STI Vibration Monitoring Inc.

Field Application Note

Fault Detection Circuits/OK Circuits FDC

Over the years, two methods of vibration transducer fault detection have become prominent: OK Circuits and Fault Detection Circuits. The objective of both types of fault detection is to disable a vibration monitoring system's ability to produce alarms or shutdown a piece of rotating machinery when the transducer systems integrity is in doubt.

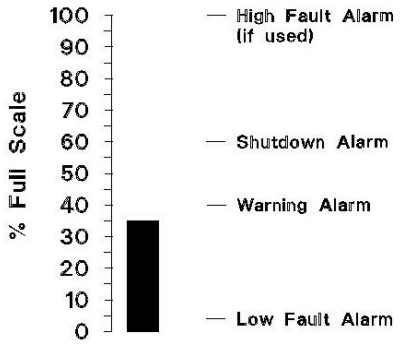
It is important for the engineer responsible for the installation and set-up of a vibration monitoring system to fully understand how Fault Detection and OK Circuits function. This insures that the system's credibility is not damaged from false alarms and false machinery trips.

Fault Detection Circuits

STI Vibration Monitoring developed Fault Detection Circuitry for Case Mounted Transducers such as Accelerometers and Velocity Pick-ups. STI now uses Fault Detection Circuits for all types of vibration transducers in all permanently installed monitoring systems. Fault Detection Circuits have an early foundation in the instrument industry and have an excellent record of reliability.

Theory of Operation

The theory of operation behind Fault Detection Circuits is that all vibration transducers whether Accelerometers, Velocity Pick-ups or Non Contacting Pick-ups (NCPU's) have a minimum and maximum vibration signal output while a machine is running.



STI provides two (2) levels (Low and High) of fault detection in all monitoring systems. These levels are programmed or set at time of installation to best suit each installation's needs.

In some cases, only low level fault alarms are programmed as the possibility of very high vibration levels exist.

As an example, a rolling element bearing machine rotating at 3600 RPM may have a scale of 0-1 in/sec, with warning and alarm set at 0.2 and 0.3 in/sec respectively. The lower fault alarm may be programmed at 4 to 8% of Full Scale or 0.04 to 0.08 in/sec. The high fault alarm, if used, may be set at 1 in/sec. As the machine normally vibrates in the 0.1 to 0.2 in/sec range no fault alarm exists unless there has been a failure with the vibration transducer or associated instrument wiring.

As the signal will drop below the low fault alarm when the machine is shut down, STI has equipped all monitoring systems with a Machine On/Off Contact. This is used to signal the monitor that the machine is no longer running and to disable all alarms. In STI's more advanced monitors, the On/Off Contact will also signal the monitor to suspend such tasks as trending and spectrum gathering while the machine is not running.

Another advantage of Machine On/Off Contacts is that start up attenuation is automatically triggered, and vibration signals can be attenuated by a factor of three (3) during the start-up time programmed. This allows a machine to reach a steady state running speed, and pass through it's critical speeds before alarms reach full value.

Advantages

Works with all types of vibration transducers.

Levels are programmed for each installation.

Monitors the transducer vibration signal output.

Disadvantages

Designed for Velocity and Acceleration transducers.

Does not monitor NCPU Gap.

Machine On/Off Contact required to prevent false fault alarm when machine is shutdown.

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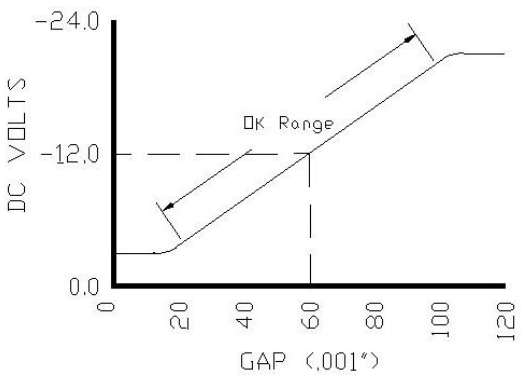
OK Circuits

The OK Circuit was developed specifically for the Non-Contacting Pick-up (NCPU) or Proximity Probe Systems used in Sleeve Bearing-Radial Vibration applications. It was then applied to other types of transducers by some vibration system manufactures.

Theory of Operation

The theory of operation behind OK Circuits is that the NCPU or Proximity System has a fixed linear range with associated minimum and maximum DC Voltage Gaps. If the DC Gap is outside of the permissible range, then the transducer is no longer within it's linear range and the output is suspect.



As Sleeve type bearings limit the total relative motion between the shaft and bearing, OK Circuits work well for Non-Contacting Pick-Ups installed for Radial Vibration measurements.

In Thrust Position Installations, the OK Circuitry is not allowed to disable the monitors ability to alarm and shutdown, as severe thrust failure may cause the thrust collar to travel outside of the range of the NCPU transducer.

As an example, a standard proximity probe's linear range is 80 mils or 0.080". The output sensitivity is 200 mV/mil. This relates to a total DC Voltage Range of 16 VDC. If the center of the Linear range is -12 VDC then the useful range of the proximity transducer is -4.0 VDC to -20.0 VDC.

Theory suggests that an open circuit will drive the DC Voltage above -20.0 VDC, and a shorted circuit will drive the voltage below -4.0 VDC. DC Voltage Comparator circuits are used to monitor the existing probe gap minimum (-4.0 VDC) and maximum (-20.0 VDC). If the DC Voltage is outside the selected range, the monitor's ability to alarm or shutdown a machine is disabled.

Other types of vibration transducers were adapted to this circuitry by applying a DC bias voltage within the OK Range through the transducer system. As the OK Circuit was not specifically designed for other types of transducers such as accelerometers and velocity pick-ups, it will not detect failure of the transducer itself but simply open or shorted wiring.

Advantages

Works well for NCPU Sleeve Bearing-Radial Vibration Applications.

Works with the machine running or shutdown.

Disadvantages

Does not check the complete transducer system in transducer types other than NCPU's.

Only indicates if the NCPU transducer is gapped properly, not if there is any vibration signal output.

Cannot be used in Thrust Position applications as thrust collar may move outside the NCPU linear range during thrust failure.

Summary

Two methods of insuring transducer integrity exist in the industry today, Fault Detection Circuits and OK Circuits. OK Circuits were developed specifically for proximity vibration transducer systems. These circuits insure that the transducer has been installed within it's linear range, however this does not insure that the transducer is measuring a machine's vibration. At a later date, OK circuits were adapted to provide partial insurance of other vibration transducers' integrities.

Fault Detection Circuits have been used by the machinery monitoring instrumentation industry for many years. STI initially utilized these circuits to insure the integrity of case mounted transducers such as Accelerometers and Velocity Pick-ups. This method was then used for the NCPU Transducer system. Since Fault Detection Circuits measure the transducer system's vibration signal output, the integrity of each component in the transducer system is insured.

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