

Model ST Infrasound Sensor Datasheet



- Low Power 12 Volt Direct Current Operation
- 2 - 30 Hz Nominal Range
- Extended Low Frequency (< 2 Hz) Range
- ± 5 Volt Balanced Differential Output Signal with Single Ended Output Signal Option
- ~ 30 Hz Acoustic Low Pass Filter
- Integral 4 Port Acoustic Manifold
- Low Self Noise
- Reverse Polarity Power Supply Protection
- Low Cost

DESCRIPTION

IML's model ST infrasound sensor is a re-design of the model SS infrasound sensor that was intended for snow avalanche monitoring, which requires robust operation in winter environments that often exhibit extreme ambient winds. The model ST infrasound sensor was pursued in an effort to provide a sensor that is still adequate for snow avalanche monitoring, while also being more appropriate for general scientific infrasound monitoring. A sturdy sensor enclosure provides acoustic isolation and an integral 4 port hose adaptor summing manifold for convenient connectivity to commonly used wind noise reducing hose arrays¹. The fast starting low power sensor will drive long cables for subsequent data acquisition. A balanced differential output or selectable single ended output provides a clean signal conditioned for the desired frequency band. Output signal sensitivity and low frequency high pass filtering can be easily altered via hardware configuration settings. Custom options include an extended frequency range², modified balanced differential sensitivity, and an 8 or 12 port hose adaptor summing manifold.

ELECTRICAL INPUT/OUTPUT

Electrical input and output is provided via a box mount Amphenol Industrial Operations MIL-C-26482 Series 1 Type circular bayonet lock connector. The pin out for making a signal cable equipped with an Amphenol PT06E10-6S(SR) connector is as follows:

- A – Power supply voltage
- B – Positive balanced differential signal (or single ended signal analog ground reference)
- C – Negative balanced differential signal (or single ended signal)
- D – Power ground
- E – No connection³
- F – Connected to sensor chassis

¹ Hose arrays are not provided with sensor.

² May be increased to 100Hz or more.

³ Can optionally be connected to the analog ground that the differential output signal is balanced about.

OBSERVED SPECIFICATIONS

Parameter	Nominal Value	Comments
Width	17.5 cm	Includes hose adaptors
Length	17.5 cm	Includes hose adaptors
Height	9 cm	
Weight	1.4 kg	
Operating Temperature Range	-40 to 85 °C	Design criteria
Power Supply Voltage	12 Volts	5 Volts min, 18 Volts max
Current Consumption*	24 mA	@ 12 Volts with 35 active microphone elements
Low Pass Acoustic Filtering	30 Hz corner	Can be customized
Signal Frequency Band**	2 – 30 Hz	Content does extend below 2 Hz
Balanced Differential Signal Sensitivity***	0.20 Volts/Pa	@ 2 Hz w/ ± 5 Volt Range
Balanced Differential Signal Self Noise†	< -85 dBV/√Hz	@ 2 Hz
Phase Match††	±5 °	Relative to a reference sensor

* Removing microphone elements via jumpers P1 and P2 decreases current consumption.

** Can be increased to ~100 Hz. See Application Notes for details regarding sub 2 Hz operation.

*** Varies with frequency, and can be easily altered from default via hardware DIP switch settings and potentiometer adjustment.

† Decreases as frequency increases. IML measurement environment does not allow for better determination.

†† Phase match in signal frequency band is provided for sensors manufacturing lots.

APPLICATION NOTES

Moisture

Moisture is detrimental to the sensor microphone elements. Care must be taken during installation to eliminate the potential for water intrusion into the enclosure. The hose adaptors designate the bottom half of the sensor enclosure while the electronic mount connector designates the top half of the sensor enclosure. The sensor and any associated hose arrays should be installed in a manner that eliminates the potential for water entry through the hose adaptor capillaries. During removal of a sensor from an installation, the sensor should be maintained in a proper top/bottom orientation until the sensor enclosure halves have been separated and inspected for possible water intrusion. Following this practice will ensure that any water intrusion remains in the bottom half of the sensor enclosure, away from the sensor electronics mounted in the top half of the sensor enclosure.

If humidity is a pressing concern, a thin moisture barrier (e.g. plastic stretch wrap) can be placed between the top and bottom portions of the sensor enclosure or across the hose adaptor capillaries. The use of a moisture barrier has not been extensively tested and may impact the quality of measurements. However, IML has received clientele feedback of a successful moisture barrier implementation.

Microphone Element Jumpers

Two banks of jumpers labeled as P1 and P2 on the circuit card provide the ability to remove one or more rows and/or columns of microphone elements from being active within the circuit. Removal of microphone elements can be useful for reducing circuit current consumption or eliminating a

problematic microphone element. However, removal of P1 or P2 jumpers could result in alteration of the specified response. If utilization of the sensor response below 2 Hz is desired, then removal of P1 or P2 jumpers is not recommended, since this certainly will alter the low frequency factory tuning.

DIP Switches

A bank of 8 DIP switches labeled as S1 on the circuit card provides several hardware configuration capabilities. The functionality of the DIP switches is discussed in general below with additional information residing in following topics.

S1 switches 1 and 2 determine whether the output is single ended or a balanced differential signal. S1 switches 1 and 2 should NEVER be in the same position.

S1 switch 3 determines the corner frequency of the high pass filtering of the output signal.

S1 switches 4–8 allow setting the coarse gain amplification in powers of 2, which dictates output signal sensitivity.

Signal Outputs

The analog output signal can be configured as either a balanced differential signal or a single ended signal. Selection of a balanced differential signal output requires S1 switch 1 to be on while S1 switch 2 is off. Selection of a single ended signal output requires S1 switch 1 to be off while S1 switch 2 is on. S1 switches 1 and 2 should NEVER be in the same positions.

The default factory configuration is for a differential output signal (i.e. I/O Pin B = Positive signal output and I/O Pin C = Negative signal output), which is balanced around the internal analog ground that is nearly equivalent to power ground. When the single ended output signal option is utilized (i.e. I/O Pin B = Analog ground reference and I/O Pin C = Single ended signal output), the single ended signal is referenced to analog ground. For single ended output operation the analog ground signal reference residing on I/O Pin B should be properly connected to analog ground on the data acquisition system to prevent introducing a power supply ground loop while also providing for an isolated signal current return path.

High Pass Frequency Filter Selection

During internal signal conditioning there is a one pole high pass filtering stage that cuts low frequency content from the output signal. Switch 3 of S1 selects the corner frequency of the high pass filter. If S1 switch 3 is in the factory default configuration off position, the low frequency corner is set to support sensor operation that includes enhanced microphone element response occurring below 2 Hz. If S1 switch 3 is in the on position, the low frequency corner is moved up to further to attenuate microphone element response occurring below 2 Hz. Placing S1 in the on position might be beneficial in highly windy deployment conditions, or if a low dynamic range digitizer is utilized. Potentiometer R7 provides fine tuning adjustment of the low frequency corner, which is useful for precisely matching sensor phase responses.

Sensitivity

The sensitivity of the output signal is largely dictated by the positions of S1 switches 4–8, which provide coarse gain amplification in powers of two. With switches 4–8 all in the off position, the maximum coarse gain of 31 is applied. Alternatively, unity coarse gain amplification is applied when only switch 4 is in the off position and switches 5–8 are in the on position. Switches 4–8 should NEVER all be placed in the on position.

The wide coarse gain range allows one to have a constant sensitivity when running the sensor with a differing number of microphone elements included as is allowed via the microphone element jumpers P1 and P2. Potentiometer R19 provides fine tuning adjustment of the gain amplification, which is useful for precisely matching sensor amplitude responses.

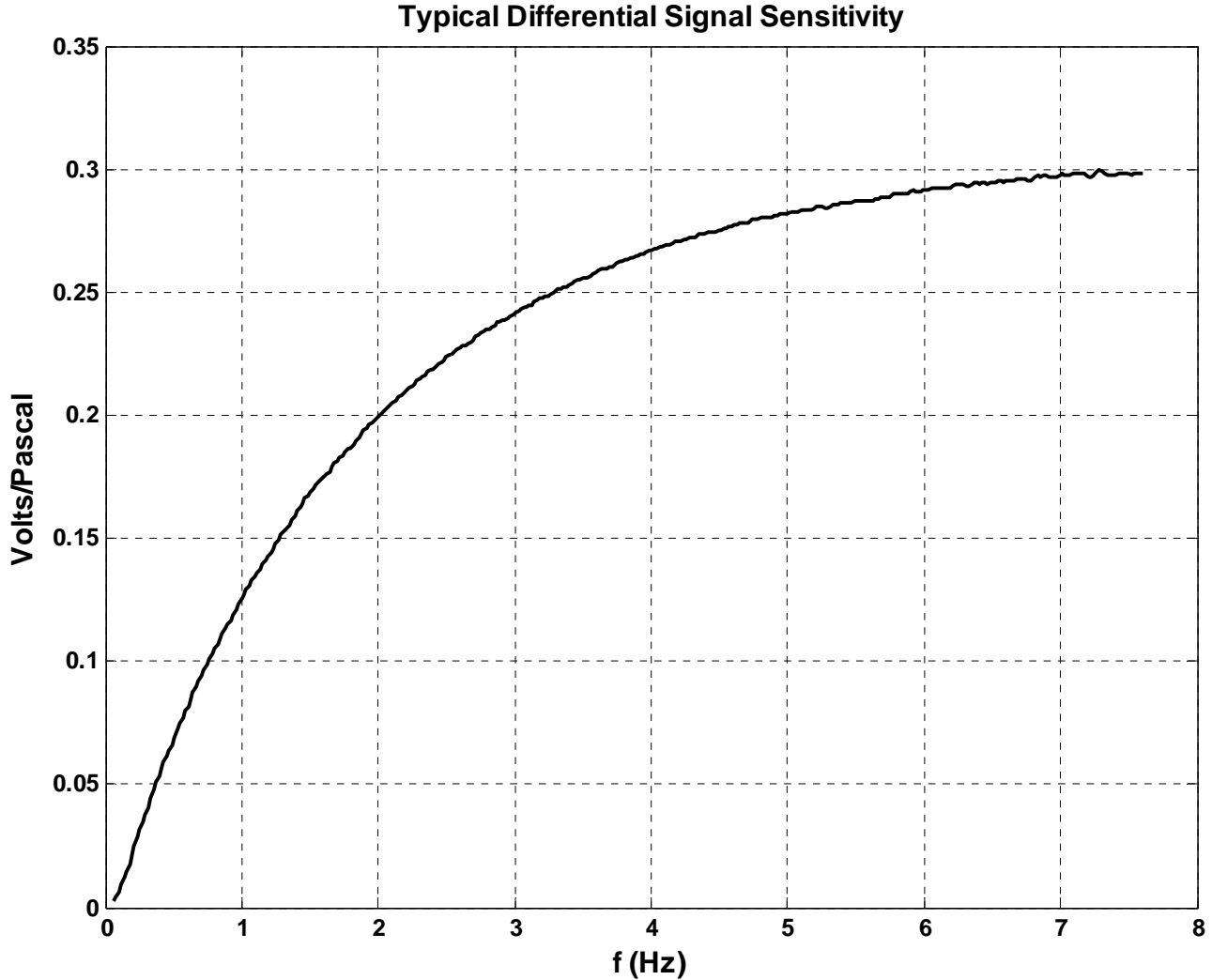


Figure 1. Typical Factory Default Differential Signal Sensitivity

Traditional field operational use of IML’s infrasond sensors has targeted frequency content above 2 Hz, but recent activities have established the use of the model ST sensor for frequency content below 2 Hz. While attenuated, signal content does extend down to near 0.1 Hz. Figure 1 shows the typical factory default differential ended signal output sensitivity for the classic infrasond frequency band. If the single ended output signal option is selected for use, then the output sensitivity will typically increase by a factor of 1.2.

Since the output signal amplitude response exhibits a sharp roll off characteristic at low frequencies, IML has developed methods that can provide a software correction of sensor data to flatten the amplitude response while maintaining integrity of the phase response. Such a technique may be useful for scaling to engineering units in applications that require knowledge of absolute pressure levels. Figure 2 shows an example of using software correction to flatten the factory default differential ended signal output sensitivity, which provides an approximate 0.30 Volts/Pa scaling factor across the frequency band. For more detailed information on software correction options, contact IML.

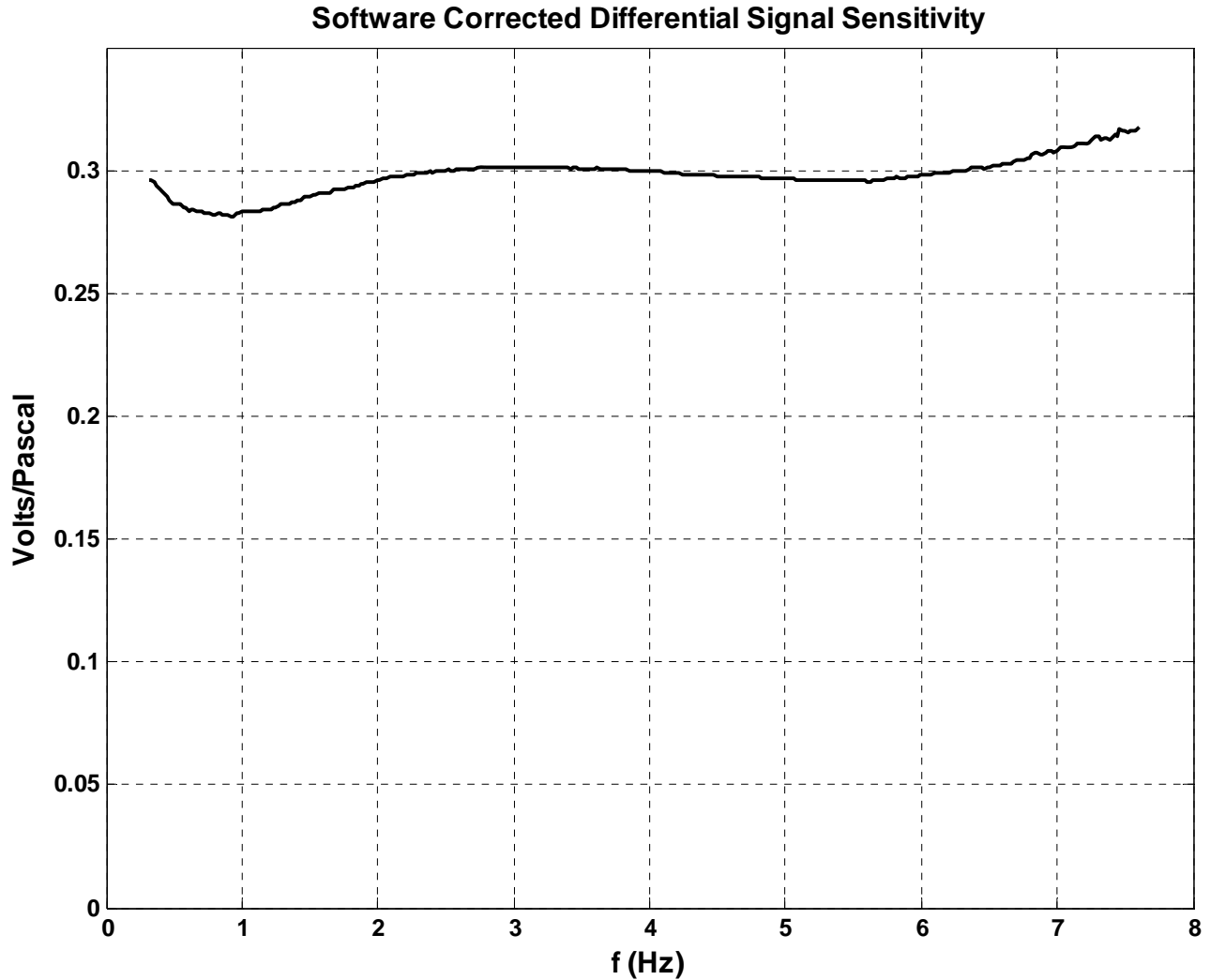


Figure 2. Differential Signal Sensitivity Flattened via Software Correction

Sensor Array Monitoring

Infrasound monitoring applications typically require the utilization of arrays of sensors, which have precision amongst phase responses. Significant effort and attention is applied towards providing well matched hardware phase responses within a manufactured sensor lot. However, the manufacturing process does not readily lend itself to assuring phase response precision amongst hardware constructed in differing lots, so it is encouraged that sensors being deployed in arrays be procured at the same time. If necessary or desired, applying a software calibration technique to acquired sensor data can improve the phase response precision amongst a batch of sensors. For more detailed information on software calibration options and services, contact IML.

WARRANTY

IML warrants that its model ST infrasond sensor will perform in accordance with the specifications described within, or in the case of custom instruments, the specifications agreed to at the time of order. Testing and other quality control techniques are used to the extent IML deems necessary to support this warranty.

The warranty period for instruments is twelve months and covers service Monday through Friday 8:00 AM – 5:00 PM local time. The twelve month warranty will begin upon installation or thirty days after the date of shipment, whichever occurs first. IML will replace or repair, at its option free of charge, any instrument or part, excluding consumable items, which fails within the warranty period, due to defects in materials or workmanship, provided that the instrument has been operated at all times in accordance with the intended method. Only the unexpired original warranty period on the instrument shall be in effect on any replacement parts, which may be new or reconditioned at the discretion of IML.

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