EVX2002-44018A-00B

140W, Type-C PD3.1 Adapter Evaluation Board

DESCRIPTION

The EVX2002-44018A-00B evaluation board is a 140W, Type-C power delivery 3.1 (PD 3.1) adapter designed to demonstrate the capabilities of the MP44018A and MPX2002. The EVX2002-44018A-00B is designed in a very small form factor with a high power density. Its electrical specifications are well-suited for cellphone and computer power adapters. The evaluation board provides very low, no-load power consumption (<100mW), and its high overall efficiency meets DOE Level VI and CoC Tier 2.

The MP44018A is a critical conduction mode (CrM)/discontinuous conduction mode (DCM), multi-mode power factor correction (PFC) controller that provides simple and high-performance active PFC using minimal external components. The switching frequency (f_{SW}) is reduced by dead time (DT) extension technology under light-load conditions, which improves light-load efficiency. The MP44018A also achieves reduced total harmonic distortion (THD) due to variable-on-time control in DCM compared to conventional constant-on-time (COT) control.

The MPX2002 is an all-in-one flyback controller with an integrated primary driving circuit, secondary controller, synchronous rectification driver, and safety-compliant feedback. The device offers the benefits of both primary-side regulation (PSR) and secondary-side regulation (SSR).

The MPX2002 does not require a feedback circuit, reducing system complexity and the total BOM cost. The synchronous rectifier (SR) can match the driving signal of the primary-side MOSFET, meaning the SR can operate safely in continuous conduction mode (CCM). This increases the overall efficiency and design flexibility.

The MPX2002 adopts novel quasi-resonant (QR) mode switching when it runs in DCM. Due to this feature, the power supply has improved efficiency. Under very light loads, the controller enters burst mode to achieve very low standby power consumption. The MPX2002 offers frequency jittering to help dissipate the energy generated by conducted noise.

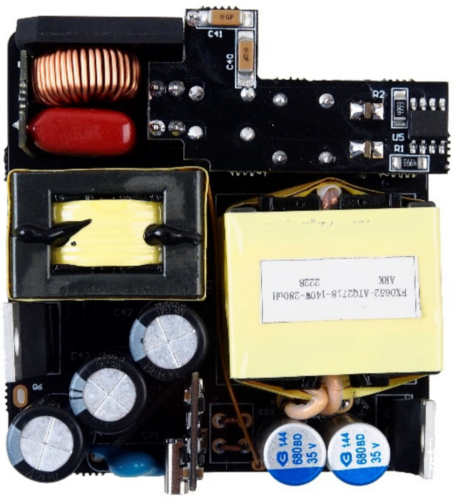
The EVX2002-44018A-00B evaluation board provides a reference design for a universal offline isolated power supply with a 28V/5A, 20V/5A, 15V/3A, 12V/3A, 9V/3A, or 5V/3A output. This datasheet contains the complete specification of the power supply, a detailed circuit diagram, the entire bill of materials required to build the power supply, a drawing of the transformers, and performance testing.

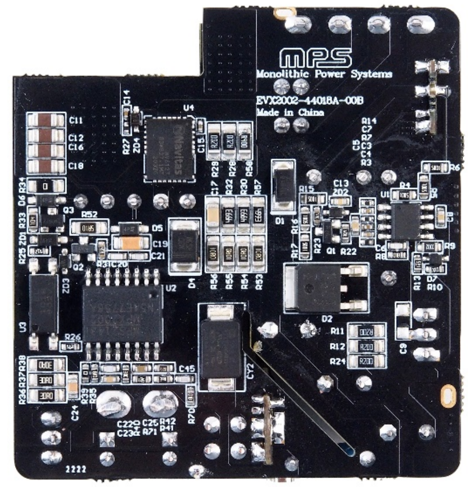
PERFORMANCE SUMMARY

Specifications are at T_A = 25°C, unless otherwise noted.

Parameters	Conditions	Value
AC input voltage (V_{AC})		$90V_{AC}$ to $264V_{AC}$
AC input frequency		47Hz to 63Hz
Output voltage (V_{OUT}) / output current (I_{OUT})	Power delivery 3.1 (PD 3.1)	28V/5A, 20V/5A, 15V/3A,12V/3A, 9V/3A,5V/3A
Maximum efficiency	V_{IN} = $264V_{AC}$, V_{OUT} = 28V, I_{OUT} = 5A	94.3%
No-load power consumption	V_{IN} = $264V_{AC}$	<100mW

EVX2002-44018A-00B EVALUATION BOARD





LxWxH (62mmx59mmx23.5mm)

Board Number	MPS IC Number
EVX2002-44018A-00B	MPX2002GY
	MP44018A

QUICK START GUIDE

1. Preset the AC input voltage (V_{AC}) to be between $90V_{AC}$ and $264V_{AC}$.
2. Turn the AC power supply off.
3. Connect the load to the Type-C connector.
4. Connect the power supply's line and neutral terminals to the AC input.
5. Turn the power supply on. The board should start up automatically.

EVALUATION BOARD SCHEMATICS

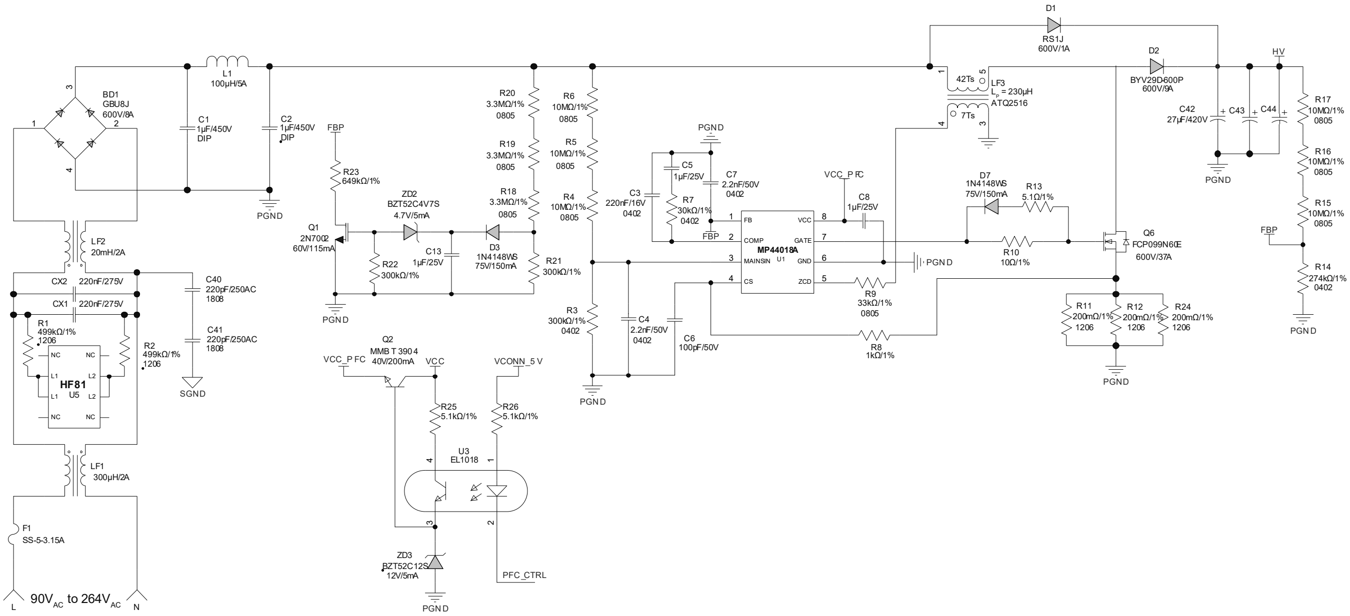


Figure 1: Main Board/Boost PFC Controller

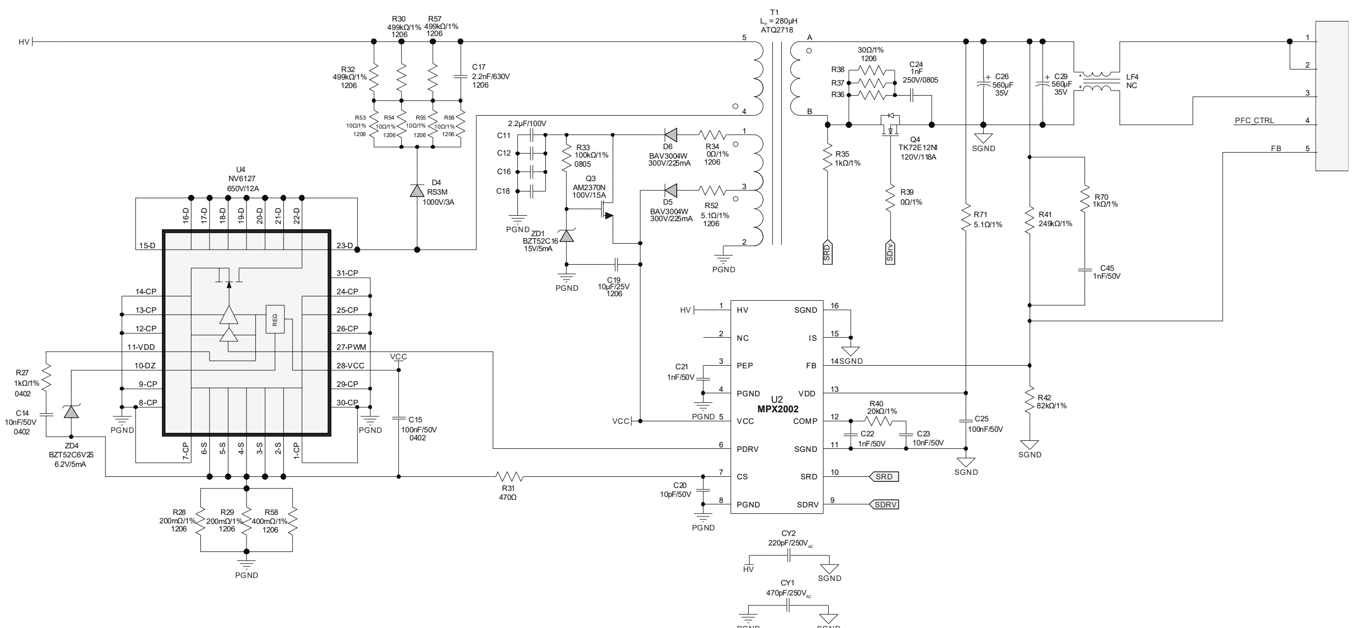


Figure 2: Main Board/Flyback Converter

EVALUATION BOARD SCHEMATICS *(continued)*

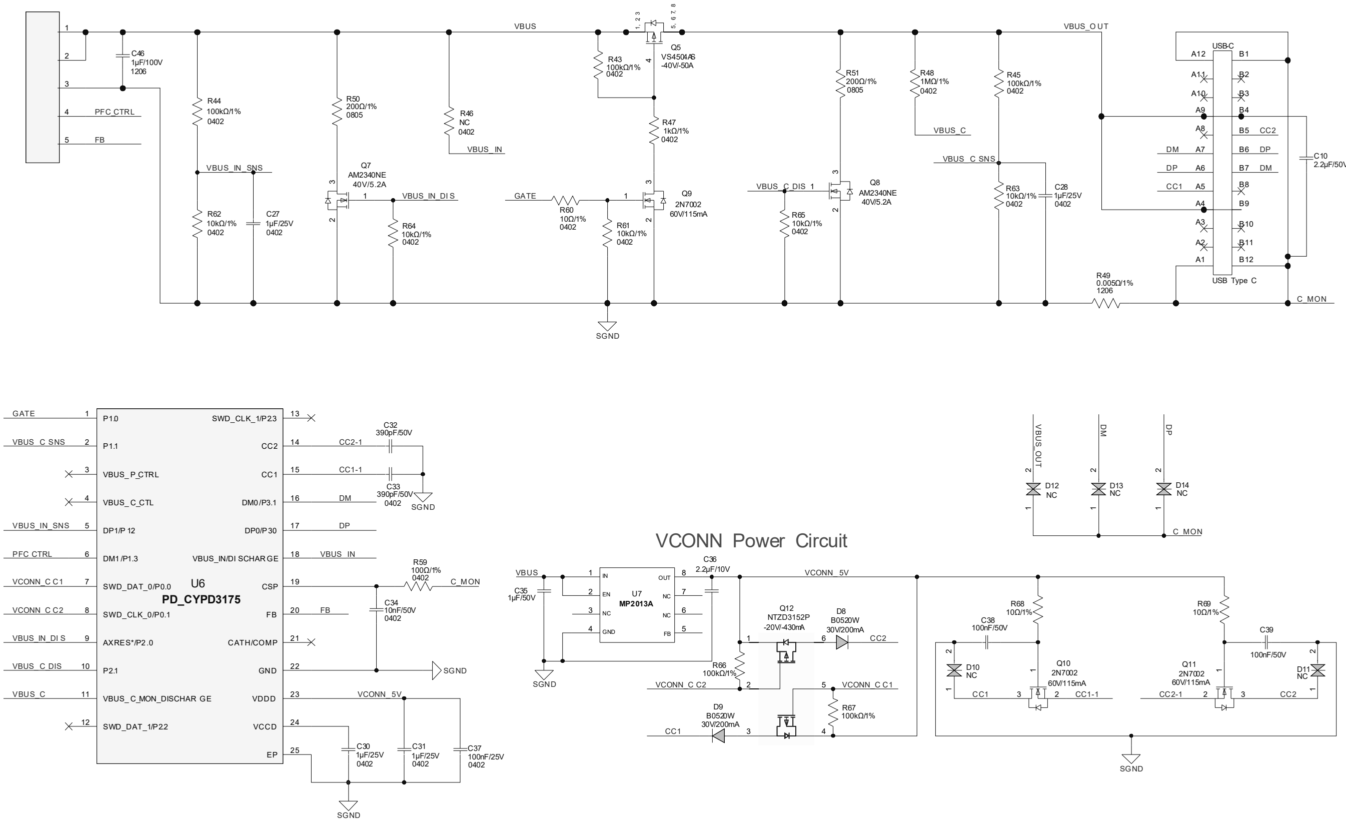


Figure 3: Daughter Board/PD 3.1 Controller

EVX2002-44018A-00B BILL OF MATERIALS

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
Main Board/Power Stage						
1	BD1	600V	Bridge rectifier, 8A	DIP	Vishay	GBU8J-E3/51
2	C1, C2	1µF	CBB capacitor, 450V	DIP	DGCX	MPP105J450DP10T6
1	C3	220nF	Ceramic capacitor, 16V, X7R	0402	Murata	GRM155R71C224KA12D
2	C4, C7	2.2nF	Ceramic capacitor, 50V, X7R	0402	Murata	GRM155R71H222KA01D
3	C5, C8, C13	1µF	Ceramic capacitor, 25V, X7R	0603	Murata	GCM188R71E105KA64D
1	C6	100pF	Ceramic capacitor, 50V, NP0	0603	Wurth	885012006057
4	C11, C12, C16, C18	2.2µF	Ceramic capacitor, 100V, X7R	1206	Murata	GRM31CR72A225KA73L
1	C14	10nF	Ceramic capacitor, 50V, X7R	0402	Murata	GRM155R71H103KA88D
1	C15	100nF	Ceramic capacitor, 50V, X7R	0402	Murata	GRM155R71H104KE14D
1	C17	2.2nF	Ceramic capacitor, 630V, X7R	1206	Murata	GRM31BR72J222KW01L
1	C19	10µF	Ceramic capacitor, 25V, X7R	1206	Murata	GRM31CR71E106KA12
1	C20	10pF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM1885C1H100JA01
2	C21, C22	1nF	Ceramic capacitor, 50V, C0G	0603	Murata	GRM1885C1H102JA01D
1	C23	10nF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM188R71H103KA01D
1	C24	1nF	Ceramic capacitor, 250V, X7R	0805	TDK	C2012X7R2E102K
1	C25	100nF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM188R71H104KA93D
2	C26, C29	680uF	Electrolytic capacitor, 35V	DIP	Beryl	PBD035M681F180RR1B
2	C40, C41	220p	Ceramic capacitor, 250V, X7R	1808	Murata	GA342DR7GF221KW02
3	C42, C43, C44	27µF	Electrolytic capacitor, 420V	DIP	Beryl	ME420M270LO10*18TA-1A3ET
1	C45	1nF	Ceramic capacitor, 25V, X7R	0603	Murata	GRM1885C1E102JA01D
2	CX1, CX2	220nF	Capacitor, 275V_{AC}	DIP	DGCX	MPX224K275AP7.5T6Y
1	CY1	220pF	Capacitor, 400V	DIP	Murata	DE1B3KX221KA4BL01
1	CY2	470pF	Capacitor, 400V	SMD	TRX	THY1470J
1	D1	600V	Diode, 1A	SMA	Diodes, Inc.	RS1J-13-F
1	D2	600V	Diode, 9A	DPAK-3	WeEn	BYV29D-600P
2	D3, D7	75V	Diode, 0.15A	SOD-323	Diodes, Inc.	1N4148WS-7-F
1	D4	1000V	Diode, 3A	SMB	Diodes, Inc.	RS3MB
2	D5, D6	300V	Diode, 225mA	SOD-123	Diodes, Inc.	BAV3004W-7-F
1	F1	250V_{AC}	Fuse, 3.15A	DIP	Cooper Bussmann	SS-5-3.15A
1	L1	100µH	Choke, 5A	DIP	CSC	50125
1	LF1	300µH	Common choke, 2A	DIP	Emei	TP4U300-00

EVX2002-44018A-00B BILL OF MATERIALS *(continued)*

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	LF2	20mH	Common choke, 2A	DIP	SANCI	14*9*5MH
1	LF3	230µH	Inductor, ATQ2516 core	DIP	ARK	FX0651
1	LF4	NC				
1	Q1	60V	N-channel MOSFET, 115mA	SOT-23	Onsemi	2N7002LT1G
1	Q2	40V	Transistor, 200mA	SOT-23	Onsemi	MMBT3904LT1
1	Q3	100V	N-channel MOSFET, 1.5A	SOT-23	Analog Power	AM2370N-T1-PF
1	Q4	120V	N-channel MOSFET, 179A	TO-220	Toshiba	TK72E12N1
1	Q6	600V	N-channel MOSFET, 37A	TO-220	Onsemi	FCP099N60E
5	R1, R2, R30, R32, R57	499kΩ	Film resistor, 1%	1206	Yageo	RC1206FR-07499KL
1	R3	300kΩ	Film resistor, 1%	0402	Yageo	RC0402FR-07300KL
6	R4, R5, R6, R15, R16, R17	10MΩ	Film resistor, 1%	0805	Yageo	RC0805FR-0710ML
1	R7	30kΩ	Film resistor, 1%	0402	Yageo	RC0402FR-0730KL
2	R8, R70	1kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-071KL
1	R9	33kΩ	Film resistor, 1%	0805	Yageo	RC0805FR-0733KL
1	R10	10Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0710RL
5	R11, R12, R24, R28, R29	200mΩ	Film resistor, 1%	1206	Yageo	RL1206FR-070R2L
1	R13	5.1Ω	Film resistor, 1%	0603	Yageo	RC0603FR-075R1L
1	R14	274kΩ	Film resistor, 1%	0402	Yageo	RC0402FR-07274KL
3	R18, R19, R20	3.3MΩ	Film resistor, 1%	0805	Yageo	RC0805FR-073M3L
2	R21, R22	300kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07300KL
1	R23	649kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07649KL
2	R25, R26	5.1kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-075K1L
1	R27	1kΩ	Film resistor, 1%	0402	Yageo	RC0402FR-071KL
1	R31	470Ω	Film resistor, 1%	0603	Yageo	RC0603FR-07470RL
1	R33	100kΩ	Film resistor, 5%	0805	Yageo	RC0805JR-07100KL
1	R34	0Ω	Film resistor, 1%	1206	Yageo	RC1206FR-070RL
1	R35	1kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-071KL
3	R36, R37, R38	30Ω	Film resistor, 1%	1206	Yageo	RC1206FR-0730RL
1	R39	0Ω	Film resistor, 1%	0603	Yageo	RC0603FR-070RL
1	R40	20kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-0720KL
1	R41	249kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07249KL
1	R42	82kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-071K82L
1	R52	5.1Ω	Film resistor, 1%	1206	Yageo	RC1206FR-075R1L
4	R53, R54, R55, R56	10Ω	Film resistor, 1%	1206	Yageo	RC1206FR-0710RL
1	R58	400mΩ	Film resistor, 1%	1206	Yageo	RL1206FR-070R4L
1	T1	280µH	Transformer, ATQ2718 core	DIP	ARK	FX0652

EVX2002-44018A-00B BILL OF MATERIALS *(continued)*

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
1	U3	5000V_{RMS}	Photocoupler, 1 channel	SOP-4L	Everlight	EL1018(TA)-VG
1	U4	650V	GaN, 260mΩ	QFN-31 (6mmx 8mm)	Navitas	NV6127-RA
1	ZD1	16V	Zener diode, 5mA	SOD-123	Diodes, Inc.	BZT52C16-7-F
1	ZD2	4.7V	Zener diode, 5mA	SOD-323	Diodes, Inc.	BZT52C4V7S
1	ZD3	12V	Zener diode, 5mA	SOD-323	Diodes, Inc.	BZT52C12S
1	ZD4	6.2V	Zener diode, 5mA	SOD-323	Diodes, Inc.	BZT52C6V2S
1	U1	MP44018 A	CrM/DCM PFC controller	SOIC-8	MPS	MP44018-AGS-Z
1	U2	MPX2002	All-in-one flyback controller	SOICW-16	MPS	MPX2002GY-Z
1	U5	HF81	X capacitor bleeder	SOIC-8	MPS	HF81GS-Z
Daughter Board/PD 3.1 Controller						
1	C46	1uF	Ceramic capacitor, 100V, X7R	1206	Murata	GRM31CR72A105KA01L
1	C10	2.2μF	Ceramic capacitor, 50V, X5R	0603	Murata	GRM188R61H225KE11D
4	C27, C28, C30, C31	1μF	Ceramic capacitor, 25V, X5R	0402	Murata	GRM155R61E105KA12
1	C32	390pF	Ceramic capacitor, 50V, C0G	0603	Murata	GRM1885C1H391JA01D
1	C33	390pF	Ceramic capacitor, 50V, X7R	0402	Yageo	CC0402KRX7R9BB391
1	C34	10nF	Ceramic capacitor, 50V, X7R	0402	Murata	GRM155R71H103KA88D
1	C35	1μF	Ceramic capacitor, 50V, X5R	0603	Murata	GRM188R61H105KAAL
1	C36	2.2μF	Ceramic capacitor, 10V, X7R	0603	Murata	GRM188R71A225KE15D
1	C37	100nF	Ceramic capacitor, 25V, X7R	0402	Murata	GRM155R71E104KE14D
2	C38, C39	100nF	Ceramic capacitor, 50V, X7R	0603	Murata	GRM188R71H104KA93D
3	R43, R44, R45	100kΩ	Film resistor, 1%	0402	Yageo	RC0402FR-07100KL
1	R46	NC				
1	R47	1kΩ	Film resistor, 1%	0402	Yageo	RC0402FR-071KL
1	R48	1MΩ	Film resistor, 1%	0402	Yageo	RC0402JR-071ML
1	R49	5mΩ	Film resistor, 1%	1206	Yageo	PA1206FRF070R005L
2	R50, R51	200Ω	Film resistor, 1%	0805	Yageo	RC0805FR-07200RL
1	R59	100Ω	Film resistor, 1%	0402	Yageo	RC0402FR-07100RL
1	R60	10Ω	Film resistor, 1%	0402	Yageo	RC0402FR-0710RL
5	R61, R62, R63, R64, R65	10kΩ	Film resistor, 1%	0402	Yageo	RC0402FR-0710KL
2	R66, R67	100kΩ	Film resistor, 1%	0603	Yageo	RC0603FR-07100KL
2	R68, R69	10Ω	Film resistor, 1%	0603	Yageo	RC0603FR-0710RL

EVX2002-44018A-00B BILL OF MATERIALS *(continued)*

Qty	Ref	Value	Description	Package	Manufacturer	Manufacturer PN
2	D8, D9	30V	Diode, 200mW	SOD-323	Diodes, Inc.	BAT43WS-7-F
5	D10, D11, D12, D13, D14	NC				
1	Q5	-40V	P-channel MOSFET, -50A	PDFN3333	Vanguard	VSE014P04MS
2	Q7, Q8	40V	N-channel MOSFET, 5.2A	SOT-23	Analog Power	AM2340NE
3	Q9, Q10, Q11	60V	N-channel Mosfet, 115mA	SOT-23	Onsemi	2N7002LT1G
1	Q12	-20V	Dual P-channel MOSFET, -430mA	SOT563-6	Onsemi	NTZD3152PT1G
1	USB-C	30V	Type-C connector	DIP	Yalian	93551001
1	U6	5.5V	USB PD controller	QFN-24 (4mmx 4mm)	Cypress	CYPD3175-24LQXQ
1	U7	MPQ2013A	40V, 150mA low-I_Q current linear regulator, AEC-Q100 qualified	QFN-8 (3mmx 3mm)	MPS	MPQ2013AGQ-5-Z

EVB TEST RESULTS

Performance waveforms are tested on the evaluation board. (1)

Table 1: Efficiency (V_{OUT} = 5V)

V_{OUT} = 5V							CoC Tier 2 Requirement
V_{IN} (V_{AC}/Hz)	Load	P_{IN} (W)	V_{OUT} (V)	I_{OUT} (A)	P_{OUT} (W)	Eff. (%)	
115/60	100%	16.420	5.085	3.001	15.260	92.94%	
	75%	12.292	5.078	2.250	11.426	92.95%	
	50%	9.020	5.076	1.500	7.614	84.42%	
	25%	4.628	5.095	0.750	3.821	82.57%	
	Average Efficiency (%)					88.22%	81.84%
	10%	1.889	5.103	0.300	1.531	81.03%	72.48%
230/50	100%	16.573	5.086	3.001	15.263	92.10%	
	75%	12.448	5.081	2.250	11.432	91.84%	
	50%	9.289	5.079	1.500	7.619	82.02%	
	25%	4.744	5.117	0.751	3.843	81.01%	
	Average Efficiency (%)					86.74%	81.84%
	10%	1.946	5.112	0.300	1.533	78.80%	72.48%

Table 2: Efficiency (V_{OUT} = 9V)

V_{OUT} = 9V							CoC Tier 2 Requirement
V_{IN} (V_{AC}/Hz)	Load	P_{IN} (W)	V_{OUT} (V)	I_{OUT} (A)	P_{OUT} (W)	Eff. (%)	
115/60	100%	29.118	9.040	3.001	27.123	93.15%	
	75%	21.804	9.031	2.250	20.320	93.19%	
	50%	14.510	9.028	1.500	13.542	93.33%	
	25%	7.797	9.028	0.750	6.771	86.85%	
	Average Efficiency (%)					91.63%	87.30%
	10%	3.173	9.038	0.300	2.711	85.46%	77.30%
230/50	100%	28.975	9.037	3.001	27.120	93.60%	
	75%	21.869	9.031	2.250	20.320	92.92%	
	50%	14.756	9.028	1.500	13.542	91.77%	
	25%	7.900	9.031	0.750	6.773	85.73%	
	Average Efficiency (%)					91.01%	87.30%
	10%	3.240	9.045	0.300	2.713	83.75%	77.30%

EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board. (1)

Table 3: Efficiency (V_{OUT} = 12V)

V_{OUT} = 12V							CoC Tier 2 Requirement
V_{IN} (V_{AC}/Hz)	**Load**	**P_{IN} (W)**	**V_{OUT} (V)**	**I_{OUT} (A)**	**P_{OUT} (W)**	**Eff. (%)**	
115/60	100%	39.410	12.01	3.001	36.042	91.45%	
	75%	28.930	12.01	2.250	27.022	93.41%	
	50%	19.231	12.00	1.500	18.000	93.60%	
	25%	9.723	12.00	0.751	9.012	92.69%	
	Average Efficiency (%)					92.79%	88.30%
	10%	4.149	12.00	0.300	3.600	86.76%	78.30%
230/50	100%	39.064	12.01	3.001	36.042	92.26%	
	75%	28.907	12.01	2.250	27.023	93.48%	
	50%	19.316	12.00	1.500	18.000	93.19%	
	25%	10.367	12.00	0.751	9.012	86.93%	
	Average Efficiency (%)					91.47%	88.30%
	10%	4.228	12.00	0.300	3.600	85.13%	78.30%

Table 4: Efficiency (V_{OUT} = 15V)

V_{OUT} = 15V							CoC Tier 2 Requirement
V_{IN} (V_{AC}/Hz)	**Load**	**P_{IN} (W)**	**V_{OUT} (V)**	**I_{OUT} (A)**	**P_{OUT} (W)**	**Eff. (%)**	
115/60	100%	48.830	14.98	3.000	44.940	92.03%	
	75%	36.221	14.97	2.250	33.683	92.99%	
	50%	24.049	14.97	1.500	22.455	93.37%	
	25%	12.096	14.97	0.750	11.228	92.82%	
	Average Efficiency (%)					92.80%	88.85%
	10%	5.108	14.98	0.300	4.494	87.97%	78.85%
230/50	100%	48.733	14.98	3.000	44.940	92.22%	
	75%	35.986	14.97	2.250	33.683	93.60%	
	50%	23.991	14.97	1.500	22.455	93.60%	
	25%	12.373	14.97	0.750	11.228	90.74%	
	Average Efficiency (%)					92.54%	88.85%
	10%	5.205	14.98	0.300	4.494	86.33%	78.85%

EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board. (1)

Table 5: Efficiency (V_{OUT} = 20V)

V_{OUT} = 20V							CoC Tier 2 Requirement
V_{IN} (V_{AC}/Hz)	Load	P_{IN} (W)	V_{OUT} (V)	I_{OUT} (A)	P_{OUT} (W)	Eff. (%)	
115/60	100%	107.51	19.91	5.001	99.570	92.61%	
	75%	80.874	19.90	3.750	74.625	92.27%	
	50%	53.891	19.90	2.500	49.750	92.32%	
	25%	26.730	19.89	1.250	24.863	93.01%	
	Average Efficiency (%)					92.55%	89%
	10%	10.896	19.90	0.500	9.950	91.32%	79%
230/50	100%	107.05	19.91	5.001	99.570	93.01%	
	75%	79.893	19.90	3.750	74.625	93.41%	
	50%	53.982	19.90	2.500	49.750	92.16%	
	25%	26.789	19.89	1.250	24.863	92.81%	
	Average Efficiency (%)					92.85%	89%
	10%	11.032	19.90	0.500	9.950	90.19%	79%

Table 6: Efficiency (V_{OUT} = 28V)

V_{OUT} = 28V							CoC Tier 2 Requirement
V_{IN} (V_{AC}/Hz)	Load	P_{IN} (W)	V_{OUT} (V)	I_{OUT} (A)	P_{OUT} (W)	Eff. (%)	
115/60	100%	149.03	27.80	5.005	139.125	93.35%	
	75%	111.73	27.79	3.750	104.213	93.27%	
	50%	75.075	27.78	2.500	69.450	92.51%	
	25%	37.431	27.77	1.250	34.713	92.74%	
	Average Efficiency (%)					92.97%	89%
	10%	15.233	27.77	0.500	13.885	91.15%	79%
230/50	100%	148.08	27.80	5.005	139.125	93.95%	
	75%	111.21	27.79	3.750	104.213	93.71%	
	50%	74.754	27.78	2.500	69.450	92.90%	
	25%	37.223	27.77	1.250	34.713	93.26%	
	Average Efficiency (%)					93.46%	89%
	10%	15.417	27.77	0.500	13.885	90.06%	79%

EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board. (1)

Table 7: Efficiency (V_{OUT} = 28V)

V_{OUT} = 28V (Full Load)						
V_{IN} (V_{AC}/Hz)	Load	P_{IN} (W)	V_{OUT} (V)	I_{OUT} (A)	P_{OUT} (W)	Eff. (%)
90/60	100%	151.11	27.95	5.005	139.876	92.32%
115/60	100%	149.03	27.80	5.005	139.125	93.35%
230/50	100%	148.08	27.80	5.005	139.125	93.95%
264/50	100%	147.39	27.80	5.005	139.125	94.21%

Table 8: No-Load Consumption

V_{IN} (V_{AC})	P_{IN} (mW)
90	44.83
115	47.64
230	66.57
264	74.69

Note:

1) The board efficiency is measured at C_{OUT} (C29).

EVB TEST RESULTS *(continued)*

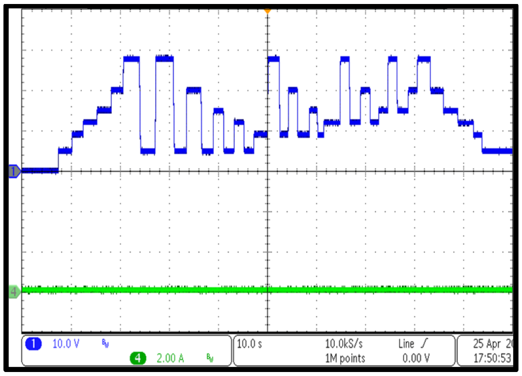
Performance waveforms are tested on the evaluation board.

Output Voltage Transient Response

V_{IN} = 115V_{AC}/60Hz, I_{OUT} = 0A

CH1: V_{OUT}

CH4: I_{OUT}

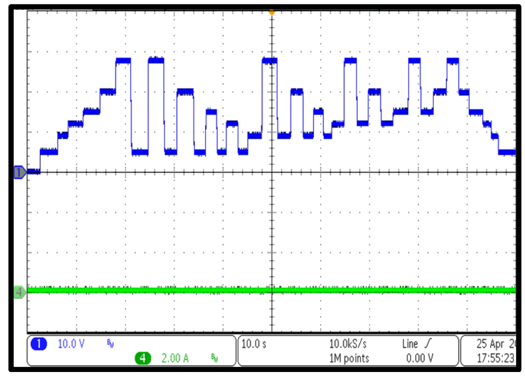


Output Voltage Transient Response

V_{IN} = 230V_{AC}/50Hz, I_{OUT} = 0A

CH1: V_{OUT}

CH4: I_{OUT}

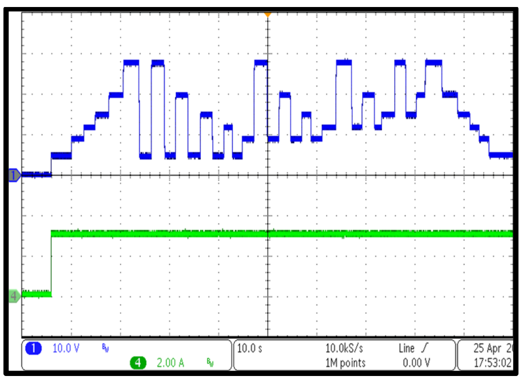


Output Voltage Transient Response

V_{IN} = 115V_{AC}/60Hz, I_{OUT} = 3A

CH1: V_{OUT}

CH4: I_{OUT}

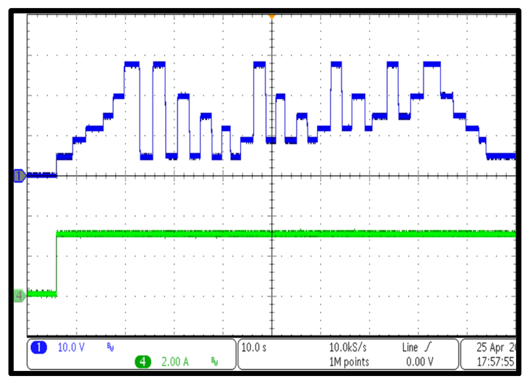


Output Voltage Transient Response

V_{IN} = 230V_{AC}/50Hz, I_{OUT} = 3A

CH1: V_{OUT}

CH4: I_{OUT}

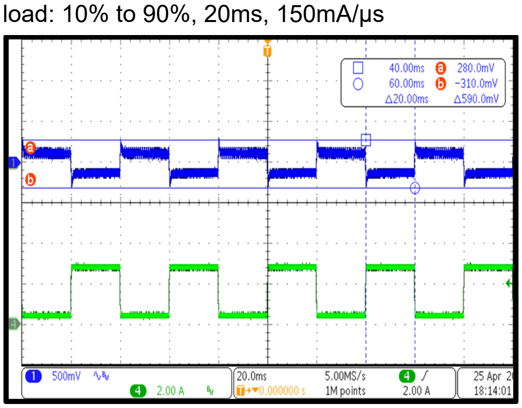


Load Transient Response

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 5V, V_{PP} = 590mV,
load: 10% to 90%, 20ms, 150mA/μs

CH1: V_{OUT}

CH4: I_{OUT}

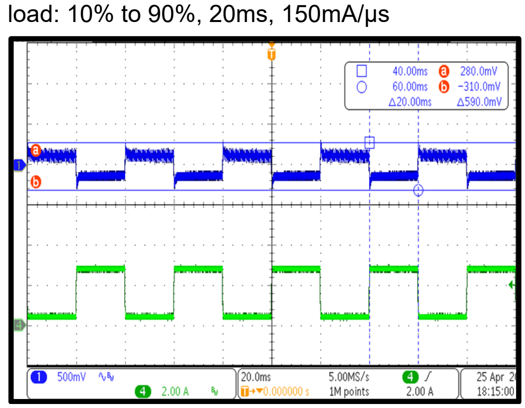


Load Transient Response

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 5V, V_{PP} = 590mV,
load: 10% to 90%, 20ms, 150mA/μs

CH1: V_{OUT}

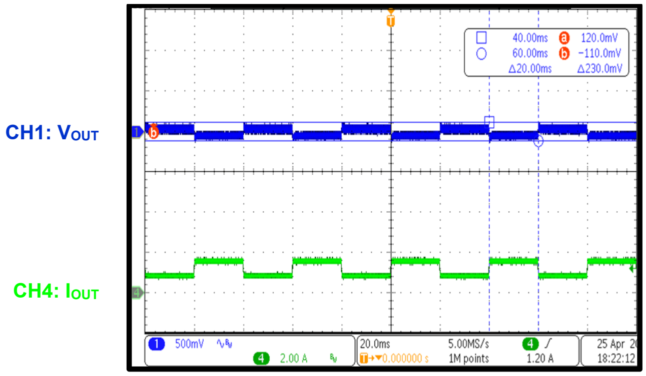
CH4: I_{OUT}



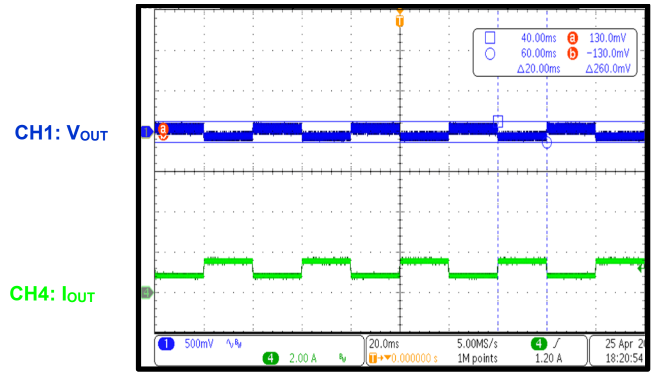
EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

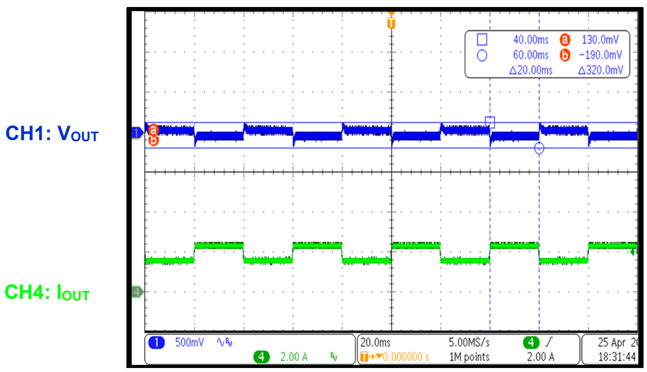
Load Transient Response
V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 5V, V_{PP} = 230mV,
load: 25% to 50%, 20ms, 150mA/μs



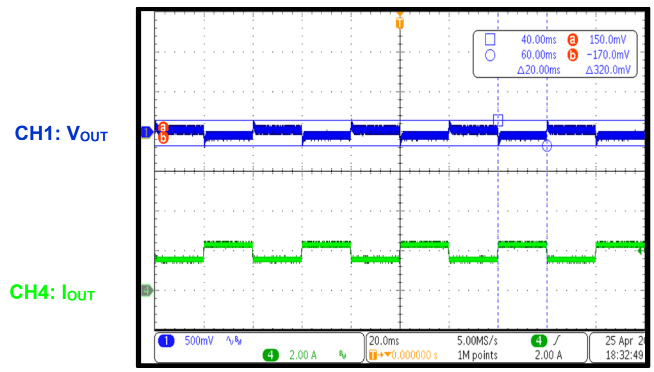
Load Transient Response
V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 5V, V_{PP} = 260mV,
load: 25% to 50%, 20ms, 150mA/μs



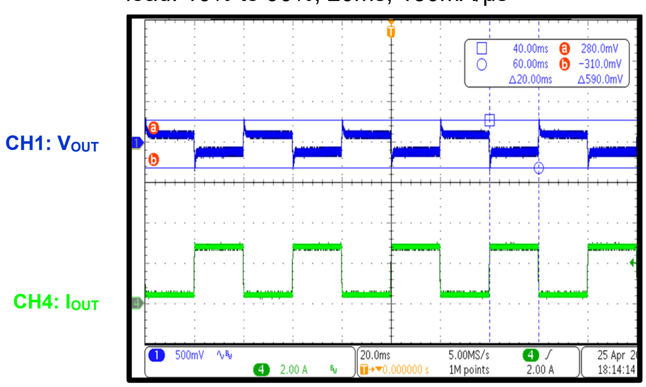
Load Transient Response
V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 5V, V_{PP} = 320mV,
load: 50% to 75%, 20ms, 150mA/μs



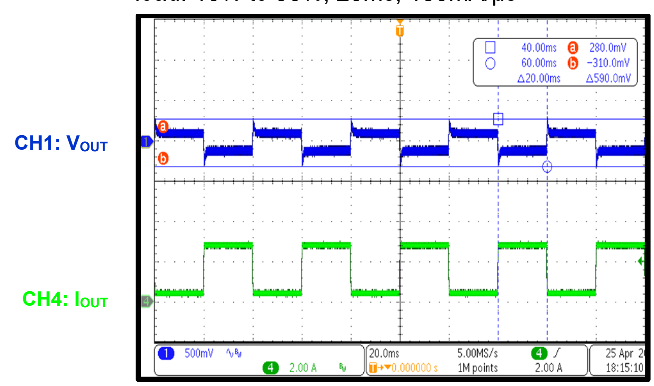
Load Transient Response
V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 5V, V_{PP} = 320mV,
load: 50% to 75%, 20ms, 150mA/μs



Load Transient Response
V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 9V, V_{PP} = 590mV,
load: 10% to 90%, 20ms, 150mA/μs



Load Transient Response
V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 9V, V_{PP} = 590mV,
load: 10% to 90%, 20ms, 150mA/μs

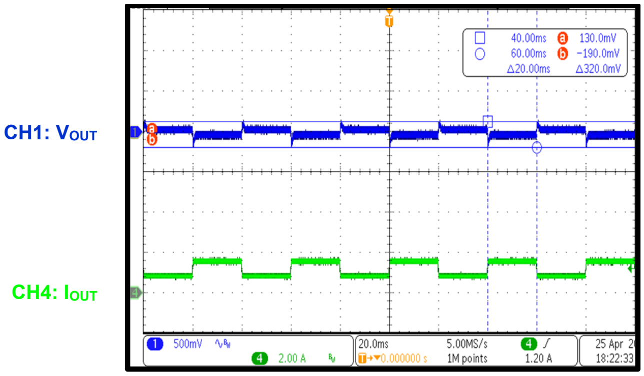


EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

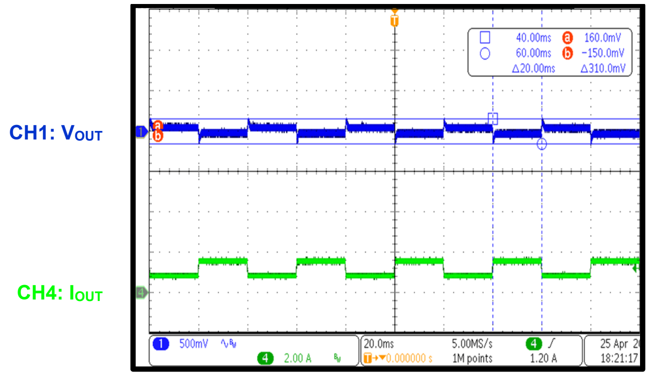
Load Transient Response

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 9V, V_{PP} = 320mV,
load: 25% to 50%, 20ms, 150mA/µs



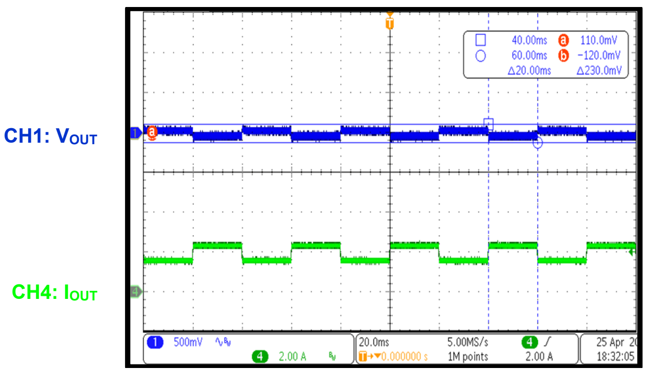
Load Transient Response

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 9V, V_{PP} = 310mV,
load: 25% to 50%, 20ms, 150mA/µs



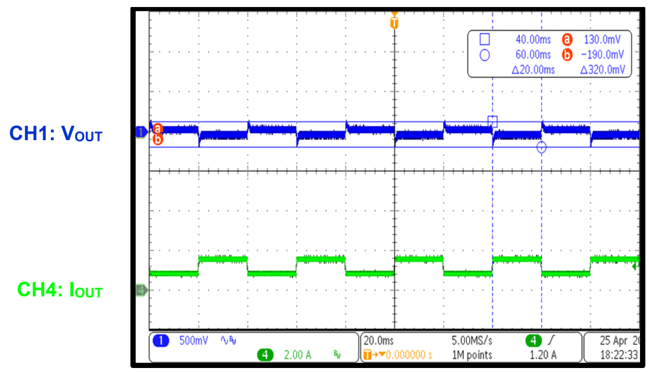
Load Transient Response

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 9V, V_{PP} = 230mV,
load: 50% to 75%, 20ms, 150mA/µs



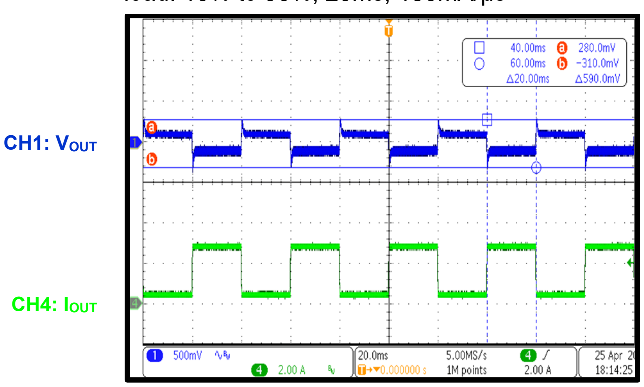
Load Transient Response

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 9V, V_{PP} = 320mV,
load: 50% to 75%, 20ms, 150mA/µs



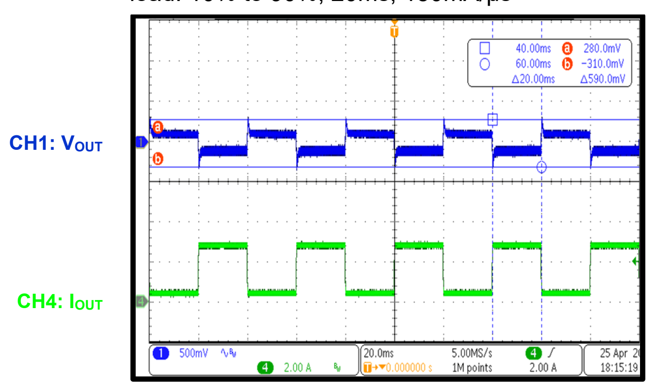
Load Transient Response

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 12V, V_{PP} = 590mV,
load: 10% to 90%, 20ms, 150mA/µs



Load Transient Response

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 12V, V_{PP} = 590mV,
load: 10% to 90%, 20ms, 150mA/µs

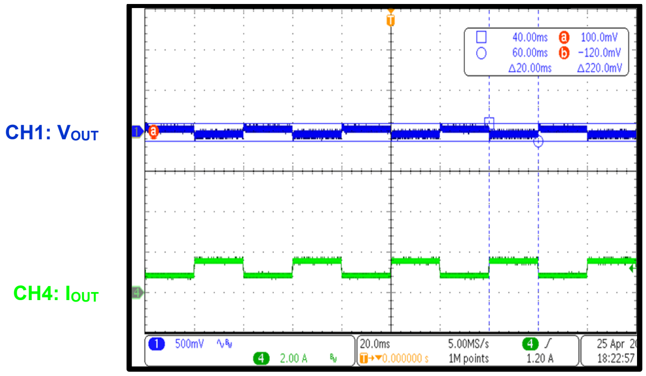


EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

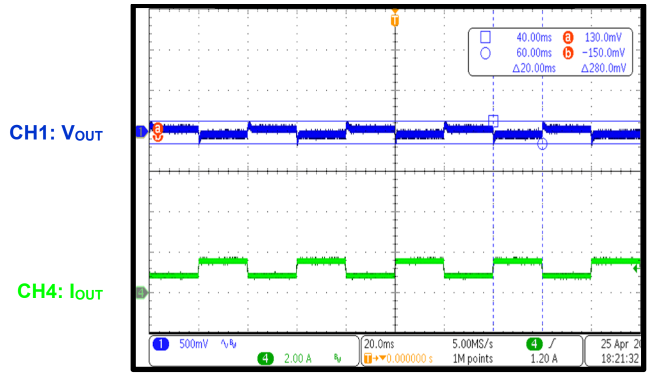
Load Transient Response

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 12V, V_{PP} = 220mV, load: 25% to 50%, 20ms, 150mA/µs



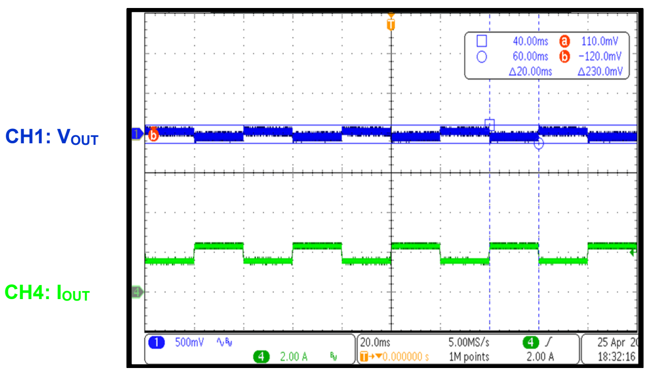
Load Transient Response

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 12V, V_{PP} = 280mV, load: 25% to 50%, 20ms, 150mA/µs



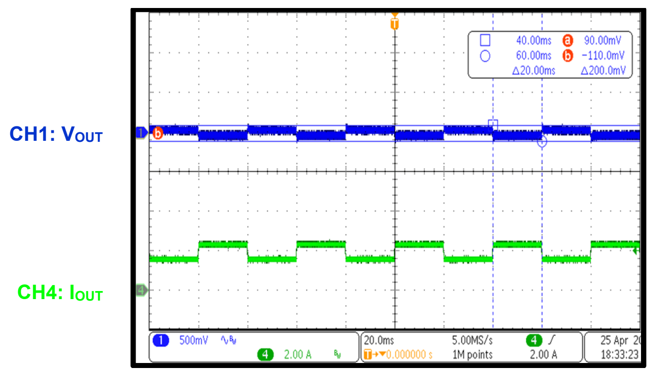
Load Transient Response

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 12V, V_{PP} = 230mV, load: 50% to 75%, 20ms, 150mA/µs



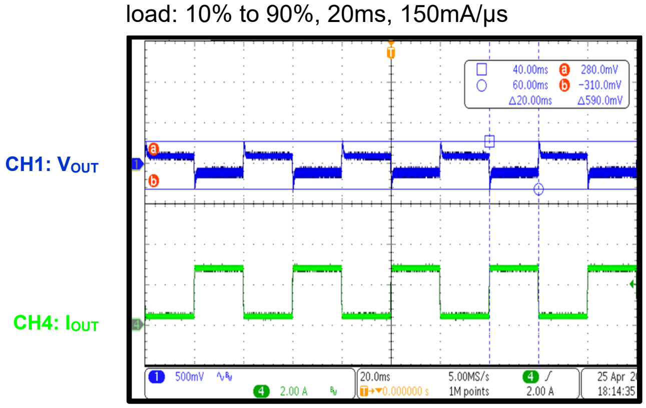
Load Transient Response

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 12V, V_{PP} = 200mV, load: 50% to 75%, 20ms, 150mA/µs



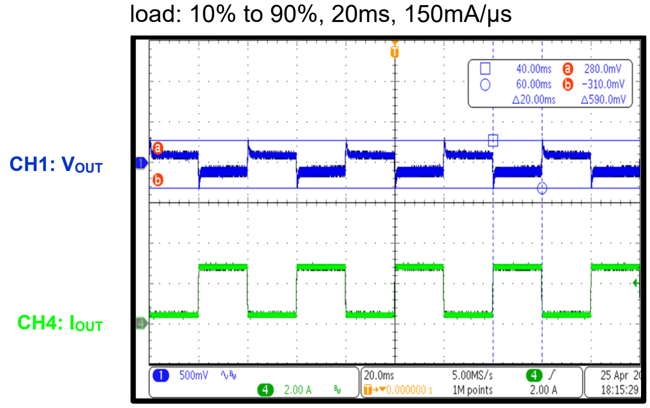
Load Transient Response

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 15V, V_{PP} = 590mV, load: 10% to 90%, 20ms, 150mA/µs



Load Transient Response

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 15V, V_{PP} = 590mV, load: 10% to 90%, 20ms, 150mA/µs



EVB TEST RESULTS *(continued)*

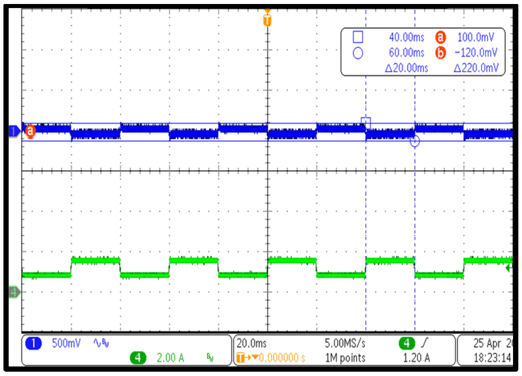
Performance waveforms are tested on the evaluation board.

Load Transient Response

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 15V, V_{PP} = 220mV, load: 25% to 50%, 20ms, 150mA/μs

CH1: V_{OUT}

CH4: I_{OUT}

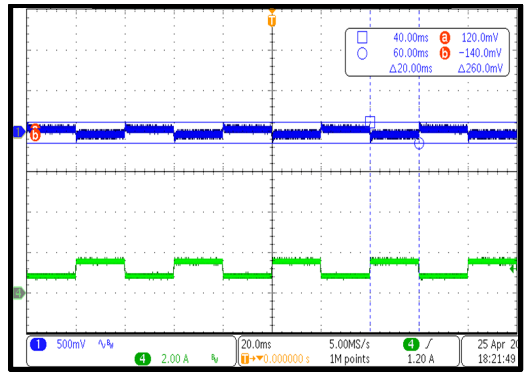


Load Transient Response

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 15V, V_{PP} = 260mV, load: 25% to 50%, 20ms, 150mA/μs

CH1: V_{OUT}

CH4: I_{OUT}

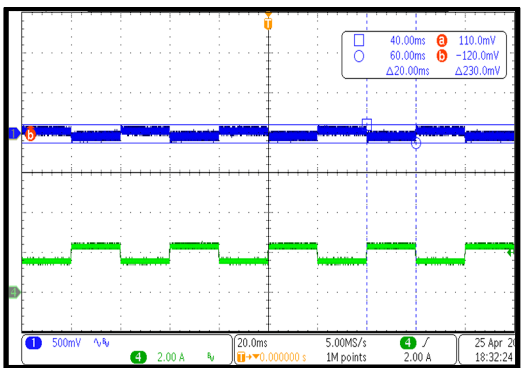


Load Transient Response

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 15V, V_{PP} = 230mV, load: 50% to 75%, 20ms, 150mA/μs

CH1: V_{OUT}

CH4: I_{OUT}

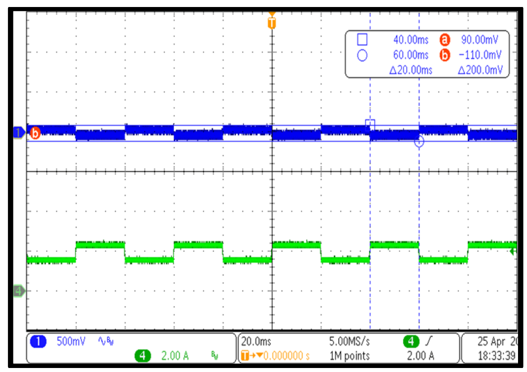


Load Transient Response

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 15V, V_{PP} = 200mV, load: 50% to 75%, 20ms, 150mA/μs

CH1: V_{OUT}

CH4: I_{OUT}

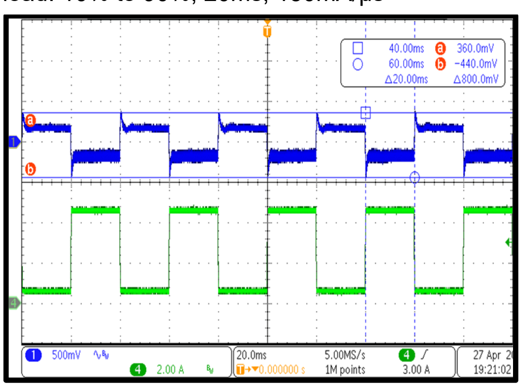


Load Transient Response

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 20V, V_{PP} = 800mV, load: 10% to 90%, 20ms, 150mA/μs

CH1: V_{OUT}

CH4: I_{OUT}

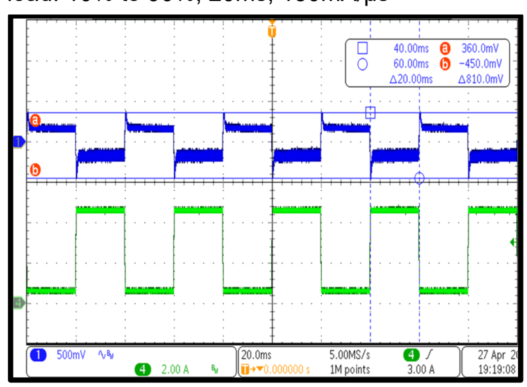


Load Transient Response

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 20V, V_{PP} = 810mV, load: 10% to 90%, 20ms, 150mA/μs

CH1: V_{OUT}

CH4: I_{OUT}

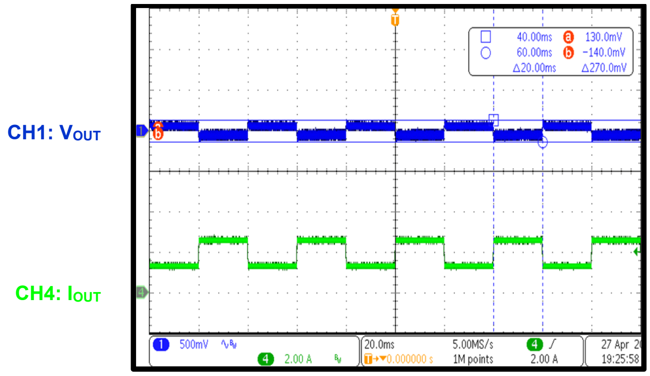


EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

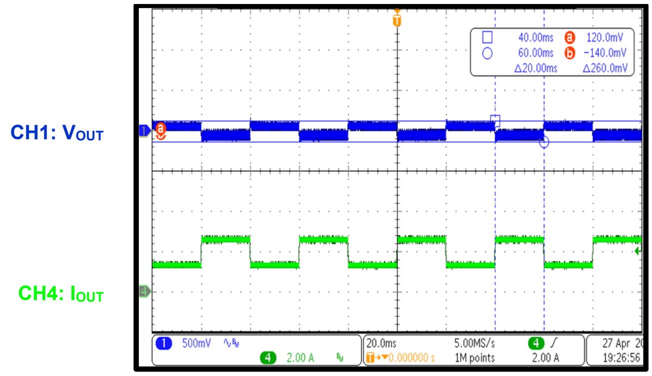
Load Transient Response

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 20V, V_{PP} = 270mV,
load: 25% to 50%, 20ms, 150mA/μs



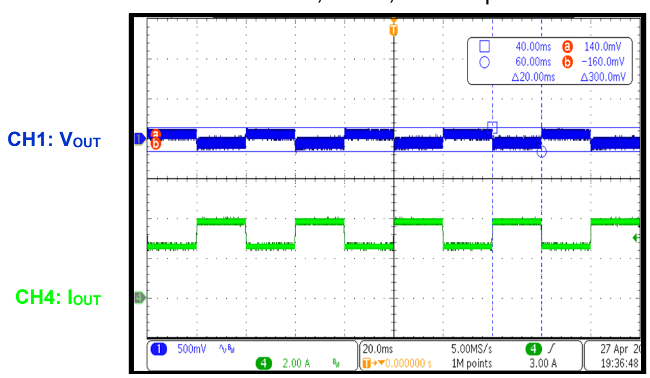
Load Transient Response

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 20V, V_{PP} = 260mV,
load: 25% to 50%, 20ms, 150mA/μs



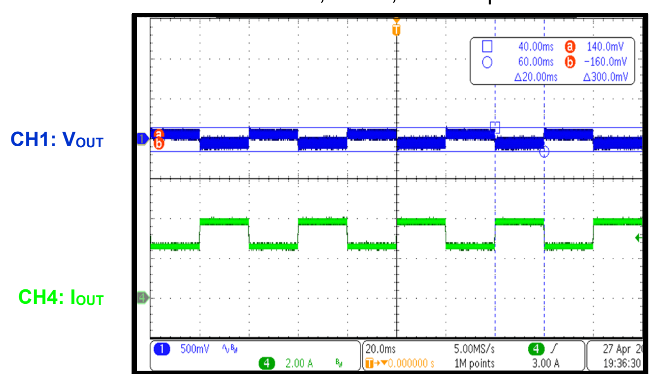
Load Transient Response

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 20V, V_{PP} = 300mV,
load: 50% to 75%, 20ms, 150mA/μs



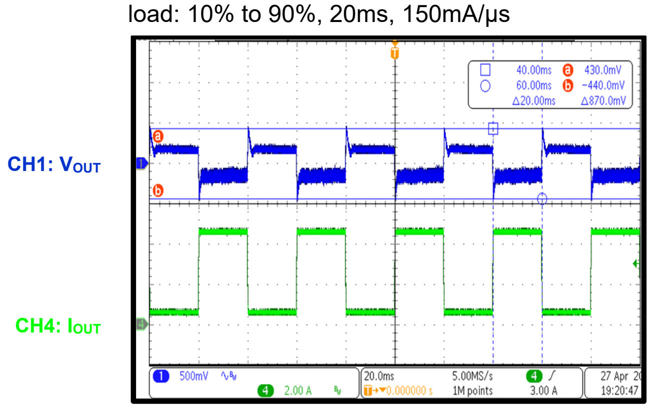
Load Transient Response

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 20V, V_{PP} = 300mV,
load: 50% to 75%, 20ms, 150mA/μs



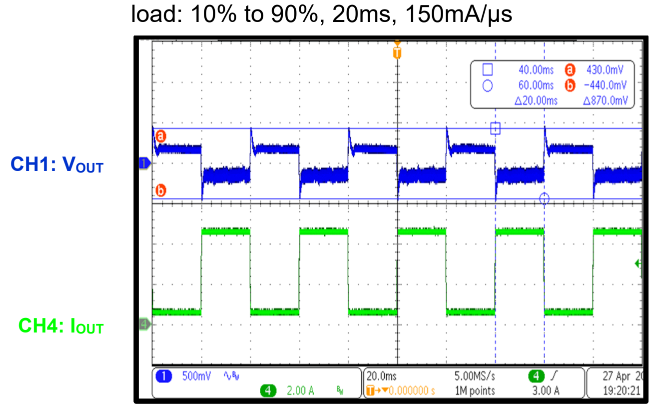
Load Transient Response

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 28V, V_{PP} = 870mV,
load: 10% to 90%, 20ms, 150mA/μs



Load Transient Response

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 28V, V_{PP} = 870mV,
load: 10% to 90%, 20ms, 150mA/μs



EVB TEST RESULTS *(continued)*

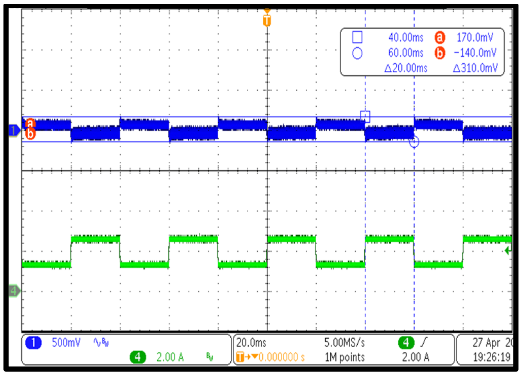
Performance waveforms are tested on the evaluation board.

Load Transient Response

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 28V, V_{PP} = 310mV, load: 25% to 50%, 20ms, 150mA/µs

CH1: V_{OUT}

CH4: I_{OUT}

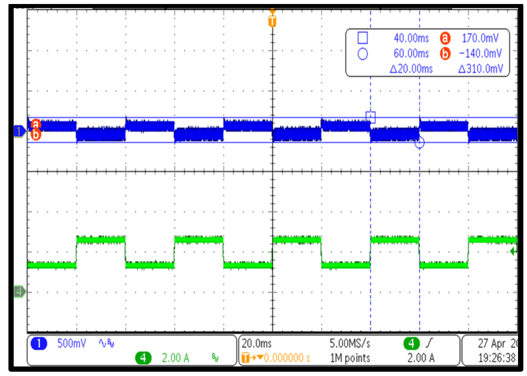


Load Transient Response

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 28V, V_{PP} = 310mV, load: 25% to 50%, 20ms, 150mA/µs

CH1: V_{OUT}

CH4: I_{OUT}

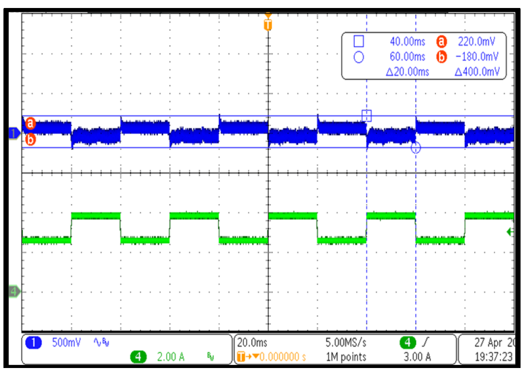


Load Transient Response

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 28V, V_{PP} = 400mV, load: 50% to 75%, 20ms, 150mA/µs

CH1: V_{OUT}

CH4: I_{OUT}

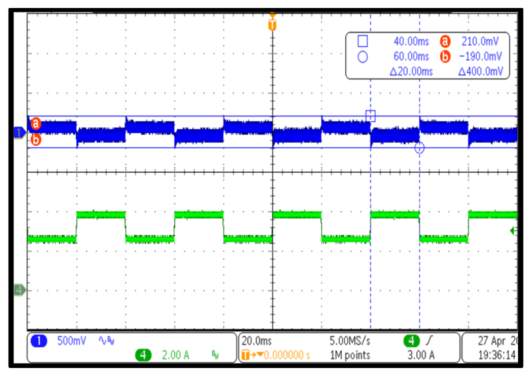


Load Transient Response

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 28V, V_{PP} = 400mV, load: 50% to 75%, 20ms, 150mA/µs

CH1: V_{OUT}

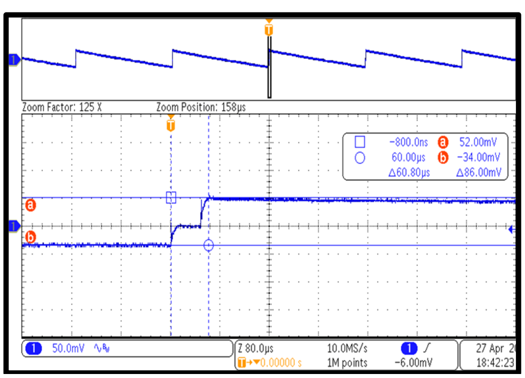
CH4: I_{OUT}



Output Voltage Ripple

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 5V, I_{OUT} = 0A, V_{PP} = 86mV

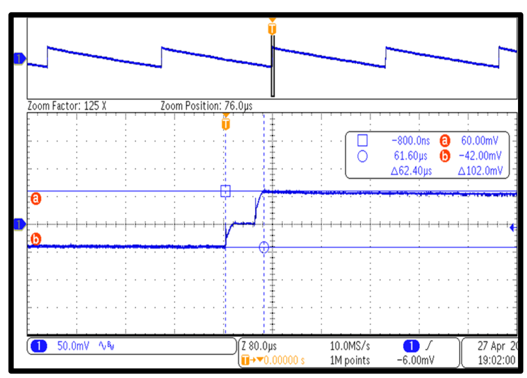
CH1: V_{OUT}



Output Voltage Ripple

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 5V, I_{OUT} = 0A, V_{PP} = 102mV

CH1: V_{OUT}



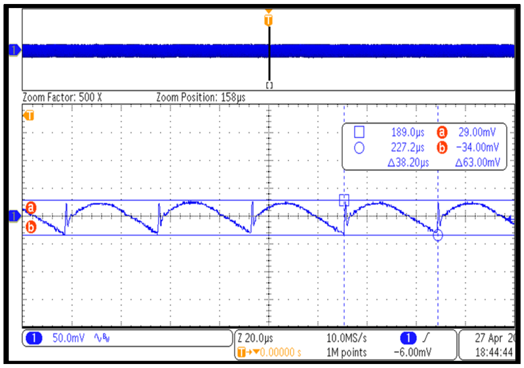
EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

Output Voltage Ripple

V_{IN} = 115VAC/60Hz, V_{OUT} = 5V, I_{OUT} = 3A, V_{PP} = 63mV

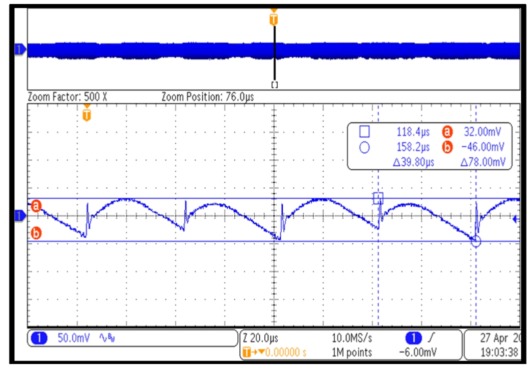
CH1: V_{OUT}



Output Voltage Ripple

V_{IN} = 230VAC/50Hz, V_{OUT} = 5V, I_{OUT} = 3A, V_{PP} = 78mV

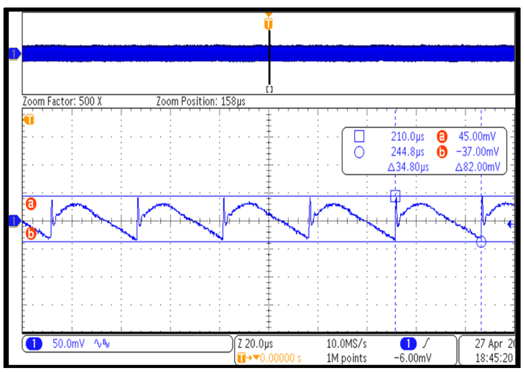
CH1: V_{OUT}



Output Voltage Ripple

V_{IN} = 115VAC/60Hz, V_{OUT} = 9V, I_{OUT} = 3A, V_{PP} = 82mV

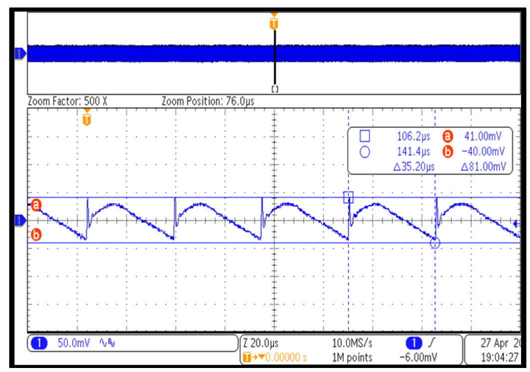
CH1: V_{OUT}



Output Voltage Ripple

V_{IN} = 230VAC/50Hz, V_{OUT} = 9V, I_{OUT} = 3A, V_{PP} = 81mV

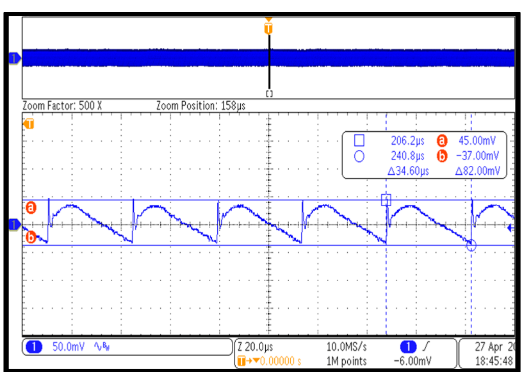
CH1: V_{OUT}



Output Voltage Ripple

V_{IN} = 115VAC/60Hz, V_{OUT} = 12V, I_{OUT} = 3A, V_{PP} = 82mV

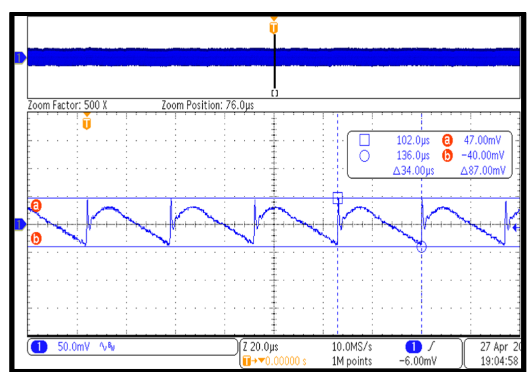
CH1: V_{OUT}



Output Voltage Ripple

V_{IN} = 230VAC/50Hz, V_{OUT} = 12V, I_{OUT} = 3A, V_{PP} = 87mV

CH1: V_{OUT}



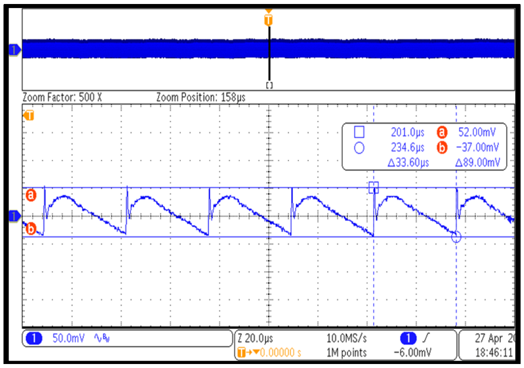
EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

Output Voltage Ripple

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 15V, I_{OUT} = 3A, V_{PP} = 89mV

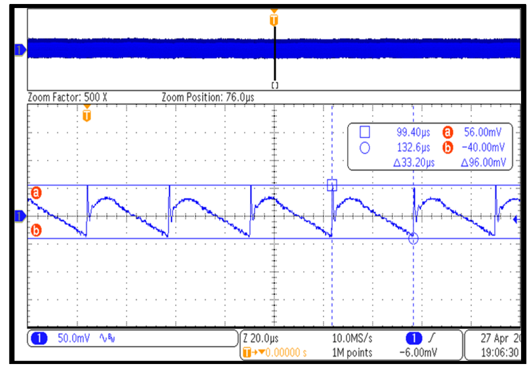
CH1: V_{OUT}



Output Voltage Ripple

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 15V, I_{OUT} = 3A, V_{PP} = 96mV

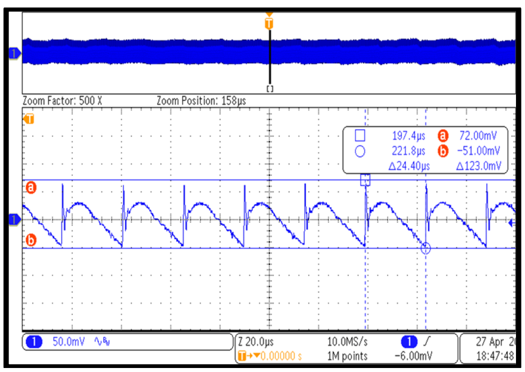
CH1: V_{OUT}



Output Voltage Ripple

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 20V, I_{OUT} = 5A, V_{PP} = 123mV

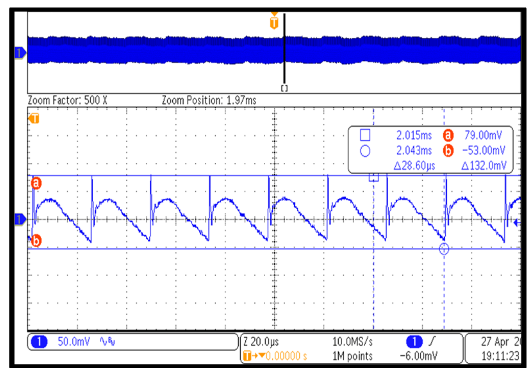
CH1: V_{OUT}



Output Voltage Ripple

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 20V, I_{OUT} = 5A, V_{PP} = 132mV

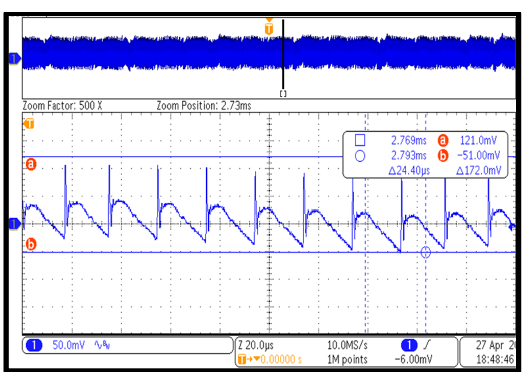
CH1: V_{OUT}



Output Voltage Ripple

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 28V, I_{OUT} = 5A, V_{PP} = 172mV

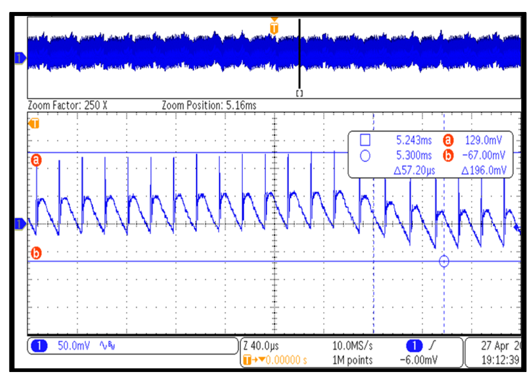
CH1: V_{OUT}



Output Voltage Ripple

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 28V, I_{OUT} = 5A, V_{PP} = 196mV

CH1: V_{OUT}

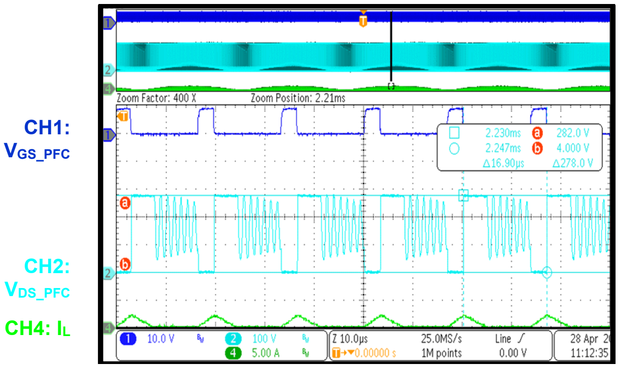


EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

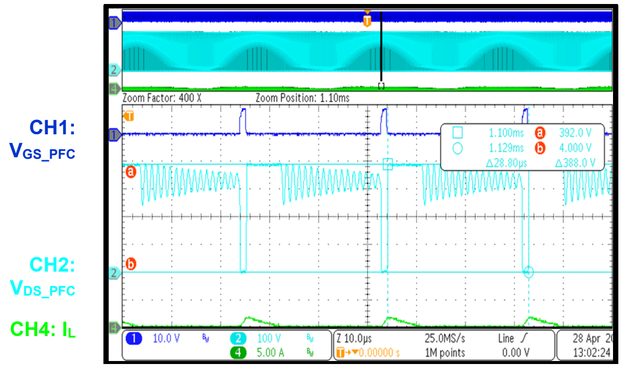
PFC Steady State

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 12V, I_{OUT} = 3A



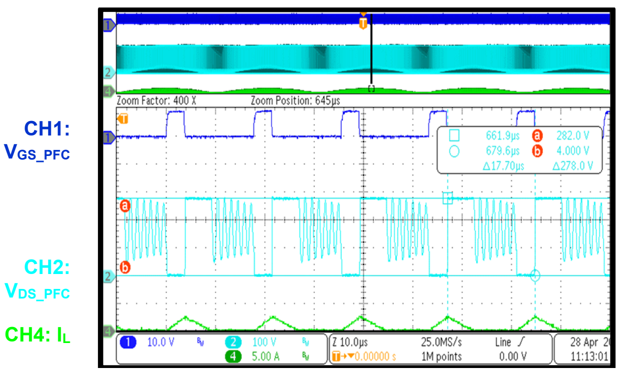
PFC Steady State

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 12V, I_{OUT} = 3A



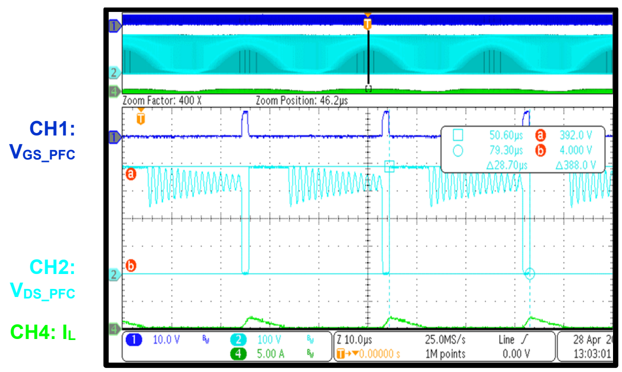
PFC Steady State

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 15V, I_{OUT} = 3A



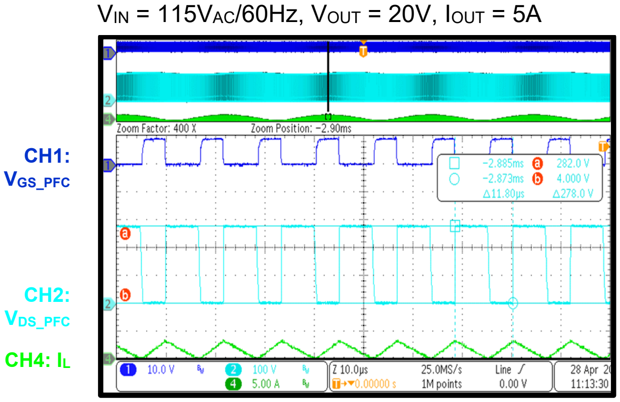
PFC Steady State

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 15V, I_{OUT} = 3A



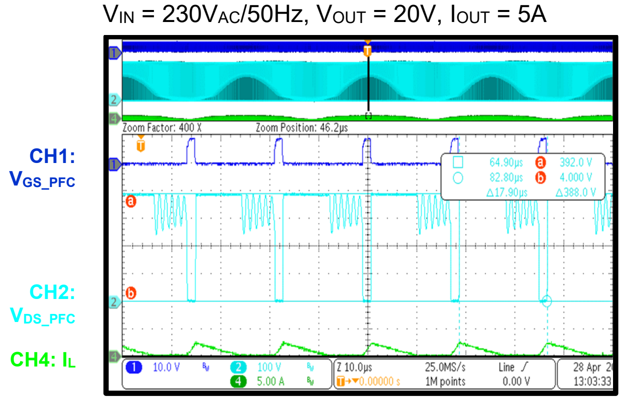
PFC Steady State

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 20V, I_{OUT} = 5A



PFC Steady State

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 20V, I_{OUT} = 5A



EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

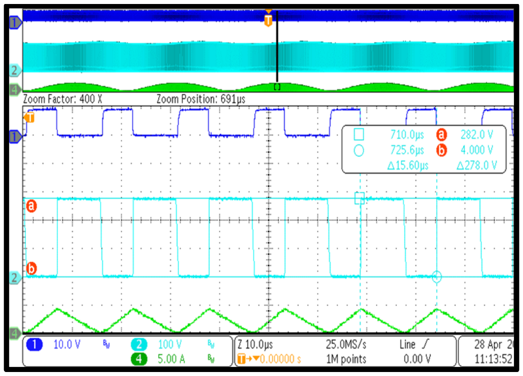
PFC Steady State

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 28V, I_{OUT} = 5A

CH1: V_{GS_PFC}

CH2: V_{DS_PFC}

CH4: I_L



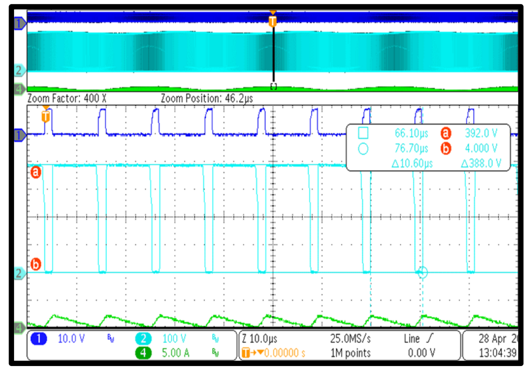
PFC Steady State

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 28V, I_{OUT} = 5A

CH1: V_{GS_PFC}

CH2: V_{DS_PFC}

CH4: I_L



Flyback Steady State

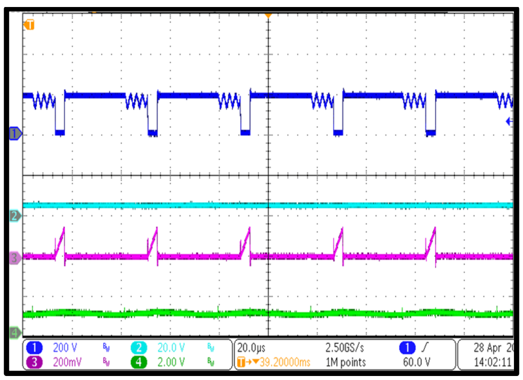
V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 5V, I_{OUT} = 3A

CH1: V_{DS_PRI}

CH2: V_{OUT}

CH3: V_{CS}

CH4: V_{COMP}



Flyback Steady State

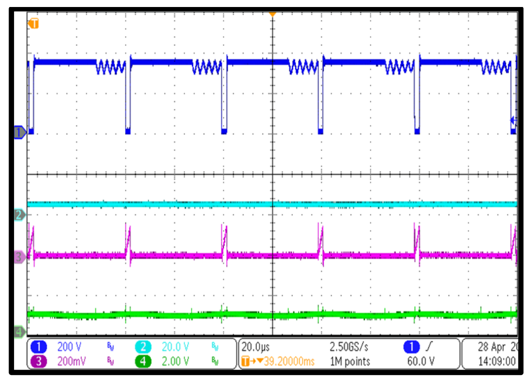
V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 5V, I_{OUT} = 3A

CH1: V_{DS_PRI}

CH2: V_{OUT}

CH3: V_{CS}

CH4: V_{COMP}



Flyback Steady State

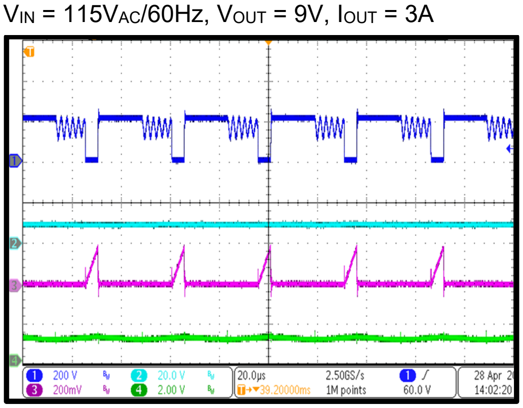
V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 9V, I_{OUT} = 3A

CH1: V_{DS_PRI}

CH2: V_{OUT}

CH3: V_{CS}

CH4: V_{COMP}



Flyback Steady State

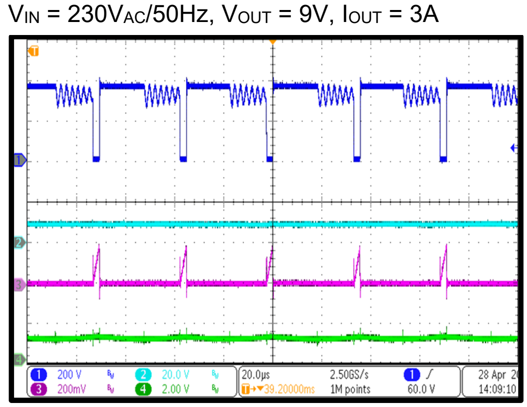
V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 9V, I_{OUT} = 3A

CH1: V_{DS_PRI}

CH2: V_{OUT}

CH3: V_{CS}

CH4: V_{COMP}

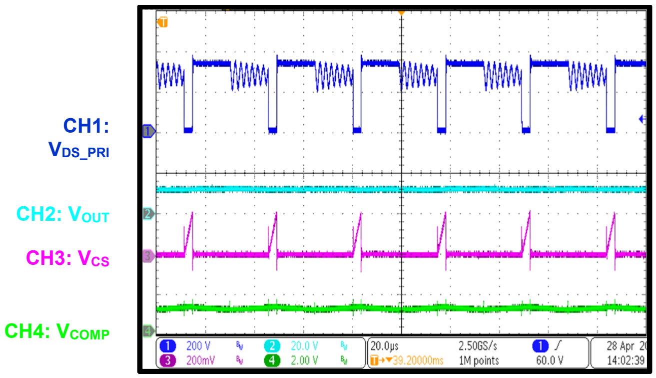


EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

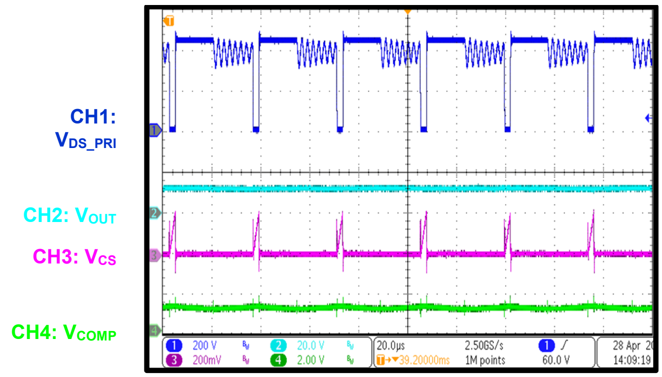
Flyback Steady State

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 12V, I_{OUT} = 3A



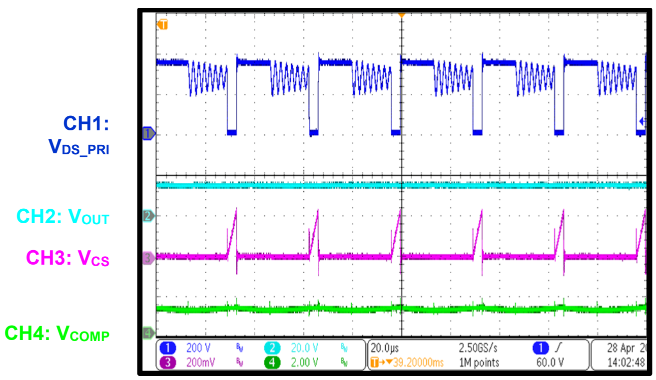
Flyback Steady State

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 12V, I_{OUT} = 3A



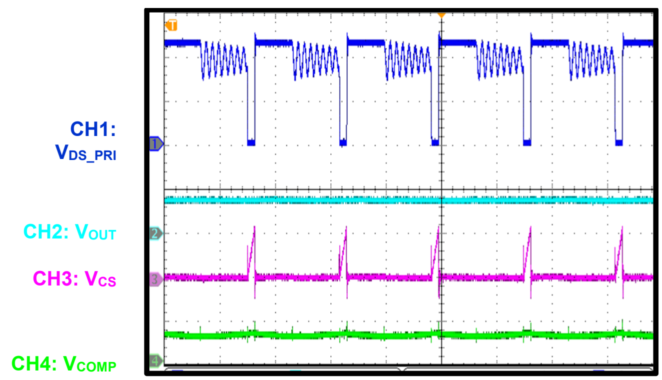
Flyback Steady State

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 15V, I_{OUT} = 3A



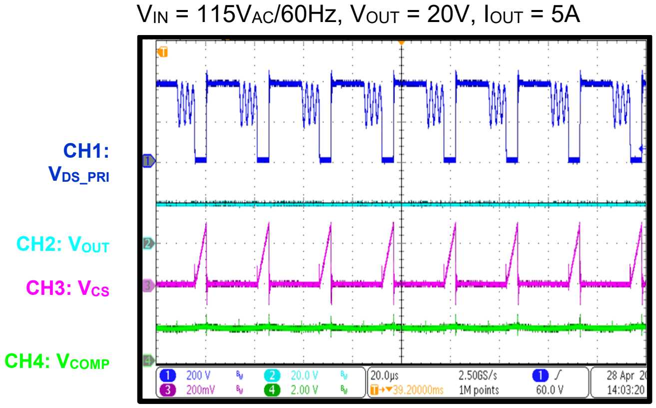
Flyback Steady State

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 15V, I_{OUT} = 3A



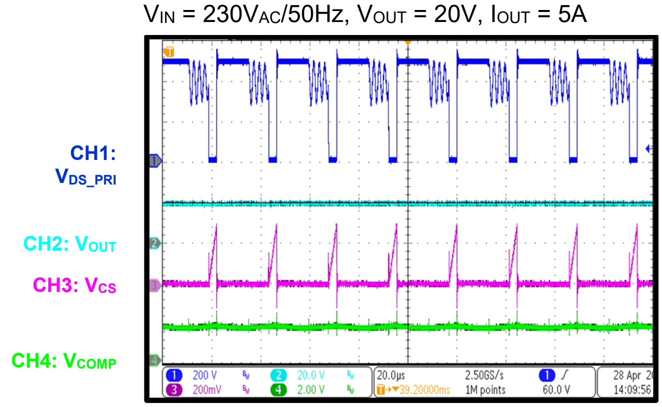
Flyback Steady State

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 20V, I_{OUT} = 5A



Flyback Steady State

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 20V, I_{OUT} = 5A

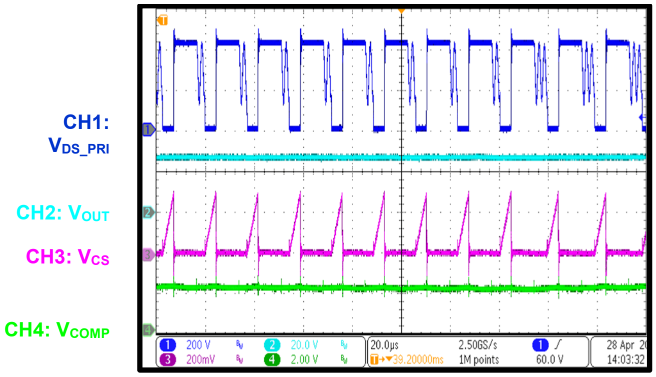


EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

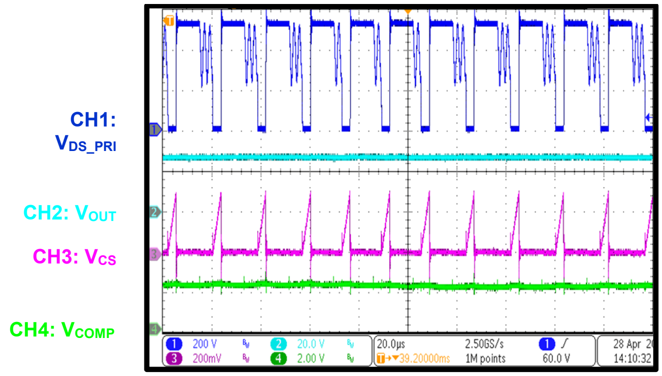
Flyback Steady State

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 28V, I_{OUT} = 5A



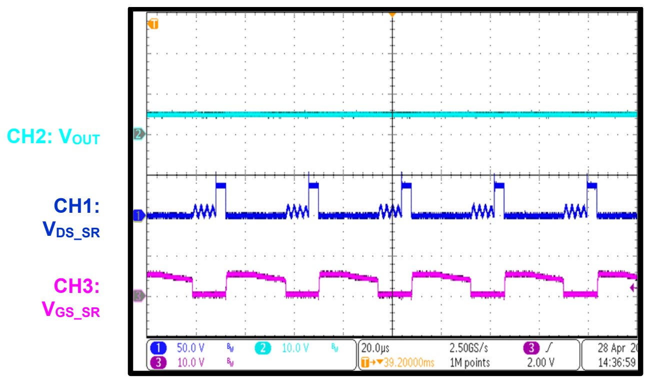
Flyback Steady State

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 28V, I_{OUT} = 5A



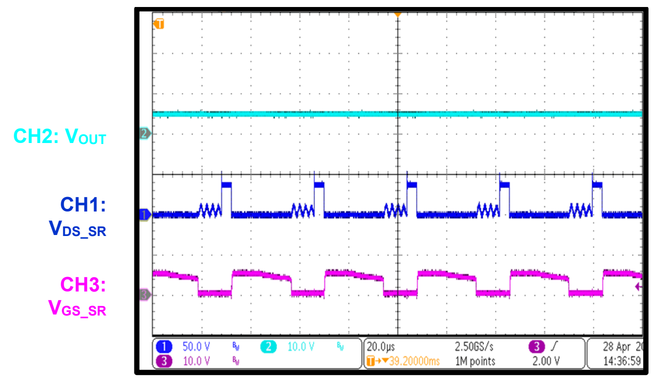
SR Steady State

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 5V, I_{OUT} = 3A



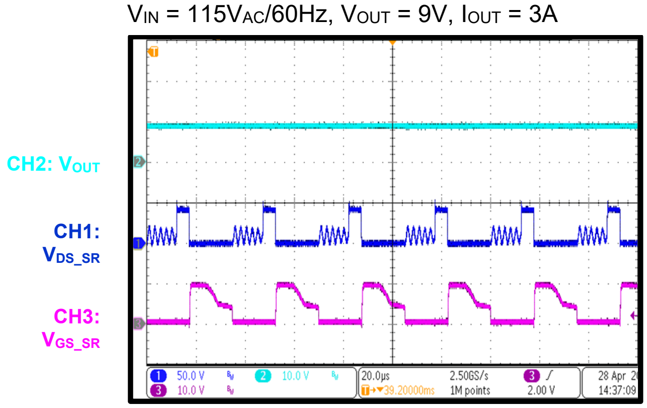
SR Steady State

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 5V, I_{OUT} = 3A



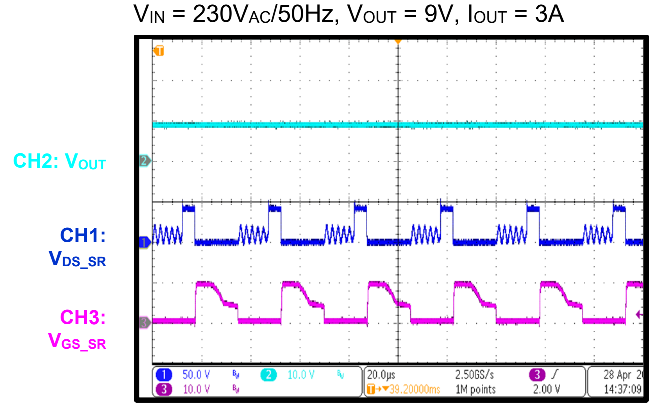
SR Steady State

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 9V, I_{OUT} = 3A



SR Steady State

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 9V, I_{OUT} = 3A

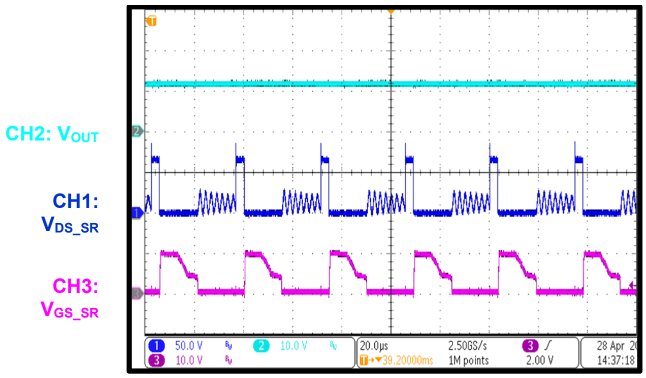


EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

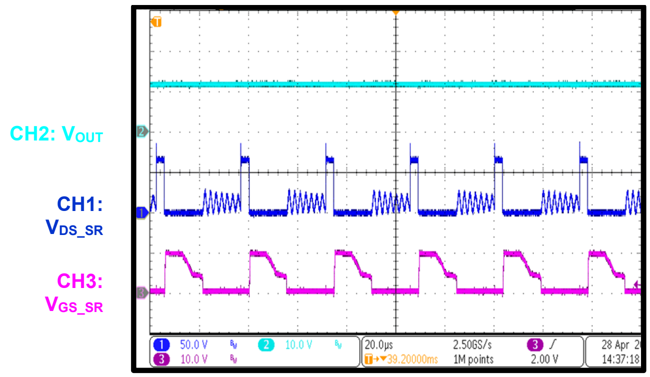
SR Steady State

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 12V, I_{OUT} = 3A



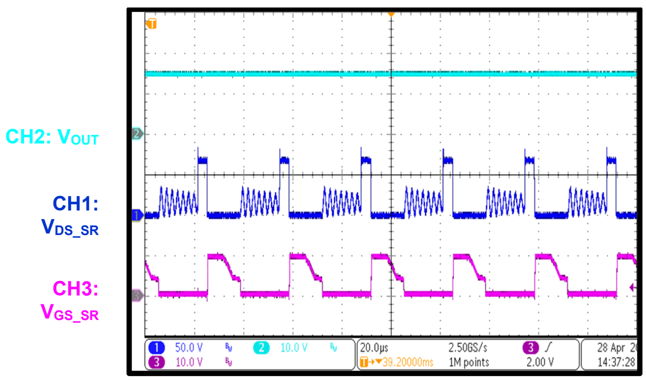
SR Steady State

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 12V, I_{OUT} = 3A



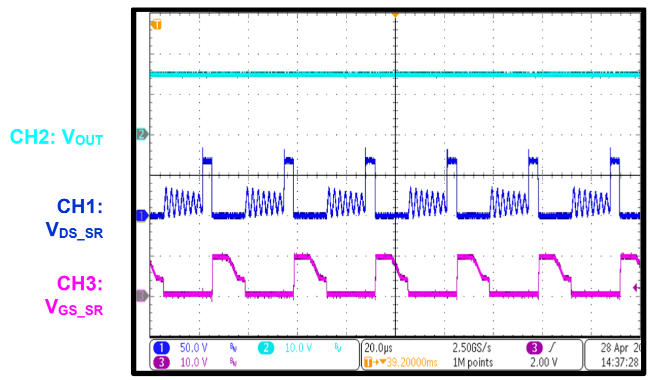
SR Steady State

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 15V, I_{OUT} = 3A



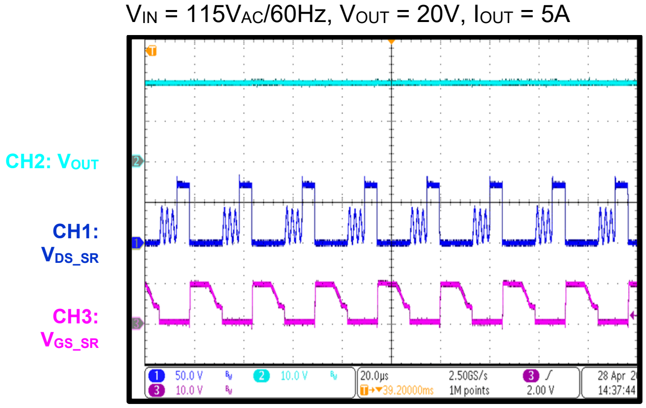
SR Steady State

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 15V, I_{OUT} = 3A



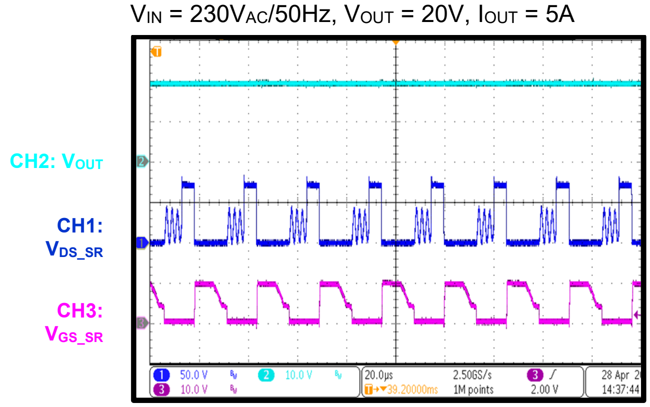
SR Steady State

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 20V, I_{OUT} = 5A



SR Steady State

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 20V, I_{OUT} = 5A

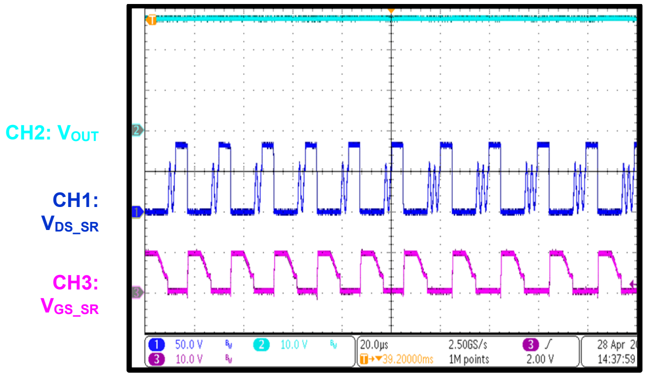


EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

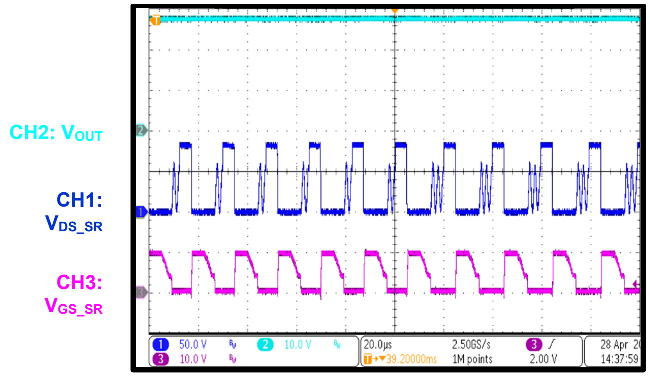
SR Steady State

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 28V, I_{OUT} = 5A



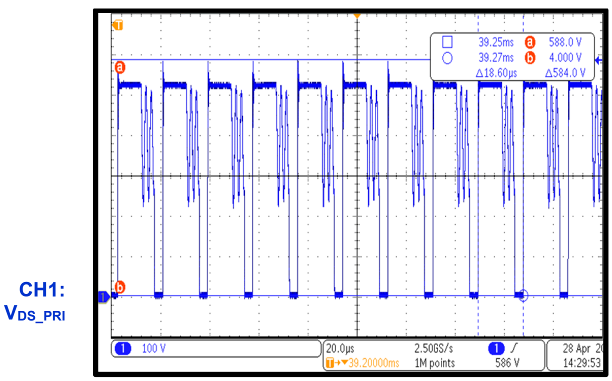
SR Steady State

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 28V, I_{OUT} = 5A



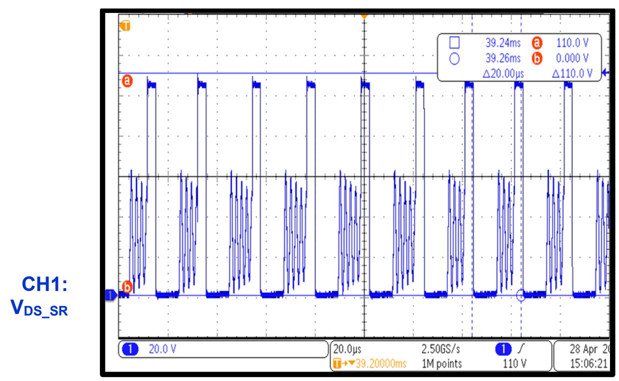
Primary MOSFET Stress

V_{IN} = 264V_{AC}, V_{OUT} = 28V, I_{OUT} = 5A, V_{MAX} = 584V



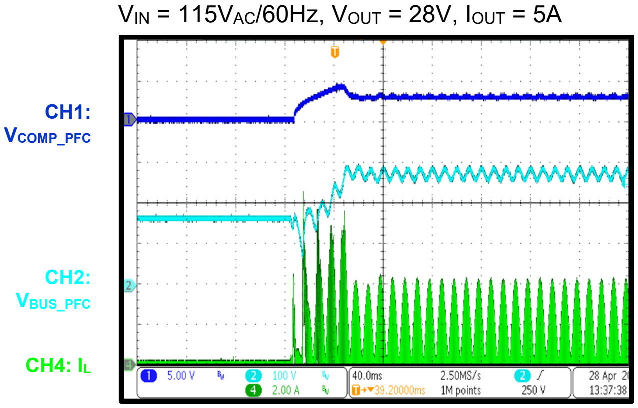
Secondary MOSFET Stress

V_{IN} = 264V_{AC}, V_{OUT} = 28V, I_{OUT} = 4.27A, V_{MAX} = 114.4V



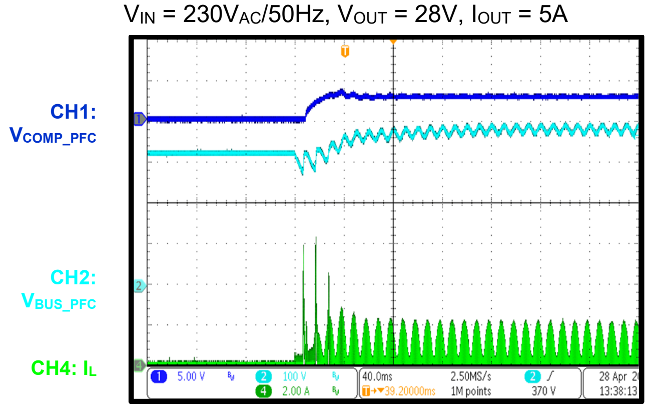
PFC Start-Up

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 28V, I_{OUT} = 5A



PFC Start-Up

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 28V, I_{OUT} = 5A



EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

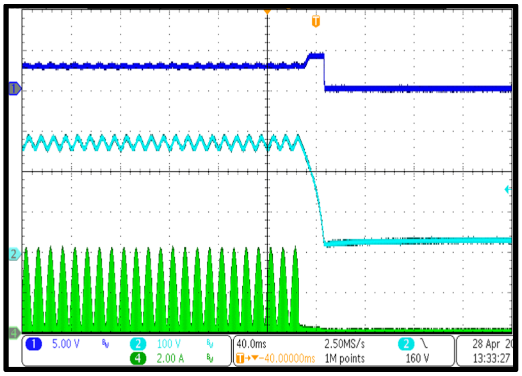
PFC Shutdown

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 28V, I_{OUT} = 5A

CH1: V_{COMP}

CH2: V_{BUS}

CH4: I_L



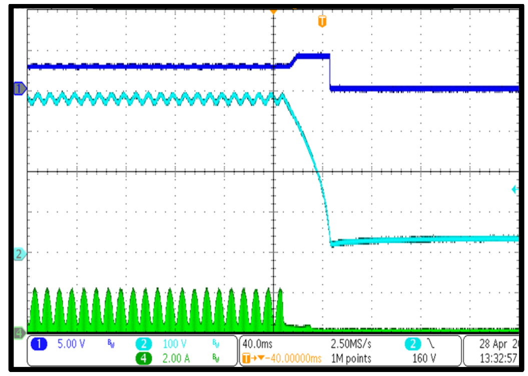
PFC Shutdown

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 28V, I_{OUT} = 5A

CH1: V_{COMP}

CH2: V_{BUS}

CH4: I_L



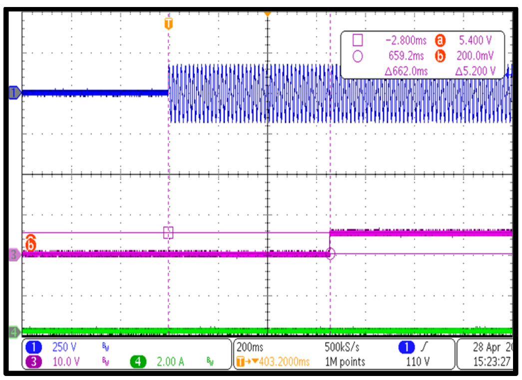
AC Input Start-Up

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 5V, I_{OUT} = 0A,
t_{RISE} = 662ms

CH1: V_{IN}

CH3: V_{OUT}

CH4: I_{OUT}



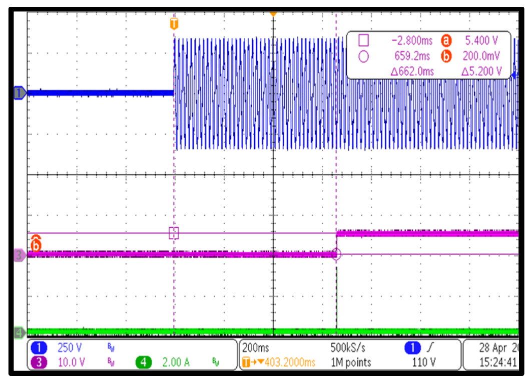
AC Input Start-Up

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 5V, I_{OUT} = 0A,
t_{RISE} = 662ms

CH1: V_{IN}

CH3: V_{OUT}

CH4: I_{OUT}



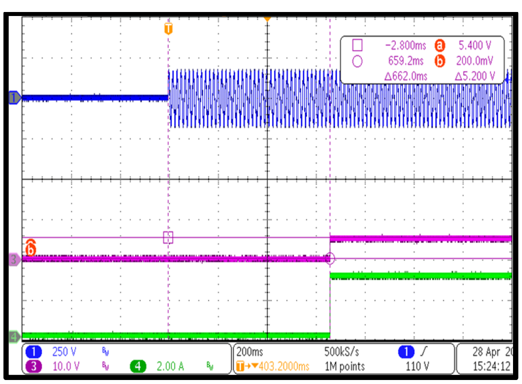
AC Input Start-Up

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 5V, I_{OUT} = 3A,
t_{RISE} = 662ms

CH1: V_{IN}

CH3: V_{OUT}

CH4: I_{OUT}



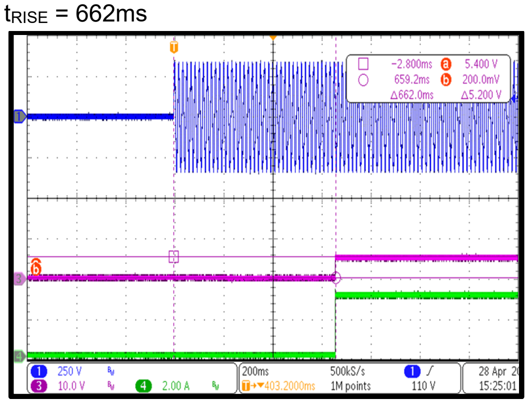
AC Input Start-Up

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 5V, I_{OUT} = 3A,
t_{RISE} = 662ms

CH1: V_{IN}

CH3: V_{OUT}

CH4: I_{OUT}

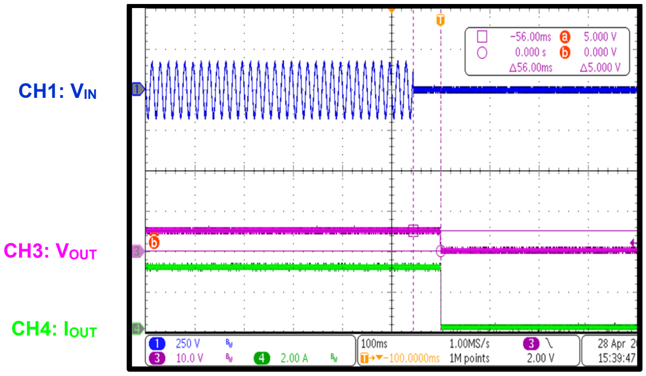


EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

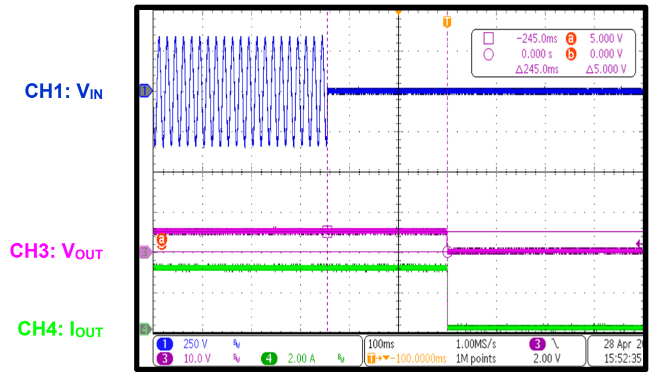
AC Input Shutdown

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 5V, I_{OUT} = 3A,
t_{HOLD} = 56ms



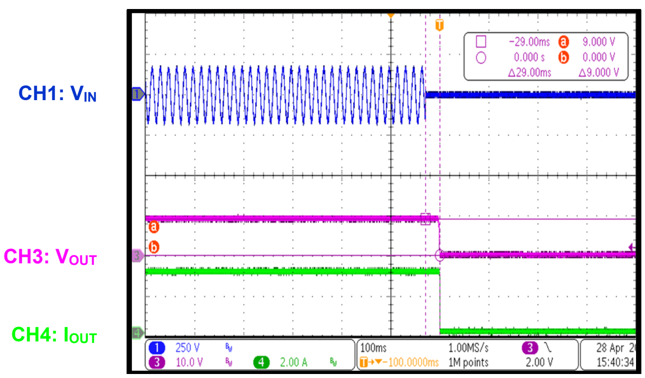
AC Input Shutdown

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 5V, I_{OUT} = 3A,
t_{HOLD} = 245ms



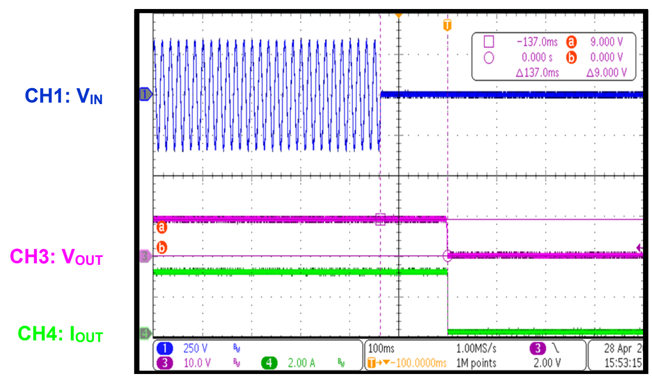
AC Input Shutdown

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 9V, I_{OUT} = 3A,
t_{HOLD} = 29ms



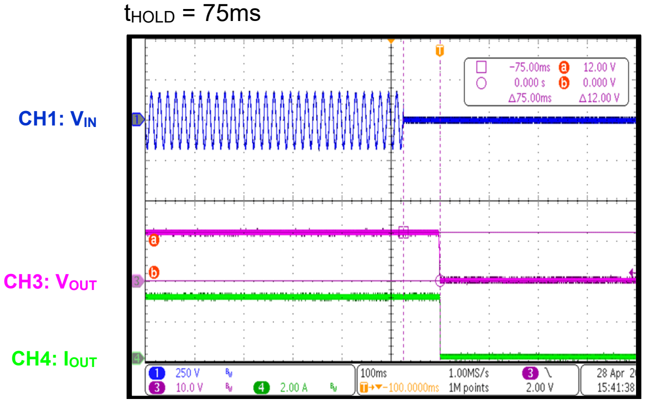
AC Input Shutdown

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 9V, I_{OUT} = 3A,
t_{HOLD} = 137ms



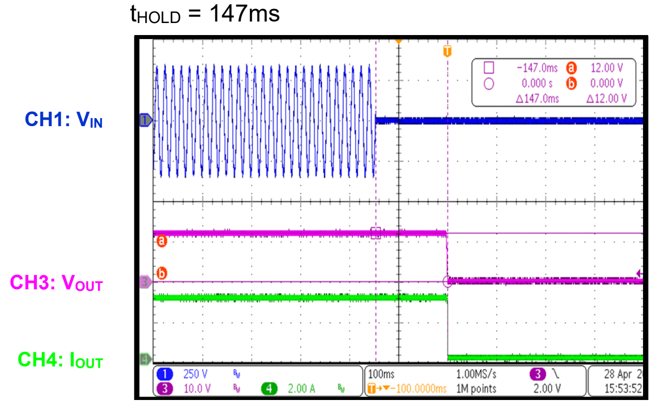
AC Input Shutdown

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 12V, I_{OUT} = 3A,
t_{HOLD} = 75ms



AC Input Shutdown

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 12V, I_{OUT} = 3A,
t_{HOLD} = 147ms

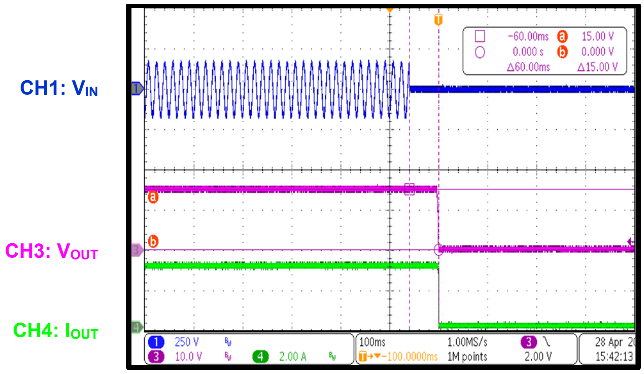


EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

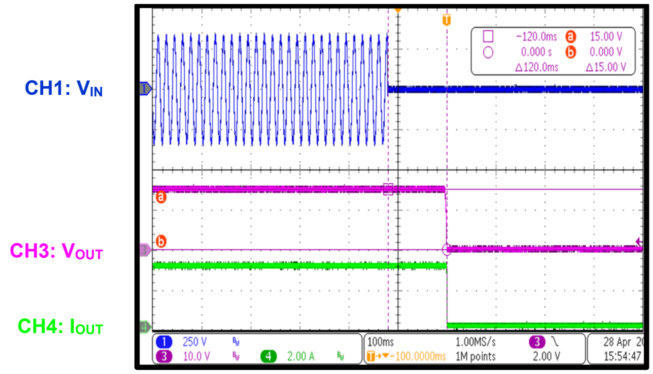
AC Input Shutdown

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 15V, I_{OUT} = 3A, t_{HOLD} = 60ms



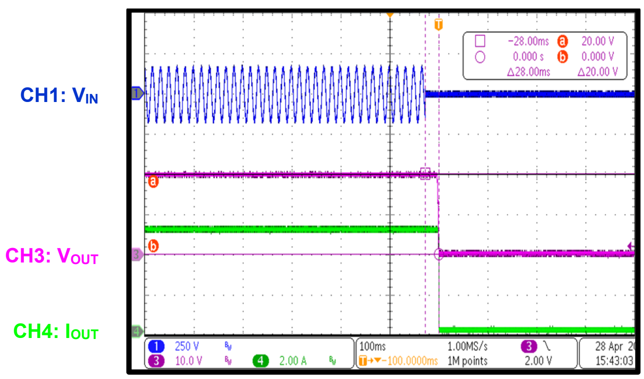
AC Input Shutdown

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 15V, I_{OUT} = 3A, t_{HOLD} = 120ms



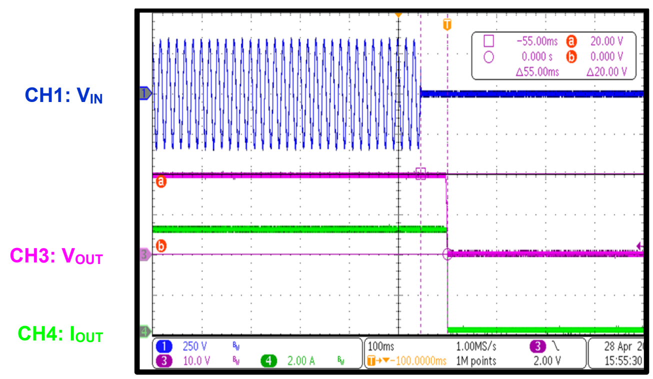
AC Input Shutdown

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 20V, I_{OUT} = 5A, t_{HOLD} = 28ms



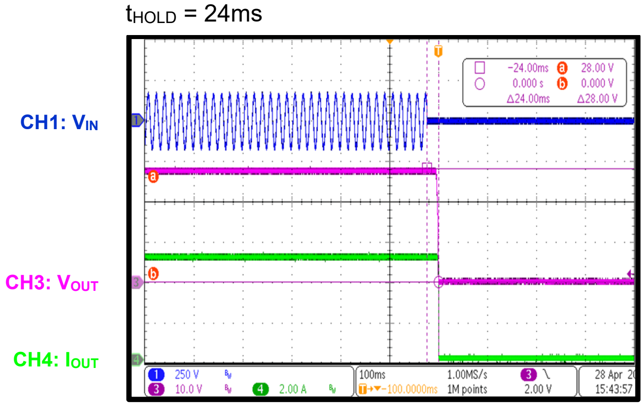
AC Input Shutdown

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 20V, I_{OUT} = 5A, t_{HOLD} = 55ms



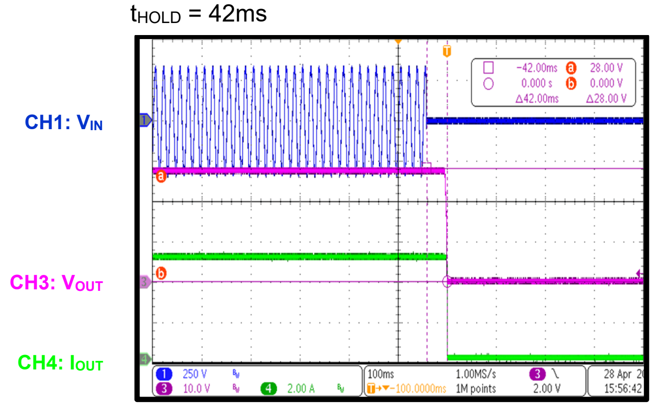
AC Input Shutdown

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 28V, I_{OUT} = 5A, t_{HOLD} = 24ms



AC Input Shutdown

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 28V, I_{OUT} = 5A, t_{HOLD} = 42ms

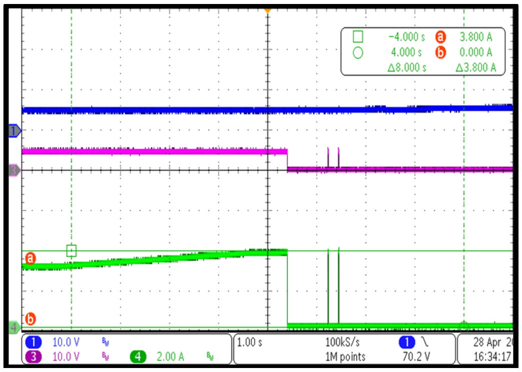


EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

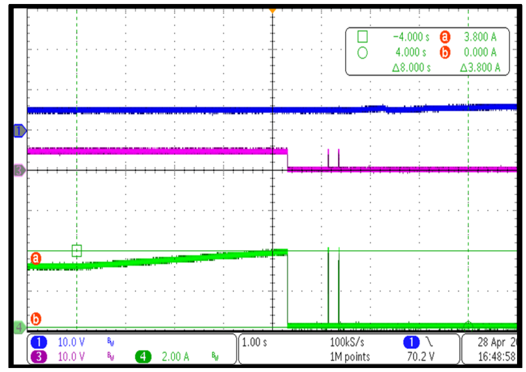
Output OCP

V_{IN} = 115VAC/60Hz, V_{OUT} = 5V, I_{OCP} = 3.8A



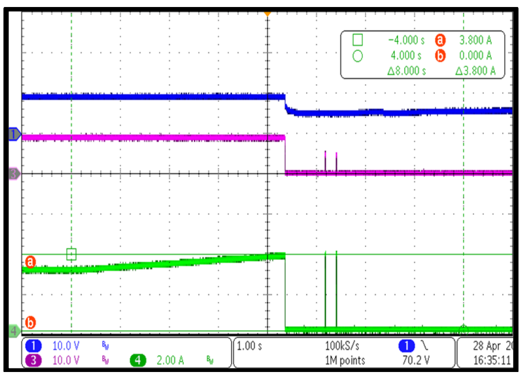
Output OCP

V_{IN} = 230VAC/50Hz, V_{OUT} = 5V, I_{OCP} = 3.8A



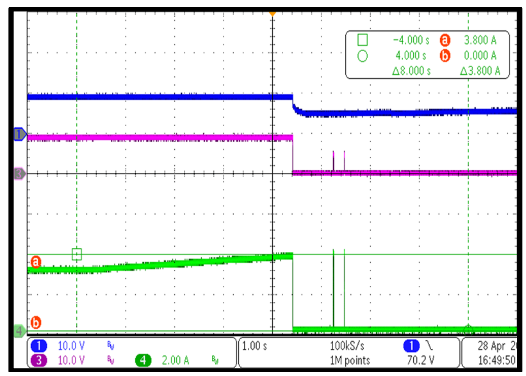
Output OCP

V_{IN} = 115VAC/60Hz, V_{OUT} = 9V, I_{OCP} = 3.8A



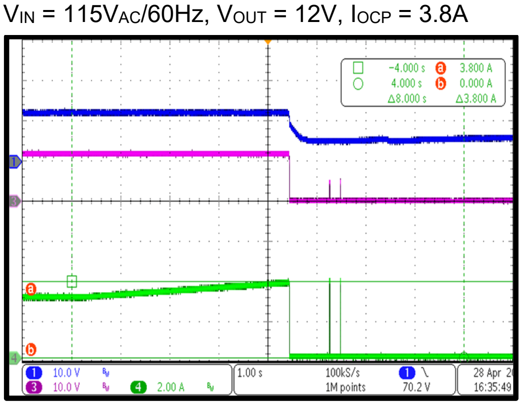
Output OCP

V_{IN} = 230VAC/50Hz, V_{OUT} = 9V, I_{OCP} = 3.8A



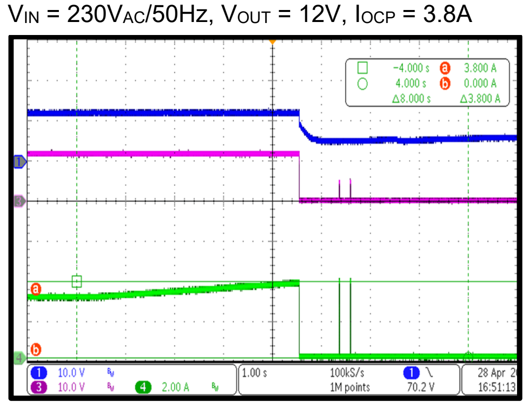
Output OCP

V_{IN} = 115VAC/60Hz, V_{OUT} = 12V, I_{OCP} = 3.8A



Output OCP

V_{IN} = 230VAC/50Hz, V_{OUT} = 12V, I_{OCP} = 3.8A



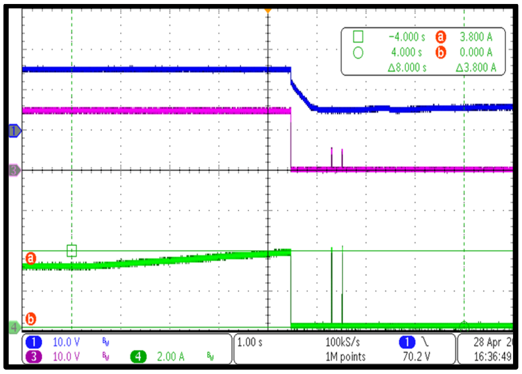
EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

Output OCP

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 15V, I_{OCP} = 3.8A

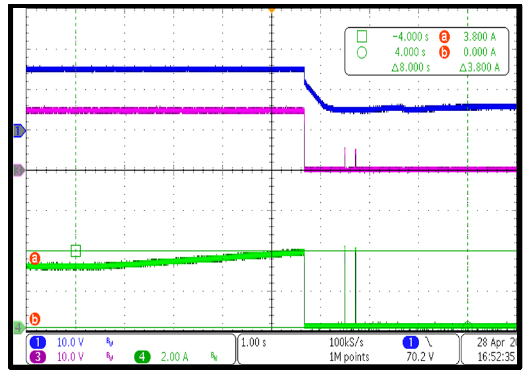
CH1: VBUS+
CH3: V_{OUT}
CH4: I_{OUT}



Output OCP

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 15V, I_{OCP} = 3.8A

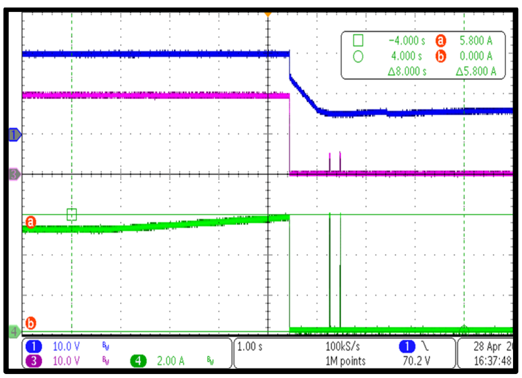
CH1: VBUS+
CH3: V_{OUT}
CH4: I_{OUT}



Output OCP

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 20V, I_{OCP} = 5.8A

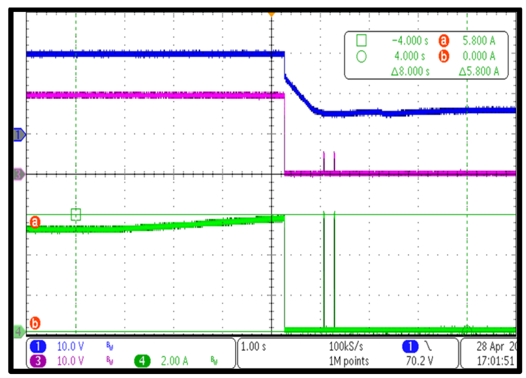
CH1: VBUS+
CH3: V_{OUT}
CH4: I_{OUT}



Output OCP

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 20V, I_{OCP} = 5.8A

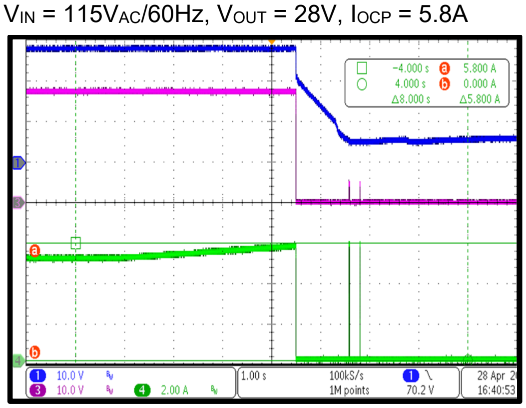
CH1: VBUS+
CH3: V_{OUT}
CH4: I_{OUT}



Output OCP

V_{IN} = 115V_{AC}/60Hz, V_{OUT} = 28V, I_{OCP} = 5.8A

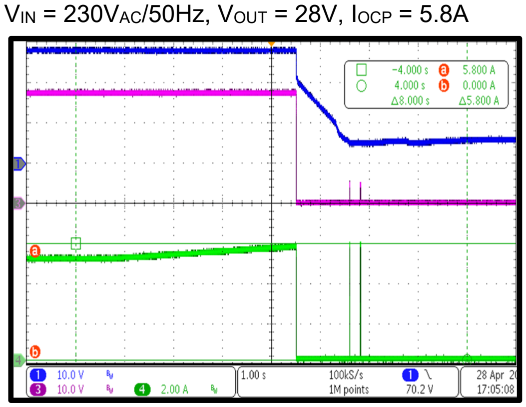
CH1: VBUS+
CH3: V_{OUT}
CH4: I_{OUT}



Output OCP

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 28V, I_{OCP} = 5.8A

CH1: VBUS+
CH3: V_{OUT}
CH4: I_{OUT}

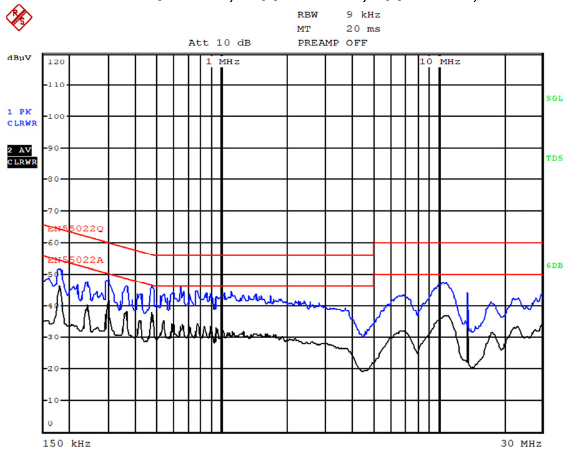


EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

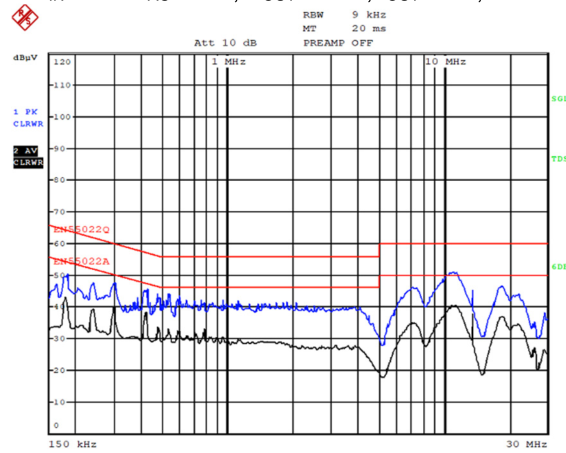
Conducted EMI

V_{IN} = 115V_{AC}/50Hz, V_{OUT} = 28V, I_{OUT} = 5A, line L



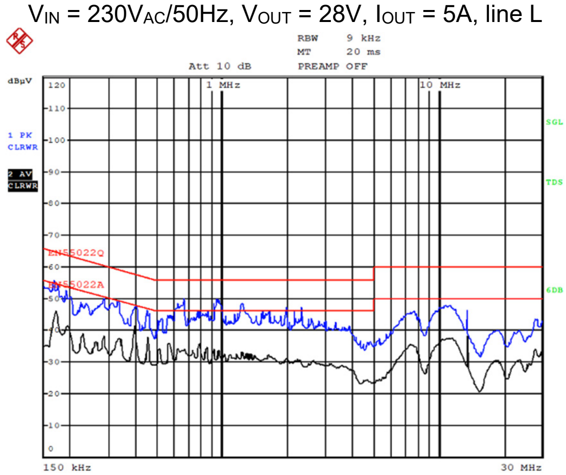
Conducted EMI

V_{IN} = 115V_{AC}/50Hz, V_{OUT} = 28V, I_{OUT} = 5A, line N



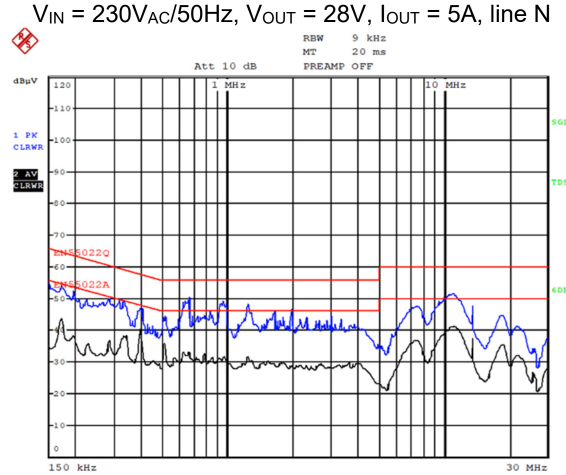
Conducted EMI

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 28V, I_{OUT} = 5A, line L



Conducted EMI

V_{IN} = 230V_{AC}/50Hz, V_{OUT} = 28V, I_{OUT} = 5A, line N

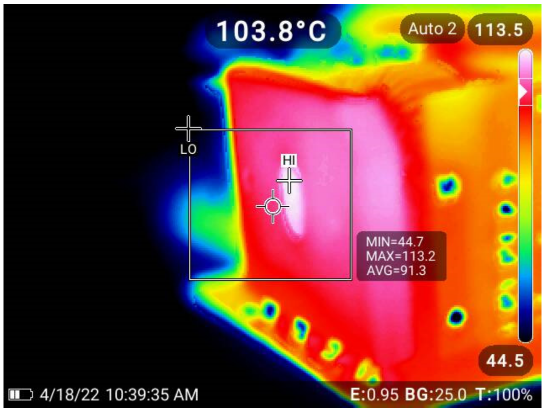


EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

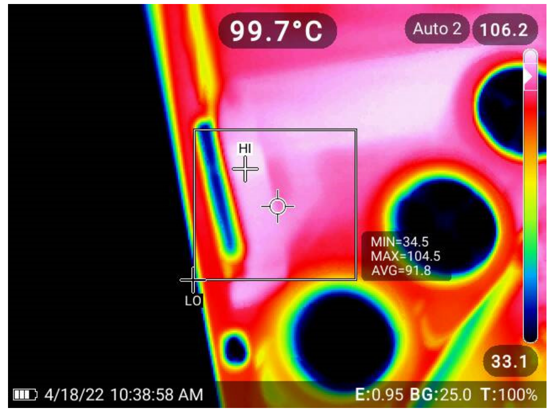
Thermal Measurements

V_{IN} = 90V_{AC}/60Hz, V_{OUT} = 28V, I_{OUT} = 5A,
bridge diode: 113.2°C



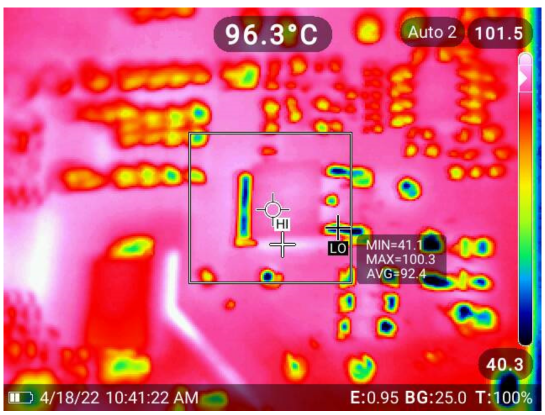
Thermal Measurements

V_{IN} = 90V_{AC}/60Hz, V_{OUT} = 28V, I_{OUT} = 5A,
PFC MOSFET: 104.5°C



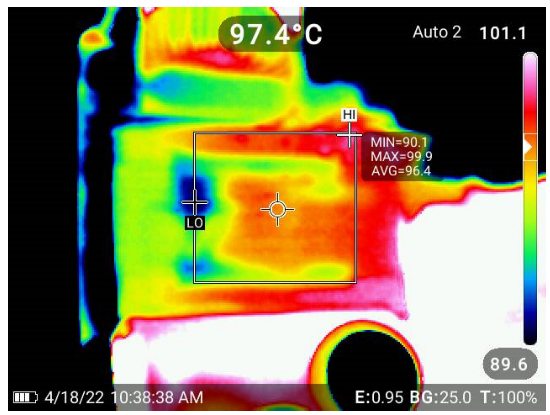
Thermal Measurements

V_{IN} = 90V_{AC}/60Hz, V_{OUT} = 28V, I_{OUT} = 5A,
PFC freewheeling diode: 100.3°C



Thermal Measurements

V_{IN} = 90V_{AC}/60Hz, V_{OUT} = 28V, I_{OUT} = 5A,
PFC inductance: 99.9°C

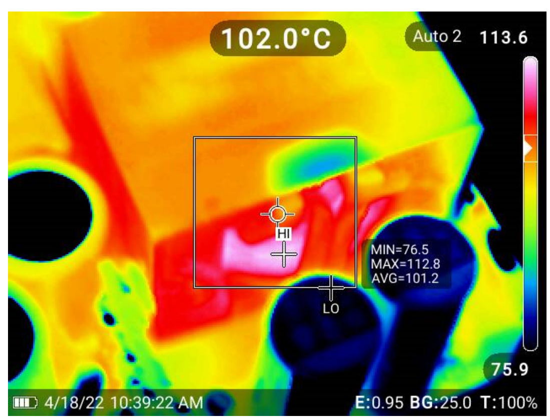


Thermal Measurements

V_{IN} = 90V_{AC}/60Hz, V_{OUT} = 28V, I_{OUT} = 5A,
flyback MOSFET: 95.8°C

Thermal Measurements

V_{IN} = 90V_{AC}/60Hz, V_{OUT} = 28V, I_{OUT} = 5A,
transformer: 112.8°C

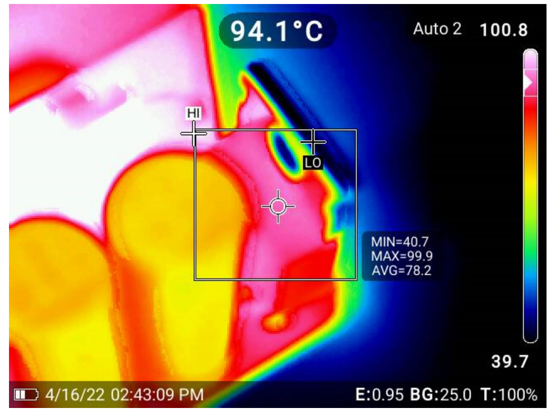


EVB TEST RESULTS *(continued)*

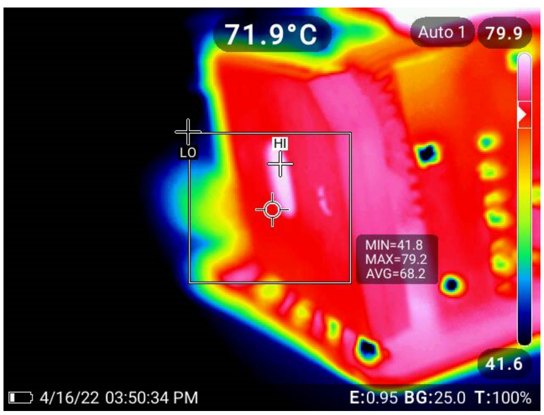
Performance waveforms are tested on the evaluation board.

Thermal Measurements
V_{IN} = 90V_{AC}/60Hz, V_{OUT} = 28V, I_{OUT} = 5A,
RCD: 100.5°C

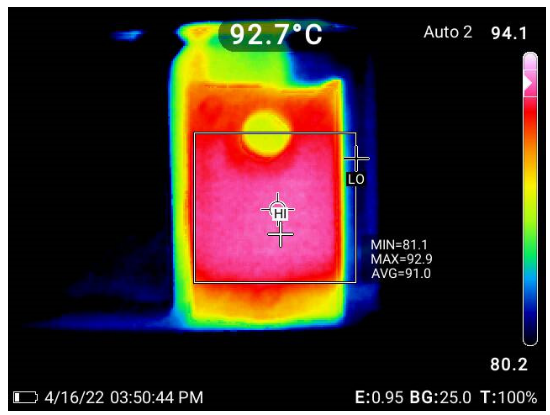
Thermal Measurements
V_{IN} = 90V_{AC}/60Hz, V_{OUT} = 28V, I_{OUT} = 5A,
SR MOSFET: 99.9°C



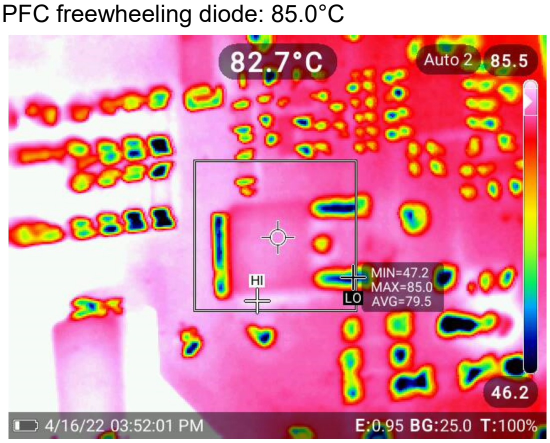
Thermal Measurements
V_{IN} = 264V_{AC}/50Hz, V_{OUT} = 28V, I_{OUT} = 5A,
bridge diode: 79.2°C



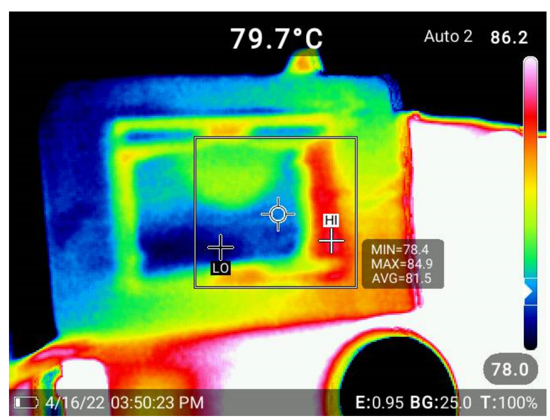
Thermal Measurements
V_{IN} = 264V_{AC}/50Hz, V_{OUT} = 28V, I_{OUT} = 5A,
PFC MOSFET: 92.9°C



Thermal Measurements
V_{IN} = 264V_{AC}/50Hz, V_{OUT} = 28V, I_{OUT} = 5A,
PFC freewheeling diode: 85.0°C



Thermal Measurements
V_{IN} = 264V_{AC}/50Hz, V_{OUT} = 28V, I_{OUT} = 5A,
PFC inductance: 84.9°C

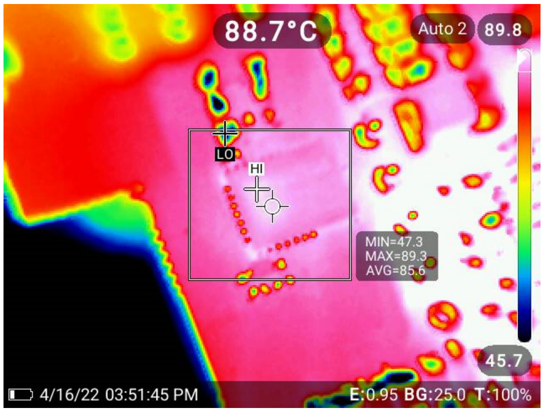


EVB TEST RESULTS *(continued)*

Performance waveforms are tested on the evaluation board.

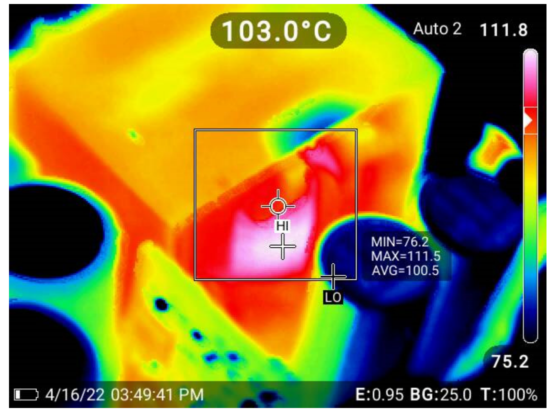
Thermal Measurements

V_{IN} = 264V_{AC}/50Hz, V_{OUT} = 28V, I_{OUT} = 5A, flyback MOSFET: 89.3°C



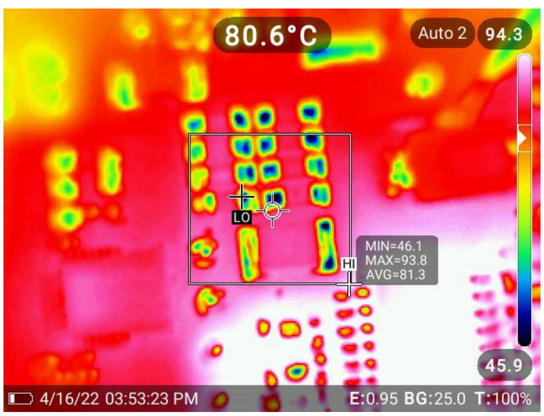
Thermal Measurements

V_{IN} = 264V_{AC}/50Hz, V_{OUT} = 28V, I_{OUT} = 5A, transformer: 111.5°C



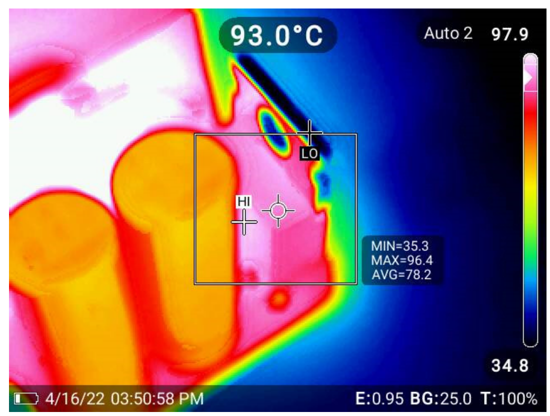
Thermal Measurements

V_{IN} = 264V_{AC}/50Hz, V_{OUT} = 28V, I_{OUT} = 5A, RCD: 80.6°C



Thermal Measurements

V_{IN} = 264V_{AC}/50Hz, V_{OUT} = 28V, I_{OUT} = 5A, SR MOSFET: 96.4°C



PCB LAYOUT

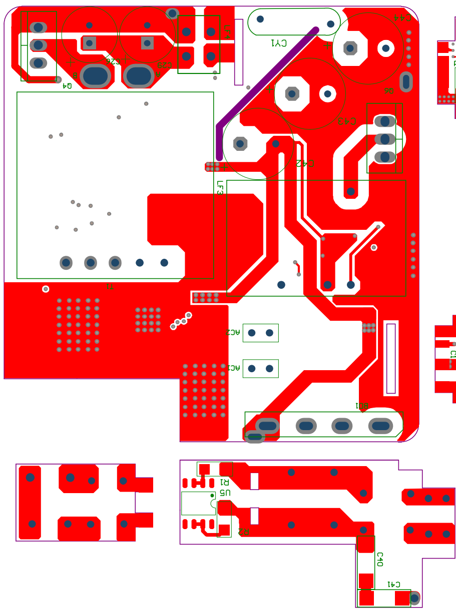


Figure 4: Top Layer

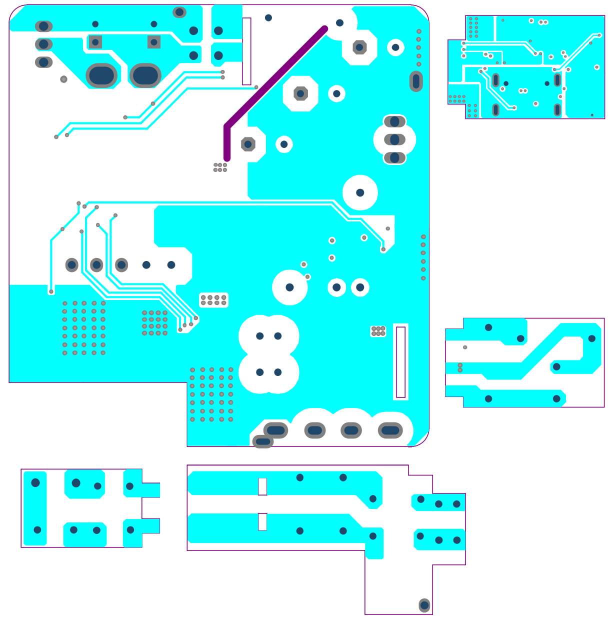


Figure 5: Mid-Layer 1

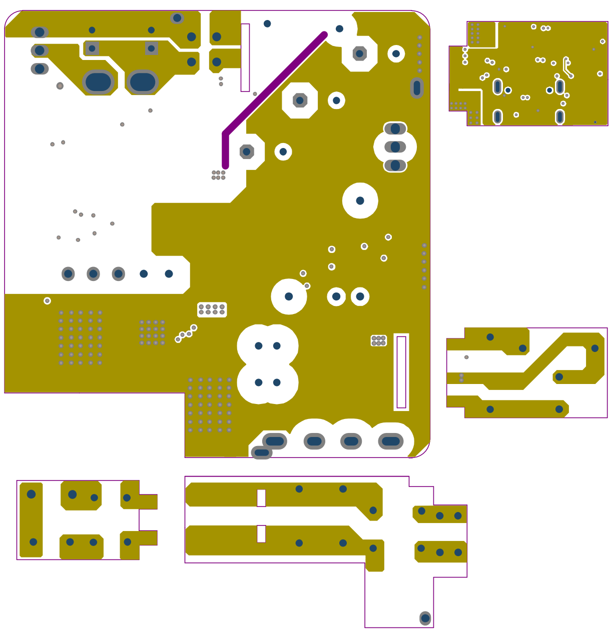


Figure 6: Mid-Layer 2

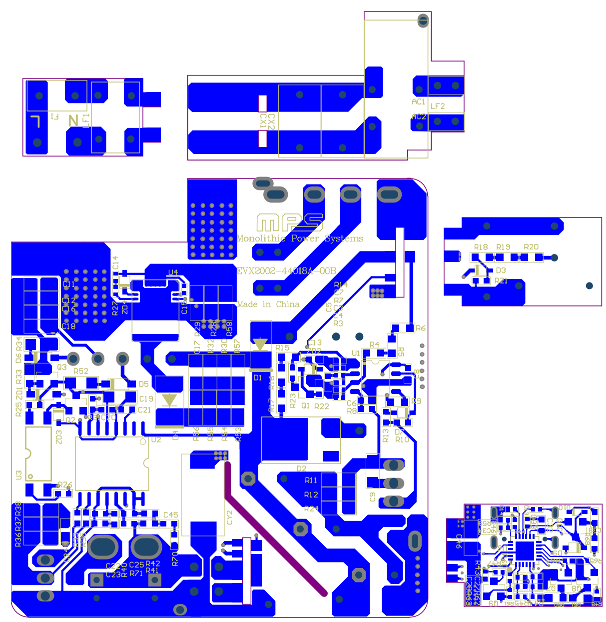


Figure 7: Bottom Layer

APPENDIX 1: PFC INDUCTOR LF3 SPECIFICATION

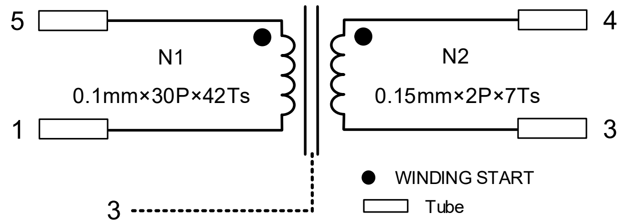


Figure 8: Electrical Diagram

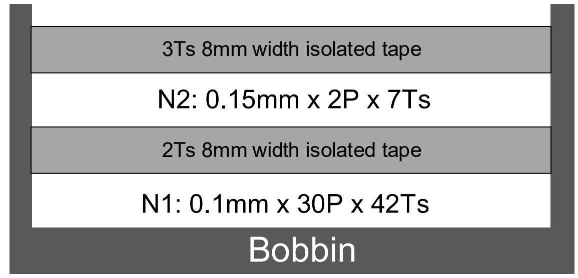


Figure 9: Winding Diagram

Table 9: Electrical Characteristic

Parameter	Condition	Value
Primary inductance	L_P (5-1)	230µH ±5%
Core	-	ATQ2516
Bobbin	-	ATQ2516
Core material	-	PC95
Turn ratio	N1:N2	42:7

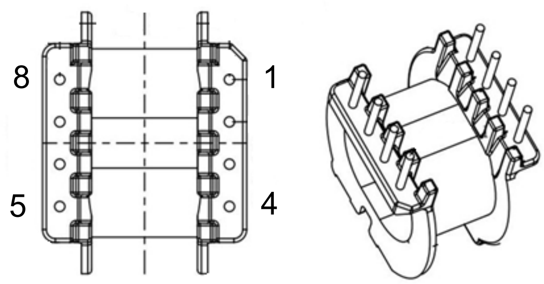


Figure 10: Pin Definition of Bobbin

Table 10: Winding Specification

Tape Turns	Winding No.	Start to End	Wire Diameter (φ)	Turns	Winding	Tube
	N1	5 to 1	0.1mm x 30P	42Ts	5 layers	Yes
2Ts						
3Ts	N2	4 to 3	0.15mm x 2P	7Ts	1 layer	Yes
Connect the core to GND (pin 3) via copper. The core center column is fixed with epoxy resin.						

APPENDIX 2: FLYBACK TRANSFORMER T1 SPECIFICATION

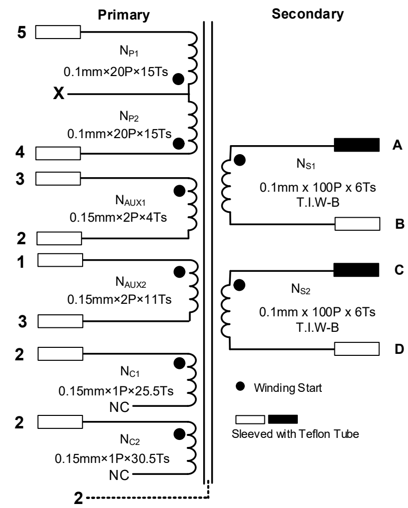


Figure 11: Electrical Diagram

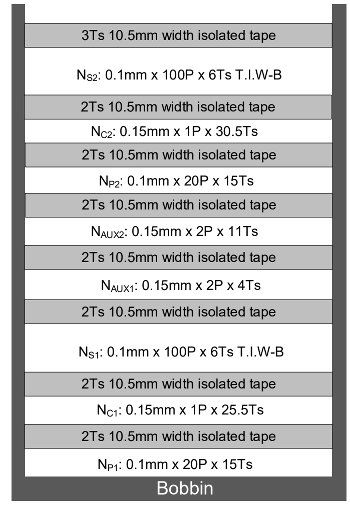


Figure 12: Winding Diagram

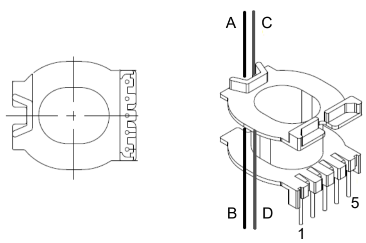


Figure 13: Pin Definition of Bobbin

Table 11: Electrical Characteristic

Parameter	Condition	Value
Primary inductance	L_P (4-5)	280µH ±5%
Leakage inductance	L_{LK} (4-5)	4µH max
Core	-	ATQ2718
Bobbin	-	ATQ2718
Core Material	-	PC95
Turn Ratio	N_P:N_{S1}:N_{S2}: N_{AUX1}:N_{AUX2}	30:6:6:9:21

Table 12: Winding Specification

Tape Turns	Winding No.	Start to End	Wire Diameter (φ)	Turns	Winding	Tube
	N_{P1}	4 to X	0.1mm x 20P	15Ts	1 full layer	Yes
2Ts	N_{C1}	2 to NC	0.15mm x 1P	25.5Ts	1-layer spread	Yes
2Ts	N_{S1}	A to B	0.1mm x 100P (T.I.W-B)	6Ts	1 full layer	Yes
2Ts	N_{AUX1}	3 to 2	0.15mm x 2P	4Ts	1 layer spread	Yes
2Ts	N_{AUX2}	1 to 3	0.15mm x 2P	11Ts	1-layer spread	Yes
2Ts	N_{P2}	X to 5	0.1mm x 20P	15Ts	1 full layer	Yes
2Ts	N_{C2}	2 to NC	0.15mm x 1P	30.5Ts	1-layer spread	Yes
2Ts 3Ts	N_{S2}	C to D	0.1mm x 100P (T.I.W-B)	6Ts	1 full layer	Yes
Connect A to C, and connect B to D. Connect the core to GND (pin 2) via 1.1Ts copper. The core center column is fixed with epoxy resin.						

REVISION HISTORY

Revision #	Revision Date	Description	Pages Updated
1.0	10/18/2022	Initial Release	-