



# PSD2 Pressure Swing Dryer User's Manual



97031 Issue 13.1  
September 2018

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## PSD2

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## Safety

The manufacturer has designed this equipment to be safe when operated using the procedures detailed in this manual. The user must not use this equipment for any other purpose than that stated. Do not apply values greater than the maximum value stated.

This manual contains operating and safety instructions, which must be followed to ensure the safe operation and to maintain the equipment in a safe condition. The safety instructions are either warnings or cautions issued to protect the user and the equipment from injury or damage. Use competent personnel using good engineering practice for all procedures in this manual.

## Electrical Safety

The instrument is designed to be completely safe when used with options and accessories supplied by the manufacturer for use with the instrument.

## Pressure Safety

DO NOT permit pressures greater than the safe working pressure to be applied to the instrument. The specified safe working pressure is 5 to 7 barg (70 to 100 psig).

## Toxic Materials

The use of hazardous materials in the construction of this instrument has been minimized. During normal operation it is not possible for the user to come into contact with any hazardous substance which might be employed in the construction of the instrument. Care should, however, be exercised during maintenance and the disposal of certain parts.

## Repair and Maintenance

The instrument must be maintained either by the manufacturer or an accredited service agent. Refer to [www.michell.com](http://www.michell.com) for details of Michell Instruments' worldwide offices contact information.

## Safety Conformity

This product meets the essential protection requirements of the relevant EU directives. Further details of applied standards may be found in the product specification.

## Abbreviations

The following abbreviations are used in this manual:

AC	alternating current
atm	pressure unit (atmosphere)
bar	pressure unit (=100 kP or 0.987 atm)
°C	degrees Celsius
°F	degrees Fahrenheit
dp	dew point
kg	kilogram
Hz	Hertz
lb	pound
l/min	liters per minute
max	maximum
mm	millimeter
ppm <sub>v</sub>	parts per million (by volume)
ppb <sub>v</sub>	parts per billion (by volume)
scfh	standard cubic feet per hour
V	Volts
"	inch(es)
%	percentage

## Warnings

The following general warning listed below is applicable to this instrument. It is repeated in the text in the appropriate locations.



**Where this hazard warning symbol appears in the following sections it is used to indicate areas where potentially hazardous operations need to be carried out.**

## 1 INTRODUCTION

### 1.1 Overview

The Michell PSD2 is a Pressure Swing Dryer in a compact rack mounting unit designed to remove moisture from compressed air down to trace levels of less than 1 part per million by volume.

The dryer operates by pressure swing regeneration of a desiccant column. Design is such that, with 2 columns operating in rotation, a constant flow of very dry air (or other inert gas) can be produced for long periods without maintenance.

Heat is not supplied to the desiccant making the unit energy efficient and extremely reliable with the typical lifetime of the desiccant being 5 years.

### 1.2 Operating Principle

The supply pressure is regulated by PR1, and indicated by either gauge PG1 or PG2, depending which column is active at that moment in time.

The gas then passes through the solenoid valves (SV1 & SV2), which direct it to the appropriate desiccant column (DC1 or DC2).

The desiccant columns are filled with 4 Ångström molecular sieve. The column capacity is designed so that, as the molecular sieve absorbs water from the gas, the moisture content at the outlet of the cylinder is reduced to <1ppmV. This output is achievable regardless of the moisture content of the gas source. the only stipulation is that it must not contain liquid water.

The dried gas then passes through the non-return valve (NRV1) before reaching the outlet port.

The life expectancy of the molecular sieve is preserved by continual regeneration of the active column (purging of accumulated moisture). At the beginning of the regeneration cycle the bulk of the moisture is removed by rapidly reducing the pressure in the column, which desorbs moisture from the molecular sieve surface. Following this, the remainder of the moisture is removed by flowing a small proportion of the dried gas from the active column.

Once this cycle is complete, the system switches columns, and begins the cycle again. This regeneration process operates on 10 minute cycles, to provide uninterrupted dry gas output.

## 2 INSTALLATION

The PSD2 is supplied with a full accessory package. Please check that you have received all the items listed on the Packing Check List.

The factory set power supply voltage is indicated on the yellow label located on the rear panel of the unit. The power supply voltage setting cannot be changed by the user as this involves replacing internal electro-mechanical parts. Contact Michell Instruments' Customer Service Department (contact details at [www.michell.com](http://www.michell.com)) if a change is needed.

### 2.1 Installing the Dryer

The PSD2 requires an operating environment of 0 to +50°C (+32 to +122°F), 0 to 90% RH. Refer to Appendix B for outline dimensions.

The PSD2 case is designed for 19" 6U rack mounting. However, it can be used as a bench mounted device without any special preparation. When rack mounting, simply screw the unit front panel to the front of the rack using 4 M6 X 15mm screws and plastic inserts.

**NOTE: A minimum depth behind the PSD2 front panel of 48cm (18.9") is required for the unit, pipes and wiring.**

### 2.2 Electrical Connections

Either 220/240 V AC, 50Hz or 100/20 V AC, 60Hz power supply is required to operate this instrument. Refer to the yellow label located on the rear panel of the unit for the correct supply voltage required.

The power supply connection is via the 3-pin IEC plug located on the rear panel of the unit. A 3-core power cable is provided, the free end of which should be wired to a suitable earthed plug or directly via a fused power spur.

Power cable conductors are colored according to the convention:

Brown	L (Live)
Blue	N (Neutral)
Green/yellow	E (Earth)

### 2.3 Gas Connections

Gas connections are made via tube fittings located on the rear panel of the unit marked 'GAS INLET' and 'GAS OUTLET'.

The gas inlet connection is a Swagelok® stainless steel 6mm bulkhead union tube fitting. The gas outlet connection is a Swagelok® stainless steel 6mm bulkhead union face seal (VCR) fitting.

Ensure the supply inlet gas is of a suitable pressure - between 5.5 to 7 barg (80 to 100 psig), free of oil and at a dew point of typically <-40°C (<-40°F). If the supply inlet gas does not meet this requirement it will reduce the dryer's efficiency and eventually lead to complete failure.

**NOTE: An oil free compressor or bulk inert gas source must be used.**



### 3 OPERATION

There are no external controls for the PSD2 Pressure Swing Dryer, operation is fully automatic and no internal adjustment is required.

After inlet and outlet gas connections are made tight the unit may be turned on by the power switch (with integral neon indicator) located on the front panel.

#### 3.1 Operating the Dryer

Two pressure gauges are provided on the front panel, these indicate the pressure in each drying column. Upon start-up the appropriate pressure gauge should register inlet line pressure. When inlet line pressure exceeds the PSD2 internally regulated value of 70 psig this regulated value will be shown on the pressure gauge. The other pressure regulator should register zero. As the changeover point is reached, the second gauge will rise to the regulated inlet line pressure. Approximately 10 seconds later the first gauge will show a rapid de-pressurization which will be accompanied simultaneously by a venting of gas from the rear panel mounted purge exhaust port. After a further 50 seconds the next changeover will occur and the reverse process can be observed.

Upon initial start-up the two desiccant columns will be at equilibrium with ambient air and therefore drying efficiency will be quite low. Initially, it is likely that the outlet dew point will be as high as  $-20^{\circ}\text{C}$  ( $-4^{\circ}\text{F}$ ) or  $-30^{\circ}\text{C}$  ( $-22^{\circ}\text{F}$ ) dew point although the exact level depends on the time since its previous use as well as local ambient conditions. The generator should be operated for a minimum of 24 hours with no flow of air being drawn from the outlet, to allow correct regeneration of the desiccant columns. If the humidity level fails to reduce below 2 parts per million ( $-72^{\circ}\text{C}$  ( $-97^{\circ}\text{F}$ ) dew point) after 12 hours of no-load operation the desiccant may have been damaged by oil or other contamination and it may need to be replaced. If this is the case, please consult Michell Instruments' Customer Service Department (see [www.michell.com](http://www.michell.com) for contact information) for further advice.

**NOTE: For optimum performance it is advisable to operate the PSD2 continuously. It is recommended that, when not in use, the dryer is kept in stand-by condition by operating at a reduced outlet flow rate of 1 l/min (2.1 scfh).**

## 4 MAINTENANCE

### 4.1 Maintaining the Dryer

Other than replacement of the desiccant no other general maintenance is required.

The period between replacement of the desiccant will be determined by the period of operation and quality of the supply gas.

#### 4.1.1 Desiccant Change

##### Desiccant Disposal Guidelines

Molecular sieve type 4 Å, 4 - 8 mesh hygroscopic used in this product must be disposed of in accordance with local regulations.

Handling must be carried out by technically qualified persons familiar with potential chemical hazards. Personal protective equipment including safety goggles, respirator, gloves, face shield and/or safety shield must be used while handling molecular sieve.



**After any change of desiccant the purge flow should always be checked.**

Proceed as follows:

**NOTE: Both cylinders should be renewed with desiccant at the same time.**

1. Disconnect power supply, gas inlet and gas outlet tube.
2. Remove the complete dryer from rack unit and place it on a clear work surface.
3. Remove the top panel.
4. Isolate the 2 long cylinders from the 4 interconnecting pipes (cylinder dimensions approximately  $\varnothing$  60mm x 400mm length ( $\varnothing$  2.4" x 15.7")) and lay horizontally across the upper portion of the unit.
5. Remove 4 retaining screws and withdraw the 2 cylinders from the unit.
6. On the end of the cylinders there is a blanking plug which can be removed in order to empty out the old desiccant.

Some of the older units may not have these blanking plugs, in which case follow the instructions below:

**Note: Each cylinder is joined to the other by two angle brackets - these brackets should be withdrawn with the cylinders still connected.**

Place the cylinders, with angle brackets VERTICALLY on the work surface.

Remove the angle bracket from one end only.

Remove the 8 nuts (4 per cylinder) exposed by the removal of the angle bracket.

With the cylinders still in the vertical position carefully remove the upper end caps by firmly holding the cylinder tube section and pulling the end caps away.

**Note: Do not pull from the lower end cap and angle bracket section.**

7. The desiccant should be carefully poured out and disposed of.
8. Fill each cylinder with new desiccant.
9. **Each cylinder should be filled so that when the end caps are replaced there is no air gap between the desiccant and the end cap.** Banging the cylinder firmly on the side will help to distribute the desiccant evenly and allow for more to be squeezed in. It is recommended to initially over fill the cylinders so that the end caps will not push fully onto the tubes. Remove a small amount of desiccant until the caps fit in fully.
10. Re-assemble the PSD2.
11. Reconnect the air supply
12. Check and if required adjust the purge flow.

### 4.1.2 Adjusting the Purge Flow

For correct operation of the PSD2, the purge flow needs to be checked annually and after a desiccant change. In order to do this, please follow the steps below:

1. The filters on the purge outlets will need to be removed (wear safety glasses).



2. Connect sample tubing for attaching a flowmeter (scaled 0-10 NL/min).



3. When the PSD-2 switches from one desiccant cylinder to the other then is a sudden depressurisation of one cylinder (do not connect the flow meter yet) as this produces a high flow at the exhaust. Note the connection thread is M5.
4. About 10 seconds later the flow should have dropped to a measurable value of about 5-6 l/m, connect the flow meter now.
5. This flow will continue to drop slightly during the next 40 seconds, until it suddenly stops when the unit changes cylinders again. At the point just before the flow stops, the flow must be between 4-5 l/m.
6. Both exhausts must be checked, so repeat the procedure with the other vent.
7. There should not be a flow difference of greater than 0.5 l/m. If there is the non-return valves need to be checked and replace if necessary.
8. If the value is less than 4l/min then the flow should be adjusted.

9. Removing the lower front panel of the PSD 2.
10. Loosen the lock nut off first (and then tighten up afterwards).



11. Increase or decrease the flow via the adjuster knob.



12. Replace front cover and gold filters on outlets.

## 4.2 Fault Diagnosis

The PSD2 is a factory set unit which should not need any further adjustment.

If a fault occurs, other than a blown fuse, it is recommended that the unit be returned to Michell Instruments (see [www.michell.com](http://www.michell.com) for contact details) or to your local Michell agent for repair or desiccant column refilling.

The table below details some likely faults and recommended actions.

SYMPTOM	POSSIBLE CAUSE	ACTION
Power neon will not illuminate	Fuse blown	Replace fuse 5A in IEC connector
	Mains power fault	Check at source
Neon lights but no column changeover	Cam timer fault	Replace cam timer
	Solenoid valve failure	Replace solenoid valve
Dryer will not produce 1ppm <sub>v</sub> or less	Incorrect purge flow	Check purge flow setting
	Desiccant saturated	Reduce flow to 1 l/min (2.1 scfh) and purge for 24 hours
	Desiccant contaminated	If low flow purge not successful, replace desiccant
	Low inlet pressure	Increase pressure
	Excess load	Reduce outlet flow

If any internal components (pressure regulators, flow valves etc.) are replaced then the following calibration procedure should be followed:

### 4.2.2 Flow, Pressure and Timing Calibration



**WHILE UNDERTAKING THIS WORK TAKE EXTREME CARE TO AVOID CONTACT WITH COMPONENTS AND CABLES WHICH ARE CARRYING HIGH VOLTAGE (MAINS POWER).**

Calibrated test equipment required:

- a. Pressure gauge, 0 to 1 barg (0 to 15 psig)
  - b. Flow meter, 0.4 to 6 l/min
  - c. Flow control valve
  - d. On/off control valve
1. Remove the lower front 3U panel to gain access to internal components.
  2. Connect a 6.9 barg (100 psig) airline to the **GAS IN** port on the rear panel (right hand side viewed from the rear). Connect an on/off valve to the **GAS OUT** port (rear panel) and close the valve. Turn the air line on.
  3. Connect the PSD2 to the appropriate power supply and switch it on. Adjust the inlet pressure regulator to give 4.8 barg (70 psig) on either of

the two front panel pressure gauges. While under pressure, check all pipe joints for leaks using a soap/water solution.

4. Check that the timer cam is rotating and the micro switches operating. By adjusting the position of the cams, set the overlap period to between 8 and 12 seconds (the time during which both front panel pressure gauges indicate pressure together) as follows:
  - a. Column 1 pressurized, column 2 rising, adjust cam 1 relative to cam 2, T = 8 to 12 seconds.
  - b. Column 2 pressurized, column 1 rising, adjust cam 2 relative to cam 1, T = 8 to 12 seconds.

**NOTE: It is vital that both overlap times are the same.**

4. Connect the 0 to 1 barg (0 to 15 psig) pressure gauge to the **GAS OUT** on/off valve and open the valve.
5. By adjustment of the output pressure regulator set the output pressure to between 0.7 and 0.8 barg (10 and 12 psig). Lock the regulator shaft by tightening the lock nuts.
6. Replace the 0 to 1 barg (0 to 15 psig) pressure gauge by the flow control valve and connect the flow meter on the outlet of the flow control valve. Set the output flow rate to about 6 l/min as indicated on the flow meter.
7. Check that the internal non-return valves are not rattling i.e. that the operation is quiet. Allow the dryer to cycle during this test. After this test shut the on/off valve on the **GAS OUT** port.
8. Remove both sintered guard filters from the back-flow outlets on the PSD2 rear panel.
9. Connect the flow meter to one outlet using a suitable adapter. Wait until the air flow is constant then adjust the small valve (located at the 'cross roads' of the non-return valves) to give a back flow-rate of 4 l/min. Repeat this operation on the other outlet.
10. Repeat until both 4 l/min readings are within 0.2 l/min at the lowest flow level i.e. just before switch-over. Remove the flow meter from the back-flow outlet and replace both of the sintered filters.
11. Connect the flow meter to the flow control valve (already connected to the **GAS OUT** port of the PSD2).
12. Connect a Michell Instruments' hygrometer (calibrated down to -75°C (-103°F) dew point) to the outlet of the flow meter. By adjustment of the flow control valve set the PSD2 gas flow rate to 2 l/min. Leave the system operating until a hygrometer reading of -70°C (-94°F) dew point or drier is achieved (-70°C (-94°F) dew point should be achieved within 24 hours).
13. Fit the lower front 3U panel back in position.

The PSD2 is now ready for use.

# Appendix A

## Technical Specifications



## Appendix A Technical Specifications

General	
Type	Twin column desiccant, pressure swing
Desiccant	4 Ångström molecular sieve bead (approx. 2 kg required)
Timer	Motorized cam
Gauges	Bourdon type
Gas Ports	6mm compression fittings
Exhausts	Sintered bronze silencers
Gas Inlet	10 l/min (21 scfh) @ 5 to 7 barg (70 to 100 psig) (Oil and liquid water free)
Gas Outlet	7 l/min (14.8 scfh) max. at stp less than 1 ppm <sub>v</sub> (= less than -75°C dew point) Outlet pressure 0.7 barg (10 psig)
Power	100/120 or 220/240 V AC, 50/60Hz
Operating Temperature	+5 to +35°C (+41 to +95°F)
Storage Temperature	-40 to +50°C (-40 to +122°F)
Construction	Aluminum case, 19" sub-rack 6U x 350mm (13.7") deep
Weight	12.5kg (27.5lb) approximately

# Appendix B

## System Drawings

Appendix B System Drawings

B.1 System Layout Drawing

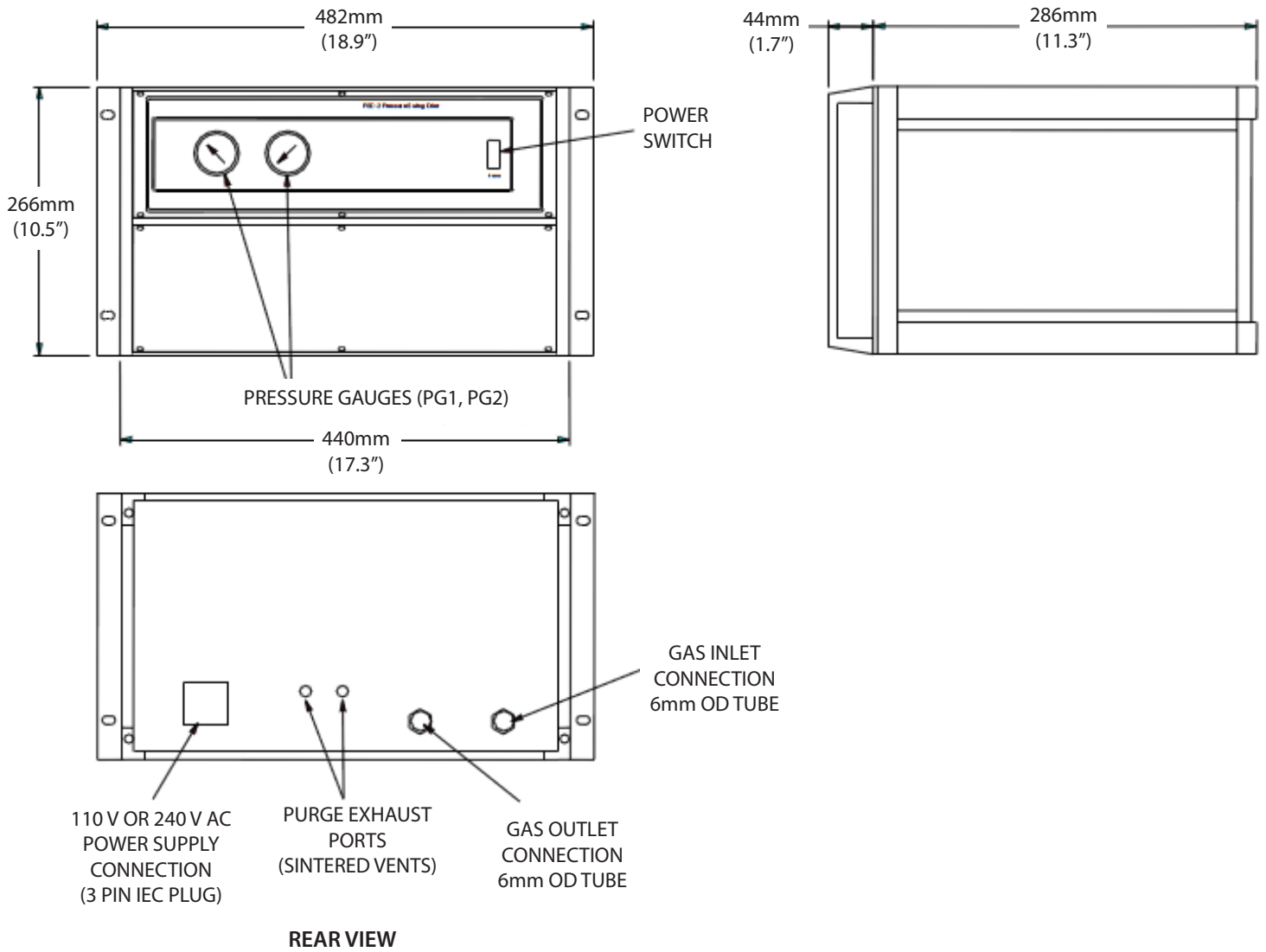


Figure 1 System Layout Drawing

B.2 Schematic Flow Drawing

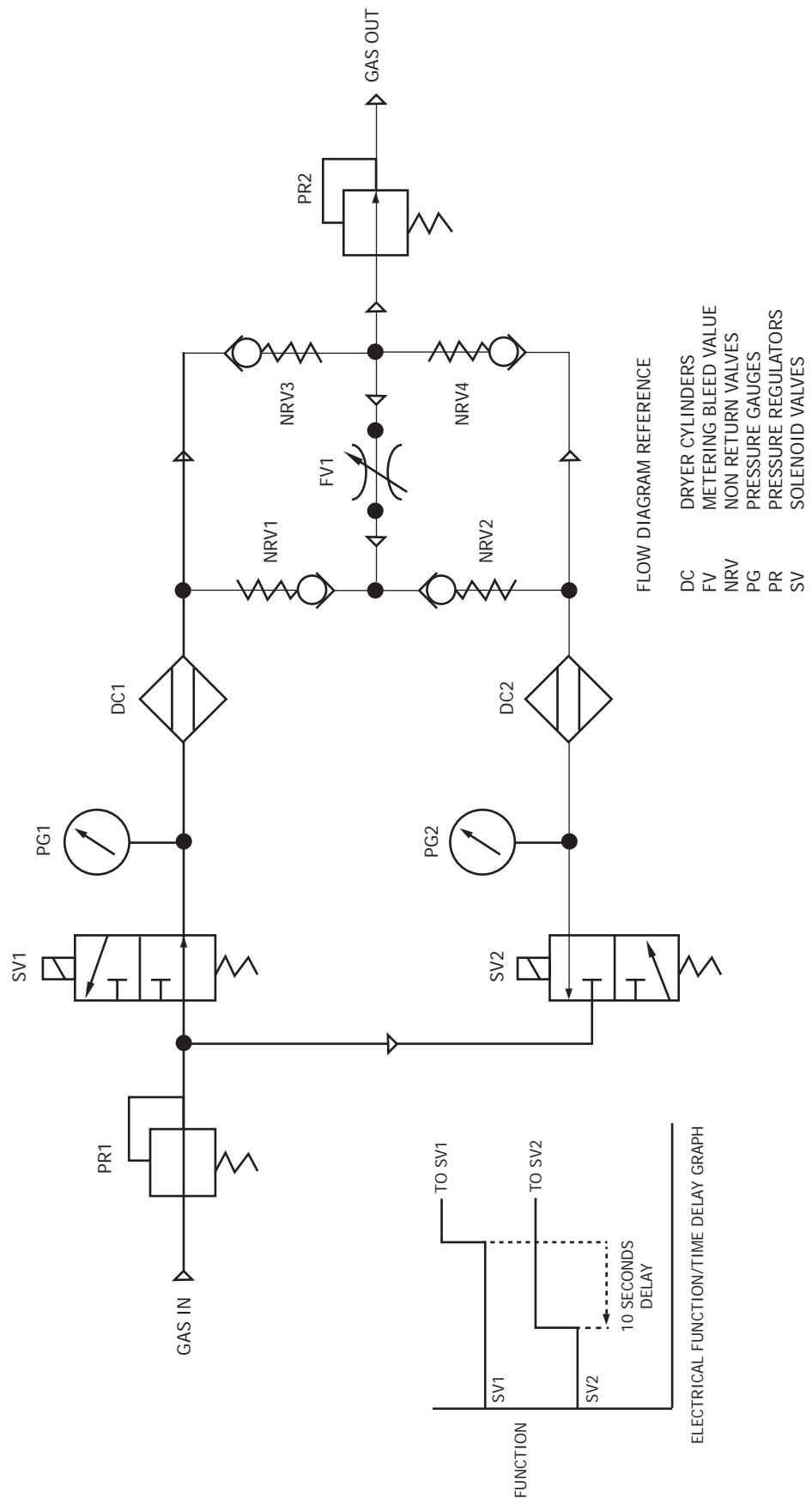


Figure 2 Schematic Flow Drawing

# Appendix C

## Quality, Recycling & Warranty Information

**Appendix C      Quality, Recycling, Compliance & Warranty Information**

Michell Instruments is dedicated to complying to all relevant legislation and directives. Full information can be found on our website at:

**[www.michell.com/uk/aboutus/compliance](http://www.michell.com/uk/aboutus/compliance)**

This page contains information on the following directives:

- ATEX Directive
- Calibration Facilities
- Conflict Minerals
- FCC Statement
- Manufacturing Quality
- Modern Slavery Statement
- Pressure Equipment Directive
- REACH
- RoHS2
- WEEE2
- Recycling Policy
- Warranty and Returns

This information is also available in pdf format.

# Appendix D

## Return Document & Decontamination Declaration

## Appendix D Return Document &amp; Decontamination Declaration

## Decontamination Certificate

**IMPORTANT NOTE:** Please complete this form prior to this instrument, or any components, leaving your site and being returned to us, or, where applicable, prior to any work being carried out by a Michell engineer at your site.

Instrument			Serial Number	
Warranty Repair?	YES	NO	Original PO #	
Company Name			Contact Name	
Address				
Telephone #		E-mail address		
Reason for Return /Description of Fault:				
Has this equipment been exposed (internally or externally) to any of the following? Please circle (YES/NO) as applicable and provide details below				
Biohazards	YES		NO	
Biological agents	YES		NO	
Hazardous chemicals	YES		NO	
Radioactive substances	YES		NO	
Other hazards	YES		NO	
Please provide details of any hazardous materials used with this equipment as indicated above (use continuation sheet if necessary)				
Your method of cleaning/decontamination				
Has the equipment been cleaned and decontaminated?	YES		NOT NECESSARY	
Michell Instruments will not accept instruments that have been exposed to toxins, radio-activity or bio-hazardous materials. For most applications involving solvents, acidic, basic, flammable or toxic gases a simple purge with dry gas (dew point <-30°C) over 24 hours should be sufficient to decontaminate the unit prior to return. <b>Work will not be carried out on any unit that does not have a completed decontamination declaration.</b>				
<b>Decontamination Declaration</b>				
I declare that the information above is true and complete to the best of my knowledge, and it is safe for Michell personnel to service or repair the returned instrument.				
Name (Print)			Position	
Signature			Date	



F0121, Issue 2, December 2011



# EU Declaration of Conformity



Manufacturer: **Michell Instruments Limited**  
**48 Lancaster Way Business Park**  
**Ely, Cambridgeshire**  
**CB6 3NW. UK.**



On behalf of the above named company, I declare that, on the date that the equipment accompanied by this declaration is placed on the market, the equipment conforms with all technical and regulatory requirements of the directives. The product:

## PSD2 & 4 Pressure Swing Dryer

complies with all the essential requirements of the EU directives listed below.

**2014/30/EU EMC Directive**  
**2014/35/EU Low Voltage Directive (LVD)**  
**2011/65/EU Restriction of Hazardous Substances Directive (RoHS2)**

and has been designed to be in conformance with the relevant sections of the following standards or other normative documents.

EN61326-1:2013 Electrical equipment for measurement, control and laboratory use – EMC requirements –Class A (emissions) and Industrial Locations (immunity).

EN61010-1:2010 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements

### **2014/68/EU PE Directive**

This product and sample systems & accessories that may be supplied with it do not bear CE marking for the Pressure Equipment Directive, and are supplied in accordance with Article 4, paragraph 3 of 2014/68/EU by using SEP (sound engineering practice) in the design and manufacturer and are provided with adequate instructions for use.

Mr. Andrew Stokes, Technical Director  
Ely UK

August 2018



<http://www.michell.com>