EV1566A_S0_R0

Offline QR GaN Flyback Converter

Parameters Subject to Change Without Notice

FEATURES

- Integrated 650V 480mΩ GaN
- Wider VDD Operation Range (Up to 90V)
- QR Operation for High Efficiency
- Maximum 260kHz Switching Frequency
- Optional OCP and OPP Function for Different PD and QC Output Application
- Very Low Standby Power Consumption
- Cycle-by-Cycle Current Limit
- Reliable Fault Protections: VDD OVP, VS OVP and UVP, Brown-In, CS Open Protection, OCP, OPP, Internal OTP
- Frequency Jitter to Ease EMI Compliance
- DFN5X6-7 Package

APPLICATIONS

- PD and Quick-Charging Chargers
- AC/DC Adapters with Wide Output Range

DESCRIPTION

The JW®1566A is an isolated offline Flyback converter with GaN integrated, which features quasi-resonant (QR) operation. QR control improves efficiency by reducing switching loss and benefits EMI performance with nature frequency variation, and an internal maximum frequency limitation to overcome the inherent disadvantages of QR Flyback.

The JW1566A combines PWM and PFM control at different input and load condition for highest average efficiency. It can comply with the most stringent efficiency regulations.

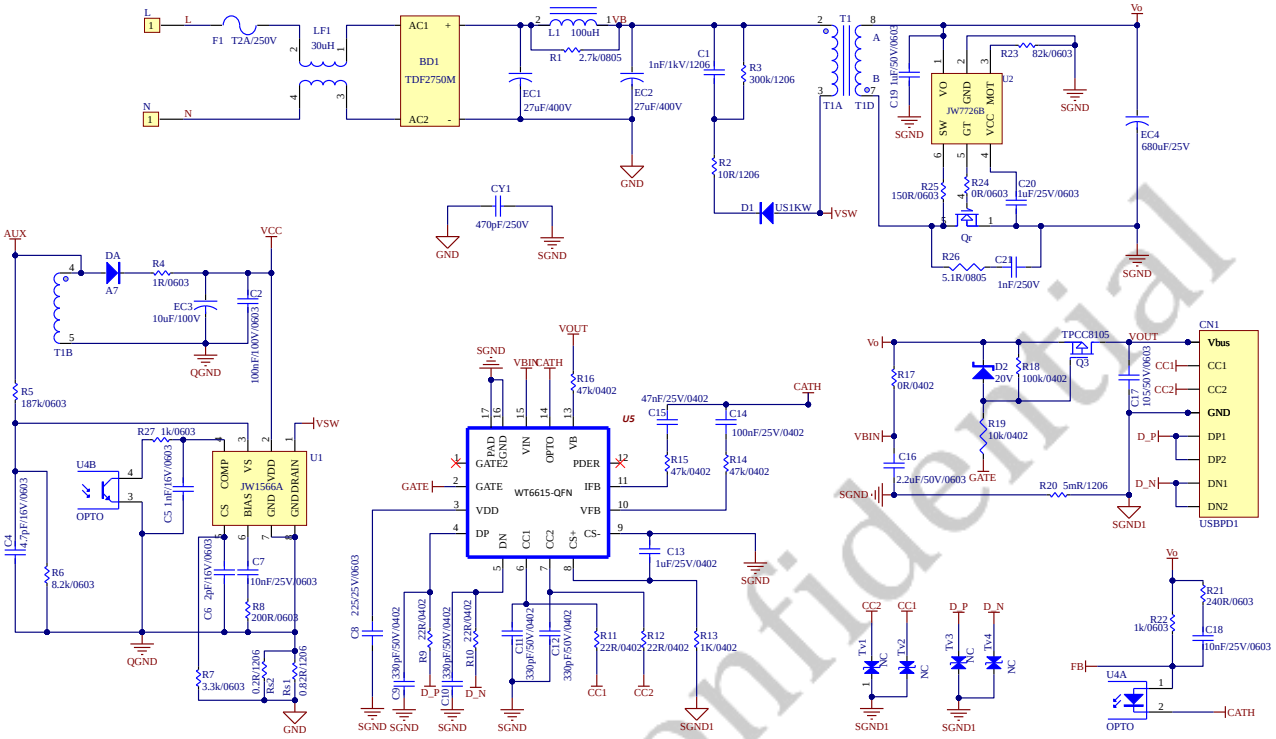
The JW1566A is available in the 5mm*6mm DFN package. The high level of integration results in a simple to use, low component count, and high efficiency application solution for isolated power delivery.

EVALUATION BOARD

ELECTRICAL SPECIFICATIONS

Description	Symbol	Min	Typ.	Max	Unit	Comment
Input						
Input voltage(RMS)	V_{IN}	90	115/230	264	V	
Input line frequency	F_{LINE}	47	50/60	63	HZ	
Input power at no-load	P_{STBY}		21.0/20.3		mW	V_{IN}=115/230V_{AC}, I_{OUT}=0A
Output						
Output voltage & current	V_{OUT}		20.0		V	I_{OUT}=0 to 1.5A
			15.0		V	I_{OUT}=0 to 2.0A
			12.0		V	I_{OUT}=0 to 2.5A
			9.0		V	I_{OUT}=0 to 3.0A
			5.0		V	
Output Ripple Voltage	V_{RIPPLE}			120	mV	Set oscilloscope at 20MHz bandwidth
Efficiency						
Efficiency at full load	η		92.20%		%	V_{IN}=90V_{AC}, V_{OUT}=20V, I_{OUT}=1.5A
4-point average efficiency V_{IN}= 115/230V_{AC}	η_{AVG}		92.16%/91.87%		%	V_{OUT}=20V
			92.84%/92.55%		%	V_{OUT}=12V
			92.64%/92.30%		%	V_{OUT}=9V
			91.64%/90.62%		%	V_{OUT}=5V

SCHEMATIC



PRINTED CIRCUIT BOARD LAYOUT

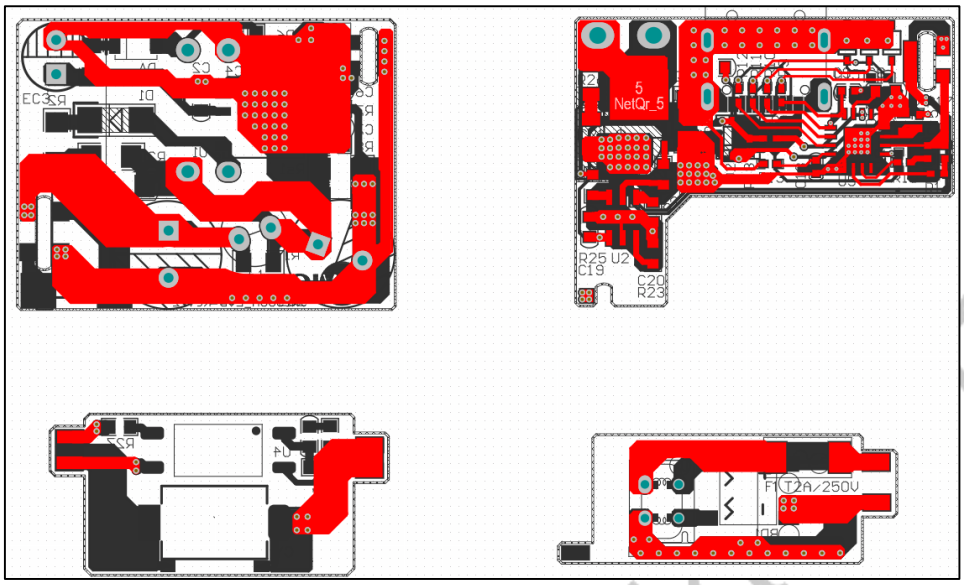


Figure1. Top Layer of PCB

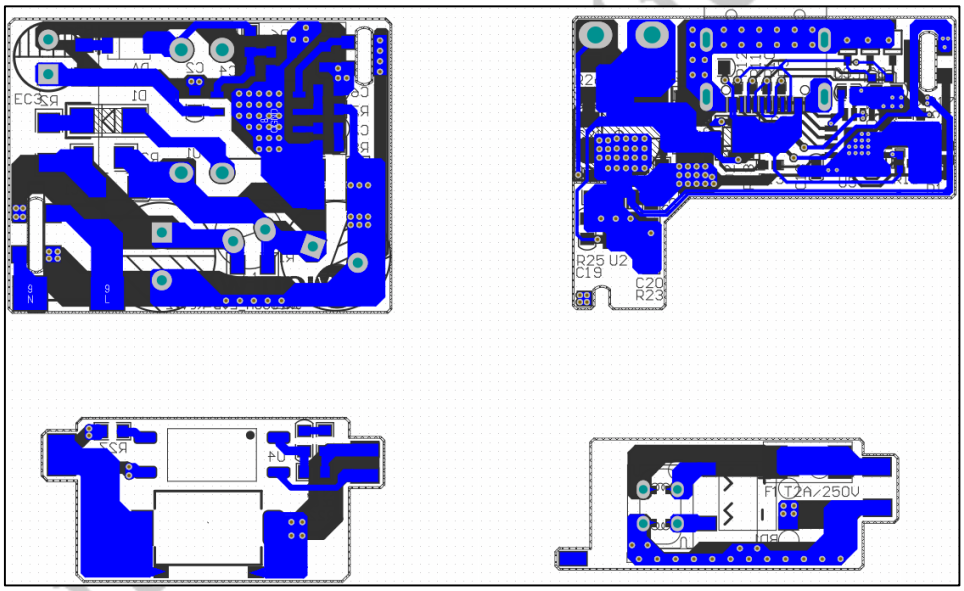


Figure2. Bottom Layer of PCB

QUICK START

1. Connect the load with V_{OUT}, PGND.
2. Set the AC source to 90V~264V, turn off the source.
3. Connect the “+” of AC source to the “L”, and “-” to “N”.
4. Turn on the AC source, the evaluation board starts operating in normal condition.
5. To get more information, please refer to the datasheet of JW1566A.

TYPICAL PERFORMANCE CHARACTERISTICS

1. Efficiency

Test condition: input voltage ranges: **115V_{AC}/230V_{AC}**, output voltage V_{OUT} was **20V/12V/9V/5V**.

Input	V_{OUT}(V)	I_{OUT}(A)	P_{IN}(W)	Efficiency	P_{OUT}(%)	Average Effi. 25%~100% load
230V	19.981	1.502	32.38	92.69%	100%	91.87%
230V	19.934	1.127	24.27	92.57%	75%	
230V	19.876	0.752	16.24	92.04%	50%	
230V	19.818	0.3775	8.294	90.20%	25%	
Input	V_{OUT}(V)	I_{OUT}(A)	P_{IN}(W)	Efficiency	P_{OUT}(%)	Average Effi. 25%~100% load
230V	15.253	2.001	32.87	92.85%	100%	92.39%
230V	15.184	1.502	24.56	92.86%	75%	
230V	15.109	1.002	16.37	92.48%	50%	
230V	15.028	0.502	8.258	91.35%	25%	
Input	V_{OUT}(V)	I_{OUT}(A)	P_{IN}(W)	Efficiency	P_{OUT}(%)	Average Effi. 25%~100% load
230V	12.245	2.501	32.93	93.00%	100%	92.55%
230V	12.149	1.877	24.57	92.81%	75%	
230V	12.049	1.252	16.29	92.60%	50%	
230V	11.95	0.627	8.165	91.77%	25%	
Input	V_{OUT}(V)	I_{OUT}(A)	P_{IN}(W)	Efficiency	P_{OUT}(%)	Average Effi. 25%~100% load
230V	9.43	3.001	30.55	92.63%	100%	92.30%
230V	9.311	2.252	22.66	92.53%	75%	
230V	9.19	1.502	14.95	92.33%	50%	
230V	9.068	0.752	7.435	91.72%	25%	
Input	V_{OUT}(V)	I_{OUT}(A)	P_{IN}(W)	Efficiency	P_{OUT}(%)	Average Effi. 25%~100% load
230V	5.469	3.002	17.99	91.26%	100%	90.62%
230V	5.349	2.252	13.237	91.00%	75%	
230V	5.228	1.502	8.642	90.86%	50%	
230V	5.107	0.752	4.298	89.35%	25%	
Input	V_{OUT}(V)	I_{OUT}(A)	P_{IN}(W)	Efficiency	P_{OUT}(%)	Average Effi. 25%~100% load
115V	19.98	1.502	32.35	92.77%	100%	92.16%
115V	19.936	1.127	24.22	92.77%	75%	
115V	19.878	0.752	16.197	92.29%	50%	
115V	19.82	0.377	8.229	90.80%	25%	

Input	V_{OUT}(V)	I_{OUT}(A)	P_{IN}(W)	Efficiency	P_{OUT}(%)	Average Effi. 25%~100% load
115V	15.253	2.002	32.82	93.04%	100%	92.75%
115V	15.185	1.502	24.5	93.09%	75%	
115V	15.108	1.002	16.298	92.88%	50%	
115V	15.026	0.502	8.199	92.00%	25%	
Input	V_{OUT}(V)	I_{OUT}(A)	P_{IN}(W)	Efficiency	P_{OUT}(%)	Average Effi. 25%~100% load
115V	12.242	2.501	33	92.78%	100%	92.84%
115V	12.148	1.877	24.51	93.03%	75%	
115V	12.047	1.252	16.214	93.02%	50%	
115V	11.946	0.627	8.096	92.52%	25%	
Input	V_{OUT}(V)	I_{OUT}(A)	P_{IN}(W)	Efficiency	P_{OUT}(%)	Average Effi. 25%~100% load
115V	9.43	3.001	30.62	92.42%	100%	92.64%
115V	9.311	2.252	22.59	92.82%	75%	
115V	9.188	1.502	14.862	92.86%	50%	
115V	9.067	0.752	7.375	92.45%	25%	
Input	V_{OUT}(V)	I_{OUT}(A)	P_{IN}(W)	Efficiency	P_{OUT}(%)	Average Effi. 25%~100% load
115V	5.469	3.001	17.915	91.61%	100%	91.64%
115V	5.348	2.252	13.115	91.83%	75%	
115V	5.227	1.502	8.568	91.63%	50%	
115V	5.106	0.752	4.197	91.49%	25%	

1.1 No-load power consumption

Test condition: Power consumption performance of the total application board at no load was measured with a Yokogawa WT210 digital power meter. To measure the power consumption over a long time, the integration time function was used.

Condition	requirement	Output voltage	Power consumption
115V/60Hz	≤75mW	5V	21.03mW
230V/50Hz	≤75mW	5V	20.30mW

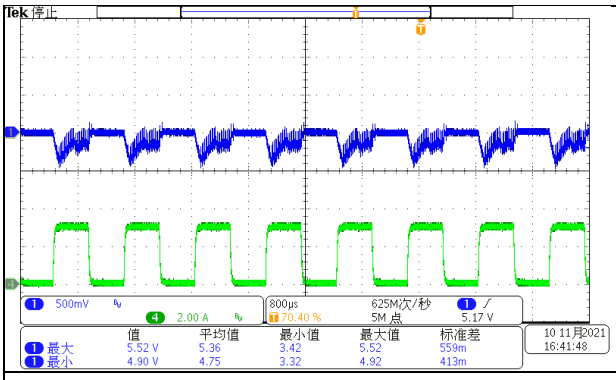
2. Dynamic Load Response

Test condition: input voltage was **230V_{AC}**, output voltage V_{OUT} was **20V/12V/9V/5V**.

Frequency: 1kHz; duty cycle: 50%; load: 0A->1.5A/2.5A/3A->0A.

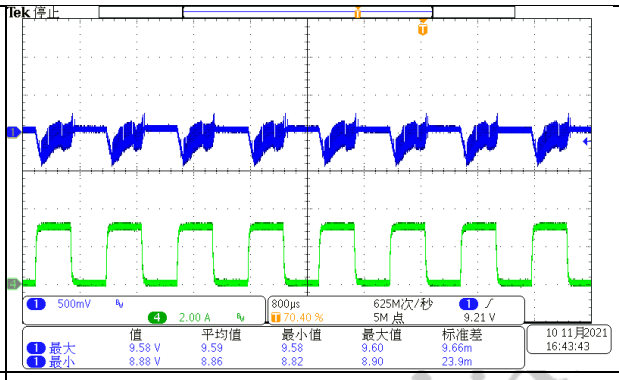
Output Voltage	Load	Overshoot/Undershoot
5V	0A->3.0A->0A	5.52V/4.90V
9V	0A->3.0A->0A	9.58V/8.88V
12V	0A->2.5A->0A	12.6V/11.8V
15V	0A->2.0A->0A	15.6V/14.9V
20V	0A->1.5A->0A	20.4V/19.8V

CH1: Output voltage, CH4: Output current



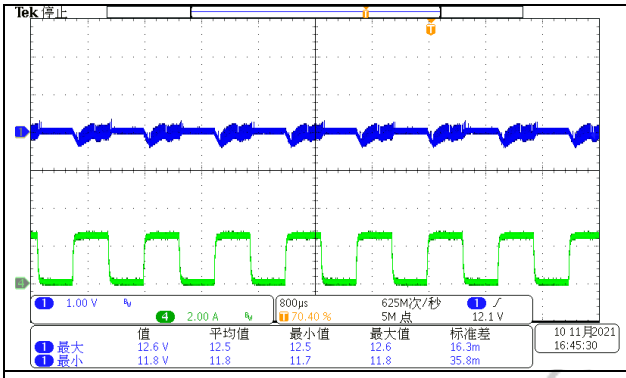
Load Transient Response at V_{OUT}= 5V

Overshoot / Undershoot=5.52V/4.90V



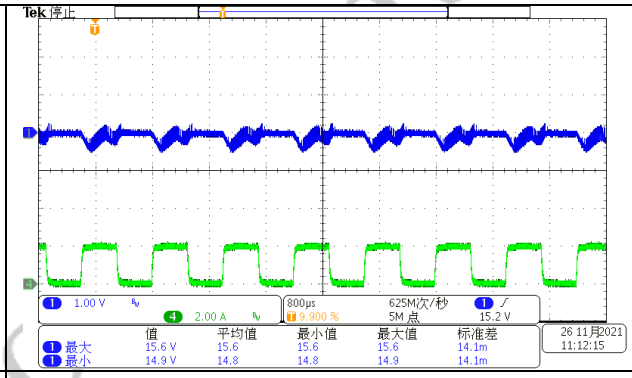
Load Transient Response at V_{OUT}= 9V

Overshoot / Undershoot= 9.58V/8.88V



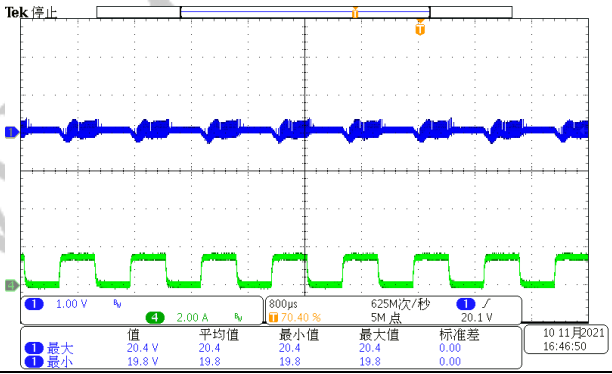
Load Transient Response at V_{OUT}= 12V

Overshoot / Undershoot= 12.6V/11.8V



Load Transient Response at V_{OUT}= 15V

Overshoot / Undershoot=15.6V/14.9V



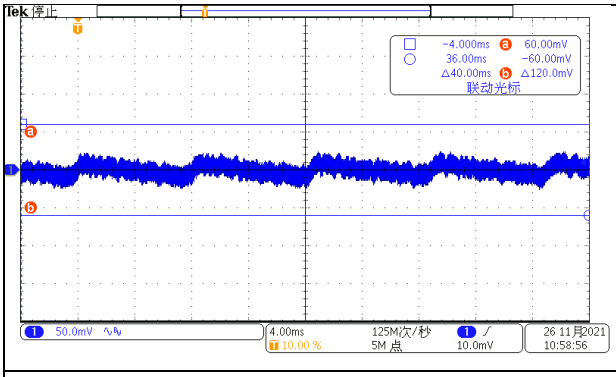
Load Transient Response at V_{OUT}= 20V

Overshoot / Undershoot=20.4V/19.8V

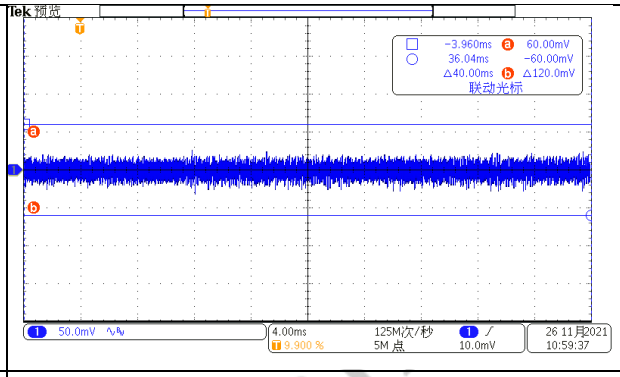
3. Output Ripple Voltage

Oscilloscope Channel Bandwidth = 20 MHz, 0.1uF and 10uF capacitors on the load. Voltage span between two dashed lines is 120mV. The ripples are with the 100% load condition under 115V_{AC}/230V_{AC} unless specified in the associated figures.

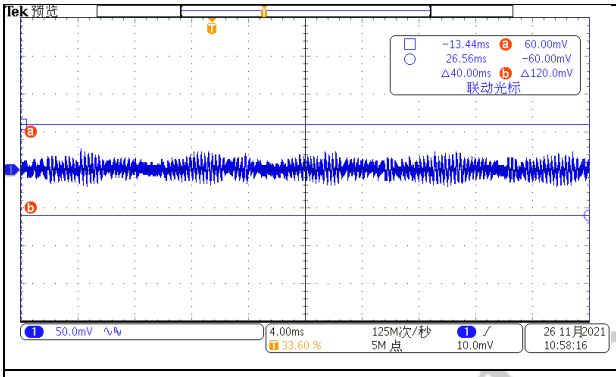
CH1: Output voltage (AC mode)



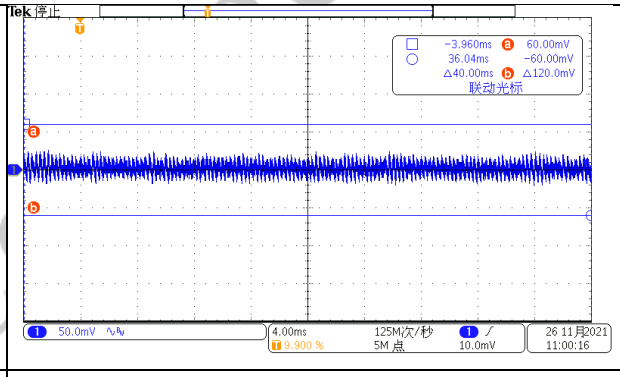
Typical Ripple Voltage of Vin=115V_{AC}/V_{OUT}=5V



Typical Ripple Voltage of Vin=230V_{AC}/ V_{OUT}=5V



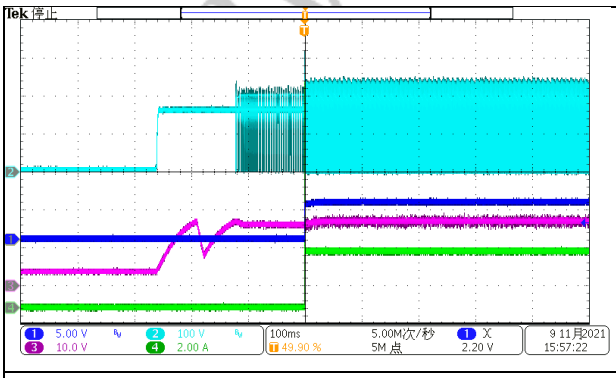
Typical Ripple Voltage of V_{IN}=115V_{AC}/V_{OUT}=20V



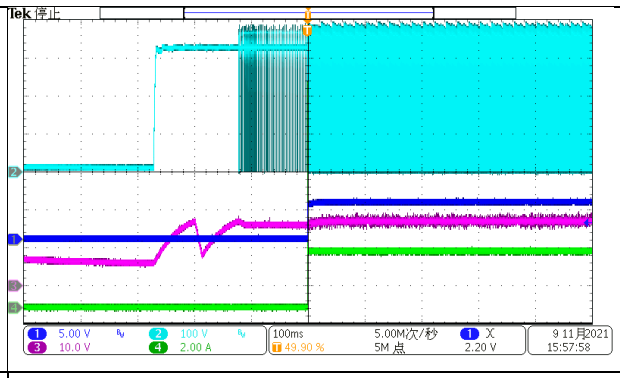
Typical Ripple Voltage of V_{IN}=230V_{AC}/ V_{OUT}=20V

4. Start Up

CH1: Output voltage, CH2: Switch voltage, CH3: VDD voltage, CH4: Output current



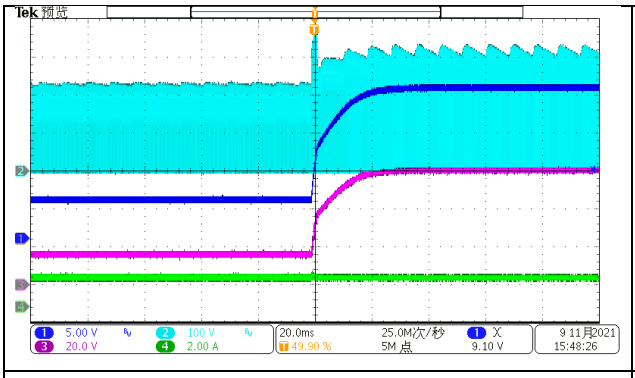
Start up at 115V_{AC} with 5V full load



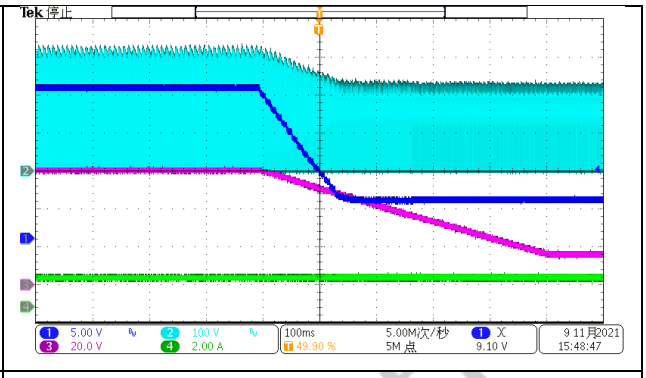
Start up at 230V_{AC} with 5V full load

5. Output Voltage Adjustment by USB-C PD

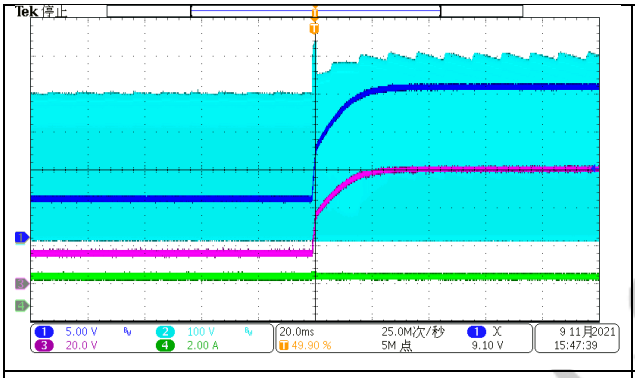
CH1: Output voltage, CH2: Switch voltage, CH3: VDD voltage, CH4: Output current



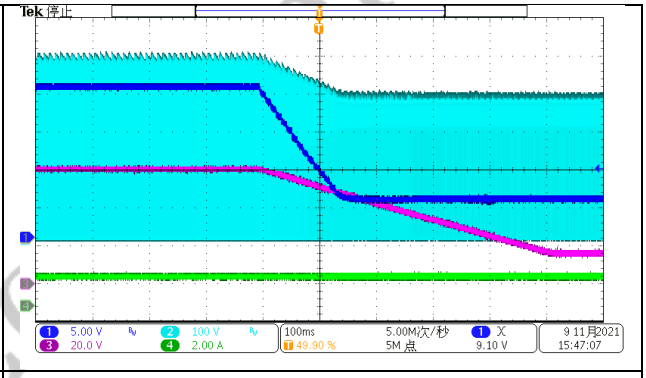
115V_{AC} USB-C PD Output Change from 5V 1.5A to 20V 1.5A



115V_{AC} USB-C PD Output Change from 20V 1.5A to 5V 1.5A



230V_{AC} USB-C PD Output Change from 5V 1.5A to 20V 1.5A



230V_{AC} USB-C PD Output Change from 20V 1.5A to 5V 1.5A

6. Bill of Materials

Designator	Description	PartNumber	Manufacturer
BD1	Passivated bridge rectifier , 1000V , 2A , ABS8	TDF2750M	
C1	Capacitor , 1nF , 1kV , 1206		
C2	Capacitor , 100nF , 100V , 0603		
C4	Capacitor , 4.7pF , 16V , 0603		
C5	Capacitor , 1nF , 16V , 0603		
C6	Capacitor , 2pF , 16V , 0603		
C7, C18	Capacitor , 10nF , 25V , 0603		
C8	Capacitor , 2.2uF , 25V , 0603		
C9, C10, C11, C12	Capacitor , 330pF , 50V , 0402		
C13	Capacitor , 1uF , 25V , 0402		
C14	Capacitor , 100nF , 25V , 0402		
C15	Capacitor , 47nF , 25V , 0402		
C16	Capacitor , 2.2uF , 50V , 0603		
C17,C19	Capacitor , 1uF , 50V , 0603		
C20	Capacitor , 1uF , 25V , 0603		
C21	Capacitor , 1nF , 250V , 0805		
CN1	Type C , USBPD1		
CY1	Capacitor , 470pF/250V , Y-CAP222D-3D		
D1	Diode, 800V, 1A, SOD-123F	US1KW	Comchip Technology
D2	Zener , 20V , SOD323-M		
DA	Diode , A7 , 1000V , 1A , SOD123-2-3D	1N4007	BLUE ROCKET
EC1, EC2	Electrolytic capacitor,8*20mm , 27uF/400V , CAP-8		YMIN
EC3	Electrolytic capacitor, 5*10mm , 10uF/100V , CAP-8		
EC4	Solid capacitor , 680uF/25V , CAP-6.3-SMT	/	YMIN
F1	FUSE , T2A/250V , FUSE-SMD	/	
L1	Inductor,100uH, 5*8mm , 100uH , L-6*8-2	7447462101	Wurth
LF1	Inductor , 30uH , TRANS		FUAN
Q3	SIS413DN-T1-GE3, P-MOS, PowerPAK 1212-8	TPCC8105	VISHAY
Qr	NMOSFET 5*6 , AONS62922 , SUPERSO8	AONS62922	AOS
R1	Resistor , 2.7k , 0805		
R2	Resistor , 10R , 1206		
R3	Resistor , 300k , 1206		
R4	Resistor , 1R , 0805		
R5	Resistor , 187k , 0603		
R6	Resistor , 8.2k , 0603		
R7	Resistor , 3.3k , 0603		
R8	Resistor , 200R , 0603		
R9, R10, R11, R12	Resistor , 22R , 0402		
R13	Resistor , 1k , 0402		
R14, R15, R16	Resistor , 47k , 0402		
R17	Resistor , 0R , 0402		
R18	Resistor , 100k , 0402		
R19	Resistor , 10k , 0402		
R20	Resistor , 5mR , 1206		
R21	Resistor , 240R , 0603		
R22, R27	Resistor , 1k , 0603		
R23	Resistor , 82k , 0603		
R24	Resistor , 0R , 0603		
R25	Resistor , 150R , 0603		
R26	Resistor , 5.1R , 0805		
Rs1	Resistor , 0.82R , 1206		
Rs2	Resistor , 0.2R , 1206		
T1	ATQ18 , 200uH		
Tv1, Tv2, Tv3, Tv4	TVS , NC		
U1	Flyback Controller , JW1566A , DFN5X6-7	JW1566A	JoulWatt
U2	SR Controller , JW7726B , SOT23-6	JW7726B	JoulWatt
U4	Optoisolator , EL1019	EL1019	EVERLIGHT
U5	USP PD Controller , WT6615-QFN , QFN-16E-4*4	WT6615F	Weltrend

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