

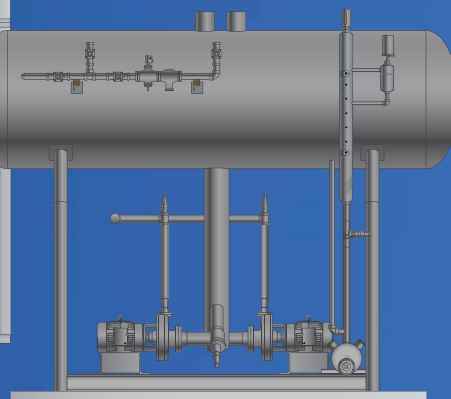
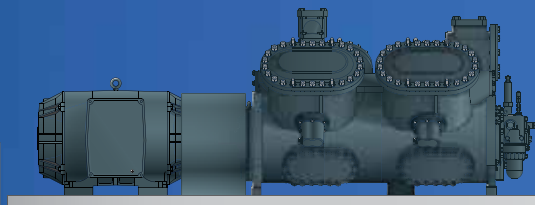
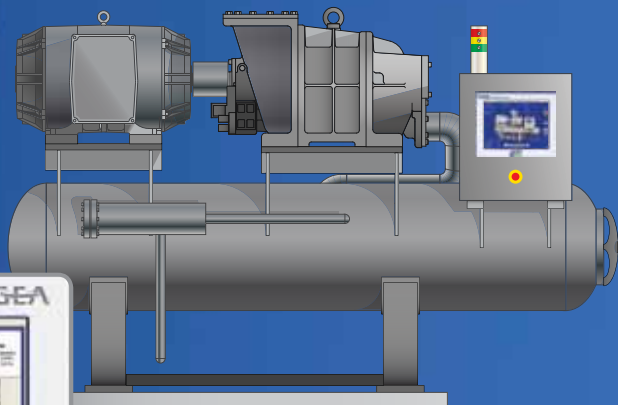


REFRIGERATION EQUIPMENT CONTROLLER

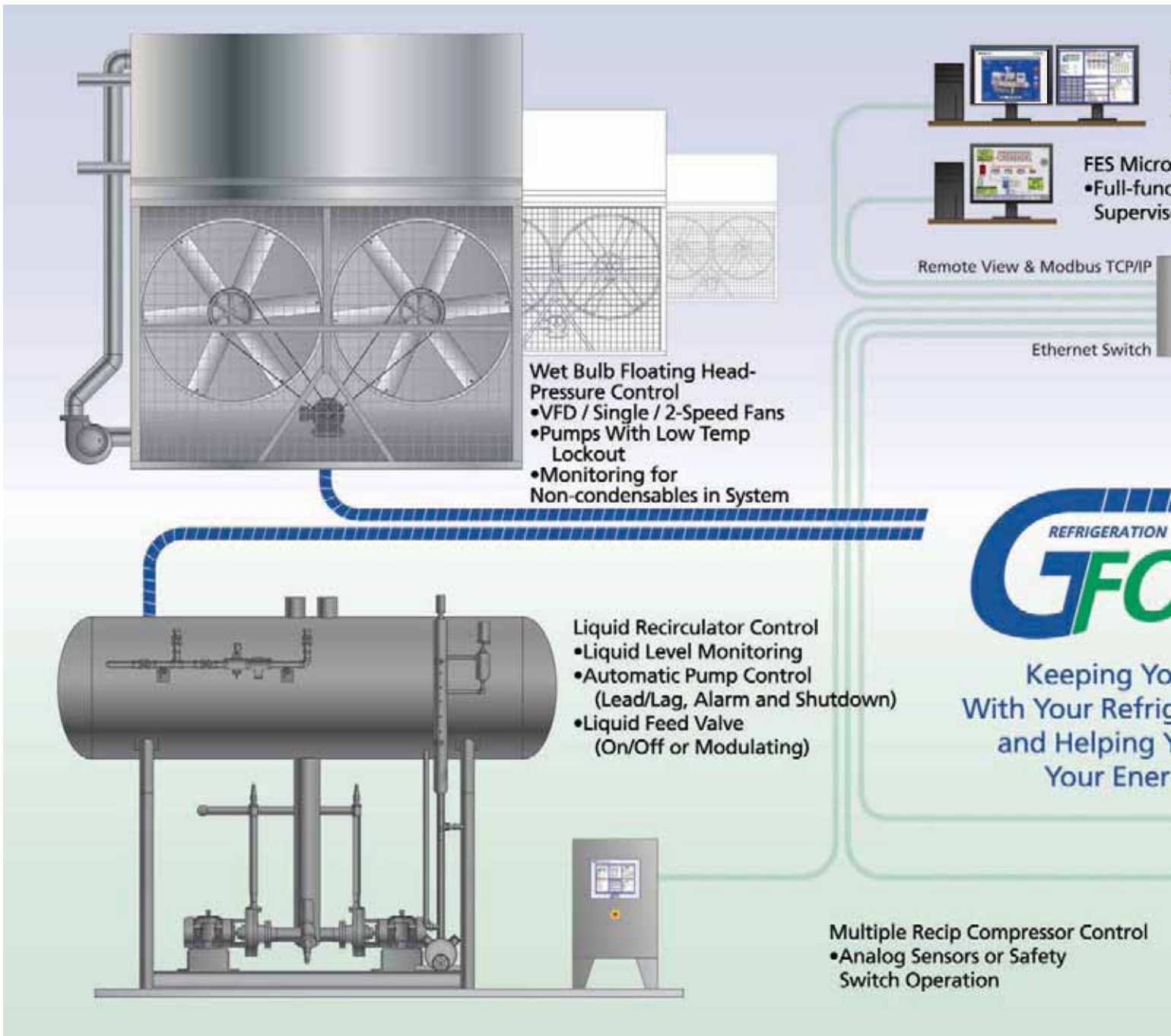
# GFORCE™

## Microprocessor Control System

KEEPING YOU  
IN "TOUCH" WITH  
YOUR REFRIGERATION  
SYSTEM...



...AND PROVIDING  
NEW TOOLS FOR  
EFFECTIVELY  
MANAGING YOUR  
ENERGY USAGE



**GEA FES, Inc.**, the first compressor package manufacturer to provide microprocessor-based control for screw compressor packages and systems, continues to enhance the GForce™ control panel, the most operator-friendly, practical, and easy-to-use control panel in the industry.

### The GForce™ Panel can do the following:

- Screw compressor control
- Rotary/Reciprocating compressor control
- Centrifugal compressor control
- Compressor sequencing
- Condenser fan/pump sequencing
- Air unit cooling & defrost control
- Vessel & Pump package control
- Chiller control
- Refrigerant leak detection
- kW limiting/load shedding

All of these functions and many more are possible in a single, or distributed across multiple, GForce™ panels.

Remote Viewer Software  
 • Using Standard PC  
 • Built-In

MicroLINK  
 Integration SCADA  
 Primary Computer System



Satellite Panel  
 • Factory Floor  
 Remote Viewer Client



Remote I/O Capabilities  
 • Simplify Wiring  
 • Single Communication Cable  
 Between GForce™ and  
 Remote Panel

Air Unit Control  
 • Variable Speed Fans  
 • Advanced Defrost &  
 Setpoint Scheduling  
 • Suction Valve Operation  
 (On / Off or Modulating)  
 • Refrigerant Leak Detection

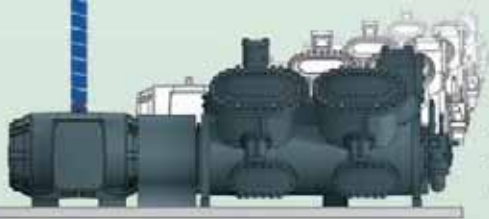
EQUIPMENT CONTROLLER  
**GFORCE™**

Keep You In Touch  
 Refrigeration System  
 You Manage  
 Energy Usage

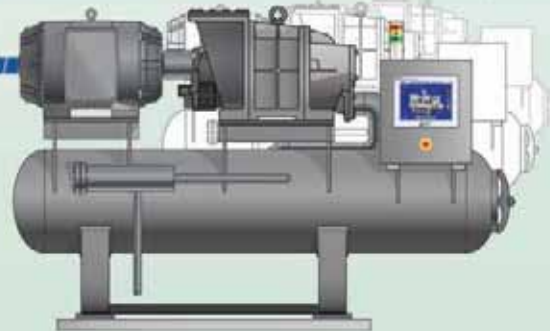


Engine Room Safeties & Ventilation  
 • Refrigerant Leak Detection  
 • Exhaust Fan Control  
 • Temperature Control

Intelligent Refrigeration Screw Compressor Control  
 • Retrofits Available for Most Manufacturer's Compressors



- 100%
- 75%
- 50%
- 25%



GForce™ Panels to replace existing controls are available for, and have been installed on the following compressors: All types of FES packages, Grasso, Mycom, Howden WRV & XRV, Dunham-Bush, Kobe, Sullair, Frick, Stal and Sabroe twin screws; Vilter and Hall single-screws; single and compound reciprocating compressors manufactured by Grasso, Vilter, Mycom, Sabroe & Frick/York; and York and Carrier Centrifugals.

## Easy Ethernet Communications

The GForce™ Ethernet port makes the panel highly compatible with outside communications. Through a secure Ethernet network, new or existing, a remote user is able to view and access the panel as if standing right in front of it. Free FES supplied software or any Java-enabled web browser can be used; no additional software is needed.

A dedicated network can be built using only an Ethernet switch and standard Ethernet CAT5 cable running to each GForce™ panel and to the remote viewing computer. It's as simple as that!

The GForce™ panel's Ethernet Port also supports Modbus/TCP/IP industry standard protocols as well as Ethernet/IP protocol for providing access to an FES MicroLINK SCADA System, a PLC, the plant's DCS, or any other supervisory system.

### Existing ComMENT Network?

A ComMENT Network interface option available for GForce™ panels makes new FES compressors backward compatible with existing Micro-III based sequencing via the FES ComMENT Network.



## General Description

### Reliable & Secure

Built on an industrial processor hardware platform and utilizing the proven Microsoft Windows® XP Embedded operating system software, the GForce™ Panel provides the reliability required by the Industry.



I/O Interface Board



Industrial Processor Assembly

### *Want more details on its reliability and construction?*

The GForce™ industrial processor is made for tough environments and is designed for control purposes, not for a desktop PC. It is based on an Intel processor that is currently used in many products. And obsolescence is not a concern—the GForce™ panel design allows for future replacement of a malfunctioning processor with a newer processor that is available, extending the panel's useful life.

Programs and data are stored on a "disk on chip" type flash memory. The GForce™ mass storage media will provide reliable data storage for many years.

The GForce™ Panel screen is weather and chemical resistant, and it can withstand even a high-speed impact from a blunt object. The display's backlight will last tens of thousands of hours; the panel's screen saver feature makes sure these are hours of real use.

Integral to the monitoring and control provided by the GForce™ panel is an I/O Interface Board custom-designed by GEA FES, Inc. for interfacing directly to the field devices. The processor accesses all field devices via a robust RS485/Modbus network connection to this I/O interface board, a very reliable means for reading the state of the inputs and directing the outputs.

The I/O Interface Board, with its own microprocessor, can override the main processor and shut off the outputs for failsafe operation if it detects a problem. It will direct all control outputs to their safe state.

Three levels of "watchdog" protection are designed into the panel hardware and software to ensure that the compressor (or other equipment) is only driven when the panel is working properly. Even the inside panel temperature is monitored, and will generate an alarm if too high. Each I/O

Interface Board provides up to 16 analog inputs (16-bit resolution) and now up to 12 analog outputs (previously 4).

Rounding out the hardware is the I/O Rack connected to the I/O Interface Board. Each rack has space for 24 I/O modules configured as inputs or outputs by the panel program. The industry standard modules with fuse and LED indicator are available with a built-in H-O-A toggle switch. Each I/O rack includes a fuse tester and spare fuse.

### *And the Software?*

The GForce™ Panel's operating application software was developed directly from the FES Micro-III panel, providing functionality that has been well-tested and proven reliable since the mid 1990's. This application software interfaces to Microsoft's Windows® XP Embedded operating system, custom tailored for the GForce™ panel hardware. Windows® XP Embedded and software tools used to develop the GForce™ application software are in use by many companies and in many, many products operating throughout the world. By using proven operating system and development tools, the FES GForce™ development team has been able to concentrate on implementing and testing the control and monitoring of the compressor and other refrigeration equipment. All helping to ensure reliable GForce™ panel software.

### *Is it Secure?*

The GForce™ panel has 3 levels of security—Basic, User, and Service—each with increased capabilities and each accessible via unique password entry.

## ■ Easy to Operate & View

The GForce™ Control Panel display is clear, crisp, and easy to view. Utilizing a large 15" diagonal, full 32-bit-color, LCD display with 1024 x 768 pixel resolution and a 120° viewing angle, the GForce™ provides high resolution color images, making even very detailed screens appear with superior clarity.

The GForce™ display is also a resistive touch screen with active touch areas clearly indicated. The screen can sense a stylus or a bare, oil-covered, or even gloved finger.

## ■ Easy to Maintain & Update

An ordinary USB Flash Memory Device plugged into the GForce™ Panel's USB port is the means for transferring data to and from the panel. The transfer capabilities are simple and versatile—operating program, parameters, historical trend data, alarm history—all can be transferred from the GForce™ memory and archived or used for analysis. Manuals and drawings, even a User's document or picture in PDF format (SOP's, equipment service photos, etc.) can be loaded into the panel's memory and viewed on the panel display. Program updates are easy—the update is e-mailed from FES and transferred to the GForce™ processor in the field through this same USB port.

For cleaning the screen, a Washdown mode is included. After cleaning, a series of touches in sequence at specific points on the screen will return the screen to its normal operational mode.

## ■ Easy to Support

The GForce™ Panel can now generate its own startup record document which lists current values of all analog and digital points and all adjustable parameter settings. When trouble-shooting a problem, the refrigeration technician can quickly look at diagnostic utility screens, on-screen manuals, drawings and trouble-shooting guides. Also capturing "Rx-Trend" historical data, the technician can quickly display all analog and digital status with the capability of e-mailing the data for diagnosis.

The GForce™ Panel has a minimal number of components to change and a minimal number of connections between them, making troubleshooting & repair easier. The main components are: Processor/ Touch Screen Assembly, I/O Interface Board, I/O Rack, Power Supply, I/O Modules, relays, and fuses.

Using the diagnostic & support features of the GForce™ Panel, how can an Operator find out why a compressor shut down unexpectedly?

- The Shutdown Failure annunciation shows the actual shutdown condition.
- The "Rx-Trend" graphical screen displays the status of

Navigating from screen to screen is so easy it is almost natural. A touch of the Suction Pressure Display area near the compressor's suction inlet will bring up a screen with all Suction Pressure parameters—control, alarm & shutdown. Access of all panel information is one or two screen touches away!

Multi-language support is included for standard screens—English, German, French, Spanish, and Chinese are standard. Further customization is available; the GForce™ is adaptable for almost any language.

The GForce™ Maintenance Scheduler lists tasks with time interval between service operations, time



stamping when service is done, and tracking of time remaining (in Run-time hours) until due. The GForce™ Maintenance Log provides a date and time-stamped log of activities and a way for Users to enter maintenance records and/or notes for the next shift Users to view.

all analog and digital control signals recorded for the 10 minutes prior to the shutdown. Analyzing this display or comparing the data to data still retained in panel's memory from earlier failures may help indicate the source of the problem.

- To get additional help, the "Rx-Trend" data transferred to a USB flash memory drive can be e-mailed to the servicing contractor or FES for analysis and support assistance.
- Sensor or interface hardware failures can be pinpointed using diagnostic screens available.
- FES-supplied drawings, data sheets and parts lists stored in the panel memory can be viewed to locate the part that must be ordered, again right at the GForce™ panel.
- The repair can be logged into the panel's own User-customized, date-stamped Maintenance Log for future reference.
- Alarms & shutdowns can automatically cause an email or text message to be sent to multiple levels of personnel with acknowledgement capability when message is received.



# Screw Compressor Control

## View it Your Way!

The GForce™ panel is flexible. Operators can view the compressor the way they like to see it with a choice of three main operating screens.

Many different tasks can be done at the panel while the compressor is running—  
parameter access; viewing on-screen drawings and manuals; maintenance log and scheduler entries; viewing historical trend data and alarm history; etc.



← The **Compressor** view shows a graphical representation of the compressor and system components.



← The **OmniView** is a tabular display of everything you need to know about the compressor on a single screen, giving the ability to change a parameter and watch the effect.



← The **Classic** view, a favorite of people who have worked with refrigeration systems for a long time; shows gauges, meters, lamps and pushbuttons typical of an electro-mechanical panel.

## System Control

A single GForce™ System Panel can be configured for compressor sequencing, control and monitoring of screw, reciprocating and rotary vane compressors; control of condenser fans and pumps; control of air units; and other refrigeration system functions like vessel/pump package control, refrigerant leak detection, engine room ventilation, and KW monitoring and load shedding.

Up to 48 Analog Inputs, now 36 Analog Outputs, and 120 Digital I/O in one panel; Remote I/O GForce™ panels expand these to 160 Analog Inputs, 120 Analog Outputs, and 480 Digital I/O. GForce™ Remote I/O Panels connect to their GForce™ Processor Panel with a single, shielded, 3-wire, communications cable, up to thousands of feet in length.

### Panel Sizes and I/O Capacity

Four panel sizes are currently available; all are designed and built to meet UL/cUL 508A, Type 4 rating—22" H x 26" W x 8" D, 30" H x 26" W x 8" D, 40" H x 30" W x 10" D, and 76" H x 36" W x 12" D.



GForce™ Main System Overview



Historical Trending

# Compressor Sequencing

The Compressor Sequencing function is an energy management control method that maintains stable refrigeration plant suction pressures on process temperatures by coordinating the operation of multiple screw, recip and rotary vane compressors in a system. The function's purpose is to utilize the plant's compressor capacity in the most energy efficient manner.



## Features

- Sequence up to 50 compressors—GForce™-controlled via an Ethernet network; FES Micro-III, Micro-II/IE or MicroMASTER-controlled and Frick's Plus or Quantum-controlled (version 3 or later) via the FES COMMENT network; electro-mechanically- controlled recip and rotary vane compressors via hard-wired digital I/O; on up to 4 suction air temperature levels.
- Drum sequencer operation – a rise in suction pressure above designated differential “moves” drum in direction to increase capacity; drop in suction pressure moves drum in decreasing capacity direction and moving from step to step is governed by individual user-adjustable timers just for that step.
- Each step of sequencer has User-adjustable soak, next step and previous step timers.



- Each step has User-configurable operation—starting, stopping, loading, unloading or automatic control—for each compressor individually.

- Energy saving scheduler functions include:
  - Enable/Disable of compressors
  - Enable/Disable of sequencer
  - Changing/Ramping suction pressure or process temp setpoint

## Benefits

- Minimize horsepower consumption at partial plant load.
- Minimal installation costs using commonly-available Ethernet switches and Ethernet CAT5 cable to the GForce™ sequencing panel and to each of the compressor panels.
- Recip and rotary vane compressors with electro-mechanical controls do not require replacement of existing controls to be included in sequencing; GForce™ panel is configured with the I/O needed for each recip or rotary. Existing safety switches are left intact.
- Provides cost effective and easily implemented way of adding sequencing to existing compressor installations.
- Adding future GForce™ controlled compressors to the sequencing on existing suction levels requires no factory configuration changes, only Ethernet wiring and User-adjustable addition of the compressor using the GForce™ panel's touch screen.
- The sequencing function can be either added into a compressor's GForce™ panel or in a GForce™ panel remote from the compressors.
- Touch screen display of the sequencing GForce™ panel can be used to remotely view operation of each compressor being sequenced.
- Sequencer operates independently of the compressors; therefore, it is unaffected by failed or marginally-operating compressors.
- The sequencing function is fully predictable as defined by the User's setup.



## Condenser Control

Condenser Control maintains stable system discharge pressure by providing automatic cycling of the fans and water pumps of evaporative or air-cooled condensers. The condenser sequencer's purpose is to utilize the plant's evaporative condenser capacity in the most energy efficient manner. Other features are provided to compliment and enhance this control.

### Features

- Controls up to 50 devices on a common discharge level. Factory configurable devices include any combination of water pumps and single, dual, and variable speed fans.
- Drum sequencer operation - rise in discharge pressure above designated differential "moves" drum in direction to increase evaporative condenser capacity; drop in pressure moves drum in decreasing capacity direction.
- A condenser setup matrix allows the User to select and change each step of the sequencer at any time:
  - The operation of each device—starting, stopping, high/low speed as well as automatic control for variable speed fans
  - "Soak" time for system to respond to change in condenser capacity
  - Delay times for stepping forward and backward
- The condenser setup matrix allows:
  - Any combination of device starting sequences
  - Single or multiple devices can be started or stopped on the same step
- Manual override of automatic stepping by touching HOLD, LOAD (one step) or UNLOAD (one step) screen buttons
- Two setup matrices exist so that two different fan/pump sequences (example: winter/summer) can be pre-programmed by the Operator. Matrix selection is manual or can be factory configured to change automatically based on ambient air temperature or other system-defined function.
- Run time is accumulated and displayed for each device.
- User-adjustable High-to-low spin down time for 2-speed fans
- User-adjustable Proportional, Integral and Derivative constants for PID loop controlled variable speed fans
- Energy saving scheduler functions include:
  - enable/disable of fans and pumps
  - changing discharge pressure set point
  - switching control from one matrix to the other

### Optional Features

- Automatic water pump lockout on low ambient air temperature with a high discharge pressure override set point.
- Monitoring of condensed refrigerant liquid temperature and alarm when non-condensables are in the system.
- Wet-bulb control—floating discharge pressure control set point based on wet-bulb temperature calculation using outside relative humidity and ambient air temperature. This feature can help keep the discharge pressure as low as possible while reducing wasted energy usage when ambient outdoor conditions are not favorable for evaporative condensing.
- Hand-Off-Auto toggle switches in output modules for manual override of the condenser device control outputs;
- Condenser sump monitoring/control

EVAPORATOR CONTROL				
	Freezer Zone #1 AU1 & 2	Freezer Zone #2 AU3 & 4	Freezer Zone #3 AU5 & 6	Freezer Zone #4 AU7 & 8
Actual Temperature	20.8 °F	20.2 °F	-17.8 °F	-10.0 °F
Temperature Setpoint	20.0°F	20.0°F	-10.0°F	-10.0°F
Zone Status	Cooling	Defrosting 0017:43	Satisfied Fan off in 0017:43	Not Started
Defrost Status	Pending Defrost 13:24:20	Pump Down	Not Started	Not Started
Liquid Run Time	14:45:00	00:00:00	00:00:00	00:00:00
Fan Cycling Status	Not Enabled	Not Enabled	Fan On (Cycling)	Not Enabled

## Air Unit Control

The Evaporator Control functions provide temperature monitoring and control for plant areas. Control outputs of the GForce™ panel direct the opening and closing of valve station solenoid or modulating valves and the starting and stopping or speed control of air unit fans, providing the cooling and defrost functions for each evaporator zone.

## Features

- GForce™ panels can provide up to 80 configured evaporator zone control groups for control of valve stations and air unit fans.
- Zone control groups are factory-configured to provide monitoring of a zone temperature and control of fans and liquid, suction, soft hot gas, hot gas, bleed, and humidity control solenoid valves.
- All defrost cycle timers—pump down, soft hot gas, hot gas, bleed, and fan delay—are easily adjustable.
- All zones have temperature alarm differential set points above and below the current zone set point.

## Benefits

- Various standard features that can be used to minimize energy usage:
  - Zone defrost cycles can be initiated by liquid runtime set point, scheduler, or manual initiate.
  - Zone defrost terminate on coil temperature or other condition is possible through optional factory configuration.
  - Zone temperatures can be lowered during lower-cost energy periods and raised during peak energy periods.
  - Ramping of zone temperatures is possible for controlling temperature pull down and temperature increase rates.
  - Fan cycling feature can be enabled for stopping the fans when the zone temperature is at set point, another energy saving feature. Fans run periodically for several minutes to agitate the air in the room and to check the zone temperature.
  - Automatically delayed startup of each zone stag-
- es the turning on of zone fans to avoid power spikes during power up.
- Defrost loops provide a means for avoiding simultaneous zone defrosts; if defrost is initiated for a second zone on a single loop, that zone's defrost cycle will be delayed until the first zone's defrost is terminated.
- Easily-adjusted zone probe assignment is especially useful for temporary re-assignment if a probe fails.
- Zone outputs may be controlled from GForce™ panel with processor or from a remote I/O GForce™ panel; remote I/O panel can be located closer to valve stations to minimize field wiring.
- An extremely flexible Energy Saving Scheduler is provided for initiating defrosts, changing/ramping zone temperature setpoints, enabling/disabling individual zones, and prohibiting individual zone defrosts; all entries are user-defined.

Enable	Type	Date/Time	Control Down	De
001	Defrost	12:00 AM Tue 12/15/11	0.00 Hz, 0.00 Hz	Freezer 22
002	Defrost	12:00 AM Tue 12/15/11	0.00 Hz, 0.00 Hz	Freezer 22
003	Defrost	12:00 AM Tue 12/15/11	0.00 Hz, 0.00 Hz	Freezer 22
004	Defrost	12:00 AM Tue 12/15/11	0.00 Hz, 0.00 Hz	Freezer 22

## Optional Features

- Factory configurable functions:
  - Humidity control (Reheat function)
  - Variable-speed air unit fan control
  - KW limiting/load shedding
  - Heating control—hot gas or electric
  - Defrost termination by coil temperature sensor or other status
- Hand-Off-Auto toggle switches in zone output modules provide means for manual override.
- Fan isolation relays can be included in panel for zones with fan loads that exceed output module current capacity.
- Zone can be configured for Glycol air unit control.
- Defrost cycle can include a water-wash step.



## Reciprocating and Rotary Vane Compressor Control

Safety Monitoring and Capacity Control of reciprocating and rotary vane compressors using direct, hard-wired I/O connections can be a cost effective way of retrofitting existing instrumentation or providing automated control for these compressors.

### Features

- Each recip/rotary compressor can be factory-configured with up to 5 capacity solenoid outputs and up to 10 capacity steps (including start).

*For total replacement of existing sensors and controls:*

- One GForce™ panel can accommodate up to four reciprocating or rotary vane compressors with full instrumentation.
- Capacity control of each compressor based on compressor's own suction pressure is included with load limiter functions standard.
- Each compressor's suction pressure, discharge pressure, discharge temperature, oil pressure, motor current and a miscellaneous temperature (e.g., for oil temperature or coolant temperature) are monitored with User-adjustable alarm and safety shutdown set points provided.
- Unloaded Start and Oil Return outputs are available

- Control relay contacts are included for Oil Heater and Oil Cooling control
- Panel E-Stop switch is included

*For those who wish to keep existing safety switches and devices, but still want sequencing of the compressor:*

- A maximum of ten hard-wired compressors can be configured in one GForce™ panel
- If more than 10 are needed, a second GForce™ panel can accommodate.
- Monitoring of safety shutdown input is included for electro-mechanical safety annunciation.

#### **Optional features**

- Dual Discharge configuration monitoring
- 2-Stage reciprocating compressor control and monitoring

## Management of Energy Usage and Other Refrigeration System Monitoring and Control Functions

*Many other functions normally needed in a complete refrigeration control system are also configurable in a GForce™ panel. These include, but are not limited to:*

- Chiller system monitoring and control
- Monitoring of miscellaneous pressures, temperatures, levels and humidity with alarm annunciations
- Monitoring and control for glycol and water system with single or multiple pumps
- Vessel and Pump Package monitoring and control with liquid level makeup control, high and low liquid level alarms/shutdowns from level sensor and set points or float switches, multiple pump lead/lag control with automatic switchover on loss of pump run interlock, loss of pump pressure or seal oil level.
- Refrigerant Leak Detector monitoring, alarm annunciation and equipment shutdown
- Fail-safe Engine Room Exhaust Fan control for room temperature and refrigerant leak detection
- kW Usage monitoring and kW limiting functions
- Underfloor heating system monitoring and control
- **NEW Energy Saving Scheduler, with both proactive (kW demand control) and reactive (kW limiting/load shed control) operation, will save energy costs!**

## GEA FES, Inc. MicroLINK Supervisory Computer System

- A full-function, desktop PC-Based Supervisory Control & Data Acquisition (SCADA) System for an FES Refrigeration Control System
- Able to communicate with and provide SCADA functions for any combination of FES Micro Panels, FES PLC Panels and even PLC Panels and Micro Panels supplied by other manufacturers
- Includes Custom Overview screen showing P&ID and overview status of the refrigeration system
- Includes Custom Planview screen of the facility showing location and status of each air unit
- A single point of collection for all historical and alarm history data
- Provides logging of supervisory operations and changes
- Able to show any two screens selected by user at one time



## Satellite Panel

The FES GForce™ Satellite Panel is used to display information from, and interact with, multiple GForce™ compressor control and system panels. The front of the control panel features a 15" full color LCD with a resistive touch screen as the user interface.

- GForce™ panel dedicated to remote viewing capability
- Able to remotely view information from, and interact with, multiple GForce™ compressor and system control panels
- View up to four GForce™ panel screens at the same time!
- Provides 15" full-color touch screen display, same as all GForce™ panels
- Provides a cost-effective central HMI station suitable for factory floor use; UL Type 4/Nema 4 enclosure rating standard, Nema 4X stainless or fiberglass optional
- Provides a central location for documentation storage/viewing and maintenance logging
- Replaceable processor/touch screen assembly common for this panel and all other GForce™ panels
- Available with mushroom-style Emergency-Stop switch for common point of equipment shutdown via hardwired connections to other GForce™ panels

## GEA FES, Inc. Parts Centers

There are five strategically located parts and compressor rebuild centers in the United States. Contact the nearest center for certified FES parts.

### Pennsylvania Headquarters

GEA FES, Inc.  
3475 Board Road  
York, PA 17406  
Phone: 717-767-6411  
Fax: 717-764-3627

### Texas

GEA FES, Inc.  
18574 Van Road  
Houston, TX 77049  
Phone: 281-456-8500  
Fax: 281-456-8504

### California

GEA FES, Inc.  
3210 North Ad Art Road  
Unit B1  
Stockton, CA 95205  
Phone: 209-931-3970  
Fax: 209-931-1710

### Arkansas

GEA FES, Inc.  
780 W. Randall Wobbe Lane  
Springdale, AR 72764  
Phone: 479-751-6440  
Fax: 479-751-6448

### Florida

GEA Refrigeration CNA  
3038 N.W. 82nd Avenue  
Miami, FL 33122  
Phone: 305-913-7500  
Fax: 305-913-7501

GEA FES, Inc. Headquarters, York, Pennsylvania



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