# EVAL-ADMX6020 1 GSPS Digitizer Module Evaluation Board

## FEATURES

- Complete digitizer solution including FPGA
- Two differential DC-coupled inputs
- Compact form-factor: 2.2in × 3.4in
- Broad sampling rate:
  - 1GSPS (8-bit) (1 nanosecond resolution)
  - 640MSPS (12-bit)
  - 105MSPS (14-bit)
- Wide frequency data capture from DC to 500MHz
- Input range: −0.4 to +2 V
- Built-in nonvolatile memory
- Programmable trigger functionality
- SPI, USB, and $I^2C$ interfaces for control and data offloading

## HARDWARE REQUIREMENTS

- ADMX6020M digitizer module board
- EVAL-ADMX6020 digitizer evaluation carrier board
- 2× Micro-USB cables
- 12V power adapter
- Host PC
- SMA cable(s)
- Ethernet cable(s)
- Low-noise source (for calibration only)
  - DC power supply or signal generator capable of generating a low-noise voltage sweep with appropriate source impedance across desired calibration range
  - Remotely configurable using VISA or other Python-compatible interfaces over GPIB, USB, Ethernet, or other communication protocol

## SOFTWARE REQUIREMENTS

The following software tools, available on the product webpage, must be installed on the host PC for configuration, control, and data collection:

- Terminal application capable of opening a serial connection
  - Recommended: PuTTY
- Analog Devices, Inc., PlutoSDR USB Drivers
  - Download **PlutoSDR-M2k-USB-Drivers.exe**
- LibIIO
  - Click **show all assets** and download **libiio-0.25.gb6028fd-setup.exe**
- Python 3.11.5
  - Download **Windows Installer (64-bit)**
- Git for Windows
- Copy of the ADMX6020 project folder
  - Download from Software Distribution Platform (SSD)

## GENERAL DESCRIPTION

The ADMX6020M is a complete 2-channel digitizer module solution capable of sampling up to 1GSPS with configurable sampling rates and bit resolutions. The module features the ADA4817 input buffer amplifier, the AD5696 digital-to-analog converter (DAC), the LTC6409 driver amplifier, and the HMCAD1520 analog-to-digital converter (ADC) for a low-noise input signal chain capable of handling inputs from −0.4V to +2.0V with adjustable DC-offsetting. With an on-board field programmable gate array (FPGA), nonvolatile memory and programmable trigger functionality, data can be automatically sampled, stored, and offloaded over USB.

The EVAL-ADMX6020 provides an evaluation platform for the ADMX6020M digitizer module with USB interface, coaxial signal input connectors, and externally exposed $I^2C$ and SPI communication links to the module board.

PLEASE SEE THE LAST PAGE FOR AN IMPORTANT WARNING AND LEGAL TERMS AND CONDITIONS.

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## REVISION HISTORY

**7/2026—Rev. 0 to Rev. A**

Changed EVAL-ADMX6020-EBZ to EVAL-ADMX6020 (Throughout)..... 1

**7/2026—Revision 0: Initial Version**

## EVALUATION BOARD PHOTOGRAPH

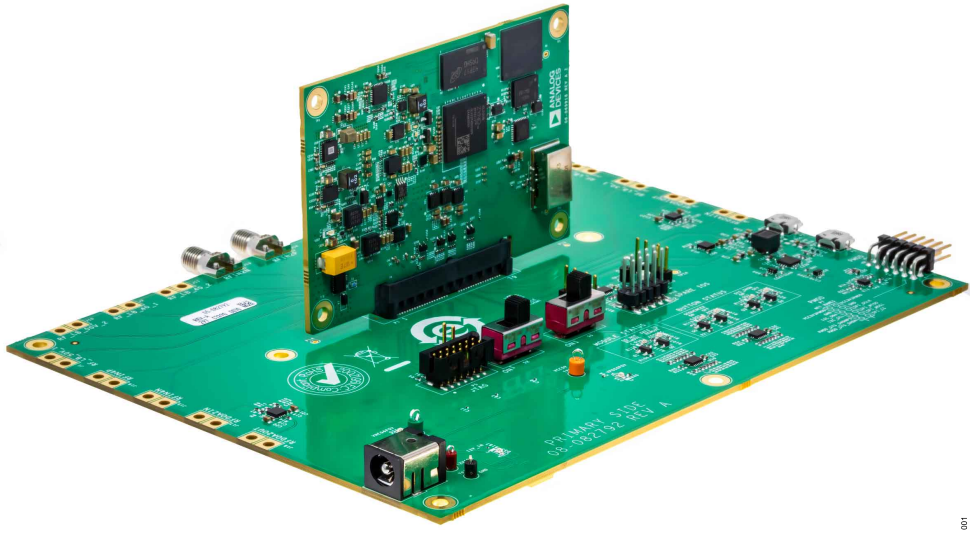

*Figure 1. Digitizer Module Board ADMX6020M and Evaluation Carrier Board EVAL-ADMX6020*

## INITIAL SETUP

To set up and use the ADMX6020 digitizer module for the first time, proceed through the following instructions:

1. Plug in the module board.
   - Plug the module board into Connector P1 on the carrier board as shown in Figure 1.
2. Connect the carrier board to the host PC.
   - Connect the Micro-USB cables between the host PC and carrier board Connector P2 and Connector P3. These cables must remain connected at all times when using the digitizer module.
3. Power on the digitizer module.
   - Ensure that the carrier board switch states are in the correct positions:
     - S2 to Position 0.
     - S5 to Position 1.
   - Connect the 12V power adapter to Connector P6 on the carrier board. The following light-emitting diodes (LEDs) turn on as described:
     - Carrier board LEDs DS1, DS3, DS5, DS6, and DS8 turn green.
     - Carrier board LEDs DS2 and DS9 turn red.
     - Module board LED DS3 turns green.
     - If the module board has been imaged, LED DS2 turns blue.
4. Open a serial connection to the digitizer module.
   - Open device manager on the host PC and identify the COM port of the connected digitizer module. It displays as **PlutoSDR Serial Console**.
   - Using a terminal application such as PuTTY, open a serial connection to the identified COM port with a baud rate of 115200. Once open, you may have to select **enter** before anything appears in the terminal window.
   - To login, enter the following information:
     - Username: **root**.
     - Password: **analog**.
   - The terminal window matches the window as shown in Figure 2.

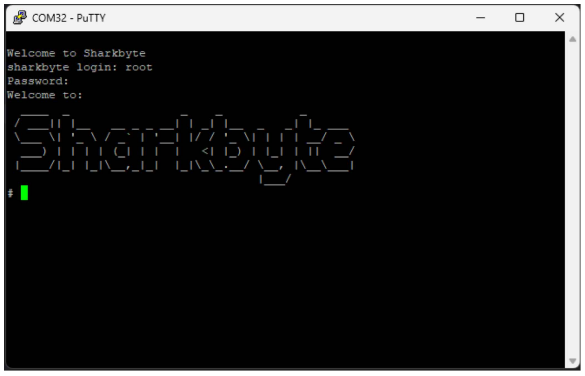


*Figure 2. ADMX6020 Terminal Window*

5. Determine the IP address of the module board.
   - Enter **ifconfig** in the terminal window to determine the IP address of the digitizer module. The IP address is **192.168.2.1** by default.
   - Confirm that a connection has been established between the host PC and module by pinging the address from a local terminal. If you do not receive a reply, ensure that the PlutoSDR drivers are installed and up to date.

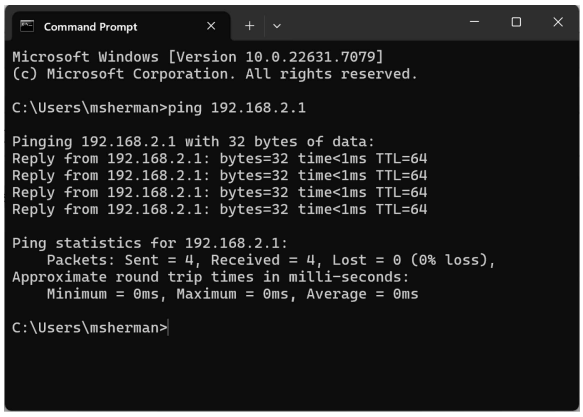


*Figure 3. ADMX6020 Connection Test*

## HOST PC SOFTWARE CONFIGURATION

To configure the software environment for control of and data acquisition from the digitizer module, proceed through the following instructions. This process handles the environment setup the first time it is run, and then it can be used to configure and control the ADMX6020 digitizer as described in the Capture Data Using the Graphical User Interface (GUI) section.

1. Download the ADMX6020 folder to the host PC.
   - Select a location for the ADMX6020 folder downloaded from the Software Distribution Platform (SSD).
   - Open the Windows command prompt by entering **cmd** into the Start menu search box.
   - Navigate to the **admx6020-app** directory in the scripting folder using the **cd** command.
2. Run the ADMX6020 application.
   - Run the **admx6020-run** batch file. When running the file for the first time, it will set up a Python virtual environment and install all required packages. Once this process completes, the ADMX6020 GUI opens in the PC's default browser.

## SYSTEM BOOT AND FIRMWARE UPDATE INSTRUCTIONS (OPTIONAL)

The FPGA on the module board loads an image saved to the nonvolatile memory via quad serial peripheral interface (QSPI) when power is applied to the board. All boards must be preimaged with the latest software for control and configuration.

There are two ways to update the firmware, as follows:

1. Use the web application.
   a. Navigate to the settings page.

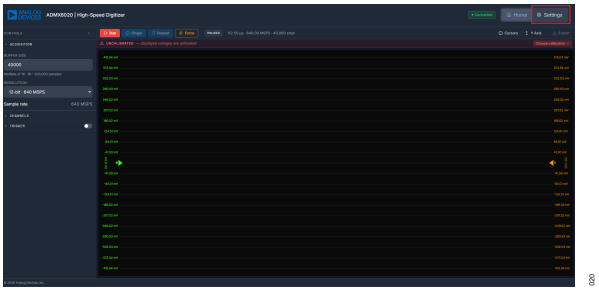

*Figure 4. Web Application UI*

   b. Select **Choose firmware bundle** from the **Firmware Update** section.

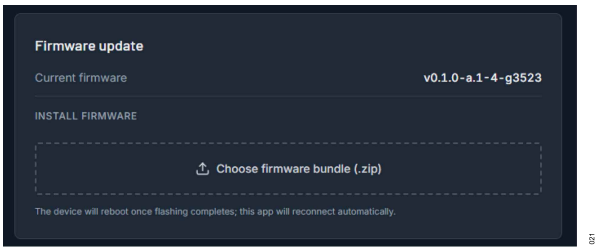


*Figure 5. Firmware Update Panel in Settings*

   c. The release package has an associated firmware bundle. Choose the desired **firmware.zip** file and select **Apply Update**.

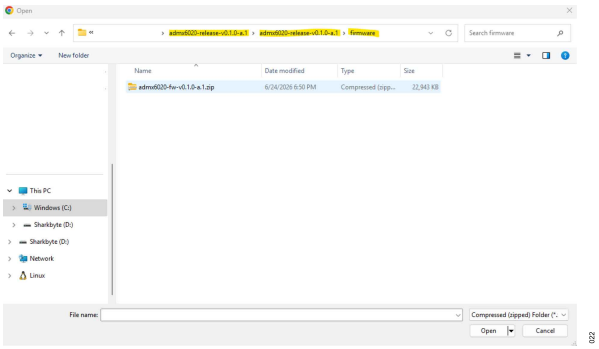

*Figure 6. Explorer to Select Firmware Bundle*

   d. An overlay will show with the update status and can take ~4 minutes.

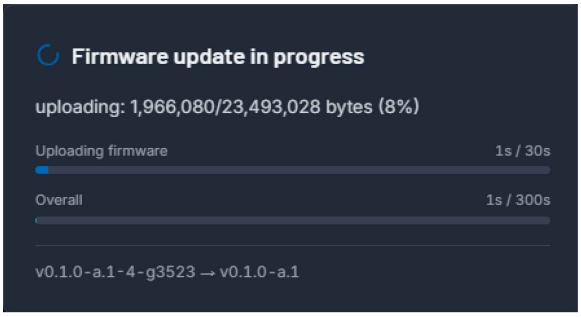


*Figure 7. Firmware Update Progress Indicator*

   e. The web application refreshes, automatically reconnects, and shows the updated firmware version.


*Figure 8. Updated Firmware Version*

2. Use the Python API.
   a. Open the Python API in the terminal and activate the virtual environment.


*Figure 9. Terminal with Activated Virtual Environment*

   b. Execute the command (highlighted in yellow) with a firmware bundle (highlighted in green) as shown in Figure 10.



*Figure 10. Example Run for Updating Firmware*

   c. Execute the command. The firmware will take ~4 minutes to complete. Note that **ERROR** in the last line covers a stale handle on reboot and can be ignored.

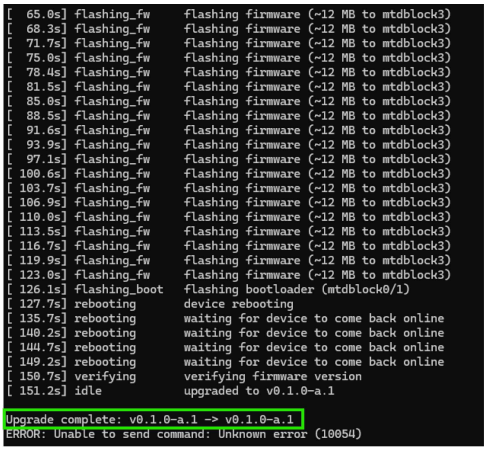


*Figure 11. Firmware Update and Complete Status*

## CALIBRATE THE DIGITIZER MODULE (OPTIONAL)

The ADMX6020 digitizer module supports user-defined, source-agnostic, DC voltage calibration. To utilize the calibration framework, an appropriate calibration source must be provided that matches the criteria described in the Hardware Requirements section. The calibration framework script, **cal_framework.py**, can be modified with user-written code to connect to the calibration source and implement a calibration voltage sweep. The captured data is saved as a .json file that can be loaded into Analog Devices-provided or user-written scripts for calibrated measurements. Default calibrations for a −400mV to +400mV input range with either 0Ω or 50Ω source impedance are provided.

1. Set up the calibration source.
   - Connect a communication cable from the host PC to the low-noise calibration source. Depending on the source, this connection can be established over Ethernet, USB, GPIB, or any other communication link supported with a Python library.
   - Confirm that the calibration source is connected to the host PC over the desired communication interface.
2. Connect the calibration source.
   - Connect a Subminiature Version A (SMA) cable from the OUT1 port of the calibration source to the RFIN1P connector of the carrier board (J5).
   - Terminate the negative input RFIN1N of the carrier board (J4) with the same impedance presented by the calibration source.
3. Set up the calibration python script.
   - In the ADMX6020 app **examples** folder, open **cal_framework.py**.
   - Define desired calibration parameters as shown in Figure 12.

```
# ====================== Configuration ======================
CAL_FILE  = "default_cal_filename"
ADC_CH    = 0                   # channel to be calibrated (0 or 1)
RANGE_MIN = -0.4                # low end of cal range (V)
RANGE_MAX = 0.4                 # high end of cal range (V)
N_POINTS  = 801                 # number of calibration points (at least 1pt per 3mV recommended for 8-bit mode)
VOS_INIT  = 0                   # initial offset voltage - center of range recommended
# ===========================================================
```

*Figure 12. Calibration Parameter Settings*

   - Add relevant code to the script for configuration and control of the calibration source in each section marked **user defined**. This includes the following:
     - Source connection setup (line 46), as shown in Figure 13.
     - DC voltage sweep (line 53), as shown in Figure 13.
     - Offset voltage adjustment (line 75), as shown in Figure 13.
   - Set the upper and lower voltage levels across which to calibrate using the **range_min** and **range_max** variables.

```
def run_cal(board: (capture, sample_rate_hz), channel: (__eq__), range_min, range_max, npts, vos):  1 usage  Sh

    if channel == 0:
        board.ch0.dc_offset_volts = vos
    elif channel == 1:
        board.ch1.dc_offset_volts = vos

    Vin_range = np.linspace(range_min, range_max, npts)

    #### USER DEFINED SECTION ####
    # User should insert code here to set up a source to supply each DC voltage
    ##############################

    data_avg = []
    for voltage in Vin_range:

        #### USER DEFINED SECTION ####
        # User should insert code here to set the DC output of their source to = voltage
        ##############################

        result = board.capture()
        sample_rate_hz = board.sample_rate_hz

        if channel == 0:
            raw_ch0 = result.ch0
            data_avg.append(np.round(np.average(raw_ch0)))
        elif channel == 1:
            raw_ch1 = result.ch1
            data_avg.append(np.round(np.average(raw_ch1)))


    # Plot calibration sweep results (optional)
    # plt.plot(Vin_range, data_avg)
    # plt.title('Calibration Sweep Results')
    # plt.xlabel('Input voltage (V)')
    # plt.ylabel('ADC Code')
    # plt.show()

    #### USER DEFINED SECTION ####
    # If the input voltage range is <850mV and the results of the calibration process show clipping,
    # Vos must be adjusted.
    # If necessary, adjust the offset voltage and run a second calibration, using the following commands:
    ## board.ch0.dc_offset_volts = vos
    ## board.ch1.dc_offset_volts = vos
    ##############################
```

*Figure 13. User-Defined Calibration Settings*

4. Run the calibration script
   - Run the **cal_framework.py** script. Once complete, a .json file containing calibration coefficients is saved to the **calibration** folder within the ADMX6020 directory.

## CAPTURE DATA USING THE GRAPHICAL USER INTERFACE (GUI)

1. Connect a source.
   - Connect an input signal to the carrier board to Connector RFIN1P and Connector RFIN1N (J4 and J5) to apply a signal to ADC 1, or connect a signal to Connector RFIN4P and Connector RFIN4N (J15 and J16) to apply a signal to ADC 2.
     - For single-ended measurements, terminate the negative input connector with 50Ω.
2. Start the GUI.
   - Run the **admx6020-run** batch script.
   - The browser window opens displaying the menu shown in Figure 14.
3. Configure measurement parameters.
   - Apply the desired measurement settings using the text boxes in the GUI. The list of options is as follows:
     - Buffer size—enter the desired capture length, in samples. The maximum available buffer size is 65536.
     - Resolution—select from **1GSPS/8-bit**, **640MSPS/12-bit**, or **105MSPS/14-bit**.
       - Note that the module must be restarted for this change to take effect. Initiate a restart using the **Restart** button at the bottom of the GUI window.
     - Channel options—enable **Ch 0**, **Ch 1**, or both to select the active measurement channel(s).
       - A voltage offset can be specified for each channel. If using a calibration file, this will automatically be set to the offset used during the calibration and must not be modified.
     - Trigger—select one channel to be the trigger source. Choose between **Rising**, **Falling**, or **Threshold** to select a trigger method.
       - For **Rising** and **Falling** modes that trigger on a transient edge, a single threshold voltage must be selected.
       - For the **Threshold** trigger, high and low threshold voltages can be selected.
       - The number of pre-trigger samples to be displayed can be selected using the **Pre-trigger** slider
       - A holdoff between trigger events can be specified in ms, that takes effect if using **Repeat** capture mode.
     - Views—select between time domain waveform display, frequency-domain spectrum display (FFT), or both.
       - To change the Y-axis limits in either view mode, open the display menu by clicking **Y Axis** in the upper right corner.
4. Start a capture.
   - Apply calibration—select an available calibration file from the dropdown menu by clicking **Change** in the top right corner of the GUI.
     - By default, calibration files for 0Ω and 50Ω impedance sources for a −400mV to +400mV input range are provided.
     - User-generated calibration files, created using the instructions in Calibrate the Digitizer Module (Optional) section, will be available here.
   - Initiate a capture—select **Single** for a single capture of the length set in **Buffer Size**, **Repeat** to capture a trigger event every time the specified conditions are met, or **Run** for continuous capture mode.
     - Use the **Single** mode to capture a waveform once the assigned trigger conditions are met.
     - Use the **Repeat** mode to capture waveforms every time the assigned trigger conditions are met, and the specified holdoff time has elapsed.
     - Use the **Force** button to take an immediate capture regardless of trigger conditions.
     - If a trigger threshold is assigned, a capture is taken when the input signal next crosses the threshold.
5. Save captured data.
   - Use the **Export** button to save the currently displayed waveform(s) in a .csv format to a desired location on the host computer.

## CAPTURE DATA USING THE GRAPHICAL USER INTERFACE (GUI)


*Figure 14. ADMX6020 User Interface*

## CAPTURE DATA USING PYTHON

1. Connect a source.
   - Connect an input signal to the carrier board Connector RFIN1P and Connector RFIN1N (J4 and J5) to apply a signal to ADC 1, or connect a signal to Connector RFIN4P and Connector RFIN4N (J15 and J16) to apply a signal to ADC 2.
     - For single-ended measurements, terminate the negative input connector with 50Ω.
2. Capture data.
   - Use the **capture_data.py script** in the ADMX6020 examples folder to capture an arbitrary number of samples using either ADC channel.
   - To capture calibrated data, specify the calibration file in the parameters section shown in Figure 15 . This can be a default calibration or a user generated calibration, created as described in the Calibrate the Digitizer Module (Optional) section.

```
# ====================== Configuration ======================
N_SAMPLES = 16535
CAL_FILE  = Path(__file__).parent / "default_cal_50ohm.json"
USE_CAL   = True
PLOT      = True
SAVE_DATA = True
SAVE_FILE = "default_data_filename"
# ===========================================================
```

*Figure 15. capture_data.py*

## NOTES

**ESD Caution**
**ESD (electrostatic discharge) sensitive device**. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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