Valve Manifold Box Controller

Instruction Manual

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1. DESCRIPTION

1.1. Overview

Series 600 includes a variety of controllers related to monitoring and controlling the distribution of process gases throughout a laboratory or a manufacturing plant.

This manual describes those Series 600 Models that are designed to support Valve Manifold Boxes. The hardware and software architecture of Series 600 supports a group of similar products in this category ranging from an 8-stick fully automatic VMB controller to a single stick Emergency Shutoff Station.

In the context of this manual, a Valve Manifold Box (VMB) is a cluster of solenoid valves, pressure regulators and sensors designed to control and monitor the distribution of a single process gas to up to eight separate process tools or eight separate process areas in a laboratory or manufacturing plant.

In general, a Valve Manifold Box contains an array of similar sections ("sticks"), each of which controls distribution to a single tool or area. In addition, a Valve Manifold Box contains a "master" section that provides EMO (Emergency Shutoff) control and other centralized services.

The series includes:

- Model 674, a manual 4-stick controller,
- Model 676, a manual 6-stick controller,
- Model 678, a manual 8-stick controller,

- Model 684, a fully automatic 4-stick controller,
- Model 686, a fully automatic 6-stick controller, and
- Model 688, a fully automatic 8-stick controller.

Note that a complete gas distribution system would contain one or more VMB controllers depending on the number of process gases required and the number of distribution sticks required for each gas. In addition, many installations require Purge and Shutoff Systems at the gas source to provide a cylinder crossover function and the first stage of pressure reduction.

1.2. Features

- *Each model in the series includes two processors, one to manage the sensors and valves (IO) and a second to handle the User Interface (UI) and sequencing.*
- *Models are available for up to eight-gas distribution "sticks" per VMB.*
- *Each unit includes eight optically isolated digital sensor inputs per stick plus eight optically isolated digital sensor inputs for centralized functions. A set of dipswitches is provided to disable individual unused sensors.*
- *Each unit includes four pneumatic outputs per stick plus four pneumatic outputs for centralized functions.*
- *Each unit includes four relay outputs per stick plus four relay outputs for centralized functions. These provide status signals to remote process tools and to house alarm systems.*
- *All relay coils and pilot valves are monitored for opens and shorts.*
- *Internal communications between circuit boards are implemented using RS-422 through high-speed magically coupled isolators.*
- *The status of all sensors and valves is constantly displayed on discrete front panel LED's providing instant system information.*
- *A bright 4-line, 20 characters per line Vacuum Fluorescent Display provides access to programming menu and purge functions*
- *Two internal pressure transducers are provided: one +/-1.0 inch differential transducer for installations that require Z-Purge and one 150-PSI transducer for CDA pressure. A 10-bit A/D converter in the IO processor monitors these transducers.*
- *Optional analog inputs for analog transducers are implemented using 3rd party modules - each containing (8) 16-bit isolated analog inputs.*
- *24 Volt switching power supplies provide power for all of the electronics.*
- *Timing is independent of the AC line frequency. The system can operate from an input supply ranging from 100 to 240 Volts AC at 50 or 60 Hertz.*
- *A SEMI-approved, latching EMO switch physically interrupts the power for the pilot solenoids.*
- *A key-lock option prevents the solenoids from being re-energized without a key; otherwise, a password provides access.*

2. INSTALLATION – INTERNAL CONNECTIONS

There are up to six different types of printed circuit boards in the control section of a Valve Manifold Box. In most cases these boards are assembled into the electronics enclosure prior to shipping to the user site. The following information is provided for those cases where the electronics enclosure needs to be assembled after shipping from the manufacturer and for those cases where the installation needs to be upgraded after the initial installation.

The circuit boards used in Series 600 are identified as follows:

Part Number	Title
9990472	VMB Front Panel, Master
9990473	VMB Front Panel, Slave (4-stick)
9990469	VMB I/O Board, Master
9990468	VMB I/O Board, Slave (4-stick)
9990477	VMB Display Module
RCM3200	Rabbit CPU Core Module

The Master I/O Board contains four terminal blocks for connections to the power supplies, the EMO switch, the Front Panel processor and to the Slave I/O Boards. In addition, RJ12 connectors are provided for communications with the Front Panel assembly and optional analog input modules.

2.1. J1 – Power Supplies

J1 provides connections for two 24 Volt DC power supplies. The power distribution buss of the Series 600 is split into two sections to improve noise immunity and to provide solenoid valve isolation.

Power Supply A provides power for the 3.3 Volt DC/DC converter that powers the main processor board. It also provides power for the 5.0 Volt DC/DC converter that powers the vacuum fluorescent display and the circuitry on the I/O boards.

Power Supply B provides power for the digital sensor inputs, the solenoid valves and the relays.

Pinout of J1 is as follows:

Pin	
1	Power Supply B, +24 Volts DC
2	Power Supply B, 24 Volt Return
3	Power Supply A, 24 Volt Return
4	Power Supply A, +24 Volts DC

2.2. J2 – Board Interconnects

The Master I/O Board and the Slave I/O boards are interconnected using J2 on the Master I/O Board and J1 and J2 on the Slave I/O Boards.

J2 on the Master I/O Board connects to J1 on the first Slave I/O Board. Then, J2 on the first Slave I/O Board connects to J1 on the second Slave I/O Board (if present). J2 on the last Slave I/O Board must be jumpered between pin 9 and pin 10 to provide a loop connection for the SPI buss that is used to distribute I/O signals between boards.

Pinout of J2 on the Master I/O Board is as follows:

Pin	
1	VCC_RAW
2	+24V_B_EMO
3	24V_B_RET
4	INP_STR
5	INP_CLK
6	OUT_CLK
7	OUT_STR
8	OUT_CLEAR
9	OUT_MISO
10	INP_MISI
11	GND
12	+24_B

It is beyond the scope of this manual to discuss the purpose of these signals other than to say that they distribute power and I/O signals between the various I/O boards.

2.3. J3 – EMO Switch

J3 provides connections for a front panel EMO switch. In the standard configuration, the EMO switch is mechanically latching and is wired to interrupt

the +24 Volts for the solenoid valves while leaving the relays, sensors and processors powered up.

Pinout of J3 is as follows:

Pin	
1	+24 Volts DC from EMO Switch
2	+24 Volts DC to EMO Switch

2.4. J4 – Front Panel Assembly

J4 provides power and control signals to the front panel. The pins of this connector must be wired pin-for-pin to the corresponding pins of J3 on the front panel assembly.

Pinout of J4 on the Master I/O Board (and J3 on the front panel) is as follows:

Pin	
1	EMO Status
2	5 Volt Enable
3	5 Volt Return
4	+5 Volts (for VFD)
5	+3.3Volts (for CPU)
6	3.3Volt Return (for CPU)

Notes:

- The EMO Status signal reports the status of the EMO switch to the main CPU.
- The 5 Volt Enable signal allows the main CPU to control the 5-Volt DC/DC converter.

3. INSTALLATION – USER ACCESSIBLE CONNECTIONS

The I/O hardware includes up to three circuit boards. Every VMB contains one Master I/O Board. In addition, a particular installation might include one or two four-stick Slave I/O Boards, and, possibly, a two-stick Slave I/O Board.

Note that the manual versions do not require as much I/O as the automatic versions and a single 4-stick or even 2-stick board may provide enough I/O for a 4, 6 or 8 stick manual system.

The following table summarizes board requirements for the various models:

Model	Type	Sticks	Master	4-Stick Slave	2-Stick Slave
674	Manual	4	1	-	1
676	Manual	6	1	-	1
678	Manual	8	1	1	-
684	Automatic	4	1	1	-
686	Automatic	6	1	1	1
688	Automatic	8	1	2	-

3.1. Digital Sensors and Relays

Two 12-pin terminal blocks are provided on the Master I/O Board. In addition, two 12-pin terminal blocks are provided for each stick on the 2-Stick and on the 4-Stick Slave I/O Boards. For purposes of documentation, each pair of 12-pin terminal blocks shares a single connector number such as J101. The pin numbers extend from pin 1 through 12 on one terminal block and from 13 through 24 on the second.

In all cases, the pinout of the 24-pin terminal block pair on the Master I/O Board is the same as the 24-pin terminal block pairs on the Slave I/O Boards. On the Master I/O Board, the terminal blocks are identified as J901 and, on the Slave I/O Boards, the first terminal block pair is identified as J101. The remaining terminal block pairs are identified as J102, J103 and J104.

Note that if a system contains two 4-Stick Slave I/O boards, there will be two connectors labeled 'J101', one on the first board for Stick #1 and one on the second board for Stick #5. Similarly, there will be two connectors labeled 'J102', two connectors labeled 'J103' and two connectors labeled 'J104'.

The following table itemizes the pins on connectors J109, J101, J102, J103 and J104:

Pin		Pin	
1	Sensor 1	13	24V RETURN
2	Sensor 2	14	24V RETURN
3	Sensor 3	15	24V RETURN
4	Sensor 4	16	24V RETURN
5	Sensor 5	17	24V RETURN
6	Sensor 6	18	24V RETURN
7	Sensor 7	19	24V RETURN
8	Sensor 8	20	24V RETURN
9	+24 VDC	21	24V RETURN
10	Relay 1&2 Common	22	Relay 3&4 Common
11	Relay 1 NO	23	Relay 3 NO
12	Relay 2 NO	24	Relay 4 NO

3.1.1. Sensor Assignments

Note that the sensor assignment is configured in software and may vary between installations. The following tables itemize a standard sensor assignment, but may not apply to all installations.

Sensor	Master I/O Board	Slave I/O Boards
1	Toxic Gas Alarm	Toxic Gas Alarm
2	Exhaust	Process Line Coax
3	Flame Detector Fault	Excess Flow
4	UV/IR	Pressure
5	CDA Monitor	Remote Tool Enable
6	Enclosure Pressure	Remote Spare
7	Vacuum	Remote EMO
8	Purge Pressure	Remote ALarm Silence

3.1.2. Relay Assignments

Note that the relay assignment is configured in software and may also vary between installations. The following tables itemize a standard relay assignment, but may not apply to all installations.

Relay	Master I/O Board	Slave I/O Boards
1	GLOBAL STATUS (to House Alarm)	STICK STATUS (to House Alarm)
2	GLOBAL ABORT (to House Alarm)	STICK ABORT (to House Alarm)
3	GLOBAL STATUS (to HPM-3)	STICK STATUS (Buzzer at Tool)
4	GLOBAL ABORT (to HPM-3)	STICK ABORT (Indicator at Tool)

3.2. Solenoid Valves

Generally, four solenoid control signals and four relay control signals are provided on each Master I/O Board. In addition, four solenoid control signals and four relay control signals are provided for each stick on each Slave I/O Board

For wiring convenience, all solenoid control signals are provided on 4-pin connectors with each connector providing control of two solenoids. The solenoid connectors on the Master I/O Board are identified as S901 and S902. The solenoid connectors are the Slave I/O Boards are identified as S101 and S102 for stick #1 and stick #5, S201 and S202 for stick #2 and stick #6, S301 and S302 for stick #3 and stick #7 and S401 and S402 for stick #4 and stick #8.

The pinout of the 4-pin connectors is as follows:

Master	Stick # 1 & 5	Stick # 2 & 6	Stick # 3 & 7	Stick # 4 & 8	
S901.1	S101.1	S201.1	S301.1	S401.1	Solenoid A (-)
S901.2	S101.2	S201.2	S301.2	S401.2	Solenoid A (+)
S901.3	S101.3	S201.3	S301.3	S401.3	Solenoid B (+)
S901.4	S101.4	S201.4	S301.4	S401.4	Solenoid B (-)
S902.1	S102.1	S202.1	S302.1	S402.1	Solenoid C (-)
S902.2	S102.2	S202.2	S302.2	S402.2	Solenoid C (+)
S902.3	S102.3	S202.3	S302.3	S402.3	Solenoid D (+)
S902.4	S102.4	S202.4	S302.4	S402.4	Solenoid D (-)

3.2.1. Solenoid Assignments

Note that the solenoid assignment is configured in software and could possibly vary between installations. The following tables itemize a standard solenoid assignment, but may not apply to all installations.

Solenoid	Master	Sticks
A	ESV	ESV
B	SPARE	TIV
C	VAV	TVV
D	PGM	PGI

4. INSTALLATION – FIRMWARE INSTALLATION

The Rabbit CPU Core Module provides a connector for in-the-field programming. This connector allows software to be installed or upgraded after the electronics is assembled.

In order to install the VMB application software, a serial connection must be established between a personal computer and the CPU Core Module using a programming cable provided by Rabbit Semiconductor. The part number of the programming cable is 101-0542.