The EXOGAM Auto-Fill System

Instruction Manual and Specification for the Electronic Control Elements of the Auto-Fill System

(EDOC408)

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Version 1.2, June 1999

Contents

General Description

Hardware and Electronic Interface Panels

The basic system is comprised of the following components:

The Manifold Control Unit

The control unit has four blocks of eight identical control channels, (see fig. 504/G) each block controlling one manifold (either via the computer system or manually), The inputs and outputs of each block are located on the rear panel. There is also a key switch on the right hand side of the front panel which controls the Manual Fill switches on all four blocks.

Manifolds

As described above, up to four manifolds may be controlled from the system, and these manifolds will be mounted on the array in a convenient position. Each manifold has eight valves, one inlet, six outlets to detectors and one outlet to purge the manifold.

Valve Control Unit

These are die cast boxes attached to each manifold containing the electronics to activate the manifold valves in response to signals sent from the manifold control unit via a 25 way ribbon cable.

Liquid nitrogen sensors

There are seven sensors associated with each manifold (the inlet valve does not use a sensor) and these are connected, via BNC cables to a small patch box located near by. The patch box is then connected to the manifold control unit via a nine way ribbon cable

The Bias Shut-down patch panels

These allow the bias shut-down signal from the pre-amps to be sent to the manifold control unit via a 25 way ribbon cable.

The following section contains a more detailed description of the two main elements of the system, the Manifold Control Unit and Valve Control Units. (See diag. 504/C/98 for a block diagram of one Manifold Control Unit and its associated hardware.)

The Manifold Control Unit

The Manifold Control Unit has sixteen plug-in modules with two control channels per module (note that these channels are not assigned to the same manifold see diag 504/G),and although each module is electrically identical, its position in the control unit is dictated by the legend on its front panel.

Each control channel has the following front panel controls and inputs/outputs

1. N_2 Liquid Detected: This yellow LED indicates that N_2 Liquid has been detected by the exhaust sensor indicating that its dewar is full. The pre-set potentiometer below the LED is used to adjust the point at which the LED switches on.

2. Detector Cool: This yellow LED indicates that the bias shut-down is not active

3. Detector Cool Override: If the bias shut-down becomes active it inhibits the input from the computer system preventing or halting an auto fill on that channel. If it is desirable, the above condition may be overridden by this switch allowing auto filling to continue. (Note, if the bias shut-down is not connected then the switch must be in the override position to allow auto filling on that channel.)

4. Valve Open/Closed: This Bi-coloured LED indicates the state of the solenoid valve on that channel, red when the valve is closed, green when it is open.

5. Manual Fill: This switch operates the valve manually allowing the operator to test the system or fill the dewar without computer control. (Note that the Manual Fill switches must be enabled by the Manual Fill key switch on the right hand side of the Control Unit.

Inputs

1. From computer system. This opens and closes the valve

2. From the Exhaust Sensor. This detects liquid nitrogen

3. From the Valve Control Unit. This detects the presence of a voltage on the valve (valve open).

4. From the bias shut-down patch panel. If active, it inhibits "input 1" above.

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Outputs

1. To the computer system, this informs the system that the Exhaust Sensor has detected liquid nitrogen

2. To the computer system. This informs the system that the bias shut-down is active.

3. To the Valve Control Unit . This activates the valve on the manifold.

The control unit also has a power supply located behind the left hand front panel (disconnect from mains before removing power supply). It has three fuses mounted on the printed circuit board, one supplying power to the modules in the control unit and the other two supplying power to the Valve Control Units. The mains fuse is in the combined I.E.C. inlet, switch and fuse, located on the rear panel.

Located on the right hand front panel there is a key switch to enable the manual fill switches, and a power status LED. This panel is connected by a cable which may be un-plugged when the panel is removed.

Note that the Manifold Control Unit has an extra pug-in card (diag. 504/H/99) behind the centre front panel. Its purpose is to inhibit the filling of the 160L dewars whenever a fill procedure is instigated, whether manually or via the computer system. It also informs the computer system when the manual fill key switch has been operated. The connections to the 160L dewars are found below the mains inlet on the rear panel.

The connectors at the rear, with the exception of the mains input and the connectors referred to in the above paragraph are mounted on a printed circuit board attached to the rear panel and as the rear panel assembly is plugged into the module backplane by IDC and Molex connectors, it may be removed once the control unit has been disassembled.

The Valve Control Unit

The Valve Control Unit associated with each manifold contains eight pcb mounted relays which control the manifold valves. These are operated by the Manifold Control Unit via a ribbon cable. The status of each valve is monitored by an opto-isolator and this information is sent to the Manifold Control Unit via the control cable. (See diag. 504/D for a block diagram of a Valve Control Unit and manifold.)

(Note that as the valves are operated by <u>240 volts AC</u>, this voltage <u>is present on the printed circuit board</u> and the mains supply should be disconnected before the lid is removed).

The mains supply is connected to each unit via a connector on the side of the box. Also located on the side are the mains fuse and indicator, and the 25 way control connector. (Note that each Valve Control Unit has its own voltage regulator, and its associated fuse is found on the printed circuit board).

Operating Procedure

Automatic Filling

In this mode the Manifold Control Unit is controlled by the Auto Fill program running on the computer system. To operate in this mode set the *Manual Fill* switches to "off" (up) and the *Manual Fill* key switch to off. The *Detector Cool Override* switches should normally be set to "off" except for those on the *Inlet* and *Purge* channels which must always be set to "on" (down), It should be noted that if the bias shut-down signal is not connected to a particular channel then its associated *Detector Cool Override* switch must be set to "on".

It will now be possible to fill the detectors from the computer system either manually via the terminal or by running the Auto-Fill sequence (see the appropriate manual for instructions on these procedures).

If one of the detectors starts to warm up and its bias shut-down becomes active, it will inhibit or terminate the filling of its dewar. If it is considered desirable its associated *Detector Cool Override* switch may be set to "on" enabling filling to continue.

Manual Filling

In this mode the Manifold Control Unit is operated via the front panel controls and the operator must be vigilant when operating the system in this mode, as there are no automatic checks on nitrogen flow. Also the *Detector Cool* LEDs should be observed, as if a detector warms up although the LED will go out it **will not prevent the dewar from being filled**

To operate in this mode the *Manual Fill* switches should initially be set to off and then the key switch may be set to on.

To fill a detector (or group of detectors on the same manifold) the following procedure should be followed.

1. Purging the manifold

a. Switch the *Purge* channel to on

b. Switch the *Inlet* channel to on, liquid nitrogen will now flow into the manifold.

c. The N2 Liquid Detected LED on the *Purge* channel should now be observed. When a steady indication is observed the manifold is full of liquid nitrogen and the *purge* channel should be switched to off

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2. Filling the detectors

a. Switch the appropriate detector channel (or group of channels) to on.

b. The *N2 Liquid Detected* LEDs on the appropriate channels should now be observed and when a steady indication is seen on an LED that detector will be full and the channel should be switched to off (note that the detectors will not all fill at the same rate).

c. When the detector (or detectors) on the manifold are full, the Inlet channel should be switched to off.

If any detectors on other manifolds require filling the above procedure should be followed

(Note, more than one manifold may be filled at the same time if it is desired.)

Circuit Description

The Power Supply

This is on a plug in card behind the left hand front panel (disconnect the mains before removing). It consists of a toroidal transformer, a bridge rectifier and three smoothing capacitors. It has three fused outputs, one supplies power to the cards in the Control Unit , of the other two, one supplies power to the two relay units controlled by the modules on the left and the other one supplies power to the two relay units controlled by the modules on the right.

Valve Control Unit

The circuit of the Valve Control Unit is described below, together with the valve control section of the plug-in module.

Plug-in Modules.

Each of the plug-in modules is electrically identical and operates two separate channels. As noted above each card has two control channels and the following description applies to both.

Each channel may be split into two sections, a nitrogen detection circuit and a valve control circuit. (see diag 504/F & diag 504/A/98). The card also has a voltage regulator which is common to both channels, (see diag 504/E/98) for circuit of full card.)

Nitrogen detector (diag. 504/F)

This circuit informs the operator, (via an LED) and the computer system when liquid nitrogen is detected by its sensor.

This is done by a comparator which looks for the change in resistance of the sensor when nitrogen flows over it, when the dewar is full. When the comparator switches it turns on the N_2 *Liquid Detected* LED on the front panel, (this point may be calibrated by ensuring that liquid nitrogen is flowing over the sensor and adjusting the pre-set potentiometer, which is below the LED on the front panel until the LED just turns on.)

The computer system does not use the output of the comparator to detect when the dewar is full, instead it takes the differential signal from the input of the comparator and uses this instead. Because of this the Auto-Fill program has a procedure to calibrate the point at which each channel on the computer system senses that nitrogen is detected, and this should be checked if the pre-set on the comparator is adjusted.(the procedure for this is contained in the manual)

The valve control circuit, One channel (diag 504/A/98 and 504/B)

As the valve control circuit on the module works in conjunction with the Valve Control Unit on the manifold, the two circuits are described together

The solenoid valve is activated by RL1 , which in turn is activated by either :

1. The computer system - in this mode the computer system connects E1 to E2 and if TR2 is conducting RL1 will be activated, along with the Detector Cool LED. TR2 is controlled by the opto-isolator which in turn is controlled by the state of the bias shut-down signal. In its none active state the bias shut-down signal turns the opto- isolator on, its output transistor conducts, turning on TR1 & TR2 .

(TR1 provides a TTL compatible signal which is used by the computer system to sense the state of the bias shut-down signal (0V = inactive 5V = active))

If the bias shut-down becomes active TR1 & TR2 turn off, the output to the computer system goes to 5V, the detector cool LED turns off and RL1 is de- activated turning the solenoid valve off. If necessary the detector Cool Override switch SW1 can be used to short out TR2 allowing uninterrupted control of the solenoid valve.

2. The Manual Fill switch. In this mode the Manual Fill switch by-passes the input from the computer system and the bias shut-down, controlling RL1 directly (the key switch must be turned to on).

The state of the solenoid valve is indicated in both of the above conditions by the bi-coloured LED. When the relay is de-activated point T is at approximately 12V, and TR3 and the "closed" LED is turned on. When RL1 is activated point T almost at 0V and TR3 and the red LED turn off.

The "open" LED is controlled by the opto-isolator OI2. when mains voltage is present on the solenoid valve the opto-isolator conducts, turning the "open" LED on. When mains voltage is not present the LED is turned off.

Dewar Fill Inhibit circuit (diag.504/H/99)

This circuit prevents the 160L dewars from filling while a detector fill is taking place.

To inhibit the filling of the 300l dewars used previously on EUROGAM, a 12V signal was required and this was provided by RL1. The following describes the current design.

For flexibility, the output to the Dewar Level Controller may be set to provide either a 12v signal or a contact closure. For the Dewar Level Controllers currently in use, it is set to a normally open contact.

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The signal to the Dewar Level Controller is produced by RL1, the jumpers AA,BB,CC allow the choice of a 12v signal or a switch contact as a control signal. RL1 is controlled by TR2 which in turn is controlled by NOR 2. This gate is enabled by either a signal from the computer system when an auto-fill is in progress, or by the Manual Fill key switch when a manual fill is in progress. The signal from the key switch is conditioned by TR1 and NOR 1 before being applied to NOR gate 2. This conditioned signal is also sent to the computer system to indicate that a manual fill is taking place. (The signals to and from the computer are active low)