

**FEATURES**

- Fully assembled evaluation board with test pins and standoffs
- User-selectable jumpers for easy configuration changes
- Optimized layout to reduce ground bounce and EMI
- Multiple ground test-pins for easy grounding
- Test pins labeled and segmented for each functional block

**PACKAGE CONTENTS**

- ADD8754 evaluation board
- 5 ADD8754 devices
- ADD8754 data sheet
- ADD8754-EVAL data sheet
- CD including
  - Electronic version of ADD8754 data sheet
  - Electronic version of ADD8754-EVAL data sheet
  - Excel®-based spreadsheet for power dissipation calculations
  - Excel-based spreadsheet for loop compensation components selection

**PRODUCT DESCRIPTION**

The ADD8754-EVAL simplifies the evaluation of the [ADD8754](#) device. It includes a fully assembled evaluation board and detailed usage instructions.

This data sheet describes the ADD8754 evaluation board only. For specific information regarding the ADD8754 device, LCD power, VCOM, and gate modulation, see the ADD8754 data sheet.

**EVALUATION BOARD DIGITAL PICTURE**

Figure 1.

**Rev. A**

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## REVISION HISTORY

### 3/07—Rev. 0 to Rev. A

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### 6/06—Revision 0: Initial Version

# EVALUATION BOARD HARDWARE

## QUICK START INSTRUCTIONS

Follow these steps to begin using the ADD8754 evaluation board:

1. Connect ground to at least one of the 10 pins labeled GND.
2. Connect a 5 V power supply to at least one of the two pins labeled VIN.
3. Apply a 2.5 V to 5 V digital control signal on VFLK. This control signal determines when VGH\_M is at GPM\_H or GPM\_L. See the Gate Pulse Modulator section to determine a typical waveform.

After these steps are completed, users can probe the preconfigured output voltages and waveforms.

## FACTORY SETTINGS

The ADD8754-EVAL arrives fully assembled and ready to use. The factory voltage settings are detailed in Table 1. See the Quick Start Instructions section for power-up instructions.

Table 1. Factory Settings

Test Point	Value <sup>1</sup>	Description
BOOST_OUT <sup>2</sup>	9.8 V	Step-up output voltage
LDO_OUT	3.3 V	LDO output voltage
VCOM	4.9 V	VCOM output voltage
VGH_M	28 V	Gate pulse modulation output
VDD_1	9.8 V	GPM low ramp voltage
VGL	-5 V	Gate low voltage

<sup>1</sup> Actual voltages may differ slightly ( $\pm 3\%$ ).

<sup>2</sup> Soft start time is 100  $\mu$ s when VIN = 5 V and 500  $\mu$ s when VIN = 3.3 V.

## JUMPER SELECTION

The jumper pins are listed and described in this section.

### JP1— $\overline{\text{SHDN}}$ Control

If the JP1 jumper is shorted, the  $\overline{\text{SHDN}}$  pin is shorted to ground, causing the ADD8754 to shut down. When the jumper is opened, the ADD8754 continues to operate normally. If external shutdown control is desired, remove this jumper.

### JP2—FREQ Select

If the JP2 jumper is shorted, the ADD8754 operates at a 650 kHz internal switching frequency. If this jumper is open, the device operates at 1.2 MHz. See the ADD8754 data sheet for details.

### JP3—LDO Output Select

The JP3 jumper has three positions (3.3 V, 2.85 V, and 2.5 V) for setting the LDO output voltage. Table 2 illustrates the proper jumper configuration.

Table 2. LDO Output Voltage Jumper Selection

Jumper Position	Description
Short Pin 2 and Pin 3	LDO_OUT = 3.3 V, see Figure 2.
Open all pins	LDO_OUT = 2.85 V, see Figure 3.
Short Pin 1 and Pin 2	LDO_OUT = 2.5 V, see Figure 4.



Figure 2. JP3 Short Pin 2 and Pin 3



Figure 3. JP3 Open All Pins



Figure 4. JP3 Short Pin 1 and Pin 2

### JP4—VCOM Buffer Mode

When the JP4 jumper is shorted, the VCOM negative input and output are shorted together. This configures VCOM as a unity gain buffer. Remove this jumper if external VCOM feedback is desired.

### JP5—VDPM from Step-Up

When the JP5 jumper is shorted, the step-up output connects to VDPM. This enables GPM and requires no external signal on VDPM. Remove this jumper if an external VDPM control is desired.

### JP6—VCOM Supply from Step-Up

When the JP6 jumper is shorted, the VCOM supply (VDD\_2) is connected to the step-up output. This eliminates the need for an external VCOM supply voltage. If the use of an external VCOM power supply is desired, remove this jumper and connect a power supply to VDD\_2.

### JP7—VGH from Positive Charge Pump

When the JP7 jumper is shorted, GPM receives its VGH voltage from the positive charge pump. If an external VGH voltage is desired, remove this jumper to drive the VGH pin externally.

# ADD8754-EVAL

## BASIC CIRCUIT

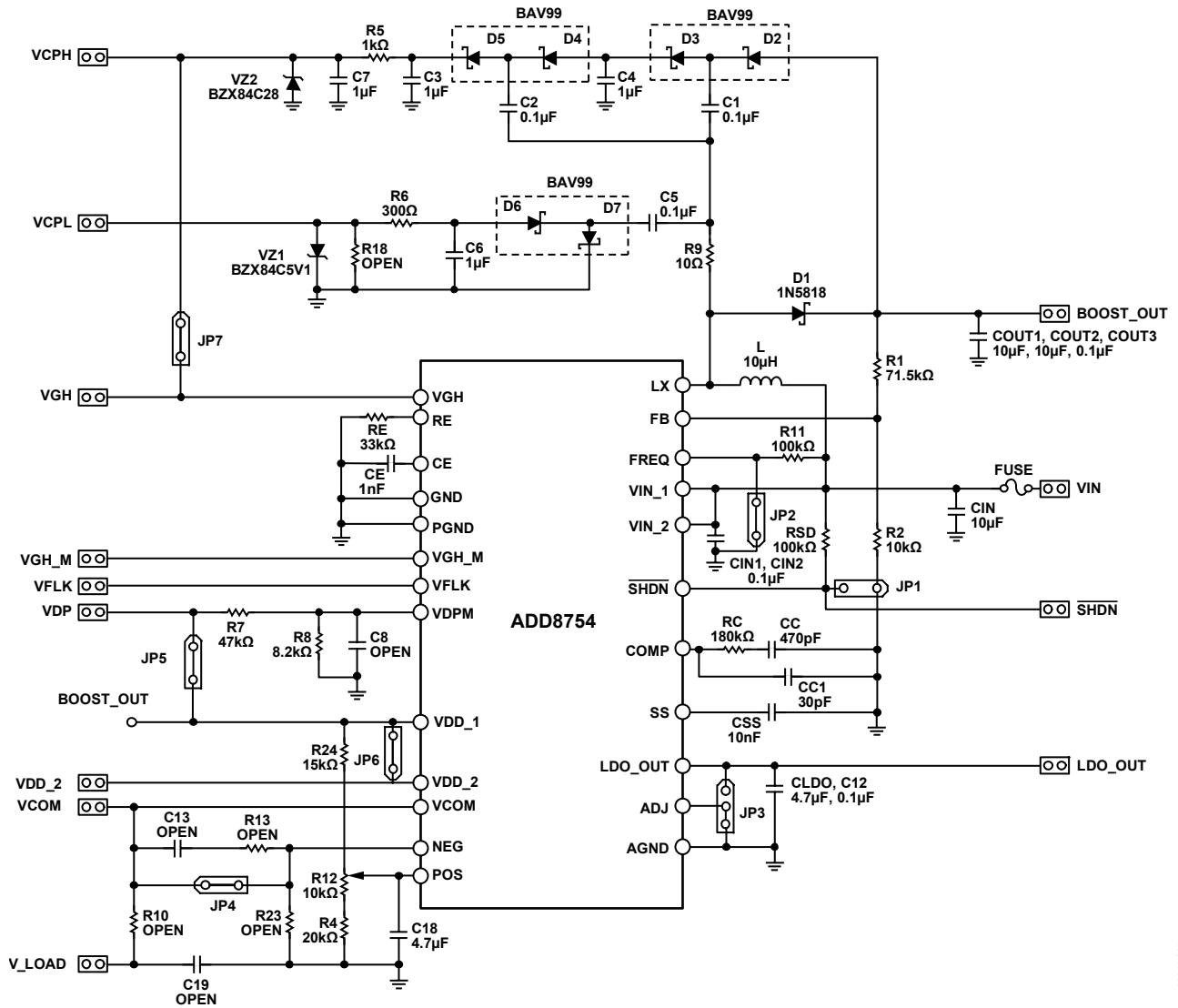


Figure 5. Basic Board Circuit with Factory-Installed Component

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## FUNCTIONAL BLOCK OVERVIEW

This section provides an overview of the important features of each functional block to assist in evaluating the ADD8754 device. For detailed information about the ADD8754, see the [ADD8754](#) data sheet. See Table 1 for a list of factory voltage settings.

When reviewing this section, keep the following points in mind:

- The ADD8754 has an undervoltage lockout circuit that prevents operation below a VIN of 2.8 V.
- The high-side charge pump has a Zener diode regulated output (VCPH) of 28 V.
- The low-side charge pump has a Zener diode regulated output (VCPL) of -5 V.
- The evaluation board shuts down when the  $\overline{\text{SHDN}}$  pin is connected to ground (JP1 is shorted).

### STEP-UP SWITCHING REGULATOR

The step-up switching regulator, or boost converter, converts a dc voltage input of 5 V to an output of 10 V (adjustable up to 20 V). With its factory setting, the boost converter can output up to 750 mA of load current. Typically, a TFT-LCD monitor requires about 500 mA of current at 10 V.

For an accurate evaluation of the step-up regulator, it is recommended that an equivalent panel load (20  $\Omega$  to 40  $\Omega$ ) be applied from BOOST\_OUT to GND.

#### Resetting the Boost Output Voltage

BOOST\_OUT is determined by the divider resistors R1 and R2. To obtain a given output, set R2 = 10 k $\Omega$  and calculate

$$R1 = R2 \times \frac{(\text{BOOST\_OUT} - 1.21)}{1.21}$$

#### Loop Compensation

Resistor RC and Capacitor CC set the loop compensation for stability. If the input voltage, output voltage, inductor, or output capacitor values need to be changed, see the ADD8754 data sheet for a method to recalculate the compensation values for stable operation of the step-up switching regulator.

#### Inductor Current Rating

The factory-installed inductor is rated for 1.5 A. If the output current and/or output voltage make the inductor current higher than 1.5 A, then the inductor should be replaced with an appropriate inductor to prevent saturation.

#### Soft Start

The soft start time is adjusted by Capacitor CSS. See the ADD8754 data sheet for instructions on recalculating a new soft start time.

### LDO

The LDO generates a selectable logic voltage output for the digital logic needs of a TFT-LCD display. Typically, this voltage is applied to the timing controller (TCON) and gate drivers. For instructions on selecting the 3.3 V, 2.85 V, or 2.5 V voltage output, see Table 2.

### VCOM AMPLIFIER

#### Buffer and Feedback Configurations

The VCOM amplifier of the ADD8754 can be used as a unity-gain buffer or with panel feedback. To set the ADD8754 in a unity-gain buffer configuration, short Jumper JP4. Please note that if using model ADD8754ACPZ, buffer mode is not recommended.

To use panel feedback, open Jumper JP4 and use the VCOM\_S pin, Resistor R16, Resistor R17, Capacitor C16, and Capacitor C17 to configure the feedback network.

To add VCPL feedback, R14, R15, C14, and C15 can be changed. R13, R21, C13, and C22 are used to set the VCOM amplifier gain. R10 and C9 are used if a filtered output is desired from the VCOM amplifier.

#### Adjusting VCOM

The reference voltage for VCOM is adjustable by turning the on-board potentiometer (Potentiometer R12) using a small screwdriver. The VCOM voltage range depends on the boost output voltage and how it is divided by Resistor R24, Resistor R4, and Resistor R12.

If your board includes an [AD5259](#) 256-position digital potentiometer, this device is configured for use (the analog potentiometer is disabled). See the AD5259 Digital Potentiometer (Optional) section for details about setting and disabling this device. For more information about the AD5259, see the AD5259 data sheet.

### GATE PULSE MODULATOR

The gate pulse modulator takes a high voltage (VGH) and ramps this voltage down to a lower voltage (VDD\_1). The VFLK signal determines when the voltage begins ramping. The CE capacitor and RE resistor determine the delay and the ramp rate.

VDPM must be pulled high to enable GPM (Jumper JP5 should be shorted). A startup delay for VGH\_M can be set with C8.

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## Setting VDD\_1

The VDD\_1 voltage is the GPM low ramp voltage. With R25 shorted and RZ open, the step-up output (BOOST\_OUT) is connected to VDD\_1. This ramps the GPM\_H waveform down to the BOOST\_OUT voltage level. If other voltages are desired, a voltage divider or Zener diode can be used to set this voltage. If a voltage divider is used, a low divider impedance (<1 kΩ) is recommended. See the [ADD8754](#) data sheet for more information.

## Adjusting the Delay and Ramp Rate

Capacitor CE adjusts the negative ramp delay of the VGH\_M waveform. RE adjusts the negative ramp rate of the VGH\_M waveform. See the [ADD8754](#) data sheet for details.

## VFLK Input

The amplitude of the input signal on VFLK must be between 2.5 V to 5.0 V. Typically, VFLK is a digital waveform that switches from high to low for each horizontal line of the TFT-LCD display (from TCON).

If a signal generator is used, the following settings are recommended to simulate a 1280 × 1024 60 Hz panel:

- Digital pulse signal
- 3.3 V amplitude (low = 0 V, high = 3.3 V)
- 16 μs period
- 30% duty cycle

## AD5259 DIGITAL POTENTIOMETER (OPTIONAL)

If the [ADD8754-EVAL](#) includes an optional [AD5259](#) digital potentiometer, the VCOM output voltage is set by using Resistor R3, Resistor R4 and the programmed output resistance of the 10 kΩ digital potentiometer, AD5259. Set the components as shown in Table 3.

Table 3. AD5259 Component Differences

Label	Description	Value
C13	VCOM feedback capacitor	Open
C23	AD5259 VDD bypass capacitor	Open
R12	Variable resistor for VCOM positive input	10 kΩ
R13	VCOM feedback resistor	Open
R21	VCOM negative input resistor	Open
R22, R23	AD5259 digital control pull-up resistor	Open
R24	VCOM positive input divider resistor (top)	15 kΩ
R_SCA, R_SCL	AD5259 digital control series resistors	Open

To use the programmable potentiometer

1. Connect the [ADD8754-EVAL](#) to the parallel port of a PC using a parallel port cable.
2. Insert the CD from the evaluation kit into the CD drive and click **setup.exe** to install the software.
3. Once installation is complete, open the **AD5259 Evaluation Board Program** from the **Start** menu.
4. Enter data in the **Enter Data** text box and then click **Write to RDAC** to write the data.
5. Click the **Store RDAC Content to EEMEM** button to store the current RDAC setting to EEMEM.

Note that because the AD5259 is a low voltage part (supply from LDO\_OUT), the appropriate VCOM gain resistors must be configured to raise the VCOM output voltage. If Resistor R13 and Resistor R21 are set to the values listed in Table 3, the gain is set to +3.

For more information, see the AD5259 Evaluation Board User Manual on the [ADD8754](#) Evaluation Kit CD.

# EVALUATION BOARD LAYOUT

## FUNCTIONAL BLOCKS

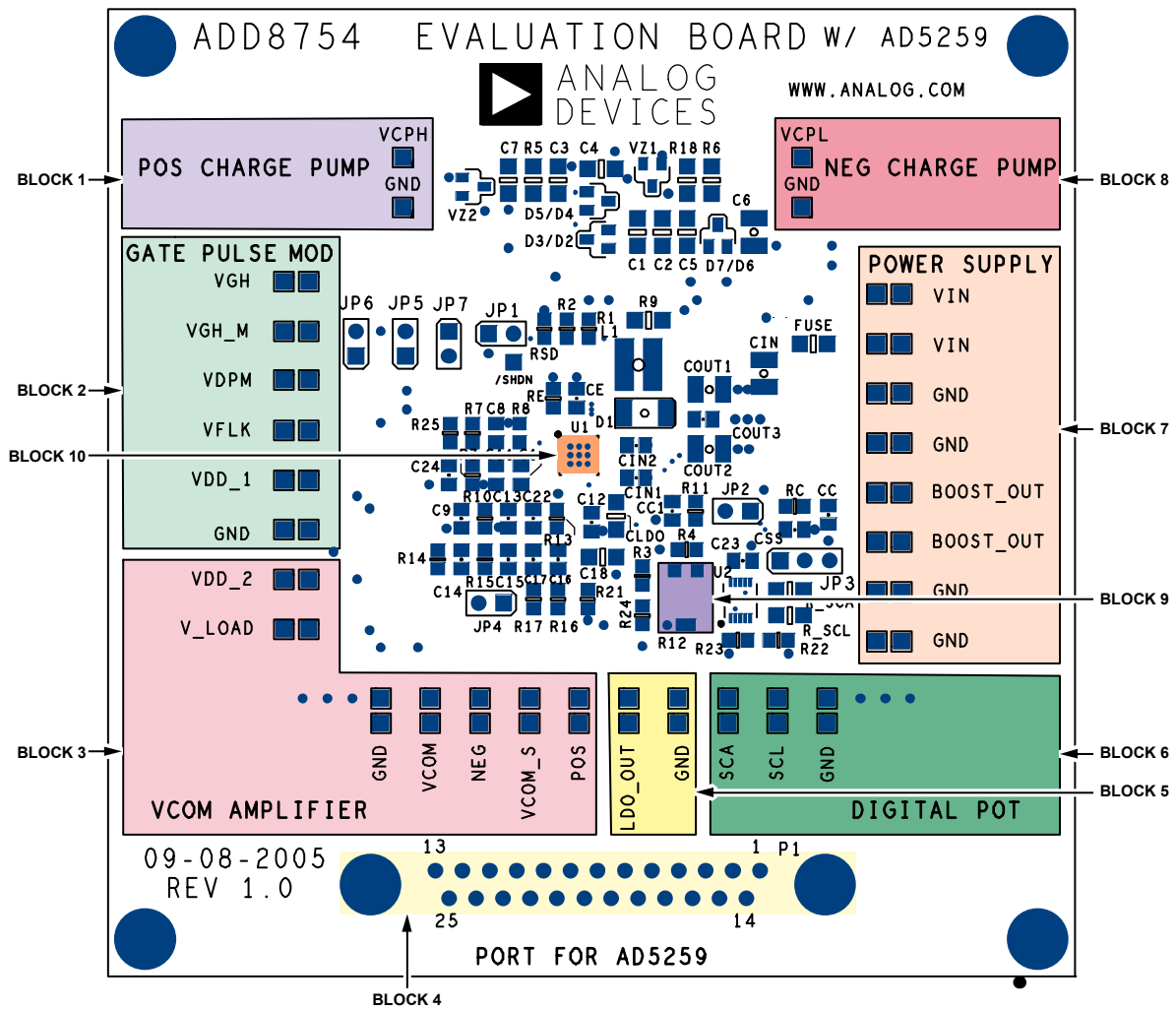


Figure 6. Evaluation Board Layout

Table 4. Evaluation Board Functional Block Descriptions

Block	Description
1	Positive Charge Pump. Provides access to the positive charge pump output (VCPH) and ground.
2	Gate Pulse Modulation. Accepts digital inputs from the timing controller (TCON) and provides a modulated VGH waveform (VGH_M).
3	VCOM Amplifiers. Provides access to the VCOM amplifier. The potentiometer in Block 9 adjusts the VCOM voltage.
4	AD5259 Serial Port. Accepts a serial port. Only boards with the optional AD5259 digital potentiometer include this port.
5	LDO. Provides access to the LDO output.
6	Digital Potentiometer. For digital control of the AD5259. Only boards equipped with the optional AD5259 use this pin.
7	Power Supply. Accepts an input voltage and provides the step-up output voltage (BOOST_OUT) and various ground pins.
8	Negative Charge Pump. Provides access to the negative charge pump output (VCPL) and ground.
9	VCOM Potentiometer. Includes one analog potentiometer configured in a rheostat mode for VCOM adjustment.
10	ADD8754. Includes a soldered ADD8754 24-lead LFCSP. If the part needs to be replaced, care should be taken to properly solder the thermal vias to the thermal pad on the bottom side of the IC.

# ADD8754-EVAL

## LAYERS

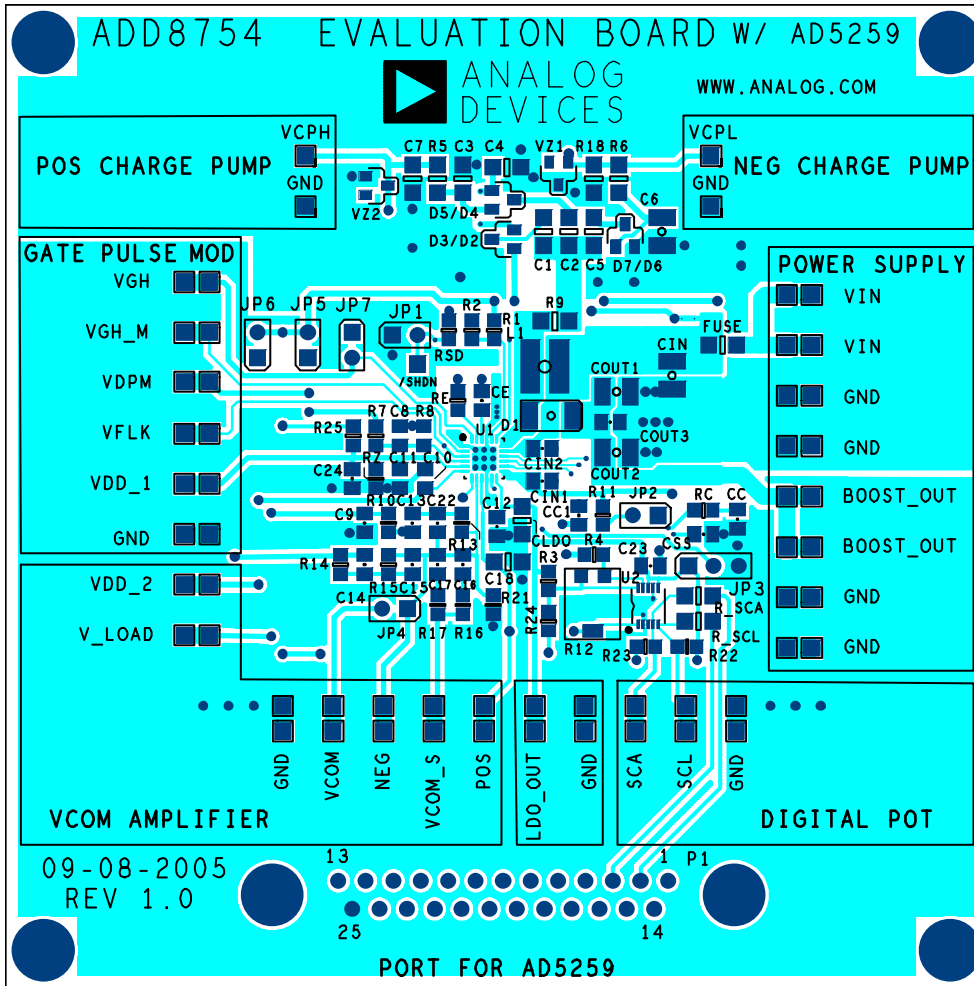


Figure 7. Evaluation Board Layout—Top Layer



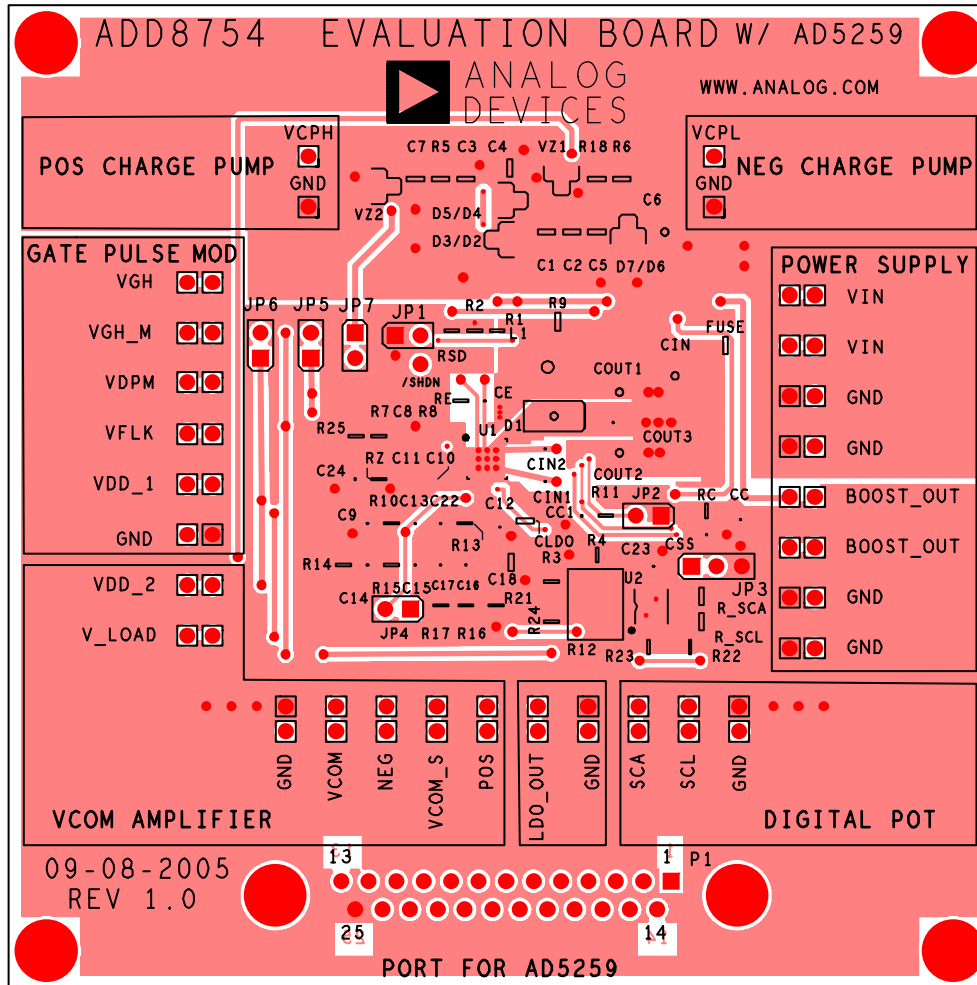


Figure 8. Evaluation Board Layout—Bottom Layer

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Table 5. Evaluation Board Layer Descriptions

Layer	Description
Blue (Top)	Top-of-board metal traces and ground plane. See Figure 7.
Red (Bottom)	Bottom-of-board metal traces and ground plane. Note that the top-view is shown in Figure 8. Silkscreen text is shown for orientation purposes only; text does not appear on bottom of board.

# ADD8754-EVAL

## SCHEMATIC

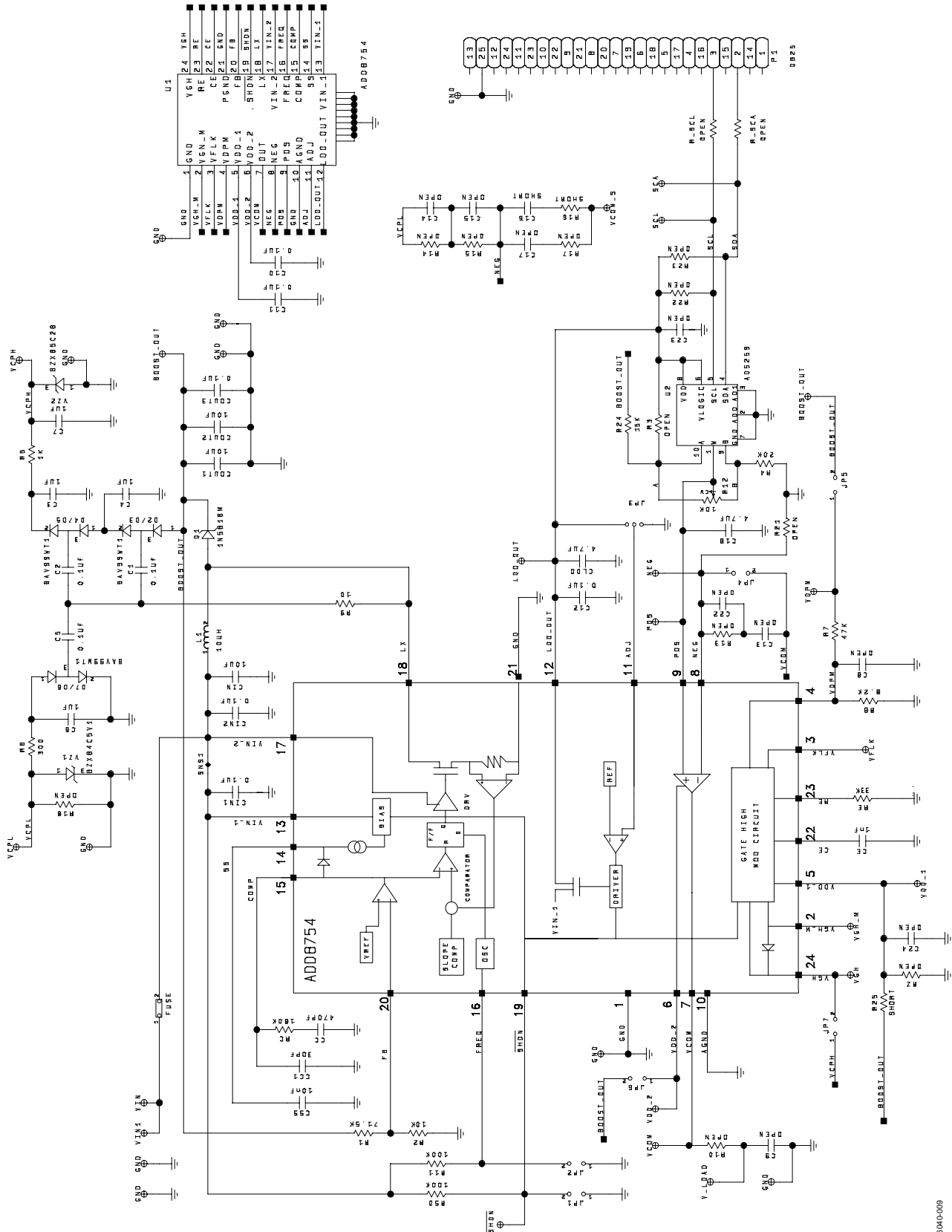


Figure 9. Evaluation Board

## ORDERING INFORMATION

### COMPONENT LISTING

Table 6.

Qty.	Reference Designator	Description	Value
2	C1, C2	Positive charge pump flying capacitors	0.1 $\mu$ F
2	C3, C4	Positive charge pump charging capacitors	1 $\mu$ F
1	C5	Negative charge pump flying capacitor	0.1 $\mu$ F
1	C6	Negative charge pump charging capacitor	1 $\mu$ F
1	C7	Negative charge pump filter capacitor	1 $\mu$ F
1	C8	VPDM start-up delay capacitor	Open
1	C9	VCOM load capacitor	Open
1	C10	VDD_2 (VCOM supply) bypass capacitor	0.1 $\mu$ F
1	C11	VDD_1 (GPM low) bypass capacitor	0.1 $\mu$ F
1	C12	LDO output bypass capacitor	0.1 $\mu$ F
1	C13 <sup>1</sup>	VCOM feedback capacitor	Open
2	C14, C15	VCOM VGH feedback capacitors	Open
1	C16	VCOM sense feedback capacitor	Short
1	C17	VCOM sense feedback capacitor	Open
1	C18	VCOM positive input bypass capacitor	4.7 $\mu$ F
1	C22	VCOM feedback capacitor	Open
1	C23 <sup>1</sup>	AD5259 VDD bypass capacitor	Open
1	C24	VDD_1 filter capacitor	Open
1	CC	Step-up loop compensation capacitor	470 pF
1	CC1	Step-up loop compensation capacitor	30 pF
1	CE	GPM negative ramp delay capacitor	1 nF
1	CIN	VIN_1 and VIN_2 bypass capacitor	10 $\mu$ F
1	CIN1	VIN_1 bypass capacitor	0.1 $\mu$ F
1	CIN2	VIN_2 bypass capacitor	0.1 $\mu$ F
1	CLDO	LDO output capacitor	4.7 $\mu$ F
2	COUT1, COUT2	Step-up output (charging) capacitors	10 $\mu$ F
1	COUT3	Step-up output capacitor	0.1 $\mu$ F
1	CSS	Soft-start capacitor	10 nF
1	D1	Step-up converter diode	1N5818
2	D2/D3	Positive charge pump doubler diodes	BAV99WT1
2	D4/D5	Positive charge pump tripler diodes	BAV99WT1
2	D6/D7	Negative charge pump diodes	BAV99WT1
1	FUSE	Input supply fuse	1A
1	JP1	SHDN jumper	Open
1	JP2	FREQ select jumper	Short
1	JP3	LDO output select jumper	Short 1 and Short 2
1	JP4	VCOM buffer configuration jumper	Short
1	JP5	VDPM from step-up jumper	Short
1	JP6	VCOM supply from step-up jumper	Short
1	JP7	Positive charge pump to VGH	Short
1	L1	Step-up converter inductor	10 $\mu$ H
1	R1	Step-up feedback divider resistor (top)	71.5 k $\Omega$
1	R2	Step-up feedback divider resistor (bottom)	10 k $\Omega$
1	R3 <sup>1</sup>	AD5259 divider resistor (top)	Open
1	R4	VCOM positive input divider resistor (bottom)	20 k $\Omega$
1	R5	Positive charge pump current limiting resistor	1 k $\Omega$
1	R6	Negative charge pump current limiting resistor	300 $\Omega$
1	R7	VDPM step-up voltage divider resistor (top)	47 k $\Omega$
1	R8	VDPM step-up voltage divider resistor (bottom)	8.2 k $\Omega$

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Qty.	Reference Designator	Description	Value
1	R9	Charge pump surge current limiting resistor	10 $\Omega$
1	R10	VCOM series load resistor	Open
1	R11	FREQ select pull-up resistor	100 k $\Omega$
1	R12 <sup>1</sup>	Variable resistor for VCOM positive input	10 k $\Omega$
1	R13 <sup>1</sup>	VCOM feedback resistor	Open
2	R14, R15	VCOM VGH feedback resistors	Open
1	R16	VCOM sense feedback resistor	Short
1	R17	VCOM sense feedback resistor	Open
1	R18	VGH output voltage divider resistor (bottom)	Open
1	R21 <sup>1</sup>	<a href="#">AD5259</a> VCOM negative input resistor	Open
2	R22 <sup>1</sup> , R23 <sup>1</sup>	<a href="#">AD5259</a> digital control pull-up resistors	Open
1	R24 <sup>1</sup>	VCOM positive input divider resistor (top)	15 k $\Omega$
1	R25	VDD_1 (GPM low) resistor divider (top)	Short
1	RC	Step-up loop compensation resistor	180 k $\Omega$
1	RE	GPM negative ramp rate (slope) resistor	33 k $\Omega$
2	R_SCA <sup>1</sup> , R_SCL <sup>1</sup>	<a href="#">AD5259</a> digital control series resistors	Open
1	RSD	$\overline{\text{SHDN}}$ pull-up resistor	100 k $\Omega$
1	RZ	VDD_1 (GPM low) resistor divider (bottom)	Open
1	U1	<a href="#">ADD8754</a> 24-lead LFCSP	ADD8754
1	U2	<a href="#">AD5259</a> 8-lead SOIC	AD5259
1	VZ1	Negative charge pump output Zener diode	BZX84C5V1
1	VZ2	Positive charge pump output Zener diode	BZX85C28

<sup>1</sup> These component values must be changed when using the [AD5259](#) digital potentiometer.

## ORDERING GUIDE

Model	Description
ADD8754-EVAL	Evaluation Kit

## 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.