

# Gas Panel Interface - LPCVD

## Instruction Manual

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## Table of Contents

1. Description .....	1
1.1. Overview .....	1
1.2. Features.....	1
1.3. Suggested Tymkon Configuration .....	1
2. Installation .....	2
2.1. DDC Interface Connector, J1 .....	2
2.2. MFC Connectors, J2 through J7.....	4
2.3. Solenoid Valves, J8 .....	4
2.4. Sensors, J9.....	5
2.5. Loader, J10.....	6
2.6. Remote, J11 .....	8
2.7. Power Input.....	9
3. Configuration and Operation .....	10
3.1. Power Supply Jumper, JP1 .....	10
3.2. Polarity Jumper, JP2 .....	10
3.3. Input Jumpers, JP3 through JP8 .....	10
3.4. Voltage Adjustment, +24 Volts DC .....	11
3.5. Door Sensor.....	11
3.6. Hardware Interlocks.....	11
4. Specifications .....	13
4.1. Physical .....	13
4.2. AC Power Requirements .....	13
4.3. MFC Power Supply.....	13
5. Appendix .....	14
Front Panel Artwork.....	14

## 1. DESCRIPTION

### 1.1. Overview

Model GPI-804 is a gas panel interface designed primarily for semiconductor processes performed in horizontal diffusion furnaces under reduced pressure conditions. This includes deposition of Polymorphous Silicon (Poly), Silicon Nitride and Low Temperature Oxides.

### 1.2. Features

- *+/- 15 VDC Power Supply adequate for (6) MFC's*
- *+24 VDC Power Supply for solenoids and sensors*
- *MFC Override relays to provide positive shutoff*
- *Signal conditioning circuit to scale pressure sensor*
- *Hardware interlocks on gas channels*
- *Control of upstream or downstream solenoid valves using the same control signals that control the MFC's or by using separate control signals*

### 1.3. Suggested Tymkon Configuration

Following is a recommended function template for installations in which the GPI-804 is used with a vertical Tymkon process sequencer. Tymkon software allows front panel functions to be remapped to different hardware ports, but adherence to the suggested layout to whatever extent possible minimizes hardware remapping and eases installation.

Outputs				Inputs	
<b>0</b>	Load	<b>8</b>	Loader Speed	<b>0</b>	Purge
<b>1</b>	Unload	<b>9</b>	Throttle Setpoint	<b>1</b>	Door
<b>2</b>	Gas 1 Sol	<b>A</b>	Gas 1 MFC	<b>2</b>	Leak
<b>3</b>	Gas 2 Sol	<b>B</b>	Gas 2 MFC	<b>3</b>	OverPressure
<b>4</b>	Gas 3 Sol	<b>C</b>	Gas 3 MFC	<b>4</b>	GPI Fault
<b>5</b>	Gas 4 Sol	<b>D</b>	Gas 4 MFC	<b>5</b>	
<b>6</b>	Gas 5 Sol	<b>E</b>	Gas 5 MFC	<b>6</b>	BIC
<b>7</b>	Gate Valve	<b>F</b>	Gas 6 MFC	<b>7</b>	BOC

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## **2. INSTALLATION**

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### **2.1. DDC<sup>1</sup> Interface Connector, J1**

The GPI-804 provides a 50-pin communications connector plug for interface to a process controller. The pinout of the connector exactly matches that of the most common Tymkon I/O boards, but may be adapted to process sequencers from other manufacturers.

Extension cables for this type of connector are available both in flat cable and round cable types and have gained wide acceptance in the communications and instrumentation industries.

A typical ribbon-cable receptacle-end connector is 3M P/N 3565-1000 and a mating plug-end connector is 3M P/N 3564-1002. These connectors may be used with standard flat ribbon (e.g. 3M P/N 3365-50) or with the round, shielded ribbon cable.

The pinout of the Interface Connector follows on the next page. Not all of the signals listed on the connector pinout are implemented in the GPI-804. The connector provides a generic interface that is shared by both atmospheric and LPCVD<sup>2</sup> gas panel interfaces.

The pins labeled “Digital Output” and those labeled “Analog Output” are signals from the process sequencer to the gas panel interface. These labeled “Digital Input” and those labeled “Analog Input” are signals from the gas panel interface to the process sequencer.

Note that the (16) “Digital Output” pins expect to see either mechanical contact closures or solid-state relay closures to “- SUPPLY” from the DDC. This signal is available on pin 38 of the Interface Connector. Furthermore, the (8) “Digital Input” pins provide contact closures to “- SUPPLY” to the DDC when the sensors are safe.

Note also that the signals present on the “Analog Output” and “Analog Input” pins are generally 0 to 5 Volts DC.

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<sup>1</sup>DDC: Direct Digital Control system - Computer-controlled system that sequences gas valves, furnace temperature, boat loaders etc. in response to time-based recipes and external sensors.

<sup>2</sup>LPCVD: Low Pressure Chemical Vapor Deposition.

**DDC Interface Connector, J1**

Pin	Function	IDC
1	ANALOG OUTPUT F	1
2	ANALOG OUTPUT E	3
3	ANALOG OUTPUT D	5
4	ANALOG OUTPUT C	7
5	ANALOG OUTPUT B	9
6	ANALOG OUTPUT A	11
7	ANALOG OUTPUT 9	13
8	ANALOG OUTPUT 8	15
9	ANALOG COMMON	17
10	DIGITAL GROUND	19
11	ALARM SILENCE INPUT	21
12	RUN INPUT	23
13	DIGITAL INPUT 7	25
14	DIGITAL INPUT 5	27
15	DIGITAL INPUT 3	29
16	DIGITAL INPUT 1	31
17	OUTPUT F (NO)	33
18	OUTPUT D (NO)	35
19	OUTPUT B (NO)	37
20	OUTPUT 9 (NO)	39
21	OUTPUT 7 (NO)	41
22	OUTPUT 5 (NO)	43
23	OUTPUT 3 (NO)	45
24	OUTPUT 1 (NO)	47
25	+ SUPPLY (+5 to +40 VOLTS)	49

Pin	Function	IDC
26	ANALOG INPUT F	2
27	ANALOG INPUT E	4
28	ANALOG INPUT D	6
29	ANALOG INPUT C	8
30	ANALOG INPUT B	10
31	ANALOG INPUT A	12
32	ANALOG INPUT 9	14
33	ANALOG INPUT 8	16
34	ALARM (-) OUTPUT	18
35	ALARM (+) OUTPUT	20
36	ABORT INPUT	22
37	RESET INPUT	24
38	- SUPPLY (-5 to -40 VOLTS)	26
39	DIGITAL INPUT 6	28
40	DIGITAL INPUT 4	30
41	DIGITAL INPUT 2	32
42	DIGITAL INPUT 0	34
43	OUTPUT E (NO)	36
44	OUTPUT C (NO)	38
45	OUTPUT A (NO)	40
46	OUTPUT 8 (NO)	42
47	OUTPUT 6 (NO)	44
48	OUTPUT 4 (NO)	46
49	OUTPUT 2 (NO)	48
50	OUTPUT 0 (NO)	50

## 2.2. MFC Connectors, J2 through J7

20-conductor ribbon cables are used to connect the GPI to the Mass Flow Controllers. Following is the pinout of MFC 1 through MFC 6 (J2 through J7 respectively) on the Model 804 Gas Panel Interface. (The numbers in the "IDC" columns are the ribbon cable conductor numbers.)

Card Edge	IDC		Card Edge	IDC	
1	1	Case GND	A	2	Setpoint
2	3	Power Common	B	4	Signal Common
3	5	Output (0-5v)	C	6	Signal Common
4	7	+15 VDC	D	8	Valve Test
5	9	N/C	E	10	N/C
6	11	N/C	F	12	-15 VDC
7	13	Keyway	G	14	Keyway
8	15	N/C	H	16	N/C
9	17	N/C	I	18	N/C
10	19	Common	J	20	Valve Off

Unless requested by the customer, the GPI-804 provides an ***MFC Override*** relay for each gas channel. These six relays are controlled by Digital Outputs 'A' through 'F'. When an override relay is not energized, a set of normally closed contacts connects the appropriate *MFC Valve Off* pin to the *MFC Common* pin thereby forcing the MFC closed regardless of the analog setpoint. When the relay becomes energized, the override signal is released and the MFC is allowed to soft-start to the setpoint.

The analog setpoints for the MFC's originate at the DDC connector (J1). The signals are buffered by op amps before being routed to the MFC connectors.

## 2.3. Solenoid Valves, J8

J8 is a 25-pin female 'D' connector located at the right side of the front panel. This connector contains the signals necessary to drive up to sixteen pilot valves or gas solenoids. Note that two of these signals are unavailable if boat loader signals are connected to the GPI-804. Also note that six of the valve signals (Outputs A through F) are shared with MFC Override relays.

If the valves are polarized, the positive side of the coil must be connected to one of the +24 Volts pins, while the negative side must be connected to one of the valve output signals.

Note: Shorting any of the outputs on the Valve Connector may cause permanent damage to the GPI or to the process sequencer or DDC which drives the outputs.

J8 Pin	Function	Recommended Use	804 Labels
1	Output 2	* Gas 1 Upstream	Valve 1
2	Output 4	* Gas 3 Upstream	Valve 3
3	Output 6		Valve 5
4	Output 0	Shared with relay on J10	Valve 7
5	Output 8	Shared with relay on J11	Valve 9
6	Output A	Shared with MFC 1 Override	MFC 1
7	Output C	Shared with MFC 3 Override	MFC 3
8	Output E	Shared with MFC 5 Override	MFC 5
9	+24 VDC		Valve Common
10	+24 VDC		Valve Common
11	+24 VDC		Valve Common
12	+24 VDC		Valve Common
13	+24 VDC		Valve Common
14	Output 3	* Gas 2 Upstream	Valve 2
15	Output 5	* Gas 4 Upstream	Valve 4
16	Output 7	* Gate Valve	Valve 6
17	Output 1	Shared with relay on J10	Valve 8
18	Output 9	Shared with relay on J11	Valve 10
19	Output B	Shared with MFC 2 Override	MFC 2
20	Output D	Shared with MFC 4 Override	MFC 4
21	Output F	Shared with MFC 6 Override	MFC 6
22	+24 VDC		Valve Common
23	+24 VDC		Valve Common
24	+24 VDC		Valve Common
25	+24 VDC		Valve Common

\* Note: Valves 1, 2, 3 & 4 are interlocked to the Gate Valve and to several sensors.

## 2.4. Sensors, J9

A 9-pin female 'D' connector is provided for various sensors. Any sensor that provides a relay contact or an NPN transistor output may be used.



Sensors that provide a relay contact output should be wired “*closed when safe*” and must provide contact closure to 24-volt return (available on pin 6 of J9).

Sensors that provide an NPN transistor output should be capable of 24-volt operation. A 24 Volts DC power supply is available on connectors J8 and J10 if required. The emitter of the sensor’s output transistor should be wired to 24-volt return available on pin 6 of J9 and the collector of the sensor’s output transistor should be wired to the appropriate Digital Input pin on J9.

Pin	Item	Hardware Signal
1	Chassis	
2	Purge Monitor	DINP 0
3	Door	DINP 1
4	Leak	DINP 2
5	OP	DINP 3
6	24V RET	
7	Pressure Setpoint	Analog Output 2
8	Anal Common	
9	Pressure Read	Analog Input 2

The circuit board in the Model 804 contains (4) jumpers, JP3 thru JP6, which control the behavior of Digital Input 4 (Lo O<sub>2</sub>), Digital Input 5 (Lo Temp) & Digital Input 6 (GPI Fault). See page 10.

## 2.5. Loader, J10

A 15-pin female 'D' connector is provided for connection to a boat loader. Two relays isolate the LOAD and UNLOAD commands from the DDC. The LOAD relay is controlled by Digital Output 0 and the UNLOAD relay is controlled by Digital Output 1.

The Boat-In-Complete (BIC) and Boat-Out-Complete (BOC) signals from the boat loader are isolated by non-polarized opto-isolators and buffered by relays before being sent back to the DDC. The opto-isolators provide a universal interface to any conventional boat-loader and the relays provide contact closures that can be sent to any DDC.

The contacts of the BIC and BOC relays are routed through jumpers JP7 and JP8 so the installer can choose ‘*safe when open*’ or ‘*safe when energized*’ operation.

A 0 to 5 volt speed setpoint from the DDC is buffered by an operational amplifier and, then, sent to the loader connector, J10. In addition, an analog position signal is routed from J10 through the GPI-804 to the DDC.

Pin	Function
1	Chassis
2	Load Command (N.O.)
3	Load Common
4	Load Command (N.C.)
5	Unload Command (N.O.)
6	Unload Common
7	Unload Command (N.C.)
8	Analog Common
9	+24 Volts
10	24 Volt Return
11	BIC Limit
12	Limit Common
13	BOC Limit
14	Speed Setpoint
15	Position Read

If Pin 12 (Limit Common) is connected to +24 volts, then Pin 11 (BIC Limit) and Pin 13 (BOC Limit) should be switched to 24-volt return.

If Pin 12 (Limit Common) is connected to 24-volt return, then Pin 11 (BIC Limit) and Pin 13 (BOC Limit) should be switched to +24 volts.

The Load Common and Unload Common can be connected to whatever voltage the loader accepts as command signals.

## 2.6. Remote, J11

A 15-pin female 'D' connector is provided for access to various DDC control signals and to two digital outputs.

Pin	Function	Connects to:
1	Alarm (+)	J1.35
2	Alarm (-)	J1.34
3	DIGITAL OUTPUT 9 (N.O.)	
4	DIGITAL OUTPUT 9 (COM)	
5	DIGITAL OUTPUT 9 (N.C.)	
6	DIGITAL OUTPUT 10 (N.O.)	
7	DIGITAL OUTPUT 10 (COM)	
8	DIGITAL OUTPUT 10 (N.C.)	
9	+24 VDC	
10	24V RETURN	
11	Control 1 (RUN)	J1.12
12	Control 2 (RESET)	J1.37
13	Control 3 (AL SILENCE)	J1.11
14	Control 4 (ABORT)	J1.36
15	Control Common (see below)	J1.10

Note that the signals that control the two relays (Digital Output 9 and Digital Output 10) also appear on the Valve connector, J8.

The remote control signals on pins 11 through 15 behave differently on different Tymkon versions. In early 2001, opto-isolators were added to the Tymkon power board to avoid exposing the microprocessor's digital ground to external electrical noise.

When the GPI-804 is used with Tymkons manufactured prior to 2001, the installer must connect the common of any remote control switches or relays to J11, Pin 15 which, in earlier versions, was connected to the Tymkon's digital ground. The remote switches would then ground the appropriate control signals on pins 11 through 14.

When the GPI-804 is used with Tymkons manufactured during 2001 and later, the installer must connect the 'Control Common' signal on J11, Pin 15 to the positive side of a control power supply ranging from +5VDC to +24VDC (+24V from the internal power supply is available on J11, Pin 9). In this newer design, 'Control Common' is connected to the anodes of four opto-isolators. The common pin of any remote control switches or relays must then be connected to the

negative side of the control power supply (24V RETURN is available on J11, Pin 10). Current-limiting resistors are provided on the Tymkon power board to protect the opto-isolators.

## **2.7. Power Input**

The current version of the GPI-804, Revision B, operates on 110 Volts AC. A standard IEC style power receptacle is provided for connection to an AC power source. See page 13 for additional information.

<b>Note: Do not connect the unit to AC power until the valves and sensors are connected.</b>
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### 3. CONFIGURATION AND OPERATION

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#### 3.1. Power Supply Jumper, JP1

A jumper is provided on the circuit board to disconnect the internal 24-volt power supply. In most installations, the internal power supply powers the:

- interface between the DDC and the GPI-804,
- pilot valves
- relays, and
- sensors.

If the jumpers on JP1 are removed, those functions can be powered externally by connecting to J1.25 (+) and J1.38 (-).

#### 3.2. Polarity Jumper, JP2

A set of jumpers is provided on the circuit board to select the polarity of the output signals and the input signals.

In most installations, the DDC provides contacts to 24-volt return (ground) to control the outputs (valves and relays etc). Similarly, the external sensors are wired to switch 24-volt return.

The jumpers on JP2 are installed during assembly and should not be changed by the installer or user. If non-standard behavior is required, the circuit board must be assembled with different relays (non-polarized) and with the LEDs reversed. In addition, much of the information in this document no longer applies.

#### 3.3. Input Jumpers, JP3 through JP8

While the GPI-804 always expects sensors to be wired “Energized when Safe” for fail-safe operation, the signals that are returned to the DDC in response to the sensors may be configured for the reverse behavior.

The circuit board in the Model 804B contains [6] optional jumpers, JP3 thru JP8, which control the behavior of selected digital input signals sent from the GPI-804 back to the process sequencer. These jumpers are not installed on the circuit board unless requested by the customer. In the default assembly with the jumpers uninstalled, signals sent to the DDC are “Energized when Safe”.

Jumper	Digital Input	Normal Function
JP3	0	Purge
JP4	1	Door
JP5	2	Leak
JP6	3	OverPressure
JP7	6	BIC
JP8	7	BOC

### **3.4. Voltage Adjustment, +24 Volts DC**

A potentiometer is provided to adjust the regulated 24-volt power supply. The supply has a range of approximately 3 to 30 volts, but the valves, relays and sensors may have restricted operating ranges. It is advisable to operate in the range of 20 to 28 volts, preferably 23 to 25 volts.

In most cases the 24-volt supply will not require adjustment during the life of the equipment, but it is advisable to confirm proper operation once every two years.

### **3.5. Door Sensor**

In the standard configuration, the GPI-804 accepts a signal from an external Door switch to indicate when it's safe to turn on the Gate Valve. When requested, an optional 5-psi pressure switch is mounted internally to accept a pneumatic Door closure signal.

### **3.6. Hardware Interlocks**

Most DDC's provide software interlocks to protect the vacuum pump and to prevent toxic gases from being energized when the process chamber (tube) is at atmospheric pressure.

While software interlocks serve a useful purpose, it is usually advisable to provide additional hardware interlocks on critical functions.

The GPI-804 provides hardware interlocks on the Gate Valve and on up to four gas channels.

The first level of interlocks prevents the Gate Valve from being energized unless the Pump Purge sensor is satisfied and the Door is closed.

The second level of interlocks prevents four upstream gas valves (Valves 1 through 4) from being energized unless the Gate Valve is on and the OverPressure signal from the Throttle Valve Controller or external pressure meter relay is satisfied.

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## 4. SPECIFICATIONS

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### 4.1. Physical

Dimensions: 10.05 in. high x 6 in. wide x 4 in. deep  
Weight: 5 lbs. maximum  
Finish: Cardinal, high bake, water-based paint, medium texture.

### 4.2. AC Power Requirements

Frequency: 50 or 60 Hertz  
Voltage @ 60 Hz: 100 to 125 VAC  
Voltage @ 50 Hz: 110 to 125 VAC  
Power: 100 watts maximum

### 4.3. MFC Power Supply

Part Number: Cosel, MMB50A-6-N  
Current: 1.7 Amps at +15 Volts  
1.7 Amps at -15 Volts



## 5. APPENDIX

### Front Panel Artwork

