Evaluating the ADM1273 High-Voltage Positive Hot-Swap Controller and Digital Power Monitor with PMBus

FEATURES

- Fully functional evaluation board for the ADM1273
- Populated with 54V, 30A, 1mF design
- 40V undervoltage and 60V overvoltage settings
- 120V absolute maximum
- Flexible N-channel MOSFET footprint suits different packages
- Up to 4 parallel MOSFETs, 2 parallel sense resistors
- I^2C/PMBus communication
- MOSFET temperature measurement capability
- LED indicated status outputs
- Toggle and push-button switch for easy input control

PACKAGE CONTENTS

- EVAL-ADM1273-AZ evaluation board

ADDITIONAL HARDWARE NEEDED

- DC1613A USB-to-PMBus controller for use with LTpowerPlay® (order separately)

SOFTWARE NEEDED

- LTpowerPlay

GENERAL DESCRIPTION

The EVAL-ADM1273-AZ is a full featured evaluation board for the ADM1273. The board layout provides a clear visual of all the peripheral components and the hot swap power path. The layout also maximizes the ability of the board to dissipate heat for some of the key components on the power path, allowing the evaluation of high-current hot-swap setups. The evaluation board is prepopulated and tested with a 54V, 30A hot-swap design capable of working with a 1mF output capacitor.

Two sense resistor footprints and four multipackage MOSFET footprints (two on the bottom side) provide great flexibility and allow a wide range of application setups. Multiple test points allow easy access to all critical points and pins. Six LEDs provide direct visual indication of board status such as supply input, output, GPIO1, GPIO2, power good, and fault.

The board supports PMBus™ communication with the ADM1273 and is fully compatible with the LTpowerPlay evaluation software. A USB-to-PMBus controller (DC1613A) is required to connect EVAL-ADM1273-AZ to a Windows-based computer running LTpowerPlay.

Complete specifications for the ADM1273 are available in the ADM1273 data sheet, which must be consulted in conjunction with this user guide when using the evaluation board.

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REVISION HISTORY

8/2025—Revision 0: Initial Version

BOARD PHOTOGRAPHY

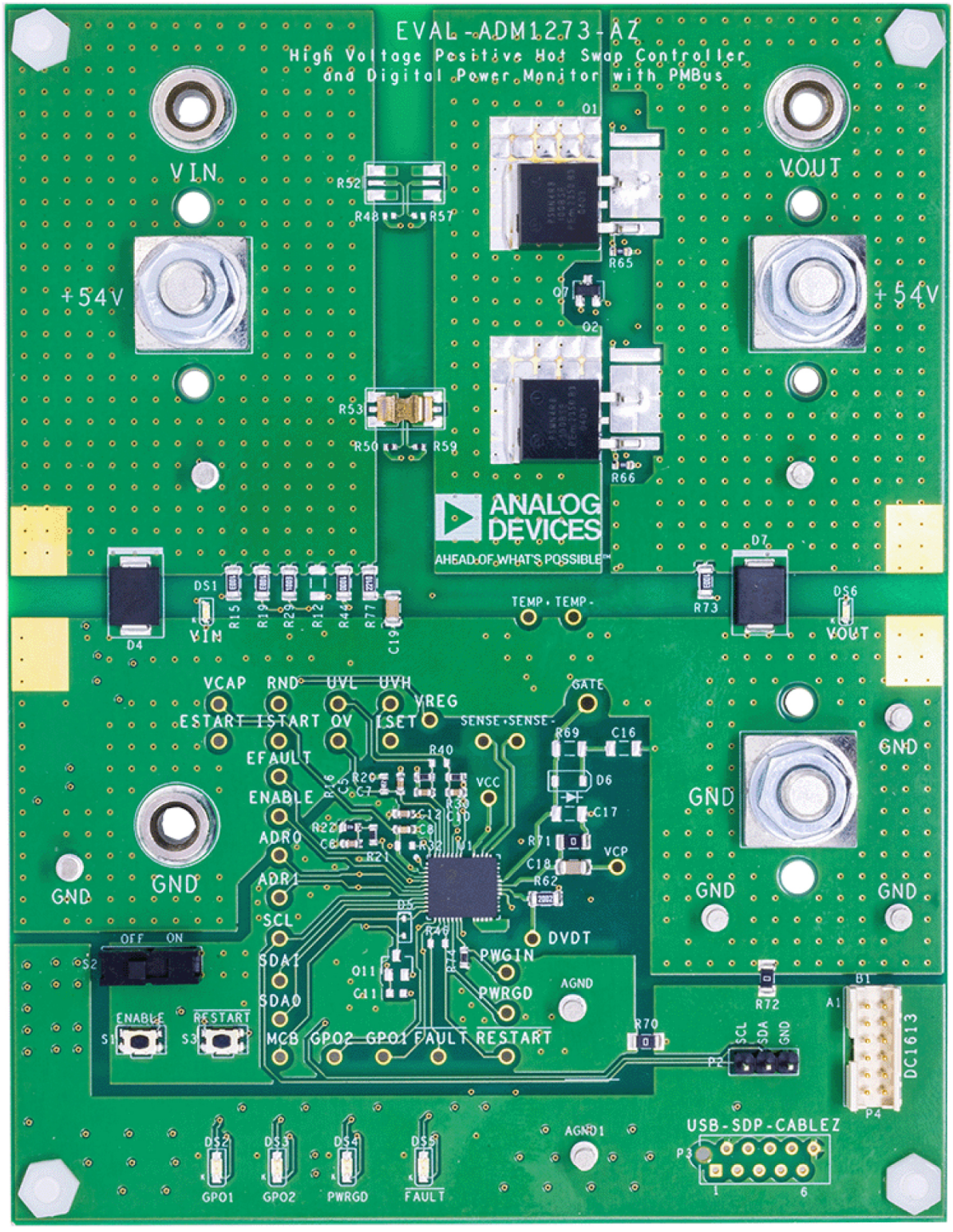

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Figure 1. EVAL-ADM1273-AZ Photograph

QUICK START GUIDE

The EVAL-ADM1273-AZ board is easily set up to evaluate the performance of the ADM1273. See Figure 2 for equipment setup and follow the evaluation steps with the proper measurement techniques and precautions.

MEASUREMENT TECHNIQUES AND PRECAUTIONS

The EVAL-ADM1273-AZ is designed to operate in a 54V, 30A system with natural convection. At this current and power level, there is a danger of serious injury and equipment damage if proper techniques are not used. All cabling between the power supply and the load should be capable of handling the current levels used, including the GND connection to the EVAL-ADM1273-AZ. While probing, note that even a 10MΩ probe or voltmeter affects measurements of high-impedance nodes, such as GATE, DVDT, ESTART, and EFAULT. High-current connectors and banana plugs may protrude through the bottom of the board. Even though the EVAL-ADM1273-AZ is equipped with standoffs, the underlying surface must be non-conductive and clear of any wire, solder, and other conductive debris.

High currents and fast transients can cause unexpected voltage drops in cables connecting the test equipment to the EVAL-ADM1273-AZ due to parasitic resistance and inductance. The cable drops may cause ground loops for the current via various cables and scope probes. This causes unexplained ringing, distorted oscilloscope waveforms, voltage and current spikes, and signals appearing to be below ground. A very large, low equivalent series resistance (ESR) capacitor from VIN to GND can reduce supply droop and ground bounce during testing.

A common sneak path for current is the third wire grounds used on power cords of test equipment in use. Using ground lifting connectors at the wall outlet do not necessarily alleviate these effects since most equipment has line bypassing capacitors between the mains voltage and local chassis ground. Isolating test equipment using line isolation transformers with low primary to secondary capacitance is recommended. Probe ground leads may intercept induced fields from the high-current paths and should be minimized or avoided. Another method to remove these artifacts is the use of a differential scope probe connected between the signal to be observed and a ground connection located close to the point of measurement.

Be careful to not allow an open ground from the power supply or load to cause return current through the grounds of the various devices connected to the demo board. This may present a fire hazard or cause damage to the test equipment.

If the current limit is increased or the board is operated in a high temperature environment, additional airflow may be needed to keep it within safe thermal operating limits for continuous operation. If additional current is required without sufficient airflow, multiple MOSFETs must be connected in parallel with the existing MOSFETs to lower their I^2R losses.

EVALUATION STEPS

To set up and start using the evaluation board, take the following steps:

1. On a Windows PC, download and install the LTpowerPlay application from https://www.analog.com/en/lp/ltpower-play.html.
2. Connect EVAL-ADM1273-AZ to the PC through the 12-pin connector, P4, and the USB-to-PMBus controller (DC1613A) as shown in Figure 2.
3. Connect a power supply, initially off, across VIN and GND using thick wires (10 AWG) suitable for the current levels to be observed.
4. To confirm that the board is configured correctly, set the output of the power supply to 54V with less than 1A current limit and with no load capacitance. If the board is configured correctly, the green PWRGD LED illuminates.
5. Move the S2 ENABLE switch from the ON position to OFF. The PWRGD LED turns off. It turns back on when S2 is moved to the ON position.
6. Similarly, disable and enable the hot swap using LTpowerPlay.
7. Connect an output load, initially off, across VOUT and GND after increasing the power supply current limit above 30A.
8. Check that LTpowerPlay reports the expected voltage and current values.
9. Increase the load current above 30A. The PWRGD LED extinguishes and the red $\overline{\text{FAULT}}$ LED lights up, indicating a fault. Turn off the load and toggle the ENABLE switch to clear the fault and power up the output.

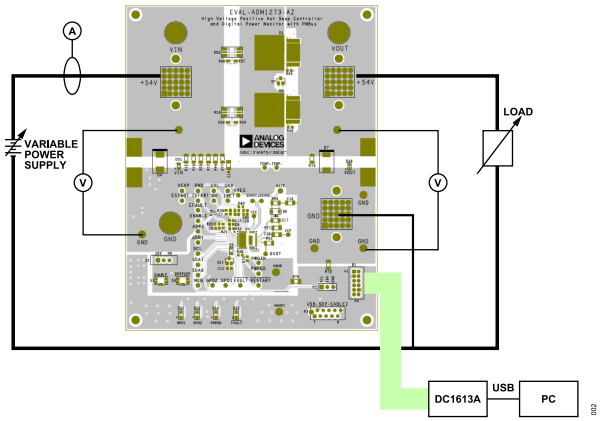

Figure 2. EVAL-ADM1273-AZ Evaluation Setup

EVALUATION BOARD

The EVAL-ADM1273-AZ is a 6-layer PCB with 2oz copper on all layers and large copper planes for input, output, and ground. A simplified connection diagram of the evaluation board is shown in Figure 3. The evaluation board is connected to a PC using a DC1613A controller for PMBus communication.

The EVAL-ADM1273-AZ is configured to operate between 40V and 60V with a current limit of 30A. Loads with up to 1000µF of capacitance can be connected using the VOUT and GND connectors or soldered across the exposed copper pads next to D7. To prevent startup faults, keep DC loads off until PWRGD is asserted.

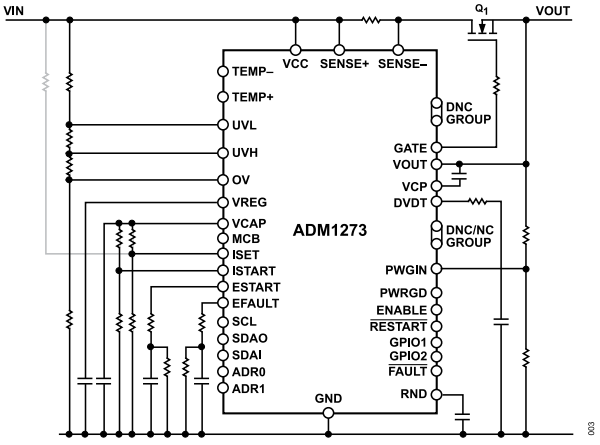

Figure 3. Basic EVAL-ADM1273-AZ Connections

MOSFET

The EVAL-ADM1273-AZ uses a custom MOSFET footprint, shown in Figure 4, to accommodate a variety of common MOSFET packages, including D2PAK, DPAK, LFPAK, and other SO-8 variants.

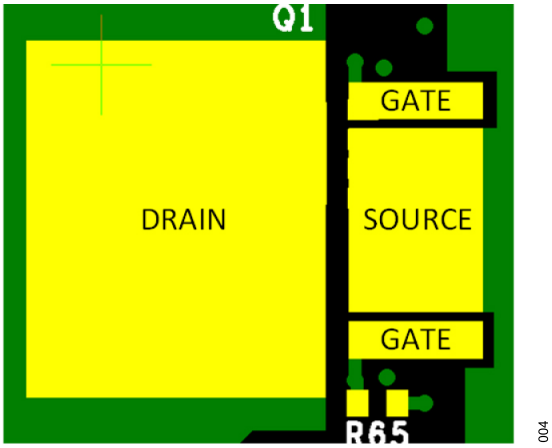

Figure 4. Multipackage N-Channel MOSFET Footprint

CURRENT SENSE RESISTOR

For optimum current sensing accuracy with standard 2512 size sense resistors, the footprint shown in Figure 5 is preferred. This footprint may not be optimized to all resistors and results may vary depending on resistor composition and size. The center pads are used as the Kelvin connection to sense the voltage at the resistor. Some resistors provide more accurate results if sensed at the inner edge of the resistor. Consult and follow the guidance provided by the resistor manufacturer. The Kelvin connections are combined using a resistive network made with 0402 resistors.

If replacing the current sense resistor, ensure that the layout dimensions and structure of the footprint comply with individual SMT manufacturing requirements in order to maintain telemetry accuracy.

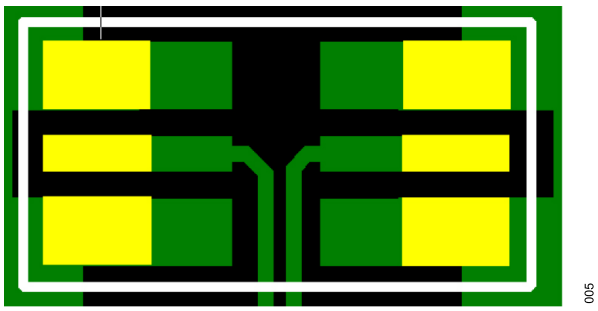

Figure 5. Current Sense Resistor Kelvin Sensing Footprint

SWITCH AND LED FUNCTIONS

Table 1. Switch Functions

Designator	Operation
S1	Push-button switch for the ENABLE pin. Push to connect ENABLE to GND and disable the output.
S2	Slide switch for the ENABLE pin. Slide to ON to enable or OFF to disable the output.
S3	Push-button switch for the $\overline{\text{RESTART}}$ pin. Push to disable the output and automatically reenable after the restart time has elapsed (default is approximately 10 sec).

Table 2. LED Functions

Designator	Label	Color	Light Indicates
DS1	VIN	Green	VIN voltage is above 2.5V.
DS6	VOUT	Green	VOUT voltage is above 2.5V.
DS4	PWRGD	Green	PWRGD high, that is, output power is good.
DS5	$\overline{\text{FAULT}}$	Red	$\overline{\text{FAULT}}$ low, that is, a fault occurred.
DS2	GPO1	Green	GPIO1 high.
DS3	GPO2	Green	GPIO2 high.

EVALUATION BOARD

BOARD SPECIFICATIONS

Table 3.

Parameter	Typical Value	Unit
Undervoltage Rising Threshold (UVH)	44.1	V
Undervoltage Falling Threshold (UVL)	39.7	V
Overvoltage Rising Threshold (OV)	60	V
VOUT Falling Threshold for Power Bad (PWGIN)	40.2	V
Startup Current Limit (ISTART)	4	A
Normal Current Limit (ISET)	30	A
Severe Overcurrent Threshold	60	A
Maximum Ambient Temperature	60	°C
Load Capacitance	1000	µF

EVALUATION SOFTWARE

LTpowerPlay is a PC graphical user interface (GUI) that gives complete access to the registers of the ADM1273 and many other Analog Devices, Inc., power system management devices. LTpowerPlay communicates using the I^2C bus in the evaluation system or in the real-world product environment. LTpowerPlay provides extensive help and documentation under the **Help** menu, including quick-start videos, tutorials, and detailed technical documentation from the Analog Device website.

Launch the LTpowerPlay GUI on the PC. The software identifies the DC1613A controller. Click on the **Detect Chips** button (Figure 6).

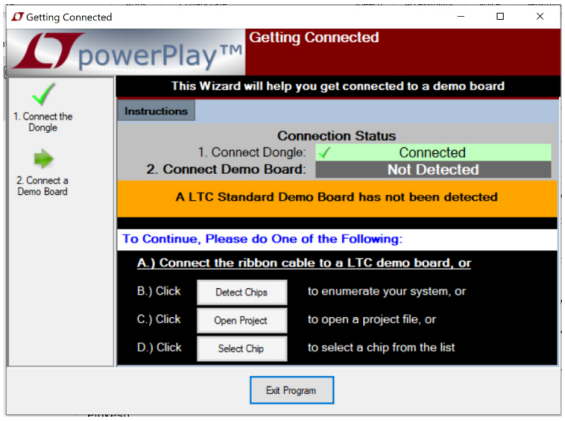

Figure 6. LTpowerPlay Getting Connected Window

LTpowerPlay will search the PMBus for all supported devices. After establishing communication with the ADM1273, the GUI displays the main window (Figure 7).

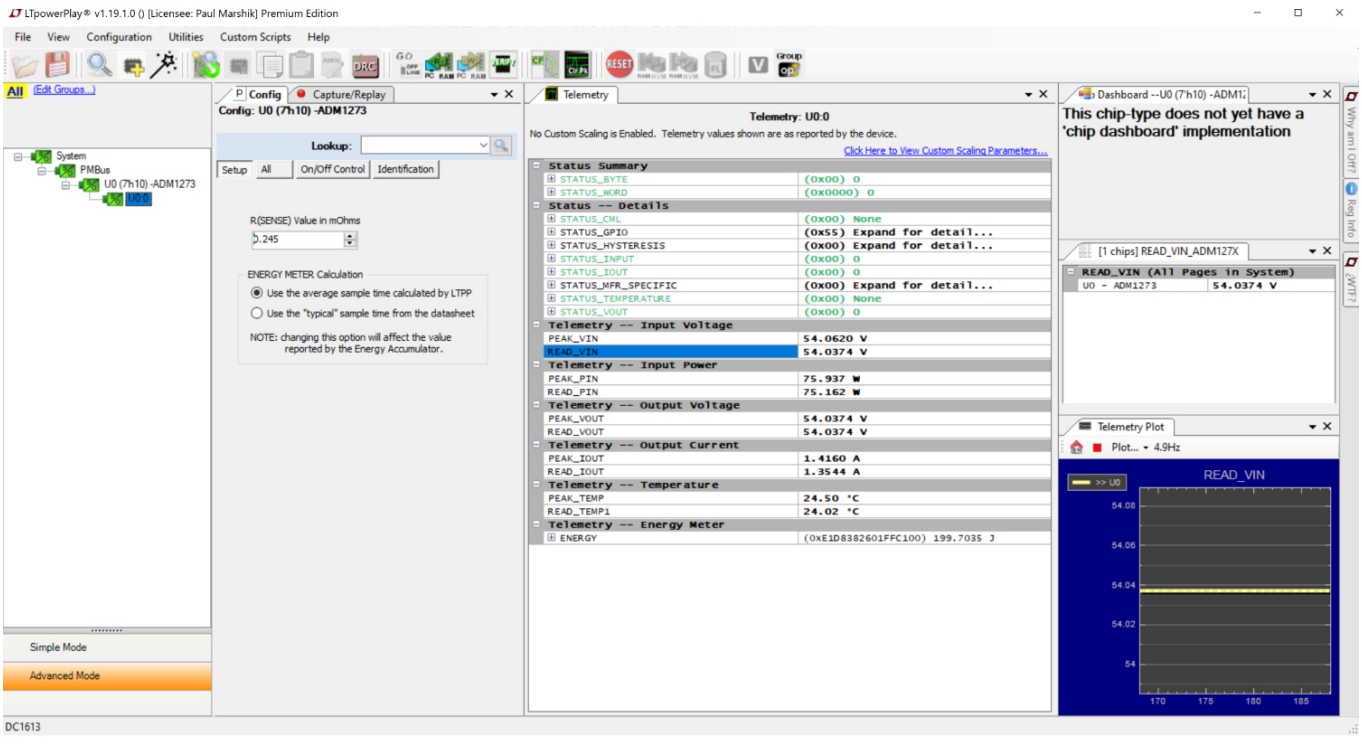

Figure 7. LTpowerPlay Window for ADM1273

EVALUATION SOFTWARE

SETUP AND TIPS

The value of the current sense resistor, used for current and power calculations, must be entered in LTpowerPlay every time it is launched. For EVAL-ADM1273-AZ, enter 1.00 in the **R(SENSE) Value in mOhms** box under **Setup** as shown in Figure 8.

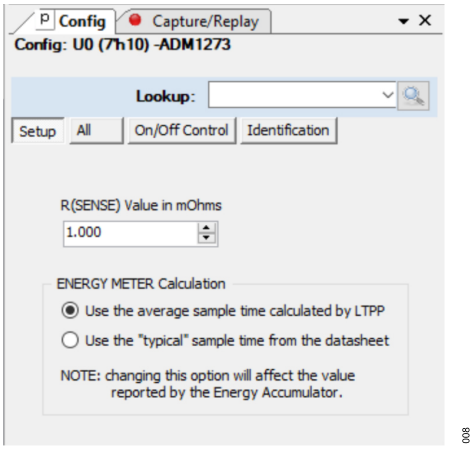

Figure 8. Setting ADM1273 Sense Resistor Value in LTpowerPlay

The ADM1273 register contents are updated by clicking or typing to change the desired registers, then selecting the **PC to RAM** button in the top toolbar, prompting LTpowerPlay to write changes to the updated registers.

Figure 9. LTpowerPlay PC to RAM Button

Right of center in LTpowerPlay is the **Telemetry** pane (Figure 10), which displays read-only information contained in the status registers of the selected part. The GUI periodically polls the I^2C bus and updates the **Telemetry** contents in real time and provides a user-friendly interpretation of the bits.

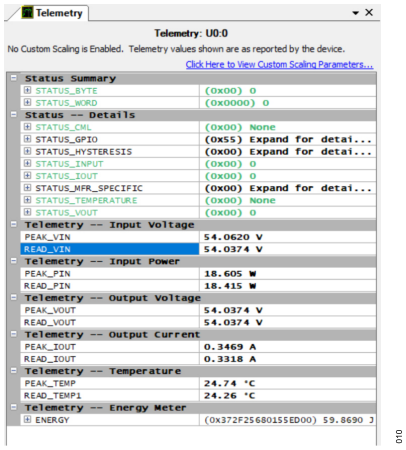

Figure 10. LTpowerPlay Telemetry Pane for ADM1273

Output voltage and temperature measurements are disabled when the ADM1273 powers up. They can be turned on by checking the **VOUT_EN** and **TEMP1_EN** boxes in the **PMON_CONFIG** register as shown in Figure 11. Click the **PC to RAM** button to transfer the settings to the ADM1273.

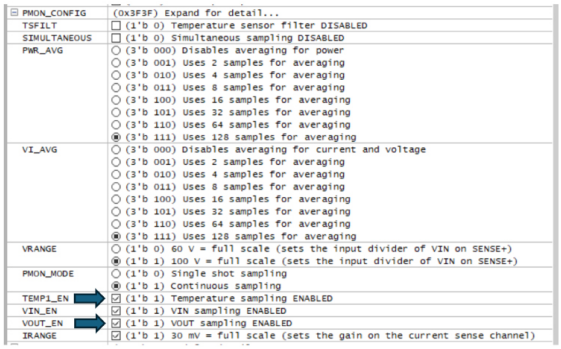

Figure 11. ADM1273 PMON_CONFIG Register in LTpowerPlay

LAB TEST WAVEFORMS

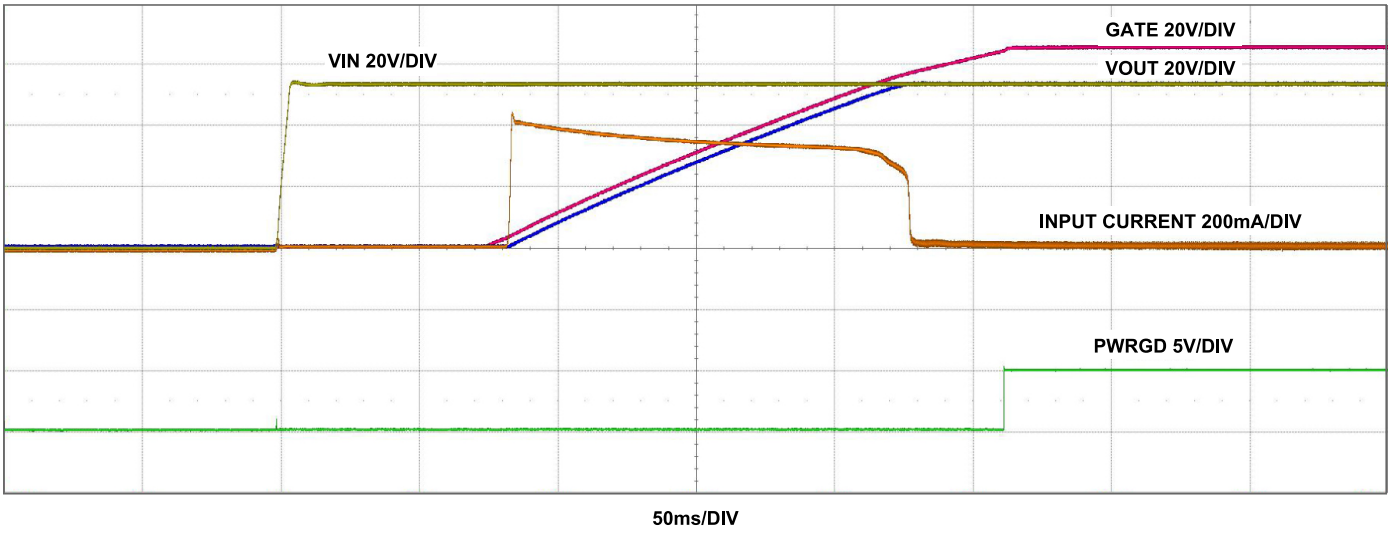

Figure 12. Input Powerup Triggered Startup with 1mF Output Capacitor and No DC Load

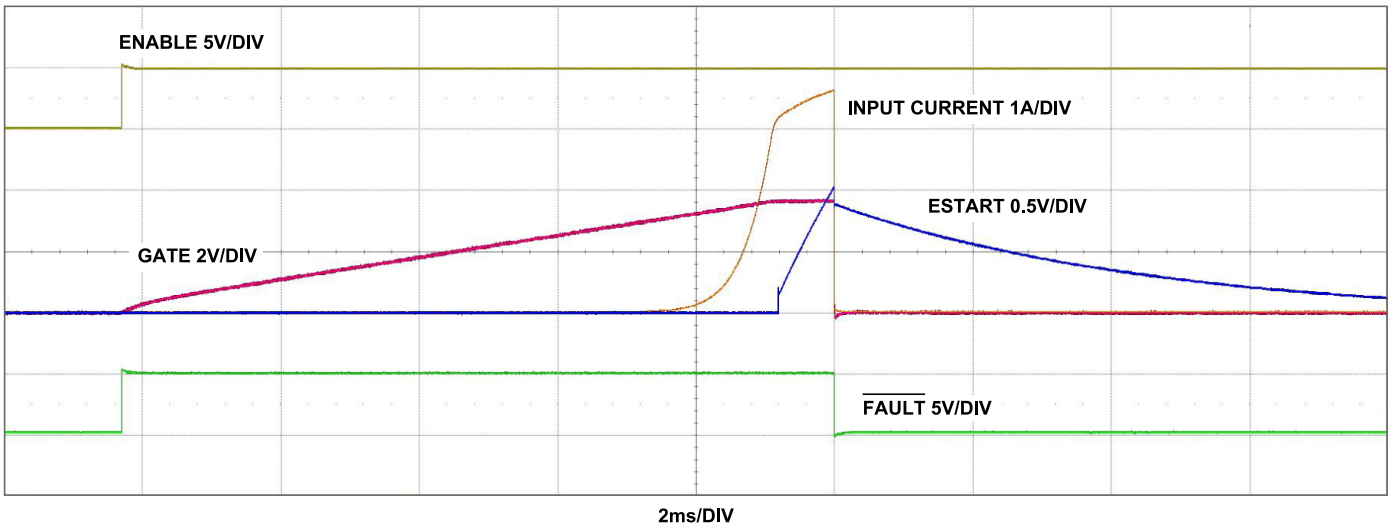

Figure 13. ENABLE Triggered Startup with Fault Turn-Off Due to Shorted Output

LAB TEST WAVEFORMS

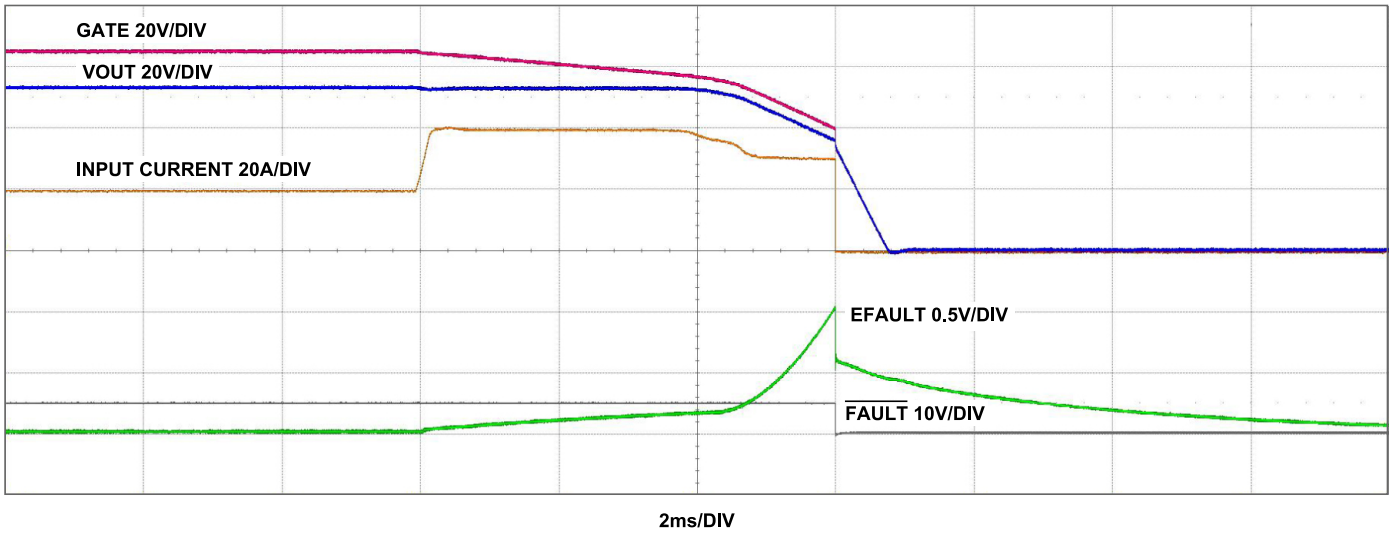

Figure 14. Overload Fault Turn-Off When 20A Load Steps to 40A During Normal Operation

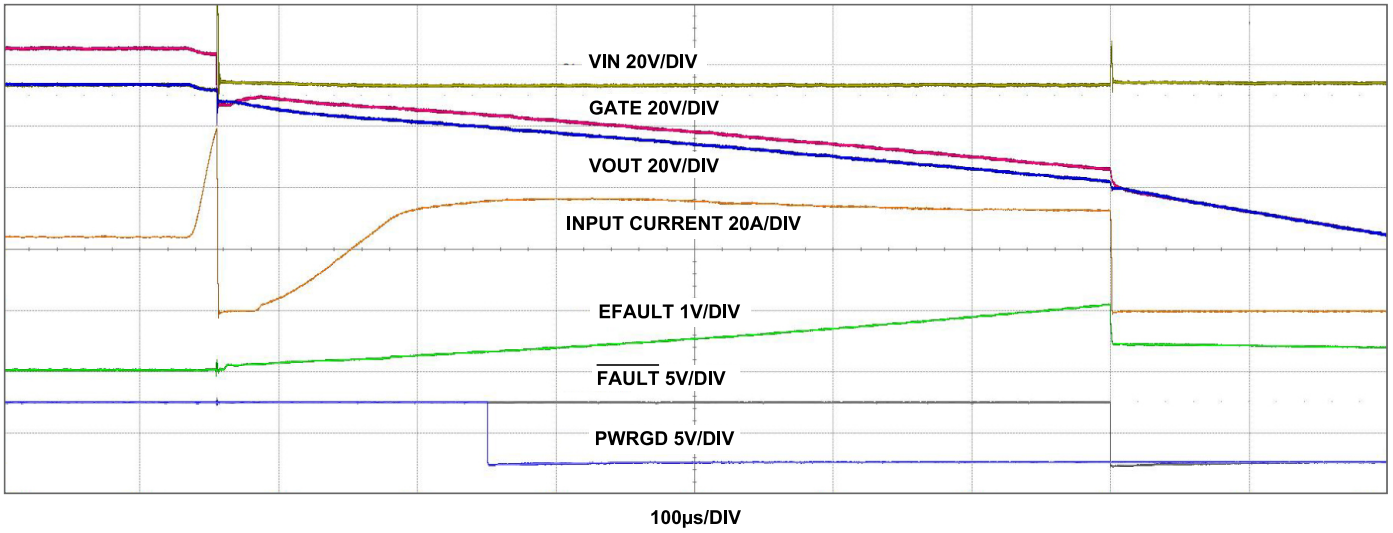

Figure 15. Severe Overcurrent Fault Turn-Off When 24A Load Steps to 70A During Normal Operation

LAB TEST WAVEFORMS

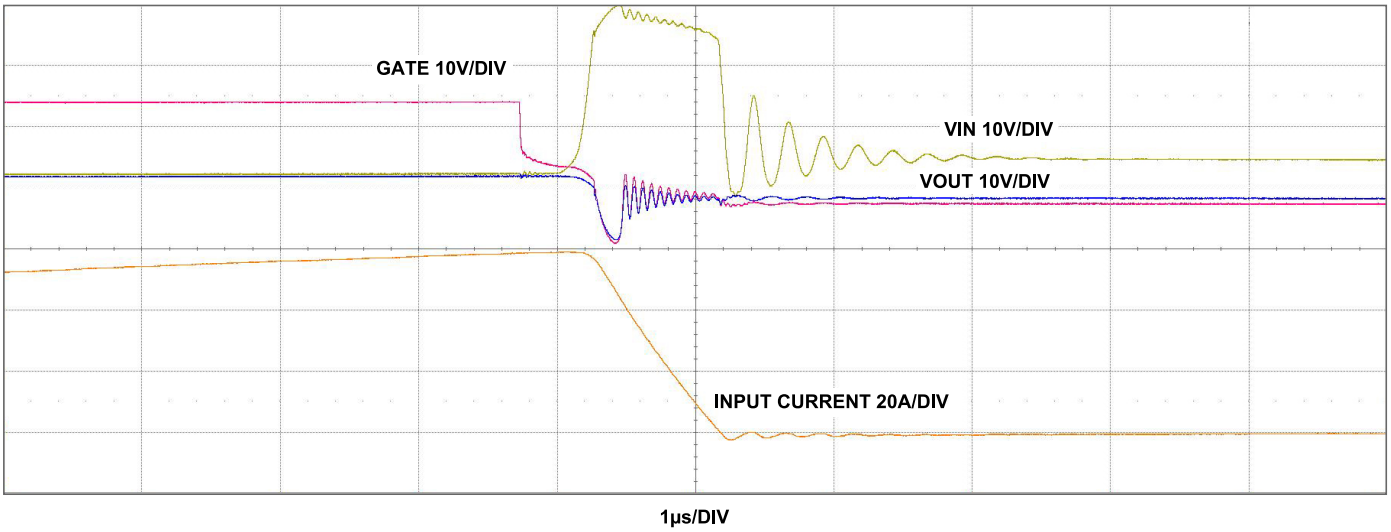

Figure 16. Severe Overcurrent Response Zoom-In

BOARD SCHEMATIC

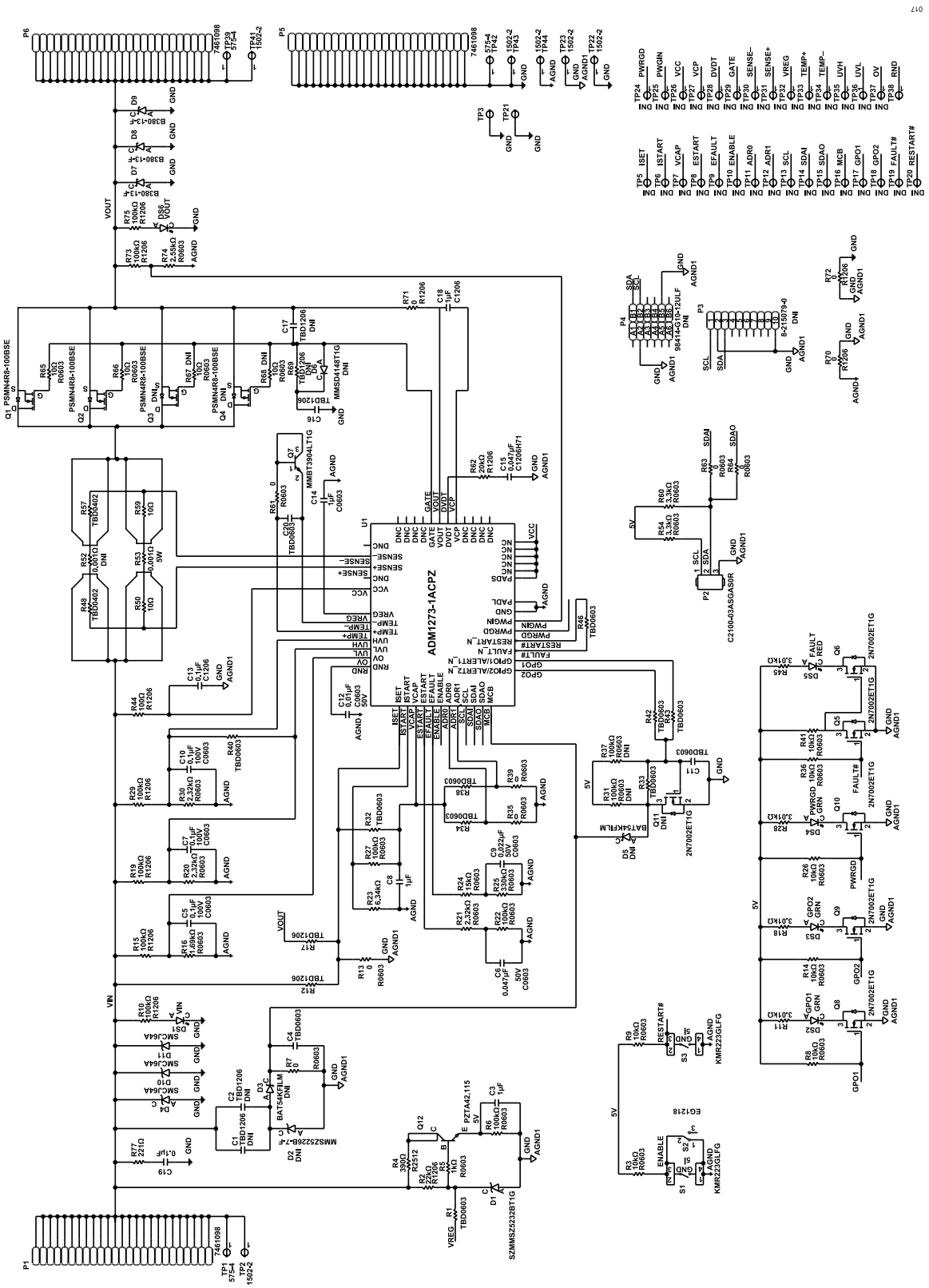

Figure 17. EVAL-ADM1273-AZ Schematic

BOARD LAYER PLOTS

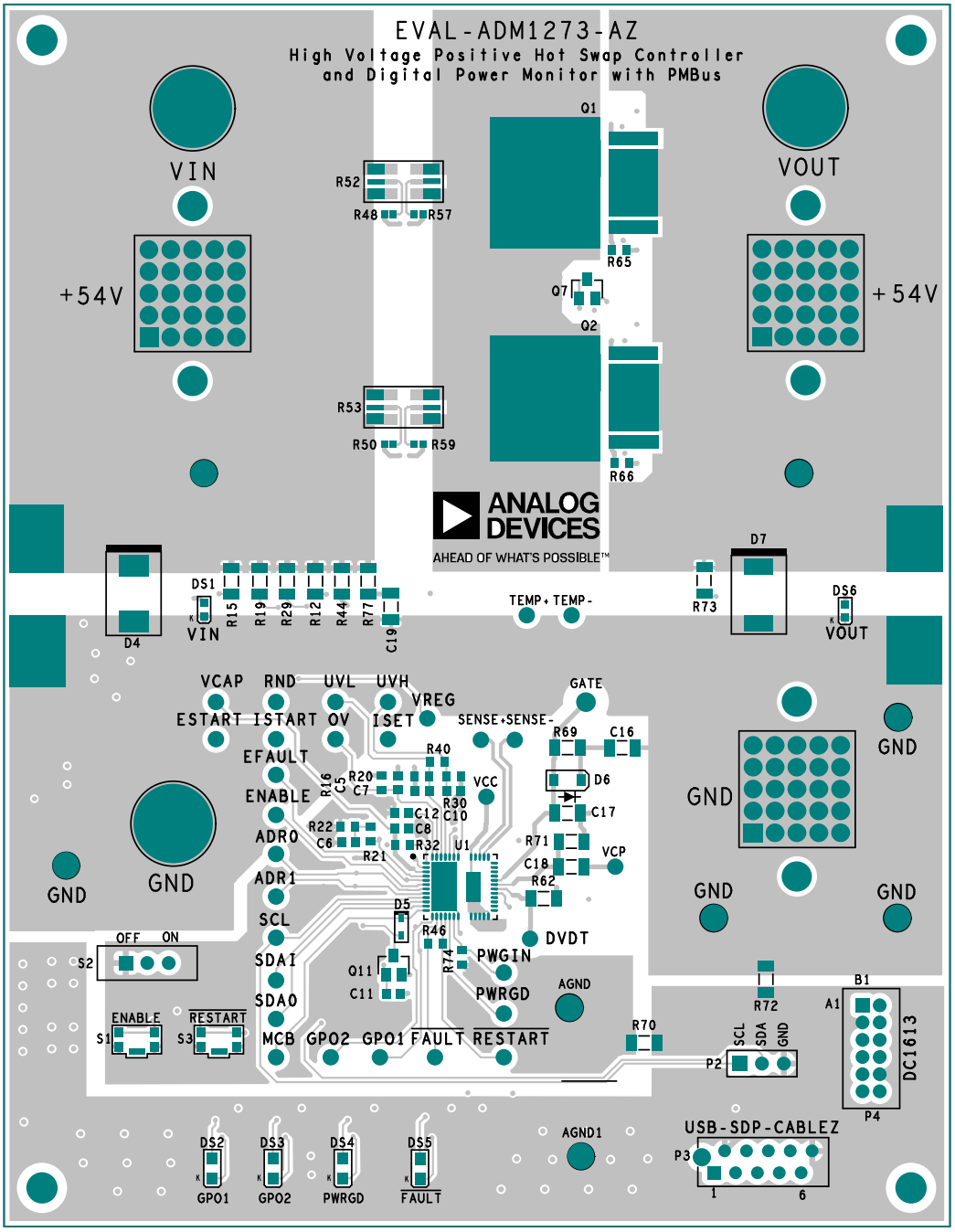

Figure 18. EVAL-ADM1273-AZ Top Layer

BOARD LAYER PLOTS

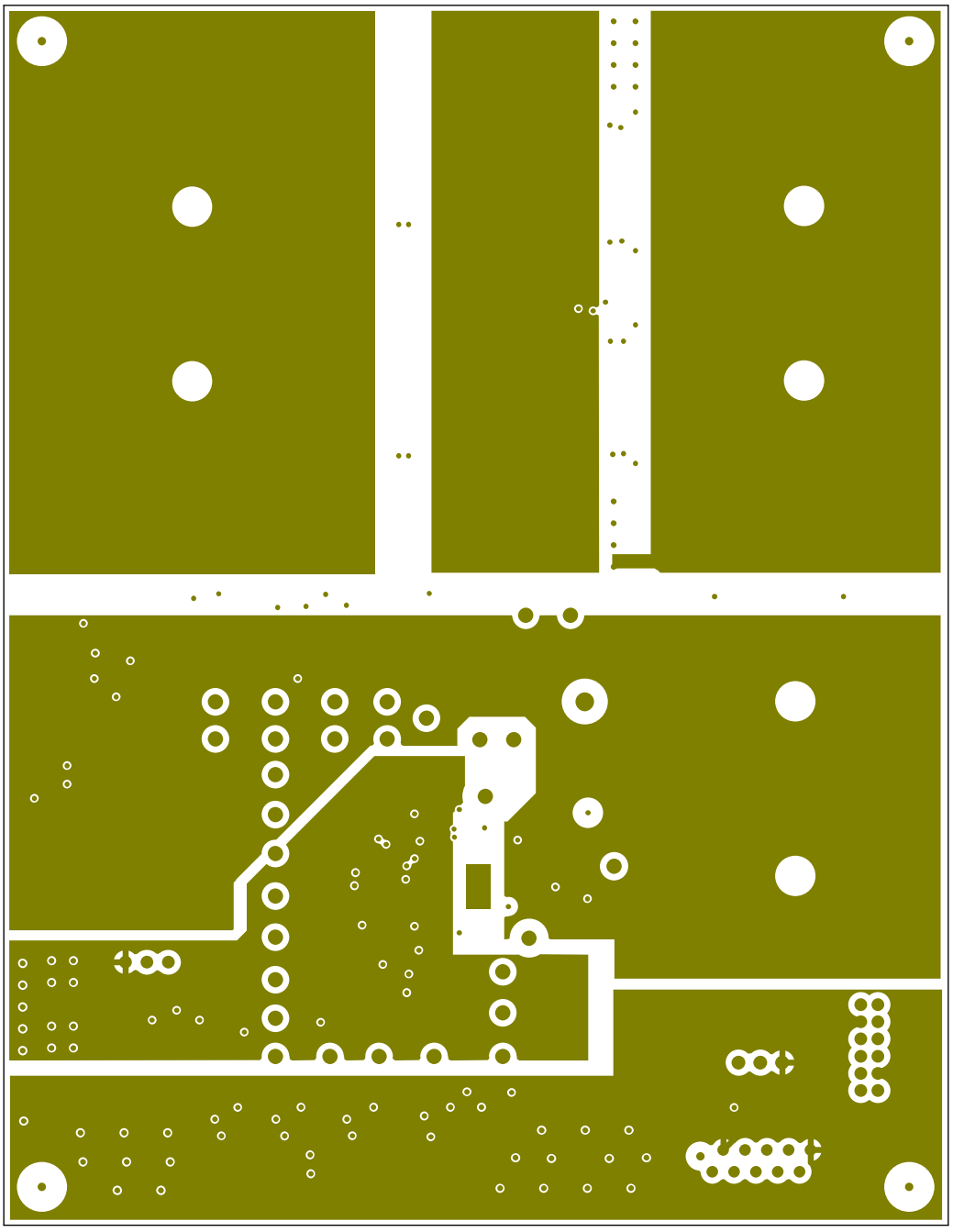

Figure 19. EVAL-ADM1273-AZ Layer 2

BOARD LAYER PLOTS

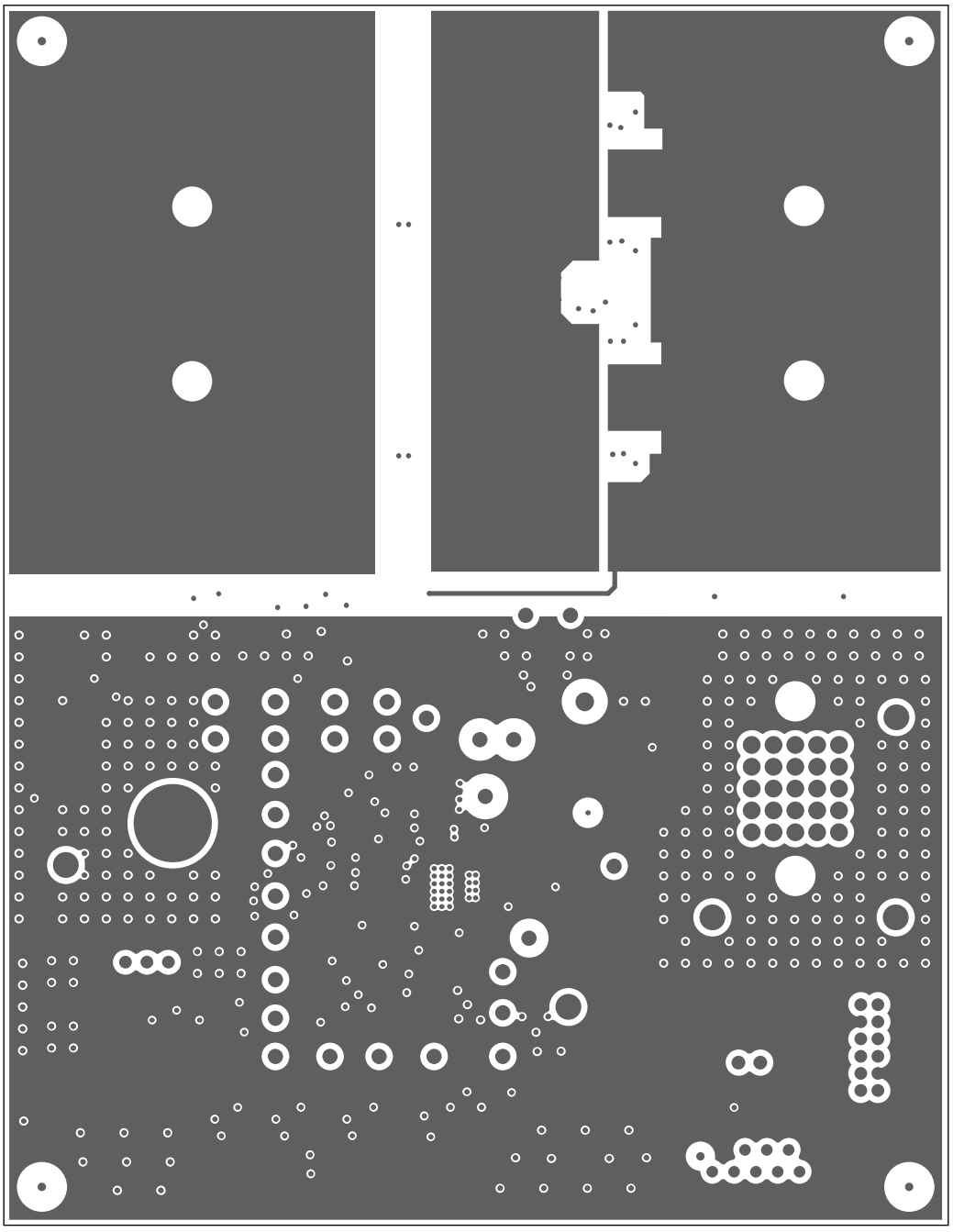

Figure 20. EVAL-ADM1273-AZ Layer 3

BOARD LAYER PLOTS

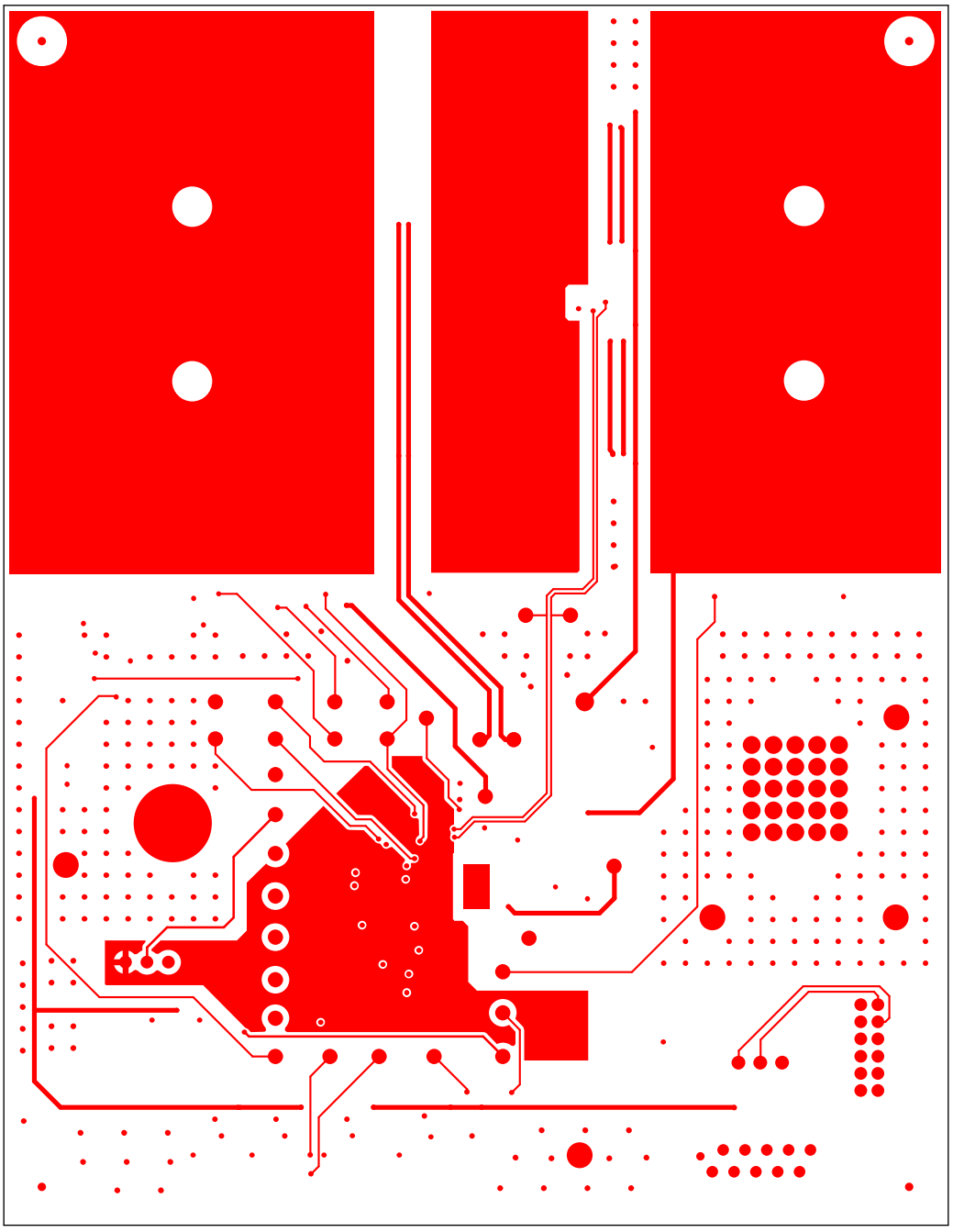

Figure 21. EVAL-ADM1273-AZ Layer 4

BOARD LAYER PLOTS

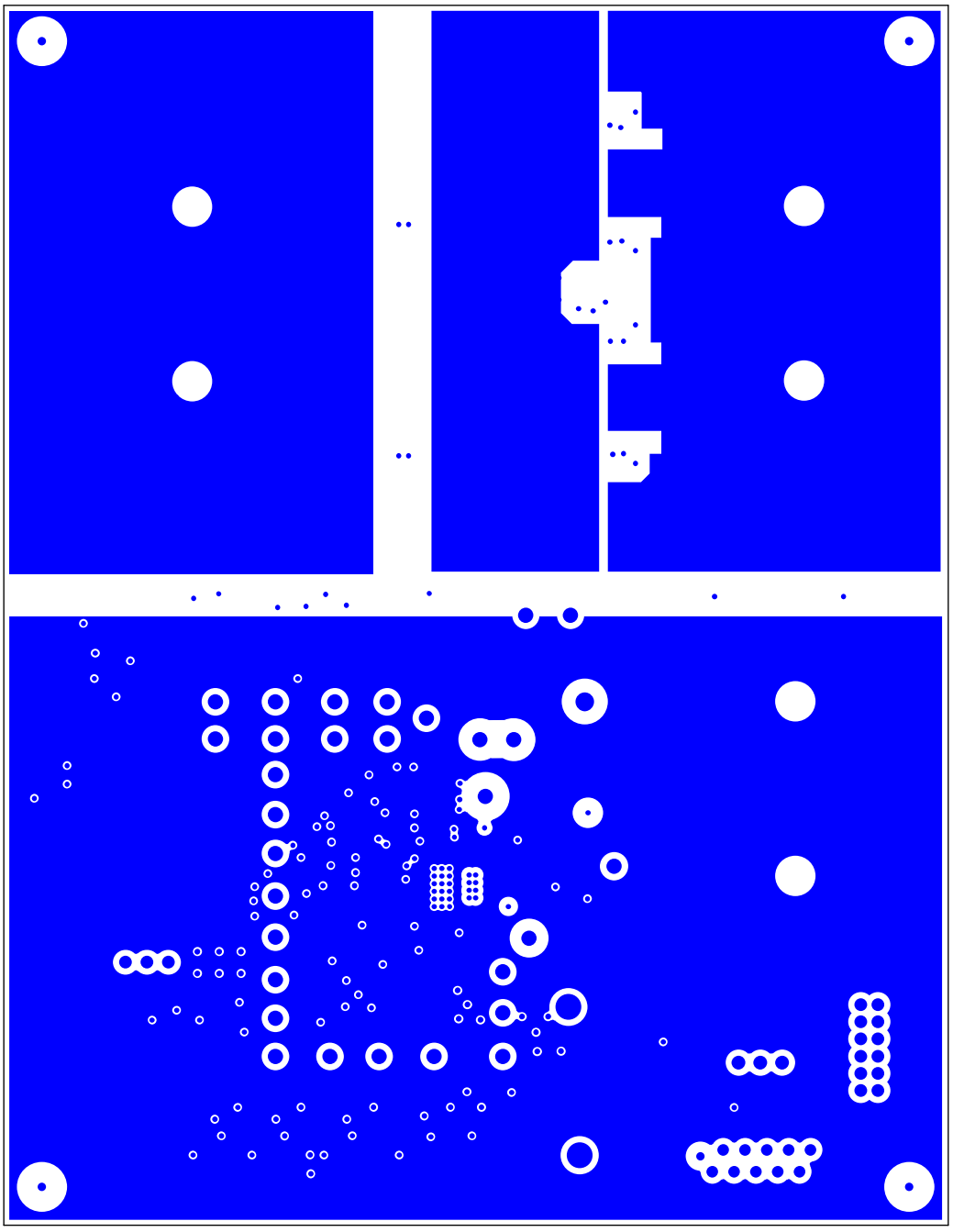

Figure 22. EVAL-ADM1273-AZ Layer 5

BOARD LAYER PLOTS

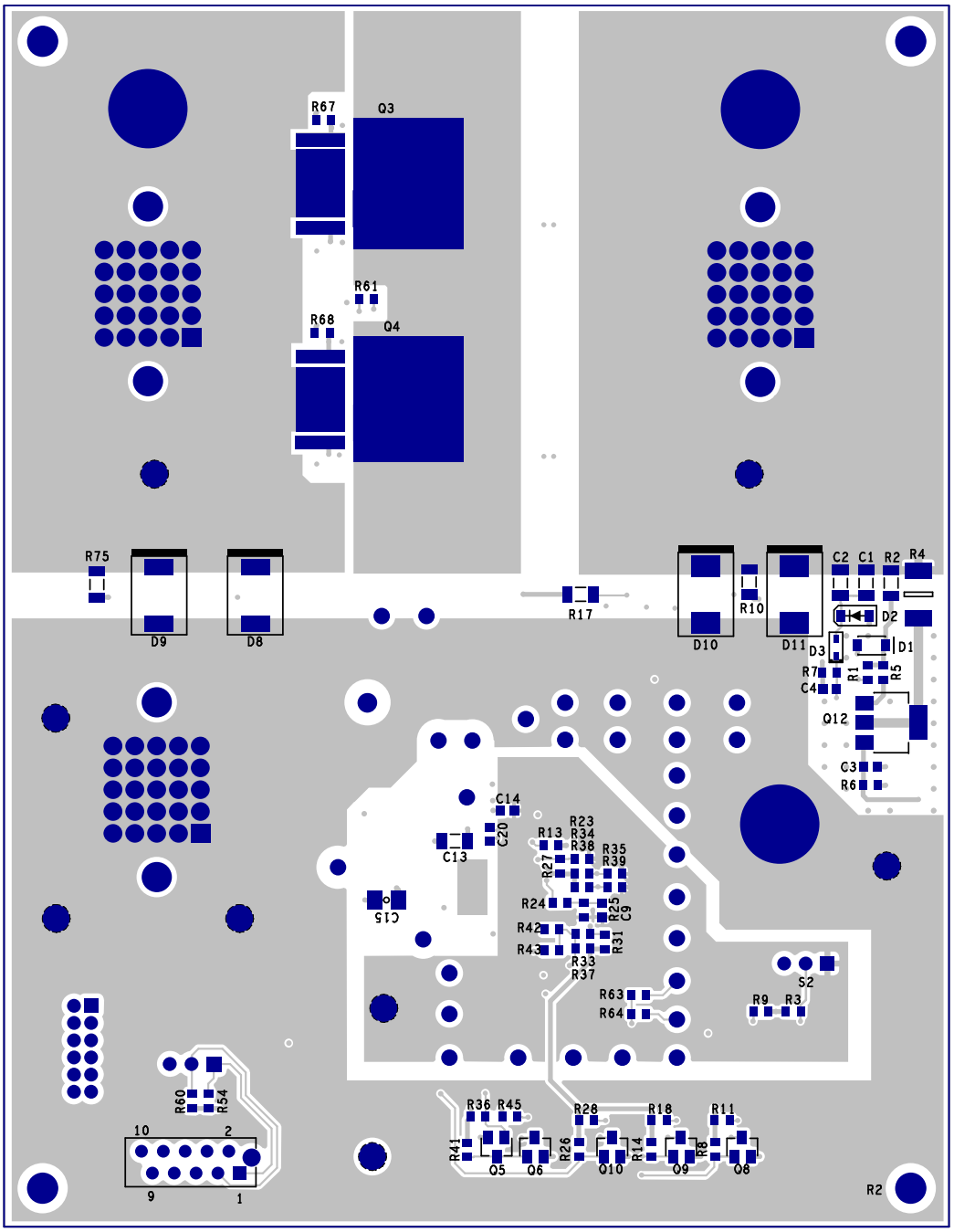

Figure 23. EVAL-ADM1273-AZ Bottom Layer

ORDERING INFORMATION

EVALUATION BOARD

Model[1]	Description
EVAL-ADM1273-AZ	Evaluation Board

[1] Z = RoHS Compliant Part.

BILL OF MATERIALS

Table 4. Bill of Materials

Reference Designator	Description	Manufacturer	Part Number[1]
C5, C7, C10	Capacitors, 0.1µF, 100V, 10%, X7R, 0603	Yageo	CC0603KRX7R0BB104
C12	Capacitor, 0.01µF, 50V, 10%, X8R, 0603	TDK	C1608X8R1H103K080AA
C13, C19	Capacitor, 0.1µF, 200V, 5%, X7R, 1206	Kemet	C1206C104J2RACTU
C3, C8, C14	Capacitors, 1µF, 25V, 10%, X7R, 0603	Wurth Electronik	885012206076
C15	Capacitor, 0.047µF, 200V, 10%, X7R, 1206	Kemet	C1206C473J2RACTU
C18	Capacitor, 1µF, 50V, 10%, X7R, 1206	Murata	GCJ31MR71H105KA12L
C6	Capacitor, 0.047µF, 50V, 10%, X8R, 0603	TDK	C1608X8R1H473K080AA
C9	Capacitor, 0.022µF, 50V, 10%, X7R, 0603	AVX	06035C223KAZ2A
D1	Diode, Zener, 5.6V, 5%, 0.5W	Onsemi	SZMMSZ5232BT1G
D4, D10, D11	Diodes, TVS, 64V, 1500W, DO-214AB	Littelfuse, Inc.	SMCJ64A
D7, D8, D9	Diodes, Schottky, 80V, 3A, DO-214AB	Diodes Incorporated	B380-13-F
DS1, DS6	LEDs, green, water-clear, 0603	Wurth Electronik	150060GS75000
DS2, DS3, DS4	LEDs, green, water-clear, 0805	Wurth Electronik	150080VS75000
DS5	LED, red, water-clear, 0805	Wurth Electronik	150080RS75000
MP1, MP2, MP3, MP4	Hex nut, 1/4", 4-40 thread, nylon	Keystone	9605
MP5, MP6, MP7, MP8	Hex standoff, 1/2", 4-40 thread, nylon	RAF Electronic Hardware	4534-440-N
P1, P5, P6	Connectors, press-fit through hole, M6, 25-pin	Wurth Electronik	7461098
P1, P5, P6	Hex nut, 0.394", M6	B&F Fastener Supply	MHNZ 006
P1, P5, P6	Washer, flat, steel, M6	B&F Fastener Supply	MFWZ 006
P2	Connector, header, unshrouded 3-pos male single row, 2.54mm pitch	Hsuan Mao Tech Co Ltd	C2100-03ASGAS0R
P4	Connector, header, shrouded male, 2 × 6, 2mm, vertical, through-hole	Amphenol FCI	98414-G10-12ULF
Q1, Q2	N-channel MOSFETs, 100V, 4.8mΩ, D2PAK	Nexperia	PSMN4R8-100BSE
Q5, Q6, Q8, Q9, Q10	N-channel MOSFETs, 60V, 300mA, SOT-23-3 (TO-236)	Onsemi	2N7002ET1G
Q12	NPN, 300V, 0.1A, SOT-223	Nexperia	PZTA42,115
Q7	NPN, 40V, 200mA, SOT23-3	Onsemi	MMBT3904LT1G
R10, R15, R19, R29, R73, R75	Resistors, 100kΩ, 1%, ¼W, 1206	Panasonic	ERJ-8ENF1003V
R11, R18, R28, R45	Resistors, 3.01kΩ, 1%, 1/10W, 0603	Panasonic	ERJ-3EKF3011V
R7, R13, R35, R39, R61, R63, R64	Resistors, 0Ω, 1/10W, 0603	Panasonic	ERJ-3GEY0R00V
R3, R8, R9, R14, R26, R36, R41	Resistors, 10kΩ, 1%, 1/10W, 0603	Panasonic	ERJ-3EKF1002V
R16	Resistor, 1.69kΩ, 1%, 1/10W, 0603	Yageo	RC0603FR-071K69L
R2	Resistor, 22kΩ, 1%, ¼W, 1206	Vishay	CRCW120622K0FKEA
R20, R21, R30	Resistors, 2.32kΩ, 1%, 1/10W, 0603	Panasonic	ERJ-3EKF2321V
R6, R22, R27	Resistors, 100kΩ, 1%, 1/10W, 0603	Bourns	CR0603-FX-1003ELF
R23	Resistor, 6.34kΩ, 1%, 1/10W, 0603	Panasonic	ERJ-3EKF6341V
R24	Resistor, 15kΩ, 1%, 1/10W, 0603	Yageo	RC0603FR-0715KL
R25	Resistor, 330kΩ, 1%, 1/10W, 0603	Panasonic	ERJ-3EKF3303V
R4	Resistor, 390Ω, 5%, 1W, 2512	TE Connectivity	4-1622820-1
R44	Resistor, 100Ω, 1%, ¼W, 1206	Panasonic	ERJ-8ENF1000V
R50, R59	Resistors, 10Ω, 1%, 1/10W, 0402	Panasonic	ERJ-2RKF10R0X
R5	Resistor, 1kΩ, 1%, 1/10W, 0603	Panasonic	ERJ-3EKF1001V
R53	Resistor, 0.001Ω, 1%, 5W, 2512	Bourns	CSS2H-2512R-1L00FE

ORDERING INFORMATION

Table 4. Bill of Materials (Continued)

Reference Designator	Description	Manufacturer	Part Number[1]
R54, R60	Resistors, 3.3kΩ, 1%, 1/10W, 0603	Vishay	CRCW06033K30FKEA
R62	Resistor, 20kΩ, 1%, ¼W, 1206	Panasonic	ERJ-8ENF2002V
R65, R66	Resistors, 10Ω, 1%, 1/10W, 0603	Vishay	CRCW060310R0FKEA
R70, R71, R72	Resistors, 0Ω, ¼W, 1206	Yageo	RC1206JR-070RL
R74	Resistor, 2.55kΩ, 1%, 1/10W, 0603	Panasonic	ERJ-3EKF2551V
R77	Resistor, 221Ω, 1%, ¼W, 1206	Panasonic	ERJ-8ENF2210V
S1, S3	Switches, tactile, SPST-NO, 0.01A, 32V	C&K	KMR223GLFG
S2	Switch, PC mount, slide switch	E-Switch	EG1218
TP1, TP39, TP42	Connectors, banana jack, female, THT, non-insulated, swage, 0.218"	Keystone Electronics	575-4
TP2, TP3, TP21, TP22, TP23, TP41, TP43, TP44	Test points, turret	Keystone Electronics	1502-2
U1	IC, high-voltage hot-swap controller and power monitor with PMBus	Analog Devices	ADM1273-1ACPZ

[1] Equivalent parts may be substituted. Optional parts not listed.

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.