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Design Note – DN05125/D

90W TYPE-C PD3.0 / QC4.0 Power Adapter Solution with WT6636F

ON's Device	Application	Input Voltage	Output Power	Topology	I/O Isolation
NCP1622AEC NCP1568B06ABDR2G NCP151530AMNTWG NCP4306AADZZZADR2G FCMT299N60 FDMT800120DC NTMFS4C05NT1G	Smart phone, PAD and NB adapter supporting PD3.0, QC4.0,QC4.0+, PPS	90 Vac to 264 Vac	90 W	CrM PFC with VSFF control /Active clamp Flyback	Isolated (3 kV)

	PD Output Specification	QC Output Specification
Output Voltage	5 V, 9 V, 12 V, 15 V, 20 V	5 V, 9 V, 12 V
Nominal Current	5V/3A, 9V/3A, 12V/3A,15V3A, 20V/4.5A	5 V / 3 A, 9 V / 3 A, 12 V / 2.67 A
Max Current	5V/3A, 9V/3A, 12V/3A,15V3A, 20V/4.5A	5 V / 3 A, 9 V / 3 A, 12 V / 2.67 A
Min Current	zero	zero

Avg. Efficiency	>91%@ 20 V 4.5 A at board end, 115 & 230 Vac
Ripple	<150mV @5V
Standby Power	<75mW @ 5 V & 230 Vac (No cable plug in)
Power Density	1.27W/cm^3
Protection	Adaptive UVP, OVP, OVP, SCP, OTP
Size	63mmx63mmx21mm

Circuit Description

This design note describes a 90 W, Type C interface PD3.0, universal AC input, constant voltage power supply intended for smart phone, PAD and NB adaptor supporting PD3.0 or QC4.0,QC4.0+,PPS protocol, where isolation from the AC mains is required, and low cost, high efficiency, and low standby power are essential.

The featured power supply has an optional boost follower PFC combining an Active Clamp Flyback topology utilizing ON Semiconductor's NCP1622 CrM VSFF PFC controller, NCP1568 ACF controller, NCP51530 high speed high-bridge driver, NCP4306D synchronous rectified controller, FCMT299N60 PFC Switching FET, FDMT800120DC synchronous MOSFET and NTMFS4C05 PD Switch MOSFET. This Design Note provides the complete circuit schematic details, PCB and BOM for 90 W Type C Interface PD3.0 Power adapter solution which supports PD output (5 V / 3 A, 9 V / 3 A, 12 V / 3 A, 15 V / 3 A, 20 V / 4.5 A).

This design combined with Weltrend's WT6636F PD3.0 protocol controller to provide PD3.0 and QC3.0/4.0, PPS functions. This design also proposes a dual auxiliary power supply to supply PWM controller, the PWM controller is supplied by high voltage auxiliary voltage at low output voltage and supplied by low voltage auxiliary voltage at high output voltage and also shuts down zener bias of high voltage Vcc while low voltage auxiliary voltage supplies controller.

This design also uses NCP4306 synchronous rectified controller to provide high efficiency and also has no external Vcc regulator to supply synchronous controller to ensure controller can works below 3.6 V.

Key Features

- Universal AC input range (90 – 264 Vac)
- <75mW standby (5 V & 230 Vac) power consumption with no cable plug in
- High efficiency at full load
- Inherent SCP and OCP protection
- High power density (1.27 W/cm^3)
- Quick switching off FET while unplugging cable and switching on FET at Vbus dropping to 5 V while plugging cable again
- Optional Boost follower PFC control
- Active Clamp Flyback Topology with peak current mode control
- High frequency operation
- High power density (1.27 W/cm^3)
- Support TYPE-C PD3.0 & QC4.0,QC4.0+,PPS protocol
- Adaptive Output OVP and UVP
- Two stage OCP for 15v and 20v output
- Open loop protection
- Compact profile with board size 63mmx63mmx21mm

Block Diagram and BOARD Photos

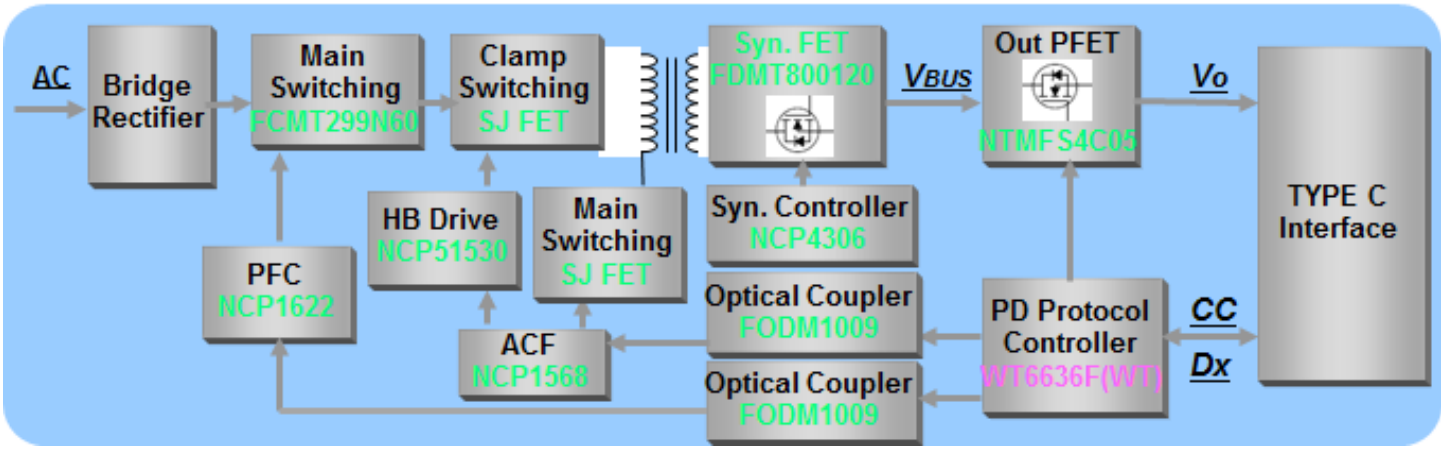


Figure 1, Overall cycle of 90 W TYPE-C PD Adapter Solution

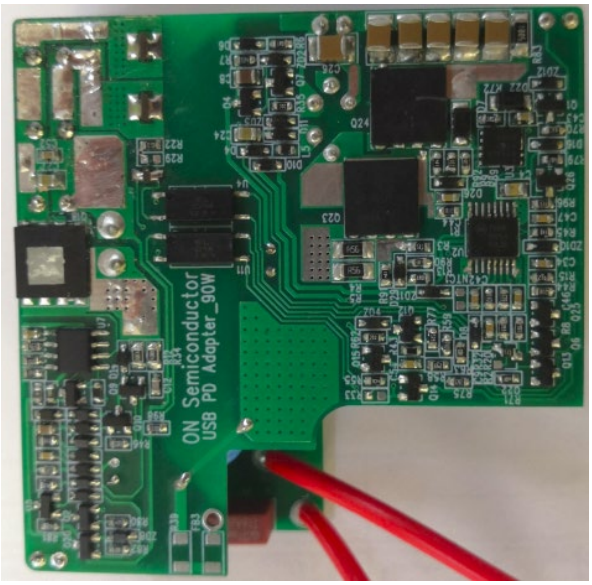


Figure 2, Side view 1 of demoboard

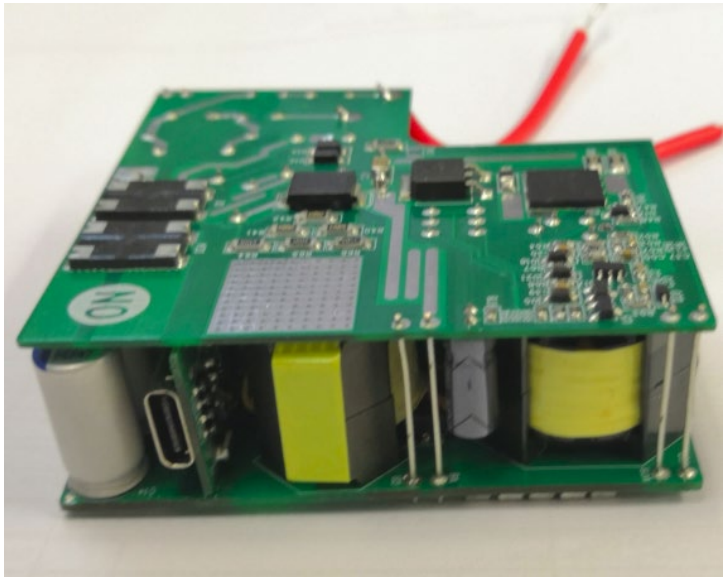
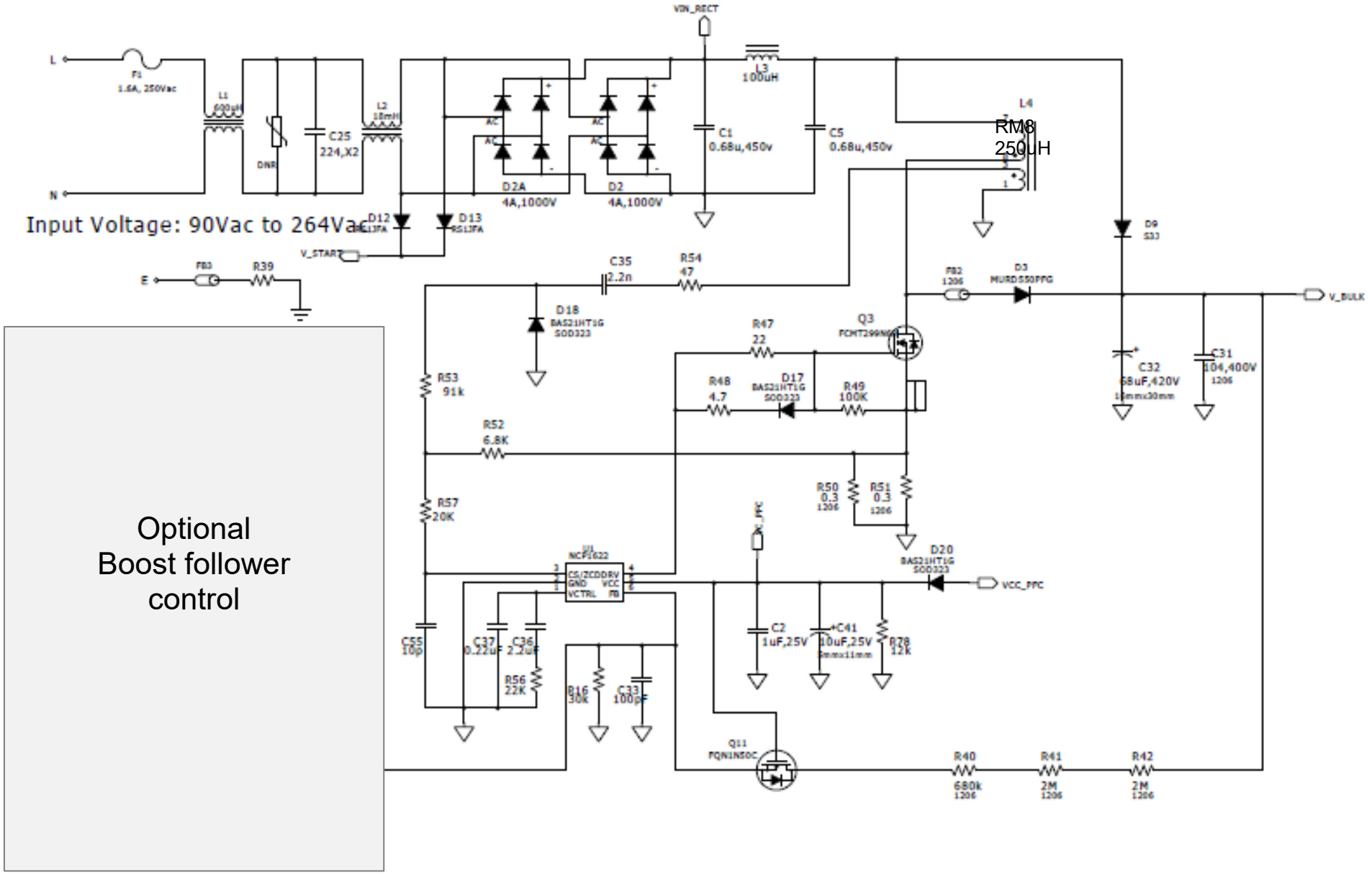


Figure 3, Side view 2 of demoboard

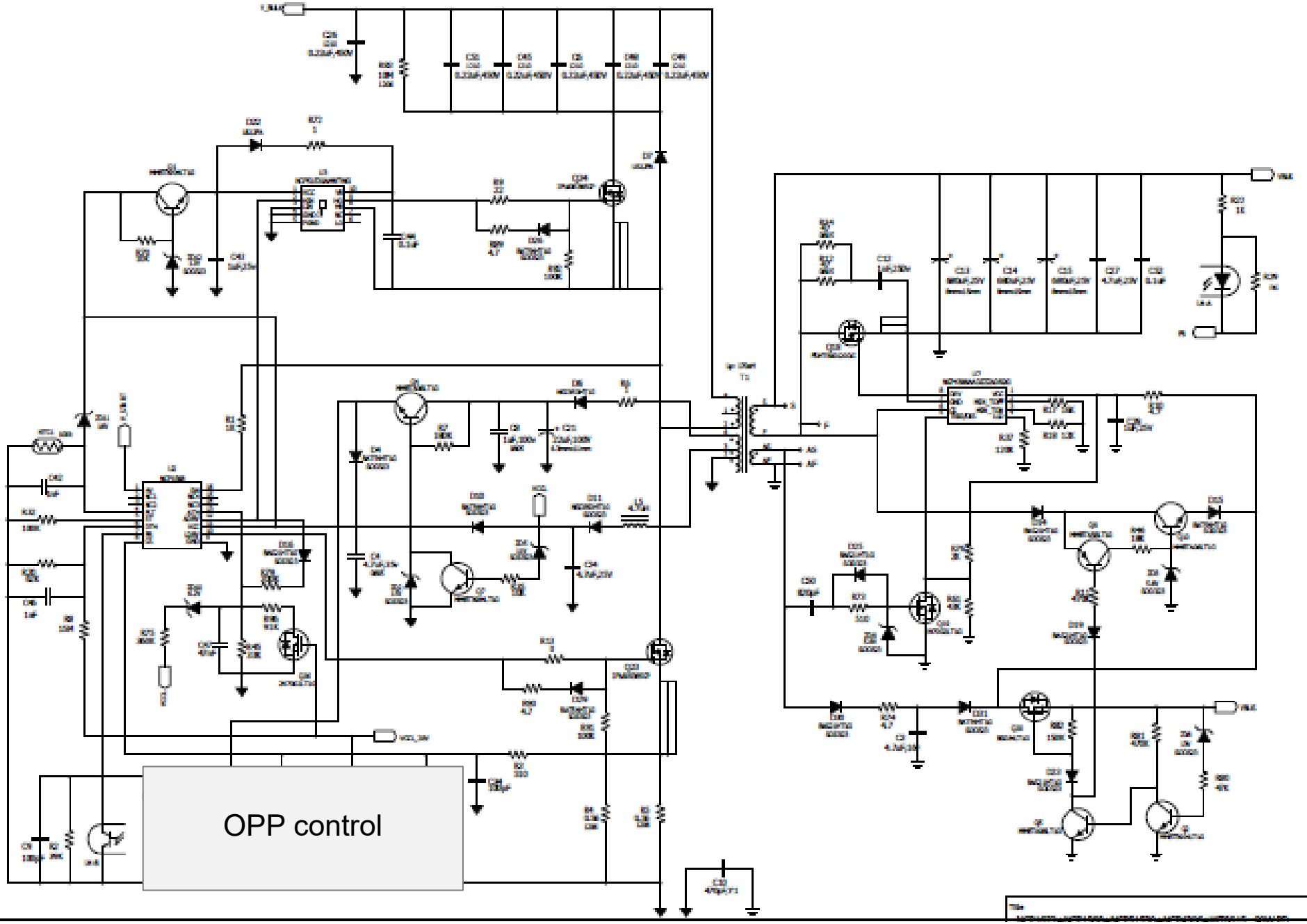
Circuit Schematic

NOTE: For detailed version, see separate Schematic PDF



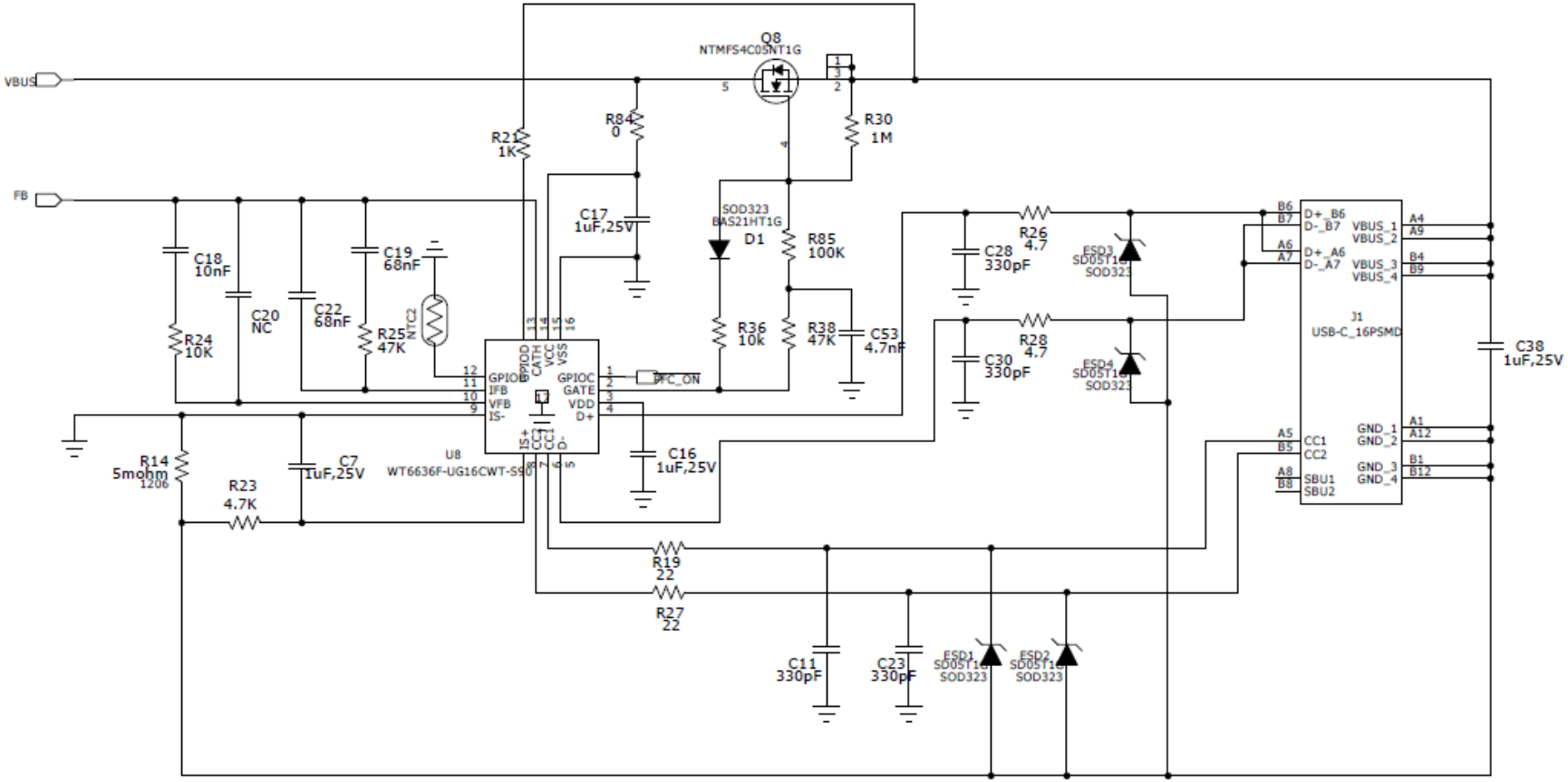
Circuit Schematic (continued)

NOTE: For detailed version, see separate Schematic PDF

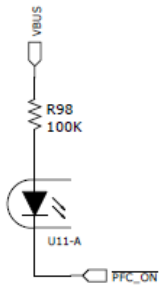


Circuit Schematic (continued)

NOTE: For detailed version, see separate Schematic PDF



PFC control



PCB

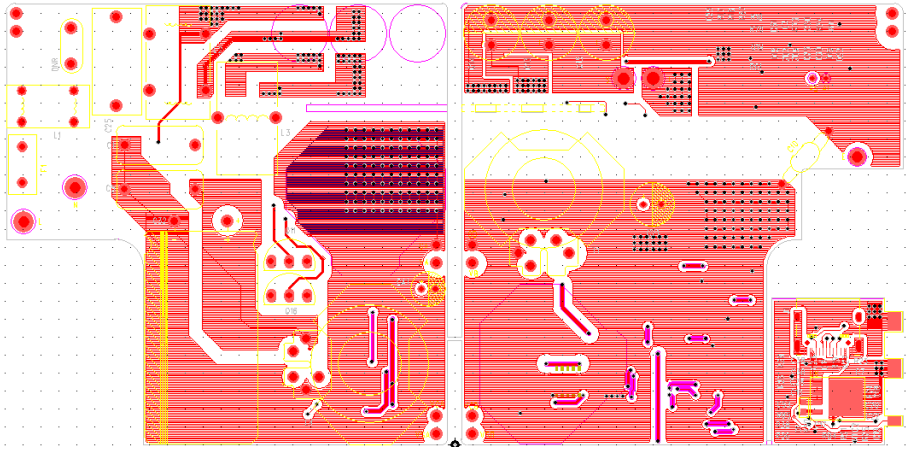


Figure 3, Top View of PCB

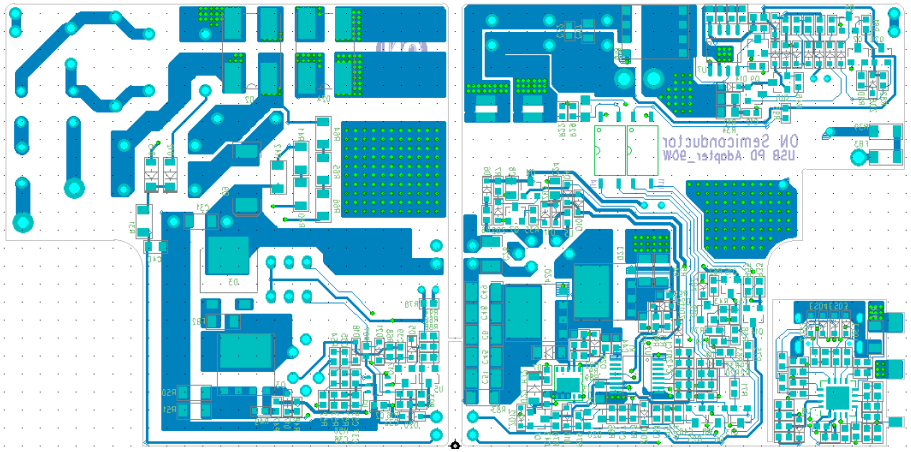


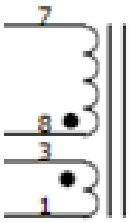
Figure 4, Bottom View of PCB

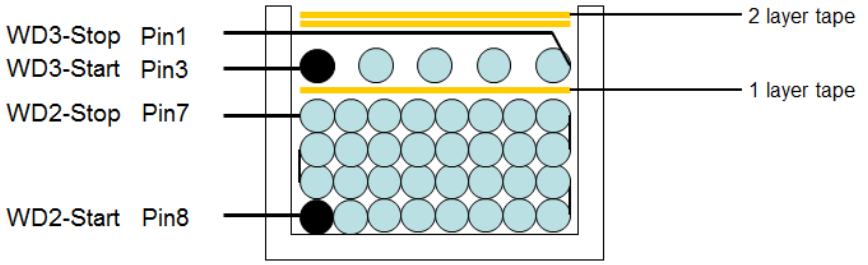
PFC Inductor Designs (Available from Wurth Electronics)

Core Type: RM8
Core material: PC95, TPW33 or equivalent
Bobbin: 6Pin TH type bobbin
Bobbin vendor: TBI-208-05101.11XX(RM8-8P-TH-A0-11)Rev.1

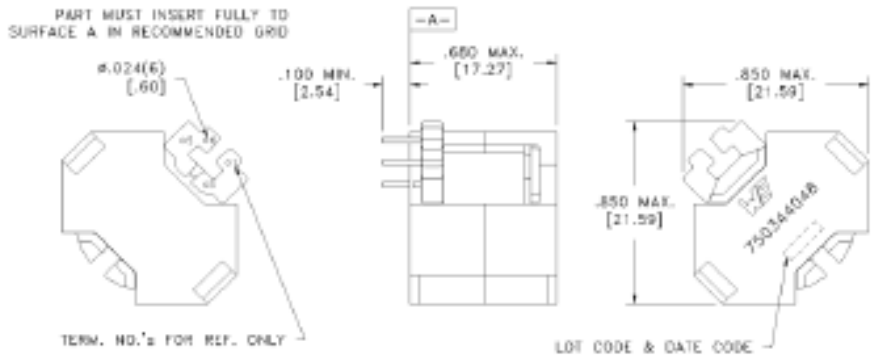
WD2=Primary, 50T, 35*0.1mmLitz

WD3=Auxiliary, 5T, 0.18mm



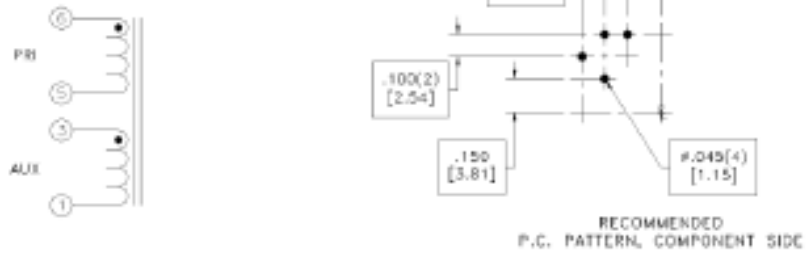


CUSTOMER TERMINAL	RoHS	LEAD(Pb)–FREE
Sn 96%, Ag 4%	Yes	Yes



ELECTRICAL SPECIFICATIONS @ 25° C unless otherwise noted:

PARAMETER		TEST CONDITIONS	VALUE
D.C. RESISTANCE	5-6	@20°C	0.16 ohms max.
D.C. RESISTANCE	1-3	@20°C	0.24 ohms max.
INDUCTANCE	5-6	10kHz, 1.0V, Ls	250.00µH ±10%
TURNS RATIO		(6-5):(3-1)	10:1, ±2%



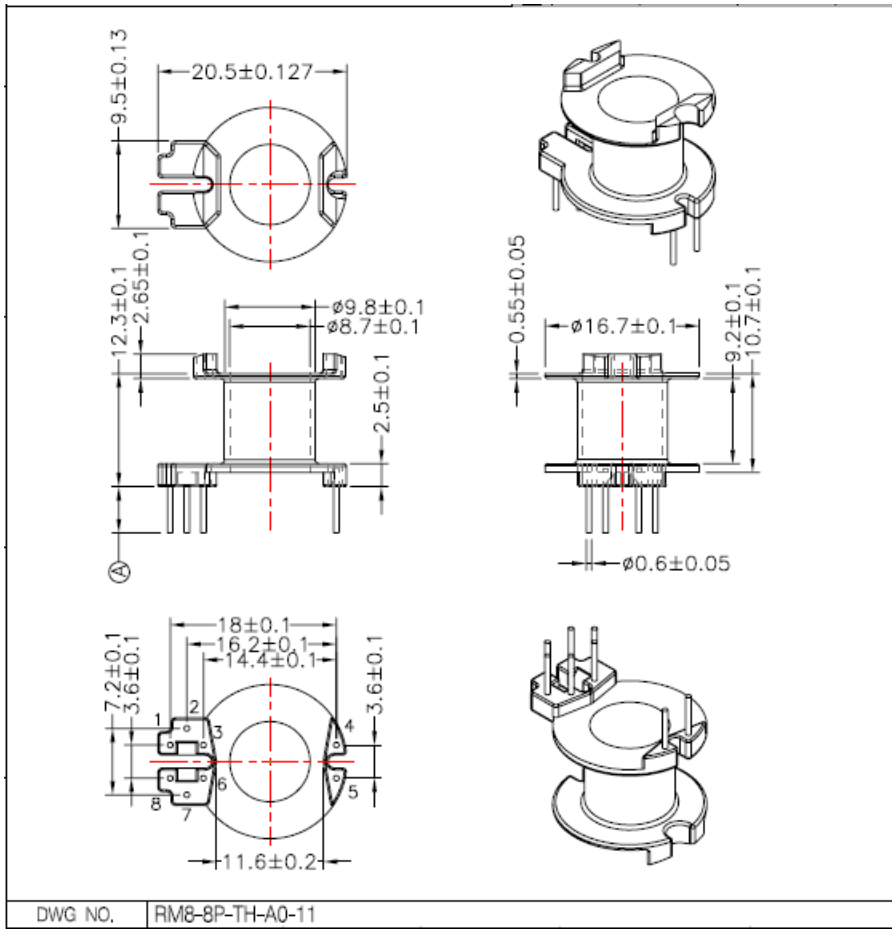
GENERAL SPECIFICATIONS:

OPERATING TEMPERATURE RANGE: -40°C to +125°C including temp rise.

Wire insulation & RoHS status not affected by wire color. Wire insulation color may vary depending on availability.

DFM		Packaging Specifications	Tolerances unless otherwise specified:	DRAWING TITLE	PART NO.
DATE		Method: Tray	Angles: ±1° Decimals: ±.005 [.13]	INDUCTOR	750344048
ENG	IYU	PKG-0002	Fractions: ±1/64 Footprint: ± .001 [.03]		
REV.	01	CONVENTION PLACEMENT	This drawing is dual dimensioned. Dimensions in brackets are in millimeters.		SPECIFICATION SHEET 1 OF 1
DATE	8/3/2018				

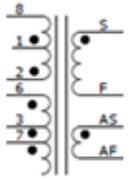
T1 Transformer Designs (Available from Wurth Electronics)



WD8=Primary, 17T, 35x0.1mmLitz
WD1=Primary, 17T, 35x0.1mmLitz

WD7=Auxiliary, 13T, 0.17mm
WD6=Auxiliary, 4T, 0.17mm

WD2=Shielding, 20T, 2x0.17mm
WD5=Shielding, 4T, 0.17mm



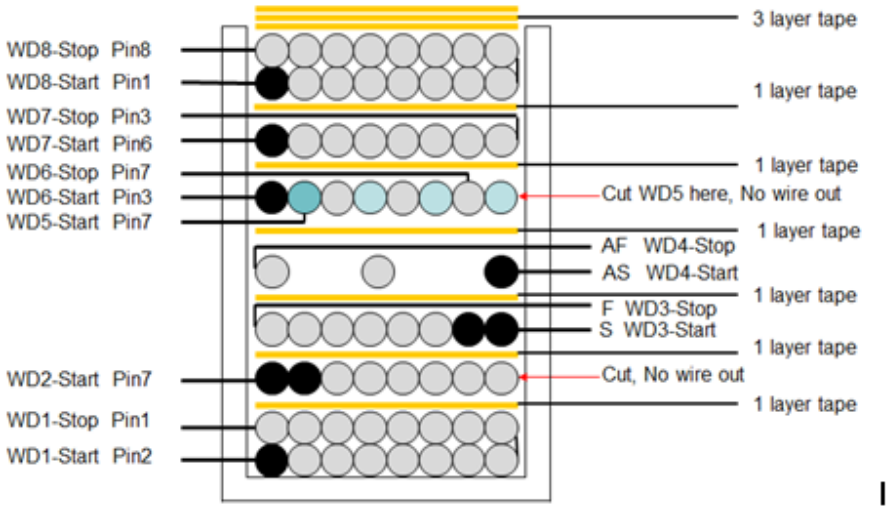
WD3=Output
5T, 2x40x0.07mm triple isolating Litz wire

WD4=Output
3T, 0.2mm triple isolating wire

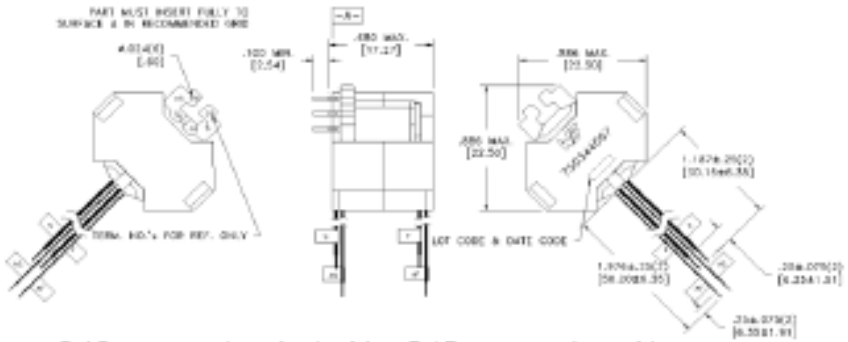
3. Electrical specification

Electrical Strength	Pin1, 2, 3, 6, 7, 8 to Pin S, F, AS, AF	3000V
Primary Inductance	Pins 2-8, all other windings open, measured at 10 kHz, 1V	170uH+/-10%

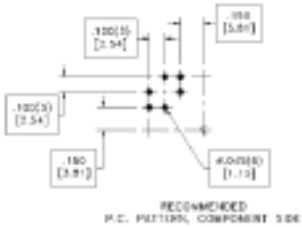
4. Transformer building construction diagram



CUSTOMER TERMINAL	RoHS	LEAD(Pb)–FREE
Sn 96%, Ag 4%	Yes	Yes



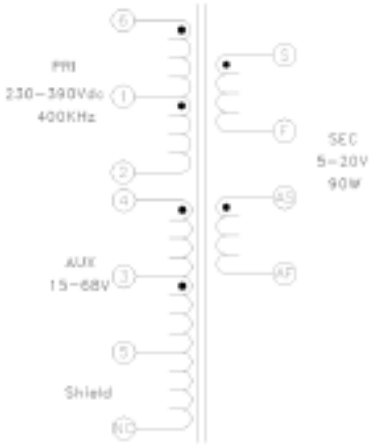
S,AS are on terminal side, F,AF are on top side.
Thin and long wires are AS and AF.



RECOMMENDED
P.C. PATTERN, COMPONENT SIDE

ELECTRICAL SPECIFICATIONS @ 25° C unless otherwise noted:

PARAMETER		TEST CONDITIONS	VALUE
D.C. RESISTANCE	2-6	@20°C	0.115 ohms max.
D.C. RESISTANCE	4-5	@20°C	1.065 ohms max.
D.C. RESISTANCE	S-F	@20°C	0.024 ohms max.
D.C. RESISTANCE	AS-AF	@20°C	0.294 ohms max.
INDUCTANCE	2-6	10kHz, 1V, Ls	170.00µH ±10%
LEAKAGE INDUCTANCE	2-6	tie(4+5+6+F+AS+AF),100kHz, 1V, Ls	4.50µH max.
DIELECTRIC	2-S	tie(5+6,F+AS), 3000VAC, 1 second	
TURNS RATIO		(2-6):(4-5)	2:1, ±2%
TURNS RATIO		(2-6):(S-F)	6.8:1, ±2%
TURNS RATIO		(2-6):(AS-AF)	11.33:1, ±2%



GENERAL SPECIFICATIONS:

OPERATING TEMPERATURE RANGE: -40°C to +125°C including temp rise.
Designed to comply with the following requirements as defined by IEC60950-1,
EN60950-1, UL60950-1/CSA60950-1 and AS/NZS60950.1:

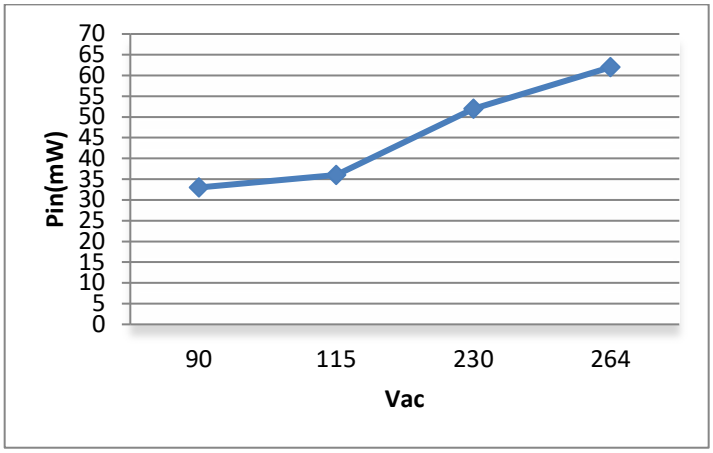
- Reinforced insulation for a primary circuit at a working voltage of 265Vrms, 400Vpeak, Overvoltage Category II, Pollution Degree 2.

Wire Insulation & RoHS status not affected by wire color. Wire Insulation color may vary depending on availability.

DFM		Packaging Specifications	Tolerances unless otherwise specified:	DRAWING TITLE	PART NO.
DATE		Method: Tray	Angles: ±1° Decimals: ±.005 [.13]	TRANSFORMER	750344067
ENG	HJH	PKG-TBD	Fractions: ±1/64 Footprint: ± .001 [.03]		
REV.	01		This drawing is dual dimensioned. Dimensions in brackets are in millimeters.		SPECIFICATION SHEET 1 OF 1
DATE	2019-02-19				

Standby Power at 5V Output (Cable unplug) @ 90 Vac to 264 Vac Input

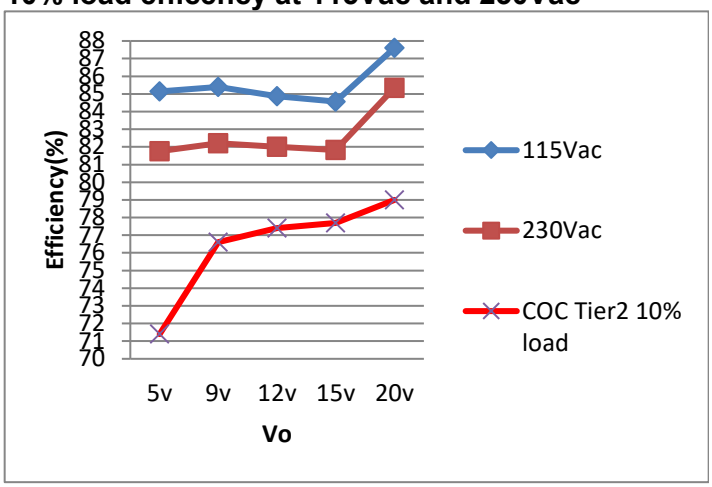
Test condition: all efficiency are tested at board end



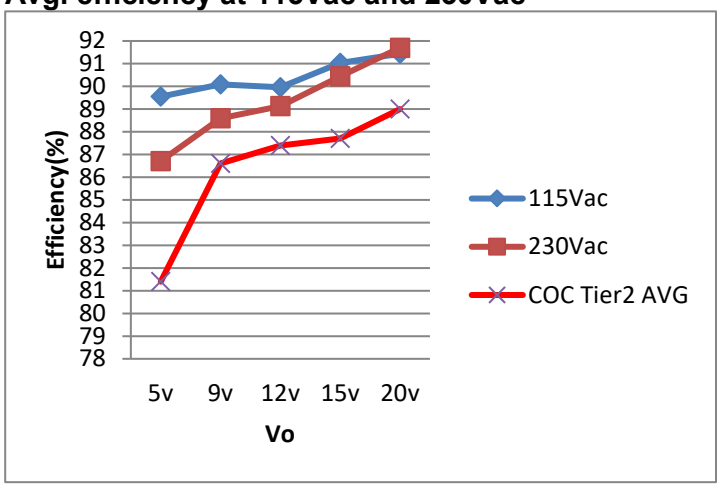
10% Load and Average Efficiency

Test condition: all efficiency are tested at board end

10% load efficency at 115Vac and 230Vac



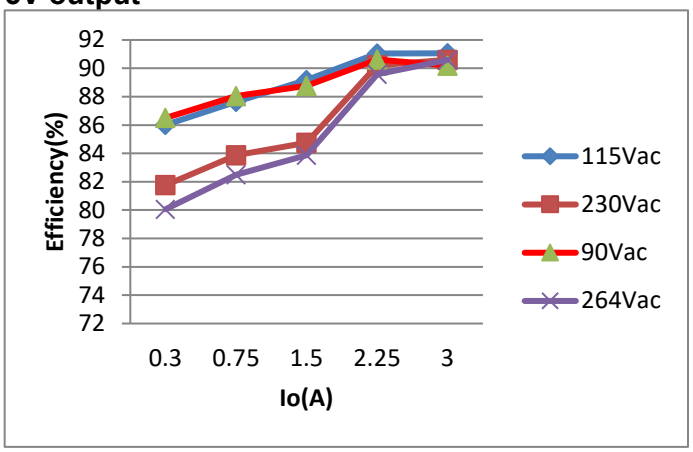
Avg. efficiency at 115Vac and 230Vac



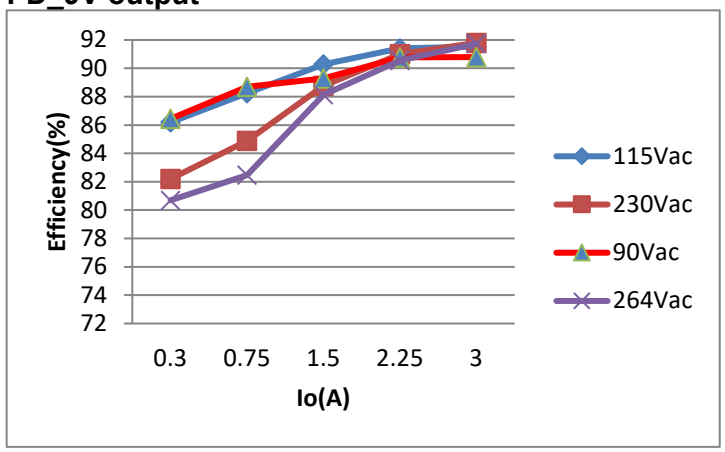
Efficiency vs Output Load Curves

Test condition: all efficiency are tested at board end

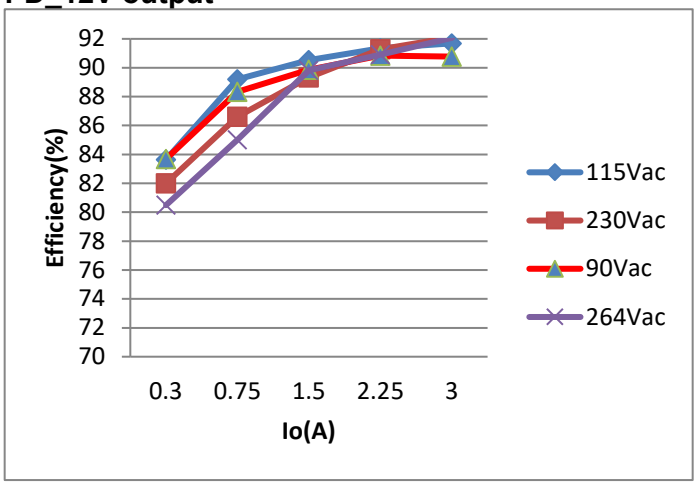
5V output



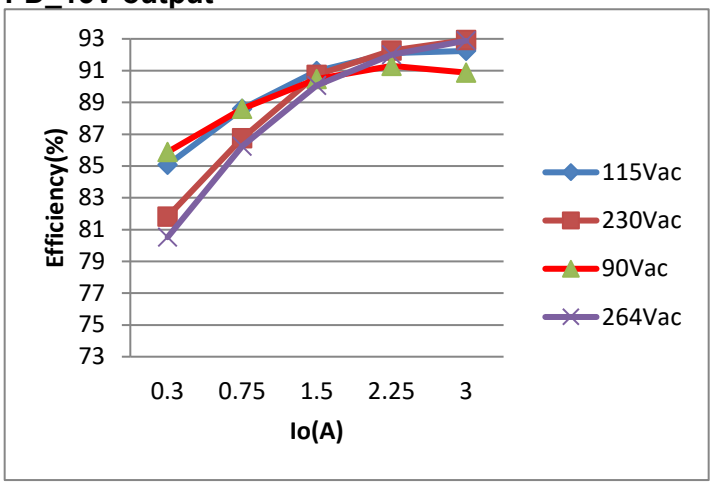
PD_9V output



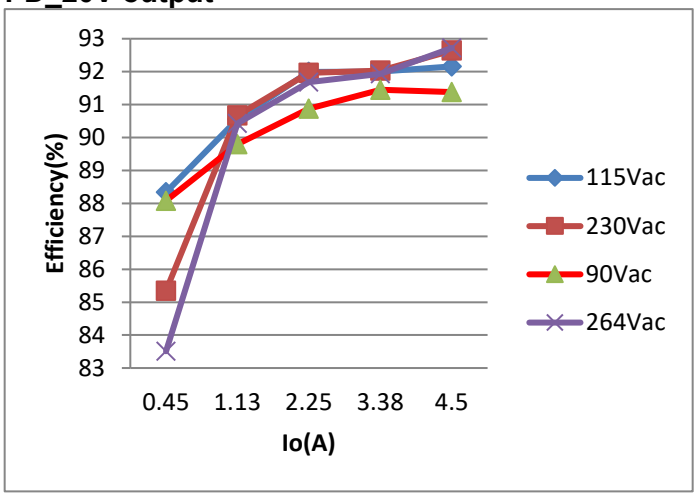
PD_12V output



PD_15V output

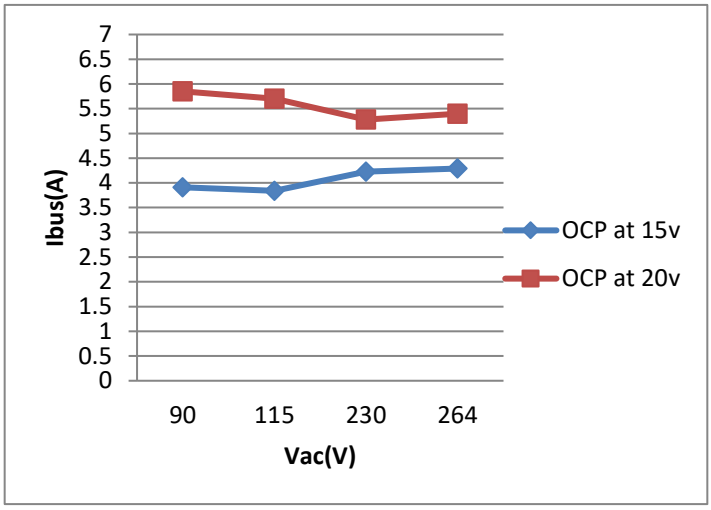


PD_20V output

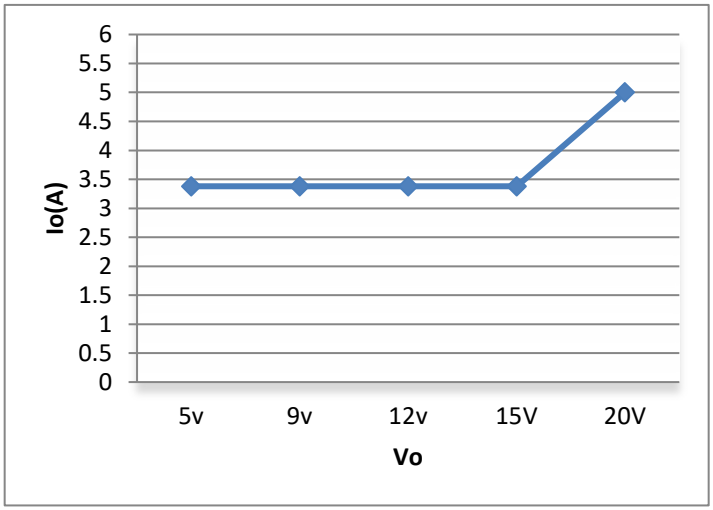


OCP

OCP for PWM at 15V and 20V

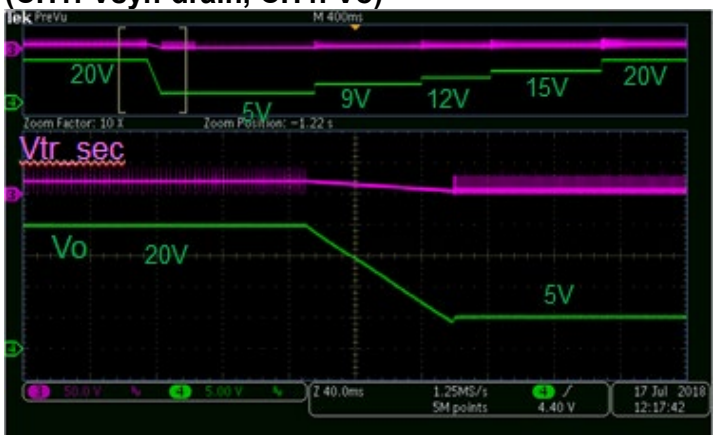


OCP for PD



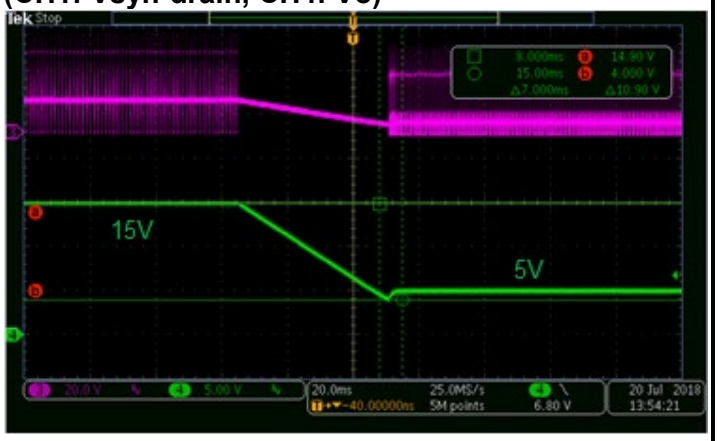
PD Volatge Change from 20v to 5v at 0A

(CH1: Vsyn-drain, CH4: Vo)



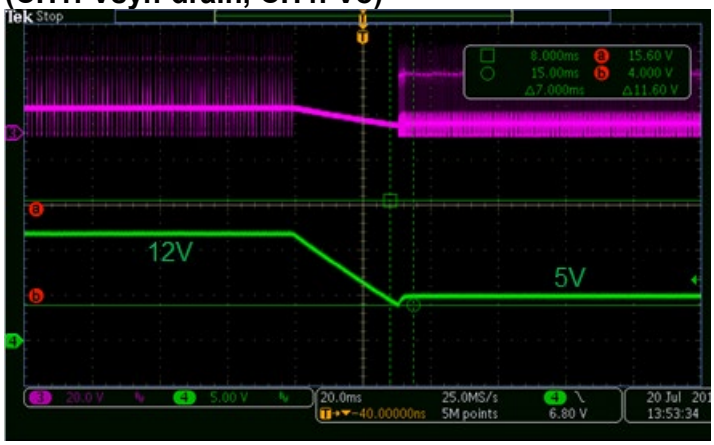
PD Voltage Change from 15v to 5v at 0A

(CH1: Vsyn-drain, CH4: Vo)



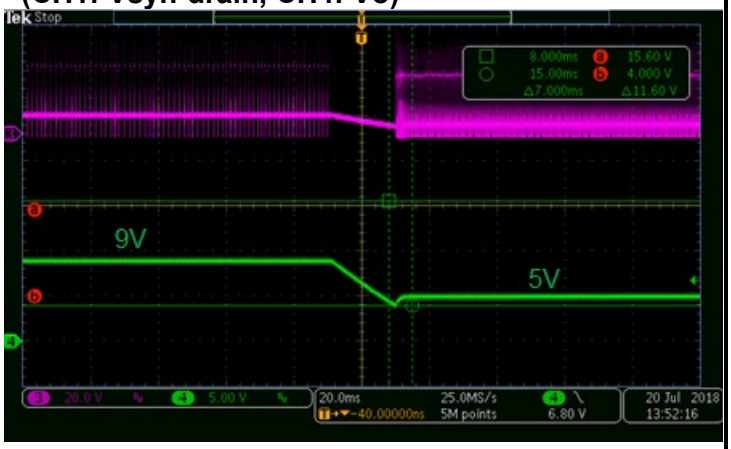
PD Volatge Change from 12v to 5v at 0A

(CH1: Vsyn-drain, CH4: Vo)



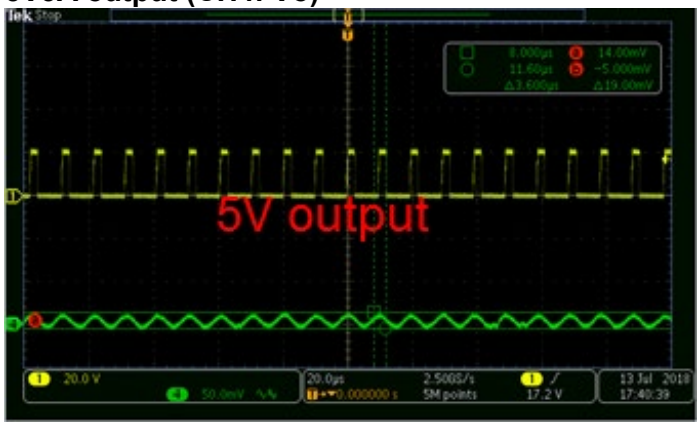
PD Voltage Change from 9v to 5v at 0A

(CH1: Vsyn-drain, CH4: Vo)

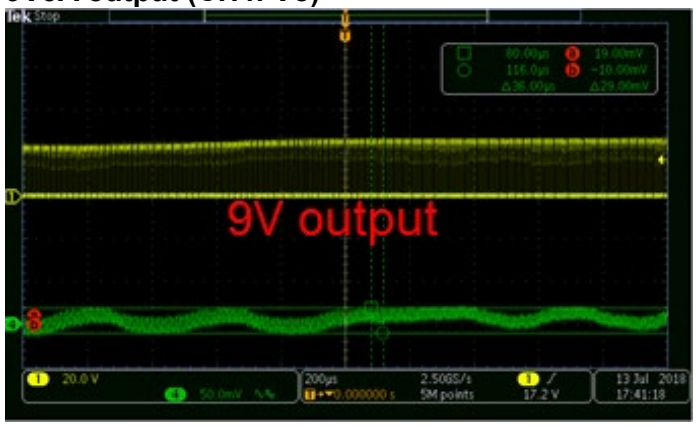


Output Ripple @ 90 Vac and 3A Output

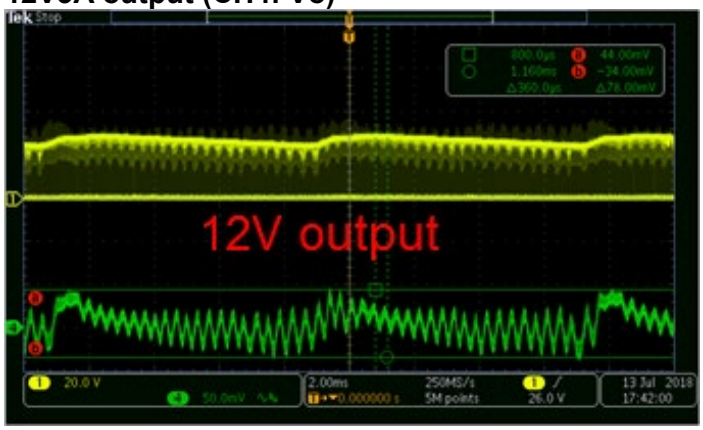
5V3A output (CH4: Vo)



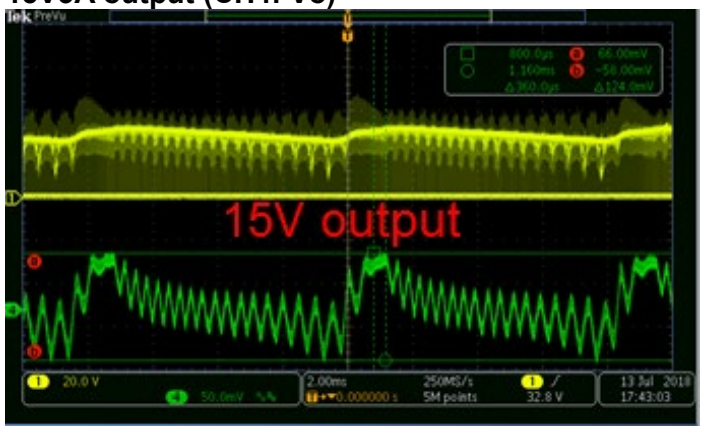
9V3A output (CH4: Vo)



12V3A output (CH4: Vo)



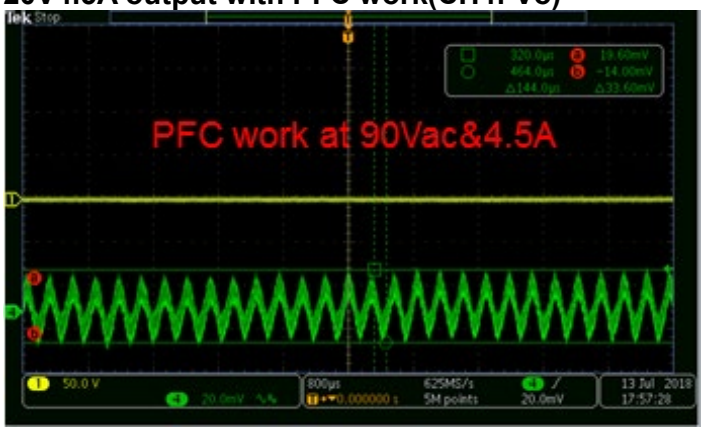
15V3A output (CH4: Vo)



Output Ripple @ 90 Vac and 20v output

20V2.5A output without PFC work(CH4: Vo)

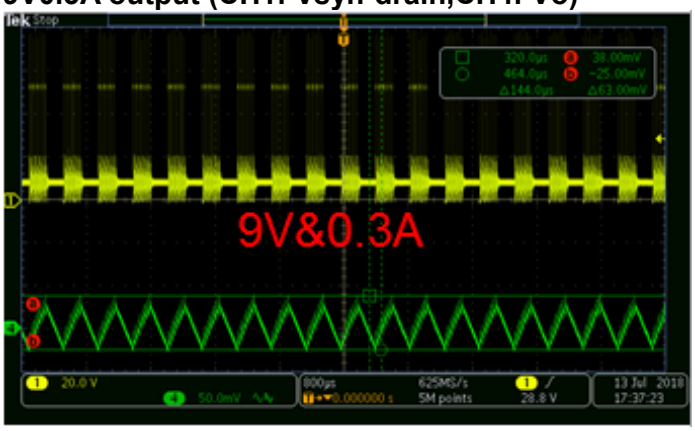
20V4.5A output with PFC work(CH4: Vo)



Output Max Skip Ripple @ 230 Vac

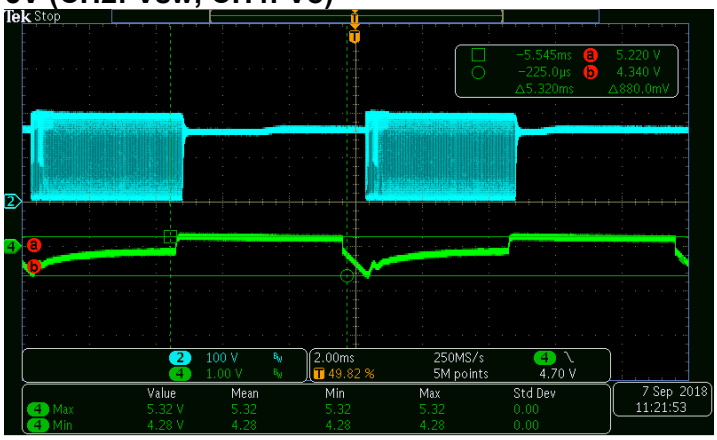
5V0.53A output (CH1: Vsyn-drain,CH4: Vo)

9V0.3A output (CH1: Vsyn-drain,CH4: Vo)



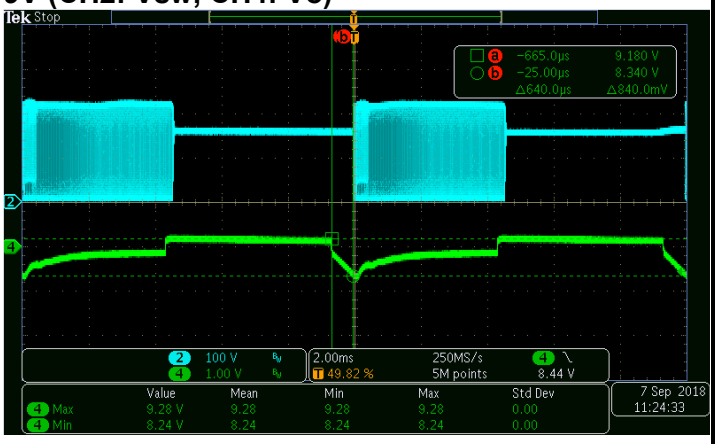
Dynamic Test Between 0-50% Load @ 115 Vac Input

5V (CH2: Vsw, CH4: Vo)



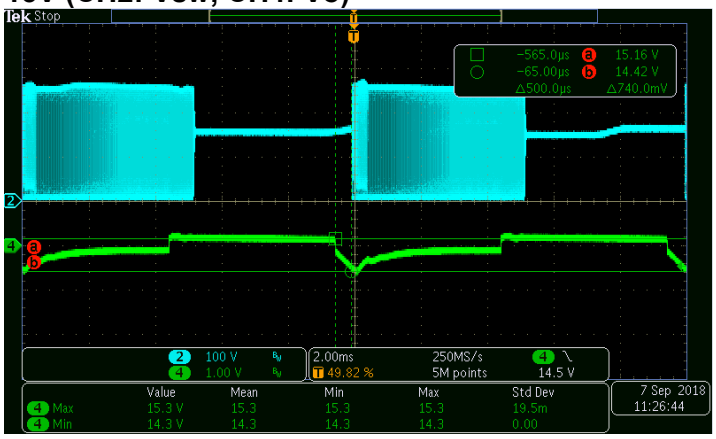
Test condition: 0-1.5A, 10ms cycle, 125mA/us 1m cable, tested at E-load

9V (CH2: Vsw, CH4: Vo)



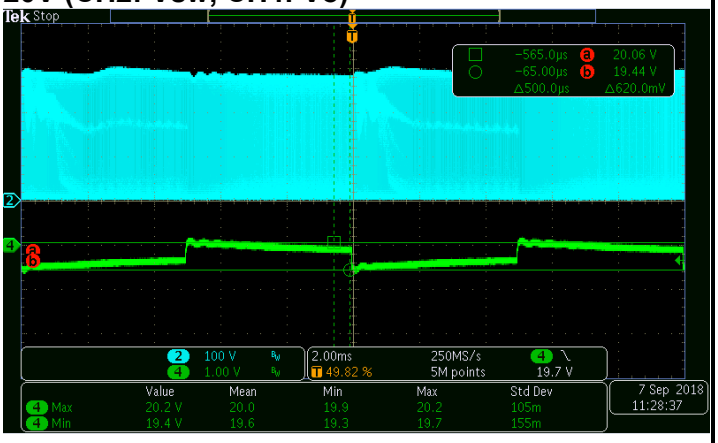
Test condition: 0-1.5A, 10ms cycle, 125mA/us 1m cable, tested at E-load

15V (CH2: Vsw, CH4: Vo)



Test condition: 0-1.5A, 10ms cycle, 125mA/us 1m cable, tested at E-load

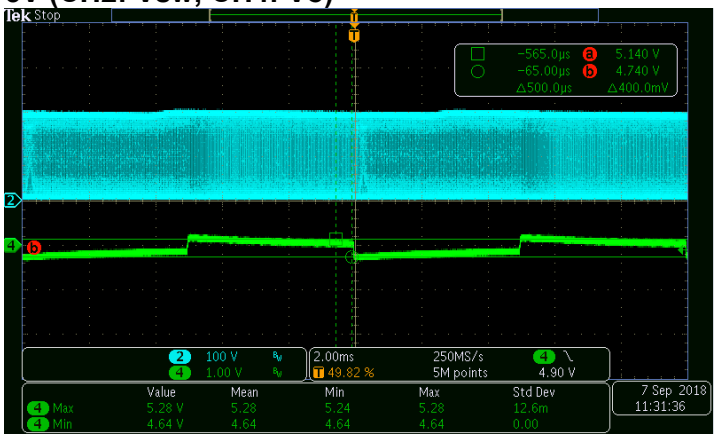
20V (CH2: Vsw, CH4: Vo)



Test condition: 0-2.25A, 10ms cycle, 125mA/us 1m cable, tested at E-load

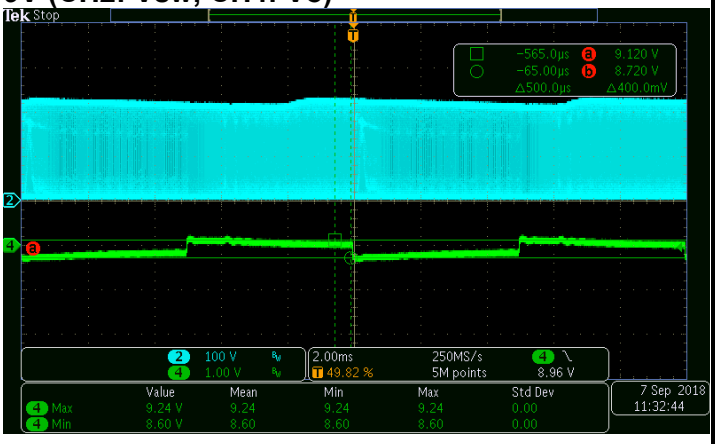
Dynamic Test Between 25%-75% Load @ 115 Vac Input

5V (CH2: Vsw, CH4: Vo)



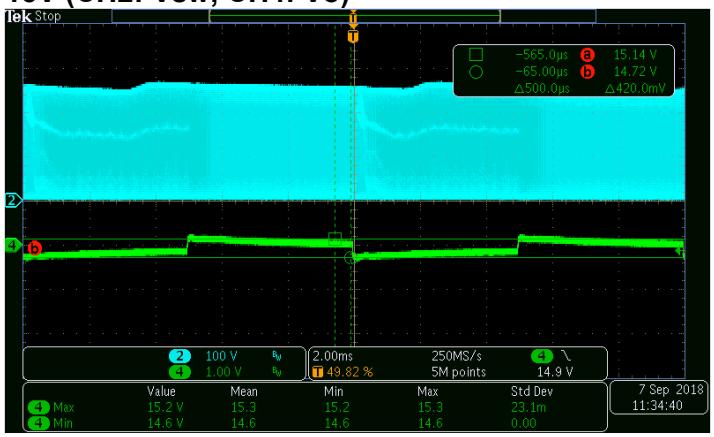
Test condition: 0.75A-2.25A, 10ms cycle, 125mA/us, 1m cable, tested at E-load

9V (CH2: Vsw, CH4: Vo)



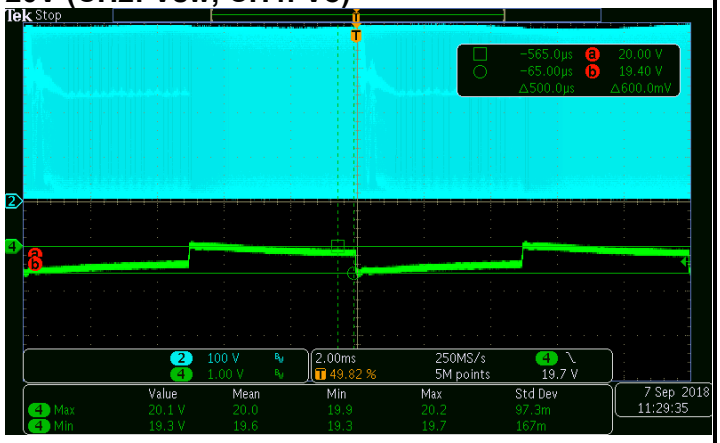
Test condition: 0.75A-2.25A, 10ms cycle, 125mA/us, 1m cable, tested at E-load

15V (CH2: Vsw, CH4: Vo)



Test condition: 0.75A-2.25A, 10ms cycle, 125mA/us,1m cable, tested at E-load

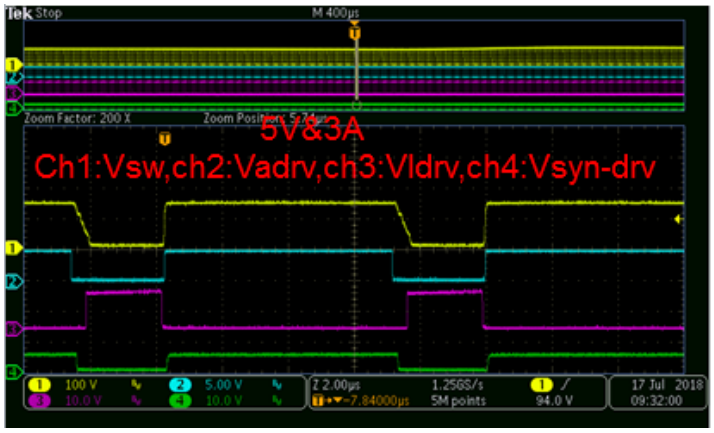
20V (CH2: Vsw, CH4: Vo)



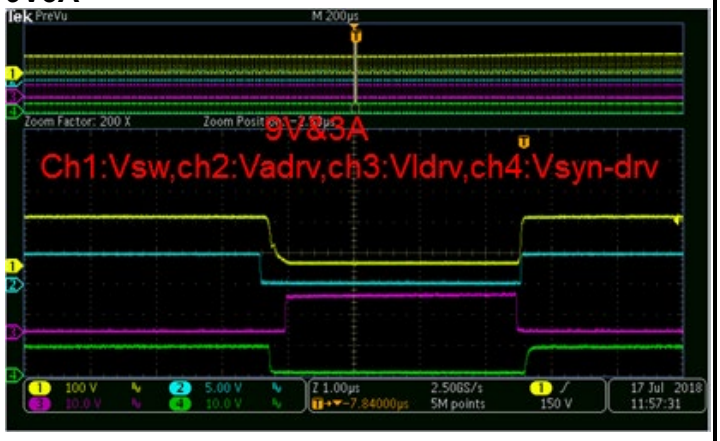
Test condition: 1.13A-3.38A, 10ms cycle, 125mA/us,1m cable, tested at E-load

Key ACF waveform @ 90 Vac Input

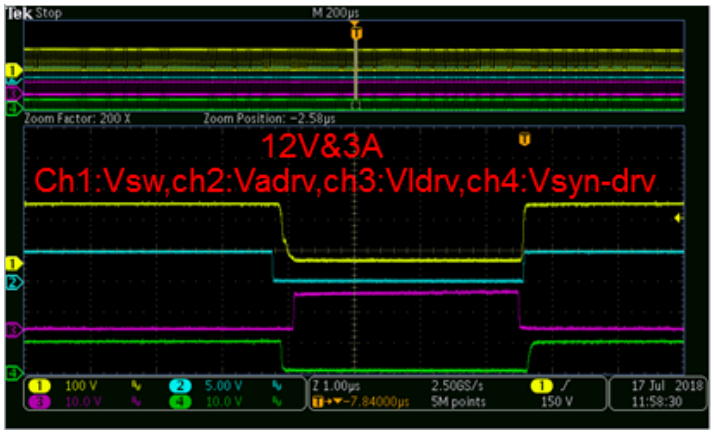
5V3A



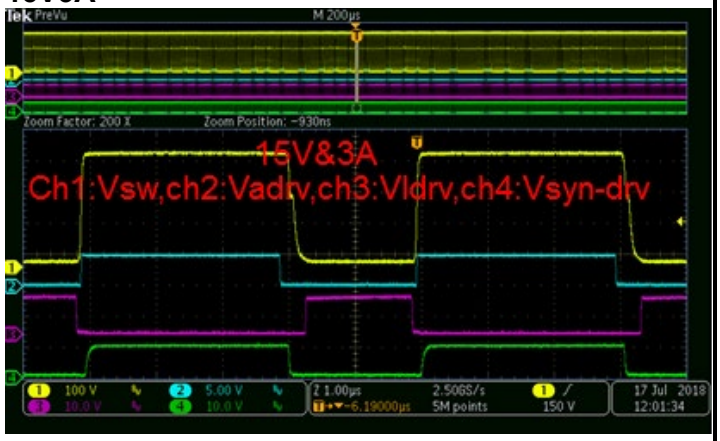
9V3A



12V3A

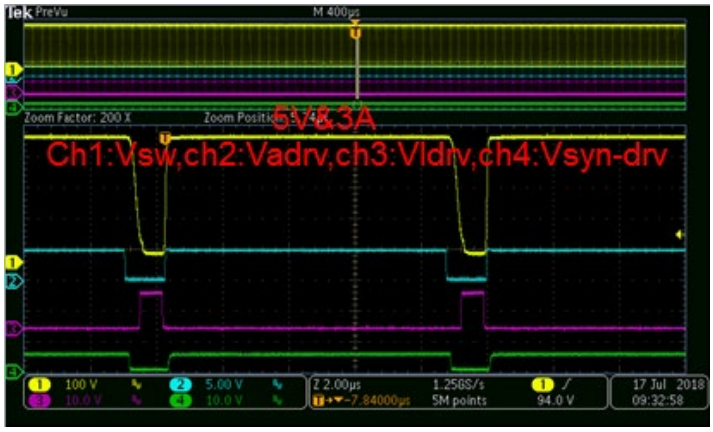


15V3A

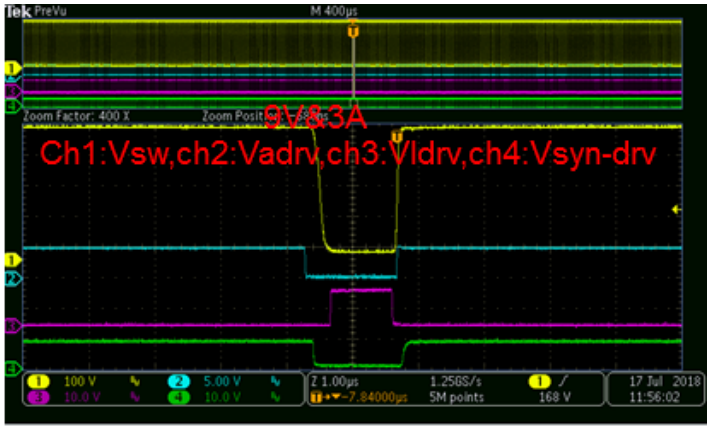


Key ACF waveform @ 264 Vac Input

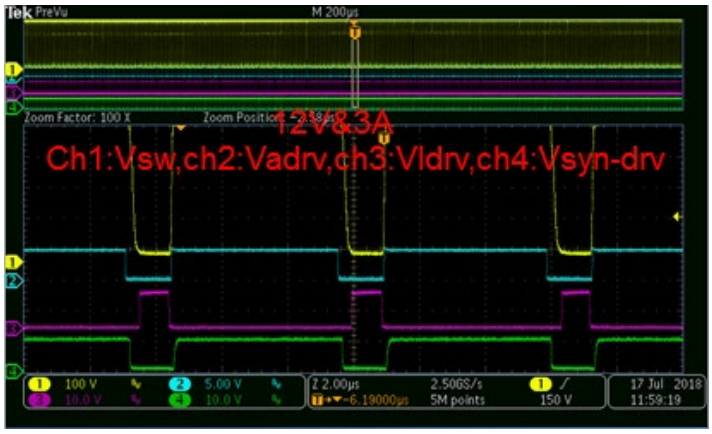
5V3A



9V3A



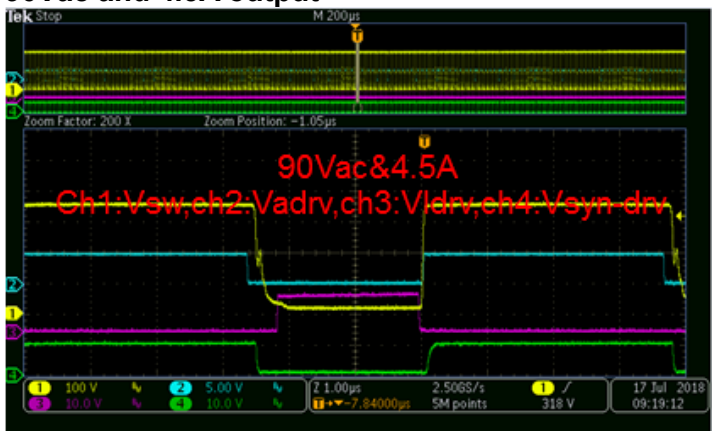
12V3A



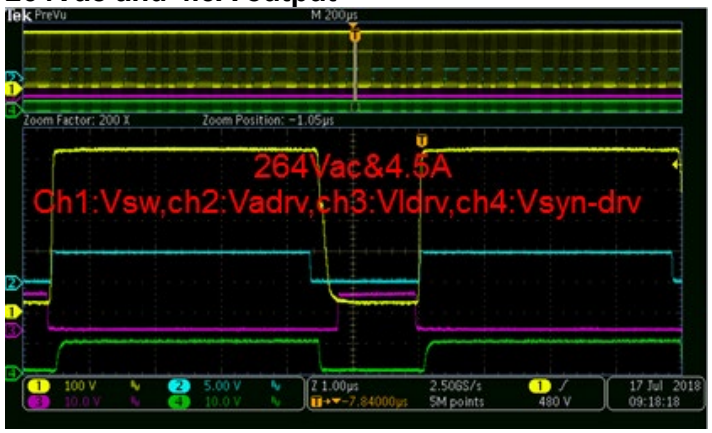
15V3A

Key ACF waveform @ 20V output

90Vac and 4.5A output

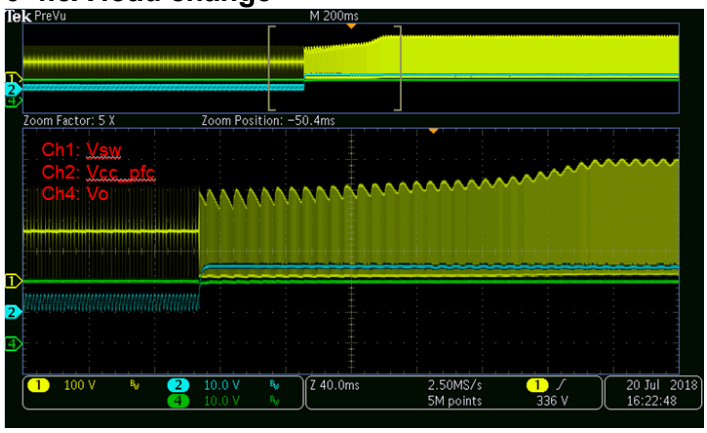


264Vac and 4.5A output



Load change at 115Vac and 20V

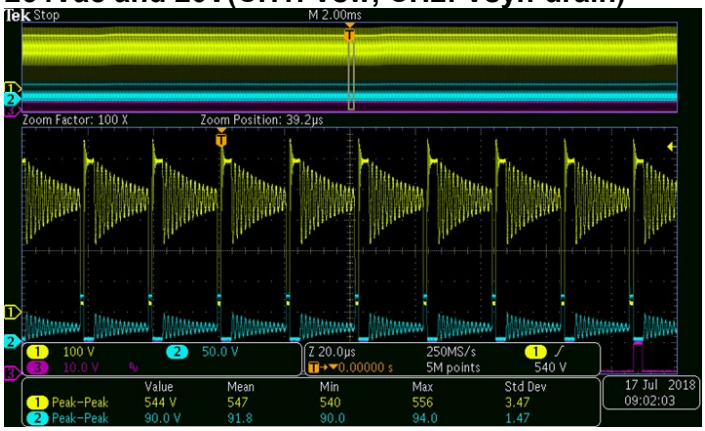
0-4.5A load change



4.5A-0 load change

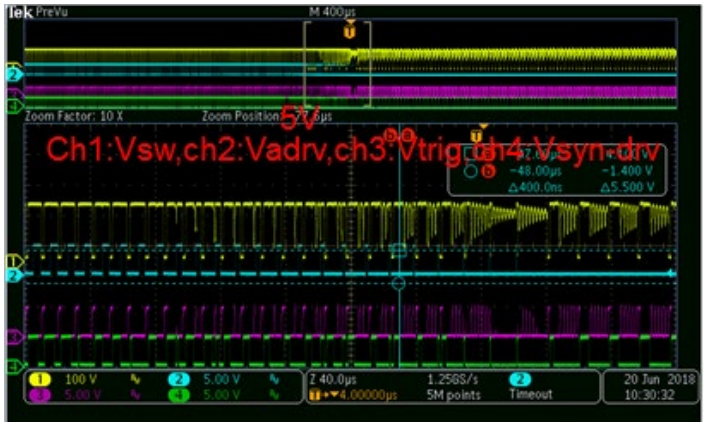
Max voltage stress in DCM

264Vac and 20V(CH1: Vsw, CH2: Vsyn-drain)

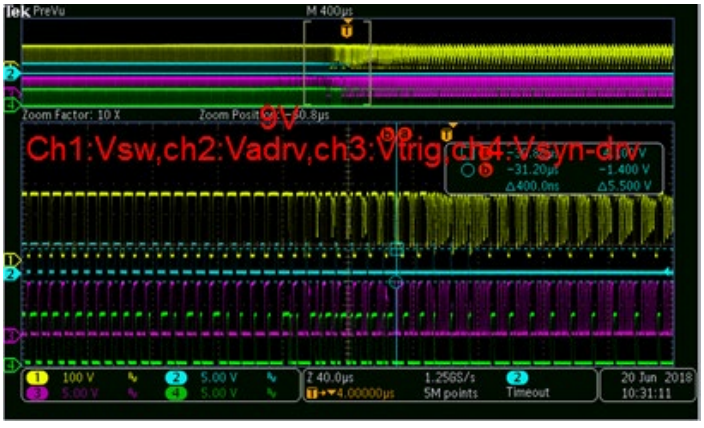


ACF to DCM mode transition

115Vac and 5V

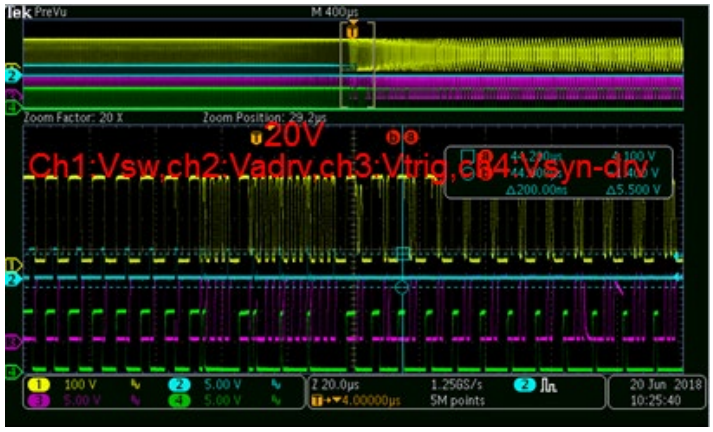


115Vac and 9V



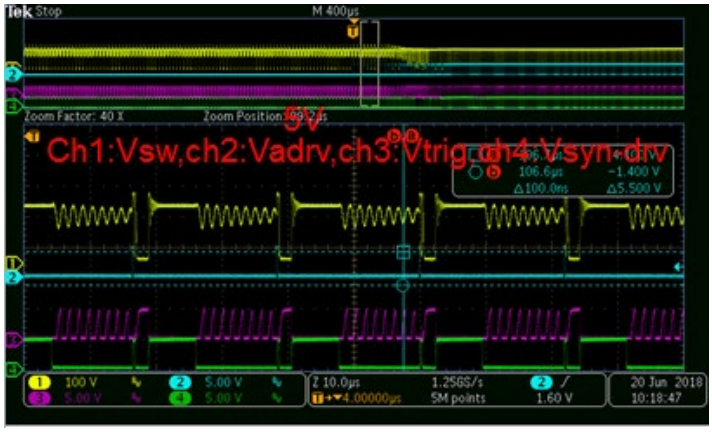
115Vac and 15V

115Vac and 20V

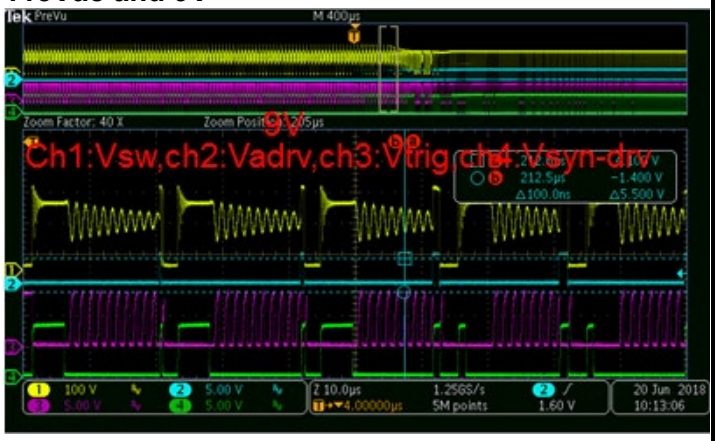


DCM to ACF mode transition

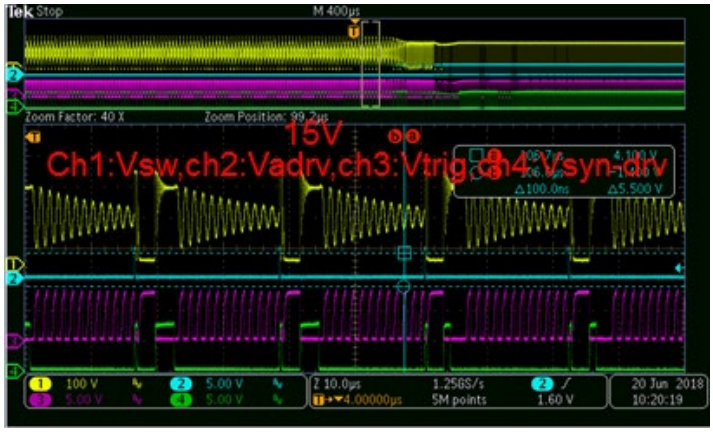
115Vac and 5V



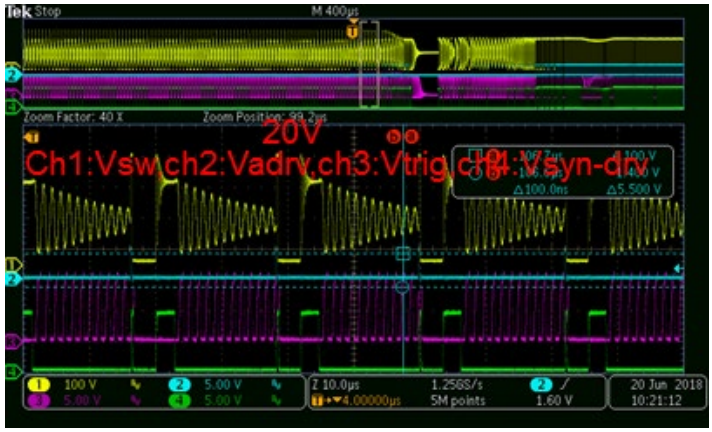
115Vac and 9V



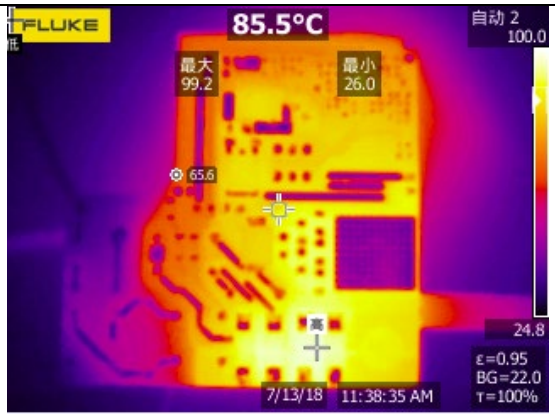
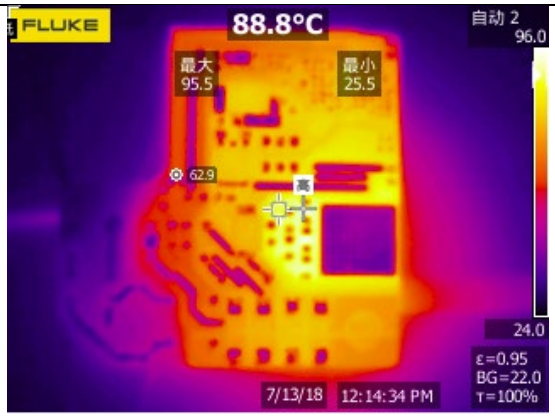
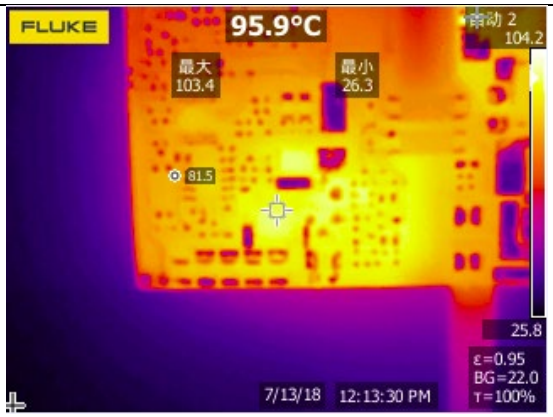
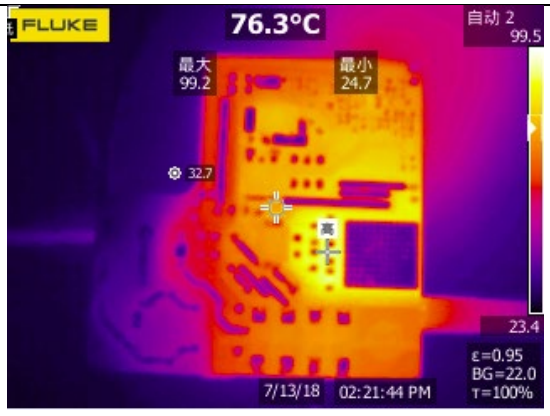
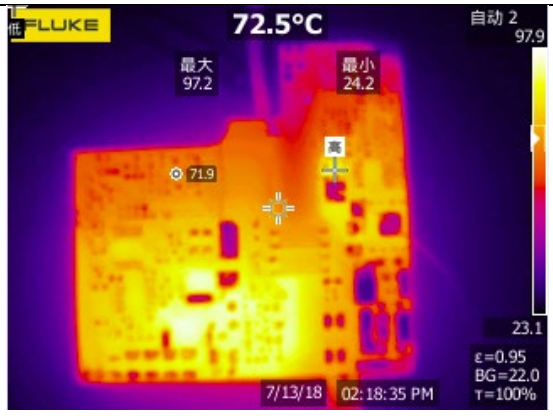
115Vac and 15V



115Vac and 20V



Thermal Image @ 20V4.5A Output

Input	PFC Side	ACF side
90 Vac		
115 Vac		
230 Vac		
264 Vac		

DN05125/D
BOM

Item	Qty	Reference	Type	Part Name	MFR	Value	Package	Description
1	4	Q6 Q19 Q25-26	NMOSFET	2N7002LT1G	ON	0.2A,60V	SOT23	NMOSFET
2	4	C39 C44 C52 C54	Ceramic Capacitor	/885012206095	Wurth	0.1uF	603	Capacitor, Ceramic, 50V, 10%
3	1	C37	Ceramic Capacitor	/885012206073	Wurth	0.22uF,25V	603	Capacitor, Ceramic, 25V, 10%
4	6	C6 C26 C45 C48 49 C51	Ceramic Capcitor	C3225X7T2W224K	TDK	0.22uF,450V	1210	Capacitor, Ceramic, Chip, 10%
5	2	C1 C5	Film Capcitor	ECWFD2W684Q	Panasoni	0.68u,450v	THT,10mm, 13mmx6mmx12mm	
6	3	C9 C33-34	Ceramic Capacitor	/885012206077	Wurth	100pF	603	Capacitor, Ceramic, 50V, 10%
7	1	C31	Ceramic Capcitor	C3216X7T2W104K	TDK	104,400V	1206	Capacitor, Ceramic, SMD, 5%
8	1	C18	Ceramic Capacitor	/885012206089	Wurth	10nF	603	Capacitor, Ceramic, 50V, 10%
9	1	C55	Ceramic Capacitor	/885012006051	Wurth	10pF	603	Capacitor, Ceramic, 50V, 10%
10	2	C42 C46	Ceramic Capacitor	/885012206083	Wurth	1nF	603	Capacitor, Ceramic, 50V, 10%
11	1	C12	Ceramic Capacitor	/885342206003	Wurth	1nF,250v	603	Capacitor, Ceramic, 250V, 10%
12	1	C8	Ceramic Capacitor	C2012X7S2A105K	TDK	1uF,100v	805	Capacitor, Ceramic, 100V, 10%
13	7	C2 C7 C16-17 C29 C38 C43	Ceramic Capacitor	/885012206076	Wurth	1uF,25V	603	Capacitor, Ceramic, 25V, 10%
14	1	C35	Ceramic Capacitor	/885012206085	Wurth	2.2nF	603	Capacitor, Ceramic, 50V, 10%
15	1	C36	Ceramic Capacitor	/885012106018	Wurth	2.2uF,16V	603	Capacitor, Ceramic, 16V, 10%
16	1	C25	X2 Capcitor	/890324024002	Wurth	224,X2	THT, 12.5mm, 15mmx7mmx12mm	X2 capacitor, Safety standard approved, 10%
17	4	C11 C23 C28 C30	Ceramic Capacitor	/885012206080	Wurth	330pF	603	Capacitor, Ceramic, 50V, 10%
18	1	C53	Ceramic Capacitor	/885012206094	Wurth	4.7nF	603	Capacitor, Ceramic, 50V, 10%
19	1	C3	Ceramic Capacitor	C1608X6S1C475M	TDK	4.7uF,16v	603	Capacitor, Ceramic, 16V, 10%
20	3	C4 C24 C27	Ceramic Capacitor	C2012X7R1E475K	TDK	4.7uF,25V	805	Capacitor, Ceramic, 25V, 10%
21	1	C50	Ceramic Capacitor	C1608C0G1H821J	TDK	820pF	603	Capacitor, Ceramic, 50V, 5%
22	1	C10	Ceramic Capcitor	CS65-B2GA101KYNKA	TDK	470pF,Y1	Lead type	HV Ceramic Capacitor, safety standard approved, 10%
23	1	C47	Ceramic Capacitor	/885012206083	Wurth	47nF	603	Capacitor, Ceramic, 50V, 5%
24	2	C19 C22	Ceramic Capacitor	/885012206094	Wurth	68nF	603	Capacitor, Ceramic, 50V, 10%
25	1	C20	Ceramic Capacitor	Std	std	NC	603	Capacitor, Ceramic, 50V, 10%
26	1	C40	Ceramic Capcitor	nc	nc	nc	805	Capacitor, Ceramic, Chip, 5%
27	2	D2 D2A	Bridge rectifier	Z4GP40MH	ZOWIE	4A,1000V	Z4PAK	Bridge Rectifier, 1000V, 4A
28	1	D9	Rectifier	S3J	ON	3A,600V	SMC	General Rectifier
29	1	DNR	Varistor	820573011	Wurth	10D471K	TH	Varistor, 10D471K
30	8	D1 D8 D14 D16 D19 D23 D25 D30	Switching diode	BAS21HT1G	ON	0.2A,250V	SOD323	Switching diode, SMD

BOM (Continued)

Item	Qty	Reference	Type	Part Name	MFR	Value	Package	Description
31	6	D4 D10 D15 D26 D29 D31	Switching diode	BAT54HT1G	ON	0.2A,30V	SOD323	Switching diode, SMD
32	2	D6,D11	Switching diode	NSD350HT1G	ON	0.2A,350V	SOD323	Switching diode, SMD
33	2	D12-13	Standard rectifie	RS1JFA	ON	0.8A,600V	SOD123FL	Standard Rectifier, 0.8A, 600V
34	2	D7 D22	Ultrafast rectifi	US1JFA	ON	1A,600V	SOD123FL	Ultrafast Rectifier, 1A, 600V
35	5	D5 D17-18 D20 D21	Switching diode	BAS21HT1G	ON	0.2A,250V	SOD323	Switching diode, SMD
36	1	FB2	Ferrite bead	742792121	Wurth		1206	300ohm@100MHz
37	1	FB3	Ferrite bead	nc	nc	nc	1206	nc
38	1	L2	Common filter	T12x8x7	std	18mH	TH type	CM Filter, T type core
39	1	L1	Common filter	T9*5*3	std	600uH	TH	T type, 9*5*3, 0.5 wire
40	1	F1	Fuse	5ET-016H	Hollyfu	1.6A, 250Vac	Axial lead	Micro Fuse, 1.6A/250V
41	5	Q1-2 Q7 Q12-1	NPN Transistor	MMBT3904LT1G	ON		SOT23	General NPN Transistor, SMD
42	3	Q5 Q4 Q10	NPN Transistor	MMBTA06LT1G	ON		SOT23	General NPN Transistor, SMD
43	1	Q9	PNP Transistor	MMBTA56LT1G	ON		SOT23	General PNP Transistor, SMD
44	3	Q14-15 Q17	PNP Transistor	MMBT3906LT1G	ON		SOT23	General PNP Transistor, SMD
45	1	D3	Ultrafast Rectifi	MURD550PFG	ON	5A, 520V	DPAK	Ultrafast Rectifier, 5A, 520V
46	1	U5	Programmable pricision	NCP431ASNT1G	ON		SOT23	PROGRAMMABLE PRECISION REFEREN
47	1	U2	ACF Controller	NCP1568S02DBR2G	ON		TSSOP16	ACF Controller
48	1	U1	PFC controller	NCP1622AEC	ON		TSOP6	PFC Controller
49	1	U7	Syn. rectified controller	NCP4306AADZZZADI	ON		SO8	Syn. Rectified Controller
50	1	U3	HS HB Driver	NCP51530AMNTWG	ON		DFN10	
51	1	NTC1	NTC	SDNT1608X104J42	Shunlor	100k	603	replaced by 13k resistor or nc
52	1	NTC2	NTC	SDNT1608X104J42	Shunlor	100k	603	replacerment of 100k resistor
53	2	U4 U11	Optical coupler	FODM1009	ON		LSOP4	optical coupler
54	1	Q20	PMOS	BSS84LT1G	ON	60V	SOT23	
55	1	L3	Toroidal Line Cho	7447021	Wurth	100uH	TH type	Toroidal Line Choke,15.8x8.5,2
56	1	L5	SMD inductor	MCL1608S4R7MT	Shunlor	4.7uH	603	SMD inductor
57	1	Q3	MOSFET	FCMT299N60	ON		PQFN-4	MOSFET, NChan, 600V
58	2	R13 R84	Resistor	Std	Std	0	603	Resistor, Chip, 1/8W, 1%
59	2	R6 R72	Resistor	Std	Std	1	603	Resistor, Chip, 1/8W, 1%
60	1	R15	Resistor	Std	Std	1.64K	603	Resistor, Chip, 1/8W, 1%
61	7	R32 R49 R59 R85 R91-92 R98	Resistor	Std	Std	100K	603	Resistor, Chip, 1/8W, 1%
62	7	R18 R24 R35 R62 R67 R70 R94	Resistor	Std	Std	10K	603	Resistor, Chip, 1/8W, 1%
63	1	R36	Resistor	Std	Std	10k	603	Resistor, Chip, 1/8W, 1%
64	1	R37	Resistor	Std	Std	120K	603	Resistor, Chip, 1/8W, 1%
65	1	R78	Resistor	Std	Std	12K	603	Resistor, Chip, 1/8W, 1%
66	1	R88	Resistor	Std	Std	130K	603	Resistor, Chip, 1/8W, 1%
67	3	R63 R69 R82	Resistor	Std	Std	150K	603	Resistor, Chip, 1/8W, 1%
68	1	R8	Resistor	Std	Std	15M	603	Resistor, Chip, 1/8W, 1%

BOM (Continued)

Item	Qty	Reference	Type	Part Name	MFR	Value	Package	Description
68	1	R8	Resistor	Std	Std	15M	603	Resistor, Chip, 1/8W, 1%
69	1	R17	Resistor	Std	Std	16K	603	Resistor, Chip, 1/8W, 1%
70	1	R7	Resistor	Std	Std	180K	603	Resistor, Chip, 1/8W, 1%
71	1	R46	Resistor	Std	Std	18K	603	Resistor, Chip, 1/8W, 1%
72	3	R1 R21 R44	Resistor	Std	Std	1K	603	Resistor, Chip, 1/8W, 1%
73	1	R22	Resistor	Std	Std	1K	603	Resistor, Chip, 1/8W, 1%,
74	2	R30 R68	Resistor	Std	Std	1M	603	Resistor, Chip, 1/8W, 1%
75	1	R79	Resistor	Std	Std	200K	603	Resistor, Chip, 1/8W, 1%
76	1	R57	Resistor	Std	Std	20K	603	Resistor, Chip, 1/8W, 1%
77	4	R9 R19 R27 R47	Resistor	Std	Std	22	603	Resistor, Chip, 1/8W, 1%
78	1	R56	Resistor	Std	Std	22K	603	Resistor, Chip, 1/8W, 1%
79	1	R58	Resistor	Std	Std	24K	603	Resistor, Chip, 1/8W, 1%
80	1	R76	Resistor	Std	Std	2K	603	Resistor, Chip, 1/8W, 1%
81	2	R55 R71	Resistor	Std	Std	300K	603	Resistor, Chip, 1/8W, 1%
82	1	R16	Resistor	Std	Std	30K	603	Resistor, Chip, 1/8W, 1%
83	1	R45	Resistor	Std	Std	33K	603	Resistor, Chip, 1/8W, 1%
84	1	R75	Resistor	Std	Std	360K	603	Resistor, Chip, 1/8W, 1%
85	1	R2	Resistor	Std	Std	39K	603	Resistor, Chip, 1/8W, 1%
86	7	R10 R26 R28 R48 R74 R89-90	Resistor	Std	Std	4.7	603	Resistor, Chip, 1/8W, 1%
87	1	R23	Resistor	Std	Std	4.7K	603	Resistor, Chip, 1/8W, 1%
88	1	R61	Resistor	Std	Std	43K	603	Resistor, Chip, 1/8W, 1%
89	1	R54	Resistor	Std	Std	47	603	Resistor, Chip, 1/8W, 1%
90	2	R11 R81	Resistor	Std	Std	470K	603	Resistor, Chip, 1/8W, 1%
91	3	R25 R38 R80	Resistor	Std	Std	47K	603	Resistor, Chip, 1/8W, 1%
92	2	R3 R73	Resistor	Std	Std	510	603	Resistor, Chip, 1/8W, 1%
93	1	R77	Resistor	Std	Std	510K	603	Resistor, Chip, 1/8W, 1%
94	1	R93	Resistor	Std	Std	56K	603	Resistor, Chip, 1/8W, 1%
95	1	R52	Resistor	Std	Std	6.8K	603	Resistor, Chip, 1/8W, 1%
96	1	R20	Resistor	Std	Std	62K	603	Resistor, Chip, 1/8W, 1%
97	1	R43	Resistor	Std	Std	75K	603	Resistor, Chip, 1/8W, 1%
98	2	R53 R96	Resistor	Std	Std	91K	603	Resistor, Chip, 1/8W, 1%
99	1	R29	Resistor	Std	Std	nc	603	Resistor, Chip, 1/8W, 1%,
100	1	R33	Resistor	Std	Std	nc	603	Resistor, Chip, 1/8W, 1%
101	2	R50-51	Resistor	ERJ8BQFR30V	Panasoni	0.3	1206	Resistor, Chip, 1/2W, 1%
102	2	R4-5	Resistor	ERJ8BQFR56V	Panasoni	0.56	1206	Resistor, Chip, 1/2W, 1%
103	1	R64	Resistor	Std	Std	100K	1206	Resistor, Chip, 1/2W, 1%
104	1	R83	Resistor	Std	Std	10M	1206	Resistor, Chip, 1/2W, 1%
105	2	R65-66	Resistor	Std	Std	160K	1206	Resistor, Chip, 1/2W, 1%
106	1	R31	Resistor	Std	Std	1K	1206	Resistor, Chip, 1/2W, 1%
107	1	R39	Resistor	Std	Std	nc	1206	Resistor, Chip, 1/2W, 1%
108	2	R41-42	Resistor	Std	Std	2M	1206	Resistor, Chip, 1/2W, 1%
109	2	R12 R34	Resistor	Std	Std	47	805	Resistor, Chip, 1/5W, 1%

BOM (Continued)

Item	Qty	Reference	Type	Part Name	MFR	Value	Package	Description
110	1	R14	Resistor	Std	Std	5mohm	1206	Resistor, Chip, 1/2W, 1%
111	1	R40	Resistor	Std	Std	680K	1206	Resistor, Chip, 1/2W, 1%
112	1	T1	Transformer	750344067	WE-midcon		TH type	RM8, 6Pin
113	1	L4	PFC inductor	750344048	WE-midcon		TH type	RM8, 6Pin
114	1	C41	ECAP	KF Series	CapXon	10uF,25V	5mmx11mm	size:5mmx11mm
115	1	C21	ECAP	KF Series	CapXon	22uF,100V	6.3mmx11mm	size:6.3mmx11mm
116	3	C13-15	Electrolytic soli	PS681M025F080P	CapXon	680uF,25V	8mmx12mm	size:8mmx15mm
117	1	C32	Electrolytic elec	KL680M420J300A00H	CapXon	68uF,420V	16mmx30mm	size:16mmx30mm
118	1	Q8	MOSFET	NTMFS4C05NT1G	ON		QFN5X6mm	MOSFET, NChan, 3.4mohm
119	1	Q18	MOSFET	FDMT800120DC	ON		PQFN8L	MOSFET, NChan, 120V
120	2	Q23-24	MOSFET	IPL60R385CP	INFINEON		ThinPAK-8*8	MOSFET, NChan, 600V
121	1	J1	USB Type C connec	CUS31738616001	CSCONN		SMD	Type C connector, SMT
122	1	U8	PD Controller	WT6636F-UG16CWT-S9	Weltrend		DFN5X5	PD protocol controller
123	1	ZD4	Zener	MM3Z10VT1G	ON	10V	SOD323	GENERIC ZENER-DIODE
124	1	ZD5	Zener	MM3Z11VT1G	ON	11V	SOD323	GENERIC ZENER-DIODE
125	1	ZD12	Zener	MM3Z12VT1G	ON	12V	SOD323	GENERIC ZENER-DIODE
126	1	ZD8	Zener	MM3Z13VT1G	ON	13V	SOD323	GENERIC ZENER-DIODE
127	1	ZD2	Zener	MM3Z15VT1G	ON	15V	SOD323	GENERIC ZENER-DIODE
128	1	ZD11	zener	MM3Z16VT1G	ON	16v	SOD323	GENERIC ZENER-DIODE
129	2	ZD3 ZD9	Zener	MM3Z5V6T1G	ON	5.6V	SOD323	GENERIC ZENER-DIODE
130	4	ESD1-4	ESD	SD05T1G	ON	5V	SOD323	ESD protection device
131	1	ZD10	zener	MM3Z6V2T1G	ON	6.2v	SOD323	GENERIC ZENER-DIODE
132	2	Q11,Q16	NMOSFET	FQN1N50C	ON		TO-92	Nch MOSFET

References

ON Semiconductor datasheet for NCP1622, NCP51530, NCP1568 and NCP4306

ON Semiconductor Design Notes DN05043

Weltrend semiconductor datasheet for WT6636F

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