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Evaluating the ADM1272 High Voltage Positive Hot Swap Controller and Digital Power Monitor with PMBus

FEATURES

Fully functional support evaluation kit for the ADM1272
Populated and tested with 48 V, 30 A, 1 mF design
40 V undervoltage and 60 V overvoltage settings
Custom N-MOSFET footprint suits different packages
Supports up to 2 sense resistors in parallel
Supports up to 4 FETs in parallel
LED indicated status outputs
Wide input voltage range: 16 V to 80 V
120 V absolute maximum
FET temperature measurement capability
Supports cascade setup for multiple boards
Toggle and push-button switch for easy input control
PMBus (I^2C) communication supported

PACKAGE CONTENTS

EVAL-ADM1272EBZ evaluation board

ADDITIONAL HARDWARE NEEDED

Serial input/output interface, USB-SDP-CABLEZ (not included in the evaluation kit, must be ordered separately)
Only one dongle is required in multiple board cascade setup

SOFTWARE NEEDED

Analog Devices, Inc., hot swap and power monitoring evaluation software (download from ADM1272 product page)

GENERAL DESCRIPTION

The EVAL-ADM1272EBZ is a compact, full featured evaluation board for the ADM1272. 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.

Two sense resistor slots and four (two on the bottom side) multipackage FET slots 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 on variations in the board status, such as supply input, output, GPIO1, GPIO2, power good, and fault.

The kit supports PMBus™ communication, allowing the user to communicate with the ADM1272. The evaluation kit also supports cascade setup so that multiple evaluation boards can be connected together and share the same PMBus.

The boards are fully compatible with the ADM1272 evaluation software, which can be downloaded from the ADM1272 product page.

A USB-to-I^2C dongle (USB-SDP-CABLEZ) is required to use the evaluation software.

The standard evaluation kit is prepopulated and tested with a 48 V, 30 A hot swap design capable of working with a 1 mF output capacitor.

Complete specifications for the ADM1272 are available in the ADM1272 data sheet, which must be consulted in conjunction with this user guide when using the evaluation board.

TABLE OF CONTENTS

REVISION HISTORY

4/2017—Revision 0: Initial Version

EVALUATION BOARD PHOTOGRAPH

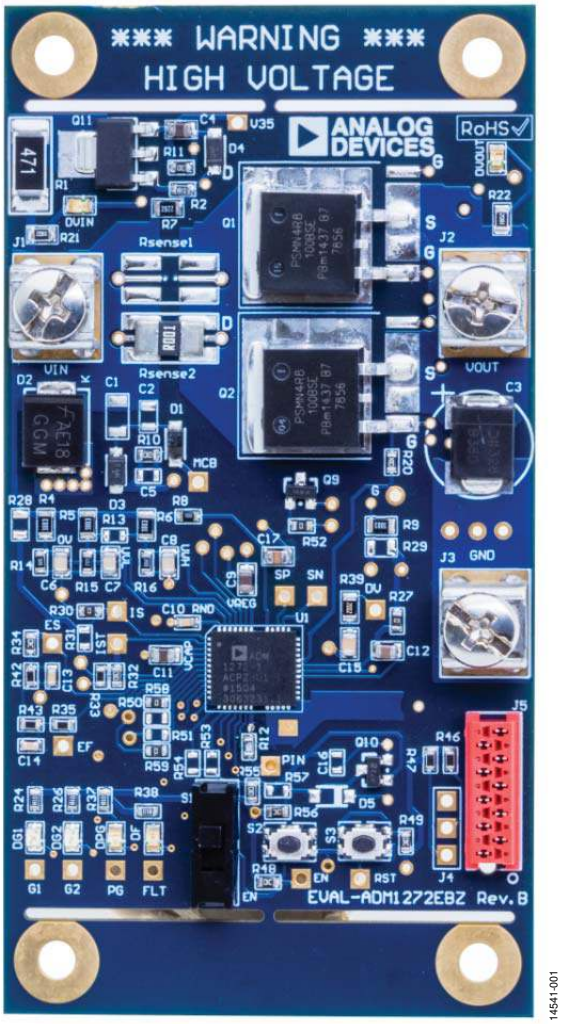

Figure 1.

QUICK START GUIDE

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

1. Download the hot swap and power monitoring software from the ADM1272 product page (see the UG-353 for more information).
2. Connect the evaluation board (EVAL-ADM1272EBZ) to a PC through the 10-way connector and the USB-to-I²C dongle (USB-SDP-CABLEZ).
3. Connect the power supply to the evaluation board using thick wires suitable for the current levels to be observed.
4. To confirm that the boards are configured correctly, set the output of the power supply to 48 V with less than 1 A current limit and with no load capacitance. If the boards are configured correctly, the green LED (labeled PWRGD) on the evaluation board illuminates.
5. Push the ENABLE switch to the off position or press the push button on the evaluation board. The green LED (labeled PWRGD) turns off and then turns back on again when reenabled.
6. The restart signal can be provided using the RST switch (S3). Pressing this switch disables the output, and it is automatically reenabled after the restart time has elapsed (default is approximately 10 sec).
7. If a fault event occurs (for example, a short circuit during operation), the red LED (labeled $\overline{\text{FAULT}}$) illuminates. This fault can be cleared by toggling the ENABLE pin after the fault condition has been removed.
8. Disable the hot swap using the **Hot Swap Control** section in the **Basic Operation** tab of the software graphical user interface (GUI). Disabling the hot swap turns off the green LED (labeled PWRGD) on the evaluation board.
9. Manually program the sense resistor value, if required, using the options in the GUI.
10. Check that the voltage and current measurements are as expected (for example, VIN = 48 V) in the **Power Monitor** tab of the software GUI.

EVALUATION BOARD DESCRIPTION

The EVAL-ADM1272EBZ evaluation board is designed to demonstrate several features of the ADM1272. A simplified diagram of the evaluation board is shown in Figure 2.

The evaluation board is connected to a PC using a USB-to-I²C dongle (USB-SDP-CABLEZ) for PMBus communication. The evaluation board is shown in Figure 1.

To minimize inductance and losses, use appropriately rated wires between the power supply, the evaluation board connectors, and the load. There is only one GND connector, so the main system current does not normally flow through the evaluation board.

CONFIGURATION

The EVAL-ADM1272EBZ evaluation board is configured to operate between 40 V and 60 V, with a current limit of 30 A. Loads with up to 1000 µF of capacitance can be connected. This capacitance is not included on the board, because it is intended to be plugged into a system where load capacitance already exists. If load capacitance does not already exist, add capacitance across the load using the J2 (VOUT) and J3 (GND) connectors, or solder across D6 and/or on the bottom side pads under D6. To prevent faults at power up, take care to avoid any dc loads being enabled until after PWRGD is asserted.

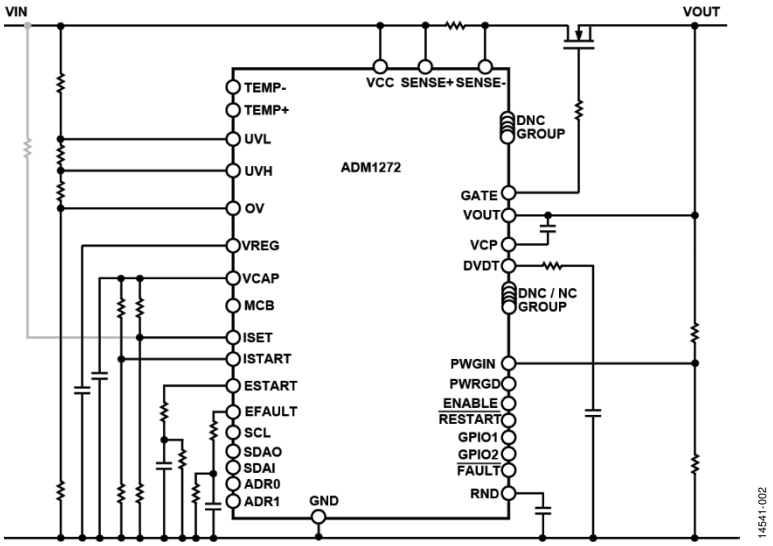

Figure 2. Basic ADM1272 Connection Diagram

MOSFETS

The EVAL-ADM1272EBZ uses a custom MOSFET footprint, shown in Figure 3, to accommodate a variety of common MOSFET packages. Examples include D2PAK, DPAK, LFPAK, and other SO-8 variants.

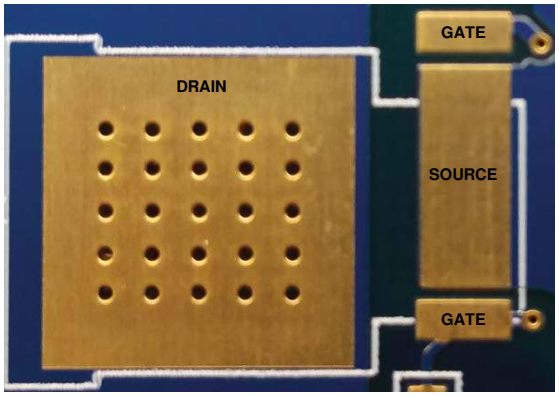

Figure 3. Multipackage N-Channel MOSFET Footprint

SENSE RESISTORS

For optimum current sensing accuracy with standard 2512 sense resistors, the footprint shown in Figure 4 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 outer edge of the resistor (labeled A in Figure 4). Alternatively, the user can configure the sense connections to be made through center locations (labeled B in Figure 4), which may yield better results for certain resistor types. The board can be configured through the eight resistors located on the underside of the printed circuit board (PCB), directly under the sense resistors. R7O, R8O, R17O, and R18O connect the outside vias (labeled A in Figure 4), and R7I, R8I, R17I, and R18I connect the inside vias (labeled B in Figure 4). The outside vias are connected by default.

Sense resistors must be tested independently. It is the responsibility of the user to ensure that the layout dimensions and structure of the footprint comply with individual SMT manufacturing requirements.

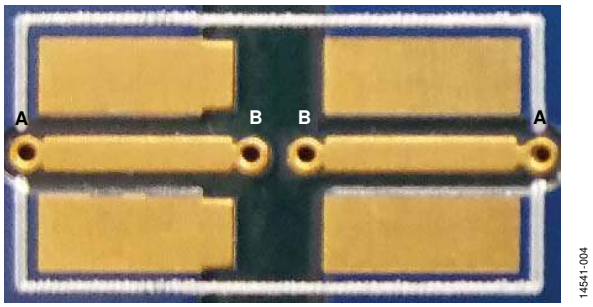

Figure 4. Sense Resistor—Kelvin Footprint

BOARD SPECIFICATIONS

Table 1.

Parameter	Typical Value	Unit
Load Capacitance	1000	µF
Severe Circuit Breaker Current	60	A
Normal Current Limit	30	A
Start-Up Current Limit	4	A
Maximum Ambient Temperature	60	°C
Undervoltage (UV) Falling Threshold (UVL)	39.7	V
UV Rising Threshold (UVH)	41.2	V
Overvoltage (OV) Rising Threshold	60	V
PWRGD Falling Threshold	40.2	V

EVALUATION BOARD HARDWARE

CONNECTOR, SWITCH, AND LED FUNCTIONS

Table 2. Connector Functions

Connector	Description
J1	Hot swap line voltage input, which also powers the board. Input voltage is 40 V to 60 V.
J2	Hot swap line voltage output. Connect to load.
J3	GND connector.
J4	Can be used to connect PMBus nodes to system host or dongle. Pin 1 is SCL. Pin 2 is SDA. Pin 3 is GND (top).
J5	10-way connector for USB-SDP-CABLEZ PMBus connection.

Table 3. Switch Functions

Switch	Description
S1	Toggle switch for the ENABLE pin. Up means on.
S2	Push-button switch for the ENABLE pin. Push to reset.
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 4. LED Functions

LED	Description
DVIN	Board input power; green.
DVOUT	Board output power; green.
DPG	Power good; green (LED on means PWRGD high).
DF	$\overline{\text{FAULT}}$; red (LED on means $\overline{\text{FAULT}}$ low).
DG1	GPO1; blue (LED on means GPIO1 high).
DG2	GPO2; blue (LED on means GPIO2 high).

EVALUATION BOARD SCHEMATICS AND ARTWORK

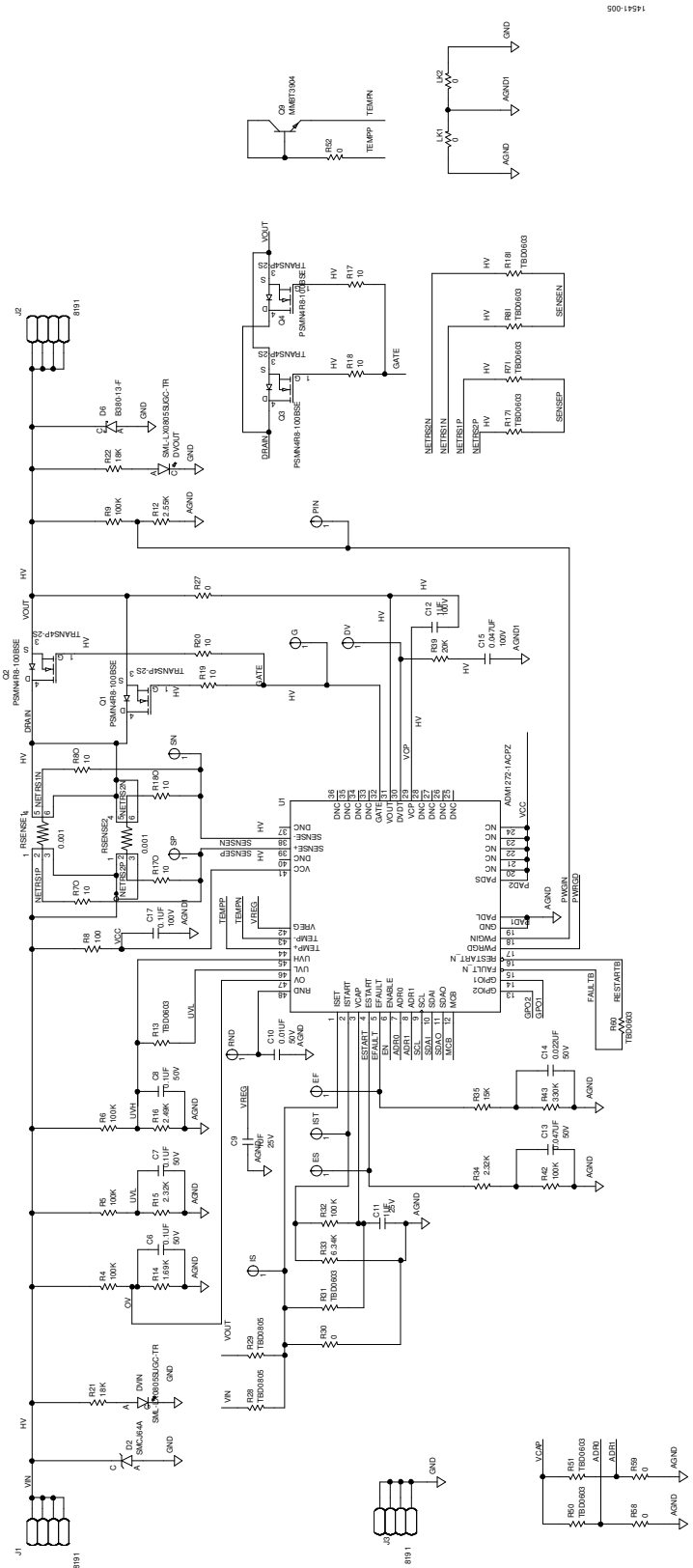

Figure 5. Evaluation Board Schematic—Main Circuitry

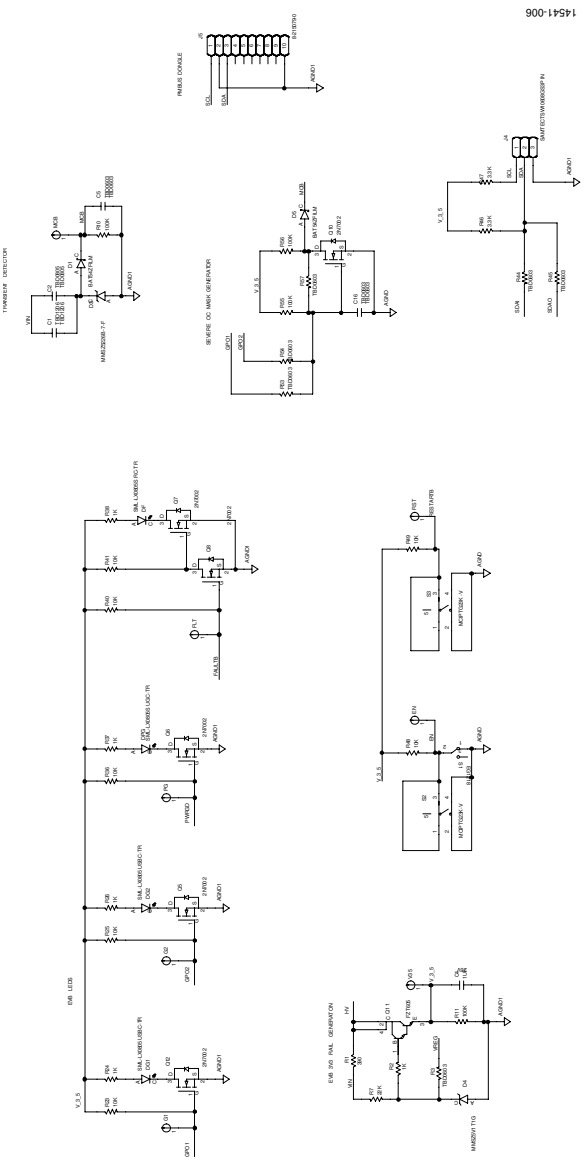

Figure 6. Evaluation Board Schematic—Connectors and Miscellaneous

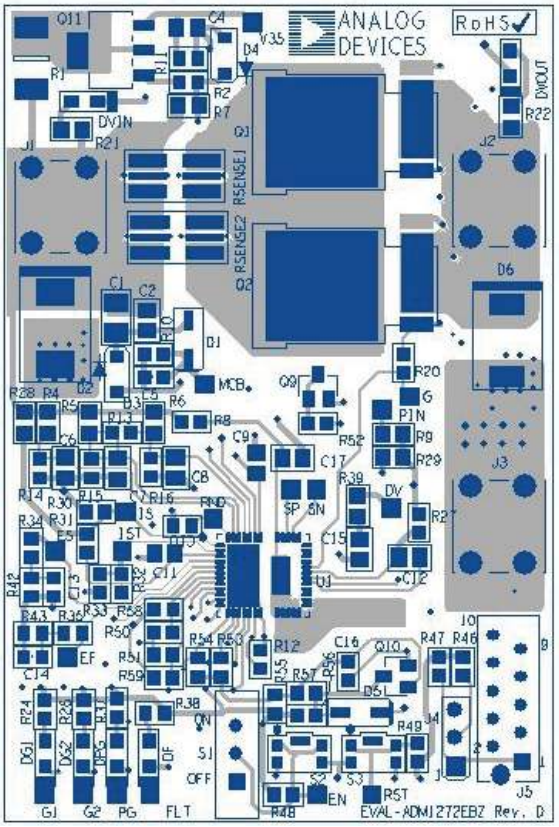

Figure 7. Top Layer 1

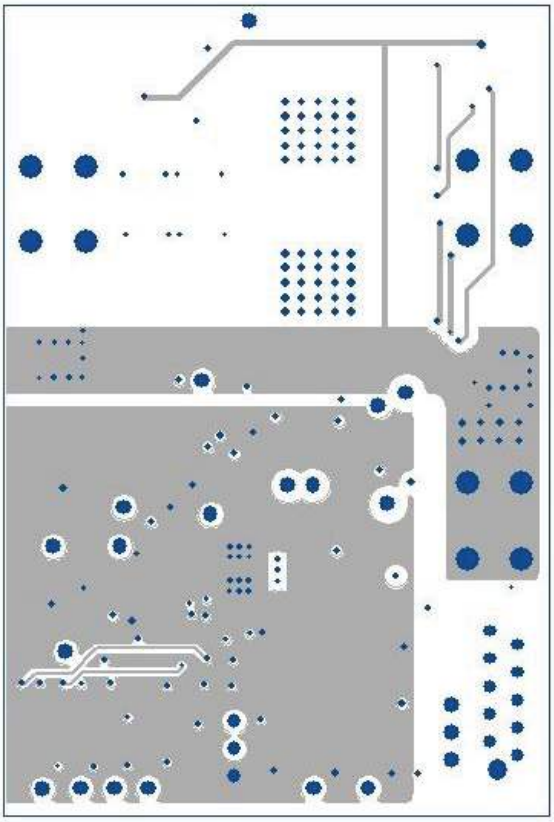

Figure 9. Inner Layer 3

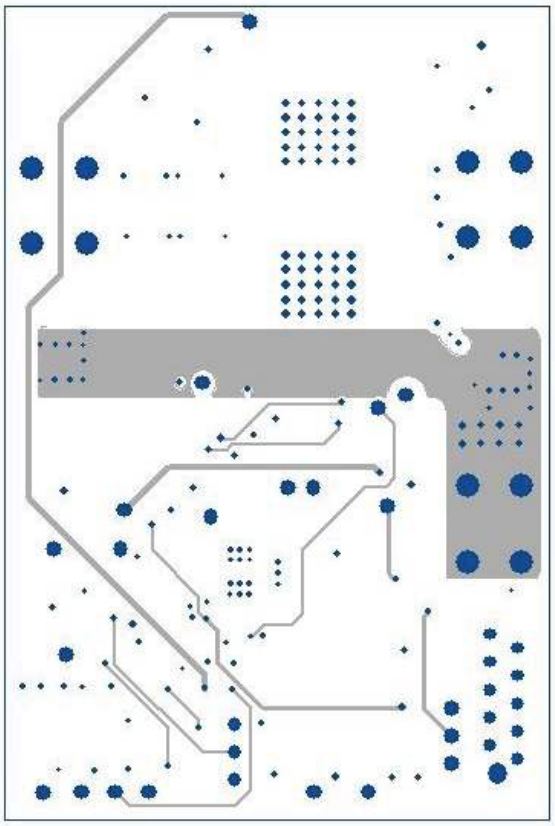

Figure 8. Inner Layer 2

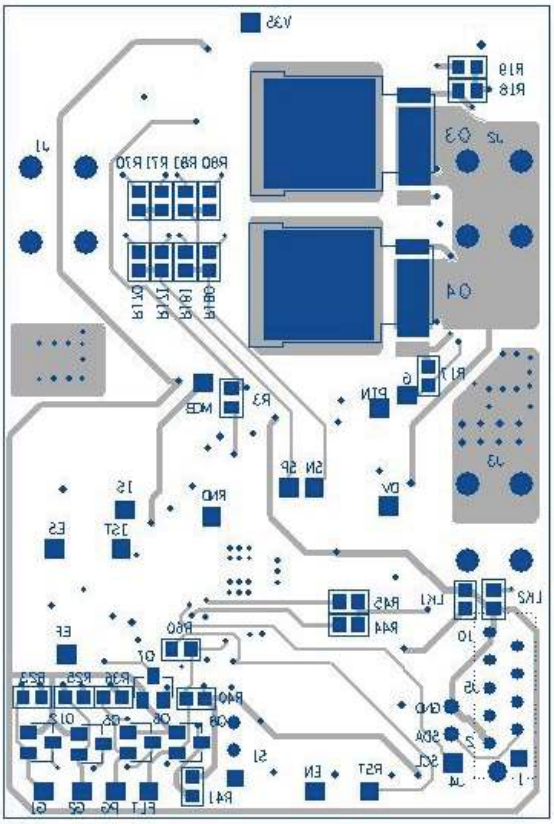

Figure 10. Bottom Layer

ORDERING INFORMATION

BILL OF MATERIALS

Table 5.

Reference Designator	Description	Manufacturer/Part Number
C1	Do not install (C1206)	Not applicable
C2	Do not install (C0805)	Not applicable
C4, C9, C11	Capacitor, chip, ceramic, X7R	Murata, GCM21BR71E105KA56L
C5, C16	Do not install (C0603)	Not applicable
C6 to C8	Capacitor, ceramic, X7R	Kemet, C0805C104J5RACTU
C10	Capacitor, ceramic, X7R	Murata, GRM188R71H103KA01D
C12	Capacitor, ceramic, X7S	TDK, C2012X7S2A105K125AB
C13	Capacitor, ceramic, 0603, X7R	Kemet, C0603X473K5RAC7867
C14	Capacitor, ceramic, X7R, 0603, 16 V, 10%	Yageo, 06035C223KAZ2A
C15	Capacitor, ceramic, X7R, commercial grade	Kemet, C0805C473K1RACTU
C17	Capacitor, ceramic, X7R	AVX, 08051C104JAT2A
D1, D5	Do not install (diode, Schottky)	STMicroelectronics, BAT54ZFILM
D2	Diode, TVS, unidirectional	Littelfuse, Inc., SMCJ64A
D3	Diode, Zener	Diodes, Inc., MMSZ5226B-7-F
D4	Diode, Zener, voltage regulator	ON Semiconductor, MMSZ5V1T1G
D6	Diode, Schottky, barrier rectifier, 3.0 A	Diodes, Inc., B380-13-F
DF	Diode, LED, red, clear, 660 nm wavelength peak	Lumex, Inc., SML-LX0805SRC-TR
DG1, DG2	Diode, LED, blue, clear, 470 nm wavelength peak	Lumex, Inc.,SML-LX0805USBC-TR
DPG, DVIN, DVOUT	LED, super ultragreen, water clear lens	Lumex, Inc., SML-LX0805SUGC-TR
G, DV, EF, EN, ES, G1, G2, IS, PG, SN, SP, FLT, IST, MCB, PIN, RND, RST, V35	Do not install (connector, PCB, PC board pin)	Not applicable
J1 to J3	Connector, PCB, screw terminal, vertical	Keystone, 8191
J4	Connector, PCB, Berg, header, straight, male, 3-pin	Samtec, TSW-103-08-G-S
J5	Connector, PCB, board to board and mezzanine, micromatch	TE Connectivity, 8-215079-0
LK1,LK2,R27,R30,R52,R58,R59,R44, R45	Resistor, film, SMD, 0603	Yageo, RC0603FR-072K49L
Q1, Q2	Transistor, N-channel, MOSFET, 0.0048 Ω, RDS-ON	NXP Semiconductors, PSMN4R8-100BSE
Q3, Q4	Do not install	NXP Semiconductors, PSMN4R8-100BSE
Q5 to Q8, Q10, Q12	Transistor, N-channel, enhance mode, FET	Fairchild, 2N7002
Q11	Transistor, NPN, Darlington	Diodes, Inc., FZT605
Q9	Transistor, MMBT3904, NPN, SOT-23	Fairchild, MMBT3904
R1	Resistor, power, SMD, 3520 series, 5%, 1 W, 2512	TE Connectivity, 3520390RJT
R10, R11, R32	Resistor, precision, thick film, chip	Panasonic, ERJ-3EKF1003V
R55, R56	Do not install	Panasonic, ERJ-3EKF1003V
R12	Resistor, metal film, high reliability	Panasonic, ERA-3AEB2551V
R3, R13, R31, R44, R45, R50, R51, R53, R54, R57, R60, R7I, R8I, R17I, R18I	Do not install (R0603)	Not applicable
R14	Resistor, film, SMD 0603	Panasonic, ERJ-3EKF1691V
R15, R34	Resistor, precision, thick film, chip, R0603	Panasonic, ERJ-3EKF2321V
R16	Resistor, general-purpose, chip	Yageo, RC0603FR-072K49L
R17 to R20, R7O, R8O, R17O, R18O	Resistor, precision, thick film, chip, R0603	Panasonic, ERJ-3EKF10R0V
R2, R24, R26, R37, R38	Resistor, precision, thick film, chip, R0603	Panasonic, ERJ-3EKF1001V
R21, R22	Resistor, metal film, chip	Panasonic, ERA-6AEB183V
R23, R25, R36, R40, R41, R48, R49	Resistor, thick film, chip	Panasonic, ERJ-3EKF1002V
R28, R29	Do not install (R0805)	Not applicable
R33	Resistor, precision, thick film, chip, R0603	Vishay, CRCW06036R34FKEA
R35	Resistor, metal film, high reliability	Panasonic, ERA-3YEB153V
R39	Resistor, film, SMD, 0805	Meggit, RN73C2A20KBTDF
R4 to R6, R9	Resistor, precision, thick film, chip, R0805	Panasonic, ERJ-6ENF1003V

Reference Designator	Description	Manufacturer/Part Number
R42	Do not install (R0603)	Not applicable
R43	Resistor, film, SMD, 0603	Susumi, RR0816P-334-D
R46, R47	Resistor, film, SMD, 0603	Panasonic, ERJ-3EKF3301V
R7	Resistor, film, SMD, 0805	Panasonic, ERJ-6ENF2202V
R8	Resistor, precision, thick film, chip, R0603	Panasonic, ERJ-3EKF1000V
RSENSE2	Resistor, customized pad layout of metal element current sense	TT Electronics, ULRG32512R001FLFSLT
RSENSE1	Do not install	Not applicable
S1	Switch, PC mount, slide switch	E-Switch, EG1218
S2, S3	Switch, tactile, SPST-NO	C&K Components, KMR211GLFS
U1	IC, high voltage positive swap controller and digital power monitor with PMBus	Analog Devices, Inc., ADM1272-1ACPZ

RELATED LINKS

Resource	Description
ADM1272	Product Page, High Voltage Positive Hot Swap Controller and Digital Power Monitor with PMBus

I²C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).