

## 6½ Digit, ±20 V Digital Voltage Meter

### FEATURES

- ▶ 6½ digit resolution
- ▶ ±0.2 V, ±2 V, and ±20 V range
- ▶ Dual channel
- ▶ 90 days accuracy: <17 ppm of reading range at 2 V range
- ▶ <0.225 ppm RMS noise of 2 V range at 1 NPLC, 1000 samples
- ▶ Up to 1 kSPS data rate
- ▶ Auto-zero function
- ▶ Supports SCPI protocol
- ▶ UART communication interface
- ▶ Power sequence self checking
- ▶ Input protection
- ▶ 5 V power supply
- ▶ 0°C to 45°C operation

### APPLICATIONS

- ▶ Precision voltage measurement
- ▶ Industry automation test

### ADMX3652 DIGITAL VOLTAGE METER

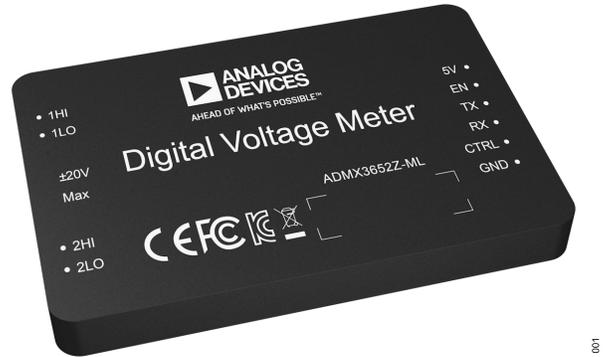


Figure 1. ADMX3652 Digital Voltage Meter (Top View)



Figure 2. ADMX3652 Digital Voltage Meter (Bottom View)

### GENERAL DESCRIPTION

The ADMX3652 6½ digit, digital voltage meter (DVM) offers fast throughput (1 kSPS), flexible measurements (manual or automatic selection range), and trustworthy results (25 ppm of measurement accuracy for 90 days under 2 V range). The ADMX3652 provides a compact solution with the most common DVM measurements. With long measurement times, the norm for high integration precision applications—a simple, reliable, pocketable device that can save system space—is a popular addition to the toolbox of engineers.

The current consumption of the ADMX3652 is only around 310 mA for a 5 V power supply in stable working mode. Compared to complex instruments with numerous settings, the ADMX3652 requires simple settings with a preset configuration for a typical application. Electrically, the ADMX3652 is compatible with 1.8 V, 2.5 V, and 3.3 V interfaces, using an internal independently logic supply.

The ADMX3652 is available in a [77.70 mm × 46.30 mm × 20.15 mm, 10-lead module package](#) with operating temperature specified from 0°C to 45°C.

Rev. B

DOCUMENT FEEDBACK

TECHNICAL SUPPORT

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**REVISION HISTORY****10/2024—Rev. A to Rev. B**

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**11/2023—Rev. 0 to Rev. A**

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**8/2023—Revision 0: Initial Version**

## SPECIFICATIONS

$V_{CC} = 5.0\text{ V}$ , EN floating, and auto-zero on, unless otherwise noted.

**Table 1. DC Specification**

| Parameter   | Test Conditions/Comments                                   | Min | Typ             | Max   | Unit   |
|---|--|-----|-----------------|-------|--|
| RESOLUTION  | 2 V range, 1000 samples,<br>10 NPLC <sup>1</sup>           |     | 6½              |       | Digits   |
| READING RATE (DC)   |  |     |                 |       |  |
| Resolution  |  |     |                 |       |  |
| 5½  | NPLC = 0.05  |     | 1000            |       | Samples/sec  |
|   | NPLC = 0.1   |     | 500             |       | Samples/sec  |
| 6½  | NPLC = 100   |     | 0.5             |       | Samples/sec  |
|   | NPLC = 10  |     | 5               |       | Samples/sec  |
| RMS NOISE   | 2 V range, 1000 samples                                    |     |                 |       |  |
| 100 NPLC  |  |     |                 | 0.091 | ppm of range   |
| 10 NPLC   |  |     |                 | 0.216 | ppm of range   |
| 1 NPLC  |  |     |                 | 0.225 | ppm of range   |
| 0.50 NPLC   |  |     |                 | 0.246 | ppm of range   |
| 0.25 NPLC   |  |     |                 | 0.250 | ppm of range   |
| 0.10 NPLC   |  |     |                 | 2.5   | ppm of range   |
| 0.05 NPLC   |  |     |                 | 4.0   | ppm of range   |
| DC ACCURACY <sup>2</sup>  | NPLC = 100, auto-zero on<br>$T_{CAL} = 25^{\circ}\text{C}$ |     |                 |       |  |
| 24 Hours (Calculation<br>Temperature ( $T_{CAL} \pm 1^{\circ}\text{C}$ )) |  |     |                 |       |  |
| 200 mV  | 200 nV resolution  |     | 0.0017 + 0.0017 |       | $V_{\pm}(\% \text{ of reading} + \% \text{ of range})$ |
| 2 V   | 2 $\mu\text{V}$ resolution                                 |     | 0.0005 + 0.0002 |       | $V_{\pm}(\% \text{ of reading} + \% \text{ of range})$ |
| 20 V  | 20 $\mu\text{V}$ resolution                                |     | 0.0006 + 0.0001 |       | $V_{\pm}(\% \text{ of reading} + \% \text{ of range})$ |
| 90 Days ( $T_{CAL} \pm 5^{\circ}\text{C}$ )                               |  |     |                 |       |  |
| 200 mV  | 200 nV resolution  |     | 0.0098 + 0.0040 |       | $V_{\pm}(\% \text{ of reading} + \% \text{ of range})$ |
| 2 V   | 2 $\mu\text{V}$ resolution                                 |     | 0.0017 + 0.0008 |       | $V_{\pm}(\% \text{ of reading} + \% \text{ of range})$ |
| 20 V  | 20 $\mu\text{V}$ resolution                                |     | 0.0012 + 0.0004 |       | $V_{\pm}(\% \text{ of reading} + \% \text{ of range})$ |
| Temperature Coefficient/ $^{\circ}\text{C}$                               |  |     |                 |       |  |
| 200 mV  | 200 nV resolution  |     | 0.0005 + 0.0005 |       | $V_{\pm}(\% \text{ of reading} + \% \text{ of range})$ |
| 2 V   | 2 $\mu\text{V}$ resolution                                 |     | 0.0005 + 0.0001 |       | $V_{\pm}(\% \text{ of reading} + \% \text{ of range})$ |
| 20 V  | 20 $\mu\text{V}$ resolution                                |     | 0.0005 + 0.0001 |       | $V_{\pm}(\% \text{ of reading} + \% \text{ of range})$ |
| NOISE REJECTION   |  |     |                 |       |  |
| Common-Mode Rejection Ratio (CMRR)  | NPLC = 100   | 100 |                 |       | dB   |
| Normal-Mode Rejection Ratio (NMRR)  | NPLC $\geq 1$  | 90  |                 |       | dB   |
|   | NPLC $\leq 1$  | 0   |                 |       | dB   |
| INPUT RESISTANCE  |  |     |                 |       |  |
| $\pm 0.2\text{ V}$ Range  |  | 200 |                 |       | M $\Omega$   |
| $\pm 2\text{ V}$ Range  |  | 2   |                 |       | G $\Omega$   |
| $\pm 20\text{ V}$ Range   |  | 20  |                 |       | G $\Omega$   |
| Input Bias Current  |  |     |                 |       |  |
| $\pm 0.2\text{ V}$ Range  |  |     |                 | 1     | nA   |
| $\pm 2\text{ V}$ Range  |  |     |                 | 1     | nA   |
| $\pm 20\text{ V}$ Range   |  |     |                 | 1     | nA   |

<sup>1</sup> NPLC is the number of power cycles.

<sup>2</sup> Warm-up time = 30 minutes

## SPECIFICATIONS

Table 2. General Specification

| Parameter                      | Test Conditions/Comments                  | Min  | Typ     | Max     | Unit |
|--------------------------------|---|------|---------|---------|------|
| <b>POWER CONSUMPTION</b>       |   |      |         |         |      |
| Input Voltage                  |   | 4.5  | 5       | 5.5     | V    |
| EN Threshold Voltage           |   |      | 1.05    |         | V    |
| Inrush Current                 |   |      | 860     |         | mA   |
| Operating Current              |   |      | 310     |         | mA   |
| <b>TRIGGER CONDITIONS</b>      |   |      |         |         |      |
| Minimum Pulse Width            |   | 1    |         |         | μs   |
| Maximum Data Rate              |   |      |         | 1       | kSPS |
| Edge Type                      |   |      | Rising  |         |      |
| CTRL Threshold Voltage         | See Figure 3                              |      |         |         |      |
| Logic High                     |   | 2.31 |         |         | V    |
| Logic Low                      |   |      |         | 0.99    | V    |
| <b>OVERRANGE</b>               | All ranges                                |      | 10      |         | %    |
| <b>SYSTEM SPEED</b>            |   |      |         |         |      |
| Auto Range Time                | NPLC = 10, auto-zero on                   |      | 400     |         | ms   |
| Trigger Latency                | NPLC = 10, auto-zero on, external trigger |      | 400     |         | ms   |
| <b>COMMUNICATION INTERFACE</b> |   |      |         |         |      |
| Type                           |   |      | UART    |         |      |
| Baud Rate <sup>1</sup>         |   | 9600 | 460,800 | 460,800 | BPS  |
| Stop Bit                       |   |      | 1       |         | Bit  |
| Data Bit                       |   |      | 8       |         | Bits |
| Check Bit                      |   |      | None    |         |      |
| RX Input Threshold Voltage     |   |      |         |         |      |
| Logic High                     |   | 2.31 |         |         | V    |
| Logic Low                      |   |      |         | 0.99    | V    |
| TX Output Voltage              |   |      |         |         |      |
| Logic High                     |   | 3.2  | 3.3     |         | V    |
| Logic Low                      |   |      | 0.0     | 0.1     | V    |

<sup>1</sup> The options of baud rate are 9600, 14,400, 19,200, 38,400, 57,600, 115,200, 230,400, and 460,800.

## SPECIFICATIONS

## TIMING DIAGRAM

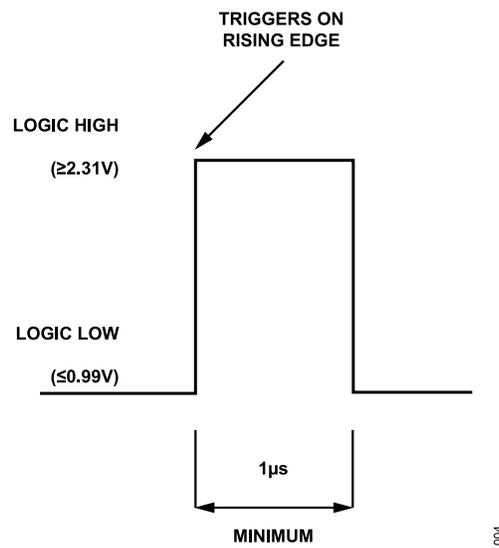


Figure 3. External Trigger for the CTRL Threshold Voltage Specification

## ABSOLUTE MAXIMUM RATINGS

**Table 3. Absolute Maximum Ratings**

| Parameter                     | Rating                                |
|-------------------------------|---------------------------------------|
| V <sub>CC</sub> to GND        | 0 V to ~7 V                           |
| EN to GND                     | 0 V to ~V <sub>CC</sub>               |
| CTRL to GND                   | -0.5 V to ~+3.8 V                     |
| UART TX to GND                | -0.5 V to ~+3.8 V                     |
| UART RX to GND                | -0.5 V to ~+3.8 V                     |
| Analog Input Voltage to GND   |                                       |
| Channel 1                     | 70 V                                  |
| Channel 2                     | 70 V                                  |
| Environment (Indoor Use Only) |                                       |
| Maximum Altitude              | 2,000 m (at 25°C ambient temperature) |
| Pollution Degree              | 2                                     |
| Operating Environment         |                                       |
| Temperature                   |                                       |
| Operating Range               | 0°C to ~45°C                          |
| Storage Range                 | -40°C to ~+70°C                       |
| Relative Humidity Range       | 10% to 90%, noncondensing             |
| Calibration Interval          | 1 year recommended                    |
| Warm-Up Time                  | 30 minutes to rated accuracy          |

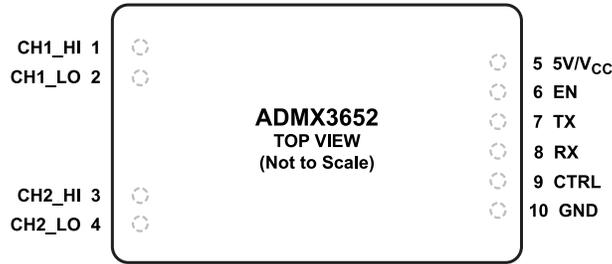
Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

## 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.

**PIN CONFIGURATION AND FUNCTION DESCRIPTION**



**NOTES**

1. THE 0327-0-15-01-34-27-10-0 (MILL-MAX) IS RECOMMENDED AS THE PIN RECEPTACLE, AND THE SOLDER MOUNT IN 1.91mm MINIMUM MOUNTING HOLES.
2. THE TWO M3 NUTS CAN BE USED TO ASSIST IN SECURING THE PRODUCT, IF REQUIRED. THE MAXIMUM THREAD DEPTH ON PRODUCT IS 3mm. SCREWING BOLTS INTO THE PRODUCT FOR MORE THAN 3mm MAY DAMAGE THE PRODUCT. CONTACT ANALOG DEVICES FOR SELECTING THE SCREWS PROPERLY.

003

*Figure 4. Pin Configuration*

**Table 4. Pin Function Descriptions**

| Pin No. | Mnemonic           | Description  |
|---------|--------------------|--|
| 1       | CH1_HI             | Channel 1 Input High.  |
| 2       | CH1_LO             | Channel 1 Input Low.   |
| 3       | CH2_HI             | Channel 2 Input High.  |
| 4       | CH2_LO             | Channel 2 Input Low.   |
| 5       | 5V/V <sub>CC</sub> | Positive Power Supply, 5 V DC.   |
| 6       | EN                 | Enable Input. The ADMX3652 is shut down when the EN pin is low and active when the EN pin is high. Leave floating if the shutdown feature is not used. |
| 7       | TX                 | UART Transmit.   |
| 8       | RX                 | UART Receive.  |
| 9       | CTRL               | External Trigger Input. The external trigger input requires a rising-edge pulse with the specifications, as shown in <a href="#">Figure 3</a> .        |
| 10      | GND                | Power Ground.  |

## TERMINOLOGY

### APERTURE TIME

Aperture time is the period, measured in seconds, during which the analog-to-digital converter (ADC) samples the input signal for measurement. A longer aperture yields better resolution, and a shorter aperture provides for faster measurements. This mode allows the user to set a specific integration time that is not based on power-line frequency. Use aperture, instead of PLC, only when precise control over the integration time of the DVM is required.

### RESOLUTION

The display digits refer to the level of resolution that the DVM can measure. Resolution is a level of detail that is quantifiable on a DVM. The higher the number of DMM display digits, the higher the resolution of the DVM. A 6½ digit DVM has an actual measurement range of ±1,999,999 resolution counts or +2,000,000 resolution counts. The ½ digit refers to the most significant digit but can only be either a 0 or a 1. Resolution is the level of detail that is measurable or the number of significant digits on a digital multimeter.

### POWER LINE CYCLES (PLCS)

Using PLCs sets the number of PLCs during which the ADC samples the input signal for measurement. The DVM automatically detects the AC line frequency, using it and the PLC selection to set integration time. Use a larger PLC value for better resolution, and use a smaller PLC value for faster measurements. To obtain normal mode (line-frequency noise) rejection, select PLC mode, with an integral number of PLCs (for example, 1 PLC, 10 PLCs, or 100 PLCs).

### COMMON-MODE REJECTION RATIO (CMRR)

CMRR describes the ability of the digital multimeter (DMM) to reject a common-mode signal and is often specified with a 1 kΩ resistance in the input lead (CHx\_LO) of the ADMX3652. CMRR is important because it indicates how much of the common-mode signal affects measurement.

## THEORY OF OPERATION

The ADMX3652 is a digital voltage meter of a precision signal chain with a selectable range of 0.2 V, 2 V, or 20 V. At the front end, the ADMX3652 incorporates a precision ADC driver with integrated precision resistors. The precision resistors can be strapped to achieve different gains for the ADC driver, which allows the user to match with the input signal range.

All active and passive components in the circuit, including the thin-film resistors with precise matching, are designed by Analog Devices, Inc., and are factory calibrated to achieve a high degree of specified accuracy and minimize temperature dependent error sources.

**APPLICATIONS INFORMATION**

Refer to the [EVAL-ADMX3652 User Guide](#) for the applications information.

**COMPLIANCE AND CERTIFICATIONS****ELECTROMAGNETIC COMPATIBILITY**

The ADMX3652 meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- ▶ EN 61326-1: Class A emissions; basic immunity
- ▶ FCC 47 CFR Part 15: Class A emissions
- ▶ ICES-003: Class A emissions
- ▶ KS C9991-2019 Class A emissions

**CE MARK**

The ADMX3652 meets the essential requirements of the following applicable European Union directives:

- ▶ 2014/35/EU: Low-Voltage Directive (Safety)
- ▶ 2014/30/EU: Electromagnetic Compatibility Directive (EMC)
- ▶ 2011/65/EU + 2015/863/EU: RoHS Directive

OUTLINE DIMENSIONS

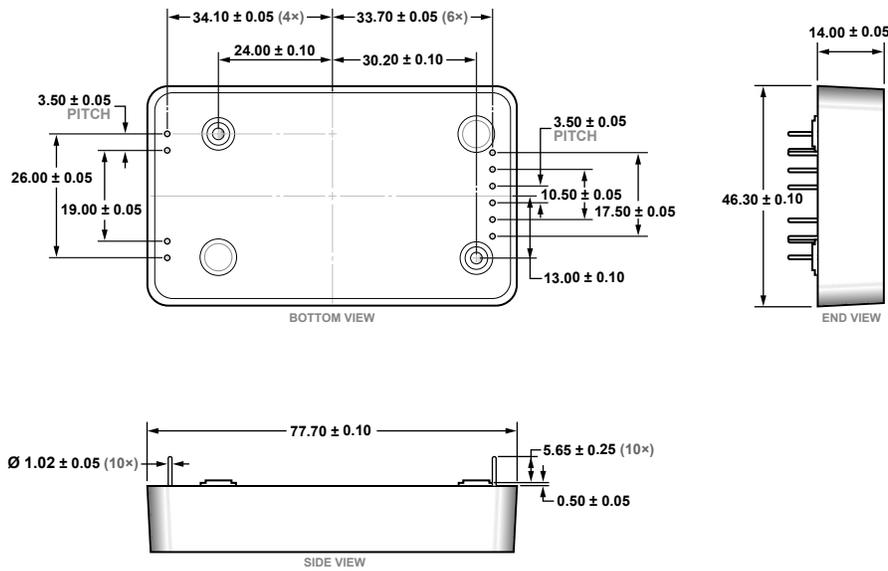


Figure 5. 10-Lead Module with Connector Interface [MODULE] (ML-10-1)  
Dimensions shown in millimeters

Updated: March 20, 2024

ORDERING GUIDE

| Model <sup>1</sup> | Temperature Range | Package Description                     | Packing Quantity | Package Option |
|--------------------|-------------------|---|------------------|----------------|
| ADMX3652Z-ML       | 0°C to +45°C      | 10-Lead Module with Connector Interface | EACH, 1          | ML-10-1        |

<sup>1</sup> Z = RoHS Compliant Part.

EVALUATION BOARDS

| Model <sup>1</sup> | Description      |
|--------------------|------------------|
| EVAL-ADMX3652Z-INT | Evaluation Board |

<sup>1</sup> Z = RoHS Compliant Part.