bluetooth



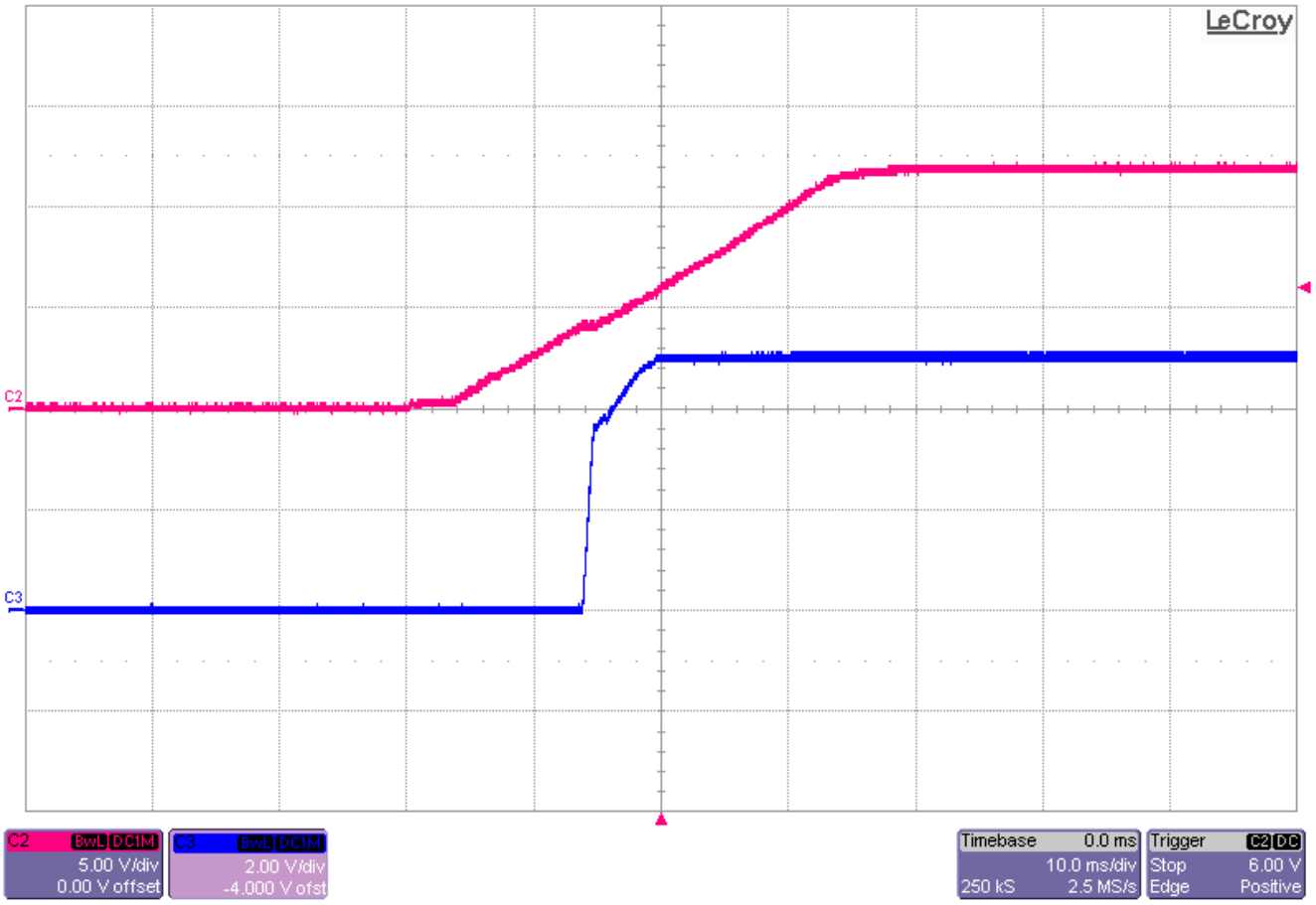
4.3 U9: Core 1 CPU



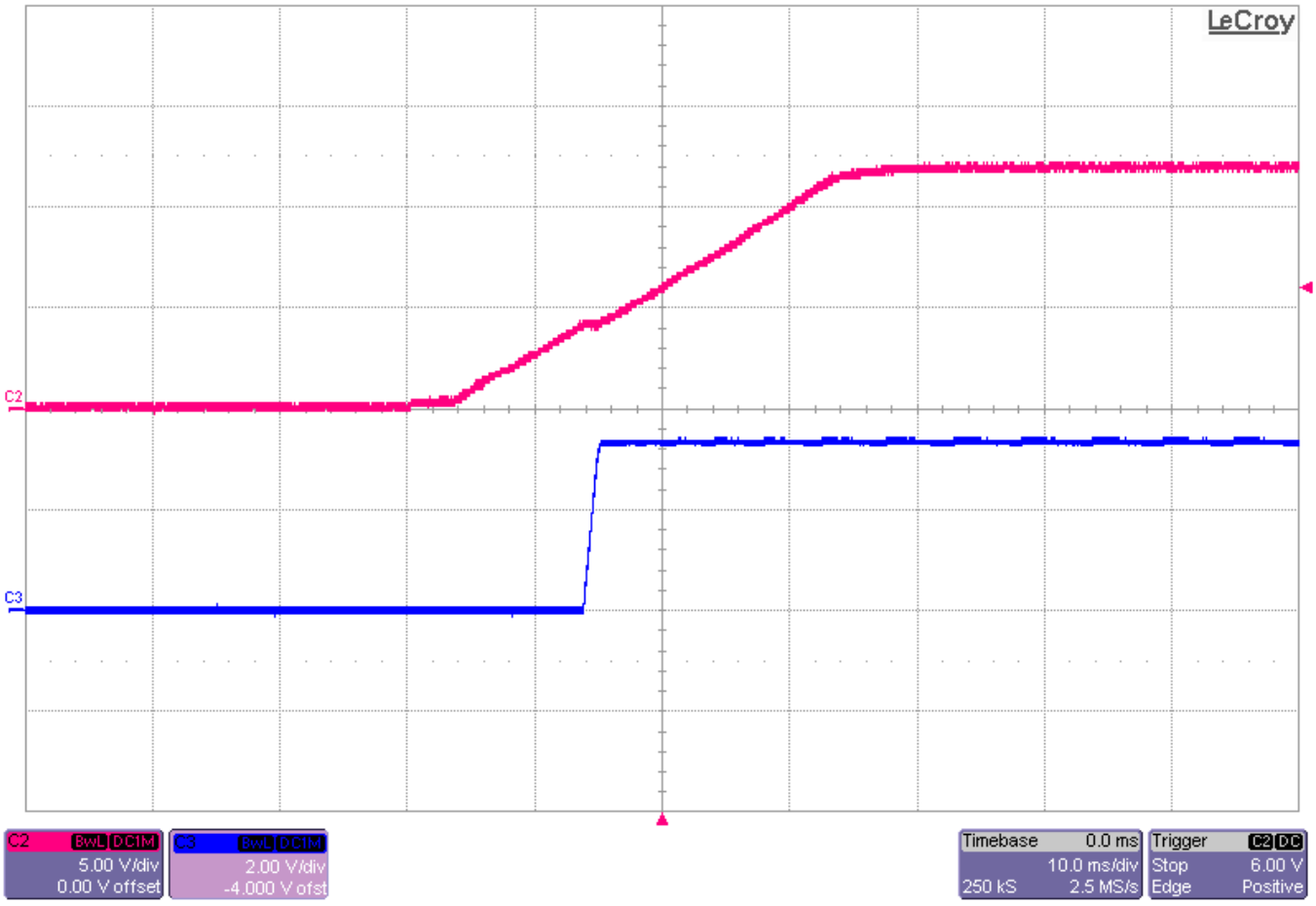
4.4 U11: Core 2 Set Top Box



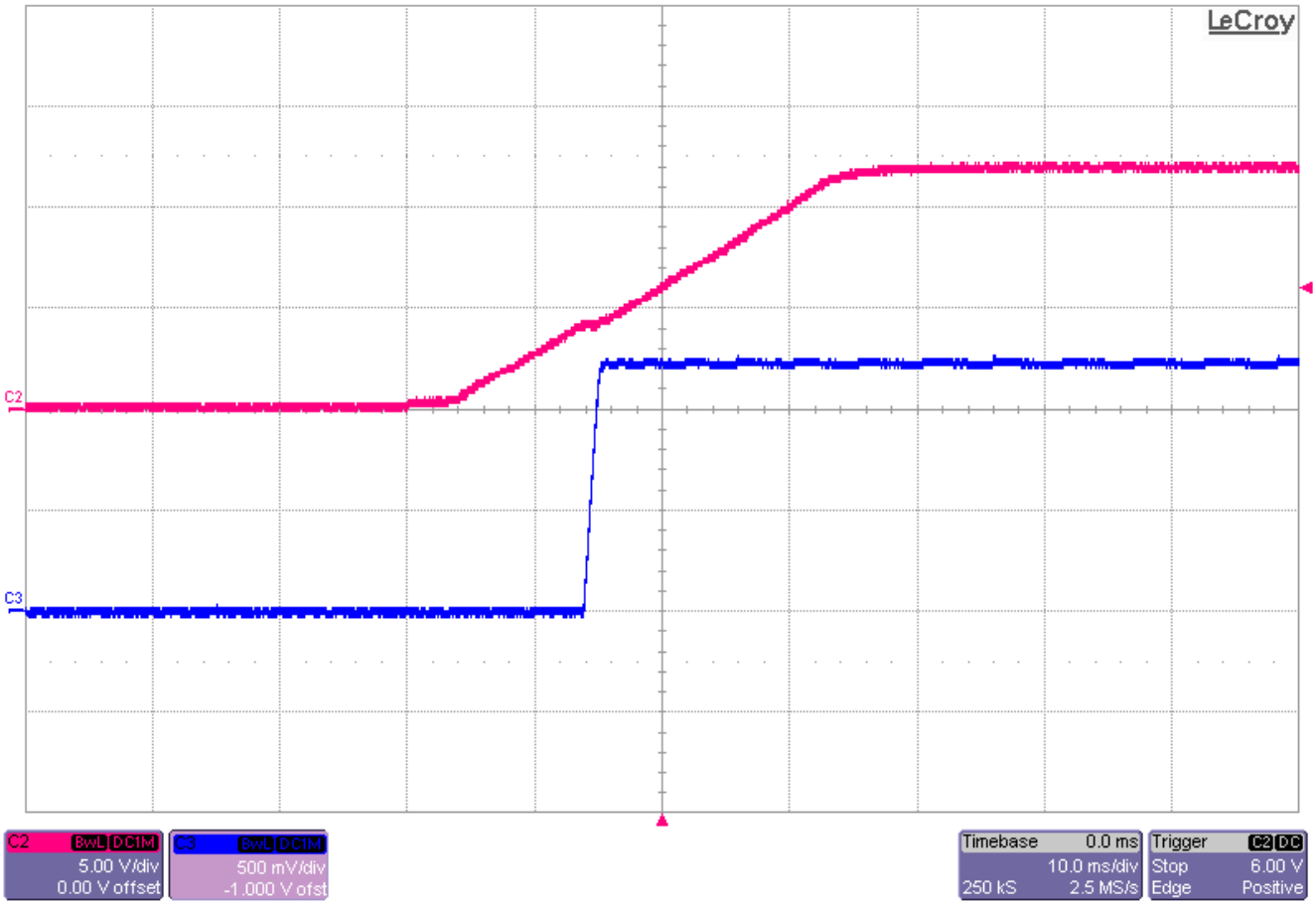
4.5 U7: HDMI/USB



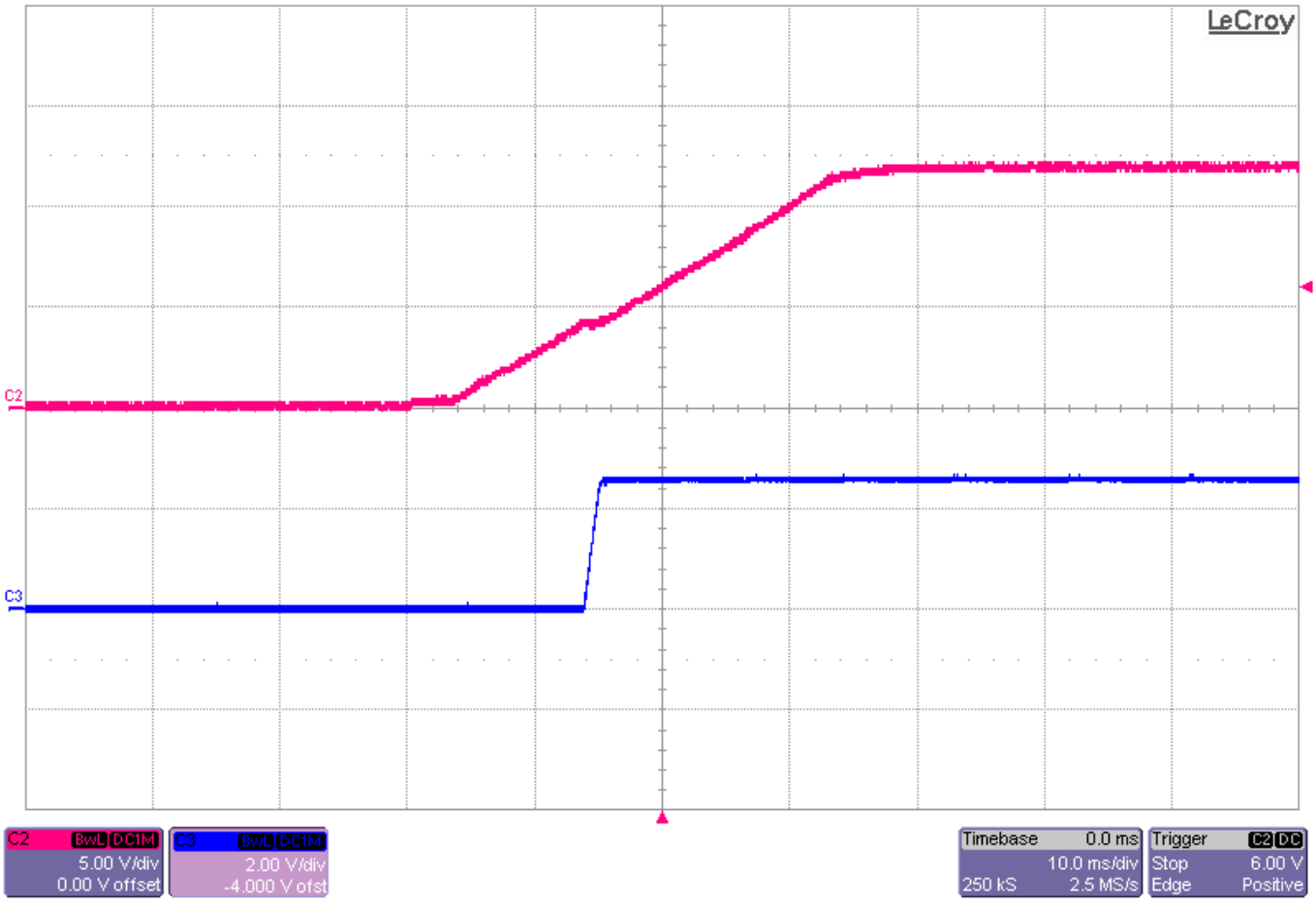
4.6 U4: Analog I/O



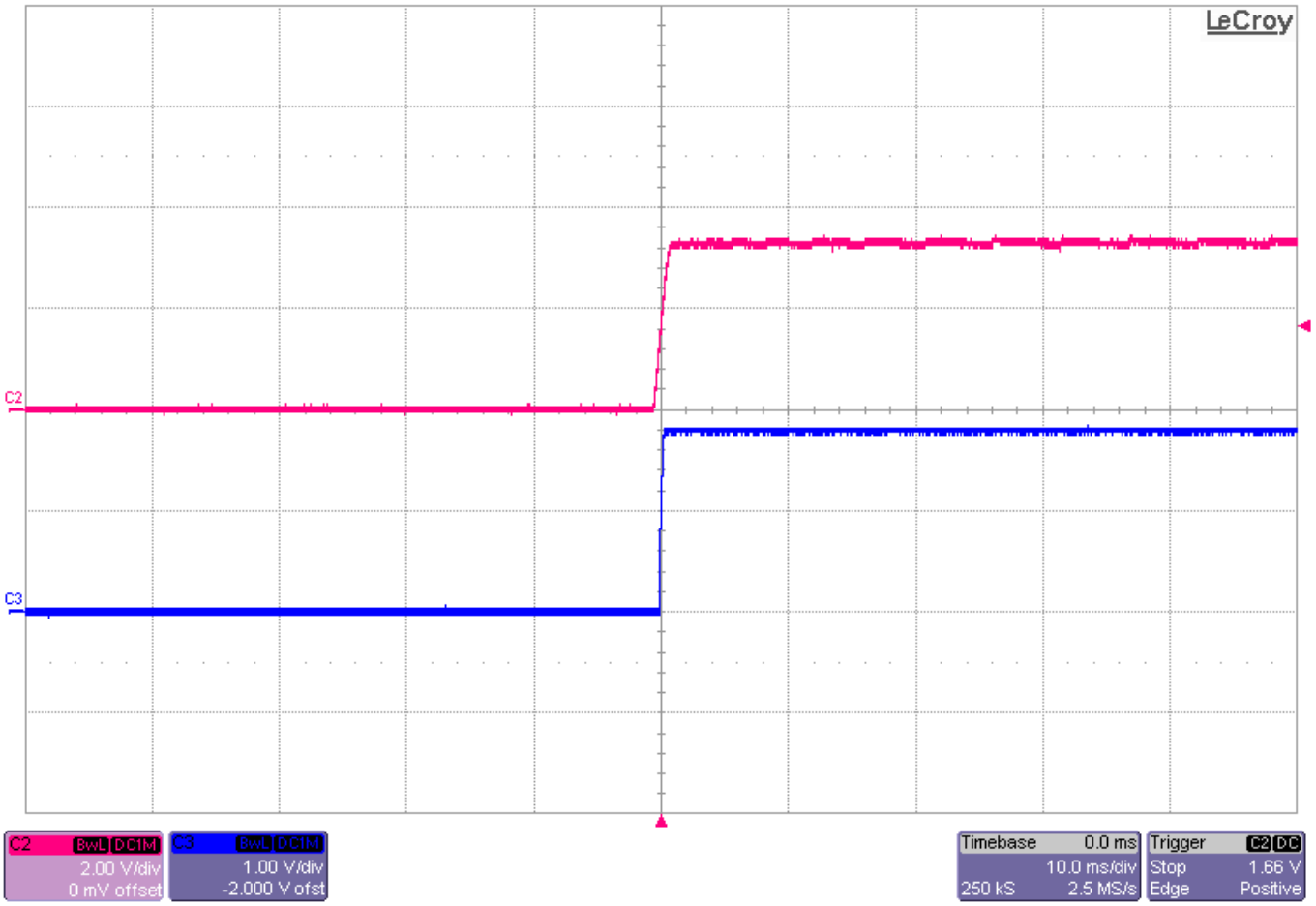
4.7 U1: DDR4 VDDQ



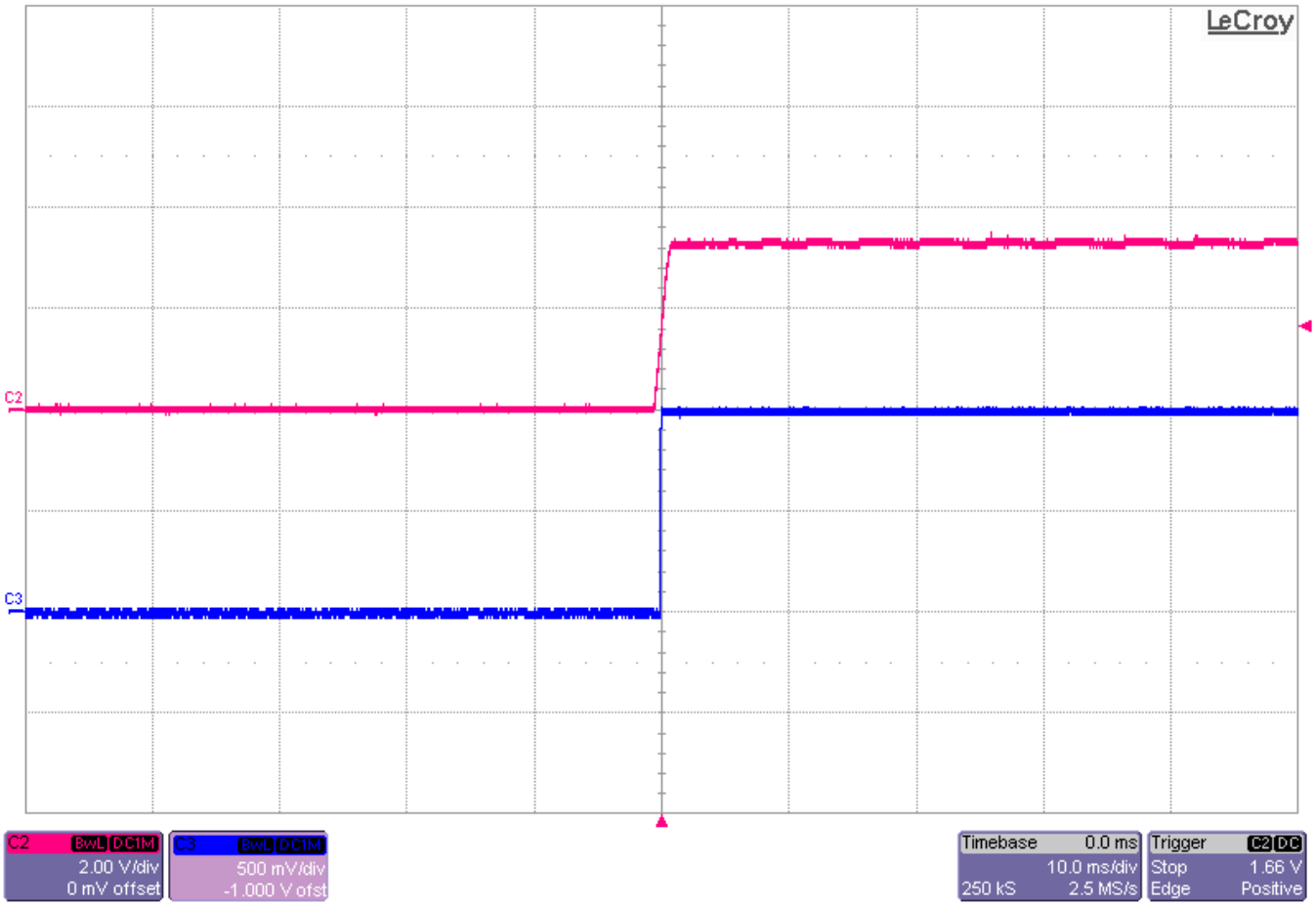
4.8 U3: DDR4 VPP



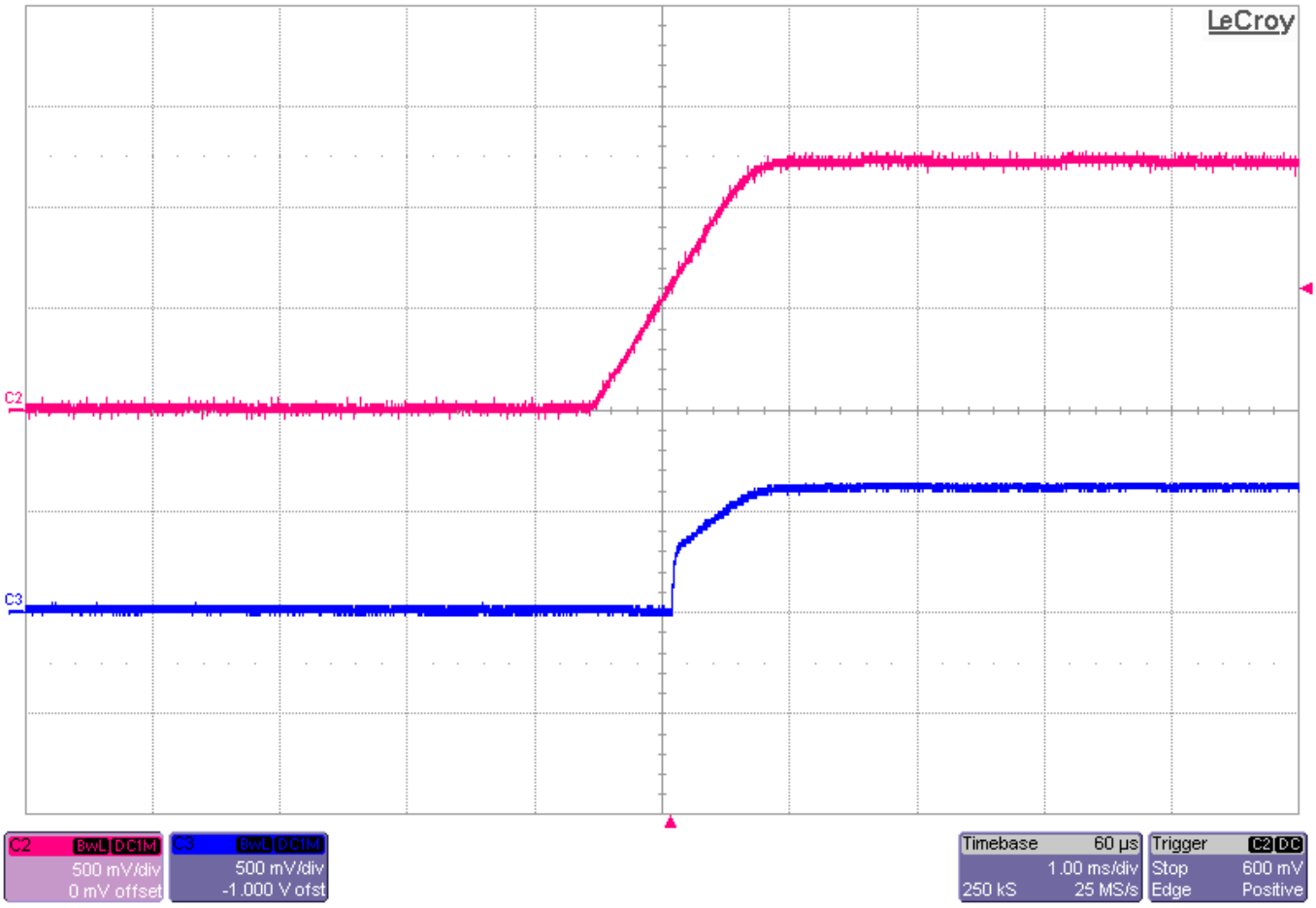
4.9 U5: Analog I/O 1.8V



4.10 U13: Analog I/O 1.0V



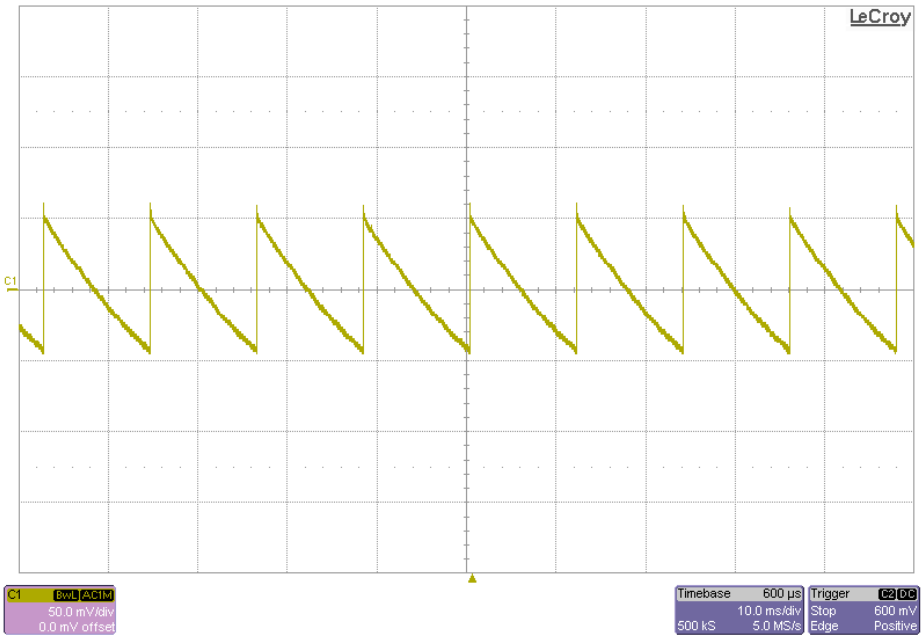
4.11 U2: DDR4 VDDQ Terminator



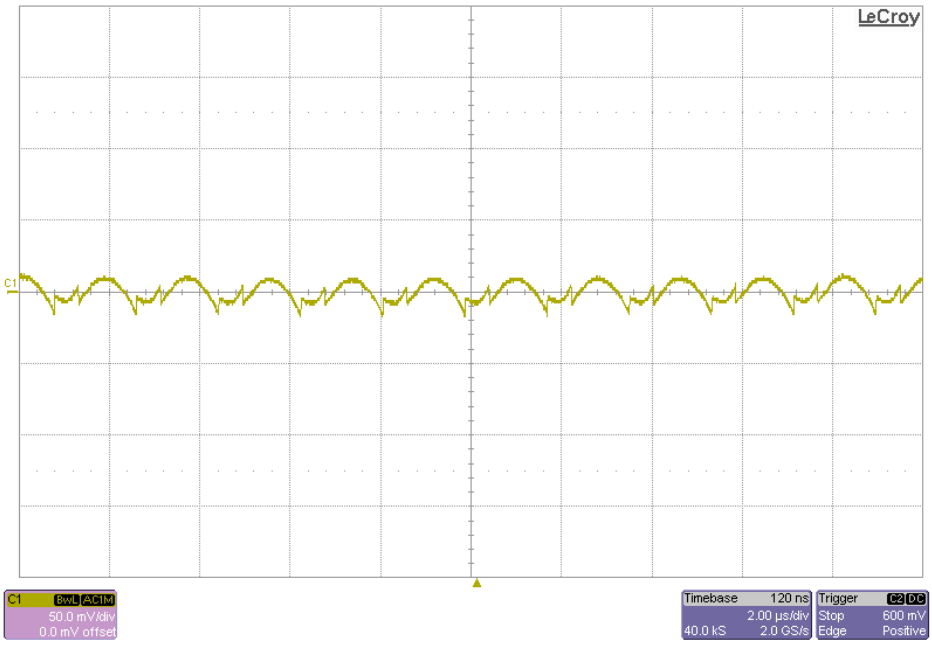
5 Output Ripple Voltage

The following images show the output ripple at no load and typical load.

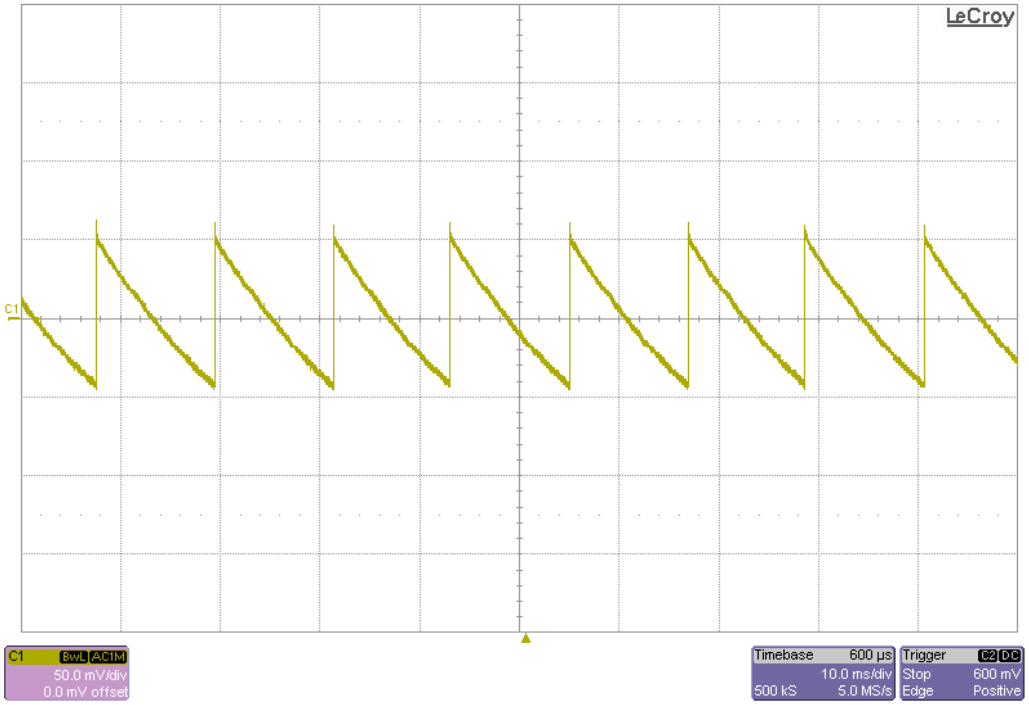
5.1 U10: WiFi Output Ripple (No Load)



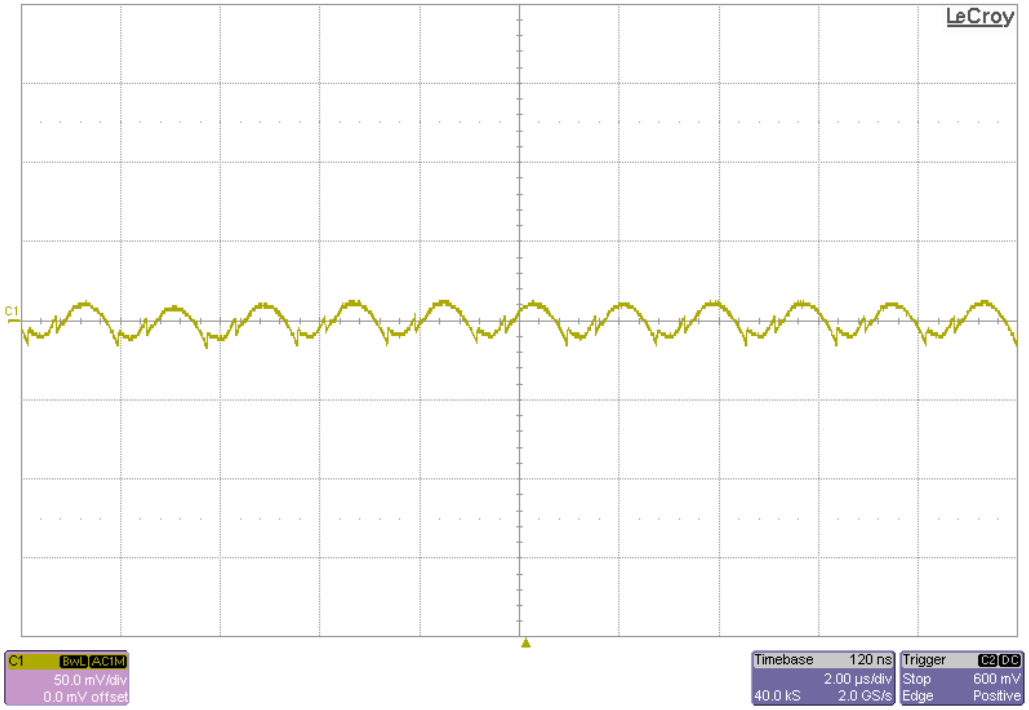
5.2 U10: WiFi Output Ripple (1A Load)



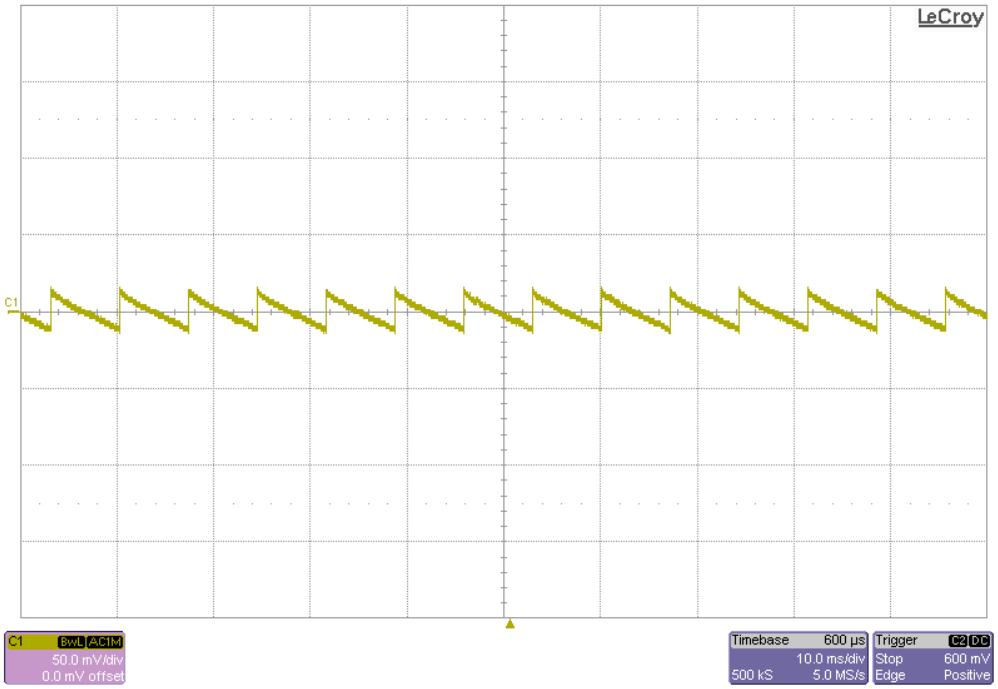
5.3 U12: Bluetooth Output Ripple (No Load)



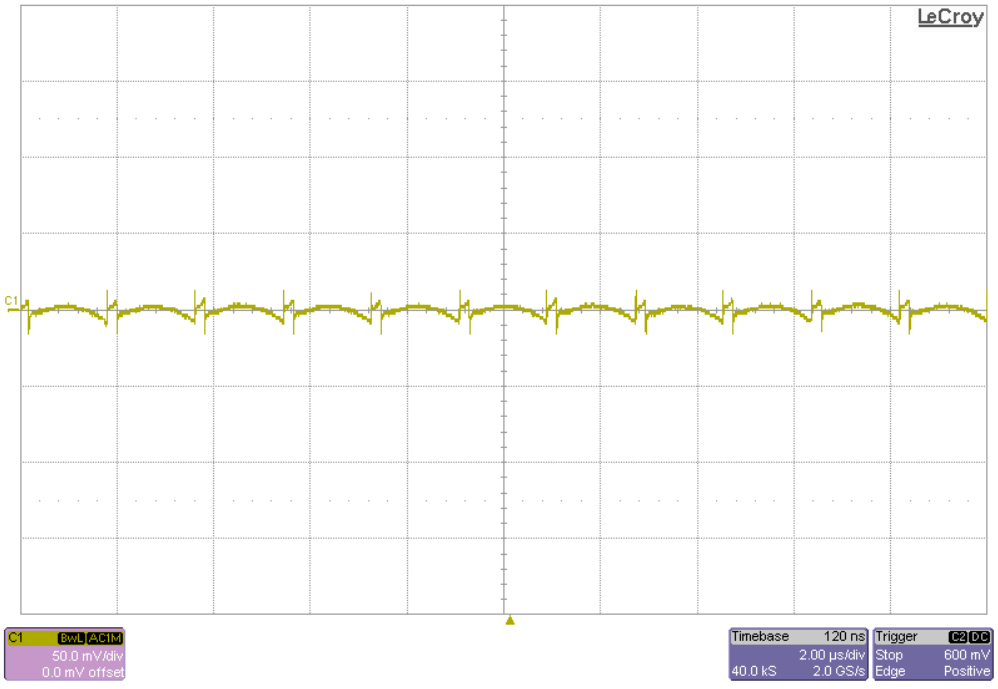
5.4 U12: Bluetooth Output Ripple (2A Load)



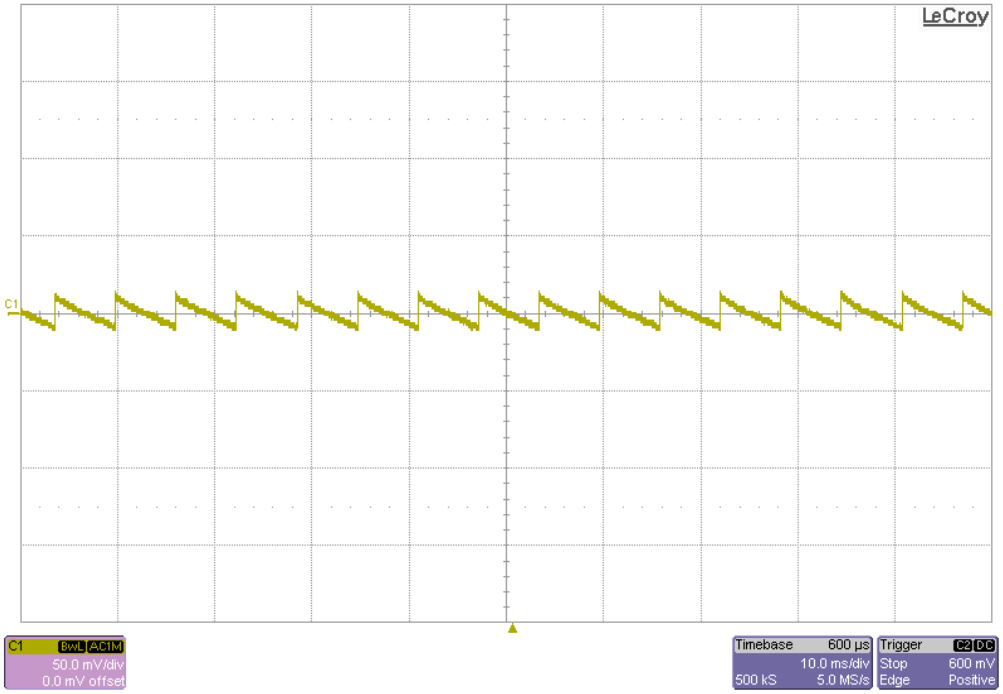
5.5 U9: Core 1 CPU Output Ripple (No Load)



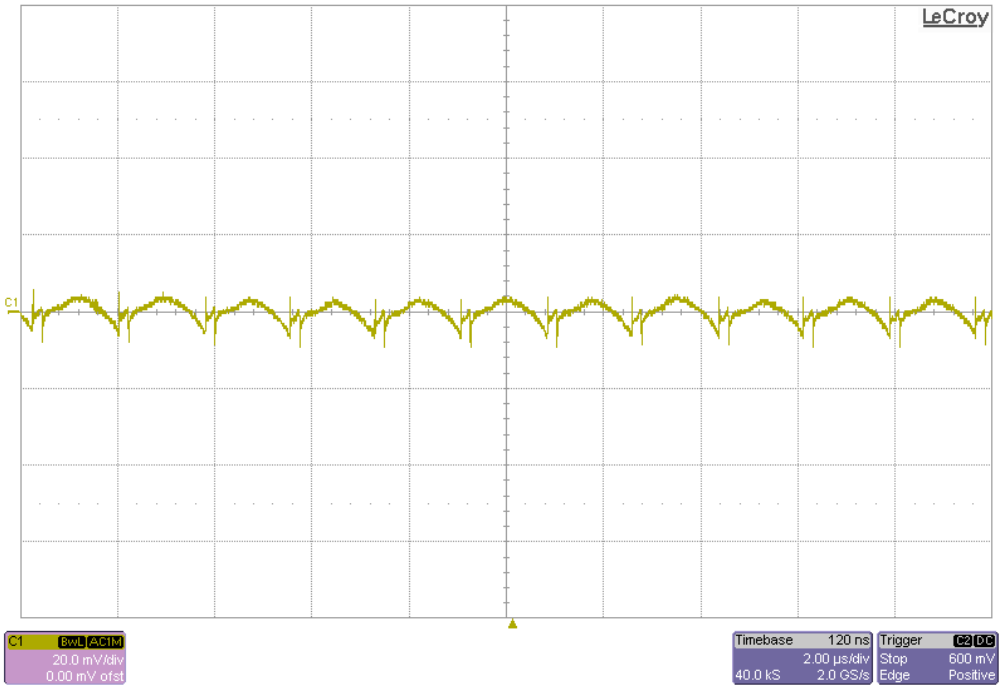
5.6 U9: Core 1 CPU Output Ripple (3.9A Load)



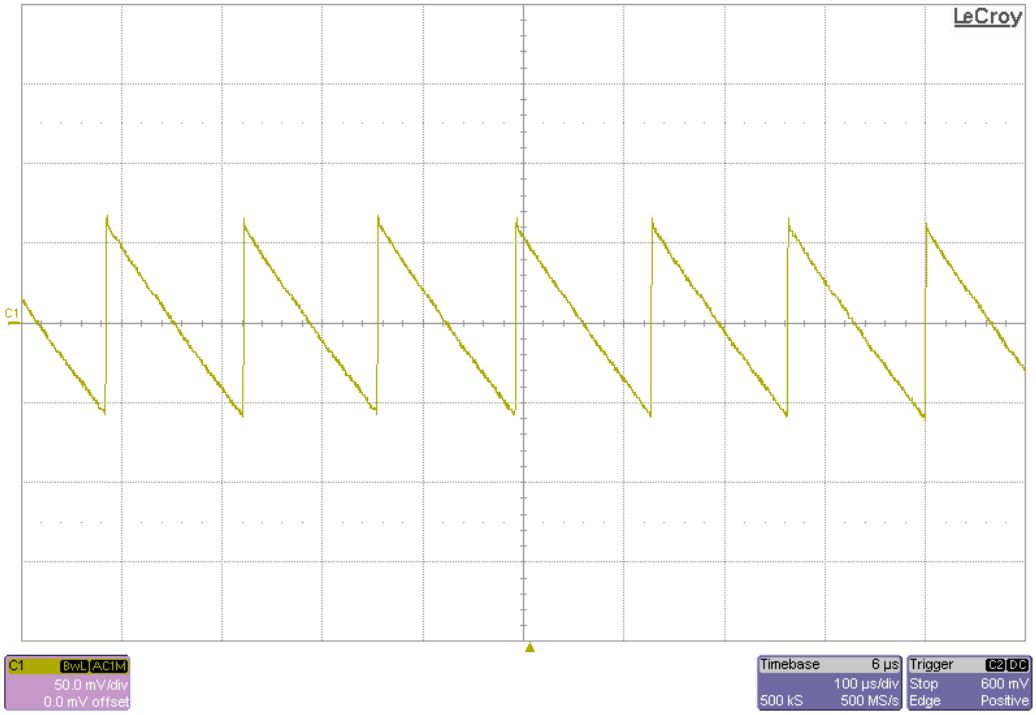
5.7 U11: Core 2 Set Top Box Output Ripple (No Load)



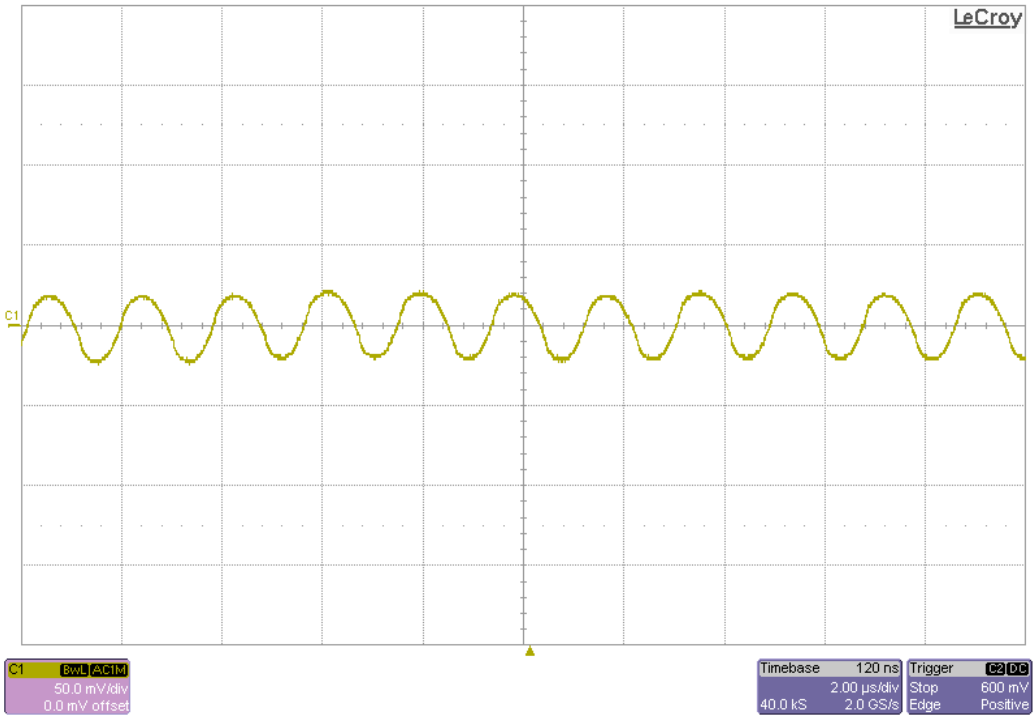
5.8 U11: Core 2 Set Top Box Output Ripple (3.5A Load)



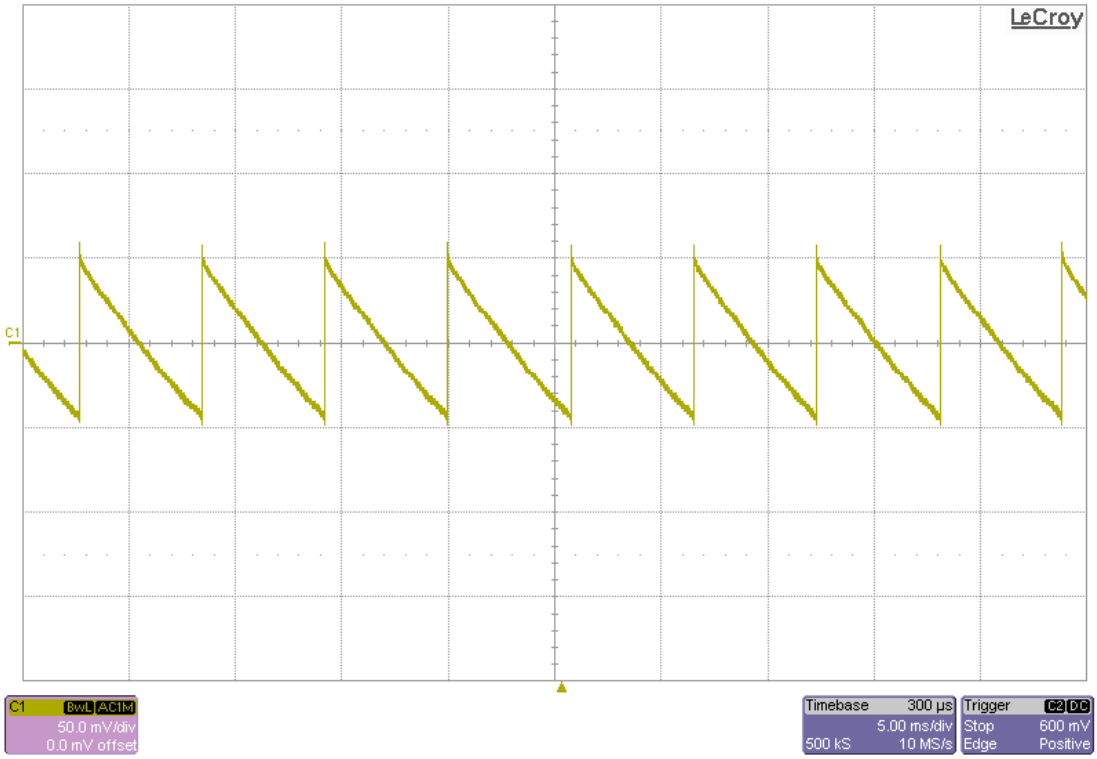
5.9 U7: HDMI/USB Output Ripple (No Load)



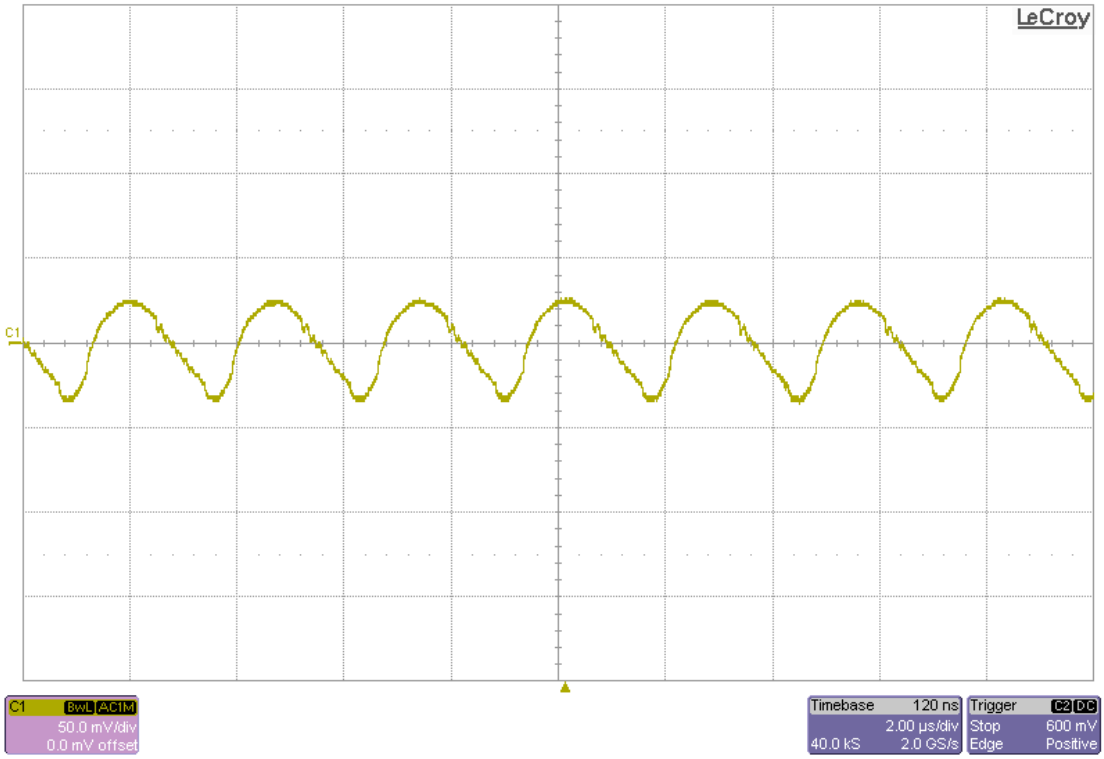
5.10 U7: HDMI/USB Output Ripple (1.055A Load)



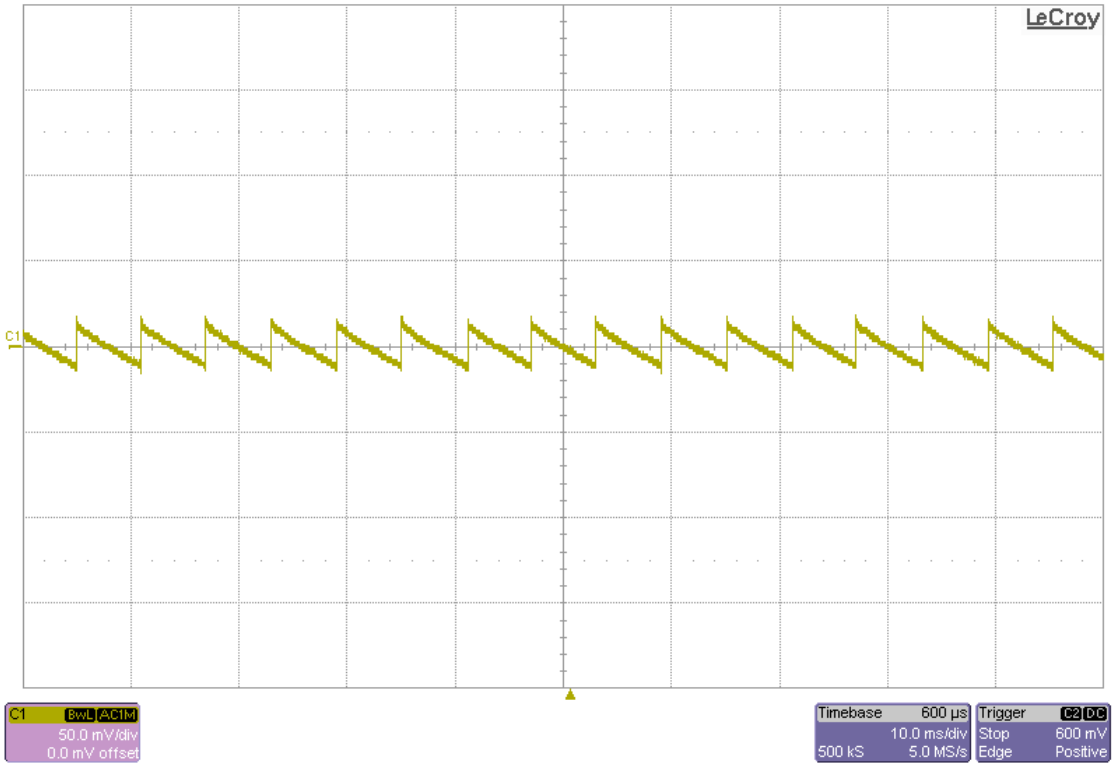
5.11 U4: Analog I/O Output Ripple (No Load)



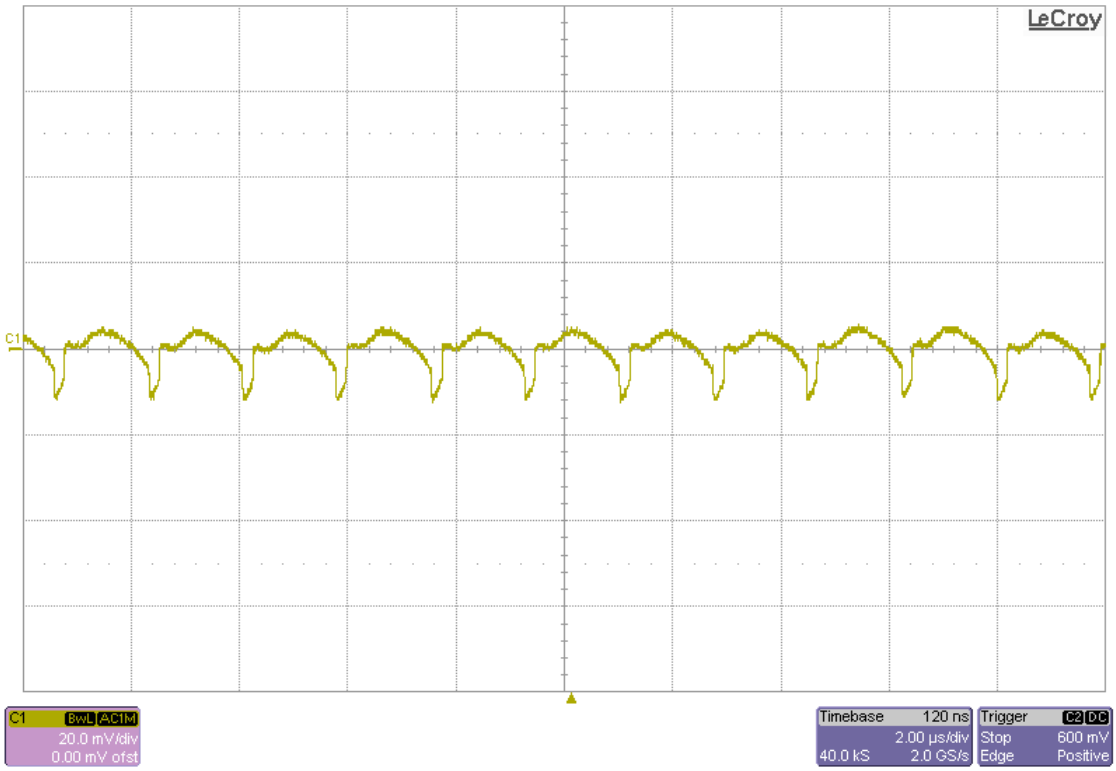
5.12 U4: Analog I/O Output Ripple (0.4A Load)



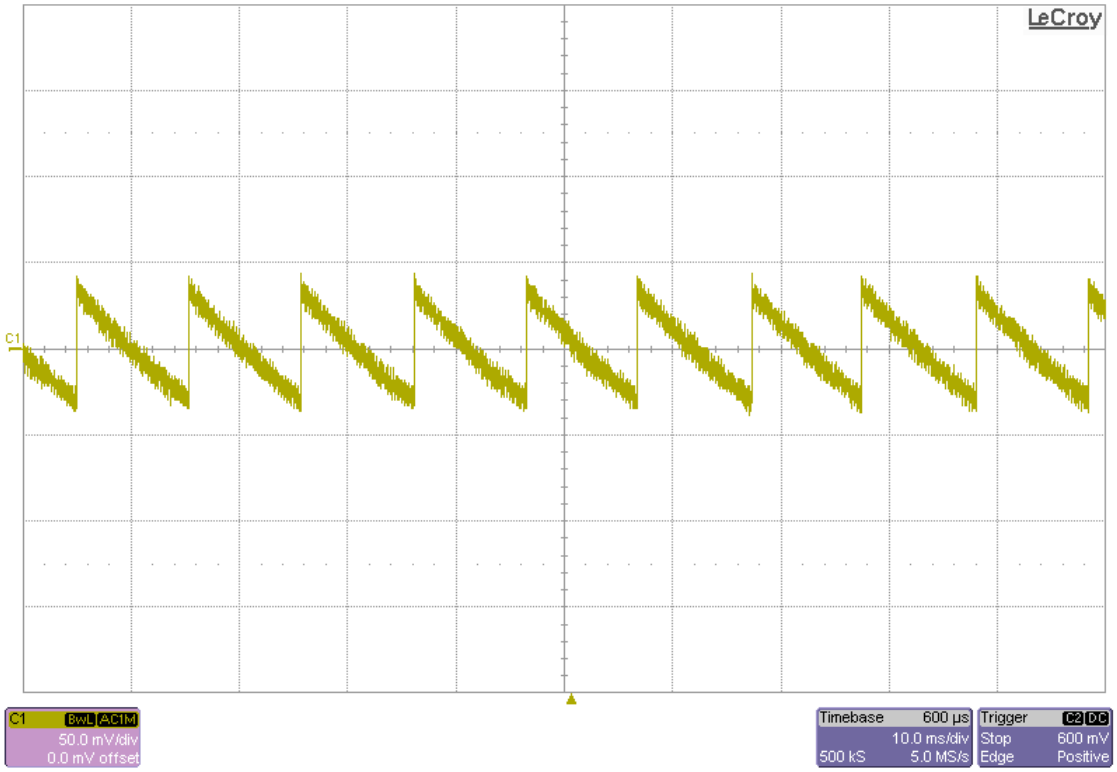
5.13 U1: DDR4 VDDQ Output Ripple (No Load)



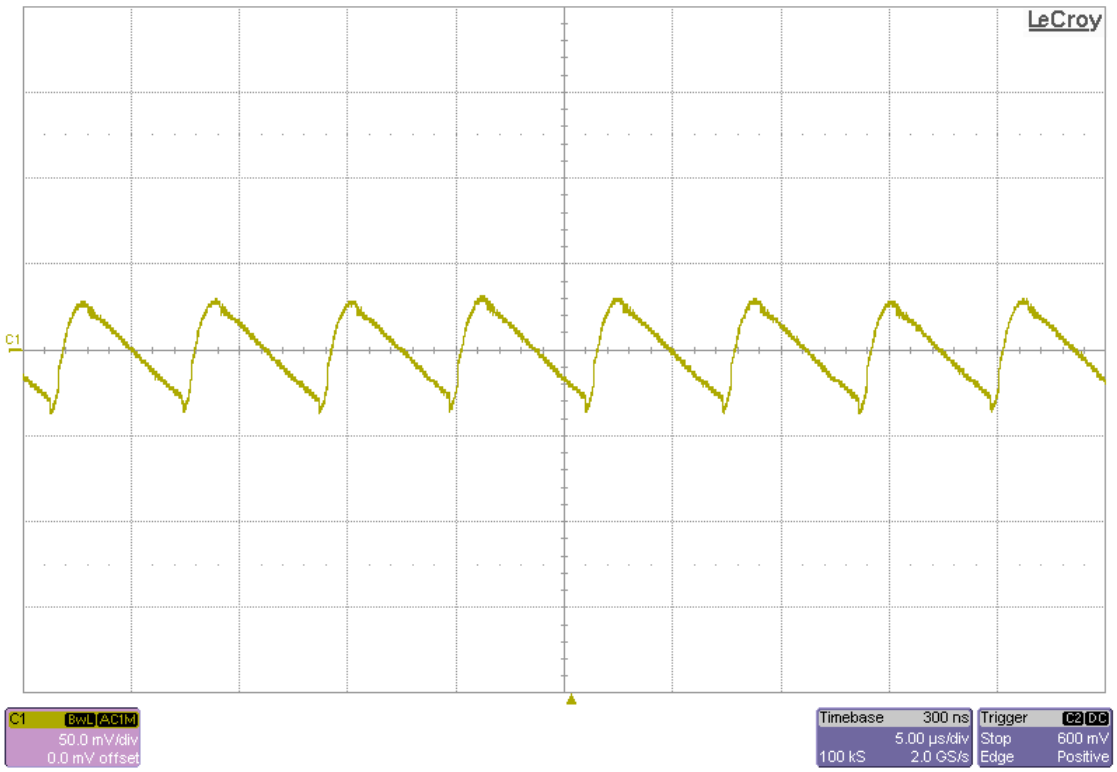
5.14 U1: DDR4 VDDQ Output Ripple (0.8A Load)



5.15 U3: DDR4 VPP Output Ripple (No Load)

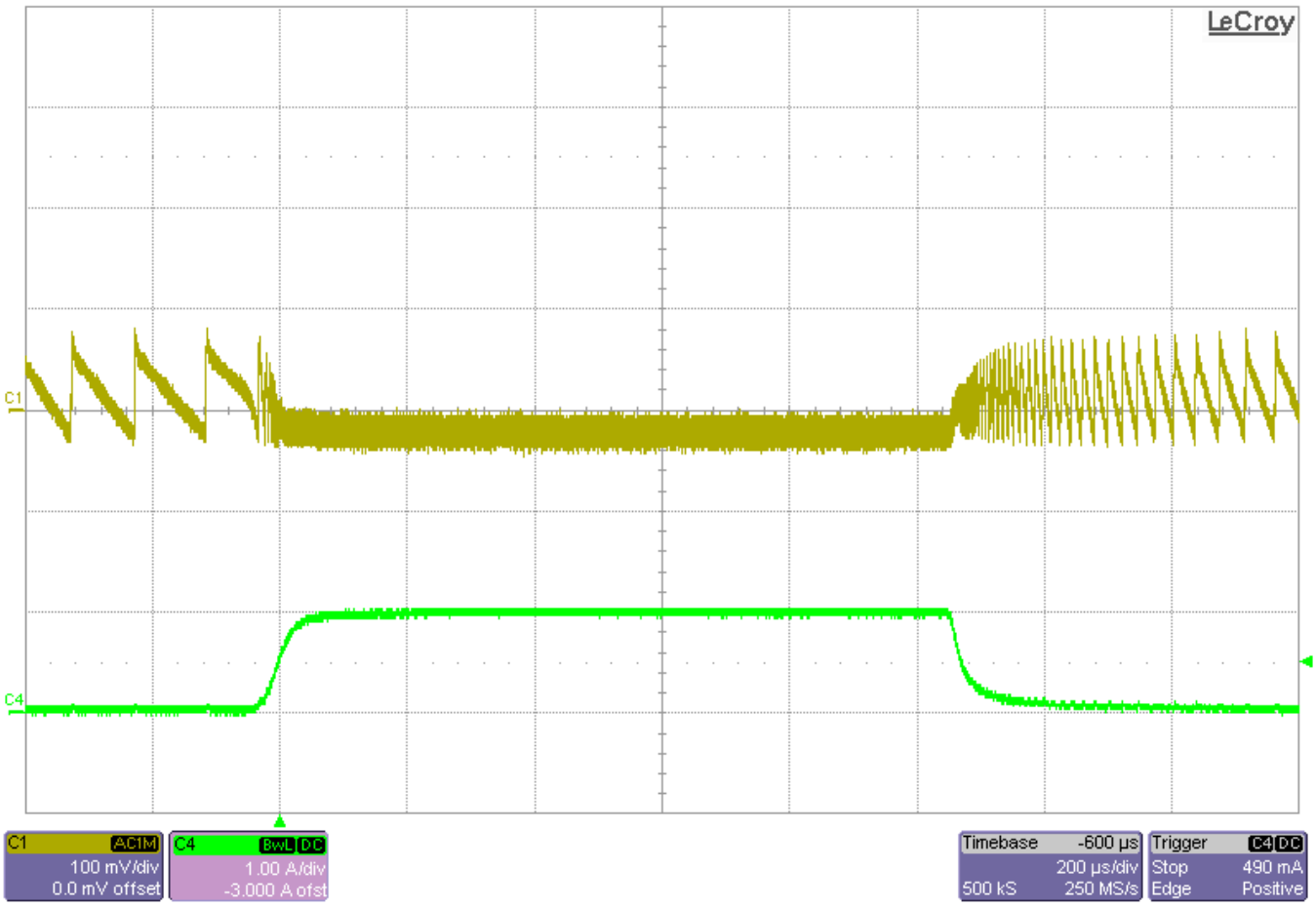


5.16 U3: DDR4 VPP Output Ripple (0.15A Load)

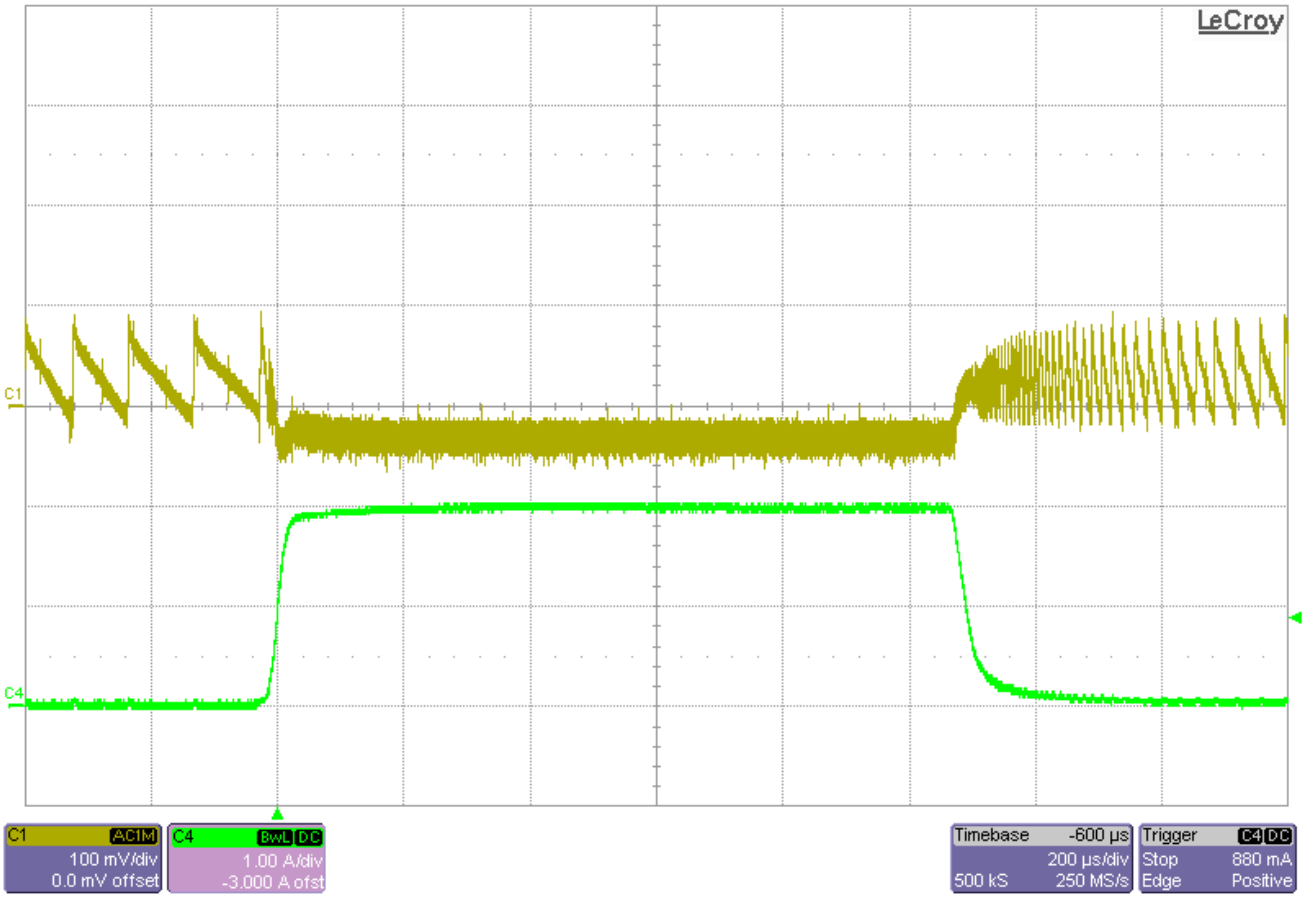


6 Load Transients

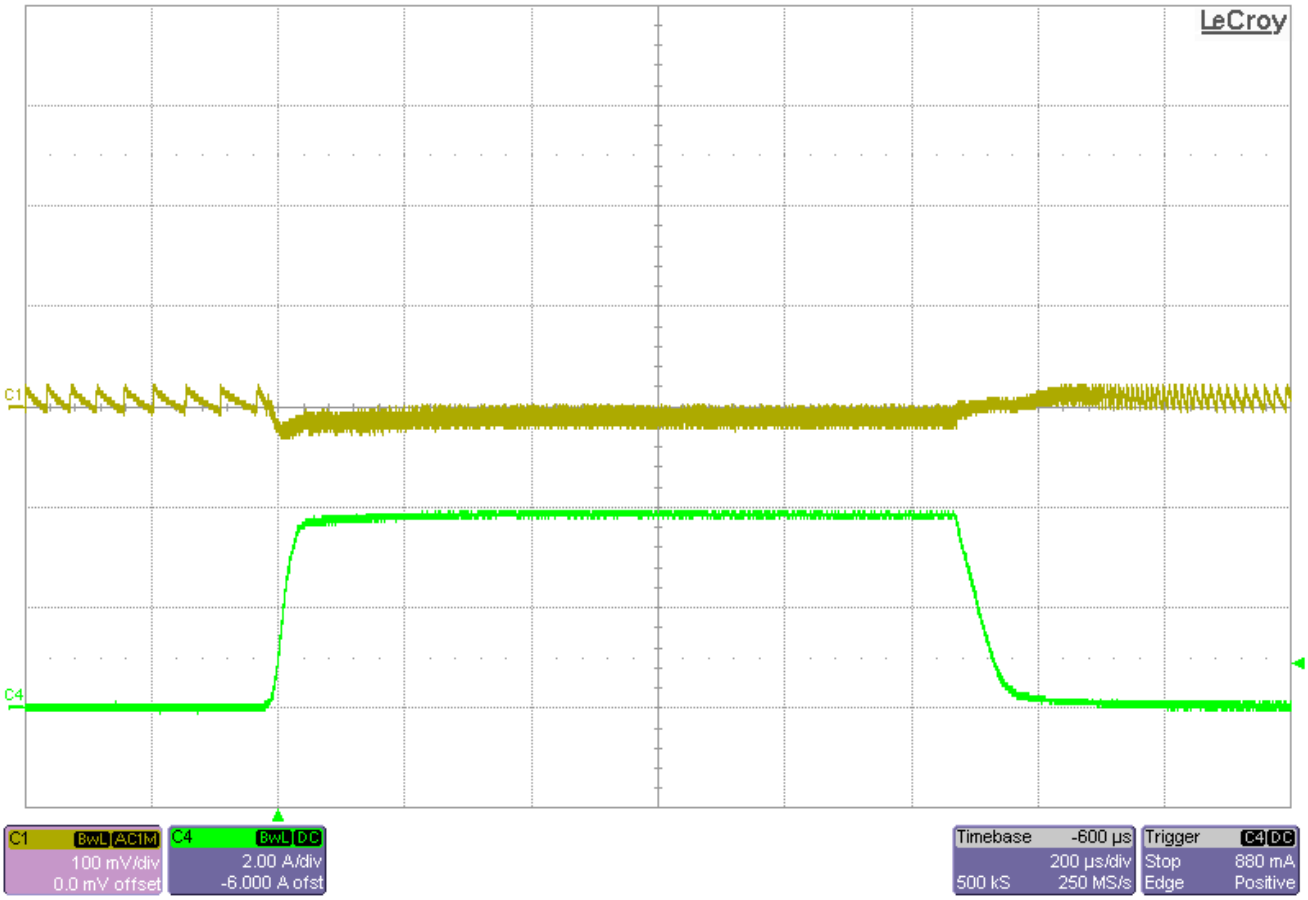
6.1 U10: WiFi 3.3Vout, 0A – 1A Load Step



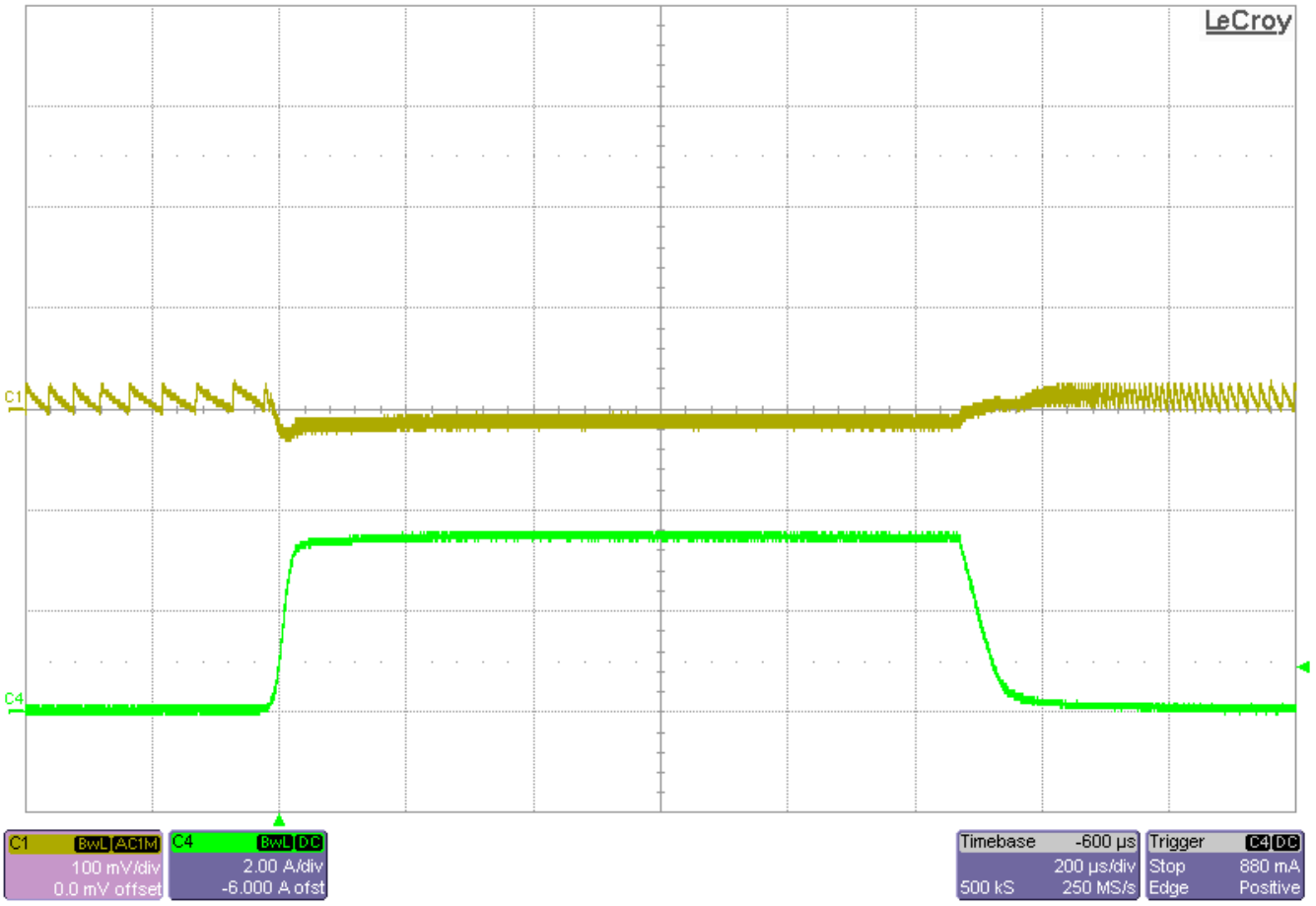
6.2 U12: Bluetooth 3.3Vout, 0A – 2A Load Step



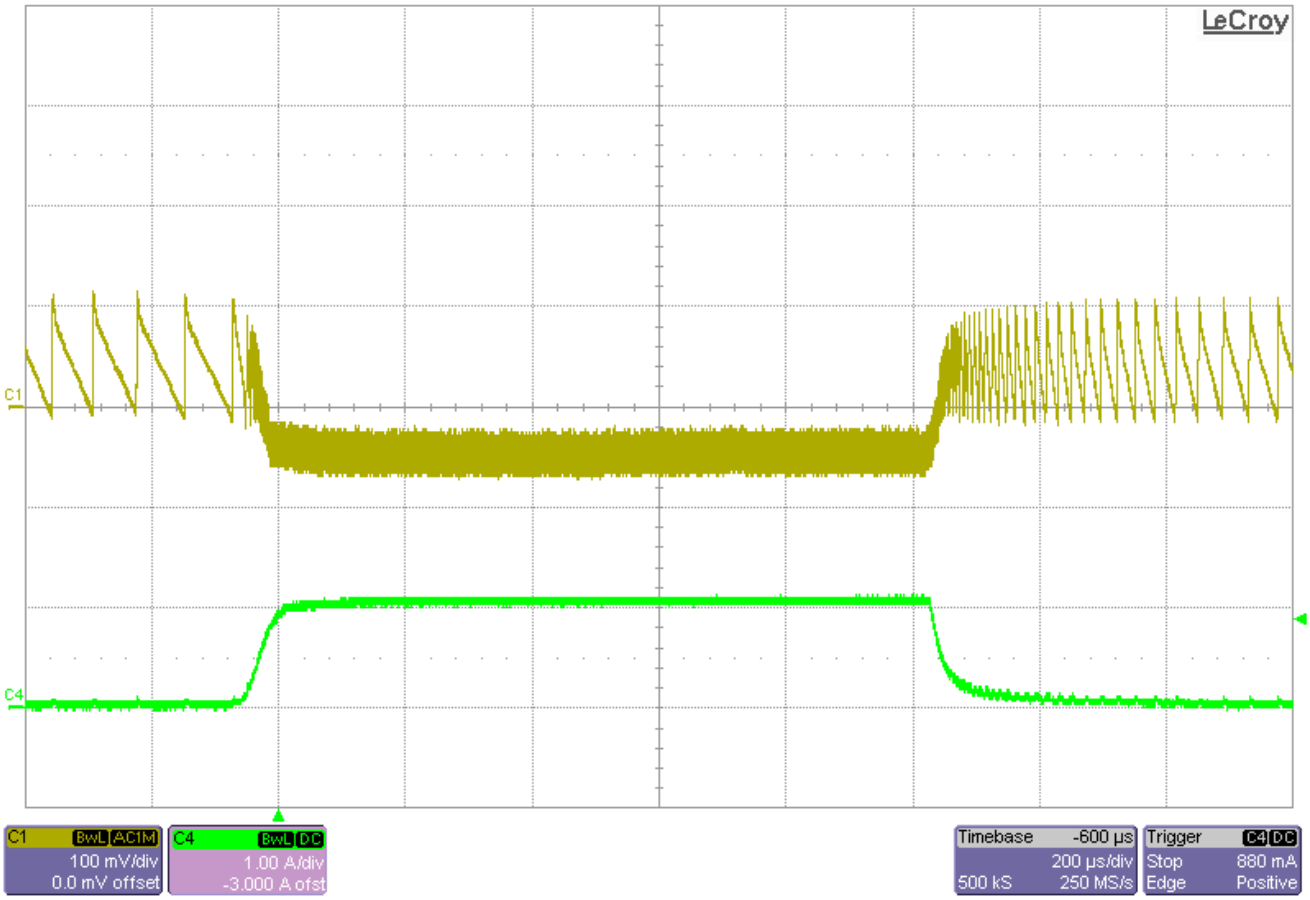
6.3 U9: Core 1 CPU 0.95 Vout, 0A – 3.9A Load Step



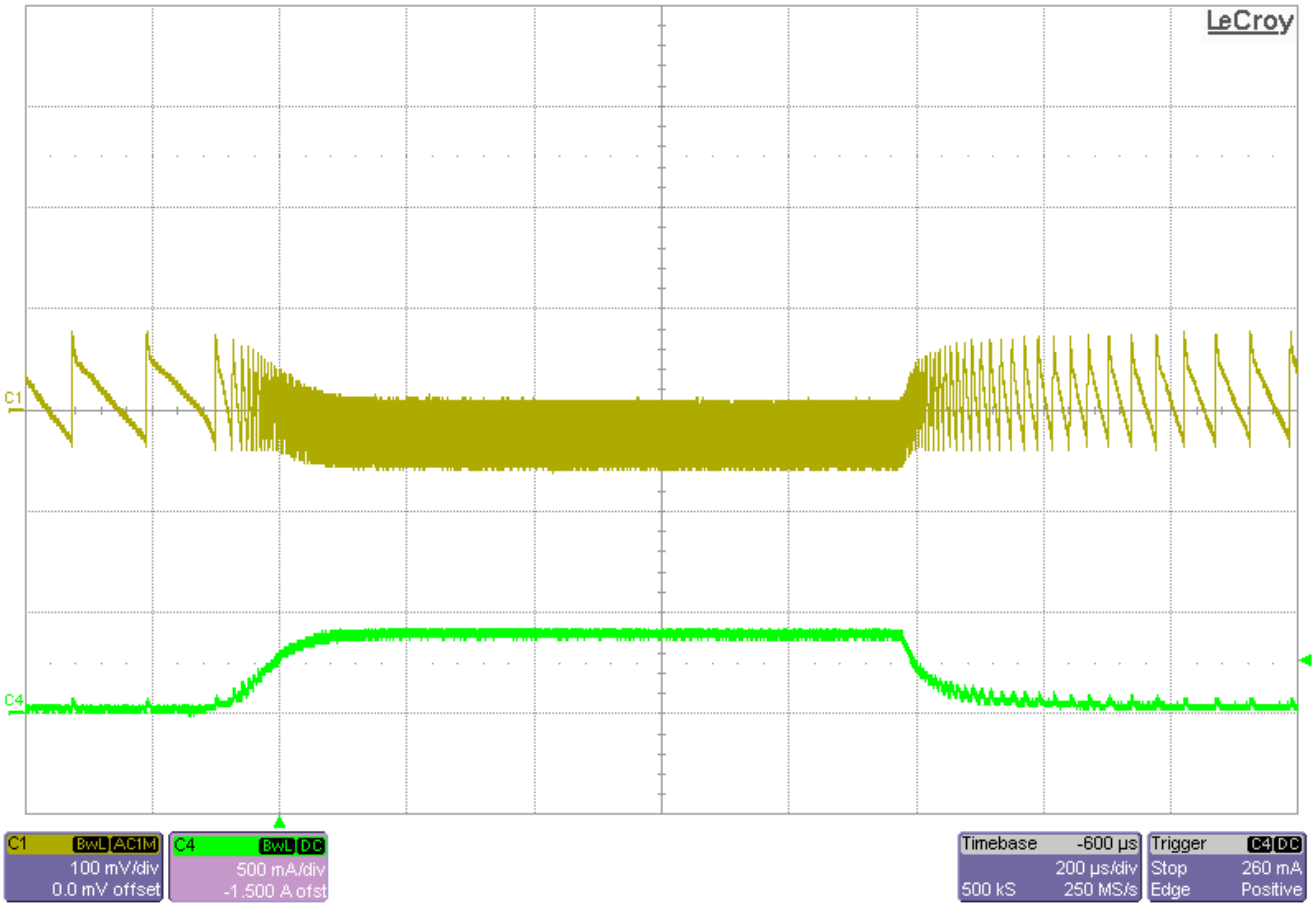
6.4 U11: Core 2 Set Top Box 0.95Vout, 0A – 3.5A Load Step



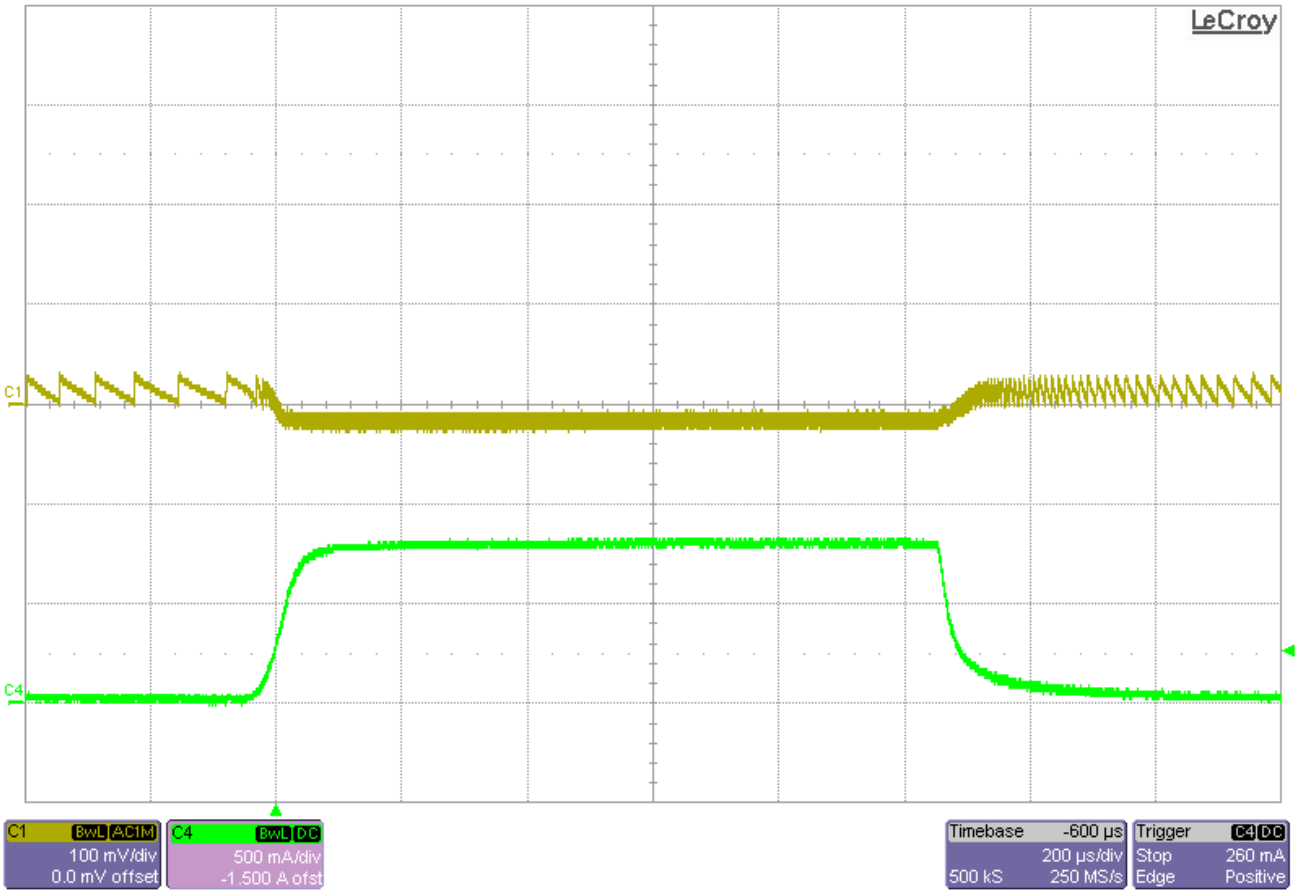
6.5 U7: HDMI/USB 5Vout, 0A – 1.055A Load Step



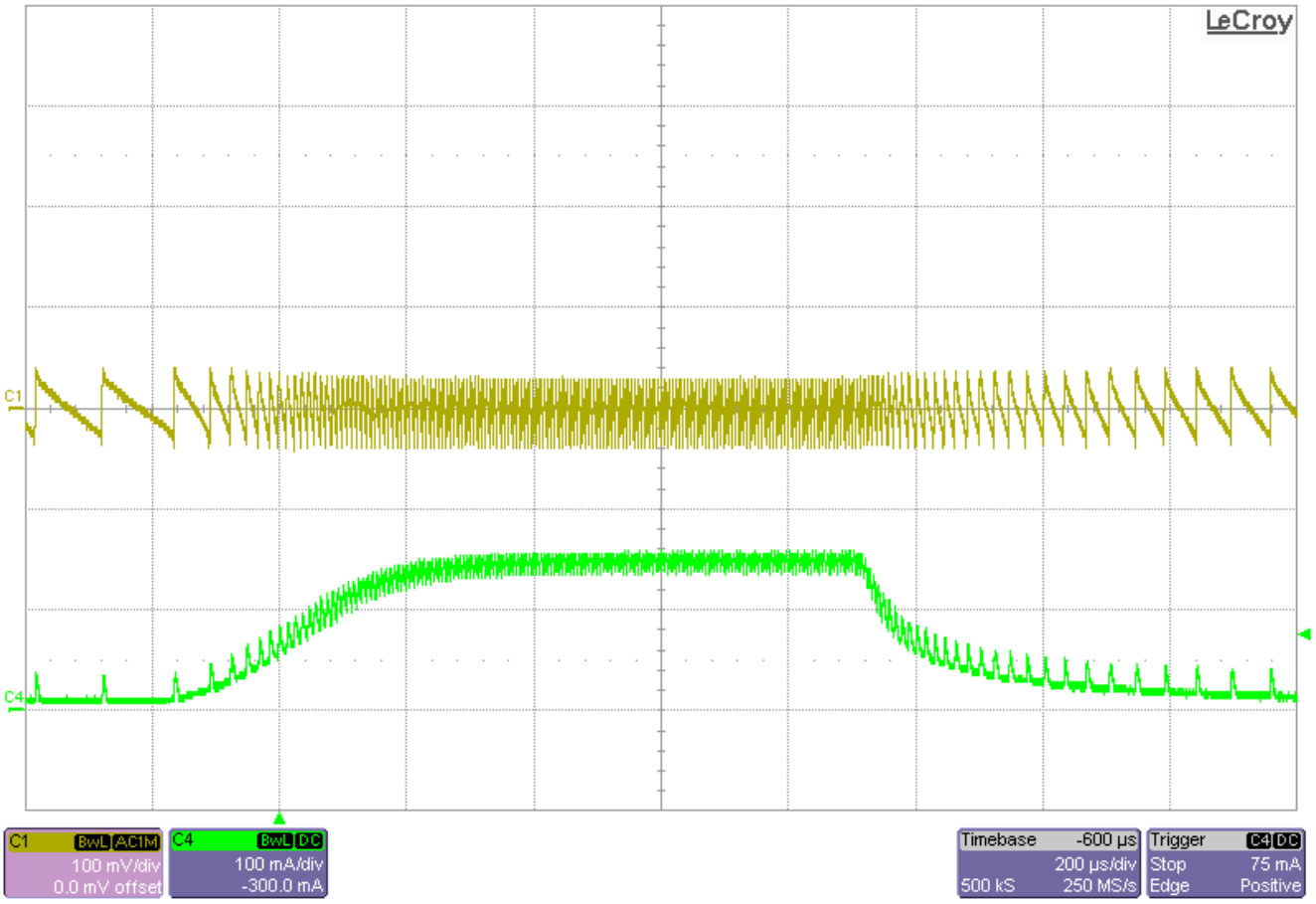
6.6 U4: Analog I/O 3.3Vout, 0A – 0.4A Load Step



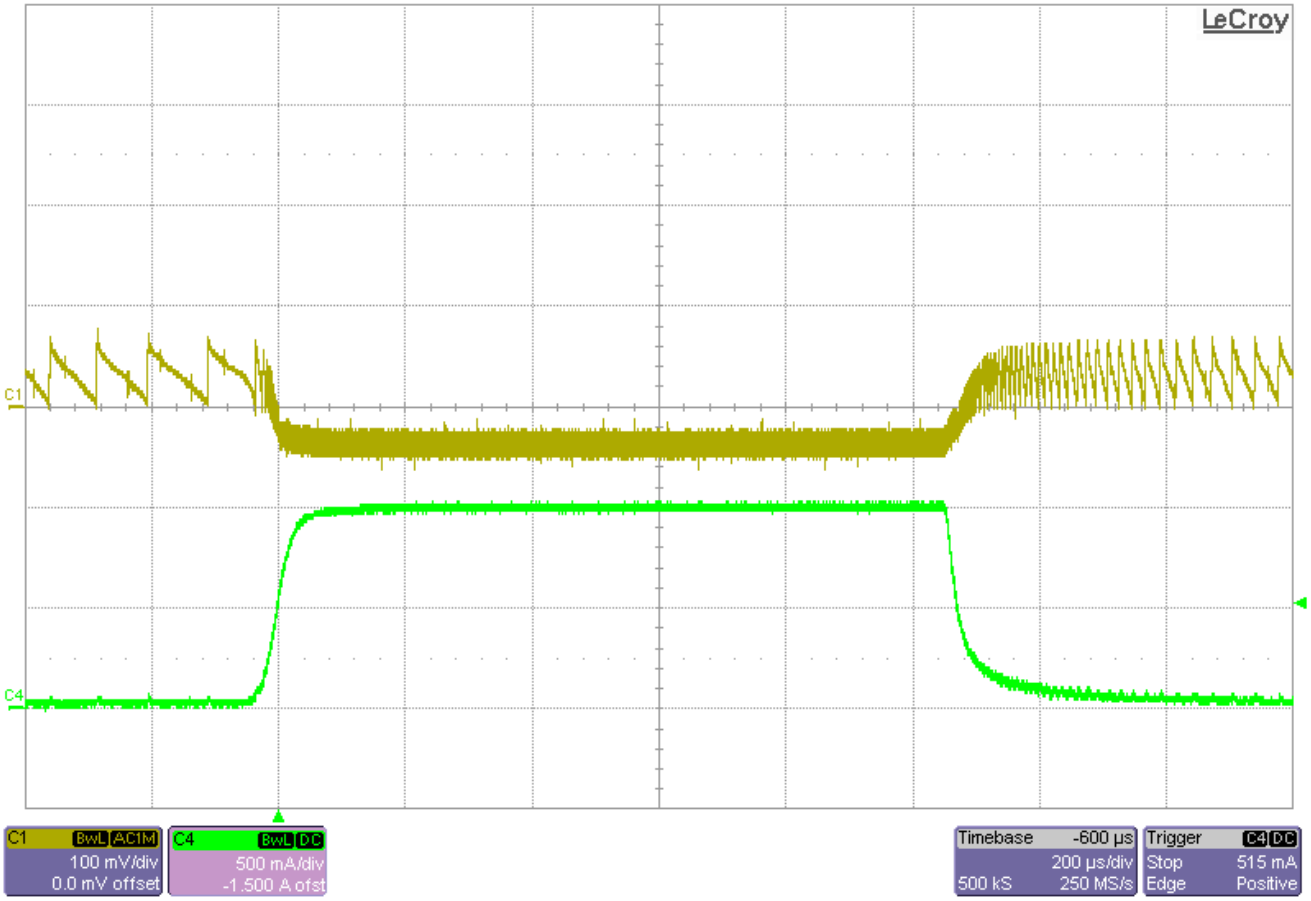
6.7 U1: DDR4 VDDQ 1.2Vout, 0A – 0.4A Load Step



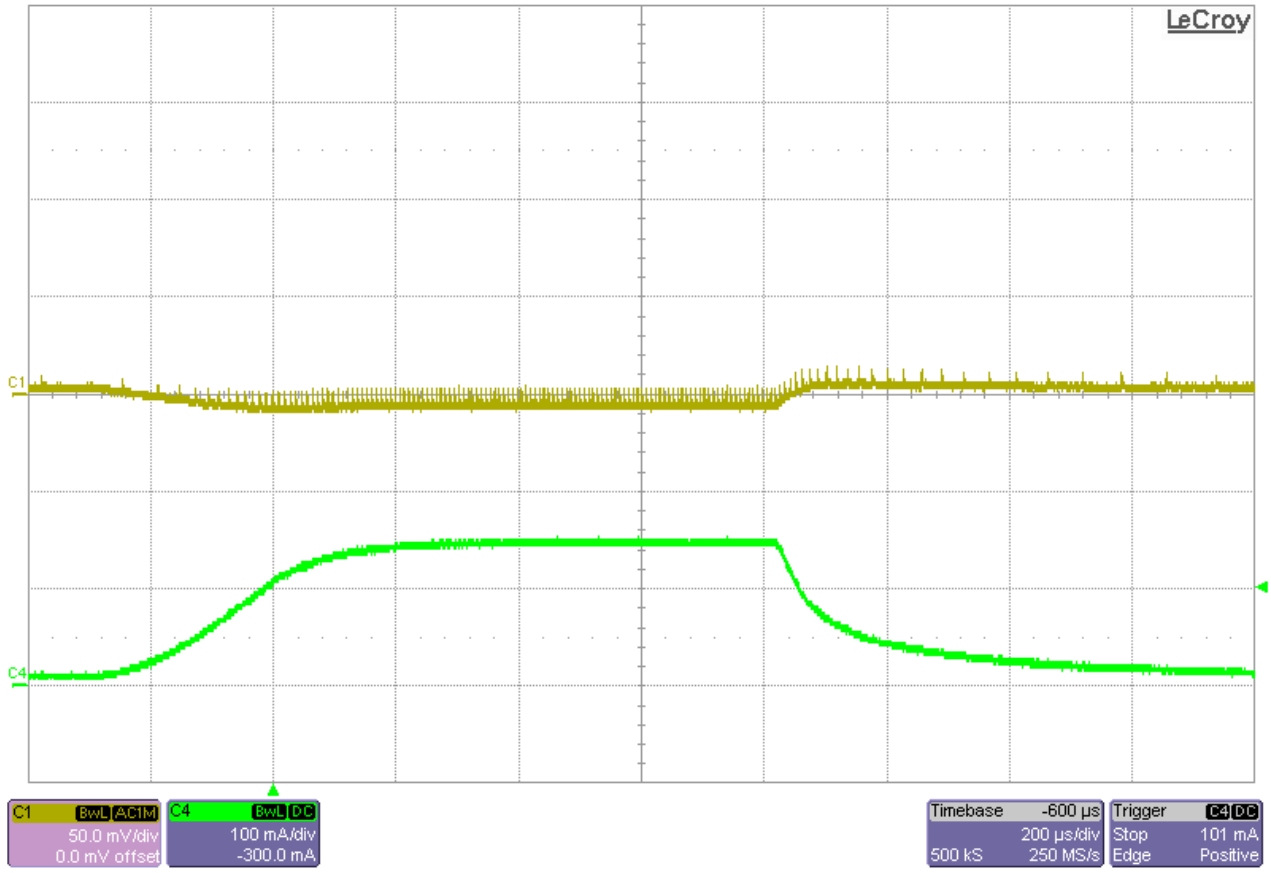
6.8 U3: DDR4 VPP 2.5Vout, 0A – 0.15A Load Step



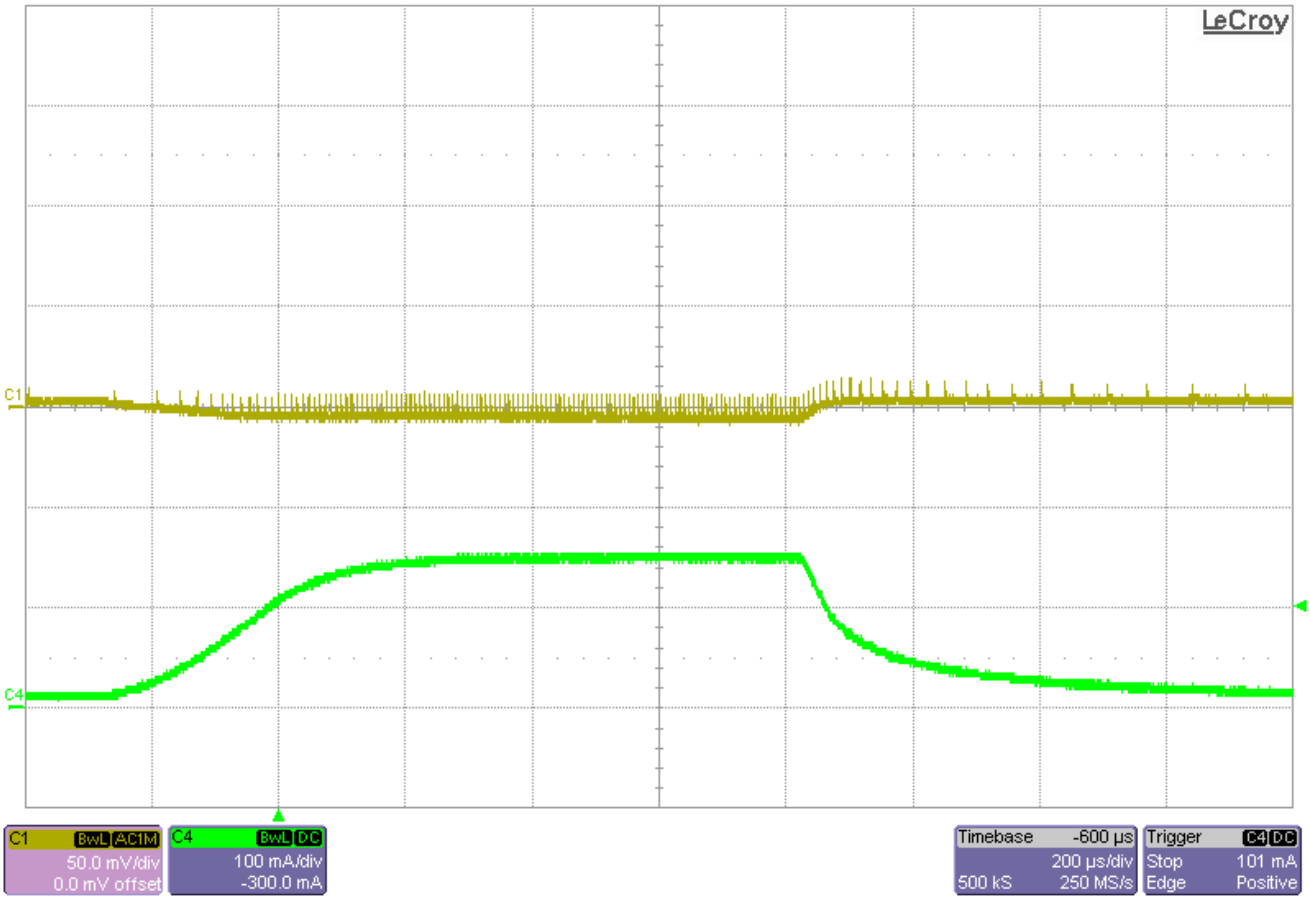
6.9 U3: DDR4 VPP 2.5Vout, 0A – 1A Load Step (Transient is more visible)



6.10 U5: Analog I/O 1.8V 1.8Vout, 0A – 0.15A Load Step



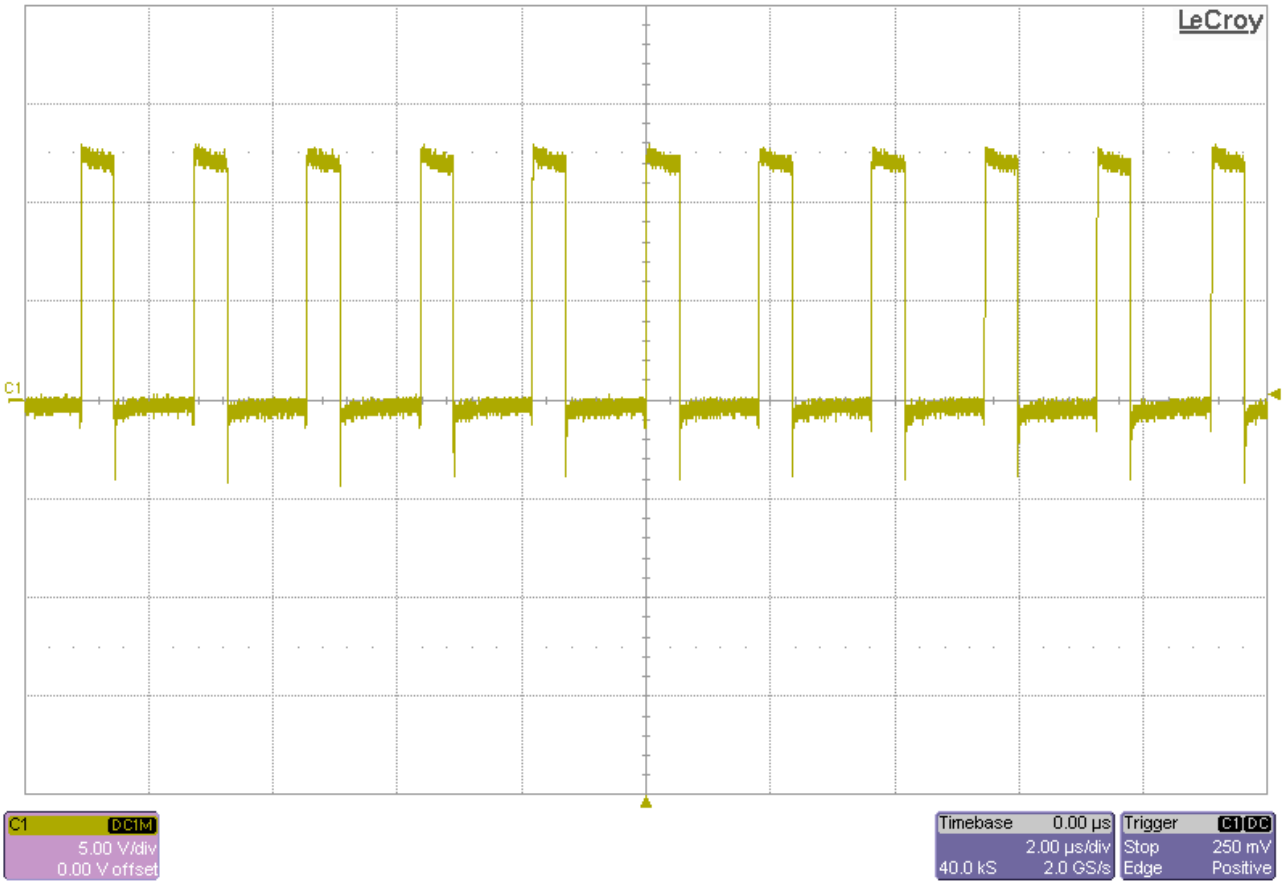
6.11 U13: Analog I/O 1.0V 1.0Vout, 0A – 0.15A Load Step



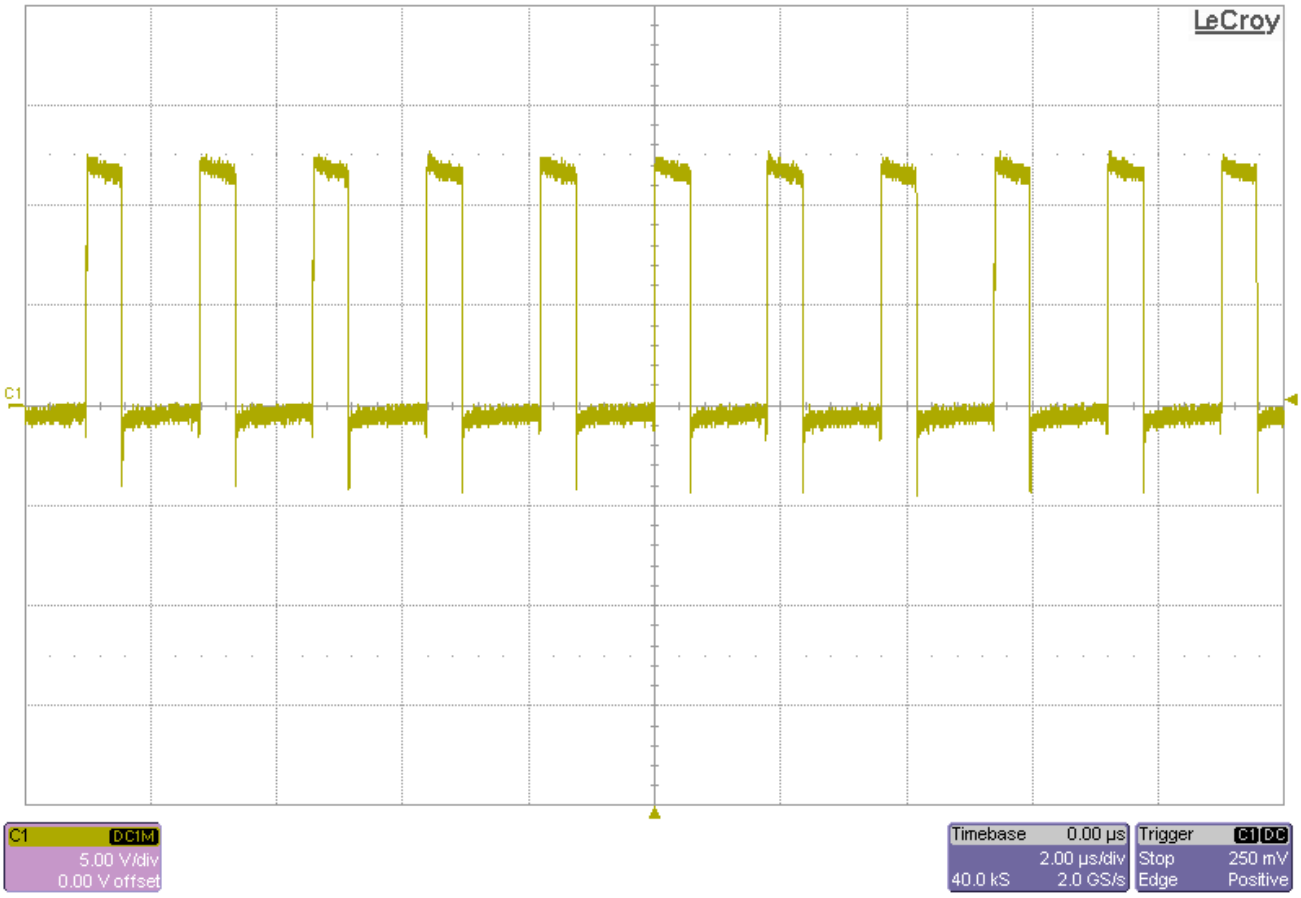
7 Switch Node Waveforms

The following waveforms were taken with typical loads on the outputs

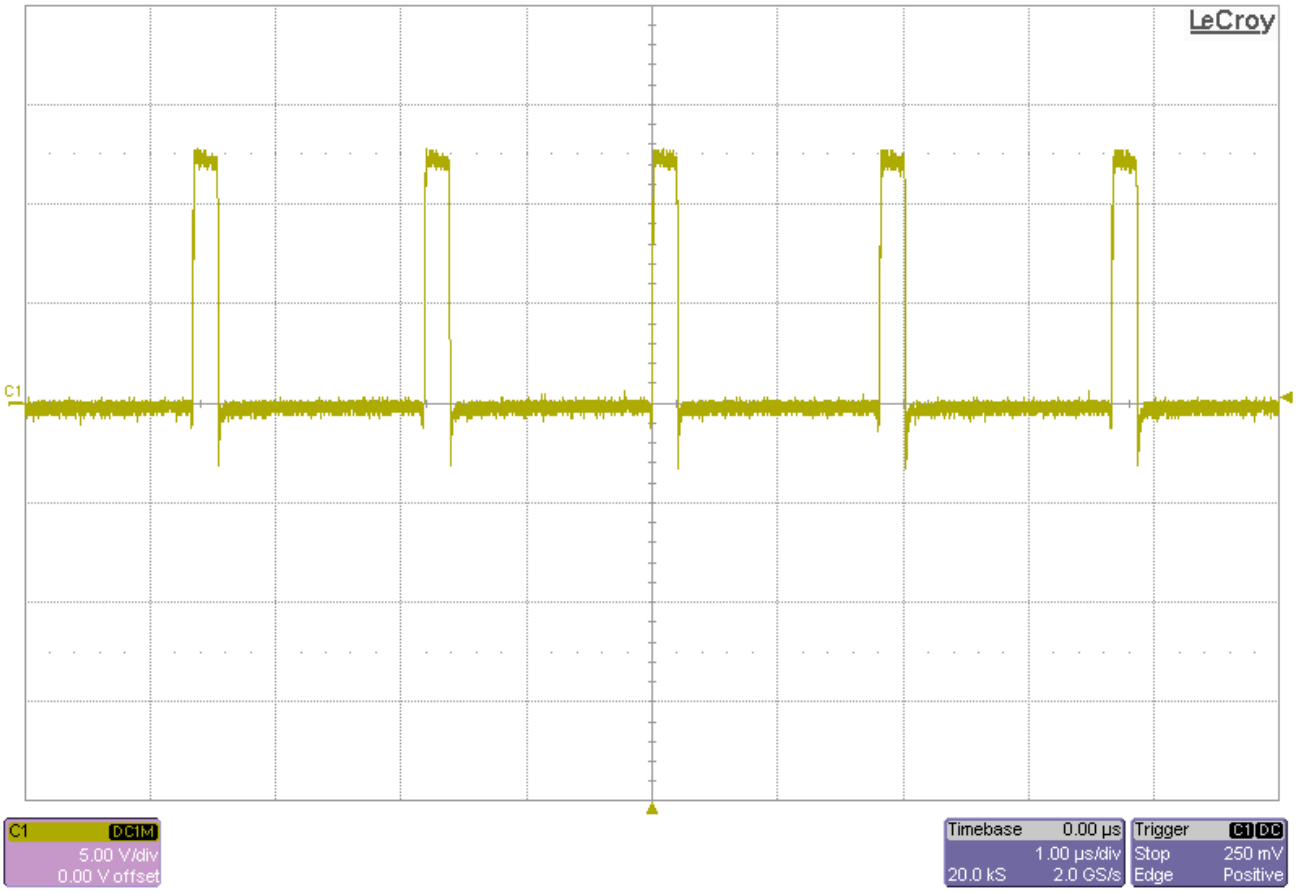
7.1 U10: WiFi



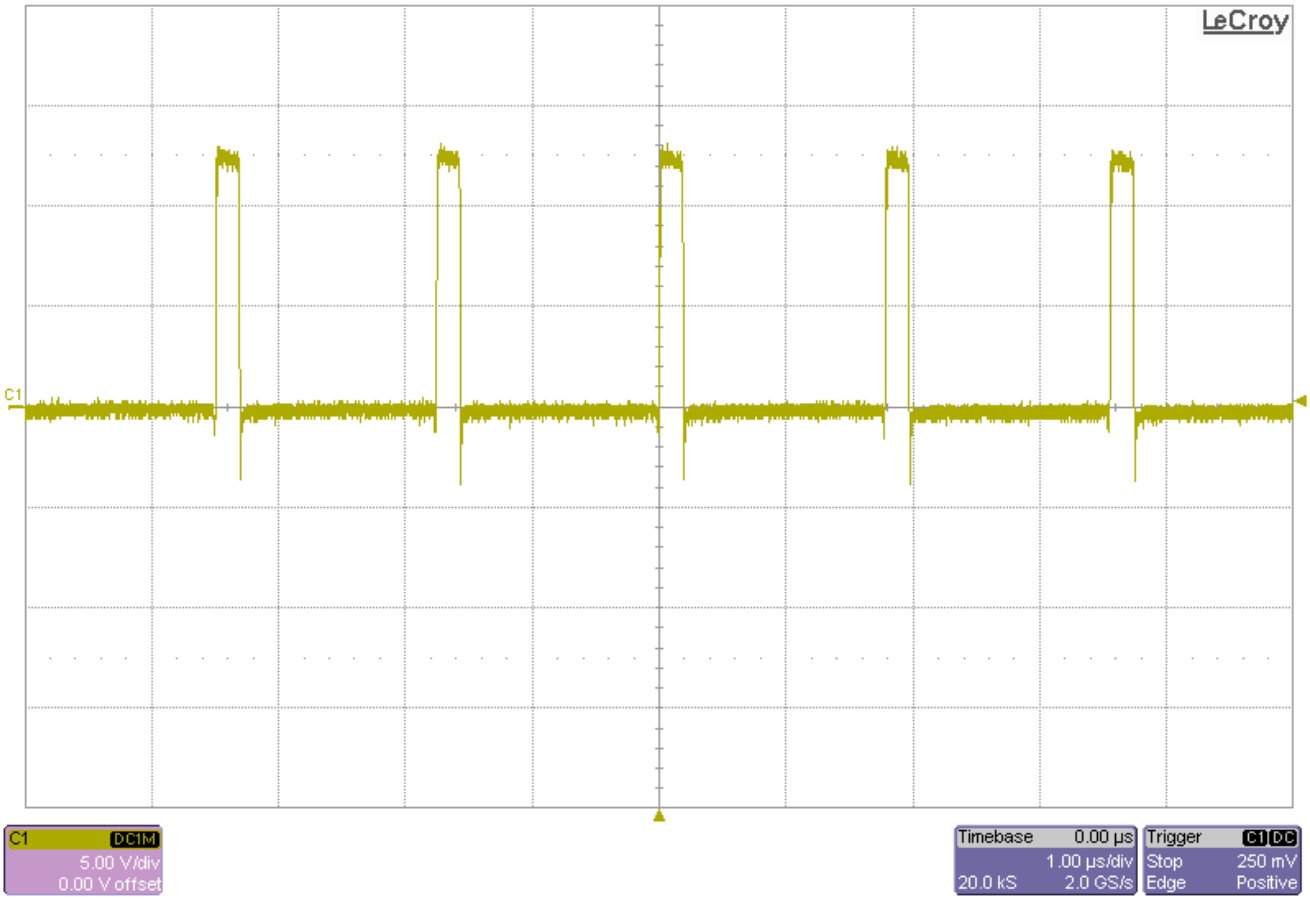
7.2 U12: Bluetooth



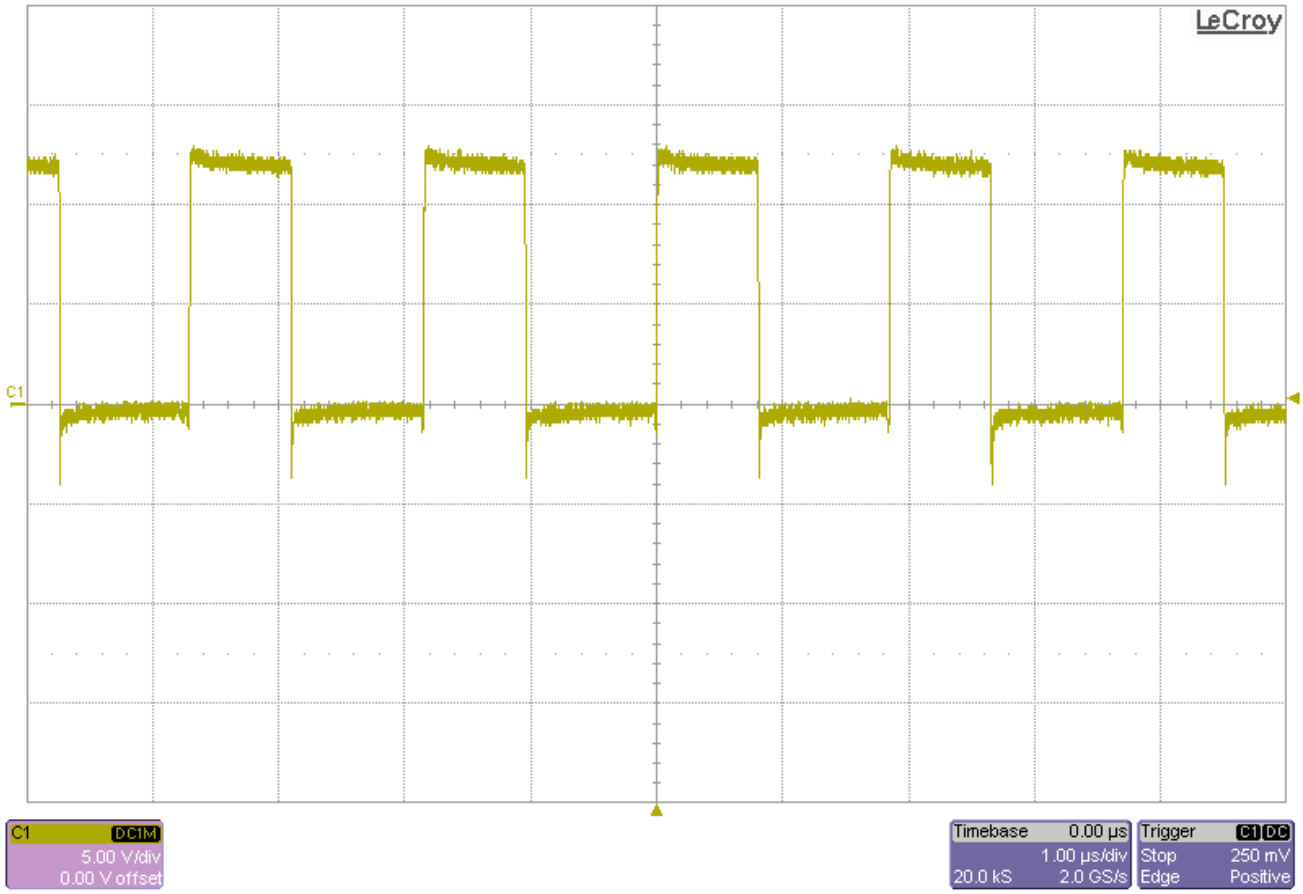
7.3 U9: Core 1 CPU



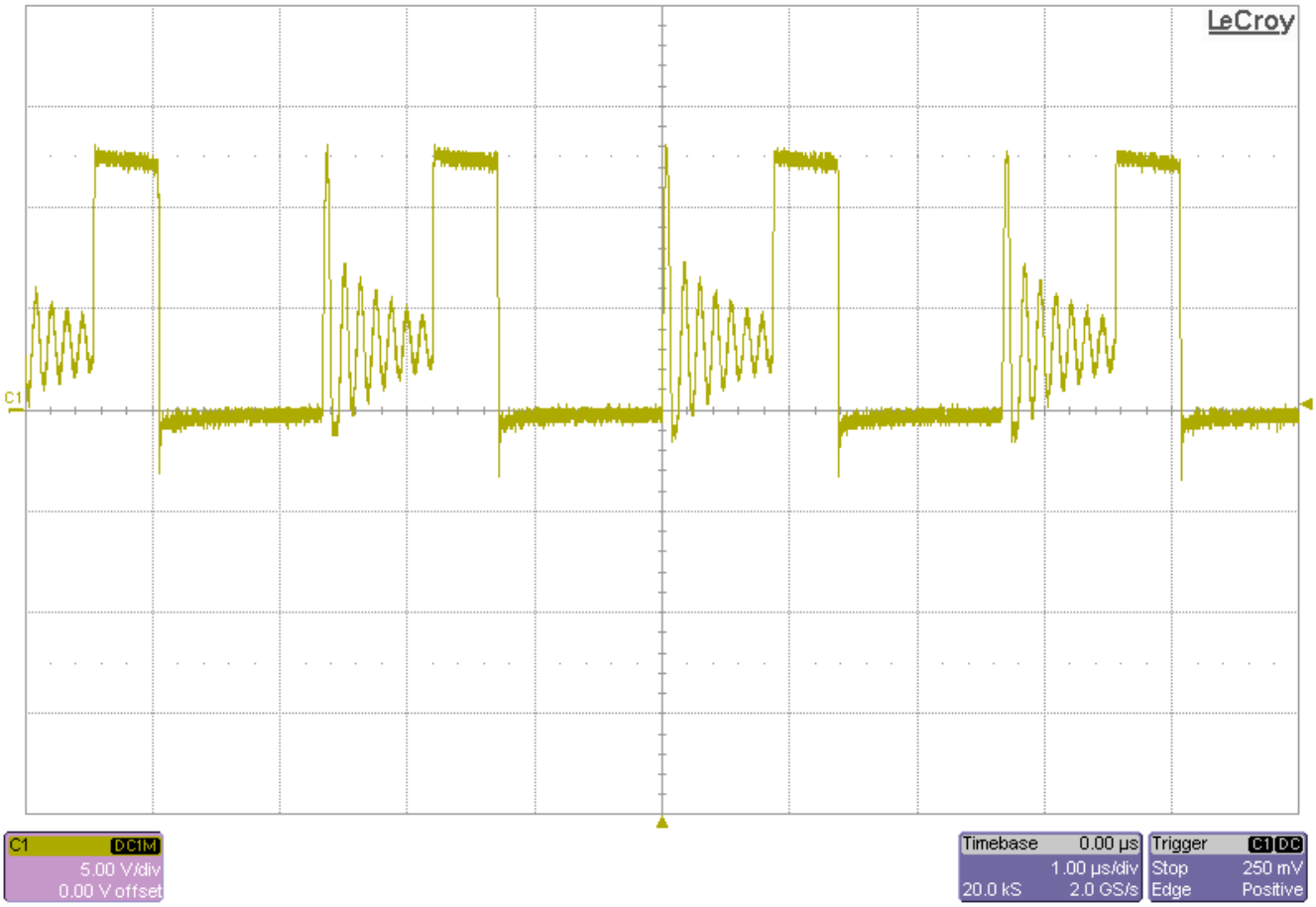
7.4 U11: Core 2 Set Top Box



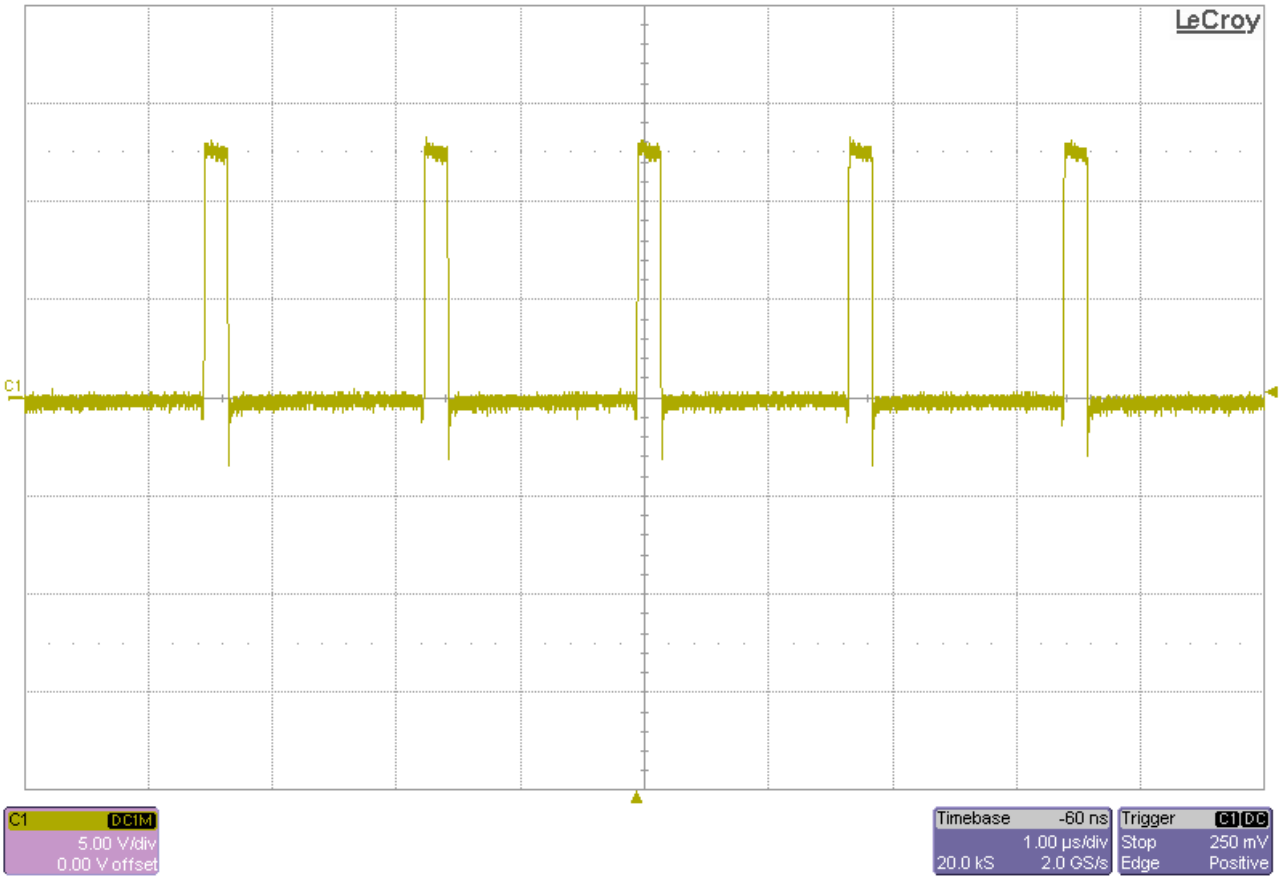
7.5 U7: HDMI/USB



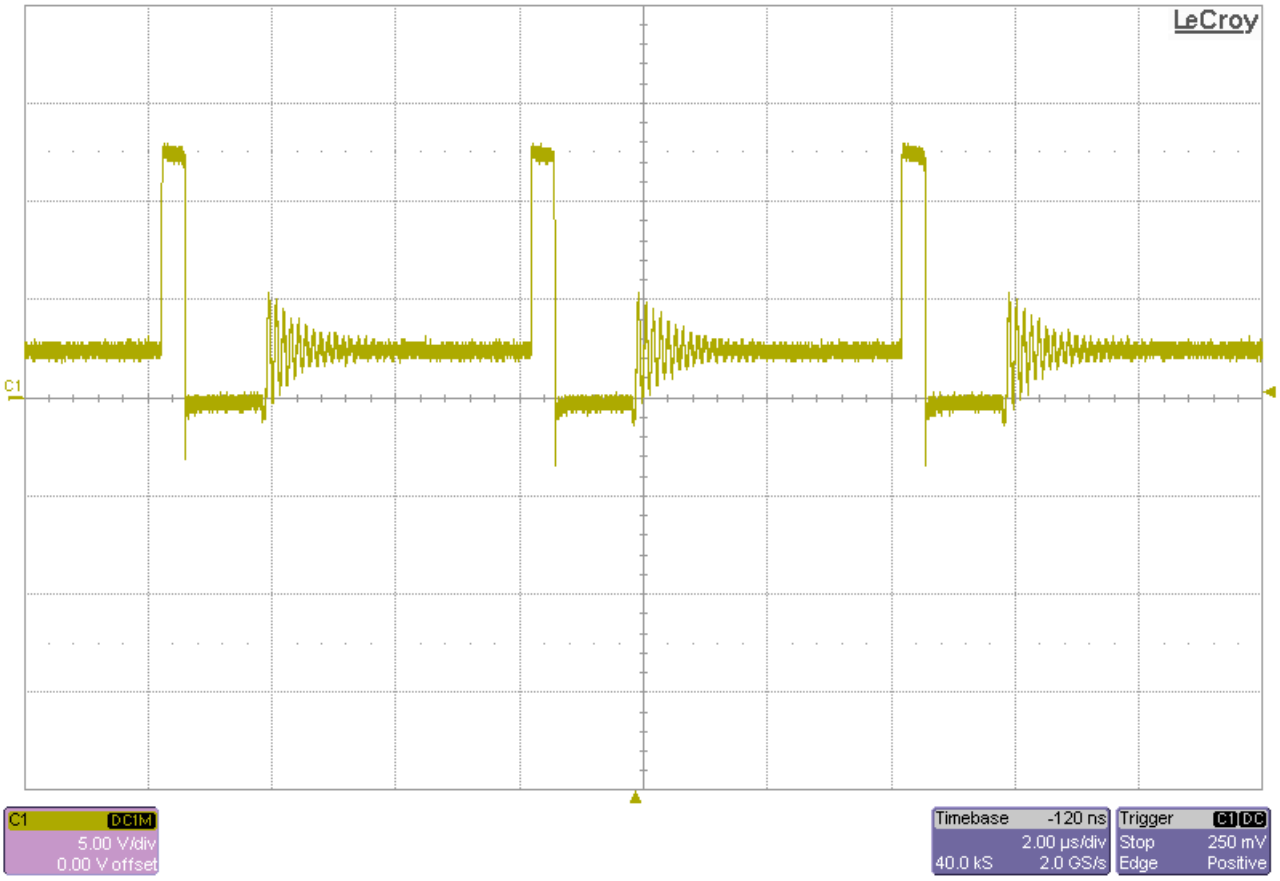
7.6 U4: Analog I/O



7.7 U1: DDR4 VDDQ



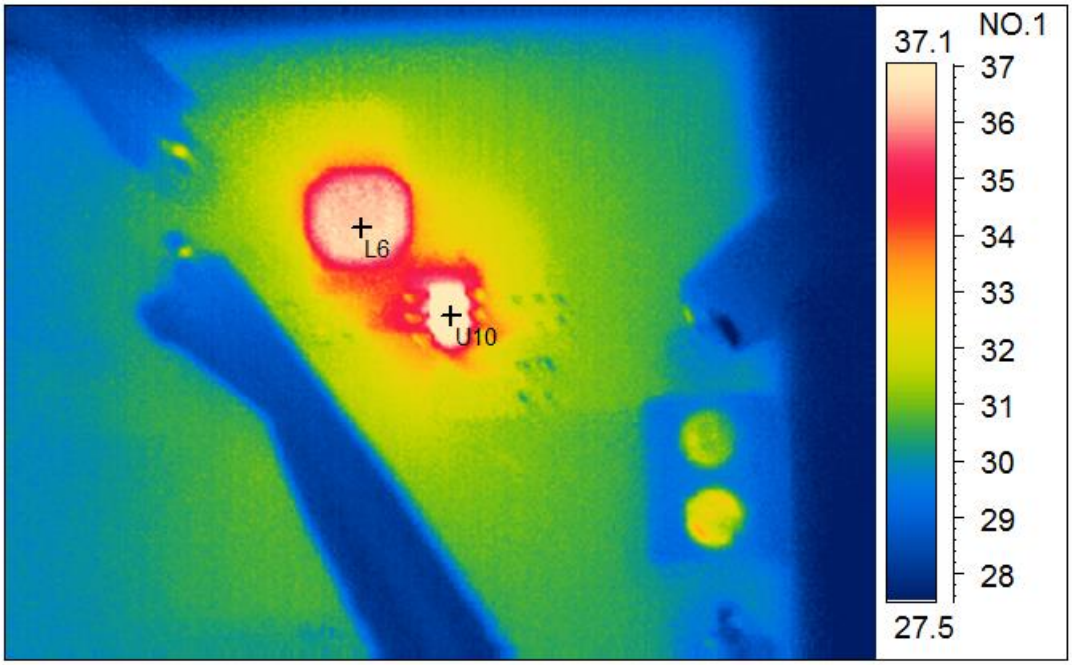
7.8 U3: DDR4 VPP



8 Thermal Images

These thermal images were taken after a 5 minute soak when loaded to typical values.

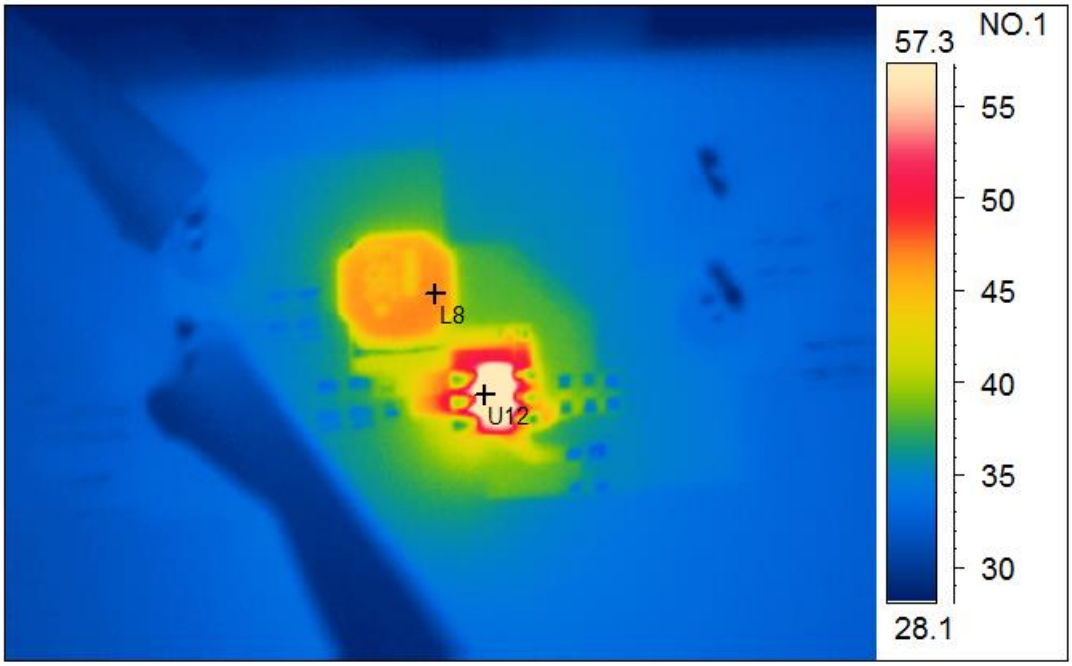
8.1 U10: WiFi



NO.1

Spot analysis	Value
L6Temperature	36.4°C
U10 Temperature	39.3°C

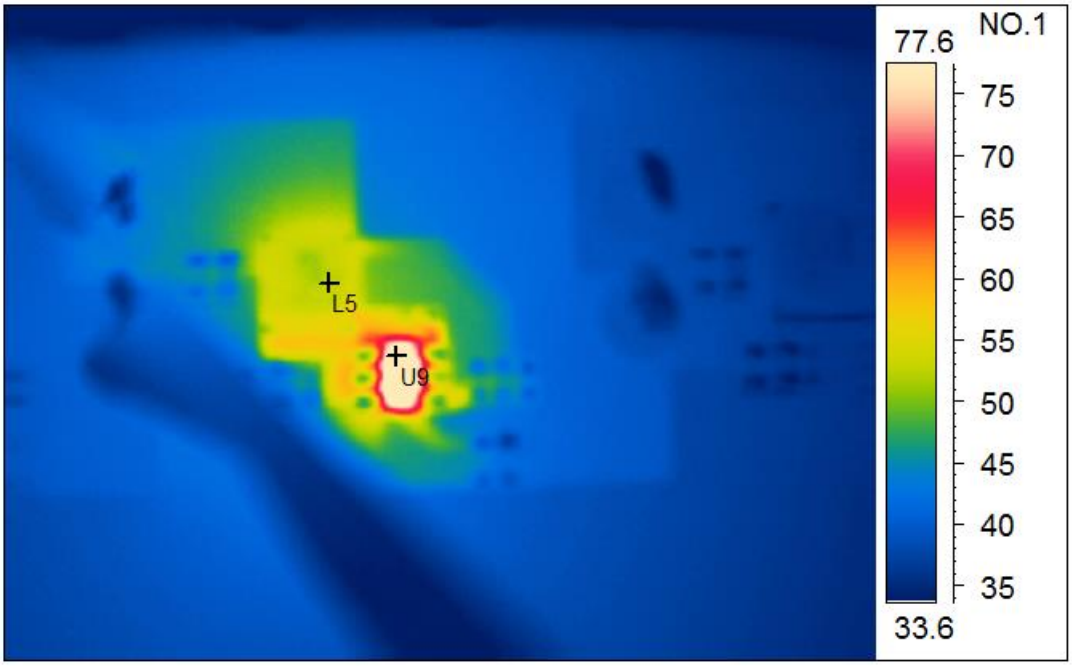
8.2 U12: Bluetooth



NO.1

Spot analysis	Value
L8 Temperature	47.2°C
U12 Temperature	68.1°C

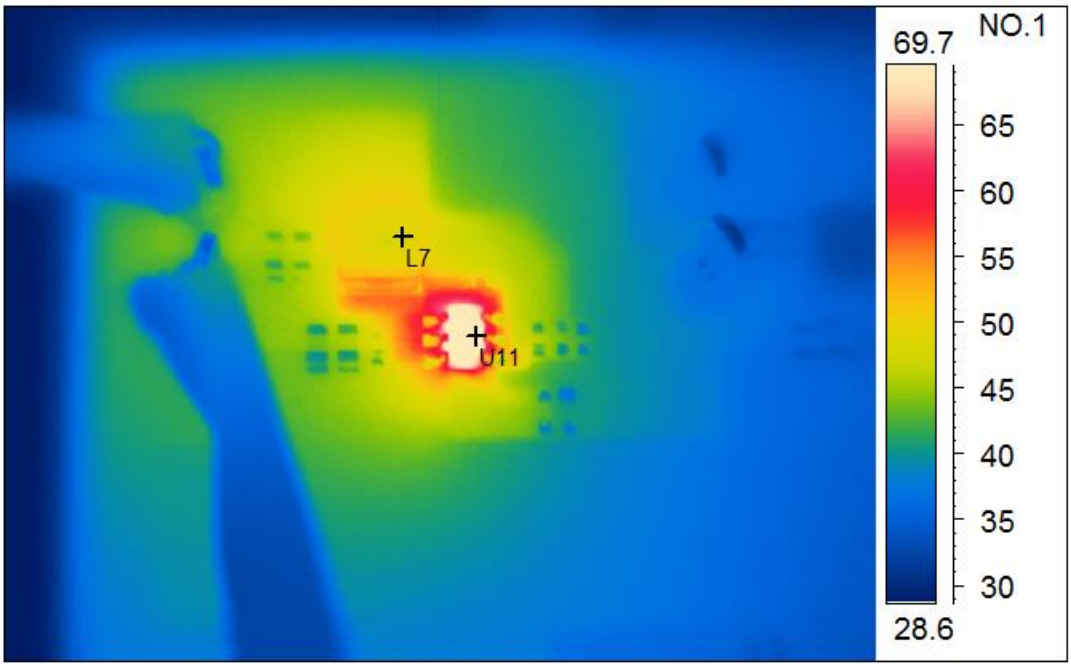
8.3 U9: Core 1 CPU



NO.1

Spot analysis	Value
U9Temperature	83.3°C
L5 Temperature	54.3°C

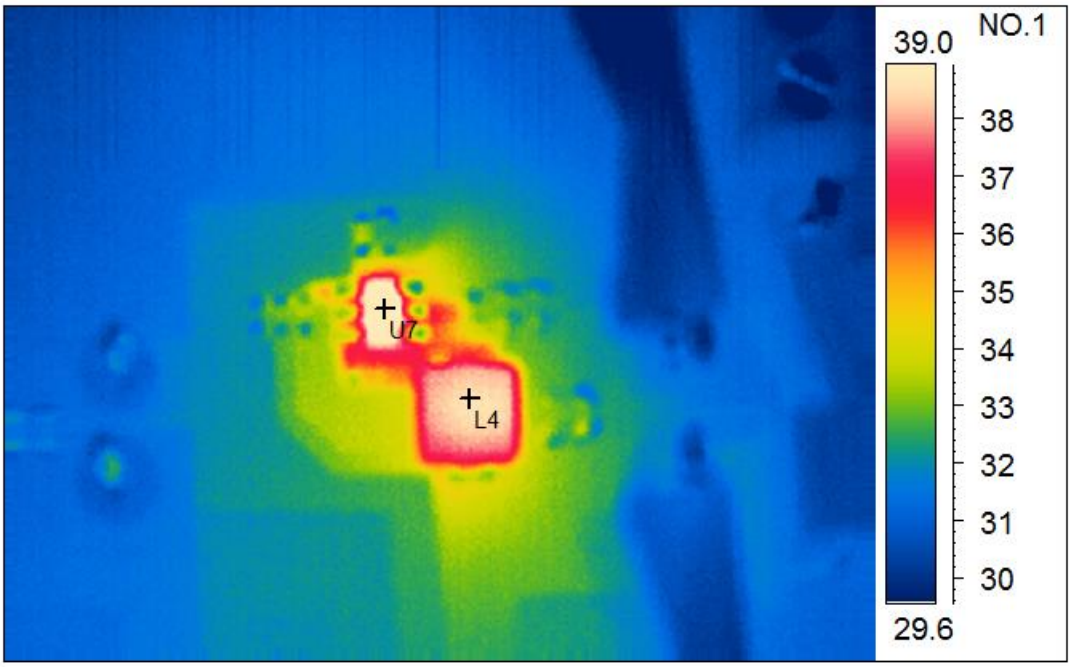
8.4 U11: Core 2 Set Top Box



NO.1

Spot analysis	Value
U11Temperature	72.4°C
L7 Temperature	49.8°C

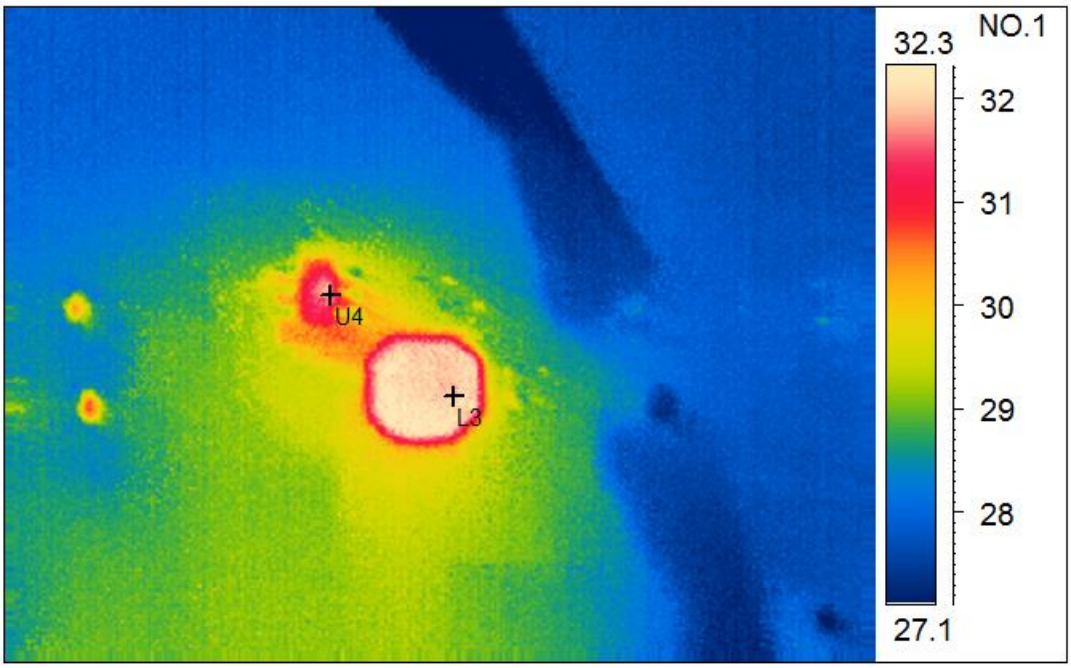
8.5 U7: HDMI/USB



NO.1

Spot analysis	Value
L4Temperature	38.6°C
U7 Temperature	41.3°C

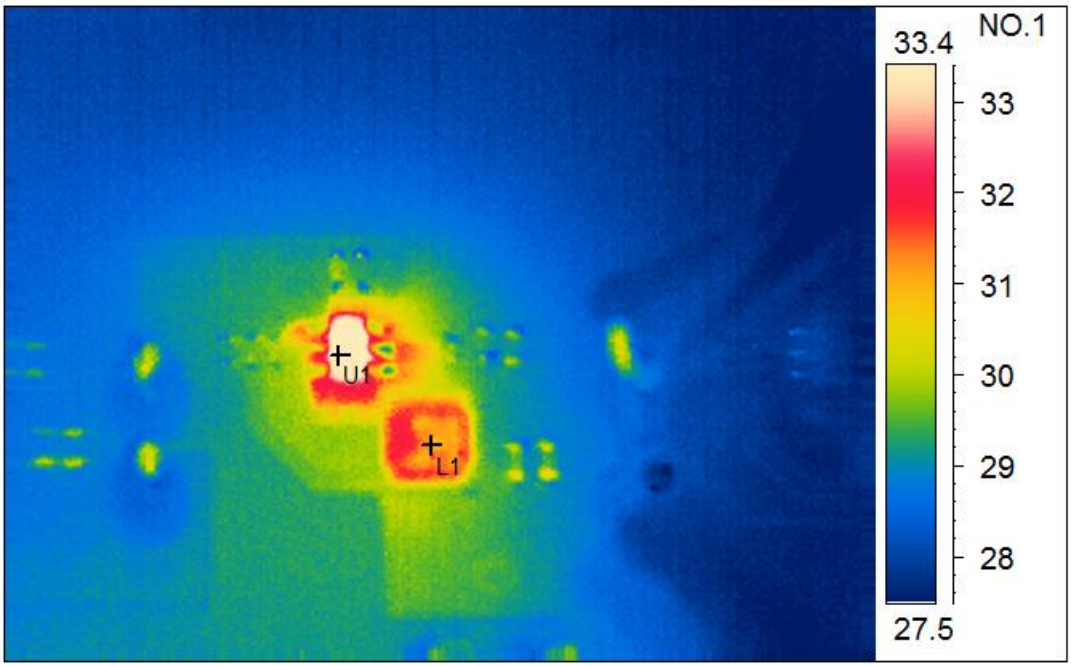
8.6 U4: Analog I/O



NO.1

Spot analysis	Value
L3Temperature	32.1°C
U4 Temperature	31.6°C

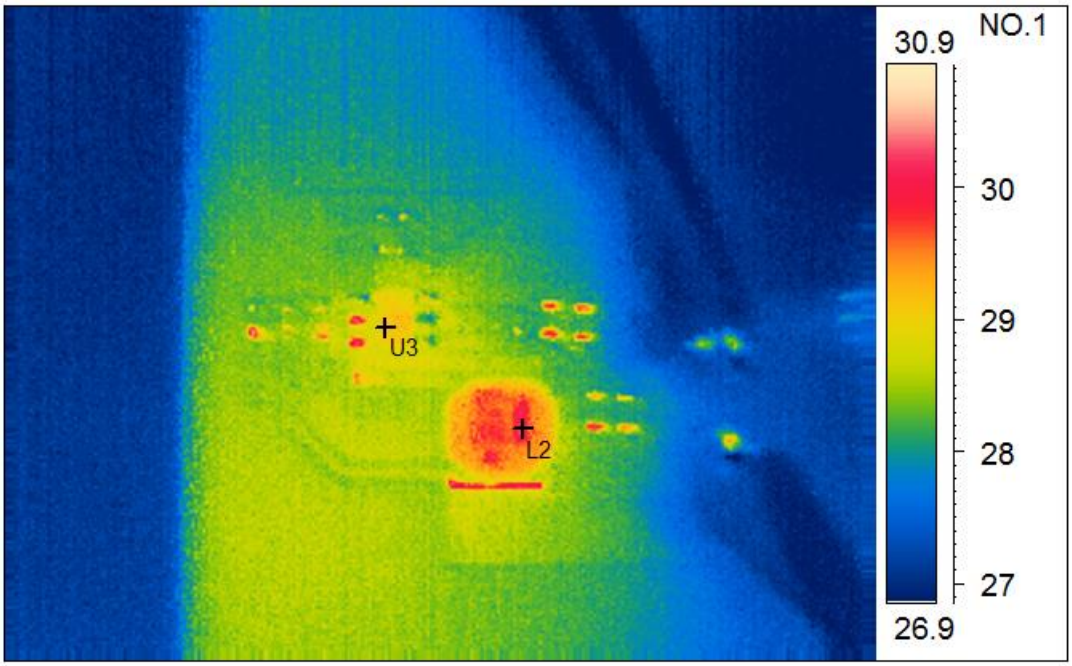
8.7 U1: DDR4 VDDQ



NO.1

Spot analysis	Value
U1 Temperature	34.2°C
L1 Temperature	31.2°C

8.8 U3: DDR4 VPP



NO.1

Spot analysis	Value
L2Temperature	30.1°C
U3 Temperature	29.1°C

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale (https:www.ti.com/legal/termsofsale.html) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265