One Technology Way • P.O. Box 9106 • Norwood, MA 02062-9106, U.S.A. • Tel: 781.329.4700 • Fax: 781.461.3113 • www.analog.com

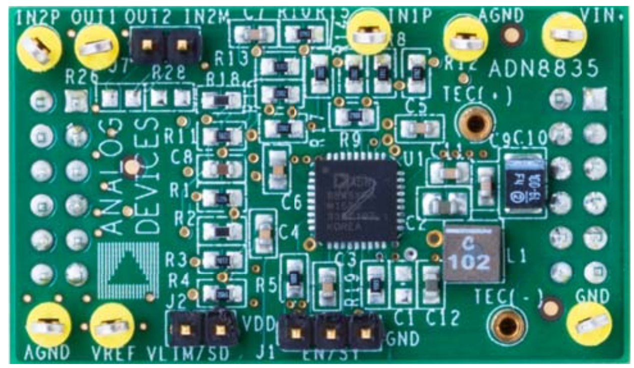
Evaluating the ADN8835 Ultracompact, 3 A Thermoelectric Cooler (TEC) Controller

FEATURES

Full featured evaluation board for the ADN8835; the device includes the following features:
- **Complete TEC controller with integrated 3 A TEC driver**
- **Operating voltage range: V_{IN} = 2.7 V to 5.5 V**
- **TEC voltage and current operation monitoring**
- **Independent TEC heating and cooling current-limit settings**
- **Programmable maximum TEC voltage**
- **External synchronization from 1.85 MHz to 3.25 MHz**

2.5 V reference output
Input for NTC thermistor connection
Output for TEC module wires
Disable jumper
45 mm × 25 mm evaluation board size

ADN8835CP-EVALZ EVALUATION BOARD



14342-001

Figure 1.

GENERAL DESCRIPTION

The ADN8835CP-EVALZ is a configurable evaluation board designed to work with various TEC modules and thermistors. The ADN8835, which is included on the evaluation board, delivers and controls bidirectional current through a TEC controller using two pairs of the complementary integrated MOSFETs in an H bridge configuration.

The TEC cooling and heating current limits are set to 3 A, and the maximum TEC voltage is programmed to 3.5 V using two on-board resistor dividers. The temperature setpoint circuit is optimized to work with a 10 kΩ negative thermal coefficient (NTC) thermistor. The on-board proportional integral differential (PID) compensation network components can be replaced by soldering different value components that match the temperature control loop characteristics with the thermal load to achieve the required response time and temperature stability. The cooling and heating TEC current limits and maximum TEC voltage setting can also be modified by changing the values of the corresponding components.

In addition, the board can be plugged into the ADN8835 base board, which has adjustable components for the tunable analog thermal PID network, the temperature setpoint, and the maximum TEC current and TEC voltage limits.

Full specifications on the ADN8835 are available in the ADN8835 data sheet, which should be consulted in conjunction with this user guide when working with the evaluation board.

TABLE OF CONTENTS

REVISION HISTORY

12/2016—Revision 0: Initial Version

USING THE EVALUATION BOARD

BOARD CONNECTION

Apply a power source to the VIN+ and GND terminals. Connect the TEC module to the TEC(+) and TEC(−) terminals . Connect the thermistor to the THERM and AGND terminals. The power source voltage must be between 2.7 V and 5.5 V, which matches the power supply range of the ADN8835. Connect the EN/SY pin to VDD (on the board) and remove the shunt from the VLIM/SD jumper to enable the controller.

MAXIMUM TEC COOLING VOLTAGE

The maximum TEC cooling voltage is set to 3.5 V by the values of R_{V1} = 4.29 kΩ and R_{V2} = 10 kΩ.

To change this setting, modify the value of R_{V1} using the equations provided in the Using a Resistor Divider to Set the TEC Voltage Limit section (for more information, refer to the ADN8835 data sheet) or by following the recommended values in Table 1.

Using a Resistor Divider to Set the TEC Voltage Limit

Calculate the cooling and heating limits using the following equations:

$$V_{VLIMC} = V_{REF} \times R_{V2}/(R_{V1} + R_{V2}) \quad (1)$$

where V_{REF} = 2.5 V.

$$V_{VLIMH} = V_{VLIM\_COOLING} - I_{SINK\_VLIM} \times R_{V1}||R_{V2} \quad (2)$$

where I_{SINK_VLIM} = 10 µA (see Figure 2).

$$V_{TEC\_MAX\_COOLING} = V_{VLIM\_COOLING} \times A_{VLIM} \quad (3)$$

where A_{VLIM} = 2 V/V.

$$V_{TEC\_MAX\_HEATING} = V_{VLIM\_HEATING} \times A_{VLIM} \quad (4)$$

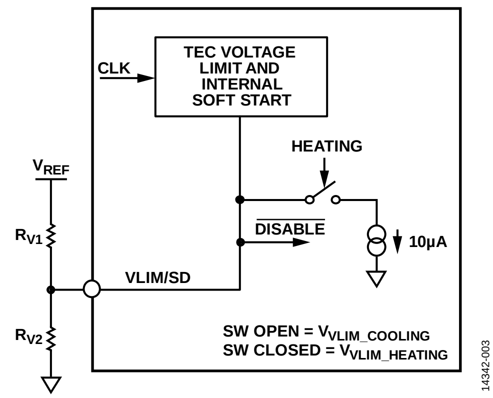


Figure 2. Programming the Maximum TEC Voltage

Table 1. Setting the Maximum TEC Voltage (R_{V2} = 10 kΩ)

$V_{TEC\_MAX\_COOLING}$ (V)[1]	V_{VLIMC} (V)[2]	R_{V1} (kΩ)[3]	$V_{TEC\_COOLING}$ (V)[4]	$R_{V1}||R_{V2}$ (kΩ)[3]	V_{VLIMH} (V)[5]	$V_{TEC\_MAX\_HEATING}$ (V)[6]	$V_{TEC\_HEATING}$ (V)[7]
4.750	2.375	0.53	2.438	0.5	2.370	4.740	0.065
4.500	2.250	1.11	2.375	1.0	2.240	4.480	0.130
4.250	2.125	1.76	2.313	1.5	2.110	4.220	0.195
4.000	2.000	2.50	2.250	2.0	1.980	3.960	0.260
3.750	1.875	3.33	2.188	2.5	1.850	3.700	0.325
3.500	1.750	4.29	2.125	3.0	1.720	3.440	0.390
3.250	1.625	5.38	2.063	3.5	1.590	3.180	0.455
3.000	1.500	6.67	2.000	4.0	1.460	2.920	0.520
2.750	1.375	8.18	1.938	4.5	1.330	2.660	0.585
2.500	1.250	10.00	1.875	5.0	1.200	2.400	0.650
2.250	1.125	12.22	1.813	5.5	1.070	2.140	0.715
2.000	1.000	15.00	1.750	6.0	0.940	1.880	0.780
1.750	0.875	18.57	1.688	6.5	0.810	1.620	0.845
1.500	0.750	23.33	1.625	7.0	0.680	1.360	0.910
1.250	0.625	30.00	1.563	7.5	0.550	1.100	0.975
1.000	0.500	40.00	1.500	8.0	0.420	0.840	1.040
0.750	0.375	56.67	1.438	8.5	0.290	0.580	1.105
0.500	0.250	90.00	1.375	9.0	0.160	0.320	1.170
0.250	0.125	190.00	1.313	9.5	0.030	0.060	1.235

[1] $V_{TEC\_MAX\_COOLING}$ is the maximum target TEC voltage when the ADN8835 operates in cooling mode.
[2] V_{VLIMC} is the voltage set at the VLIM/SD input pin for cooling.
[3] R_{V1} is the required value of Resistor R1. R_{V2} is the required value of Resistor R2.
[4] $V_{TEC\_COOLING}$ is the voltage at the VTEC output when the TEC voltage reaches the maximum limit in cooling mode.
[5] V_{VLIMH} is the voltage set at the VLIM/SD input pin for heating.
[6] $V_{TEC\_MAX\_HEATING}$ is the maximum TEC voltage set when the ADN8835 operates in heating mode.
[7] $V_{TEC\_HEATING}$ is the voltage at the VTEC output when the TEC voltage reaches the maximum limit in heating mode.

COOLING AND HEATING TEC CURRENT LIMITS

The maximum TEC cooling and heating current limits are both set to 1.5 A by the values of the resistors, R_{C3} = 270.6 kΩ and R_{C4} = 50.8 kΩ. To change these settings, use the equations provided in the Using a Resistor Divider to Set the TEC Current Limit section (for more information, refer to the ADN8835 data sheet) or use the values recommended in Table 3.

Using a Resistor Divider to Set the TEC Current Limit

Use the following equations to calculate the maximum TEC currents:

$$V_{ILIMH} = V_{REF} \times R_{C2}/(R_{C1} + R_{C2}) \quad (5)$$

where V_{REF} = 2.5 V.

$$V_{ILIMC} = V_{ILIMH} + I_{SINK\_ILIM} \times R_{C1}||R_{C2} \quad (6)$$

where I_{SINK_ILIM} = 40 µA.

$$I_{TEC\_MAX\_COOLING} = \frac{V_{ILIM\_COOLING} - 1.25\ \text{V}}{R_{CS}} \quad (7)$$

where R_{CS} = 0.285 V/A.

$$I_{TEC\_MAX\_HEATING} = \frac{1.25\ \text{V} - V_{ILIM\_HEATING}}{R_{CS}} \quad (8)$$

V_{ILIMH} must not exceed 1.2 V and V_{ILIMC} must be more than 1.3 V to leave proper margins between the heating and the cooling modes.

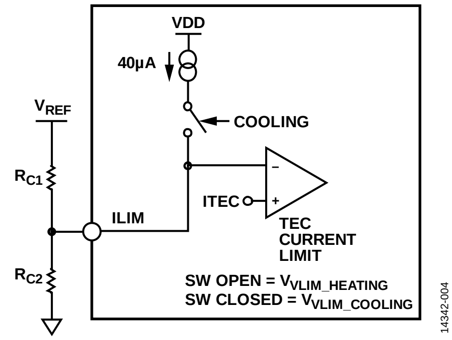


Figure 3. Programming the TEC Current Cooling and Heating Limits

PWM OPERATION FREQUENCY

The frequency of the pulse-width modulation (PWM) TEC driver stage can be configured at the 3-pin jumper, J1. Apply the external synchronization clock signal to the middle pin of the jumper. Note that the middle pin can also be used to shut down the device when it is pulled below 0.8 V. Therefore, when applying the external clock signal, ensure that the high level is greater than 2.1 V and the low level is less than 0.8 V. The combinations of the EN/SY pin settings are shown in Table 2.

Table 2. EN/SY Pin Settings

EN/SY Pin State	PWM Operation Frequency
Low (<0.8 V)	Shutdown
Open	Shutdown
High (>2.1 V)	2 MHz
External clock signal (high > 2.1 V, low < 0.8 V)	From 1.85 MHz to 3.25 MHz

Table 3. Values of the Resistor Divider for ILIM Settings

$I_{TEC\_MAX\_COOLING}$ (A)[1]	V_{ILIMC} (V)[2]	$I_{TEC\_MAX\_HEATING}$ (A)[3]	V_{ILIMH} (V)[4]	R_{C1} (kΩ)[5]	R_{C2} (kΩ)[5]	R_{C1}‖R_{C2} (kΩ)[5]
3.0	2.105	−3.0	0.395	270.6	50.8	42.750
2.9	2.077	−2.9	0.424	243.9	49.8	41.325
2.8	2.048	−2.8	0.452	220.7	48.7	39.900
2.7	2.020	−2.7	0.481	200.2	47.6	38.475
2.6	1.991	−2.6	0.509	182.0	46.5	37.050
2.5	1.963	−2.5	0.538	165.7	45.4	35.625
2.4	1.934	−2.4	0.566	151.1	44.2	34.200
2.3	1.906	−2.3	0.595	137.8	43.0	32.775
2.2	1.877	−2.2	0.623	125.8	41.8	31.350
2.1	1.849	−2.1	0.652	114.8	40.5	29.925
2.0	1.820	−2.0	0.680	104.8	39.1	28.500

$I_{TEC\_MAX\_COOLING}$ (A)[1]	V_{ILIMC} (V)[2]	$I_{TEC\_MAX\_HEATING}$ (A)[3]	V_{ILIMH} (V)[4]	R_{C1} (kΩ)[5]	R_{C2} (kΩ)[5]	R_{C1}‖R_{C2} (kΩ)[5]
1.9	1.792	−1.9	0.709	95.5	37.8	27.075
1.8	1.763	−1.8	0.737	87.0	36.4	25.650
1.7	1.735	−1.7	0.766	79.1	34.9	24.225
1.6	1.706	−1.6	0.794	71.8	33.4	22.800
1.5	1.678	−1.5	0.823	65.0	31.9	21.375
1.4	1.649	−1.4	0.851	58.6	30.2	19.950
1.3	1.621	−1.3	0.880	52.7	28.6	18.525
1.2	1.592	−1.2	0.908	47.1	26.9	17.100
1.1	1.564	−1.1	0.937	41.8	25.1	15.675
1.0	1.535	−1.0	0.965	36.9	23.2	14.250

[1] $I_{TEC\_MAX\_COOLING}$ is the maximum target TEC current when the ADN8835 operates in cooling mode.
[2] V_{ILIMC} is the voltage set at the ILIM pin when the ADN8835 operates in cooling mode.
[3] $I_{TEC\_MAX\_HEATING}$ is the maximum target TEC current when the ADN8835 operates in heating mode.
[4] V_{ILIMH} is the voltage set at the ILIM pin when the ADN8835 operates in heating mode.
[5] R_{C1} is the required value of Resistor R3. R_{C2} is the required value of Resistor R4.

READING THE TEC VOLTAGE

The voltage on the VTEC output pin is proportional to the voltage across the TEC and is measured at Connector J6/Pin 11. The relationship between the voltage on the VTEC output and the voltage across the TEC is as follows:

$$V_{TEC} = V_{LDR} - V_{SFB} = 4 \times (V_{VTEC} - 0.5 \times V_{REF}) \quad (9)$$

where:
V_{TEC} is the voltage across the TEC.
V_{LDR} is the voltage measured at the LDR pin.
V_{SFB} is the voltage measured at the SFB pin.
V_{VTEC} is the voltage measured at the VTEC pin.
V_{REF} is the reference voltage, 2.5 V.

READING THE TEC CURRENT

The voltage on the ITEC output pin is proportional to the TEC current, and is measured at Connector J6/Pin 12. Calculate the TEC current (I_{TEC}) from the ITEC pin voltage as follows:

$$I_{TEC} = \frac{V_{ITEC} - 0.5 \times V_{REF}}{R_{CS}} \quad (10)$$

where:
I_{TEC} is the TEC current, defined as the current flowing into the positive TEC terminal (TEC+) and out of the negative TEC terminal (TEC−).
V_{ITEC} is the voltage measured at the ITEC pin.
V_{REF} is the reference voltage, 2.5 V.
R_{CS} is the current sense gain, 0.285 V/A.

TEC DRIVER CONTROL

The TEC driver has a linear driver (LDR) and a PWM driver with an SW output and a voltage feedback input pin (SFB). The TEC driver is controlled by the voltage signal at the OUT2 pin. The equations for the linear and PWM driver outputs, respectively, are as follows:

$$V_{LDR} = V_B - 40\,(V_{OUT2} - 1.25\text{ V}) \quad (11)$$

$$V_{SFB} = V_{LDR} + 5\,(V_{OUT2} - 1.25\text{ V}) \quad (12)$$

where:
V_{LDR} is the voltage at the liner driver output.
V_B is determined by voltage at the VDD pin (V_{VDD}) as follows:

$$V_B = 1.5\text{ V}\ (V_{VDD} < 4.0\text{ V}) \quad (13)$$

$$V_B = 2.5\text{ V}\ (V_{VDD} > 4.0\text{ V}) \quad (14)$$

V_{OUT2} is the voltage at the OUT2 pin.
V_{SFB} is the voltage at the PWM driver output.

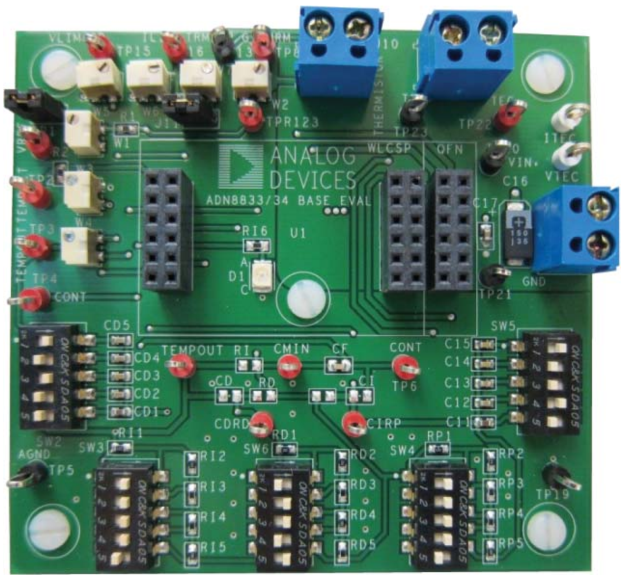
The V_{LDR} and V_{SFB} voltages are limited by the power supply voltage with the upper limit of V_{VDD} and the lower limit of 0 V.

The voltage at the OUT2 pin is determined by the compensation amplifier with the PID network. This amplifier receives the temperature setpoint voltage at the IN2P input pin and the thermistor voltage at the IN2N pin, fed by the OUT1 pin of the error amplifier.

If the digital temperature control loop is used, configure the compensation amplifier as a unity-gain follower by connecting the OUT2 pin to the IN2N pin, and then apply the control signal from a digital-to-analog converter (DAC) to the IN2P input. Thus, the OUT2 pin voltage is equal to the DAC voltage at the IN2P pin, and the TEC driver outputs follow Equation 11 and Equation 12.

USING THE ADN8835 BASE BOARD

The ADN8835 base board, which is compatible with the ADN8833, ADN8834, and ADN8835, is available upon request. The base board allows the user to tune the PID components in an analog thermal control loop due to the set of selectable R and C values (these values are on the base board). In addition, the base board offers adjustable components that allow the user to change the maximum TEC voltage and cooling and heating current limits. The temperature setpoint can be also changed manually by connecting an ADN8835CP-EVALZ board to the base board as the daughter card. To avoid duplication, remove several configuration components from the daughter card before connecting it into the ADN8835 base board (see Table 4). Align the silkscreen labels on the two boards in the same orientation when plugging in.



14342-005

Figure 4. ADN8835 Base Board (Compatible with the ADN8833, ADN8834, and ADN8835)

Table 4. Configuration Components to Be Removed from the ADN8835CP-EVALZ Board

Component	Value	Function
R1	4.22 kΩ	Voltage limit (VLIM)
R3	270.6 kΩ	Current limit (ILIM)
R4	50.8 kΩ	ILIM
R10	165 kΩ	PID compensation amplifier
C7	10 µF	PID compensation amplifier
R13	1.87 MΩ	PID compensation amplifier
R16	20 kΩ	Temperature setpoint (TEMPSET)
R17	20 kΩ	TEMPSET
R11	1.87 MΩ	PID compensation amplifier
C8	1.5 µF	PID compensation amplifier
C6	0.01 µF	PID compensation amplifier
R9	80.6 kΩ	Thermistor amplifier
R8	7.68 kΩ	Thermistor amplifier
R12	17.8 kΩ	Thermistor amplifier

EVALUATION BOARD SCHEMATICS AND ARTWORK

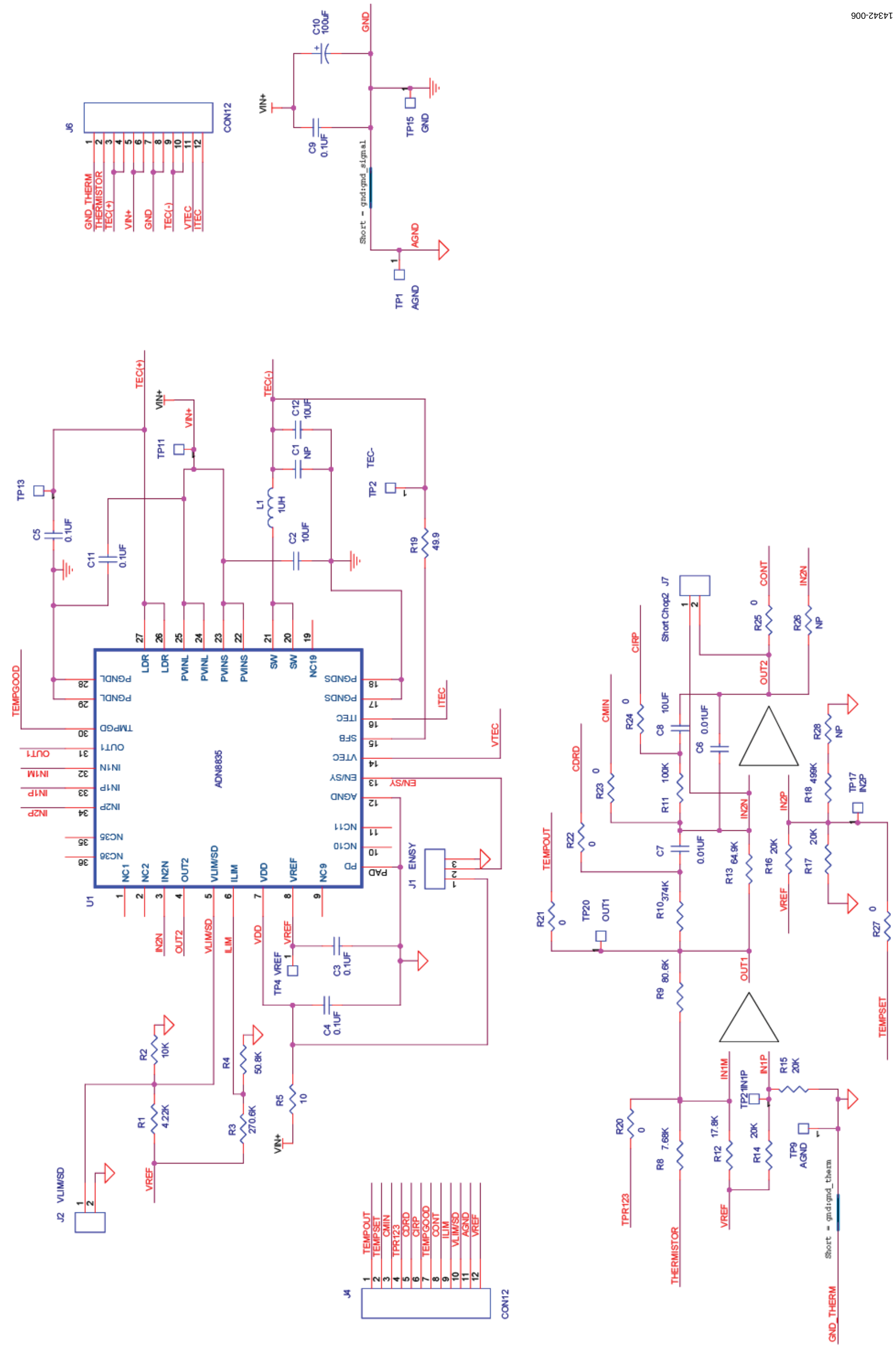


Figure 5. ADN8835CP-EVALZ Evaluation Board Schematic

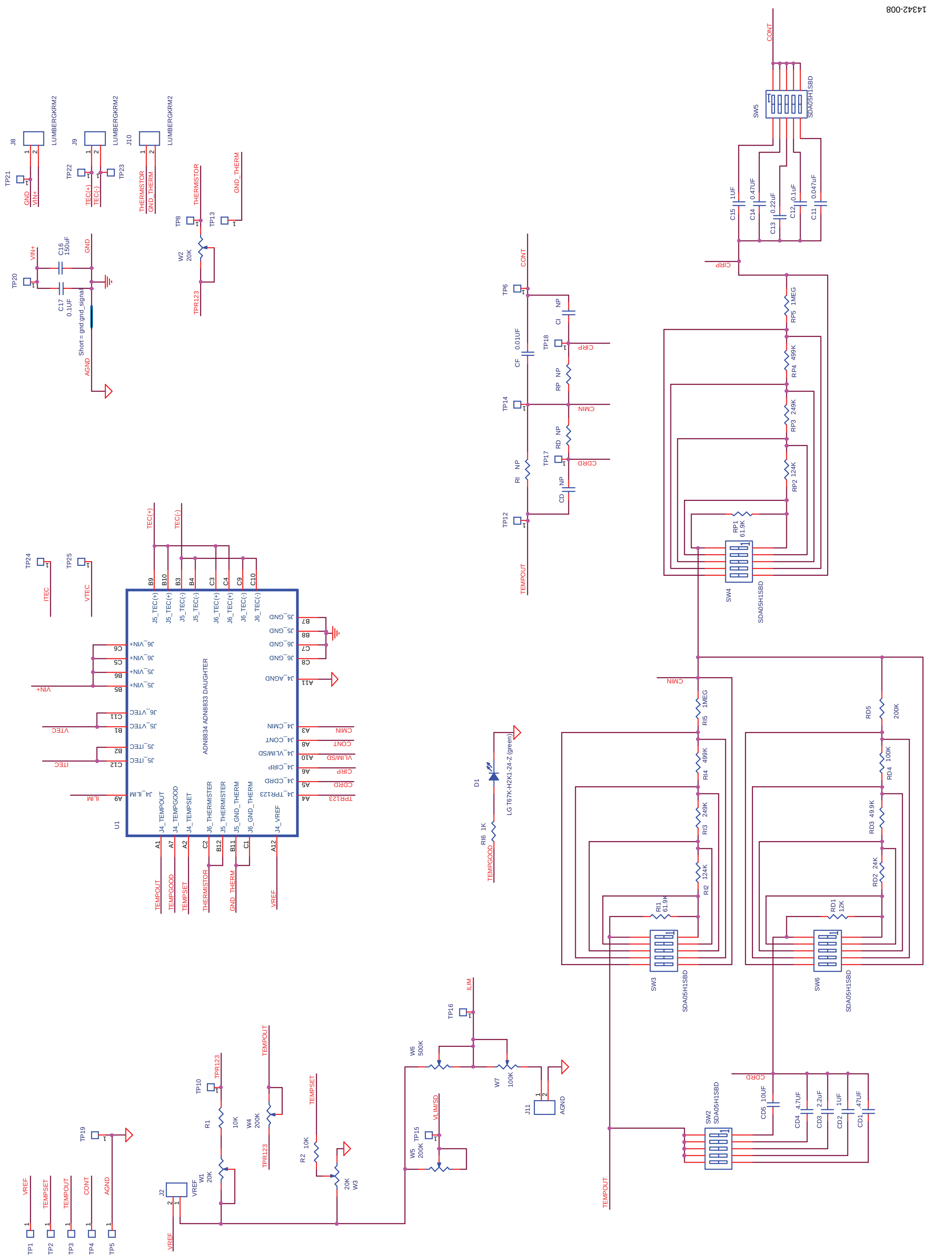


Figure 6. ADN8835 Base Board Schematic

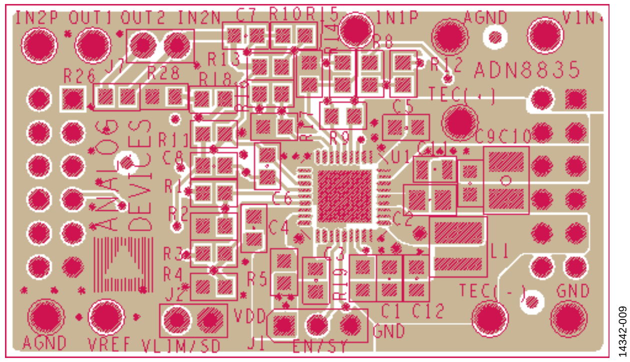


Figure 7. ADN8835CP-EVALZ Evaluation Board, Top Layer

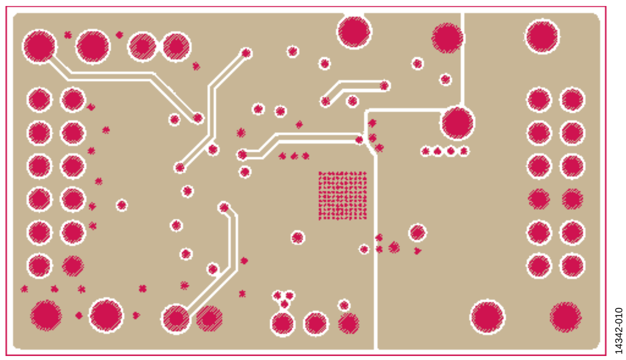


Figure 8. ADN8835CP-EVALZ Evaluation Board, Second Layer

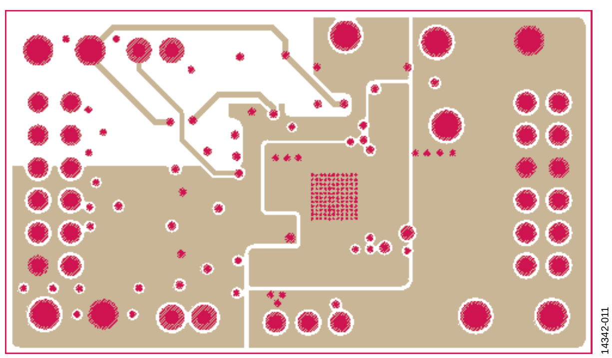


Figure 9. ADN8835CP-EVALZ Evaluation Board, Third Layer

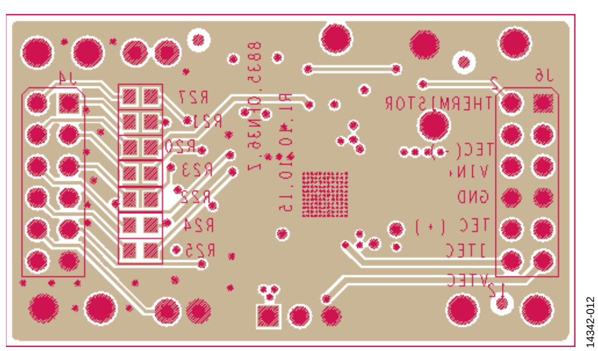


Figure 10. ADN8835CP-EVALZ Evaluation Board, Bottom Layer

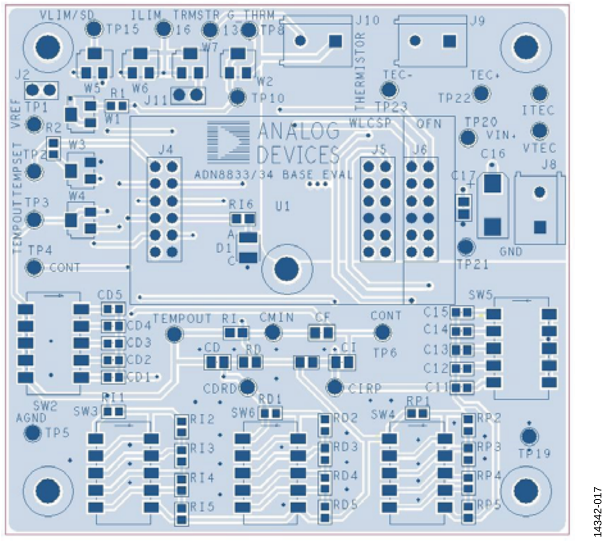


Figure 11. ADN8835 Base Board, Top Layer

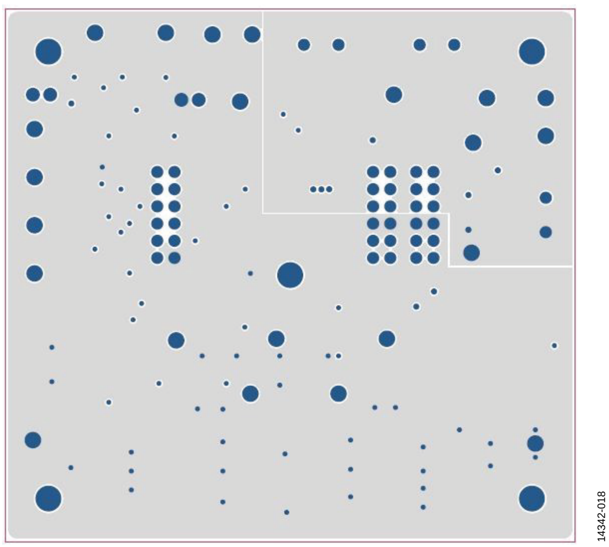
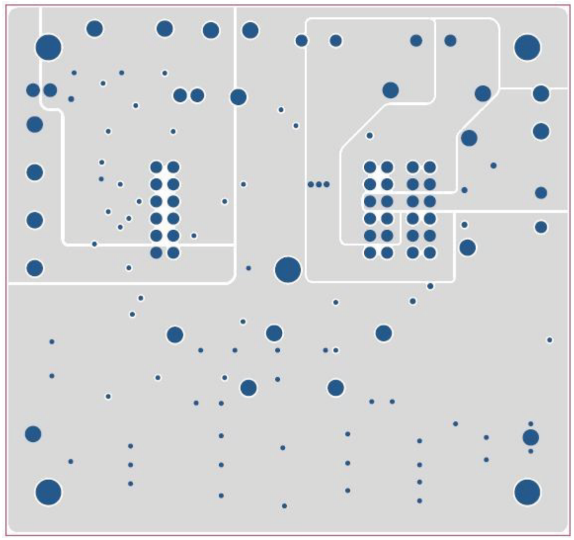
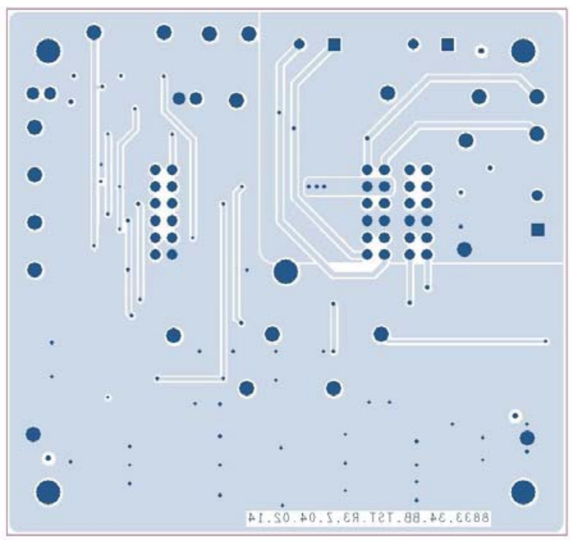


Figure 12. ADN8835 Base Board, Layer 2



14342-019

Figure 13. ADN8835 Base Board, Layer 3



14342-020

Figure 14. ADN8835 Base Board, Bottom Layer

ORDERING INFORMATION

BILL OF MATERIALS

Table 5. Bill of Materials for the ADN8835CP-EVALZ Evaluation Board

Quantity	Reference	Description	Manufacturer	Part Number
3	C2, C8, C12	Ceramic capacitor, 10 µF, 10 V, 10%, X7R 0805	Taiyo Yuden	LMK212B7106KG-TD
5	C3, C4, C5, C9, C11	Ceramic capacitor, 0.1 µF, 10 V, 10%, X7R 0603	Kemet	C0603C104K8RACTU
2	C6, C7	Ceramic capacitor, 0.01 µF, 50 V, 10%, X7R 0603	Kemet	C0603C103K5RACTU
1	C10	Tantalum capacitor, 100 µF, 6.3 V, 20%, 1411	Vishay	293D107X06R3B2T
1	J1	Jumper, 3-pin	Samtec	TSW-103-08-G-S
1	J2	Jumper, 2-pin	Samtec	TSW-103-08-G-S
2	J4, J6	Connector, double row, male, 12-pin	Samtec	TSW-112-08-G-D
1	L1	Inductor, 1 µH	Coilcraft	XFL4020-102MEB
1	R1	Resistor, 4.22 kΩ, 1/10 W, 1%, 0603, SMD	Vishay	CRCW06036K65FKEA
1	R2	Resistor, 10 kΩ, 1/10 W, 1%, 0603, SMD	Vishay	ERJ-3EKF1002V
1	R3	Resistor, 274 kΩ, 1/10 W, 1%, 0603, SMD	Vishay	CRCW0603210KFKEA
1	R4	Resistor, 51.1 kΩ, 1/10 W, 1%, 0603, SMD	Vishay	CRCW060348K7FKEA
1	R5	Resistor, 10.0 Ω, 1/10 W, 1%, 0603, SMD	Vishay	CRCW060310R0FKEA
1	R8	Resistor, 7.68 kΩ, 1/10 W, 1%, 0603, SMD	Vishay	CRCW06037K68FKEA
1	R9	Resistor, 80.6 kΩ 1/10 W, 1%, 0603, SMD	Vishay	CRCW060380K6FKEA
1	R12	Resistor, 17.8 kΩ, 1/10 W, 1%, 0603, SMD	Vishay	CRCW060317K8FKEA
1	R10	Resistor, 374 kΩ, 1/10 W, 1%, 0603, SMD	Vishay	CRCW0603374KFKEA
1	R11	Resistor, 562 kΩ, 1/10 W, 1%, 0603, SMD	Vishay	CRCW0603562KFKEA
1	R13	Resistor, 64.9 kΩ, 1/10 W, 1%, 0603, SMD	Vishay	CRCW060364K9FKEA
4	R14, R15, R16, R17	Resistor, 20.0 kΩ, 1/10 W, 1%, 0603, SMD	Vishay	CRCW060320K0FKEA
1	R18	Resistor, 499 kΩ, 1/10 W, 1%, 0603, SMD	Vishay	ERJ-3EKF4993V
1	R19	Resistor, 49.9 Ω, 1/10 W, 1%, 0603, SMD	Vishay	CRCW060349R9FKEA
7	R20, R21, R22, R23, R24, R25, R27	Resistor, 0.0 Ω, 1/10 W, 0603, SMD	Vishay	ERJ-3GEY0R00V
10	TP1, TP4, TP9, TP13, TP15, TP17, TP18, TP19, TP20, TP21	Test point	Keystone	5010
2	TP2, TP11	Connector	Mill-Max	3102-2-00-21-00-08-0
1	U1	Ultracompact, 3 A, TEC controller, LFCSP package	Analog Devices, Inc.	ADN8835ACPZ-R7

Table 6. Bill of Materials for the ADN8835 Base Board

Quantity	Reference	Description	Manufacturer	Part Number
2	CD1, C14	Ceramic capacitor, 0.47 µF, 16 V, 10%, X5R, 0603	TDK	C1608X5R1C474K080AA
2	CD2, C15	Ceramic capacitor, 1 µF, 16 V, 10%, X5R, 0603	Murata	GRM188R61C105KA
1	CD3	Ceramic capacitor, 2.2 µF, 16 V, 10%, X5R, 0603	Murata	GRM188R61C225KE
1	CD4	Ceramic capacitor, 4.7 µF, 6.3 V, 10%, X5R, 0603	Murata	GRM188R60J475KE19D
1	CD5	Ceramic capacitor, 10 µF, 6.3 V, 20%, X5R, 0603	Panasonic	ECJ-1VB0J106M
1	CF	Ceramic capacitor, 0.01 µF, 50 V, 10%, X7R, 0603	Kemet	C0603C103K5RACTU
1	C11	Ceramic capacitor, 0.047 µF, 6.3 V, 10%, X5R, 0603	Murata	GRM033R60J473KE19D
2	C12, C17	Ceramic capacitor, 0.1 µF, 50 V, 10%, X7R, 0603	AVX	06035C104KAT2A
1	C13	Ceramic capacitor, 0.22 µF, 6.3 V, 10%, X5R, 0603	TDK	C0603X5R0J224K030BB
1	C16	Tantalum capacitor, 150 µF, 6.3 V, 20%, 2917	Sanyo	6TPE150MI
1	D1	LED, green, 570 nm, clear, 2-PLCC	OSRAM	LG T67K-H2K1-24-Z
2	J2, J11	Jumper, 2-pin	Samtec	TSW-150-07-G-S
3	J8, J9, J10	Connector, PCB terminal, black, 2-pin	On Shore	OSTVN02A150

Quantity	Reference	Description	Manufacturer	Part Number
1	RD1	Resistor, 12 kΩ, 1/10 W, 1%, 0603, SMD	Vishay	CRCW060312K0FKEA
1	RD2	Resistor, 24.3 kΩ, 1/10 W, 1%, 0603, SMD	Vishay	CRCW060324K3FKEA
1	RD3	Resistor, 49.9 kΩ, 1/10 W, 1%, 0603, SMD	Panasonic	ERJ-3EKF4992V
1	RD4	Resistor, 100 kΩ, 1/10 W, 1%, 0603, SMD	Vishay	CRCW0603100KFKEA
1	RD5	Resistor, 200 kΩ, 1/10 W, 1%, 0603, SMD	Panasonic	ERJ-3EKF2003V
2	RP1, RI1	Resistor, 61.9 kΩ, 1/10 W, 1%, 0603, SMD	Vishay	CRCW060361K9FKEA
2	RP2, RI2	Resistor, 124 kΩ, 1/10 W, 1%, 0603, SMD	Vishay	CRCW0603124KFKEA
2	RP3, RI3	Resistor, 249 kΩ, 1/10 W, 1%, 0603, SMD	Panasonic	ERJ-3EKF2493V
2	RP4, RI4	Resistor, 499 kΩ, 1/10 W, 1%, 0603, SMD	Panasonic	ERJ-3EKF4993V
2	RP5, RI5	Resistor, 1 MΩ, 1/10 W, 1%, 0603, SMD	Vishay	CRCW06031M00FKEA
1	RI6	Resistor, 1 kΩ, 1/10 W, 1%, 0603, SMD	Panasonic	ERJ-6ENF4123V
2	R1, R2	Resistor, 10 kΩ, 1/10 W, 1%, 0603, SMD	Panasonic	ERJ-3EKF1002V
5	SW2, SW3, SW4, SW5, SW6	Switch, low profile DIP, top slide, 5-position	C&K	SDA05H1SBD
18	TP1, TP2, TP3, TP4, TP5, TP6, TP8, TP10, TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP19, TP20, TP21	Test point	Keystone	5010
1	U1	Connector[1]	Samtec	SSW-106-01-G-D
3	W1, W2, W3	Trimmer, 20 kΩ, 0.25 W, SMD	Murata	PVG5A203C03R00
2	W4, W5	Trimmer, 200 kΩ, 0.25 W, SMD	Murata	PVG5A204C03R00
1	W6	Trimmer, 500 kΩ, 0.25 W, SMD	Murata	PVG5A504C03R00
1	W7	Trimmer, 100 kΩ, 0.25 W, SMD	Murata	PVG5A104C03R01

[1] U1 has a reserved area to plug in the daughter board. The silkscreen mark includes three 12-pin female connectors and several other components.

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.

UG14342-0-12/16(0)

ANALOG DEVICES

www.analog.com