Texas Instruments

PMP4496 Test Report

Asia Power Design Service

1 General

1.1 PURPOSE

Provide the detailed data for evaluating and verifying the PMP4496.
PMP4496 is a power bank reference design within single USB type C Dual Role Port (DRP). This type C DRP supports 5V/3A output when a UFP is attached and is also capable for handling fast charger input.

The valid input voltage can be up to 12V according to the charging protocol. The output voltage of type C port is fixed at 5.1V and max current advertisement is also rated at 3A. This reference design can recognize the external device automatically.

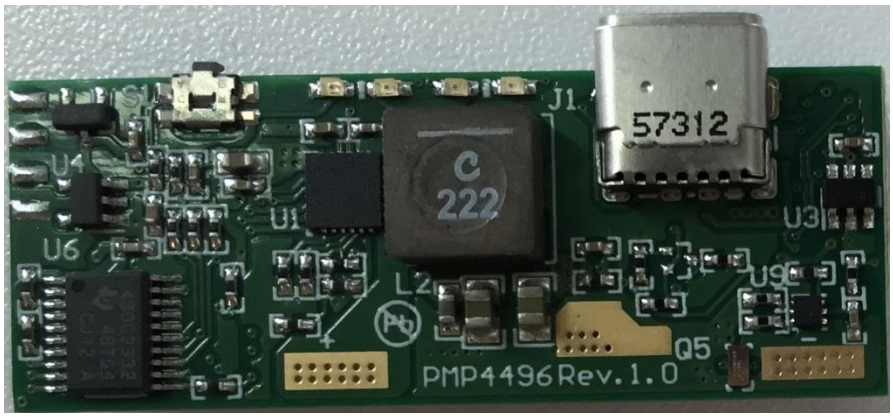
1.2 REFERENCE DOCUMENTATION

PMP4496_Schematic.pdf
PMP4496_Layout.zip
PMP4496_BOM.pdf

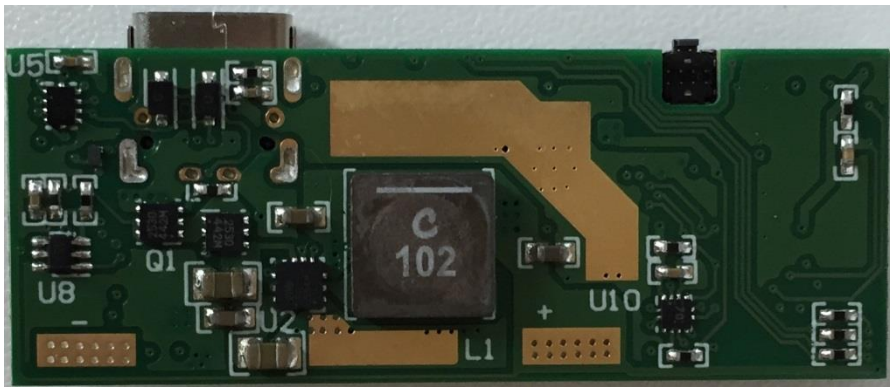
1.3 TEST EQUIPMENTS

Multi-meter: FLUKE 287B
DC Source: Chroma 62024P-100-50
Electronic Load: Chroma 63103A
Oscillation: Tektronix DPO3054
Infrared Thermometer: FLUKE Ti9

1.4 PHOTOS



Top View



Bottom View

2 INPUT AND OUTPUT CHARACTERISTICS

2.1 STANDBY CURRENT

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
I_{STD}	Standby current	VBAT=3.5V, Port unattached		140		uA

2.2 EFFICIENCY

12Vin Charging & VBAT=3.2V

V_{in}(V)	I_{in}(A)	V_{BAT}(V)	I_{BAT}(A)	EFF.(%)
12.098	0.042	3.1939	0.0666	41.86%
12.085	0.1764	3.201	0.4444	66.73%
12.069	0.3405	3.2101	0.9498	74.19%
12.053	0.5096	3.2195	1.4644	76.76%
12.036	0.6813	3.2287	1.9697	77.55%
12.025	0.828	3.2181	2.4628	79.60%
12.009	0.994	3.226	2.9053	78.52%

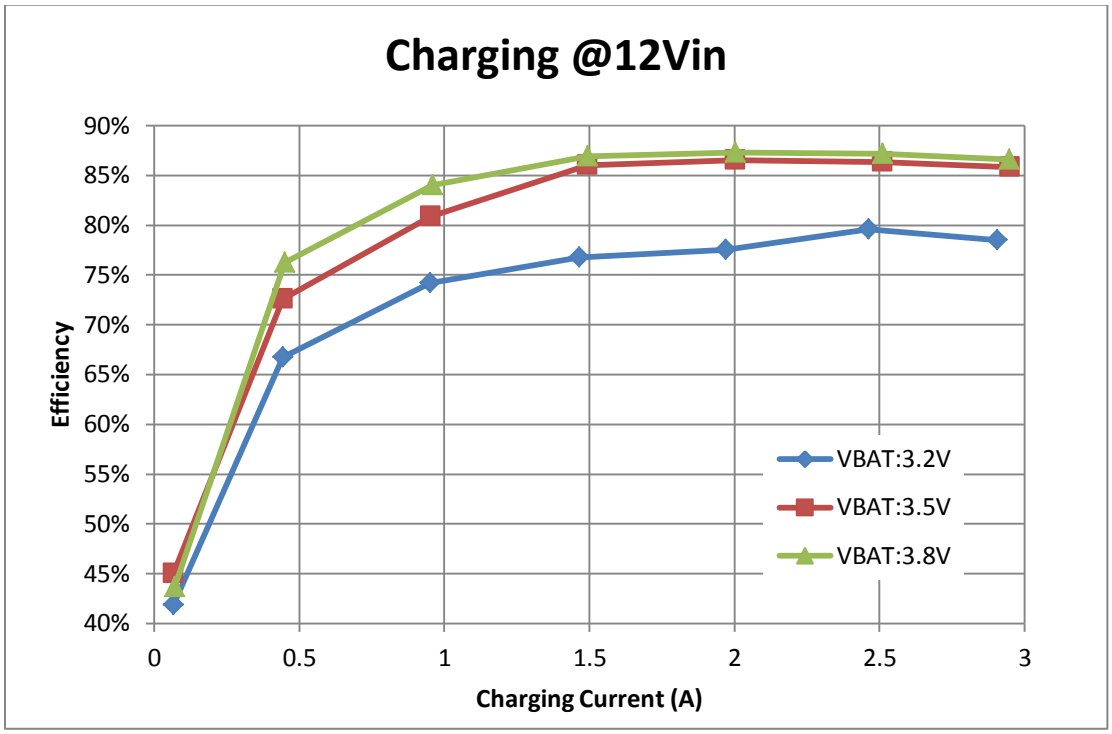
12Vin Charging & VBAT=3.5V

V_{in}(V)	I_{in}(A)	V_{BAT}(V)	I_{BAT}(A)	EFF.(%)
12.099	0.042	3.4875	0.0656	45.02%
12.085	0.177	3.4945	0.4444	72.60%
12.069	0.3423	3.5038	0.9534	80.86%
12.052	0.506	3.5136	1.4934	86.04%
12.035	0.6776	3.5229	2.0034	86.55%
12.017	0.8545	3.532	2.5106	86.36%
12.001	1.014	3.5401	2.9494	85.80%

12Vin Charging & VBAT=3.8V

V_{in}(V)	I_{in}(A)	V_{BAT}(V)	I_{BAT}(A)	EFF.(%)
12.098	0.0503	3.7809	0.0703	43.68%

12.084	0.1847	3.788	0.4491	76.22%
12.067	0.3592	3.7973	0.9591	84.02%
12.048	0.543	3.807	1.4934	86.90%
12.03	0.7275	3.8162	2.0025	87.32%
12.011	0.9171	3.8254	2.5097	87.16%
11.993	1.0875	3.8334	2.9475	86.63%



9Vin Charging & VBAT=3.2V

V_{in}(V)	I_{in}(A)	V_{BAT}(V)	I_{BAT}(A)	EFF.(%)
9.097	0.0447	3.1939	0.0656	51.53%
9.079	0.217	3.2009	0.4444	72.20%
9.056	0.434	3.2101	0.9497	77.57%
9.032	0.6578	3.2194	1.4625	79.25%
9.008	0.886	3.2286	1.9688	79.64%
8.998	1.101	3.2181	2.4656	80.09%
8.969	1.33	3.2264	2.9128	78.78%

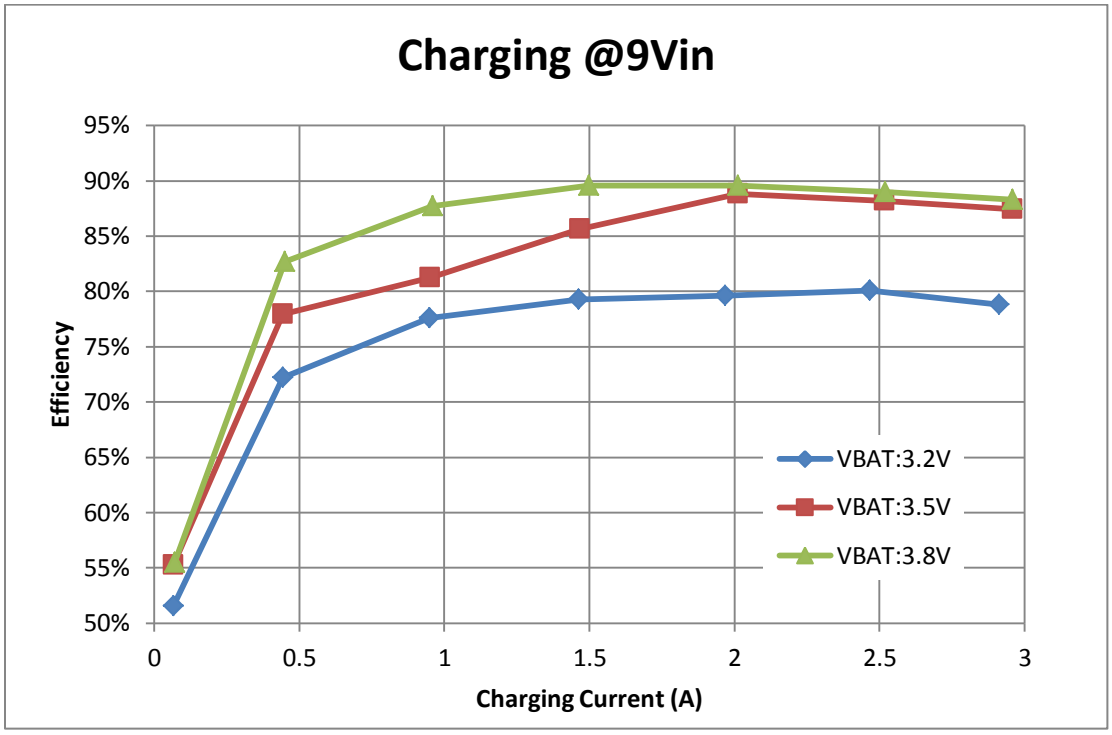
9Vin Charging & VBAT=3.5V

V_{in}(V)	I_{in}(A)	V_{BAT}(V)	I_{BAT}(A)	EFF.(%)
9.097	0.045	3.4481	0.0656	55.26%
9.079	0.217	3.4552	0.4444	77.94%
9.057	0.435	3.3644	0.9516	81.26%
9.034	0.659	3.4738	1.4672	85.61%

9.012	0.876	3.4837	2.0128	88.82%
8.987	1.116	3.5125	2.5172	88.16%
8.964	1.329	3.5206	2.9588	87.44%

9Vin Charging & VBAT=3.8V

V_{in}(V)	I_{in}(A)	V_{BAT}(V)	I_{BAT}(A)	EFF.(%)
9.097	0.052	3.7809	0.0694	55.47%
9.079	0.227	3.788	0.45	82.71%
9.056	0.459	3.7973	0.96	87.70%
9.031	0.7048	3.807	1.4972	89.55%
9.007	0.952	3.8164	2.0119	89.55%
8.981	1.2063	3.8256	2.52	88.99%
8.958	1.4347	3.8336	2.9597	88.28%



5Vin Charging & VBAT=3.2V

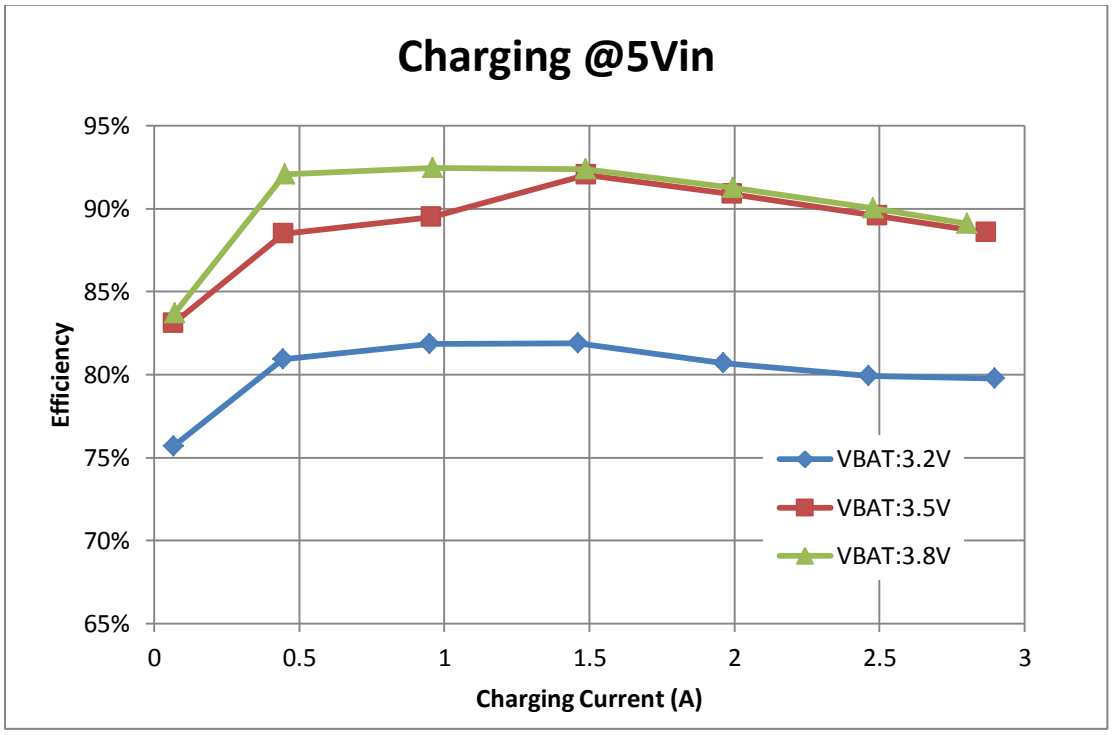
V_{in}(V)	I_{in}(A)	V_{BAT}(V)	I_{BAT}(A)	EFF.(%)
5.09	0.0544	3.1939	0.0656	75.67%
5.0669	0.3469	3.2007	0.4444	80.92%
5.0362	0.7387	3.2096	0.9488	81.86%
5.0042	1.1479	3.2187	1.4616	81.90%
4.9452	1.578	3.2089	1.9622	80.69%
4.9027	2.0225	3.218	2.4628	79.93%
4.8676	2.407	3.226	2.8969	79.76%

5Vin Charging & VBAT=3.5V

V_{in}(V)	I_{in}(A)	V_{BAT}(V)	I_{BAT}(A)	EFF.(%)
5.0897	0.0541	3.4874	0.0656	83.08%
5.0667	0.3471	3.4943	0.4453	88.48%
5.0358	0.7418	3.5033	0.9544	89.51%
5.0055	1.1352	3.5126	1.4888	92.03%
4.9729	1.5533	3.5216	1.9931	90.87%
4.9371	1.9907	3.5306	2.4928	89.55%
4.9098	2.3331	3.5371	2.8678	88.55%

5Vin Charging & VBAT=3.8V

V_{in}(V)	I_{in}(A)	V_{BAT}(V)	I_{BAT}(A)	EFF.(%)
5.0883	0.0613	3.7612	0.0694	83.69%
5.0604	0.364	3.7683	0.45	92.06%
5.0226	0.78	3.7775	0.9591	92.48%
4.9817	1.2234	3.7871	1.4869	92.39%
4.9396	1.679	3.7964	1.9941	91.28%
4.8969	2.138	3.8051	2.4769	90.02%
4.8665	2.4624	3.8111	2.8022	89.12%



Discharging @ VBAT=3.2V

V_{BAT}(V)	I_{BAT}(A)	V_o(V)	I_o(A)	EFF.(%)
3.164	0.157	5.194	0.0881	92.12%

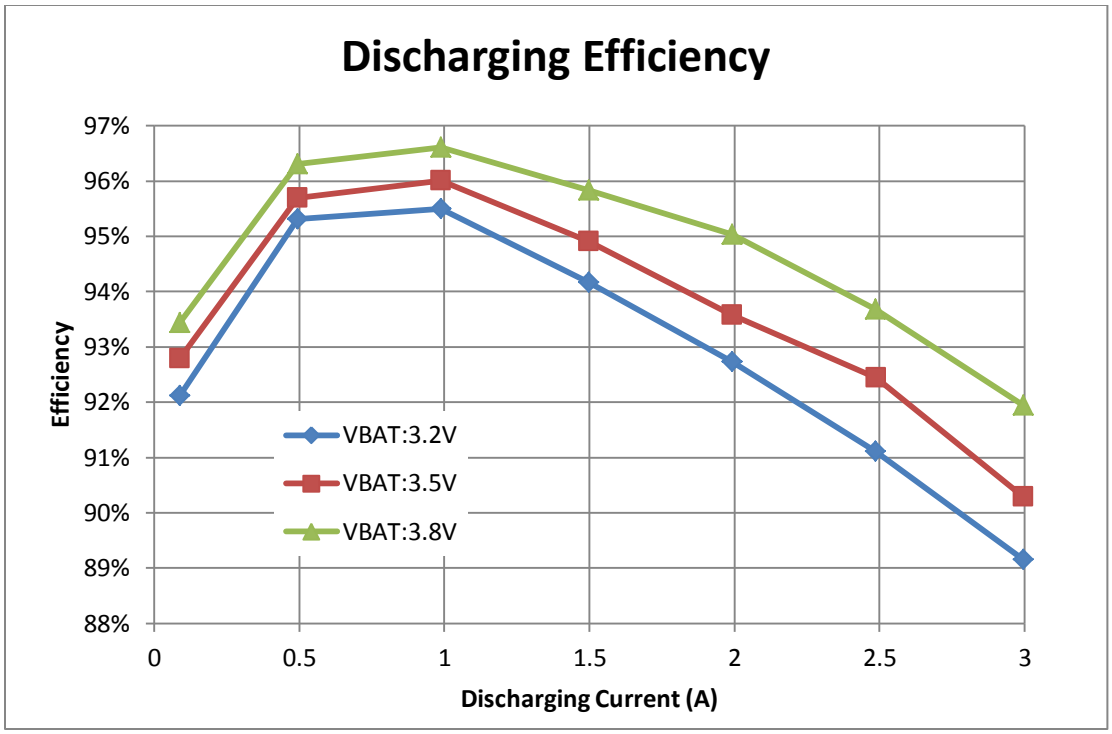
3.205	0.8342	5.1478	0.495	95.31%
3.245	1.635	5.1278	0.9881	95.50%
3.163	2.5683	5.106	1.4981	94.16%
3.183	3.431	5.0813	1.9931	92.74%
3.201	4.313	5.0572	2.4872	91.11%
3.213	5.261	5.0285	2.9972	89.16%

Discharging @ VBAT=3.5V

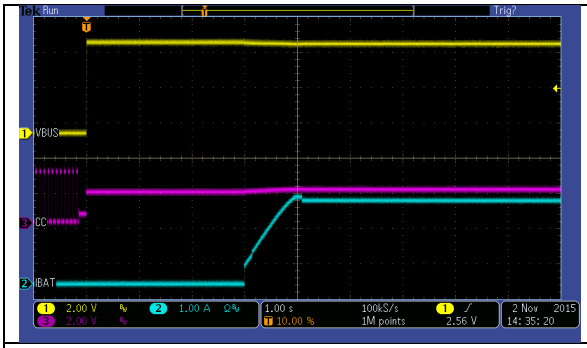
V_{BAT}(V)	I_{BAT}(A)	V_o(V)	I_o(A)	EFF.(%)
3.474	0.142	5.1956	0.0881	92.79%
3.516	0.756	5.1478	0.4941	95.69%
3.549	1.487	5.1278	0.9881	96.01%
3.475	2.318	5.103	1.4981	94.91%
3.505	3.087	5.0802	1.9931	93.58%
3.535	3.85	5.0564	2.4881	92.44%
3.446	4.843	5.0275	2.9972	90.29%

Discharging @ VBAT=3.8V

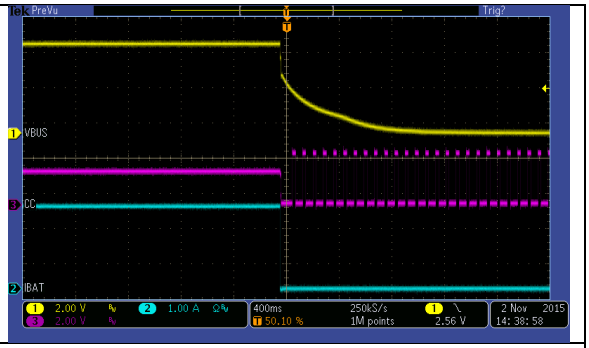
V_{BAT}(V)	I_{BAT}(A)	V_o(V)	I_o(A)	EFF.(%)
3.767	0.1301	5.1976	0.0881	93.43%
3.813	0.694	5.1486	0.495	96.31%
3.853	1.3615	5.1289	0.9881	96.61%
3.787	2.1085	5.1081	1.4981	95.84%
3.824	2.79	5.0871	1.9931	95.03%
3.755	3.581	5.0645	2.4872	93.68%
3.784	4.34	5.0381	2.9972	91.95%



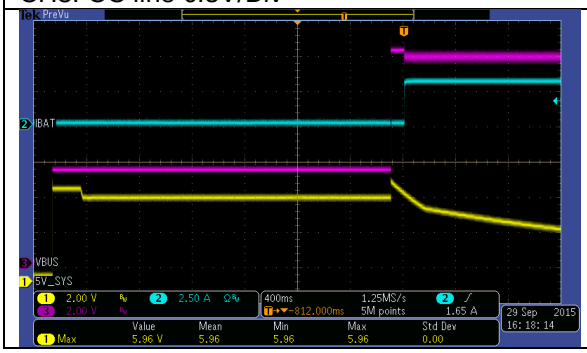
2.3 INPUT DETECTION

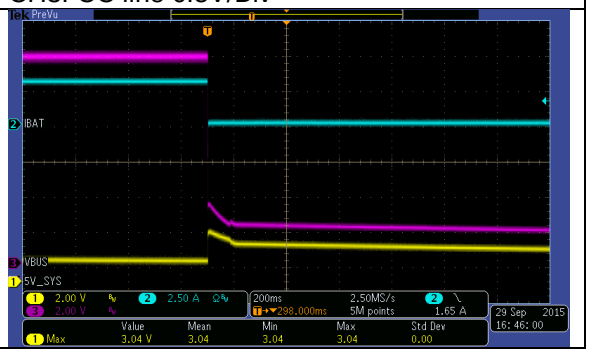


Type C DFP attach
CH1: VBUS Voltage 2V/Div
CH2: Battery Current 1A/Div
CH3: CC line 0.5V/Div



Type C DFP detach
CH1: VBUS Voltage 2V/Div
CH2: Battery Current 1A/Div
CH3: CC line 0.5V/Div

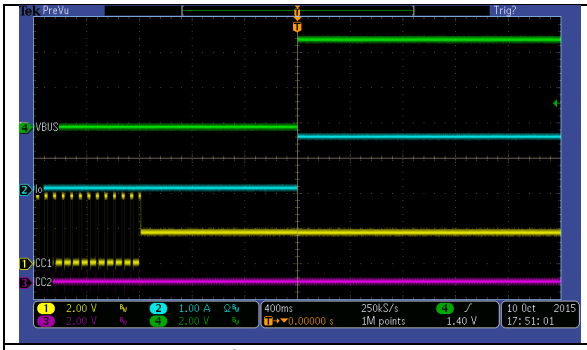
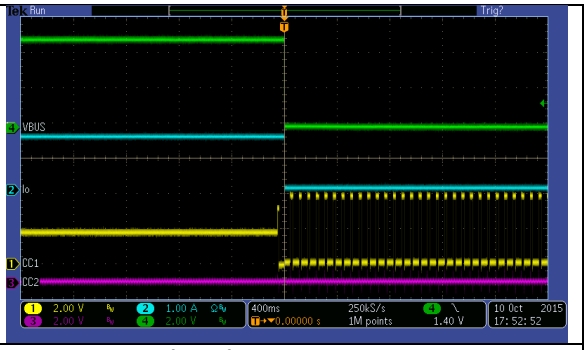




Fast Charger attach CH1: Output of boost 2V/Div CH2: Battery Current 2.5A/Div CH3: VBUS Voltage 2V/Div	Fast Charger detach CH1: Output of boost 2V/Div CH2: Battery Current 2.5A/Div CH3: VBUS Voltage 2V/Div

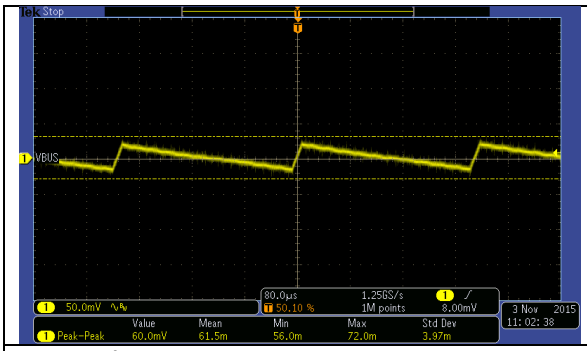
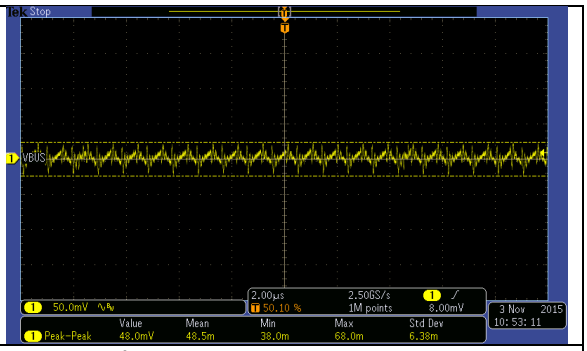
2.4 OUTPUT DETECTION

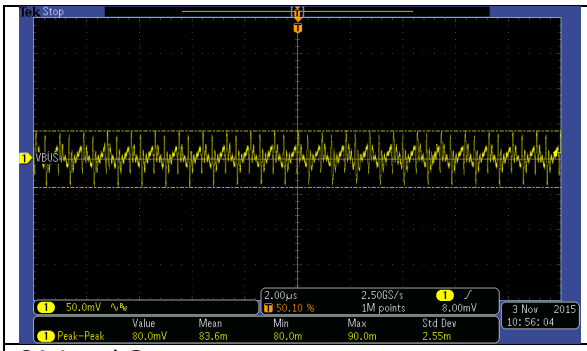
Type C to Type C UFP

	
Type C UFP attach CH1: CC1 2V/Div CH2: Output Current of Type C 1A/Div CH4: VBUS Voltage of Type C 2V/Div	Type C UFP detach CH1: CC1 2V/Div CH2: Output Current of Type C 1A/Div CH4: VBUS Voltage of Type C 2V/Div

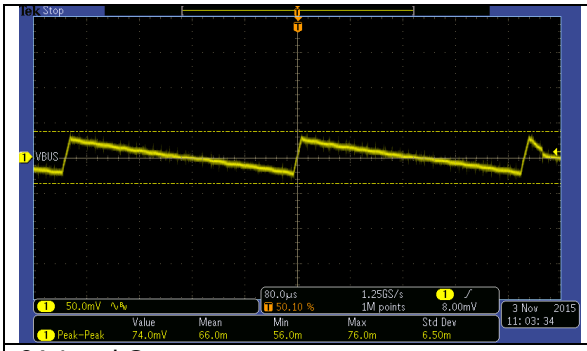
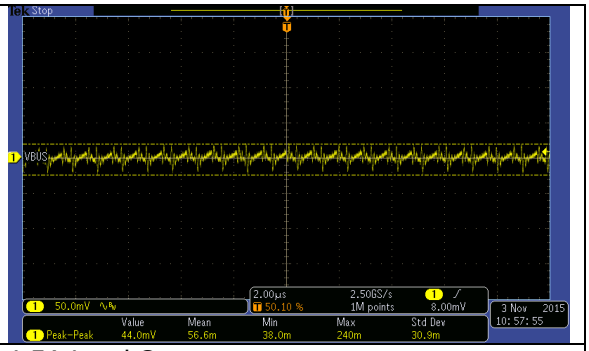
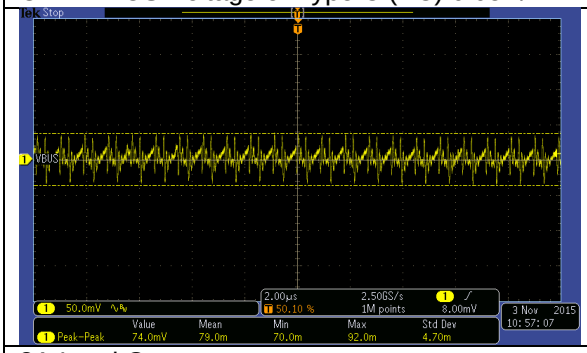
2.5 OUTPUT RIPPLE

Vo Ripple @VBAT=3.2V

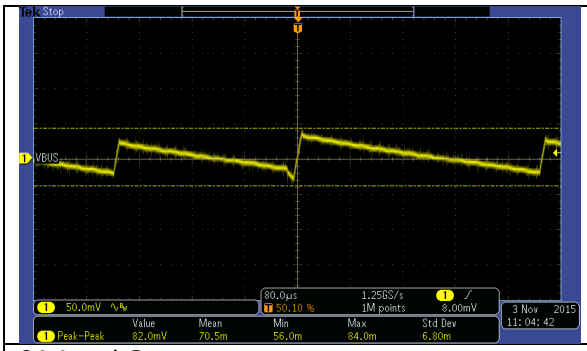
	
0A Load Current CH1: VBUS Voltage of Type C (AC) 0.05V/Div	1.5A Load Current CH1: VBUS Voltage of Type C (AC) 0.05V/Div

	
3A Load Current CH1: VBUS Voltage of Type C (AC) 0.05V/Div	

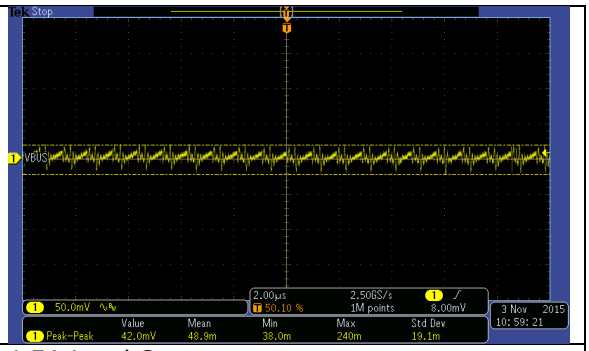
Vo Ripple @VBAT=3.5V

	
0A Load Current CH1: VBUS Voltage of Type C (AC) 0.05V/Div	1.5A Load Current CH1: VBUS Voltage of Type C (AC) 0.05V/Div
	
3A Load Current CH1: VBUS Voltage of Type C (AC) 0.05V/Div	

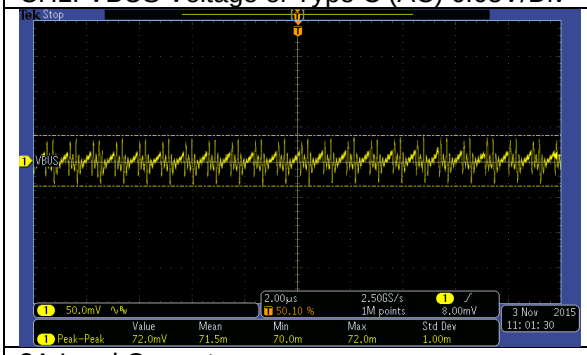
Vo Ripple @VBAT=3.8V



0A Load Current
CH1: VBUS Voltage of Type C (AC) 0.05V/Div

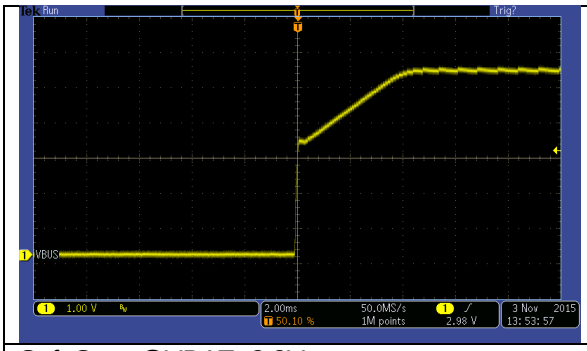


1.5A Load Current
CH1: VBUS Voltage of Type C (AC) 0.05V/Div

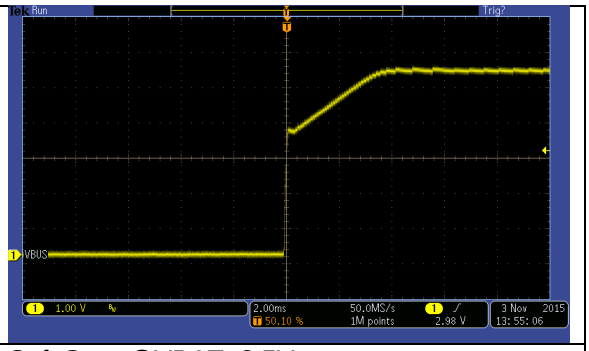


3A Load Current
CH1: VBUS Voltage of Type C (AC) 0.05V/Div

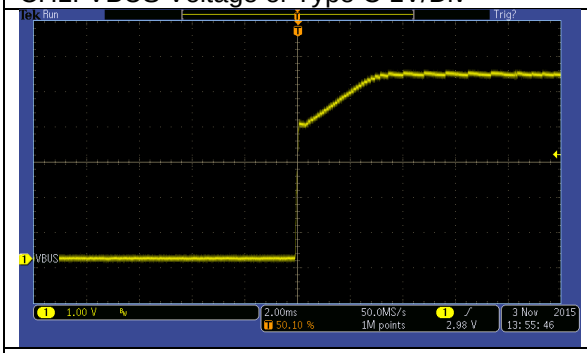
2.6 SOFT START



Soft Start @VBAT=3.2V
CH1: VBUS Voltage of Type C 1V/Div



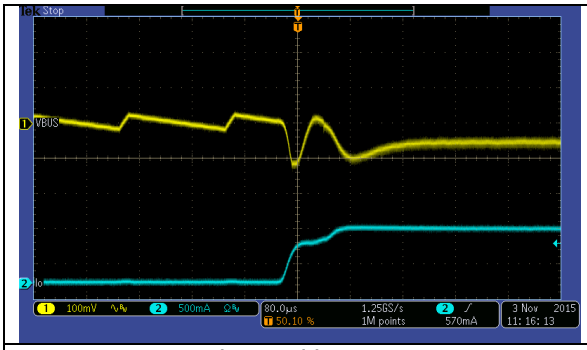
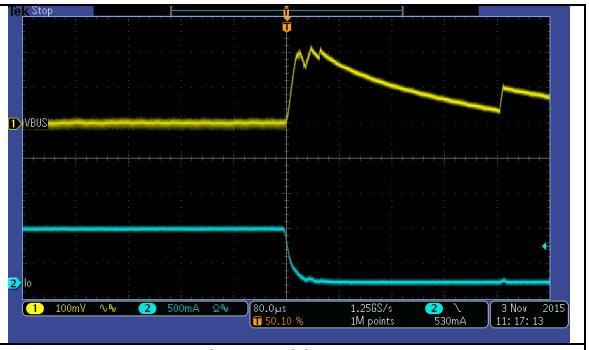
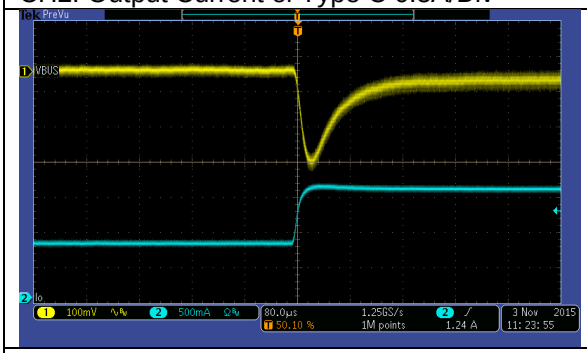
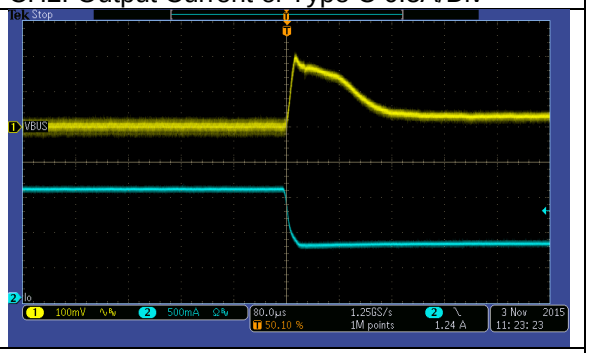
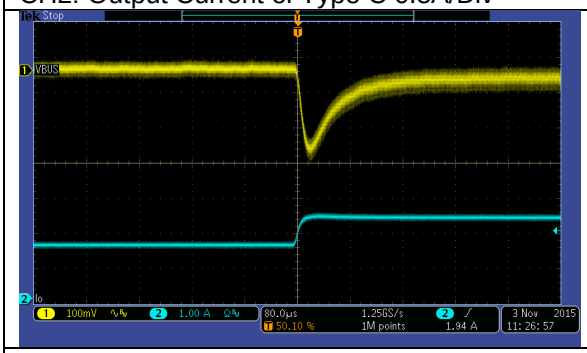
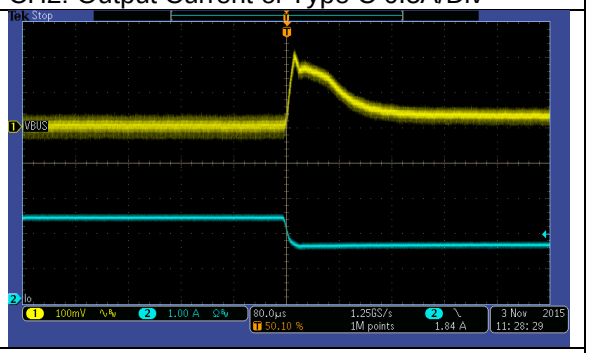
Soft Start @VBAT=3.5V
CH1: VBUS Voltage of Type C 1V/Div

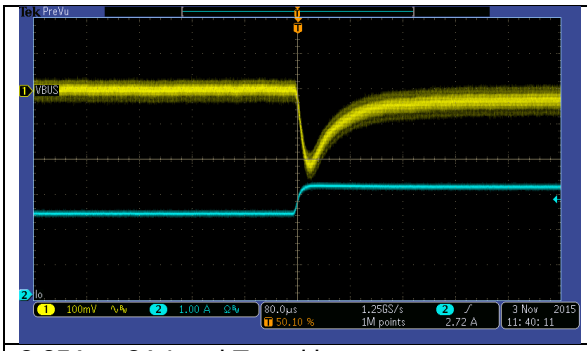
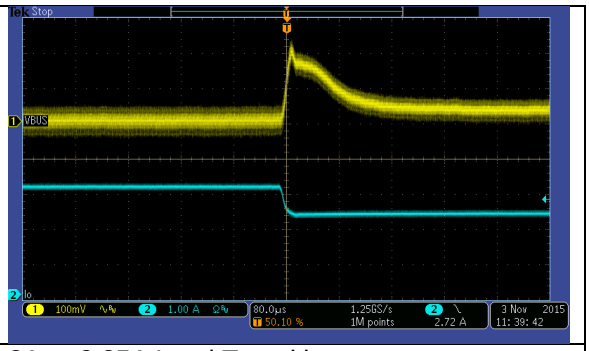


Soft Start @VBAT=3.8V
CH1: VBUS Voltage of Type C 1V/Div

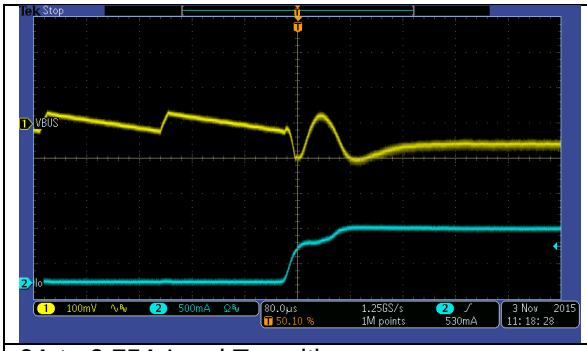
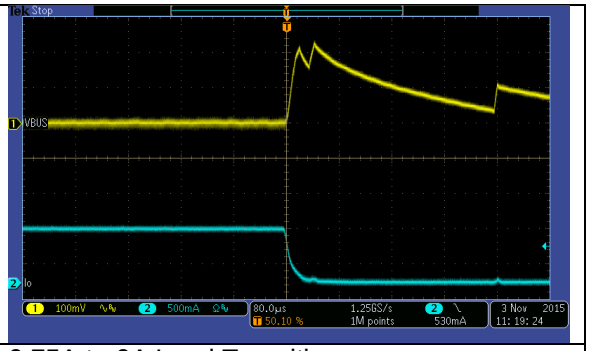
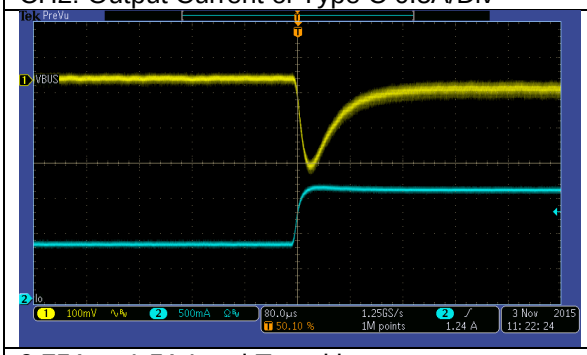
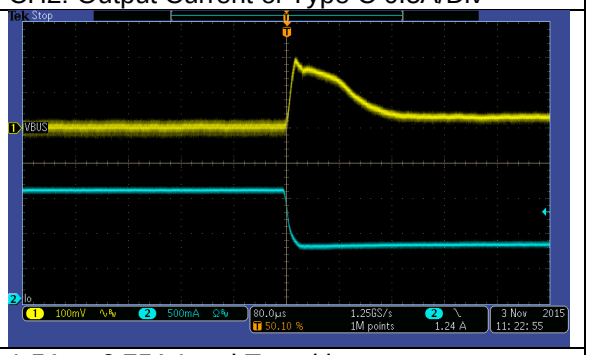
2.7 DYNAMIC TRANSITION

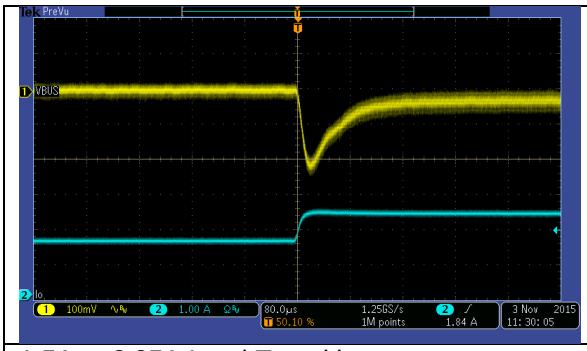
VBAT=3.2V

	
0A to 0.75A Load Transition CH1: VBUS Voltage of Type C (AC) 0.1V/Div CH2: Output Current of Type C 0.5A/Div	0.75A to 0A Load Transition CH1: VBUS Voltage of Type C (AC) 0.1V/Div CH2: Output Current of Type C 0.5A/Div
	
0.75A to 1.5A Load Transition CH1: VBUS Voltage of Type C (AC) 0.1V/Div CH2: Output Current of Type C 0.5A/Div	1.5A to 0.75A Load Transition CH1: VBUS Voltage of Type C (AC) 0.1V/Div CH2: Output Current of Type C 0.5A/Div
	
1.5A to 2.25A Load Transition CH1: VBUS Voltage of Type C (AC) 0.1V/Div CH2: Output Current of Type C 1A/Div	2.25A to 1.5A Load Transition CH1: VBUS Voltage of Type C (AC) 0.1V/Div CH2: Output Current of Type C 1A/Div

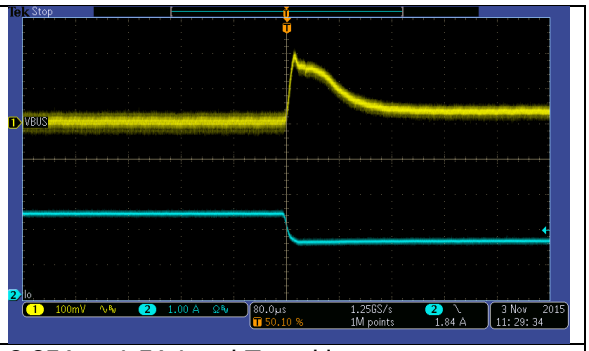
	
2.25A to 3A Load Transition CH1: VBUS Voltage of Type C (AC) 0.1V/Div CH2: Output Current of Type C 1A/Div	3A to 2.25A Load Transition CH1: VBUS Voltage of Type C (AC) 0.1V/Div CH2: Output Current of Type C 1A/Div

VBAT=3.5V

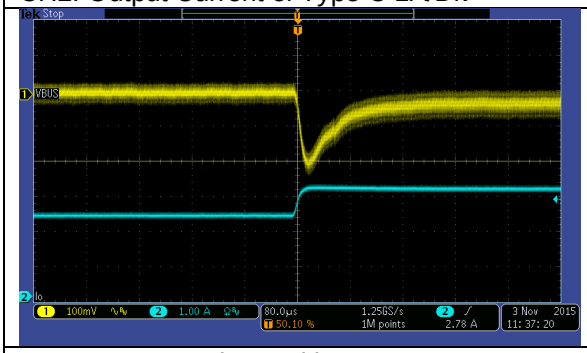
	
0A to 0.75A Load Transition CH1: VBUS Voltage of Type C (AC) 0.1V/Div CH2: Output Current of Type C 0.5A/Div	0.75A to 0A Load Transition CH1: VBUS Voltage of Type C (AC) 0.1V/Div CH2: Output Current of Type C 0.5A/Div
	
0.75A to 1.5A Load Transition CH1: VBUS Voltage of Type C (AC) 0.1V/Div CH2: Output Current of Type C 0.5A/Div	1.5A to 0.75A Load Transition CH1: VBUS Voltage of Type C (AC) 0.1V/Div CH2: Output Current of Type C 0.5A/Div



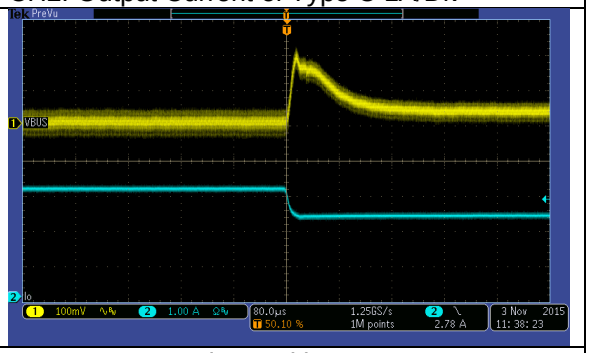
1.5A to 2.25A Load Transition
CH1: VBUS Voltage of Type C (AC) 0.1V/Div
CH2: Output Current of Type C 1A/Div



2.25A to 1.5A Load Transition
CH1: VBUS Voltage of Type C (AC) 0.1V/Div
CH2: Output Current of Type C 1A/Div

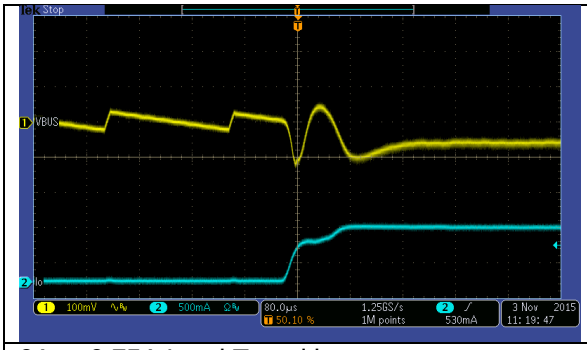


2.25A to 3A Load Transition
CH1: VBUS Voltage of Type C (AC) 0.1V/Div
CH2: Output Current of Type C 1A/Div

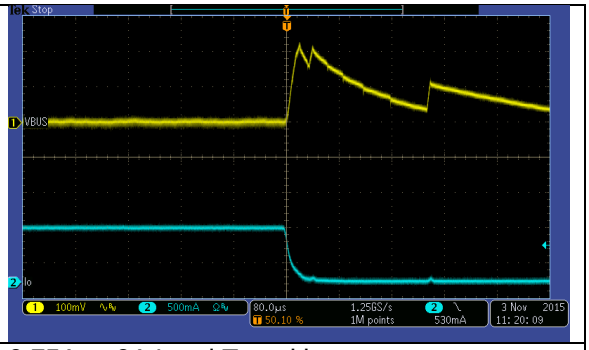


3A to 2.25A Load Transition
CH1: VBUS Voltage of Type C (AC) 0.1V/Div
CH2: Output Current of Type C 1A/Div

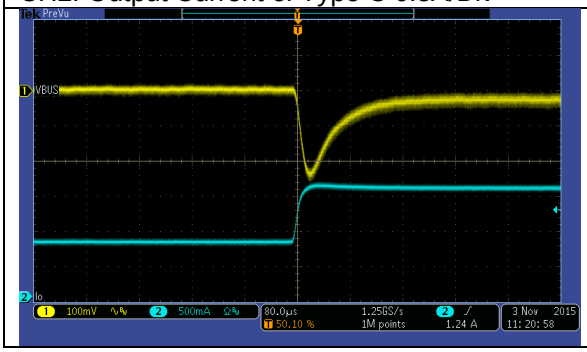
VBAT=3.8V

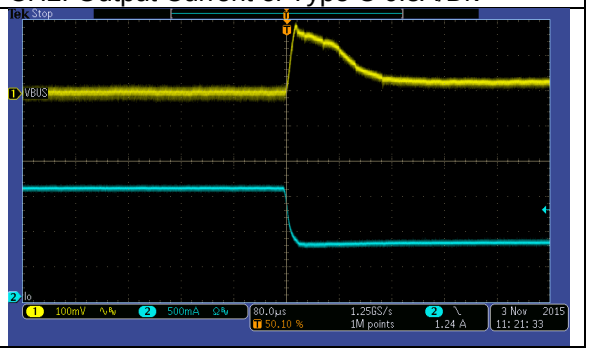


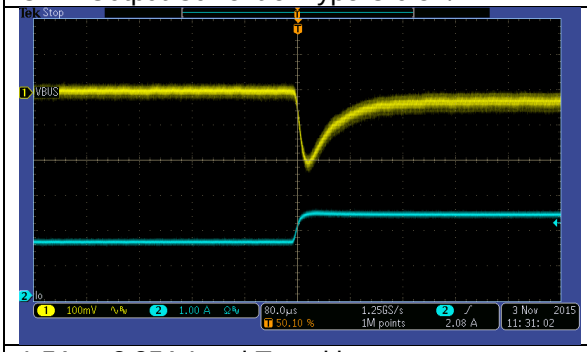
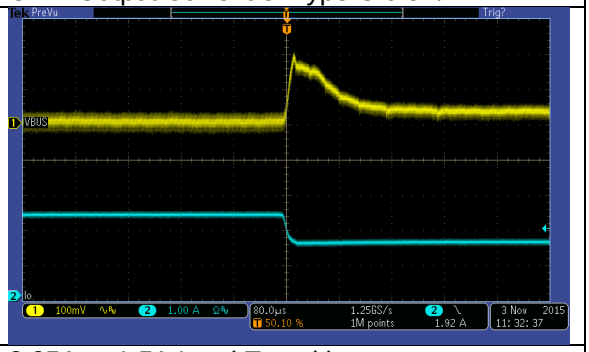
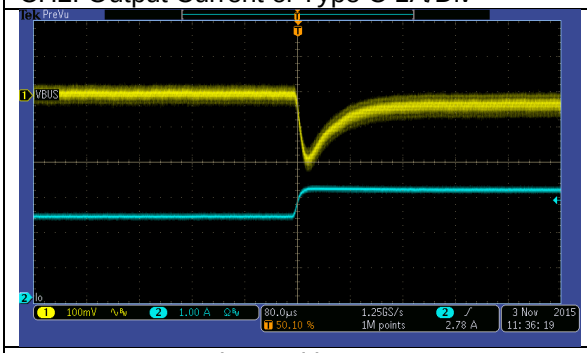
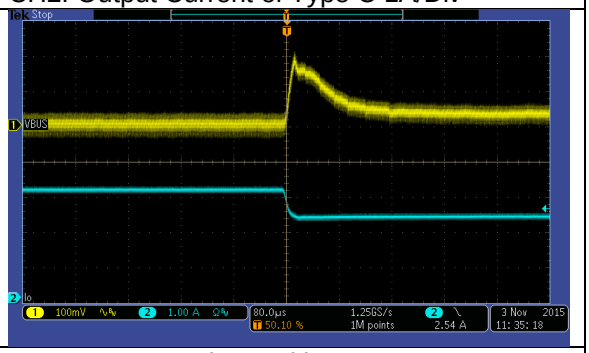
0A to 0.75A Load Transition
CH1: VBUS Voltage of Type C (AC) 0.1V/Div
CH2: Output Current of Type C 0.5A/Div



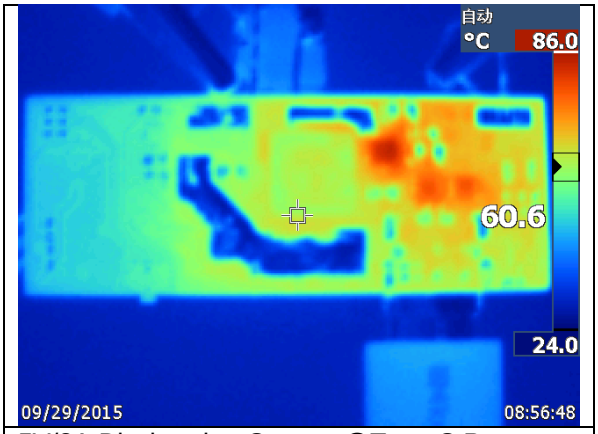
0.75A to 0A Load Transition
CH1: VBUS Voltage of Type C (AC) 0.1V/Div
CH2: Output Current of Type C 0.5A/Div





0.75A to 1.5A Load Transition CH1: VBUS Voltage of Type C (AC) 0.1V/Div CH2: Output Current of Type C 0.5A/Div	1.5A to 0.75A Load Transition CH1: VBUS Voltage of Type C (AC) 0.1V/Div CH2: Output Current of Type C 0.5A/Div
	
1.5A to 2.25A Load Transition CH1: VBUS Voltage of Type C (AC) 0.1V/Div CH2: Output Current of Type C 1A/Div	2.25A to 1.5A Load Transition CH1: VBUS Voltage of Type C (AC) 0.1V/Div CH2: Output Current of Type C 1A/Div
	
2.25A to 3A Load Transition CH1: VBUS Voltage of Type C (AC) 0.1V/Div CH2: Output Current of Type C 1A/Div	3A to 2.25A Load Transition CH1: VBUS Voltage of Type C (AC) 0.1V/Div CH2: Output Current of Type C 1A/Div

3 THERMAL



5V/3A Discharging Current @Type C Port
VBAT=3.5V & T_{room}=27℃

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