ZL8800-2PH-DEMO1Z

Demonstration Board

AN1901
Rev 0.00
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The ZL8800 is a digital power conversion and management IC that combines an efficient step-down DC/DC converter with key power and thermal management functions in a single package. The ZL8800 incorporates compensation-free ChargeMode control to achieve single-cycle transient response.

The ZL8800-2PH-DEMO1Z demonstration board is a 6-layer board demonstrating a 2 phase 60A synchronous buck converter. Sequencing, margining, plus other features can be evaluated using this demonstration board.

A USB to PMBus™ adapter board is used to connect the demonstration board to a PC. The PMBus command set is accessed by using the Zilker Labs PowerNavigator™ evaluation software from a PC running Microsoft Windows.

Key Features

- 2 phase 60A synchronous buck converter with compensation-free ChargeMode control
- Designed to be easy to use and modify. Optimized for small circuit footprint and dynamic response
- Configurable through PMBus
- V_{IN} range of 4.5V to 14V, V_{OUT} adjustable from 0.54 to 5.5V
- Enable switches and power-good indicators

Ordering Information

PART NUMBER	DESCRIPTION
ZL8800-2PH-DEMO1Z	ZL8800 Demonstration Kit (EVB, USB Adapter, Cable)

Target Specifications

- V_{IN} = 12V
- V_{OUT} = 1.2V/60A max
- f_{SW} = 400kHz
- Efficiency: 91% at 40A
- Output Ripple: ±1%
- Dynamic response: ±1% (50% to 100% to 50% load step, di/dt = 10A/µs)
- Board temperature: +25°C

Functional Description

The ZL8800-2PH-DEMO1Z provides all circuitry required to demonstrate the features of the ZL8800. The ZL8800-2PH-DEMO1Z has a functionally-optimized ZL8800 circuit layout that allows efficient operation up to the maximum output current.

A majority of the features of the ZL8800, such as compensation-free ChargeMode control, soft-start delay and ramp times, supply sequencing, voltage tracking, and voltage margining are available on this demonstration board. For voltage tracking and sequencing demonstration, the board can be connected to any other Zilker Labs demonstration board that supports the Digital-DC™ (DDC) bus.

Figure 1 shows a simplified schematic diagram of the ZL8800-2PH-DEMO1Z board.

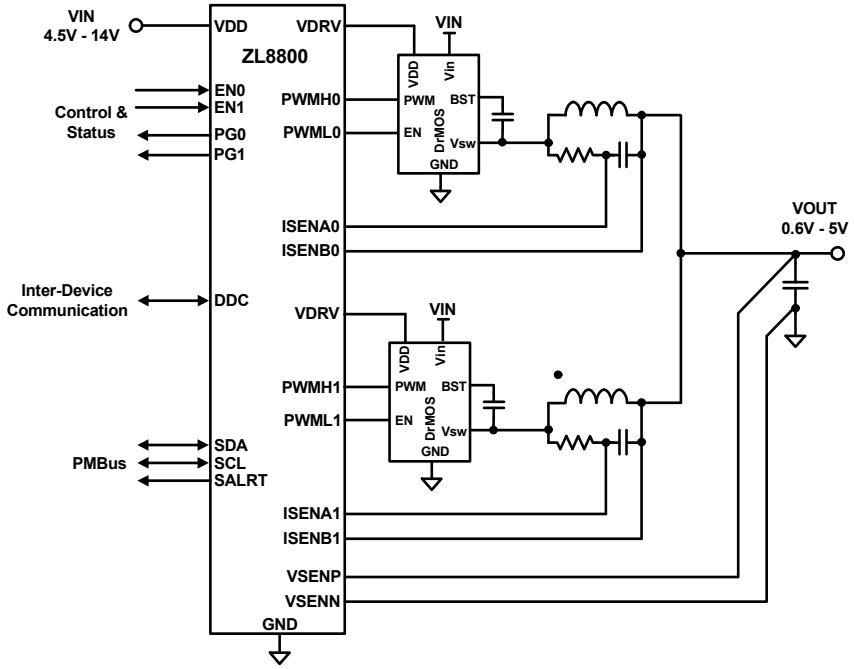

FIGURE 1. ZL8800-2PH-DEMO1Z SIMPLIFIED SCHEMATIC

The hardware enable function is controlled by a toggle switch on the ZL8800-2PH-DEMO1Z board. The power-good (PG) LEDs indicate the correct state of PG for each phase when external power is applied to the ZL8800-2PH-DEMO1Z board and the corresponding phase is functioning properly. The right angle headers at opposite ends of the board are for connecting a USB to PMBus adapter board or for daisy chaining multiple demonstration boards together to build multi-output configurations.

Figures 2 and 3 show the detailed demonstration circuit. Figure 2 shows the ZL8800 IC with its minimal component count to realize a 60A output. Figure 3 has interface circuitry unique to the demonstration board that is not typically contained in a user's application circuit. Figures 4 through 10 show typical performance data, and Figures 15 through 22 demonstrate the PCB board layout. The default configuration file is shown on page 6, and the Bill of Materials (BOM) is included for reference beginning on page 5.

Operation

PMBus Operation

The ZL8800 utilizes the PMBus protocol. The PMBus functionality can be controlled via USB from a PC running the PowerNavigator evaluation software in a Windows XP or Windows 7 operating systems.

Install the evaluation software from the following Intersil website:
http://www.intersil.com/en/products/power-management/zilker-labs-digital-power/powernavigator.html

For board operation, connect the included USB-to-PMBus adapter board to J8 of the ZL8800-2PH-DEMO1Z board labeled "DONGLE". Connect the desired load and an appropriate power supply to the input and connect the included USB cable to the PC running the PowerNavigator evaluation software. Place the ENABLE switches in "DISABLE" and turn on the power.

The evaluation software allows modification of all ZL8800 PMBus parameters. The ZL8800 device on the board has been pre-configured as described in this document, but the user may modify the operating parameters through the evaluation software or by loading a predefined set-up from a configuration file.

The ENABLE switch can then be moved to "ENABLE" and the ZL8800-2PH-DEMO1Z board can be tested. Alternately, the PMBus ON_OFF_CONFIG and OPERATION commands may be used from the PowerNavigator GUI.

Quick Start Guide

Stand Alone Operation

1. Set ENABLE switch to "DISABLE"
2. Apply load to VOUT0 and/or VOUT1
3. Connect the USB to PMBus adapter board to J8 (labeled "DONGLE") of ZL8800-2PH-DEMO1Z
4. Connect supplied USB cable from computer to USB to PMBus adapter board
5. Connect power supply to VIN (supply turned off)
6. Turn power supply on
7. Set ENABLE switch to "ENABLE"
8. Monitor ZL8800-2PH-DEMO1Z board operation using an oscilloscope

USB (PMBus) Operation

1. Set ENABLE switch to "DISABLE"
2. Apply load to VOUT and/or VOUT1
3. Connect power supply to VIN (supply turned off)
4. Turn power supply on
5. Connect USB to PMBus adapter board to J8 of ZL8800-2PH-DEMO1Z
6. Connect supplied USB cable from computer to USB to PMBus adapter board.

Install the PowerNavigator evaluation software from the following Intersil website:
http://www.intersil.com/en/products/power-management/zilker-labs-digital-power/powernavigator.html.

7. Set ENABLE switch to "ENABLE".
8. Monitor and configure the ZL8800-2PH-DEMO1Z board using PMBus commands in the evaluation software.
9. Test the ZL8800-2PH-DEMO1Z operation using an oscilloscope and the evaluation software.

ZL8800-2PH-DEMO1Z Board Schematics

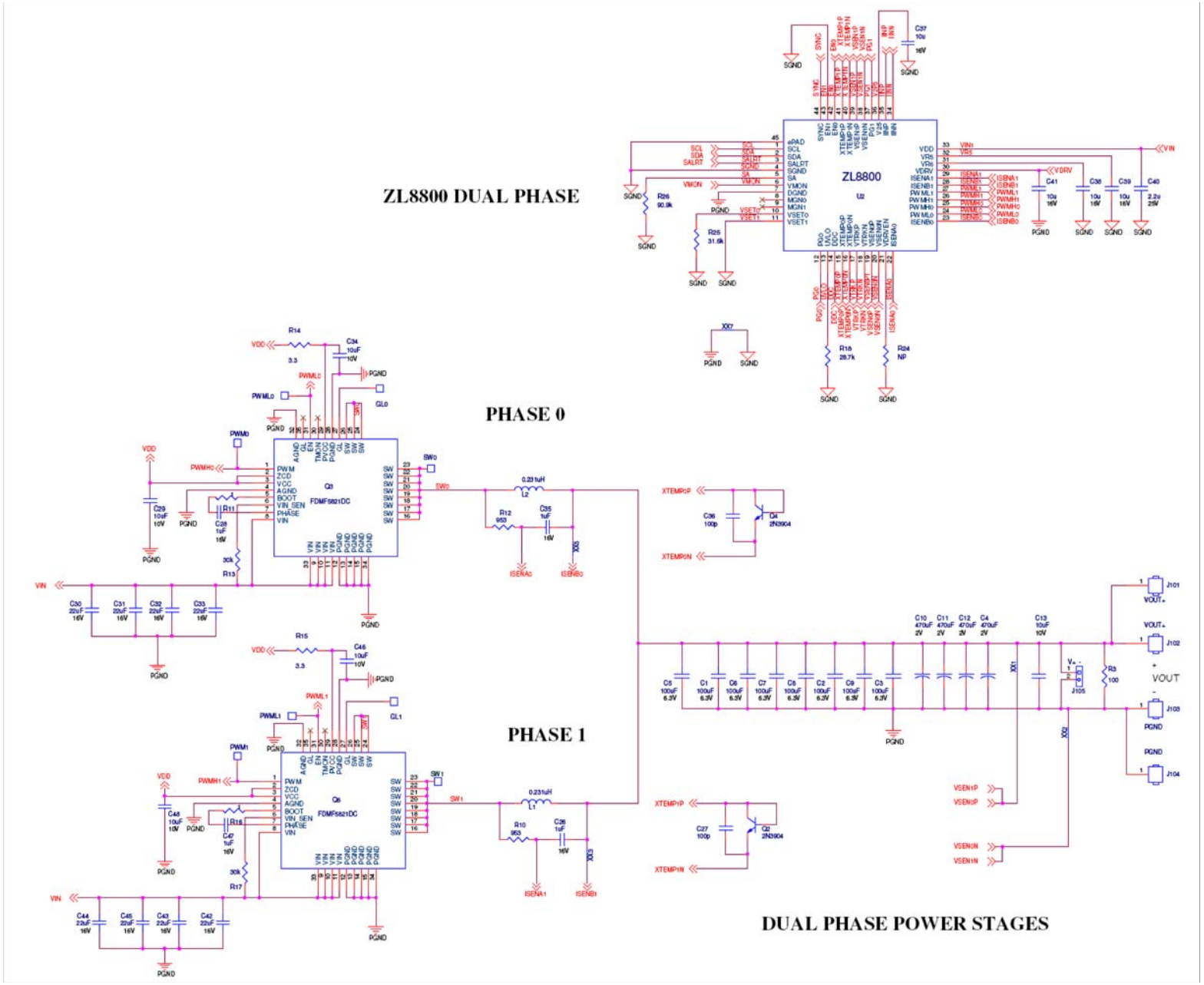

FIGURE 2. APPLICATION CIRCUIT

ZL8800-2PH-DEMO1Z Board Schematics (Continued)

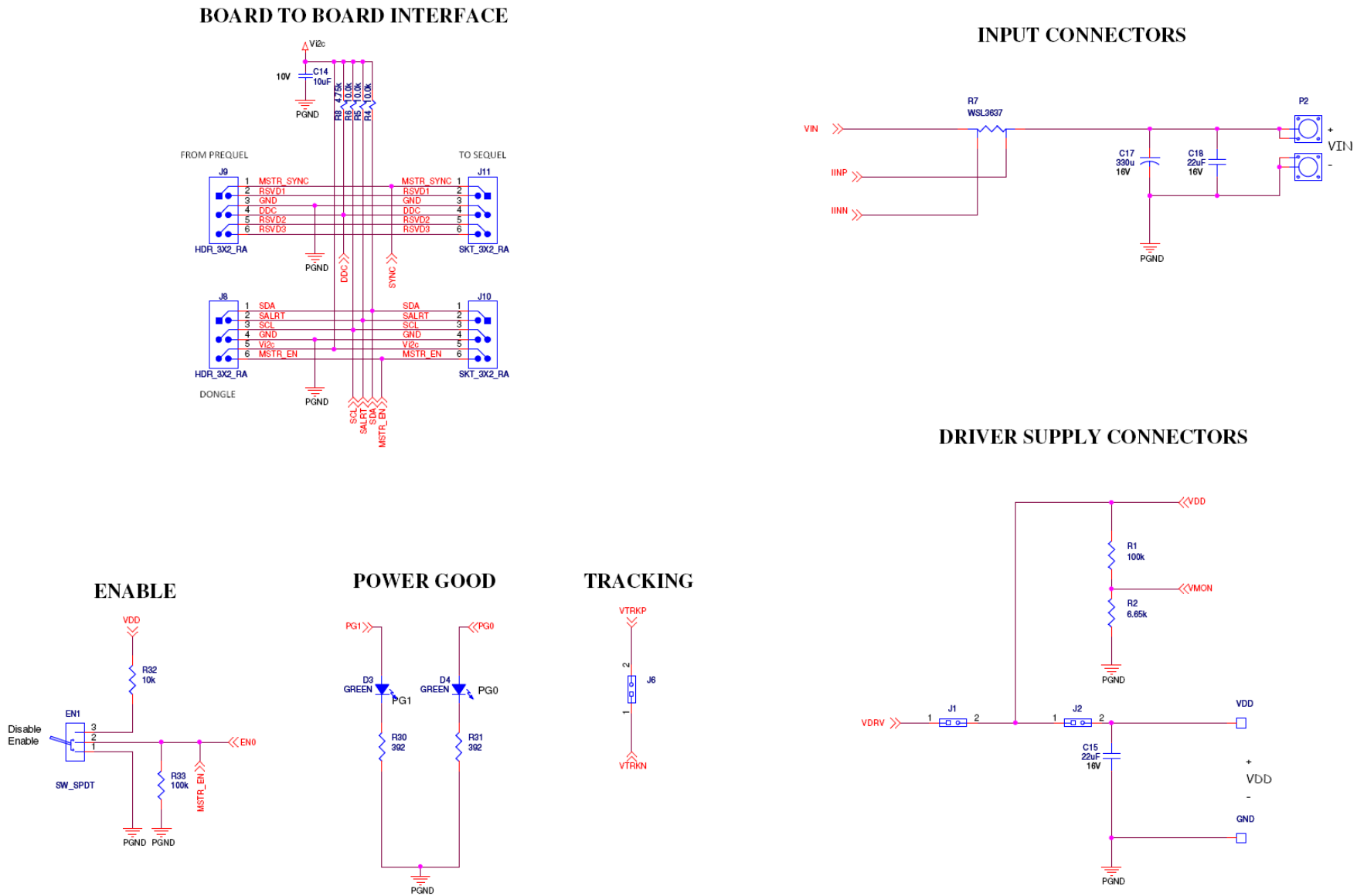

FIGURE 3. ZL8800-2PH-DEMO1Z AUXILIARY CIRCUITRY

ZL8800-2PH-DEMO1Z Bill of Materials

QTY	REFERENCE	VALUE	TOL	RATING	TYPE	PCB FOOTPRINT	MFR	PART NUMBER
1	U2	ZL8800	-	14V	-	MLF44_7X7_XX	Intersil-Zilker Labs	ZL8800ALAFTK
8	C1, C2, C3, C5, C6, C7, C8, C9	100µF	20%	6.3V	X5R	SM1210	Taiyo Yuden	JMK325BJ107MY-T
4	C4, C10, C11, C12	470µF	20%	2V	AL	SM7343P	Panasonic	EEF-SX0D471E4
5	C13, C46, C34, C48, C29	10µF	10%	10V	X5R	SM0805	Taiyo Yuden	LMK212B7106KG-TD
10	C15, C18, C30, C31, C32, C33, C42, C43, C44, C45	22µF	20%	16V	X5R	SM1206	Murata	GRM31CR61C226ME15L
1	C17	330u	20%	16V	AL POLY	SM_CAP_10.5X10.5	UNITED CHEMI	APXA160ARA331MJC0G
4	C47, C26, C28, C35	1µF	20%	16V	X7R	SM0603	TDK	C1608X7R1C105K
2	C27, C36	100p	5%	50V	NPO	SM0402_WSS	MURATA	GRM1555C1H101JZ01D
4	C38, C39, C41, C37	10µ	0.2	16V	X5R	SM0603	Taiyo Yuden	EMK107BBJ106MA-T
1	C40	2.2µ	10%	25V	X5R	SM0805	MURATA	GRM21BR71E225KA73L
2	L1, L2	0.231µH	5%	35A	FERRITE	IND_SLC1175	Coil Craft	SLC1175-231ME_
2	Q6, Q3	FDMF5821DC	-	60A/20V	DR MOS	PQFN40_5X5_P5S	Fairchild	FDMF5821DC
2	Q2, Q4	2N3904	-	40V	NPN	SOT-23	ON SEMI	MMBT3904LT1G
2	R1, R33	100k	1%	63mW	THK FILM	SM0603	Panasonic	ERJ-3EKF1003V
1	R2	6.65k	1%	63mW	THK FILM	SM0603	Panasonic	ERJ-3EKF6651V
1	R3	100	1%	100mW	THK FILM	SM0805	Panasonic	ERJ-6ENF1000V
1	R7	5mΩ	1%	3W	THK FILM	WSL3637	Vishay Dale	WSL36375L000FEA
2	R16, R11	1	5%	63mW	THK FILM	SM0603	Panasonic	ERJ-2RKF1R00X
2	R10, R12	953	1%	63mW	THK FILM	SM0603	Panasonic	ERJ-3EKF9530V
1	R18	28.7k	1%	50mW	THK FILM	SM0402	Panasonic	ERJ-3EKF2872V
1	R25	31.6k	1%	63mW	THK FILM	SM0603	Panasonic	ERJ-3EKF3162V
0	R26	90.9k	1%	63mW	THK FILM	SM0603	Panasonic	ERJ-3EKF9092V
2	R17, R13	30k	5%	63mW	THK FILM	SM0603	Panasonic	ERJ-3GEYJ303V
2	R14, R15	3.3Ω	5%	63mW	THK FILM	SM0603	Panasonic	ERJ-3GEYJ3R3V
DEMONSTRATION BOARD SPECIFIC AUXILIARY PARTS BILL OF MATERIALS								
2	R30, R31	392	1%	63mW	THK FILM	SM0603	Panasonic	ERJ-3EKF3920V
0	R24	NOT USED	-		-	SM0603	-	-
1	R8	4.75k	1%	63mW	THK FILM	SM0603	Panasonic	ERJ-2RKF4751X
4	R4, R5, R6, R32	10.0k	1%	63mW	THK FILM	SM0603	Panasonic	ERJ-2RKF1002X
2	P2	JACK_BANANA	-	15A	-	JACK_F_NI_2P.750SP	EMERSON	108-0740-001
2	D3, D4	GREEN	-	2V, 20mA	LED	SM0805	CHICAGO MINI	CMD17-21VGC/TR8
1	EN1	SW_SPDT	-	-	PCB VERT	SW_TOG_SPDT	NKK	G12AP
3	J1, J2, J105	2 POS	-	-	VERT	SIP2/100	SAMTEC	TSW-102-07-L-S
2	J8, J9	HDR_3X2_RA	-	-	RA	HDRMDUALRA100X100	SAMTEC	TSW-103-08-T-D-RA
2	J10, J11	SKT_3X2_RA	-	-	RA	HDRFDUALRA100X100	SAMTEC	SSQ-103-02-T-D-RA
4	J101, J102, J103, J104	VOUT+, PGND	-	-	-	JACK_F_.175PLUG	Burndy	KPA8CTP
1	C14	10µF	10%	10V	X5R	SM1206	Murata	GRM31CR61A106KA01L
0	VDD	TP	-	Red	PC Test Point	TP_036H_SSREF	Keystone Electronics	5000
0	GND	TP	-	Black	PC Test Point	TP_036H_SSREF	Keystone Electronics	5001

Configuration File

The following text is loaded into the ZL8800 device on the ZL8800-2PH-DEMO1Z as default settings. Each PMBus command is loaded via the PowerNavigator software. The # symbol is used for a comment line.

```
# Initialize device to factory settings

RESTORE_FACTORY
STORE_DEFAULT_ALL
STORE_USER_ALL

### Begin Default Store
RESTORE_DEFAULT_ALL

# Global commands

FREQUENCY_SWITCH          0xfb20       # 400 kHz
VIN_OV_FAULT_LIMIT        0xd380       # 14 V
VIN_OV_FAULT_RESPONSE     0xff
VIN_OV_WARN_LIMIT         0xd360       # 13.5 V
VIN_UV_WARN_LIMIT         0xca40       # 4.5 V
VIN_UV_FAULT_LIMIT        0xca00       # 4 V
VIN_UV_FAULT_RESPONSE     0xff
IIN_CAL_GAIN              0xca80       # 5 mV/A
DDC_ENG                   0xa5a
USER_GLOBAL_CONFIG        0x100
VMON_OV_FAULT_RESPONSE    0x80
VMON_UV_FAULT_RESPONSE    0x80
PRIVATE_PASSWORD
PUBLIC_PASSWORD
UNPROTECT
0x00FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFF

# PAGE 0 commands
PAGE                      0x0
ON_OFF_CONFIG             0x17
VOUT_COMMAND              0x2666       # 1.2 V
VOUT_TRIM                 0x0          # 0 V
VOUT_CAL_OFFSET           0x0          # 0 V
VOUT_MAX                  0x4000       # 2 V
VOUT_MARGIN_HIGH          0x2852       # 1.26 V
VOUT_MARGIN_LOW           0x247b       # 1.14 V
VOUT_TRANSITION_RATE      0xba00       # 1 mV/us
VOUT_DROOP                0x0          # 0 mV/A
INTERLEAVE                0x0
IOUT_CAL_GAIN             0xb127       # 0.288 mV/A
IOUT_CAL_OFFSET           0xbe00       # -1 A
VOUT_OV_FAULT_LIMIT       0x2a6f       # 1.326 V
VOUT_OV_FAULT_RESPONSE    0x80
VOUT_UV_FAULT_LIMIT       0x225e       # 1.074 V
VOUT_UV_FAULT_RESPONSE    0x80
IOUT_OC_FAULT_LIMIT       0xe370       # 55 A
IOUT_UC_FAULT_LIMIT       0xe490       # -55 A
OT_FAULT_LIMIT            0xebe8       # 125 °C
OT_FAULT_RESPONSE         0x80
OT_WARN_LIMIT             0xeb70       # 110 °C
UT_WARN_LIMIT             0xdc40       # -30 °C
UT_FAULT_LIMIT            0xe530       # -45 °C
UT_FAULT_RESPONSE         0x80
POWER_GOOD_ON             0x228f       # 1.08 V
TON_DELAY                 0xca80       # 5 ms
TON_RISE                  0xca80       # 5 ms
TOFF_DELAY                0xca80       # 5 ms
TOFF_FALL                 0xca80       # 5 ms
DEADTIME_MAX              0x3838
ISENSE_CONFIG             0x4204
USER_CONFIG               0x786
DDC_CONFIG                0x101
POWER_GOOD_DELAY          0xba00       # 1 ms
PID_TAPS                  0x64
INDUCTOR                  0xb114       # 0.27 uH
VOUT_MARGIN_RATIO         0xca80       # 5 %
OVUV_CONFIG               0x0
XTEMP_SCALE               0xba00       # 1 1/°C
XTEMP_OFFSET              0x8000       # 0 °C
TEMPCO_CONFIG             0xa7
DEADTIME                  0x1010
DEADTIME_CONFIG           0x8080
ASCR_CONFIG               0x15a0100
SEQUENCE                  0x0
TRACK_CONFIG              0x0
DDC_GROUP                 0x0
MFR_IOUT_OC_FAULT_RESPONSE  0x80
MFR_IOUT_UC_FAULT_RESPONSE  0x80
IOUT_AVG_OC_FAULT_LIMIT   0xe230       # 35 A
IOUT_AVG_UC_FAULT_LIMIT   0xe5d0       # -35 A
SNAPSHOT_CONTROL          0x0
MFR_VMON_OV_FAULT_LIMIT   0xcb00       # 6 V
MFR_VMON_UV_FAULT_LIMIT   0xca00       # 4 V

# PAGE 1 commands
PAGE                      0x1
VOUT_COMMAND              0x2666       # 1.2 V
VOUT_MAX                  0x4000       # 2 V
VOUT_MARGIN_HIGH          0x2852       # 1.26 V
VOUT_MARGIN_LOW           0x247b       # 1.14 V
IOUT_CAL_GAIN             0xb127       # 0.288 mV/A
IOUT_CAL_OFFSET           0xbe00       # -1 A
VOUT_OV_FAULT_LIMIT       0x2a6f       # 1.326 V
VOUT_UV_FAULT_LIMIT       0x225e       # 1.074 V
IOUT_OC_FAULT_LIMIT       0xe370       # 55 A
IOUT_UC_FAULT_LIMIT       0xe490       # -55 A
POWER_GOOD_ON             0x228f       # 1.08 V
USER_CONFIG               0x786
DDC_CONFIG                0x2101
INDUCTOR                  0xb114       # 0.27 uH
TEMPCO_CONFIG             0xa7
IOUT_AVG_OC_FAULT_LIMIT   0xe230       # 35 A
IOUT_AVG_UC_FAULT_LIMIT   0xe5d0       # -35 A
MFR_VMON_OV_FAULT_LIMIT   0xcb00       # 6 V
MFR_VMON_UV_FAULT_LIMIT   0xca00       # 4 V

STORE_DEFAULT_ALL
### End Default Store
```

Measured Data

The following data was acquired using a ZL8800-2PH-DEMO1Z Rev B demonstration board.

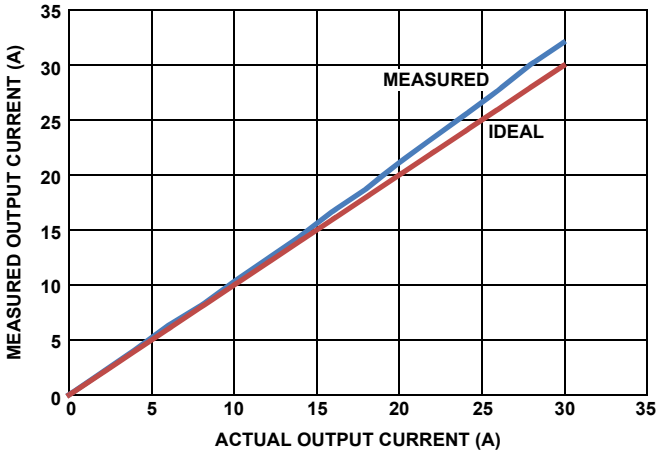

FIGURE 4. OUTPUT CURRENT MEASUREMENT ACCURACY (Single Phase)

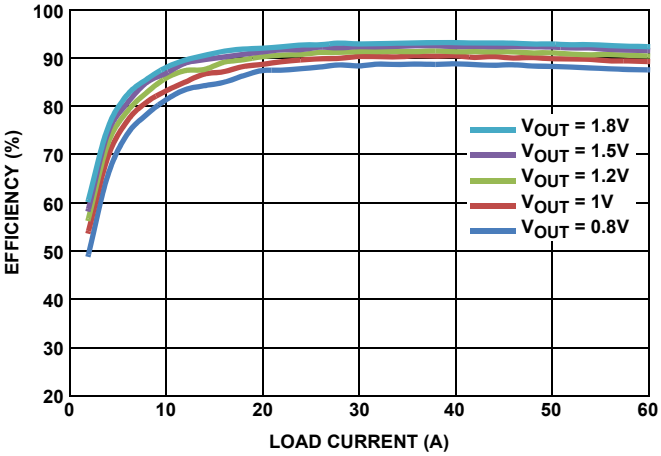

FIGURE 5. EFFICIENCY, V_{IN} = 12V, f_{SW} = 300kHz

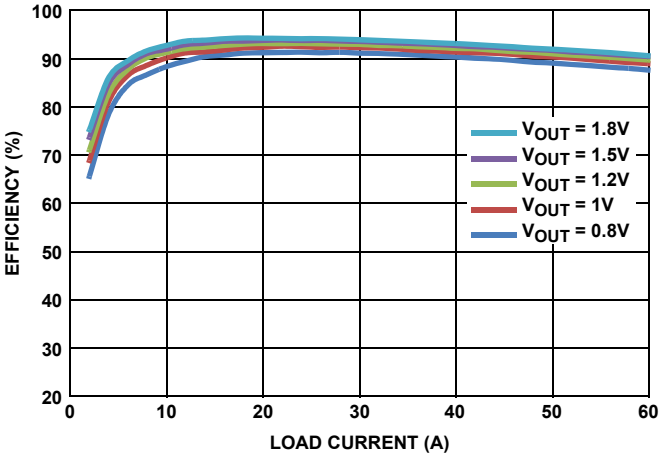

FIGURE 6. EFFICIENCY, V_{IN} = 5V, f_{SW} = 300kHz

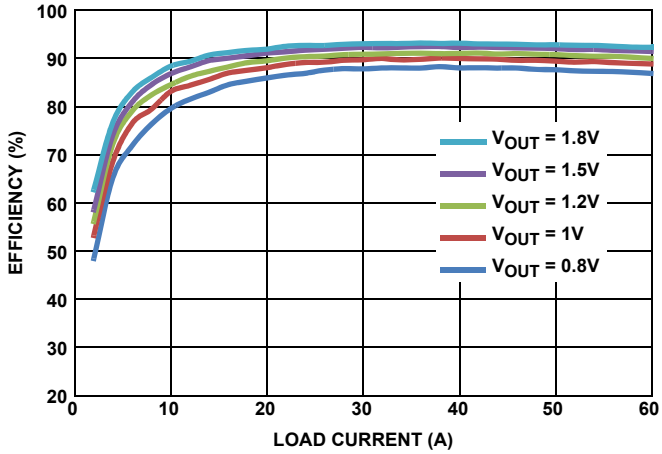

FIGURE 7. EFFICIENCY, V_{IN} = 12V, f_{SW} = 400kHz

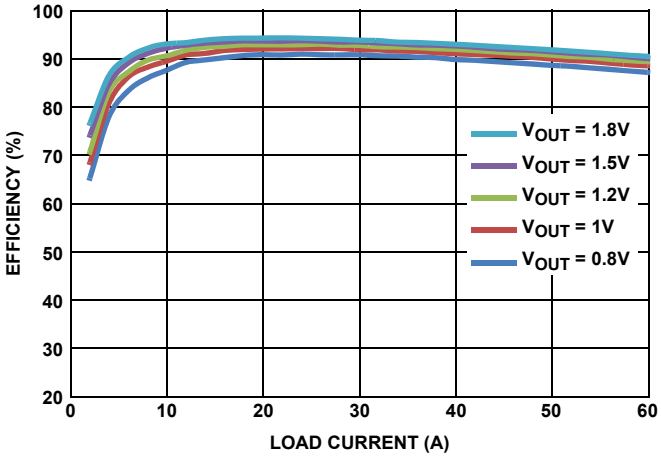

FIGURE 8. EFFICIENCY, V_{IN} = 5V, f_{SW} = 400kHz

Measured Data

The following data was acquired using a ZL8800-2PH-DEMO1Z Rev B demonstration board. **(Continued)**

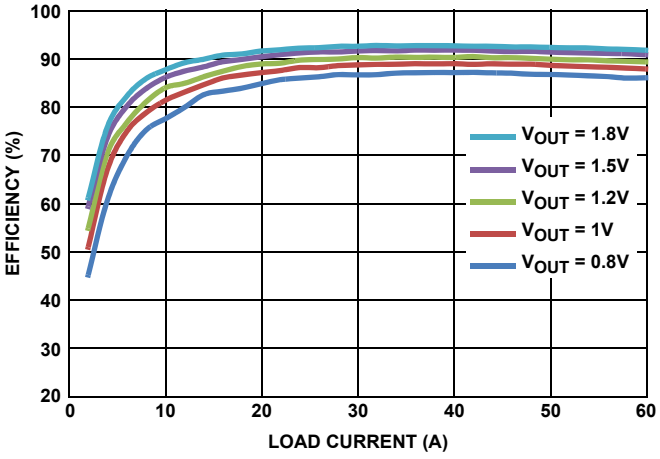

FIGURE 9. EFFICIENCY, V_{IN} = 12V, f_{SW} = 516kHz

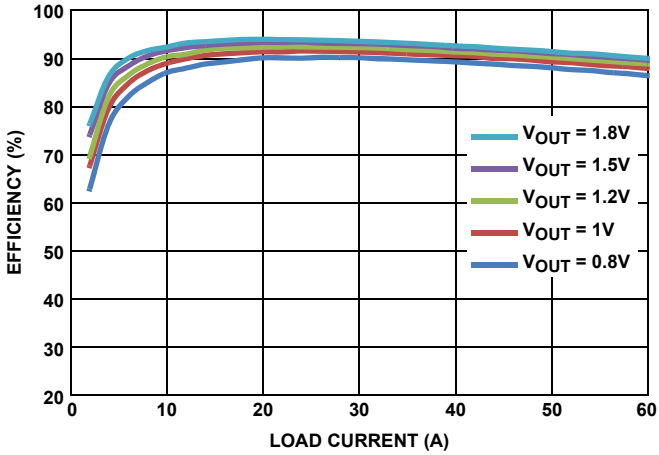

FIGURE 10. EFFICIENCY, V_{IN} = 5V, f_{SW} = 516kHz

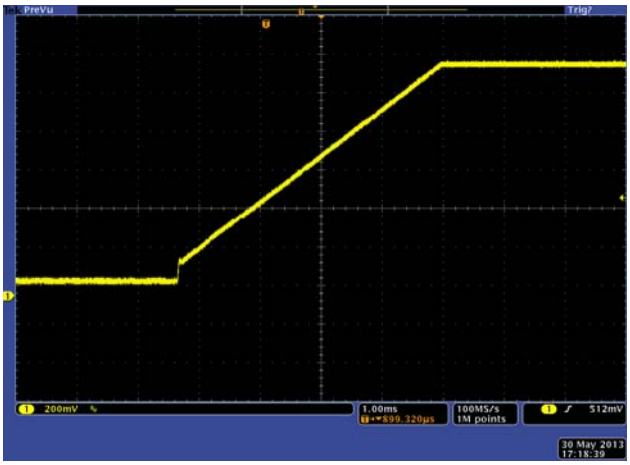

FIGURE 11. RAMP UP

FIGURE 12. RAMP DOWN

FIGURE 13. STEP RESPONSE, 20A TO 40A @ 5A/µs, ASCR = 1200 TOTAL DEVIATION WINDOW 25mV = 2.5%

FIGURE 14. STEP RESPONSE, 20A TO 40A @ 5A/µs, ASCR = 400 TOTAL DEVIATION WINDOW 50mV = 5%

ZL8800-2PH-DEMO1Z Board Layout

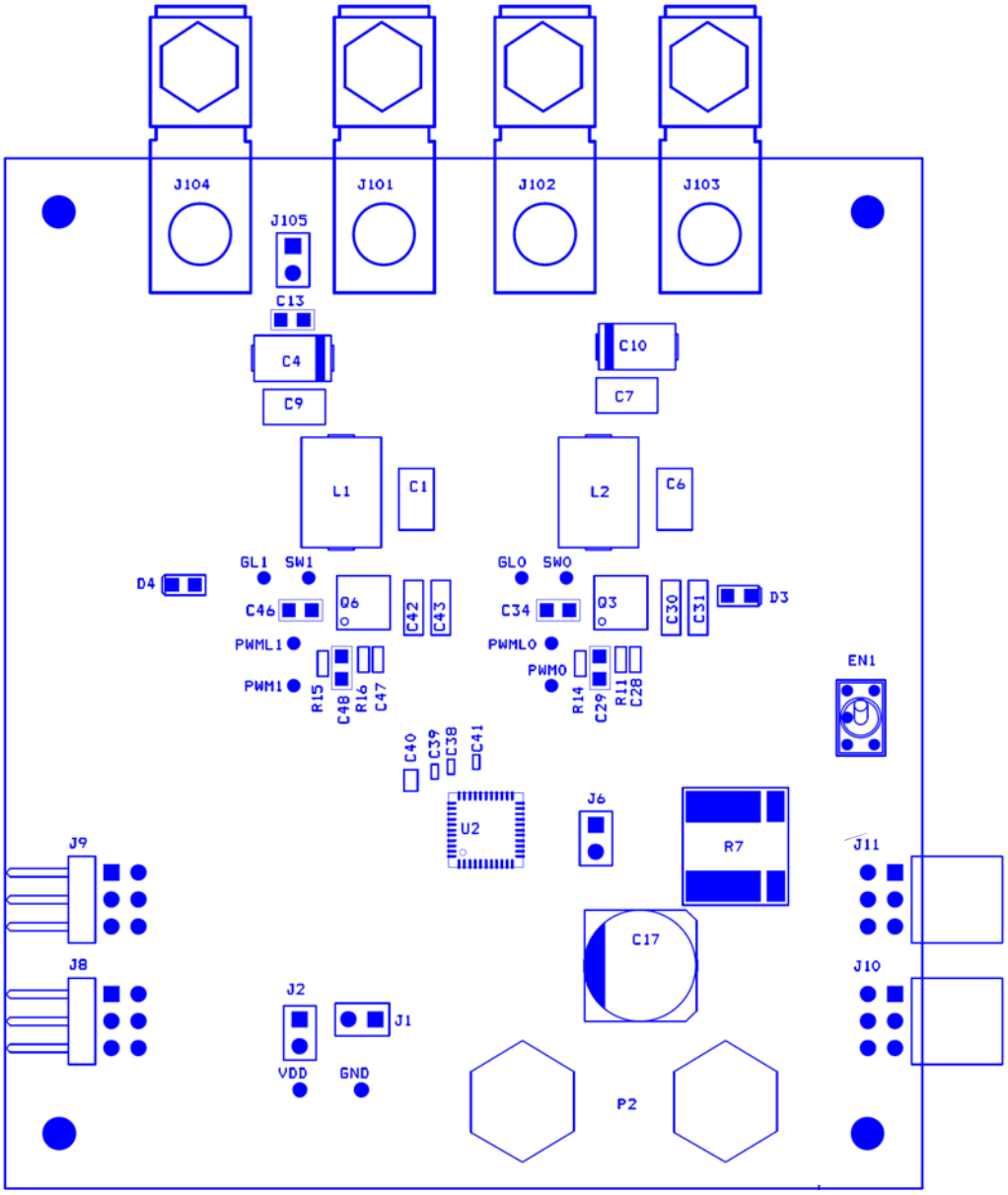

FIGURE 15. PCB - TOP ASSEMBLY

ZL8800-2PH-DEMO1Z Board Layout (Continued)

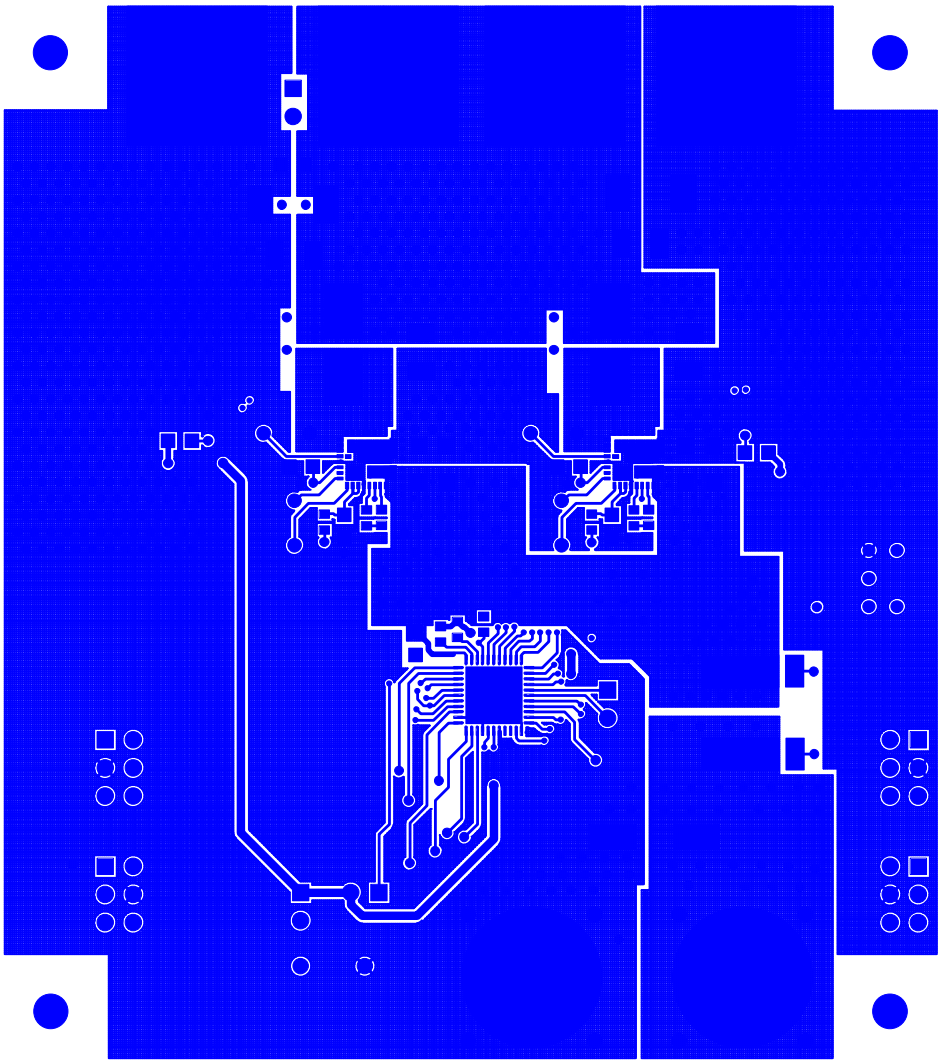

FIGURE 16. PCB - TOP LAYER

ZL8800-2PH-DEMO1Z Board Layout (Continued)

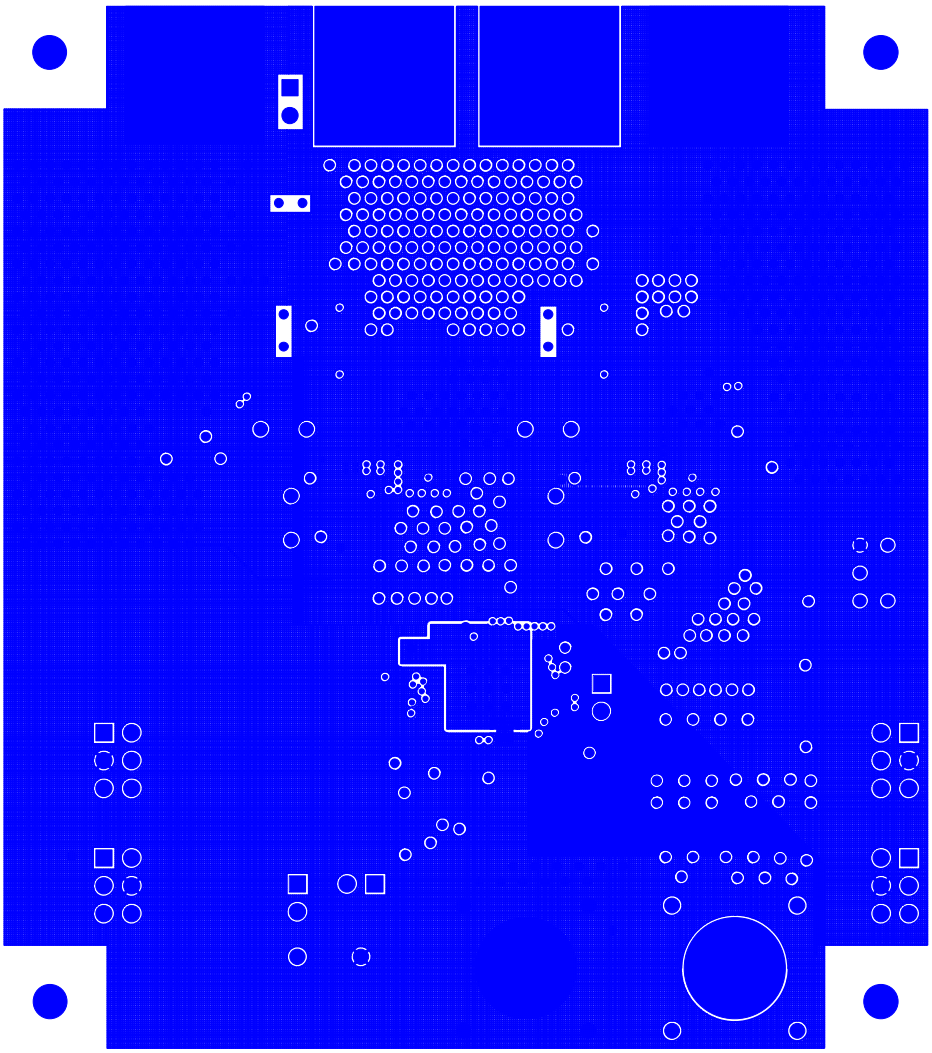

FIGURE 17. PCB - INNER LAYER 1 (TOP VIEW)

ZL8800-2PH-DEMO1Z Board Layout (Continued)

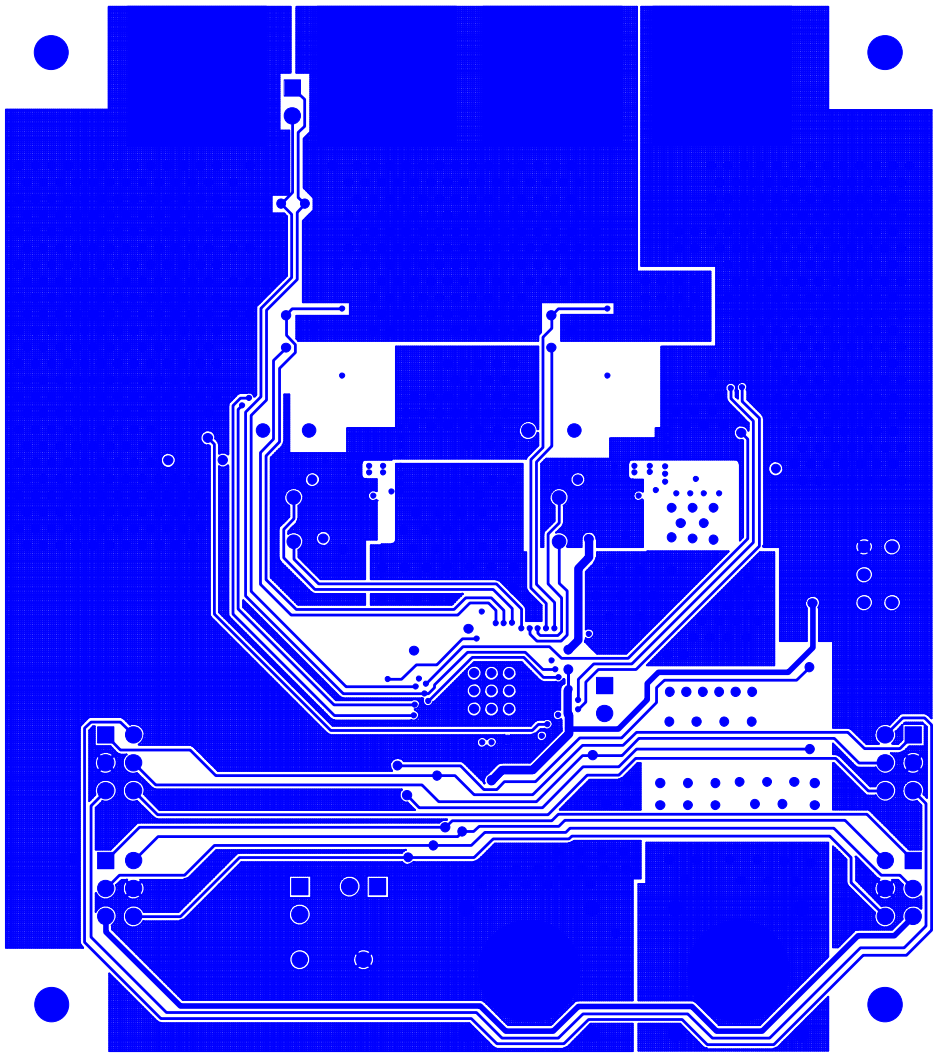

FIGURE 18. PCB - INNER LAYER 2 (TOP VIEW)

ZL8800-2PH-DEMO1Z Board Layout (Continued)

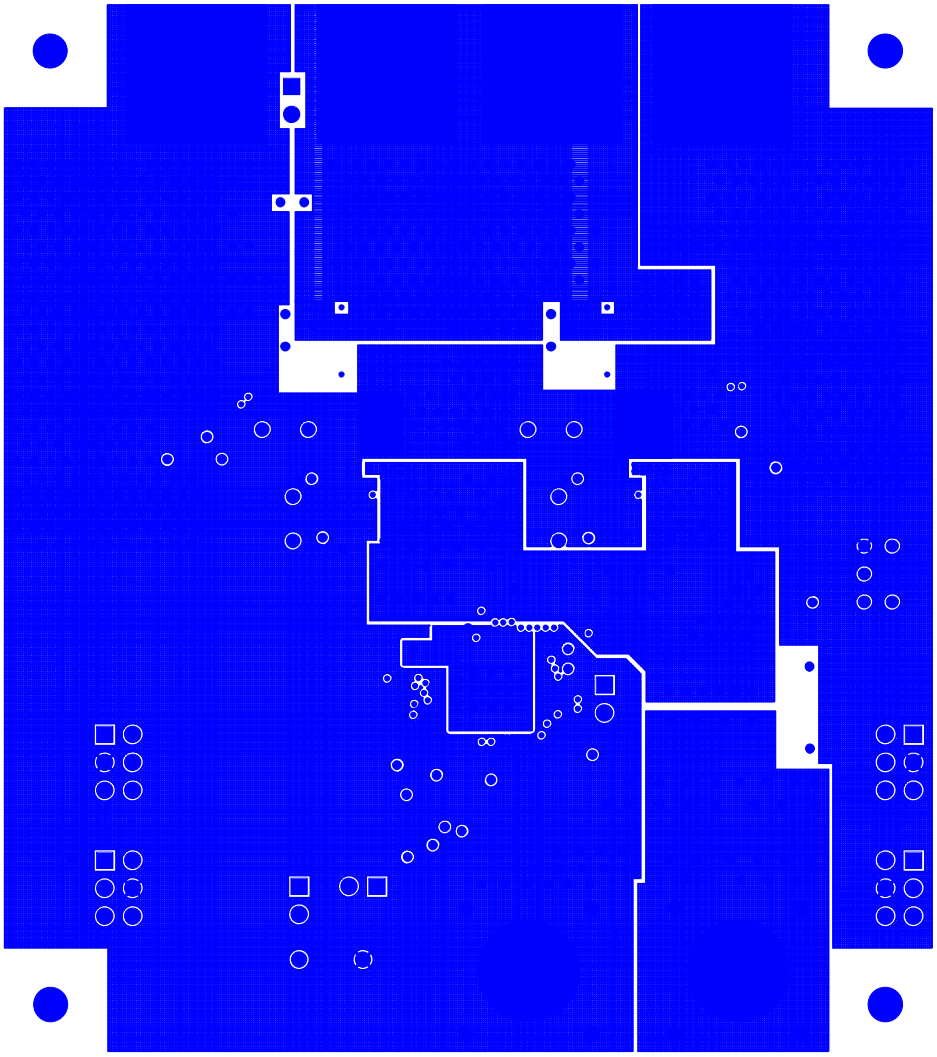

FIGURE 19. PCB - INNER LAYER 3 (TOP VIEW)

ZL8800-2PH-DEMO1Z Board Layout (Continued)

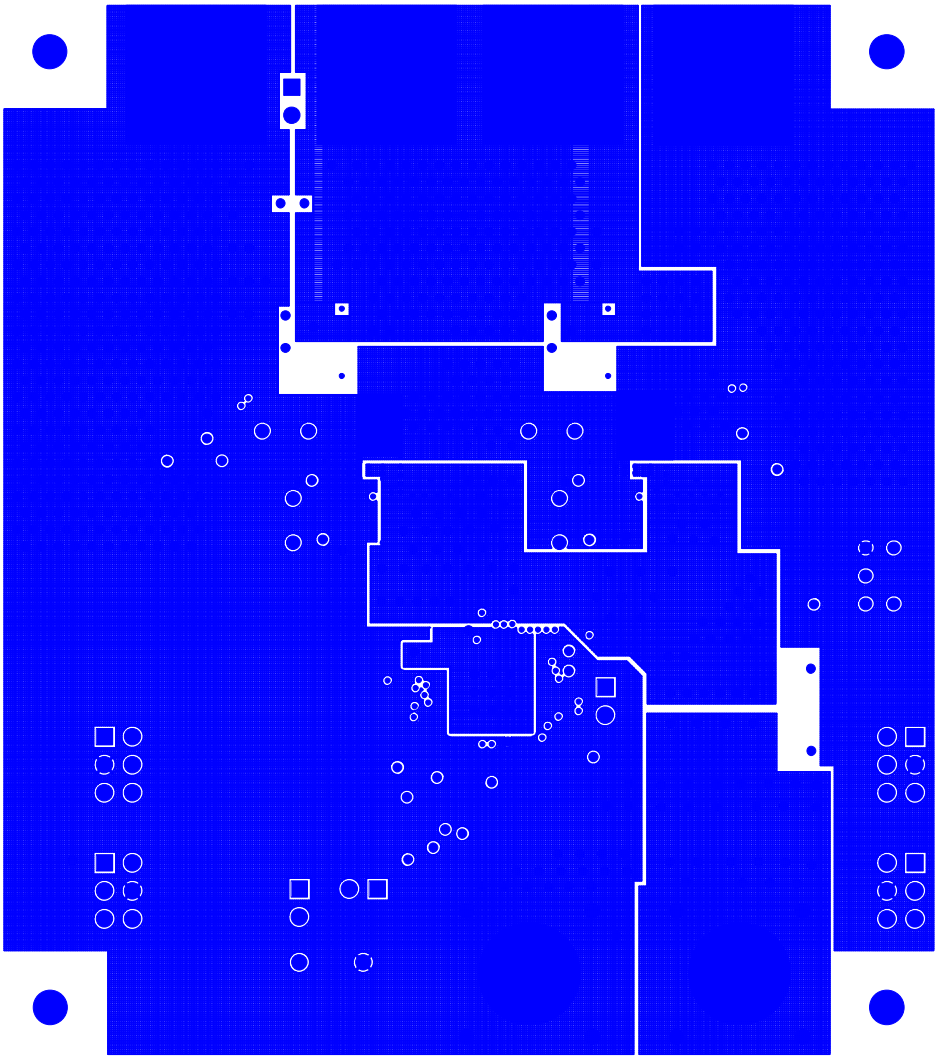

FIGURE 20. PCB - INNER LAYER 4 (TOP VIEW)

ZL8800-2PH-DEMO1Z Board Layout (Continued)

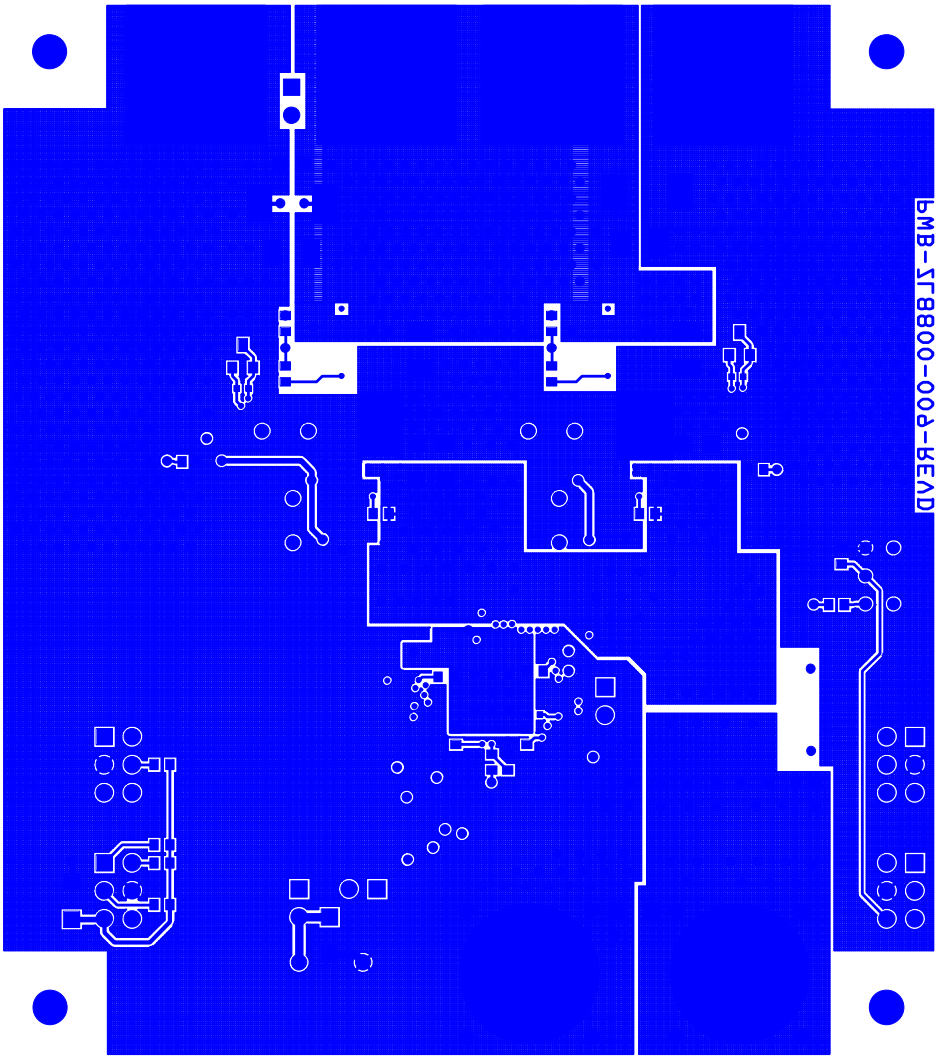

FIGURE 21. PCB - BOTTOM LAYER (TOP VIEW)

ZL8800-2PH-DEMO1Z Board Layout (Continued)

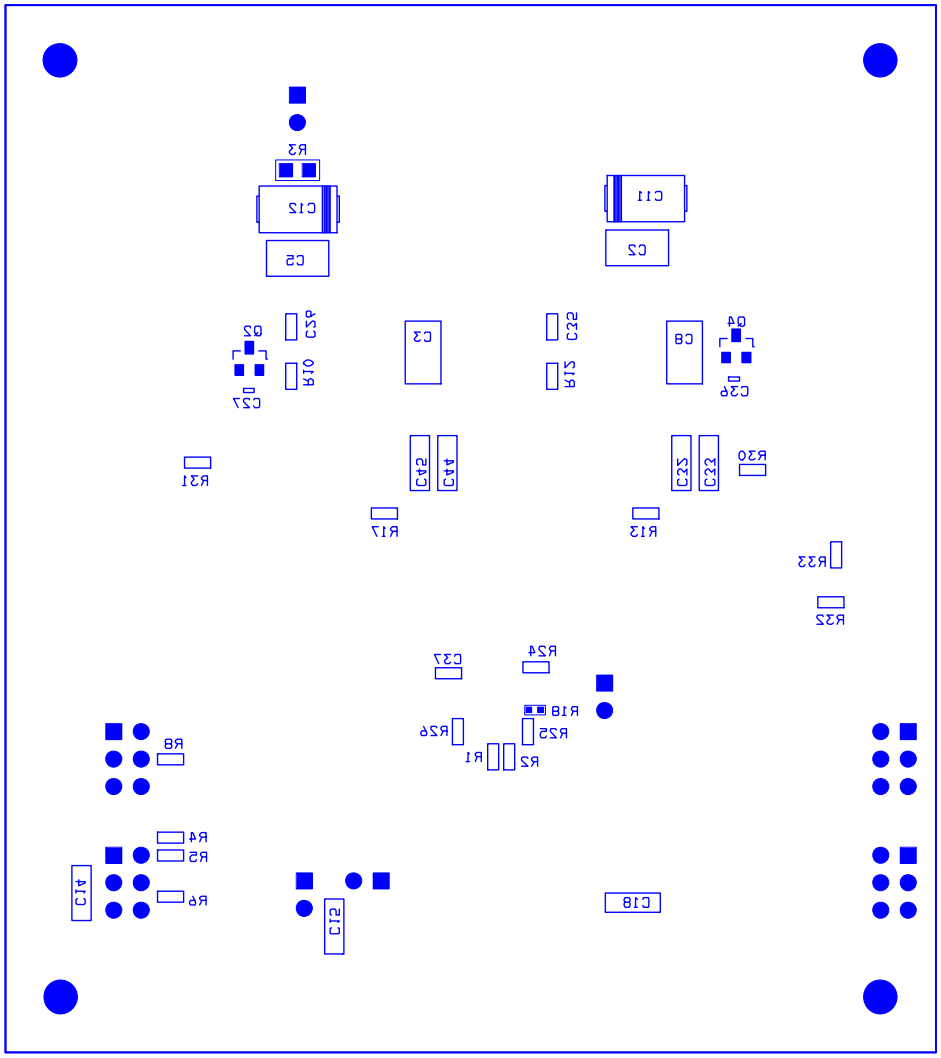

FIGURE 22. PCB - BOTTOM ASSEMBLY (TOP VIEW)

Related Tools and Documentation

DOCUMENT	DESCRIPTION
FN7558	ZL8800 Datasheet, “Dual Channel/Dual Phase PMBus™ ChargeMode Control DC/DC Digital Controller”

Notice

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