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ACOUSTIC MONITOR

USER'S MANUAL

ACOUSTIC LEAK DETECTION

GENERAL

The Acoustic Monitor was designed to detect discharges of gases under pressure into the atmosphere. Its first principal application is in generating an alarm when there is a blow-out in the piping at a natural gas wellhead or the separator unit. The Acoustic Monitor is a cost-effective solution for the monitoring of the points most prone to major leaks, especially when a well is first brought on line and sand coming up may eat away at bends.

Gases escaping under pressure create noticeable amounts of audible sound, but also generate high levels of ultrasound, that is, frequencies above the range of hearing. As higher frequencies are more rapidly absorbed by air, ultrasound is the preferred frequency range for early detection of leaks at high pressure. Ultrasound sensors are more tolerant of other sound sources, and their proximity to potential blow-out points means that a leak will predominate in amplitude over any other, more remote, sources of ultrasound.

The basic elements of the Acoustic Monitor are an ultrasound microphone, amplifier, frequency discriminator, envelope detector, and a microcontroller to monitor the output. The unit is packaged in a polycarbonate enclosure designed for outdoor use. The cover is clear to allow indications via LEDs of unit functionality and level of ultrasound currently detected.

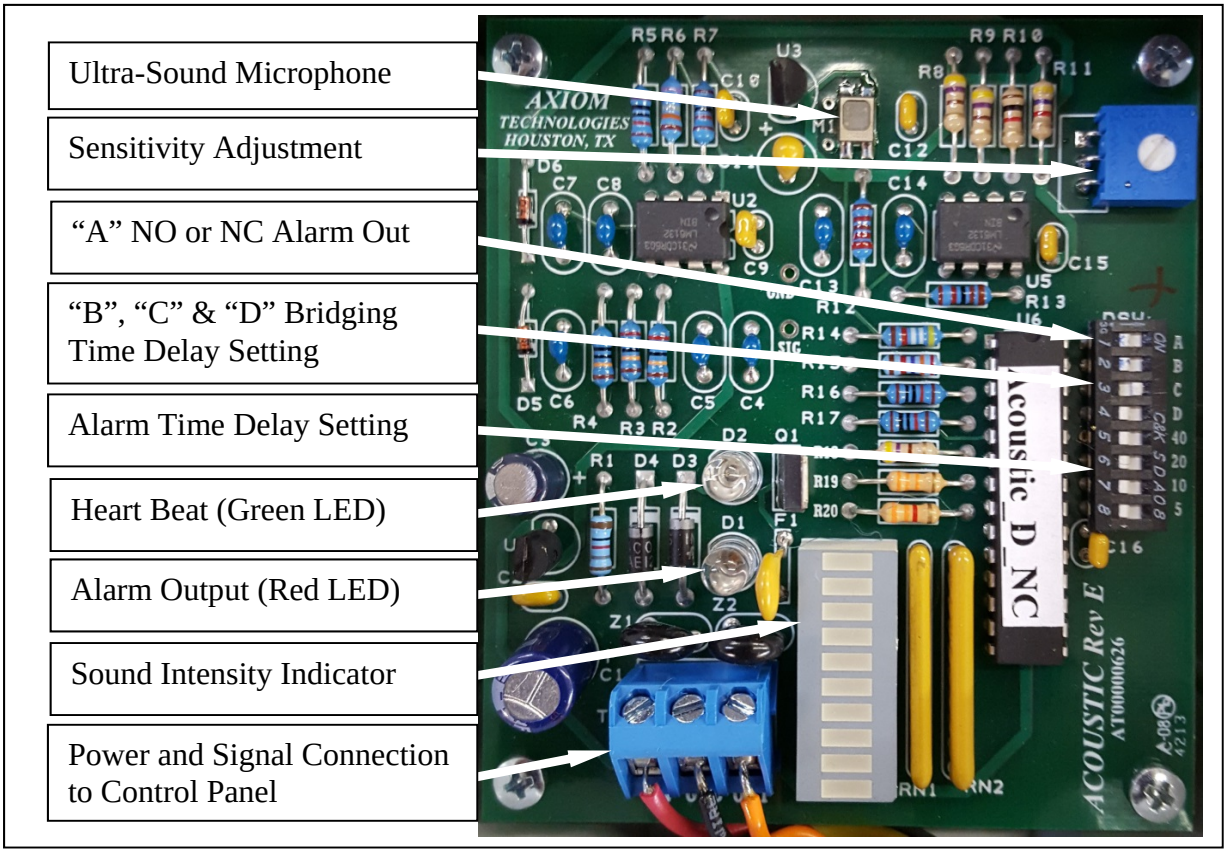

Fig. 1 Acoustic Monitor Layout

INSTALLATION

Because of the compact nature of the Acoustic Monitor and the strut channel on the back of the mounting plate, it is easily installed in a location favorable for detection of leaks in problem areas. Be aware in mounting the device that ultrasound travels very readily through metal. Therefore, the device should not be tightly anchored to any pipes which will have high frequency vibrations due to normal processes. Either attach the Acoustic Monitor to non-process structures, or provide ultrasound-deadening material between the mounting plate and the pipe. Typical installation is within 10 feet of spots being monitored.

Connections to the Acoustic Monitor are made via three wires. There is an input for nominal 12 Volt D.C. power ("12V" by the terminal block on the printed circuit board) with corresponding ground ("GND"). The alarm output ("OUT") shorts to ground, making it suitable for direct connection to Axiom safety systems or any other device which can monitor a contact closure. The power input and alarm output have transient protection to the ground connection. During normal (no alarm) operation, the Acoustic Monitor draws 3 mA of current. As long as adequate power is available, the green LED will blink. If ultrasound acoustic signal is detected, then the green LED blinking is supplanted by an indication of ultrasound noise amplitude.

OPERATION

The microcontroller drives an LED bar graph display of sensed ultrasound amplitude when it is above negligible levels. It keeps track of time above the alarm level, and activates the alarm output and red alarm LED when the ultrasound levels are persistently high. The miniature switches of the Acoustic Monitor allow the setting of alarm delays from 5 to 75 seconds before levels above threshold will cause the output to be activated. Even though many common activities generate some occasional ultrasound, they are screened out because of their transient nature. Additionally, the bridging time delay switches (B, C, D) allow "dropouts" to be ignored. A dropout is a short period of time when the ultrasound amplitude drops back below the alarm threshold. It is common with gas containing significant amount of water to make a sputtering sound when the leak is still small. By ignoring short dropouts in ultrasound level, the monitor will "remember" the alarm threshold for the indicated amount of time (any possible combination of 4, 2, and 1 seconds: up to 7 seconds.) This allows the monitor to catch leaks sooner.

A potentiometer in the Acoustic Monitor allows the gain to be adjusted by a factor of 100. The unit is shipped with the gain (amplification of ultrasound frequencies) close to the maximum. If the unit is deemed to be too sensitive for a location, perhaps because of unavoidable background ultrasound sources, the gain can be decreased while referring to the amplitude display. Axiom Technologies also makes a small handheld ultrasound generator ("USG") for testing the Acoustic Monitor without having to resort to pneumatic simulation of leaks. The USG provides a 40 KHz symbol of consistent amplitude which is ideal for testing the Acoustic Monitor from front-end sensitivity to activation of the alarm output.

MAINTENANCE

The Acoustic Monitor requires little maintenance, but a minimum of a monthly visual examination and testing is recommended to insure that the unit as well as the systems and devices associated with the safety shutdown are operating properly.

ACOUSTIC MONITOR ELECTRICAL RATING

Electrical Power : Nominal 12 Volt D.C. with battery supplied from external source
Current consumption : 5.0 mA max. (under no alarm)
Alarm Output : "Open Collector" to GND.

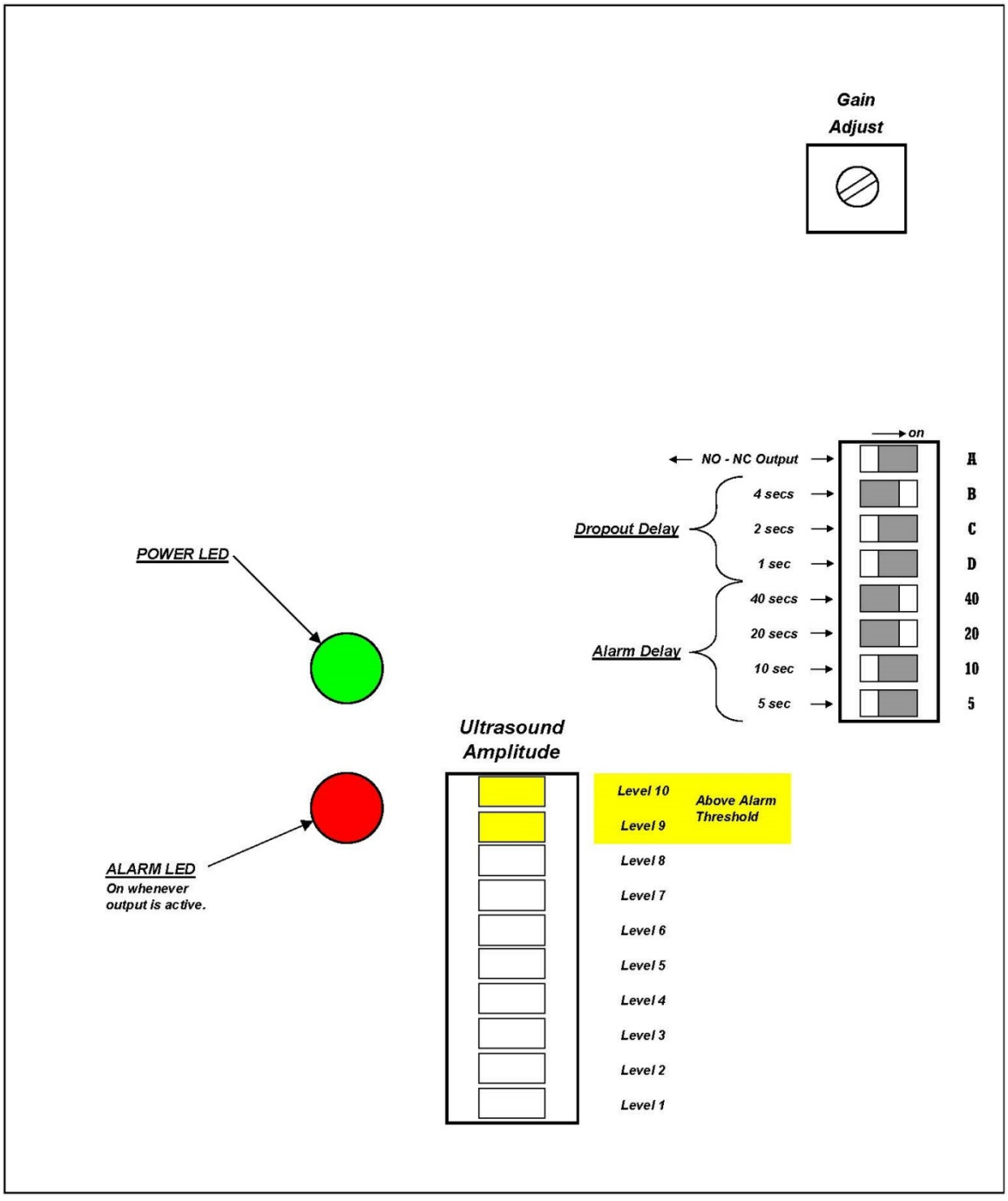

Fig. 2 Acoustic Monitor Indicators and Controls