



# ANALOG DEVICES MAXREFDES183 Portable Precision Calibrator User Guide

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**ANALOG DEVICES MAXREFDES183 Portable Precision Calibrator**



## Introduction

The MAXREFDES183# provides the following functions:

- Precision Analog Voltage Output,  $\pm 10\text{V}$  (+25% over range)
- Precision Analog Current Output,  $\pm 20\text{mA}$  (+25% over range)
- Precision Analog Voltage Input,  $\pm 10\text{V}$  (+25% over range)
- Precision Analog Current Input,  $\pm 20\text{mA}$  (+25% over range)
- Precision Temperature Measurement (external PT100/PT1000/Thermocouple Type K)
- Precision Temperature Simulator (simulates a temperature sensor)

This Quick Start Guide provides information about:

- First power-up/insert batteries
- Quick explanation on how to measure/source in each mode
- Special menu items
- System calibration

## Required Equipment

Supplied by Maxim Integrated®:

- MAXREFDES183#

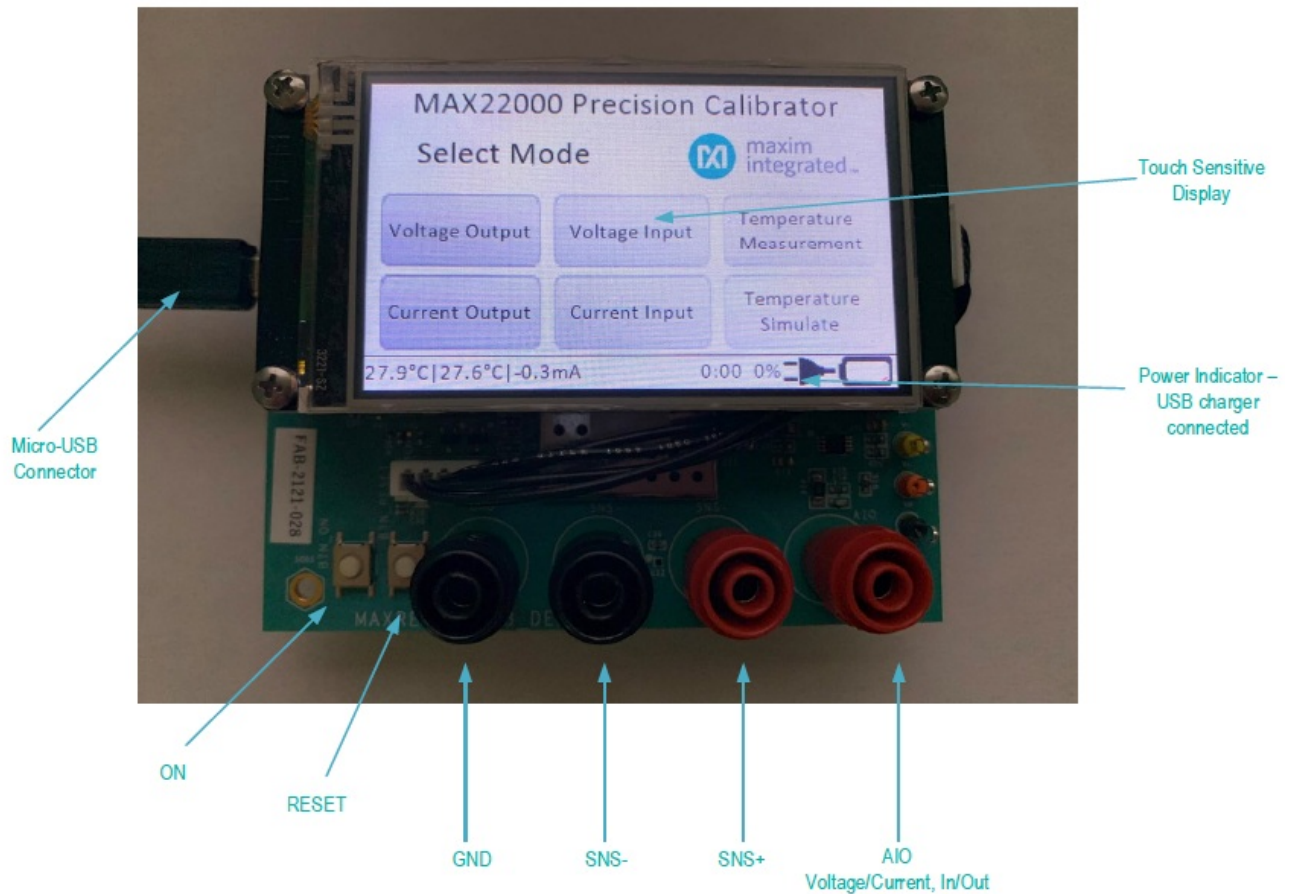
## User Supplied

- Batteries

- USB Charger
- Micro USB Cable
- Digital Multimeter (at least 6.5-digit DMM is recommended)

### First Power-Up/Insert Batteries

- The MAXREFDES183# is shipped without Li-ion batteries; the user must purchase and install these.
- The MAXREFDES183# can operate without batteries, by powering the system from a USB charger via a micro-USB cable. To avoid ground loops, please make sure your USB charger is isolated from GND and does not connect to anything else.
- The fully assembled (but without batteries) MAXREFDES183# reference design looks like







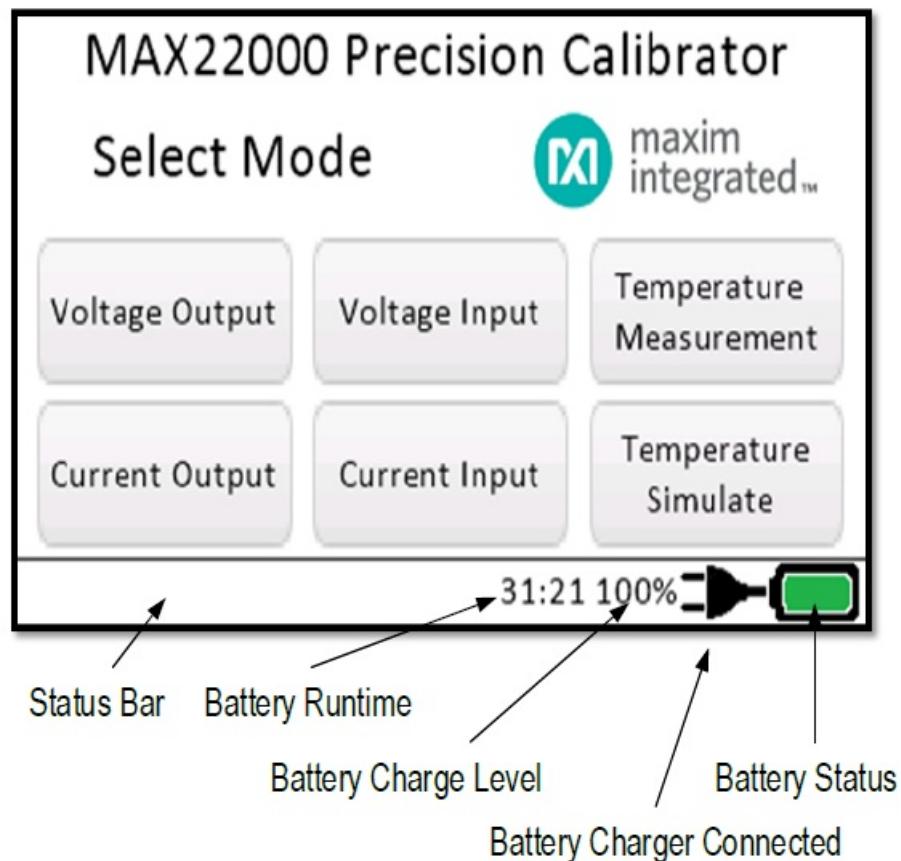


Figure 4. MAXREFDES183# bottom view.

**Status Bar:** System information is displayed here.

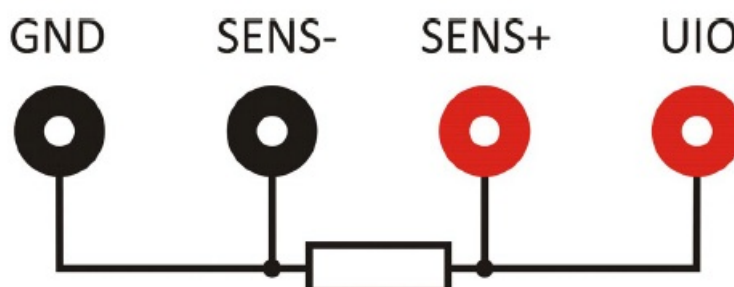
**Battery Runtime:** Estimated remaining battery runtime (hh:mm) at current power usage vs. battery charge level. Note, this time is estimated by the ModelGauge™ M5 algorithm. Initially, it may be inaccurate during the first 1 to 2 charge cycles. The algorithm resets if the batteries are removed.

**Battery Charge Level:** Display in % of maximum charge.

**Battery Charging Indicator:** This is displayed if a USB charger is connected, and the battery is charging.

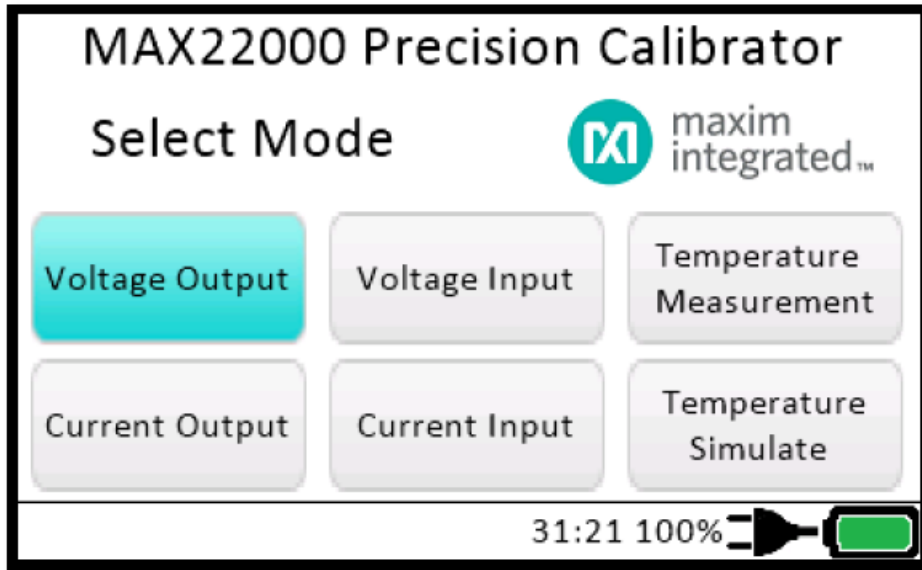
**Battery Status:** Color indicates battery status.

- As shown in Figure 1, the button to the right of the power button is a Reset button. This button resets the system. Sometimes it is more convenient to go back to the main screen by clicking the Reset button.
- The four banana plugs form a 4-wire port, which allows the system to source or measure voltage or current between the outer pins (GND) and (UIO). The two inner pins, SNS+ and SNS-, are inputs that allow true 4-wire measurements.



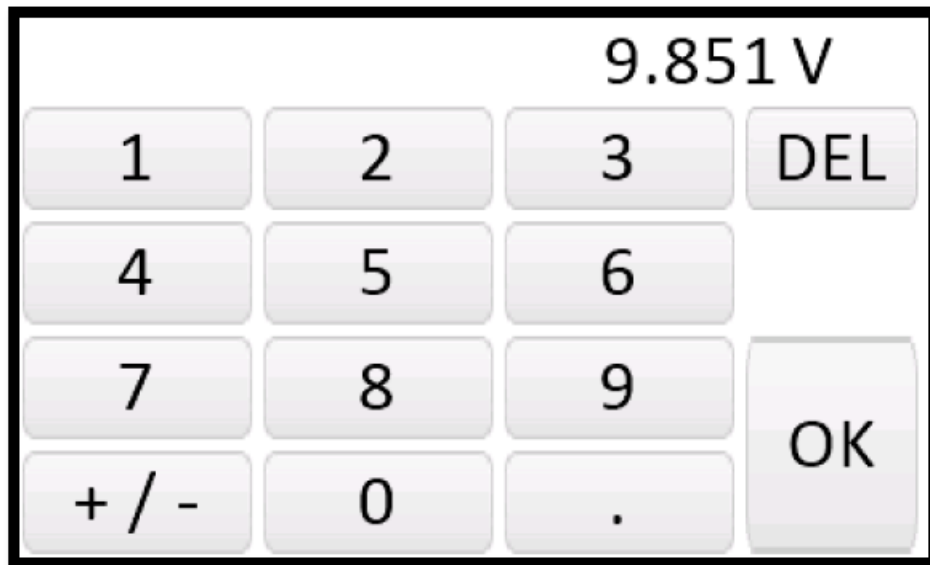
## How to Measure/Source in Each Mode

- To source voltage, click on the Voltage Output button



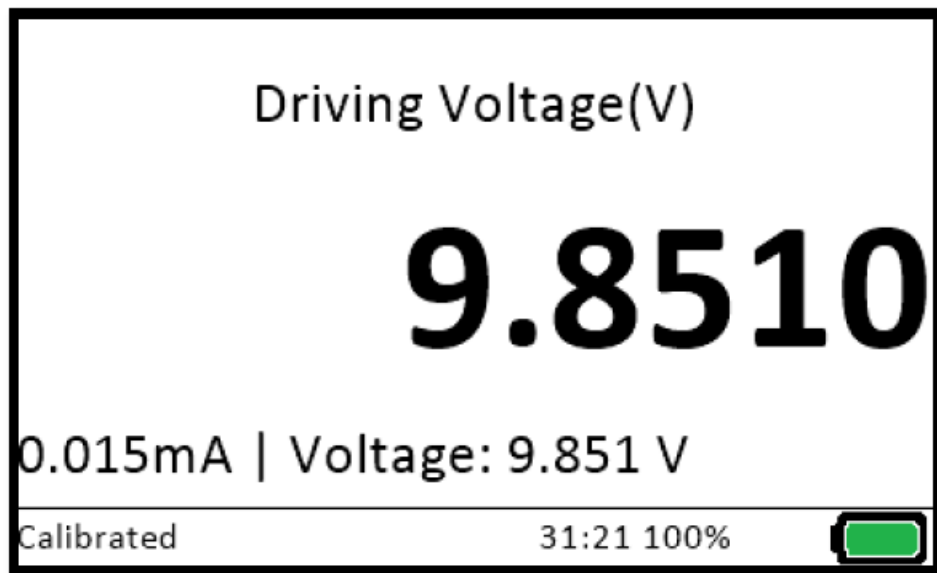
*Figure 6. MAXREFDES183# Voltage Output mode.*

- The next screen will ask the user to enter a voltage. Please enter a voltage between – 12.5V and +12.5V. Note for best accuracy, stay within the range of -10.5V and +10.5V. Once done, click OK. The voltage will be applied between the GND and UIO banana plugs.



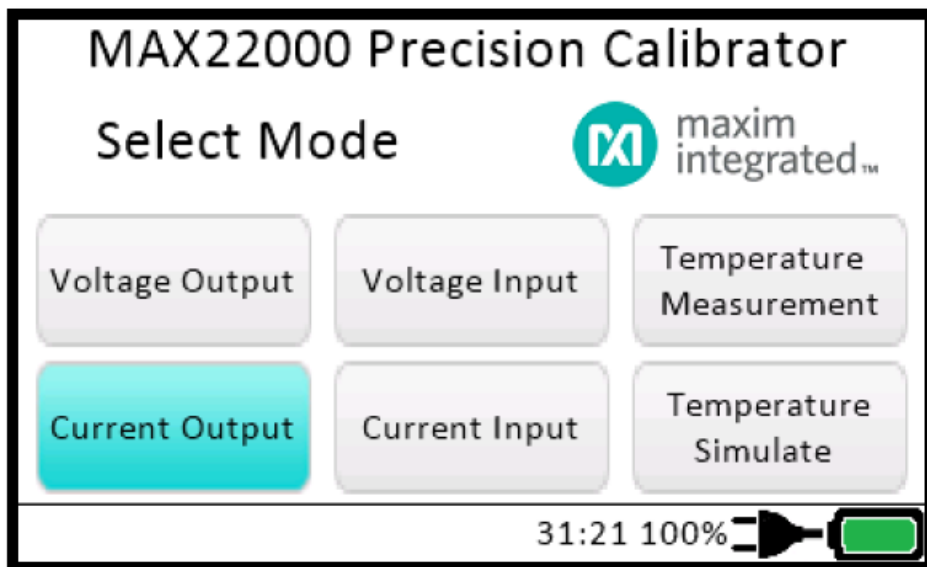
*Figure 7. MAXREFDES183# voltage output setting.*

- The next screen will show the setting that was typed in before. Below that, in smaller font, the current drawn at the UIO port as well as the measured voltage is shown. For example, if you short the output, the setting will still say 9.851V, while the readback should show approximately 0V.



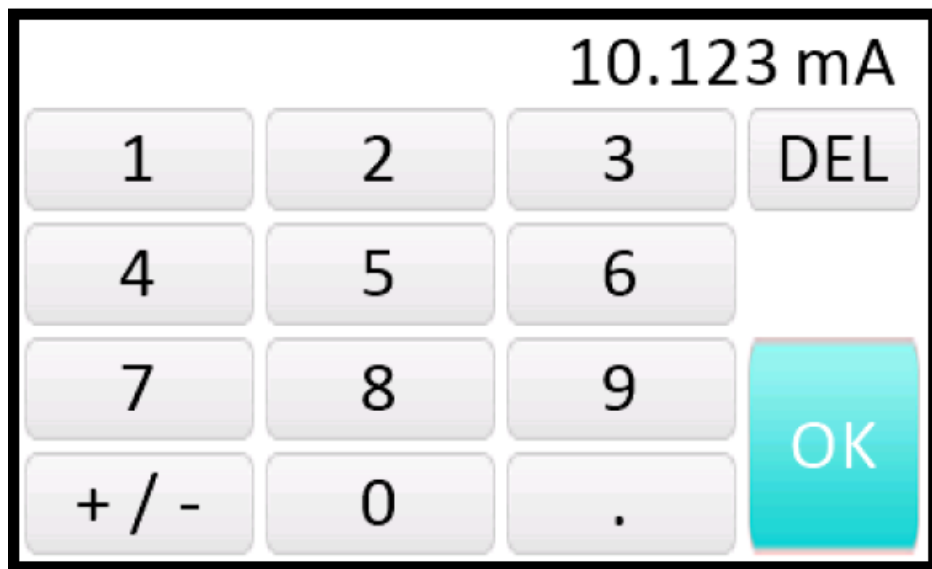
*Figure 8. MAXREFDES183# voltage output calibrated.*

- To source current, click on the Current Output button (Figure 9).



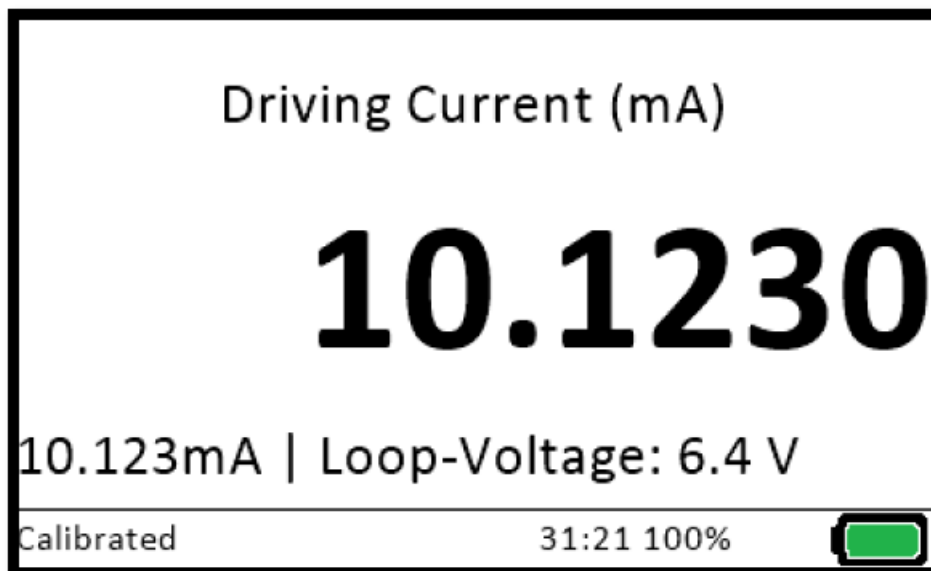
*Figure 9. MAXREFDES183# Current Output mode.*

- A new screen will show up and ask to enter a value for the current. Please enter a value between -25mA and +25mA. Note for best accuracy, stay within the range of -21mA and +21mA. Once done, click OK.



*Figure 10. MAXREFDES183# Current Output setting.*

- The next screen will show the setting that was entered previously. Below that, in smaller font, the current drawn at the UIO port, as well as the measured loop-voltage, is



*Figure 11. MAXREFDES183# current output calibrated.*

- To measure voltage, click on the Voltage Input button .



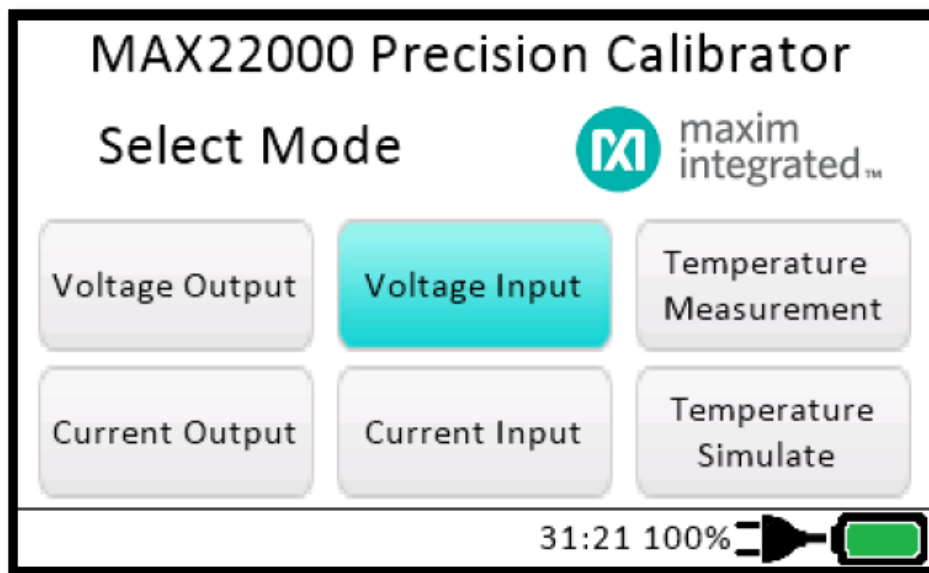


Figure 12. MAXREFDES183# Voltage Input mode.

- Connect a voltage source between the UIO and the GND ports. The next screen will directly show the voltage applied between the UIO and the GND plugs. Please note, the voltage range that can be measured is  $\pm 12.5V$ , but the best accuracy is achieved in the range of  $\pm 10.5V$
- To measure current, click on the Current Input button .

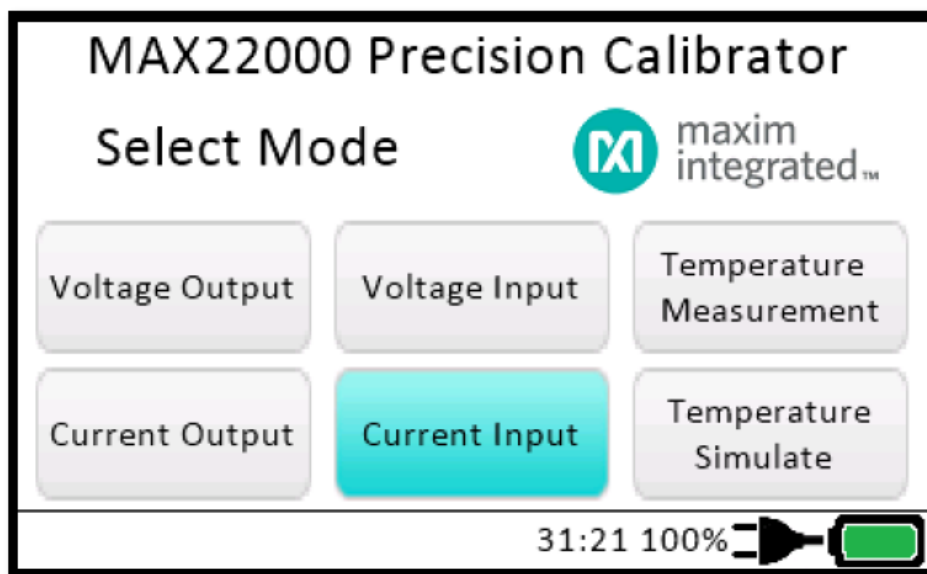


Figure 13. MAXREFDES183# Current Input mode.

- Connect a current source between the UIO and the GND ports. The next screen will directly show the current flowing between the UIO and the GND ports
- To measure temperature (PT100/PT1000/TC Type K), click on the Temperature Measurement button

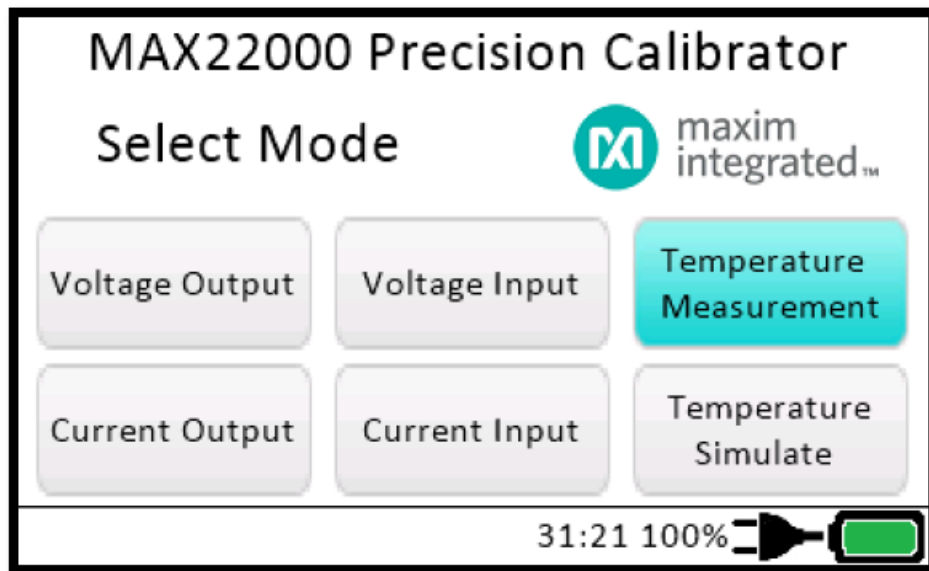


Figure 14. MAXREFDES183# Temperature Measurement mode

- The next screen will show how to connect the temperature-sensor (4-wire mode). Connect a sensor as instructed and click OK.

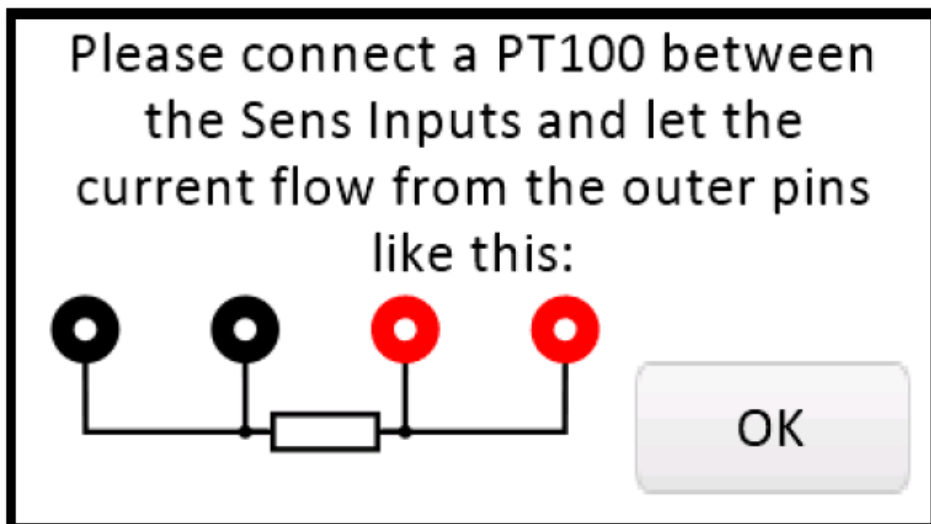


Figure 15. MAXREFDES183# temperature measurement connection.

- The next screen will display the temperature based on the selected temperature-sensor type and measured resistance (PTxxx)/voltage (TC).

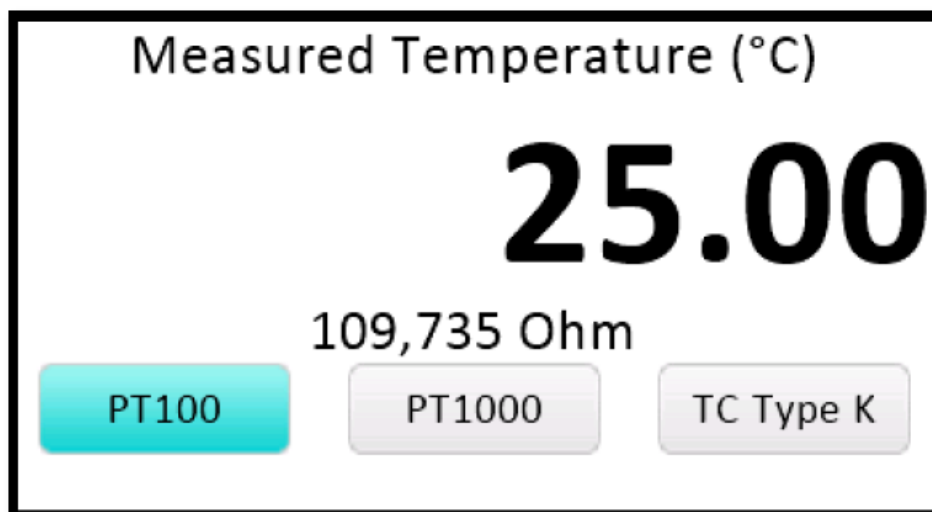
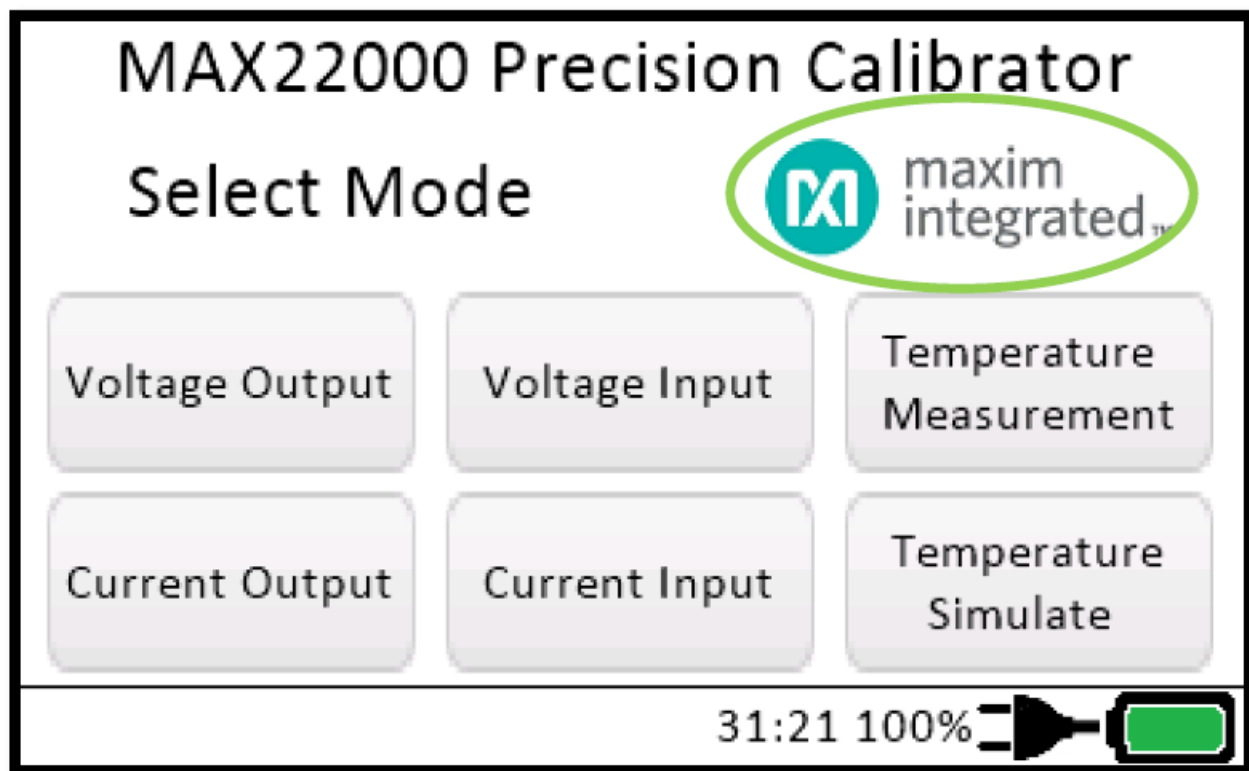


Figure 16. MAXREFDES183# temperature measurement options.

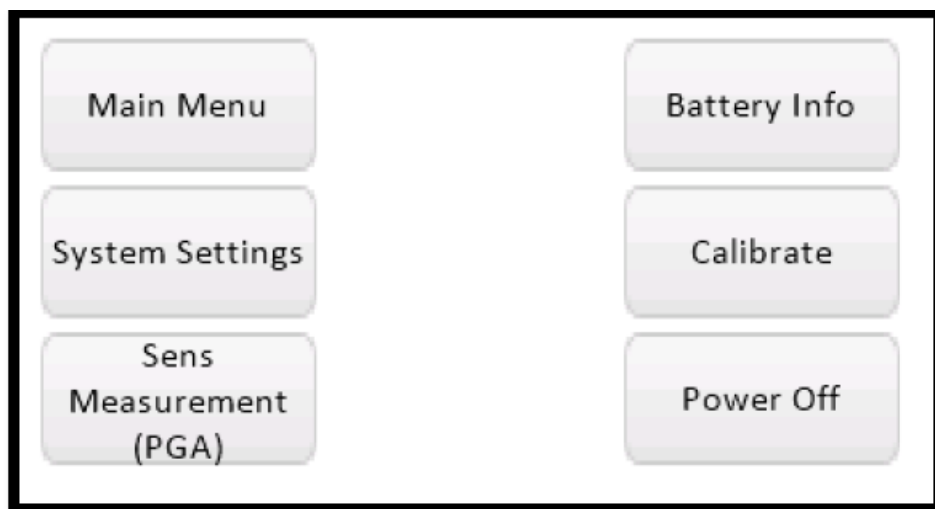
## Special Menu Items

- In addition to the normal user functions found in commercial precision calibrators, MAXREFDES183# has some special functions which can be accessed by clicking on the Maxim Logo in the main menu



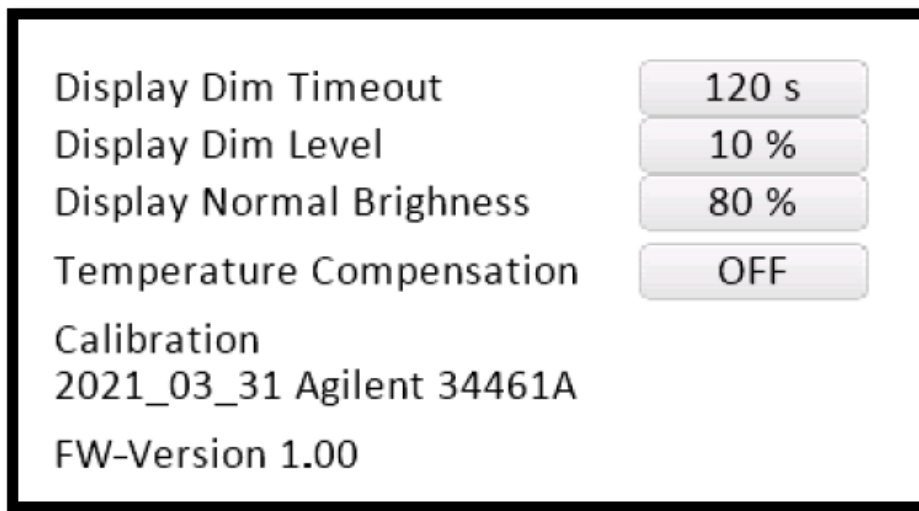
*Figure 17. MAXREFDES183# Special Function mode.*

- After clicking the Maxim logo, an extra menu will be displayed



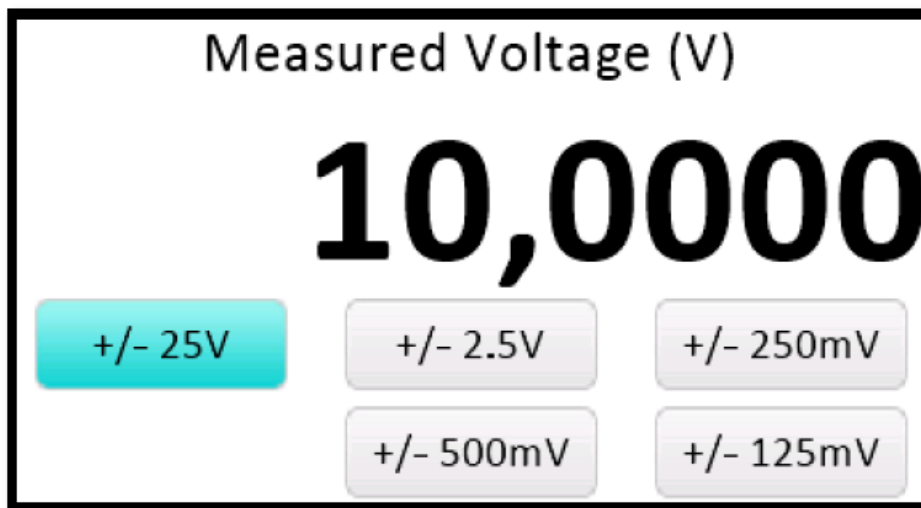
*Figure 18. MAXREFDES183# Special Functions.*

- Clicking Main Menu leads back to the Main Menu System Settings allows the user to adjust a few settings



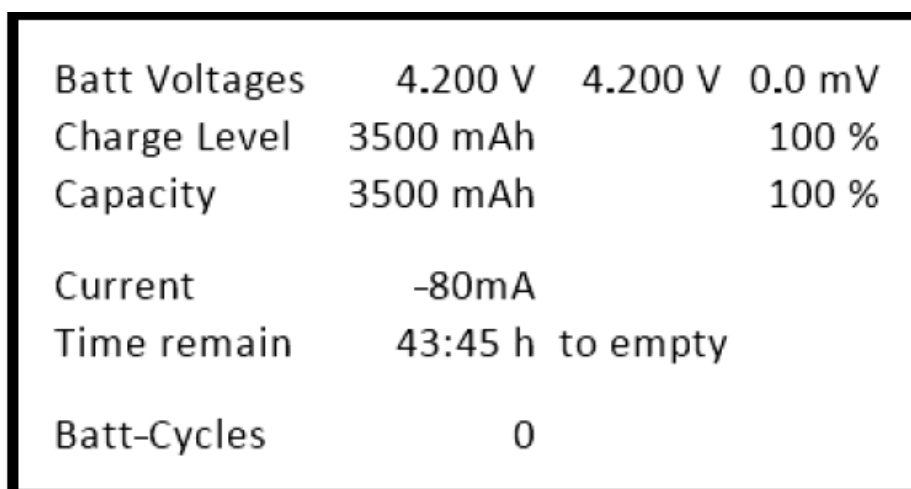
*Figure 19. MAXREFDES183# Display Dimming.*

- The Sense Measurement inputs use the on-chip programmable gain amplifier (PGA), which allows the calibrator to measure very small voltages between the SNS+ and SNS- inputs



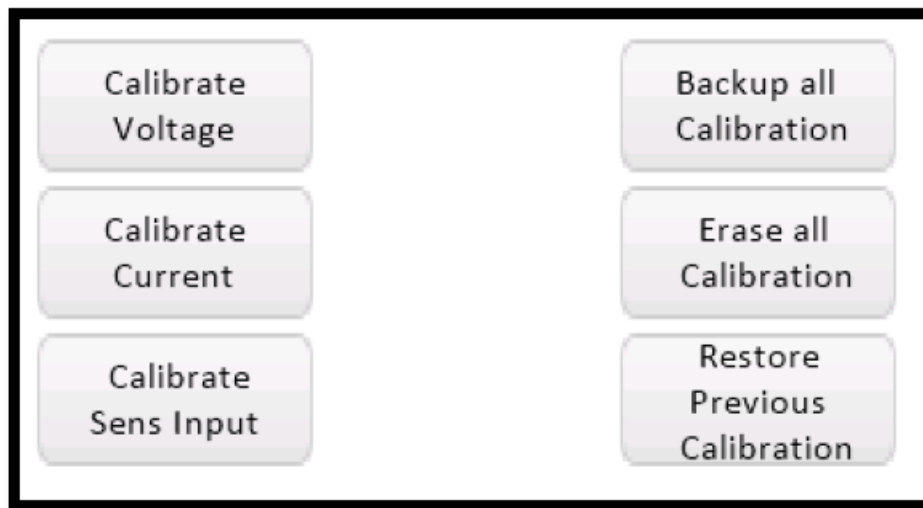
*Figure 20. MAXREFDES183# PGA.*

- Battery Info: This screen displays the detailed status of the battery utilizing Maxim's fuel gauge IC, the MAX17320. Charge Level, Wear Level, and the estimated battery operation time (Time remain) are all displayed



*Figure 21. MAXREFDES183# Battery Status screen.*

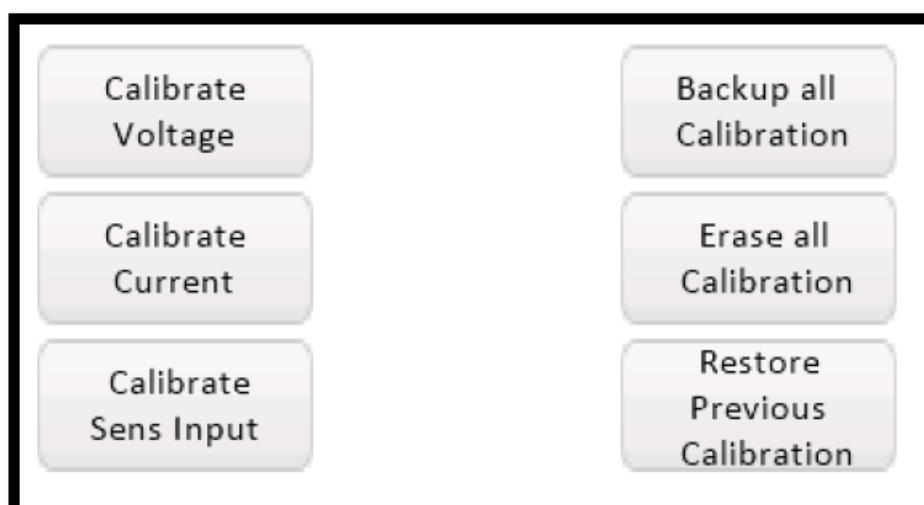
- The Calibrate menu allows the user to calibrate the complete system; details will be explained in the Calibrating the MAXREFDES183# section of the Quick Start Guide.



*Figure 22. MAXREFDES183# Calibration options.*

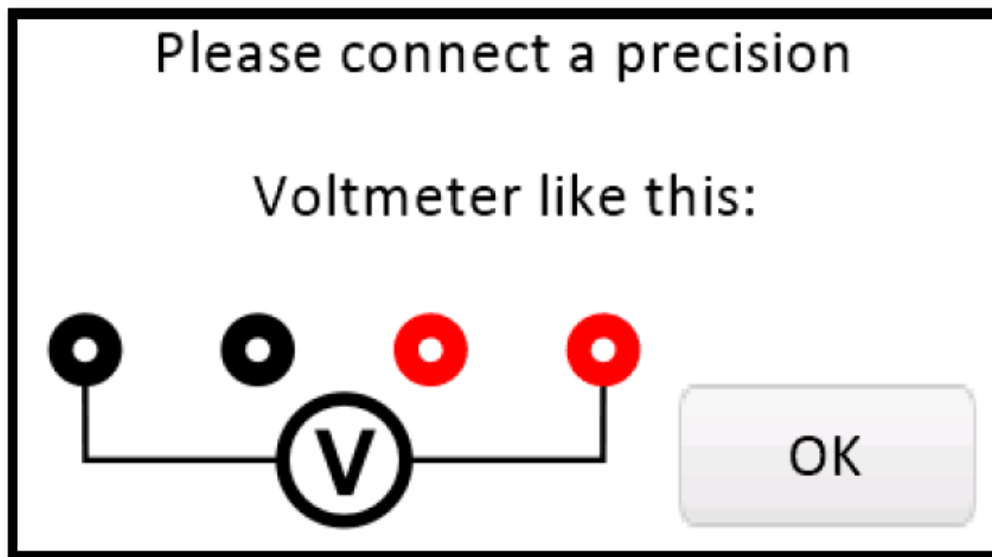
### Calibrating the MAXREFDES183#

- For an accurate calibration process, a high-accuracy precision volt and current Meter (or DMM) is required with a recommended minimum of 6.5 digits resolution.
- However, no precision voltage or current sources are needed.
- Ideally, the system should be completely isolated, meaning run from the battery. Even if the USB charger is isolated, there is still possible capacitive coupling of noise between the mains supply lines and the MAXREFDES183# system. The same concern is true for mains-powered precision meters; even very small 50/60Hz noise that is coupled in might affect the performance/accuracy of the resulting calibration factors.
- As long as only one side is connected to the mains (i.e., the precision meter), there is no potential for ground loop-inducing noise, and so there should not be any issues.
- Before the MAXREFDES183# is calibrated, let your precision meter as well as the MAXREFDES183# warm up and reach stable thermal levels, for example, let both operate for 15 to 30 minutes. Note, this is usually also recommended practice for precision equipment like 6.5- or 8.5-digit DMMs.
- Calibrate Voltage: Click the Calibrate Voltage button



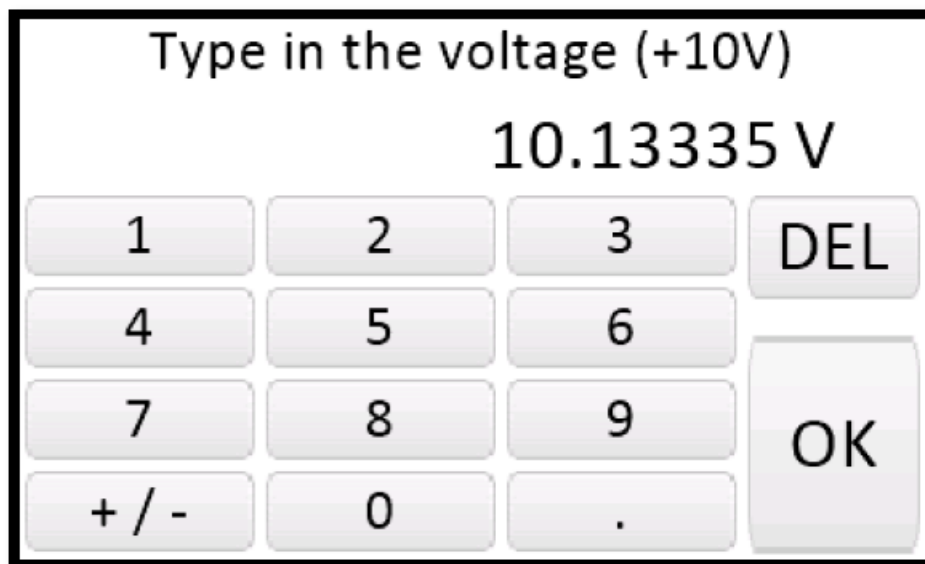
*Figure 23. MAXREFDES183# Calibrate Voltage screen.*

- A screen will show how to connect the precision DMM.



*Figure 24. MAXREFDES183# Calibrate Voltage connection.*

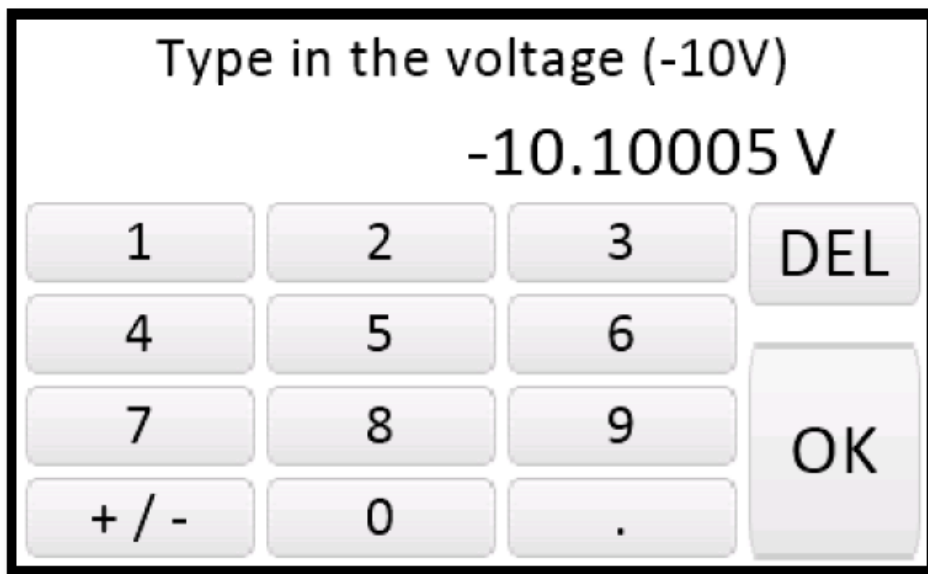
- The MAXREFDES183# will now produce a “high” voltage of approximately 10V between the UIO and GND



*Figure 25. MAXREFDES183# Calibrate +Voltage input.*

- Next, the MAXREFDES183# will produce a “low” voltage of approximately “-10” between the UIO and GND (Figure 26). It should be stable in at least 5 digits, if not, then something is wrong with your setup.





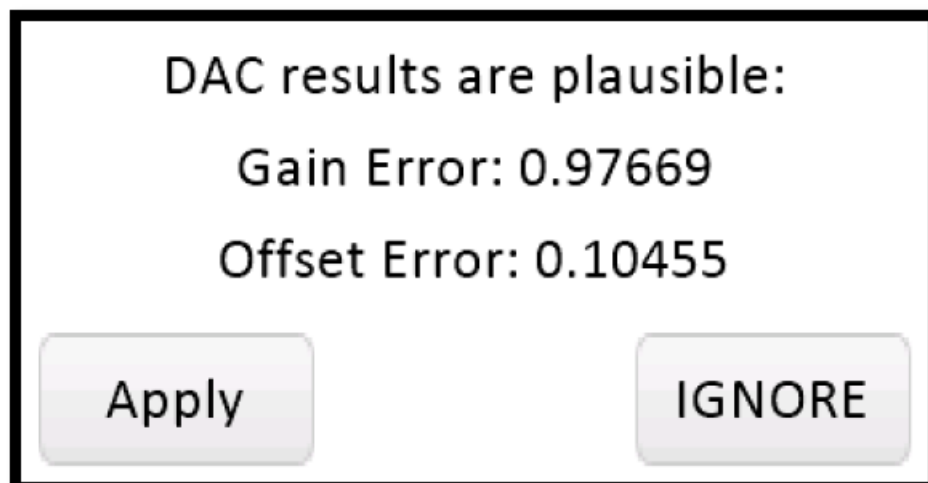
Type in the voltage (-10V)

-10.10005 V

1	2	3	DEL
4	5	6	OK
7	8	9	
+ / -	0	.	

*Figure 26. MAXREFDES183# Calibrate -Voltage input.*

- The MAXREFDES183# will calculate and show the results for the gain and offset errors. The results for the DAC in the MAX22000 should look like. If the results make sense, the display will show “DAC results are plausible



DAC results are plausible:

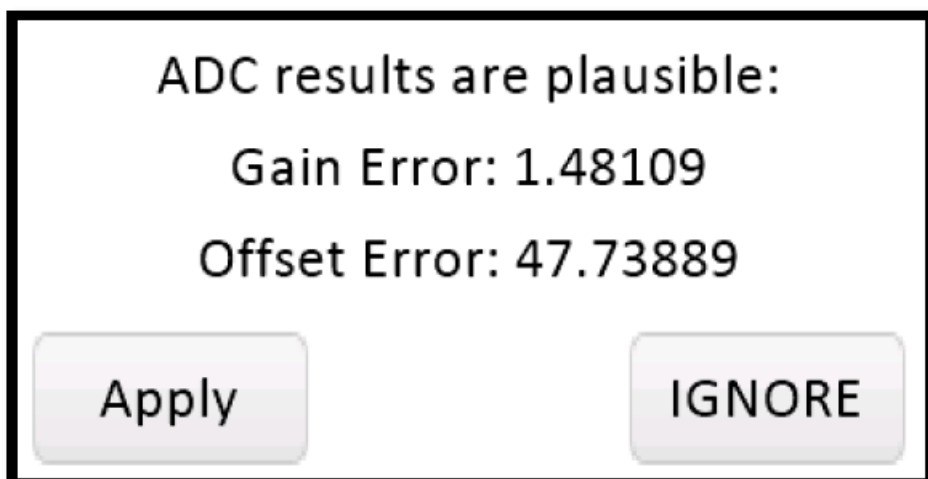
Gain Error: 0.97669

Offset Error: 0.10455

Apply IGNORE

*Figure 27. MAXREFDES183# Calibrate DAC voltage result.*

- Next, the MAXREFDES183# will show the results from calibrating for the ADC in the MAX22000. The procedure is identical to that for the DAC to generate gain and offset error data



ADC results are plausible:

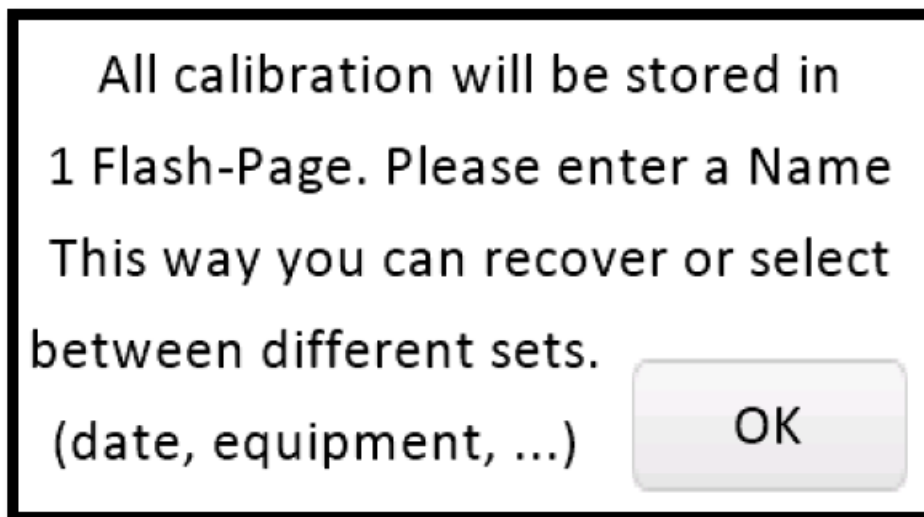
Gain Error: 1.48109

Offset Error: 47.73889

Apply IGNORE

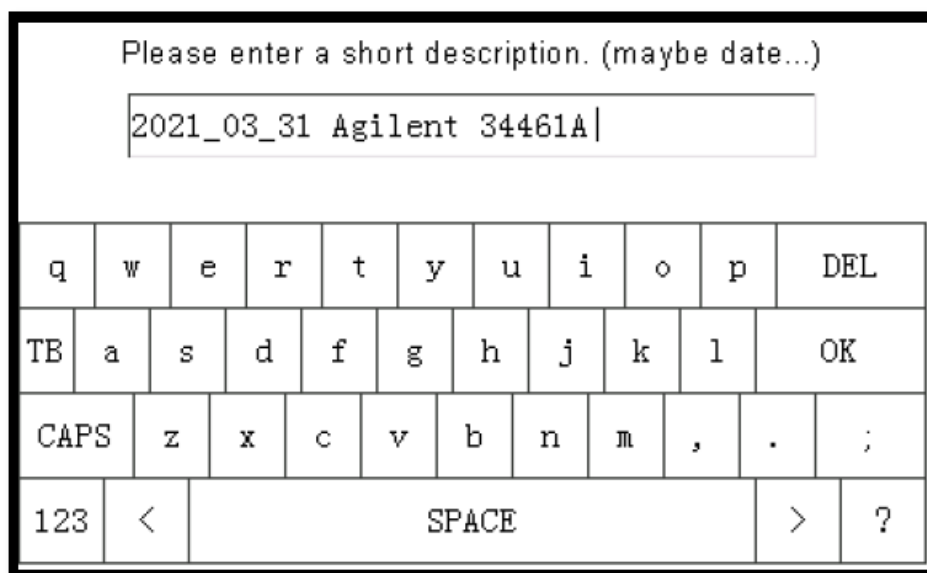
*Figure 28. MAXREFDES183# Calibrate ADC voltage result.*

- The MAXREFDES183# has onboard nonvolatile memory (FLASH) which is used to store calibration data for



*Figure 29. MAXREFDES183# Calibrate data saved.*

- The next step in the calibration process is to enter a description or name for the new calibration data. After clicking OK, a keyboard will show up and allow the user to enter free-form text, that will be saved in the FLASH together with the calibration data.



*Figure 30. MAXREFDES183# Calibrate data naming.*

- Calibrate Sense Inputs: Calibrating the SNS+ / SNS- inputs follows the same procedure as calibrating voltage, with the exception that, for this operation, the UIO pin must be connected to the SNS+ pin and GND must be connected to the SNS- pin.

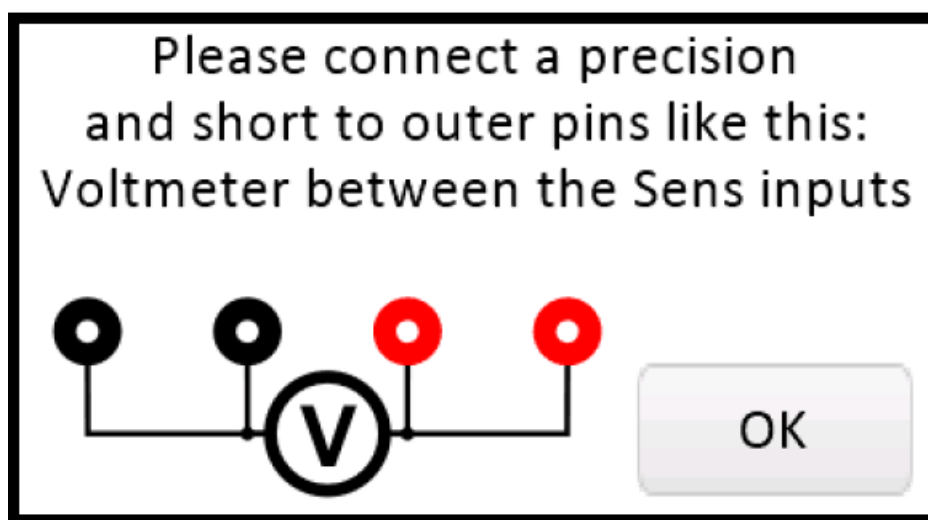


Figure 31. MAXREFDES183# Calibrate SENS inputs.

## Revision History


REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	8/21	Initial release	—

## Trademarks

Maxim Integrated is a registered trademark and ModelGauge and Cycle+ are trademarks of Maxim Integrated Products, Inc.

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## Documents / Resources

 <p>MAXREFDES183 Portable Precision Calibrator User's Guide Rev 0.0, August 2021</p>	<p><a href="#">ANALOG DEVICES MAXREFDES183 Portable Precision Calibrator</a> [pdf] User Guide MAXREFDES183 Portable Precision Calibrator, MAXREFDES183, MAXREFDES183 Precision Calibrator, Portable Precision Calibrator, Precision Calibrator</p>
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