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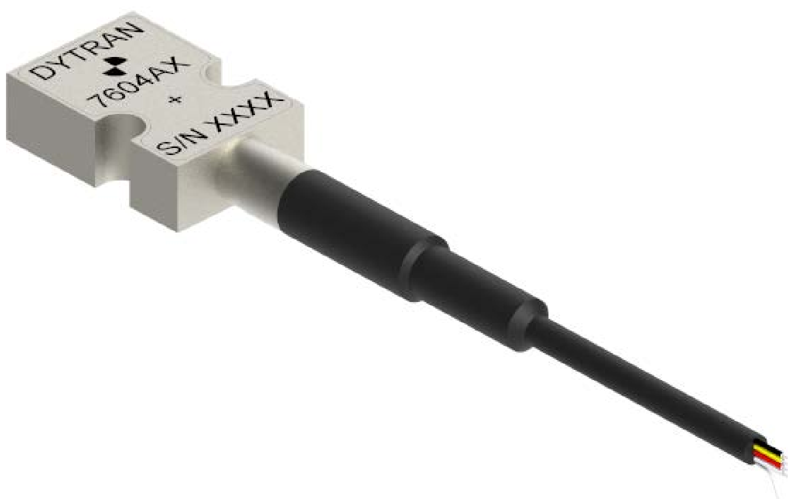
OG7604A
REV A, ECN 12393, 12/10/15
REV B, ECN 12548, 03/18/16

OPERATING GUIDE

SERIES 7604A

Variable Capacitance Accelerometer with Piezoresistive Electrical Interface, Integral Cable with Splash-proof Boot



OPERATING GUIDE
SERIES 7604A ACCELEROMETER

INTRODUCTION

Dytran Series 7604A is a family of high performance, wide temperature range variable capacitance (VC) accelerometers intended to directly replace piezoresistive units for existing or new applications. This accelerometer utilizes a capacitive sensing element and an advanced ASIC to simulate the operation of a piezoresistive bridge. It combines an integrated VC accelerometer chip with high drive, low impedance buffering for measuring acceleration in commercial/industrial environments.It is tailored for zero to medium frequency instrumentation applications. This module contains a hermetically sealed micromachined capacitive sensing element, a custom integrated circuit amplifier, and differential output stages. The hermetically sealed titanium case is attached to an integral cable with splash-proof boot, and is easily mounted via two 4-40 screws. On-board regulation is provided to minimize the effects of supply voltage variation. It is relatively insensitive to temperature changes and thermal gradients. The cable shield is electrically connected to the titanium case; the power and signal wires are isolated from the case. An initial calibration sheet is included and periodic calibration checking is available.

OPERATION

Series 7604A produces two analog output voltages (AON & AOP), which vary with acceleration as shown in Figure 1 below.

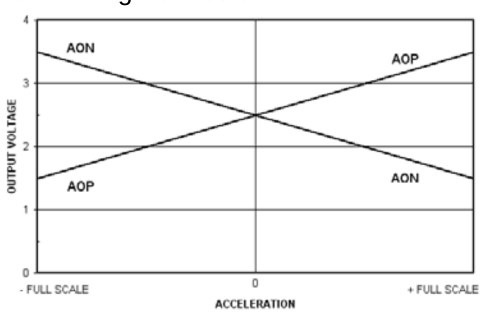


Figure 1 - AOP & AON - Output Voltage vs. Acceleration

The sensitive axis is perpendicular to the bottom of the package, with positive acceleration defined as a force pushing on the bottom of the package. The signal outputs are fully differential about a common mode voltage of approximately 2.5 volts. The output scale factor is independent from the supply voltage of +3 to +11 volts. Single supply operation is possible, in which case the negative supply wire should be grounded. The bias voltage is expected to be half of the supply voltage at the positive supply pin.

At zero acceleration, the output differential voltage is nominally 0 VDC; at ± full scale acceleration the output is ±0.5 VDC respectively.

CABLE LENGTH CONSIDERATIONS

The electrical connections from the sensor are brought out to the power unit via an integral cable, 10 ft long. The cable features flying leads at the end for connection to the power unit and data acquisition system. Consult the Outline/Installation drawing 127-7604A for the color coding of the wires. The integral cable features a splash-proof boot, rated to IP64, to protect the sensor and cable from water ingression.

Cable lengths of up to 15 meters (50 feet) can be used with the 7604A accelerometer. For lengths longer than 15 meters, we recommend you check each individual installation for oscillation by tapping the accelerometer and watching the differential output for oscillation in the 20kHz to 50kHz region. If no oscillation is present, then the cable length being used is acceptable. From the standpoint of output current drive and slew rate limitations, the 7604A series is capable of driving over 600 meters (2000 feet) of its cable type but at some length between 15 and 600 meters, each device will likely begin to exhibit oscillation.

DIFFERENTIAL vs. SINGLE-ENDED MODE

Model 7604A accelerometer will provide its best performance when you connect it to your instrumentation in a differential configuration using both the **AOP** and **AON** output signals. But a differential connection may not always be possible. In such cases, it is perfectly fine to connect the accelerometer to your instrumentation in single-ended mode by connecting **AOP** and **GND** to your instrumentation and leaving **AON** disconnected. Keep in mind that the signal-to-noise ratio is reduced by half for a single-ended vs. a differential connection.

ADDING A SINGLE-ENDED OUTPUT

To achieve the highest resolution and lowest noise performance from the Series 7604A accelerometer, it should be connected to a voltage measurement instrument in a differential configuration using both the **AOP** and **AON** output signals. If the measurement instrument lacks differential input capability, or it is desired to use a differential input capable instrument in single-ended mode, then the circuit shown in Figure 2 can be used to preserve the low noise performance of the Series 7604A while using a single-ended type connection.

This circuit converts the ±0.5V differential output of the Series 7604A accelerometer, centered at +2.5 volts, to a single ended output centered about ground (0.0Vdc). It provides the advantage of low common-mode noise by preventing the accelerometer's ground current from causing an error in the voltage reading.

The op-amp should be located as close as possible to the voltage monitoring equipment. The majority of the signal path can therefore be differential so any noise will affect the wire run as a common mode signal which will be rejected. The op-amp type is not critical; a **µA741** or a ¼ of a **LM124** can be used. The power supplies need to be ±5V to ±15V to allow for both positive and negative output swing.

The gain of the op-amp is determined by the ratio R2/R1 (where R4=R2 and R3=R1). If R1 through R4 are all the same value, the gain equals 1 and the output swing will be ±2V single ended with respect to ground.

To obtain a ±5V single ended output, set R2/R1= R4/R3= 5/4 = 1.25. The single ended output of the op-amp will be centered at ground if R2 and C1 are tied to ground; using some other fixed voltage for this reference can shift the output. The value of the optional capacitors C1 and C2 (C1=C2) can be selected to roll off the frequency response to the frequency range of interest.

SINGLE-ENDED MODE (EQUIPMENT)

For the best performance we recommend differential mode, however if only single-ended data acquisition equipment is available you should follow these guidelines, see Figure 3 and Figure 4 in the Appendix for reference.

Single ended-sensitivity is half the differential sensitivity. Data sheets will contain information specific to each accelerometer.

In single-ended mode Full Scale is between +.5 to 4.5 Volts. If you are seeing voltages outside this range and recheck your connections.

All of the test data on the NIST traceable calibration sheets or printed on the ESD bag label are for differential mode. Dividing the differential value by 2 does not always provide the most accurate Scale Factor value. For lower G units we suggest you use a +/1G Flip Test Calibration (using Earth's gravity) to determine single ended values for 0G Bias and Scale Factor.

The output wiring **AOP/ AON** provides actual voltage signals. When using the sensor in single-ended mode only the **+AOP** signal wires are used.

The unused **-AON** signal wires should be either trimmed off or well insulated with electrical tape (do not tape them all together). Connecting these (-) wires to the frame of the test equipment or to the 0 volt power supply rail will potentially cause the sensor to overheat. and prematurely fail. Test equipment like oscilloscopes with BNC type connections may often cause this problem, since the outside shell of the BNC typically connects directly to the frame ground of the instrument. See the attached information regarding using an oscilloscope. One of the first symptoms of this is unstable readings with increasing electronic noise as the output circuits of the accelerometer overheat.

DIFFERENTIAL MODE WITH OSCILLOSCOPE

Connecting the +AOP and -AON signal to an oscilloscope using conventional oscilloscope probe will ground the AON – signal to the case of the device, can cause signal problems, and may cause the accelerometer to overheat and eventually fail.

Use a differential probe to make sure that both +AOP and -AON remain isolated from the ground of the oscilloscope.

Single-Ended Probe

Differential Probe

MAINTENANCE AND REPAIR

Should you experience a problem with your system, contact the Dytran factory for technical assistance with analysis and troubleshooting. If the product must be returned for evaluation and/or repair, you will be given an RMA (returned materials authorization) number and instructions for returning the instrument to the factory. Do not return the instrument without first obtaining this authorization to return.

APPENDIX

SIGNAL DESCRIPTIONS

V+ and V- RED and BLACK respectively. Power ±3 to ±11 Volts DC

AOP and AON (Output): YELLOW and WHITE respectively. Analog output voltages proportional to acceleration; AOP voltage increases (AON decreases) with positive acceleration. At zero acceleration both outputs are nominally equal to the midway between two supply voltages. The device experiences positive (+1g) acceleration with its lid facing up in Earth's gravitational field. Either output can be used individually or the two outputs can be used differentially but differential mode is recommended for both lowest noise and highest accuracy operation.

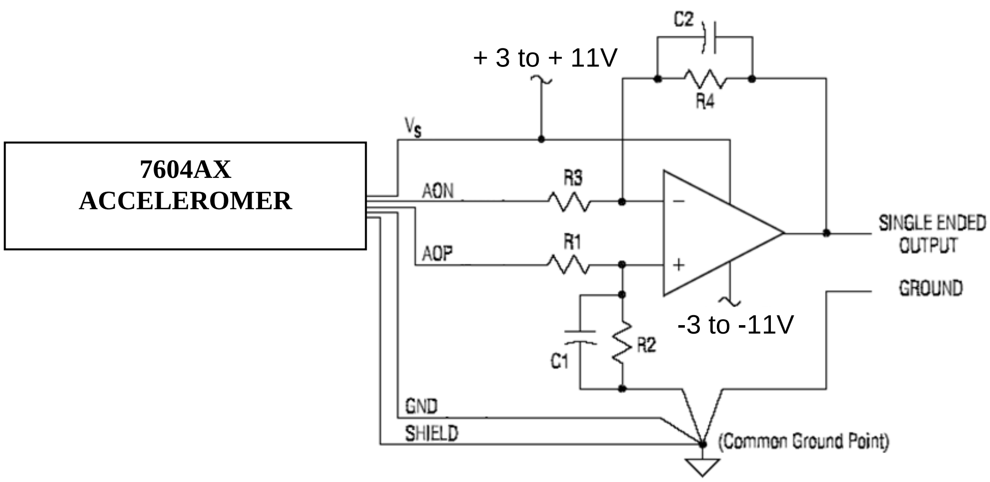


Figure 2- Adding a Single-Ended Output

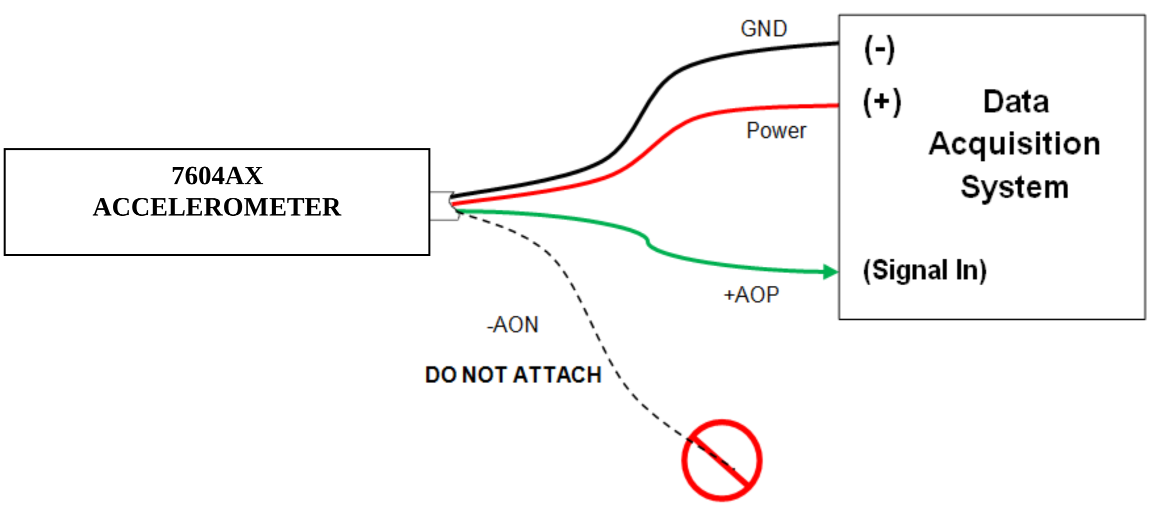


Figure 3 – Single-Ended Mode - Using a data acquisition system with an integrated power supply

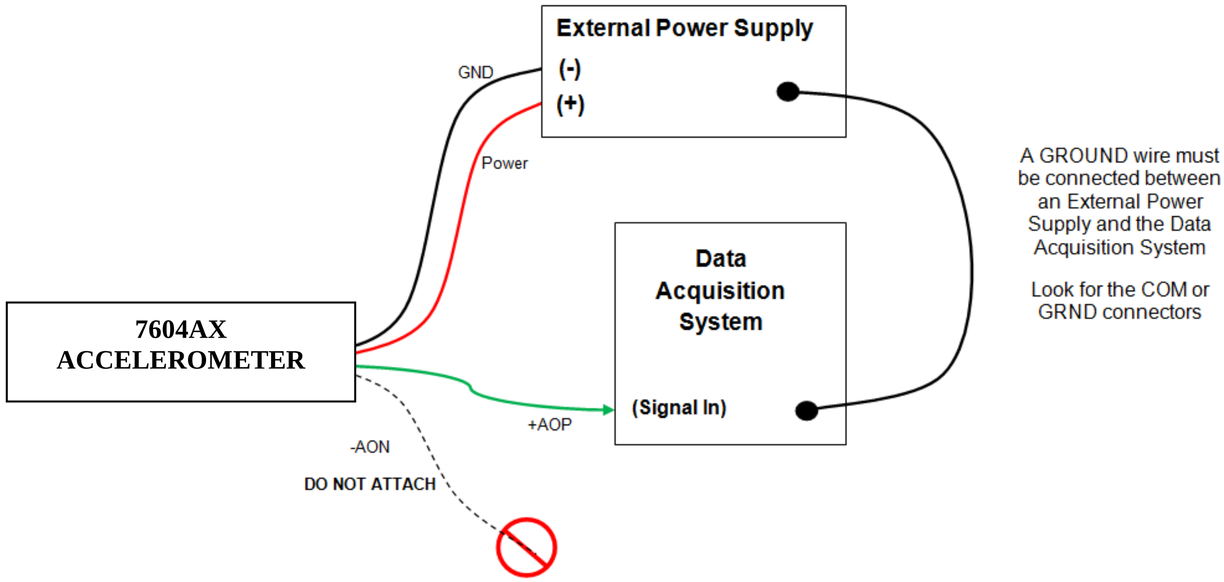


Figure 4 – Single-Ended Mode - Using a data acquisition system with a separate power supply