



MP3DR User's Guide



Televac...The Finest In Vacuum Instrumentation

Document History

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IMPORTANT SAFETY NOTICES

High Voltage Warning!

High voltages capable of causing injury or death are present within the MP3DR. Do not operate the instrument with the sensor or the outer enclosure removed. Avoid touching the sensor socket, any of the sensor pins and internal circuitry. THERE ARE NO USER-SERVICEABLE POINTS WITHIN THE INSTRUMENT. Service work should only be performed by Televac personnel.

Instrument Ground Warning!

Safe operation of the MP3DR requires that the instrument's power supply and the vacuum chamber to which the MP3DR is connected, be properly grounded. Under some operating conditions, LETHAL VOLTAGES could be present if the instrument and its power supply are not properly grounded.

Ion producing equipment such as the MP3DR, may, under some conditions provide sufficient conduction via plasma, to couple a high voltage electrode to a vacuum chamber. If conductive portions of the vacuum chamber are not grounded, they may attain a potential near that of the high voltage electrodes during this coupling. Potentially fatal electrical shock could then occur because of the voltage between these vacuum chamber parts and ground. Grounding, though simple, is imperative. Be certain that your ground circuits are properly utilized on both the MP3DR and your vacuum system.

Explosive Gases & Mixtures Warning!

Do not turn on the MP3DR if there is any danger of explosion from explosive or combustible gases or gas mixtures. The sensor filaments of the MP3DR operate at incandescent temperatures and could become an ignition source.

Product Cautions!

Sustained operation of the MP3DR at pressures higher than 10^{-3} torr is not recommended. Operating filaments at atmospheric pressure can lead to damage to the sensor assembly.

Be certain that the vacuum level is less than 10^{-5} torr before attempting Degas. Operating Degas at higher pressures can damage the sensor assembly.

The MP3DR is a unique and rugged power supply, controller and display device for our miniature Bayard-Alpert vacuum sensor. It is easy to use and will provide you with many years of trouble-free service. This manual is designed to help MP3DR users gain the greatest benefit from the instrument's use. Please review the manual completely before attempting to operate the instrument.

1.0 General Information

1.1 - Product Description & Major Features:

The MP3DR is a miniature Bayard-Alpert high vacuum sensor and integral control electronics in a compact envelope. It is designed to be closely coupled to the user's vacuum system and provide a local pressure indication and/or digital interface to a computer control system. Features include -

- Measurement range from 1×10^{-2} torr to 1×10^{-10} torr
- Dual filaments that are coated and supported for extended lifetime
- UHV compatible sensor design, when equipped with a CF type flange
- Leak rate of 10^{-11} std. cc/sec. (He) when equipped with a CF flange
- Sensor is bakable to 200 degrees C
- Four digit LED pressure display
- Selectable emission current
- Selectable e-beam degas
- Dual TTL setpoints
- RS232/485 digital communications
- Powered from 11.5 to 30 VDC

1.2 - Miniature B-A Sensor

The MP3DR utilizes a proprietary all-metal miniature Bayard-Alpert ionization gauge sensor whose performance exceeds that of traditional glass ion gauges by a wide margin. The sensor's dual filaments are thorium coated and the apex of the filament is supported. These two features greatly extend the filament lifetime for most applications. The sensor's collector is a 0.003" diameter stainless wire, thereby enabling an ultra-low x-ray limit of $>1 \times 10^{-10}$. When equipped with a CF type flange, the sensor achieves UHV performance levels in leak rate specification.

PLEASE TURN TO THE NEXT PAGE

1.3 Product Specifications

OPERATING SPECIFICATIONS

Measurement Range:	1×10^{-2} to 1×10^{-10} Torr
Sensitivity for Nitrogen:	10/Torr
Degas Power:	5 Watts e-beam
Bakeout Temp. (sensor only):	200 C
Operating Temp.:	0 to 40 C
X-ray Limit:	$< 1 \times 10^{-10}$ Torr
Filament Emission Current:	0.01, 0.1, 1.0 mA or Auto
Filament Bias Potential:	+30 Volts +/- 0.3%
Grid Potential:	+180 Volts +/- 0.3%
Filament Heating Voltage:	1.5 Volts (2.5 V Max.)
Filament Heating Current:	2 Amps (3 A Max.)
Mounting Orientation:	Any

CONTROL SYSTEM

Power Input:	11.5 -30.0 VDC@750 mA
Display:	Segmented. blue-green
Process Control Outputs:	2 each TTL
Digital Communications:	RS232/485
Power/Signal Connector:	15 pin d-sub
Digital Port:	Dual, 6 pin modular

PHYSICAL DATA

Height:	5.25"
Diameter:	3.00"
Weight:	19.5 oz. (KF25 flange)

OPERATING ENVIRONMENT

Location:	Indoors
Altitude:	To 2000 meters
Temperature:	0 to 40 C
Relative Humidity:	80% RH to 31 C
Installation:	Category II

2.0 Installing Your MP3DR

2.1 - Inspect Upon Receipt: Compare the list of items from your original purchase documents against the items listed on our shipping documents. Compare these against the actual contents of the shipping container. Report any differences to Televac. In the unlikely event that the shipping container was damaged in transit, carefully inspect the contents for damage. If the MP3DR Instrument or any of its accessories were damaged in transit, contact the freight carrier and tell them you wish to make a damage claim. Contact Televac for further instructions on replacement of damaged materials.

2.2 - Installation Notes:

Physical Mounting - The MP3DR is designed for indoor use and can be mounted in any physical attitude in any suitable location on the vacuum system. Ensure that there is sufficient room for the power and digital communications cables, noting to keep cables from touching any heated surfaces. If you plan to view the instrument's digital display, rotate the instrument body to the optimum viewing position.

Grounding - Safe operation of the MP3DR requires that the instrument's power supply and the vacuum chamber to which the MP3DR is connected, be properly grounded. Under some operating conditions, LETHAL VOLTAGES could be present if the instrument and its power supply are not properly grounded.

Ion producing equipment such as the MP3DR, may, under some conditions provide sufficient conduction via plasma, to couple a high voltage electrode to a vacuum chamber. If conductive portions of the vacuum chamber are not grounded, they may attain a potential near that of the high voltage electrodes during this coupling. Potentially fatal electrical shock could then occur because of the voltage between these vacuum chamber parts and ground. Grounding, though simple, is imperative. Be certain that your ground circuits are properly utilized on both the MP3DR and your vacuum system.

Electrical Connections - The required 24vdc electrical power is supplied to the MP3DR via its d-sub connector. Televac can supply you with a mating plug and cable in standard lengths of 10', 20', 35', 50' or any custom length. If your vacuum system does not have 24vdc available, you may order a 110vac/24vdc power module with cable (pn 7900-096) from Televac.

Pin No.	Function
1	High Setpoint
2	Low Setpoint
3	Power Input + 12 to 30 vdc
4	Power Return
5	NC
6	NC
7	NC
8	Digital Ground
9	NC
10	NC
11	NC
12	NC
13	NC
14	NC
15	NC

Digital Communication - RS232/485 signals are sent via the twin RJ-11 ports. Televac offers 7' long digital communications cables. Each is equipped with an RJ-11 modular plug to spade lug connector. Order p/n 9855-07. Custom lengths are available upon request.

2.3 - The B-A Sensor:

The miniature Bayard-Alpert sensor can be operated in any orientation. Reasonable care should be taken to minimize extreme operating conditions where the sensor is exposed to process effluent or deposition. In such cases, consider mounting the sensor via a 90 degree elbow. If in doubt, ask for assistance from a Televac applications engineer.

2.5 MP3DR Quick Starting Guide

Important Notifications:

High voltages capable of causing injury or death are present within the MP3DR. Avoid touching the connector sockets, sensor pins and internal circuitry within the instrument. Service must only be performed by qualified Televac personnel.

Do not turn on the MP3DR if there is any danger of explosion from explosive or combustible gases or gas mixtures. Ionization gauge filaments operate at temperatures sufficiently high enough to be considered an ignition source.

Safe operation of the MP3DR requires grounding of its power supply and the equipment to which it is installed. Lethal voltages may be established under some operating conditions unless grounding is provided.

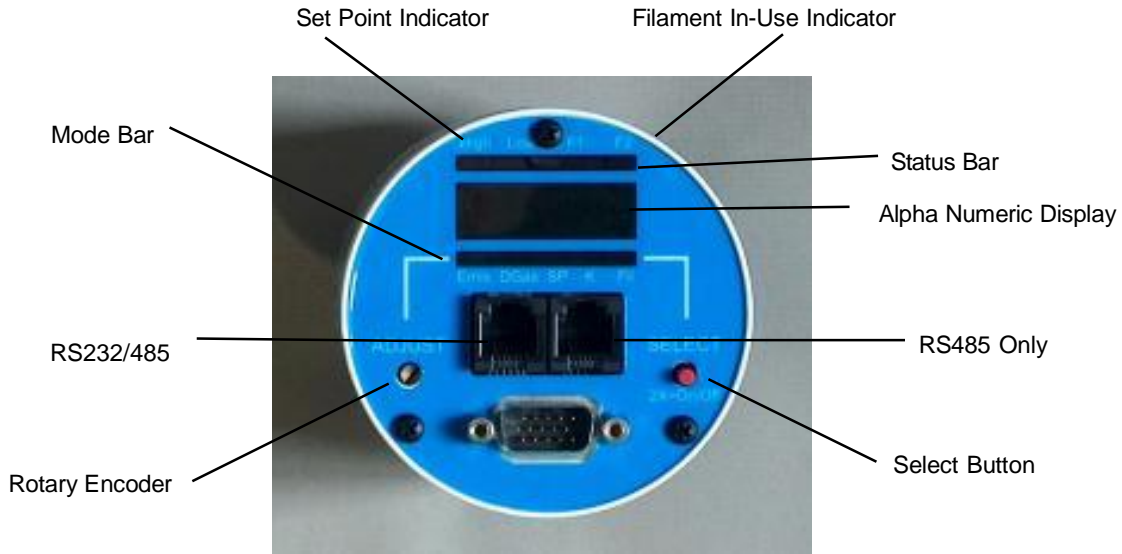
Ensure that the sensor filaments are not turned on unless vacuum is less than 1 millitorr. Operating filaments at atmospheric pressure will dramatically shorten their useful life.

Before initiating Degas, vacuum level must be 10⁻⁵ torr or less. Performing Degas at higher pressures can damage the sensor.

- 1.0 Attaching the MP3DR to Your Vacuum System: While the MP3DR can be operated in any physical orientation, the preferred orientation is somewhat vertical, for ease in reading the display and operating the controls. If you are planning to operate the instrument through its digital interface, any mounting orientation will suffice. Connect the MP3DR to your vacuum system. Pump your vacuum system to a high vacuum condition.
- 2.0 Power Supply: Attach the d-sub cable connector to the mating port on top of the MP3DR. Plug the modular power supply into a 110VAC wall outlet.
- 3.0 Start-up: The MP3DR CPU will go through initialization, during which the individual LEDs will sequentially illuminate. To turn on the sensor, press the red select button once. The display will initially show dashes (- - - -), indicating no sensor output. As sensor comes to temperature, a pressure will be displayed. Either F1 or F2 (filament indicator LED) will be illuminated.
- 4.0 Operating Modes:
 - 4.1 Emission – To change emission setting, press red SELECT button until Emis LED is illuminated. Rotate ADJUST until desired emission (.01mA, .1mA, 1mA or auto) is displayed. Auto is recommended.
 - 4.2 Degas – Filament must be on. Press red SELECT button until Degas LED is illuminated. Rotate ADJUST to set desired degas time (in tenths of a minute, up to 5 minutes duration). Press red SELECT button to start Degas timer.
 - 4.3 SP (set point) – Press red SELECT button until desired SP LED is illuminated. Rotate ADJUST to set desired set point.
 - 4.4 K Factor – To change the K Factor (gauge sensitivity), press the red SELECT button until K LED is illuminated. The default value is “10”. Rotate ADJUST to desired correction factor. The range is 1 to 100.
 - 4.5 FILAMENT – To sequence to the alternate sensor filament, press red SELECT button and rotate ADJUST to select desired filament; F1 or F2.

3.0 Operations Information

3.1 User Interface Panel & Modes of Operation:



Select - A push button that permits the user to sequence through the available operating modes. The filament can be turned on or off by rapidly double-clicking the Select button.

Adjust - A rotary encoder that permits the user to change the desired operating parameter within the various operating modes of the MP3DR.

Status Bar (Red LEDs) - The Status Bar provides information about the operating condition of the MP3DR. When a segmented LED is illuminated, it signifies that an operating condition has been met.

- High or Low will illuminate when a Set Point has been activated.
- F1 or F2 will illuminate when the respective filament has been turned on.
- Error will illuminate when the pressure is too high or low.

Mode Bar (Green LEDs) - Each operating mode is represented by a segmented LED. The MP3DR has six modes of operation, three of which may be entered by the user. The sixth mode; 'No Mode', is the default mode when no other mode has been selected and is the normal operating mode of the MP3DR.

No Mode - Default operating mode under normal operating conditions. The alpha-numeric display will indicate a pressure being measured if the filament has been turned on. If a filament has not been turned on, dashes ---- will be displayed. No Mode is automatically entered when no other modes have been selected or when the current selected mode has timed out.

Emis (emission) Mode - The Emis Mode is entered by toggling the Select button until the green LED designating Emis is illuminated. The desired sensor emission current is selected by rotating the Adjust encoder to the desired emission range. The available ranges are: .01mA, .1mA, 1mA, or Auto. In most situations, the optimum setting for the MP3DR is Auto ranging, where the instrument's CPU automatically determines and sets the optimum emission current range. If you desire to operate the MP3DR in manual emission mode, the following are recommended -

- From 1×10^{-3} to 1×10^{-4} torr - use .01mA
- From 1×10^{-4} to 1×10^{-5} torr - use .1mA
- From 1×10^{-5} to 1×10^{-10} torr - use 1mA

Dgas Mode - Dgas (degas) mode is used to rid the sensor of volatile contaminants. This is achieved by increasing the emission current and grid voltage, which raises the operating temperature of the sensor. The sensor's performance will typically be improved after the Dgas cycle is complete.

Cautionary Note: Before initiating Dgas, ensure that the vacuum level is at or below 10-5 torr. Attempting to degas at higher pressure may damage the sensor.

Dgas mode is entered by toggling the Select button until the green LED designating Dgas is illuminated. Dgas time is set while in this mode by rotating the Adjust encoder to the desired time. Dgas time can range from 10 seconds to 5 minutes, in 10 second increments. Toggle the Select button once more to initiate Dgas. In the event the Select button is not depressed this second time, the instrument will default to the No Mode, but the Dgas time will remain as defined by the user. To discontinue the Dgas sequence (once underway), return to the Dgas mode and adjust the time to 'zero'. Once the Dgas cycle is complete, the instrument will return to the No Mode of operation.

K (K-factor) Mode - The K factor is associated with sensor sensitivity and is a function of the design of the sensor.

K Mode mode is entered by toggling the Select button until the green LED designating K Mode is illuminated. The default and normal K factor for the MP3DR sensor is 10. If a value other than 10 is desired (the range is 1 to 99), the new value can be selected via rotation of the Adjust encoder.

Fil (filament) Mode - The MP3DR sensor is equipped with dual filaments. Fil mode is entered by toggling the Select button until the green LED designating Fil is illuminated. The desired filament can be selected by rotating the Adjust encoder until the desired filament is shown.

Cautionary Note: Do not activate the sensor's filament until the sensor is operating at high vacuum. Attempting to power the filament at or near atmospheric pressure will shorten the sensor's life.

3.2 Establishing Your Set Points:

SP (set point) Mode - SP mode is entered by toggling the Select button until the green LED designating SP Mode is illuminated. The set point values can be selected by rotating the Adjust encoder for two set points. The corresponding TTL output of these two setpoints are available on pins 1 and 2 of the d-sub connector. When a set point has been triggered, the alarm will be indicated by the associated segmented LED on the status bar.

To view the High set point, place the MP3DR in the High mode by pressing the Select button until the SP and High LEDs are flashing. The alpha numeric display will indicate the High SP value. To change the SP value, rotate the Adjust encoder CW to increase the value or CCW to decrease the value. During normal operation, the alarm LED will be triggered and the TTL output on pin #1 will go high (+5V) if the pressure exceeds the SP value.

To view the Low set point, place the MP3DR in the Low mode by pressing the Select button until the SP and Low LEDs are flashing. The alpha numeric display will indicate the High SP value. To change the SP value, rotate the Adjust encoder CW to increase the value or CCW to decrease the value. During normal operation, the alarm LED will be triggered and the TTL output on pin #2 will go high (+5V) if the pressure becomes less than the SP value.

The alarm LEDs cannot indicate an alarm condition while in the SP Mode. Therefore it is not advisable to leave the instrument in this mode. The mode will automatically return to No Mode after 15 seconds if no other actions are initiated.

4.0 Device Theory:

Bayard-Alpert ionization sensors consist of three principal elements: filament, grid and ion collector.

The filament is located outside of the cylindrical grid.

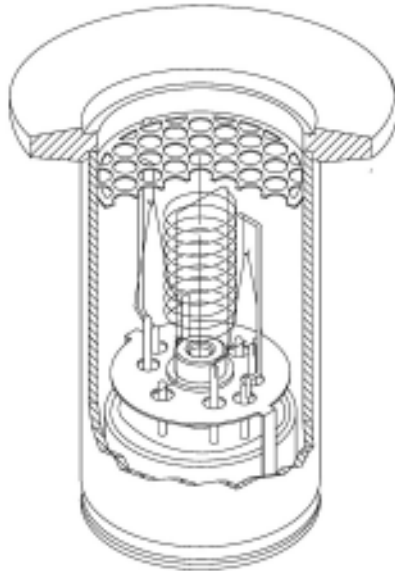
The collector is located within the grid, and on the axial centerline.

When the filament is powered, a voltage drop causes sufficient heating to result in electron emission. The filament current is maintained at a constant level to assure constant electron emission. The electrical potential difference between the filament and grid causes the emitted electrons to be accelerated toward the grid. Some of the electrons will pass through the grid.

When an electron collides with a gas molecule, some of the molecule's electrons may disassociate, resulting in a positive ion. These ions accelerate toward the collector.

The rate of the electron/molecule collision is proportional to the density of the gas molecules. The resulting ion current (at the collector) is therefore proportional to the density of the gas.

A precision electrometer receives the ion current and converts it into a d.c. voltage. An A/D converter processes the d.c. voltage and the digital signal is fed to the MP3DR processor.



MP3DR Miniature Bayard-Alpert Sensor

5.0 Digital Communication

The MP3DR has several setup and control commands which can be accessed by using the Adjust rotary encoder and Select push button, while viewing the alpha numeric display. Most of the commands described below can be accessed using equivalent RS232/485 commands.

The user can scan through the parameters noted below, while the instrument is in the No Mode. Each click of the rotary encoder in a CW direction will advance the display to the next command. At the desired command, the user can change or initiate the command by pressing the select button. When the user has completed establishing these parameters, the instrument can be returned to normal operation by rotating the encoder in a CCW direction until the pressure is displayed.

Note: Any changes to operating parameters will be lost when the instrument is returned to normal operation. To effect a permanent change, the user will need to initiate the Save EEPROM command via RS232/485.

Normal Run
RS485
Baud Rate
Data Bits / Parity Bits / Stop Bits
Save EE PROM
Restore EE PROM

The following provides a brief description for each of the commands noted above with syntax for the equivalent RS232/485 command. See following section 5.1 RS232/485 for further details.

RS485 Address: A_01

The RS485 address is the address of the MP3DR. If the unit is configured for RS232, this parameter should not be adjusted. A-01, A-02,...A_FE, A_FF

(Valid range 01 to DF)

*{aa} A={aa} <CR>

Baud Rate: B_2.4

B_2.4, B_4.8, B_9.6, B_19.2, B_57.6, B_125, B_250, B_500

The baud rate is given in kbaud. For example, B_9.6 corresponds to 9600 baud.

Data Bits/Parity Bits/Stop Bits: 8n1

The first character, "8" corresponds to the number of data bits (e.g 7 or 8).

The second character, "n" corresponds to the parity bit (e.g. n-no parity, E-even parity, o-odd parity, 0-space, 1-mark)

The last character, "1" corresponds to the number of stop bits (e.g. 1 or 2)

8n1, 8n2, 7n2, 7E1, 7E2, 7o1, 7o2, 701, 711, 712

Note: There is no equivalent RS232/485 command.

Save EEPROM: S_EE

EEW<CR>

Restore EEPROM: r_EE

EER<CR>

5.1 RS232/485:

Ion Gauge Device Status: 4-Digit Octal Word

When requested to transmit its status, the MP3DR responds with a 4-digit octal word

bit 11:	Serial Receiver Overload bit
10:	Main Board EEPROM Error
bit 9:	Communications Syntax Error
bits 7&8:	Emission Setting
bit 6:	Filament Selection. (0=filament 1, 1=filament 2)
bit 5:	Filament Status. (0=non-operating, 1=operating)
bit 4:	Degas. (0=degas off, 1=degas on)
bit 3:	Pressure Less Than (1.0e-9 Torr) Set if true
bit 2:	Pressure Greater Than (1.0e-3 Torr) Set if True
bit 1:	High Setpoint Alarm Set if pressure is greater than the high setpoint
bit 0:	Low Setpoint Alarm Set if pressure is less than the low setpoint

Command Syntax

In the following examples of syntax codes, the special characters are explained:

The characters in square brackets [] represents a command string, either upper or low case command characters accepted. All characters must follow each other in the string with no spaces or other characters.

The characters within wavy brackets {} contain choices for the appropriate command.

The characters within these symbols <> are the command abbreviations for the one digit ASCII control codes which they represent, (e.g. <CR> represents carriage return).

When entering more than one command in the same data string, they must be separated by a comma. All command strings must be followed by the terminator character (carriage return <CR>, also known as Enter).

When a lower case character is present in an example, it represents an option.

Character Description Valid Inputs:

a	RS485 Address (hexadecimal 0-9, A-F) 01-DF
m	Most Significant Digit of Mantissa 1-9
d	Decimal Digit 0-9
e	Exponent 0-5
u	Unit of Pressure T, M or P
,	Command Separator (comma) N/A
<CR>	Command Terminator (carriage return) N/A

Interrogation Commands:

<u>Command Description</u>	<u>Format</u>	<u>Sample Response</u>
Transmit Averaged Pressure	P<CR>	Pa: 1.23456e+0Torr<CR>
Transmit RS485 Address	A<CR>	Multidrop Address:01<CR>
Transmit High Setpoint	H<CR>	Hi: 1.00000e+1Torr<CR>
Transmit Low Setpoint	L<CR>	Lo: 1.00000e-2Torr<CR>
Transmit Device Status	S<CR>	00044<CR>
Transmit Turnaround Delay	T<CR>	Comm Delay: 6<CR>
Transmit Selected Units	U<CR>	Torr<CR>
Transmit Software Version	V<CR>	
Transmit Ion Current	I<CR>	Ion Current: 1.23456e8Amp<CR>
Transmit Filament	F<CR>	f1<CR>
Transmit Emission Setting	E<CR>	Emission: 0.01mA<CR>
Transmit Remaining Degas Time	R<CR>	Remaining Degas Time: 5 minutes<CR>

Parameter Modification Commands

Modify High Setpoint	H={m.dd}E{+e}<CR>	1.00000e-9 to 9.99999e+9
Modify Low Setpoint	L={m.dd}E{-e}<CR>	1.00000e-9 to 9.99999e+9
Modify RS485 Address	*{aa}A={aa}<CR>	1 to DF (Hexadecimal)
Modify Turnaround Delay	*{aa}T={dd}<CR>	0 to 255 (Decimal)

Ion Gauge Specific Parameter Modification Commands

Modify Filament	F={d}<CR>	1 or 2 (Decimal)
Modify Emission	E={m.d}E{-e}<CR>	*must be exact
Modify Degas Time	R={dd}<CR>	0 to 5 (Decimal)
Turn Gauge/Filament On	1<CR>	NA
Turn Gauge/Filament Off	0<CR>	NA
Escape	<Esc>	Reset Command Buffer (Ignore Prior Input)
Software Reset	/R<CR>	Reinitialize Software

6.0 Useful Information

6.1 Vacuum Terminology and The MP3DR:

Atmospheric pressure is defined at 760 torr (at sea level, when the barometric pressure is 29.92" Hg). One Torr is 1/760 of atmospheric pressure. One Torr can also be expressed as 1000 Millitorr or 1000 Microns. One Millitorr or one Micron is 1/760,000 of atmospheric pressure.

The Miniature Bayard-Alpert sensor used in your MP3DR is designed to measure a small portion of that wide band of reduced pressure that extends from atmospheric pressure to a region known as very ultrahigh vacuum ($\sim 1 \times 10^{-14}$ torr). This total spectrum of measurable vacuum contains about 18 decades of pressure.

For example:

The MP3DR sensor measures from 1×10^{-2} torr (10 millitorr) to 1×10^{-10} torr...eight decades of measurement.

6.2 Practical issues to consider with Bayard-Alpert sensors:

√ The most common failure mechanism is gross contamination. If there is a probable risk of contamination, we recommend mounting the sensor behind a 90 degree elbow.

√ If possible, avoid mounting locations where excessive vibration or mechanical shock is likely to occur.

6.3 Contacting us:

Our main telephone number is 215-947-2500 and our normal hours are 8:00am to 4:30pm eastern time.

Our fax number is 215-947-7464.

Our main email address is sales@televac.com

You can locate the name and contact information of your local Televac representative through our website - www.televac.com.

7.0 Warranty Information

The Televac division of The Fredericks Company warrants instruments and components to be free of defects in material and workmanship for a period of one year after the date of shipment unless otherwise specified in the quotation or product literature. No salesman, representative or agent of The Fredericks Company or its divisions is authorized to give any guarantee or warranty or make any representation in addition or contrary to those stated herein.

Other than those expressly stated herein, there are no other warranties of any kind, express or implied and specially excluded but not by way of limitation, are the implied warranties of fitness for a particular purpose and merchantability. It is understood and agreed the seller's liability whether in contract, in tort, under any warranty, in negligence or otherwise, shall not exceed the return of the amount of the purchase price of the product. Under no circumstances shall the seller be liable for special, indirect, incidental or consequential damages. The price stated for the equipment is a consideration in limiting seller's liability. No action regardless of form, arising out of transactions of this agreement may be brought by purchase more than one year after the cause of action has accrued, sellers maximum liability shall not exceed and buyer's remedy is limited to either repair or replacement.

8.0 Recommended Options & Spares

<u>Description</u>	<u>Part Number</u>
Sensor with 1" tubulation	2-7990-101
Sensor with NW25 flange	2-7990-131
Sensor with 2.75" CF flange	2-7990-152
Digital Comm.Cable, RJ11 to spade lug, 7' length	9855-07
110VAC to 24VDC Power Module with 6' cable and d-sub conn.	7900-096
Power & Signals Cable with 15 pin d-sub connector, 10' length	2-9867-010
Power & Signals Cable with 15 pin d-sub connector, 20' length	2-9867-020
Power & Signals Cable with 15 pin d-sub connector, 35' length	2-9867-035
Power & Signals Cable with 15 pin d-sub connector, 50' length	2-9867-050



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