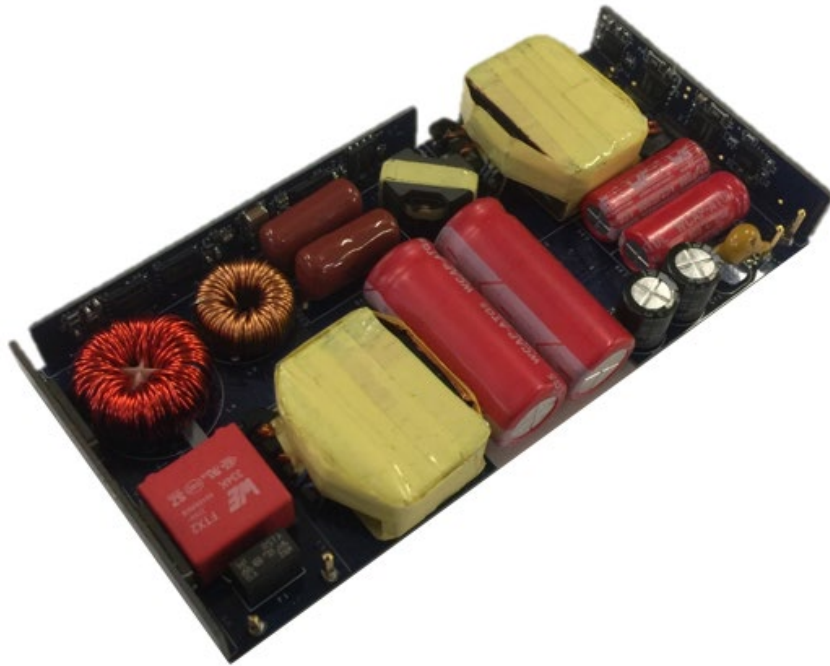


150W, AC-19V_{DC} PFC+LLC Demo Board

UG022

This user's guide covers:

Demo Board#	Description	Part(s) Used
NVE031E	150W, AC-19V (PFC+LLC) PFC min 200 kHz, LLC 500 kHz	NV6115



IMPORTANT NOTICE:

Hazardous voltages are present on this demo board. Personal contact with high voltages may result in injury or death. Correct handling and safety procedures must be observed. Boards are for lab bench evaluation only. Not for installation in end-user equipment.



CAUTION:

This product contains parts that are susceptible to damage by electrostatic discharge (ESD). Always follow ESD prevention procedures when handling the product.

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1. Specifications:

Ref.	Parameter	Value	Units
V _{IN}	Input Voltage	90-265	V _{AC}
		47-63	Hz
V _{OUT}	Output Voltage	19	V
I _{OUT}	Output Current (100% load)	8	A
I _{OUT_LIM}	Output Current Limitation (short-circuit or over-load)	9.5	A
P _{OUT}	Output Power (max)	150	W
F _{SW}	Switching Frequency	PFC (120V, 100% load, CrCM)	200 kHz
		PFC (220V, 100% load, DCM)	100 kHz
		LLC	500 kHz
η	Efficiency	230 V _{AC} , 150 W	94.3 %
		115 V _{AC} , 150 W	93.0 %
P _{STBY}	Standby Power Consumption	115 V _{AC}	< 210 mW
		230 V _{AC}	< 210 mW
PF	Power Factor	0.95	
	Board Dimensions	110 x 50 x 12.5	mm
	Board Volume (uncased)	68.75	cc
	Power Density (uncased)	35.75	W/in ³
		2.18	W/cc

2. Topology: CrCM PFC + LLC + SR

This design uses a Critical Conduction Mode (CrCM/DCM) PFC (AC-400 V_{bc}), followed by an LLC DC-DC (400-19 V_{bc}). For both stages, the switching frequency was increased to the maximum allowed by the off-the-shelf control ICs available. The board is designed to be a 'demonstration' board, and is not yet optimized as a production design. With this design, a power density of 2.18 W/cc or 35.75 W/in³ is achieved, which is around 2x typical and 40% more than the best-on-class Si-based design today. Customer designs are expected to achieve even higher power density.

The PFC section is a standard ON Semi NCP1615 CrCM/DCM powering 2x NV6115 (parallel) GaNFast Power ICs directly. Critical mode PFC (also known as boundary mode) is a soft-switching topology which allows higher frequency operation.

The DC-DC section uses the NCP13992 current-mode resonant controller (LLC) driving NV6115s. The NV6115s have monolithically-integrated gate drivers, so the NCP13992's drivers are not used and loss is minimized.

For secondary-side synchronous rectification, two NCP43080 controllers are used to drive silicon 60 V FETs.

As shown in the 'scope images – the waveforms are extremely clean, with no overshoot / oscillation. This 'controlled' switching performance is also a key factor in good EMI performance. If required, dV/dt may be programmed using a simple resistor (see NV6115 datasheet) to adjust EMI signature for compliance testing.

Notes:

DO NOT TEST EXTREME INPUT VOLTAGE. The demo is not designed for safety, surge, lightning, etc.

BOARD REQUIRES THERMAL MANAGEMENT. Use fan or heat spreading with copper wrapper.

Datasheets:

NCP1615: http://www.onsemi.com/pub_link/Collateral/NCP1615-D.PDF

NCP1399: http://www.onsemi.com/pub_link/Collateral/NCP1399-D.PDF

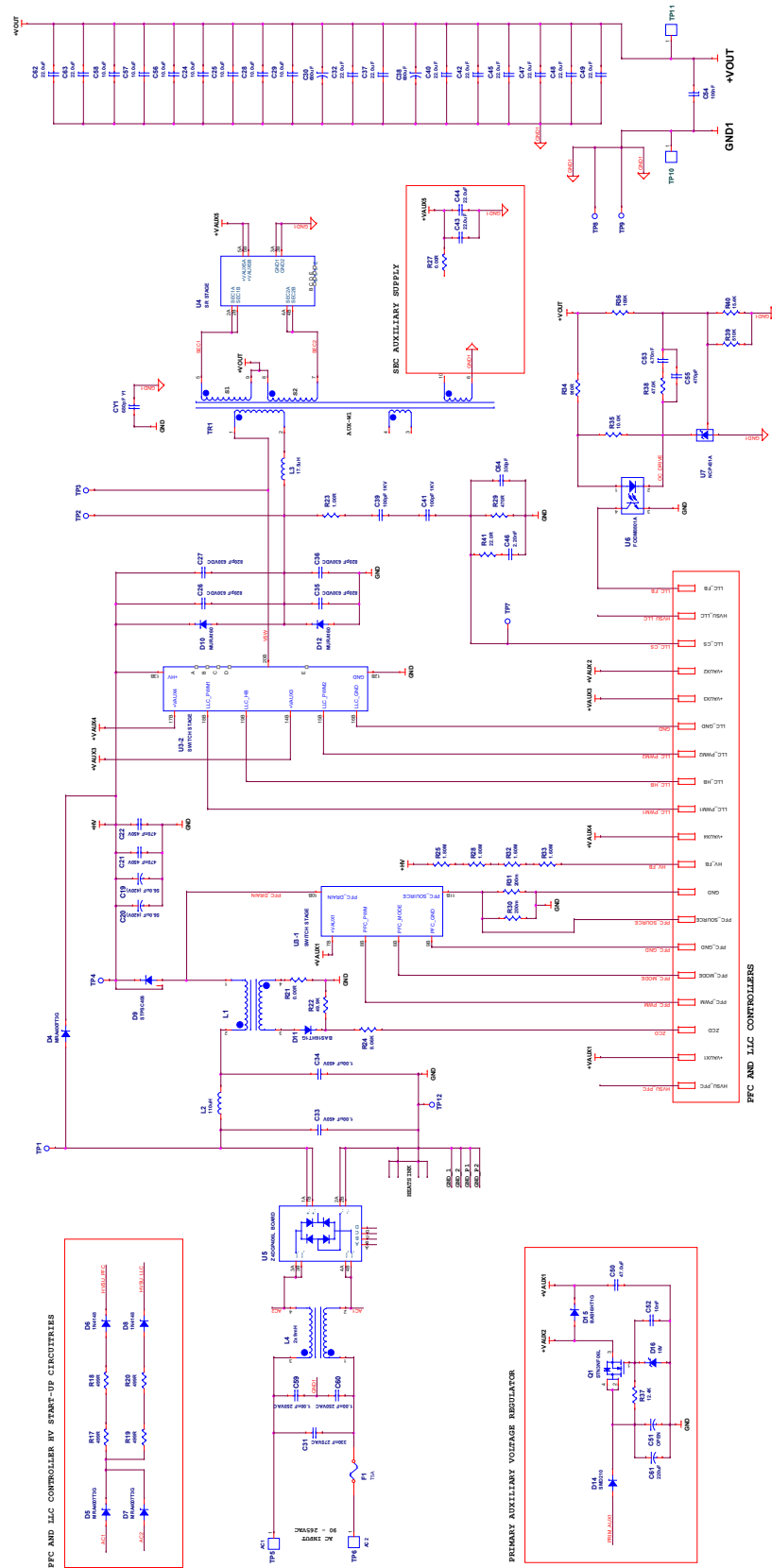
NCP43080: http://www.onsemi.com/pub_link/Collateral/NCP43080-D.PDF

NV6115 (via Digi-Key):

[https://media.digikey.com/pdf/Data%20Sheets/Navitas%20Semi%20PDFs/NV6115%20Datasheet%20\(FINAL\)%205-15-18.pdf](https://media.digikey.com/pdf/Data%20Sheets/Navitas%20Semi%20PDFs/NV6115%20Datasheet%20(FINAL)%205-15-18.pdf)

3. Schematics and Board Layers:

Fig. 1a: Overall Schematic



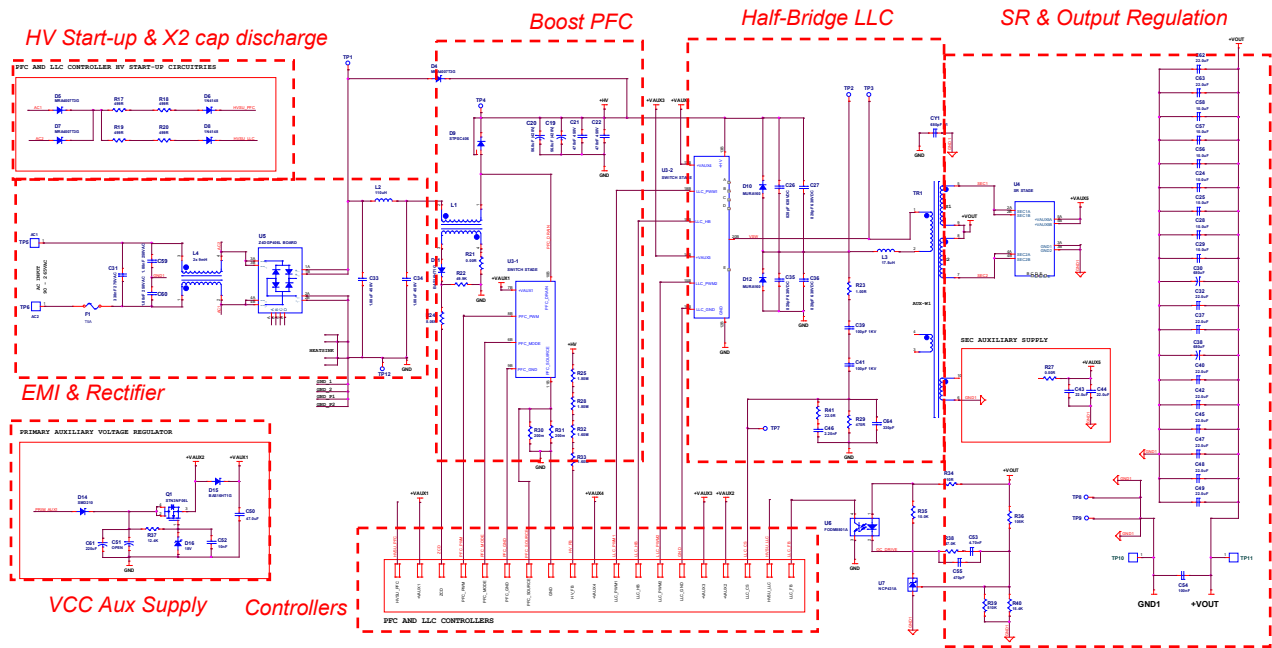


Fig. 1b: Schematic with functional blocks

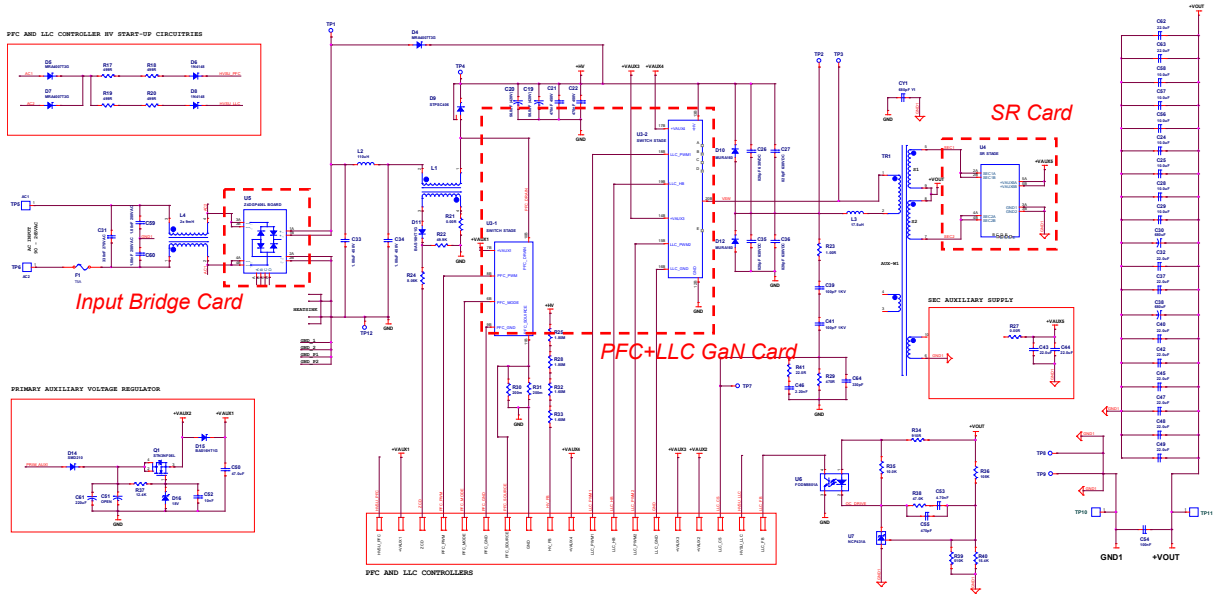


Fig. 1c: Schematic with daughtercard content

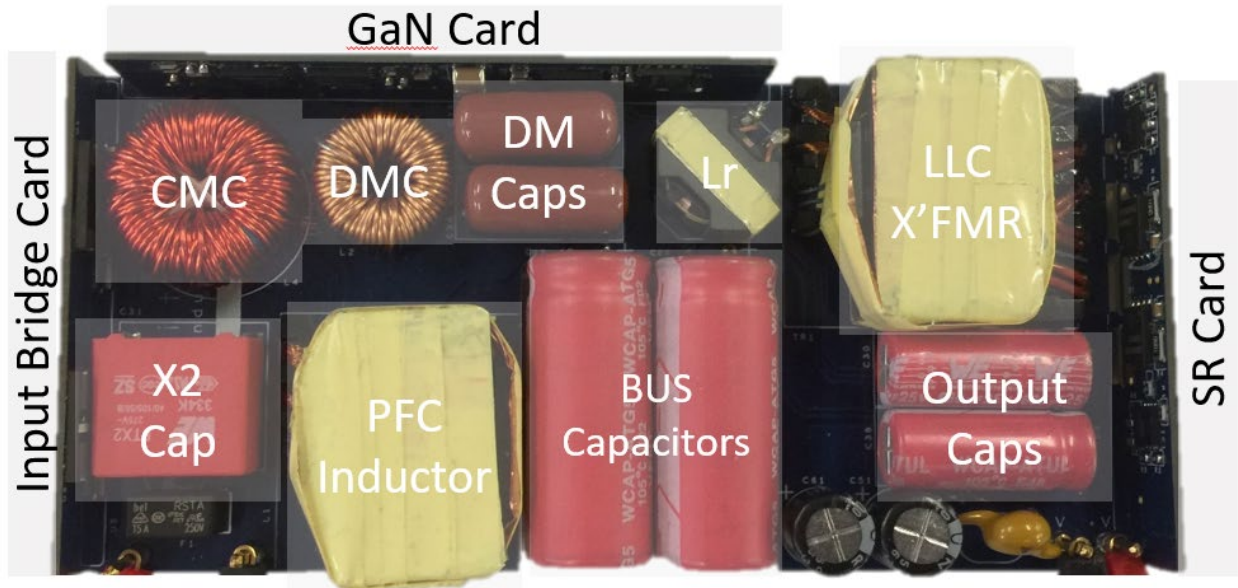


Fig. 2a: Power board top-side components (see BOM, section 12, for most recent part numbers)

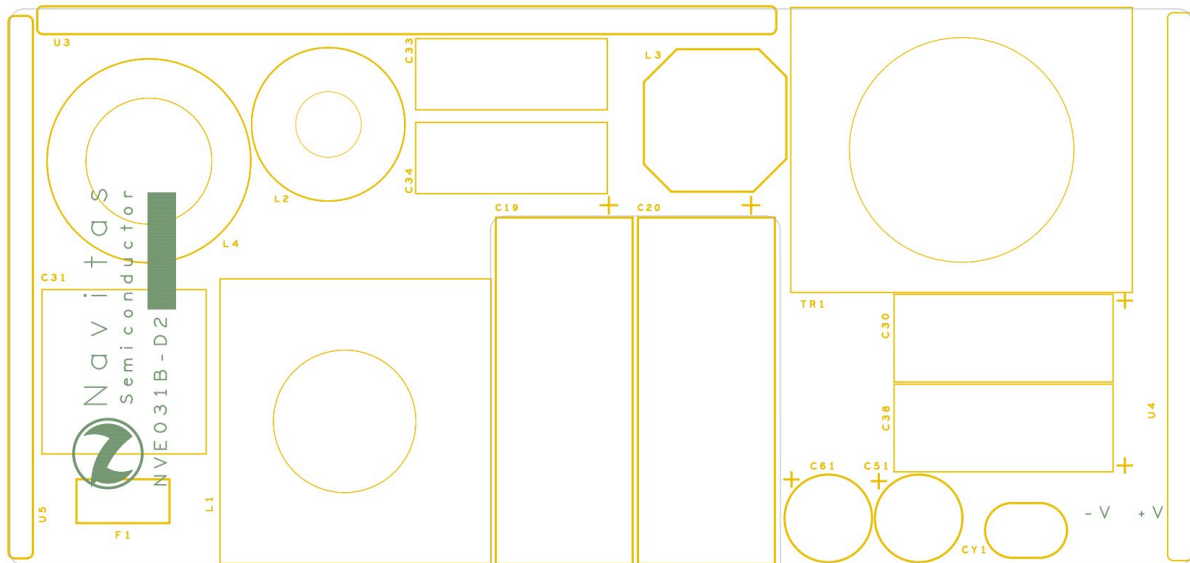


Fig. 2b: Power board NV031B-D2 top-side silkscreen

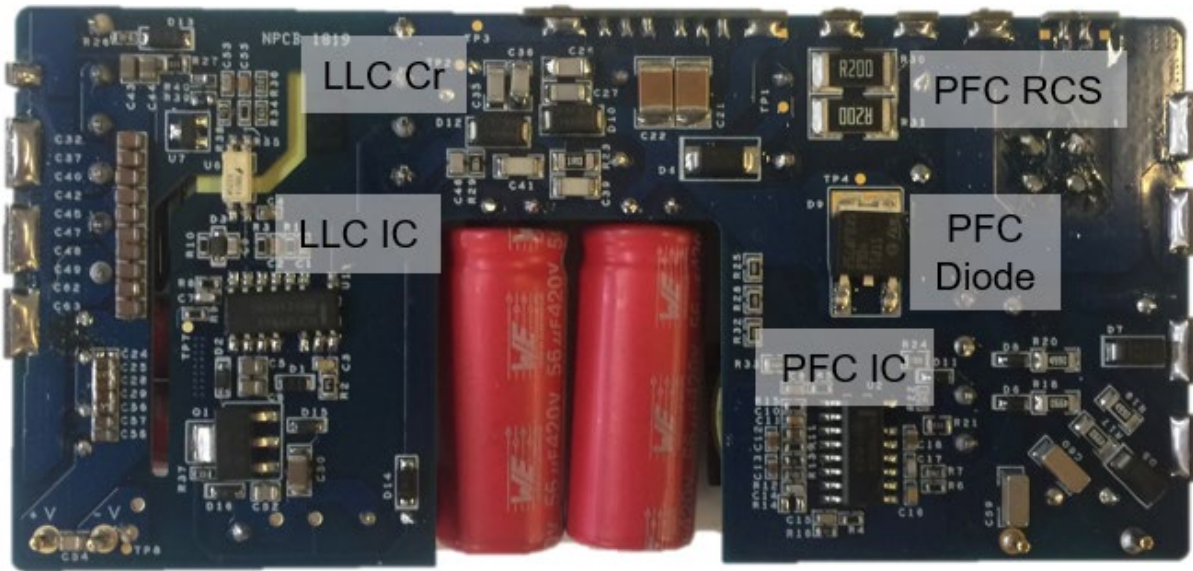


Fig. 2c: Power board bottom-side components

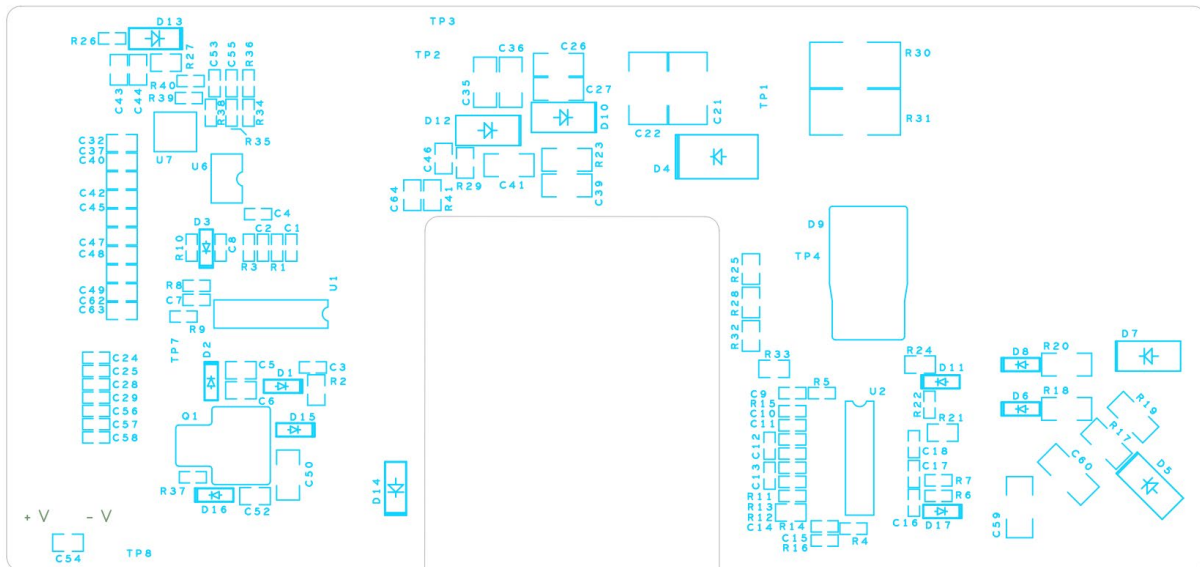
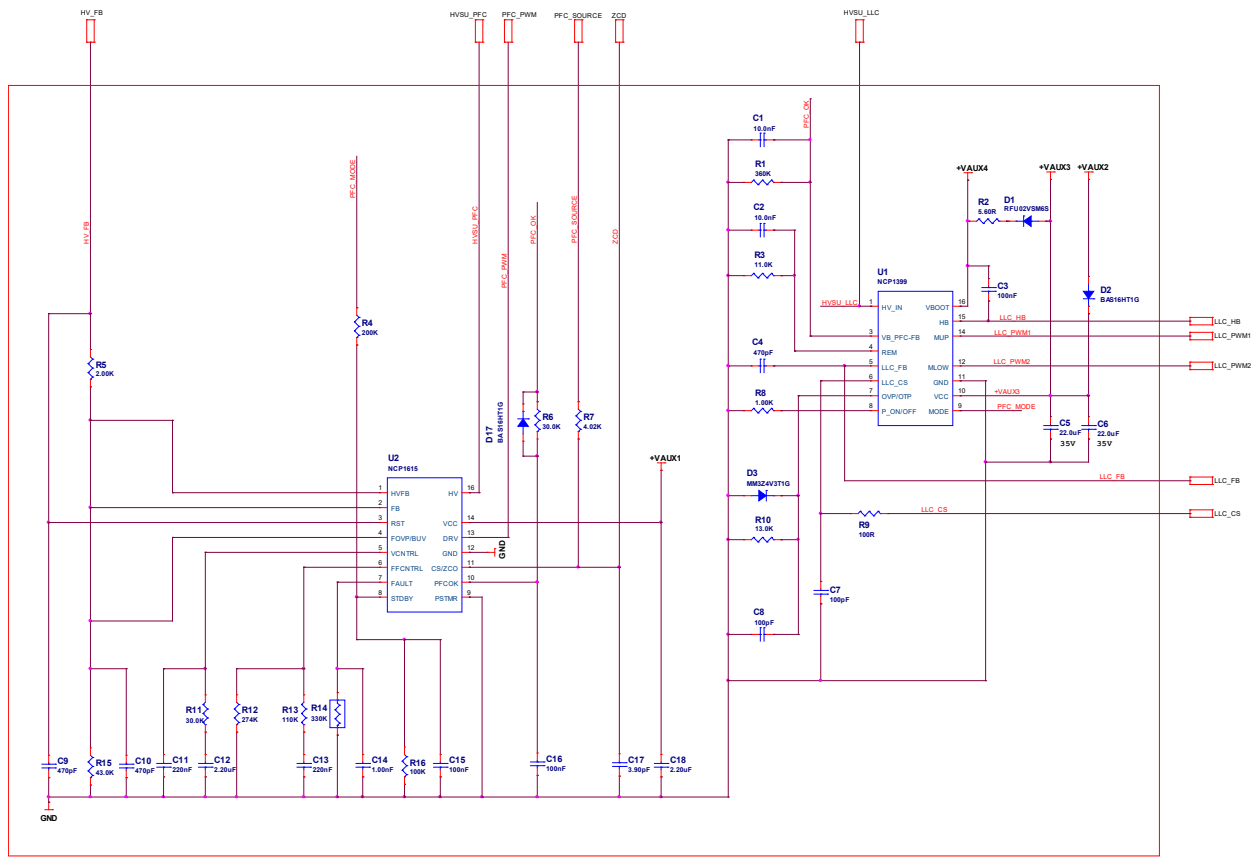


Fig. 2d: Power board NVE031B-D2 bottom-side silkscreen



PFC AND LLC CONTROLLERS

Fig. 3a: Controller schematic

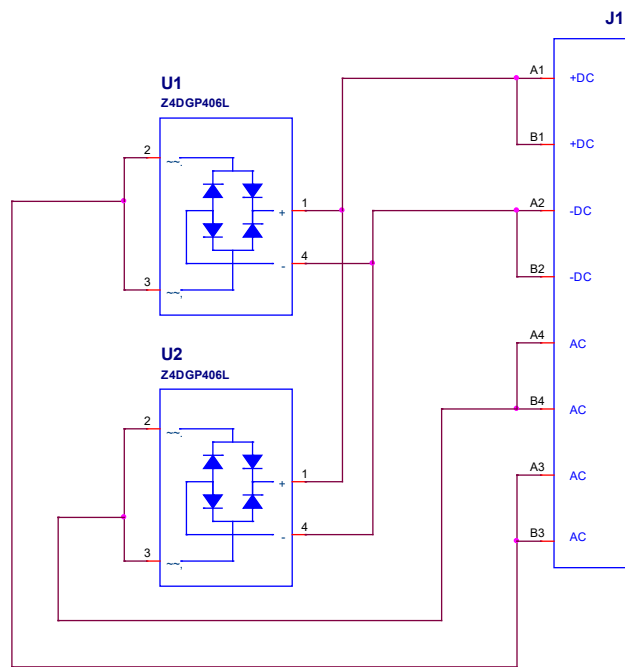


Fig. 3b: Input bridge daughtercard schematic

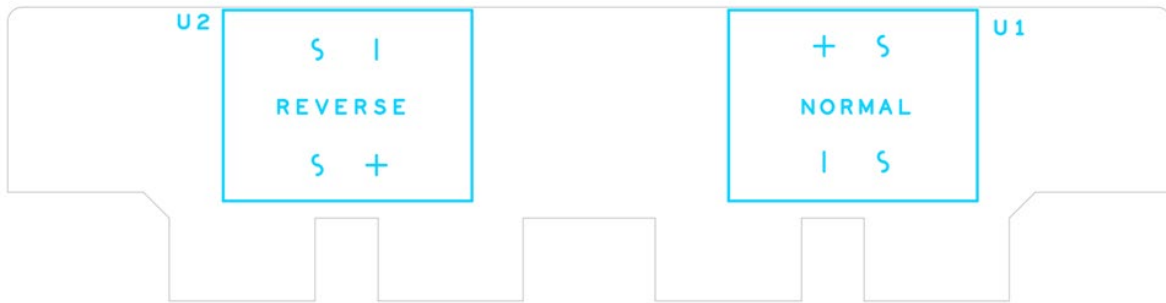


Fig. 3c: PFC, LLC control module daughtercard silkscreen

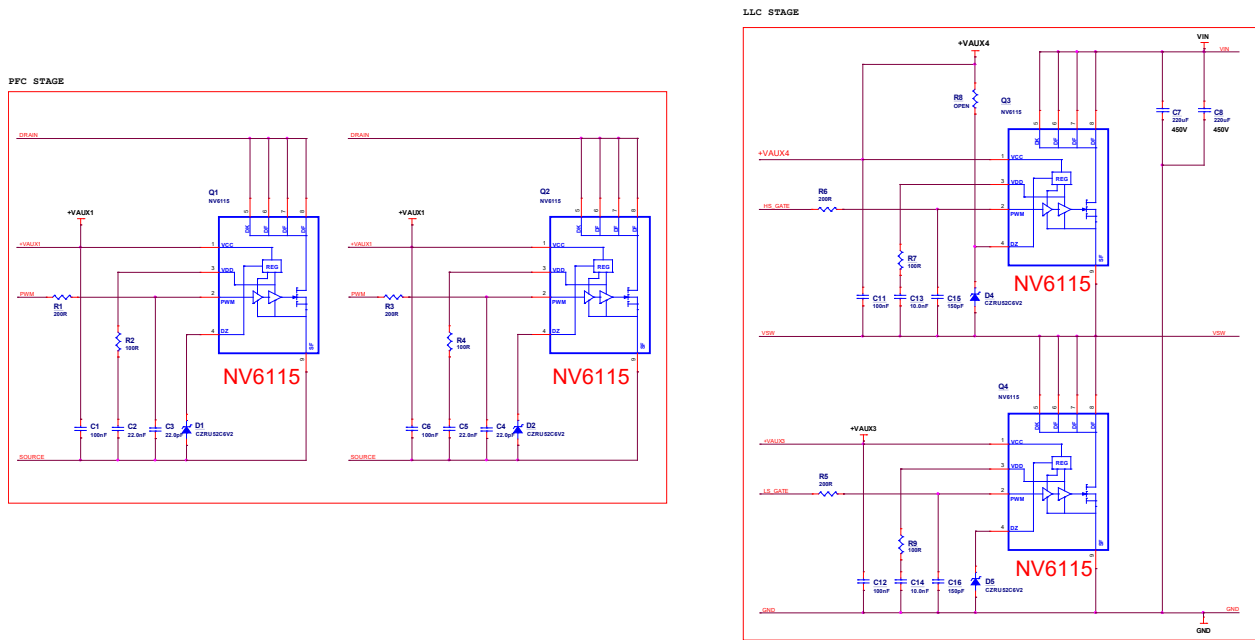


Fig. 4a: PFC, LLC powertrain daughtercard schematic

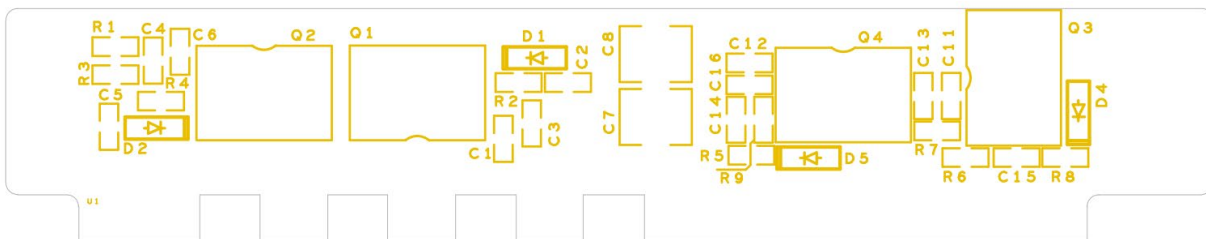


Fig. 4b: PFC, LLC powertrain daughtercard silkscreen

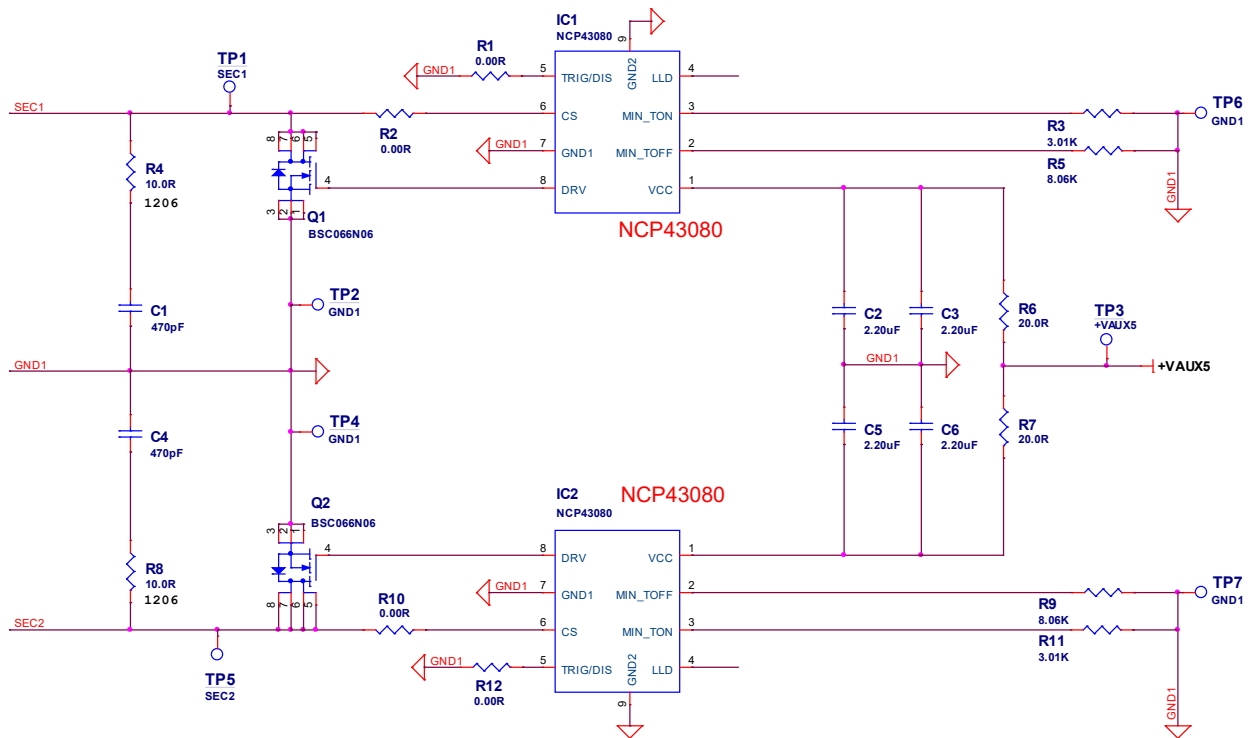


Fig. 5a: Secondary rectifier daughtercard schematic

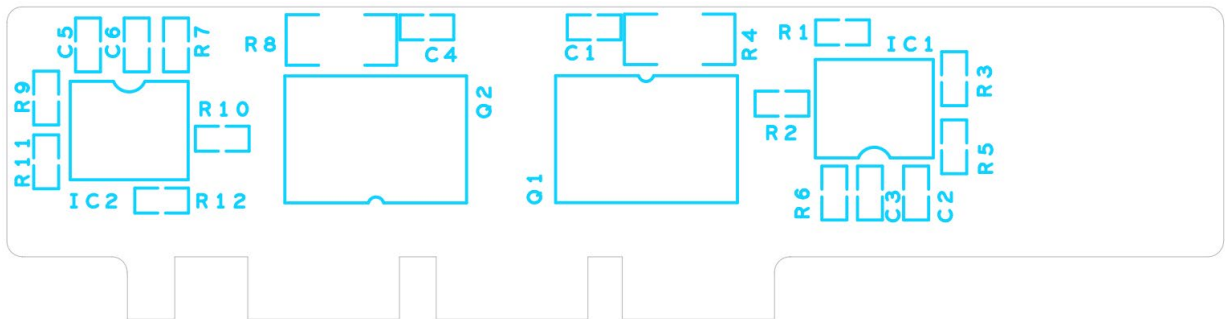


Fig. 5b: Secondary rectifier daughtercard silkscreen

4. PCB Construction:

This demoboard is constructed using 1 main board (4-layer) plus 3 daughtercards (4-layer). This assists evaluation and allows the user to exchange daughtercards for experimentation, plus allows for easy heat sinking and thermal management. PCB material is standard FR4 with 2 oz copper. Comprehensive PCB information and design files (gerber, .dxf, etc.) are available from info@navitassemi.com.

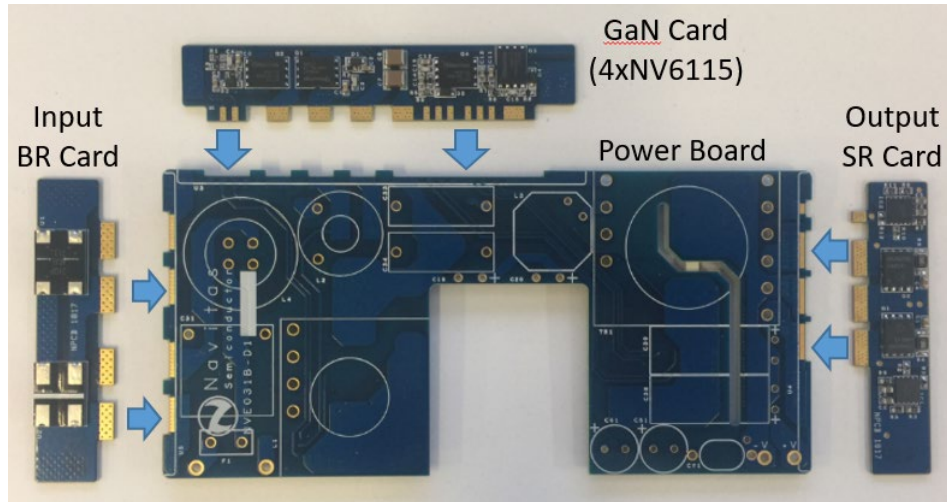


Fig. 6: Power board and daughtercard PCBs (generic construction shown, actual board design may vary)

5. Connections and Start-up Sequence:

DO NOT TEST EXTREME INPUT VOLTAGE. The demo is not designed for safety, surge, lightning, etc.

BOARD REQUIRES THERMAL MANAGEMENT. Use fan or heat spreading with copper plate.

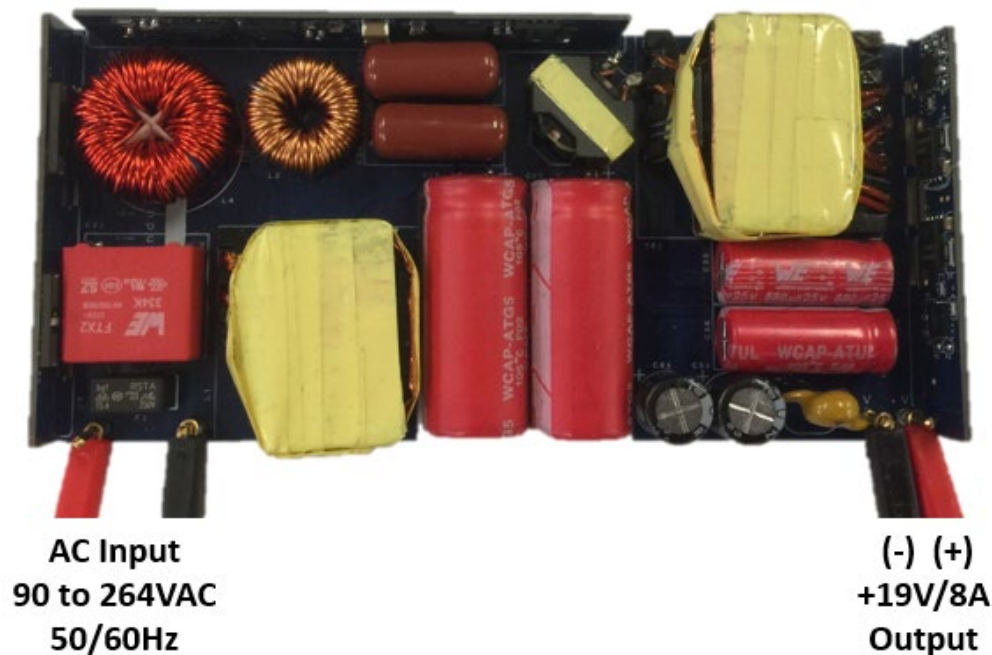


Fig. 7: AC input and DC output connections

Start-up:

DO NOT TEST EXTREME INPUT VOLTAGE. The demo is not designed for safety, surge, lightning, etc.

BOARD REQUIRES THERMAL MANAGEMENT. Use fan or heat spreading with copper plate.

1. Set AC line to 0 V_{AC}
2. Set AC line to OFF
3. Connect AC line input
4. Connect DC load at the output
5. Set AC line input to 120 V_{AC}
6. Turn AC line input to ON
7. Measure DC output voltage (19 V)
8. Increase output load current and monitor output voltage

Power-down sequence:

1. Turn off AC power supply
2. Turn off the load

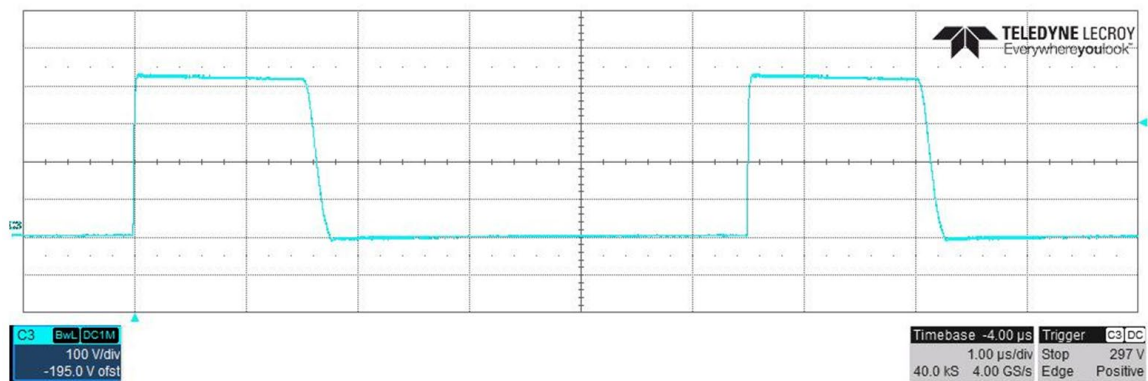
Switching Waveforms: CrCM PFC Boost Stage


Fig. 8a: CrCM PFC Boost 90 V_{IN}, 400 V_{OUT}, 150 W, 182 kHz (peak of AC line)

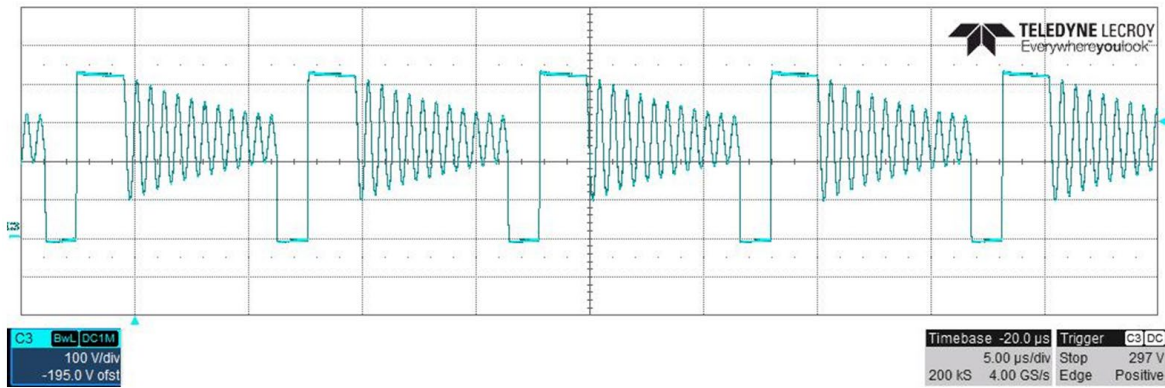


Fig 8b: PFC Boost at 220 V_{AC}, 150 W (peak of AC line, DCM mode)

Switching Waveforms: DC-DC (LLC) Stage

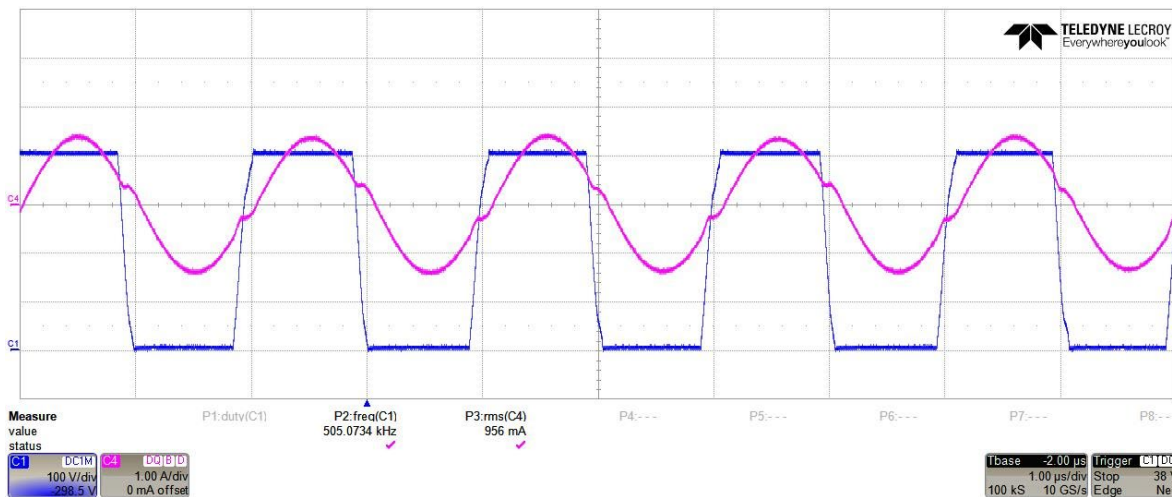


Fig. 9a: LLC V_{sw}, I_L, 19 V_{out}, 8 A

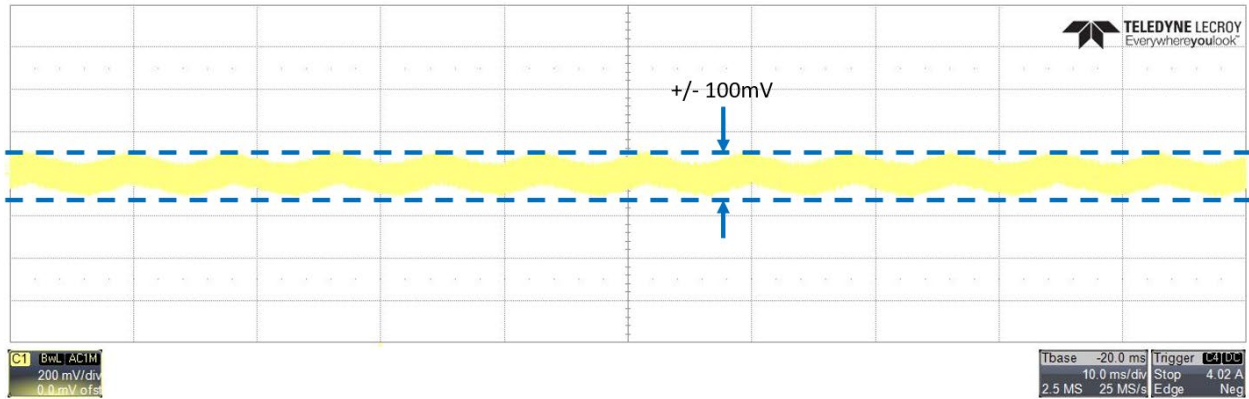


Fig. 9b: V_{out} ripple voltage, 8 A

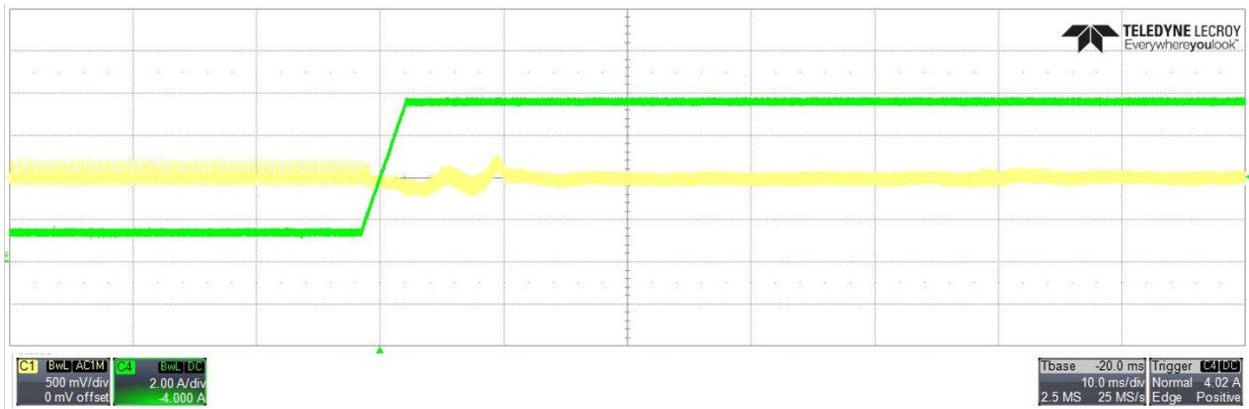


Fig. 9c: V_{out} (yellow) and I_{out} (green) during load step change, 1 A to 7 A

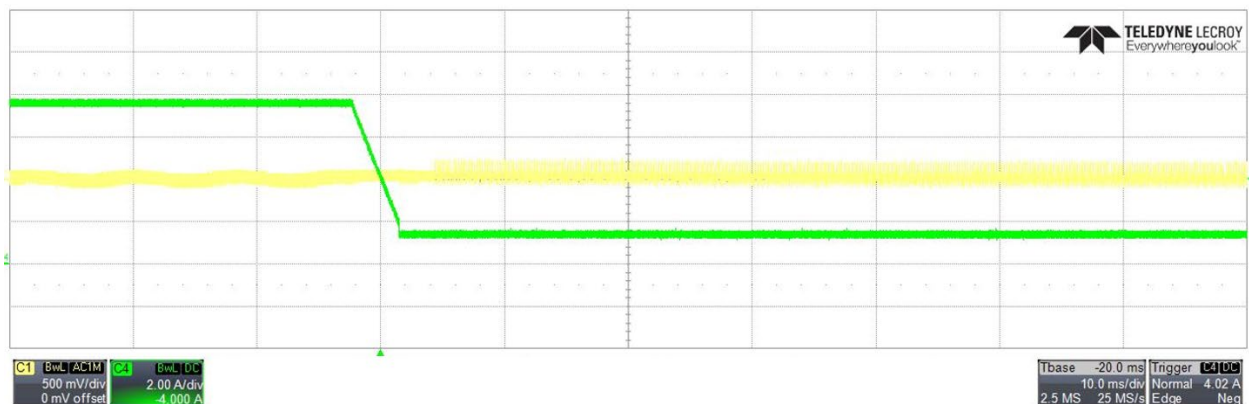


Fig. 9d: V_{out} (yellow) and I_{out} (green) during load step change, 7 A to 1 A

6. Efficiency:

a. Full load

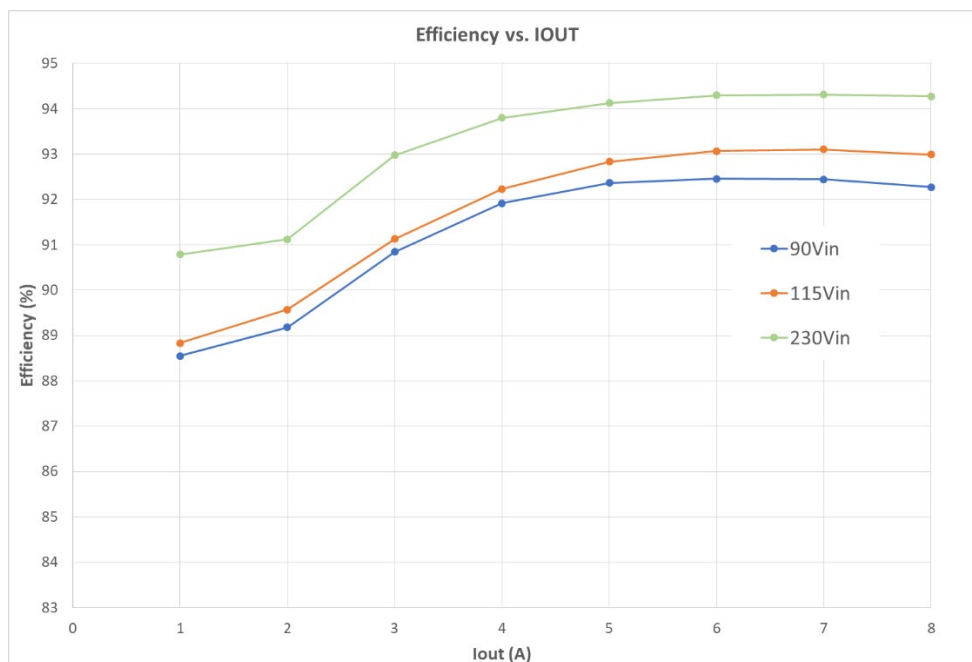


Fig. 10: Efficiency vs. load, AC line voltage (w/copper wrapper, room ambient)

b. Light load / Standby

Load Condition	Pout/Efficiency Vin = 230 VAC
No Load	185 mW
250 mW	50.9 %
500 mW	61.4 %

7. Power Factor:

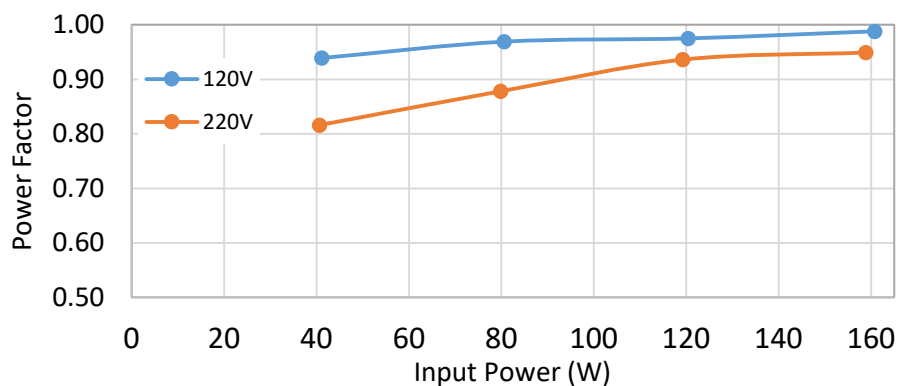


Fig. 11: Power factor vs. load

8. Thermal Performance:

Note: BOARD REQUIRES THERMAL MANAGEMENT. Use fan or heat spreading with copper wrapper.

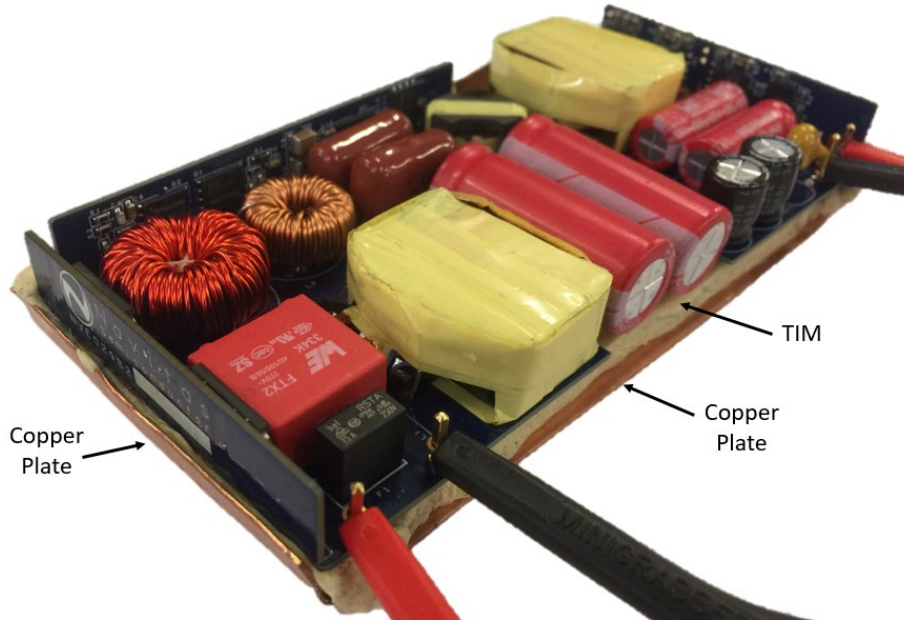


Fig. 12: Topside thermals, 90 V_{AC}, 100% Load (with TIM and copper plate, t_{AMB}=25°C).

9. EMI Measurements:

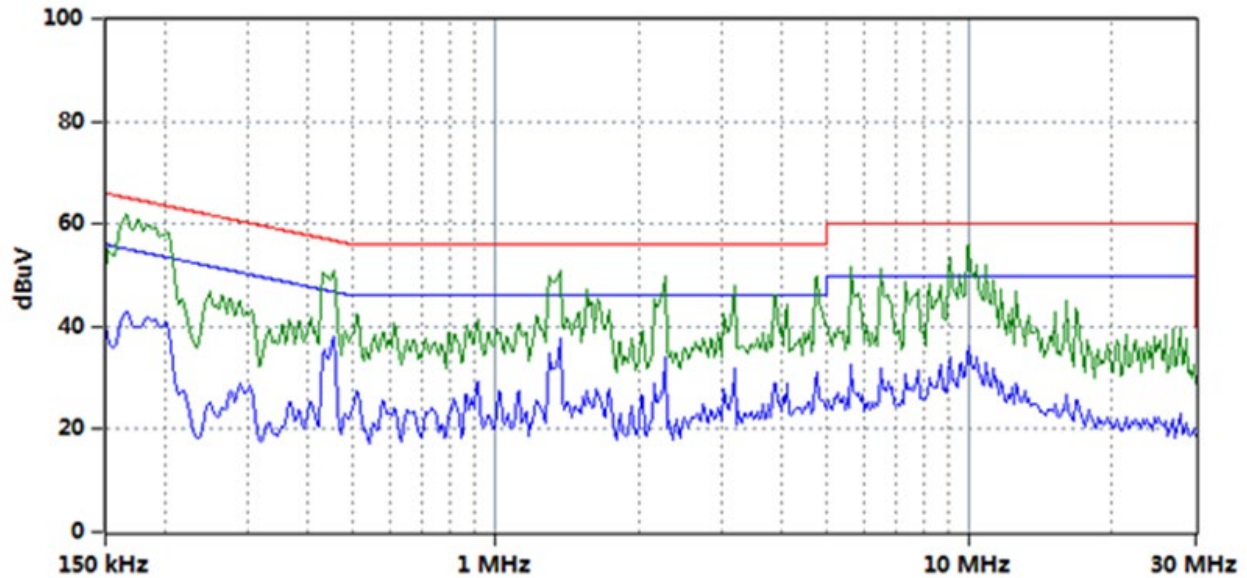


Fig. 11a: Conducted EMI (Quasi-Peak green/red and AVG blue/blue, $V_{in} = 230$ VAC, $P_{out} = 150$ W)

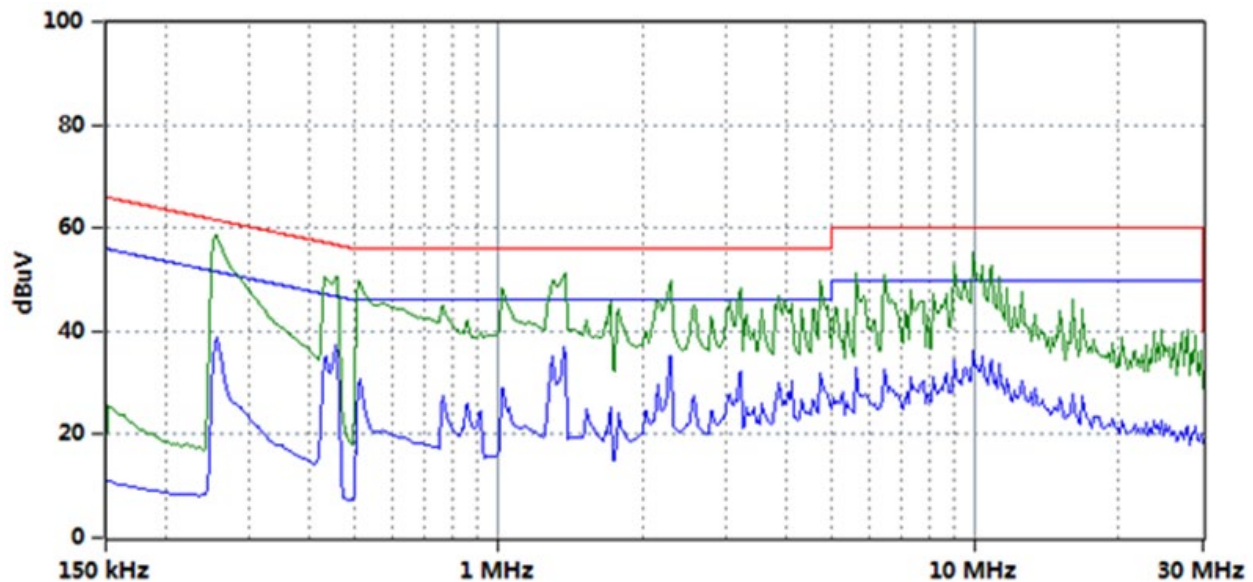


Fig. 11b: Conducted EMI (Quasi-peak green/red and AVG blue/blue, $V_{in} = 115$ VAC, $P_{out} = 150$ W)

10. Bill of Materials: Power Board (top side components)

(for BOM in .xls, please contact info@navitassemi.com)

FILENAME:	NVE031B-D2		COMPANY:	NAVITAS SEMICONDUCTOR				LAYER:	TOP
	150W PFC POWER BOARD			2101 EL SEGUNDO BLVD #201, EL SEGUNDO, CA 90245					
ITEM	QTY	REFERENCE	DESCRIPTION	VALUE	PKG	VOLTAGE	TOL.	MFGR. NAME	MFGR. PART #
1	2	C19, C20	CAP AL 56UF 20% 420V RAD	56.0uF	TH	420V	±20%	Würth	860021978001
2	2	C30, C38	CAP AL 680UF 20% 25V RAD	680uF	TH	25.0V	±20%	Würth	860020475016
3	1	C31	CAP FILM 0.33UF 10% 275VAC RAD	330nF	TH	275VAC	±10%	Würth	890324024003
4	2	C33, C34	CAP FILM 1UF 10% 450VDC RAD	1.00uF	TH	450V	±10%	Panasonic	ECW-FD2W105K
5	1	C61	CAP ALUM 220UF 20% 35V RAD	220uF	TH	35.0V	±20%	Würth	860020574012
6	1	CY1	CAP CER 680PF 760VAC Y5U RAD	680pF	TH	760VAC	±20%	Vishay	VY1681M29Y5UC63V0
7	1	F1	FUSE 5A 250/277V RADIAL	Fuse	TH	250V, 5.00A	-55°C ~ 125°C	Bel Fuse Inc.	RSTA 5 BULK
8	1	L1	PFC Inductor, 80uH, ER25	80.0uH	TH	-	-	Würth	750317297
9	1	L2	DM choke	110uH	TH	-	-	Würth	7447012
10	1	L3	Resonant Inductor, 17.5uH, RM5/ILP	17.5uH	TH	-	-	Navitas	LR01
11	1	L4	CM choke	2x 5mH	TH	-	-	Navitas	CMC01
12	4	TP10, TP11, TP5, TP6	CONN PC PIN CIRC 0.048DIA GOLD	Hardware	0.15 x 0.25"	-	-	Mill-Max Manufacturing	0600-0-05-15-00-00-01-0
13	1	TR1	LLC Transformer, 200uH, ER25	200uH	TH	-	-	Würth	750317229
14	1	U3	SWITCH BOARD	Board	TH	-	-	Navitas	NVE031B-B1
15	1	U4	SR BOARD	Board	TH	-	-	Navitas	NVE031B-A1
16	1	U5	DIODE BRIDGE BOARD	Board	TH	-	-	Navitas	NVE029B1
17	2	TP12, C51	OPEN COMPONENT	Open	-	-	-	-	-

Bill of Materials: Power Board (bottom side components)

FILE:	NVE031B-D2		COMPANY:	NAVITAS				LAYER:	BOTTOM
	150W PFC POWER BOARD		2101 EL SEGUNDO BLVD #201, EL SEGUNDO, CA 90245						
ITEM	QTY	REFERENCE	DESCRIPTION	VALUE	PKG	VOLT	TOL.	Manufacturer	MFGR. PART #
1	2	C1, C2	CAP CER 10000PF 50V 10% X7R 0603	10.0nF	0603	50.0V	±10%	AVX	06035C103KAT2A
2	4	C10, C4, C55, C9	CAP CER 470PF 25V 10% X7R 0603	470pF	0603	25.0V	±10%	Kemet	C0603C471K3RACTU
3	2	C11, C13	MLCC - SMD/SMT 0603 25volts 0.22uF X7R 10%	220nF	0603	25.0V	±10%	TDK	C1608X7R1E224K080AC
4	2	C12, C18	2.2uF ±20% 16V Ceramic Capacitor X7R 0603	2.20uF	0603	16.0V	±20%	Taiyo Yuden	EMK107BB7225MA-T
5	1	C14	CAP CER 1000PF 25V 1% NPO 0603	1.00nF	0603	25.0V	±1%	Kemet	C0603C102F3GACTU
6	3	C15, C16, C3	CAP CER 0.1UF 25V 10% X7R 0603	100nF	0603	25.0V	±10%	AVX	06033C104KAT4A
7	1	C17	CAP CER 3.9PF 50V NPO 0603	3.90pF	0603	50.0V	±10%	AVX	06035A3R9CAT2A
8	2	C21, C22	CAP CER 0.47UF 450V X7T 1812	470nF	1812	450V	±20%	Panasonic	C4532X7T2W474M230KE
9	7	C24, C25, C28, C29, C56, C57, C58	CAP CER 10UF 25V 20% X5R 0603	10.0uF	0603	25.0V	±20%	Murata	GRM188R61E106MA73D
10	4	C26, C27, C35, C36	CAP CER 820PF 630V COG 1206	820pF	1206	630V	±5%	TDK	CGA5F4C0G2J821J085AA
11	14	C32, C37, C40, C42, C43, C44, C45, C47, C48, C49, C5, C6, C62, C63	CAP CER 22UF 35V X5R 0805	22.0uF	0805	35.0V	±20%	TDK	C2012X5R1V226M125AC
12	2	C39, C41	CAP CER 100PF 1KV NPO 1206	100pF	1206	1000V	±5%	Yageo	CC1206JKNPOCBN101
13	1	C46	CAP CER 2200PF 50V COG 0805	2.20nF	0805	50.0V	±5%	TDK	CGA4C2C0G1H222J060AA
14	1	C50	47uF 25V Ceramic Capacitor	47.0uF	1206	25.0V	±20%	TDK	C3216JB1E476M160AC
15	1	C52	CAP CER 10000PF 50V COG 0805	10.0nF	0805	50.0V	±5%	TDK	C2012C0G1H103J060AA
16	1	C53	CAP CER 4700PF 50V COG/NPO 0603	4.70nF	0603	50.0V	±5%	TDK	C1608C0G1E472J080AA
17	1	C54	CAP CER 0.1UF 50V X7R 0805	100nF	0805	50.0V	±5%	AVX	08055C104JAT2A
18	2	C59, C60	CAP CER 1000PF 250VAC X7R 1808	1.00nF	1808	250VAC	±10%	Johanson Dielectrics	502R29W102KV3E-****-SC
19	1	C64	CAP CER 330PF 50V COG/NPO 0805	330pF	0805	50.0V	±5%	Murata	GRM2165C1H331JA01D
20	2	C7, C8	MLCC - SMD/SMT 0603 100pF 50volts COG 5%	100pF	0603	50.0V	±5%	TDK	C1608C0G1H101J080AA
21	1	D1	DIODE GP 600V 200MA TUMD2SM	RFU02VSM6S	SOD323	600V, 200mA	-55°C ~150°C	Rohm	RFU02VSM6STR
22	2	D10, D12	DIODE GEN PURP 600V 2A SMA	MURA160	DO214	600V, 2.00A	-65°C ~175°C	ON Semi	MURA160T3G
23	3	D11, D15, D2	DIODE GEN PURP 100V 200MA SOD323	BAS16	SOD323	100V, 150mW	-55°C ~150°C	ON Semi	BAS16HT1G
24	2	D13, D14	DIODE SCHOTTKY 100V 2A SOD123FL	SMD210	SOD123	100V, 2.00A	-65°C ~150°C	Micro Commercial	SMD210PL-TP
25	1	D16	DIODE ZENER 18V 300MW SOD323	MM3Z18	SOD323	18.0V, 300mW	-65°C ~150°C	ON Semi	MM3Z18VT1G
26	1	D3	DIODE ZENER 4.3V 300MW SOD323	MM3Z4V3	SOD323	4.30V, 300mW	-65°C ~150°C	ON Semi	MM3Z4V3T1G
27	3	D4, D5, D7	DIODE GEN PURP 1KV 1A SMA	MRA4007	DO214	1000V, 1.00A	-65°C ~175°C	ON Semi	MRA4007T3G
28	2	D6, D8	DIODE GEN PURP 250V 200MA SOD323	BAS21	SOD323	250V, 200mA	-55°C ~150°C	ON Semi	BAS21AHT1G
29	1	D9	DIODE SCHOTTKY 600V 4A DPAK	STPSC406	DPAK	600V, 4.00A	-40°C ~175°C	ST Micro	STPSC406B-TR
30	1	Q1	MOSFET N-CH 60V 4A SOT223	STN3NF06	SOT223	60.0V, 100mW	-55°C ~150°C	ST Micro	STN3NF06L
31	1	R1	RES SMD 360K OHM 1% 1/10W 0603	360K	0603	100mW	±1%	Panasonic	ERJ-3EKF3603V
32	1	R10	RES SMD 13K OHM 1% 1/10W 0603	13.0K	0603	100mW	±1%	Panasonic	ERJ-3EKF1302V
33	2	R11, R6	RES SMD 30.1K OHM 1% 1/10W 0603	30.1K	0603	100mW	±1%	Panasonic	ERJ-3EKF3012V

34	1	R12	RES SMD 274K OHM 1% 1/10W 0603	274K	0603	100mW	±1%	Yageo	RC0603FR-07274KL
35	1	R13	RES SMD 110K OHM 1% 1/10W 0603	110K	0603	100mW	±1%	Vishay	CRCW0603110KFKEA
36	1	R14	NTC THERMISTOR 330K OHM 5% 0805	330K	0805	210mW	±5%	Vishay	NTCS0805E3334JHT
37	1	R15	RES SMD 43K OHM 1% 1/10W 0603	43.0K	0603	100mW	±1%	Panasonic	ERJ-3EKF4302V
38	1	R16	RES SMD 100K OHM 1% 1/10W 0603	100K	0603	100mW	±1%	Vishay	CRCW0603100KFKEA
39	4	R17, R18, R19, R20	RES SMD 499 OHM 1% 1/4W 1206	499R	1206	250mW	±1%	Panasonic	ERJ-8ENF4990V
40	1	R2	RES SMD 5.6 OHM 1% 1/8W 0805	5.60R	0805	125mW	±1%	Panasonic	ERJ-6RQF5R6V
41	2	R21, R27	RES SMD 0.0 OHM JUMPER 1/8W 0805	0.00R	0805	125mW	±1%	Vishay	CRCW08050000Z0EA
42	1	R22	RES SMD 49.9K OHM 1% 1/10W 0603	49.9K	0603	100mW	±1%	Vishay	CRCW060349K9FKEA
43	1	R23	RES SMD 1 OHM 1% 1/4W 1206	1.00R	1206	250mW	±1%	Panasonic	ERJ-8RQF1R0V
44	1	R24	RES SMD 8.06K OHM 1% 1/8W 0805	8.06K	0805	125mW	±1%	Yageo	RC0805FR-078K06L
45	2	R25, R28	RES SMD 1.8M OHM 1% 1/8W 0805	1.80M	0805	125mW	±1%	Panasonic	ERJ-6ENF1804V
46	1	R26	RES SMD 51 OHM 1% 1/10W 0603	51R	0603	100mW	±1%	Yageo	RC0603JR-0751RL
47	1	R29	RES SMD 470 OHM 1% 1/8W 0805	470R	0805	125mW	±1%	Stackpole	RMCF0805FT470R
48	1	R3	RES SMD 11K OHM 1% 1/10W 0603	11.0K	0603	100mW	±1%	Panasonic	ERJ-3EKF1102V
49	2	R30, R31	RES SMD 0.2 OHM 1% 2W 2512	0.20R	2512	2.00W	±1%	Stackpole	CSRN2512FKR200
50	2	R32, R33	RES SMD 1.6M OHM 1% 1/8W 0805	1.60M	0805	125mW	±1%	Panasonic	ERJ-6ENF1604V
51	1	R34	RES SMD 909 OHM 1% 1/10W 0603	909R	0603	100mW	±1%	Yageo	RC0603FR-07909RL
52	1	R35	RES SMD 10K OHM 1% 1/10W 0603	10.0K	0603	100mW	±1%	Panasonic	ERJ-3EKF1002V
53	1	R36	RES SMD 105K OHM 1% 1/10W 0603	105K	0603	100mW	±1%	Yageo	RC0603FR-07105KL
54	1	R37	RES SMD 12.4K OHM 1% 1/10W 0603	12.4K	0603	100mW	±1%	Yageo	RC0603FR-0712K4L
55	1	R38	RES SMD 47K OHM 1% 1/10W 0603	47.0K	0603	100mW	±1%	Yageo	RC0603FR-0747KL
56	1	R39	RES SMD 511K OHM 1% 1/10W 0603	511K	0603	100mW	±1%	Yageo	RC0603FR-07511KL
57	1	R4	RES SMD 200K OHM 1% 1/10W 0603	200K	0603	100mW	±1%	Panasonic	ERJ-3EKF2003V
58	1	R40	RES SMD 15.4K OHM 1% 1/10W 0603	15.4K	0603	100mW	±1%	Vishay	CRCW060315K4FKEA
59	1	R41	RES SMD 22 OHM 1% 1/8W 0805	22.0R	0805	125mW	±1%	Yageo	RC0805FR-0722RL
60	1	R5	RES SMD 2K OHM 1% 1/10W 0603	2.00K	0603	100mW	±1%	Panasonic	ERJ-3EKF2001V
61	1	R7	RES SMD 4.02K OHM 1% 1/10W 0603	4.02K	0603	100mW	±1%	Yageo	RC0603FR-074K02L
62	1	R8	RES 1K OHM 1/10W 1% 0603 SMD	1.00K	0603	100mW	±1%	Panasonic	ERJ-3EKF1001V
63	1	R9	Thick Film Resistors - SMD 0603 100ohms 1% Tol	100R	0603	100mW	±1%	Panasonic	ERJ-3EKF1000V
64	7	TP1, TP2, TP3, TP4, TP7, TP8, TP9	Open component	Open	-	-	-	-	-
65	1	U1	IC OFFLN CONV HALF-BRIDGE 16SOIC	NCP13992	SO16	60.0V, 750KHz	-55°C ~150°C	ON Semi	NCP1399AADR2G
66	1	U2	IC CTRLR PFC HV ACTIVE X2 16SOIC	NCP1615	SO16	28.0V, 26.0KHz	-40°C ~125°C	ON Semi	NCP1615CDR2G
67	1	U6	OPTOISO 3.75KV TRANS 4-MINI-FLAT	FODM8801	SO4	3.75KV	-40°C ~125°C	Fairchild	FODM8801AV
68	1	U7	IC VREF SHUNT ADJ SOT23-3	NCP431	SOT23-3	36.0V, 100mA	-40°C ~125°C	ON Semi	NCP431ACSNT1G

Bill of Materials: GaN Daughtercard

FILE:	NVE031B-B2		COMPANY:	NAVITAS				LAYER:	TOP & BOTTOM
	150W PFC+LLC SWITCH BD			2101 EL SEGUNDO BLVD #201, EL SEGUNDO, CA 90245					
ITEM	QTY	REFERENCE	DESCRIPTION	VALUE	PKG	VOLTAGE	TOL.	MFGR. NAME	MFGR. PART #
1	4	C1, C11, C12, C6	CAP CER 0.1UF 25V 10% X7R 0603	100nF	0603	25.0V	±10%	AVX	06033C104KAT4A
2	2	C13, C14	CAP CER 10000PF 50V 10% X7R 0603	10.0nF	0603	50.0V	±10%	AVX	06035C103KAT2A
3	2	C15, C16	CAP CER 150PF 50V NPO 0603	150pF	0603	50.0V	±5%	Yageo	CC0603JRNPO9BN151
4	2	C2, C5	0.022µF ±5% 50V Ceramic Capacitor X7R 0603	22.0nF	0603	50.0V	±5%	AVX	06035C223JAT2A
5	2	C3, C4	22pF ±5% 50V COG, NPO Ceramic Capacitor	22.0pF	0603	50.0V	±5%	Murata	GQM1885C1H220JB01D
6	2	C7, C8	0.22µF ±10% 450V Ceramic Capacitor X7T 1210	220nF	1210	450V	±10%	Panasonic	C3225X7T2W224K200AA
7	4	D1, D2, D4, D5	ZENER 6.2V 150MW SOD323F	MM3Z6V2B	SOD323F	6.20V, 150mW	-55°C ~125°C	ON Semiconductor	MM3Z6V2B
8	4	Q1, Q2, Q3, Q4	GaNFast Power IC (170mΩ)	NV6115	QFN-5x6mm	650V, 170mΩ	-40°C ~150°C	Navitas	NV6115
9	4	R1, R3, R5, R6	RES SMD 200 OHM 1% 1/10W 0603	200R	0603	100mW	±1%	Panasonic	ERJ-3EKF2000V
10	4	R2, R4, R7, R9	Thick Film Res- SMD 0603 100ohms 1%	100R	0603	100mW	±1%	Panasonic	ERJ-3EKF1000V
11	2	R8, U1	Open component	Open	-	-	-	-	-

Bill of Materials: Input Bridge Daughtercard

FILE:	NVE029B2		COMPANY:	NAVITAS				LAYER:	TOP & BOTTOM
	DIODE BRIDGE BOARD			2101 EL SEGUNDO BLVD #201, EL SEGUNDO, CA 90245					
ITEM	QTY	REFERENCE	DESCRIPTION	VALUE	PKG	VOLT	TOL.	MFGR. NAME	MFGR. PART #
1	1	J1	Open component	Open	-	-	-	-	-
2	2	U1, U2	Bridge Rectifier Single Phase 600V 4A	Z4DGP406	SMD4	600V, 4.00A	-55°C ~ 175°C	Comchip Technology	Z4DGP406L-HF

Bill of Materials: Synchronous Rectification Daughtercard

FILE:	NVE031B-A2		COMPANY:	NAVITAS				LAYER:	TOP & BOTTOM
	150W PFC SR BOARD			2101 EL SEGUNDO BLVD #201, EL SEGUNDO, CA 90245					
ITEM	QTY	REFERENCE	DESCRIPTION	VALUE	PKG	VOLT	TOL.	MFGR. NAME	MFGR. PART #
1	2	C1, C4	CAP CER 470PF 25V 10% X7R 0603	470pF	0603	25.0V	±10%	Kemet	C0603C471K3RACTU
2	4	C2, C3, C5, C6	2.2µF ±20% 16V Ceramic Capacitor X7R 0603	2.20uF	0603	16.0V	±20%	Taiyo Yuden	EMK107BB7225MA-T
3	2	IC1, IC2	IC SECONDARY SIDE CTRLR 8DFN	NCP43080	DFN-4x4mm	35.0V, 4.00A	-40°C ~ 125°C	ON Semi	NCP43080DMNTWG
4	2	Q1, Q2	MOSFET N-CH 60V 64A 8TDSO	BSC066N06	QFN-5x5mm	60.0V, 6.60mΩ	-55°C ~ 150°C	Infineon	BSC066N06NSATMA1
5	4	R1, R10, R12, R2	Thick Film Resistors - SMD 0603 Zero Ohms	0.00R	0603	100mW	±1%	Panasonic	ERJ-3GEY0R00V
6	2	R11, R3	RES SMD 3.01K OHM 1% 1/20W 0201	3.01K	0603	100mW	±1%	Yageo	RC0201FR-073K01L
7	2	R4, R8	RES SMD 10 OHM 1% 1/4W 1206	10.0R	1206	250mW	±1%	Yageo	RC1206FR-0710RL
8	2	R5, R9	RES SMD 8.06K OHM 1% 1/10W 0603	8.06K	0603	100mW	±1%	Vishay	CRCW06038K06FKEA
9	2	R6, R7	RES SMD 20 OHM 1% 1/10W 0603	20.0R	0603	100mW	±1%	Panasonic	ERJ-3EKF20R0V
10	8	TP1, TP2, TP3, TP4, TP5, TP6, TP7, U1	Open component	Open	-	-	-	-	-

11. Revision History:

Date	Status	Notes
5-2-18	Preliminary	NVE031 (green PCB)
7-25-18	Final	NVE031 Identified by blue PCB, updated magnetics bobbins. Updated LLC IC from NCP1399 to higher-frequency NCP13992.
2-5-2019	Final	NVE031E. Identified by wrapped magnetics and revision / serial number. Includes updated standby power, EMI performance.

Additional Information:

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Navitas Semiconductor Inc., 2101 E. El Segundo Blvd, Suite 201, El Segundo, California 90245, USA.

Contact info@navitassemi.com

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