Evaluating the ADATE320 1.25 GHz Dual Integrated DCL with PPMU, Level Setting DACs, and On-Chip Calibration Registers

FEATURES

- Full feature evaluation board for the ADATE320
- Supply voltages: +12 V and −8 V on-board voltage regulators
- Signal input and output breakout through SMA connectors
- Differential pairs provided with 50 Ω-controlled impedance traces with equal lengths
- LED indicators for read and write data
- PC software for control through USB

EVALUATION KIT CONTENTS

- EVAL-ADATE320EBZ evaluation board

EQUIPMENT NEEDED

- PC running Windows®
- USB 2.0 port and USB 2.0 high speed A cable to B cable
- Benchtop power supplies and connector cables
- Data timing generator (DTG) or equivalent
- Oscilloscope

DOCUMENTS NEEDED

- ADATE320 data sheet

SOFTWARE NEEDED

- **ADATE320 Evaluation Board Software**

EVALUATION BOARD PHOTOGRAPH

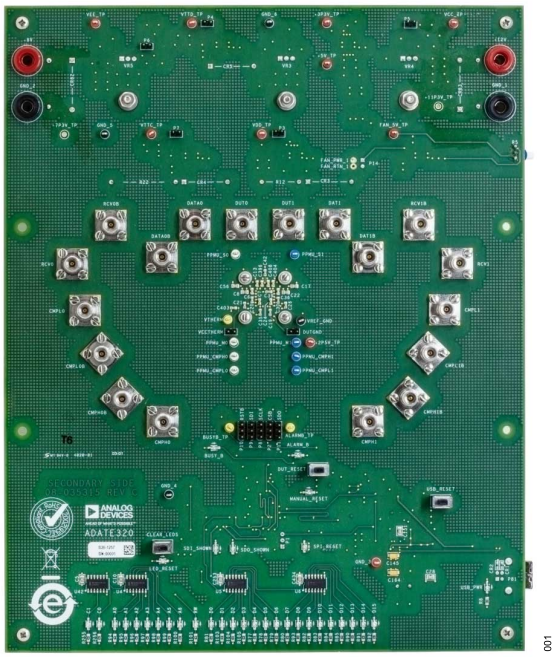

Figure 1. EVAL-ADATE320EBZ Evaluation Board

GENERAL DESCRIPTION

The EVAL-ADATE320EBZ is a full-featured evaluation board designed to allow the user to simply evaluate all features of the ADATE320 dual-integrated driver, comparator, and active load (DCL) with a per pin parametric measurement unit (PPMU). The EVAL-ADATE320EBZ features breakout connections through the Subminiature Version A (SMA) terminals for all of the signal inputs and outputs. The differential pairs are provided with 50 Ω-controlled impedance traces with equal lengths.

The EVAL-ADATE320EBZ only takes in +12 V and −8 V supplies, and the on-board regulators provide the required device supplies. The EVAL-ADATE320EBZ can be controlled through the on-board connectors or through the USB port of a Windows-based PC using the **ADATE320 Evaluation Board Software**, which is available for download on the EVAL-ADATE320EBZ product page. The default setup is for control through the USB port. Communication with the ADATE320 Evaluation Software is through the USB, and the light emitting diode (LED) indicators on the EVAL-ADATE320EBZ provide displays for the read and write data.

The ADATE320 data sheet provides full details on the ADATE320, as well as the information on each of the registers within the ADATE320, and must be consulted when using the EVAL-ADATE320EBZ.

PLEASE SEE THE LAST PAGE FOR AN IMPORTANT WARNING AND LEGAL TERMS AND CONDITIONS.

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REVISION HISTORY

5/2023—Revision 0: Initial Version

QUICK START GUIDE

To run the EVAL-ADATE320EBZ with the ADATE320 for the first time, take the following steps:

1. Install the software. Note that the **ADATE320 Evaluation Board Software** must be installed before connecting the EVAL-ADATE320EBZ or the USB communications may not function properly.
   a. To install the required USB drivers and software to the PC, download the **ADATE320 Evaluation Board Software** and run the **setup.exe** file. By default, all software, documentation, and setup files copy to **C:\ProgramData\Microsoft\Windows\Start Menu\Programs\ADATE320 Evaluation Board Software**.
2. Restart the PC.
3. Plug in the hardware.
   a. Turn the following power supplies on:
      - 12 V DC = 12 V
      - −8 V DC = −8 V
      - GND = 0 V
   b. Using a USB cable, connect the EVAL-ADATE320EBZ to the PC. Most Windows PCs automatically install the USB drivers the first time a powered FTDI chip is connected through the USB. However, the user can retrieve the drivers from the **FTDI Chip D2XX Direct Drivers** page, if required.
4. Open the **ADATE320 Evaluation Board Software** using one of the following options:
   - Select the **ADATE320 Evaluation Board Software** in the Windows **Start** menu (see Figure 2).

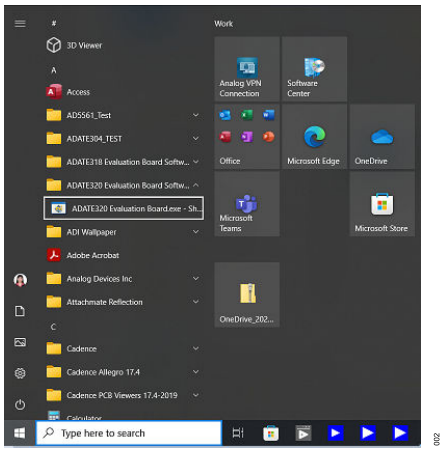

Figure 2. ADATE320 Evaluation Board Software in Start Menu

   - Search for the **ADATE320 Evaluation Board Software** using the Windows search feature, and then select the **ADATE320 Evaluation Board Software** in the results pane (see Figure 3).

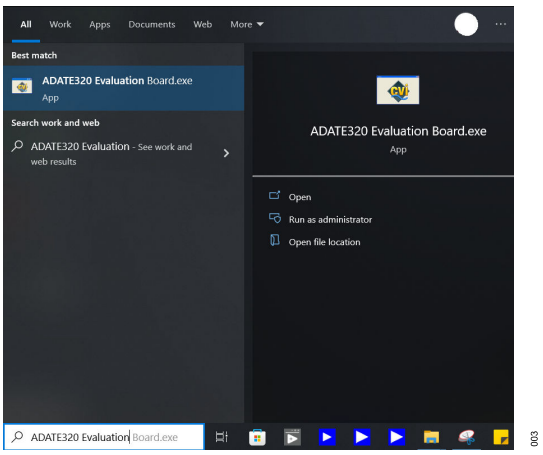

Figure 3. Windows Search

5. Verify that the PC is communicating with the hardware.
   a. When the **ADATE320 Evaluation Board Software** opens, the main window opens if there are no issues (see Figure 4). Otherwise, a command prompt indicating any error pops up. Figure 5 shows an example of an error prompt with four asterisks. Follow all the recommendations within the prompt window before attempting to start the software again.

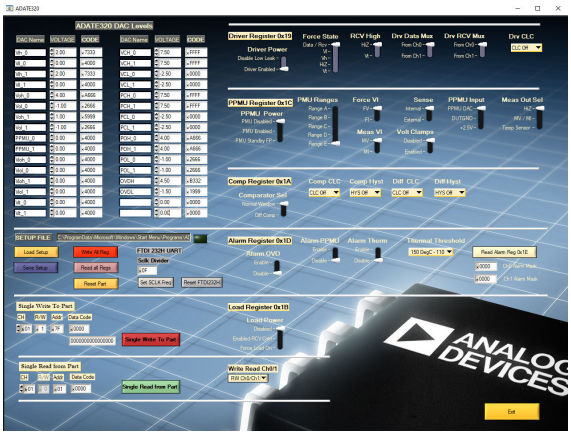

Figure 4. ADATE320 Main Window

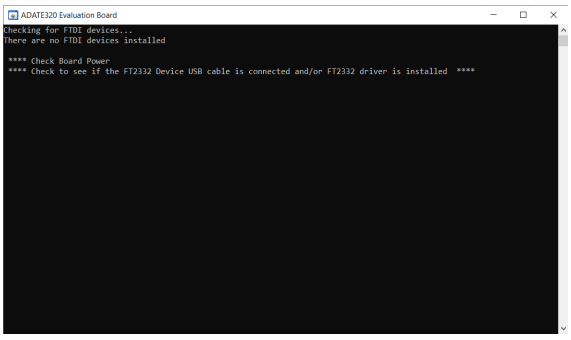

Figure 5. Error Prompt Example

   b. To verify the hardware communication, click on the **Reset Part** button, and then click the **Read all Regs** button in the main window. If there is successful communication,

QUICK START GUIDE

the software user interface (see Figure 6) and command prompt (see Figure 7) reflect the default values (see the ADATE320 data sheet for more information). If the user interface and the command prompt do not reflect the default values, perform the following steps:

1. Close the **ADATE320 Evaluation Board Software**.
2. Disconnect the USB cable.
3. Turn off the power supply.
4. Activate the power supply again.
5. Reconnect the USB cable.
6. Open the **ADATE320 Evaluation Board Software**, click the **Reset Part** button, and then click the **Read all Regs** button again to confirm that the user interface (see Figure 6) and command prompt (see Figure 7) reflect the default values of the registers.

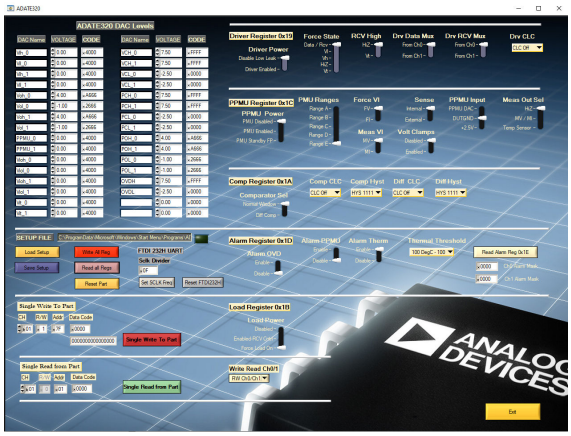

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Figure 6. User Interface Default Values

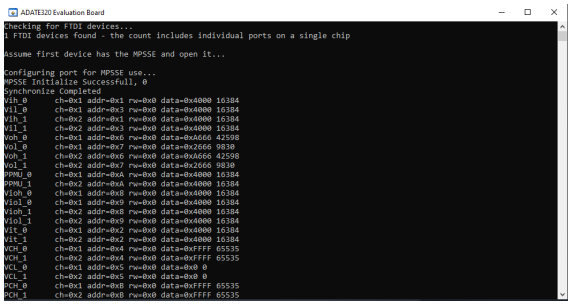

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Figure 7. Command Prompt Default Values

EVALUATION BOARD HARDWARE

POWER SUPPLIES

Provide the following external power supplies:

- 12 V between 12 V DC and GND
- −8 V between −8 V DC and GND

The GND input is provided on the EVAL-ADATE320EBZ. Each device supply is decoupled to GND with a 10 µF and 0.1 µF capacitor. Each device supply pin is again decoupled with a 0.1 µF capacitor to GND. See the Figure 13 and Figure 14 for reference.

DEFAULT JUMPER SETUP

The default setup is for control by the PC through the USB port. The default link options are listed in Table 1.

Table 1. Default Jumper Setup

Jumper No.	Default	Function
P3	Inserted	Current measurement terminal for VDD_TP (0.1 Ω sense resistor)
P4	Inserted	Current measurement terminal for VTTD_TP (0.1 Ω sense resistor)
P5	Inserted	Current measurement terminal for VCC_TP (0.1 Ω sense resistor)
P6	Inserted	Current measurement terminal for VEE_TP (0.1 Ω sense resistor)
P7	Inserted	Current measurement terminal for VTTC_P (0.1 Ω sense resistor)
P1	Pin 2 to Pin 3	BUS_RW control to indicate whether SPI bus is reading or writing
P2	Pin 1 to Pin 2	Device SPI chip select (CS_B_EVAL), on-board or external
P11	Pin 1 to Pin 2	Device SPI target device out (SDO_EVAL), on-board or external
P8	Pin 1 to Pin 2	Device SPI clock (SCLK_EVAL), on-board or external
P9	Pin 1 to Pin 2	Device SPI target device input (SDI_EVAL), on-board or external
P10	Pin 1 to Pin 2	Device reset signal (RESET_B_EVAL), on-board or external

EVALUATION BOARD HARDWARE

USING THE EVAL-ADATE320EBZ

The EVAL-ADATE320EBZ requires two voltage supplies (+12 V and −8 V). The +12 V and −8 V supplies are enough to power the entire board including the digital portion. The EVAL-ADATE320EBZ also has SMA provision for both the inputs and outputs. The EVAL-ADATE320EBZ must be controlled through the USB and can be used with the provided software for simple access to user registers within the ADATE320. Designed to be interactive, the EVAL-ADATE320EBZ also features an LED array at the bottom portion to help the user know that the correct data are being written to or read from the device.

EVALUATION BOARD SOFTWARE

SOFTWARE OPERATION

To start the **ADATE320 Evaluation Board Software**, follow these steps:

1. Use the Windows search feature to find the **ADATE320 Evaluation Board Software**.
2. When the search displays the **ADATE320 Evaluation Board Software**, select it. The main **ADATE320 Evaluation Board Software** window opens as shown in Figure 4. Note that the software loads the **adate320_default.sbus** file upon startup.

The main **ADATE320 Evaluation Board Software** window provides controls for the main functions of the ADATE320, including access to the DAC registers. The main window of the **ADATE320 Evaluation Board Software** also includes the following panels:

- The **ADATE320 DAC Levels** panel allows the user to write to the DACs within the ADATE320.
- The **Single Read from Part** and **Single Write to Part** panels allow the user to read or write to a specific register, for example, the DAC register or the control register.
- The control register panel allows the user to configure the settings of the ADATE320.

DAC LEVELS

The **ADATE320 DAC Levels** panel, located in the upper-left corner of the user interface (see Figure 4), lists all the current settings of the DACs within the ADATE320 (see Figure 8). Changing values in the number field and pressing **Enter** (on the keyboard) in the **ADATE320 DAC Levels** panel is equivalent to writing that value to the specific DAC. The corresponding value (hex code or voltage) changes accordingly.

Figure 8. ADATE320 DAC Levels Panel

SETUP FILE

The **SETUP FILE** panel allows the user to load or save register settings for all DAC and control registers for quicker testing by clicking the **Load Setup** button or the **Save Setup** button (see Figure 9).

To write the current DAC and control registers values displayed in the GUI to the ADATE320, click the **Write All Reg** button.

The user can read back the DAC and control registers from the ADATE320 and display each reading to the main window, as well as update the DAC levels and control registers of the GUI, by clicking the **Read All Regs** button.

The **Write Read Ch0/1** dropdown menu allows users to set which channel the control registers panel sends the commands to. The user can select either one channel or both channels to be written at the same time. Note that this dropdown menu affects the writing and displaying of the control registers only and does not influence the **Write All Reg**, **Read All Regs**, **Load Setup**, or **ADATE320 DAC Levels** buttons.

The user can reset the device by clicking the **Reset Part** button. To have the main window match the settings of the device after a reset, click **Read all Regs**.

To set the SCLK frequency, modify the **Sclk Divider** field and click the **Set SCLK Freq** button to apply the set value. Note that the higher the **Sclk Divider** value, the slower the SCLK is as shown by this equation:

$$SCLK = 60\ \text{MHz}/((1 + SCLK\ Divider) \times 2)$$

The FTDI232H, the microcontroller chip being used on the board, can also be reset through the **Reset FTDI232H** button.

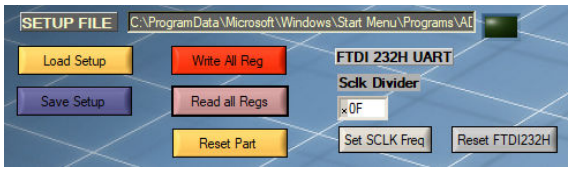

Figure 9. SETUP FILE Panel

SINGLE READ FROM PART AND SINGLE WRITE TO PART FUNCTIONS

The **Single Read from Part** and **Single Write to Part** functions of the user interface (see Figure 10) makes it easy for the user to write to or read from the specific registers as required. Note that when reading from a register, it is not necessary to fill the **Data** field as this field shows the data read from the device.

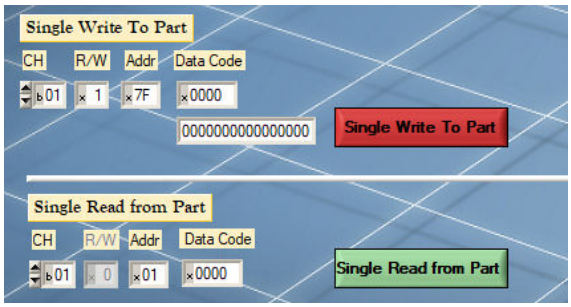

Figure 10. Single Read and Write Functions Panel

EVALUATION BOARD SOFTWARE

CONTROL REGISTERS

It is difficult for the user to manually fill the single write panel to configure the settings of the ADATE320, thus the control registers panel was added to address this. The control registers panel allows the modification of the settings of the ADATE320 by letting the user know which register is being written to, and what specific setting is being changed (see Figure 11). Alarms can also be read from this panel.

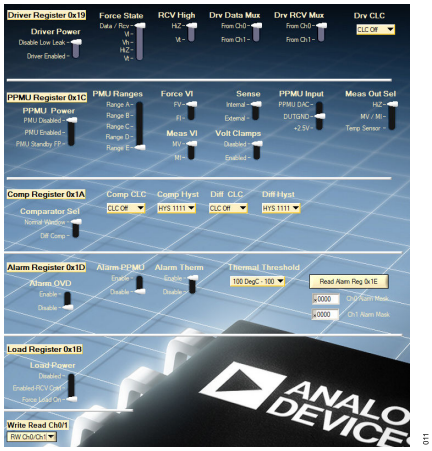

Figure 11. Control Registers Panel

EVALUATION BOARD SCHEMATICS AND SILKSCREENS

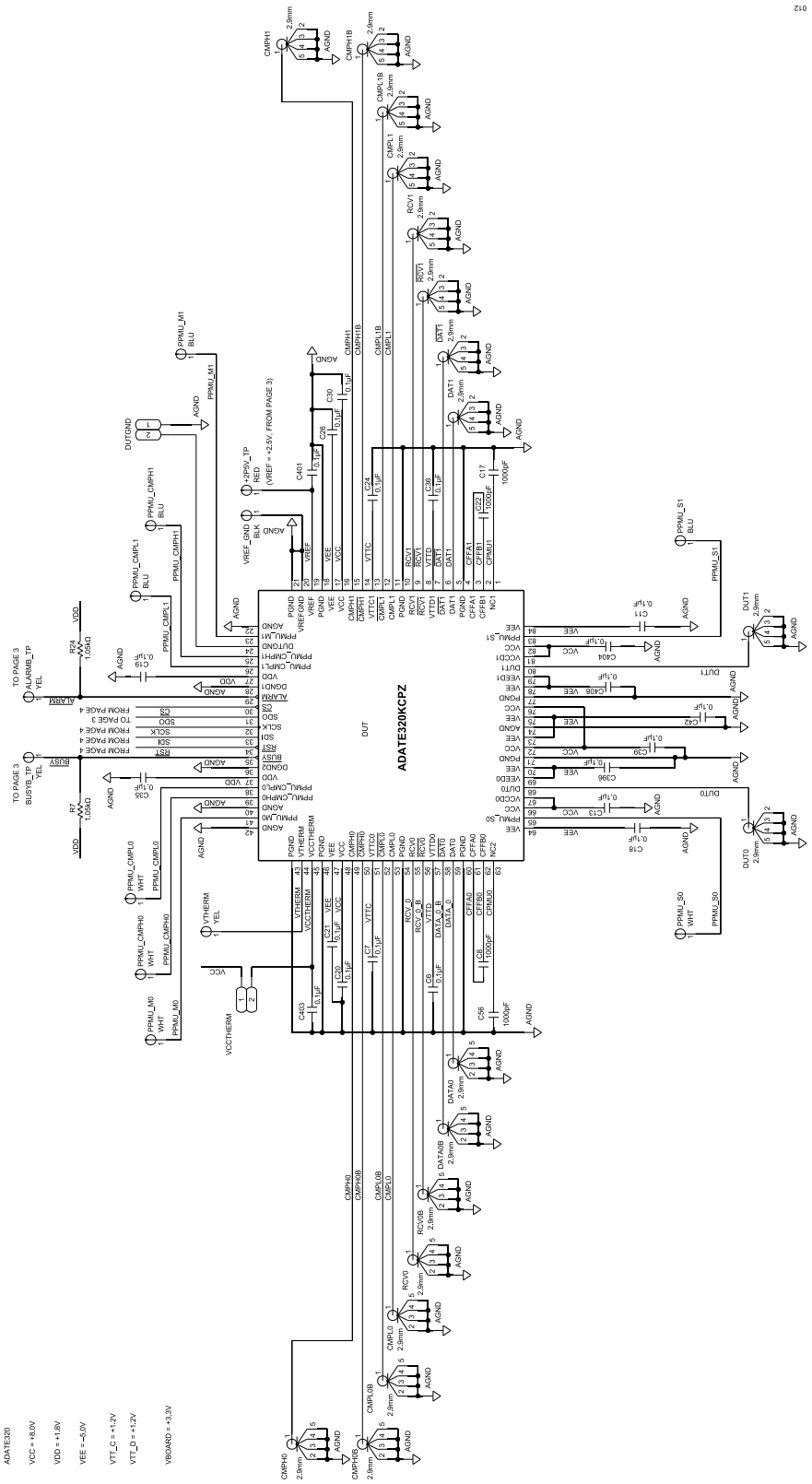

Figure 12. EVAL-ADATE320EBZ Schematic, Page 1

EVALUATION BOARD SCHEMATICS AND SILKSCREENS

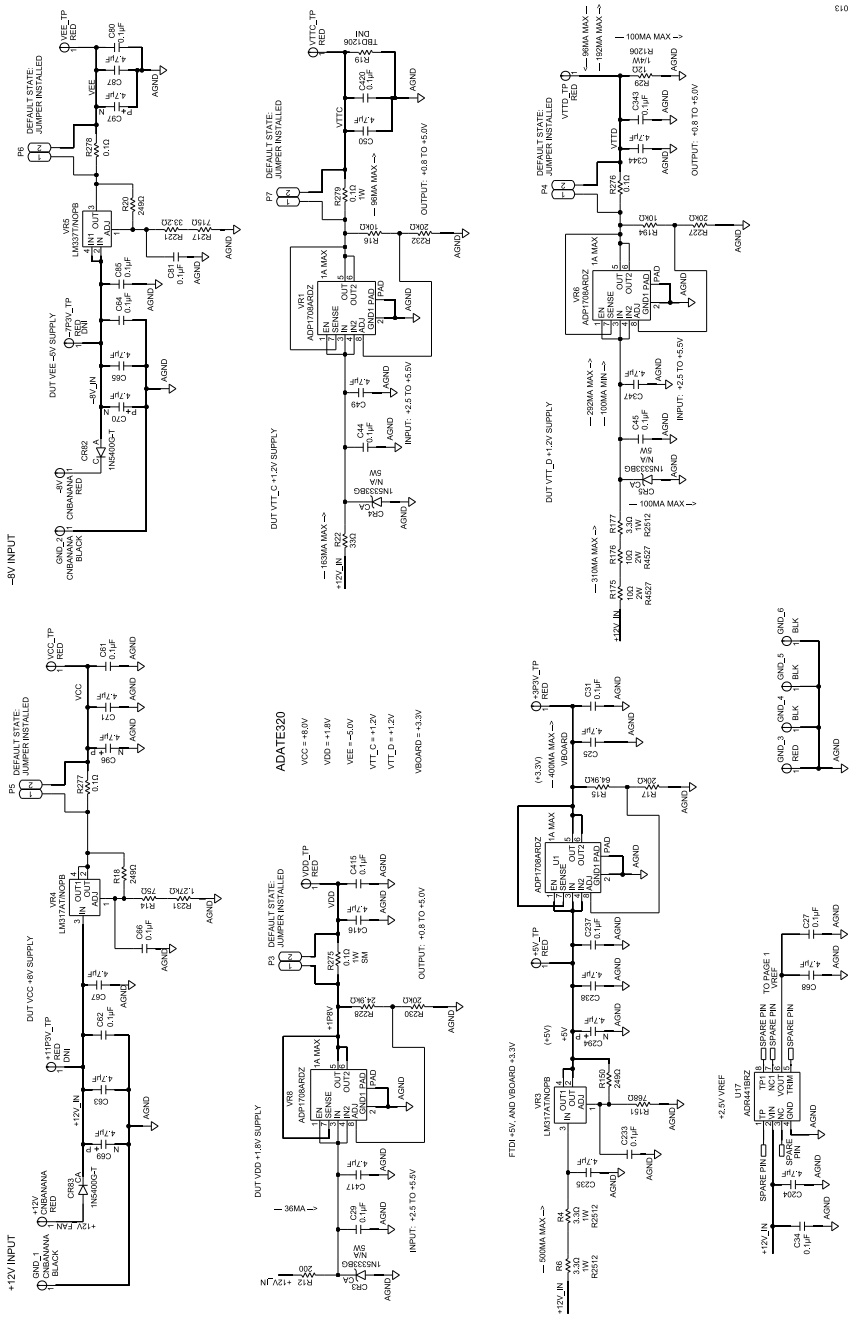

Figure 13. EVAL-ADATE320EBZ Schematic, Page 2

EVALUATION BOARD SCHEMATICS AND SILKSCREENS

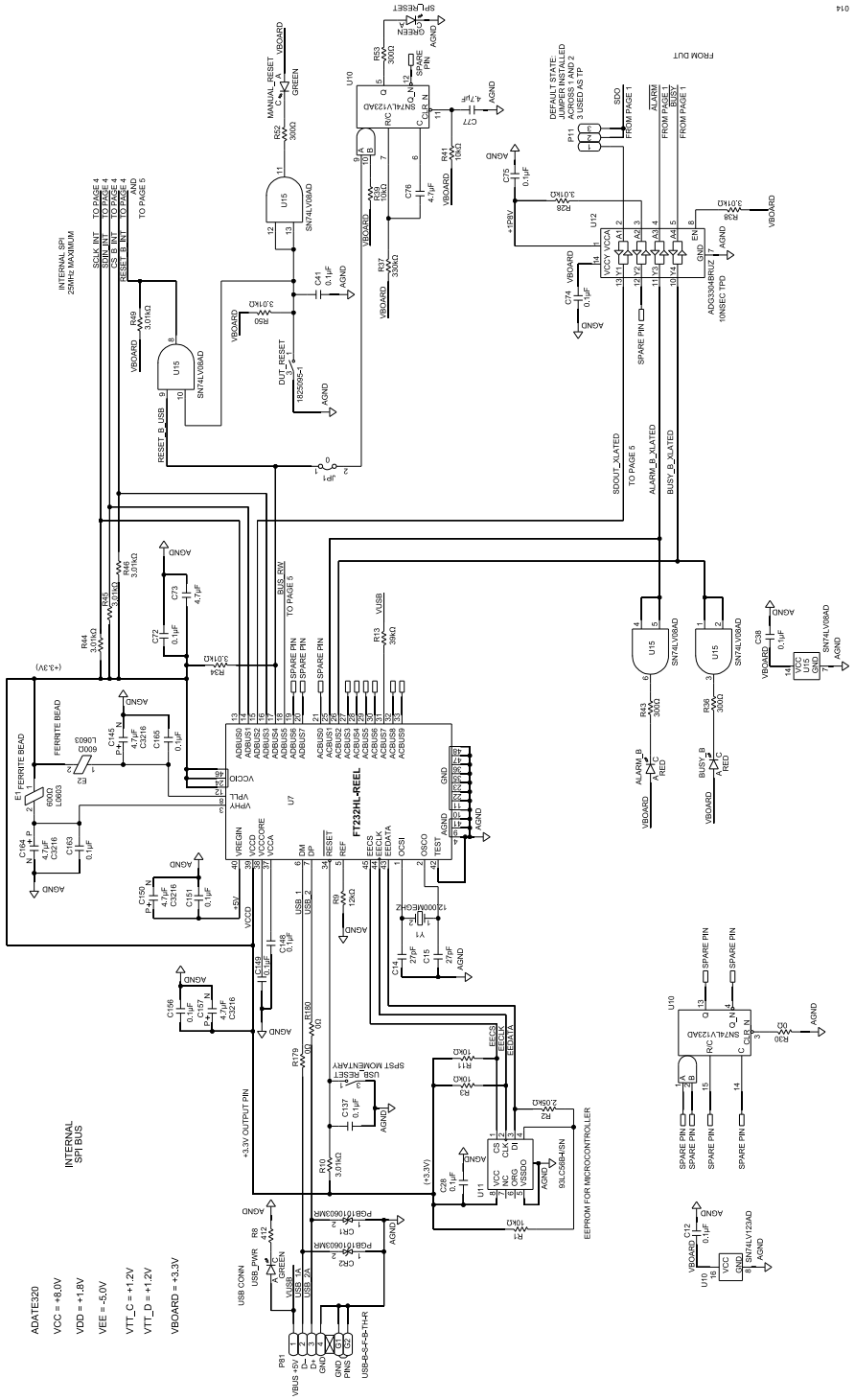

Figure 14. EVAL-ADATE320EBZ Schematic, Page 3

EVALUATION BOARD SCHEMATICS AND SILKSCREENS

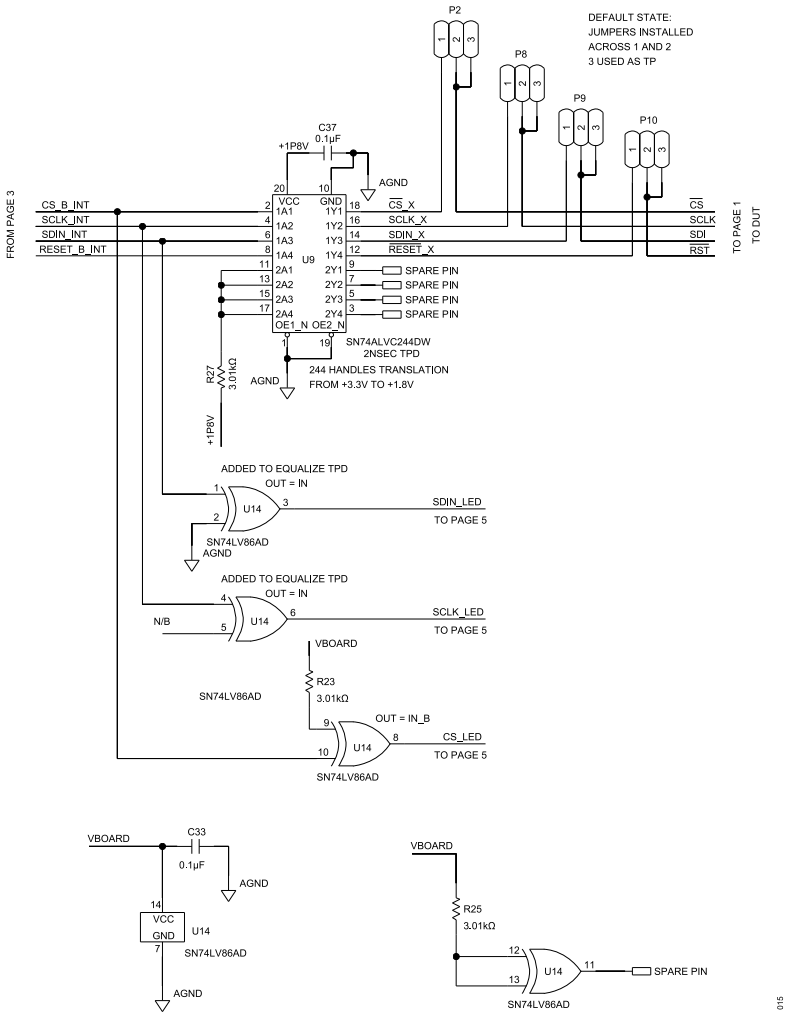

Figure 15. EVAL-ADATE320EBZ Schematic, Page 4

EVALUATION BOARD SCHEMATICS AND SILKSCREENS

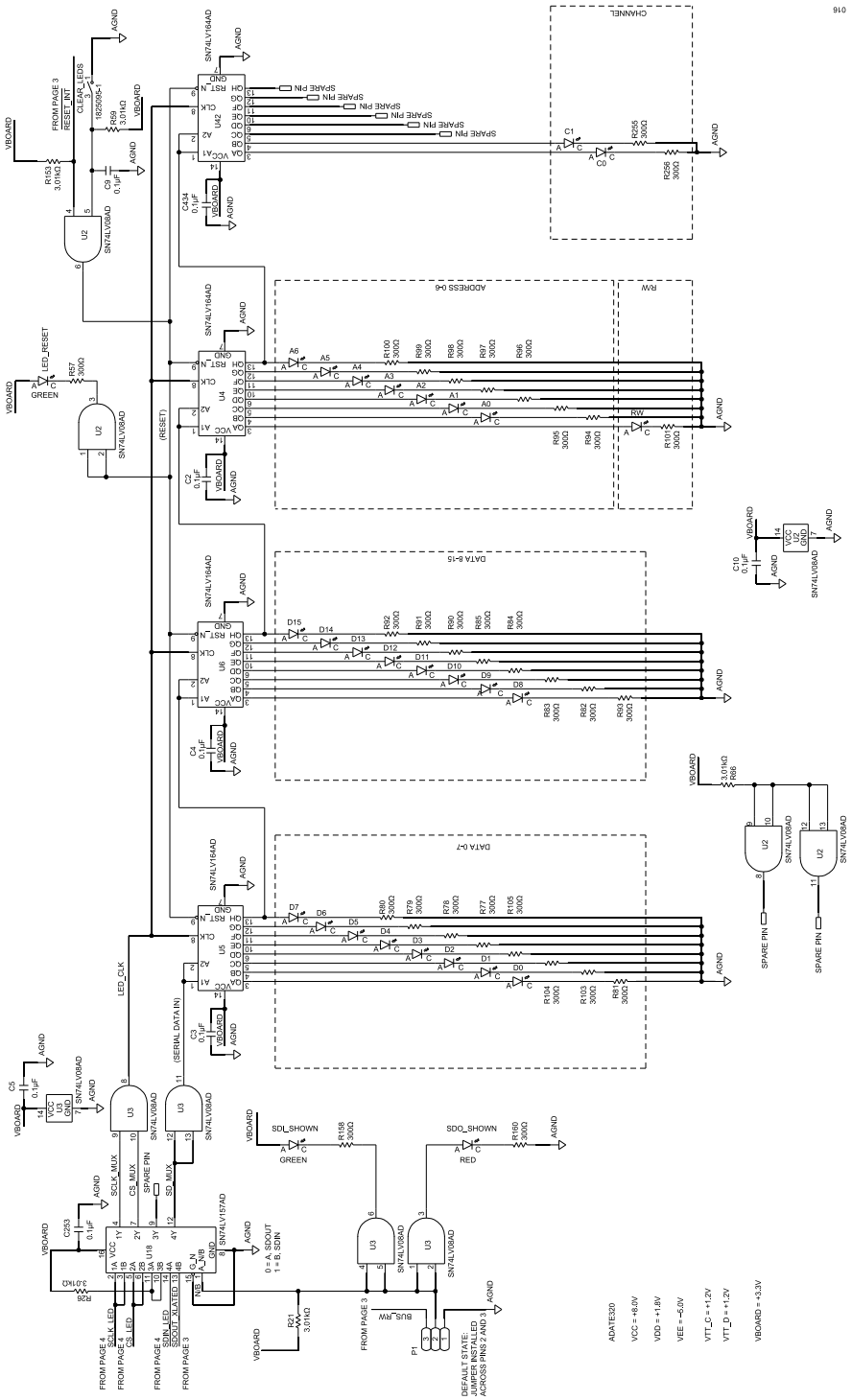

Figure 16. EVAL-ADATE320EBZ Schematic, Page 5

EVALUATION BOARD SCHEMATICS AND SILKSCREENS

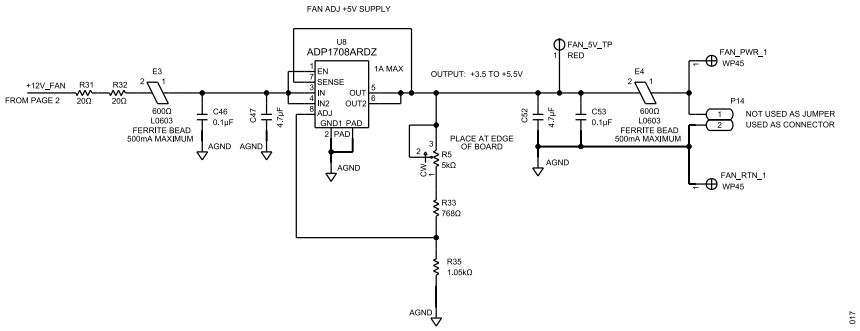

Figure 17. EVAL-ADATE320EBZ Schematic, Page 6

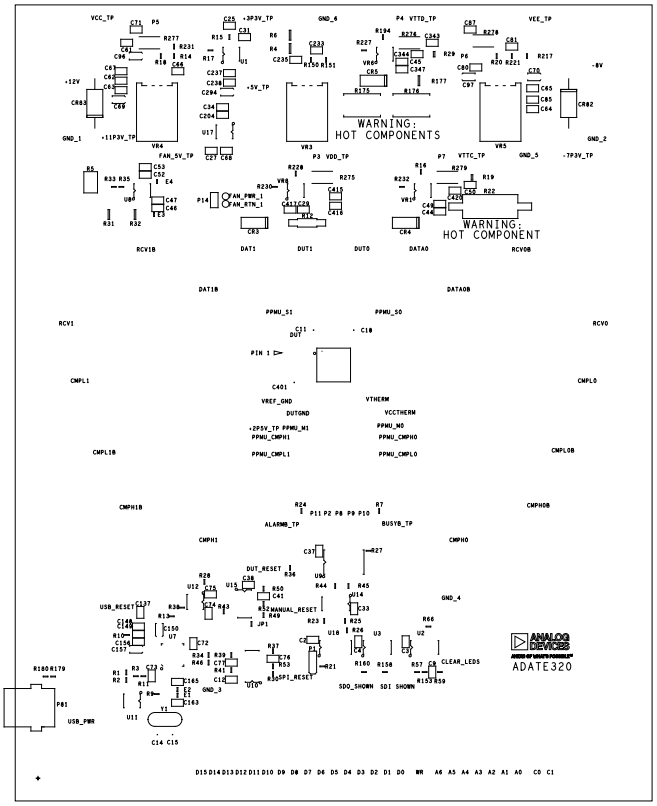

Figure 18. EVAL-ADATE320EBZ Silkscreen, Primary

EVALUATION BOARD SCHEMATICS AND SILKSCREENS

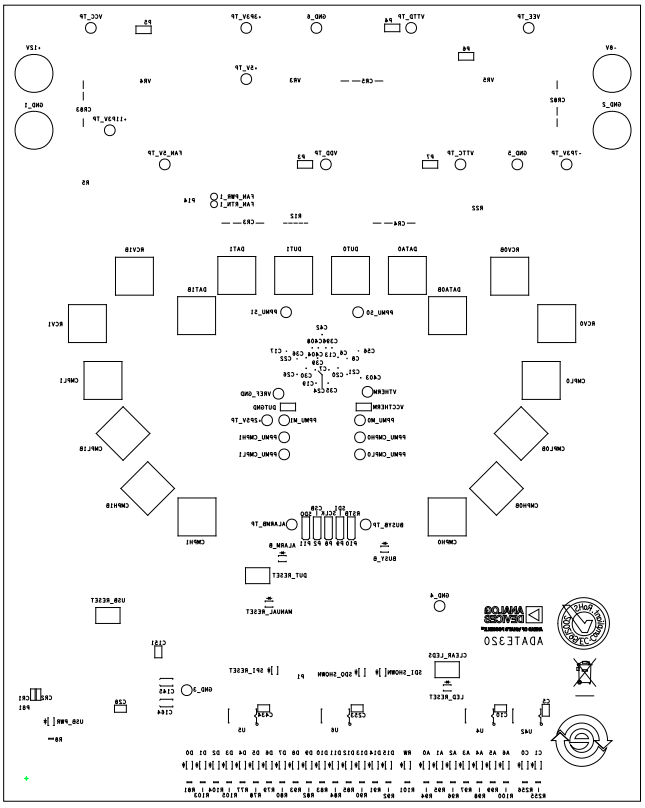

Figure 19. EVAL-ADATE320EBZ Silkscreen, Secondary

ORDERING INFORMATION

BILL OF MATERIALS

Quantity	Reference Designator	Description	Part No.	Manufacturing
1	Not applicable	Printed circuit board (PCB)	08_035315d	Analog Devices supplied
2	+12V, −8V	Connector PCB, banana jacks uninsulated standard red	108-0902-001	Cinch Connectivity Solutions
10	+2P5V_TP, +3P3V_TP, +5V_TP, FAN_5V_TP, GND_3, VCC_TP, VDD_TP, VEE_TP, VTTC_TP, VTTD_TP	Connector PCB, red test points	TP-104-01-02	Components Corporation
29	A0, A1, A2, A3, A4, A5, A6, ALARM_B, BUSY_B, C0, C1, D0, D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12, D13, D14, D15, RW, SDO_SHOWN	Diodes, LED red, surface-mounted device (SMD)	CMD28-21VRC/TR8	Visual Communications Company
3	ALARMB_TP, BUSYB_TP, VTHERM	Connector PCB, yellow test points	TP-104-01-04	Components Corporation
44	C2, C3, C4, C5, C9, C10, C12, C27, C28, C29, C31, C33, C34, C37, C38, C41, C44, C45, C46, C53, C61, C62, C64, C66, C72, C74, C75, C80, C81, C85, C137, C148, C149, C151, C156, C163, C165, C233, C237, C253, C343, C415, C420, C434	0.1 µF ceramic capacitors, 50 V, 10%, X7R, 0805, AEC-Q200	08055C104K4T4A	AVX Corporation
20	C6, C7, C11, C13, C18, C19, C20, C21, C24, C26, C30, C35, C36, C39, C42, C396, C401, C403, C404, C408	0.1 µF ceramic capacitors, 25 V, 10%, X7R, 0603	C0603C104K3RACTU	KEMET Corporation
2	C14, C15	27 pF ceramic capacitors, 50 V, 5%, C0G, 0805	CC0805JRNPO9BN270	Yageo
9	C69, C70, C96, C97, C145, C150, C157, C164, C294	4.7 µF tantalum capacitors, 20 V, 10%, 3216-18	TAJA475K020RNJ	AVX Corporation
4	C8, C17, C22, C56	1000 pF ceramic capacitors,100 V, 10%, X7R, 0805	08051C102KAT2A	AVX Corporation
21	C25, C47, C49, C50, C52, C63, C65, C67, C68, C71, C73, C76, C77, C87, C204, C235, C238, C344, C347, C416, C417	4.7 µF ceramic capacitors, 25 V, 10%, X7R, 0805, low effective series resistance (ESR)	C2012X7R1E475K125AB	TDK
3	CLEAR_LEDS, DUT_RESET, USB_RESET	Switches, push, SPST, normally open, 0.4 A, 20 V	1825095-1	TE Connectivity, LTD
18	CMPH0, CMPH0B, CMPH1, CMPH1B, CMPL0, CMPL0B, CMPL1, CMPL1B, DAT1, DAT1B, DATA0, DATA0B, DUT0, DUT1, RCV0, RCV0B, RCV1, RCV1B	Connector PCB, 2.92 mm jacks, 4-hole flange, use with the 1× M014778	1012-01SF	Southwest Microwave Inc.
2	CR1, CR2	Zener diodes, suppressor electrostatic discharge (ESD), 24 V DC, 0603	PGB1010603MR	Littelfuse Inc.
3	CR3, CR4, CR5	3.3 V Zener diodes, 1N5333B, 17-02	1N5333BG	ON Semiconductor
2	CR82, CR83	Rectifier diodes	1N5400G-T	Diodes Inc.
1	DUT	IC, 1.25 GHz dual integrated DCL with PPMU, level setting DACs, and on-chip calibration registers	ADATE320KCPZ	Analog Devices, Inc.
8	DUTGND, P3, P4, P5, P6, P7, P14, VCCTHERM	Connector PCB, Berg, jumpers, straight, male, two position	69157-102HLF	Amphenol FCI
4	E1, E2, E3, E4	Inductors, ferrite chip surface-mount	BLM18EG601SN1D	Murata Manufacturing
2	GND_1,GND_2	Connector PCB, banana jack, uninsulated, standard black	108-0903-001	Cinch Connectivity Solutions
4	GND_4,GND_5,GND_6,VREF_GND	Connector PCB, black test points	TP-104-01-00	Components Corporation
1	JP1	RES SMD 0 Ohm JUMPER 1/8W 0805 AEC-Q200	ERJ-6GEY0R00V	Panasonic

ORDERING INFORMATION

Quantity	Reference Designator	Description	Part No.	Manufacturing
5	LED_RESET, MANUAL_RESET, SDI_SHOWN, SPI_RESET, USB_PWR	LED UNI-COLOR GREEN, 570NM	CMD28-21VGC/TR8	Visual Communications Company
6	P1, P2, P8, P9, P10, P11	Connector PCB, Berg, headers, straight, male, three position	TSW-103-08-G-S	Samtec
1	P81	Connector PCB, receptacle, side entry shielded data link (SDL)	USB-B-S-F-B-TH-R	Tyco Electronics Connectivity
4	PPMU_CMPH0, PPMU_CMPL0, PPMU_M0, PPMU_S0	Connector PCB, white test points	TP-104-01-09	Components Corporation
4	PPMU_CMPH1, PPMU_CMPL1, PPMU_M1, PPMU_S1	Connector PCB, blue test points	TP104-01-06	Components Corporation
7	R1, R3, R11, R16, R39, R41, R194	10 kΩ resistors, SMD, 1%, 1/8 W, 0805, AEC-Q200	ERJ-6ENF1002V	Panasonic
17	R10, R21, R23, R25, R26, R27, R28, R34, R38, R44, R45, R46, R49, R50, R59, R66, R153	3.01 kΩ resistors, SMD, 1%, 1/8 W, 0805, AEC-Q200	ERJ-6ENF3011V	Panasonic
33	R36, R43, R52, R53, R57, R77, R78, R79, R80, R81, R82, R83, R84, R85, R90, R91, R92, R93, R94, R95, R96, R97, R98, R99, R100, R101, R103, R104, R105, R158, R160, R255, R256	300 Ω resistors, SMD, 5%, 1/8 W, 0805, AEC-Q200	ERJ-6GEYJ301V	Panasonic
1	R12	200 Ω through-hole resistor, 5%, ½ W, 6 mm × 2.3 mm	CFM12JT200R	Stackpole Electronics, Inc.
1	R13	39 kΩ resistor, SMD, 0.1%, 1/8 W, 0805, AEC-Q200, high reliability	ERA-6AEB393V	Panasonic
1	R14	75 Ω resistor, SMD, 1%, 1/8 W, 0805, AEC-Q200	ERJ-6ENF75R0V	Panasonic
1	R15	64.9 kΩ resistor, SMD, 1%, 1/8 W, 0805, AEC-Q200	ERJ-6ENF6492V	Panasonic
3	R18, R20, R150	249 Ω resistors, SMD, 1%, 1/8 W, 0805, AEC-Q200	ERJ-6ENF2490V	Panasonic
2	R33, R151	768 Ω resistors, SMD, 1%, 1/10 W, 0805, AEC-Q200	ERJ-6ENF7680V	Panasonic
4	R17, R227, R230, R232	20 kΩ resistors, SMD, 1%, 1/8 W, 0805, AEC-Q200	ERJ-6ENF2002V	Panasonic
2	R175, R176	10 Ω resistors, SMD, 1%, 2 W, 4527, J-lead, AEC-Q200	WSC452710R00FEA	VISHAY
3	R4, R6, R177	3.3 Ω resistors, SMD, 5%, 1 W, 2512, AEC-Q200	ERJ-1TYJ3R3U	Panasonic
3	R30, R179, R180	0 Ω resistors, SMD, 1/8 W, 0805, AEC-Q200	ERJ-6GEY0R00V	Panasonic
1	R2	2.05 kΩ resistor, SMD, 1%, 1/8 W, 0805, AEC-Q200	ERJ-6ENF2051V	Panasonic
1	R217	715 Ω resistor, SMD, 1%, 1/8 W, 0805, AEC-Q200	ERJ-6ENF7150V	Panasonic
1	R22	33 Ω through-hole resistor, 5% 5 W, 18 mm × 7.5 mm, AEC-Q200 CEMENT	AC05AT0003309JAC00	VISHAY
1	R221	33.2 Ω resistor, SMD, 1%, 1/8 W, 0805, AEC-Q200	ERJ-6ENF33R2V	Panasonic
1	R228	24.9 kΩ resistor, SMD, 1%, 1/8 W, 0805, AEC-Q200	ERJ-6ENF2492V	Panasonic
1	R231	1.27 kΩ resistor, SMD, 1%, 1/8 W, 0805, AEC-Q200	ERJ-6ENF1271V	Panasonic
3	R7, R24, R35	1.05 kΩ resistors, SMD,1%, 1/8 W, 0805, AEC-Q200	ERJ-6ENF1051V	Panasonic

ORDERING INFORMATION

Quantity	Reference Designator	Description	Part No.	Manufacturing
5	R275, R276, R277, R278, R279	0.1 Ω resistors, SMD, 1%, 1 W, J-lead	RW1S0BAR100FE	OHMITE
1	R29	12 Ω resistor, SMD, 1%, ¼ W, 1206	WCR1206-12RFI	IRC Components of TT Electronics
2	R31, R32	20 Ω resistors, SMD, 1%, 1 W, 2512, AEC-Q200	CRCW251220R0FKEG	VISHAY
1	R37	330 kΩ resistor, SMD, 5%, 1/8 W, 0805, AEC-Q200	ERJ-6GEYJ334V	Panasonic
1	R5	5 kΩ through-hole resistor, trimmer, 10%, ¼ W, 6.8 mm × 5 mm × 7.8 mm	T63YA502KT20	VISHAY
1	R8	412 Ω resistor, SMD, 1%, 1/8 W, 0805, AEC-Q200	ERJ-6ENF4120V	Panasonic
1	R9	12 kΩ resistor, SMD, 0.1%, 1/8 W, 0805, AEC-Q200, high reliability	ERA-6AEB123V	Panasonic
5	U1, U8, VR1, VR6, VR8	IC, 1 A, low dropout, complementary metal–oxide semiconductor (CMOS) linear regulator	ADP1708ARDZ-R7	Analog Devices
1	U10	IC, TTL dual, one shot	SN74LV123AD	Texas Instruments
1	U11	IC, CMOS, 2K, 16-bit microwire-compatible serial electrically erasable programmable read-only memory (EEPROM)	93LC56B-I/SN	Microchip Technology
1	U12	IC, low voltage 1.15 V to 5.5 V, 4 channel, bidirectional, logic level translator	ADG3304BRUZ	Analog Devices
1	U14	IC, TTL, quad, two input, EX-OR	SN74LV86AD	Texas Instruments
3	U2, U3, U15	IC, TTL, quad, two input, positive AND gates	SN74LV08AD	Texas Instruments
1	U17	IC, ultralow noise, LDO XFET® 2.5 V voltage reference with current sink and source	ADR441BRZ	Analog Devices
1	U18	IC, TTL, quad two line to 1 line selectors/mux	SN74LV157AD	Texas Instruments
4	U4, U5, U6, U42	IC,TTL, 8-bit, parallel out, serial shift registers	SN74LV164AD	Texas Instruments
1	U7	IC,1-channel, high speed, USB to multipurpose universal asynchronous receiver-transmitter (UART)/first in, first out (FIFO)	FT232HL-REEL	FTDI
1	U9	IC,TTL octal buffer/line driver with three-state outputs	SN74ALVC244DW	Texas Instruments
2	VR3, VR4	IC, linear, 3-term, adjustable regulators, X1 M000386 and 1X M021972	LM317AT/NOPB	Texas Instruments
1	VR5	IC, linear adjustable negative regulator, add 1X M000386 AND 1X M021972	LM337T/NOPB	Texas Instruments
1	Y1	IC, crystal quartz	ECS-120-20-4X	ECS
1	Not applicable	Fan, DC, 20 mm × 20 mm × 8 mm 5 V DC vapo-bearing	MF20080V1-1000U-A99	SUNON Fans
1	Not applicable	Heat sink, forged with adhesive tap, 19 mm × 19 mm	APF19-19-10CB/A01	CTS Corporation
18	Not applicable	Pins, connector center pin, 2.92 mm, 12" diameter	1090-07G	Southwest Microwave Inc.
3	Not applicable	Mounting kits for the TO-220 heat sink	4880G	Aavid
3	Not applicable	Heat sinks, TO-202	577404B00000G	Aavid
4	Not applicable	Nuts, #2-56 X 60	KF2-256	PEM

ORDERING INFORMATION

Quantity	Reference Designator	Description	Part No.	Manufacturing
4	Not applicable	Standoffs, round 2-56 aluminum 9.5 mm length, 3.9 OD	1801D	Keystone
4	Not applicable	Standoffs, round 2-56 aluminum 6.4 mm length, 3.9 OD	1801B	Keystone
4	Not applicable	Washers, flat 0.81 mm thick nylon, 2.46 mm ID, 4.8 mm OD	3114	Keystone
7	Not applicable	Screws, pan head, SLOTD, 2-56 × 1/2	91792A081	MCMASTER-CARR
2	+11P3V_TP, −7P3V_TP	Connector PCB, red test points	TP-104-01-02	Components Corporation
1	R19	Do not install (DNI) (TBD_R1206), use SYM_3 and/or SYM_4	TBD1206	TBD1206

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