Evaluation Board User Guide

EVAL-KW4504Z

Op Amp DC Test Loop KWIK Demo Board

Feature and Benefits

- Enables quick and easy measurement of the DC parameters of an operational amplifier (op amp)
- Accommodates other single-channel, op amps in 5-lead SOT-23 packages with the same pin configuration as the device under test (DUT) and single-channel, op amps in 8-lead small outline integrated circuit (SOIC) (via IC socket) packages
- Easy connection to *ADALM2000*

Evaluation Kit Contents

- EVAL-KW4504Z evaluation board
- Optional IC socket for SOP8/SO8/SOIC8 package
- 4-position shunt connector, open top jumpers

Equipment Needed

- ADALM2000 active learning module
- USB-A to micro-USB cable
- Computer with USB port

Software Needed

- *ADALM2000* Windows Drivers
- *Libm2k* library
- LabVIEW Runtime Engine (to download the software, go to the national instruments corp. website)
- *EVAL-KW4504Z - Two Opamp DC Test Loop KWIK Demo* executable file

Documents Needed

- *AD8601* data sheet
- *Two Op Amp DC Test Loop KWIK Demo (Wiki)*
- *ADALM2000* user guide

Applications

- Advance education

General Description

The EVAL-KW4504Z is a know-how with integrated knowledge (KWIK) demonstration board designed to educate users on how to evaluate and measure the DC parameters of an op amp, including the input offset voltage (V_{OS}), power supply rejection ratio (PSRR), common-mode rejection ratio (CMRR), and open-loop gain (A_{OL}). It also has the capability to measure and plot the relationship between the input offset voltage vs. common-mode voltage (V_{OS} vs. CMV), input offset voltage vs. power supply voltage (V_{OS} vs. V_S), and input offset voltage vs. output voltage (V_{OS} vs. V_{OUT}).

Input offset voltage (V_{OS}) is the amount of input differential voltage applied between the +IN and −IN terminals of the op amp required to force the output voltage to zero volts.

Power supply rejection ration (PSRR) is the change in input offset voltage as a result of a change in total power supply voltage.

Common-mode rejection ratio (CMRR) is generally defined as the ratio of the differential gain and the common-mode gain. It can also be expressed as the change in input offset voltage as a result of a change in input common-mode voltage.

The open-loop gain (A_{OL}) is the gain of the amplifier without the feedback loop being closed, hence the name open-loop. It can be expressed as the change in input offset voltage as a result of a change in output voltage.

By default, EVAL-KW4504Z uses AD8601 as its DUT. The AD8601 is a single channel, rail-to-rail, input and output, single-supply amplifier featuring a very low offset voltage and a wide signal bandwidth. This amplifier uses a new, patented trimming technique that achieves superior performance without laser trimming. It is fully specified to operate on a 3V to 5V single supply. In addition, the AD8601 is specified over the extended industrial (−40°C to +125°C) temperature range and is available in a tiny, 5-lead SOT-23 package.

The EVAL-KW4504Z can accommodate other single-channel operational amplifiers in 5-lead SOT-23 packages with the same pin configuration as the DUT. It can also accommodate single-channel operational amplifiers in 8-lead SOIC packages by installing the IC socket on the board. This enables its users to quickly test and evaluate the DC parameters of other operational amplifiers aside from AD8601. *Figure 1* and *Figure 2* show the top and bottom view of the EVAL-KW4504Z, respectively.

***Ordering Information* appears at end of data sheet.**

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

Evaluation Kit Photographs

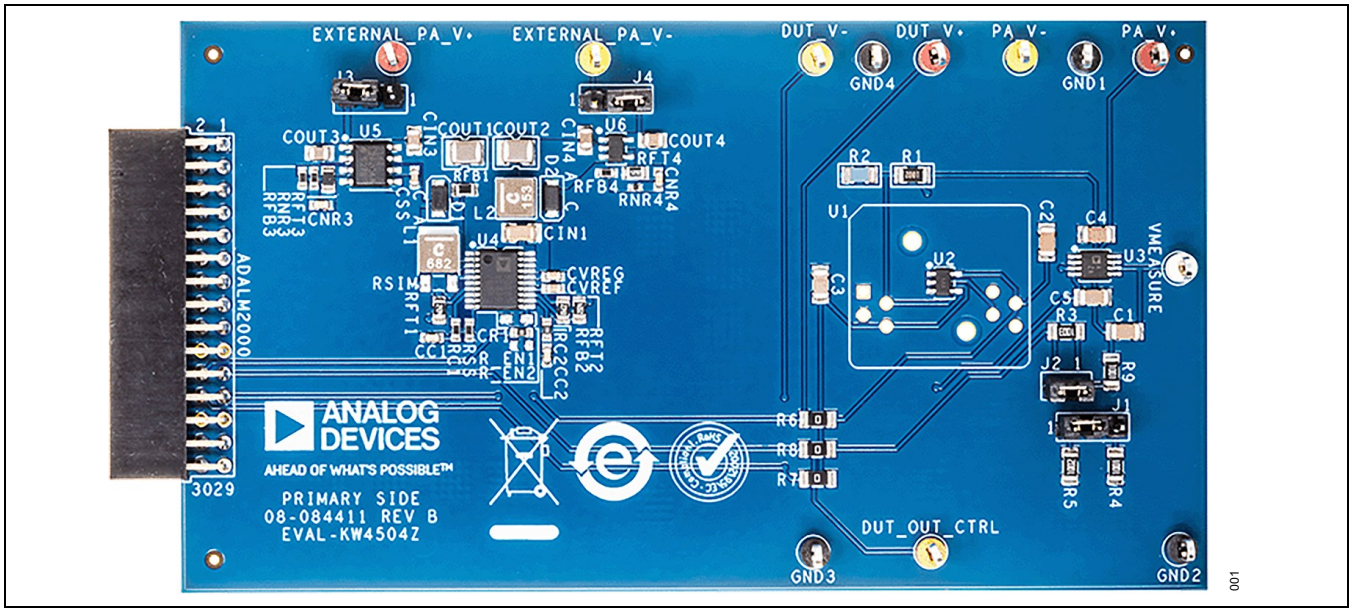

Figure 1. EVAL-KW4504Z, Top View

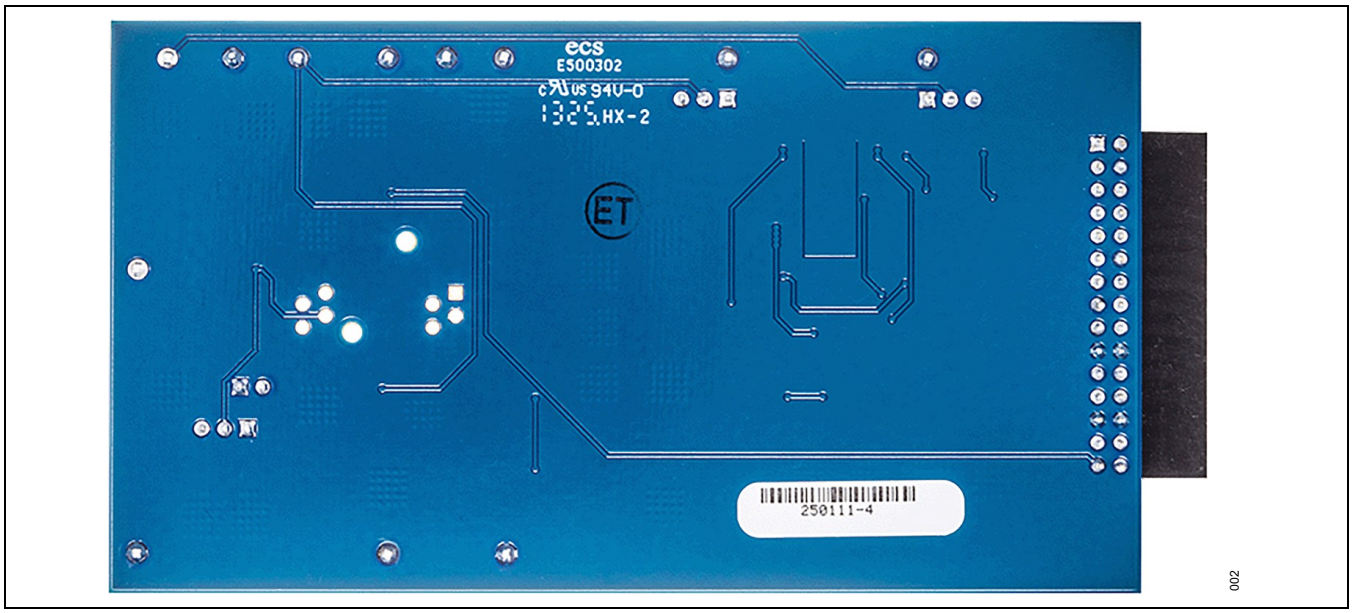

Figure 2. EVAL-KW4504Z, Bottom View

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Getting Started

Default Jumper Configuration

By default, the jumpers must be installed on J1, J2, J3, and J4, as shown in *Figure 3*.

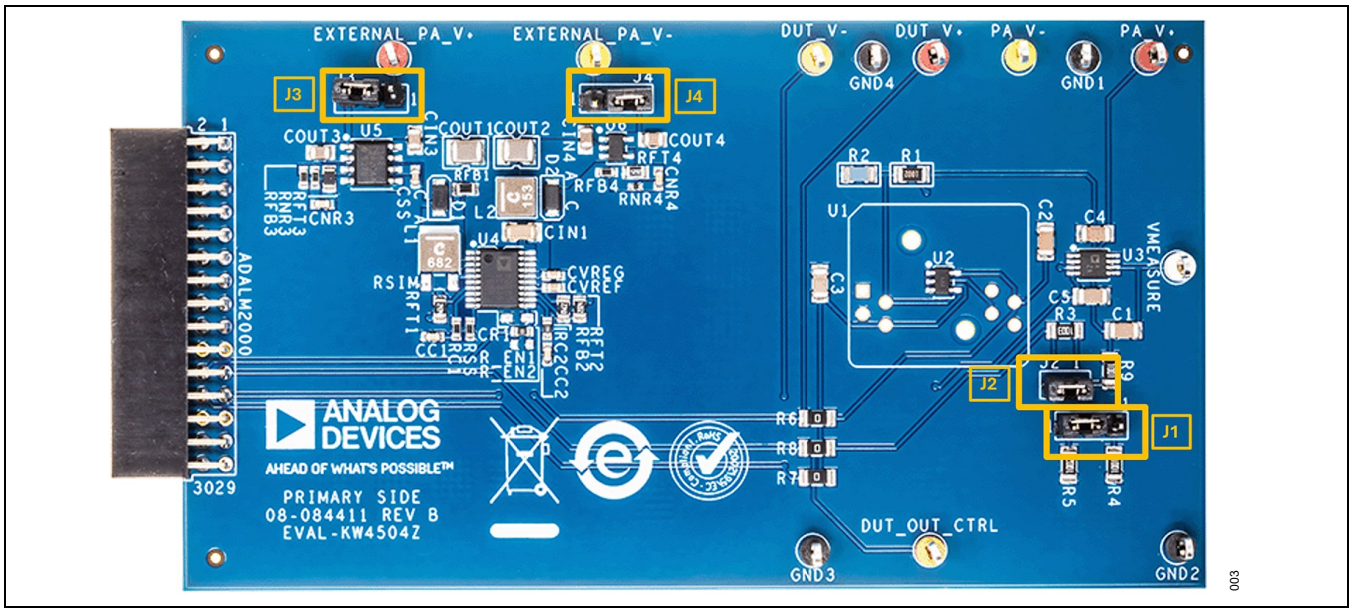


Figure 3. Default Jumper Configurations

Table 1. Jumper Connection Guide

JUMPER	DESCRIPTION	DEFAULT CONNECTION
J1	Jumper-Configurable Load Resistor.	**Left (R5 = 10kΩ)**, Right (R4 = 1kΩ)
J2	Configurable Resistor to Control DUT's Output.	**Installed (R3 = 0Ω)**, Not Installed (R3 = 100kΩ)
J3	Configurable Positive Supply Voltage Source (PA_V+) for U3.	**Left (Connected to Power Management Circuit via LDO_POS)**, Right (Connected to External Voltage Source)
J4	Configurable Negative Supply Voltage Source (PA_V−) for U3.	Left (Connected to External Voltage Source), **Right (Connected to Power Management Circuit via LDO_NEG)**

*Default options are in **bold**.*

Software and Hardware Integration

To use the EVAL-KW4504Z, download the EVAL-KW4504Z - Two Opamp DC Test Loop KWIK Demo executable file from the evaluation board wiki page (*Two Op Amp DC Test Loop KWIK Demo (Wiki)*). To open and run the executable file, install the required device drivers, the libM2k library, and the LabVIEW Runtime Engine.

For a first-time installation, proceed to the *Software Installation* section. If the prerequisites of the executable file are already installed, do the following next steps:

1. Freshly connect the *ADALM2000* to the computer's USB port by using the provided USB cable. If the ADALM2000 is already plugged into the computer, remove and plug it again. Freshly plug the ADALM2000 in the computer by the time of opening the EVAL-KW4504Z - Two Opamp DC Test Loop KWIK Demo executable file.

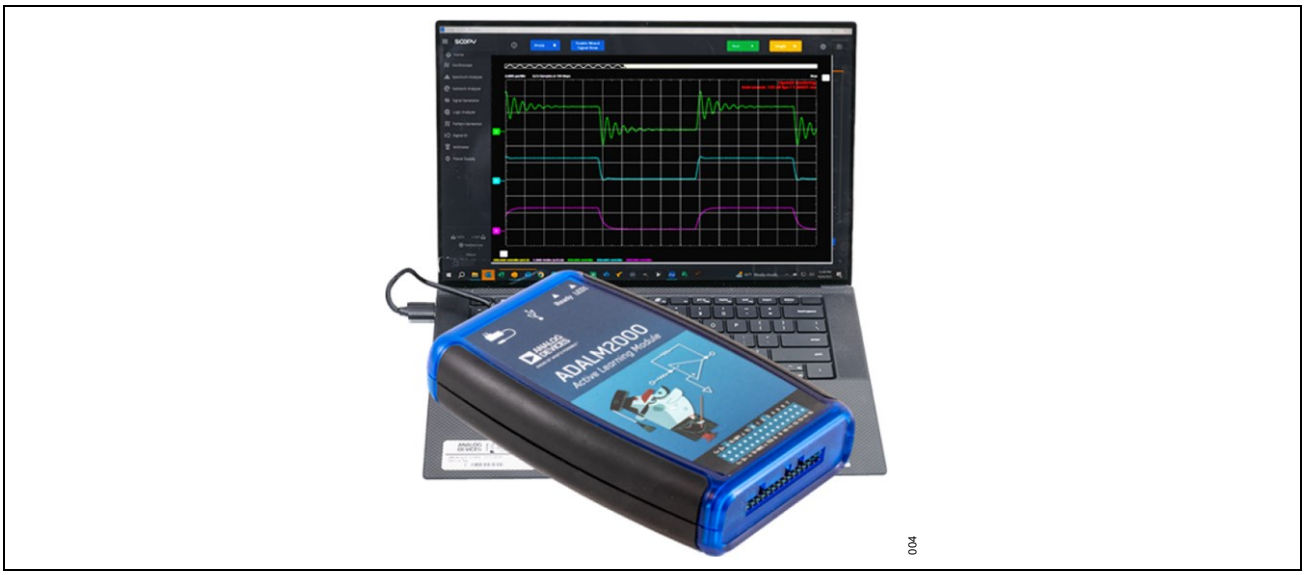


Figure 4. Connecting the ADALM2000 to the Computer

2. Wait for the LED on the ADALM2000 to blink before opening the EVAL-KW4504Z - Two Opamp DC Test Loop KWIK Demo executable file.
3. Open the EVAL-KW4504Z - Two Opamp DC Test Loop KWIK Demo executable file.

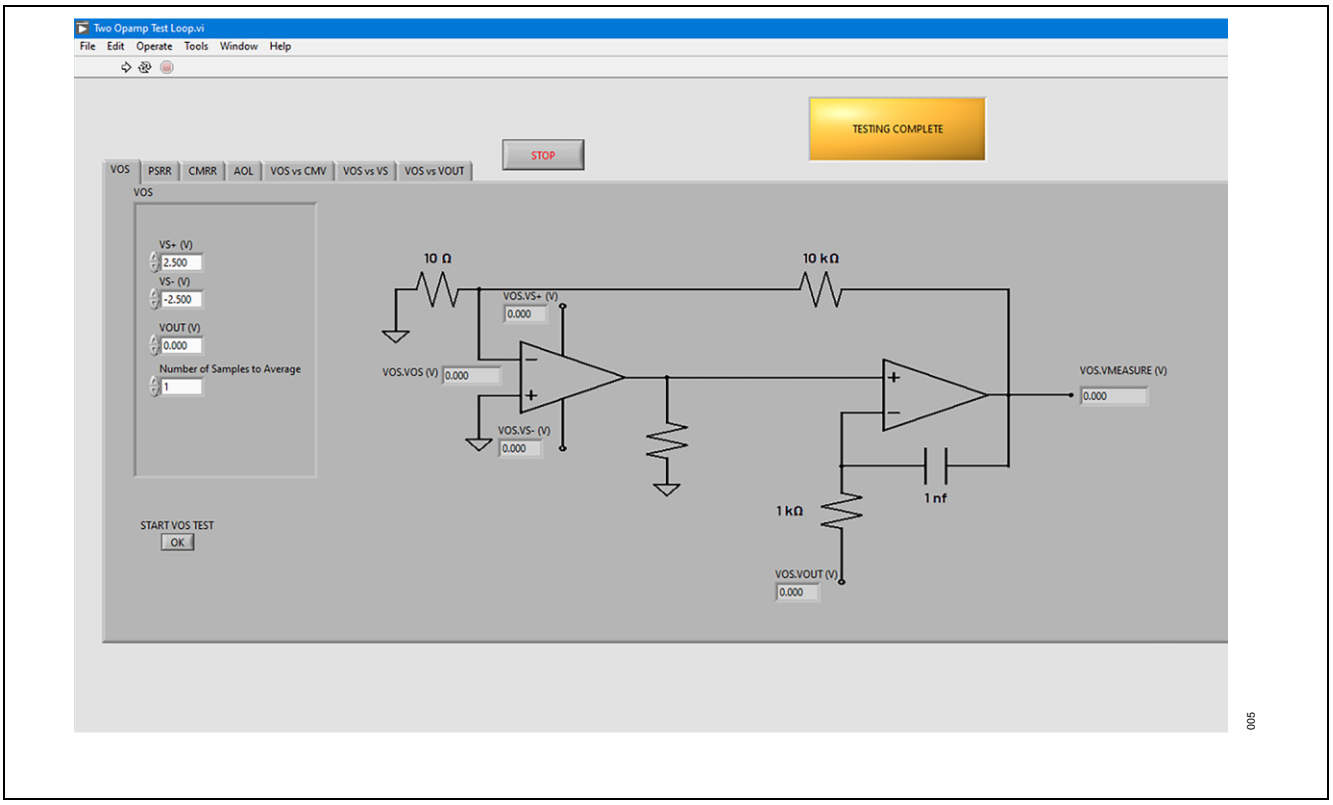


Figure 5. EVAL-KW4504Z - Two Opamp DC Test Loop KWIK Demo Executable File

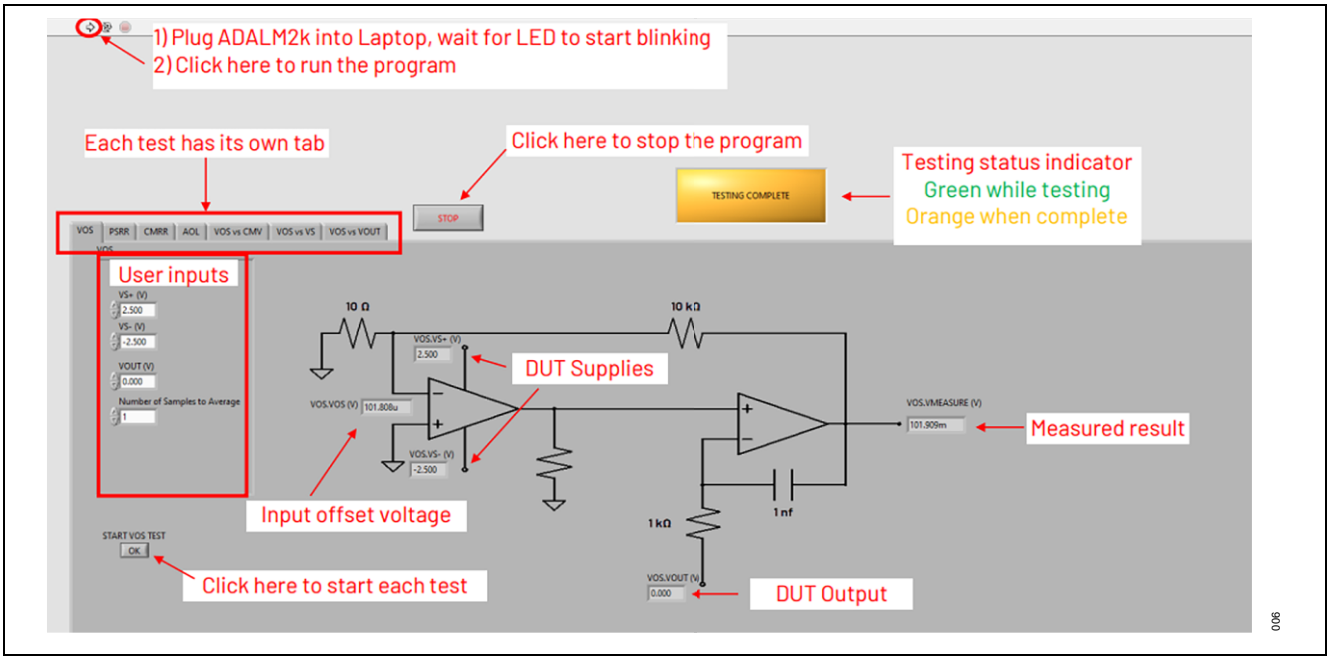


Figure 6. EVAL-KW4504Z - Two Opamp DC Test Loop KWIK Demo Graphical User Interface (GUI) Overview

4. Configure the jumpers on the board, as shown in the *Default Jumper Configuration* section and *Figure 3*. Then, carefully align the pins of the EVAL-KW4504Z's *ADALM2000* connector and insert it firmly on the ADALM2000, as shown in *Figure 7*.

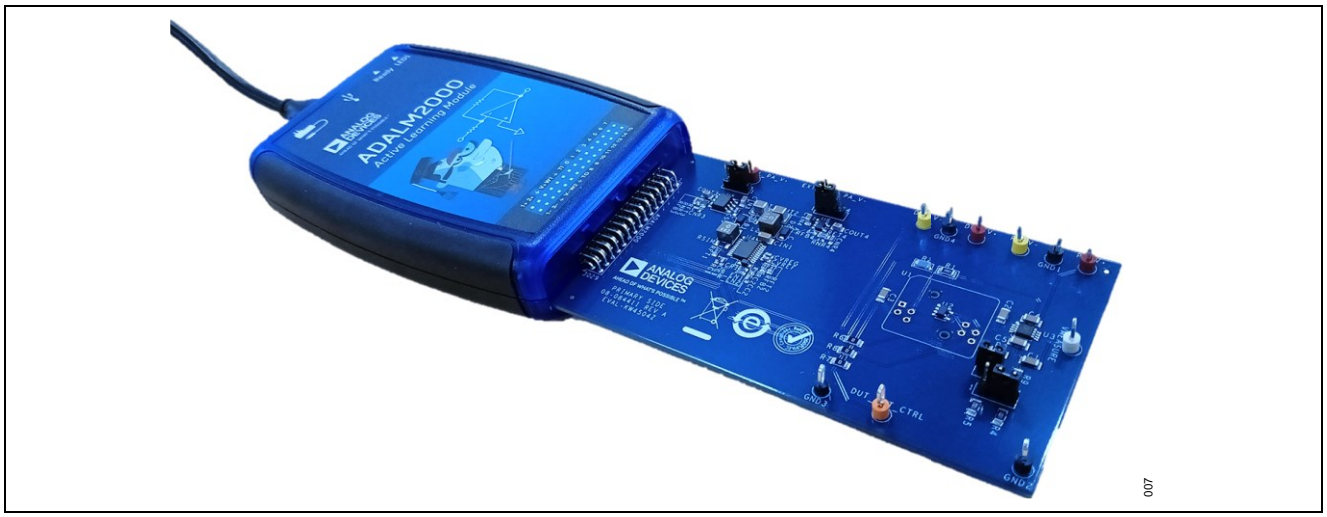


Figure 7. Connecting the EVAL-KW4504Z to the ADALM2000 via the ADALM2000 Connector

5. Go back to the GUI. Click the white arrow in the upper-left corner of the menu bar to run the program, as shown in *Figure 8*. The white arrow turns black once the program is running.

   Note: *It is important to run the program first before starting any of the tests. The DC Tests do not proceed unless the program is running.*

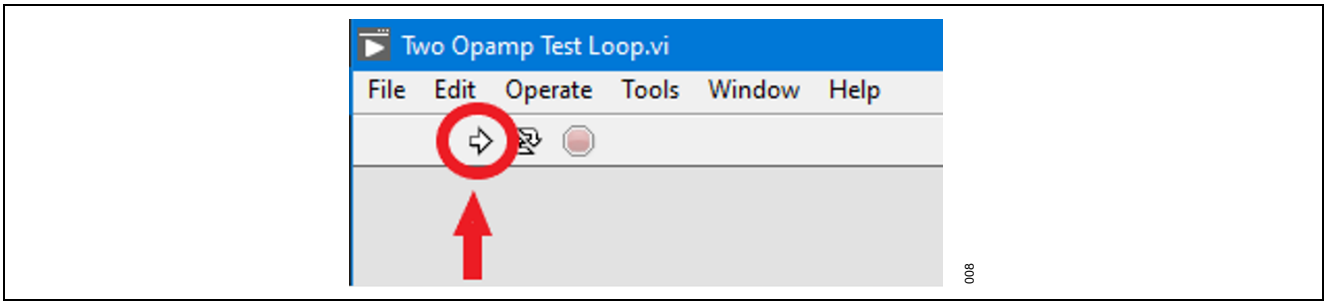


Figure 8. Running the EVAL-KW4504Z - Two Opamp DC Test Loop KWIK Demo Executable File

Quick Evaluation

Currently, the default DUT installed on the EVAL-KW4504Z is AD8601ARTZ (5-lead SOT-23). But there is an option to connect another 5-lead SOT-23 op amp with the same pin configuration by replacing AD8601ARTZ. Op amps in 8-lead SOIC packages can also be used and tested by connecting the OTS-8-16-1.27-03 IC socket on the board.

***Note:** If op amps other than the AD8601 are used, then to configure the parameters for the tests, refer to their respective data sheets. In addition, ADALM2000's power supply is only capable of producing ±5V. Ensure that the supply voltage requirement for the installed op amp do not exceed ±5V (dual supplies) or 5V (single supply), and do not drop below −5V (single supply).*

Input Offset Voltage (V_{OS}) Measurement

Input offset voltage (V_{OS}) is the amount of input differential voltage applied between the +IN and −IN terminals of the op amp required to force the output voltage to zero volts.

To measure the input offset voltage of the AD8601 (DUT), do the following steps:

1. On the GUI, choose the **VOS** tab and input the following (see Figure 9):
   - VS+ = +2.5V
   - VS− = −2.5V
   - Number of Samples to Average = 1
2. After that, click the **START VOS TEST OK** button, as shown in Figure 9 to measure the input offset voltage of the AD8601. Once the measurement is complete, the testing indicator turns orange and **TESTING COMPLETE** appears. The **VOS.VOS (V)** section of the GUI shows the measured input offset voltage of the part.

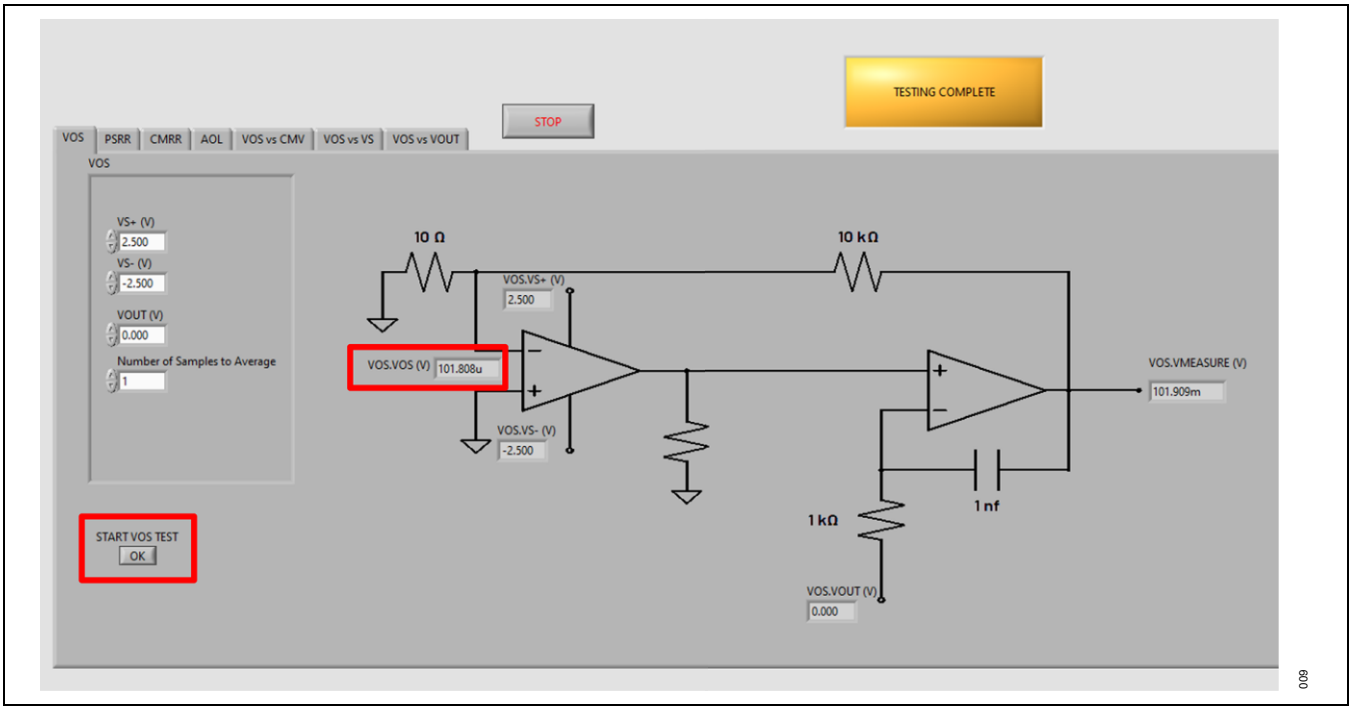


Figure 9. Input Offset Voltage (V_{OS}) Test

3. Check the measured input offset voltage. According to AD8601's data sheet, the input offset voltage of the part is typically 80µV, and 500µV max, at V_S = 5V or V_S = ±2.5V. For a **PASS** result, the measured input offset voltage must be less than or equal to 500µV (max).

Power Supply Rejection Ratio (PSRR) Measurement

The PSRR is the change in input offset voltage as a result of a change in total power supply voltage. It is measured in units of V/V, occasionally expressed in dB in a data sheet.

$$PSRR = \frac{\Delta Vs}{\Delta Vos}$$

To measure the PSRR of the AD8601 (DUT), do the following steps:

1. On the GUI, choose the **PSRR** tab and input the following (see Figure 10):
   - VS+ HI = 2.750V
   - VS+ LO = 1.350V
   - VS− HI = −2.750V
   - VS− LO = −1.350V
   - Number of Samples to Average = 1
2. After that, click the **START PSRR TEST OK** button, as shown in Figure 10 to measure the PSRR of the AD8601. Once the measurement is complete, the testing indicator turns orange and **TESTING COMPLETE** appears. The measured PSRR in V/V and in dB appears on the upper-right corner of the GUI, as shown in Figure 10.

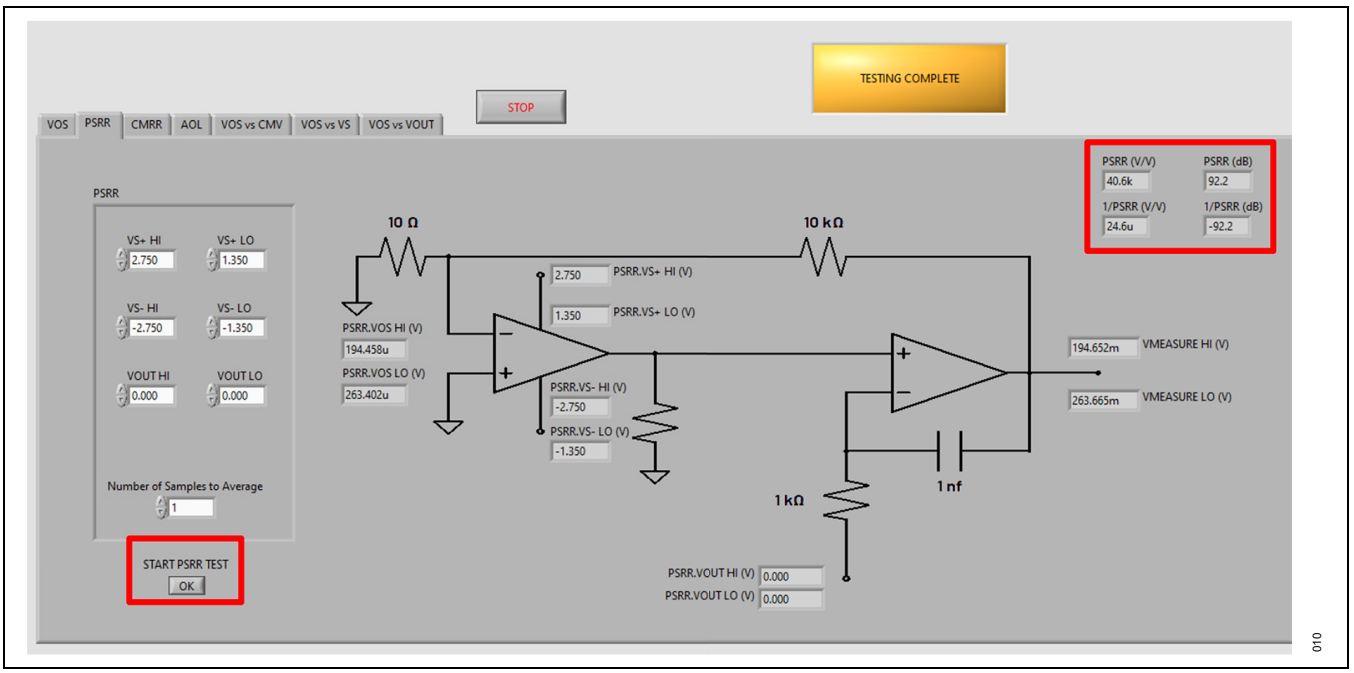


Figure 10. Power Supply Rejection Ratio (PSRR) Test

3. Check the measured PSRR. According to AD8601's data sheet, the PSRR of the part is typically 80dB, and 67dB min, at V_S = 5V or V_S = ±2.5V. For a **PASS** result, the measured PSRR must be more than or equal to 67dB (min).

Common-Mode Rejection Ratio (CMRR) Measurement

The CMRR is generally defined as the ratio of the differential mode gain and the common-mode gain. It can also be expressed as the change in input offset voltage as a result of a change in input common-mode voltage. It is measured in units of V/V, generally expressed in dB in a data sheet.

$$CMRR = \frac{\Delta Vcm}{\Delta Vos}$$

To measure the CMRR of the AD8601 (DUT), do the following steps:

1. On the GUI, choose the **CMRR** tab and input the following (see Figure 11):
   - VS+ LO = 5V
   - VS− HI = −5V

- VOUT HI = −2.5V
- VOUT LO = 2.5V
- Number of Samples to Average = 1

2. After that, click the **START CMRR TEST OK** button, as shown in *Figure 11* to measure the CMRR of the *AD8601*. Once the measurement is complete, the testing indicator turns orange and **TESTING COMPLETE** appears. The measured CMRR in V/V and in dB appears on the upper-right corner of the GUI, as shown in *Figure 11*.

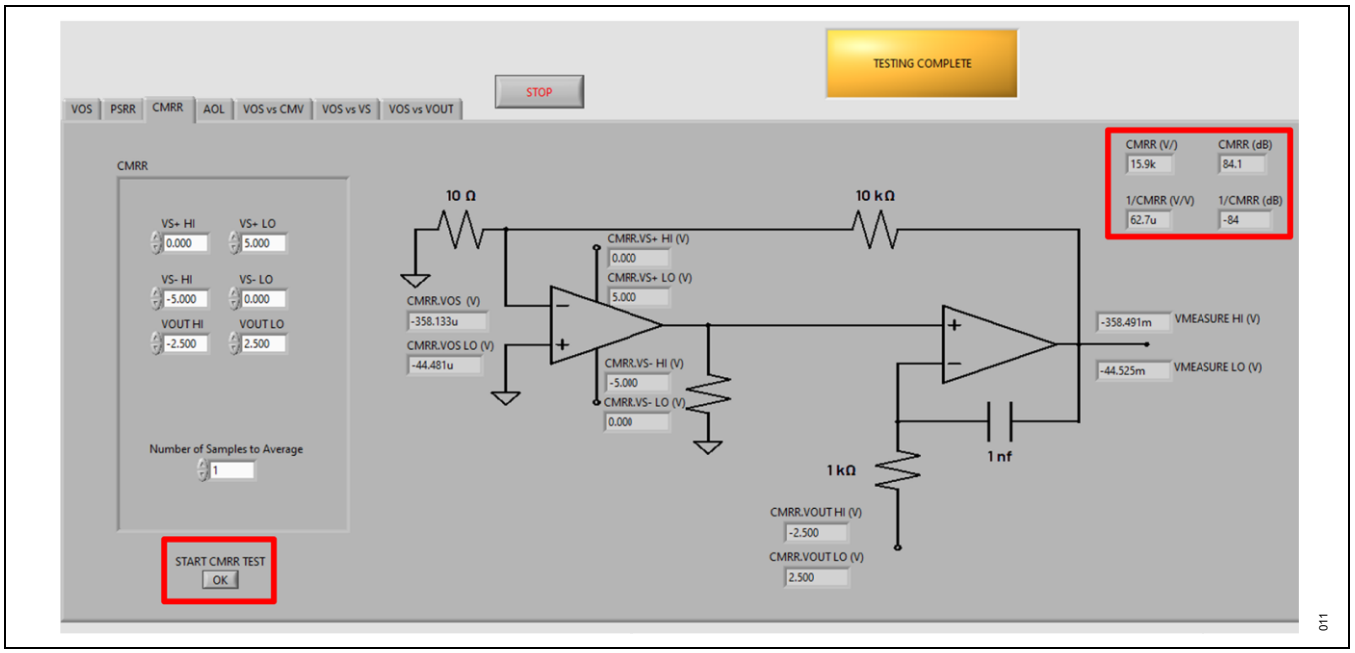


Figure 11. Common-Mode Rejection Ratio (CMRR) Test

3. Check the measured CMRR. According to *AD8601*'s data sheet, the CMRR of the part is typically 89dB, and 74dB min, at V_S = 5V or V_S = ±2.5V. For a **PASS** result, the measured CMRR must be more than or equal to 74dB (min).

Open-Loop Gain (A_{OL}) Measurement

The A_{OL} is the gain of the amplifier without the feedback loop being closed, hence the name open-loop. It can be expressed as the change in input offset voltage as a result of a change in output voltage. It is measured in units of V/V, generally expressed in dB in a data sheet.

$$AOL = \frac{\Delta Vout}{\Delta Vos}$$

To measure the A_{OL} of the *AD8601* (DUT), do the following steps:

1. On the GUI, choose the **AOL** tab and input the following (see *Figure 12*):
   - VS+ = 2.5V
   - VS− = −2.5V
   - VOUT HI = 2V
   - VOUT LO = −2V
   - Number of Samples to Average = 1
2. After that, click the **START AOL TEST OK** button, as shown in *Figure 12* to measure the A_{OL} of the *AD8601*. Once the measurement is complete, the testing indicator turns orange and **TESTING COMPLETE** appears. The measured A_{OL} in V/V and in dB appears on the upper-right corner of the GUI, as shown in *Figure 12*.

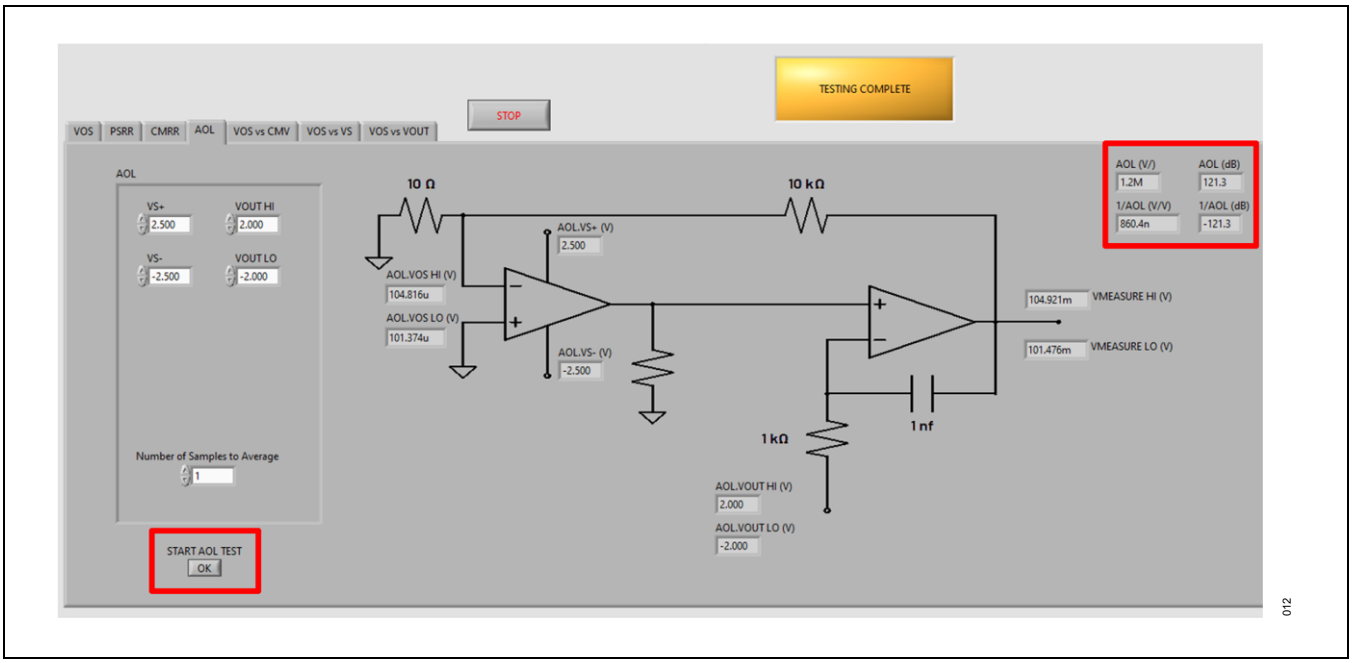


Figure 12. Open-Loop Gain (A_{OL}) Test

3. Check the measured A_{OL}. According to *AD8601*'s data sheet, the A_{OL} of the part is typically 80dB, and 30dB min, at V_S = 5V or V_S = ±2.5V. For a **PASS** result, the measured A_{OL} must be more than or equal to 30dB (min).

Input Offset Voltage vs. Common Mode Voltage (V_{OS} vs. CMV) Measurement

To measure and plot the relationship between the input offset voltage and common-mode voltage of the *AD8601* (DUT), do the following steps:

1. On the GUI, choose the **VOS vs. CMV** tab and input the following (see *Figure 13*):
   - Total Supply Voltage (V) = 5V
   - Increment (V) = 100mV
   - Number of Samples to Average = 1
2. After that, click the **START VOS vs. CMV SWEEP OK** button, as shown in *Figure 13* to plot the V_{OS} vs. CMV of the *AD8601*. Once the measurement is complete, the testing indicator turns orange and **TESTING COMPLETE** appears. The V_{OS} vs. CMV plot appears on the right corner of the GUI, as shown in *Figure 13*.

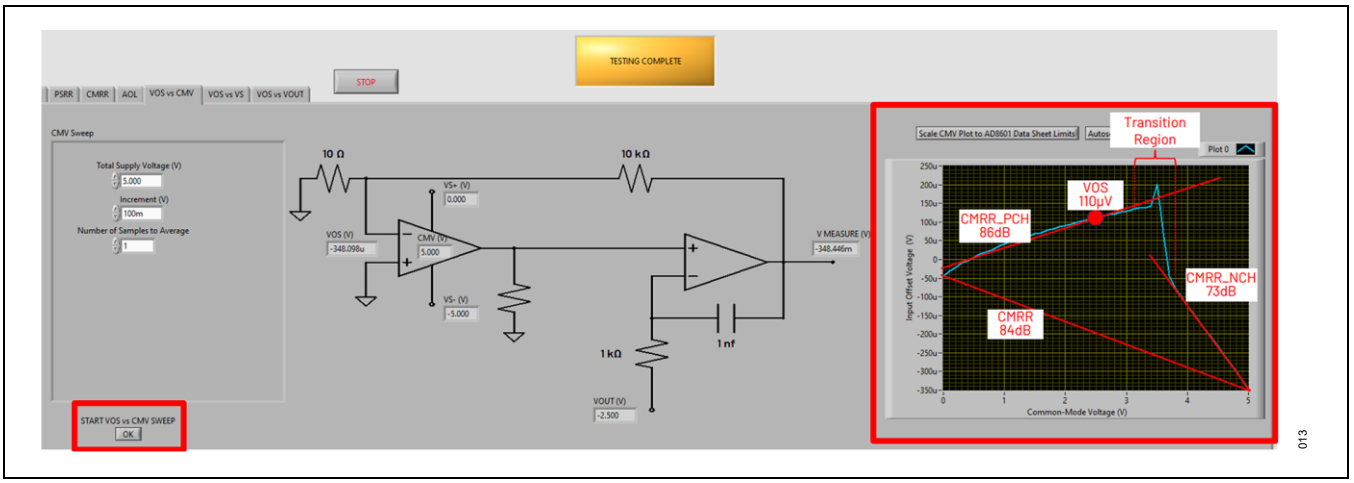


Figure 13. Input Offset Voltage vs. Common Mode Voltage (V_{OS} vs. CMV) Test

3. Compare the resulting plot to V_{OS} vs. CMV's typical curve, refer to the AD8601 data sheet.

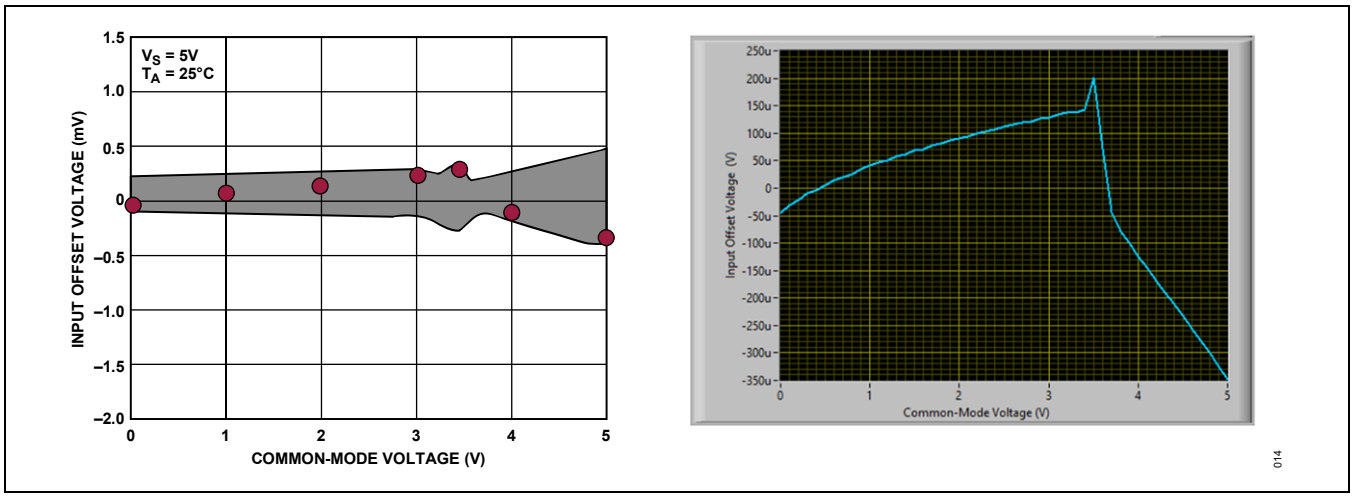


Figure 14. Comparison between Measured V_{OS} vs. CMV Plot and Typical V_{OS} vs. CMV Plot

Input Offset Voltage vs. Power Supply Voltage (V_{OS} vs. V_S) Measurement

To measure and plot the relationship between the input offset voltage and power supply voltage of the AD8601 (DUT), do the following steps:

1. On the GUI, choose the **VOS vs. VS** tab and input the following (see Figure 15):
   - TOTAL SUPPLY VOLTAGE MAX = 5V
   - TOTAL SUPPLY VOLTAGE MIN = 2.7V
   - INCREMENT = 100mV
   - Number of Samples to Average = 1
2. After that, click the **START VOS vs. POWER SUPPLY SWEEP OK** button, as shown in Figure 15 to plot the V_{OS} vs. V_S of the AD8601. Once the measurement is complete, the testing indicator turns orange and **TESTING COMPLETE** appears. The V_{OS} vs. V_S plot appears on the right corner of the GUI, as shown in Figure 15.

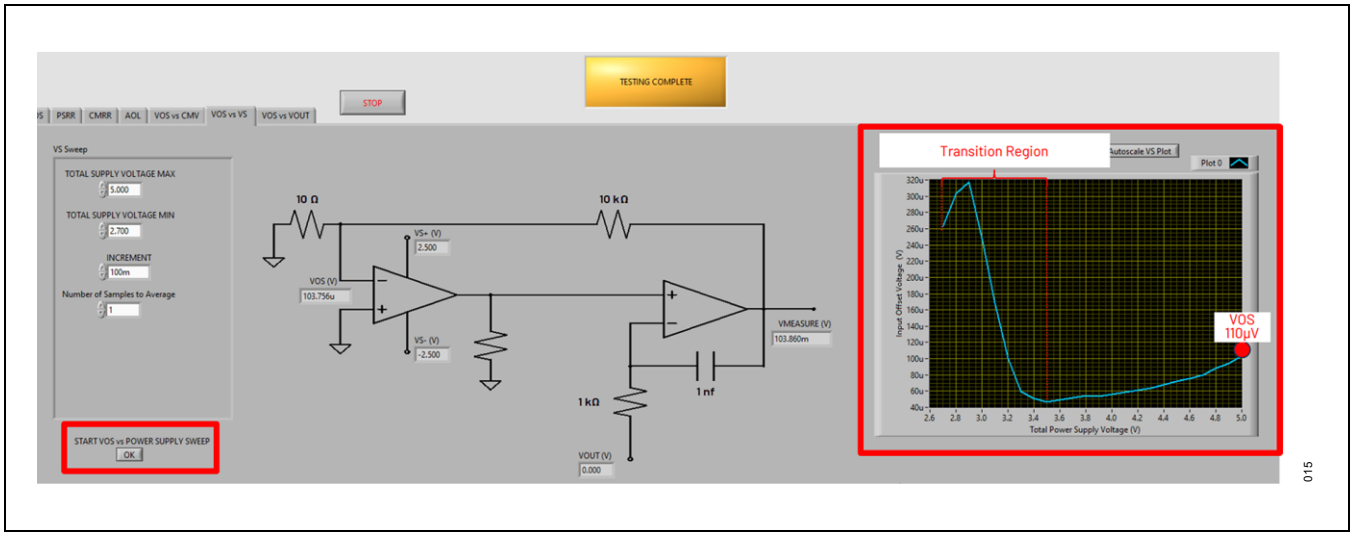


Figure 15. Input Offset Voltage vs. Power Supply Voltage (V_{OS} vs. V_S) Test

Input Offset Voltage vs. Output Voltage (V_{OS} vs. V_{OUT}) Measurement

To measure and plot the relationship between the input offset voltage and output voltage of the the AD8601 (DUT), do the following steps:

1. Remove the J1 jumper from the demo board to remove the load resistor from the DUT.
2. On the GUI, choose the **VOS vs. VOUT** tab and input the following (see Figure 16):
   - VS+ = 2.5V
   - VS− = −2.5V
   - VOUT HI = 2V
   - VOUT LO = −2V
   - INCREMENT = 100mV
   - Number of Samples to Average = 1
3. After that, click the **START VOS vs. VOUT SWEEP OK** button, as shown in Figure 16 to plot the V_{OS} vs. V_{OUT} of the AD8601. Once the measurement is complete, the testing indicator turns orange and **TESTING COMPLETE** appears. The V_{OS} vs. V_{OUT} plot appears on the right corner of the GUI, as shown in Figure 16.

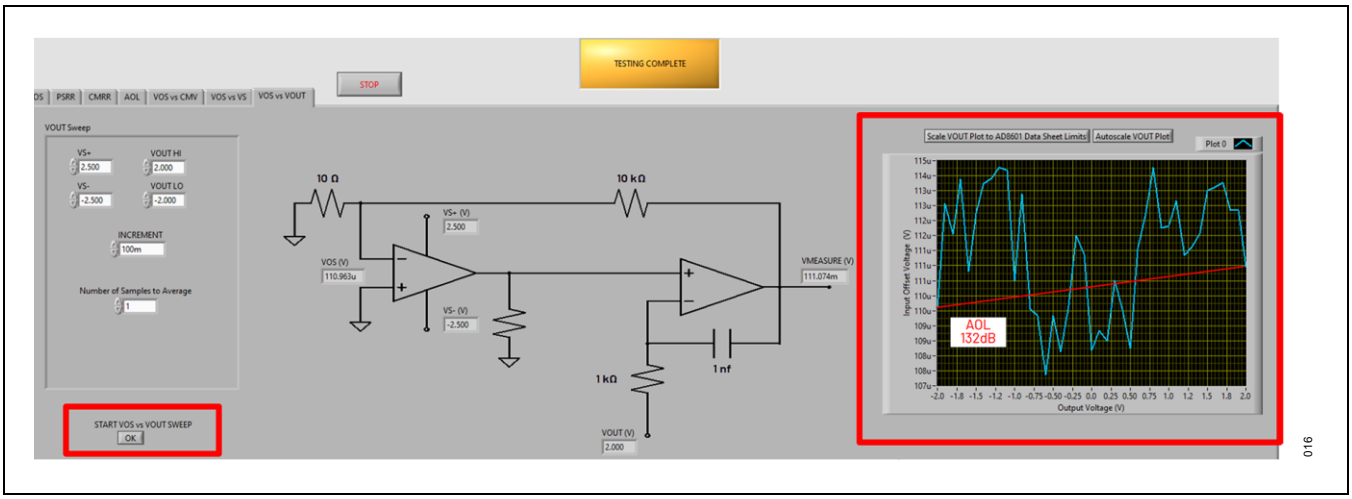


Figure 16. Input Offset Voltage vs. Output Voltage (V_{OS} vs. V_{OUT}) Test – No Load

4. On the demo board, connect the J1 jumper to R5 to configure the AD8601 with a 10kΩ load resistor. Afterwards, click the **START VOS vs. VOUT SWEEP OK** button again and wait for the testing indicator to turn orange. Once the test is finished, the new V_{OS} vs. V_{OUT} plot appears on the right corner of the GUI, as shown in Figure 17.

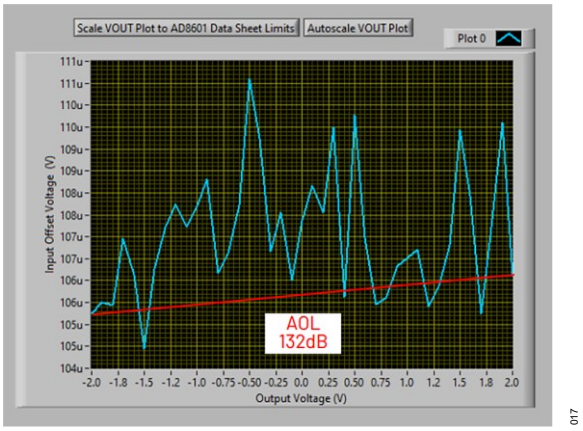


Figure 17. Input Offset Voltage vs. Output Voltage (V_{OS} vs. V_{OUT}) Test Result – 10kΩ Load

5. For the last test, connect the J1 jumper to R4 to configure the *AD8601* with a 1kΩ load resistor. Afterwards, click the **START VOS vs. VOUT SWEEP OK** button again and wait for the testing indicator to turn orange. Once the test is finished, the new V_{OS} vs. V_{OUT} plot appears on the right corner of the GUI, as shown in *Figure 18*.

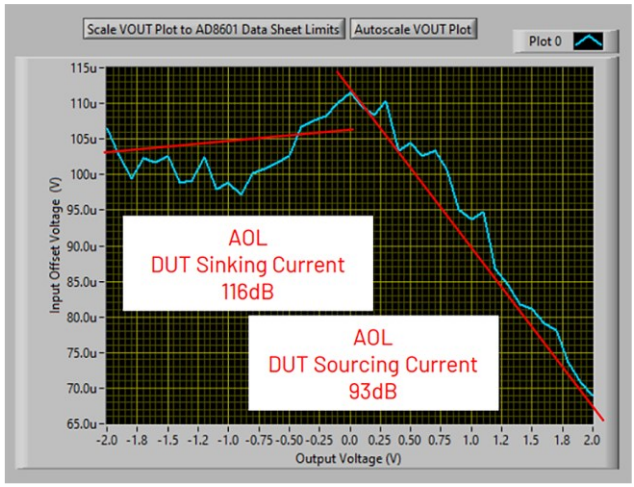


Figure 18. Input Offset Voltage vs. Output Voltage (V_{OS} vs. V_{OUT}) Test Result – 1kΩ Load

Software Installation

To open and run the *EVAL-KW4504Z - Two Opamp DC Test Loop KWIK Demo* executable file, install the required device drivers, libM2k library, and the LabVIEW Runtime Engine. To install the prerequisites of the executable file, do the following steps:

1. To install the Windows OS Drivers, do the following steps:
   a. Click *here* to download the *PlutoSDR-M2k-USB-Drivers* for Windows. Navigate to the **Downloads** folder and run the file named: **PlutoSDR-M2k-USB-Drivers.exe**. After running the executable file, accept the license agreement, click **Next**, and then **Install** (see *Figure 19*).

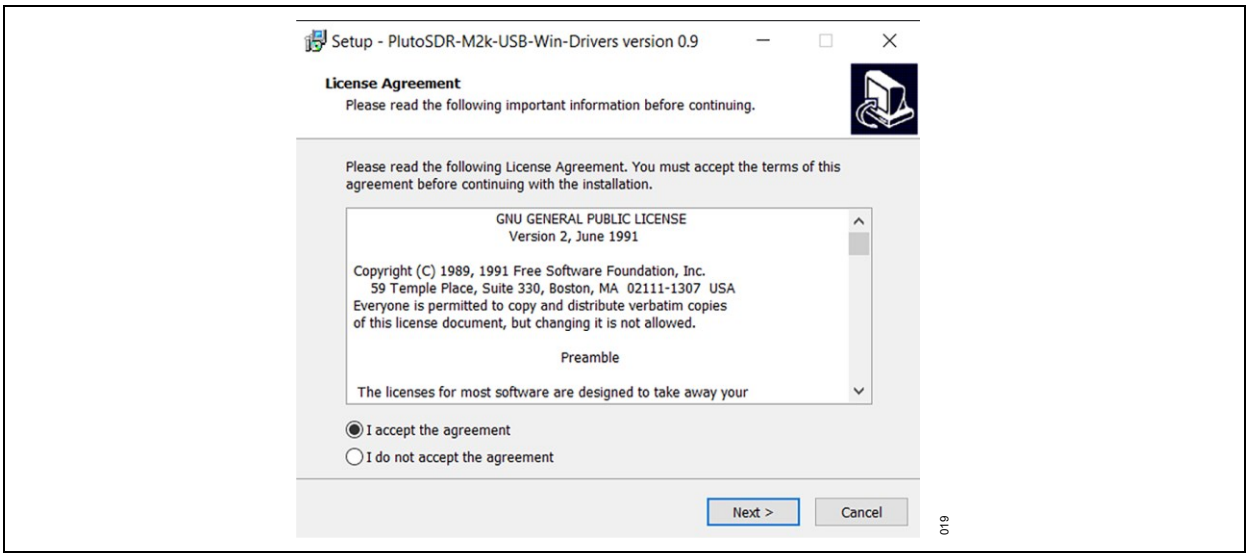


Figure 19. Licence Agreement for the Windows OS Drivers

   b. After clicking Install, a **Welcome to the Device Driver Intstallaltion Wizard!** window appears, as shown in *Figure 20*, click **Next** to continue.

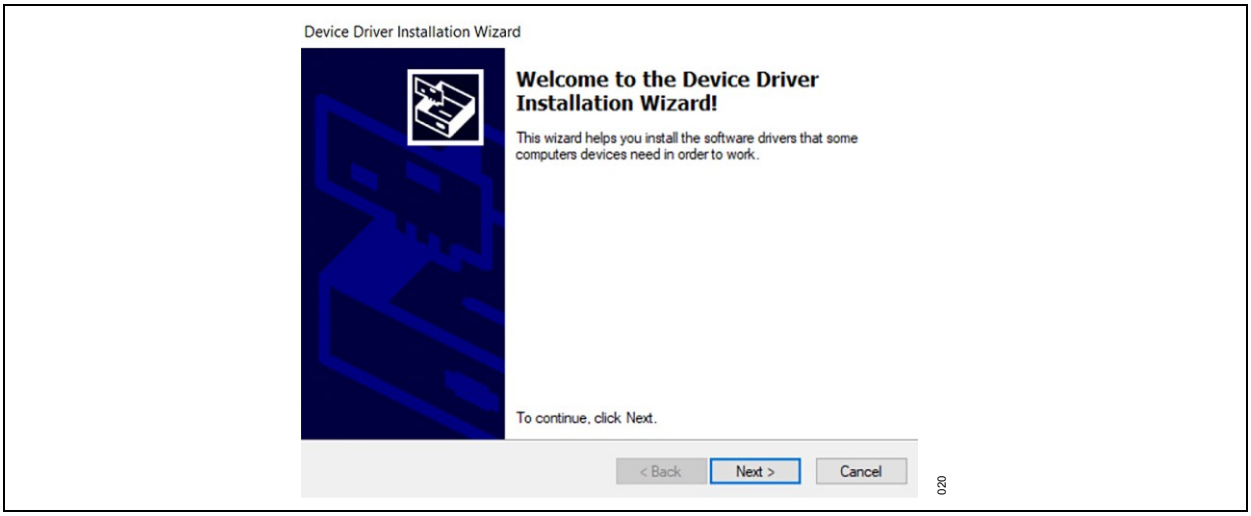


Figure 20. Installing the Windows OS Drivers

   c. After the successful installation of the device drivers, a **Completing the Device Driver Installation Wizard** window appears, as shown in *Figure 21*. Click **Finish** to complete the installation.

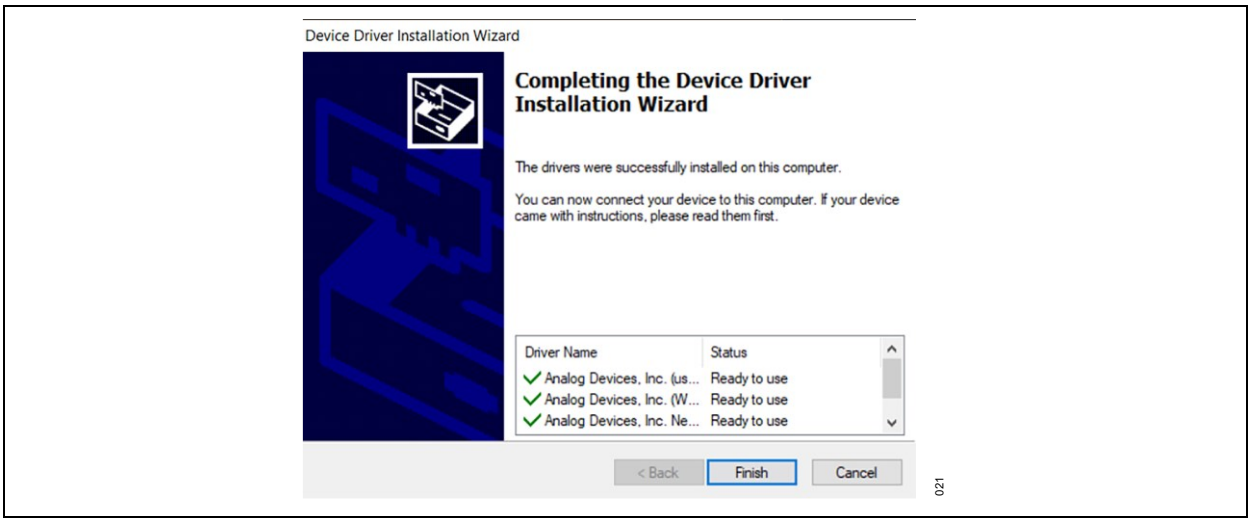


Figure 21. Successful Installation of the Windows OS Drivers

2. To install **libm2k** for **LabVIEW**, do the following steps:
   a. Click *here* to download the *libm2k for LabVIEW*.
   b. Navigate to the **Downloads** folder and run the file named: **libm2k-0.8.0-Windows-setup.exe**. A new window appears afterwards, then, select **English** as the language to be used during the installation.
   c. Accept the license agreement and click **Next** (see *Figure 22*).

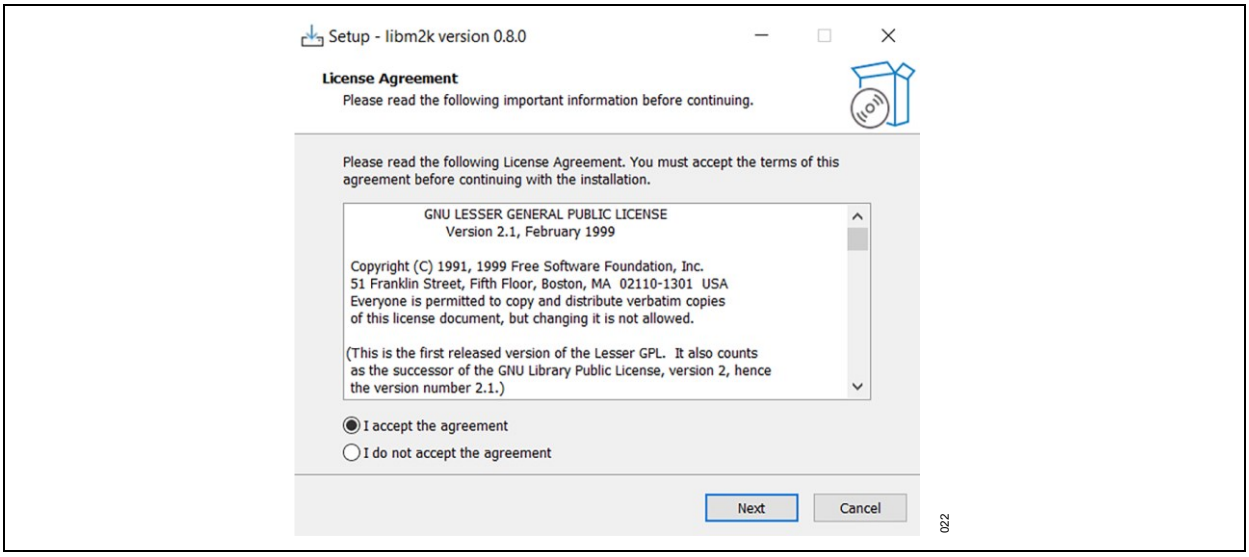


Figure 22. Licence Agreement for libM2k for LabVIEW

   d. While installing, if prompted for additional tasks, select all of the check boxes and click **Next**, as shown in *Figure 23*. Click **Install** afterwards. Once the libm2k library successfully installs, a **Completing the libm2k Setup Wizard** window appears, as shown in *Figure 24*. Click **Finish** to complete the installation.

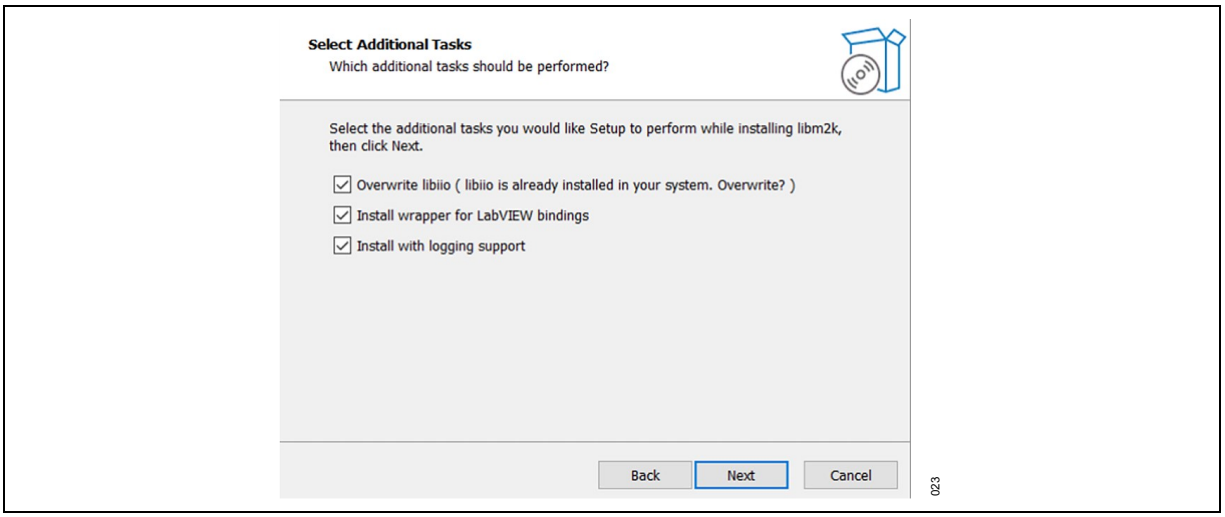


Figure 23. Additional Tasks while Installing the libm2k Library

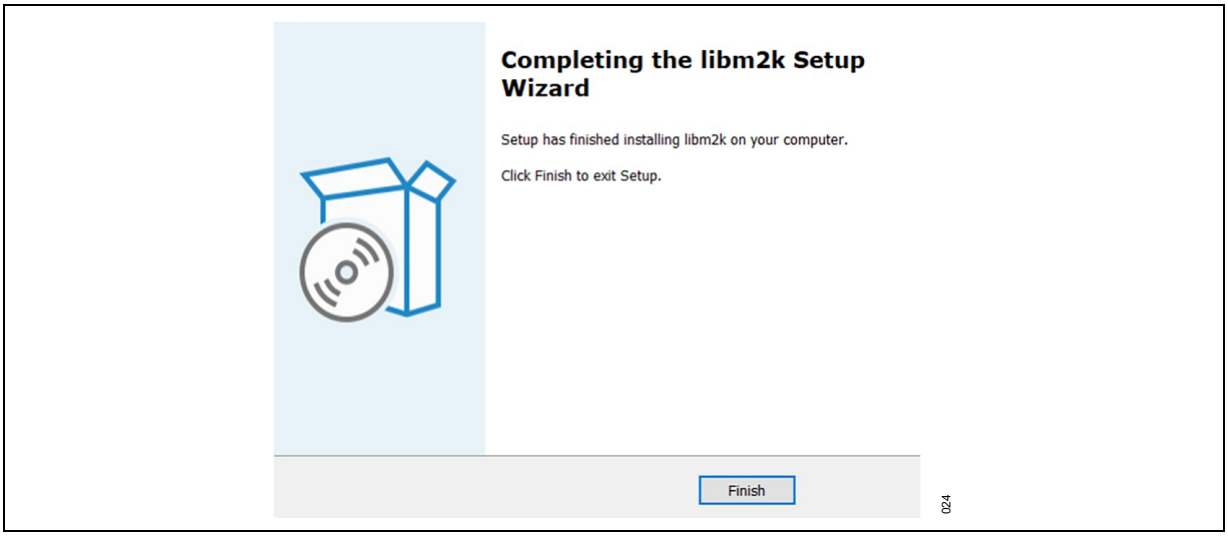


Figure 24. Succesful Installation of the libm2k Library

3. To install the **LabVIEW Runtime Engine**, do the following steps:
   a. To download the **LabVIEW Runtime Engine**, go to the national instruments corp. website.
   b. As shown in *Figure 25*, in the **Supported OS** field, select **Windows** and in the **Version** field, select the **2022 Q3** version. Afterwards, click the **Log in to download** button. A user needs to login to NI account to be able to proceed with the download. If a user do not have an NI account, first create one. Note that it is free to create an NI account.

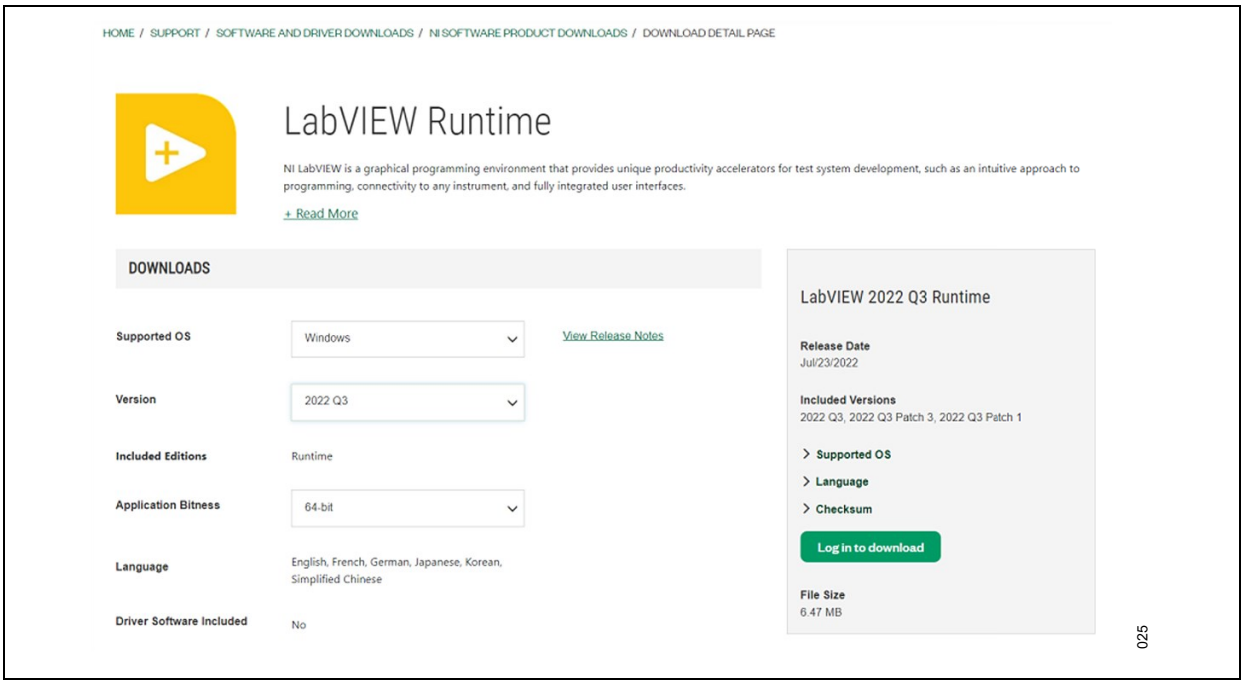


Figure 25. LabVIEW Runtime Engine Download

c. To begin the installation, navigate to the **Downloads** folder and run the file named: **ni-labview-2022-runtime-engine_22.3_online**. After running the executable file, accept the license agreement and click **Next** (see *Figure 26*).

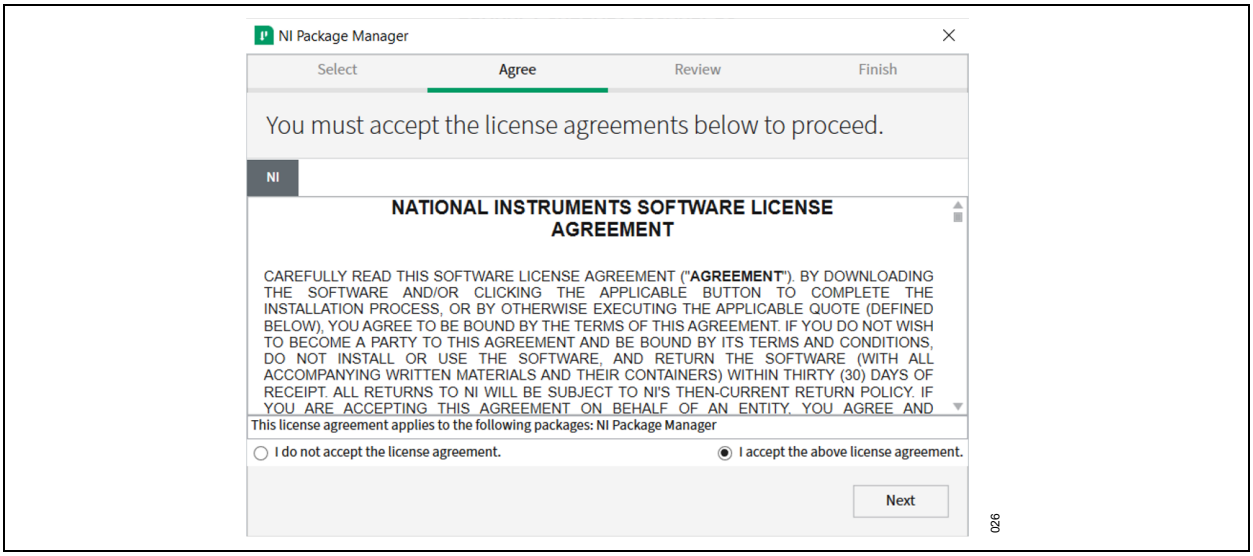


Figure 26. National Instruments Software License Agreement

d. The program installs the **NI Package Manager** if needed, as shown in *Figure 27*.

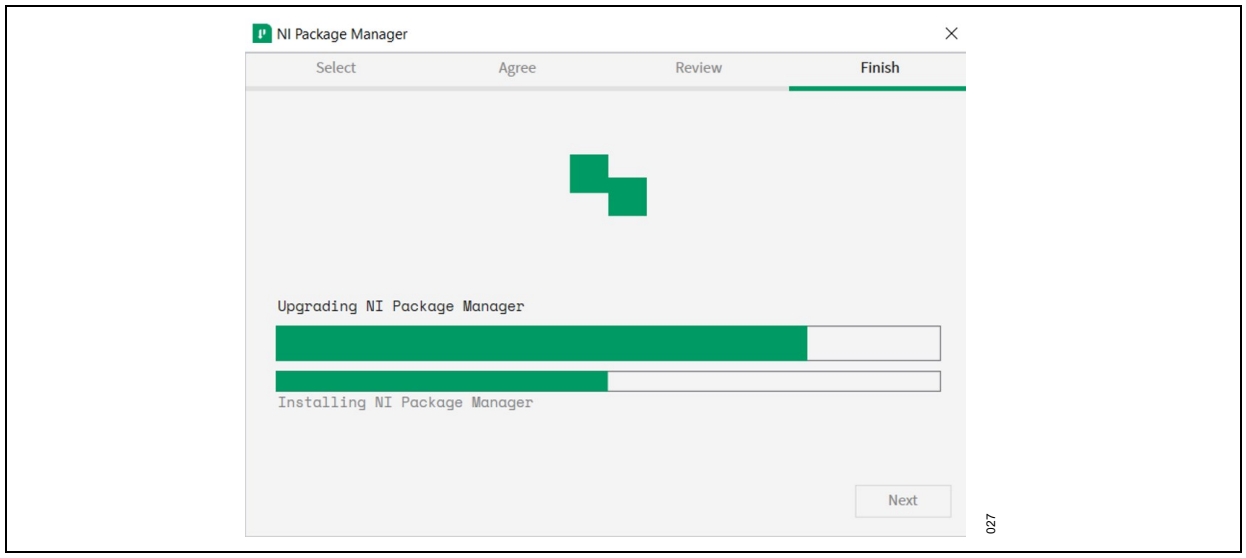


Figure 27. Installing the NI Package Manager

e. Next, the program installs the **LabVIEW Runtime Engine**. Accept the license agreement and click **Next** (see *Figure 28*).

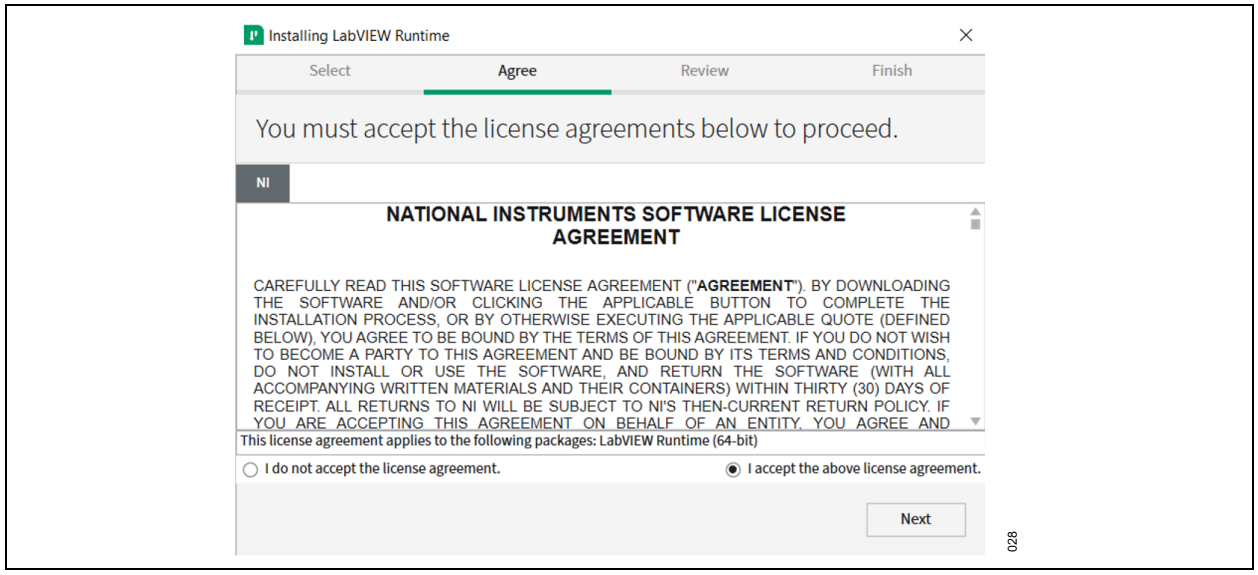


Figure 28. License Agreement for LabVIEW Runtime Engine

f. The user must review the installation details and confirm installing of the **LabVIEW Runtime (64-bit)** version **2022 Q3 Patch 3** and then click **Next**. The installation takes several minutes but once the runtime engine successfully installs, a **Reboot to complete operation** window appears, as shown in *Figure 29*. Reboot the computer afterwards.

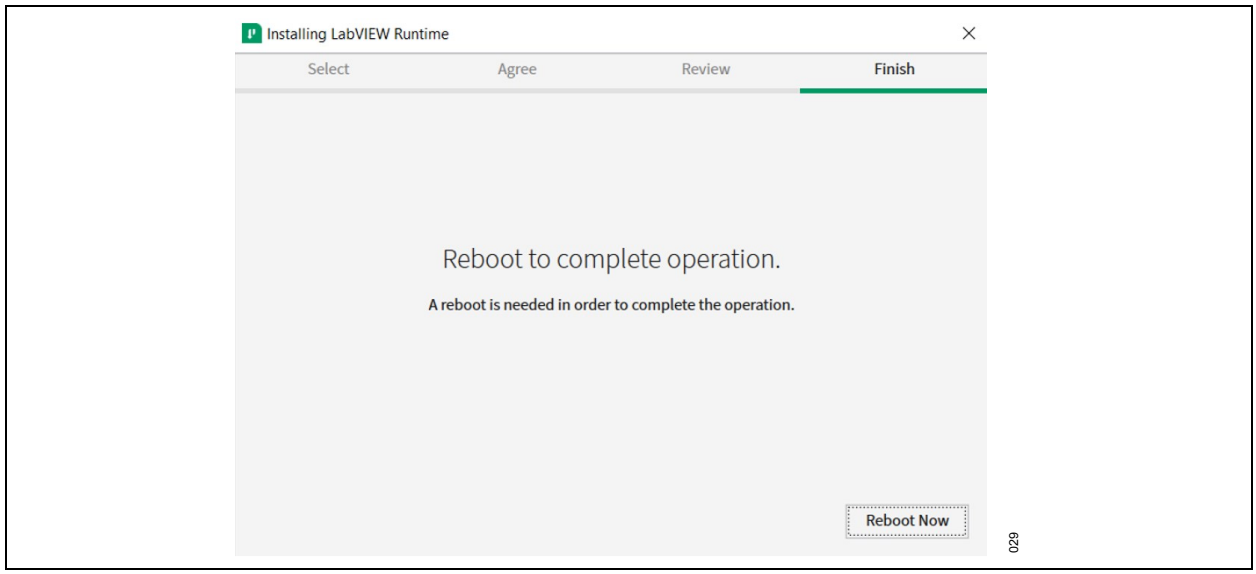


Figure 29. Successful Installation of the LabVIEW Runtime Engine

Ordering Information

PART	TYPE
EVAL-KW4504Z	EV Kit

Z = RoHS Compliant Part.

EVAL-KW4504Z EV Kit Bill of Materials

Table 2. EVAL-KW4504Z: Two Op Amp Test Loop Bill of Materials

ITEM	QTY	REF_DES	MFG PART #	DNI/DNP	MANUFACTURER	DESCRIPTION
1	1	U1	OTS-8-16-1.27-03	DNI	Enplas	Test and burn-in socket, package SOP8
2	1	U2	AD8601ARTZ-REEL	-	Analog Devices, Inc.	IC, Precision CMOS, single-supply, rail-to-rail, input/output wideband operational amplifiers
3	1	U3	OP1177ARMZ	-	Analog Devices, Inc.	IC, Precision low noise, low input bias current operational amplifiers
4	5	C1, C2, C3, C4, C5	CC1206KRX7R9BB104	-	Yageo	Ceramic capacitors, 0.1µF, 50V, 10%, X7R, 1206
5	1	R1	CRT1206-BY-1002ELF	-	Bourns	Resistor, SMD, 10kΩ, 0.1%, 1/4W, 1206
6	1	R2	WINT1206LF0310R0B	-	IRC/TT Electronics	Resistor, SMD, sulfur resistant, 10Ω, 0.1%, 1/4W, 1206
7	1	R3	RC1206FR-07100KL	-	Yageo	Resistor, SMD, 100kΩ, 1%, 1/4W, 1206
8	2	R4, R9	RC1206FR-071KL	-	Yageo	Resistors, SMD, 1kΩ, 1%, 1/4W, 1206
9	1	R5	RC1206FR-0710KL	-	Yageo	Resistor, SMD, 10kΩ, 1%, 1/4W, 1206
10	3	R6, R7, R8	RC1206JR-070RL	-	Yageo	Resistors, SMD, jumper, 0Ω, 1/4W, 1206
11	3	DUT_V+, EXTERNAL_PA_V+, PA_V+	5010	-	Keystone Electronics	PCB test point connectors, red
12	3	DUT_V-, EXTERNAL_PA_V-, PA_V-	5014	-	Keystone Electronics	PCB connectors, multipurpose, through hole mounting, yellow PC test point, tail length 3.2mm
13	1	VMEASURE	5012	-	Keystone Electronics	PCB test point connector, white
14	1	DUT_OUT_CTRL	5013	-	Keystone Electronics	PCB test point connector, orange
15	4	GND1, GND2, GND3, GND4	5011	-	Keystone Electronics	PCB test point connectors, black
16	1	ADALM2000	PPPC152LJBN-RC	-	Sullins	PCB connector, 30-positions, female socket 2.54mm solder, right angle, through hole
17	3	J1, J3, J4	61300311121	-	Wurth Elektronik	PCB connectors, unshrouded, header, 6mm post height, 2.54mm pitch
18	1	J2	61300211121	-	Wurth Elektronik	PCB connector 2-positions, header, vertical, 2.54mm pitch

DNI = Do not install.

DNP = Do not procure.

EVAL-KW4504Z EV Kit Bill of Materials (continued)

Table 3. EVAL-KW450AZ: Power Management Circuit Bill of Materials

ITEM	QTY	REF_DES	MFG PART #	DNI/DNP	MANUFACTURER	DESCRIPTION
1	1	U4	ADP5070AREZ	-	Analog Devices, Inc.	IC, 1A/0.6A, DC-to-DC switching regulator with independent positive and negative outputs
2	1	U5	ADP7142ARDZ-R7	-	Analog Devices, Inc.	IC, 40V, 200mA, low noise CMOS LDO linear regulator
3	1	U6	ADP7182AUJZ-R7	-	Analog Devices, Inc.	IC, −28V, −200mA, low noise, linear regulator
4	1	CC1	0603YC473KAT2A	-	AVX Corporation	Ceramic capacitor, 0.047µF, 16V, 10%, X7R, 0603
5	1	CC2	0603YC683KAT2A		AVX Corporation	Ceramic capacitors, 0.068µF, 16V, 10%, X7R, 0603
6	1	CIN1	GRM31CR71E106KA12L	-	Murata	Ceramic capacitor, 10µF, 25V, 10%, X7R, 1206
7	4	CIN3, CIN4, COUT3, COUT4	UMK212BB7225KG-T	-	Taiyo Yuden	Ceramic capacitors, 2.2µF, 50V, 10%, X7R, 0805
8	1	CNR3	CC0603KRX7R7BB104	-	Yageo	Ceramic capacitor, 0.1µF, 16V, 10%, X7R, 0603
9	1	CNR4	06035C104KAT2A	-	AVX Corporation	Ceramic capacitor, 0.1µF, 50V, 10%, X7R, 0603
10	2	COUT1, COUT2	CGA6P1X7R1N106K250AC	-	TDK	Ceramic capacitors, low ESR, 10µF, 75V, 10%, X7R, 1210, AEC-Q200
11	1	CSS	C1608X8R1H102K080AA	-	TDK	Ceramic capacitor, 1000pF, 50V, 10%, X8R, 0603
12	2	CVREF, CVREG	CL10B105KP8NNNC	-	Samsung	Ceramic capacitors, 1µF, 10V, 10%, X7R, 0603
13	1	CR1	MMSZ5233BS-7-F	DNI	Diodes Inc.	Single Zener diode
14	2	D1, D2	DFLS240-7	-	Diodes Inc.	Schottky diodes barrier rectifier
15	1	L1	XAL4030-682MEC	-	Coilcraft	Shielded power inductor
16	1	L2	XAL4040-153MEC	-	Coilcraft	Shielded power inductor
17	1	RC1	ERJ-3EKF1202V	-	Panasonic	Resistor, SMD, 12kΩ, 1%, 1/10W, 0603, AEC-Q200
18	1	RC2	ERJ-3EKF1002V	-	Panasonic	Resistor, SMD 10kΩ, 1%, 1/10W, 0603, AEC-Q200
19	1	RFB1	ERA-6AEB3743V	-	Panasonic	Resistor, SMD, metal film, 374kΩ, 0.1%, 1/8W, 0805, AEC-Q200
20	1	RFB2	RC0805FR-07274KL	-	Yageo	Resistor, SMD, 274kΩ, 1%, 1/8W, 0805
21	1	RFB3	ERJ-3EKF2872V	-	Panasonic	Resistor, SMD, 28.7kΩ, 1%, 1/10W, 0603, AEC-Q200

EVAL-KW4504Z EV Kit Bill of Materials (continued)

ITEM	QTY	REF_DES	MFG PART #	DNI/DNP	MAUFACTURER	DESCRIPTION
22	1	RFB4	ERJ-3EKF1692V	-	Panasonic	Resistor, SMD, 16.9kΩ, 1%, 1/10W, 0603, AEC-Q200
23	1	RFT1	RC0805FR-072M43L	-	Yageo	Resistor, SMD, 2.43MΩ, 1%, 1/8W, 0805
24	1	RFT2	RC0805FR-072M32L	-	Yageo	Resistor, SMD, 2.32MΩ, 1%, 1/8W, 0805
25	1	RFT3	CRCW080591K0FKEA	-	Vishay	Resistor, SMD, 91kΩ,1%, 1/8W, 0805, AEC-Q200
26	1	RFT4	ERJ-6ENF5232V	-	Panasonic	Resistor, SMD, 52.3kΩ, 1%, 1/8W, 0805, AEC-Q200
27	1	RNR3	ERJ-3EKF1001V	-	Panasonic	Resistor, SMD, 1kΩ, 1%, 1/10W, 0603, AEC-Q200
28	1	RNR4	ERJ-2RKF6190X	-	Panasonic	Resistor, SMD, 619Ω, 1%, 1/10W, 0402, AEC-Q200
29	1	RSS	ERJ-3EKF4992V	-	Panasonic	Resistor, SMD, 49.9kΩ, 1%, 1/10W, 0603, AEC-Q200
30	1	R_EN1	RMCF0603ZT0R00	-	Stackpole Electronics, Inc.	Resistor, jumper, 0Ω, 1/10W, 0603
31	1	RSIM	RC1206JR-070RL	DNI	Yageo	Resistor, SMD, jumper, 0Ω, 1/4W, 1206
32	1	R_EN2	ERA-3AEB113V	DNI	Panasonic	Resistor, SMD, high reliability, 11kΩ, 0.1%, 1/10W, 0603, AEC-Q200

DNI = Do not install.

DNP = Do not procure.

EVAL-KW4504Z Schematic Diagrams

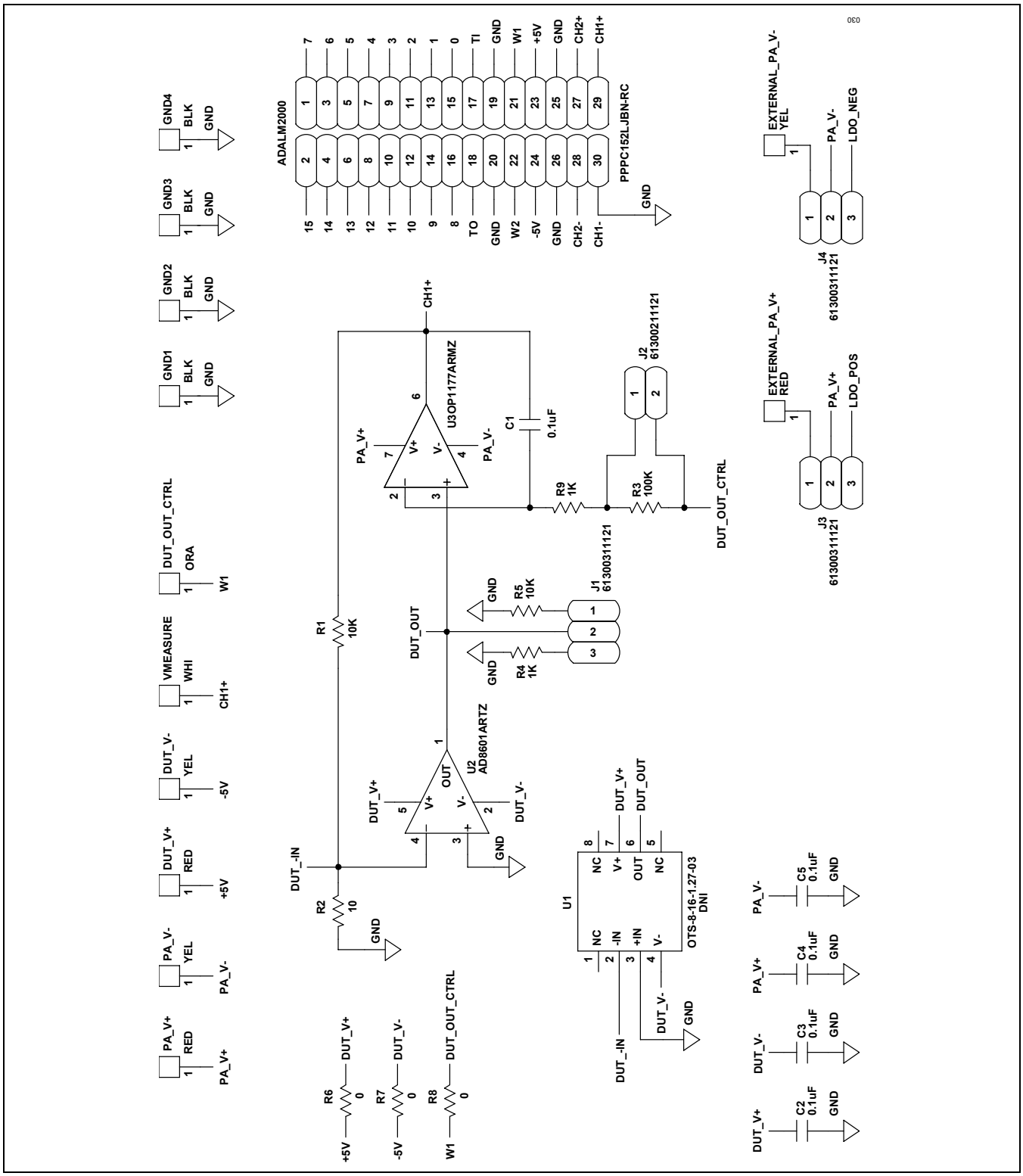


Figure 30. EVAL-KW4504Z: Two Op Amp Test Loop Schematic

EVAL-KW4504Z Schematic Diagrams (continued)

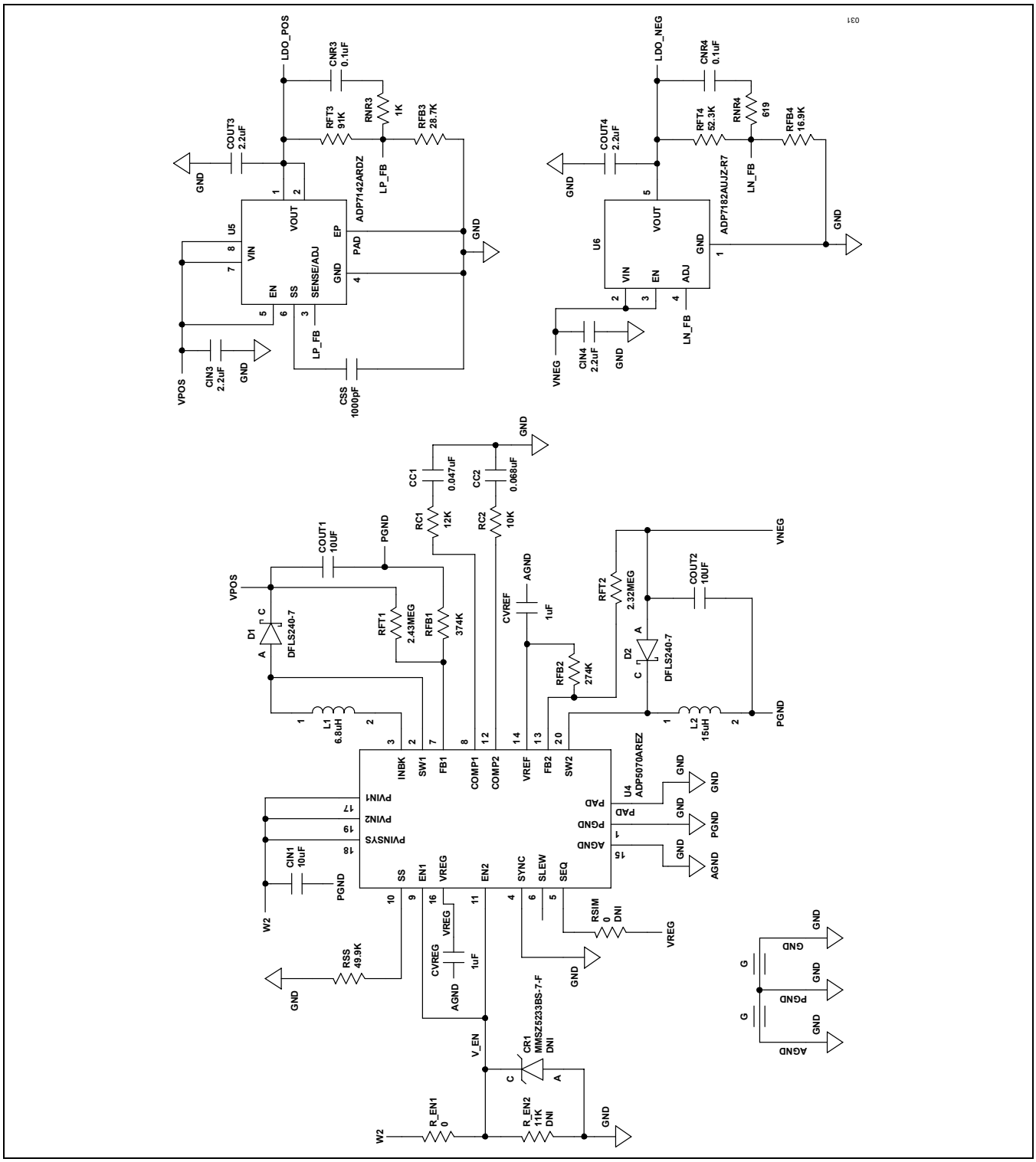
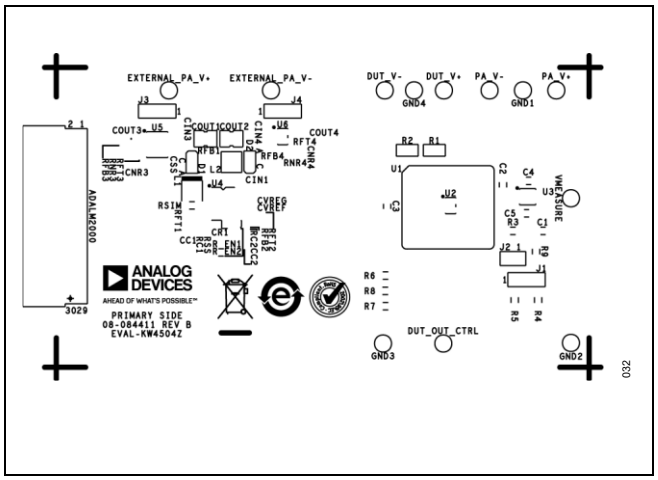
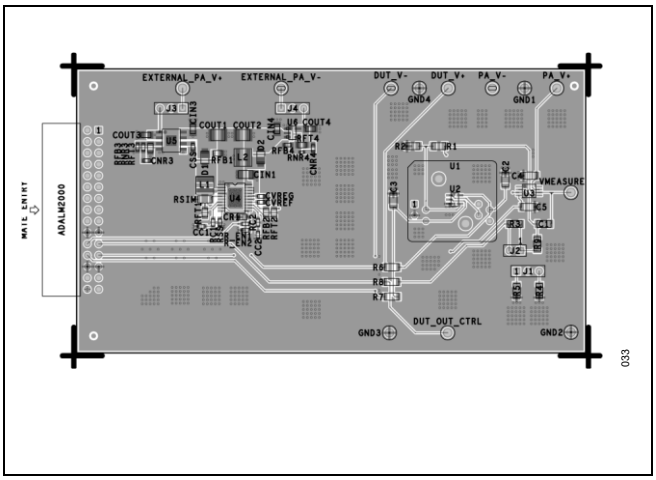


Figure 31. EVAL-KW4504Z: Power Management Circuit Schematic

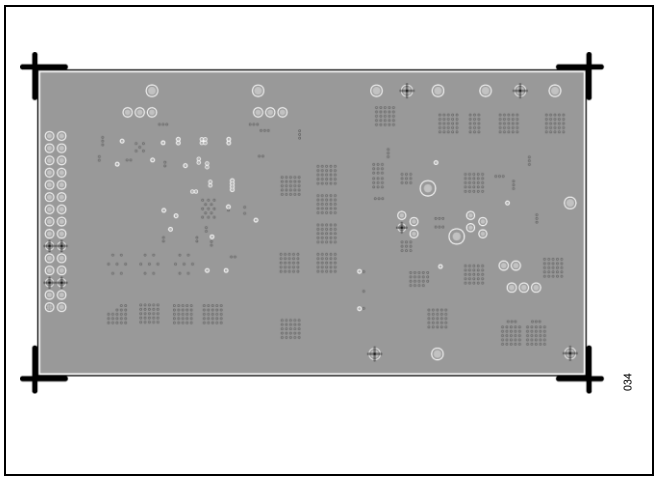
EVAL-KW4504Z PCB Layout Diagrams



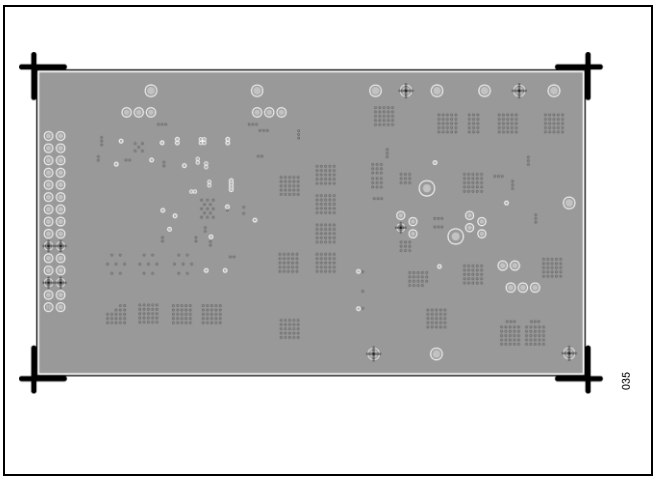
EVAL-KW4504Z EV Kit Component Placement Guide—Top Silkscreen



EVAL-KW4504Z EV Kit PCB Layout—Layer 1 Primary

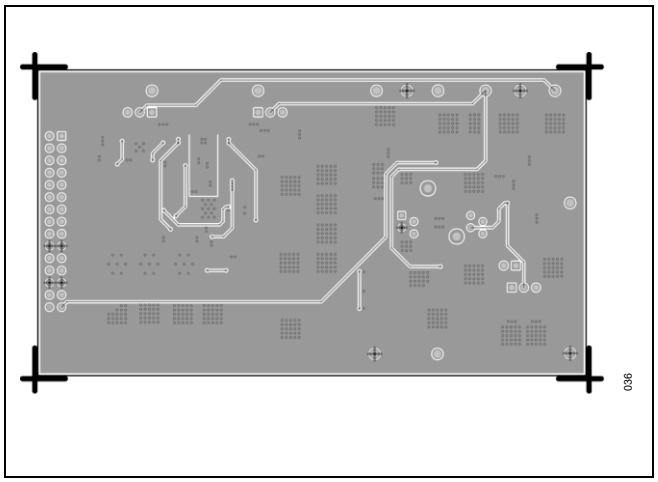


EVAL-KW4504Z EV Kit PCB Layout—Layer 2 Inner

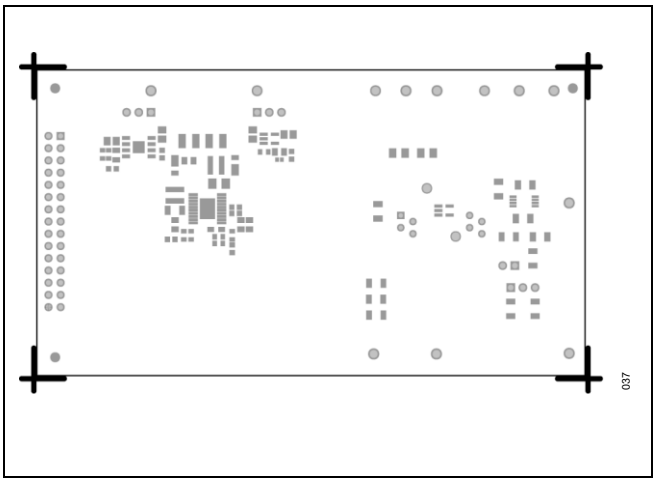


EVAL-KW4504Z EV Kit PCB Layout—Layer 3 Inner

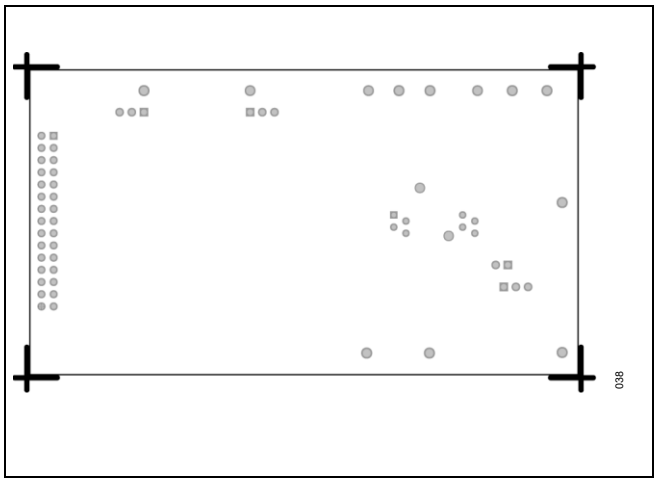
EVAL-KW4504Z PCB Layout Diagrams (continued)



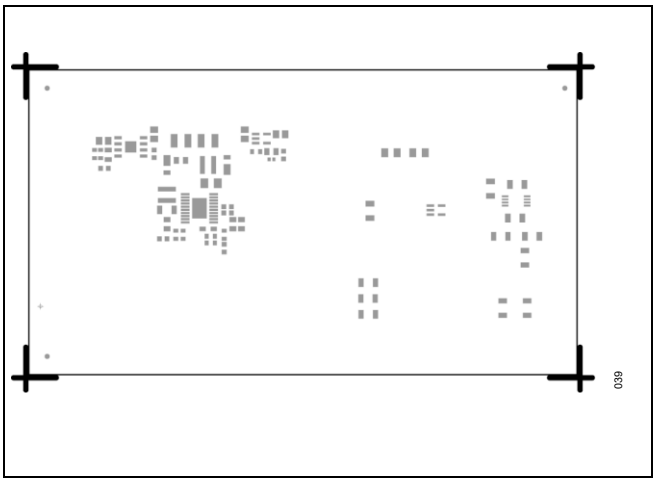
EVAL-KW4504Z EV Kit PCB Layout—Layer 4 Secondary



EVAL-KW4504Z EV Kit PCB Layout—Soldermask Primary



EVAL-KW4504Z EV Kit PCB Layout—Soldermask Secondary



EVAL-KW4504Z EV Kit PCB Layout—Pastemask Primary

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	11/25	Initial release	—

Notes