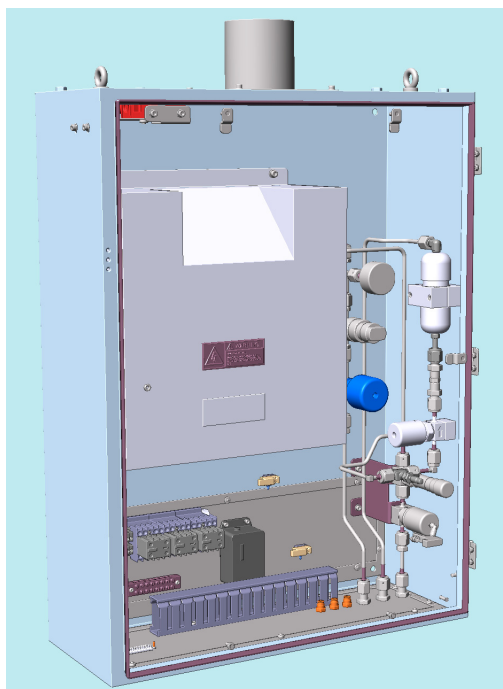


Oxford Instruments Plasma Technology Ozone Delivery System

Issue 1_A / February 2017 / Original Instructions



Contents

Section	Page
About this data sheet	3
Other Equipment Manufacturer manuals	3
Health and safety information for the ODS	3
Hazard information for ozone	3
Hazard information for the Ozone Delivery System	4
Safety features of the Ozone Delivery System	4
Services requirements for the ODS	5
Facilities inlet connections	5
Outlet connections	5
Connections between the ODS and the ALD system	5
Cabinet exhaust	5
Description of the ODS	5
Features of the ODS	6
Main parts of the ODS	6
Functional description of the ODS	7
Pneumatic control circuit of the ODS	8
ODS electrical schematic	9
Installing the ODS	12
Mounting the ODS	12
Commissioning the ODS	13
Operating the ODS	14
Representation on the pages	14
Using the ODS in a recipe	15
Maintaining the ODS	15
Troubleshooting the ODS	15
Fault displayed on the control system page	15
Elevated ozone concentration	16
Troubleshooting guide	16

About this data sheet

This data sheet provides basic information about the installation of an ozone delivery system. The ozone delivery system (ODS) is intended for use in conjunction with Oxford Instruments Plasma Technology FlexAL[®]II and OpAL[®] tools.

Other Equipment Manufacturer manuals

These OEM manuals are applicable to the ODS:

- Atlas 30 ozone generator
- C-30ZX ozone monitor

Health and safety information for the ODS

This section contains specific health and safety information for operating and maintaining the ODS.

Hazard information for ozone

Characteristics of ozone



WARNING

TOXIC SUBSTANCE

Ozone is a toxic substance that is hazardous to health if inhaled or in contact with the eyes or skin. Exercise caution when working with the ODS. Seek medical attention if inhalation or contact with ozone occurs.



WARNING

RISK OF EXPLOSION

Ozone is an unstable gas which, at normal temperatures, decomposes to diatomic oxygen. At elevated temperatures and in the presence of certain catalysts such as hydrogen, iron, copper and chromium, ozone decomposition may be explosive.

Moreover, ozone reacts with non-saturated organic compounds to produce ozonides, which are unstable and may decompose with explosive violence.

At room temperatures, ozone is a colourless gas with a characteristic sharp, irritating odour. It is a powerful oxidizing agent. Oxidation reactions involving ozone evolve more heat than similar reactions involving oxygen, and can usually be initiated at lower temperatures than similar reactions involving oxygen.

All personnel who install, maintain or operate the ODS must fully understand the hazards associated with ozone before commencing work. All such personnel must read and understand the appropriate Material Safety Data Sheet (MSDS).

Potential health effects of ozone

When inhaled, ozone irritates the nose, throat, and chest and also causes dryness of the mouth. Ozone may cause difficulty in breathing, headache, and fatigue. The characteristic sharp, irritating odour is readily detectable at low concentrations (0.01 ppm to 0.05 ppm).

Ozone Delivery System

Ozone irritates the eyes causing pain, lacrimation, and general inflammation.

Before operating the ODS, consult the appropriate MSDS to understand what first-aid measures may be required.

Hazard information for the Ozone Delivery System



WARNING

HEAVY WEIGHT

The cabinet of the ODS is a heavy object with a centre of gravity above its mid-point. Exercise caution when lifting and installing the cabinet.



WARNING

LETHAL VOLTAGES

High voltages are present inside the cabinet of the ODS. Isolate the mains electrical supply to the cabinet before attempting to open the cabinet.

Exercise extreme caution when in the vicinity of high voltages. There are no user serviceable parts inside the cabinet of the ODS.



Caution

Damage to the Ozone Delivery System

The ozone generator is not designed to pump down to vacuum. Do not evacuate the ODS, otherwise damage to the ozone generator may occur.

Safety features of the Ozone Delivery System

Safety interlocks

When the door of the ODS cabinet is opened, the following interlock actions occur:

- Electrical power to the ozone generator is interrupted, which stops ozone production.
- The compressed air supply to the cabinet is disabled, which closes the isolation and ALD dose valves.

Ozone monitoring (optional)

If the customer requests it, there is an optional ozone detector within the ODS cabinet. Ozone is denser than air, so the detector is located near the bottom of the cabinet. The detector has an LED display that illuminates to indicate the measured ozone concentration. See [Table 1](#).

Table 1 Ozone detector LEDs

Ozone concentration (ppm)	LED colour
0 to 0.05	Green
0.05 to 0.1	Yellow
Greater than 0.1	Red

If the ozone detector measures unsafe concentrations of ozone, it performs the following actions:

- Electrical power to the ozone generator is interrupted, which stops ozone production.
- The compressed air supply to the cabinet is disabled, which closes the isolation and ALD dose valves.
- An alarm is displayed on the application pages on the **FlexAL®II** or **OpAL®** system controller. This stops the recipe that is running on the controller.
- Electrical power to the ozone generator remains OFF, even if ozone concentrations return to safe levels.

Services requirements for the ODS

Facilities inlet connections

Compressed air with a pressure of >5 bar.

Oxygen with 100% purity and pressure of 2 bar. Maximum pressure 3 bar.

Outlet connections

Compressed air exhaust.

Ozone supply to the ALD chamber.

Ozone outlet to the exhaust (atmospheric pressure side of pump).

Connections between the ODS and the ALD system

AC electrical power.

24 VDC control signals.

Compressed air to drive the remote isolation valve (**OpAL®** systems only).

The ozone cabinet should be sited as close as possible to the main tool. The maximum pipe length between the ozone cabinet and the main tool is 5 m.

Cabinet exhaust

Extraction system with a minimum flow of 3 m³/minute (106 cfm) and minimum vacuum of -375 Pa (-1.5 inches of water).

Description of the ODS

The ODS is used in Oxford Instruments Plasma Technology **FlexAL®II** and **OpAL®** tools. The system provides the oxidant for ALD processes and is designed to deliver short pulses of ozone (~ few seconds) to the ALD chamber.

The unit is a complete ozone delivery system housed in a steel cabinet. The cabinet is continuously monitored to ensure that the concentration of ozone is within safe levels.

Features of the ODS

- Ozone generator, which outputs up to 22.2% w/w ozone concentration.
- Ozone destruction unit.
- Forward pressure regulation.
- Oxygen flow regulator.
- Ozone flow-restriction to regulate ozone delivery to the ALD chamber.
- A rapid ALD dose valve.

Main parts of the ODS

The ODS is housed in a stainless steel cabinet with a sealing door containing a glass viewing window to enable set-up (see [Figure 1](#)).

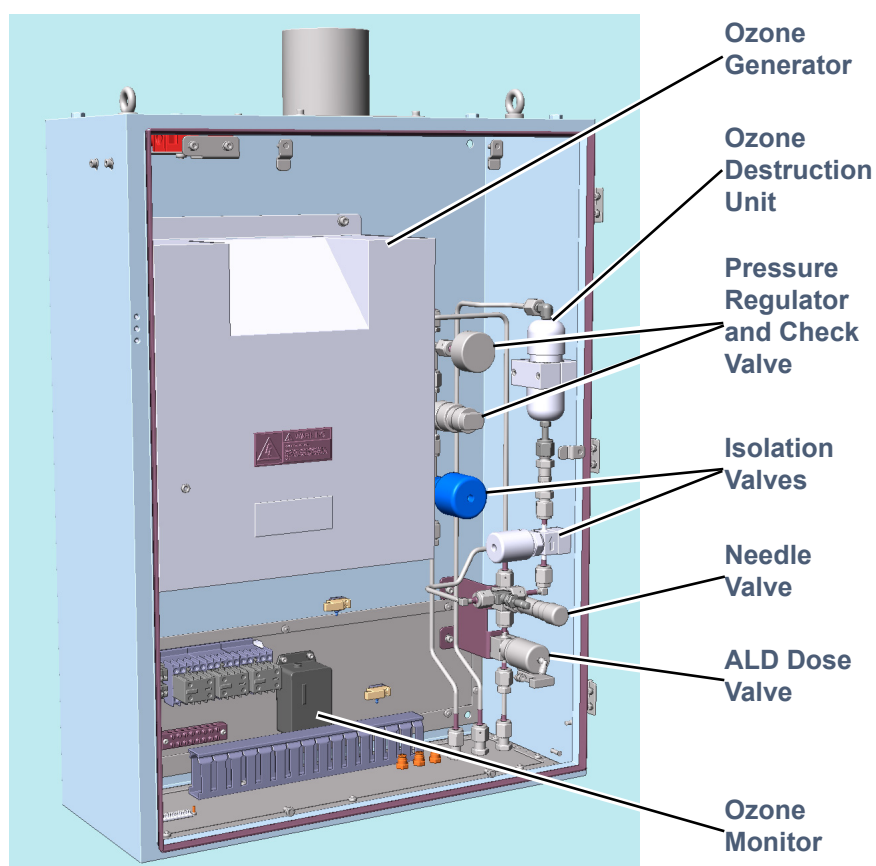


Figure 1 ODS cabinet

The main components of the ODS cabinet are:

Ozone generator

Absolute Ozone® Atlas 30 ozone generator.

Ozone destruction unit

Uses a catalyst to convert ozone to oxygen before sending it to the exhaust system.

Pressure regulator and display

Adjusts the pressure of oxygen fed into the ozone generator. The pressure in the generator must be greater than the pressure in the exhaust.

Check valve

Prevents backflow from the exhaust into the generator, if the exhaust pressure becomes greater than the generator pressure.

Isolation valves

Closed when the unit is idle or an interlock is tripped. These valves provide protection in the event of a leak or failure.

Needle valve

Regulates the flow into the ALD chamber.

ALD dose valve

Switches the flow to the ALD chamber.

Metering valve

Regulates the flow of oxygen through the ozone generator. This flow determines the percentage of ozone in oxygen that flows into the process chamber.

Ozone monitor (optional)

Model C-30ZX monitor interrupts the interlock chain if an ozone leak is detected in the cabinet.

Functional description of the ODS

Figure 2 shows a functional diagram of the ODS.

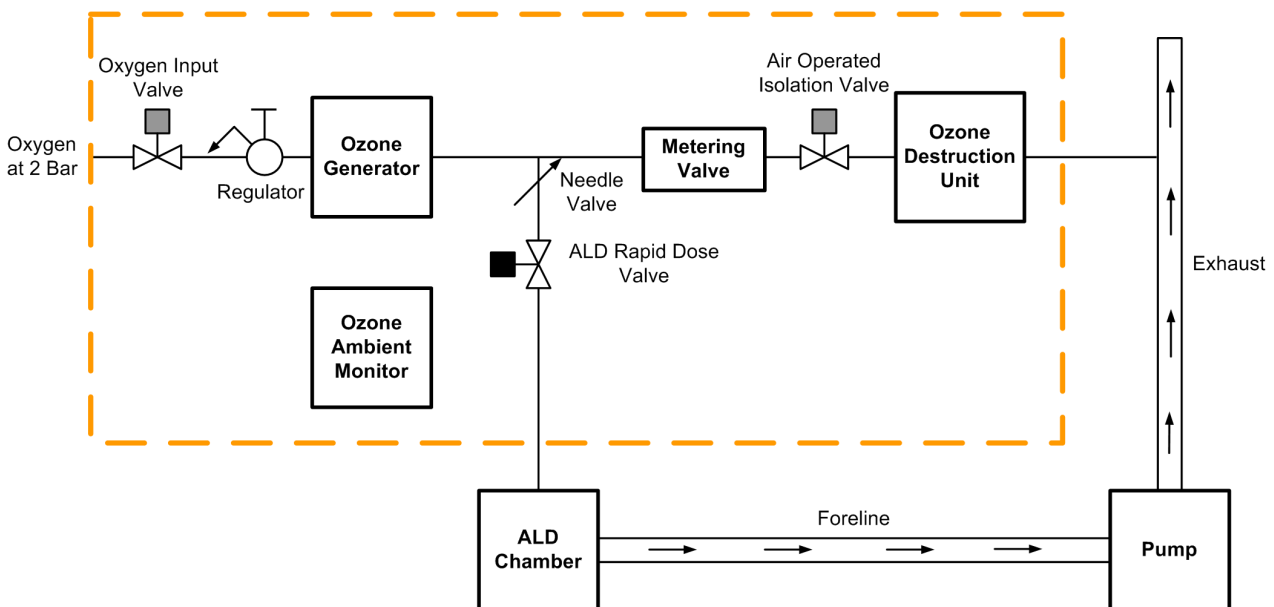


Figure 2 Functional diagram of the ODS

When the ODS is not in use, the three pneumatic valves are closed. This minimises the risk of oxygen leaking from the system.

When the oxygen input valve opens, oxygen enters the ozone generator. Some of the ozone produced by the ozone generator passes through the isolation valve into the ozone destruction system. This converts ozone into oxygen, which then passes into the facility exhaust. When the ALD rapid dose valve is open, ozone also passes through a needle valve into the ALD process chamber.

Pneumatic control circuit of the ODS

Figure 3 shows the pneumatic control circuit.

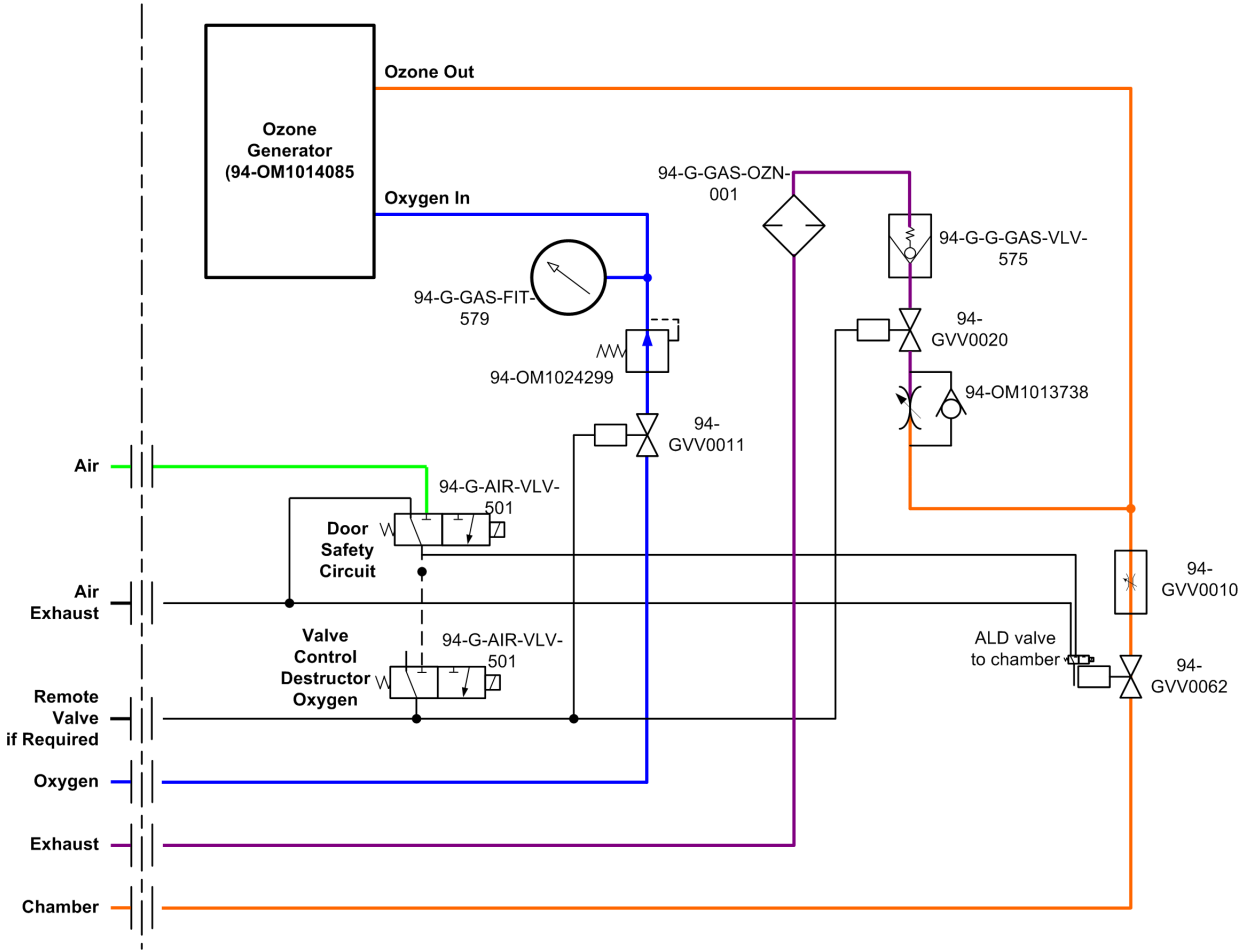


Figure 3 ODS pneumatic control circuit

ODS electrical schematic

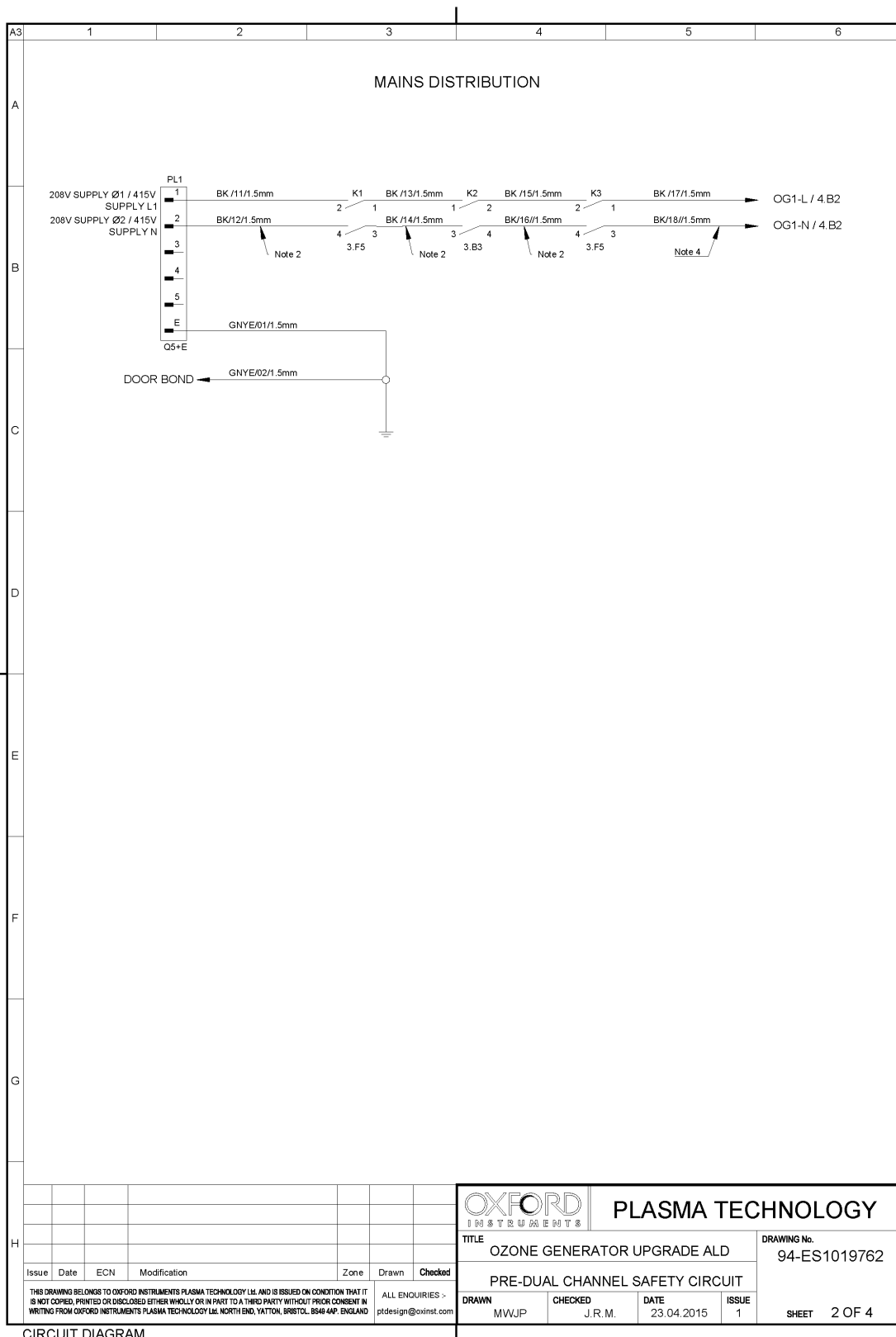


Figure 4 Electrical schematic diagram of the ODS Sheet 1

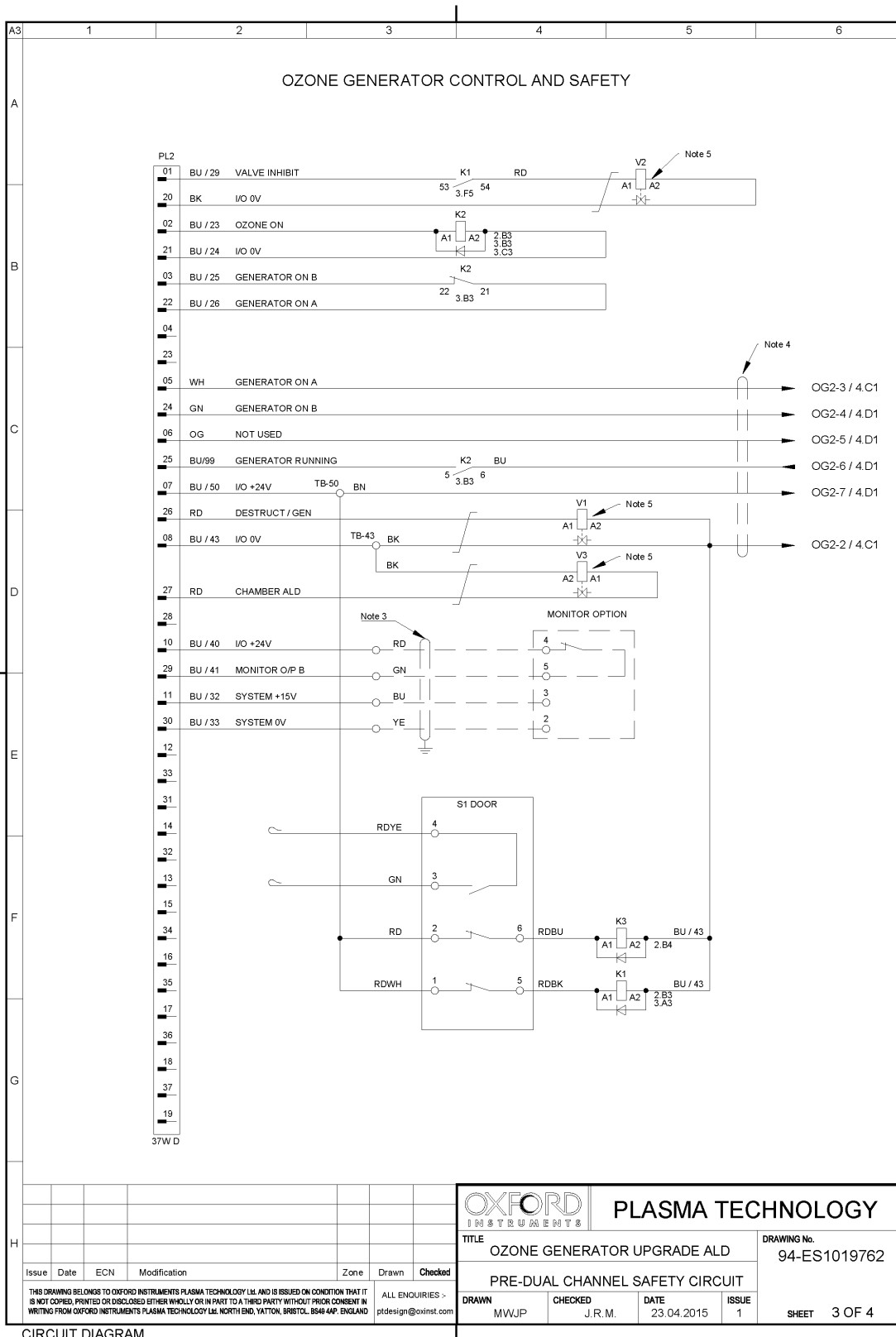


Figure 5 Electrical schematic diagram of the ODS Sheet 2

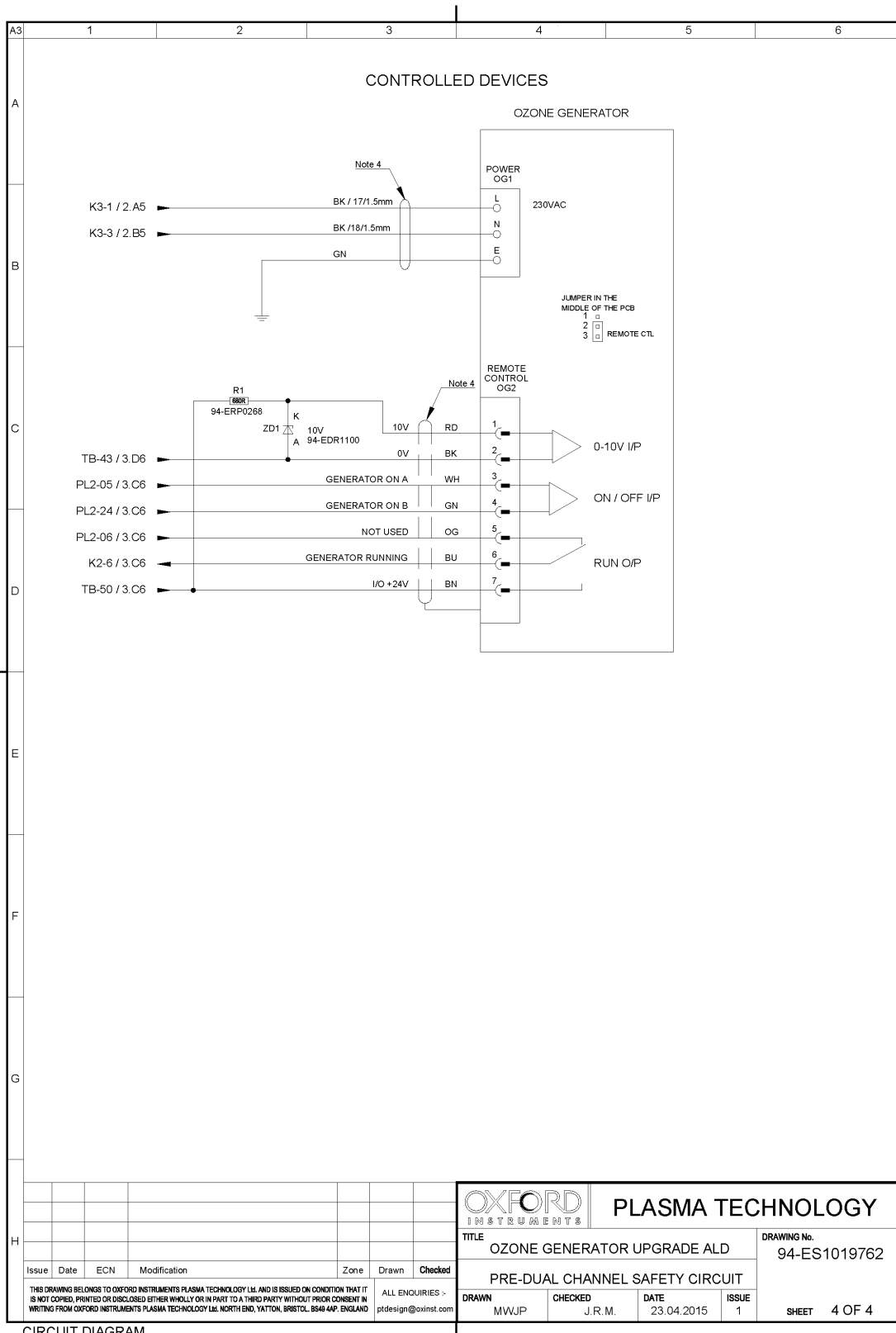


Figure 6 Electrical schematic diagram of the ODS Sheet 3

Installing the ODS

Mounting the ODS

The cabinet is mounted on a wall as shown in [Figure -1](#).

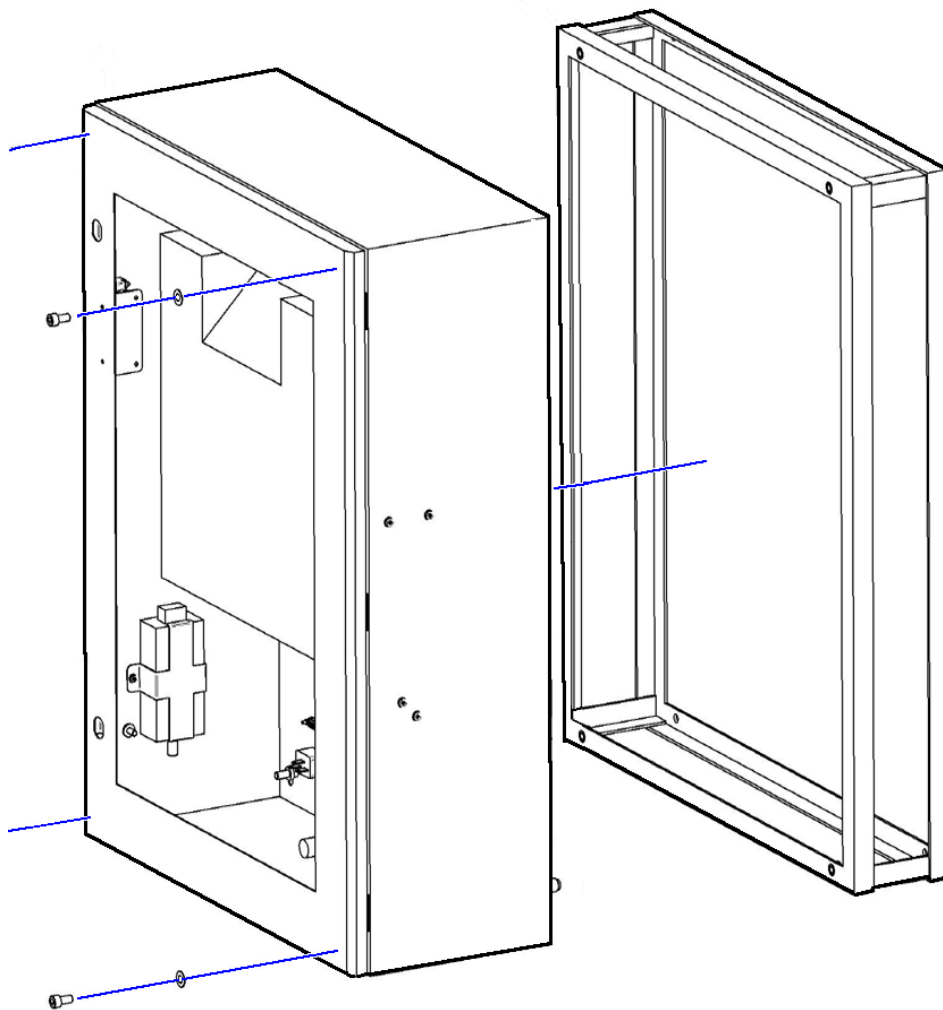


Figure 7 Mounting the ODS on a wall

Refer to section [Services requirements for the ODS](#) for information on the required services.

Commissioning the ODS

Initial power-up



WARNING

LETHAL VOLTAGES

**High voltages are present inside the cabinet of the ODS.
Isolate the mains electrical supply to the cabinet before attempting to open the cabinet.**

**Exercise extreme caution when in the vicinity of high voltages.
There are no user serviceable parts inside the cabinet of the ODS.**

When electrical power is first connected to the cabinet, the ozone monitor unit displays a high alarm reading for between 30 and 60 minutes. This is normal behaviour. Do not attempt to use the ODS until the high alarm has disappeared.

If electrical power to the system is interrupted for less than 5 minutes, the ozone monitor will only require approximately 5 minutes to warm up. If electrical power is interrupted for more than five minutes, the high alarm reading may persist for between 30 and 60 minutes.

Initial set-up procedure

Adjust the pressure regulator

- 1 Open the door of the ODS cabinet.
- 2 Set the **Power** knob on the control panel of the ozone generator to the OFF position.
- 3 Rotate the control knob on the pressure regulator fully clockwise.
- 4 Close the door of the ODS cabinet to enable the interlock switch.
- 5 Switch the ozone generator ON from the process page on the main system application. This opens the ozone isolation valves. The ozone generator will not activate as it is switched OFF.
- 6 Open the door of the ODS cabinet.
- 7 Rotate the control knob on the pressure regulator by one quarter-turn in the counter-clockwise direction.
- 8 Close the door of the ODS cabinet and note the pressure displayed on the regulator display.
- 9 Repeat steps 6 to 8 until the regulator displays a value of 1.5 bar above atmospheric pressure.

Adjust the needle valve

- 1 Open the door of the ODS cabinet.
- 2 Rotate the control knob on the needle valve fully clockwise to close it.
- 3 Close the door of the ODS cabinet.
- 4 Access the application on the main system controller.
- 5 Evacuate the ALD chamber and leave the system pumping.
- 6 Open the ALD dose valve from the main application.
- 7 Note the chamber pressure indicated on the Pumping page.
- 8 Open the door of the ODS cabinet.

Ozone Delivery System

- 9 Rotate the control knob on the needle valve slightly in the counter-clockwise direction.
- 10 Close the door of the ODS cabinet and wait until the indicated chamber pressure is stable.
- 11 Repeat steps 8 to 10 until the chamber pressure is 30 mTorr (for **FlexAL®II**) or 75 mTorr (for **OpAL®**).

Prepare the ozone delivery system for use

- 1 Access the application on the main controller.
- 2 Stop the ozone generator and close the ALD valve.
- 3 Open the door of the ODS cabinet and set the **Power** knob on the control panel of the ozone generator to the ON position.
- 4 Close the door of the ODS cabinet.

The ODS is now ready for use.

Operating the ODS

The ODS is controlled from the application on the main system controller.

Representation on the pages

Figure 1 shows the panel used to control the ODS.

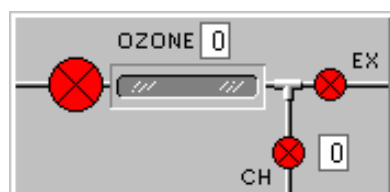


Figure 8 Ozone panel on the Process page

The **OZONE** panel contains the following controls and indicators:

O2 valve

Switches the oxygen supply to the ozone generator.

Ex valve

Switches ozone to the exhaust system.

CH valve

This fast ALD valve switches ozone to the ALD process chamber.

Status panel

Displays status messages.

Ozone generator ON/OFF field

Enter 1 to switch the ozone generator ON. Enter 0 to switch the ozone generator OFF.

Using the ODS in a recipe

The ozone generator must be switched ON from the controller at least five minutes before delivering ozone in a process step. This period allows the ozone output of the generator to optimise (see [Figure 2](#)).

- 1 If running a recipe, switch the ozone generator ON during the first recipe step.

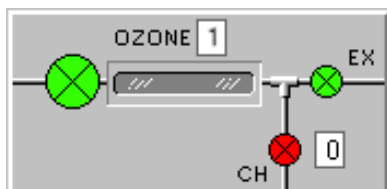


Figure 9 Ozone generator is switched ON

- 2 Switch the fast ALD valve (CH) ON to admit ozone to the process chamber (see [Figure 3](#)). For most processes, use a one-second pulse of ozone.

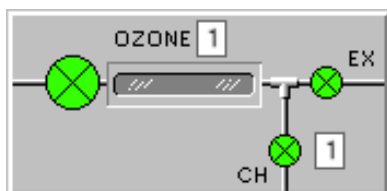


Figure 10 Fast ALD valve is open

Maintaining the ODS

Perform the following periodic maintenance checks at regular monthly intervals:

- 1 Open the door of the ODS cabinet.
- 2 Observe the colour of the granules in the ozone destruction unit. If the crystals have changed colour, contact Oxford Instruments Plasma Technology for advice. The crystals change colour when they are contaminated with moisture.
- 3 Check that all VCR and swaged connections within the ODS cabinet are secure.

Troubleshooting the ODS

Fault displayed on the control system page

[Figure 11](#) shows the OZONE panel of the main application if a fault in the ODS has occurred.

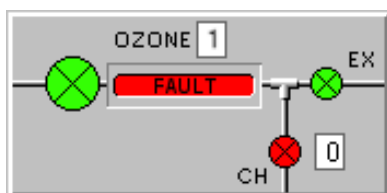


Figure 11 Fault in the ODS indicated on OZONE panel

Ozone Delivery System

A red alert message is generated if the ozone generator is switched ON but the generator does not return an OK message within 30 seconds. The red alert stops the process that is running. The alert message is:

The ozone generator output has failed, please check the generator, power connections and the ozone monitor.

Elevated ozone concentration



TOXIC SUBSTANCE

Ozone is a toxic substance that is hazardous to health if inhaled or in contact with the eyes or skin. Exercise caution when working with the ODS. Seek medical attention if inhalation or contact with ozone occurs.

If the ozone monitor displays an elevated ozone concentration, DO NOT attempt to open the ODS cabinet. Wait until the monitor indicates a safe ozone concentration before opening the cabinet. Depending on the levels of ozone within the cabinet, this may take several hours.

If the ozone concentration has not decayed to a safe level after several hours, it is possible that the ozone monitor has failed. Perform the following steps:

- 1 Check that the ozone generator is powered off.
- 2 Put on appropriate personal protective equipment.
- 3 Ensure that the area around the ODS cabinet is well ventilated. If necessary, install temporary extraction for the area.
- 4 When it is safe to do so, open the door of the ODS cabinet and check the ozone monitor for faults.

Troubleshooting guide

Symptom	Possible cause	Solution
Ozone generator cannot be switched ON from the main application page.	Ozone generator is switched OFF at the front panel.	Check that the ozone generator is switched ON.
	The ODS cabinet door is open.	Close the ODS cabinet door.
	The front panel switch of the ozone monitor is OFF.	Switch the ozone monitor ON.
Ozone generator displays a FAULT message on the main application page.	Ozone monitor is displaying a high reading.	Check the ozone monitor for faults.
	Exhaust pressure is too high.	Correct the fault.
ODS has recently been powered OFF and the ozone monitor is displaying a high reading.	Ozone monitor is warming up.	Wait 60 minutes and attempt to switch ON the ODS again.
System has been powered ON for more than 60 minutes and the ozone monitor is displaying a high reading.	Ozone level inside the ODS cabinet is high.	Wait for the ozone level to decay to a safe level. Then leak-check the ODS.
	Ozone monitor is faulty.	Wait for 60 minutes. If the ozone reading has not decreased, check the ozone monitor for faults.

Ozone Delivery System

Symptom	Possible cause	Solution
Rotameter is showing zero flow	Exhaust pressure is too high.	Correct the fault.
	Needle valve is open too far.	Adjust the needle valve.
Rotameter flow is incorrect but not zero.	Rotameter is incorrectly adjusted.	Adjust the rotameter.

OIPT locations worldwide

For more information please email plasma@oxinst.com

Oxford Instruments Plasma Technology

North End, Yatton, UK
Tel: +44(0)1934 837000

Germany

Wiesbaden
Tel: +49 (0) 6122 937 161

Japan

Tokyo
Tel: +81 3 5245 3261

People's Republic of China

Beijing

Tel: +86 10 6518 8160/1/2

Shanghai

Tel: +86 21 6132 9688

Singapore

Tel: +65 6337 6848

Taiwan

Tel: +886 3 5788696

US, Canada and Latin America

Concord, MA
TOLLFREE: +1 800 447 4717