Evaluation Board User Guide

EVAL-KW4503Z

ADA4510-2 Stability + LED Carrier KWIK Demo Board

General Description

The EVAL-KW4503Z is a know-how with integrated knowledge (KWIK) demonstration board designed to familiarize its users how to predict, measure, and simulate the stability and phase margin of an operational amplifier (op amp). It enables the stability analysis of the ADA4510-2 configured as a transimpedance amplifier (TIA) and a unity gain follower driving a capacitive load.

The EVAL-KW4503Z uses the ADA4510-2, which is a dual-channel, 40 V, high-precision, low input bias current, low offset voltage, low offset voltage drift, low noise, rail-to-rail input, and output operational amplifier that can be used at any point of the signal chain, including sensing, conditioning, and output drive. With the use of Analog Devices, Inc.'s proprietary DigiTrim™ technique, the ADA4510-2 achieves best-in-class low offset drift (±70 nV/°C typical, ±500 nV/°C maximum) and low offset voltage (±5 µV typical, ±20 µV maximum), simplifying temperature calibrations in precision designs. The ADA4510-2 is specified from −40°C to +85°C and −40°C to +125°C, and is available in an 8-lead, SOIC_N.

The EVAL-KW4503Z uses one channel of the ADA4510-2 for the TIA stability KWIK demo, which provides a hands-on platform allowing the user to select from three compensation options: a marginally stable design, a design with 45° phase margin, and a design with >70° of phase margin using the ADA4510 precision CMOS amplifier.

The EVAL-KW4503Z uses the other channel of the ADA4510-2 for the capacitive load stability KWIK demo, which provides a hands-on platform showing how to stabilize a precision, 10 MHz op amp driving a 1nF capacitive load.

Both the TIA demo and capacitive load demo are combined into a single, easy-to-use board that plugs directly into the ADALM2000. *Figure 1* and *Figure 2* show the top view and the bottom view of EVAL-KW4503Z, respectively.

Features

- Enables Stability Analysis of ADA4510-2 Configured as a TIA and a Unity Gain Follower Driving a Capacitive Load
- Easy Connection to ADALM2000

Applications

- Advanced Education

Evaluation Kit Contents

- EVAL-KW4503Z KWIK Demo Board (Main Board)
- EVAL-KW4503Z KWIK Demo Board (LED Carrier Board)
- 2-Shunt mini, close top, connector jumpers

Equipment Needed

- ADALM2000 Active Learning Module
- USB-A to Micro-USB Cable
- Computer with USB Port

Software Needed

- ADALM2000 Windows Drivers
- ADALM2000 Linux Drivers
- ADALM2000 Mac OS X Drivers
- libm2k library
- Scopy

Documents Needed

- ADA4510-2 Data sheet

One Analog Way, Wilmington, MA 01887-2356, U.S.A. | Tel: 781.329.4700

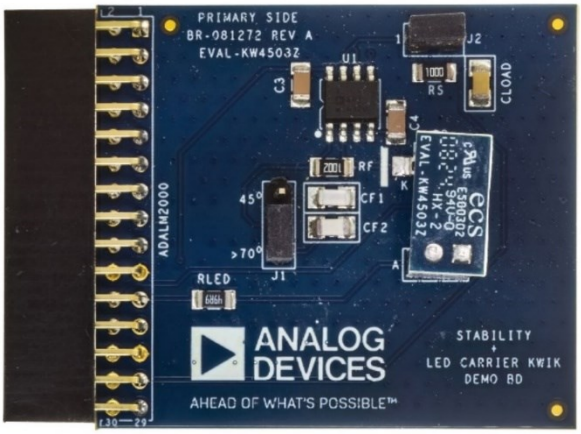

Figure 1. EVAL-KW4503Z Top View

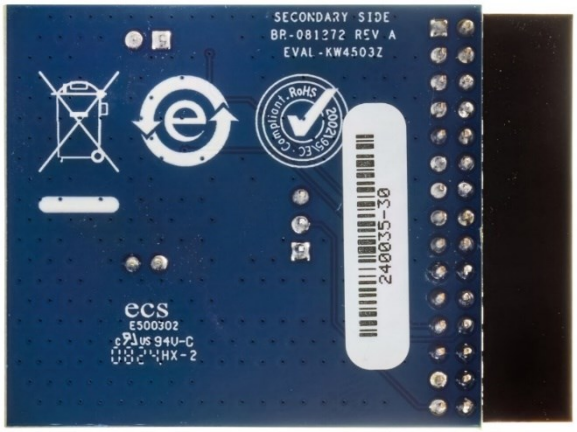

Figure 2. EVAL-KW4503Z Bottom View

Getting Started

1. Visual Inspection

Inspect the demonstration board. The top view of the board should look like *Figure 1* and the bottom view should look like *Figure 2*. The LED carrier board should also be placed on the LED socket by default as shown in *Figure 3*.

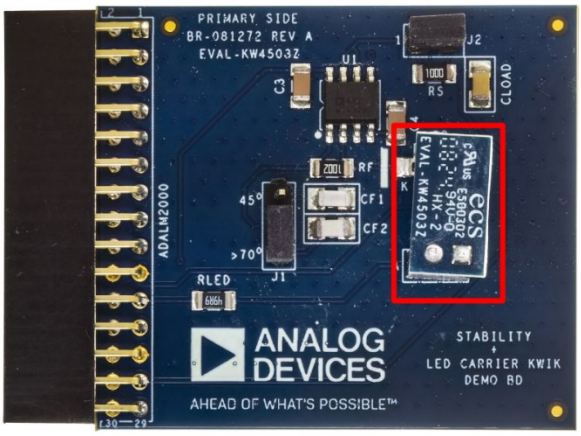

Figure 3. Placement of LED Carrier Board

2. Default Jumper Configuration

By default, the jumpers should be installed on J1 (>70° position) and J2 as shown in *Figure 4*.

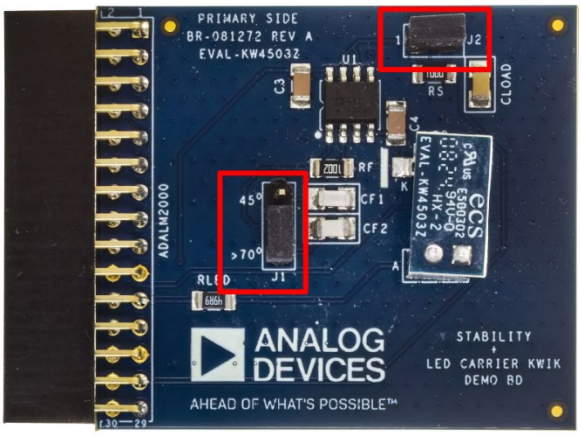

Figure 4. Default Jumper Configurations

3. Installing Scopy and the Required Device Drivers

If Scopy and the required device drivers are already installed on the user's PC, skip to the *Perform Board Tests* section. For a first-time installation of the Scopy software and the device drivers, follow these steps:

a. Go to the Wiki page *ADALM2000 for End Users [Analog Devices Wiki].*

b. Install the required device drivers by referring to point #3 (see *Figure 5*). Choose the proper version applicable for the operating system.

Figure 5. Installing Device Drivers

c. After installing the device drivers, go back to the wiki page, refer to point #9 (see *Figure 6*), and click *Scopy*. Upon clicking Scopy, it gets redirected to a new page where the user can download and install the version applicable for the operating system as shown in *Figure 7*. After installing Scopy, a system reboot is required.

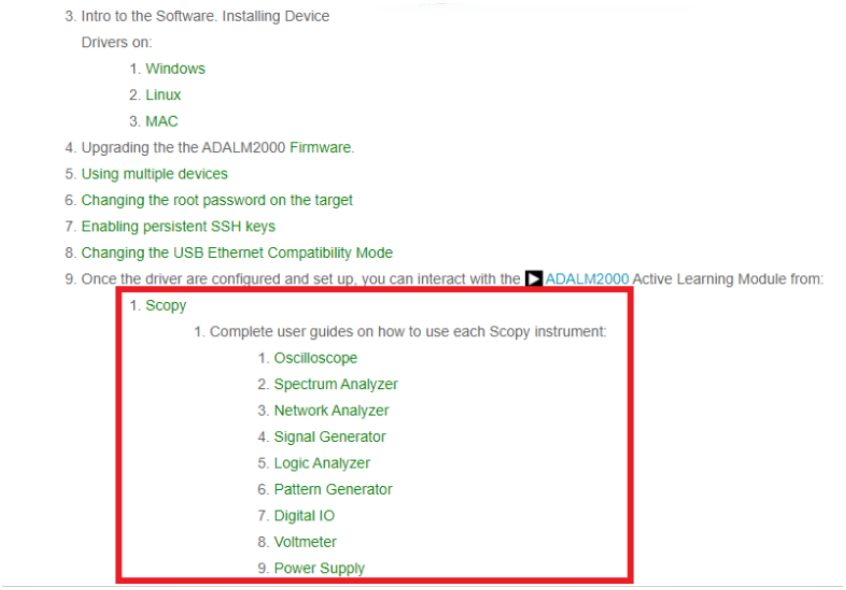

Figure 6. Installing Scopy

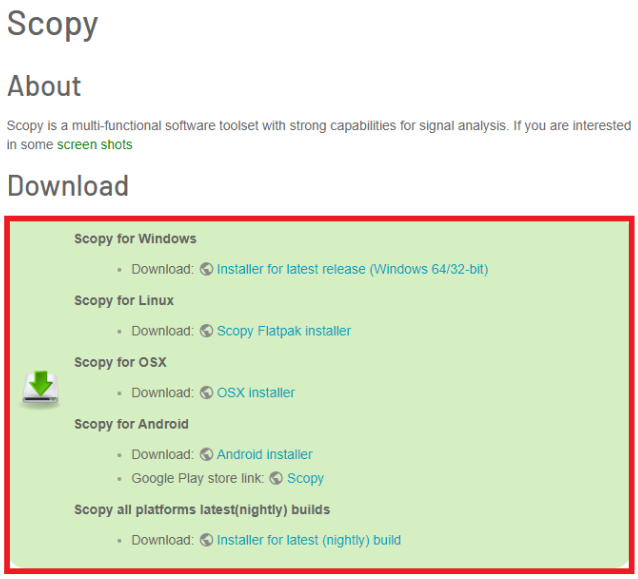

Figure 7. Different Versions of Scopy

d. After the successful installation of Scopy, install the *libm2k library*. The user can download and install different versions of the library on the page's **Download** section. Again, choose the proper version applicable for the operating system.

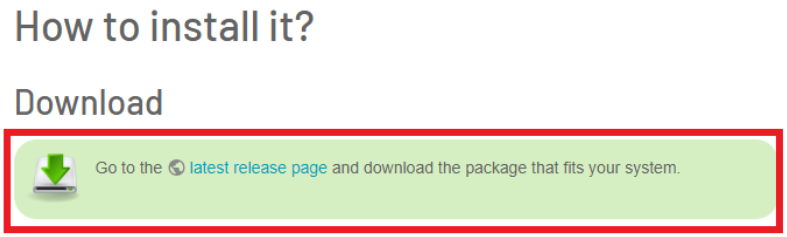

Figure 8. Installing the libm2k library

4. Perform Board Tests

General Instructions

a. Physically connect the ADALM2000 to the user computer's USB port using a USB-A to Micro-USB cable (see *Figure 9*).

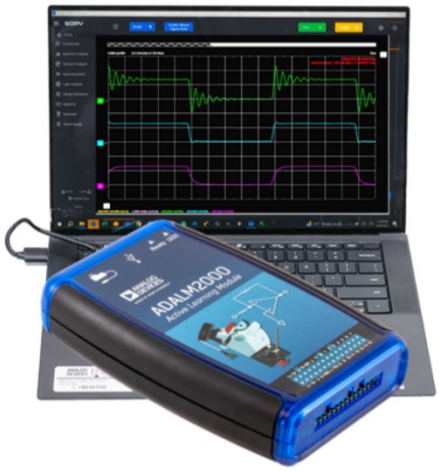

Figure 9. Connecting the ADALM2000 to the Computer

b. Launch the Scopy software from the computer. Click the **ADALM2000** icon in the **Devices** section as shown in *Figure 10*. If the icon is not showing, remove the USB cable from the computer's USB port and repeat Step a to ensure a proper physical connection.

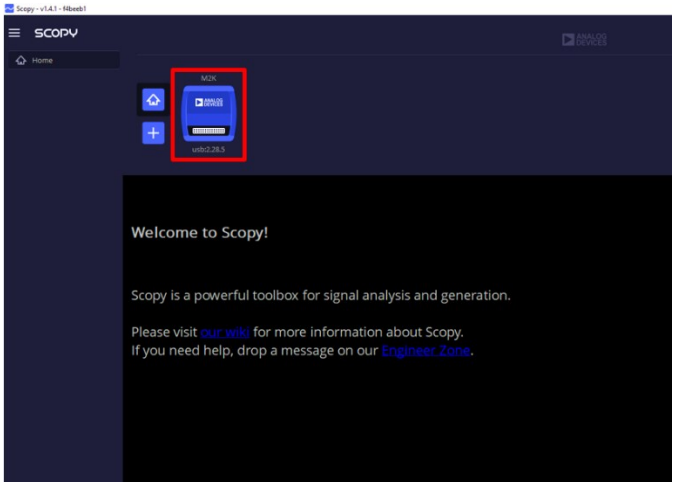

Figure 10. ADALM2000 Icon in the Devices Section

c. To connect to the ADALM2000, click the **Connect** button in the **Information Window** (see *Figure 11*). If the connection is established, the device has a green status line under it and the user is able to disconnect it from the same **Information Window** as shown in *Figure 12*.

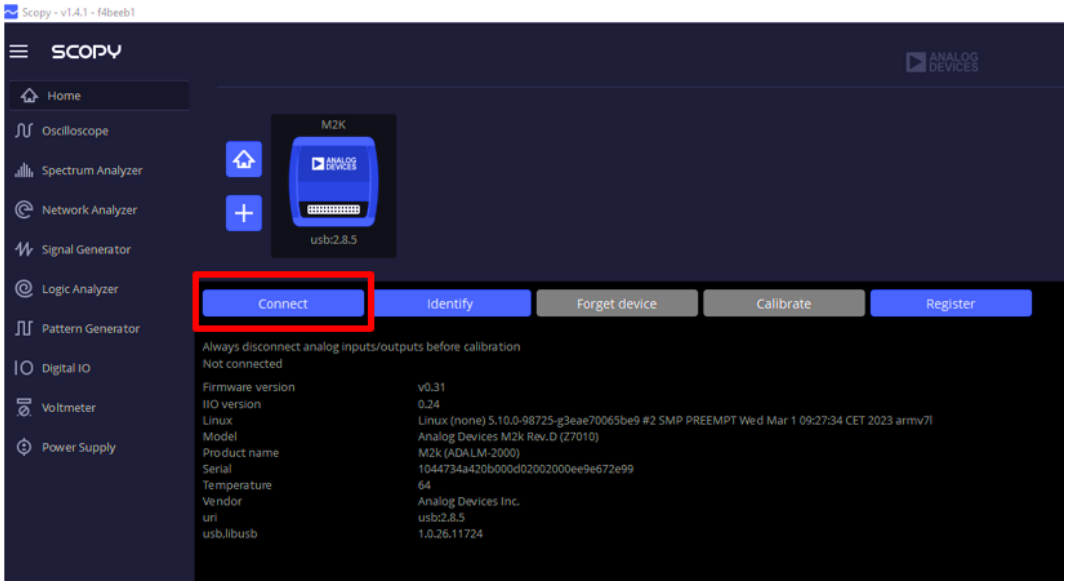

Figure 11. Connecting to ADALM2000

Figure 12. Successful Connection to ADALM2000

d. Install the LED carrier board on the Main board's **LED socket** as shown in *Figure 3*. Make sure that the LED from the LED carrier board is above the Main board's photodiode. The jumpers should be configured by default as stated in the *Default Jumper Configuration* section and *Figure 4*. Lastly, carefully align the pins of the Main board's ADALM2000 connector and insert it firmly in the ADALM2000 as shown in *Figure 13*.

Figure 13. Connecting EVAL-KW4503Z to the ADALM2000 through the ADALM2000 Connector

Part 1. Transimpedance Amplifier Stability KWIK Demo

For this demo, keep the setup away from too much light. It would be best if the setup is placed in an environment with minimal ambient lighting so that the photodiode from the main board could only detect the light from the LED carrier board. Also, keep the boards away from moving air and hot air.

1. After following the general instructions, configure the power supply, signal generator, and oscilloscope on Scopy. To manually configure the power supply, click **Power Supply** from the **Instruments Menu**. Afterwards, set a **+5V** output on the **Positive output** section and a **-5V** output on the **Negative output** section as shown in *Figure 14*.

Figure 14. Setting the Supply Voltages in Scopy for the TIA Stability Demo

2. After the supply voltages have been configured, click **Signal Generator** from the **Instruments Menu** to set the signal to be applied. Click **CH 1** (Channel 1) first on the bottom left corner of the GUI and set a **50kHz, 5Vpp square wave signal with an offset of 2.5V and a duty cycle of 50%** as shown in *Figure 15*.

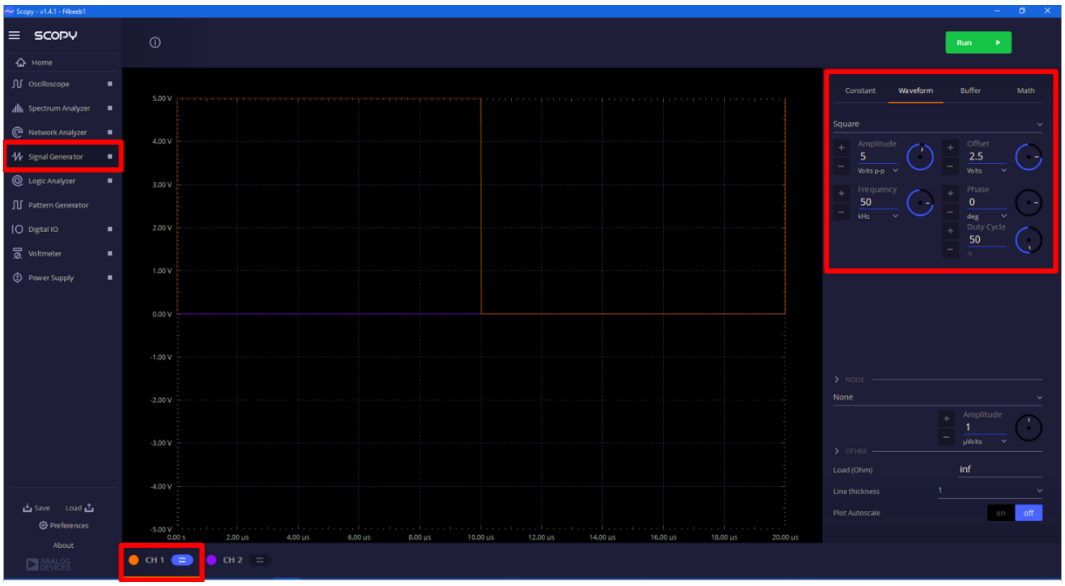

Figure 15. Channel 1 Signal Configuration for the TIA Stability Demo

Afterwards, click **CH 2** (Channel 2) from *Figure 15*. Set a **constant voltage of 0mV** for Channel 2 as shown in *Figure 16*.

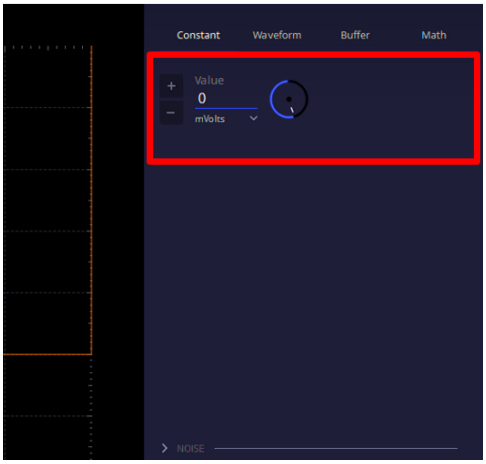

Figure 16. Channel 2 Signal Configuration for the TIA Stability Demo

3. Configure the oscilloscope next. Click **Oscilloscope** from the **Instruments Menu** and then click **CH 1** (Channel 1) on the bottom left corner of the GUI. For the Channel 1 settings, set the following:

Horizontal Settings

- **Time Base: 2µs**
- **Position: -4µs**

Vertical Settings

- **Volts/Div: 200mV**
- **Position: 0mV**

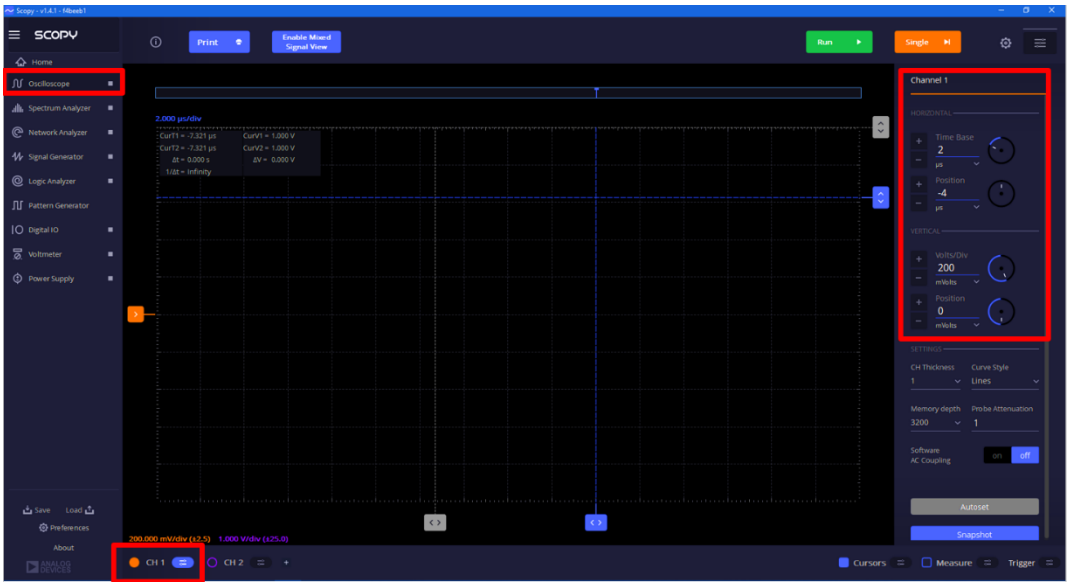

Figure 17. Oscilloscope Channel 1 Settings for the TIA Stability Demo

4. **Remove** the jumper installed on **J1 (Main board).** This configures the operational amplifier as a TIA without a compensation or feedback capacitor. **Enable/Turn** on the power supply, signal generator, and oscilloscope on Scopy in order by clicking the **triangle buttons** on the **Instruments Menu** as shown in *Figure 18*. After this, the LED on the LED carrier board should be visibly glowing **RED**, and, on the oscilloscope's Channel 1, a waveform similar to what is shown in *Figure 18* should be observed.

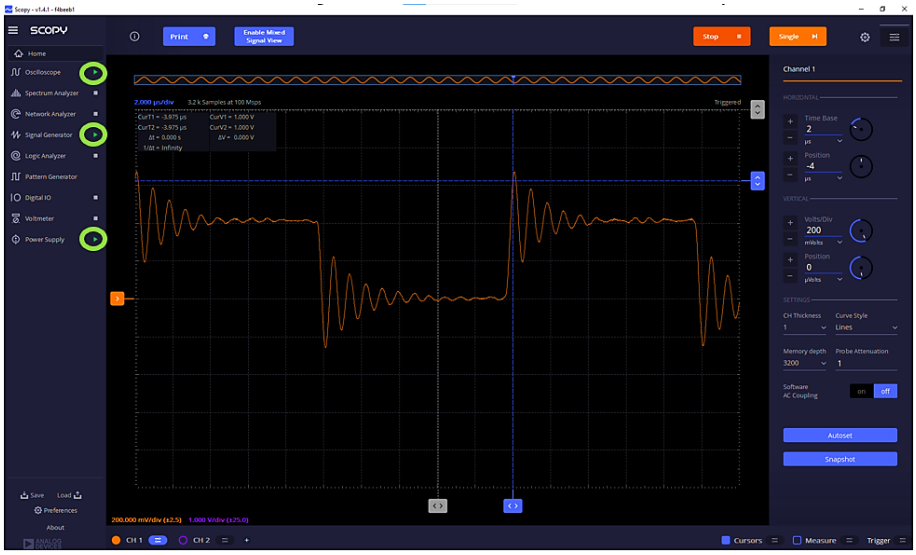

Figure 18. Expected Channel 1 Output Waveform – J1 Jumper Removed

5. Install the **J1 jumper** and place it on the **45° position.** By placing the J1 jumper on the 45° position, it configures the operational amplifier as a TIA with a 15 pF compensation or feedback capacitor. The LED on the LED carrier board should still be glowing **RED** and a waveform similar to what is shown in *Figure 19* should be observed. Also, adjust the trigger level as needed, as shown in the figure.

Figure 19. Expected Channel 1 Output Waveform – J1 Jumper Installed at the 45° Position

6. Next, place the **J1 jumper** on the **>70° position**. By placing the J1 jumper on the >70° position, it configures the operational amplifier as a TIA with a 47 pF compensation or feedback capacitor. The LED on the LED carrier board should still be glowing **RED** and a waveform similar to what is shown in *Figure 20* should be observed.

Figure 20. Expected Channel 1 Output Waveform – J1 Jumper installed at the >70° position

Part 2. Capacitive Load Stability KWIK Demo

For this demo, keep the setup away from moving air and hot air.

1. Manually configure the power supply, signal generator, and oscilloscope on Scopy. To manually configure the power supply, click **Power Supply** from the **Instruments Menu.** Afterwards, set a **+5V** output on the **Positive output** section and a **-5V output** on the **Negative output** section as shown in *Figure 21*.

Figure 21. Setting the Supply Voltages in Scopy for the Capacitive Load Stability Demo

2. After the supply voltages have been configured, click **Signal Generator** from the **Instruments Menu** to set the signal to be applied. Click **CH 1** (Channel 1) first on the bottom left corner of the GUI and set a **250kHz, 100mVpp square wave signal with an offset of 200mV and a duty cycle of 50%** as shown in *Figure 22*.

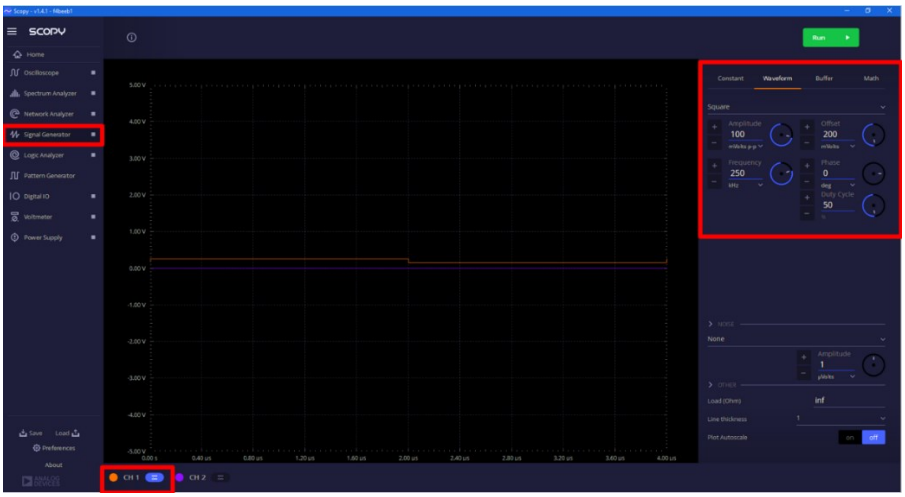

Figure 22. Channel 1 Signal Configuration for the Capacitive Load Stability Demo

Afterwards, click **CH 2** (Channel 2) as shown in *Figure 22*. Set a **constant voltage of 0mV** for Channel 2 as shown in *Figure 23*.

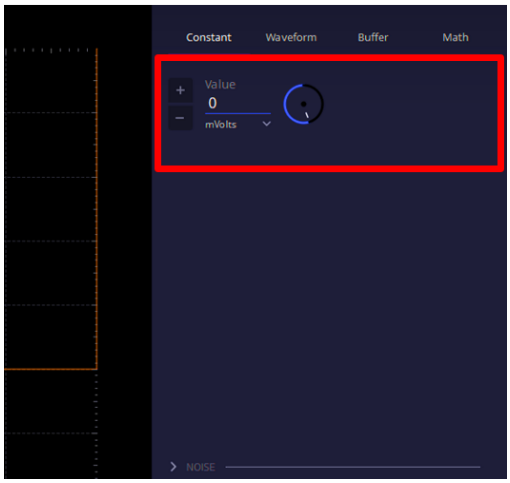

Figure 23. Channel 2 Signal Configuration for the Capacitive Load Stability Demo

3. Configure the oscilloscope next. Click **Oscilloscope** from the **Instruments Menu** and then click **CH 2** (Channel 2) on the bottom left corner of the GUI. For the Channel 2 settings, set the following:

Horizontal Settings

- **Time Base: 1µs**
- **Position: -4µs**

Vertical Settings

- **Volts/Div: 100mV**
- **Position: 0mV**

Figure 24. Oscilloscope Channel 2 Settings for the Capacitive Load Stability Demo

4. **Keep** the jumper installed on **J2 (Main board)**. **Enable/Turn** on the power supply, signal generator, and oscilloscope on Scopy in order by clicking the **triangle buttons** on the **Instruments Menu** as shown in *Figure 25*. The LED on the LED carrier board should **NOT** be glowing red, and, on the oscilloscope's Channel 2, a waveform similar to what is shown in *Figure 25* should be observed. This shows the effect of driving a 1 nF capacitive load without a compensation resistor Rs.

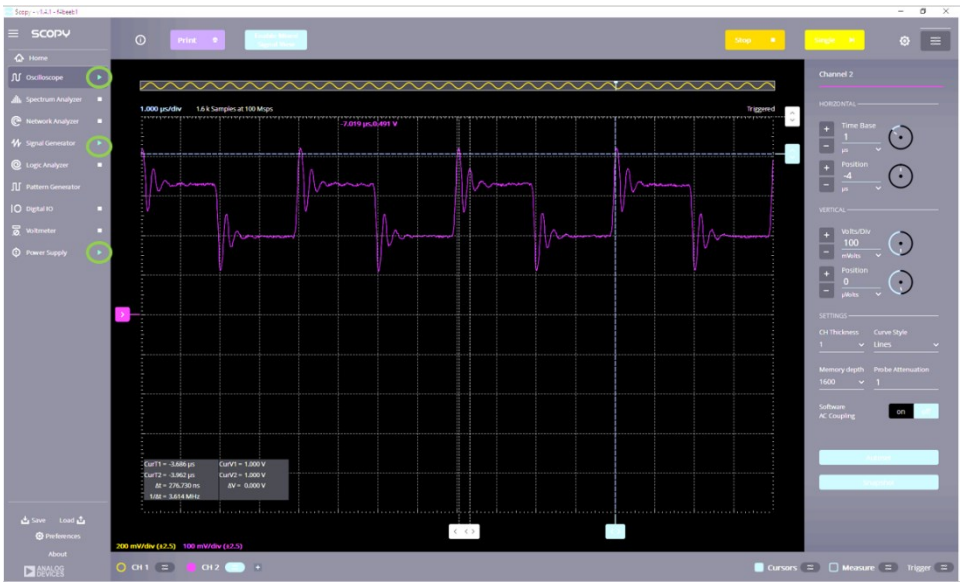

Figure 25. Expected Channel 2 Output Waveform – J2 Jumper Installed

5. **Remove** the jumper on **J2 (Main Board).** The LED on the LED carrier board should **NOT** be glowing red, and, on the oscilloscope's Channel 2, a waveform similar to what is shown in *Figure 26* should be observed. This shows the effect of driving a 1 nF capacitive load with a 100-Ω compensation resistor Rs.

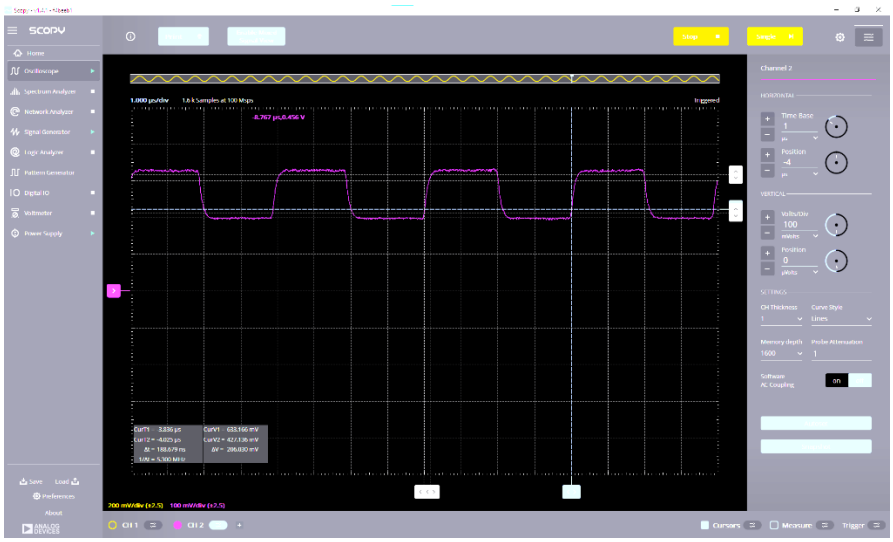

Figure 26. Expected Channel 2 Output Waveform – J2 Jumper Removed

EVAL-KW4503Z Schematic

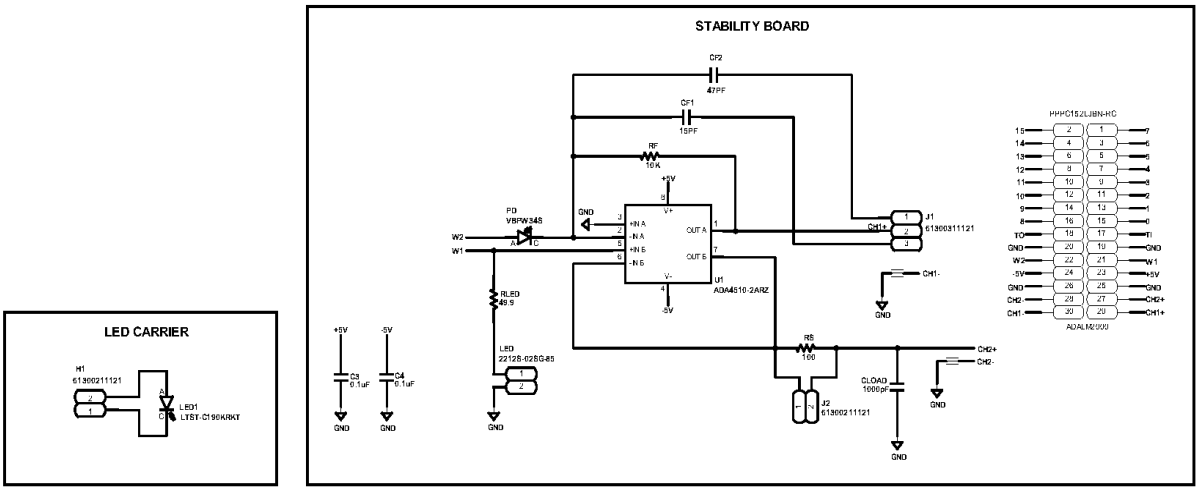

Figure 27. EVAL-KW4503Z Schematic Diagram

Bill of Materials

Item	Quantity	Reference Designator	Part Description	Manufacturer	Manufacturer Part Number
1	1	U1	IC-ADI PRECISION, RAIL-TO-RAIL INPUT AND OUTPUT OP AMP WITH DIGITRIM	ANALOG DEVICES	ADA4510-2ARZ
2	2	C3, C4	CAP CER 0.1µF 50V 10% X7R 1206	YAGEO	CC1206KRX7R9BB104
3	1	CF1	CAP CER 15PF 50V 5% C0G 1206	KEMET	C1206C150J5GAC7800
4	1	CF2	CAP CER 47PF 50V 5% X7R C0G/NP0 1206	KYOCERA	KGM31BCG1H470JT
5	1	CLOAD	CAP CER 1000pF 50V 10% X7R 1206	YAGEO	CC1206KRX7R9BB102
6	1	LED1	DIO LED RED 639NM 2LD 0603	LITE-ON TECHNOLOGY	LTST-C190KRKT
7	1	PD	PHOTODIODE SILICON PIN 940NM	VISHAY	VBPW34S
8	1	RF	RES SMD 10KΩ 1% 1/4W 1206	YAGEO	RC1206FR-0710KL
9	1	RLED	RES SMD 49.9Ω 0.1% 1/3W 1206 AEC-Q200	STACKPOLE ELECTRONICS, INC.	RNCF1206BTE49R9
10	1	RS	RES SMD 100Ω 1% 1/4W 1206	YAGEO	RC1206FR-07100RL
11	1	ADALM2000	CONN-PCB 30POS SOCKET STRIP F 2.54MM SOLDER RA THRU-HOLE	SULLINS	PPPC152LJBN-RC
12	2	H1, J2	CONN-PCB 2POS HEADER VERT 2.54MM PITCH	WURTH ELEKTRONIK	61300211121
13	1	J1	CONN-PCB UNSHROUDED HDR, 6MM	WURTH ELEKTRONIK	61300311121

			POST HEIGHT, 2.54MM PITCH		
14	1	LED	CONN-PCB SOCKET DOUBLE ROW ST 2WAY	MULTICOMP COMPANY	2212S-02SG-85
15	2		SHUNT MINI, CLOSE TOP, CONN JUMPER SHORTING	SULLINS	SPC02SYAN

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGE NUMBER
0	8/24	Initial Release	—

Notes