

LT8312 Off-Line, 400V Boundary Mode PFC Controller

DESCRIPTION

Demonstration Circuit 2104A is an off-line boundary conduction mode power factor correction (PFC) boost converter featuring the [LT[®]8312](#). Boundary conduction mode offers inherent MOSFET valley switching to reduce the switching loss and the boost diode zero current switching to remove the diode reverse-recovery loss. The demo board provides a 400V/150W constant-voltage single output suitable for applications requiring a regulated 400V supply.

The DC2104A is optimized to operate over a wide AC input voltage range (90VAC to 265VAC, 47Hz to 63Hz) and provides a high power factor (>0.95), enabling the design to be used worldwide. It is also designed to comply with the IEC61000-3-2 Class-D harmonics standard and the EN55022 conducted EMI standard. Output voltage accuracy stays within $\pm 5\%$ over the whole input voltage and load range.

The DC2104A evaluation board uses a two-layer printed circuit board (PCB) designed for 150W (400V/0.375A) rated power. It can also be changed for other power level applications. Please refer to the Typical Applications section in the data sheet for more information.

The LT8312 is available in a low profile, thermally enhanced 16-lead MSOP package.

The LT8312 data sheet gives a complete description of the part, operation and application information. The data sheet must be read in conjunction with this demo manual.

[Design files for this circuit board are available.](#)

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PERFORMANCE SUMMARY Specifications are at $T_A = 25^\circ\text{C}$

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	Input Voltage Range	Line Frequency, 47Hz to 63Hz	90	115	265	VAC
V_{OUT}	Output Voltage		380	400	420	V
I_{OUT}	Maximum Output Current		0.375			A
EFE	Efficiency	$I_{OUT} = 0.375\text{A}$		96 97.5		%
PF	Power Factor	$I_{OUT} = 0.375\text{A}$		0.99 0.98		%

QUICK START PROCEDURE

IMPORTANT NOTE TO CUSTOMERS:

HIGH VOLTAGES ARE PRESENT ON THE DEMO CIRCUIT, AND CAN LEAD TO LETHAL INJURIES TO THE HUMAN BODY. ONLY QUALIFIED PERSONNEL SHOULD OPERATE IT. IT IS STRONGLY RECOMMENDED TO USE SAFETY GLASSES AND AN ISOLATION TRANSFORMER.

NOTE: Improper components replacement on the demo circuit can cause performance deterioration, circuit malfunction, property damage, and even life threatening injuries. Contact Analog Devices applications engineers for proper component replacement.

DC2104A is easy to set up to evaluate the performance of the LT8312. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

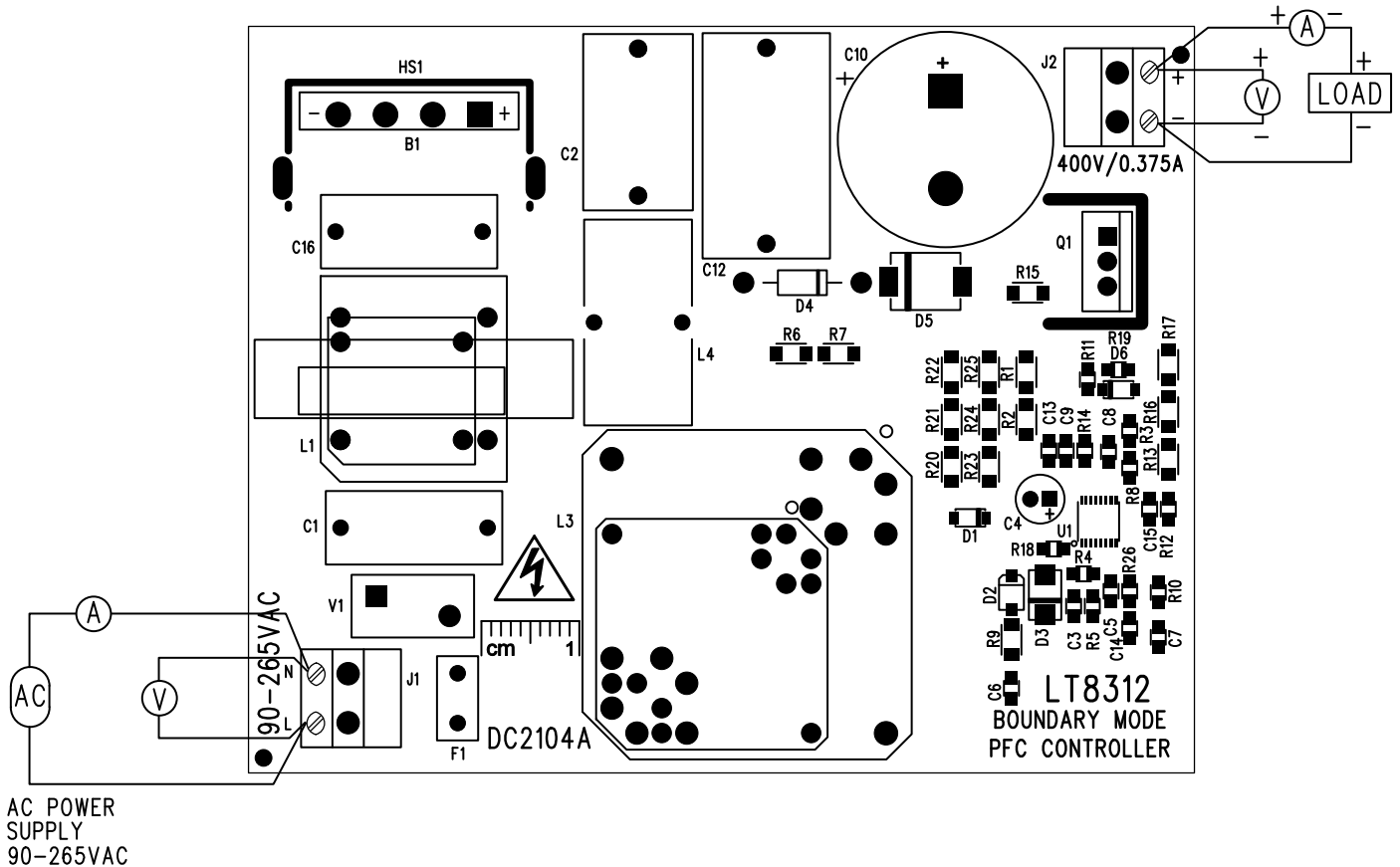
1. Connect an adjustable load between the + and – output terminals.
2. With power off, connect the input power supply to the Line (L) input and Neutral (N) input.
3. Turn on the power at the input.

NOTE: Make sure that the input voltage does not exceed the maximum input voltage (265VAC).

4. Check for the proper output voltage.

Once the proper output voltage is established, adjust the input voltage and/or the load and observe the output voltage regulation, efficiency, power factor and other parameters.

Figures 2 through 11 show typical performance measurements for the DC2104.



QUICK START PROCEDURE

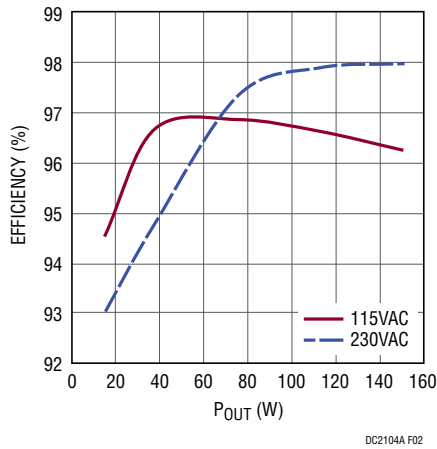


Figure 2. Efficiency vs Load

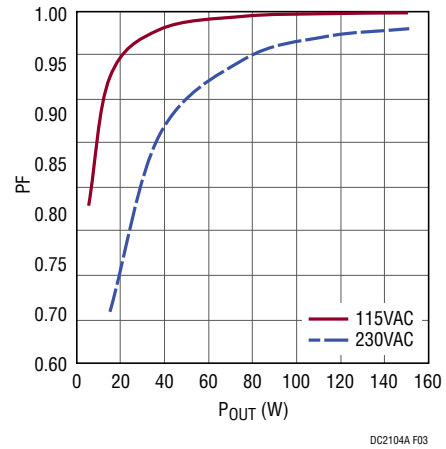


Figure 3. Power Factor vs Load

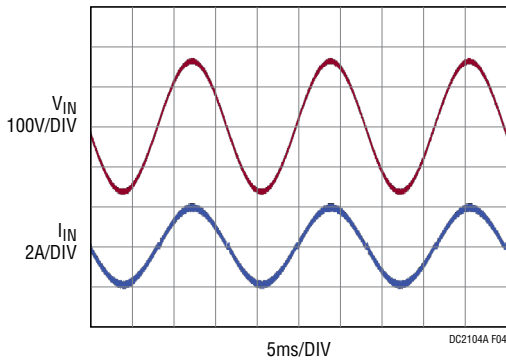


Figure 4. 115VAC Input Voltage and Current

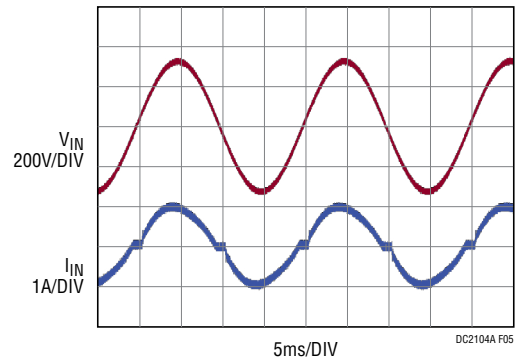


Figure 5. 230VAC Input Voltage and Current

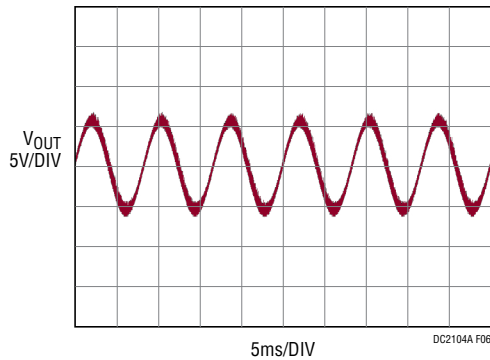


Figure 6. Output Ripple (AC-Coupled), $V_{IN} = 115VAC$

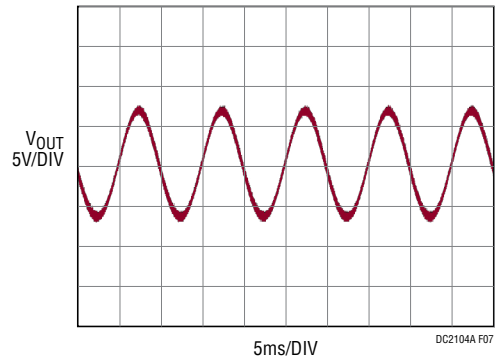


Figure 7. Output Ripple (AC-Coupled), $V_{IN} = 230VAC$

QUICK START PROCEDURE

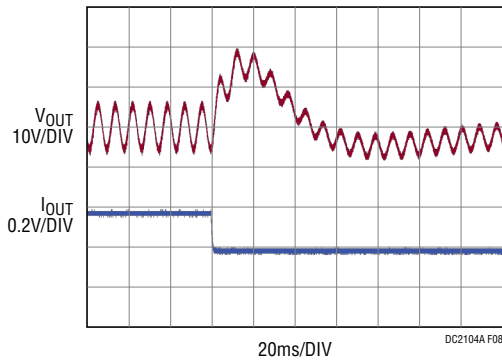


Figure 8. $V_{IN} = 115VAC$, Full Load to Half Load Transient

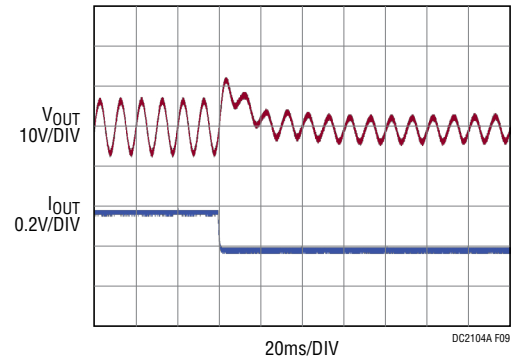


Figure 9. $V_{IN} = 230VAC$, Full Load to Half Load Transient

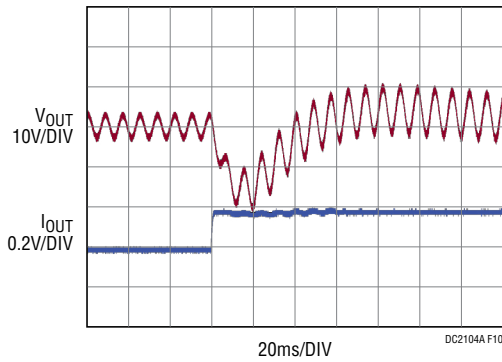


Figure 10. $V_{IN} = 115VAC$, Half Load to Full Load Transient

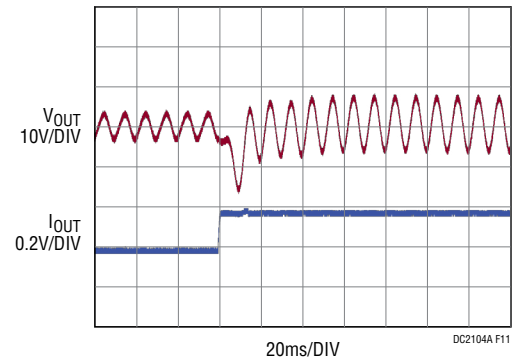


Figure 11. $V_{IN} = 230VAC$, Half Load to Full Load Transient

PARTS LIST

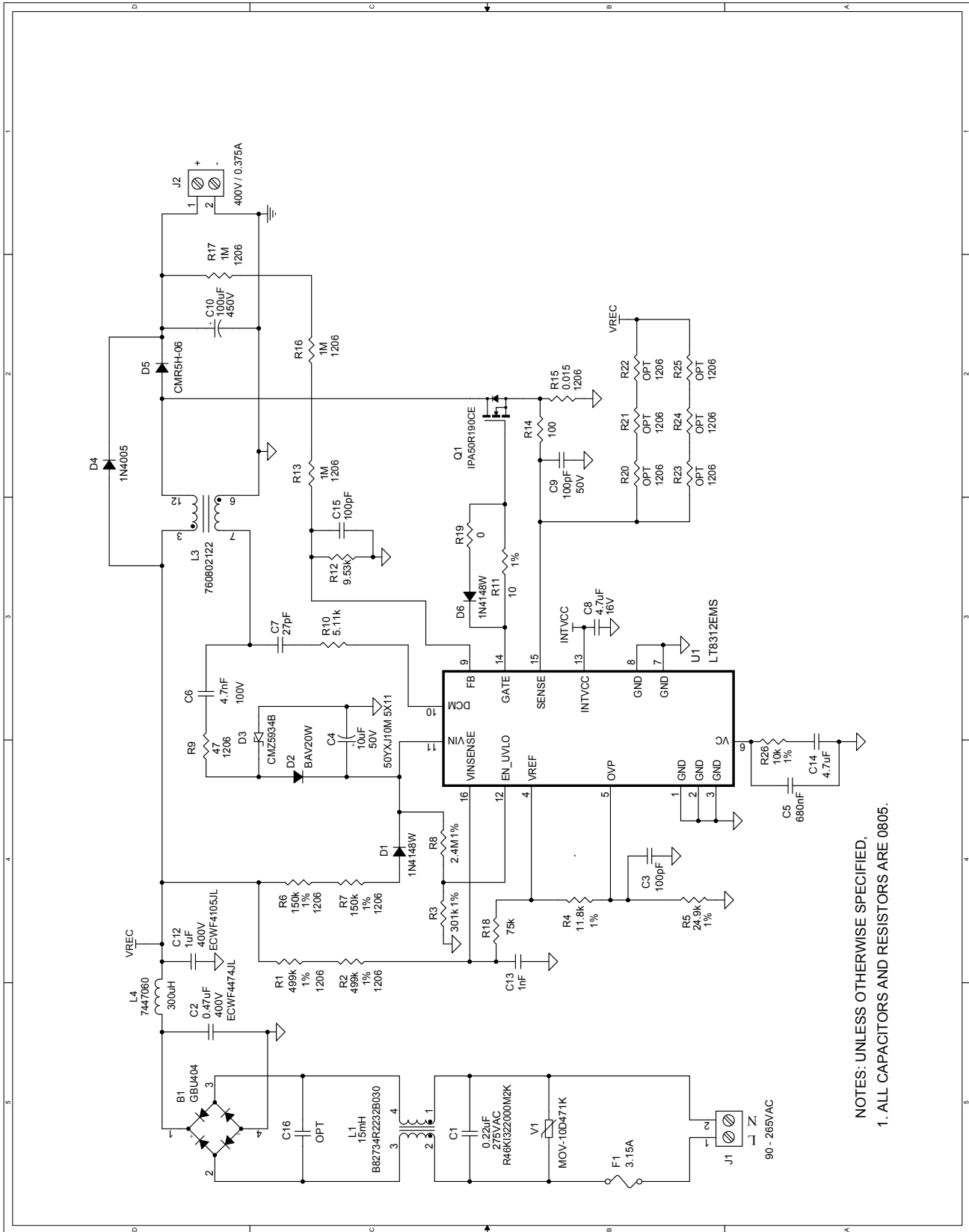
ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	B1	BRIDGE RECTIFIER	DIODES INC., GBU404
2	1	C1	CAP., FILM, 0.22 μ F, 275VAC, 10%	KEMET, R46KI322000M2K
3	1	C2	CAP., FILM, 0.47 μ F, 5%, 400V	PANASONIC, ECWF4474JL
4	1	C4	CAP, 10 μ F 20% 50V ALUM	RUBYCON, 50YXJ10M 5X11
5	1	C5	CAP., X7R, 680nF, 25V, 10%, 0805	AVX, 08053C684KAT2A
6	1	C6	Cap., COG, 4.7nF, 100V, 5% 0805	TDK, C2012COG2A472J125AA
7	1	C7	Cap., COG, 27pF, 50V, 5% 0805	AVX, 08055A270JAT2A
8	2	C8, C14	CAP., X5R, 4.7 μ F, 20%, 16V, 0805	AVX, 0805YD475MAT2A
9	1	C10	CAP., ALUM, 100 μ F, 450V, 20%	RUBYCON, 450VXH100MEFCSN22X25
10	1	C12	CAP., FILM, 1.0 μ F, 5%, 400V	PANASONIC, ECWF4105JL
11	1	C13	CAP., COG, 1nF, 10%, 25V 0805	AVX, 08053A102KAT2A
12	3	C3, C9, C15	CAP., COG, 100pF, 5%, 25V 0805	AVX, 08055A101JAT2A
13	1	D2	DIODE, 200V, SOD123	DIODES INC., BAV20W
14	1	D3	ZENER DIODE, 24V, SMA	CENTRAL SEMI., CMZ5934B
15	1	D4	DIODE, 1A, 600V, DO-41	DIODES INC., 1N4005
16	1	D5	DIODE, 5A, 600V, SMC	CENTRAL SEMI., CMR5H-06
17	2	D1, D6	DIODE, SWITCH 100V 400mW, SOD123	DIODES INC., 1N4148W-7-F
18	1	F1	FUSE, FAST ACTING, 3.15A	BUSSMAN, SS-5H-3.15A-APH
19	1	L1	CHOKE, 15mH	EPCOS, B82734R2232B030
20	1	L3	PFC CHOKE, 450 μ H	WÜRTH ELECTONIK, 760802122
21	1	L4	CHOKE, 300 μ H	WÜRTH ELECTONIK, 7447060
22	1	Q1	N-CH MOSFET, 500V, TO-220	INFINEON, IPA50R190CE
23	2	R1, R2	RES., CHIP., 499K, 1/4W, 1% 1206	VISHAY, CRCW1206499KFKEA
24	1	R3	RES., CHIP., 301K, 1/8W, 1%, 0805	VISHAY, CRCW0805301KFNEA
25	1	R4	RES., CHIP., 11.8K, 1/8W, 1%, 0805	VISHAY, CRCW080511K8FKEA
26	1	R5	RES., CHIP., 24.9K, 1/8W, 1%, 0805	VISHAY, CRCW080524K9FKEA
27	2	R6, R7	RES., CHIP., 150k, 1/4W, 1% 1206	VISHAY, CRCW1206150KFKEA
28	1	R8	RES., CHIP., 2.4M, 1/8W, 5%, 0805	VISHAY, CRCW08052M40JNEA
29	1	R9	RES., CHIP., 47, 1/4W, 5%, 1206	VISHAY, CRCW120647R0JNEA
30	1	R10	RES., CHIP., 5.11K, 1/8W, 1%, 0805	VISHAY, CRCW08055K11FKEA
31	1	R11	RES., CHIP., 10, 1/8W, 1% 0805	VISHAY, CRCW080510R0FNEA
32	1	R12	RES., CHIP., 9.53K, 1/8W, 1%, 0805	VISHAY, CRCW08059K53FKEA
33	3	R13, R16, R17	RES., CHIP., 1M, 1/4W, 1% 1206	VISHAY, CRCW12061M00FKEA
34	1	R14	RES., CHIP., 100, 1/8W, 1%, 0805	VISHAY, CRCW0805100RJNEA
35	1	R15	RES., CHIP., 0.015, 1W, 1% 1206	VISHAY, WSLP1206R0150FEA
36	1	R18	RES., CHIP., 75K, 1/8W, 1% 0805	VISHAY, CRCW080575K0FKEA
37	1	R19	RES., CHIP., 0, 1/8W, 0805	VISHAY, CRCW08050000Z0EA
38	1	R26	RES., CHIP., 10K, 1/8W, 1% 0805	VISHAY, CRCW080510K0FNEA
39	1	V1	VARISTOR, 300V RMS, 10mm RADIAL	BOURNS, MOV-10D471K
40	1	U1	I.C., PFC CONTROLLER MS-16	ANALOG DEVICES, LT8312EMS#PBF

DEMO MANUAL DC2104A

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Additional Demo Board Circuit Components				
1	0	C16 (OPT)	CAP., FILM, 0.22 μ F, 275VAC, 10%	
2	0	R20-R25 (OPT)	RES., CHIP., 1206	
Hardware: For Demo Board Only				
1	2	J1, J2	CONN., TERM BLOCK PCB 5.0mm 2POS	WEIDMULLER, 1715250000
2	1	HS1	HEAT SINK FOR B1	WAKEFIELD-VETTE, 287-1ABE

SCHEMATIC DIAGRAM



NOTES: UNLESS OTHERWISE SPECIFIED,
1. ALL CAPACITORS AND RESISTORS ARE 0805.



ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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