



[Maxim](#) > [Design Support](#) > [Technical Documents](#) > [Application Notes](#) > [Automotive](#) > APP 759  
[Maxim](#) > [Design Support](#) > [Technical Documents](#) > [Application Notes](#) > [Sensors](#) > APP 759

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#### APPLICATION NOTE 759

# Adding Diagnostic Capability to MAX14XX Low Cost High Performance Signal-Conditioning Devices

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*Abstract: A cost-effective procedure for adding system diagnostic, product diagnostic, output drift check, auto-zeroing capability, etc., to your products which are based on the MAX1452 and MAX1455 family of high-performance signal conditioning products without changing the test system or adding significant time to the calibration process.*

*This approach takes advantage of built-in nonvolatile flash memory included in these low-cost signal conditioners. The concept is implemented by making an accurate measurement of the output voltage at predefined reference conditions and storing it in the flash memory for future reference.*

This application note describes a simple and cost-effective procedure for adding diagnostic checks to determine product functionality and sensor output drift. This enhancement can be added to any MAX14XX device with nonvolatile memory without changing the test system or adding significant time to the calibration operation.

MAX14XX signal-conditioning devices are generally used in conjunction with pressure sensors to correct their inherently large temperature error. Although the same principle applies to other types of sensors, this document refers solely to pressure-sensor applications for the sake of simplicity.

## Benefits of Adding Diagnostic Capability

- Checking the functionality of the signal-conditioning device.
- Indicating the level of error after calibration.
- Indicating drift in the sensor output. *This is desirable especially in the case of absolute-pressure sensors, because loss of reference vacuum can cause output drift, which may not be easily detectable after calibration.*
- Verifying proper functioning and troubleshooting the test system. *Changes in output voltage in the reference condition could provide hints of inaccurate pressure setting, incorrect  $V_{DD}$ , malfunctioning ASIC, etc.*

## Overview

Maxim's MAX14XX series of smart signal-conditioning products include nonvolatile memory that can be used to store product-run information and calibration values. Once the device is calibrated, the output voltage ( $V_{CAL}$ ) of the device should be measured under reference conditions and the value of  $V_{CAL}$  written to memory. Reference temperature and pressure conditions should be chosen to minimize the influence of the test system on the reference conditions. For gage-pressure devices, reference conditions are usually room temperature and atmospheric pressure. For highly accurate products, room temperature may need to be controlled and atmospheric pressure measured independently. When it comes to absolute-pressure sensors, a repeatable reference pressure must be chosen (it may not be atmospheric pressure).

## Reference Temperature

Controlling the reference temperature is especially necessary for devices with a large temperature coefficient. To minimize the overhead associated with the generation of  $V_{CAL}$ , the last calibration temperature can be used as the reference. A reasonable choice is 25°C, because it is easy to achieve and control and it is used as the reference for most specifications.

## Reference Pressure

- For gage-pressure sensors, use atmospheric pressure.
- For absolute-pressure sensors, absolute (not gage) pressure must be used and controlled to the desired accuracy. To minimize the effect of any possible leak in the system, a pressure close to the atmospheric pressure is recommended (100kPA).
- For high-pressure sensors, atmospheric pressure can be used.

## Procedure for Setting Up Reference Voltage

1. Complete the compensation/calibration as this is normally done.
2. Apply the reference pressure and the temperature condition to the device.
3. Read the output voltage to the desired accuracy.
4. Store the output voltage,  $V_{CAL}$ , in the memory.

## Procedure for Using Reference Voltage

1. Apply the reference condition to the device.
2. Measure the output voltage,  $V_{out}$ .
3. Read  $V_{CAL}$  from memory.
4. Compare the  $V_{OUT}$  and  $V_{CAL}$  values,  $dV_{OUT} = V_{OUT} - V_{CAL}$ .
5. Take any specified action based on the value of  $dV_{OUT}$ . For example, shut down the system, call the operator, ignore the device output, etc.

### Related Parts

<a href="#">MAX1452</a>	Low-Cost Precision Sensor Signal Conditioner	<a href="#">Free Samples</a>
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<a href="#">MAX1455</a>	Low-Cost Automotive Sensor Signal Conditioner	<a href="#">Free Samples</a>
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