HPLC DEGASSING

SYSTEC INC. USA IN PARTNERSHIP WITH BIOTECH, SWEDEN

THE COMPLETE SOLUTION FOR OEM HPLC DEGASSING
FROM IDEA TO FINISHED PRODUCT

BIOTECH.
INNOVATIVE LABORATORY PRODUCTS

THE COMPANY

Biotech is involved in a variety of research projects with renowned European and US companies and institutes and is an innovative biotechnology company, benefitting from the synergi of scientific research and applied technology. A close liason and ownership with network partners has resulted in future opportunities for new products in biotechnology.

We are very proud of the products and services we provide and you have a standing invitation to visit our facilities here at Onsala. We are located on the Swedish Westcoast - south of Gothenburg – at the beautiful Onsala peninsula in close proximity to Gothenburg and the Landvetter International airport.

Biotech's primary business is in the areas of R & D and products for e.g.

HPLC Degassing
Detectors/sensors for fluorescence
Luminiscence incl. Bioluminiscence
Miniaturisation in Spectroscopy/Chromatography
Flow Cells based on Liquid Core Waveguide Technology
Software for Spectroscopy/Chromatography
Preparative Chromatography – Drug Candidates
Flow Analysis/FIA and SIA

THE NEW TECHNOLOGY IN DEGASSING IS HERE...

- HIGHEST EFFICIENCY DEGASSING SYSTEM AVAILABLE
- FASTEST EQUILIBRATION TIMES
- ZERO BASELINE FLUCTUATION
- ERROR AND LEAK CHECKING FUNCTIONS
- LOW OPERATING NOISE

The Vacuum Degasser is a high-efficiency, in-line module that removes dissolved gasses from HPLC solvents. Its unique design assures reliable continuous operation and the highest level of continuous performance available without the need for helium degassing. Up to five solvent lines may be degassed simultaneously by one unit. The extremely low internal volume of each Teflon AF® channel offers very quick equilibration and very short startup times compared with PTFE degassing channels which have the same degassing efficiency.

Inside the unit, the solvent flows through a short length of Teflon AF® tubing which is located in a vacuum chamber. Within this chamber a partial vacuum is maintained by a constantly running, low RPM vacuum pump. Dissolved gasses are pulled through the tubing wall by the vacuum as the solvent flows within the coil, in accordance with Henry's Law. Gasses removed are expelled, and the chamber is maintained at a constant, preset vacuum level by varying the vacuum pump speed as needed.

A special port in the vacuum pump continually flushes the pump head with a small "bleed" of air to remove any solvent vapors which may enter the pump from the vacuum chamber. This air bleed eliminates the need for any solenoid valves within the system. This patented design results in zero vacuum "hysteresis". Previous designs allowed the vacuum chamber pressure to fluctuate, with the pump cycling on and then off in response to the vacuum level.

LED DISPLAYS

Three LEDs are located on the front of the instrument above the solvent inlets and outlets. These three LEDs are used by the microprocessor to indicate the system status, including whether power is applied, whether vacuum level is within the normal operating range (described in the next paragraph), and if system error conditions occur.

START UP TEST AND PUMP OPERATION

Immediately upon turning on the instrument, the microprocessor examines the vacuum sensor signal to confirm that it is within an expected range. Following the startup test, the microprocessor ramps the vacuum pump to high RPM, to quickly exhaust atmosphere from the vacuum chamber. As the vacuum level approaches the preset control value, the pump RPM will slowly ramp down to a low speed (typically 30 to 40 RPM) and will vary slightly as needed under the changing degassing load to maintain a virtually constant vacuum level which exhibits a fluctuation of less than ± 0.5 mm Hg. This "zero hysteresis, constant run" (ZHCR®) mode is necessary, due to the extremely low mass, high response, Teflon AF® degassing tubing. The effect of vacuum changes within the vacuum chamber can easily be seen in the UV absorbance of methanol (for example) at 215 nm. Only a ZHCR® design ensures a baseline which is unaffected by the degasser.

SMART LEAK DETECTION

An additional benefit of maintaining a constant vacuum level is that a potential leak in the vacuum degassing system can be observed by monitoring the RPM of the pump. This "smart leak detection" is a benefit of the patented design of the degasser. If a leak occurs within the chamber, the microprocessor will increase the pump RPM in an attempt to maintain the vacuum level. If the pump cannot maintain the vacuum level (if it runs at an elevated RPM for more than 30 minutes), an LED will illuminate indicating a possible leak condition, and the system will shut down and go into a "safe" mode.

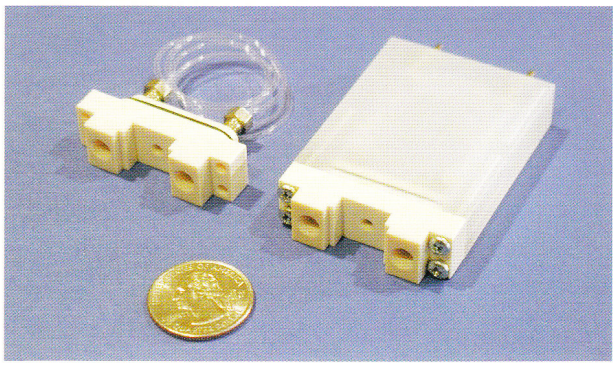
VALIDATION

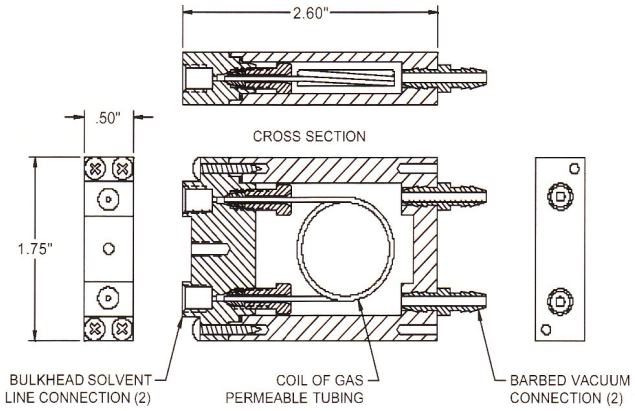
A recent requirement for validation accessory has been requested. All degassers can today have this accessory.

OEM MINI HPLC VACUUM DEGASSING CHAMBER

Systec, the leading U.S. manufacturer of analytical chemistry degassing components, is pleased to introduce a new miniaturized HPLC mobile phase degassing chamber designed for the rigors of modern analytical scale HPLC. The "MINI" degassing chamber was designed to be easy to prime, and is configured with a Teflon® AF degassing membrane (tubing) to provide maximum degassing capacity with the absolute minimum internal volume (<3% of PTFE designs with comparable degassing capacity) and a chemically inert, metal free flow path. Degassed mobile phase is available in three minutes or less!

Systec is licensed by Dupont to use Teflon® AF for degassing under U.S. Patent 5,006,382.





GENERAL SPECIFICATIONS

Degassing Channel Tubing:	Teflon® AF
Degassing Channel Pressure Rating:	70 PSIG (priming pressure)
Wetted Materials:	Teflon® AF, PEEK and Tefzel
Vacuum Housing Materials:	Polypropylene and Stainless Steel

U.S. Patents 5,340,384; 6,248,157 and 6,309,444.

SPECIFICATIONS FOR AVAILABLE CONFIGURATIONS

Part Number	Scale	Max. Flow per Channel (mL/min.)	Channel Volume (µL)	Optimized* Flow Range (mL/min.)	Pressure Drop (mm Hg/mL/min.)	Degassing Flow Path I.D. (inches)
9000-1000	Capillary	2	100	0.6	1.8	0.045
9000-1001	Capillary	4	195	1.2	2.3	0.045
9000-1002	Capillary	6	290	1.8	2.9	0.045
9000-1003	Analytical	8	385	2.4	3.4	0.045
9000-1004	Analytical	10	480	3.0	3.9	0.045
9000-1005	Analytical	12	575	3.6	4.5	0.045
9000-1006	Analytical	14	670	4.2	5.0	0.045

*Optimized Flow Range for isocratic or gradient formed 50:50 methanol/water blends.
Consult factory for mechanical and chromatographic performance data on various HPLC pumping systems.

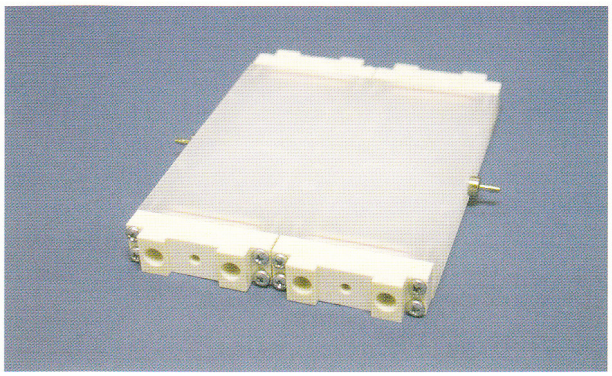
FLAT PACK MINI HPLC VACUUM DEGASSING CHAMBER

Systec, the leading U.S. manufacturer of analytical chemistry degassing components, is pleased to introduce a new miniaturized HPLC mobile phase degassing chamber designed for the rigors of modern analytical scale HPLC. Flat pack degassing chambers are available in 3, 4 or 5 channel models. The "flat pack MINI" degassing chamber was designed to be easy to prime, and is configured with a Teflon® AF degassing membrane (tubing) to provide maximum degassing capacity with the absolute minimum internal volume (<3% of PTFE designs with comparable degassing capacity) and a chemically inert, metal free flow path. Degassed mobile phase is available in three minutes or less!

We extrude Teflon® AF in-house with a state-of-the-art extrusion line, custom designed for and dedicated to degassing applications. Custom degassing capacity (degassing channel geometries) available upon request.

Please refer to the OEM Degassing Module data sheet for details on the speed, reliability, flexibility and the clean detector baselines of Systec's Teflon® AF / ZHCR® Degassing Technology.

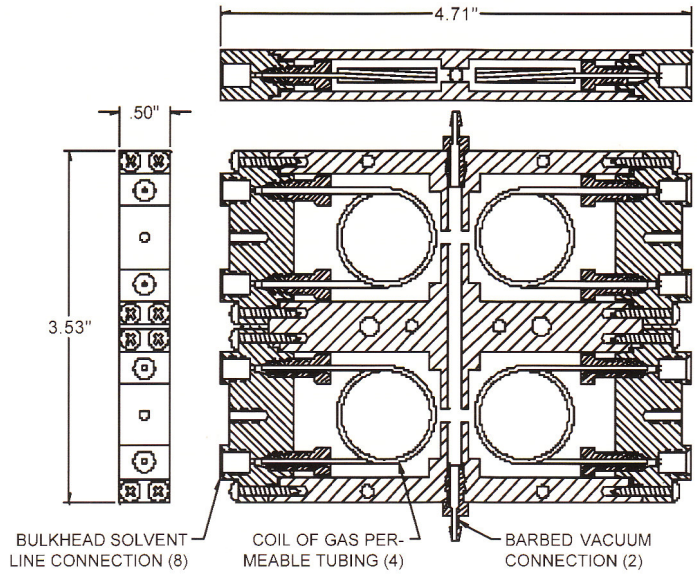
Teflon® and Tefzel are registered trademarks of E.I. duPont de Nemours. Systec is licensed by Dupont to use Teflon® AF for degassing under U.S. Patent 5,006,382.



GENERAL SPECIFICATIONS

Degassing Channel Tubing:	Teflon® AF
Degassing Channel Pressure Rating:	70 PSIG (priming pressure)
Wetted Materials:	Teflon® AF, PEEK and Tefzel
Vacuum Housing Materials:	Polypropylene and Stainless Steel

U.S. Patents 5,340,384; 6,248,157 and 6,309,444.



STANDARD SEMI-PREP. HPLC VACUUM DEGASSING CHAMBER

Systec is pleased to introduce a new HPLC mobile phase degassing chamber designed for the rigors of modern semi-preparative scale HPLC. The standard semi-prep. degassing chamber was designed to be easy to prime, and is configured with a Teflon® AF degassing membrane (tubing) to provide maximum degassing capacity with the absolute minimum internal volume (<3% of PTFE designs with comparable degassing capacity) and a chemically inert, metal free flow path. Degassed mobile phase is available in three minutes or less!

We extrude Teflon® AF in-house with a state-of-the-art extrusion line, custom designed for and dedicated to degassing applications.

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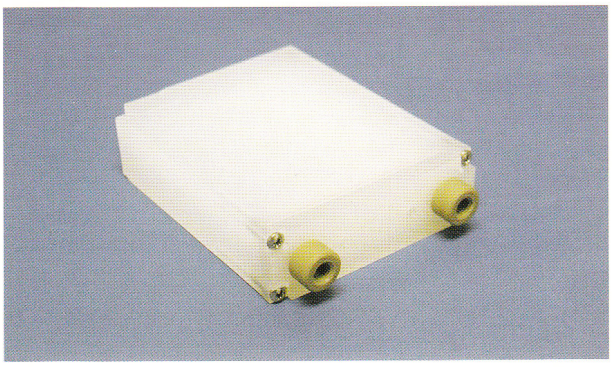
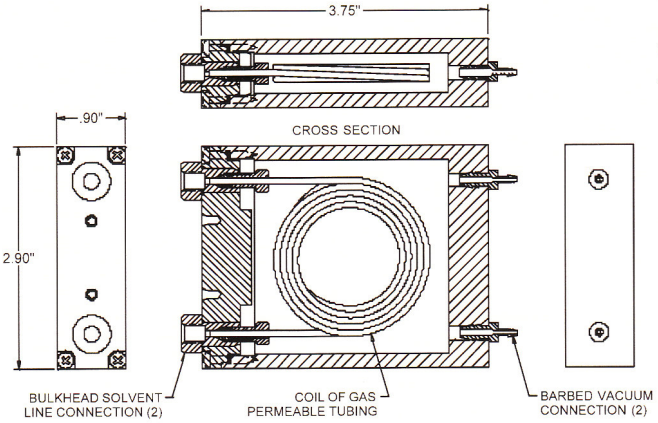


GENERAL SPECIFICATIONS

Degassing Channel Tubing:	Teflon® AF
Degassing Channel Pressure Rating:	70 PSIG (priming pressure)
Wetted Materials:	Teflon® AF, PEEK and Tefzel
Vacuum Housing Materials:	Polypropylene and Stainless Steel

U.S. Patents 5,340,384; 6,248,157 and 6,309,444.



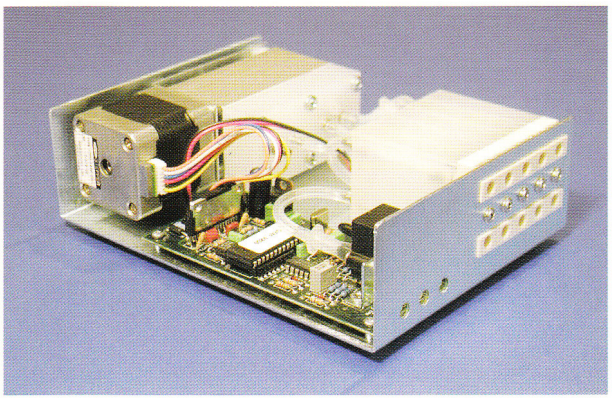
SPECIFICATIONS FOR AVAILABLE CONFIGURATIONS

Systec Part Number	Scale	Max. Flow per Channel (mL/min.)	Channel Volume (µL)	Optimized* Flow Range (mL/min.)	Pressure Drop (mm Hg/mL/min.)	Degassing Flow Path I.D. (inches)
9000-1010	Semi-Prep.	30	2.8	10.0	2.3	0.070
9000-1011	Semi-Prep.	40	4.0	15.0	2.8	0.070
9000-1012	Semi-Prep.	50	5.2	20.0	3.3	0.070
9000-1013	Semi-Prep.	50	6.5	25.0	3.8	0.070
9000-1014	Semi-Prep.	50	7.7	30.0	4.3	0.070

*Optimized Flow Range for isocratic or gradient formed 50:50 methanol/water blends.
Consult factory for mechanical and chromatographic performance data on various HPLC pumping systems.

OEM MINI HPLC DEGASSING MODULE

The OEM MINI HPLC degassing module is a state-of-the-art design that is compact and ready for integration into virtually any existing LC pump, degassing tray or stand-alone degassing application equipped with a 15-24 V DC (1 Amp) power source. This module is also available with a CE-approved wall transformer with adapters for international power.

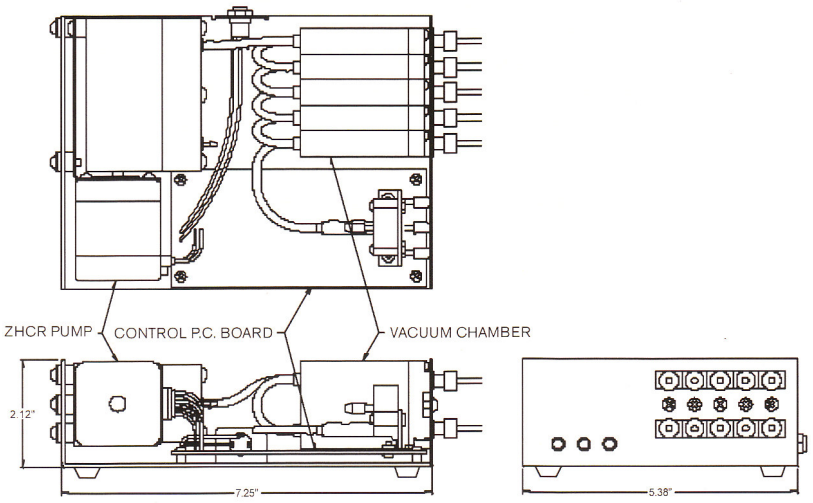


The standard OEM module may be configured with:

- Up to five of Systec's new MINI Degassing Chamber design (see Product Bulletin for details)
- ZHCR® Control P.C. Board
- ZHCR® Vacuum Pump

Teflon® AF / ZHCR® Systec Degassing Technology features:

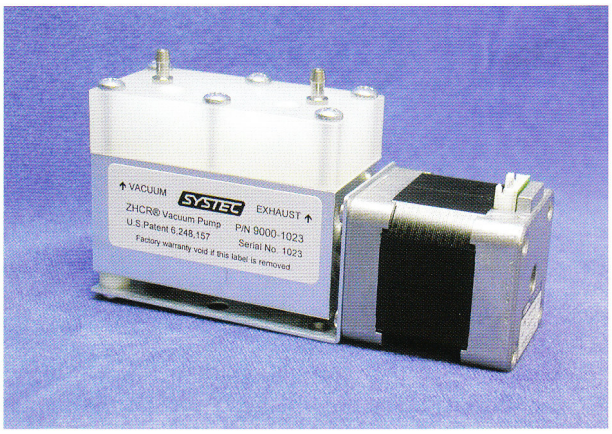
- Flow-through vacuum degassing chamber with a single amorphous perfluorinated copolymer (Teflon® AF) degassing membrane
- Continuously vented vacuum system
- ZHCR® vacuum pump, a two-stage, series, stepper motor driven, vacuum pump with a unitary PTFE diaphragm (designed specifically for the rigors of HPLC degassing)
- "System condition responsive" ZHCR® electronic control which continuously monitors the system for faults, and operates the vacuum pump in two modes: high RPM to evacuate the vacuum chamber(s), and low RPM to sustain a constant vacuum level.
- Fifty (50) times the degassing efficiency over PTFE designs, reducing internal volumes and overall package dimensions proportionately
- Very clean detector baselines due to absolutely zero vacuum hysteresis of the ZHCR® technology – the vacuum pump runs virtually silently and continuously at low RPM
- Easy to prime (low flow resistance), ultra-low internal volume, zero dead volume, metal-free degassing membrane
- "Ready to run" degassing system equilibration times of three minutes or less
- ZHCR® vacuum pump life expectancies > 220 million cycles (typically 5 years)
- ZHCR® control with built-in test diagnostics, including:
  - Microcontroller self-test vacuum sensor validation on power-up
  - Continuous vacuum system monitoring to ensure optimum operational conditions are maintained
  - Vacuum system fault detection and shutdown function indicators

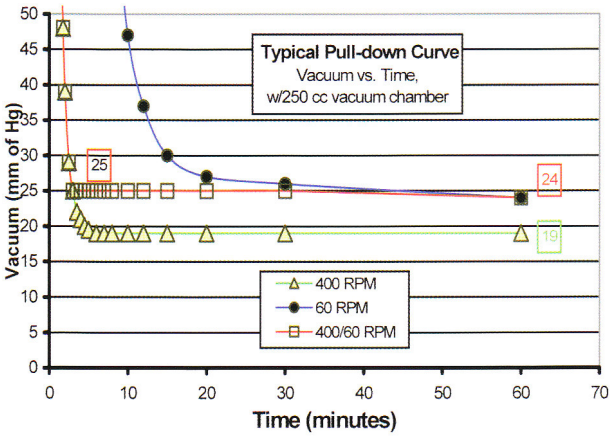


ZHCR® (ZERO HYSTERSIS/CONSTANT RUN) VACUUM PUMP FOR HPLC DEGASSING

FEATURES

- INERT FLOW PATH
- HIGH VACUUM LEVEL
- QUIET STEPPER MOTOR/BALL BEARING DRIVE
- COOL RUNNING DC MOTOR
- LONG LIFE EXPECTANCY AT LOW RPM
- CONTINUOUSLY PURGED TWO-STAGE TEFLON DIAPHRAGM HEAD
- BUILT-IN ANTI-BACKFLOW CHECK VALVES
- COMPACT IN SIZE





We introduce the ZHCR® Zero Hysteresis / Constant Run stepper motor driven vacuum pump, specifically designed and developed for membrane degassing of HPLC mobile phase. Employing a micro-stepping RPM control strategy permits the pump to run continuously, cycling between low and high speeds. The high speed provides quick pull-down, while the low speed sustains a consistent vacuum level. Fluctuations in baseline due to vacuum hysteresis are eliminated by not having to repeatedly stop and start a single-speed pump. This also greatly reduces wear and noise.

The low wattage DC stepper motor runs quietly and coolly, and is very adaptable in its power supply requirements. The brushless motor is especially appropriate for an environment where solvent vapors may be present.

Flowpath materials were chosen for their ruggedness and compatibility with exposure to organic mobile phase vapors. The need for a vent valve has been eliminated by the continuously purged head design and built-in anti-backflow duckbill check valves. The pump will start into a full vacuum, and vacuum will not be released in the event of a power loss. The entire pump assembly is compact in design.

VACUUM PUMP TECHNICAL DATA

Air Flow (no vacuum):	130 SCCM @ 400 RPM; 45 SCCM @ 60 RPM
Vacuum Level:	<30 mm Hg @ 60 RPM (1 SCCM air flow)
Pump-down Time:	3 minutes @ 400 RPM; 15 minutes @ 60 RPM (both with 4 channel degasser, 250cc internal chamber volume)
Pump Head Continuous Purge Air Flow Rate:	1 SCCM
Wetted Materials:	316 Stainless Steel, Polypropylene, Teflon ®, EPDM Rubber
Noise:	<52 dB (@ 50 dB ambient)
Expected Lifetime:	>5 years (continuous run @ 60 RPM)

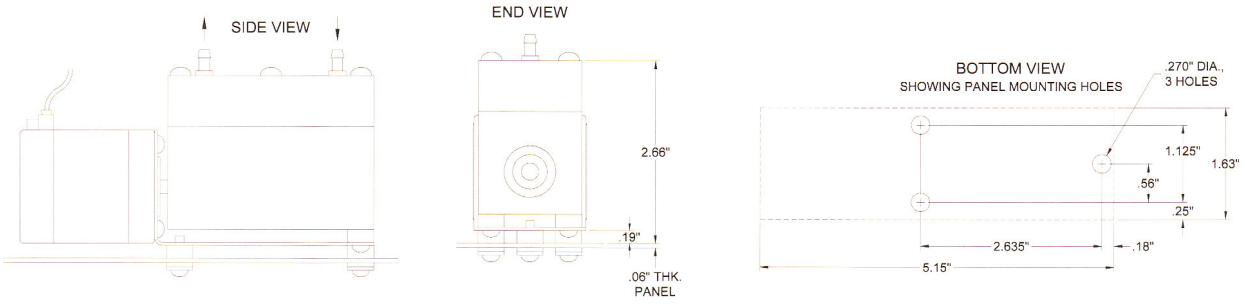
ELECTRICAL SPECIFICATIONS

STEPPER MOTOR

Type:	Uni-Polar, 1 Amp @ 4.6 VDC/phase; 200 steps/rev.
Drive:	Micro-stepped, PWM chopped current control; control current set to 600 mA/phase
Chop Freq.:	Approximately 25 kHz
Speed:	Variable. "Fast" = 400 RPM @ 800 micro-steps/rev. from atmospheric to 47 mm Hg absolute. "Slow" = 60 RPM @ 3200 micro-steps/rev. below 47 mm Hg absolute.

POWER REQUIREMENTS

Option A:	85-264 VAC; 47-63 Hz; approx. 15 W
Option B:	15-28 VDC; <1 Amp average DC current; 1.5 Amp peak current



PUMP CONTROL SPECIFICATIONS

MOTOR CONTROL

Basic Pump Drive: Motor speed controlled by external logic level(0-5 VDC) signals. Fast, Slow, Off. User senses vacuum level.

Basic Pump Drive with Vacuum Level Feedback: Motor speed controlled by external logic level (0-5 VDC) signals. Fast, Slow, Off. Vacuum sensor on board transmits PWM signal to user.

Stand-alone Controller: Motor speed controlled by vacuum level using on-board vacuum sensor.

ERROR CHECKING

Vacuum Level Reasonableness Test: On power-up, the vacuum level should be 0-810 mm Hg absolute. If not, stop operation.

Vacuum Pull-down Time Test: On power-up, if vacuum level does not reach 47 mm Hg abs. in 10 minutes, stop operation. If vacuum drifts above 80mm Hg, stop operation.

VACUUM LEVEL PWM OUTPUT

(on models so equipped)
Varying frequency from approx. 50 to 250 Hz;
10.0% duty cycle @ 0 mm Hg abs.,
91.0% duty cycle @ 810 mm Hg abs.,
Accuracy 2% of reading ±2 mm Hg

SYSTEM CONFIGURATIONS

BASIC PUMP DRIVE WITH VACUUM LEVEL FEEDBACK

Power In:	15 to 28 VDC, <1 ADC avg. current 5 VDC regulated ±3%, ~50 mADC
Logic Signals In:	HCMOS compatible (0 to 5V) 2 non-isolated lines commanding Fast, Slow, Off
Logic Signals Out:	0 to 5V, 2 non-isolated lines, function TBD
Vacuum Level Signal Out:	PWM signal, varying frequency from approx. 50 to 250 Hz; 10% duty cycle @ 0 mm Hg abs., 91.0% duty cycle @ 810 mm Hg abs.

BASIC PUMP DRIVE

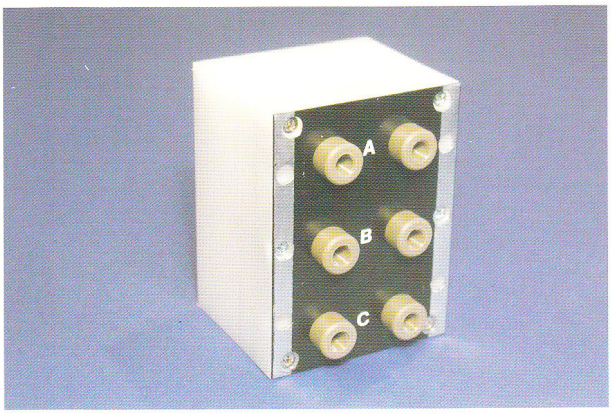
Same as above without sensor & PWM.

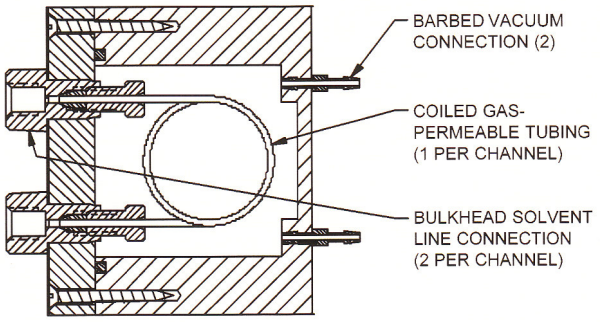
STAND-ALONE CONTROLLER

Power Requirements:	85 to 264 VAC; 47 to 63 Hz; approx. 15 Watts
Internal Power Supply:	Universal input switching supply, 15 VDC @ 1.4 A out
Vacuum Sensing Accuracy:	±2% of value ±2 mm Hg, typical
Operating Mode:	Continuous duty only
Optional Input/Output Lines:	3 user-definable logic level I/O lines, capable of sinking or sourcing 5 mA @ 5 VDC. May be used to drive LED indicators.

INTEGRATED MULTI-CHANNEL OEM HPLC
VACUUM DEGASSING CHAMBER

We are pleased to present the workhorse of our Teflon® AF HPLC mobile phase degassing chamber product line: our Integrated, Multiple-channel OEM Degassing Chamber. Designed for the rigors of modern analytical scale HPLC and configured for use in a host of OEM applications, the Integrated Degassing Chamber is compact and easy to prime. The unit is available with 3, 4 or 5 channels. The chemically inert, metal free flow path is configured with Teflon® AF degassing membrane (tubing) to provide maximum degassing capacity with the absolute minimum internal volume (<3% of PTFE designs with comparable degassing capacity). When used with Systec's patented ZHCR® Degassing Technology (vacuum pump and electronic controls) degassed mobile phase is available in three minutes or less!





CROSS SECTION

GENERAL SPECIFICATIONS

Degassing Channel Tubing:	Teflon® AF
Degassing Channel Pressure Rating:	70 PSIG (priming pressure)
Wetted Materials:	Teflon® AF, PEEK and Tefzel
Vacuum Housing Materials:	Polypropylene, UHMW and Stainless Steel

U.S. Patents 5,340,384; 6,248,157 and 6,309,444.

SPECIFICATIONS FOR AVAILABLE CONFIGURATIONS

Scale	Max. Flow per Channel (mL/min.)	Channel Volume (µL)	Optimized* Flow Range (mL/min.)	Back Pressure (mm Hg/mL/min.)	Degassing Flow Path I.D. (inches)
Capillary	2	100	0.6	1.8	0.045
Capillary	4	195	1.2	2.3	0.045
Capillary	6	290	1.8	2.9	0.045
Analytical	8	385	2.4	3.4	0.045
Analytical	10	480	3.0	3.9	0.045
Analytical	12	575	3.6	4.5	0.045
Analytical	14	670	4.2	5.0	0.045

*Optimized Flow Range for isocratic or gradient formed 50:50 methanol/water blends.
Consult factory for mechanical and chromatographic performance data on various HPLC pumping systems.

NEW BIOTECH ON-LINE DEGASSER

On-Line degassing has been shown to be more effective at removing dissolved gas from mobile phases than sonication or helium-sparging.

Up to five solvent lines can be degassed simultaneously by one unit. The extremely low volume of each Teflon® AF channel (480 microliters) offers very quick equilibration and very short start-up times.

Teflon® AF is 50X more permeable than the Old Teflon® PTFE

The new Teflon® AF membrane outperforms the older Teflon® PTFE membranes used in many other degassing systems today. This translates into the ability to use shorter tubing for removal of dissolved gases.

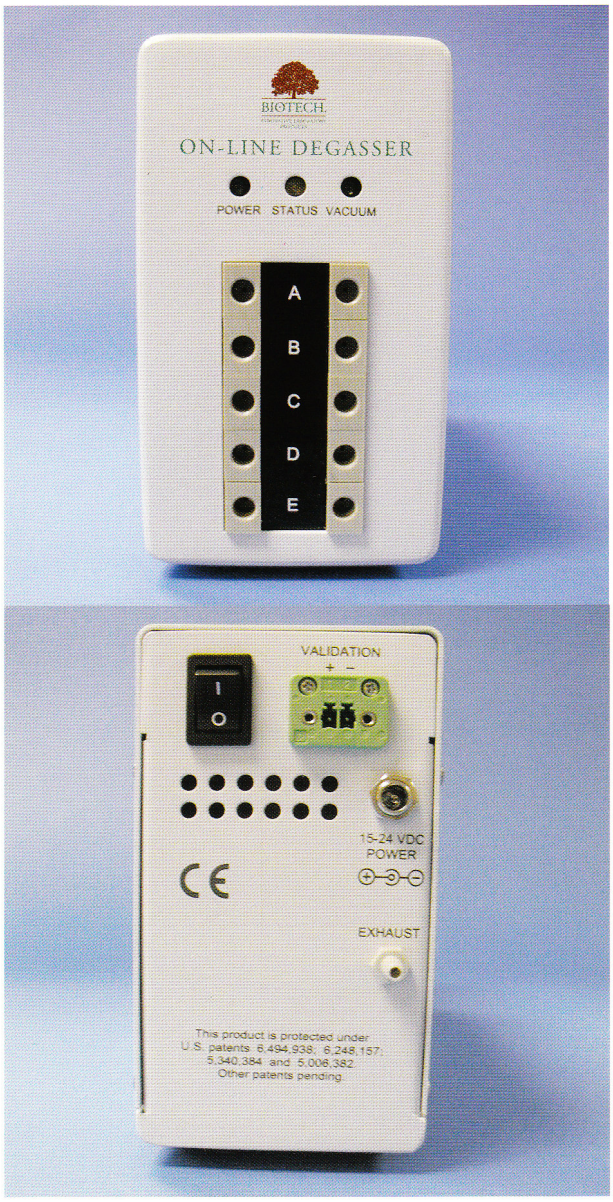
- Considerably shorter equilibration / re- equilibration times
- Very easy to prime.
- Short vacuum pull-down times, typically 3 minutes.
- Teflon AF has the ability to remove pre-pump bubbles formed by cavitation vs bubbles formed by off-the-floor eluent reservoirs are less of a reliability issue.

Vacuum Pump Technology

We introduce the ZHCR® (Zero Hysterisis Constant Run) stepper motor driven vacuum pump, specifically designed and developed for membrane degassing of HPLC mobile phase.

Employing a micro-stepping closed-loop vacuum control strategy permits the pump to maintain a constant vacuum level set-point (50 mmHg) by varying the RPM of the stepper motor. The pump initially runs at a high speed which provides for a quick pull-down and, as it approaches the vacuum control point, the RPM is gradually reduced until the desired vacuum level is reached. This patented control strategy allows the On-Line Degasser to maintain a virtually constant vacuum that is unaffected by varying degassing loads. As a consequence, fluctuations in baseline due to vacuum hysteresis are eliminated by not having the pump repeatedly stop and start as is done in many older and existing systems.

- Extremely quiet operational noise.
- Long life Expectancy - 5 years continous run.
- Pump head purge eliminates need for purge valve.
- Eliminate baseline fluctuations due to the vacuum pump.
- Short vacuum pull-down times, typically 3 minutes.
- Closed loop vacuum control means constant vacuum (variable RPM).
- Advanced error and leak checking functions.



GENERAL SPECIFICATIONS

Number of channels:	4 or 5
Internal Channel Volume:	480 microliter
Wetted Parts:	Peek and Teflon AF
Height:	5.0 in. (127 mm)
Width:	2.87 in. (73 mm)
Depth:	9.81 in. (249 mm)
Power:	15 to 24 VDC @ 0.85 A max. (0.5 A typical)
Weight:	6 lb (2.7 kg)