AD8175-EVALZ/AD8176-EVALZ/ AD8177-EVALZ/AD8178-EVALZ User Guide

UG-890

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

Evaluation Board for the AD8175/AD8176/AD8177/AD8178 Triple Video Crosspoint Switches

FEATURES

- Full-featured evaluation board for the AD8175/AD8176/AD8177/AD8178
- Supports both single-ended and differential input and output
- Supports RGBHV signal
- Drives SMA and CAT5 cables
- Decoded HV sync outputs available
- Single +5 V or dual ±2.5 V operation

EVALUATION KIT CONTENTS

- AD8175-EVALZ/AD8176-EVALZ/AD8177-EVALZ/ AD8178-EVALZ evaluation board
- Instruction guide for user guide and software download

EQUIPMENT NEEDED

- Signal source or video pattern generator and signal analyzer
- Power supplies (5 V with 3 A and ±2.5 V with 3 A)
- SMA to SMA connector for inputs and outputs
- Male VGA to male VGA connector for inputs and female VGA to male VGA connector for outputs
- CAT5 cable
- Workstation or desktop with Windows XP operating system

GENERAL DESCRIPTION

The AD8175 and AD8176 are high speed, triple 16 × 9 video crosspoint switch matrixes with a gain of 2 and 4, respectively. Both the AD8175 and AD8176 support 1600 × 1200 RGB displays at a 85 Hz refresh rate. The AD8175 has a 500 MHz bandwidth, 1800 V/µs slew rate, −88 dB crosstalk, and −94 dB isolation (at 5 MHz). The AD8176 has a 450 MHz bandwidth, 1650 V/µs slew rate, −82 dB crosstalk, and −90 dB isolation (at 5 MHz).

The AD8177 and AD8178 have the same specifications as the AD8175 and AD8176, respectively, but are 16 × 5 video crosspoint switch matrixes.

The AD8175, AD8176, AD8177, and AD8178 support two modes of operation: differential in to differential out mode with sync on common-mode (CM) signaling passed through the switch, and differential in to differential out mode with CM signaling removed through the switch. The output CM and black level can be conveniently set via external pins. The outputs can be single ended in conjunction with decoded H and V outputs to drive a monitor directly.

The independent output buffers of the AD8175, AD8176, AD8177, and AD8178 can be placed into a high impedance state to create larger arrays by paralleling the crosspoint outputs. The inputs can also be paralleled. The AD8175, AD8176, AD8177, and AD8178 offer both serial and parallel programming modes.

The AD8175/AD8176/AD8177/AD8178 are packaged in a fully populated, 26 × 16 ball PBGA package and are available over the extended industrial temperature range of −40°C to +85°C.

This user guide provides all of the supporting documents for evaluating the AD8175/AD8176/AD8177/AD8178 using the AD8175-EVALZ/AD8176-EVALZ/AD8177-EVALZ/AD8178-EVALZ evaluation board. Additional information is available in the AD8175, AD8176, AD8177, and AD8178 data sheets, which should be consulted in conjunction with this user guide when working with the evaluation board.

TABLE OF CONTENTS

Features 1
Evaluation Kit Contents 1
Equipment Needed 1
General Description 1
Revision History 2
Evaluation Board Photograph and Block Diagram 3
Evaluation Board Hardware 4
Introduction 4
Power Supply 4
Inputs 4
Outputs 4
NI USB-6501 5
VBLK, CMENC, VOCM_CMENCOFF, and VOCM_CMENCON Logic Inputs 5
Calibration Path 5
Quick Start Guide 6
Evaluation Board Schematics and Artwork 8
Ordering Information 31
Bill of Materials 31

REVISION HISTORY

10/15—Revision 0: Initial Version

EVALUATION BOARD PHOTOGRAPH AND BLOCK DIAGRAM

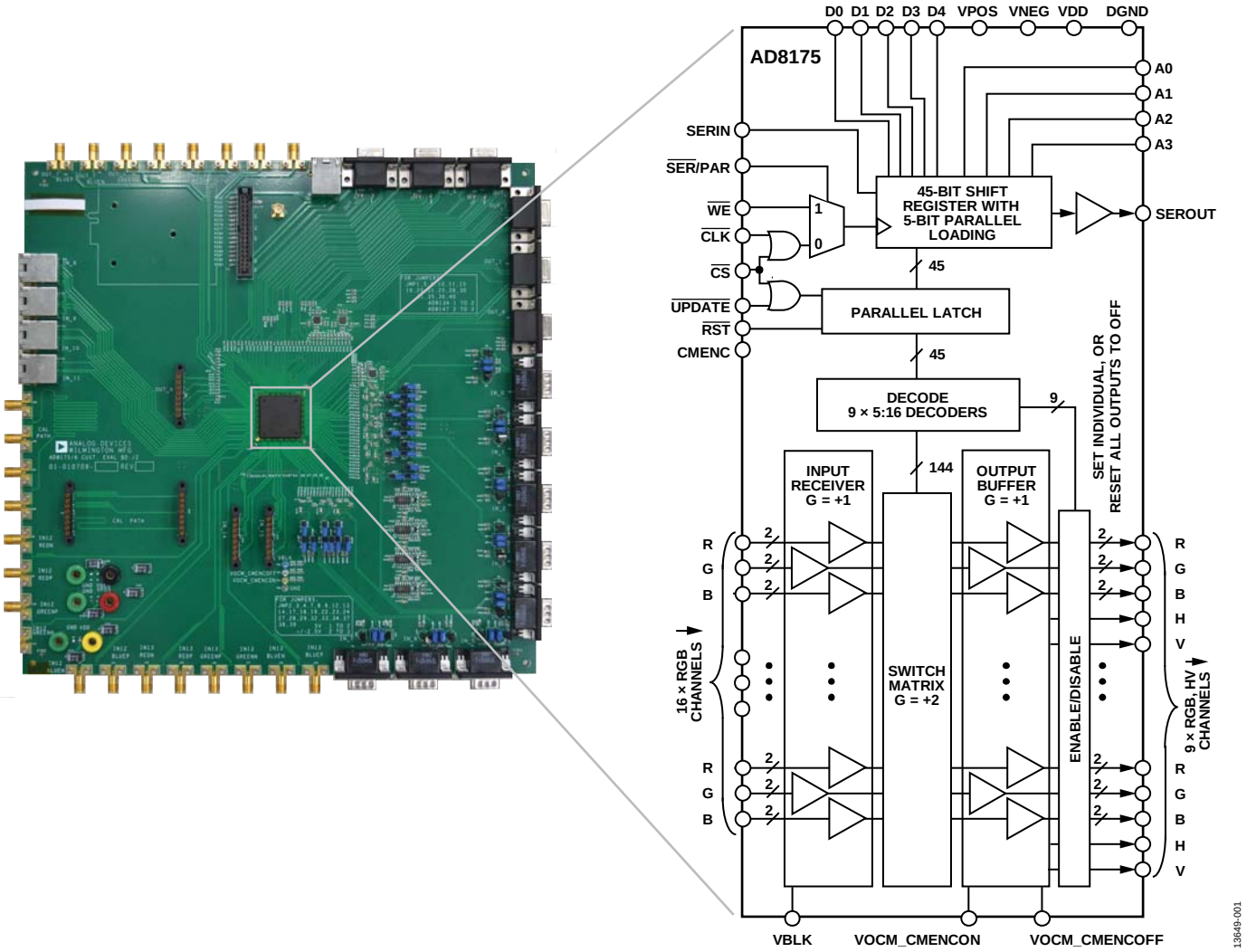

Figure 1. Evaluation Board Photograph and Block Diagram

EVALUATION BOARD HARDWARE

INTRODUCTION

The AD8175-EVALZ/AD8176-EVALZ/AD8177-EVALZ/AD8178-EVALZ evaluation board allows the user to easily evaluate the AD8175/AD8176/AD8177/AD8178 in both the 50 Ω and 75 Ω controlled impedance applications. Figure 3 shows the typical bench setup used to evaluate the 16 × 5 and 16 × 9 crosspoint switch matrixes.

Table 1. Device Options

Device	Gain (Differential to Differential)	Frequency	Switch Matrix
AD8175	2	500 MHz	16 × 9
AD8176	4	450 MHz	16 × 9
AD8177	2	500 MHz	16 × 5
AD8178	4	450 MHz	16 × 5

POWER SUPPLY

This evaluation board can be used for a single 5 V supply (and ground); dual or split supplies of ±2.5 V, +3 V/−2 V; or other combinations where the voltage difference is 5 V. There are various jumpers on the board to select the different power supply operations. Figure 26 shows the power supply schematic.

INPUTS

IN0 to IN3

The first four inputs (IN0 to IN3) accept a standard RGBHV output from a PC (sometimes referred to as VGA, but it can be any resolution).

The AD8175, AD8176, AD8177, or AD8178 do not directly accept the H and V sync signals as inputs. However, these signals can be carried on the common-mode of differential RGB inputs. A single device, the AD8134 converts the single-ended RGB signals to differential and encodes the H and V sync on the common mode. The IN0 through IN3 inputs each contain an AD8134 in the circuit path to perform this conversion and then drive the inputs to the AD8175/AD8176/AD8177/AD8178.

Figure 5 to Figure 8 show the schematics of Input 0 to Input 3.

IN4 to IN7

IN4 through IN7 have offset circuits for the differential inputs in addition to the AD8134 circuit that appears on IN0 through IN3. This offset circuit compensates the other half of a differential output if a single-ended output is used. IN4 through IN7 can also accept an RGBHV signal.

Figure 9 to Figure 12 show the schematics of Input 4 to Input 7.

IN8 to IN11

IN8 through IN11 have RJ45 connectors used to connect a standard Category 5 (CAT5) cable. An AD8134-EVALZ evaluation board can be used at the server end to convert the RGBHV output of the server to differential RGB with sync on common mode. A CAT5 cable can connect the output of the AD8134-EVALZ evaluation board to one of these inputs.

Figure 13 shows the schematic of Input 8 to Input 11.

IN12 and IN13

IN12 and IN13 have SMA connectors for each polarity of the RGB input for a total of six separate SMA connectors, which can be used to connect to test equipment that is not directly related to PC graphic signals or CAT5-based signals.

Figure 14 shows the schematic of Input 12 and Input 13.

IN14 and IN15

IN14 and IN15 have ganged, high speed coaxial connectors produced by W. L. Gore, which are used by various Analog Devices, Inc., test systems to enable rapid connector rearrangements of many circuits. These connectors are available for the AD8175-EVALZ/AD8176-EVALZ/AD8177-EVALZ/AD8178-EVALZ evaluation board to provide ports that are compatible with these test systems.

Figure 15 shows the schematics of Input 14 and Input 15.

OUTPUTS

OUT0 to OUT2

The OUT0 to OUT2 outputs provide single-ended RGB and H and V signals that are compatible with a standard RGB computer monitor. The connectors are the HD15 type, which are standard.

The signal path includes an AD8003 triple, high speed op amp. The AD8003 is configured for a gain of four. The AD8003 is provided so that an AD8175 output can be used to drive a monitor. If the board contains an AD8176, the AD8003 is not needed in the signal path.

The H and V output signals are derived from the sync on common mode at the inputs, which are directly connected to the AD8175/AD8176/AD8177/AD8178 and do not require any external buffers.

OUT1 is not used by the AD8177 and AD8178. Figure 16 to Figure 18 show the schematics of Output 0 to Output 2.

OUT3 to OUT5

OUT3 to OUT5 are similar to OUT0 to OUT2, but do not contain an AD8003 amplifier in the signal path. If using an AD8175/AD8176/AD8177/AD8178 at the OUT3 to OUT5 outputs, a picture can be seen on the monitor, but it is dim because the gain is half of what is required. An AD8176 or AD8178 provides the proper gain for these outputs to create a true picture.

OUT3 and OUT5 are not used by the AD8177 and AD8178. Figure 19 to Figure 21 show the schematics of Output 3 to Output 5.

Note that, when using any of these outputs (OUT0 to OUT5), the common-mode encoding must be turned off; turning it on distorts the color in the picture.

OUT6

OUT6 is an RJ45 connector. It carries the differential RGB with sync on common-mode signals, typically over a CAT5 cable. If this type of signal is used as input to the AD8175/AD8177 and common-mode encoding is turned on, the proper signal appears at this output, which can then drive another CAT5 cable.

This function does not work for AD8176 and AD8178 because their gains are twice that of the required signal. Figure 22 shows the schematic of Output 6.

OUT7

The OUT7 output has six separate SMA connectors for each of the polarities of the RGB output signal. Similar to the SMA inputs, these outputs are useful for connecting to various test equipment. Figure 23 shows the schematic of Output 7.

OUT8

OUT8 has the Gore header connector, the same as IN12 and IN13, which is compatible with various Analog Devices test equipment. Figure 24 shows the schematic of Output 8.

NI USB-6501

The NI USB-6501 is a portable, digital input/output device that is used as the digital controller of the evaluation board.

VBLK, CMENC, VOCM_CMENCOFF, AND VOCM_CMENCON LOGIC INPUTS

The VBLK pin defines the black level of the positive output phase.

The VBLK and VOCM_CMENCOFF inputs allow the user complete flexibility in defining the output CM level and the amount of overlap between the positive and negative phases, thus maximizing output headroom usage.

Note that, for evaluation purposes, while running off equally split supplies (±2.5 V), the VBLK and VOCM_CMENCOFF pins on the AD8175-EVALZ evaluation board must be tied to GND (0 V). These jumpers are included on the board.

VCOM_CMENCON and VCOM_CMENCOFF are typically set to midsupply (often ground), but can be moved by approximately ±0.5 V to accommodate cases where the desired output common-mode voltage is not midsupply (as in the case of unequal split supplies).

Common-Mode Operating Modes

Depending on the state of the CMENC logic input, the AD8175/AD8176/AD8177/AD8178 can be set in either of the two differential in, differential out operating modes. This only applies for CAT5 applications. See the Applications Information section in the product data sheet for more information.

Common-Mode Encoding Off, CMENC Tied to Low

In this mode, the CM of each RGB differential pair is removed through the device (or turned off), while the overall CM at the output is defined by the reference value, VOCM_CMENCOFF. CM noise is removed while the intended differential RGB signals are buffered and passed to the outputs.

Common-Mode Encoding On, CMENC Tied to High

In this mode, the CM of each RGB input is passed through the device with a gain of +1, while at the same time, the overall output CM is stripped and set equal to the voltage applied at the VOCM_CMENCON pin. The AD8175/AD8176/AD8177/AD8178 is placed in this operation mode when used with a sync on CM scheme. Although asserted, the H and V outputs are not used in this application.

CALIBRATION PATH

To calibrate for insertion loss due to input and output traces on the printed circuit board (PCB), a calibration through path is provided on this evaluation board. Figure 25 shows the schematic of the calibration path.

QUICK START GUIDE

To get started, take the following steps:

1. Remove the AD8175-EVALZ/AD8176-EVALZ/AD8177-EVALZ/AD8178-EVALZ evaluation board from the box.
2. Connect +2.5 V to VPOS, −2.5 V to VNEG, +3.3 V to VDD, and connect all ground supplies to GND. It is strongly recommended to initially operate the board from ±2.5 V to ensure basic operation. Afterwards, other power supply operation can be explored.
3. Connect shunts between Pin 1 and Pin 2 of the following jumpers: 1, 5, 6, 10, 11, 15, 16, 20, 21, 25, 26, 30, 31, 35, 36, and 40. These shunts allow the connection of IN0 through IN7 to the AD8134.
4. Connect shunts between Pin 2 and Pin 3 of the following jumpers: 2, 3, 4, 7, 8 9, 12, 13, 14, 17, 18, 19, 22, 23, 24, 27, 28, 29, 32, 33, 34, 37, 38, and 39. These shunts allow the operation of the ±2.5 V supply.
5. Connect TP2 and TP3 to TP4. This connection ties the VBLK and VOCM_CMENCOFF pins to GND.
6. Connect the NI USB-6501 board to P1 through the ribbon cable.
7. Connect a Type B to Type A USB cable between the NI USB-6501 and a workstation running the Windows® XP operating system.
8. Start the evaluation board software. (The procedure on the software download is included in the evaluation kit.)

For the RGB input, follow these steps:

1. Connect a female-to-male VGA cable between IN0 and the video pattern generator or any video signal source.
2. Connect a male-to-male VGA cable between OUT0 and the monitor or display.
3. Select the **IN0 to OUT0 LED** in the evaluation board software, and then click **APPLY**. OUT0 then produces the signal from IN0 (see Figure 2).

For the SMA input, follow these steps:

1. Connect a sine wave of 1 V p-p from the signal generator to IN12 REDN and IN12 REDP through the SMA connectors.
2. Connect SMA connectors between OUT7 REDN and the oscilloscope and between OUT7 REDP and the oscilloscope.
3. Select the **IN12 to OUT7 LED** in the evaluation board software, and then click **APPLY**. OUT12 produces the signal from IN12.

For the CAT5 input, follow these steps:

1. Connect a video driver evaluation board such as the AD8134-EVALZ on IN8 through a CAT5 cable to convert the RGB output of the video pattern generator or any other video signal source to differential RGB with sync on common mode.
2. Connect a CAT5 cable between OUT6 and a video receiver such as the AD8143-EVALZ.
3. Select the **IN8 to OUT6 LED** in the evaluation board software, and then click **APPLY**.

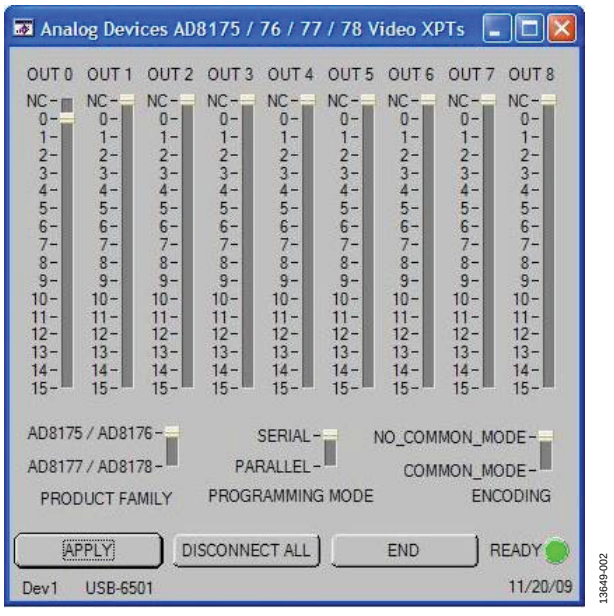

Figure 2. Sample of Input and Output Setting on the Evaluation Software

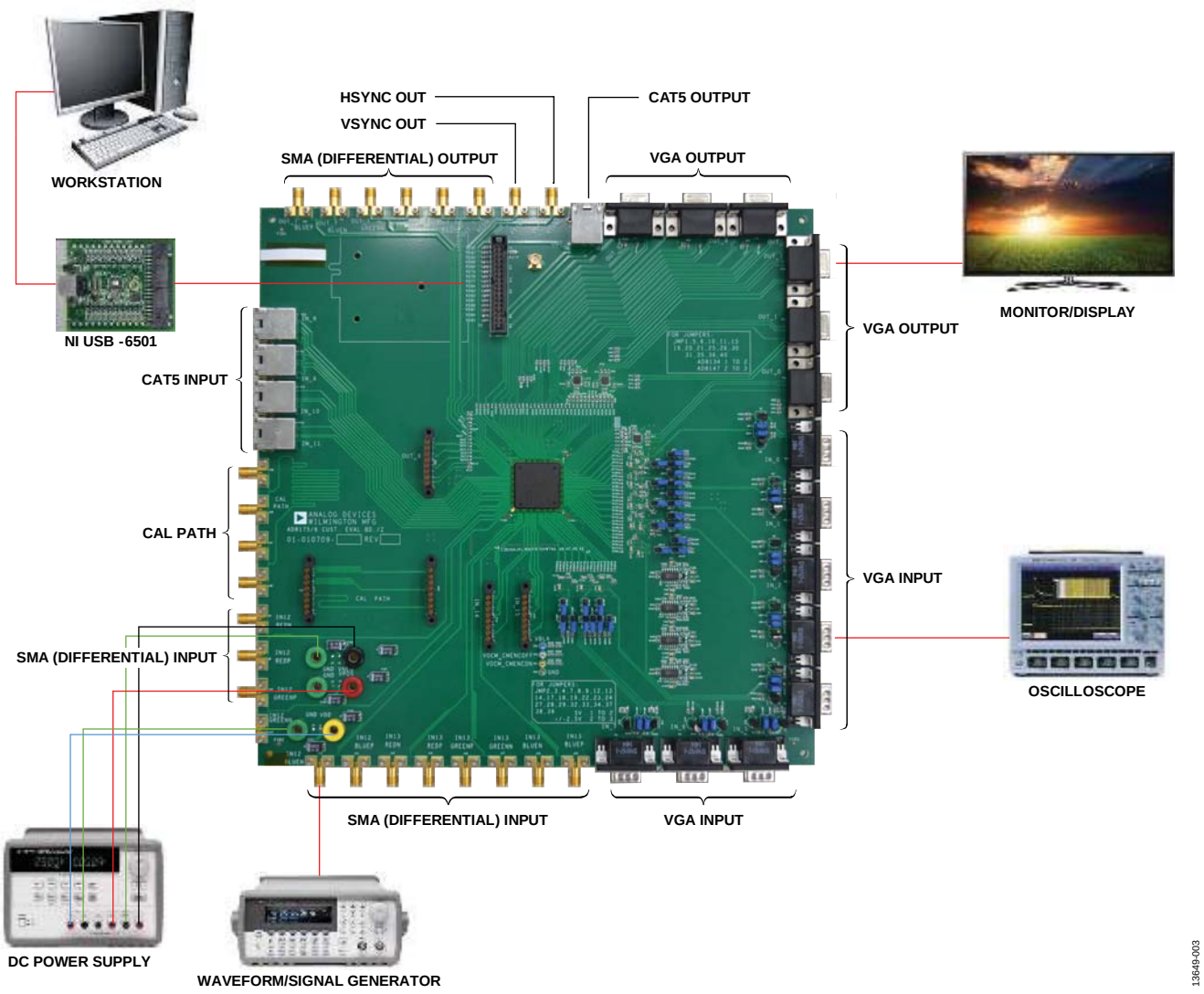

Figure 3. Typical Evaluation Setup

EVALUATION BOARD SCHEMATICS AND ARTWORK

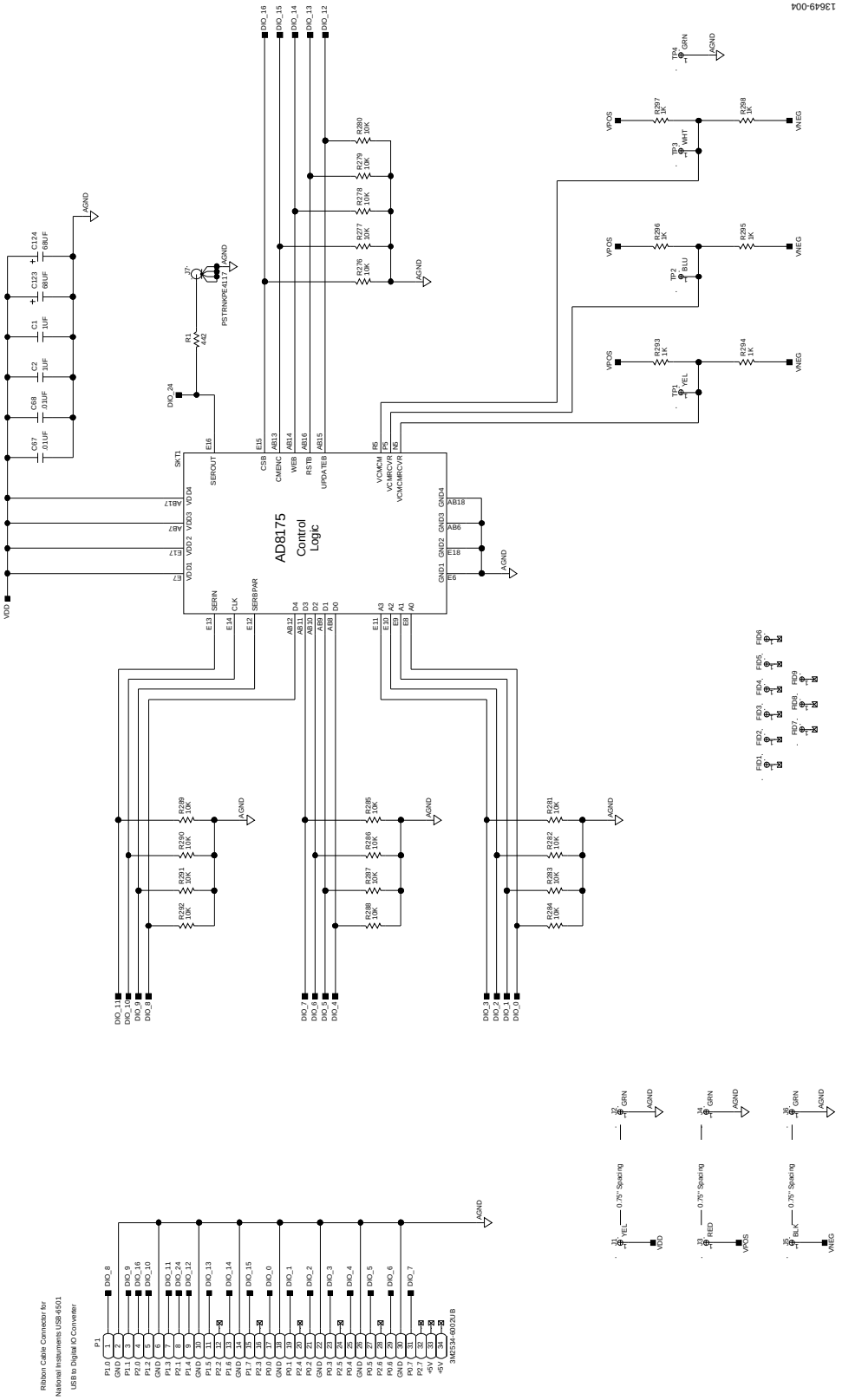

Figure 4. Logic Control Schematic

13649-005

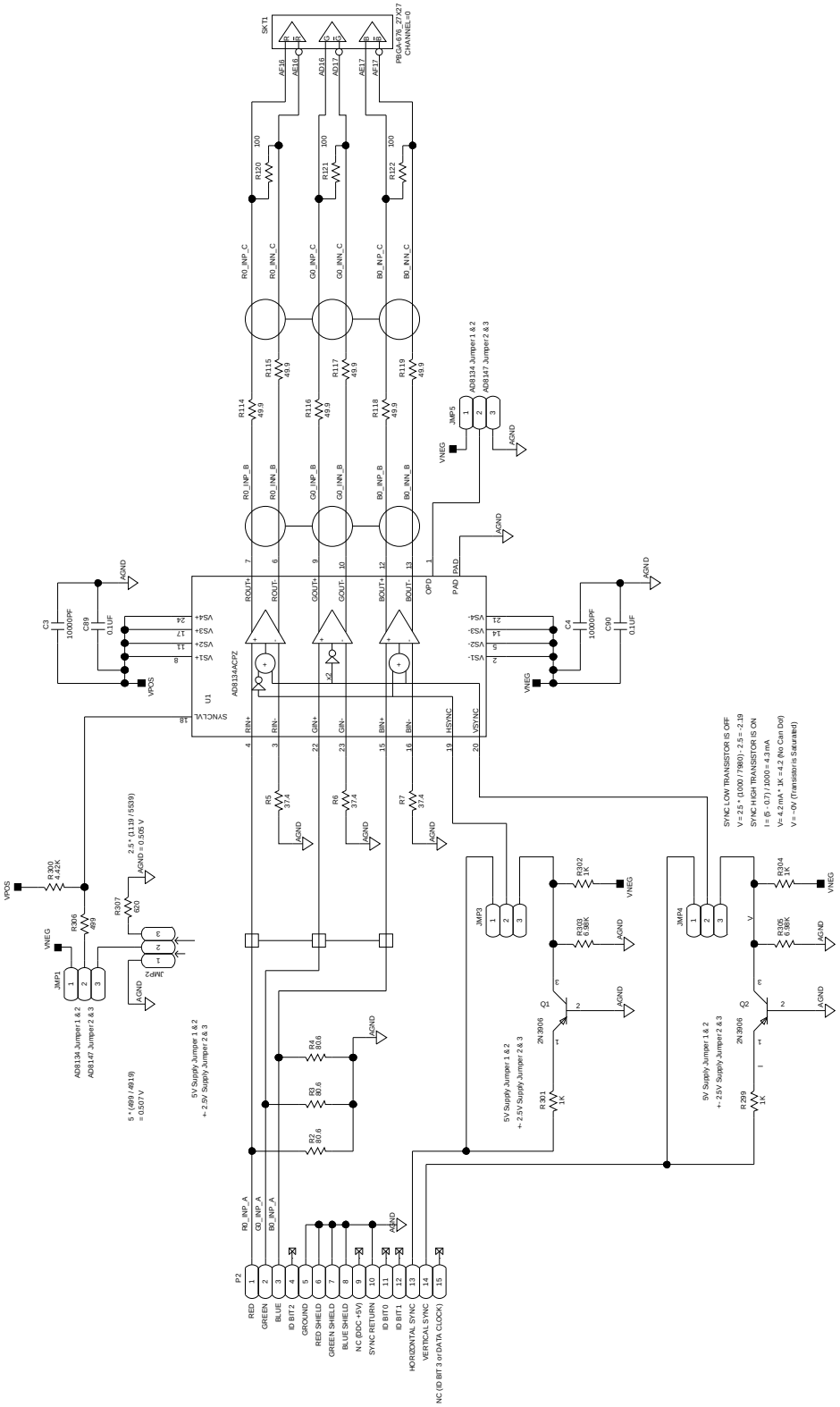

Figure 5. Input 0

13649-006

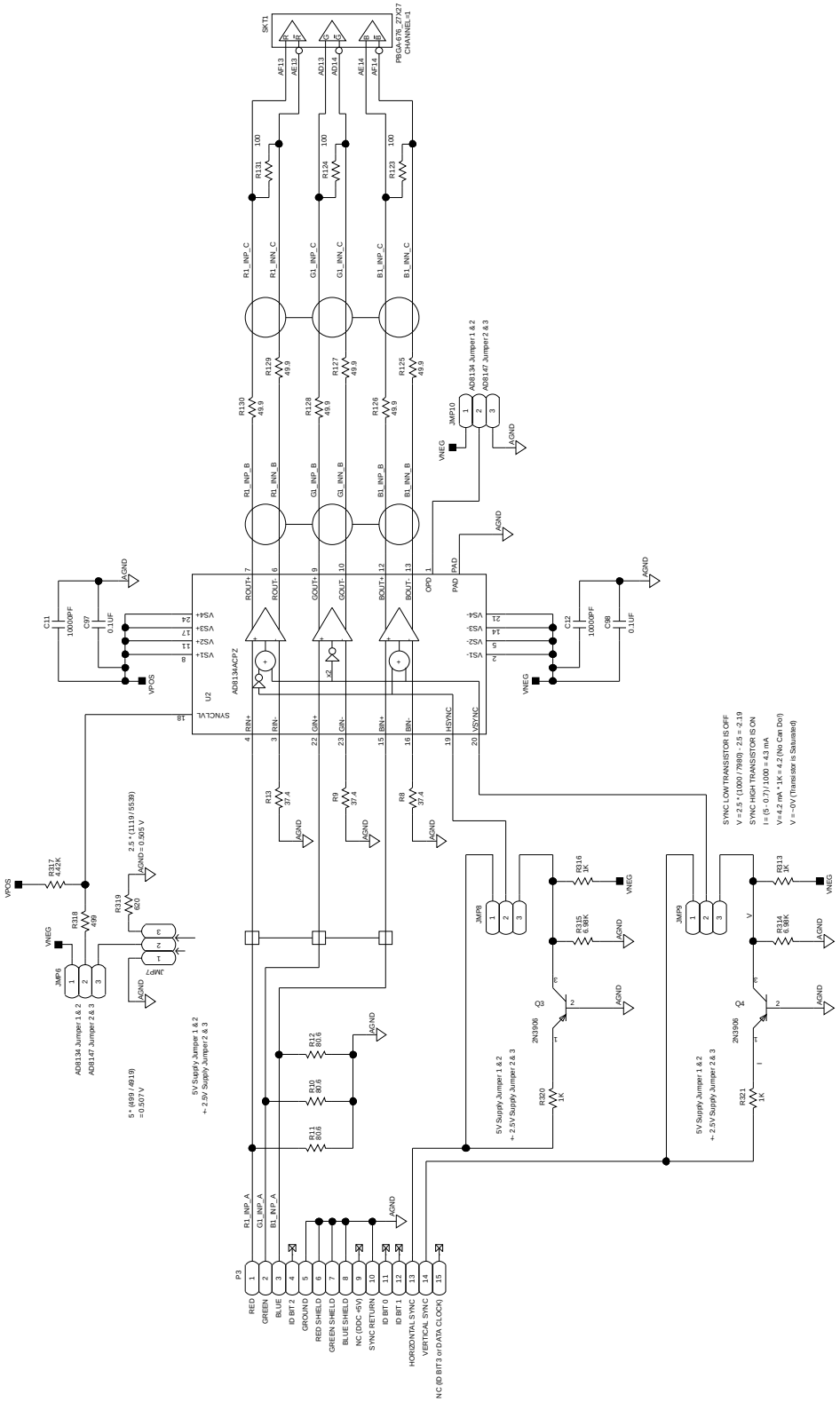

Figure 6. Input 1

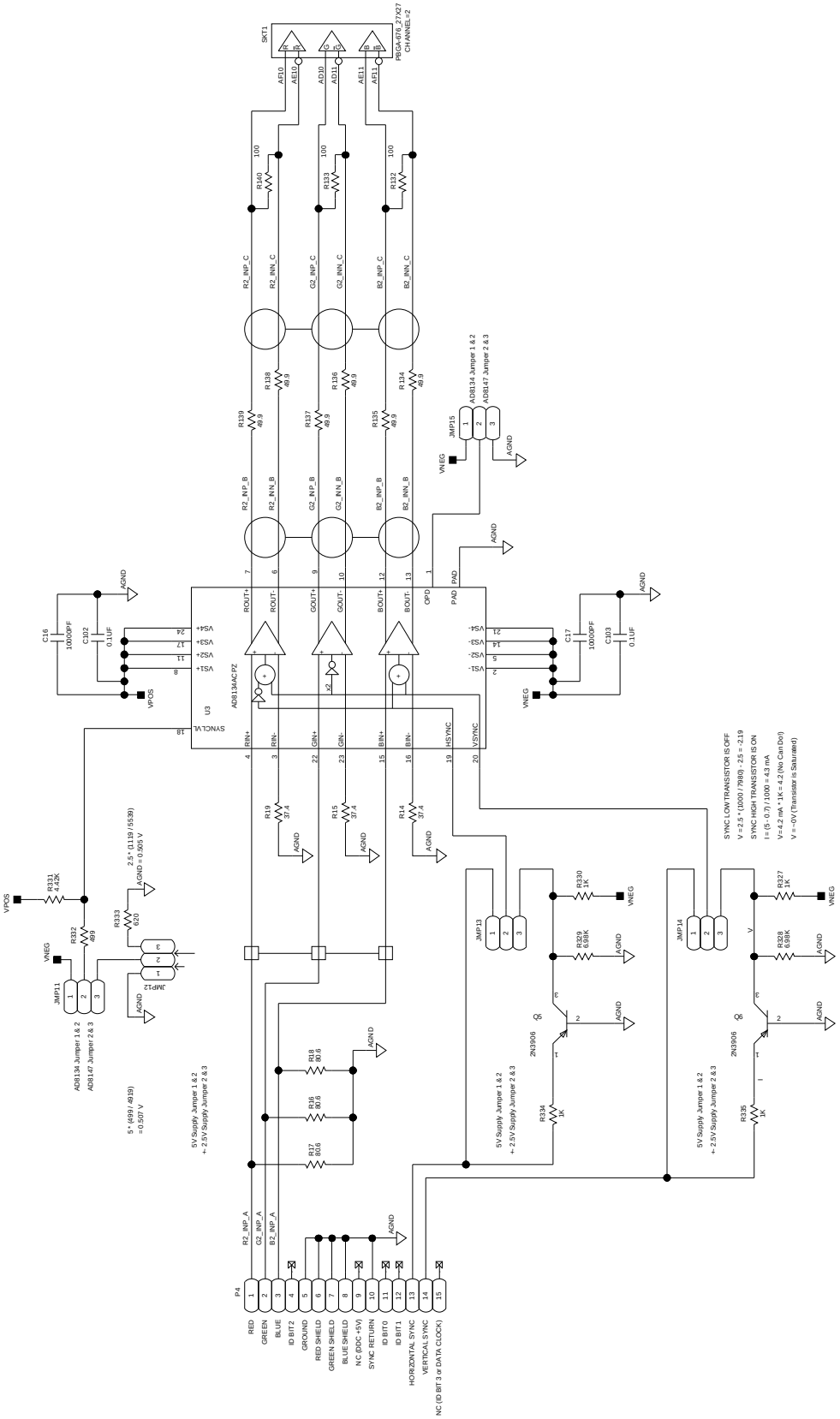

Figure 7. Input 2

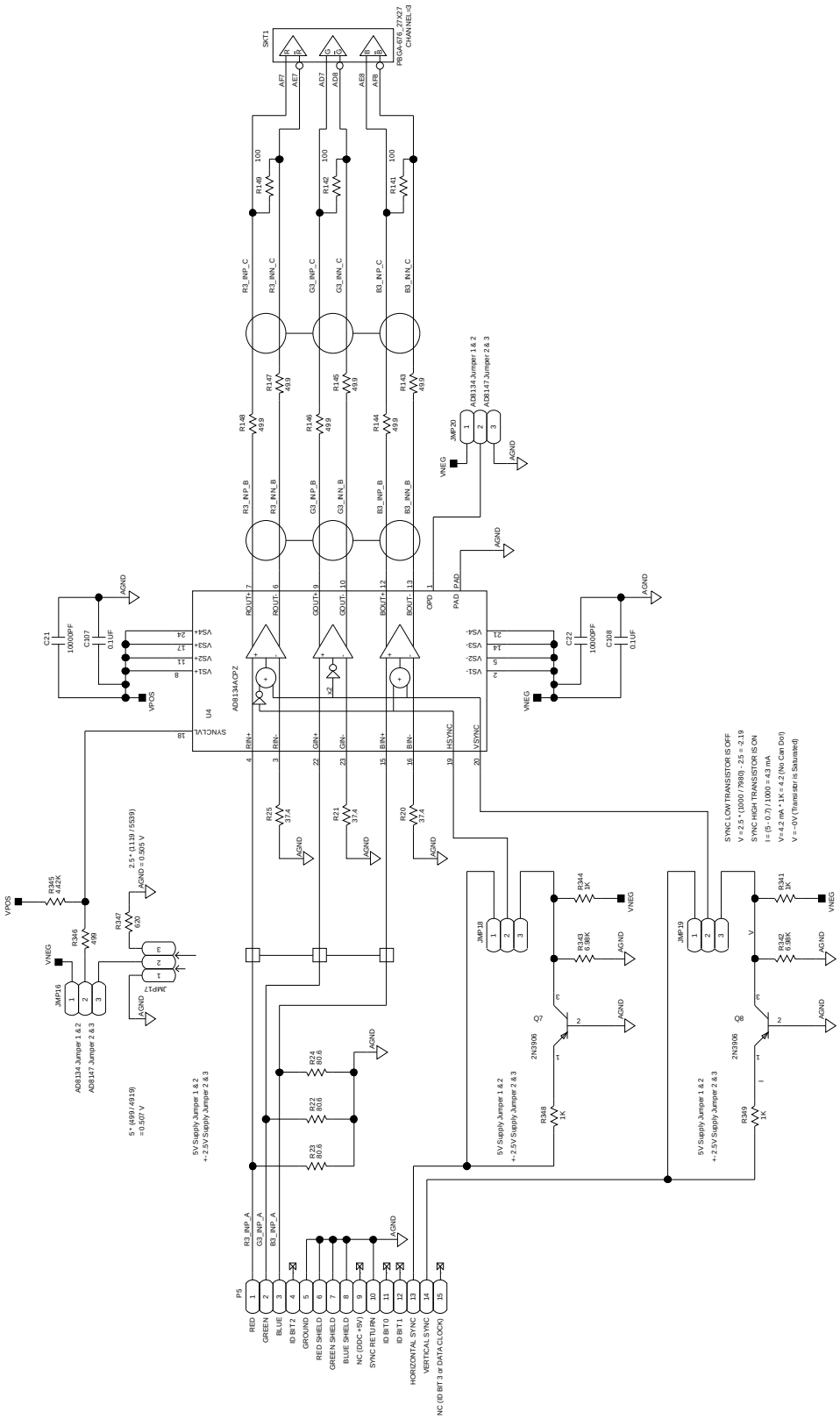

Figure 8. Input 3

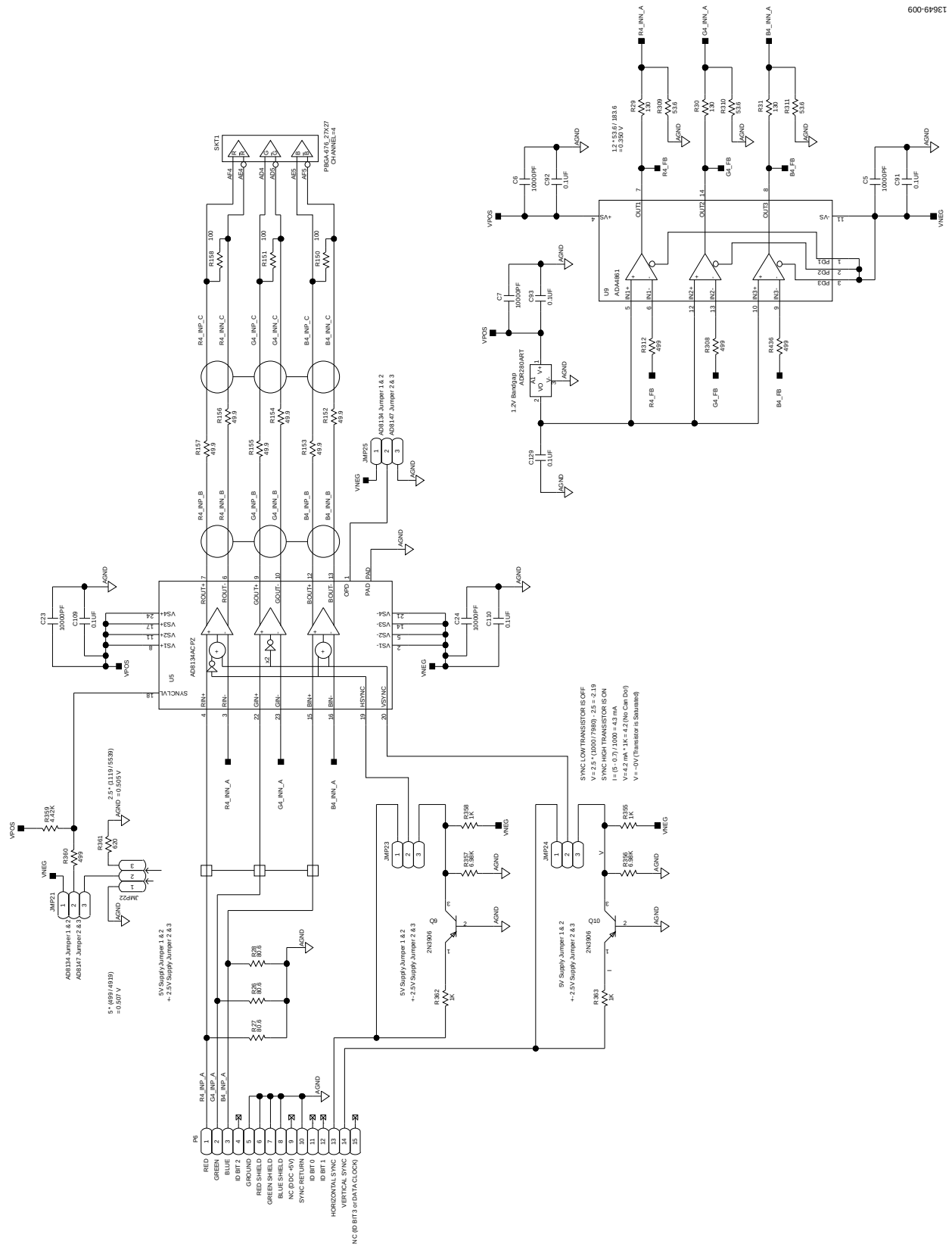

Figure 9. Input 4

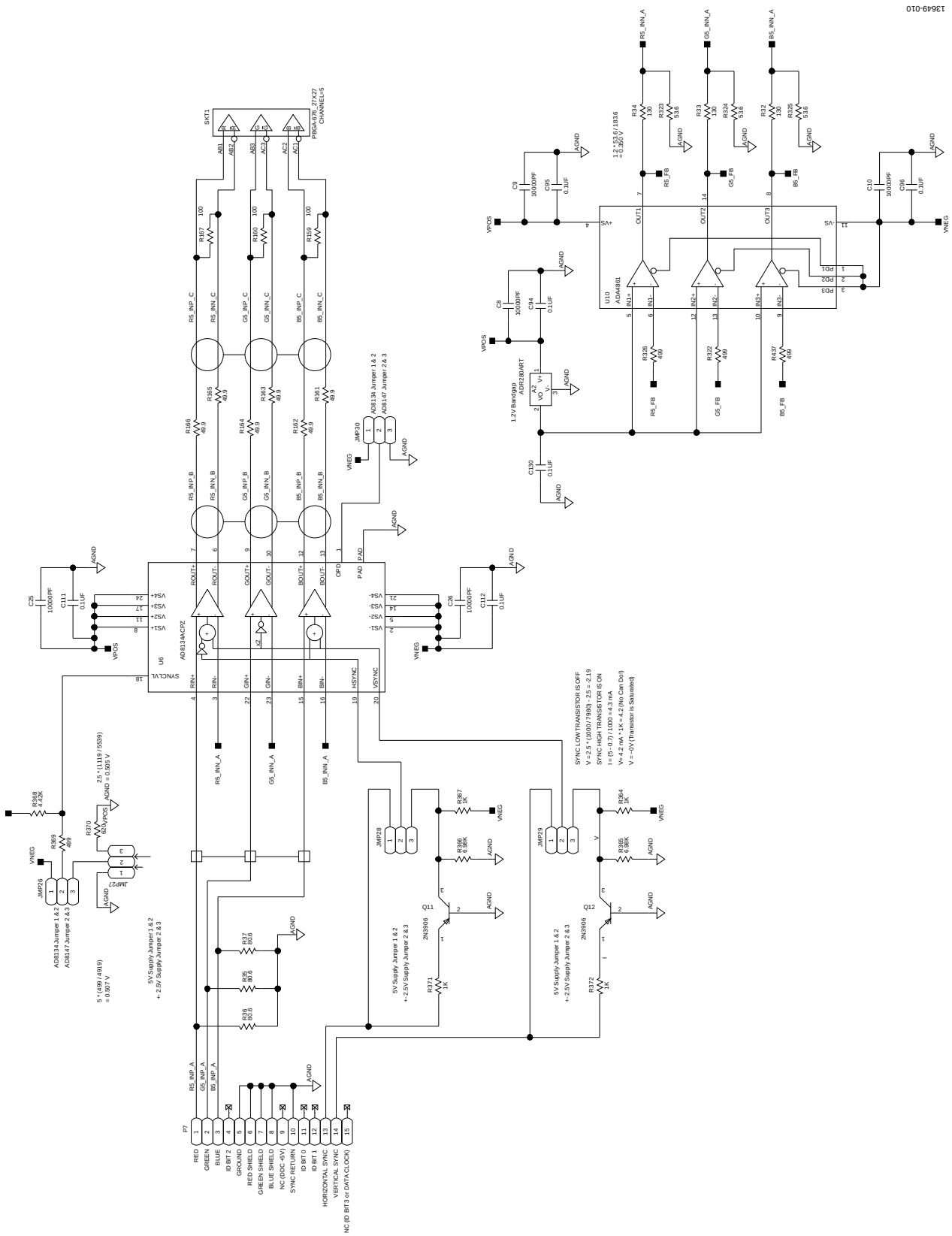

Figure 10. Input 5

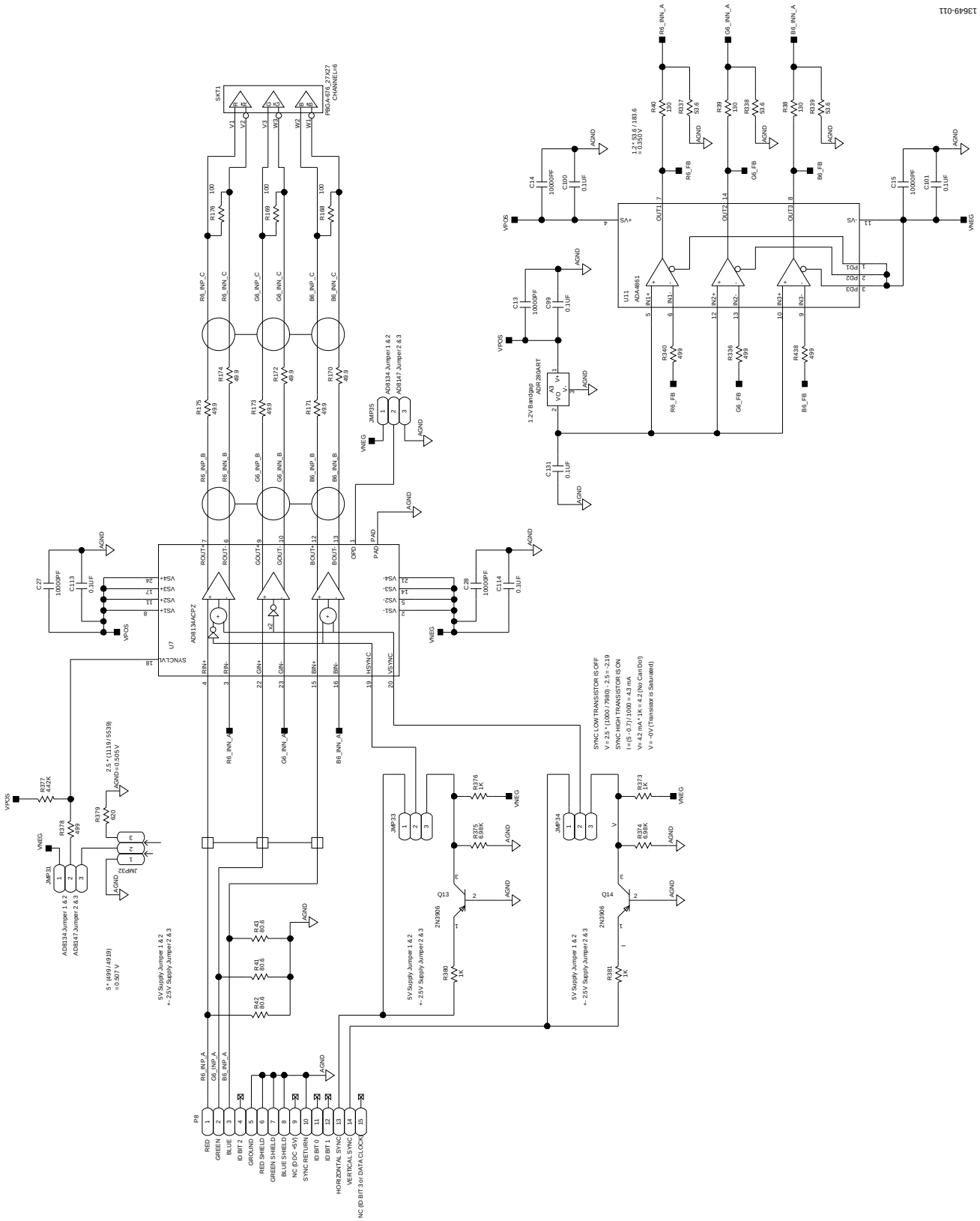

Figure 11. Input 6

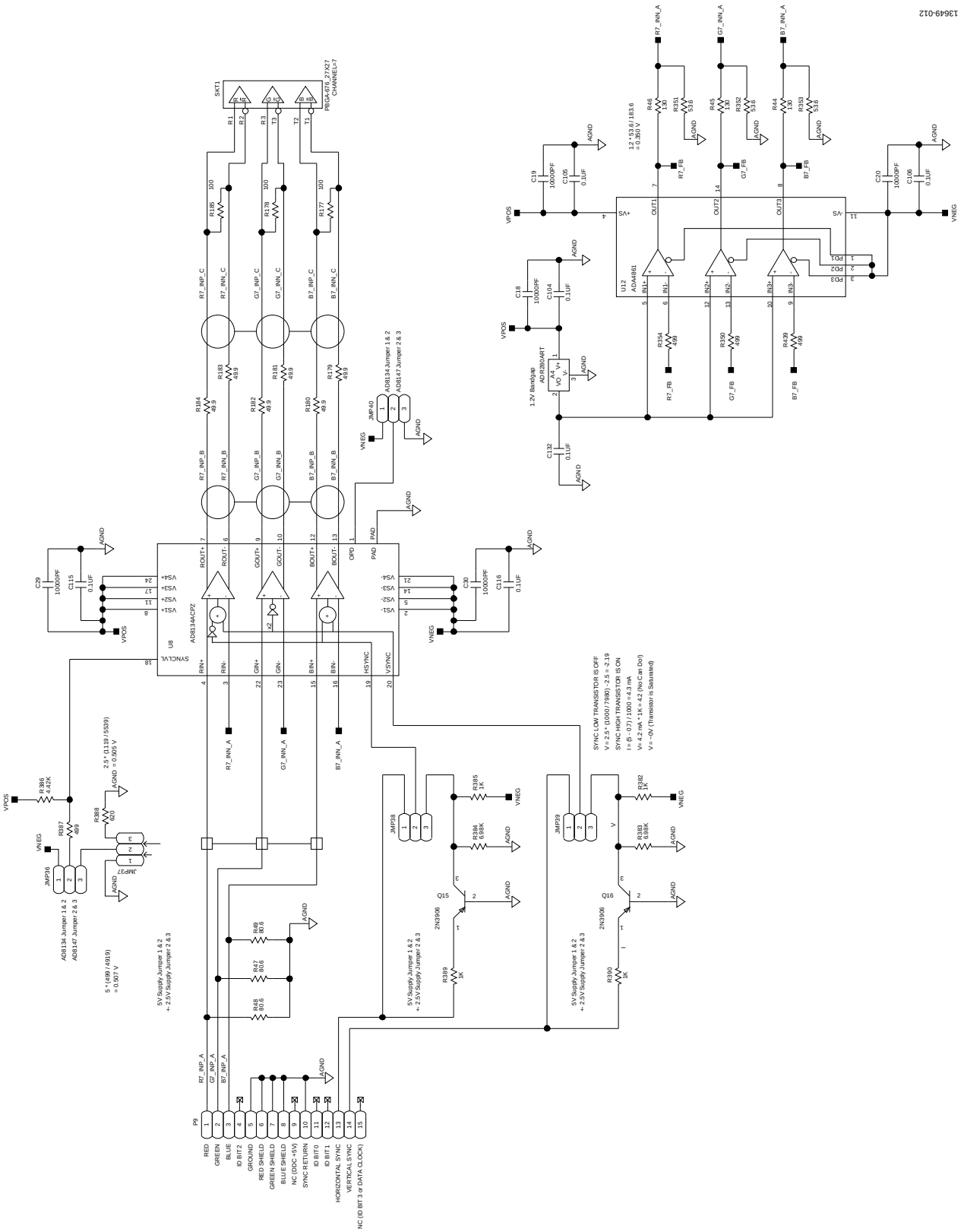

Figure 12. Input 7

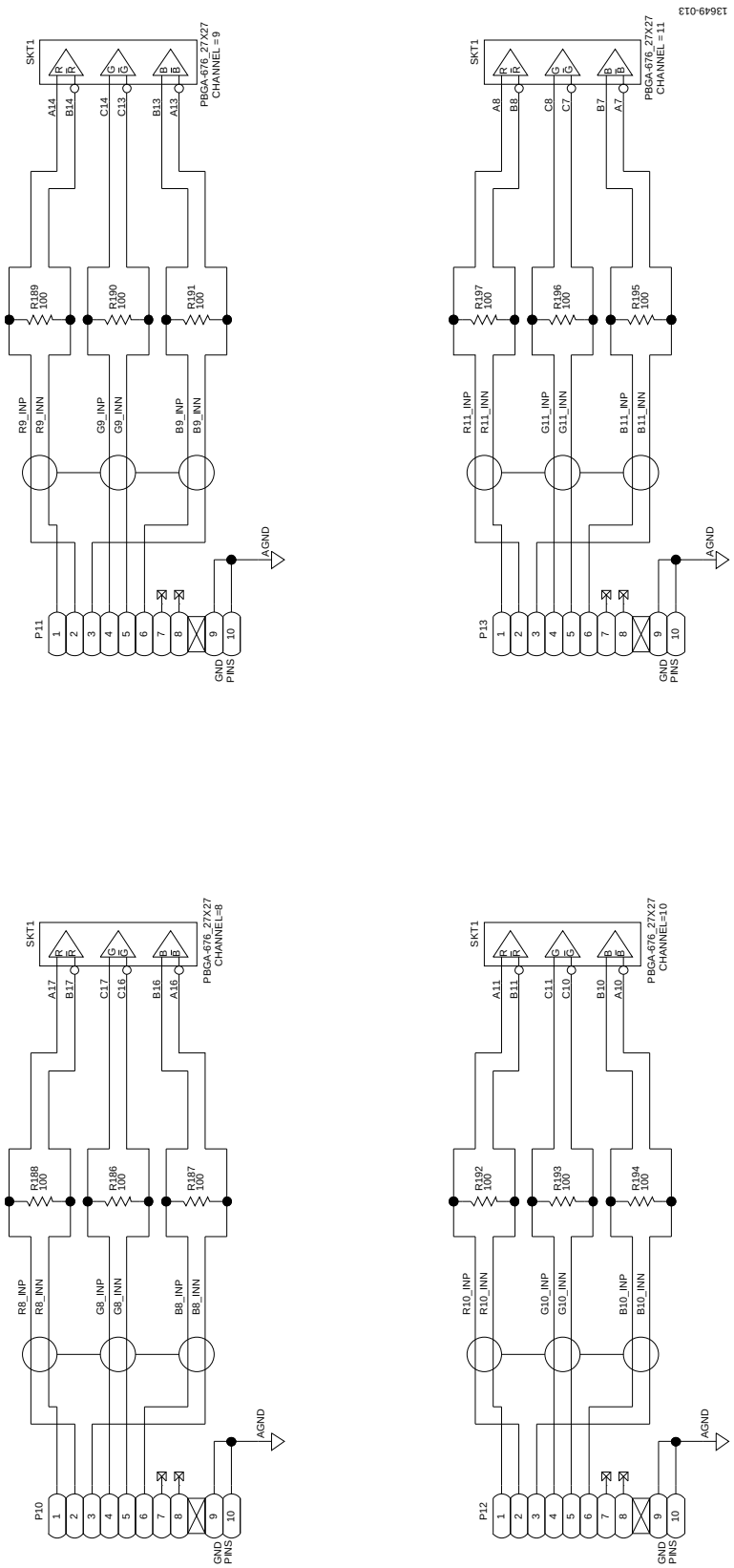

Figure 13. Input 8 to Input 11

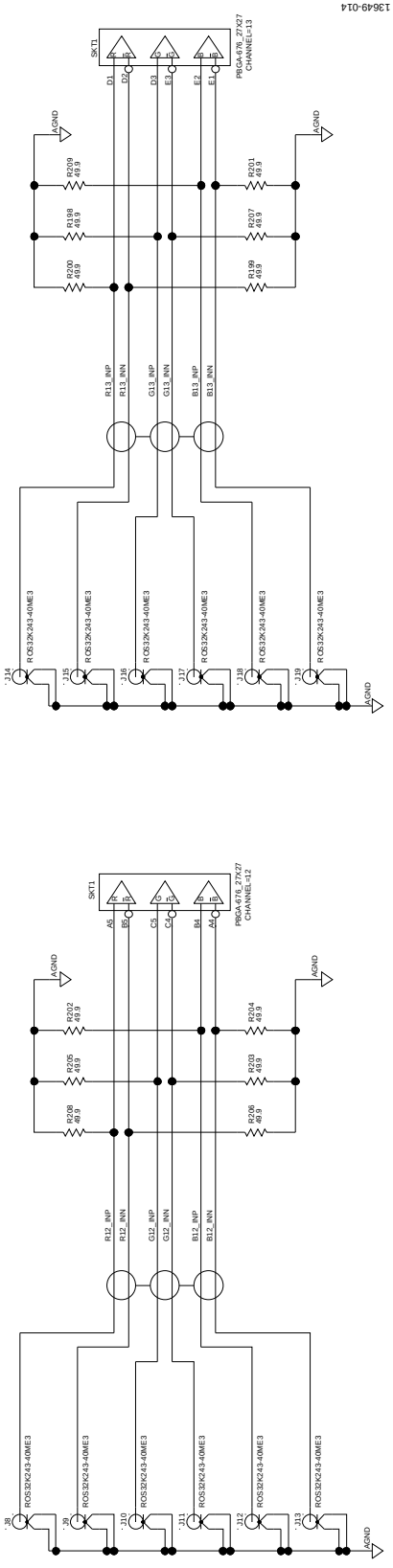

Figure 14. Input 12 to Input 13

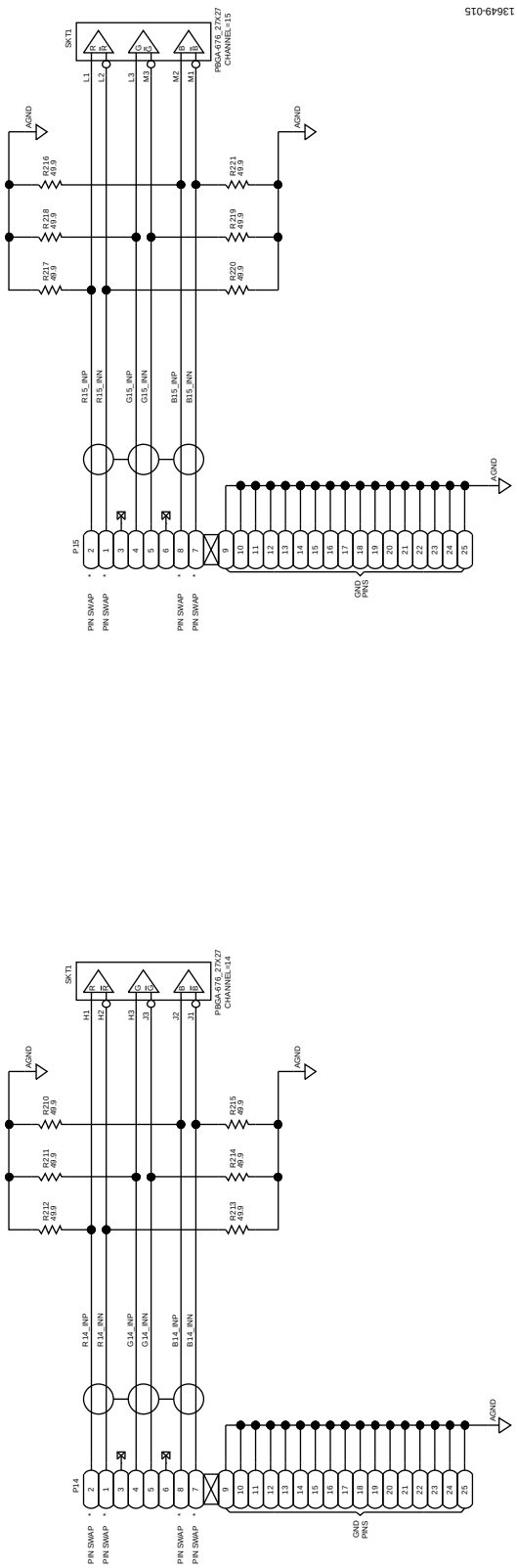

Figure 15. Input 14 to Input 15

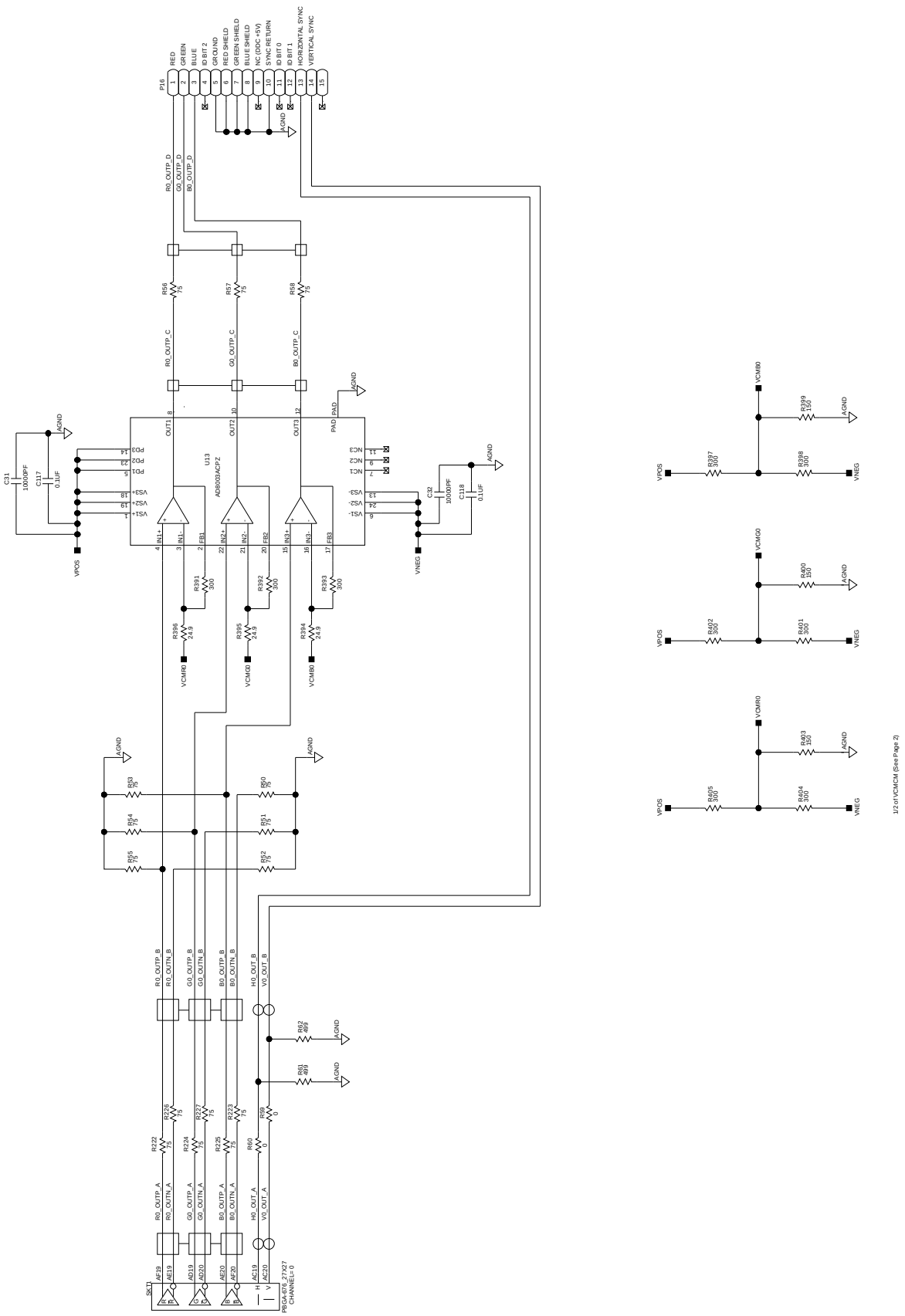

Figure 16. Output 0 and 1/2 of VCM Circuit

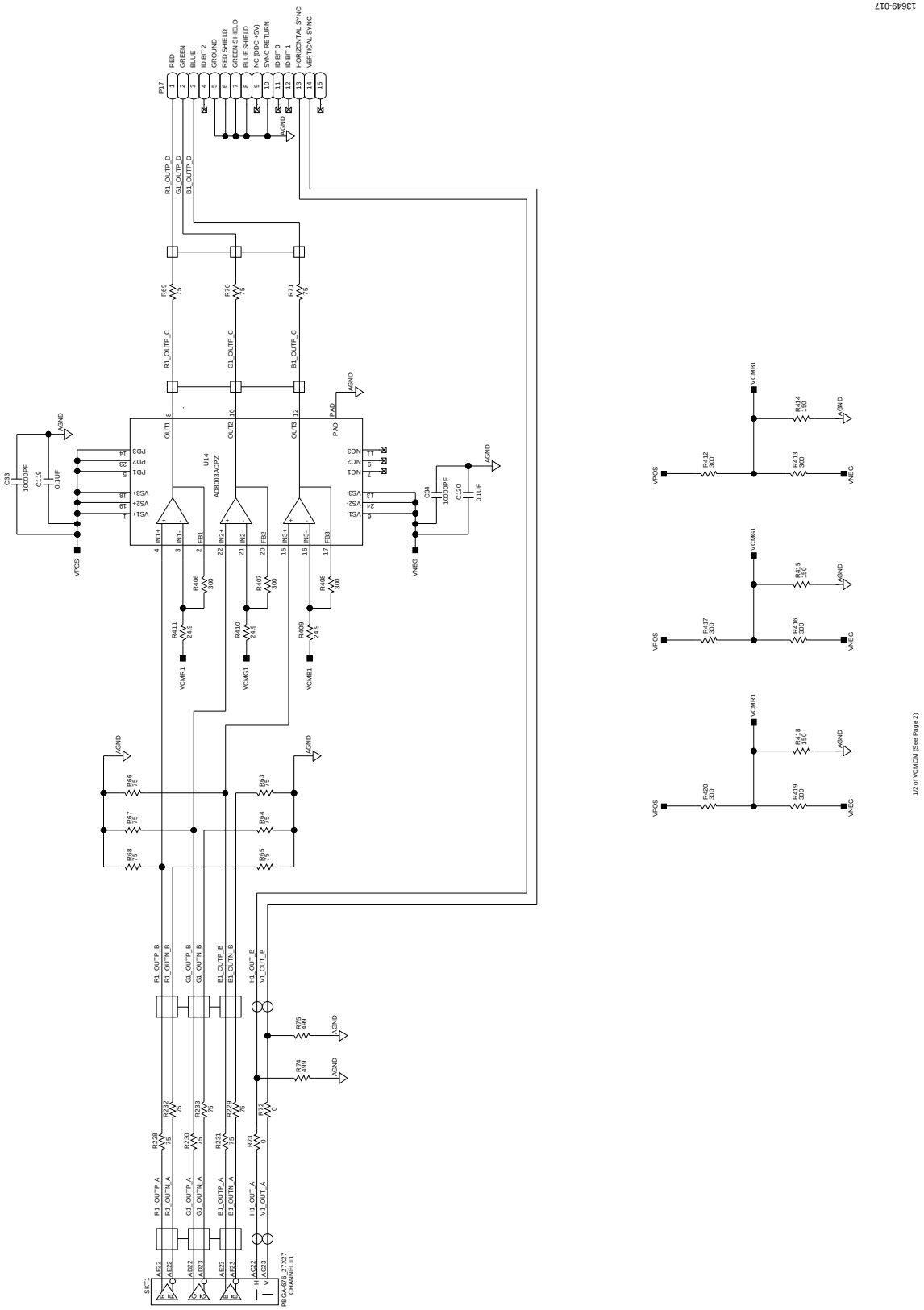

Figure 17. Output 1 and 2/2 of VCM Circuit

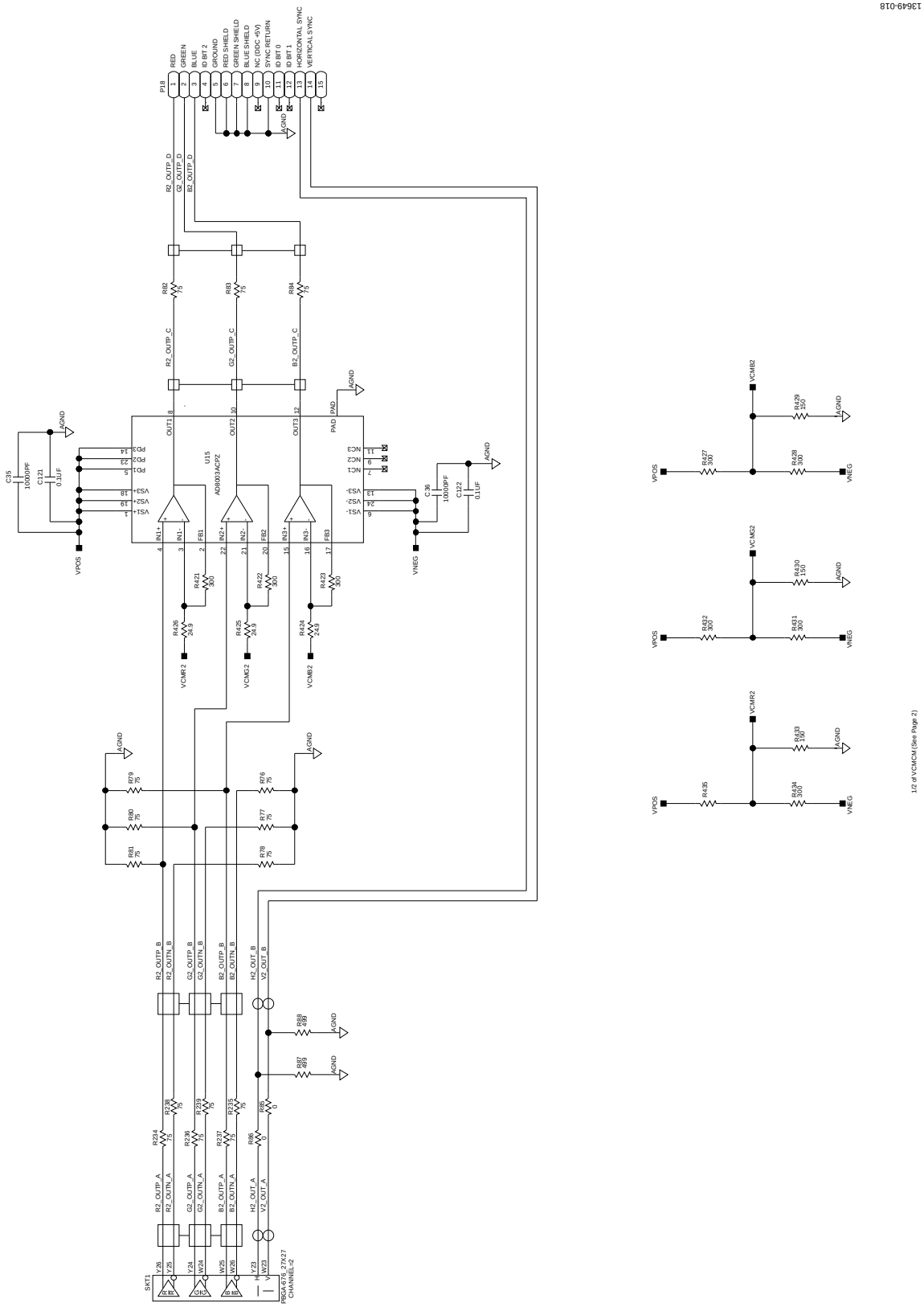

Figure 18. Output 2

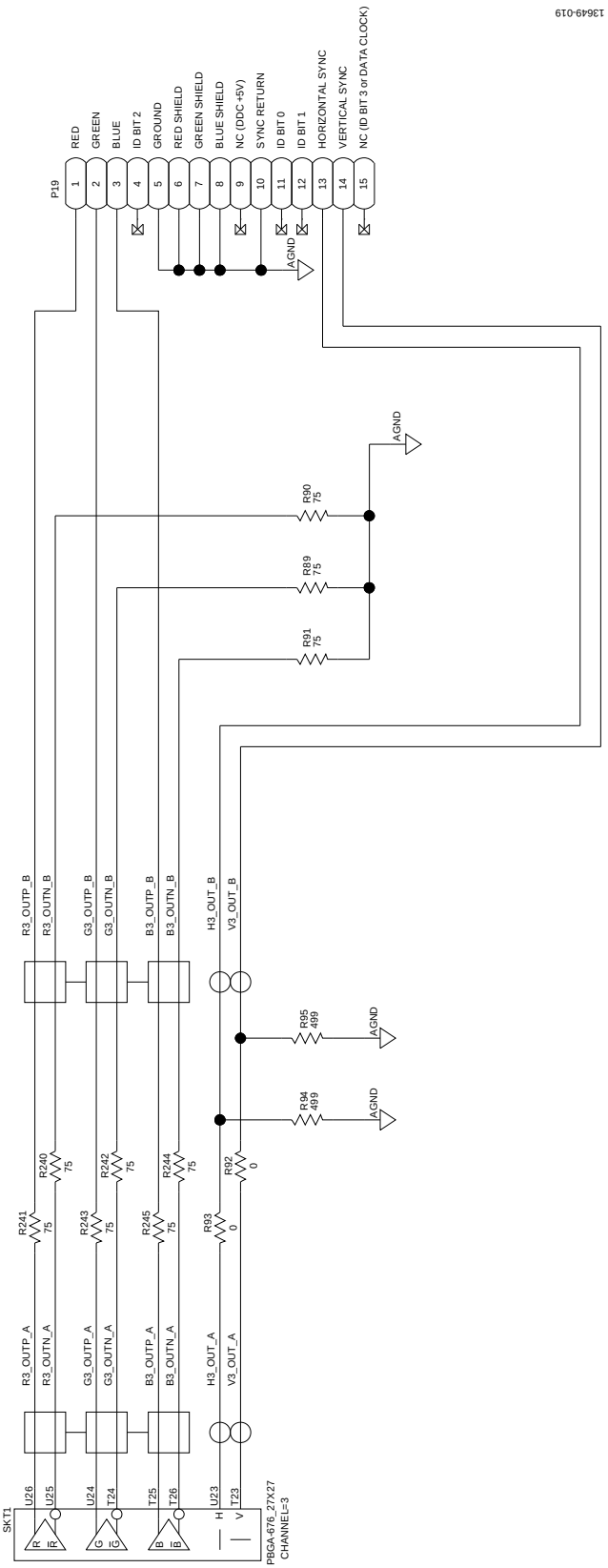

Figure 19. Output 3

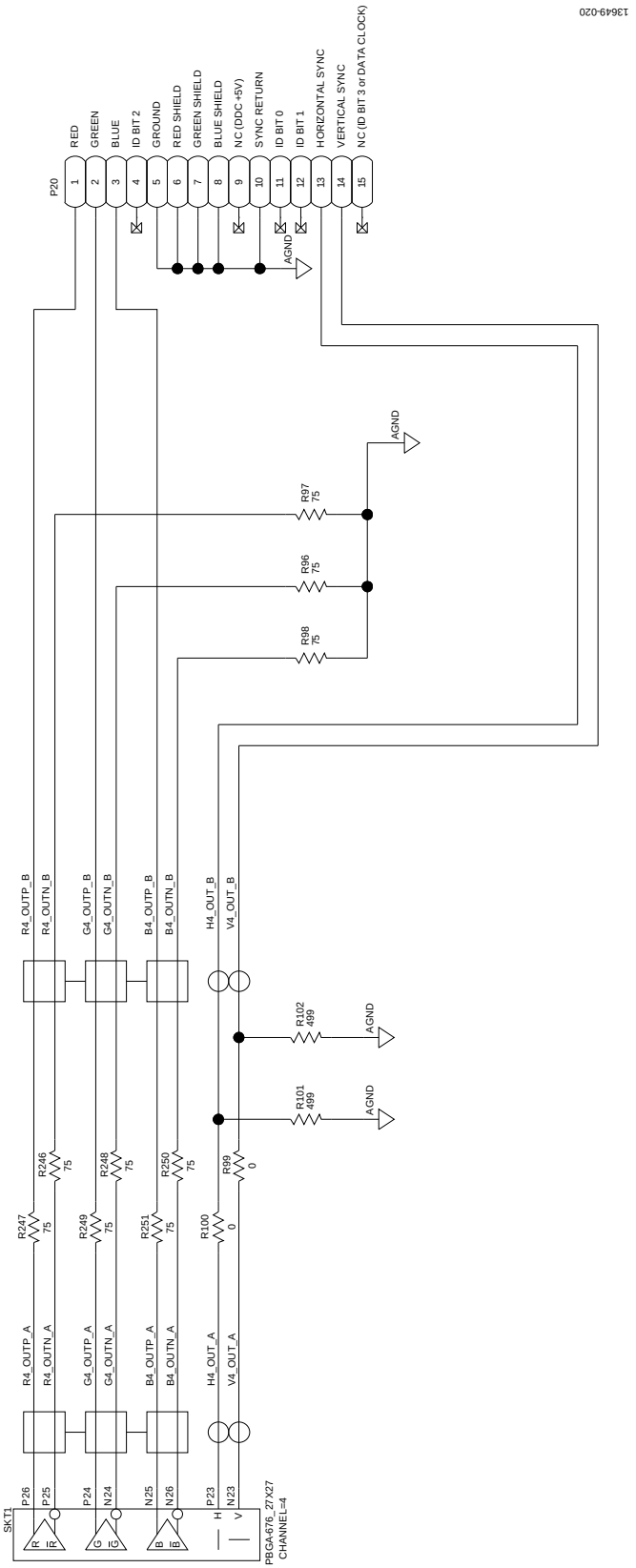

Figure 20. Output 4

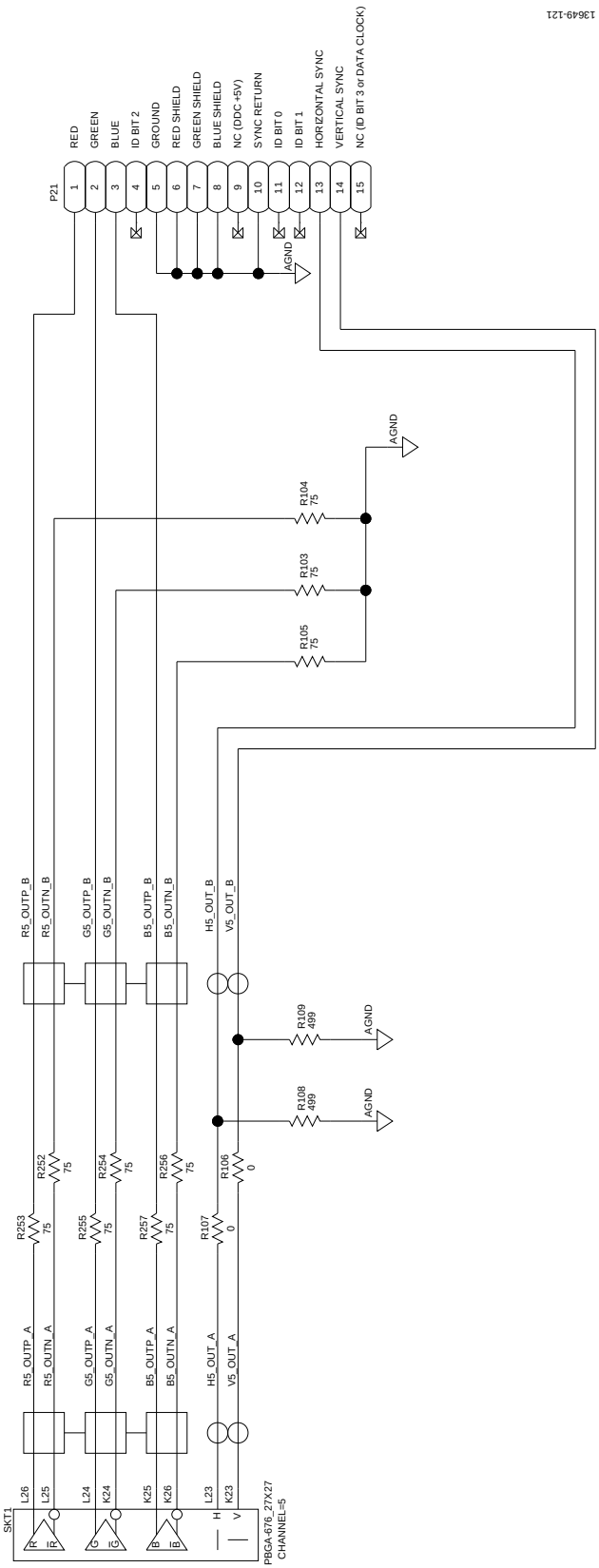

Figure 21. Output 5

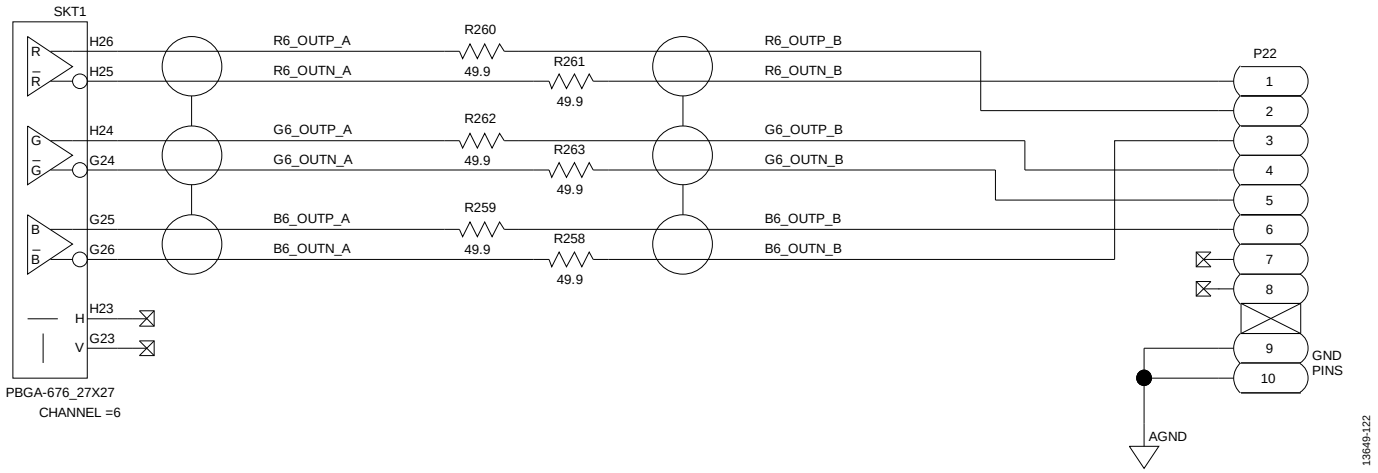

Figure 22. Output 6

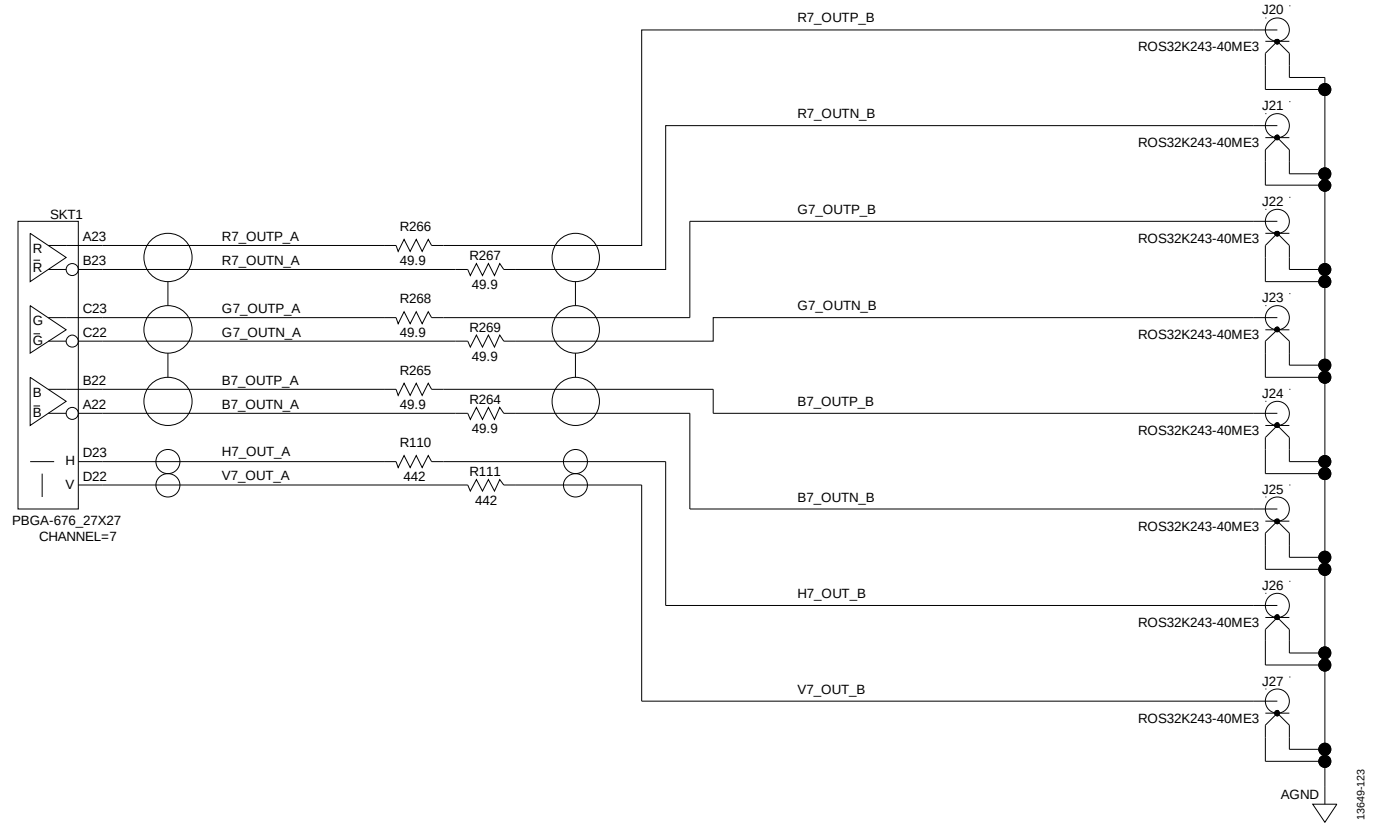

Figure 23. Output 7

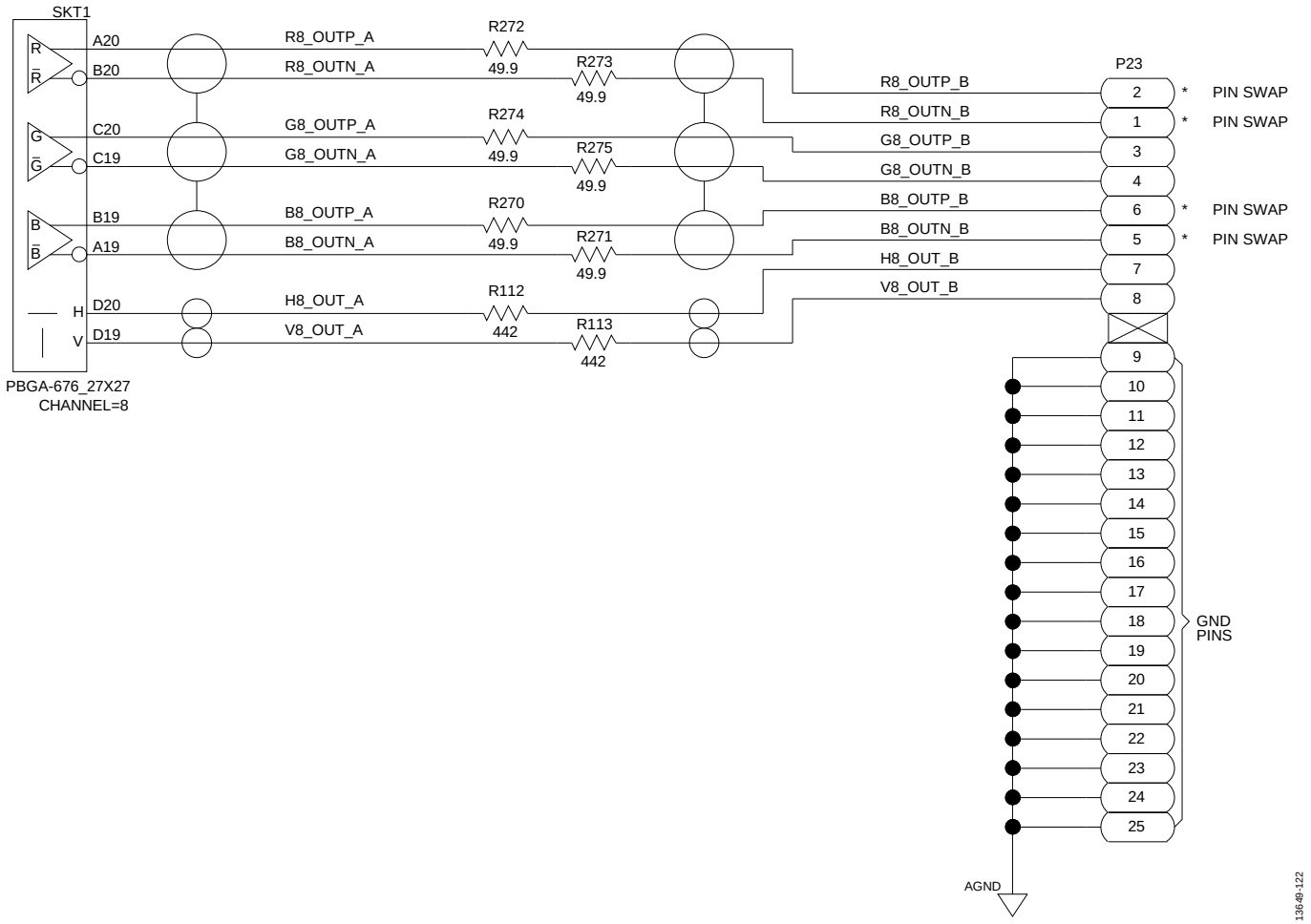

Figure 24. Output 8

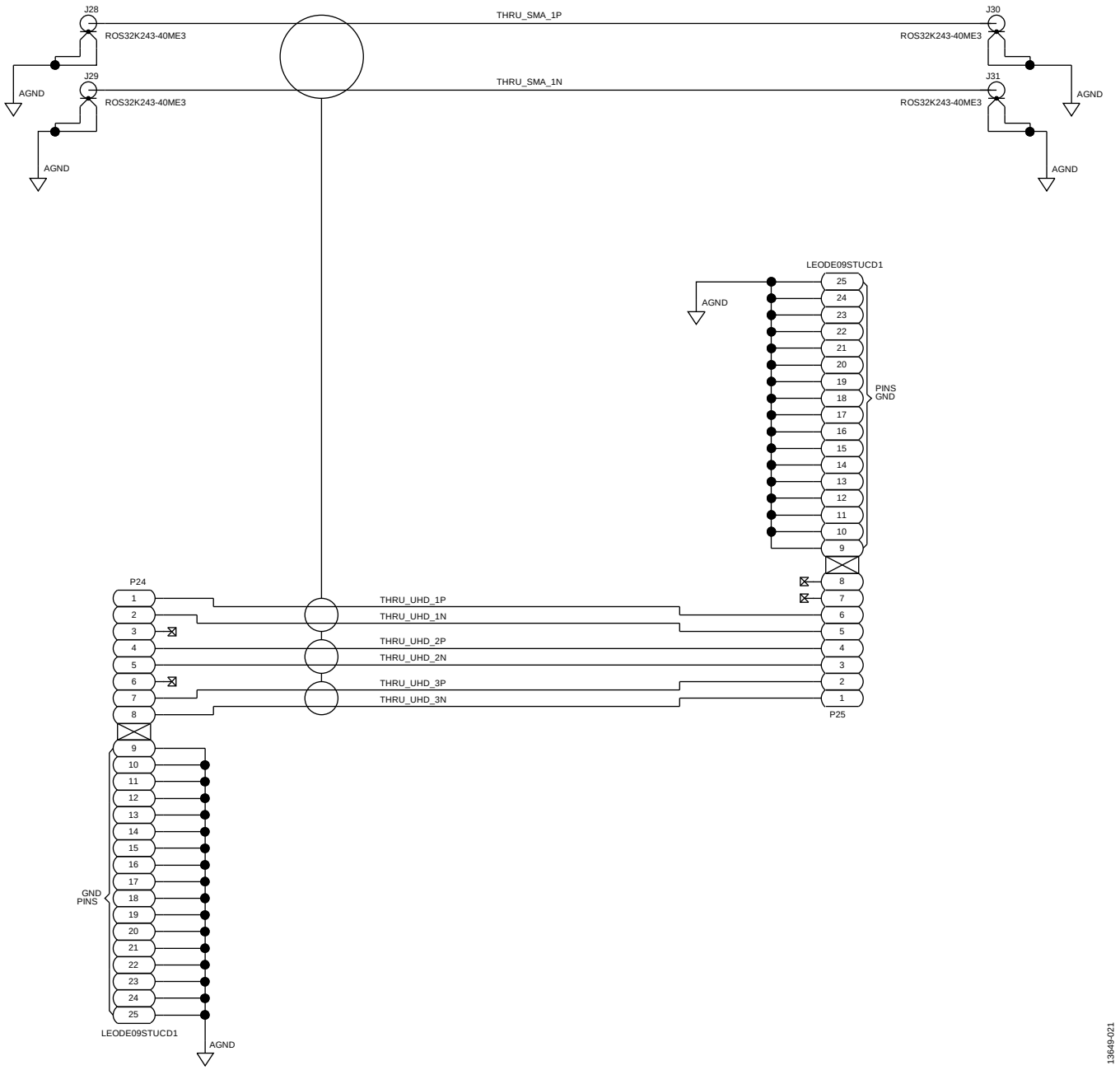

Figure 25. Network Analyzer Calibration Paths

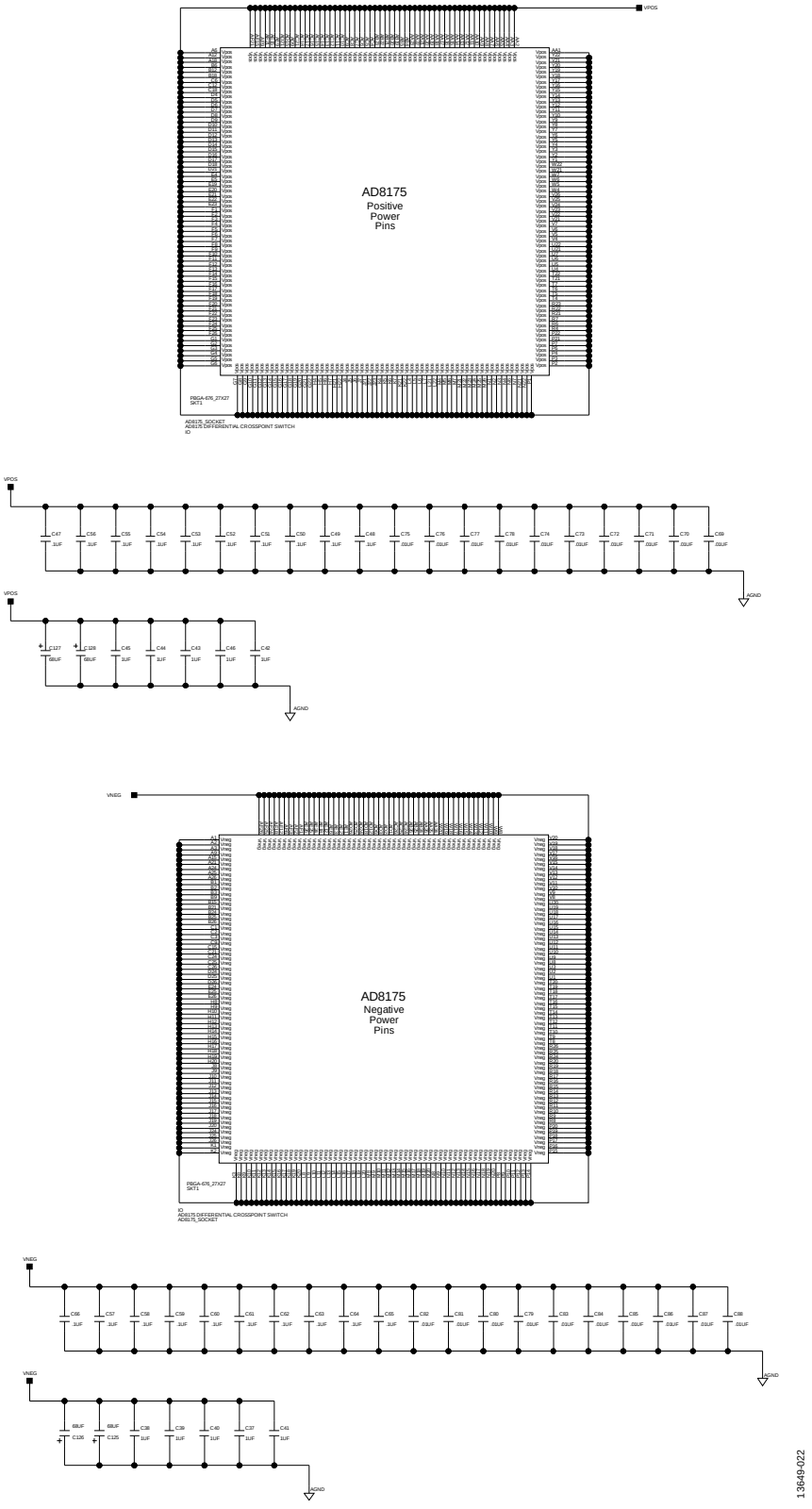

Figure 26. VPOS and VNEG

Figure 27. AD8175-EVALZ/AD8176-EVALZ/AD8177-EVALZ/AD8178-EVALZ Evaluation Board, Top View

Figure 28. AD8175-EVALZ/AD8176-EVALZ/AD8177-EVALZ/AD8178-EVALZ Evaluation Board, Bottom View

ORDERING INFORMATION

BILL OF MATERIALS

Table 2.

Item	Reference Designator	Qty	Description	Manufacturer	Part Number
1	A1 to A4	4	ADR280ART-REEL7, SOT-23, SNWD	Analog Devices, Inc.	ADR280ARTZ-REEL7
2	C1, C2, C37 to C46	12	Capacitor, ceramic, chip, 1 µF, 6.3 V, 10%, 0603, X5R	Panasonic	ECJ-1VBOJ105K
3	C3 to C36	34	Capacitor, ceramic, chip, 10000 pF, 50 V, 0603, X7R (0.01 µF)	Yageo	CC0603KRX7R9BB103
4	C47 to C66	20	Capacitor, ceramic, chip, 0.1 µF, 25 V, 10%, 0508, X7R	Panasonic	ECY-29RE104KV
5	C67 to C88	22	Capacitor, ceramic, chip, 0.01 µF, 16 V, 0402 (10,000 pF)	Panasonic	ECJ-0EBIC103K
6	C89 to C122, C129 to C132	38	Capacitor, ceramic, chip, 0.01 µF, 50 V, 10%, 0805, X7R	Panasonic	ECJ-2YB1H104K
7	C123 to C128	6	Capacitor, chip, tantalum, 68 µF, 20 V, 7343, 10%	Kemet	T495X686K020ATE150
8	FID1 to FID6	6	50 mil, pad	Do not include	
9	FID7 to FID9	3	40 mil pad	Do not include	
10	J1	1	Connector, banana jack, yellow	Johnson/Emerson	108-0907-001
11	J2, J4, J6	3	Connector, banana jack, green	Johnson/Emerson	108-0904-001
12	J3	1	Connector, banana jack, red	Johnson/Emerson	108-0902-001
13	J5	1	Connector, banana jack, black	Johnson/Emerson	108-0903-001
14	J7	1	Connector, SMA, female, PC mount	Pasternack Enterprise	PE4117
15	J8 to J31	24	Connector, SMA, right angle jack	Rosenberger of North America	32K243-40ME3
16	JMP1 to JMP40	40	Socket, header, 3-pin	FCI	69190-403HLF
17	P1	1	Connector, 34-pin, straight header	3M	N2534-6002RB
18	P2 to P9	8	Connector, 15-pin, right angle, D plug (HD)	Tyco/AMP	5749767-1
19	P10 to P13, P22	5	CAT5, RJ45, jack	Do not include	
20	P14, P15, P23 to P25	5	Connector, 8 position, UHD, header	W. L. Gore & Associates, Inc.	HFN1158-G-KES1
21	P16 to P21	6	Connector, DB, 15-pin, right angle, D receptacle	Norcomp	181-015-213R171
22	Q1 to Q16	16	Transistor, PNP, low, 2N3906G TO92	On Semi	2N3906G
23	R1, R110 to R113	5	Resistor, chip, 1%, 1/10 W, 0603, 442 Ω	Panasonic	ERJ-3EKF4420V
24	R2 to R4, R10 to R12, R16 to R18, R22 to R24, R26 to R28, R35 to R37, R41 to R43, R47 to R49	24	Resistor, chip, 1/10 W, 0603, 80.6 Ω	Panasonic	ERJ-3EKF80R6V
25	R5 to R9, R13 to R15, R19 to R21, R25	12	Resistor, chip, 1%, 1/10 W, 0603, 37.4 Ω	Yageo	RC0603FR-0737R4L
26	R29 to R34	12	Resistor, chip, 1%, 1/10 W, 0603, 130 Ω	Panasonic	ERJ-3EKF1300V
27	R50 to R58, R63 to R71, R76 to R84, R89 to R91, R96 to R98, R103 to R105	36	Resistor, chip, 1%, 1/10 W, 0603, 75 Ω	Panasonic	ERJ-3EKF75R0V, full reel
28	R59, R60, R72, R73, R85, R86, R92, R93, R99, R100, R106, R107	12	Resistor, chip, 5%, 1/10 W, 0603, 0 Ω	Panasonic	ERJ-3GEY0R00V
29	R61, R62, R74, R75, R87, R88, R94, R95, R101, R102, R108, R109	24	Resistor, chip, 1%, 1/10 W, 0603, 499 Ω	Panasonic	ERJ-3EKF4990V
30	R114 to R119, R125 to R130, R134 to R139, R143 to R148, R152 to R157, R161 to R166, R170 to R175, R179 to R184, R198 to R221, R158 to R160	90	Resistor, chip, 1%, 1/16 W, 0402, 49.9 Ω	Panasonic	ERJ-2RKF49R9X, full reel

Item	Reference Designator	Qty	Description	Manufacturer	Part Number
31	R120 to R124, R131 to R133, R140 to R142, R149 to R151, R158 to R160, R167 to R169, R176 to R178, R185 to R197	36	Resistor, chip, 5%, 1/16 W, 0402, 100 Ω	Panasonic	ERJ-2GEJ101X, full reel
32	R222 to R257	36	Resistor, chip, 1%, 1/16 W, 0402, 75 Ω	Panasonic	ERJ-2RKF75R0X, full reel
33	R276 to R292	17	Resistor, chip, 1%, 1/8 W, 0805, 10 kΩ	Panasonic	ERJ-6ENF1002V
34	R334, R335, R341, R344, R348, R349, R355, R358, R362 to R364, R367, R293 to R299, R301, R302, R304, R313, R316, R320, R321, R327, R330	38	Resistor, chip, 1%, 1/8 W, 0805, 1 kΩ	Panasonic	ERJ-6ENF1001V, full reel
35	R300, R317, R331, R345, R359, R368, R377, R386	8	Resistor, chip, 1%, 1/8 W, 0805, 4.42 kΩ	Panasonic	ERJ-6ENF4421V
36	R303, R305, R314, R315, R328, R329, R342, R343, R356, R357, R365, R366, R374, R375, R383, R384	16	Resistor, chip, 1%, 1/8 W, 0805, 6.98 kΩ	Panasonic	ERJ-6ENF6981V
37	R306, R318, R332, R346, R360, R369, R378, R387	8	Resistor, chip, 1%, 1/8 W, 0805, 499 Ω	Panasonic	ERJ-6ENF4990V
38	R307, R319, R333, R347, R361, R370, R379, R388	8	Resistor, chip, 0.1%, 1/10 W, 0805, 620 Ω	Panasonic	ERA-6YEB621V
39	R309 to R311, R323 to R325, R337 to R339, R351 to R353	12	Resistor, chip, 1%, 1/10 W, 0603, 53.6 Ω	Panasonic	ERJ-6EKF53R6V
40	R391 to R393, R397, R398, R401, R402, R404 to R408, R412, R413, R416, R417, R419 to R423, R427, R428, R431, R432, R434, R435	27	Resistor, chip, 5%, 1/8 W, 0805, 300 Ω	Panasonic	ERJ-6GEYJ301, full reel
41	R394 to R396, R409 to R411, R424 to R426	9	Resistor, chip, 1%, 1/8 W, 0805, 24.9 Ω	Panasonic	ERJ-6ENF24R9V
42	R399, R400, R403, R414, R415, R418, R429, R430, R433	9	Resistor, chip, 1%, 1/8 W, 0805, 150 Ω	Panasonic	ERJ-6ENF1500V
43	SKT1	1	AD8175 differential crosspoint switch matrix	Analog Devices, Inc.	Do not include
44	TP1	1	Test point, yellow	Component Corp	TP-104-01-04
45	TP2	1	Test point, blue	Component Corp	TP-104-01-06
46	TP3	1	Test point, white	Component Corp	TP-104-01-09
47	TP4	1	Test point, green	Component Corp	TP-104-01-05
48	U1 to U8	8	LFCSP-24, AD8147ACPZ-REEL7	Analog Devices, Inc.	AD8147ACPZ-REEL7
49	U9 to U12	4	ADA4861, IC, triple, 730 MHz, op amp	Analog Devices, Inc.	ADA4861-3YRZ
50	U13 to U15	3	AD8003ACPZ, IC, triple, 1.5 GHz, op amp	Analog Devices, Inc.	AD8003ACPZ-REEL7

NOTES

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.

ANALOG DEVICES

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