Evaluating the ADMX3652 6½ Digit, ±20 V Digital Voltage Meter

FEATURES

- Integrated calibration operation
- Data logger
- UART to USB communication
- Universal connector for DMM

DOCUMENTS NEEDED

- ADMX3652 data sheet

SOFTWARE NEEDED

- ADMX3652 Evaluation GUI Software

GENERAL DESCRIPTION

The ADMX3652 is a 6½ digit, ±20 V, dual-channel digital voltage module with a small form factor that can be easily integrated into a system. The module provides three measurement ranges that can be selected manually or automatically according to the input voltage. All operations are implemented through universal asynchronous receiver-transmitter (UART) communications with the Standard Commands for Programmable Instruments (SCPI) protocol. When the ADMX3652 connects with Analog Devices, Inc., EVAL-ADMX3652-INT evaluation board, it can be used as a portable measuring instrument that has two voltage input channels using banana jack connectors. The measured data is output to a computer through the UART to USB function on the EVAL-ADMX3652-INT. An intuitive graphical user interface (GUI) tool is provided as well for operating the module and capturing the data in the computer to evaluate the performance of the ADMX3652.

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8/2023—Revision 0: Initial Version

QUICK START GUIDE

To evaluate the ADMX3652, Analog Devices, Inc., offers a solution for quickly building a test platform that consists of the following:

1. The EVAL-ADMX3652-INT interface board
2. The ADMX3652
3. The **ADMX3652 Evaluation GUI Software**

Take the following steps to use the EVAL-ADMX3652-INT interface board to build up the evaluation platform for the ADMX3652:

Figure 1. EVAL-ADMX3652-INT Interface Board

1. Mount the ADMX3652 firmly together with the EVAL-ADMX3652-INT interface board.

Figure 2. ADMX3652 Installed on EVAL-ADMX3652-INT Interface Board

2. Connect the voltage measurement test leads to the EVAL-ADMX3652-INT interface board.
3. Connect the EVAL-ADMX3652-INT interface board to the host Windows® computer through a USB A to USB B cable.

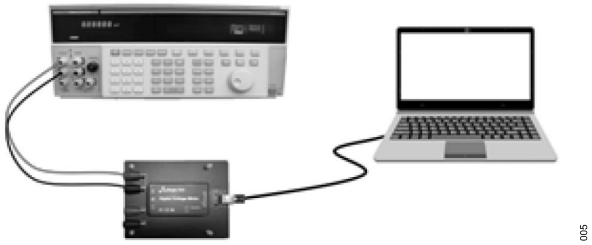

Figure 3. Quick Start Setup

4. Download and install the FT232RNL driver from the FTDI website for converting the UART to the USB on the EVAL-ADMX3652-INT board. Then, download and install the **ADMX3652 Evaluation GUI Software** from the EVAL-ADMX3652 web page.
5. Launch the GUI.

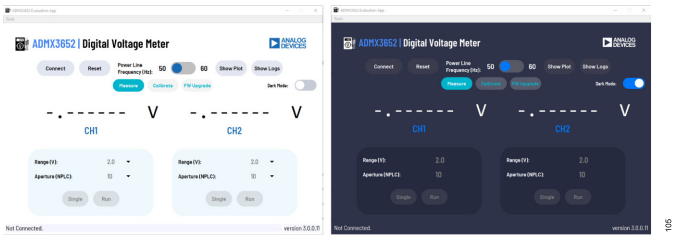

Figure 4. ADMX3652 Evaluation GUI in Light Mode (Left) and Dark Mode (Right)

ELECTRICAL INSTALLATION

Flexible installation is critical for limited space application. The ADMX3652 provides two methods of installation to integrate the product into a system and lead out the measurement pins.

PLUG AND PULL INSTALLATION

Same as the EVAL-ADMX3652-INT interface board, this installation method only designs pads of receptacle with no tail onto the system board of the user. The Mill-Max 0327-0-15-01-34-27-10-0 is recommended as the pin receptacle with a solder mount in a 1.91 mm minimum mounting hole. Refer to the ADMX3652 data sheet for these dimensions, which can be found in the pin configuration figure.

This installation method is recommended for integrating modules into the system board of the user because it is simple to disassemble the ADMX3652 for regular calibration.

SOLDERING INSTALLATION

Alternatively, another available installation approach is to solder the ADMX3652 directly onto the system board of the user with reserved pads on the board for minimum stack-up height.

To support regular calibration, the addition of functional circuitry on the system board of the user is suggested for the following:

- Disconnect the post-stage circuit of the measuring terminals.
- Measurement of the lead module pins out properly for easy access during calibration.

Because the ADMX3652 case is made with plastic, users must follow these conditions when processing:

- Iron temperature: ≤ 350°C
- Continuous soldering time: <5 seconds

Note that exceeding the previous soldering conditions may damage the enclosure of the device. Also, do not use the device in wave soldering or reflow soldering, which can damage the device.

MODULE OPERATION

The ADMX3652 operates through its UART communication port. The following sections introduce operating the ADMX3652 through software control.

ADMX3652 EVALUATION GUI SOFTWARE

The **ADMX3652 Evaluation GUI Software** is a PC intuitive tool to operate and evaluate the ADMX3652 for demonstrating the functions and performance of the product. The tool integrates and packages commands into various operating functions.

Software Installation

Download and install the FT232RNL driver from the FTDI website. Then, download the **ADMX3652 Evaluation GUI Software** package from the ADMX3652Z-ML product page, and unzip the package on a local PC. Figure 5 shows the required files for the GUI to be extracted and installed.

Note that it requires a computer running Windows 10 or newer to run the **ADMX3652 Evaluation GUI Software** tool. For normal display, the resolution must be equal to or greater than 1024 × 768.

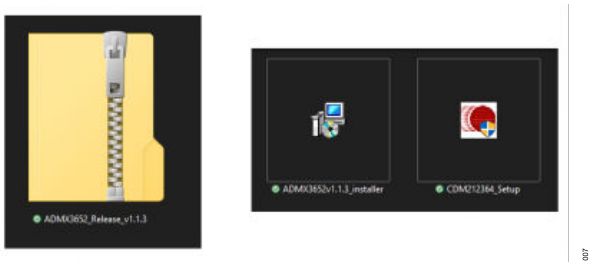

Figure 5. ADMX3652 GUI Driver and Installer

MODULE OPERATION

Driver Installation

After downloading the FTDI FT232RNL driver from the FTDI website, double-click on the downloaded driver file to extract the driver package and launch the installer (**Device Driver Installation Wizard**). See Figure 6.

Next, the **License Agreement** window pops up, select **I accept this agreement**, and then click **Next** (see Figure 7). The driver package is then extracted and installed. After it completes the installation process, click **Finish**.

Only after the driver installation is complete can the ADMX3652 be detected when a device is connected to the host PC.

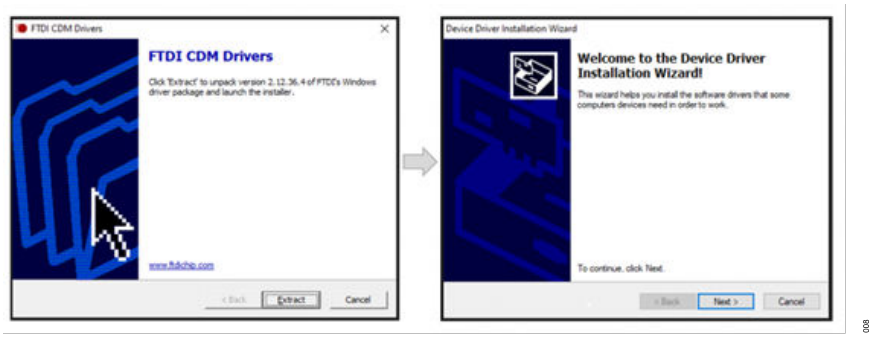

Figure 6. FTDI CDM Drivers File Package Extraction

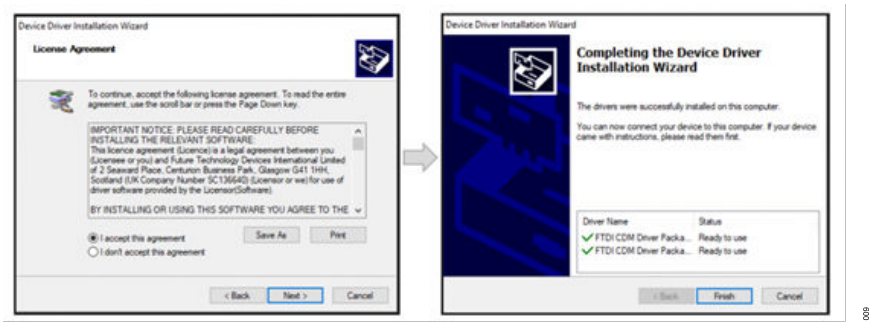

Figure 7. FTDI CDM Drivers License Agreement Acceptance

MODULE OPERATION

ADMX3652 Evaluation GUI Software Installation

Double-click on the **ADMX3652 Evaluation GUI Software** installer file to run the installer, and select **I accept the agreement**, and then click **Next** (see Figure 8).

Then, navigate to the directory that you want to install the **ADMX3652 Evaluation GUI Software** to and click **Next**. After installation completes, click **Finish** (see Figure 9).

When the software installation is complete, the **ADMX3652 Evaluation GUI Software** is ready for use.

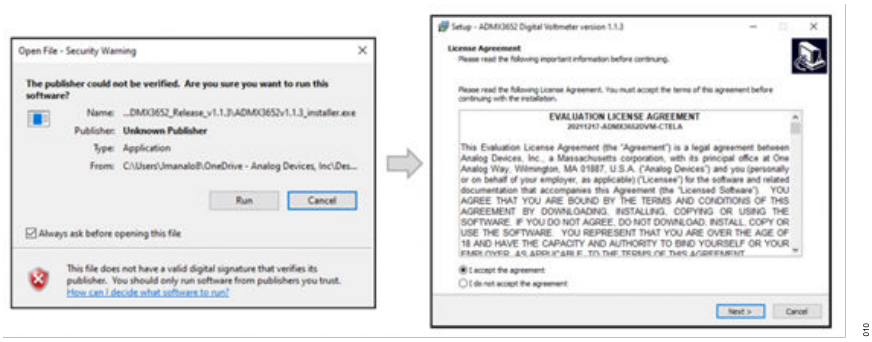

Figure 8. ADMX3652 Evaluation GUI Software License Agreement Acceptance

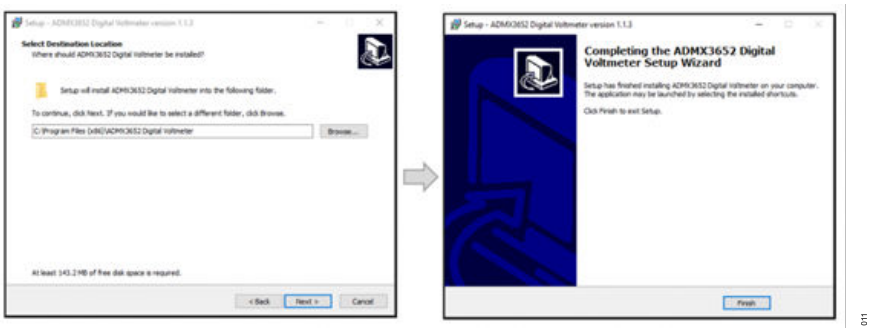

Figure 9. ADMX3652 Evaluation GUI Software Installation Location Selection

MODULE OPERATION

Software Operation

See Figure 11 for the default interface of the **ADMX3652 Evaluation GUI Software** after start-up.

Click **Connect** to start using the GUI. A dialog box then pops up for **Serial Port** and **Baud Rate** selection by the user (see Figure 10). The GUI automatically detects the serial port that the ADMX3652 is mapped to on the computer. If the GUI fails to detect the serial port, check the hardware connection, and try again. The baud rate must match device's setting and the factory default setting of baud rate is 460, 800. Then, click **Confirm** to continue.

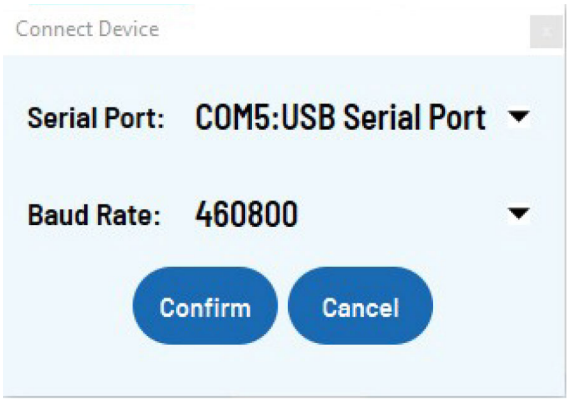

Figure 10. Serial Port Configuration

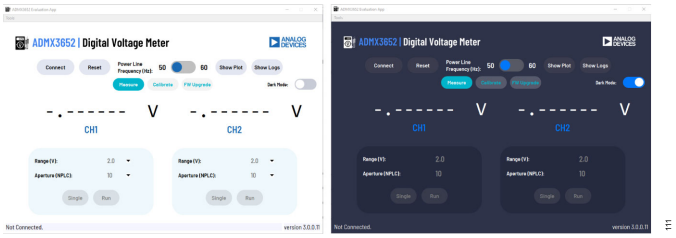

Figure 11. ADMX3652 Evaluation GUI in Display Modes

Note that it takes approximately 5 seconds to load the settings after clicking **Confirm** for this tool to initiate before it is ready for measurement.

MODULE OPERATION

Basic Functions

After establishing the connection between the ADMX3652 and the **ADMX3652 Evaluation GUI Software** tool, the functions of the tool activate and then allow operation by the user.

Connect or Disconnect Function

After a connection to the ADMX3652 is established, the **Connect** button changes to **Disconnect**. Click **Disconnect** to disconnect the communication between the **ADMX3652 Evaluation GUI Software** tool and the ADMX3652. Once disconnected, all settings are disabled and can no longer be changed.

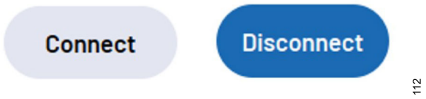

Figure 12. Connect or Disconnect Function

Reset Function

In the connection state, click **Reset** for the **ADMX3652 Evaluation GUI Software** tool to send a command of *RST (see Table 1) to the device to set it to the default factory settings. Once the device resets, users see a loading circle, and the settings are disabled.

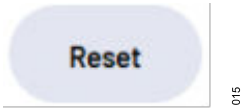

Figure 13. Reset Function

Setting the Power Line Frequency Function

Set the power line frequency according to the standard AC line frequency. This setting depresses normal mode noise from the power line frequency. Select the correct frequency according to the location of the device.

Note that the power line frequency is set to 50 Hz by default.

Figure 14. Power Line Frequency Setting

Light and Dark Mode Function

The user interface can be set according to the preference of the user.

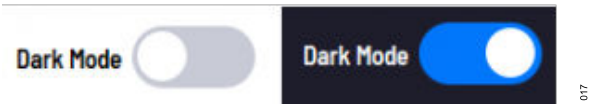

Figure 15. Light and Dark Mode Function

Voltage Display Function

The measured voltage displays in the **Voltage Display** boxes. The box displays as dash lines before any actual measurements. When the measured voltage is more than 10% tolerance of the measuring range, it displays as **OVERLOAD**.

Figure 16. Voltage Display Boxes

Status Bar Function

The status bar displays dynamically the current status of the **ADMX3652 Evaluation GUI Software** tool, for example, connected, disconnected, measurement done, and so on.

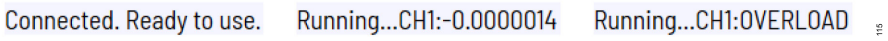

Figure 17. Status Bar Function

MODULE OPERATION

Data Logger Function

The **Data Logger** function records all measured data during the process, which can be exported to an excel file. Activate the function by clicking **Show Logs** button to pop up a window of **Data Logger**. The logs include the attributes of time stamp, channel settings, and measurements of each channel. It must be noted of that time stamp is not the time of measurements by device, but the time when GUI received measurements from device, which is for user reference only.

The user can select to display records for Channel 1, Channel 2, or both channels using the buttons in the window. Click **Clear Logs** to clear the display, and click **Export** to export the logs.

The measurements of Channel 1 and Channel 2 are recorded and saved separately.

When it is connected, the **Data Logger** starts to record measurements continuously after activating the data logger function, even if the window of **Data Logger** is closed. Disconnecting the device or clicking the **Clear Logs** button clear the historical data of **Data Logger**.

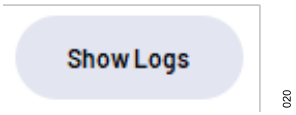

Figure 18. Show Logs Button

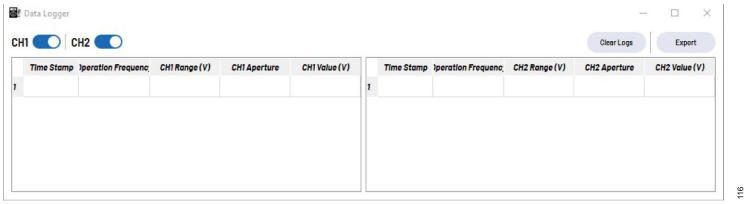

Figure 19. Data Logger

MODULE OPERATION

Data Plotter Function

The data plotter function plots measured data in a graph during the process. Click **Show Plot** to activate the feature and open a graph window. The measurement results of channel 1 are plotted in orange curve with Y-axis scale on the left. In contrast, the measurement results of channel 2 are plotted in blue curve with Y-axis scale on the right. The Y-axis scales are automatically adjusted according to measurement results by default, and users can set the Y-axis scales manually. In X-axis, it can plot maximum 5000 measurements for each channel. The window only scrolls and plots the latest 5000 measurements once it reaches the limit. It must be noted of that the depiction of the X-axis does not represent the actual measurement time, but is depicted in sequence according to the data received by the GUI.

At the bottom of window, some graph operation tools are available, including dragging, zooming in, layout configuration, axis setting, saving, and cleaning chart.

When the device is connected successfully and the data plotter function is activated, the plotting window starts to plot data in the graph. The graph continuously plots data and retains the historical data even if the plotting window is closed. The historical data is cleared when **Clear** button is clicked or when the device is disconnected.

Figure 20. Show Plot Button

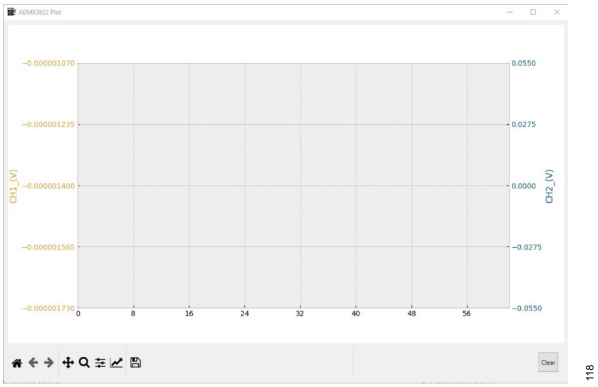

Figure 21. Data Plotter Window

Channel Configuration

The following measurement configurations: range selection, aperture and NPLC, single mode, and **Run** and **Stop**, are separately available for two channels of the ADMX3652. These settings can be configured independently based on the measurement needs of users.

Range Selection

There are four options for setting the measurement range: **Auto**, **0.2V**, **2.0V**, or **20V**. Selecting one of these measurement options results in the maximum input being within the selected range plus 10% tolerance. If the **Auto** option is selected, the ADMX3652 automatically switches the measurement range based on the input voltage.

Note that the measurement range default factory setting is **2.0V**.

Figure 22. Range Selection Choices

Aperture and Number of Power Line Cycles (NPLCs)

The aperture time is the period of time used for reading the input signal. A larger aperture time results in a better resolution, and a shorter aperture time results in a faster measurement speed and a faster sampling data output rate. The unit used for specifying aperture time with the ADMX3652 is in NPLCs.

Note that when the NPLCs are set differently and two channels are continuously measured, the sampling data output rate of two channels is determined by the slower one.

Figure 23. Aperture (NPLC) Selection

The aperture time options include **0.05**, **0.1**, **0.25**, **0.5**, **1**, **10**, or **100**.

Note that the default factory setting for aperture is **10**.

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Single Mode

When a single measurement is required, click **Single**. When a measurement is set to continuously run, click **Single**, which can also function as **Stop** button.

Figure 24. Single Mode Button

Run or Stop

To trigger continuous measurement, click **Run**. When continuously running, the **Stop** button is active, and the **Run** button is disabled.

For Channel 1 (CH1), the factory default setting is **Run**, and for Channel 2 (CH2), the factory default setting is **Stop**.

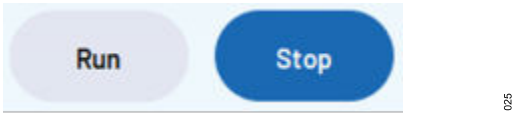

Figure 25. Run or Stop Buttons

Device Operation

Baud Rate Configuration

The ADMX3652 supports communication through SCPI protocol at different baud rate from 9600 bps to 460800 bps. The default factory setting of baud rate is 460800 bps. The user can access the function through the menu of tools on top of the GUI. A **Set Baud Rate** window pops out for user to select baud rate from list and confirm the selection by **Confirm** button. Then, there is a message to confirm if the operation succeeded or failed. If the user sets the baud rate while the device connection is still active, the GUI automatically adjusts the new baud rate.

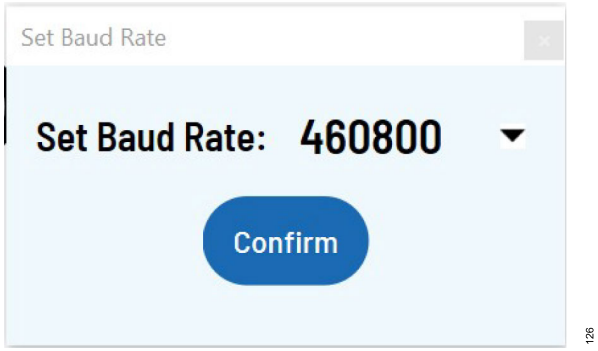

Figure 26. Set Baud Rate

Firmware Upgrade

To continuously improve user experience, the ADMX3652 may release new firmware without notifying the user in advance. The user decides whether to upgrade to the new version according to their own needs. The upgrade operation is implemented through the GUI. User can download the latest GUI version by visiting www.analog.com to obtain the latest firmware.

The FW upgrade page can be accessed by clicking the **FW Upgrade** button after connecting the device. On the page, the GUI automatically obtains the current firmware version of the device and suggests the version of firmware contained in the GUI. When the current firmware supports and meets the upgrade requirements, the GUI allows user to implement the upgrade operation.

Before upgrading, read carefully the precautions for operating firmware upgrade and follow them strictly in the process. When user is ready to upgrade, click the **Upgrade** button to start the process, and a progress bar pops up to prompt the progress. The time of upgrading operation is associated with the communication baud rate. The higher the baud rate, the faster the upgrade is completed.

The firmware upgrade function is only available for revision 4.8.1 and later.

Figure 27. FW Upgrade Button

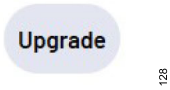

Figure 28. Upgrade Start Button

SCPI COMMANDS

The ADMX3652 supports the SCPI protocol. Users can develop their own control software or integrate software operation into their system by using the SCPI protocol commands properly.

All of the down programming data and up return data of the protocol is presented by ASCII character strings. For additional information on the SCPI protocol, refer to the SCPI Consortium or the IEEE Standard 488.

ADMX3652 Self Test

Once the ADMX3652 is powered up, it starts a self test, and outputs self test information through its communication port. The self test process checks power rails one by one. The self test process repeatedly checks each of the power rails until each power rail is normal or times out, and then checks the next power rail. The self test process takes about 45 seconds on a cold start or about

MODULE OPERATION

10 seconds on a hot start. After the self test process completes, the ADMX3652 outputs a **DAQ is ready to use** message.

IEEE 488.2 Common Commands

The following tables detail the IEEE 488.2 common commands (***RST** and ***IDN?**).

*Table 1. Command, *RST*

Syntax	***RST**
Function	Resets the ADMX3652 to the factory default states.
Explanations	After this command is received, the ADMX3652 sets all parameters to the factory default values, except the calibration parameters and baud rate setting. Then, the ADMX3652 restarts to initiate the device.
Example	***RST**

*Table 2. Command, *IDN?*

Syntax	***IDN?**
Function	Queries the ID character string of the instrument.
Explanations	The query returns two character segments separated by commas: manufacturer, internal device name.
Example	***IDN?** returns **ADMX3652**.

Configuration Commands

The following tables detail the configuration commands (**SYSTem:PLC:SET**, **CONFigure:VOLTage:DC**, **CONFigure:VOLTage:DC?**, **CONFigure:VOLTage:DC:NPLCycles**, **CONFigure:VOLTage:DC:NPLCycles?**, **SYSTem:BAUDRATE:SET**, **SYSTem:BAUDRATE:SET?**, **CONFIGURE:INFormation?**, and **CONFigure:CONTINUOUS:READ**).

Table 3. Command, SYSTem:PLC:SET

Syntax	**SYSTem:PLC:SET {50|60}**
Function	Sets the power line frequency as 50 Hz or 60 Hz.
Explanations	Users can use this function to set power line frequency to reject the power line noise when NPLC is set to be greater than or equal to 1.
Example	**SYSTem:PLC:SET 50** sets power line frequency as 50 Hz.

Table 4. Command, CONFigure:VOLTage:DC

Syntax	**CONFigure:VOLTage:DC {1|2}, {0.2|2|20|AUTO}**
Function	Sets the measuring voltage range of Channel 1 or Channel 2.
Explanations	Users can use this function to set Channel x to its measurement range option: 0.2 V, 2 V, 20 V, or auto range. Use **{1|2}** to specify the channel and **{0.2|2|20}** to specify the range. Channel 1 and Channel 2 must be set separately with two commands.
Example	**CONFigure:VOLTage:DC 1,20** sets the measurement range of Channel 1 to ±20 V.

Table 5. Command, CONFigure:VOLTage:DC?

Syntax	**CONFigure:VOLTage:DC? {1|2}**
Function	Queries the measuring voltage range of Channel 1 or Channel 2.
Explanations	Users can use this function to query the measuring voltage range of Channel x. Use **{1|2}** to specify the channel. Channel 1 and Channel 2 must be queried separately with two commands.
Example	**CONFigure:VOLTage:DC? 1** returns the measuring voltage range of Channel 1.

Table 6. Command, CONFigure:VOLTage:DC:NPLCycles

Syntax	**CONFigure:VOLTage:DC:NPLCycles{1|2}, {0.05|0.1|0.25|0.5|1|10|100}**
Function	Sets the aperture time of Channel 1 or Channel 2.
Explanations	Users can use this function to set the aperture time of Channel x according to the PLC. The higher the aperture time results in a higher measurement resolution. The aperture time is calculated as NPLC times the cycle time of the power line frequency. The aperture time can be set differently for each channel.
Example	**CONFigure:VOLTage:DC:NPLCycles1,10** sets the Channel 1 aperture time to 400 ms when the power line frequency is 50 Hz and auto-zero is enabled.

Table 7. Command, CONFigure:VOLTage:DC:NPLCycles?

Syntax	**CONFigure:VOLTage:DC:NPLCycles? {1|2}**
Function	Queries the NPLC setting of Channel 1 or Channel 2.
Explanations	User can use this function to query the NPLC setting of Channel x according to PLC. Use **{1|2}** to specify the channel. Channel 1 and Channel 2 must be queried separately with two commands.
Example	**CONFigure:VOLTage:DC:NPLCycles? 1** returns the NPLC setting of Channel 1.

Table 8. Command, SYSTem:BAUDRATE:SET

Syntax	**SYSTem:BAUDRATE:SET {9600|14400|19200|38400|57600|115200|230400|460800}**[1]
Function	Sets the baud rate of the UART communication.
Explanations	User can use this function to set the baud rate of the UART communication interface. The new baud rate activates immediately after this command is transmitted. Each baud rate matches its minimum supported NPLC setting as suggested in Table 10, which must be followed.
Example	**SYSTem:BAUDRATE:SET 460800** sets the baud rate to 460,800 bps.

[1] This command is valid in the firmware version of Revision 4.5.1 and afterward.

Table 9. Command, SYSTem:BAUDRATE:SET?

Syntax	**SYSTem:BAUDRATE:SET?**
Function	Queries the current baud rate of the UART communication.

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Table 9. Command, SYSTem:BAUDRATE:SET? (Continued)

Explanations	User can use this function to query the baud rate of the UART communication interface.
Example	**SYSTem:BAUDRATE:SET?** returns the current baud rate of the UART communication.

Table 10. Rule of Baud Rate and Minimum NPLC Setting

Baud Rate	Minimum Supported NPLC
9600	10
14,400	10
19,200	10
38,400	1
57,600	0.5
115,200	0.25
230,400	0.1
460,800	0.05

Table 11. Command, CONFIGURE:INFormation?

Syntax	**CONFIGURE:INFormation?**[1]
Function	Queries the current baud rate and the NPLC of two channels.
Explanations	The query returns the baud rate of UART communication, Channel 1 NPLC and Channel 2 NPLC.
Example	**CONFIGURE:INFormation?** returns the baud rate of the UART communication, Channel 1 NPLC and Channel 2 NPLC.

[1] This command is valid in the firmware version of Revision 4.5.1 and afterward.

Table 12. Command, CONFigure:CONTINUOUS:READ

Syntax	**CONFigure:CONTINUOUS:READ {1|2}, {ON|OFF}**
Function	Sets the measurement mode as single or continuous read for Channel 1 or Channel 2.
Explanations	Users can use this function to set Channel x to measurement mode: **ON** results in continuous mode, and **OFF** results in single mode. This setting is valid only in internal trigger mode. For a single read, the outputs of the ADMX3652 measured value is per the query command, **MEASure:COMMAND**. In continuous read, the ADMX3652 automatically outputs the measured value continuously based on the aperture time setting. Channel 1 and Channel 2 can be set into different modes.
Example	**CONFigure:CONTINUOUS:READ1,ON** sets Channel 1 to continuous measurement mode.

Measurement Command

The following table details the measurement command (**MEASure:VOLTage:DC?**).

Table 13. Command, MEASure:VOLTage:DC?

Syntax	**MEASure:VOLTage:DC? {1|2}.**

Table 13. Command, MEASure:VOLTage:DC? (Continued)

Function	Reads the measurement voltage for Channel 1 or Channel 2.
Explanations	This command is only valid when a channel is set to single read mode. The ADMX3652 returns a measured voltage value after the aperture time of the channel.
Example	**MEASure:VOLTage:DC?1** returns the measured value for Channel 1.

Trigger Command

The following table details the trigger command (**TRIGger:SOURce**, **TRIGger:SOURce?**).

Table 14. Command, TRIGger:SOURce

Syntax	**TRIGger:SOURce {INTernal|EXTernal}.**[1]
Function	Sets the trigger source as an internal or external source.
Explanations	Users can use this function to set the trigger source for measurement. This function is mainly used for synchronization when using multiple devices in a system. This command can apply to two channels simultaneously. The default for this command is an internal trigger.
Example	**TRIGger:SOURce EXTernal** sets the trigger source of the device to an external trigger.

[1] The parameter for this command is **{IMMediate|EXTernal}** in the firmware version of Revision 4.5.1 and earlier.

Table 15. Command, TRIGger:SOURce?

Syntax	**TRIGger:SOURce?**
Function	Queries the current trigger source for measurement.
Explanations	User can use this function to query current trigger source for measurement. The return represents the trigger source for two channels.
Example	**TRIGger:SOURce?** returns the trigger source of the device.as "INTERNAL" or "EXTERNAL".

System Commands

The following tables detail the system commands (**SYSTem:ZERO:CAL**, **SYSTem:POS:FULL:CAL**, **SYSTem:NEG:FULL:CAL**, **SYSTem:CAL:DATE**, **SYSTem:CAL:DATE?**, **SYSTem:CAL:STORE**, and **SYSTem:INFormation?**, **SYSTem:CAL:TIMES?**).

Table 16. Command, SYSTem:ZERO:CAL

Syntax	**SYSTem:ZERO:CAL {1|2}, {value}.**
Function	Users can use this zero calibration function to set the range for Channel 1 or Channel 2.
Explanations	Input the value from the source to Channel x, and the valid input must be between −10% and +10% of full scale. This command returns **Calibration in progress... Channel *X* Calibration Done** and the measured value once it is transmitted successfully. Otherwise, the calibration is inva-

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Table 16. Command, SYSTem:ZERO:CAL (Continued)

	lid, and this command returns **Calibration in progress... Channel 1 input voltage is too high**.
Example	**SYSTem:ZERO:CAL 1, 0.**

Table 17. Command, SYSTem:POS:FULL:CAL

Syntax	**SYSTem:POS:FULL:CAL {1|2}, {value}.**
Function	Users can use this positive full-scale calibration function to set the range for Channel 1 or Channel 2.
Explanations	The value is input from the source to Channel x and the valid input must be between 80% and 120% of positive full scale. This command returns '**Calibration in progress... Channel *X* Calibration Done**' and the measured value once it is transmitted successfully. Otherwise, the calibration is invalid, and this command returns **Calibration in progress... Channel X full scale calibration data can not exceed 80% ~ 120% of Full Scale**.
Example	**SYSTem:POS:FULL:CAL 1, 0.2.**

Table 18. Command, SYSTem:NEG:FULL:CAL

Syntax	**SYSTem:NEG:FULL:CAL {1|2}, {value}.**
Function	Users can use this negative full-scale calibration function to set the range for Channel 1 or Channel 2.
Explanations	The value is input from the source to Channel x, and the valid input must be between 80% and 120% of negative full scale. This command returns **Calibration in progress... Channel *X* Calibration Done** and the measured value once it is transmitted successfully. Otherwise, the calibration is invalid, and this command returns **Calibration in progress.. Channel X full scale calibration data can not exceed 80% ~ 120% of Full Scale**.
Example	**SYSTem:NEG:FULL:CAL 1, −0.2.**

Table 19. Command, SYSTem:CAL:DATE

Syntax	**SYSTem:CAL:DATE {20yy}, {mm}, {dd}.**
Function	Users can use this function to write the calibration date into the ADMX3652.
Explanations	This command must run after calibration, or it returns **please execute calibration firstly**. In the command, **20yy** is the year, **mm** represents the month, and **dd** represents the day. The ADMX3652 returns **Calibration Date year-month-day: 20yy-mm-dd**.
Example	**SYSTem:CAL:DATE 2023, 01, 01.**

Table 20. Command, SYSTem:CAL:DATE?

Syntax	**SYSTem:CAL:DATE?**
Function	Queries the last calibration date.
Explanations	User can use this function to query the date of the last successful calibration.

Table 20. Command, SYSTem:CAL:DATE? (Continued)

Example	**SYSTem:CAL:DATE?** returns the last calibration date.

Table 21. Command, SYSTem:CAL:STORE

Syntax	**SYSTem:CAL:STORE {ON|OFF}.**
Function	Users can use this function to save or erase calibration data and information.
Explanations	This command must go after **SYSTem:CAL:DATE**, or it returns **please input calibration date first, command: SYSTem:CAL:DATE [year],[month],[day]**.
Example	**SYSTem:CAL:STORE ON.**

Table 22. Command, SYSTem:INFormation?

Syntax	**SYSTem:INFormation? {HARdware|FIRmware|BATch|MANufacture}**
Function	Queries the device information of the instrument.
Explanations	The query returns hardware version, firmware version, serial number, and manufacturing date.
Example	**SYSTem:INFormation? FIRmware** returns the firmware version.

Table 23. Command, SYSTem:CAL:TIMES?

Syntax	**SYSTem:CAL:TIMES?**
Function	Queries the total calibration times on the device.
Explanations	The device records times of successful calibration. User can use this function to query the calibration times of the device.
Example	**SYSTem:CAL:TIMES?** returns the total calibration times.

ERROR CODES AND TROUBLESHOOTING

Error Operating the ADMX3652 Evaluation GUI Software

When using the EVAL-ADMX3652-INT interface board to power and communicate with the ADMX3652 and a PC, in some cases, the COM port may fail to be recognized because of the following reasons:

- The hardware is not connected properly; check and confirm hardware connections.
- The driver is not installed properly (see the Software Installation section to install or reinstall the driver).

Error Codes Feedback in UART Communication

When communicating with the ADMX3652, error codes or messages can be returned from the device. Refer to Table 24 for error code messages, descriptions, and troubleshooting. If the user receives an error message that is not listed below, contact Analog Devices Sales for further assistance.

MODULE OPERATION

Table 24. Error Code Messages and Troubleshooting

Index	Error Code Message	Description	Troubleshooting
1	**ADC Error during self-test**	The ADMX3652 performs a self-test of ADC at startup and periodically during measurements. When an error is detected, the device outputs a message that starts with "Adc...".	Hardware has issue. Contact Analog Devices Sales for further assistance.
2	**ADC Error during measurement**	The signal chain of the channel is not typical for ADC conversion. When an error is detected, the device outputs messages beginning with "ADC encounter ADC_ERROR...".	Hardware has issue. Contact Analog Devices Sales for further assistance.
3	****ERROR: -113, "Undefined header"**	This command is not supported by the ADMX3652.	Change the command to a supported command and retry.
4	****ERROR: -224, "Illegal parameter value"**	The parameter does not comply with the command.	Check the parameter and retry.
5	****ERROR: -101, "Invalid character"**	The command includes unrecognized characters.	Check the command and retry.
6	****ERROR: -200, "Execution error"**	This command includes execution failure.	Check if the baud rate or NPLC in the configuration command follows the rule in Table 10.

CALIBRATION

Due to the natural performance drift of electronic components, regular calibration is essential for high-precision measurement in a long run use to remove deviations for reliable results. The recommended calibration interval for the ADMX3652 is one year.

The ADMX3652 adopts three point correction: zero, positive full scale, and negative full scale. In principle, zero calibration removes offset, and positive full scale and negative full scale calibration remove gain errors.

Note that, if the board is soldered onto the board of the user, it is assumed that the suggested circuitry in the Electrical Installation section was added on the board for simple access.

CALIBRATE WITH THE ADMX3652 EVALUATION GUI SOFTWARE

The **ADMX3652 Evaluation GUI Software** integrates calibration functionality. Use a high-precision calibrator, such as the Fluke 5720A, and the EVAL-ADMX3652-INT interface board as a carry board to build a calibration system by taking the following steps:

1. Mount the ADMX3652 to EVAL-ADMX3652-INT interface board. Connect the EVAL-ADMX3652-INT interface board to the host computer and calibrator.
2. Power on and warm up the ADMX3652 for at least 30 minutes, and then connect the Channel 1 (**CH1**) port to the calibrator via a coaxial cable. Set the NPLC of both channels to 100 in the **ADMX3652 Evaluation GUI Software**, and Channel 1 is ready to calibrate.
3. In **ADMX3652 Evaluation GUI Software** interface, click **Calibrate** and the **ADMX3652 Evaluation GUI Software** switches to the calibration interface.

Figure 29. Measure and Calibrate Buttons

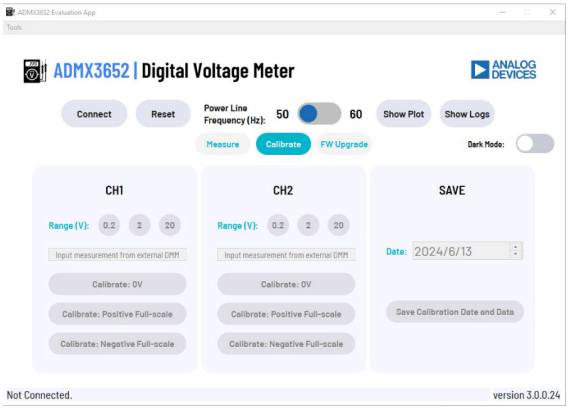

Figure 30. Main Calibration Screen

4. Set the voltage range of **CH1** to **0.2V**.

Figure 31. Range Selection Area

5. Set the calibrator to output 0 V, type **0** in the input box, and click **Calibrate: 0 V** to complete the zero calibration for the 0.2 V range. The background of **Calibrate: 0 V** is reversed after being clicked.

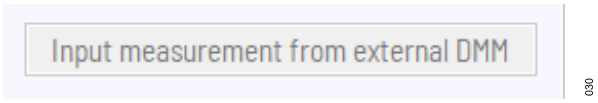

Figure 32. Calibration Point Text Box

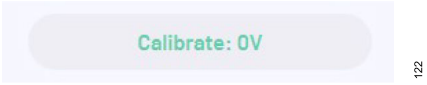

Figure 33. Confirmation Button for 0 V Calibration

6. Set the calibrator to output 0.2 V (the positive full scale of the calibration range), then type **0.2** in the input box, and click **Calibrate: 0.2V** to complete the positive full-scale calibration for the 0.2 V range.
7. Set the calibrator to output −0.2 V (the negative full scale of the calibration range), then type **−0.2** in the input box, and click **Calibrate: -0.2V** to complete the negative full-scale calibration for the 0.2 V range.
8. Repeat Step 4 to Step 7 to complete calibration for the 2 V range and 20 V range.
9. Change hardware to feed the calibrator to Channel 2, and repeat Step 4 to Step 8 to complete calibration for Channel 2.
10. Select the **Date** and click **Save Calibration Date and Data** to load and activate the new calibration data.

    Note that it is not recommended to manually change the date as the GUI reads the date automatically, unless the user intentionally selects a different date.

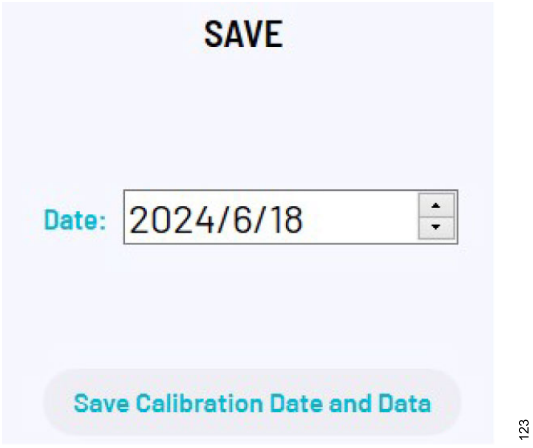

Figure 34. Save Date and Data of Calibration

CALIBRATION

Note that typically, calibration adjustment involves the use of precise devices of electrical signal sources that evaluate the performance of key properties for other devices called units under test (UUT). Because these precise devices have thoroughly known performance characteristics compared to the UUT, it is possible to use these devices to identify or minimize errors in performance evaluation and/or calibration adjustment of the UUT. Generally, the performance of such precision devices is four or more times better than the UUT. Usually, these electrical signal sources are often referred to as calibrators. For an example, the DC voltage uncertainty specification of the Fluke 5720A and Fluke 5730A can meet the calibration for the DC voltage meter up to 6½ digits.

Figure 35. Calibration Setup

CALIBRATION

CALIBRATE WITH SCPI COMMANDS

With supported SCPI commands, it is convenient for users to develop their own calibration software to avoid manual operation or to integrate calibration into the system software of the user. To build calibration software, take the following recommended steps:

1. Mount the ADMX3652 to EVAL-ADMX3652-INT interface board. Connect the EVAL-ADMX3652-INT interface board to the host computer and calibrator as shown in Figure 36.
2. Power on and warm-up the ADMX3652 for at least 30 minutes, and then connect the Channel 1 port to the calibrator via the coaxial cable. Set NPLC of both channels to 100 through the **CONFigure:VOLTage:DC:NPLCycles 1,100** command, and Channel 1 is ready to calibrate.
3. Set the output voltage range of Channel 1 to 0.2 V through the **CONFigure:VOLTage:DC 1,0.2** command.
4. Set the output voltage of the calibrator to 0 V, and then transmit the **SYSTem:ZERO:CAL 1, 0** command to complete the zero calibration for the 0.2 V range. After implementing successfully, the ADMX3652 returns a **Channel1 Calibration Done** message.
5. Set the output voltage of the calibrator to 0.2 V, and then transmit the **SYSTem:POS:FULL:CAL 1, 0.2** command to complete the positive full-scale calibration for the 0.2 V range. After implementing successfully, the ADMX3652 returns the **Channel1 Calibration Done** message.
6. Set the output voltage of the calibrator to −0.2 V, and then transmit the **SYSTem:NEG:FULL:CAL 1, −0.2** command to complete the negative full-scale calibration for the 0.2 V range. After implementing successfully, the ADMX3652 returns the **Channel1 Calibration Done** message.
7. Follow Step 3 to Step 6 to complete the calibration for 2 V and 20 V range.
8. Change hardware to feed the calibrator to Channel 2 and repeat Step 3 to Step 7 to complete the calibration of Channel 2.
9. Transmit the **SYSTem:CAL:DATE [20yy,mm,dd]** command to update the calibration date.
10. Transmit the **SYSTem:CAL:STORE ON** command to save the calibration data.

Note that it is assumed that the EVAL-ADMX3652-INT interface board is used as the carry board.

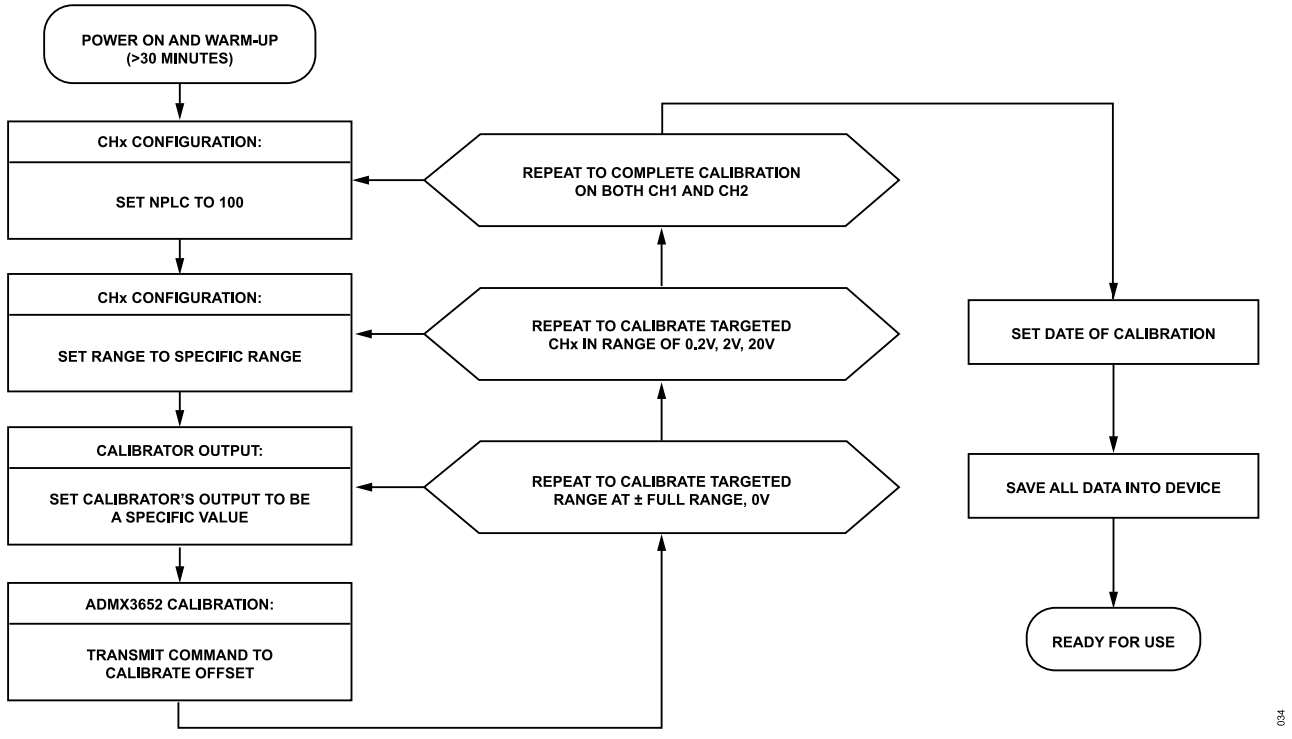

Figure 36. Process Flowchart for ADMX3652 Calibration

CALIBRATION

CALIBRATION OF THE ADMX3652 WITH THIRD PARTIES

As a general-purpose digital multimeter, the ADMX3652 can be calibrated by third-party metrology institutes. Contact Analog Devices sales for additional information on calibration service.

TECHNICAL SUPPORT

Calibration reports are available upon request for the ADMX3652, and technical support for hardware and software concerns can also be sent to admx3652-support@analog.com.

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.