ELLIOTT®GROUP
EBARA CORPORATION

Gemini Compressor
Performance Monitor

The Gemini Compressor Performance Monitor is a comprehensive compressor-focused suite of software and enabling hardware that augments your plant's predictive/proactive maintenance strategy. It includes:

• Elliott's custom-designed compressor performance comparison and evaluation

• Advanced vibration analysis

• Remote compressor and auxiliaries controls monitoring

The Gemini compressor performance monitor collects high-resolution compressor data by connecting to the compressor controls programmable logic controller (PLC) and the compressor vibration monitoring system. The collected data is stored in an integrated "Edge" database, accessed by the Gemini application software, and presented in contextually relevant, easy-to-understand graphics. The website-like interface allows multiple users (with the appropriate security credentials) to connect to the Gemini compressor performance monitor at any given time, without having to install any special software (apart from one of the standard web browsers).

■ WHAT'S INCLUDED?

• Internet access to a custom Elliott compressor model

• Unlimited internet (remote) and local access to Gemini compressor performance monitor

• Gemini local server (can be mounted in the Unit Control Panel), Machine Monitoring System (MMS) Panel, etc. Includes: Computer hardware, operating software, User dashboard, compressor digital twin application, vibration analysis application, and remote controls monitoring application

• Gemini Vibration Monitor/Vibration Analysis interface (mounted in MMS Panel)

GEMINI DIGITAL TWIN

The Gemini Compressor Digital Twin application provides a contextual and graphical representation of the deviation (and change in deviation) in the compressor's predicted to actual performance for any given set of process conditions, using real-time or historical data. The digital twin application evaluates the compressor performance by first calculating predicted compressor outputs for current process conditions. It uses the Elliott compressor performance maps, instrumented and modeled process data, application data, and an Elliott custom compressor model (specific for the compressor and application). The predicted performance value is then compared and evaluated against the actual compressor performance. Deviations in actual compressor performance vs. predicted compressor performance are represented graphically. If push notification is enabled and a change in deviation exceeds a configurable threshold, an SMS or email notification is sent to the appropriate plant personnel.

Features

• Elliott custom compressor model (digital twin)

• Compressor performance evaluation

• Custom process interface model

• Integrated system dashboard

• Configurable alarming with push notification

• Single, integrated database (with configurable update - 500msec to 5 minutes)

• Modbus TCP communications interface

• OPC DA interface

• Simple licensing

◼ DIGITAL TWIN DATA FLOW

Performance Curve: (Design Conditions) → **Compressor Data**

Piping, Valves, Flow Element etc.: → **Application Data**

Application Configuration

Measured Values from PLC: → **"Raw" Process Data** → **Process Model** → **Elliott Compressor Model** → **Comparison and Display**

Inputs **Calculations**
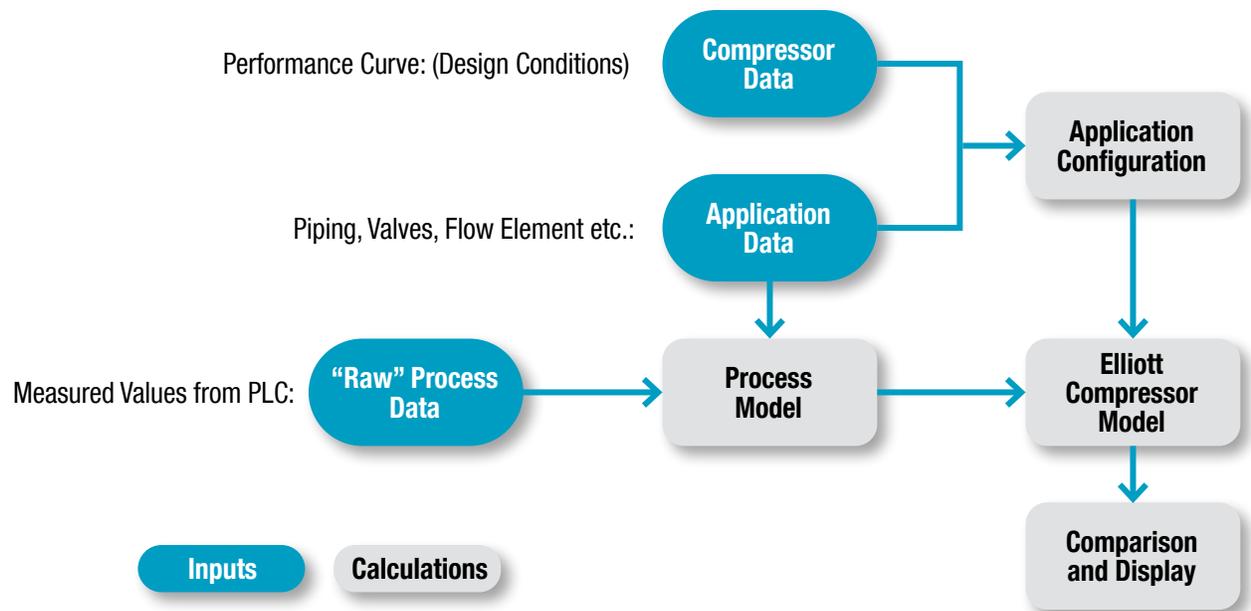
◼ GEMINI COMPRESSOR MODELS

There are two compressor models available with the Gemini compressor performance monitor: the Elliott compressor model and the local compressor model. The Elliott compressor model is the actual model used when designing and performance testing the compressor. Access to the Elliott model requires an internet connection. The local compressor model is built into the digital twin application. For the Elliott compressor model selection (maximum fidelity), the compressor design data necessary to calculate the expected performance is integral to the Elliott compressor model. Compressor design performance data for the local model is entered manually into the compressor digital twin application using the Elliott compressor performance curve data.

◼ GEMINI PROCESS MODEL AND INSTRUMENT GAPS

Many times, process instrumentation doesn't account for flow elements, block or control valves, or the last/first section of piping that flanges up to the compressor. We refer to these exclusions as "instrument gaps" around the compressor. These instrument gaps can have a significant effect on the suction and discharge pressures the compressor is actually working with. In order to maximize the accuracy of the process data sent to the compressor models, the Gemini digital twin calculates pressure at the compressor flanges taking into account pressure drops associated with these valves, flow elements, and piping.

◼ GEMINI COMPRESSOR DIGITAL TWIN USER INTERFACE

The Gemini compressor digital twin user interface includes:

⬩ Compressor information configuration

⬩ Process information configuration

⬩ Performance comparison

The interface also includes a pre-configured trending tool that enables both real-time and historical data analysis (by time interval).

In most cases, five performance maps are available for display*:

⬩ Polytropic Head

⬩ Polytropic Efficiency

⬩ Shaft Power

⬩ Discharge Pressure

⬩ Pressure Ratio

*Each of the performance maps use Flow in the x-axis (E.g.: Polytropic Head vs. Flow, etc.)

VIBRATION ANALYSIS

Accessing vibration data directly from the vibration monitor interface, the advanced vibration analysis tool provides best-in-class vibration evaluation without requiring a commitment to an Enterprise solution. The Gemini vibration analysis application collects high-resolution compressor data by connecting to the compressor controls PLC and the compressor vibration monitoring system. The collected data is stored in an integrated "Edge" database, accessed by the Gemini application software, and presented in contextually relevant, easy-to-understand graphics.
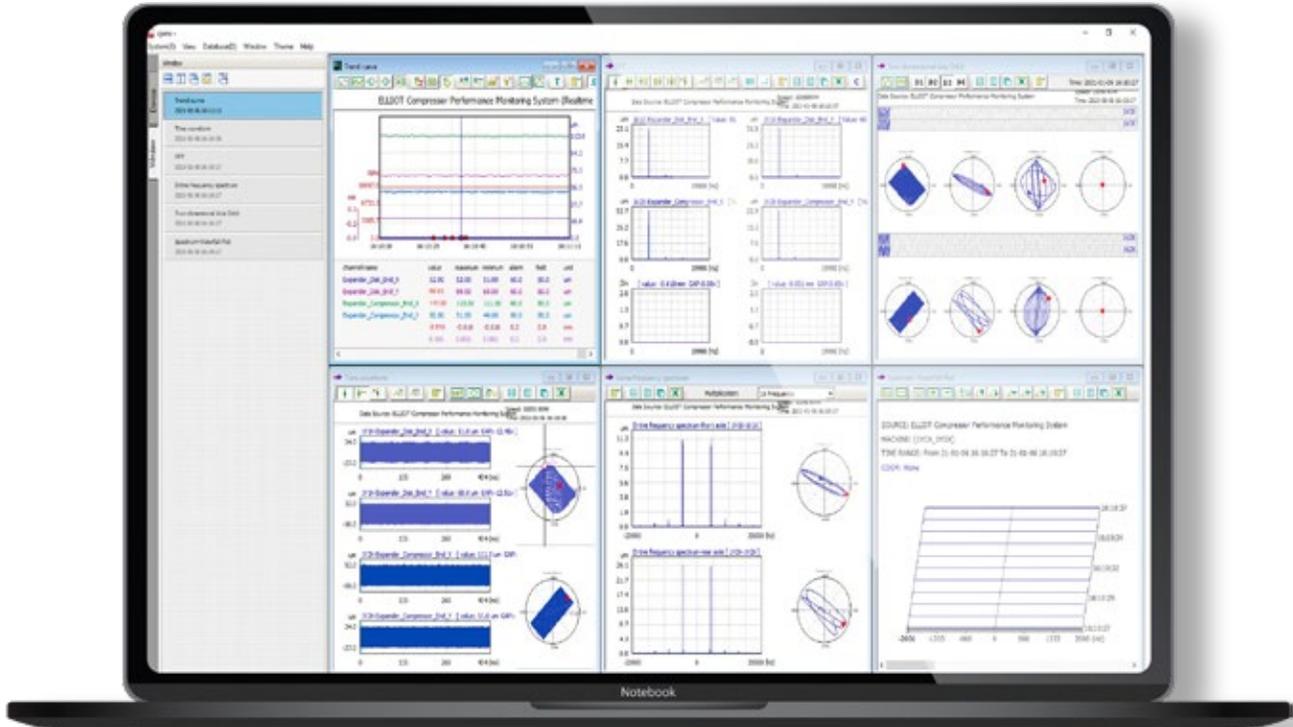
■ VIBRATION ANALYSIS INTERFACE

The Gemini vibration analysis hardware is typically mounted into the machine monitoring cabinet and connects directly to an existing Bently Nevada vibration monitor. No additional machine monitoring hardware is required. The Gemini vibration analysis interface connects to the buffered Bently Nevada vibration monitor outputs using BNC coaxial cables and a BNC cable "aggregator" (supplied with the Gemini vibration analysis interface). The vibration analysis computer connects to the Gemini server using proprietary TCP communications.

Vibration Analysis Functions Include:

Time Based

- Single-Channel Analysis
- Multiple-Channel Analysis
- Full-Train Analysis
- Statistical Analysis
- Real-Time and Historical Status and Trending
- Time Domain Waveform and Pivotal Trajectories

Frequency Domain

- FFT Spectrum Analysis
- Waterfall Chart
- Full Spectrum Chart
- Full Waterfall Map (3D spectrogram in chronological order)
- Envelope Analysis
- 2D Dynamic Holographic Spectrum
- Subband Analysis
- BODE diagram

Time Frequency

- Wavelet
- Short FFT
- Empirical Modal Decomposition (EMD)
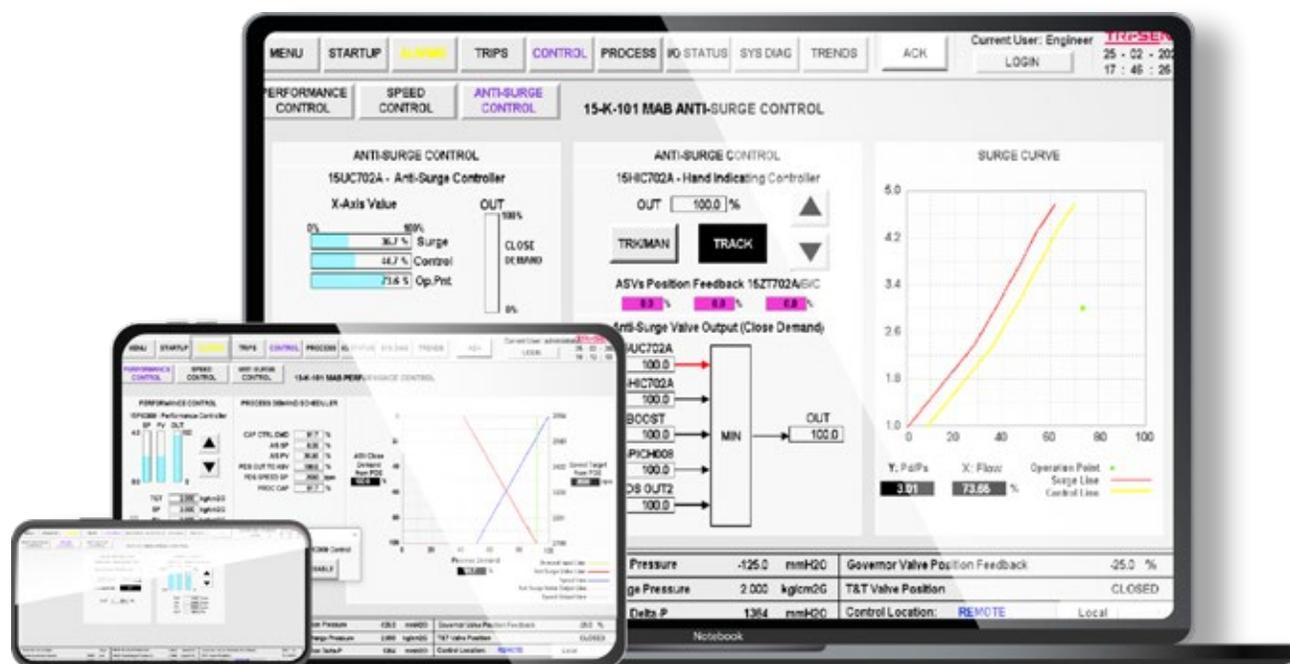
The remote controls monitoring application provides a remote user with the same compressor controls data in the same format as the data presented by the local human machine interface (HMI). Using a "smart" device that supports a web browser, a remote user can access the Gemini via the internet and monitor a given compressor like a local user without actually connecting to the local HMI. After connecting to the Gemini and accessing the Remote Controls Monitoring, you see the same data the operator sees on their local HMI, in the same context, using the same navigation and "drill-down," but without the ability to affect the compressor control.

Features

⬩ Web-like internet access to the Gemini provides remote controls monitoring that is graphically identical (or nearly identical) to the local controls HMI without actually connecting to the local HMI

⬩ Limited read-only and navigation access

⬩ Responsive graphics (the graphics resize appropriately to the smart device display)

⬩ No remote client software required apart from a standard internet browser

⬩ Two-factor user credential authentication to prevent unauthorized access

■ REMOTE CONTROLS MONITOR INTERFACE

The local Gemini server (with an individual IP address) is connected directly to the PLC that is controlling the compressor (and the associated driver and auxiliaries). Remote users can connect to the Gemini server using a standard web browser. Once a remote user has connected to the Gemini server (with two-factor authentication), they are able to view the Gemini dashboard, the digital twin, the vibration analysis tool, and the "local HMI-twin" or remote control monitor using the Gemini application dashboard drop-down menu.

Customers throughout the world choose Elliott for the design, manufacture, and service of their critical rotating equipment. Elliott supplies and services turbomachinery for the full spectrum of oil and gas, refining, LNG, petrochemical, and other process and power applications. Elliott's global service organization routinely installs, overhauls, repairs, upgrades and rerates machines from any manufacturer.

Headquartered in Houston, Tri-Sen has offices in Europe, Singapore, the Middle East, India, and China that provide turbomachinery controls solutions to the power and process industries throughout the world. Our focus is on supplying high-quality control services and products for turbines, compressors, and generators.

The Elliott + Tri-Sen alliance was born from Elliott's continuing desire to improve their turbomachinery solutions delivery. Formalized in the fall of 2012, the Elliott + Tri-Sen alliance demonstrates Elliott's commitment to all aspects of turbomachinery solutions and the acknowledgment of Tri-Sen's position as a world-class turbomachinery controls provider.

Elliott Group is a global leader in the design, manufacture, and service of technically advanced centrifugal compressors, steam turbines, power recovery expanders, cryogenic pumps and expanders, and axial compressors used in the petrochemical, refining, oil & gas, liquefied gas, and process industries, as well as in power applications.

Elliott Group is a wholly owned subsidiary of Ebara Corporation, a major industrial conglomerate headquartered in Tokyo, Japan.

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