



# ES Service Information

File In/With: 160.54-M1, 160.54-O1  
160.54-RP1

SI0082  
New 4-04

Equipment Affected: YK Chillers

Software Enhancements Effective April 2004

## General

Beginning April 2004, enhanced software will be supplied in new production YK chillers. It is backward compatible to all previous YK chillers. The enhancements are outlined below.

The versions and part numbers for 031-01730-000 Microboards are:

- NEMA 1-4 chillers C.MLM.01.10.107 (p/n 031-01797-001)
- CE chillers C.MLM.01.10.208 (p/n 031-01797-002)

The versions and part numbers for 031-02430-000 Microboards are:

- NEMA 1-4 & CE chillers C.OPT.01.10.302 (p/n 031-02474-001)

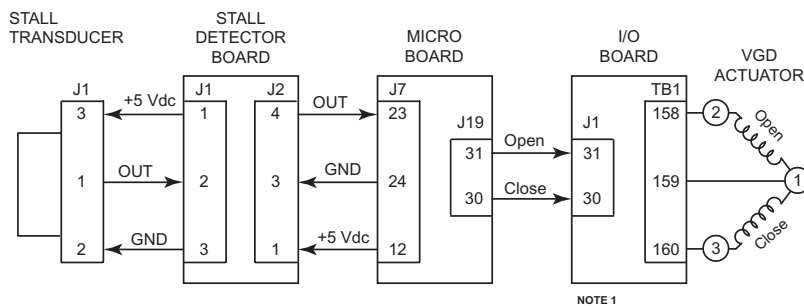
## Variable Geometry Diffuser

Certain York compressors are equipped with a Variable Geometry Diffuser (VGD). It is used to reduce rotating stall conditions and associated stall noise. Stall may occur at low load conditions with high head. A mechanical ring, located in the diffuser passage after the impeller discharge, is mechanically operated through linkages via an electric actuator like that used to operate the Pre-rotation vanes. It is closed (extended) to narrow the diffuser gap. It is opened (retracted) to open the diffuser gap. An internal actuator end switch prevents travel beyond the fully open or closed positions. In response to a stall condition, the ring is closed as much as necessary to eliminate the stall. Since stall is caused by reduced gas flow through the compressor, narrowing the diffuser gap reduces the cross sectional area through which the gas flows, thereby increasing the gas velocity through the compressor. The diffuser ring is also closed in response to surge conditions as described below.

The Variable Geometry Diffuser Screen (accessible from the Compressor Screen) displays all parameters relevant to this feature (ref Fig. 3). All setpoints related to this feature are maintained on the Variable Geometry Diffuser Setpoints Screen (accessible from the VGD Screen) (ref Fig. 4).

## Stall Detection (ref Fig. 1)

Stall noise in the compressor discharge is detected as gas pressure pulsations. A Stall Pressure Transducer (025-39464-000), mounted in the discharge scroll of the compressor, detects the pressure pulsations and outputs DC voltage pulsations to the Stall Detector Board (031-02418-000). This board converts the



NOTES:  
1. Requires I/O Board 031-01743-002

FIG. 1 - VARIABLE GEOMETRY DIFFUSER BLOCK DIAGRAM

voltage pulsations into an analog voltage that represents the magnitude of the stall noise. This analog voltage is displayed on the Variable Geometry Diffuser Screen as “Stall Detector Voltage” and is input to the Microboard where it is compared to the Low Limit and High Limit setpoint thresholds to determine if the stall noise is acceptable or unacceptable. In a typical YK chiller, a signal below 0.5 VDC indicates little or no stall. A signal above 0.8 VDC indicates stall noise is present.

### **Surge Detection**

Surge events are sensed as described in the HOT GAS BYPASS Section 20 and SURGE PROTECTION Section 22 of Service Manual 160.54-M1.

### **Automatic Operation**

The VGD operation is illustrated in the STATE DIAGRAM illustrated in figure 2. The “States” are shown in circles. They are Stall Waiting, Stall Reacting, Probing, Surge Reacting, Surge Waiting and Hot Gas Override. Arrows on the diagram indicate actions that move the control from one “State” to another. For clarity, different arrow styles are used for Stall (—), Surge (— . —) and Hot Gas (— —) response actions. During chiller operation, the current state is displayed as the “Control Status” on the Variable Geometry Diffuser Screen.

In general, the VGD is maintained in the most open position possible that does not allow stall. It is fully open when the chiller is started. If stall occurs, it is driven toward the close position until the stall is eliminated. After a wait period, it is again pulsed open until either a stall occurs or the fully open position is reached, whereupon the cycle repeats. In response to a surge, it is driven toward the close position for a selectable period of time. After a wait period, it is again pulsed open unless another surge occurs, whereupon Hot Gas operation overrides VGD operation and the VGD is held in place.

The Diffuser Gap Open and Diffuser Gap Close LED’s on the Variable Geometry Diffuser Screen illuminate when the program is initiating the respective output.

The following describes the operating states:

Chiller Off, Prelube or Coastdown:

The VGD diffuser gap is driven fully open.

#### **Stall Waiting:**

This state is entered on startup, after a Stall Reaction, or Hot Gas valve closure. The VGD is held in last position until one of the following occurs:

- The PROBE WAIT time period (0.5 – 15 minutes; default 10; as programmed with the PROBE WAIT time setpoint) expires. When the timer expires, the Probing state is entered. The time remaining in the PROBE WAIT time period is displayed on the Variable Geometry Diffuser Screen as “Time Remaining”.
- A stall is detected (stall detector board output goes above the HIGH LIMIT setpoint). Enters Stall Reacting state.
- A surge is detected. Enters Surge Reacting state.
- The compressor pre-rotation vanes (PRV) position increases more than the PRV OFFSET (1-5%; default 3; as programmed with the PRV OFFSET setpoint). Enters Probing state. The PRV position is displayed on the Variable Geometry Diffuser Screen as 0% (fully closed) to 100% (fully open). Note: Setting the PRV OFFSET setpoint to 0% disables this function. Probing will be initiated based on PROBE WAIT time only.

#### **Probing:**

In this state, the VGD mechanism is opened in pulses to open the diffuser gap. The pulses are initiated every 10 seconds. The duration of the pulses are defined by the OPEN PULSE setpoint (1-9 seconds; default 2). This probing continues until the Stall Detector Board output exceeds the HIGH LIMIT setpoint (0.5 – 1.2Vdc; default



0.8) to indicate stall is present or a surge is detected. Typically, at lower loads below 70%, stall will be sensed and controlled before a surge occurs. At higher loads and very high heads or lift, a surge can occur while probing which may be momentary in nature and not evidenced as stall noise. The number of times the Stall Detector Board output goes above the HIGH LIMIT setpoint threshold is displayed on the VGD Setpoints Screen as the “VGD Count”. This count can be reset using an ADMIN access level. The accumulated time the Stall Detector Board output voltage is greater than the “High Limit” threshold is displayed on the VGD Screen as “VGD Time”.

### **Stall Reacting:**

If a stall is detected from either the Probing or Stall Waiting states, the state is changed to Stall Reacting. In this state, the diffuser gap is closed until the Stall Detector Board output drops below the LOW LIMIT setpoint (0.4 – 0.8Vdc; default 0.6). After Stall Reacting, the state returns to Stall Waiting.

If equipped with the optional Hot Gas Bypass feature and the Hot Gas valve position is greater than 0% when the stall is detected, the VGD is held in its last position. It is not driven closed.

### **Surge Reacting:**

The VGD is closed for a specific time period, defined by the SURGE REACT time setpoint (1-30 seconds; default 5).

A surge is detected as detailed in the “Surge Protection” and “Hot Gas Bypass” sections of this manual. The Surge Detected LED on the Variable Geometry Diffuser Screen illuminates for 5 seconds each time a surge is detected. The program looks at a change in the condenser minus evaporator pressures over a short time period to detect a back flow or surge condition of the compressor. A surge is generally of more concern and potentially damaging to the compressor than stall. So, if a surge is detected, this overrides any of the Stall action states. Opening the diffuser gap may lower the lift capability of the machine. Therefore, there are some conditions where the Probing can actually cause a surge. In this case it is likely that simply closing the diffuser gap some amount will stabilize the compressor. Therefore, for units with VGD and Hot Gas options, the Hot Gas Bypass valve will not be opened on the first surge or during the time the VGD is closing.

### **Surge Waiting:**

The VGD is held in last position for a wait time, defined by the PROBE WAIT time Setpoint (0.5 – 15 minutes; default 10). During this period, any stall conditions are ignored and the controls will look for a second surge. If a second surge occurs during, normal Hot Gas Bypass Control takes over and Hot Gas Bypass Override state is entered. If there are no other surges detected during this period, the VGD returns to Probing.

The time remaining in the PROBE WAIT time period is displayed on the Variable Geometry Diffuser Screen as “Time Remaining”.

### **Hot Gas Bypass Override:**

Applies for units with optional Hot Gas Bypass. Whenever the Hot Gas Bypass valve position is greater than 0%, the VGD mechanism will be kept at last position. This keeps the VGD at a position of similar surge stability when the system head is later lowered and the hot gas valve closes. This state remains in effect until the Hot Gas Bypass valve position returns to 0%, whereupon it enters the Stall Waiting state.

Hot Gas Bypass operates as described in the Hot Gas Bypass section 20 of this manual. Except that on surge response, the Hot Gas valve will not be opened until a second surge is detected. The Hot Gas Minimum Load Override function is not affected by VGD operation.

### **Manual Operation**

The VGD can be manually controlled from the Variable Geometry Diffuser Screen in Service access level, whether the chiller is running or not. Pressing the OPEN, CLOSE or HOLD key invokes manual operation and the VGD Control Mode displays MANUAL. Each time the OPEN or CLOSE keys are pressed, the respective output is energized and the associated LED illuminates. Pressing the HOLD key causes the Hold LED to illuminate and

the VGD to be held in its present position. Pressing the AUTO key invokes automatic operation and AUTO is displayed as the control mode.

### **Setpoints**

The following setpoints are entered on the Variable Geometry Diffuser Setpoints Screen. They require SERVICE access level.

- Enable/Disable - Enables or Disables the VGD feature. Default is Disabled. Chiller must be stopped to change this setpoint.
- Surge React (1-30 seconds; default 5) - Specifies the duration of the close pulse applied to the VGD in response to a surge.
- PRV Offset (0-5%; default 3) – If the VGD control is in the Stall Waiting state and the Pre-rotation vanes position increases by more than this value, the Probing state will be entered. If the PRV Offset is set to 0%, the Stall Waiting state is performed based only on the “Probe Wait” setpoint interval.
- Probe Wait (0.5-15 minutes; default 10) – Specifies how long the VGD control remains in the Stall Waiting or Surge Waiting states before entering the Probing state.
- Open Pulse (1-9 seconds; default 2) – Specifies the length of the open pulse applied to the VGD during 10 second periods while in the Probing state.
- High Limit (0.5-1.2Vdc; default 0.8) – Specifies the Stall Detector Board output voltage that represents an acceptable amount of stall noise. Above this value is unacceptable. The minimum difference between the High Limit setpoint and the Low Limit setpoint is 0.1 vdc. If a Low Limit setpoint is entered which is less than 0.1vdc below the High Limit setpoint, the High Limit setpoint is adjusted so that it is 0.1vdc above the newly entered Low Limit value.
- Low Limit (0.4-0.8vdc; default 0.6) – in the Stall Reacting State, the VGD is driven closed until the Stall Detector Board output voltage decreases to this level. The minimum difference between the High Limit setpoint and the Low Limit setpoint is 0.1 vdc. If a Low Limit setpoint is entered which is less than 0.1vdc below the High Limit setpoint, the High Limit setpoint is adjusted so that it is 0.1vdc above the newly entered Low Limit value.

### **Pre-rotation Vanes Position**

The Pre-rotation Vanes position, as used by the VGD control, is provided by a potentiometer mounted to the PRV control arm. The potentiometer interface varies according to how the chiller is equipped as follows:

If the chiller is equipped with a compressor motor Variable Speed Drive, the potentiometer is connected to the Adaptive Capacity Control Board and the PRV position is read from there.

If the chiller is not equipped with a Variable Speed Drive, but is equipped with the Hot Gas Bypass option, the PRV potentiometer is connected to the Analog I/O Board and the PRV position is read from there.

If the chiller has neither a Variable Speed Drive nor the Hot Gas option, the potentiometer is connected directly to the Microboard at J7-10.

### **Compressor Screen**

A key is provided to navigate to the VGD screen.

### **VGD Screen**

This screen displays information pertinent to the VGD operation. Also, the VGD can be manually controlled from this screen. Refer to Fig. 3.

**VGD Setpoints Screen**

All setpoints relating to the VGD operation are maintained on this screen. Refer to Fig. 4.

**Operations Screen**

A key is provided to Enable/Disable the Variable Geometry Diffuser (VGD) feature.

**History Data/Printout**

The following VGD parameters are added to the History Data and History Printouts:

- Stall Detector Board output voltage
- Control State
- Time Remaining (if applicable)
- PRV Position
- Open signal status
- Close signal status
- VGD Cycle Count
- VGD Time

**Setpoint Report Printout**

The following VGD parameters are added to the Setpoint Report Print:

- VGD Enable
- PRV Offset
- Surge React
- Probe Wait
- Open Pulse
- High Limit
- Low Limit

**Slot Numbers (Trending & Custom View Screen)**

The following VGD slot parameters are added:

- 8280 Stall Detector Board output voltage
- 8281 VGD open
- 8282 VGD close

**Components**

- Stall Transducer 025-39464-001  
Detects stall noise as high frequency pressure fluctuations in the discharge scroll of the compressor. It converts the pressure pulsations to DC voltage pulsations and applies them to the Stall Detector Board.
- Stall Detector Board 031-02418-000  
Converts the Stall Transducer DC voltage pulsations to an analog DC voltage that represents the magnitude of stall noise. It applies this signal to the Microboard.
- I/O Board 031-01743-002  
Contains triacs Q3 and Q4, which are necessary to provide open and close signals to the VGD.

**Proximity Probe Faults**

In all previous Software versions, the Proximity Probe faults were monitored continuously, whether the chiller was running or not. In this version, the faults are only checked during the last 20 seconds of “System Prelube”, during “System Run” and during “Coastdown”. Also, to prevent noise related trips, the distance must be  $\geq +10$  mils for 2 continuous seconds before the trip will occur. Previously, the trip was instantaneous.

## VARIABLE GEOMETRY DIFFUSER SCREEN



LD09571

FIG. 3

### OVERVIEW

This screen displays information pertinent to the VGD operation. Also, the VGD can be manually controlled from this screen.

### DISPLAY ONLY

#### **Stall Detector Voltage**

Displays the Stall Detector output voltage (x.xxVdc), as received by the Microboard.

#### **Pre-rotation Vanes Position**

Displays the position of the Pre-rotation vanes over the range of 0% (fully closed) to 100% (fully open). Displayed as XXX until calibration procedure is performed by Service Technician.

#### **Diffuser Gap Close (LED)**

Illuminates when a close signal is being applied to the VGD.

#### **Diffuser Gap Open (LED)**

Illuminates when an open signal is being applied to the VGD.

#### **Surge Detected (LED)**

Illuminates for 5 seconds each time a surge is detected.

#### **VGD Count**

Displays the number of times the Stall Detector Board output voltage goes above the High Limit setpoint. The count

can be cleared with in ADMIN access level using the VGD Cycle Count key on the VGD Setpoints Screen.

#### **VGD Time ( \_\_Days \_\_Hrs \_\_Min \_\_Sec)**

Displays the accumulated time the Stall Detector Board output voltage is greater than the High Limit Setpoint while the chiller is running.

#### **Control Status**

Displays the current state of the VGD control. The states are: Stall Waiting, Stall Reacting, Probing, Surge Reacting, Surge Waiting, Hot Gas Override.

#### **Time Remaining**

While the VGD is in the Stall Waiting State, displays the time remaining in the “Probe Wait Time” interval (value programmed as the Probe Wait Time Setpoint).

#### **Diffuser Gap Control Mode**

Indicates whether the VGD is under manual or automatic control.

### PROGRAMMABLE

#### **[VGD] Open (Manual)**

This key puts the VGD in manual mode and sends an open command to the VGD.

#### **[VGD] Close (Manual)**

This key puts the VGD in manual mode and sends a close command to the VGD.

**[VGD] Hold (Manual)**

This key puts the VGD in manual mode and sends a hold command to the VGD.

**NAVIGATION****Home**

Access Level Required: VIEW

Causes an instant return to the Home Screen.

**Compressor**

Access Level Required: VIEW

Causes an instant return to the compressor Screen.

**VGD Setpoints**

*Access Level Required:* SERVICE

Move to the subscreen that allows programming of the Variable Geometry Diffuser setpoints.

## VARIABLE GEOMETRY DIFFUSER SETPOINTS SCREEN

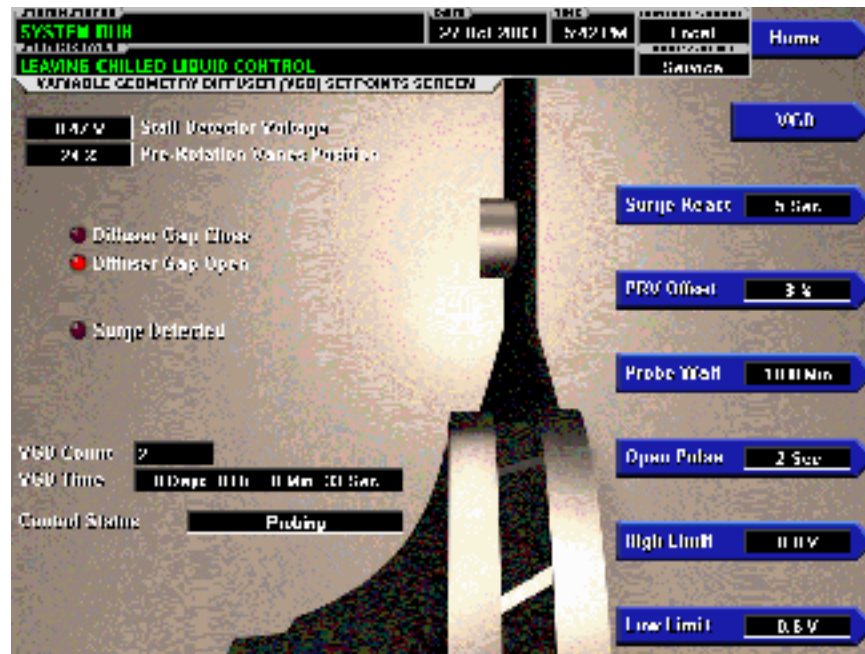


FIG. 4

LD09572

### OVERVIEW

The Variable Geometry Diffuser setpoints are maintained on this screen. All setpoints require a login access level of Service. Service Technicians refer to YORK Service Manual 160.54-M1 for operation and explanation of all setpoints and displayed values.

### DISPLAY ONLY

#### **Stall Detector Voltage**

Displays the Stall Detector output voltage (x.xxVdc), as received by the Microboard.

#### **Pre-rotation Vanes Position**

Displays the position of the Pre-rotation vanes over the range of 0% (fully closed) to 100% (fully open). Displayed as XXX until calibration procedure is performed by Service Technician.

#### **Diffuser Gap Close (LED)**

Illuminates when a close signal is being applied to the VGD.

#### **Diffuser Gap Open (LED)**

Illuminates when an open signal is being applied to the VGD.

#### **Surge Detected (LED)**

Illuminates for 5 seconds each time a surge is detected.

#### **VGD Count**

Displays the number of times the Stall Detector Board output voltage goes above the High Limit setpoint. The count can be reset with an ADMIN access level using the VGD Cycle Count key on the VGD Setpoints Screen.

#### **VGD Time ( \_\_Days \_\_Hrs \_\_Min \_\_Sec)**

Displays the accumulated time the Stall Detector Board output voltage is greater than the High Limit Setpoint while the chiller is running.

#### **Control Status**

Displays the current state of the VGD control. The states are: Stall Waiting, Stall Reacting, Probing, Surge Reacting, Surge Waiting, Hot Gas Override.

#### **Time Remaining**

While the VGD is in the Stall Waiting State, displays the time remaining in the "Probe Wait Time" interval (value programmed as the Probe Wait Time Setpoint).

### PROGRAMMABLE

#### **Surge React**

(1-30 seconds; default 5) - Specifies the length of the close pulse applied to the VGD in response to a surge.

#### **PRV Offset**

(0-5%; default 3) – If the VGD control is in the Stall Waiting state and the Pre-rotation vanes position

changes by more than this value, the Probing state will be entered. If the PRV Offset is set to 0%, the Stall Waiting state is performed based only on the “Probe Wait Time” setpoint interval.

#### **Probe Wait**

(0.5-15 minutes; default 10) – Specifies how long the VGD control remains in the Stall Waiting or Surge Waiting states before entering the Probing state.

#### **Open Pulse**

(1-9 seconds; default 2) – Specifies the length of the open pulse applied to the VGD during 10 second periods while in the Probing state.

#### **High Limit**

(0.5-1.2Vdc; default 0.8) – Specifies the Stall Detector Board output voltage that represents an acceptable amount of stall noise.

The minimum difference between the High Limit setpoint and the Low Limit setpoint is 0.1 vdc. If a Low Limit setpoint is entered which is less than 0.1vdc below the High Limit setpoint, the High Limit setpoint is adjusted so that it is 0.1vdc above the newly entered Low Limit value.

#### **Low Limit**

(0.4-0.8vdc; default 0.6) – in the Stall Reacting State, the VGD is driven closed until the Stall Detector Board output voltage decreases to this level.

The minimum difference between the High Limit setpoint and the Low Limit setpoint is 0.1 vdc. If a Low Limit setpoint is entered which is less than 0.1vdc below the High Limit setpoint, the High Limit setpoint is adjusted so that it is 0.1vdc above the newly entered Low Limit value.

#### **VGD Count**

*Access Level required:* ADMIN

Allows the user to clear the VGD Cycle Count.

### **NAVIGATION**

#### **Home**

*Access Level Required:* Service

Causes an instant return to the Home Screen

#### **VGD Screen**

*Access Level Required:* Service

Causes an instant return to the Variable Geometry Diffuser Screen