Theory of Operation for AD8555 Evaluation Hardware and Software
by Reza Moghimi

GENERAL DESCRIPTION

The Eval-AD8555-SOIC evaluation kit allows the speedy demonstration and evaluation of the AD8555 Zero-Drift, Digitally Programmable Sensor Signal Amplifier. The AD8555 is an autozero instrumentation amplifier with programmable gain and output offset adjust features. The evaluation kit is a complete unit that allows a personal computer (PC) to communicate with the AD8555. Software is provided with the kit that enables the user to send commands through the evaluation board and to read data back for the device being evaluated.

To order the evaluation kit from Analog Devices, specify the following order numbers:

Order Number
Eval-AD8555-SOIC   Evaluation board for SOIC parts
Eval-AD8555-SW   Evaluation software

System Requirements
The evaluation kit has the following system requirements:

- PC with Pentium® 90 or greater and bidirectional printer port
- Windows® operating system
- Standard Centronics® printer cable

Communicating with the Evaluation Board
The evaluation board has a high speed interface that uses the PC's printer port. Because the port is used for both sending and receiving data, it must have bidirectional capability. Consult the PC operating manual for details.

HARDWARE DESCRIPTION
The AD8555 evaluation board is designed for maximum configuration flexibility. An ac signal can be applied to $+V_{IN}$ ac, and the output can be monitored from V_{OUT} ac. DC signals can be differentially applied between $+V_{IN}$ dc and $-V_{IN}$ dc, and the results can be monitored using a voltmeter at V_{OUT}. There is provision to view the filter output signal at the FILT/DIGOUT pin. The board allows swapping of the polarity of the inputs using switches VNEG P1 and VPOS P1.

Four resistors (R1A, R1B, R2A, R2B) simulate a 100 Ω bridge configuration. The bridge can be unbalanced using the provided trim potentiometers (P1 and P2). The top and bottom of the bridge are connected to V_{DD} and V_{SS}, respectively.

Pulse shaping is performed on this board before applying the data to the AD8555 data input pin. The pulse widths are set for 5 µs, representing the low level (zero), and 80 µs, representing the high level (>2.4 V). This adjustment is made using resistors RT0 and RT1. The trim potentiometers are glued to their fixed positions.

Supply current can be monitored by placing a resistor in place of R7. Clamp voltage can be applied externally to a level or can easily be set to V_{DD} by placing a jumper from V_{CLAMP} to V_{DD}. The SOIC socket is soldered for easy programming and removal of the part. Pin 1 is the pin located in the upper left-hand corner of the socket close to R7. See the evaluation board schematic, Figure 14, at the end of this document.

SETUP PROCEDURE
Setup Requirements
Power supplies
Voltage source
Voltmeter
BNCs and power cables
PC and parallel cable

Adjusting for 0 V Differential Input

- Connect +input (high) of a voltmeter to $-V_{IN}$ dc.
- Connect −input (low) of the voltmeter to GND of p.s.
- Monitor the output (V_{OUT} dc) voltmeter.
- Adjust trim potentiometer P1 to get close to (−0.1 mV).
- Connect +input (high) of a voltmeter to $+V_{IN}$ dc.
- Connect −input (low) of the voltmeter to GND of p.s.
- Monitor the output (V_{OUT} dc) voltmeter.
- Adjust trim potentiometer P2 to get close to 0 V (0.1 mV).

QUICK INITIAL HARDWARE SETUP AND OUTPUT VERIFICATION

For an initial hardware setup and output verification, follow these steps:

1. Connect the AD8555 evaluation board to the parallel port of your PC system using a standard 25-pin (male-to-female) printer cable.

2. Position manual switches to VPOS P2 and VNEG P1.

3. Jumper the V_{CLAMP} connector pin to the V_{DD} connector pin.

4. Apply 1 mV dc signal between the $+V_{IN}$ dc and $-V_{IN}$ dc connectors, and monitor the V_{OUT} dc output using a voltmeter.

5. Place an AD8555 part in the SOIC socket, connect the V_{CLAMP} pin to the V_{DD} pin, and apply dc power to the board using an external power supply (±2.5 V).

Result: The output should be 70 mV, with the board in this configuration consuming roughly 4 mA.

Installing the AD8555 Software

To install the AD8555 software:

1. Insert the CD-ROM into the CD drive on your computer. After a few moments, a message pops up for the installation.

2. Double click AD8555_setup.exe.

3. Follow the instructions until the software installation is complete.

The AD8555 software was developed in the Microsoft Visual.Net environment. This environment requires installation of dotnetfx.exe, which takes several minutes and needs 38 MB of hard-drive memory.

The software installation places the executable program in the user-selected directory and copies the parallel port drivers to the system directory. If the data sheet box is checked, the latest copy of the data sheet is copied into the directory specified by the user. An icon is placed on the desktop (handshake icon) symbolizing the start of a new partnership. Under default conditions, the program is installed in the following directory:

C:\Program Files\Analog Devices\AD8555

For future reference and the updated data sheet on the Web, go to www.analog.com/AD8555.

Uninstalling the AD8555 Software

To uninstall the AD8555 software modules:

1. Click Start > Setting > Control Panel.

2. Double-click Add/Remove Programs and select Microsoft. Net Framework.

Result: The components that dotnetfx.exe and the AD8555 program have placed on your system are removed.

Running the AD8555 Software

To run the AD8555 software application:

1. Double-click the AD8555 icon. The program starts in No Programming mode.

2. Set the appropriate gain and offset values and click the Simulate button.

3. Program the gain between 70 and 1280 and the offset between 0 V and 5 V.

4. Click Run.

Result: The output is Input $\times$ Gain. The output responds to the specified configuration.
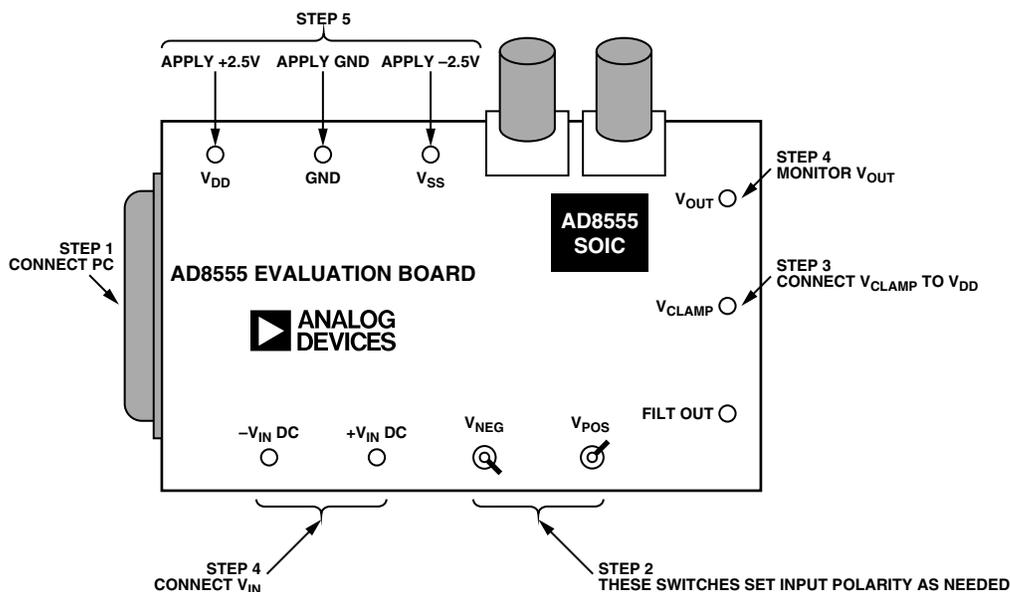
Figure 1. Hardware Setup Steps

SOFTWARE MODES
The evaluation software can be run in four modes, for different levels of expertise:

• No programming

• Easy programming

• Bit pushing

• All

To select a mode, click the corresponding button under Starting Window at the bottom of the AD8555 software dialog box. Based on the mode selected, a portion of the AD8555 software dialog box is displayed.

Click the All button to display the entire dialog box and activate all functions.

No Programming Mode
1. To select No Programming mode, click the No Programming button under Starting Window at the bottom of the AD8555 software dialog box. The following dialog box is displayed.

2. Set the desired gain or an offset in the appropriate box and press Return on the keyboard.

3. Click Run to configure the pattern for this gain and offset.

The program picks the best gain combination for first and second stage gains and configures the part accordingly. The best gain combination might not give an exact gain, but is the best and closest possible due to the limited number of gain settings available for first and second stage.

You can specify output offset adjustment as either a percentage of the power supplies or a fixed value. Click Run to place the part in simulation mode. Fuses are not blown permanently.

The Free check box is for demonstration purposes and does not have any significance during evaluation. Select the Free check box and click Run, if you want to step through the second stage gain. The demonstration stops at the last gain.

Note: While in No Programming Mode, do not use the buttons below the No Programming dialog box. These buttons are used in other modes.
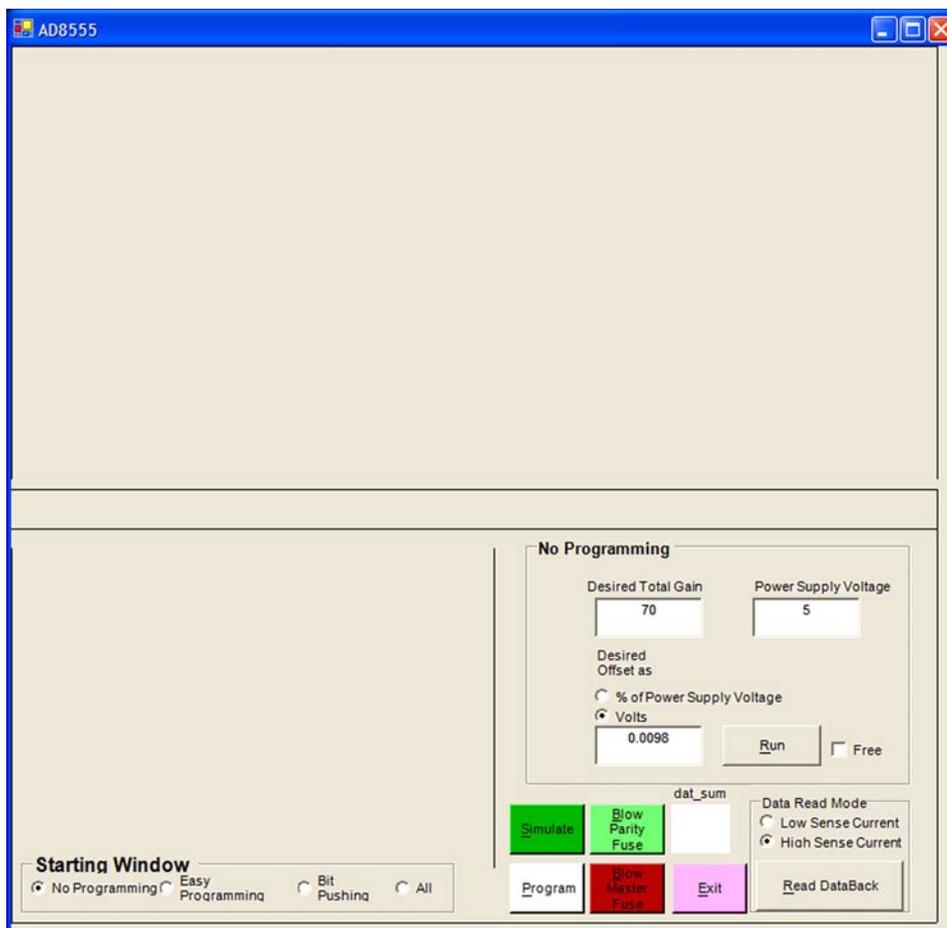
Figure 2. No Programming Dialog Box

Easy Programming Mode
In this mode, it is assumed that the user is somewhat familiar with the internal architecture and operation of the part and how it is put together (first stage, second stage, and offset adjust block).

1. To select Easy Programming mode, click the Easy Programming button under Starting Window at the bottom of the AD8555 software dialog box. The following dialog box is displayed.

2. Enter the appropriate gain and offset setting and click Simulate. The result of that action takes place.

For example:

1. To set the first stage gain to 4.025, type 4.025 in the First Stage Gain box and click Simulate.

2. To set the second stage gain to 25, type 25 in the Second Stage Gain box and click Simulate.

If, at any time, the entered value falls outside the allowed range, an error message is generated. If a value within the range is entered, the closest value and its code are displayed in the boxes. The first stage gain range is 4 to 6.4, the second stage gain range is 17.5 to 200, and the offset voltage range is –2.5 V to +2.5 V.

The static boxes to the right of the entered values show the appropriate code for the value. The Field_1 Code box shows the last action taken. All buttons to the right of this window are active and exercisable. You can simulate, program, or read back the programmed value. When you click the Read Data Back button, the Data Readback Box displays the last value of the readback function.
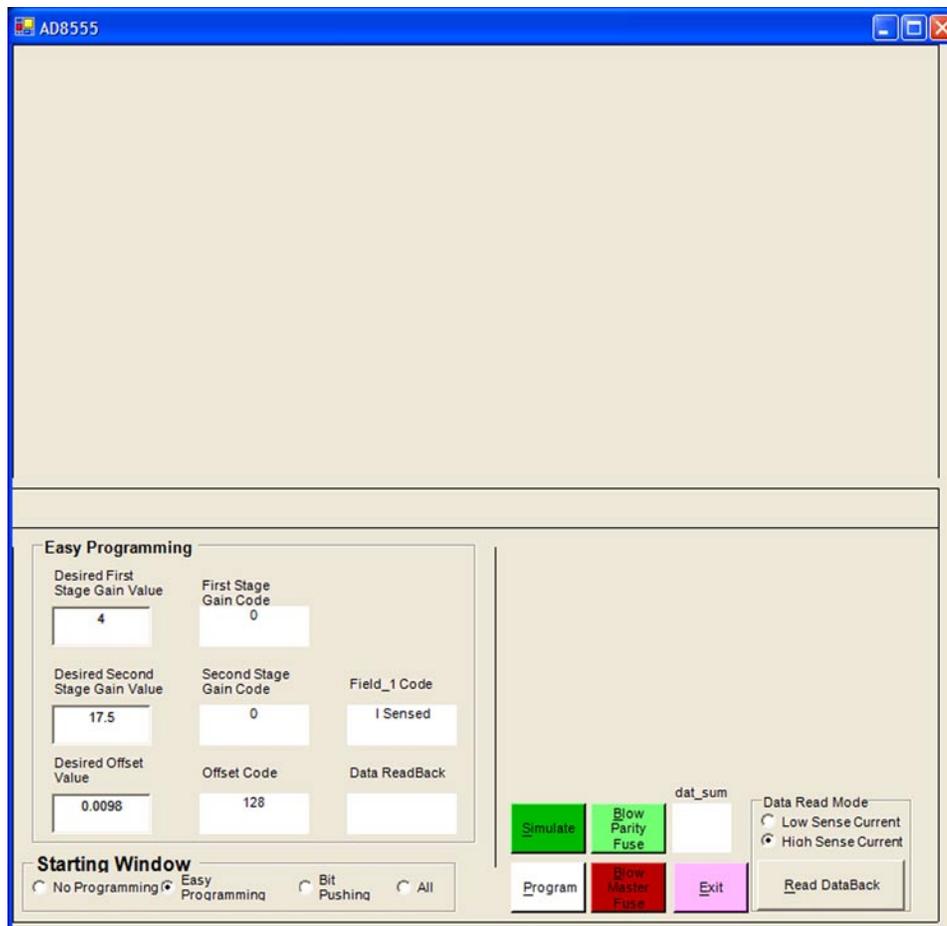
Figure 3. Easy Programming Dialog Box

Bit Pushing Mode

This mode is recommended if you are familiar with how data patterns are structured and want to send an exact bit pattern to the AD8555. Not all fields of this 38-bit pattern are available for programming. For definitions of the fields, see the AD8555 Data Sheet.

1. To select Bit Pushing mode, click the Bit Pushing button under Starting Window at the bottom of the AD8555 software dialog box. The following dialog box is displayed.

To generate and program a code:

2. Select a function, First Gain Stage, Second Gain Stage, or Offset Adjust, by clicking the appropriate radio button under Select Operation.

3. Set the pattern in Field 4.

4. Click Simulate.

Depending on the function, different numbers of bits in Field 4 are active for programming. Selecting the Offset

Adjust function activates eight bits in Field 4 for the data pattern, selecting First Gain Stage activates seven bits, and selecting Second Gain Stage activates only three bits.

For example, to offset the output by 2.5 V:

1. Select the Offset Adjust radio button.

2. Set the bit pattern in Field 4 to 10000000.

3. Click Simulate.

Result: The static boxes below the bit pattern display the code and value of the bit pattern.

All Modes

1. To display all programming windows, click the All button under Starting Window at the bottom of the AD8555 software dialog box. The following dialog box appears.

In this mode, you can enter data into any of the fields and obtain appropriate results, based on the selected function. All buttons are active. For descriptions of the button functions, see Table 1.
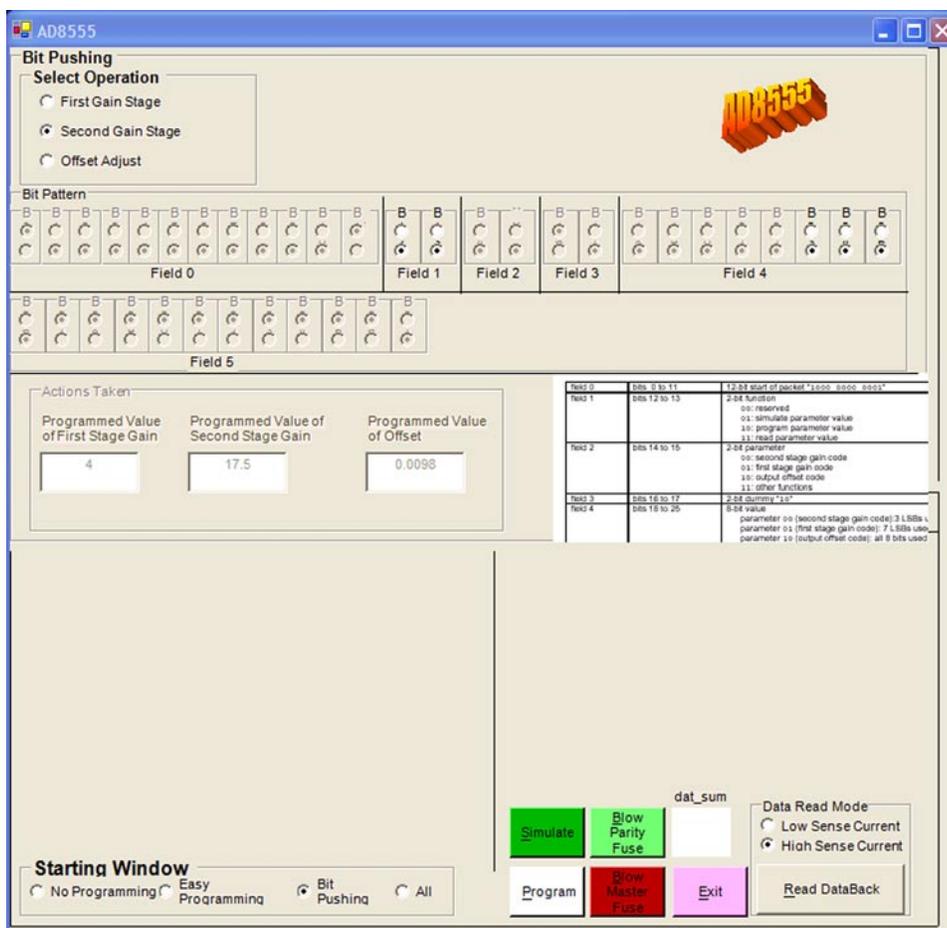
Figure 4. Bit Pushing Dialog Box
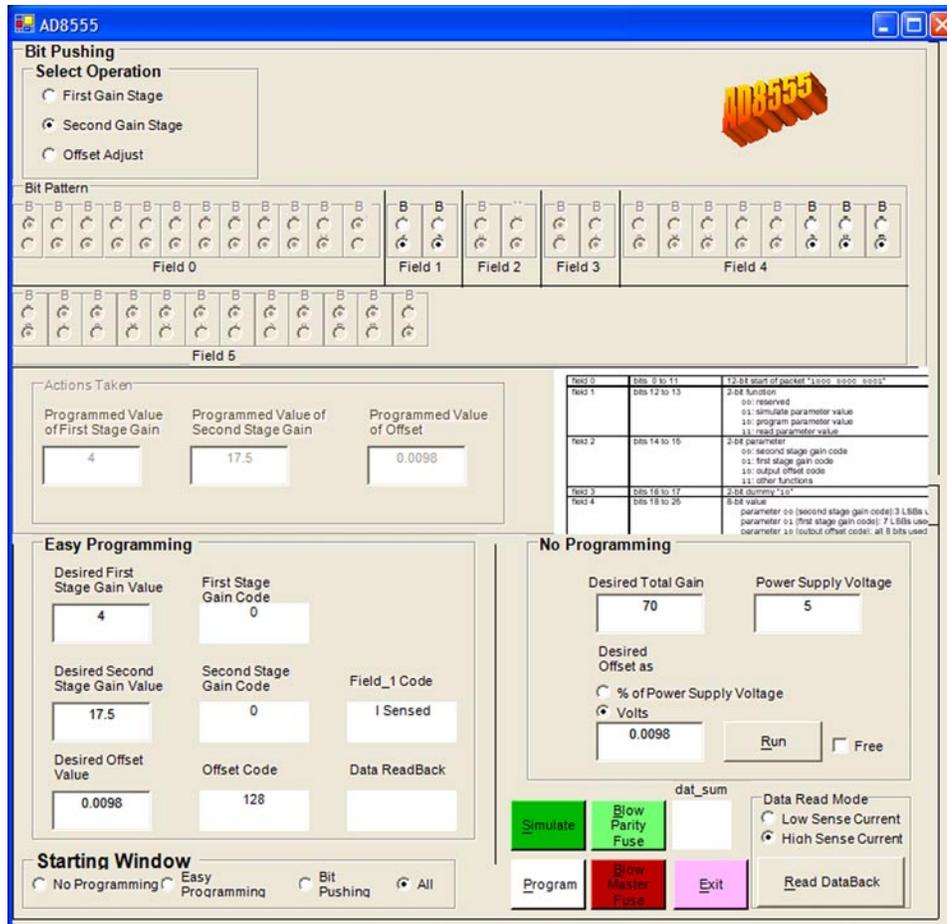
Figure 5. AD8555 Dialog Box with All Modes Displayed

Table 1. AD8555 Software Dialog Box Buttons

Button	Function
Simulate	Configures the part according to the specified pattern. This button does not blow any fuses.
Program Fuse	Blows the fuses according to the specified pattern. Blown fuses cannot be reprogrammed. Blow Master permanently sets the part to the programmed gain and offset and prevents future programming. Click this button only after selecting and programming the gain and the offset. Prior to blowing the master fuse, make sure that, if prompted, you first blow the parity fuse.
Blow Parity Fuse	Blows the parity fuse. The parity fuse keeps track of the state of the blown fuses. If, for any reason, the state of this fuse is changed either intentionally or unintentionally, the parity flag is set and an alarm is set.
Dat_Sum	Keeps track of the fuses blown. Depending on the value in this static field, you can either blow the master fuse or, if prompted to blow the parity fuse first and then blow the master fuse.
Read Data Back	Reads back the state of the programmed fuses after they have been blown. The options are: • Low Sense Current option, when dropped across a blown fuse (high impedance), creates a voltage that can trigger an internal comparator and provide the right level in the output. • High Sense Current option reads back the fuse states to make sure that the fuses are definitely blown.
Exit	Closes the AD8555 software program.
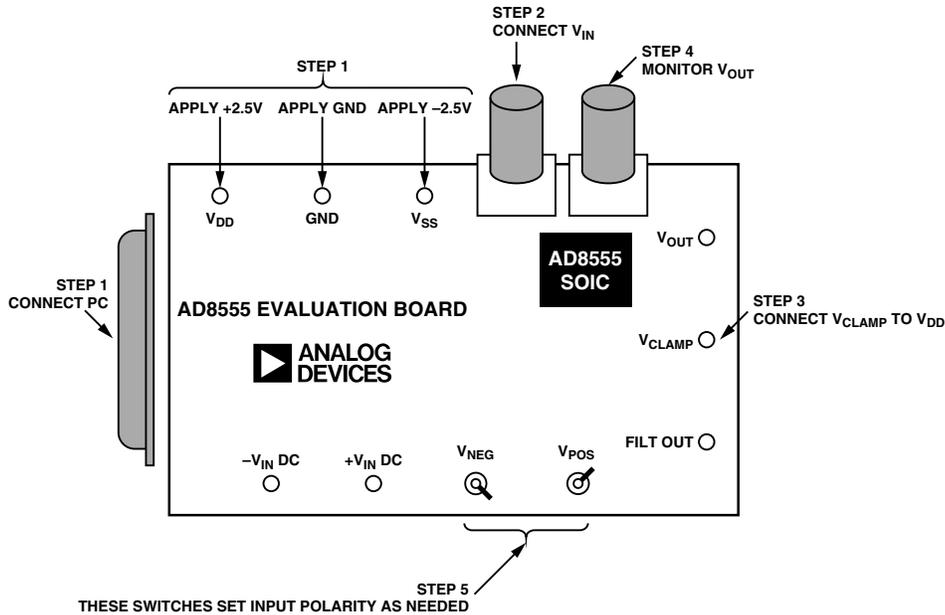
Figure 6.

TYPICAL SETUP AND RESPONSE

AC Input Example

Setup requirements are as follows:

- Power supplies
- Function generator
- Scope
- BNCs and cables
- PC and parallel cable

Results:

When the part is powered with ±2.5 V and 50 mV of input is applied, the default conditions are as follows:

V_{CC} = 2.5 V, V_{SS} = –2.5 V, Gain 1 = 4, Gain 2 = 17.5, Offset = V_{SS}. The overall gain is 70.

When you place the switches in VNEG P1 and VPOS P2, you get one set of outputs. When you change to VNEG P2 and VPOS P1, you get the exact voltage, but with the opposite polarity.

When both switches are on one side (for example, VNEG P1 and VPOS P1), the inputs are shorted together.

RT0 and RT1 are the trim potentiometers used for pulse width shaping. Do not change their settings. RT0 is adjusted to create a 5 μs pulse; RT1 is adjusted to create an 80 μs pulse. Figure 7 shows the resultant output on Channel 2, under the above mentioned condition and configuration.
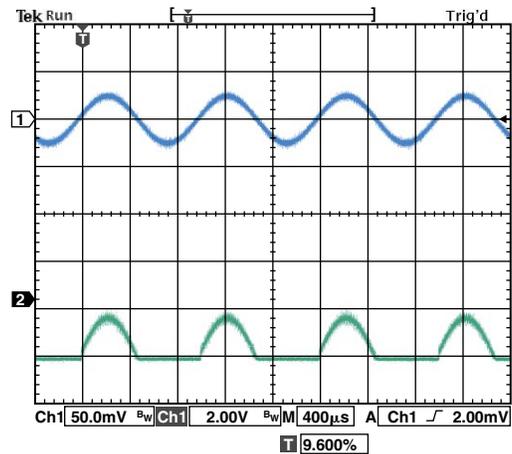
Figure 7.

Figure 8 shows the results of the previous conditions with V_{OFF} = 2.5 V or Code 128.
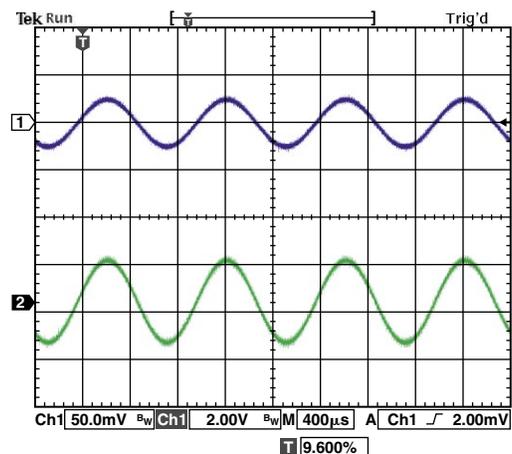
Figure 8.

In Figure 9, Overall Gain = 100 (G1 = default = 4, G2 = code 1 = 25, Offset = code 128).
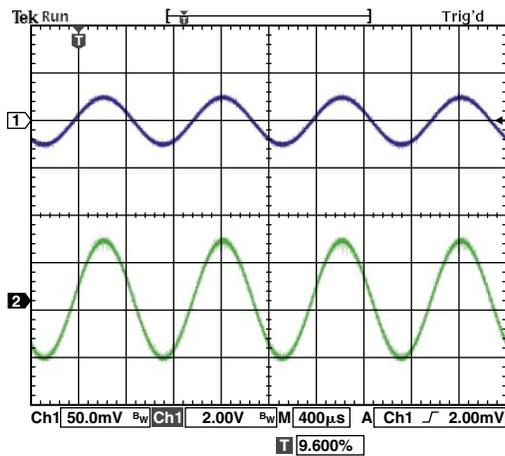
Figure 9.

In Figure 10, V_{IN} = 2 mV p-p and G1 = 6.4, G2 = 35, Offset = 2.5 or code 128.
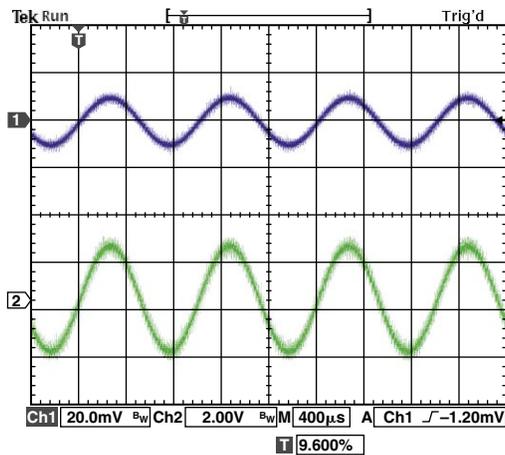
Figure 10.

OUTPUT CLAMP FEATURE

The output of the part can be clamped to a desired level. The output clamp feature is provided to protect the circuitry that follows the AD8555, in case the input to AD8555 is accidentally larger than anticipated.

In normal situations ($V_{SUPPLIES}$ = ±2.5 V, Gain = 70, V_{OFFSET} = 2.5 V, Input = 40 mV p-p), the response to an input is as shown in Figure 11.
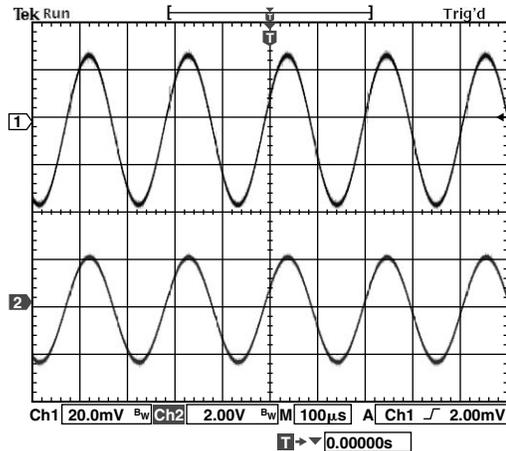
Figure 11. Normal Response

Figure 12 shows the output after V_{CLAMP} is set to 0.8 V.
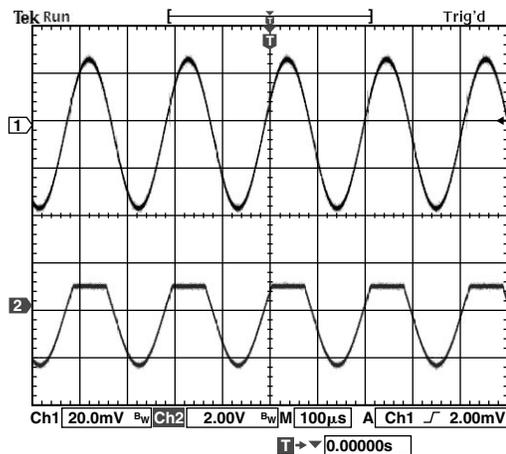
Figure 12. Response with V_{CLAMP} Set

Applying a large gain to an input yields saturation, as shown in Figure 13. The conditions are V_{IN} = 20 mV p-p, G1 = 6.4, G2 = 200, Offset = 2.5 V.
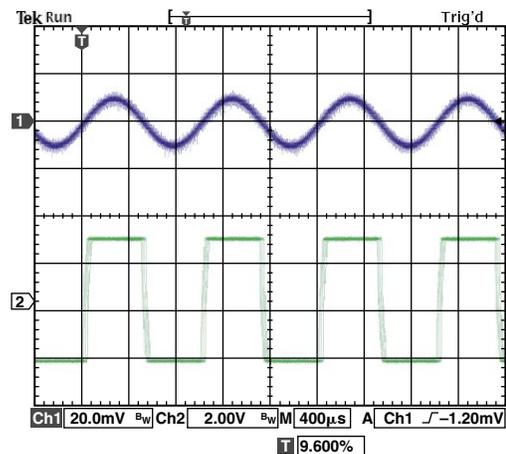
Figure 13. Results with Saturation

Note: Resistors RT1 and RT2 are used for pulse stretching; do not adjust them. They are factory-adjusted for optimal results.

EVALUATION BOARD SCHEMATIC

Figure 14.

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