



Advanced Magnetic Bearing Controller Functions

The Waukesha Magnetic Bearings® advanced digital control system is integral to the Chinook®, Elephanta® and Zephyr® controllers. The controller uses state-of-the-art digital signal processors to execute sophisticated control algorithms to optimise machine dynamic performance and ensure the highest possible efficiency of the bearing control system.

The controller is equipped with a fully featured network interface supporting both web browser and FTP client access to data within the controller. Use of standard Internet protocols allows for secure remote access. Connectivity to plant data systems is supported through both PROFIBUS DP and MODBUS (TCP & RTU) slave interfaces.

Waukesha's controllers are also equipped with a fully functional trip system to protect against excessive current or position signals. This trip system also activates a high-speed capture buffer that allows events within the machinery to be analysed off-line.

Remote connectivity is supported via suitable TCP/IP connections, including (but not limited to) ISDN, ADSL and customer provided SSL VPN. This remote connectivity enables machine health monitoring and diagnostics by Waukesha personnel without the need for site visits. Many common commissioning and troubleshooting operations may be performed locally by operating personnel.

In order to support superb dynamic performance in complex machinery the following control algorithms and functions are available:

SISO and MCC Control Law Options

The controller can be supplied with either a classic SISO controller or the proprietary Waukesha Multi-Coordinate Control (MCC) algorithm. The MCC algorithm is optimised to support the application of magnetic bearing control to flexible rotor machines – particularly those with challenging rotordynamics.

In both controller structures, gains can be speed scheduled to allow complete flexibility in tuning of system dynamics.

Vibration Attenuation Algorithms

The controller can be supplied with Open Loop Feed Forward (OLFF), runout compensation and closed loop tracking filters. These allow vibration to be attenuated at the synchronous speed (or harmonics of it). By reducing the controller effort expended in control of synchronous vibration and increasing overall controller gain, Waukesha magnetic bearing systems are able to deliver superior performance when aerodynamic effects within a machine become significant.

Advanced Amplifier Algorithm

Waukesha uses an advanced current servo algorithm that includes either measurement or dynamic modelling of magnet flux to provide superior system dynamic performance. The current servo and associated switching algorithms are also optimised to provide optimal bandwidth while still achieving excellent signal-to-noise ratios and maximum efficiency in both the amplifier and the bearing hardware. This function is essential in providing good performance in canned bearing systems.



ADDITIONAL ADVANCED SOFTWARE FUNCTIONS

Automatic Clearance Check

This function allows an automatic clearance check to be performed by the controller, thus identifying the clearances in the auxiliary bearings. When this capability is combined with Waukesha's proprietary RDS® auxiliary bearings, it allows accurate assessment of the remaining service life of the auxiliary bearing system without the need for machine tear down and inspection.

Integrated Transfer Function & Spectra

Underpinning the remote commissioning service offered by Waukesha is the integrated transfer function and spectral analysis capabilities provided by the controller. These functions allow the system dynamics to be identified, compared with previous rotordynamic modelling, and optimised prior to rotation and during rotational testing.

System noise signatures can also be captured prior to and during rotational testing, thus allowing easy identification of problem frequencies. These capabilities eliminate the need for bulky dynamic signal analysis equipment on-site and, where suitable remote connections are provided, allow these measurements to be performed remotely.

Automatic Trip Data Save and Third Level Trip

The Automatic Trip Data Save function allows for maximum machine availability. Following a machine trip it allows for rapid re-start without intervention in most cases.

The Third Level Trip function allows the bearing controller to identify if contact was made with the RDS auxiliary bearings during a run-down. If no contact was made during a run-down, then the magnetic bearing system will automatically come back on line. If contact is detected during a run-down, then the system would initiate an automatic clearance check. In either case the high-speed capture buffer will be saved for off-line analysis; up to 10 such capture buffers may be stored for subsequent analysis.

