

# ADVANCED LOAD SHARING CONTROLS FOR COMPRESSOR NETWORKS

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## Why compressor networks?

A compressor network is a compression system in which two or more compressors operate together. A parallel compressor network has flexibility to match the total supplied flow to a varying production demand. A series compressor network is useful for achieving higher compression ratios required by the process.

## Challenges in compressor load sharing

Controlling a compressor network requires consideration of overall network performance and performance of individual machines. The major process control task is to distribute the overall load between the compressors while controlling a shared process parameter, such as suction header pressure, discharge header pressure, or total header flow. One known load sharing strategy is to designate a single compressor to control the shared process variable and to base load the other compressors. This simple load distribution is characterized by constrained responsiveness to changes in flow achievable with one swing machine, increased exposure of the swing machine to surge, and frequent gas recycling of the swing machine with resulting lower overall efficiency. Changes in the steady-state load distribution require operator intervention to adjust the base-loaded machines.

Active load sharing strategies automatically distribute load across the compressors in a coordinated manner, but these strategies require more sophisticated control algorithms with data interdependencies. A single failure in the active load sharing system can force it to fall back to a simple load sharing scenario with all of its weaknesses. Typical failures in load sharing systems include faults in the Master Controller and failure of the process variable. To maximize the effectiveness of an active load sharing system, the system should have fault tolerance.

## Compressor Network Management System

Woodward has leveraged decades of experience in power management to design a compressor load sharing system that eliminates the typical dependency on a Master Controller with its associated single points of failure.

### Multi-Master vs Single Master

Active load sharing systems usually require a Master Controller to manage a shared setpoint and to balance load among compressors. Woodward's Compressor Network Management System (WCNetMS)

uses a distributed Multi-Master Control Architecture, so a dedicated Master Controller is not needed. WCNetMS allows any Performance Controller on the network to be a Master Controller, eliminating this single point of failure. Each controller is able to produce the master setpoint, common to all compressors on the network. The controller designated as the Setpoint Master owns the common master setpoint and distributes it to the other controllers over the data network. If the active Setpoint Master controller has a fault, the Setpoint Master designation automatically transfers to a standby controller. The operator can re-assign the Setpoint Master designation during any mode of operation. Load balancing logic is implemented in all controllers, so the compressor network load distribution remains in balance even when a single controller fails.

### Load Sharing Data Network

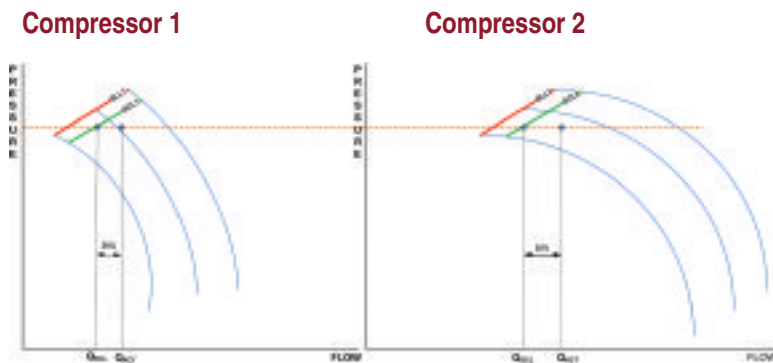
Active load sharing systems depend on a data network that shares critical parameters between the Performance Controllers. Failure of the data network can compromise availability of the system. WCNetMS maximizes availability by including two redundant CPU modules. All primary CPUs are connected on the primary data network. The backup CPUs are linked through a backup data network. The primary and backup data networks are completely independent. Thus, a failure on either network does not affect availability of the WCNetMS load sharing system.

### Considerations For Process Transmitters

The transmitter for the shared process variable, which is often exposed to harsh field conditions, can be a weak link in the system. WCNetMS supports multiple transmitters. To further maximize availability, the signals from the redundant transmitters are wired to control hardware of different compressors. The signals are shared over the data network and each controller handles redundancy management. Therefore, a failure of a single controller or transmitter will not compromise the load sharing system.

### Proven Turbomachinery Control Platform

Since the 1990s Woodward's purpose-built high-availability MicroNet™ Plus and MicroNet™ TMR platforms have been operating in petrochemical facilities and power plants worldwide. Over 500 integrated turbine-compressor systems have been commissioned. WCNetMS is engineered to run on MicroNet™ control systems.



Example Of Equidistant Load Sharing Control Strategy For Two Compressors in a Parallel Network

