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AD5235 Evaluation Kit User Manual

by Alan Li

7 STEPS TO EVALUATION KIT SETUP

The AD5235 evaluation kit (AD5235EVAL25) consists of a demonstration board and software for evaluating the AD5235. It is a user-friendly tool that you can control with your personal computer through the printer port. The driving program is self-contained, so no programming languages or skills are needed. Figure 1 provides an overview of how to set up the kit.

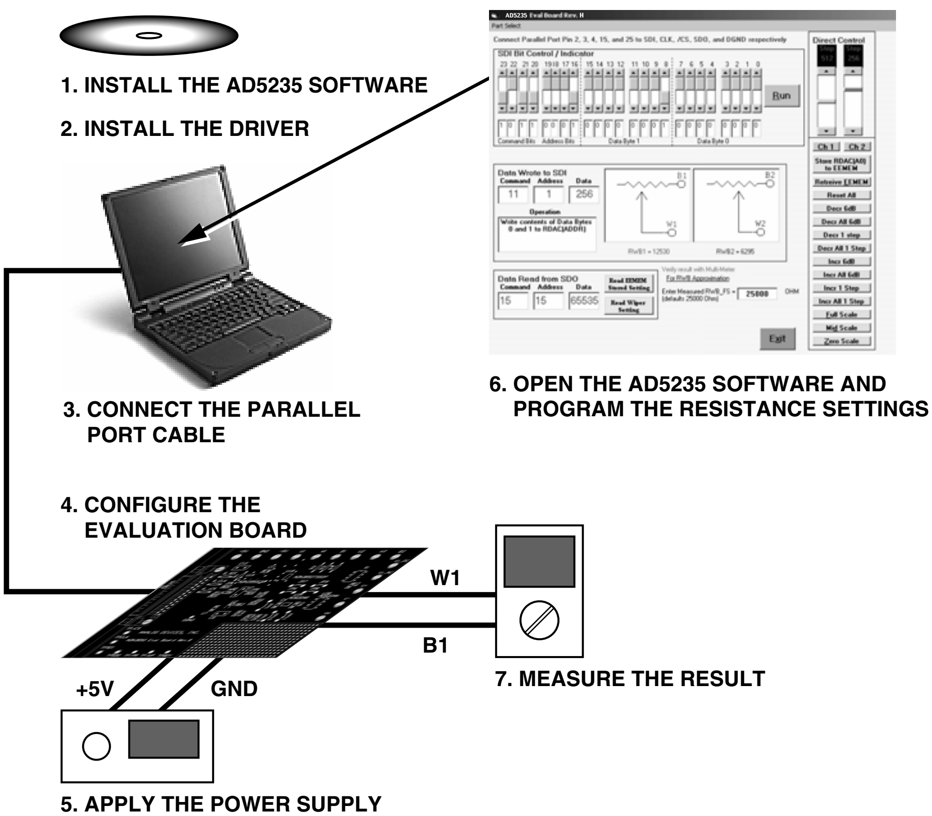


Figure 1. Evaluation Kit Setup

SETTING UP THE AD5235 EVALUATION BOARD

Step 1—Installing the AD5235 Software
To install the AD5235 software from the Revision H CD, run **setup.exe** under D:\AD5235 Evaluation Software Package. During the installation, select **Ignore** or **Yes** to bypass error messages if they occur. You may need to install the software a few times to get a successful installation.

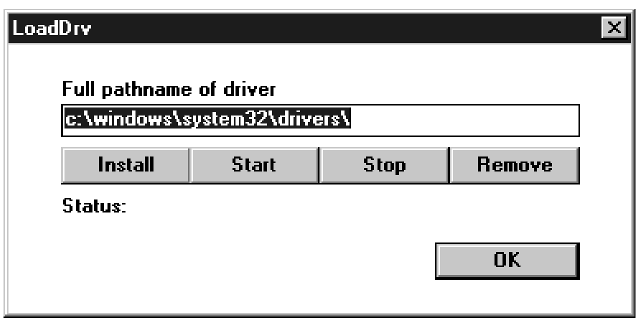
Step 2—Installing the Driver for PC Parallel Port Communications
In addition to installing the AD5235 software, you need to install a third-party driver, NTPORT from Upper Canada Technologies (UCT), for access to the PC parallel port. UCT offers a free trial with a nominal license fee after 30 days.

1. Download the driver from www.uct.on.ca. From the UCT website, download **NTPORT.OCX**. Save ntport.zip in the default or specified directory. Unzip and extract all the files to the directory.

2. Run **setup.exe**. If the setup procedure indicates file violations during installation, select **Ignore** to bypass them.

3. Ensure that the driver file, dlportio.sys, is in the correct system directory.

   a. Run **loaddrv.exe** under c:\program files\project1 or the specified directory. A dialog box appears.



Note: If Windows® displays an error message, such as "Can't connect to service control manager," contact the IS department for authority to continue installation.

   b. Change the pathname of the driver according to the operating system.

      • On a Windows 2000 or Window NT® system, enter **c:\winnt\system32\drivers\dlportio.sys**.

      • On a Windows XP system, enter **c:\windows\system32\drivers\dlportio.sys**.

   c. Click the **Install** button, then the **Start** button. If the status message indicates success, the driver is installed and operating. Click **OK**.

4. Set up the driver for automatic startup. Use the following steps that apply to your operating system.

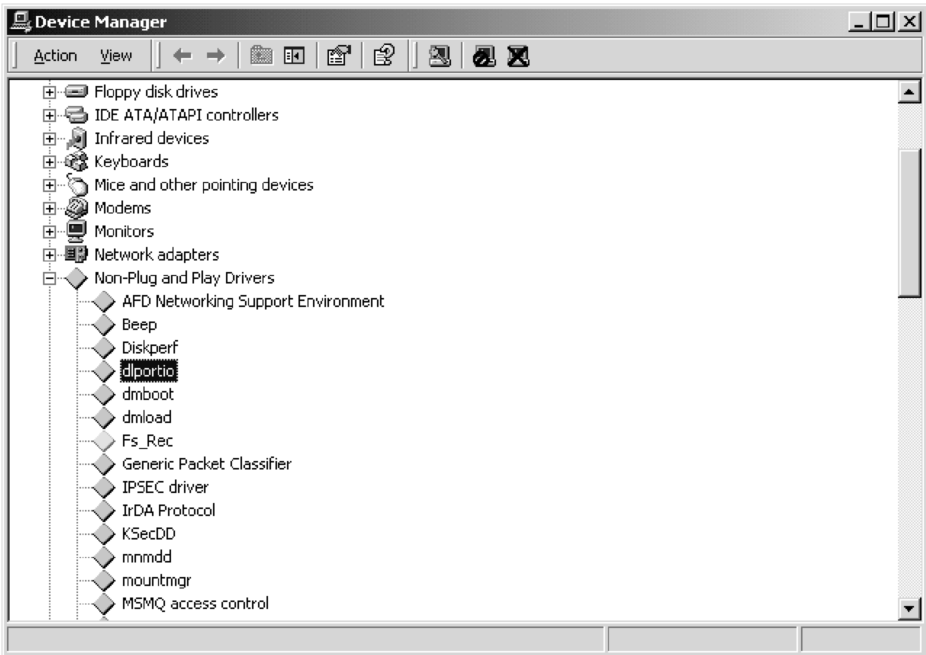
   For Windows 2000 and XP Systems
   a. Go to the Device Manager.

      • On a Windows 2000 system, click **Start** → **Settings** → **Control Panel** → **System** → **Hardware** → **Device Manager**.

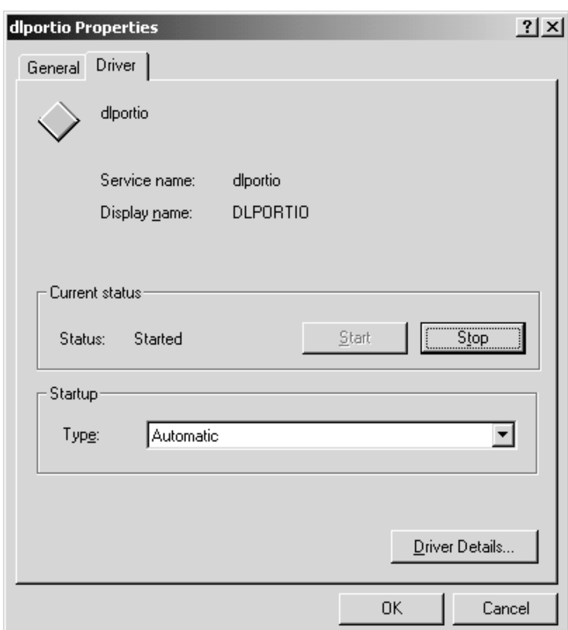
      • On a Windows XP system, click **Start** → **Control Panel** → **System** → **Hardware** → **Device Manager**.

b. Locate **Non-Plug and Play Drivers** and **dlportio** in the Device Manager.

If the **Non-Plug and Play Drivers** entry is not visible, click the **View** menu in Device Manager and select **show Hidden Devices** to make sure that hidden driver files are listed. If you do not see **dlportio**, reboot Windows or rerun **loaddrv.exe** and then reboot Windows.



c. Double-click **dlportio** in the Non-Plug and Play Drivers list. The dlportio Properties page appears.

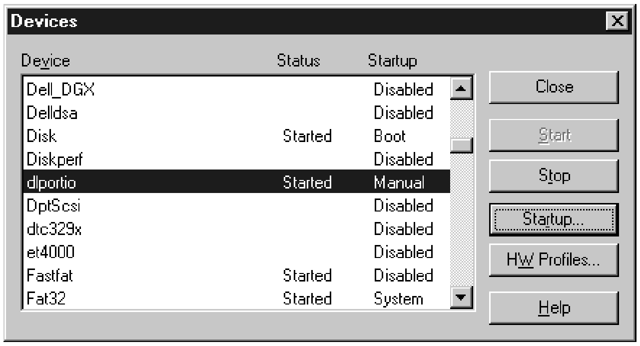


d. At the Driver tab, select Startup Type as **Automatic**, click Current status to Start, and click **OK**.

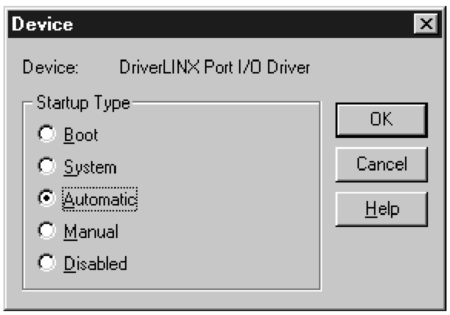
Note: If Startup is not active and you cannot change Type, your computer may be administered by your IS department. You may need to consult them to change your PC administrative setting.

For Windows NT Systems

a. From the Windows NT Control Panel, select the **Devices** icon. The Devices dialog box appears.



b. Select **dlportio** and click the **Startup** button. The Device Startup Type dialog box appears. From the option buttons, select **Automatic**, and then click **OK**.



Step 3—Connecting the Parallel Port Cable

Connect the parallel port cable from LPT1 on your PC to the AD5235 evaluation board.

Step 4—Configuring the Evaluation Board

Follow these requirements to configure the AD5235 evaluation board:

- For a single supply, connect JP14 and JP13 to ground V_{SS} of U1 and U3. Apply 5 V to Pin +5 V.

  Note: Some boards do not come with jumper caps. You should supply suitable caps or simply short the jumpers for proper operation.

- For dual supplies, connect JP15 and JP12 to connect the –5 V pin to V_{SS} of U1 and U3.

  Warning: Apply +2.5 V to Pin +5 V and –2.5 V to Pin –5 V instead.

- Select the states of $\overline{PR}$ and $\overline{WP}$ from the DIP switches on the evaluation board.

- SDO can be monitored at TPSDO.

Step 5—Applying the Power Supply

Provide a power supply to the AD5235 evaluation board according to Step 4 for a single supply or for dual supplies.

Step 6—Using the Evaluation Board

To open the AD5235 software program, from Windows click **Start** → **Programs** → **AD5235 Rev H**.

Figure 2 shows the graphical interface. In the Direct Control pane, on the right, you can move the scroll bars or click the buttons to control the device. In the top pane, you can adjust the bit pattern and then click **Run** to program the device. In the bottom pane, you can approximate R_{WA} and R_{WB} by first entering the measured R_{AB} after power is applied.

Step 7—Measuring the Result

Use a multimeter to measure the result of your program applications on the AD5235 evaluation board.

UNINSTALLING SOFTWARE

To uninstall the AD5235 software and NTPORT driver, use Add/Remove Programs in the Control Panel.

TECHNICAL SUPPORT

Due to the variations in computer platforms and configurations, Analog Devices, Inc., cannot guarantee the software described in this application note to work on all systems. If you encounter problems, send email to digital.pots@analog.com or call 1-408-382-3082 for applications support. If you are interested in the AD5235 source code, send email to alan.li@analog.com for more information.

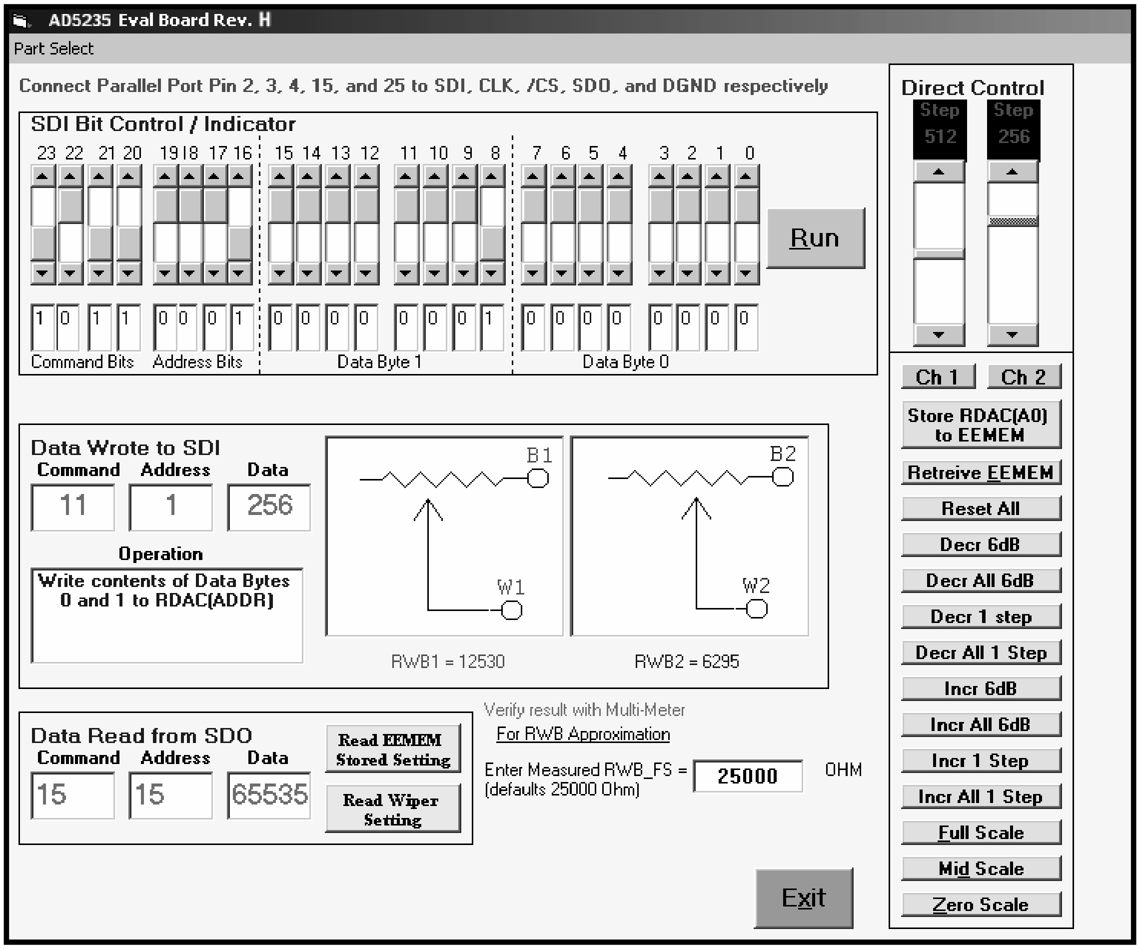


Figure 2. AD5235 Software Graphical Interface

EVALUATION BOARD SCHEMATIC

The general-purpose op amp AD820, U3A can be configured as various building block circuits in conjunction with the AD5235 for various circuit evaluations (see the Applications section). Other op amps in PDIP can replace the AD820. For a single-supply, 2.5 V voltage reference, AD1582 can be used to offset the op amp bias point for ac operation.

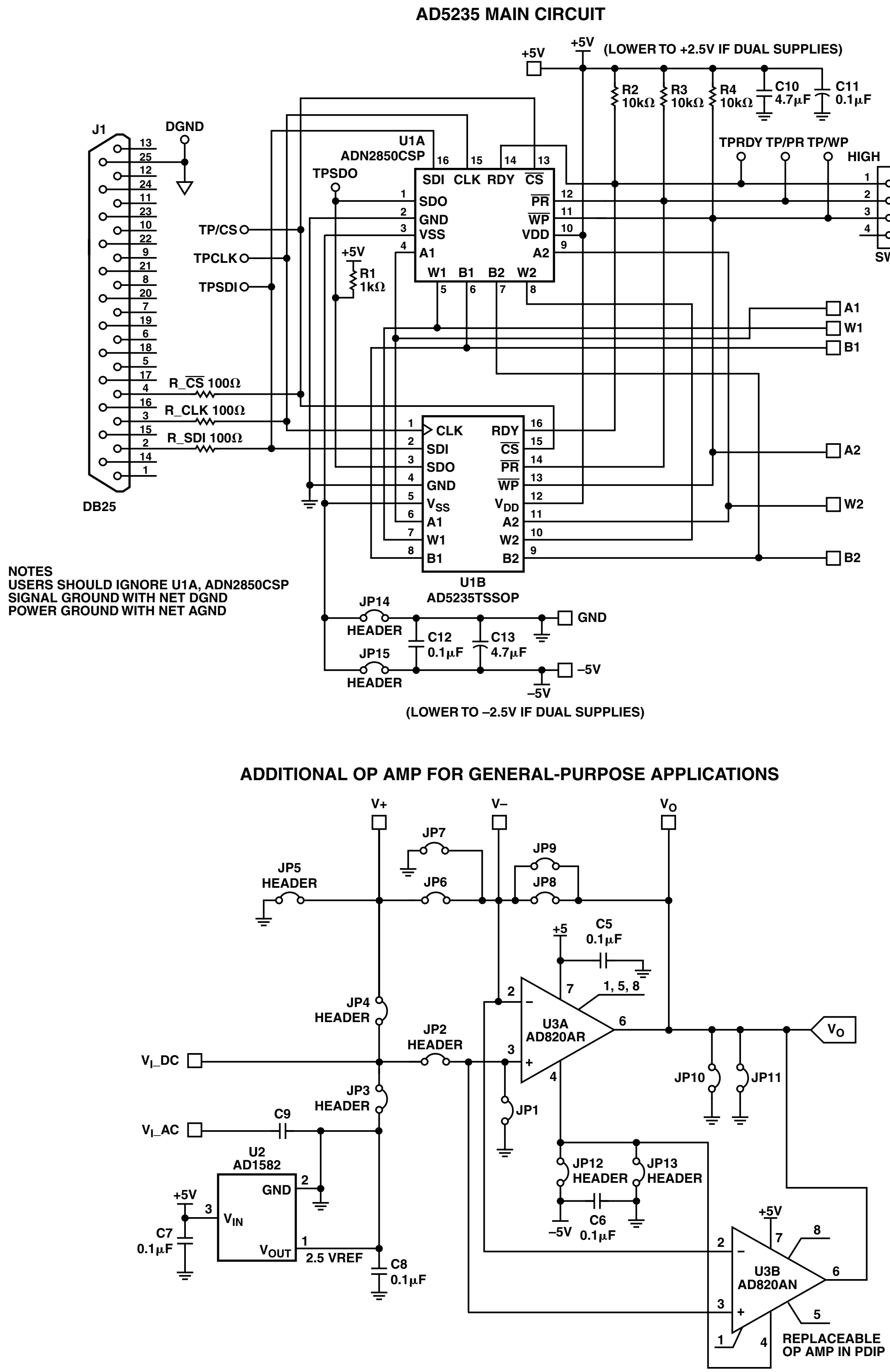


Figure 3. Evaluation Board Schematic

Table I. AD5235 24-Bit Serial Data-Word

	MSB	Instruction Byte 0							Data Byte 1								Data Byte 0							LSB
RDAC	C3	C2	C1	C0	0	0	0	A0	X	X	X	X	X	X	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
EEMEM	C3	C2	C1	C0	A3	A2	A1	A0	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0

Command bits are C0 to C3. Addresses bits are A3 to A0. Data bits D0 to D9 are applicable to the RDAC wiper register, whereas D0 to D15 are applicable to the EEMEM register. Command instruction codes are defined in Table II.

Table II. AD5235 Instruction/Operation Truth Table[1, 2, 3]

Instruction No.	Instruction Byte 0 B23 •••••••••••••••• B16 C3 C2 C1 C0 A3 A2 A1 A0	Data Byte 1 B15 ••• B8 X ••• D9 D8	Data Byte 0 B7 ••• B0 D7 ••• D0	Operation
0	0 0 0 0 X X X X	X ••• X X	X ••• X	NOP: Do nothing. See Table V.
1	0 0 0 1 0 0 0 A0	X ••• X X	X ••• X	Write the contents of EEMEM(A0) to RDAC(A0). This command leaves the device in the read program power state. To return the device to the idle state, perform NOP instruction 0. See Table V.
2	0 0 1 0 0 0 0 A0	X ••• X X	X ••• X	Save wiper setting: Write the contents of RDAC(A0) to EEMEM(A0). See Table IV.
3[4]	0 0 1 1 A3 A2 A1 A0	D15 ••• D8	D7••• D0	Write the contents of serial register data bytes 0 and 1 (total 16-bit) to EEMEM(ADDR). See Table VII.
4[5]	0 1 0 0 0 0 0 A0	X ••• X X	X ••• X	Decrement 6 dB: Right-shift contents of RDAC(A0), stops at all "zeros."
5[5]	0 1 0 1 X X X X	X ••• X X	X ••• X	Decrement all 6 dB: Right-shift contents of all RDAC registers, stops at all "zeros."
6[5]	0 1 1 0 0 0 0 A0	X ••• X X	X ••• X	Decrement contents of RDAC(A0) by "one," stops at all "zeros."
7[5]	0 1 1 1 X X X X	X ••• X X	X ••• X	Decrement contents of all RDAC registers by "one," stops at all "zeros."
8	1 0 0 0 0 0 0 0	X ••• X X	X ••• X	Reset: Load all RDACs with their corresponding EEMEM previously saved values.
9	1 0 0 1 A3 A2 A1 A0	X ••• X X	X ••• X	Write contents of EEMEM(ADDR) to serial register data bytes 0 and 1. SDO activated. See Table VIII.
10	1 0 1 0 0 0 0 A0	X ••• X X	X ••• X	Write contents of RDAC(A0) to serial register data bytes 0 and 1. SDO activated. See Table IX.
11	1 0 1 1 0 0 0 A0	X ••• D9 D8	D7 •••D0	Write contents of serial register data bytes 0 and 1 (total 10 bit) to RDAC(A0). See Table III.
12[5]	1 1 0 0 0 0 0 A0	X ••• X X	X ••• X	Increment 6 dB: Left-shift contents of RDAC(A0), stops at all "ones." See Table VI.
13[5]	1 1 0 1 X X X X	X ••• X X	X ••• X	Increment all 6 dB: Left-shift contents of all RDAC registers, stops at all "ones."
14[5]	1 1 1 0 0 0 0 A0	X ••• X X	X ••• X	Increment contents of RDAC(A0) by "one," stops at all "ones." See Table IV.
15[5]	1 1 1 1 X X X X	X ••• X X	X ••• X	Increment contents of all RDAC registers by "one," stops at all "ones."

NOTES

[1] The SDO output shifts out the last 24 bits of data clocked into the serial register for daisy-chain operation. Exception: For any instruction following instruction 9 or 10, the selected internal register data will be present in data byte 0 and 1. The instructions following 9 and 10 must also be a full 24-bit data-word to completely clock out the contents of the serial register.

[2] The RDAC register is a volatile scratchpad register that is refreshed at power-on from the corresponding nonvolatile EEMEM register.

[3] Execution of the above operations takes place when the $\overline{CS}$ strobe returns to logic high.

[4] Instruction 3 writes two data bytes (total 16 bit) to EEMEM. However, in the cases of addresses 0 and 1, only the last 10 bits are valid for wiper position setting.

[5] The increment, decrement, and shift commands ignore the contents of the shift register data bytes 0 and 1.

PROGRAMMING EXAMPLES

The following programming examples illustrate the typical sequence of events for various features of the AD5235. Refer to Table II for the instructions and data-word format. The instruction numbers, addresses, and data appearing at the SDI and SDO pins are displayed in hexadecimal format in the tables.

Table III. Scratchpad Programming

SDI	SDO	Action
$B00100_H$	$XXXXXX_H$	Loads data 100_H into the RDAC1 register. Wiper 1 moves to the 1/4 full-scale position.
$B10200_H$	$B00100_H$	Loads data 200_H into the RDAC2 register. Wiper 2 moves to the 1/2 full-scale position.

Table IV. Incrementing RDAC Followed by Storing the Wiper Setting to EEMEM

SDI	SDO	Action
$B00100_H$	$XXXXXX_H$	Loads data 100_H into the RDAC1 register. Wiper 1 moves to the 1/4 full-scale position.
$E0XXXX_H$	$B00100_H$	Increments the RDAC1 register by one to 101_H.
$E0XXXX_H$	$E0XXXX_H$	Increments the RDAC1 register by one to 102_H. Continue until the desired wiper position is reached.
$20XXXX_H$	$XXXXXX_H$	Saves RDAC1 register data into EEMEM1. Optionally tie $\overline{WP}$ to GND to protect EEMEM values.

Table V. Restoring EEMEM Values to RDAC Registers

SDI	SDO	Action
$10XXXX_H$	$XXXXXX_H$	Restores EEMEM1 value to RDAC1 register.
$00XXXX_H$	$10XXXX_H$	NOP. Recommended step to minimize power consumption.
$8XXXXX_H$	$00XXXX_H$	Resets EEMEM1 and EEMEM2 values to RDAC1 and RDAC2 registers, respectively.

EEMEM values for RDACs can be restored by power-on, strobing the $\overline{PR}$ pin or programming as shown above.

Table VI. Using Left Shift by One to Increment 6 dB Steps

SDI	SDO	Action
$C0XXXX_H$	$XXXXXX_H$	Moves wiper 1 to double the present data contained in the RDAC1 register.
$C1XXXX_H$	$C0XXXX_H$	Moves wiper 2 to double the present data contained in the RDAC2 register.

Table VII. Storing Additional User Data in EEMEM

SDI	SDO	Action
$32AAAA_H$	$XXXXXX_H$	Stores data $AAAA_H$ into spare EEMEM location USER1. Allowable to address in 13 locations with maximum 16 bits of data.
335555_H	$32AAAA_H$	Stores data 5555_H into spare EEMEM location USER2. Allowable to address 13 locations with maximum 16 bits of data.

Table VIII. Reading Back Data from Various Memory Locations

SDI	SDO	Action
$92XXXX_H$	$XXXXXX_H$	Prepares data read from USER1 location.
$00XXXX_H$	$92AAAA_H$	NOP instruction 0 sends 24-bit word out of SDO where the last 16 bits contain the contents of USER1 location. NOP command ensures device returns to idle power dissipation state.

Table IX. Reading Back Wiper Setting

SDI	SDO	Action
$B00200_H$	$XXXXXX_H$	Sets RDAC1 to midscale.
$C0XXXX_H$	$B00200_H$	Doubles RDAC1 from midscale to full scale.
$A0XXXX_H$	$C0XXXX_H$	Prepares reading wiper setting from RDAC1 register.
$XXXXXX_H$	$A003FF_H$	Reads back full-scale value from RDAC1 register.

APPLICATIONS

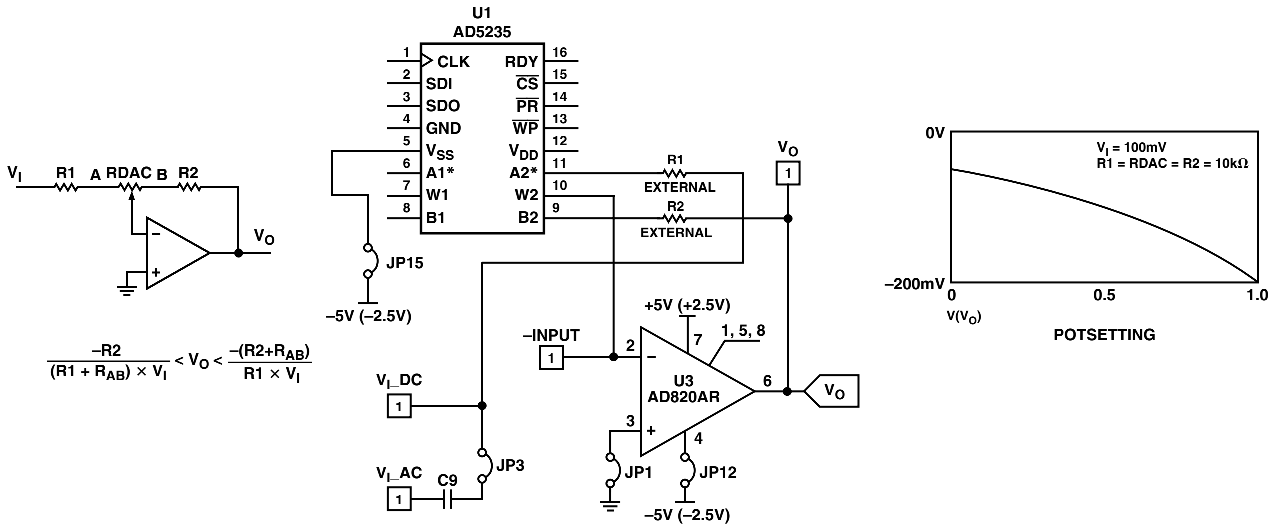


Figure 4. Inverting Gain and Attenuator

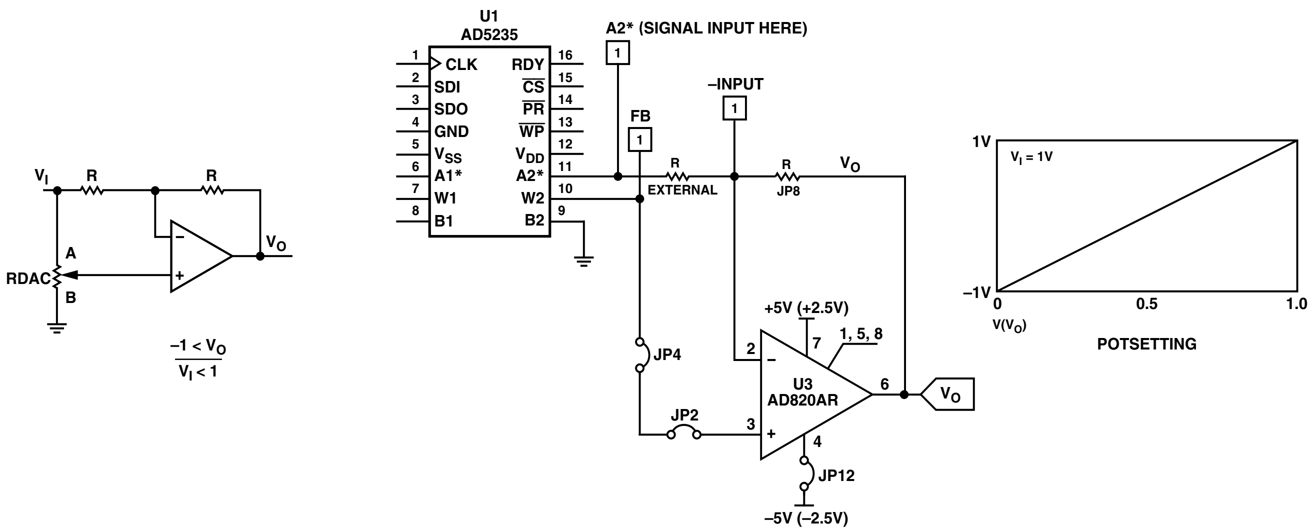


Figure 5. Bipolar Unity Gain Amplifier

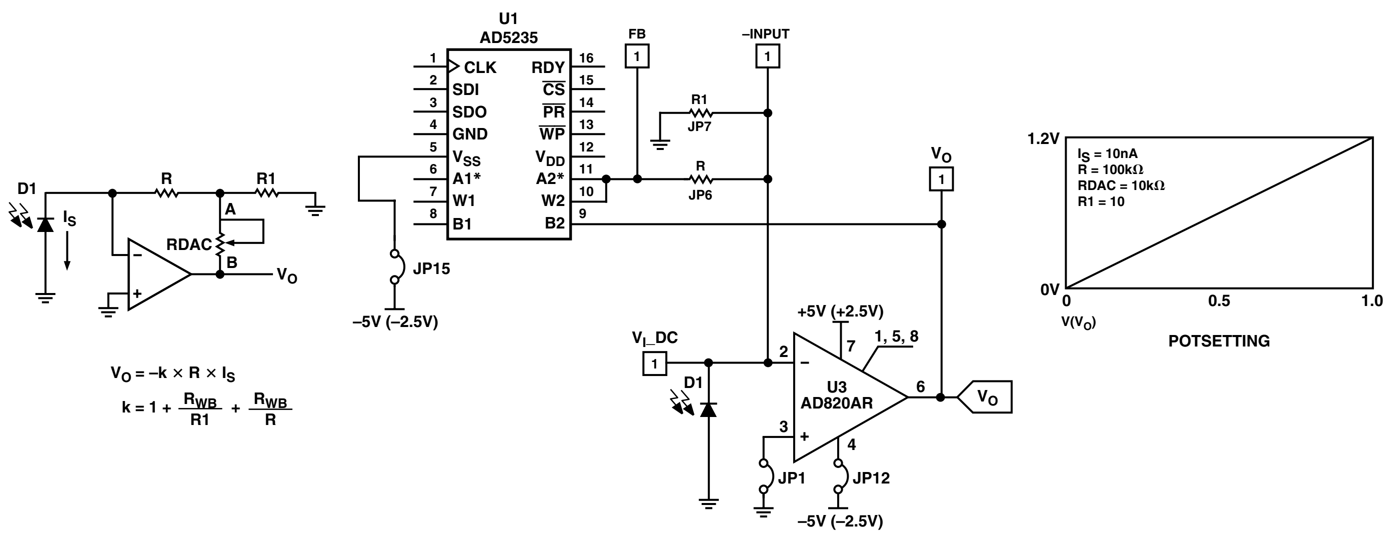


Figure 6. High Sensitivity I-V Coverter

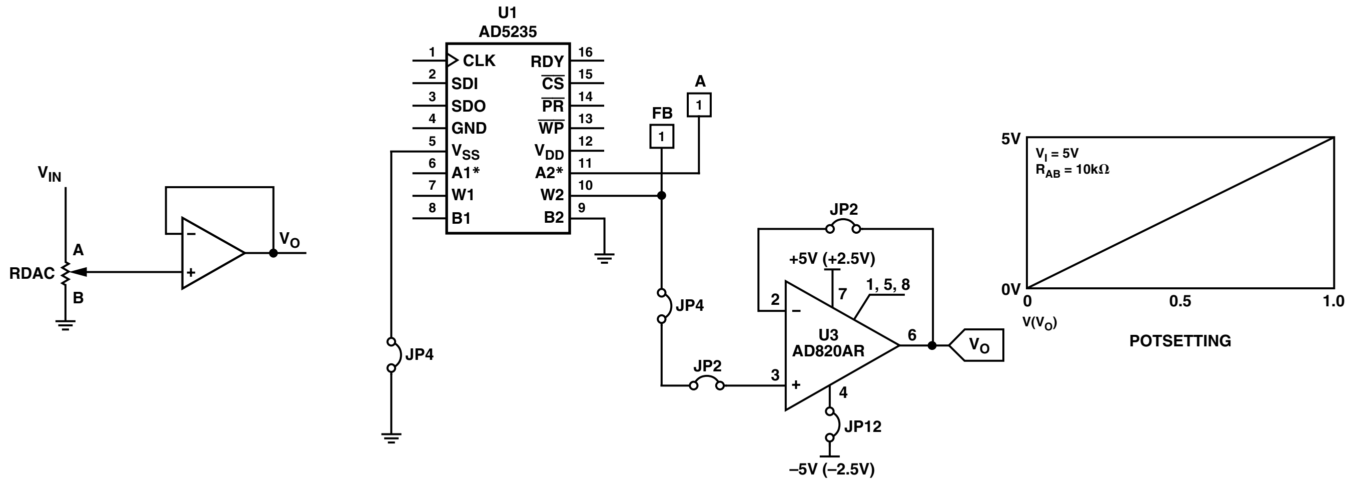


Figure 7. Buffered Output Voltage

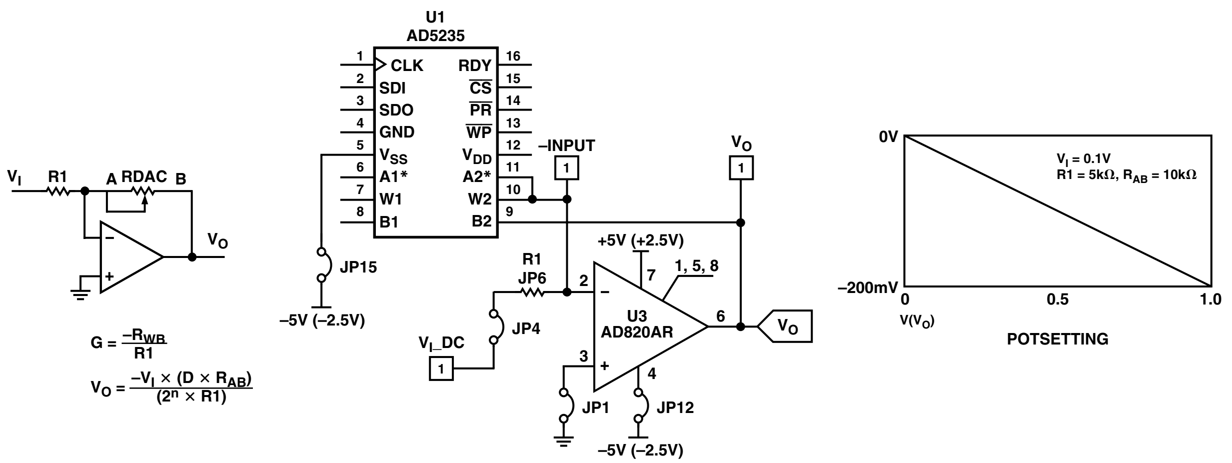


Figure 8. Inverting Linear Gain and Attenuator

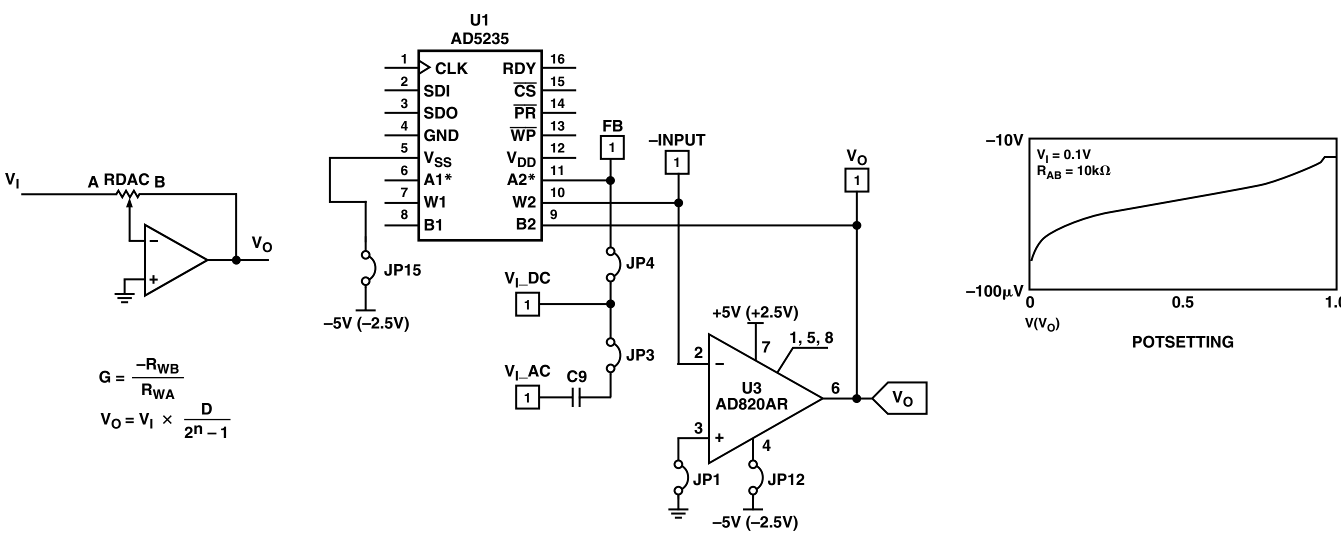


Figure 9. Inverting Quasi Log Gain and Attenuator

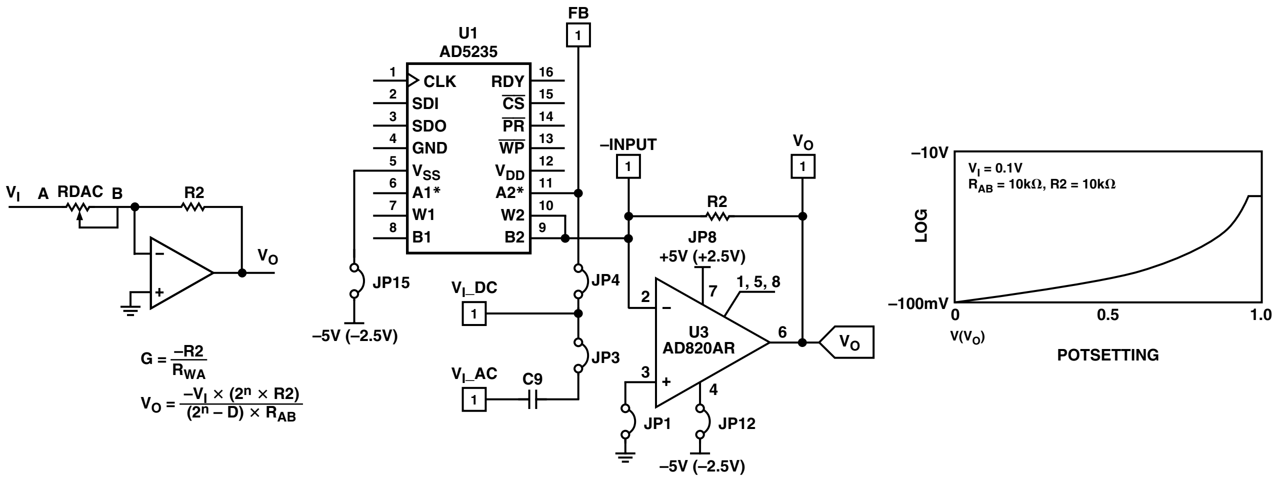


Figure 10. Inverting Exponential Gain and Attenuator

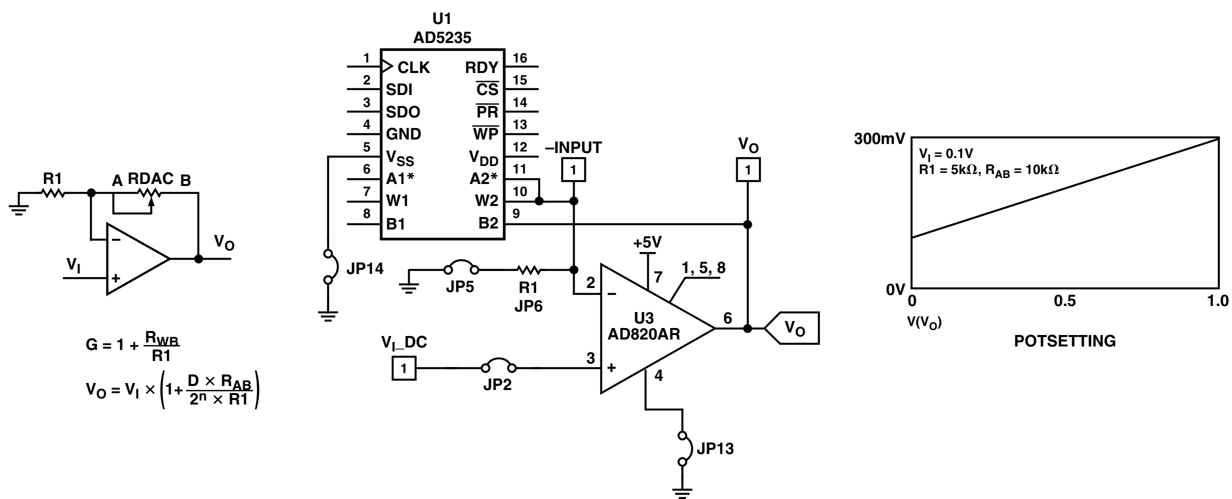


Figure 11. Noninverting Linear Gain

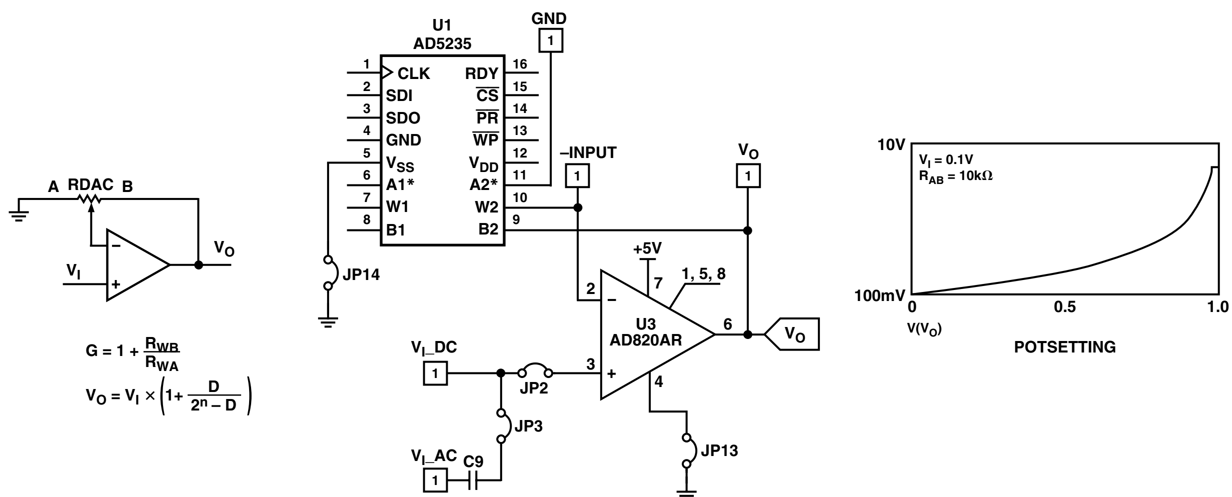


Figure 12. Noninverting Quasi Log Gain

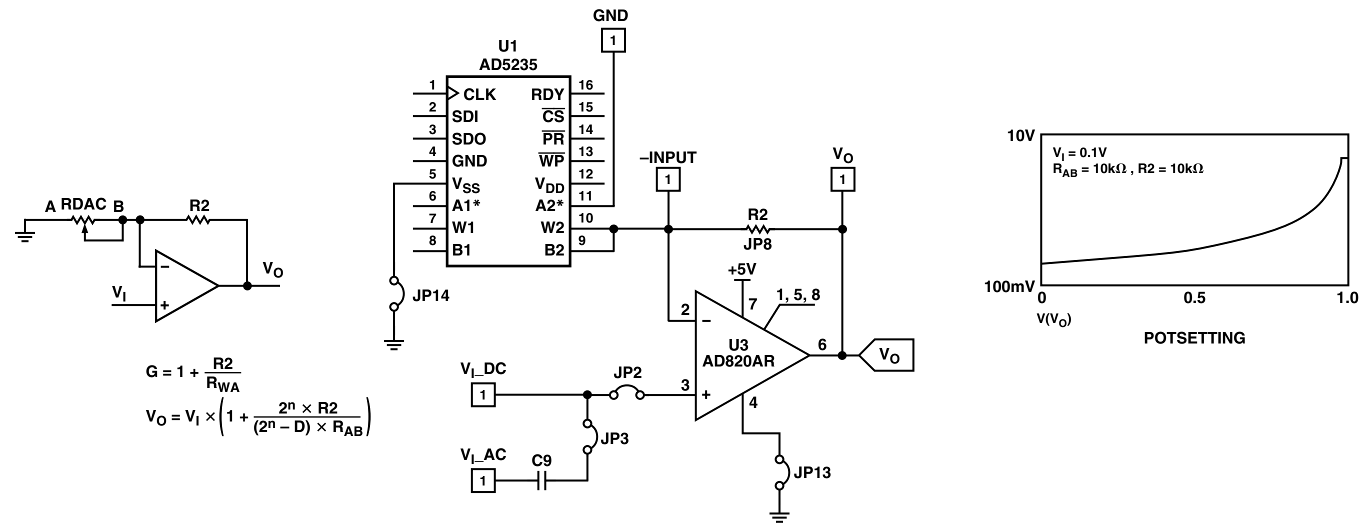


Figure 13. Noninverting Exponential Gain

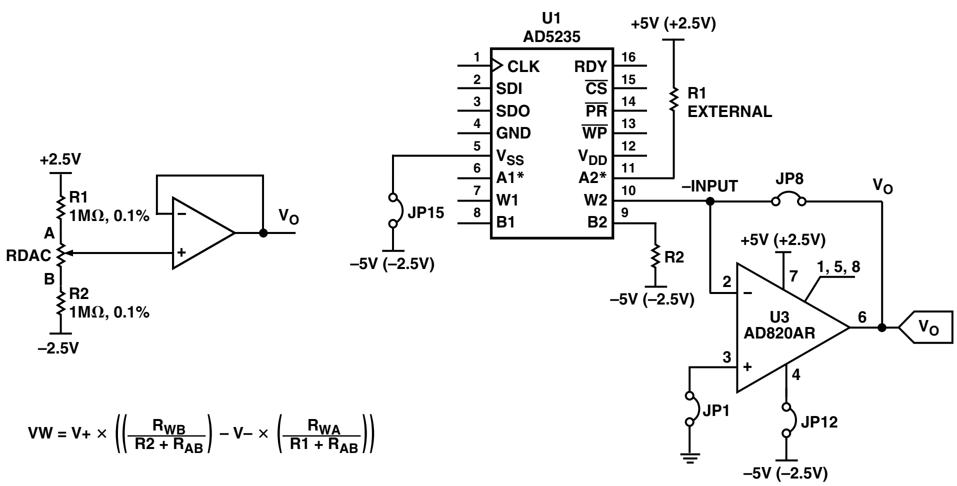


Figure 14. Ultrafine Adjustment

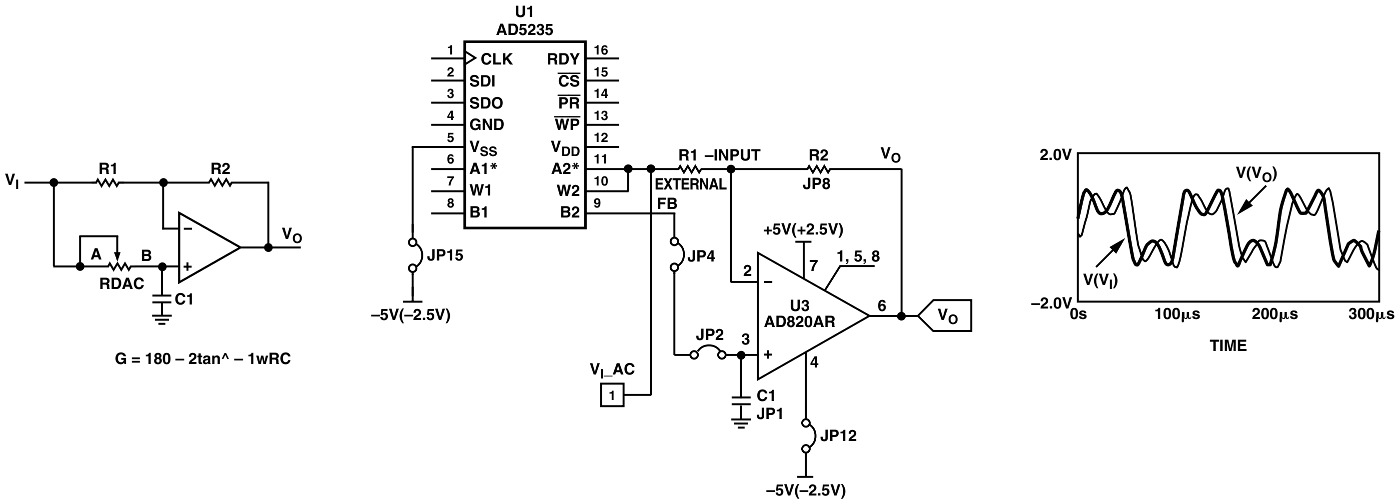


Figure 15. Phase Shifter

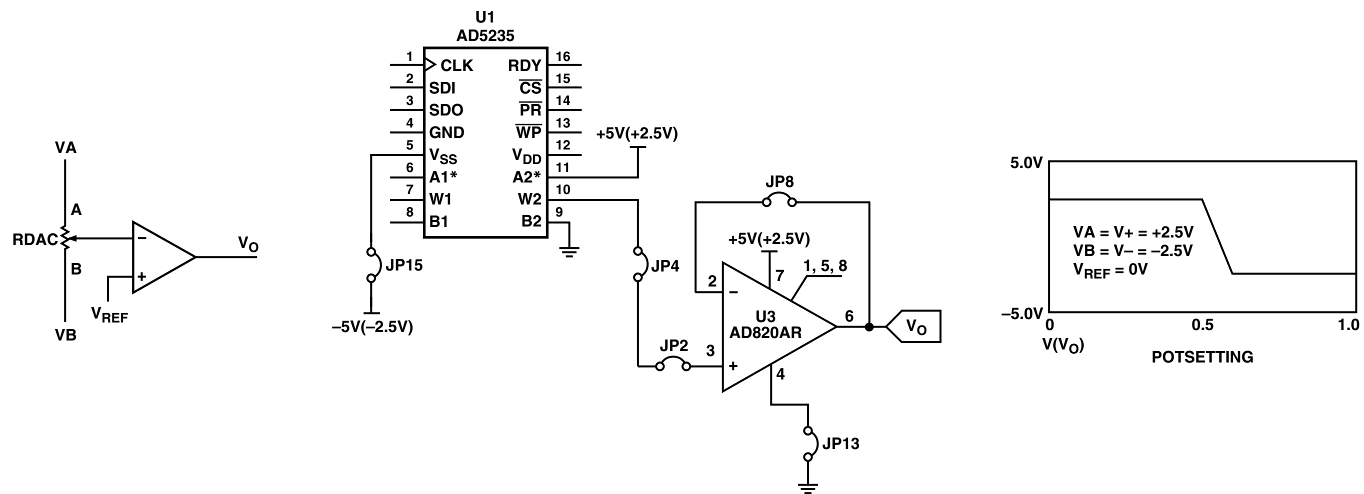


Figure 16. Level Detector

PCB LAYOUT

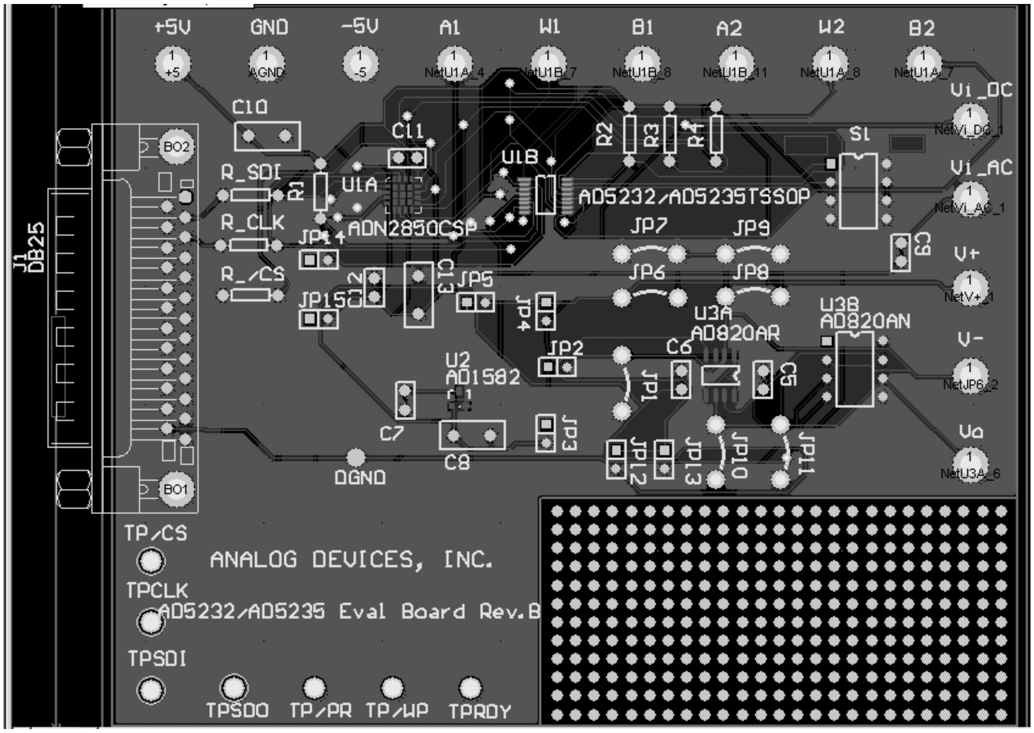


Figure 17. Evaluation Board PCB Layout

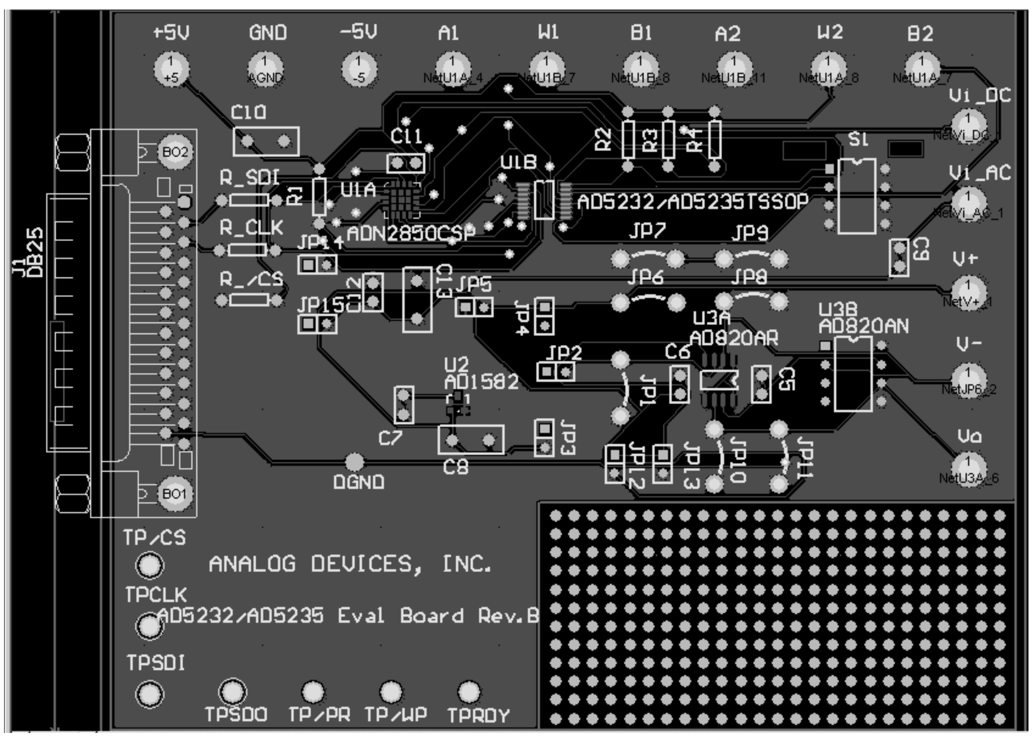


Figure 18. Top Layer

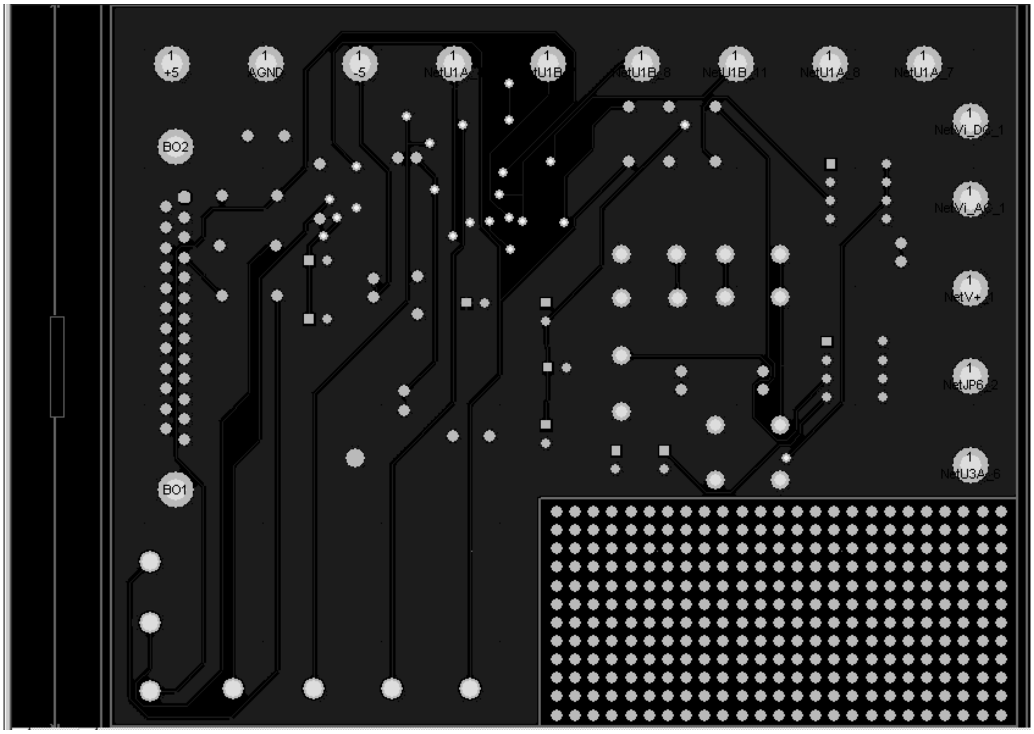


Figure 19. Bottom Layer

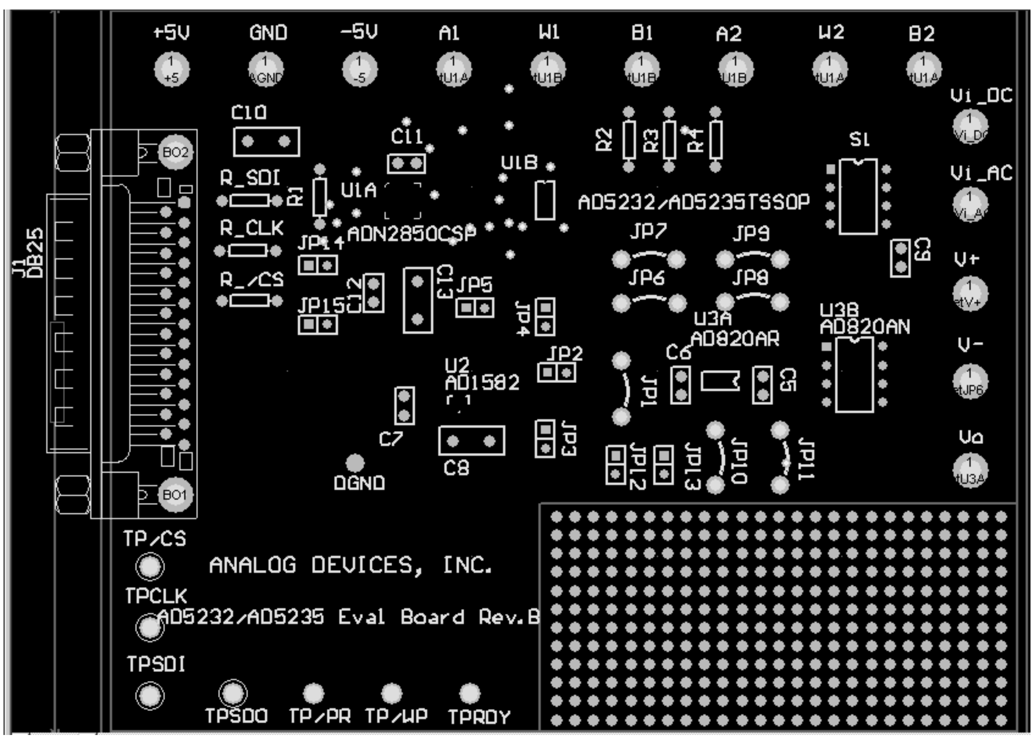


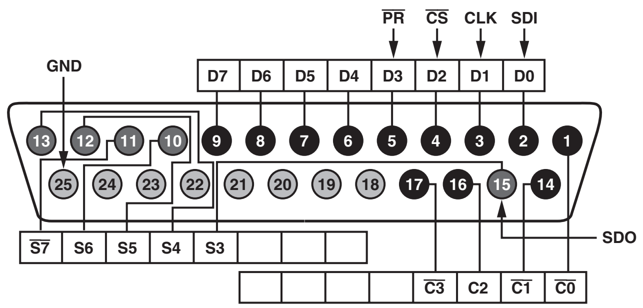
Figure 20. Top Overlay Silkscreen

PCB LAYOUT CONSIDERATIONS

To stabilize voltage supplies, bypass Pin +5 V and Pin –5 V with a 4.7 µF or 10 µF capacitor with proper polarities. Adding 0.1 µF decoupling capacitors, very close to the supply pins of the active component, can minimize high frequency noise as well.

Table X. PCB Parts List

Designator	Footprint	Comment
TPSDO	Test point 0.09	
TPCLK	Test point 0.09	
TPSDI	Test point 0.09	
TP/CS	Test point 0.09	
+5 V	Post pin 0.125	
GND	Post pin 0.125	
B1	Post pin 0.125	
W1	Post pin 0.125	
A1	Post pin 0.125	
V_I_DC	Post pin 0.125	
V_I_AC	Post pin 0.125	
C9	RAD 0.1	
A2	Post pin 0.125	
W2	Post pin 0.125	
B2	Post pin 0.125	
–5 V	Post pin 0.125	
VO	Post pin 0.125	
V–	Post pin 0.125	
V+	Post pin 0.125	
JP8	Jumper 0.3	
JP9	Jumper 0.3	
JP7	Jumper 0.3	
JP6	Jumper 0.3	
JP1	Jumper 0.3	
JP11	Jumper 0.3	
JP10	Jumper 0.3	
TPRDY	Test point 0.09	
TP/WP	Test point 0.09	
TP/PR	Test point 0.09	
DGND	DGNDPAD	
C12	RAD 0.1	0.1 µF
C7	RAD 0.1	0.1 µF
C11	RAD 0.1	0.1 µF
C6	RAD 0.1	0.1 µF
C5	RAD 0.1	0.1 µF
R_/CS	Axial 0.3	100 Ω
R_CLK	Axial 0.3	100 Ω
R_SDI	Axial 0.3	100 Ω
R4	Axial 0.3	10 kΩ
R3	Axial 0.3	10 kΩ
R2	Axial 0.3	10 kΩ
R1	Axial 0.3	1 kΩ
C8	RAD 0.2	1 µF
C13	RAD 0.2	4.7 µF
C10	RAD 0.2	4.7 µF
U2	SOT-23	AD1582
U1B	TSSOP-16	AD5235TSSOP
U1A	LFCSP-16 5 mm × 5 mm	ADN2850CSP
U3B	DIP8	AD820AN
U3A	SO-8	AD820AR
J1	DB25SL	DB25
JP15	SIP2	Header
JP14	SIP2	Header
JP5	SIP2	Header
JP3	SIP2	Header
JP2	SIP2	Header
JP4	SIP2	Header
JP12	SIP2	Header
JP13	SIP2	Header
S1	DIP8	SW-DIP4



NOTES
8 OUTPUT PINS ACCESSED VIA THE DATA PORT (NTPORT1.ADDRESS = 888)
5 INPUT PINS (1 INVERTED) ACCESSED VIA THE STATUS PORT (NTPORT1.ADDRESS = 889)
4 OUTPUT PINS (3 INVERTED) ACCESSED VIA THE CONTROL PORT (NTPORT1.ADDRESS = 890)
REMAINING 8 PINS ARE GROUNDED

Figure 21. Parallel Port Connector Configuration (For VB Program Developers Only)

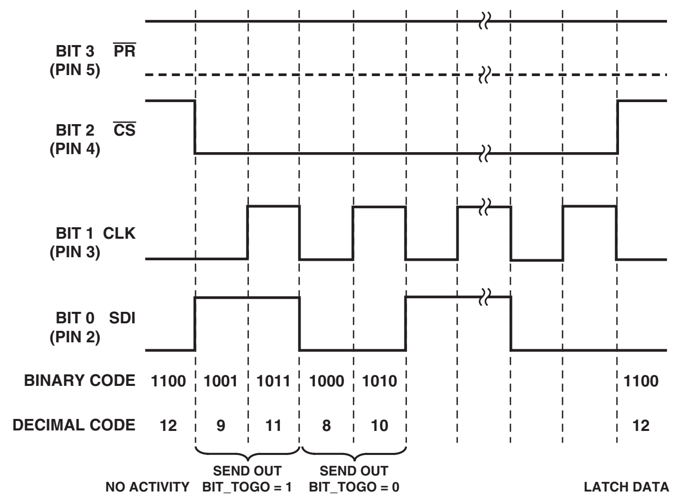


Figure 22. Timing Definition (For VB Program Developers Only)

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