Plasma Technics, Inc.®

INSTALLATION & OPERATION MANUAL
Plasma Blo$_3$ck

10 - 20g

Standard Chassis configuration   Alternate Chassis configuration

For added application information, see the Plasma Block Application Guide manual

Document: V6.e Firmware: 10008.004

PTI 1900 William Street Racine, WI 53404-1875 Tele: (262) 637-7180

Fax: (262) 637-7157
Web Page: http://www.plasmatechnics.com
http://www.plasmablock.com

E-Mail: sales@plasmatechnics.com

TABLE OF CONTENTS

PTI 1900 William Street Racine, WI 53404-1875 Tele: (262) 637-7180

Fax: (262) 637-7157
Web Page: http://www.plasmatechnics.com
http://www.plasmablock.com

E-Mail: sales@plasmatechnics.com

10g & 20g @ 5% *Plasma* Blo3ck ® (Air-Cooled)

Doc : v4.0c, 10/15/09

Firmware: 10008.004

Standard Chassis configuration Alternate Chassis configuration

Feature List

- **10g**, 5%, **2 lpm**, 5 psi. **20g**, 5%, **4 lpm**, 5 psi. 10g and 20g models in the **same chassis**.
- **Full-Auto** and **Semi-Auto** modes hold power constant over the entire pressure range: **5 - 100 psi**. Go from package to process with no setup or adjustments required. Continuously tracks and automatically optimizes performance for changes in pressure, flow and line voltage.
- **Universal, world-class product**. **Constant ozone output** and cooling: 100 – 240vac, 50/60hz, power factor .94-.99 across the entire working voltage and power range. Power supply is UL / CSA / CE approved. NO line voltage configuration jumpers – any voltage, any frequency; same unit.
- **Efficient**, compact, silent (25khz), safe, rugged, reliable, advanced – all the normal traits of a PTI product. Same precise linear control, with turndown to 1%, as with all Plasma Block products.
- Maximum up time, durable, commercial / industrial solution the ozone industry requires.

- Possible **cell flooding** is identified followed by shut down and enunciation. No damage is caused to electronics, transformer and rarely the cell. Cell flushing and drying in the field is usually sufficient to restore full service.

- Extensive two tier fault enunciation **maximizes uptime** and simplifies service diagnostics. Latched fault indicators retain fault status until serviced.

- This Gen2 cell is a scaled down version of PTI's field proven 50g product, which is virtually impervious to extremes in temperature, vibration and pressure. **Major savings are had due to its low energy use, low oxygen volume needs and competitive pricing.**

- The control electronics is accomplished via Plasma Technics® new DAT310 microcontroller-based inverter board. This state of the art controller yields a simpler user interface and many new features intended to further increase uptime and **simplify installation** and troubleshooting.

- An RS-232 connector (DB9) is available for direct monitoring and control via PLC or PC with PlasmaView software program.

- **Control connections** of the essential I/O functions are the **same** as in all other Plasma Block products.

- PDM, Voltage and Frequency potentiometers have their own jumper selection for onboard control, if desired.

- Complex and thorough onboard electronic short-circuit protection prevents nuisance circuit board failure due to accidental field wiring errors.

- Power and control connections are located at the rear of the product to enable integrators to construct 'plug & play' mounting.

- **Same mounting footprint and mounting hole centers** as the popular 50g Plasma Block. The 10/20g chassis is a miniature version of the 50g unit. This means that the general location for control connections, gas IN/OUT, cooling, etc. are the same.

- **Military grade conformal coating** eliminates problems associated with condensation and mold as well as greatly retards damage caused by accidental ozone exposure.

- Like all other Plasma Block products, the feed gas supply must be either PSA concentrator or oxygen.

- Directly installable by UL 508a panel house.

- Optional: PLASMAVIEW Software for direct PC monitoring and control via RS-232 (DB9).

INSTALLATION AND OPERATION OF Plasma BLO$_3$CK® COMPLETE ASSEMBLIES INVERTER AND CELL

Section 1. GENERAL MOUNTING REQUIREMENTS

1. Mount to allow O_2 flow meters to work for user feedback. The assembly contains a cooling fan which cools the transformer. Allow 1.25" to 1.5" clearance between the top of the fan and an enclosure surface.

2. Read the nameplate for operating line voltage and current adjustment levels. **Use copper conductors only.**

3. Apply <u>only</u> the line voltage indicated on the nameplate.

4. Ground the plate assembly to service green utilizing star washer. See installation drawing on page 14 for possible grounding locations and High Voltage safety considerations. Read section II for information regarding the individual components of the system.

5. Follow section III for field adjustment and/or verification: It is ***very important*** to at least ***verify*** that the ***system is set to the proper pressure*** and that the current values found in section III-6 agree with installed values.
6. If current varies by more than ± .2A the adjustment procedure found in Section 7 must be conducted.

Mounting Environment

The block should be mounted in an environment that is **free** from the following:

Corrosive or volatile vapors

Dust and particles

Excessive moisture

Shock, Excessive vibration

Temperature extremes

The following environmental specifications apply:

Relative humidity: 5 to 90%, non-condensing. Altitude (maximum): 3,310 ft (1,000 m), de-rating for altitude is 1% for every 300 ft (100m) above 1000m.

Mounting can be in **any axis** via the same bracket used on the 50g unit.

Pressure and flow requirements are the same as all other Plasma Block® products. Connect oxygen feed gas to port labeled INLET. OUTLET should have a flow restriction control downstream to produce an operating pressure range of 5 to 100psi.

Allow 2.5 cm (1") **MINIMUM** of space around the fan and areas which vent cooling air. 5 cm is better.

Surrounding air ambient operating temperature: 0° to 40° C (32° to 104° F)

No heat inducing stray fields are to be present within 1 M (3 feet) of the unit. These fields can radiate from large motors or large power supplies in the KW range.

Section 2

Wiring Standards and Codes

The installation person is responsible for following the wiring plan produced by the design engineer for the specific application.

All wiring must conform to the following standards:

National Electrical Code, Publication NFPA No. 70.

All local and national codes which apply. For motor usage; use appropriate NEMA relay for protection.

The supplier cannot assume responsibility for the compliance or noncompliance to any code governing the proper installation of this equipment.

Electrical Connection Wire Sizing and Fusing

The DAT310 input current ratings: 10g = 1.10 amps RMS / 20g = 2.10 amps RMS (115 VAC mains). See Section 7 for complete power adjustment data. Use branch circuit fuses suitable for use on a circuit capable of delivering not more than 10 A RMS Slo-Blo, 250 volts maximum. Refer to the National Electrical Code[NEC], Publication NFPA No. 70, Article 310, and any local codes that may apply for wire sizing and selection. Use 60/75°c wire min. Use copper conductors only.

Terminal connection max torque 0.5 newton meters (Nm) [.369 inch lbs].

Case Ground

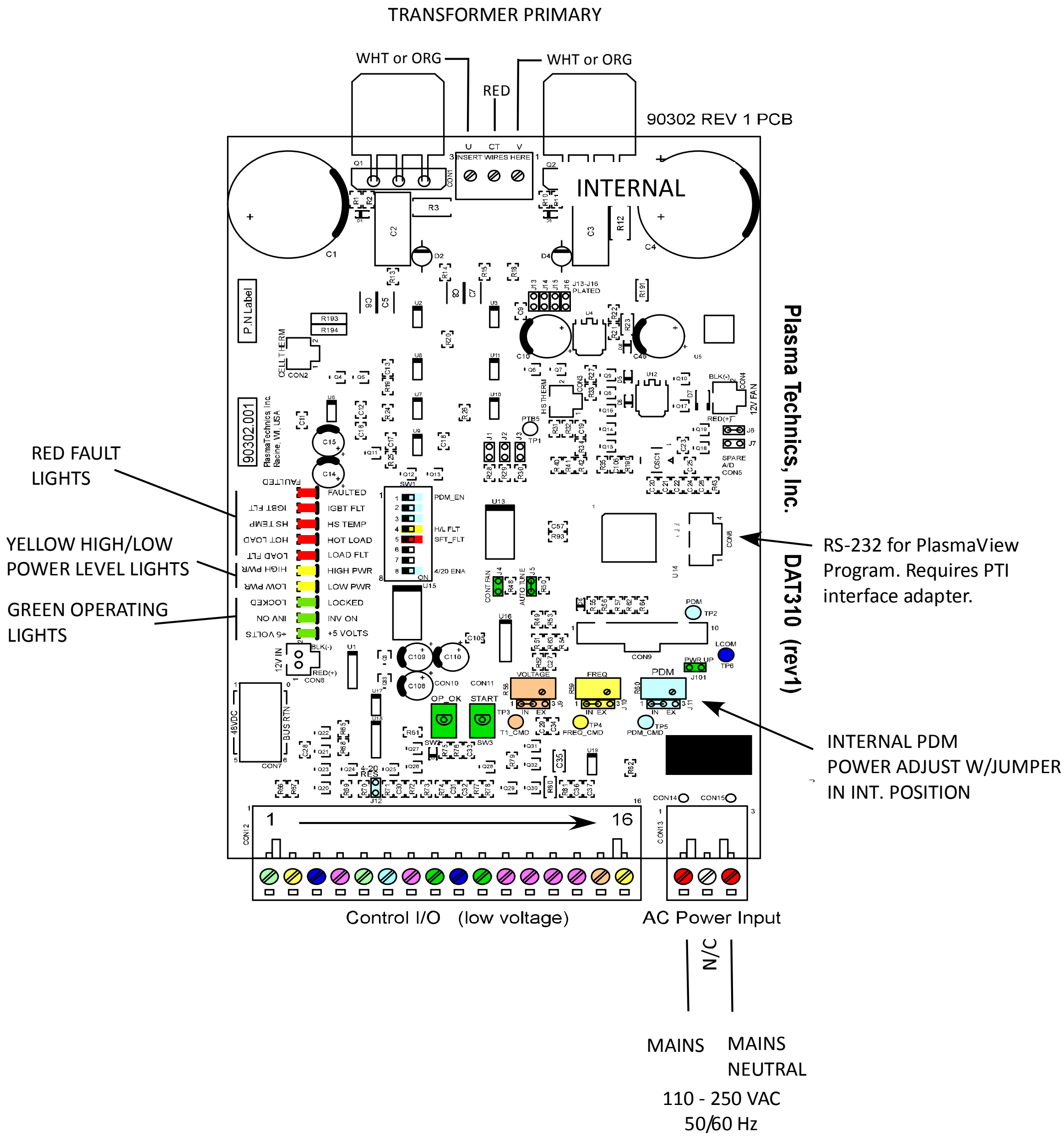
Each of the blocks must be connected to ground at their case ground terminal. A grounding electrode conductor or bonding jumper must be connected from the ground terminal to either a grounding electrode buried in the earth or a suitable plant ground with solid connections to earth ground. Refer to NFPA No. 70, Article 250, for details on grounding and grounding electrodes.

Safety Grounding

The case ground connections should be made at the ground terminals. The case ground of the various system components should be connected to the star grounding bus of the cabinet. A grounding electrode conductor or bonding jumper must be connected from the star grounding bus to either a grounding electrode buried in the earth or a suitable plant ground with solid connections to earth ground. Refer to NFPA No. 70, Article 250, for details on grounding and grounding electrodes.

The only external connections for control needed are the ON/OFF switch. Note that an OFF contact closure will shut off the inverter even if the ON contact is made. The OFF contact takes priority.

All adjustments can be made on the inverter as shown with the jumper positions shown at the INTERNAL CONTROL position. The VOLTAGE and FREQUENCY are pre-adjusted to your purchase order specifications. Power adjustment is by the PDM potentiometer only for normal operation 0 – 100%. PDM may be changed to EXTERNAL for output control in your final equipment.



115 VAC wiring should be rated 10 Amps.

There MUST be a green wire earth ground from the chassis to conduit ground. This is an important safety and reliability feature.

The mains can be from 100 to 250 VAC universal input. Since the current requirement is relatively low (3 A at 115 VAC for the 20 g/hr) 115 VAC mains is typical. No special configurations are necessary for 240 VAC mains voltage.

OZONE CELL OPERATION CONSIDERATIONS

SECTION 3.

A. Plasma BLO_3CK:

1. The Plasma Block is built with aluminum and ceramic. While aluminum provides maximum safety for applications like water purification, it does react with nitric acid that would be produced if atmospheric air were to be used rather than a concentrate for gas feed. For this reason **ONLY a concentrator or O_2 can be used to provide the feed gas.** To maintain the warrantee the feed gas must be at least -76 C (-60°F) dew point and 93% O_2 or more.

2. **IMPORTANT! BEFORE** the system is energized for the first time the Plasma Block should pre-dried by flowing the above feed gas for 3 to 5 minutes. If the installed system will be dormant for long intervals then the control system should do a pre-purge to insure the system is dry before power is applied to the cell. Failure to do this step may result in nitric acid being formed in the ozone cell.

3. The best cell seasoning is accomplished with a PSA oxygen concentrator. All cells have been factory seasoned but it is always a good idea to operate the finished system for a few hours after installation.

4. IMPORTANT! When a system is off for an extended period, it is very important to prevent backflow of liquids and gasses through the cell. Backflows void the cell warranty. For example, a system which uses a venturi and concentrator must contain a solenoid valve to block gas flow if it is possible that the venturi will be active while the concentrator is off.

5. TIP! An easy way to prevent check valve or solenoid valve backflow when all systems are shut down is a tubing loop from the venturi to an elevation higher than the highest water level to the check valve to the ozone cell.

6. When the Block requires servicing, return it to the factory - DO NOT disassemble. The Plasma Block is fitted with a tamper label. If the label is broken, the warranty is void.

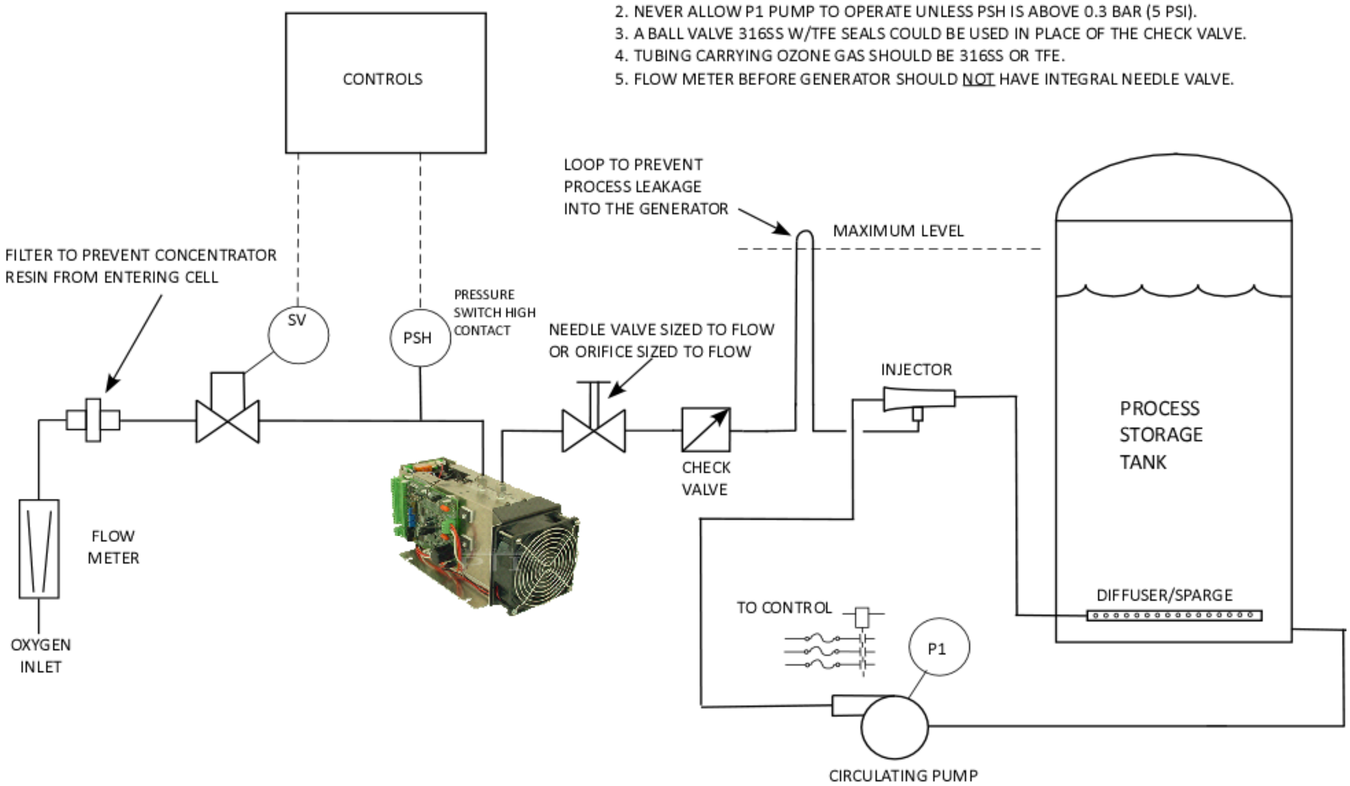
7. **While it is possible to configure the system to accommodate negative pressures, negative pressures are problematic and tend to cause large power and ozone**

fluctuations. <u>The most stable and predictable systems occur at positive pressures ABOVE 0.3 bar (5 psi)</u>.

8. **TIP! A throttling needle valve after the GAS OUT port to maintain cell pressure is required. Operating venturi produce vacuum in the ozone line. Maintain cell pressure no less than 0.3 bar (5 psi).**

9. The ozone outlet fitting mounted into the plasma block mates with other fittings inside of the unit and **<u>must not be removed or changed</u>** to another fitting type. Contact the factory if other sizes or styles are required.

NOTES;
1. ALLOW TIME FOR PSH TO REACT BEFORE TURNING OFF SV.
2. NEVER ALLOW P1 PUMP TO OPERATE UNLESS PSH IS ABOVE 0.3 BAR (5 PSI).
3. A BALL VALVE 316SS W/TFE SEALS COULD BE USED IN PLACE OF THE CHECK VALVE.
4. TUBING CARRYING OZONE GAS SHOULD BE 316SS OR TFE.
5. FLOW METER BEFORE GENERATOR SHOULD <u>NOT</u> HAVE INTEGRAL NEEDLE VALVE.



SUGGESTED INSTALLATION

SECTION 4. Operation and Tuning – BLO$_3$CK Systems

1. The generator is normally shipped to the customer's specifications for operating pressure, and ozone output control pre-tuned. No further adjustment is necessary.

2. If feed gas pressure or flowrate is to be controlled by other means than specified on your purchase order, refer to the detailed section on inverter operation.

3. The plate-mounted system has been pre-configured for optimum performance for each customer's pressure circumstances, if they were specified. Typically the range will be 5 to 15 psi. If the pressure was not specified or requires changing, follow the power up instructions and subsequent tuning instructions in the detailed section. If the pressure is expected to fluctuate over a range then create the highest pressure condition and then tune the system.

4. Start gas flow, adjust to desired values and wait for several minutes.

5. Adjust the ozone output with the PDM control either internal or external to the desired output.

6. Specific detailed setup instructions begin in Section 5.

Section 5. Power requirements and specifications

Mains Connections (Con 13)

AC Line Power – 1 & 3. 100-240vac, 50/60Hz:

Power factor 0.94 – 0.95

Power supply approvals: UL/CSA/CE

AC power is connected via the 3 pin connector. Use pins 1 and 3. Polarity is irrelevant. Pin 2 is not connected and is used to provide proper electrical spacing only.

Connect a ground at any fastener that utilizes a star washer. A solid ground is essential for safety and to reduce electrical noise.

Section 6. Detailed inverter configuration

Input / Output Connections (Con12)

Basic control connection for PDM, ON/OFF, Frequency, Voltage, Enable out, +15vdc, +5vdc are the same as all other Plasma Block products that have utilized the SSD111 control board. Note below that many new outputs are available and the enunciation outputs have been changed from 0-5v logic level types to open collector for easier interface to a wider variety of PLC's. The open collector outputs are all active low.

TERMINAL

1. +15, aux use limit = 10ma.
2. Frequency Adjust (optional), selected by jumper J10, use 5k Ω pot, 0-10vdc only (10v= 100%), impedance 10k Ω.
3. **Signal Common**, tied to #9 internally.
4. DAT 310 Flooded cell detector. (Current production inverter)

   DAT 300 – not used

   SSD111 – minus 15 VDC (-15 VDC)
5. +5vdc, aux use limit = 12ma. **Recommend this be connected to PLC for power up validation.**
6. **PDM input** (optional), selected by jumper J11, use 5kΩ pot, 0-10vdc (10v= 100%), 4-20ma or 0-20ma, impedance 10k Ω. Select current input mode via jumper J12 (500Ω load from 3 to 6).
7. **Inverter Start,** output pulls low via open collector (MMBT4401) when inverter is engaged. Follows Inv_ON LED. 10k Ω pull-up to +5.   100Ω on board.
8. **Inverter OFF** when pulled low to terminal 9 via momentary or continuous. 10kΩ pull-up to +5v.
9. **Logic Common** for # 8 and 10.
10. **Inverter ON** when pulled low to terminal 9 via momentary or continuous. 10kΩ pull-up to +5v.
11. **FAULT OUT** pulls low via open collector (MMBT4401) when inverter faults due to: Operating cell current is above or below customer programmed set point. Over temp cell, over temp electronics, sustained instantaneous over current. 100Ω on board.
12. System LOCKED. Digital auto-tune feature has found and confirmed the proper operating point. If pressure changes cause significant re-tuning the LOCKED LED will flash. The locked LED will also flash during the initial tuning acquisition, which lasts for a few seconds.

13. Analog 0 – 5vdc, follows average DC bus current out. Direct op amp (MC33272AD) thru 100Ω resistor. 1.9 VDC for the 10g, 3.8 VDC for the 20g typical output value.

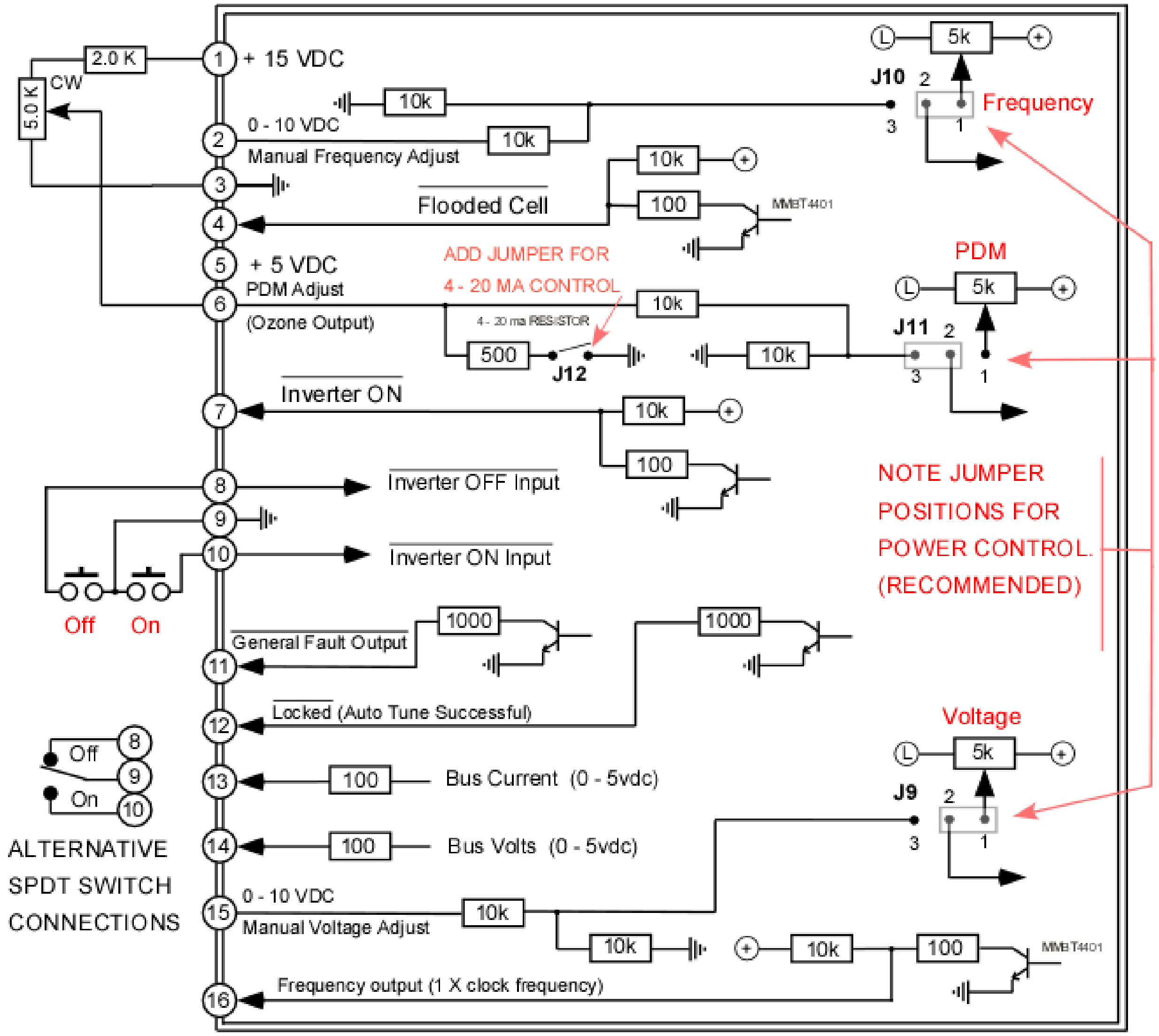
14. Analog 0 – 5vdc, follows 48 VDC bus voltage. Direct op amp (MC33272AD). 10kΩ series resistor. 4.7 VDC typical output value.

15. Voltage Adjust input (optional), selected by jumper J16, use 5kΩ pot, 0-10vdc only(10v= 100%), impedance 10k Ω.

16. Clock Freq out (1x). Output pulls low via open collector (MMBT4401). 10kΩ pull-up to +5. 100Ω on board.

ADD FOR EXTERNAL CONTROL
PIN 6: 0 -10 V OR 4 - 20 MA.

DAT310 Connections



Jumper block configuration

(Earlier models use the DAT 300 inverter. A cross reference is at the rear of the manual.)

DAT 310 JUMPER CHART

SWITCH SW1	SWITCH POSITION	NAME	FUNCTION IF INSTALLED
S1	ON	PDM Enable	If PDM is remotely commanded, remove to test 100% output level. This is especially useful if the unit is hard wired to a PLC or ORP controller.
S2	OFF	Alternate LOW PDM	Lower PDM period than 30 Hz
S3	OFF	Alternate PDM	Alternate PDM
S4	ON	HIGH/LOW current fault	A window of normal operating current. This will cause a fault if either the LOW or HIGH value is exceeded.
S5	OFF	Soft fault	Produces a wink in fault line #11 if one or more operational windows are exceeded beyond the factory limit. Will not shut down the inverter like a hard fault but attention is needed.
S6	OFF		Spare
S7	OFF		Spare
S8	OFF	4/20 ma.	Configuration for 4 - 20 ma. control 0 - 100% ozone output. At 2 ma the INV_ON LED will flash. At 3 ma. The output is reinabled. If the jumper is removed, 0 - 10 (0 - 100%) volts controls the ozone output. At zero ozone, inverter is standby.

JUMPER	INSTALLED DEFAULT		
J101	OUT	ON with power up	ON-OFF command change. The inverter will turn ON 5 seconds after power is applied and turned OFF when power is removed. This is not recommended because it eliminates gas purge.
J1, J2		ON – OFF configuration	See schematics and tables in METHODS ON – OFF CONTROL
J3	OUT	SEMI-AUTO - Tune	J5 out. Voltage pot sets maximum power. Optimal frequency is automatic.
J4	OUT	Manual fan	Fan goes on when power is applied and off when removed.
J5	IN	Full AUTO-TUNE	J3 out. Voltage and frequency pots are not active. These parameters are controlled automatically. See SEMI-AUTO.
J9	IN	Voltage control pot	1 - 2 jumper = internal control. 2 - 3 = external
J10	IN	Frequency control pot	1 - 2 jumper = internal control. 2 - 3 = external
J11	IN	PDM control pot	1 - 2 jumper = internal control. 2 - 3 = external
J12	S	4/20 ma. or 0 - 10 VDC	Adds 500 ohm resistor to control input. If two or more DAT 310s are to be controlled via one current loop, wire all Connector CON12 term. 3 together and all term. 6 together and install J12 on one DAT 310 inverter. Usually S8 ON and J12 jumper are used together.

Controls and switches

Control Potentiometers (Pots)

PDM – The onboard Pulse Density Modulation control pot is primarily of use for simple applications running at a fixed turndown level. Also helpful for bench testing. Use jumper J18 to select on board (IN) or external terminal strip control (EX). Normally terminal #6 input delivers a voltage or current to the unit, which manages a closed loop process ozone level.

Voltage – Adjusts voltage applied to cell. Use jumper J16 to select onboard (IN) or external terminal strip control (EX). This control is used to set the maximum power operating point for the unit while in the Semi-Auto mode, but is not observed in the Full-Auto mode. Remote operation is via terminal # 15. If external control is used, it must be a voltage from 0 to 10vdc, unless a 500 ohm resistor is added to terminals 3 and 15. No 4/20ma current control jumper provisions exist on the PCB.

Frequency – Adjusts cell frequency. This pot is factory set and not observed unless the unit is in the factory set-up configuration. Frequency is dynamically managed by the processor for both Semi and Full Auto modes. Provisions have been made for remote control via terminal # 2, in which case J17 should be in the (EX) location.

Switches

Op_OK – This switch has multiple uses.

1. When the inverter is ON, stores the present running parameters of voltage, frequency range, current tolerance along with other internal configuration information available, as **normal** field operation. This information becomes the re-start information after a power cycle.

2. Recalls the factory set-up table to active memory when the inverter is OFF. The factory table is never overwritten and can be recalled as a last resort if the unit has been improperly adjusted beyond recognition. If this happens, just follow the instructions in the 'Power Adjustment' section.

Start – This switch has multiple uses.

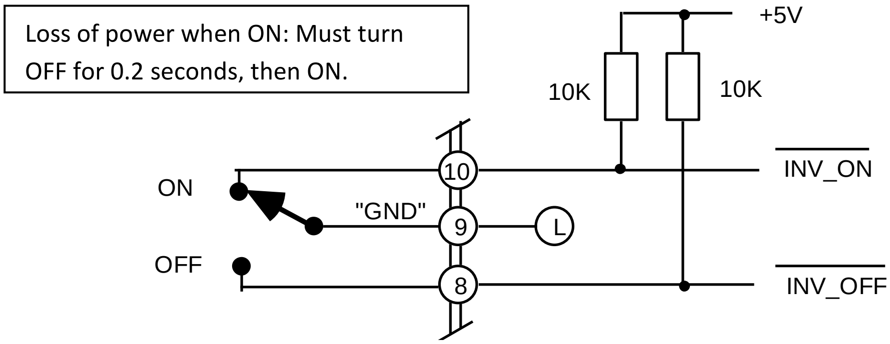
1. An **extended tuning sweep** is conducted if pushed for 2 - 4 seconds <u>AND</u> **J15** (**J7** DAT 300) **is** installed, to eliminate the possibility of tuning aliases. In other words, it allows the user to force an extended tuning adjustment and witness the results as a troubleshooting tool if needed. This type of operation also occurs automatically, but the user would be unaware of it. If either the power or current is different than the values found in the 'Power Level Table' below, store the new value by removing J15(J7), adjusting the voltage pot (per 'Power Adjustment'), store the corrected running value (per above 'Op_OK'), and re-install J15 (J7).

2. A sensitive **manual power adjustment** of the 'Voltage' control if pushed for 2 – 4 seconds <u>AND</u> J15 (J7) is removed. While this same function can be performed without pressing the 'Start' button, this mode converts the High/Low LEDs into a sensitive meter which is centered around the stored value of the programmed power table in the processors' memory. In other words, you can reset the power level with extreme accuracy to the previous or factory value, without an amp meter.

METHODS OF ON – OFF CONTROL

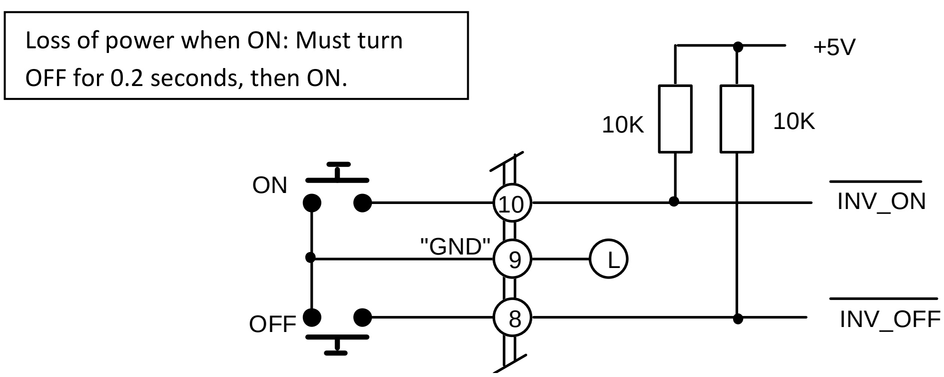
JUMPER BLOCK CONFIGURATION AND FUNCTION

SPDT RELAY OR SWITCH



FUNCTION	PWR_UP	J1	J2	J3
To start the inverter the switch must first be in the OFF position, then moved to the ON position for ozone to start.	OMIT	OMIT	X	X
To start the inverter the switch or jumper wire must first be across 9 and 10 position, then power is applied to produce ozone. The inverter will start after the "LED banner flash". If 8,9,& 10 are open with this jumper in, the inverter cannot start until the power is removed and 9 and 10 connected.	IN	OMIT	X	X
X = Don't care condition.				

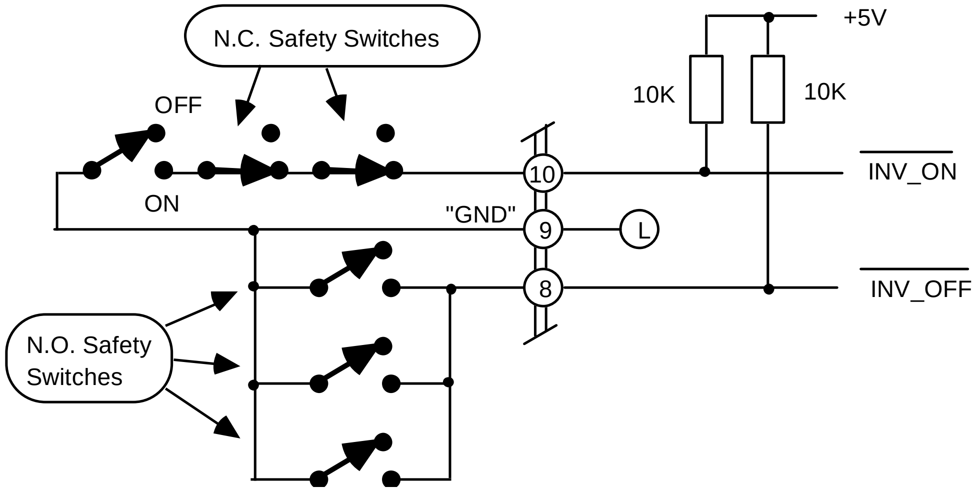
ON – OFF PUSHBUTTONS



JUMPER BLOCK CONFIGURATION AND FUNCTION

FUNCTION	PWR_UP	J1	J2	J3
Push ON and push OFF to start ozone production. If both pushbuttons are actuated simultaneously, the inverter will stay OFF.	X	OMIT	X	X
X = Don't care condition.				

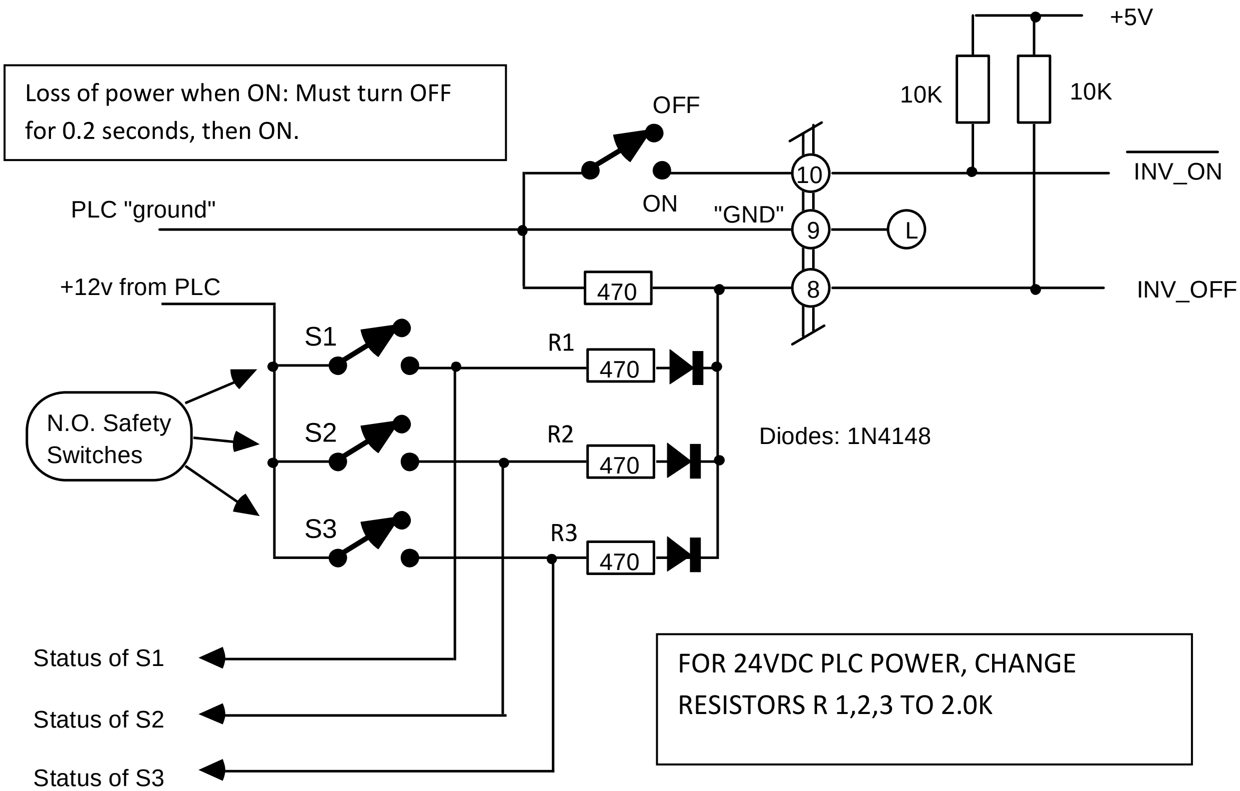
SAFETY SWITCH INVERTER CONTROL CIRCUITS



Loss of power when ON: Must turn OFF for 0.2 seconds, then ON.

FUNCTION	PWR_UP	J1	J2	J3
To start the inverter the switch must first be in the OFF position, then moved to the ON position for ozone to start.	OMIT	IN	OMIT	X
To start the inverter the switch must first be in the ON position, then power is applied to produce ozone. The inverter will start after the "LED banner flash".	IN	IN	OMIT	X
X = Don't care condition.				
If any of the normally open (N.O.) safety switches goes closed then ozone production cannot start or will cease if operating.				

PLC POWERED SAFETY SWITCHES WITH STATUS REPORTING



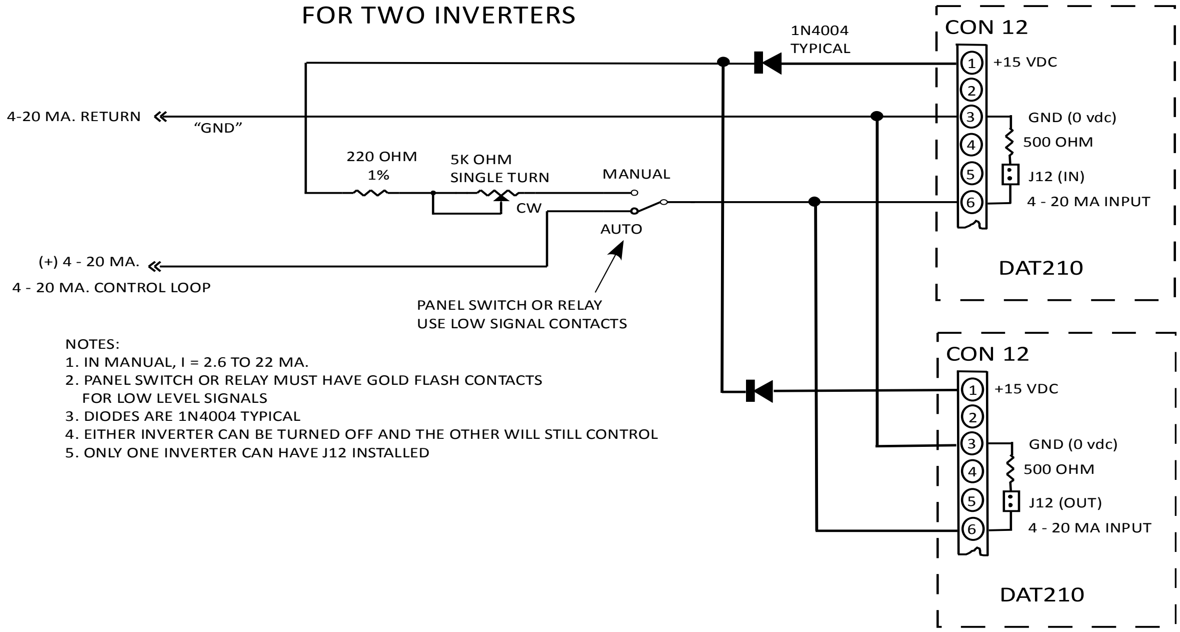
FUNCTION	PWR_UP	J1	J2	J3
To start the inverter the switch must first be in the OFF position, then moved to the ON position for ozone to start.	OMIT	IN	IN	X
To start the inverter the switch must first be in the ON position, then power is applied to produce ozone. The inverter will start after the "LED banner flash".	IN	IN	IN	X
X = Don't care condition.				
If any of the normally open (N.O.) safety switches goes closed then ozone production cannot start or will cease if operating. This circuit allows the PLC to monitor the switch status.				

SUGGESTED METHOD OF AUTO/MANUAL TRANSFER – MULTIPLE INVERTERS

If the ozone generator is used in a feedback control loop with 4 – 20 ma. control of oxidation residual, the following circuit can be useful. When the control loop is faulty due to a failed ORP electrode or dissolved ozone residual monitor, it is useful to transition control from AUTO to MANUAL while working on the analyzer. MANUAL control allows the operator to maintain an oxidation (ozone) residual in the process.

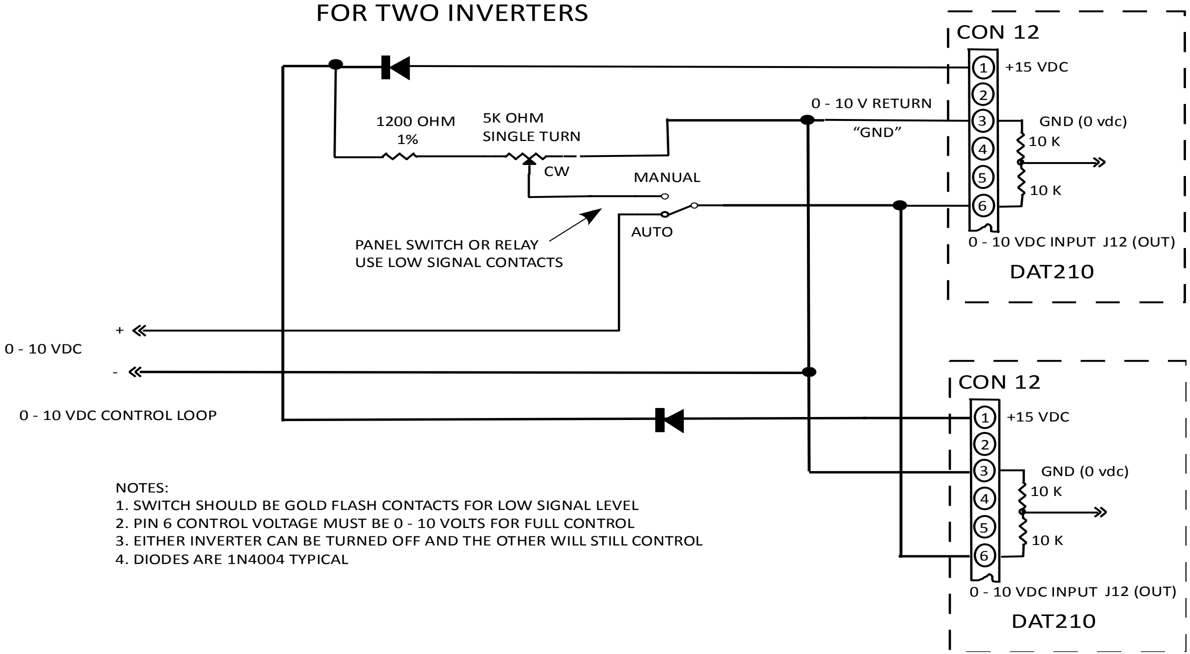
If a PLC is used, this function could be included in the PLC programming.

4 -20 MA. AUTO/MANUAL TRANSFER SWITCH CONTROL LOOP FOR TWO INVERTERS



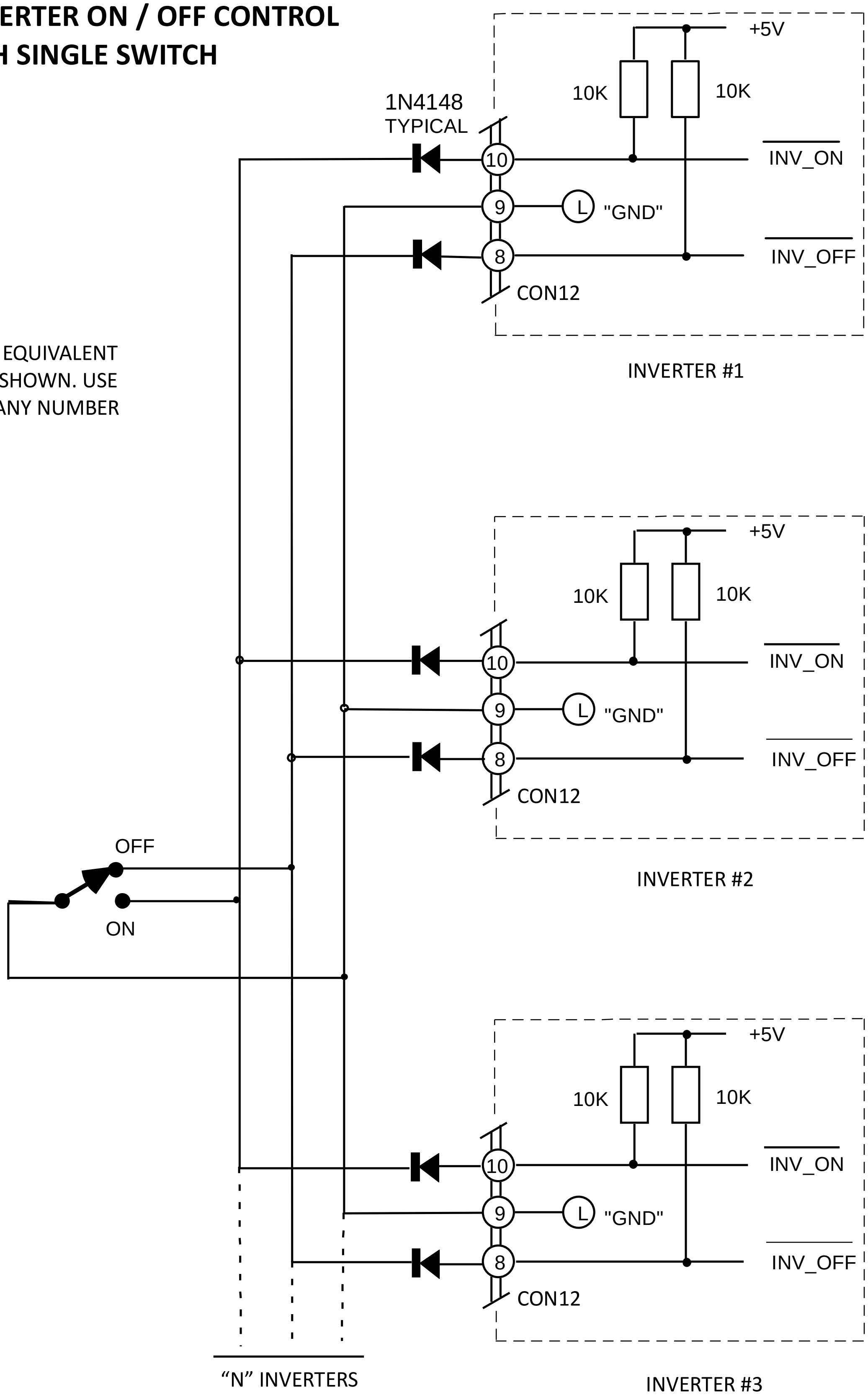
NOTES:
1. IN MANUAL, I = 2.6 TO 22 MA.
2. PANEL SWITCH OR RELAY MUST HAVE GOLD FLASH CONTACTS FOR LOW LEVEL SIGNALS
3. DIODES ARE 1N4004 TYPICAL
4. EITHER INVERTER CAN BE TURNED OFF AND THE OTHER WILL STILL CONTROL
5. ONLY ONE INVERTER CAN HAVE J12 INSTALLED

0 - 10 VDC AUTO/MANUAL TRANSFER SWITCH CONTROL LOOP FOR TWO INVERTERS

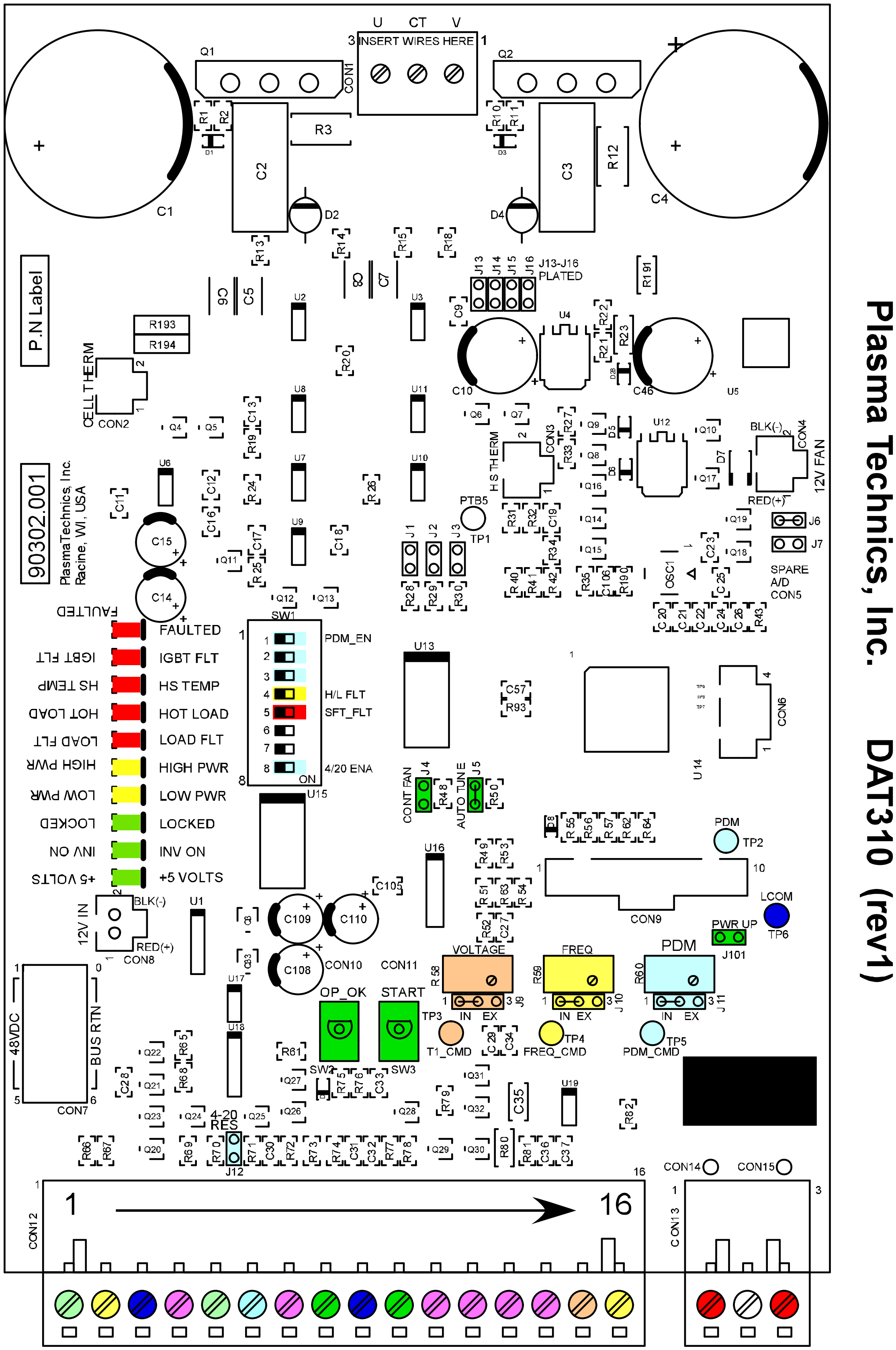


NOTES:
1. SWITCH SHOULD BE GOLD FLASH CONTACTS FOR LOW SIGNAL LEVEL
2. PIN 6 CONTROL VOLTAGE MUST BE 0 - 10 VOLTS FOR FULL CONTROL
3. EITHER INVERTER CAN BE TURNED OFF AND THE OTHER WILL STILL CONTROL
4. DIODES ARE 1N4004 TYPICAL

MULTIPLE INVERTER ON / OFF CONTROL WITH SINGLE SWITCH



NOTES:
1. USE DIODE 1N4148 OR EQUIVALENT
2. THREE INVERTERS ARE SHOWN. USE THIS TECHNIQUE FOR ANY NUMBER OF INVERTERS.



Control I/O (low voltage)

AC Power Input

PTI 1900 William Street Racine, WI 53404-1875 Tele: (262) 637-7180
Fax: (262) 637-7157
Web Page: http://www.plasmatechnics.com
http://www.plasmablock.com
E-Mail: sales@plasmatechnics.com

DAT 310 Status LED description

+5vdc	Low voltage DC supplies are operational (line voltage applied to unit).
INV ON	**On solid** – Inverter output enabled. Ozone output per PDM command, if enabled. **Flash** - Output enabled via ON command but disabled by PDM < 2ma (4/20). Output is re-enabled if PDM > 3ma, 'INV ON' LED on solid.
LOCKED	**Flash** – Semi-Automatic tuning is enabled when jumper J5 is removed. Frequency tuning occurs during flash interval. Search rate varies automatically: See switch S8. The Voltage pot is active and should be used to set the desired full power operating level. See: 'Start' button adjustment procedure. **ON solid** – Occurs only in 'Auto-Tune mode when Jumper J15 is installed and signals that the proper operating point has been established and 'locked'. The indicator is ON continuously, and only winks off momentarily while a new scan of the operating parameters is conducted.
LOW POWER	**Flash** – Output current is slightly below the programmed tolerance window. A service request enunciation is placed via the soft fault if switch S5 is ON. No disabling action is taken in this state. If the current continues to drop, the flash will transition to an on steady (solid) mode – see ON solid, below. Note: It is normal for the LOW POWER LED to flash for a few seconds when a large incremental increase in PDM is commanded. This can be helpful in that it will provide a visual indication that the PDM control input is being stimulated. No enunciation action is taken. **ON solid** – Output current to the ozone cell is lower than the allowable programmed window. If sustained, a hard fault will be generated in 32 seconds, which disables ozone production when FAULTED LED is ON solid. This LED will be latched on indefinitely to provide service

diagnostics. The latched fault is cleared by either an OFF / ON transition (includes 4/20 off as well) or power cycle.

HIGH POWER

Flash – Output current is slightly above the programmed tolerance window. A service request enunciation is placed via the soft fault if switch S5 is ON. No disabling action is taken in this state. If the current continues to increase, the flash will transition to an on steady (solid) mode – see ON solid, below.

Note: It is normal for the LOW POWER LED to flash for a few seconds when a large incremental decrease in PDM is commanded. This can be helpful in that it will provide a visual indication that the PDM control input is being stimulated. No enunciation action is taken.

ON solid – Output current to the ozone cell is higher than the allowable programmed window. If sustained, a hard fault will be generated in 32 seconds, which disables ozone production when FAULTED LED is ON solid. This LED will be latched on indefinitely to provide service diagnostics. The latched fault is cleared by either an OFF / ON transition (includes 4/20 off as well) or power cycle.

LOAD FAULT

ON solid – Possible flooded cell, shorted cell or open transformer connection.

HOT LOAD

Wink – Cell temperature is slightly above programmed limit. No disabling action is taken in this state. If the temperature continues to increase, the wink will transition to a flash (longer duty cycle than wink) – see below. During this mode the processor is reducing the PDM level automatically in an effort to lower the cell temperature. This of course also reduces ozone output.

Flash – Cell temperature continues to rise. PDM is controlling power to hold cell temperature constant in an effort to produce some ozone and remain online. This elevated temperature will not damage the cell. A service request enunciation is placed via the soft fault if switch S5 is ON.

No disabling action is taken in this state. If the temperature continues to rise, the flash will transition to an on steady (solid) mode – see ON solid, below.

ON solid – The ozone cell temperature is higher than the allowable programmed window. If sustained, a hard fault will be generated in 32 seconds, which disables ozone production when FAULTED LED is ON solid. This LED will be latched on indefinitely to provide service diagnostics. The latched fault is cleared by either an OFF / ON transition (includes 4/20 off as well) or a power cycle.

HS TEMP

Wink – Heat sink temperature (electronics) is slightly above programmed limit. No disabling action is taken in this state. If the temperature continues to increase, the wink will transition to a flash (longer duty cycle than wink) – see below. During this mode the processor is reducing the PDM level automatically in an effort to lower the heat sink temperature. This, of course, also reduces ozone output.

Flash – Heat sink temperature continues to rise. PDM is controlling power to hold cell temperature constant in an effort to produce some ozone and remain on line. This elevated temperature will not damage the cell. A service request enunciation is placed via the soft fault if jumper J4 is in place. No disabling action is taken in this state. If the temperature continues to rise, the flash will transition to an on, steady (solid) mode – see ON solid, below.

ON solid – The heat sink temperature is higher than the allowable programmed window. If sustained, a hard fault will be generated in 32 seconds, which disables ozone production when FAULTED LED is ON solid. This LED will be latched on indefinitely to provide service diagnostics. The latched fault is cleared by either an OFF / ON transition (includes 4/20 off as well) or power cycle.

IGBT FAULTED

If a short circuit is present on the inverter output, sophisticated electronic circuits instantly disable the effected power section. If this occurs over too many cycles, the output is disabled and a fault is enunciated.

FAULTED

Rapid Flash – signals a **SOFT FAULT** via open collector to terminal #11. **Switch S5 must be ON for this mode to be active**. A soft fault up to 32 seconds in length can be produced by any one of the following: cell operational current signature, high or low current, high instantaneous current in the output power section, over temp in the electronics or cell. A hard fault will **not** be latched or reported as a hard fault if the fault self-corrects within 32 seconds.

Both cell and electronics over temp conditions invoke an automatic closed loop turndown control of the PDM function that results in a constant, but elevated, cell temp. This condition can be sustained indefinitely. If the system can manage the event, no hard fault is delivered. The soft fault is continuous. **This is a summons for service.** Ozone production is curtailed, but not disabled.

On solid - signals a **HARD FAULT** via terminal #11 (pulls low). Ozone production is OFF; the nature of the fault is latched and enunciated.

DAT 310 Power Adjustment

By altering the 'Voltage' setting, you can easily modify the full power operational point if need be. Remember that the purpose of the PDM control is to provide a turndown from the 100% power set-point established by the 'Voltage' pot. Adjustment is very easy and would likely be desired if it is determined that the Plasma Block has much more ozone output than the application requires. You would know this if, for example, the closed loop control from an ORP unit always had the PDM adjusted to a very low value of current, like 6-10ma. For the sake of discussion, let's say we would like to adjust the 10g product from its normal 130w level down to 100w.

1. **Apply a current clip** to one of the AC power wires, terminals 1 or 3 of Con13.
2. **Switch S1 OFF**. This forces 100% output.
3. **Verify current** level at factory setting, which at 120vac should be per table: about 1.1a. If this does not agree try another amp meter, or better yet, a power analyzer. An inexpensive and surprisingly accurate power meter can be purchased for $25-$35: UPM model EM100 or Kill-A-Watt from P3 International.
4. **Switch S5 OFF**: fault enable. This will prevent any faults, such as current out of window, from shutting down the unit while it's being adjusted.
5. **Pull jumper J5**, which will select the Semi-Auto mode and allow the 'Voltage' pot to be observed.
6. **Adjust 'Voltage' pot** to desired value using the table below as a guide (J16 set to IN). Ozone levels alone can also be used if they are lower. The processor continues to optimize other aspects of the tuning process as indicated by the **occasional wink** of the 'Locked' LED. Additionally, the processor will not allow excessive levels to be commanded if that may endanger any of the unit's components. If the 'Voltage' control is increased excessively, and a safety limit is reached, the '**HS temp' and 'HOT load'** LEDs will **flash rapidly** in an alternating manor. Simply **reduce** (CCW) the voltage **control** to an acceptable level of current and the LEDs will extinguish.
7. Lock in the new set-point by **pushing the 'Op_OK' button** per the description found in the section titled 'programming current and operating power level'. This permanently stores the new parameters in the processors memory and causes a reboot of the unit.
8. Switch S1 and S5 to ON. Reinstall J5. Re-enable by cycling the inverter OFF and ON.

You should now observe that the PDM level (power control) being commanded from the ORP unit is much greater, hence making the control loop more stable.

Power Level Table:

Model	Watts	120/60 Amps	208/60 Amps	240/60 Amps	220/50 Amps	
10g	100	.86	.52	.47	.48	
10g	115	.98	.58	.52	.56	
10g	130	1.10	.65	.58	.62	**DEFAULT**
20g	235	1.97	1.16	1.02	1.10	
20g	250	2.10	1.22	1.08	1.17	**DEFAULT**
20g	265	2.22	1.30	1.13	1.22	Must be in a cool environment

Saving operating power configuration in memory

Method of setting "expected power" value and "tolerance" value (for running the "high power and low power" fault detection) is as follows:

Have inverter off for about 4 seconds to allow "offsets" filters to stabilize.

Turn inverter on, tune it up, making sure PDM duty cycle is at least 67%. A 100% PDM duty cycle is best, if the system can tolerate the resulting power level.

Allow inverter to run at desired operating point for at least 4 seconds.

Push "OP OKAY" button, and see two yellow LEDS come on. (This LED display pattern will remain, as long as you hold the button in for less than 5 seconds.) Release the button, and the two yellow LEDs blink slowly, indicating a loose tolerance of 40% on "expected power" for high-power and low-power detection.

Push "OP OK" button a second time, until you see the two yellow LEDS being on together. Release button, and blinking rate is medium, indicating medium tolerance of 20% for "hi/low detection."

Push "OP OK" button a third time, until you see the two yellow LEDs on together. Release button, and blinking rate is fast, indicating tight tolerance of 10% for "hi/low detection."

Push "OP OK" button a fourth time, until you see the two yellow LEDs being on together. Release button, and blinking rate is slow, indicating we're back to the "loose" tolerance level of 40%.

Select the desired band by the above process. 20% is the recommended default.

Now push "OP OK" button, and hold it in for more than 5 seconds, and you'll see two RED LEDs come on. Release the button, and all of the LEDs come on --> the inverter has computed an 'expected power' value, a 'tolerance' value, and has stored the values in on-chip FLASH, then did a power-down / power-up sequence.

If you held in the "OP OK" button for more than 5 seconds (so you get the two RED LEDs), and then released it, but you DON'T see the "power-up" flashing pattern of lights, then the software did not modify either the "expected power" nor "tolerance" data values. Try again.

Safety issues in the software:

1. If inverter is off, you can get the "two yellow LEDs" and "two RED LEDs" display patterns (by pushing the button "less than 5 seconds" or "more than 5 seconds"), but then nothing happens when you release the button. (Neither the "expected power" value nor the "tolerance" value is modified.)

2. If inverter is on, and you've set up a "tolerance" level (with a "less than 5 seconds" button push), but then don't do any follow-up button pushing, the whole "set up average power" stuff goes back to "idle" after a 60-second time-out.
3. If the inverter is on, and you did not first set up a tolerance value (with a "less than 5 seconds" button push), and then you try setting "expected power" (with a "more than 5 seconds" button push), the software will not modify any "expected power" or "tolerance" values.
4. If the PDM is set to something less than 100%, the "expected power" is computed by scaling the observed power level by 1/(PDM duty cycle). In other words, if duty cycle is 80% when the OKAY button is held in for more than 5 seconds, the "expected power at 100% PDM" would be computed as expected power = (observed power at 80% PDM) x 1.25. But if the PDM duty cycle is less than 66%, the extrapolation might start to give bad values for "expected power at 100% PDM" and then the inverter's "expected power" values are not modified at low PDM settings.
5. If, when accounting for the PDM duty cycle, the software thinks that the computed "expected power" value would be higher than 0xFF (i.e., larger than what an 8-bit byte can hold), the maximum allowable power supply value will be substituted for expected power.

Setting the power level without a meter, via the 'Start' switch

1. Check that J5 is removed. (This is the jumper plug that is most distant from the two pushbuttons.) Note: If J5 is installed, the inverter is set up to run "fully automatic" mode, not "semi-automatic".
2. Check that the jumper plug near the "T1_CMD test point" is in the proper position for your "voltage" command level. For instance, if using the Voltage potentiometer on the board, the jumper should be in the INT position. If using an external potentiometer or PLC, the jumper should be in the EXT position.
3. Check that your system can tolerate having the inverter operate at full power for several minutes (PDM will be at 100% duty cycle).
4. Turn the inverter on. Look for the "INV ON" LED to be lit. Note: This procedure will not work unless the HS TEMP indicator is blinking.
5. Push the START button for a time interval between 2 and 4 seconds. (During this push, the HIGH PWR, LOW PWR, and LOCKED lights will all light up in a flashing pattern.)
6. When you release the START button, the "HS TEMP" indicator will blink once per second. Note: This setting procedure will only work if the HS TEMP indicator is blinking.
7. If the LOW PWR indicator is lit up, turn the Voltage pot "up" slightly. Then wait for 5 seconds to see how things stabilize. If using the Voltage potentiometer, turn it CW 1/2 turn, then wait 5 seconds. If the LOW PWR indicator continues to be lit (or blink), continue to turn the Voltage pot up slightly, and wait 5 seconds after each change, until the LOW PWR indicator goes dark.

8. If the HIGH PWR indicator is lit up, turn the Voltage pot "down" slightly. Then wait for 5 seconds to see how things stabilize. If using the Voltage potentiometer, turn it CCW 1/2 turn, then wait 5 seconds. If the HIGH PWR indicator continues to be lit (or blink), continue to turn the pot down slightly, and wait 5 seconds after each change, until the HIGH PWR indicator goes dark.
9. When you are "close" to the proper point, both the HIGH PWR and LOW PWR indicators will be dark. Turn the Voltage pot "up" slightly, until the HIGH PWR indicator starts to blink. Note the control's setting (or the screwdriver position). Turn the Voltage control "down" slightly, until the LOW PWR indicator starts to blink. Note the control's setting (or the screwdriver position). Put the Voltage pot setting midway between the "HIGH PWR blink" and "LOW PWR blink" positions. This will be very close to the proper power level.
10. Push the START button for approximately 2 to 4 seconds. (The HIGH PWR, LOW PWR, and LOCKED lights will all light up in a flashing pattern.) The "HS TEMP" indicator will stop blinking. If you don't do this step, then when 2 minutes elapsed since the last time you adjusted the Voltage, the "HS TEMP" indicator will stop blinking on its own. This confirms that the unit is operating at the proper frequency.

Section 8

TROUBLESHOOTING

PROBLEM	STEP	VERIFY	NEXT STEP
ON - OFF switch/PLC control - nothing happens	1	Is there power to the inverter?	No - troubleshoot elsewhere. Yes - Get a voltmeter and do Step 2
	2	Was there 5 seconds between applying power and the ON command?	No - increase the timing between application of power and the ON command. See Section 6 p.18 & 19. Yes - Step 3
	3	+5 VDC between Terminals 5(+) and 3 on CON12 and +5 green LED ON?	No - Check connector seating, broken wires to the small power supply inside the generator toward the rear. Replace supply if necessary. Yes - There is power to the inverter. Step 4.
	4	Is the "INV ON" light on? Measure voltage terminals 3 & 5 Connector 12. Verify if the external command output power setting is at zero? Verify 4/20 or 0 - 10 VDC control as set by Switch 8 on the inverter board.	No - Step 5 Yes - Increase the ozone output control voltage/current.
	5	If you have gone through steps 1 - 4 without results, it is possible that the inverter board has failed.	Replace the inverter circuit board. Refer to the instruction sent with the replacement to ensure reliable operation.

FAULT indicators on the circuit board are illuminated.

ALL LEDS flashing	1	Low voltage power supply cycling on and off	Problem with a broken wire, mis-wiring or shorted circuits in the inverter electronics. Look for metal drilling chips caused by contractor drilling. If there, vacuum the electronics thoroughly and retry. If this is not the problem, go to 2.
	2	If there are no other shorts in the system or the system is mis-wired, the low voltage power supply may be defective.	Replace the low voltage power supply.
FAULTED light - Flashing = soft fault temporary condition	1	Caused by: High or Low cell current, high instantaneous current in power section, over temperature in the electronics or cell.	Usually this fault is a result of improper tuning of the inverter beyond factory limits. Go to Step 2
	2	Is the ambient temperature greater than 40 C (104 F)?	Yes - Improve ambient air flow. Inverter will eventually compensate by running at reduced power. No - Go to Step 3
	3	Retune the inverter using the procedure in Section 7. Review Section 4.	This should solve the problem if flashing. Flashing is a "call for service" with reduced ozone output.

FAULTED light - On solid = Hard fault condition and the inverter is locked OFF	1	Look at other fault lights to diagnose the problem. Ozone production is turned OFF.	Go to step 2.
IGBT FAULTED	2	Is IGBT faulted light ON?	Yes - There is a short in the inverter output section that has exceeded the allowable event limit. Look for damaged or loose wires, metal chips, water corrosion or anything that could cause a short. No - Go to step 3
HS TEMP	3	Is HS TEMP faulted light ON?	Yes - Review Status LED description for detail No - Go to Step 4
HOT LOAD	4	Is HOT LOAD faulted light ON	Yes - Review Status LED description Section 6 for detail. No - Go to Step 5
LOAD FAULT	5	Is LOAD FAULT light ON?	Yes - Possible water flooded cell due to the process entering the cell. If the process water is clean, empty the water out of the cell and flush with DI water or 91% alcohol. EMPTY FLUSH WATER FROM CELL! Then dry with very dry oil free air or oxygen for several minutes. Try to operate again. Do not disassemble the cell. Call the factory. No - Go to Step 6.
HIGH POWER	6	Is HIGH POWER light ON?	Yes - Review Status LED description Section 6 for detail.
LOW POWER	1	Is LOW POWER flashing?	Yes - This is non-critical indication that the power is less than the programmed window. No - Go to Step 2
	2	Is LOW POWER ON steady?	Yes - Output current is too low than the programmed window. If this condition remains for more than 32 seconds, a hard fault will shut off ozone and turn on the fault LEDs for diagnostics. Review Status LED description in Section 7 for more detail.

Other problems in your equipment:

The gas inlet solenoid valve chatters rapidly	1	The time delay for the gas pressure switch to operate and keep the valve open.	Yes - Fixed by increasing the time delay in the PLC or controls. No - Go to step 2
	2	Gas flow restrictions upstream from the generator or gas pressure too low for the pressure switch.	

Ozone output too low and under spec.	1	Is the PDM control voltage/current correct? Are the jumpers configured right for current/voltage control?	Yes - Go to Step 2 No - Review Jumper Block Configuration in Section 6
	2	Is the oxygen generator producing at least 92% oxygen?	Yes - Did you check this with an oxygen gas analyzer? You need more than 90% O2. Don't know - If an analyzer isn't available, get an oxygen bottle from a welding shop or compressed gas supplier. Install the bottled gas instead of the PSA oxygen generator. No - Go to Step 3
	3	Is there process water in the cell? The DAT 310 inverter may be faulted too.	Yes -See Troubleshooting comments under LOAD FAULT for remedy. No - It may be necessary to return the entire generator for analysis. Call the factory.
Inverter may or may not show a fault but NO ozone output detected	1	Was there a vacuum pulled in the cell by the injector with inverter power applied?	Yes - The cell(s) must be returned to the factory and be rebuilt. They cannot be field repaired due to excessive damage. Check to see if the gas inlet valve was closed while the injector was running and inverter power was applied. This is a common process design mistake. The cell should have no less than 5 psi with power applied. No - Go to step 2
	2	Is the PSA oxygen generator undersized or marginal causing it to run near maximum capacity?	Yes - This another common process mistake. The cell may be full of PSA resin and needs to be cleaned. A HEPA filter on the PSA oxygen outlet is good practice and may be necessary. No - Go to step 3
	3	Has the ozone monitor sufficient sample flow. Most monitors require about 1 LPM to operate?	Yes - Call the factory. The usual causes have been covered but there are other process considerations. No - Or no monitor available. Call the factory for further instructions.

Section 9

Ozone Performance Measurement Technique

PTI's flow bench utilizes tank supplied oxygen, delivered through pressure regulators. Our customer's most often use oxygen concentrators and their feedback confirms the notion that ozone production is equal to or better than PTI's published data using pure oxygen. We use bottled oxygen because many customers require products set to pressures in the range of 20 to 100 psi.

Flow is measured at the cell inlet via both Rotameter and mass flow. **Inlet flow devices** are on the oxygen side at **test pressure,** which implies the Rotameter must be corrected to standard LPM for proper sizing of the concentrator. PTI's mass flow meter corrects for 100% oxygen as well as gas pressure and temperature.

All pressure readings are psig and are measured at the distribution manifold outlet and inlet to minimize any pressure drop errors caused by higher flow rates.

Ozone flows from the Plasma Block under test into the flow bench, and has its flow rate controlled by precision needle valves. From this point on, ozone is essentially at atmospheric pressure. An ozone side stream is encouraged to travel into the analyzer at a rate of about 1 lpm, but is still at atmospheric pressure. A filter is also in-line with the analyzer inlet to prevent any possibility of fouling. All ozone leaves the flow bench at atmospheric pressure.

PTI has chosen the simple Rotameter method of performance presentation in the hope of simplifying the total process. Once a one-time correction is accounted for and the concentrator is sized, the actual running system will agree with PTI's published data, because virtually all installations use simple, inexpensive, air-calibrated Rotameters.

Equipment List:
Power by one of the following: Yokogawa WT110, Magtrol 5100, Fluke 43B, Fluke 41B.
Flow: Key Instruments Rotameters, Mass Flow TSI 4043 (with gas temp and absolute pressure display)
Pressure: mechanical pressure gauges, all $100+
Ozone: InUsa Mini Hicon (g/nm^3)

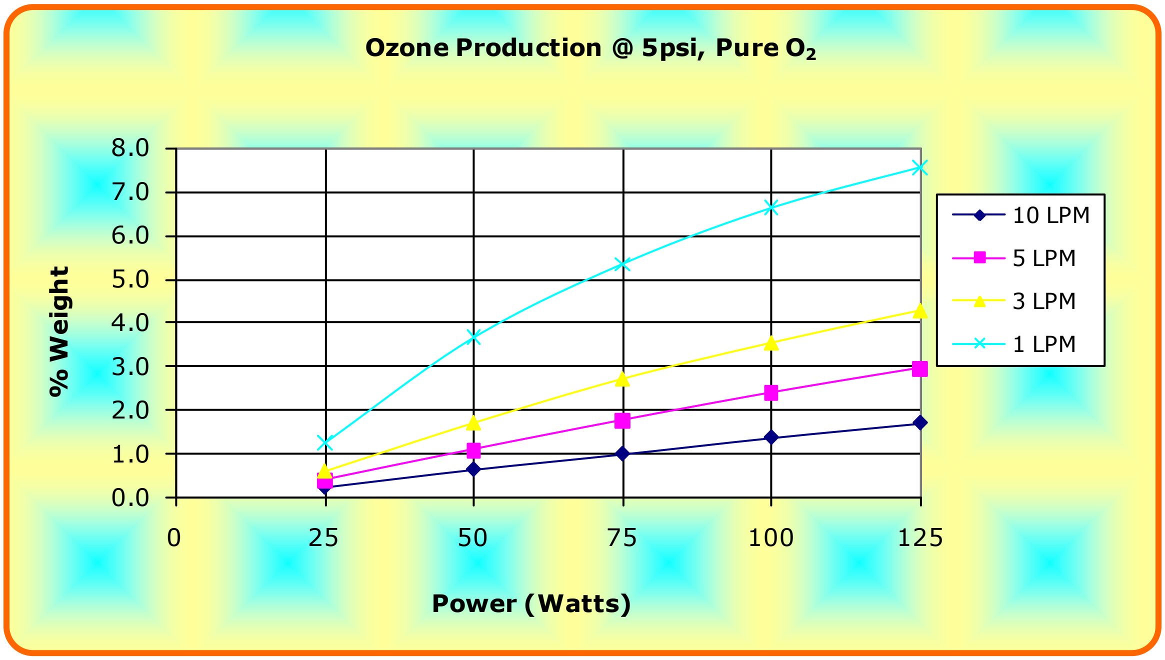
Compensation equation for PSA concentrator feed gas flow rate:

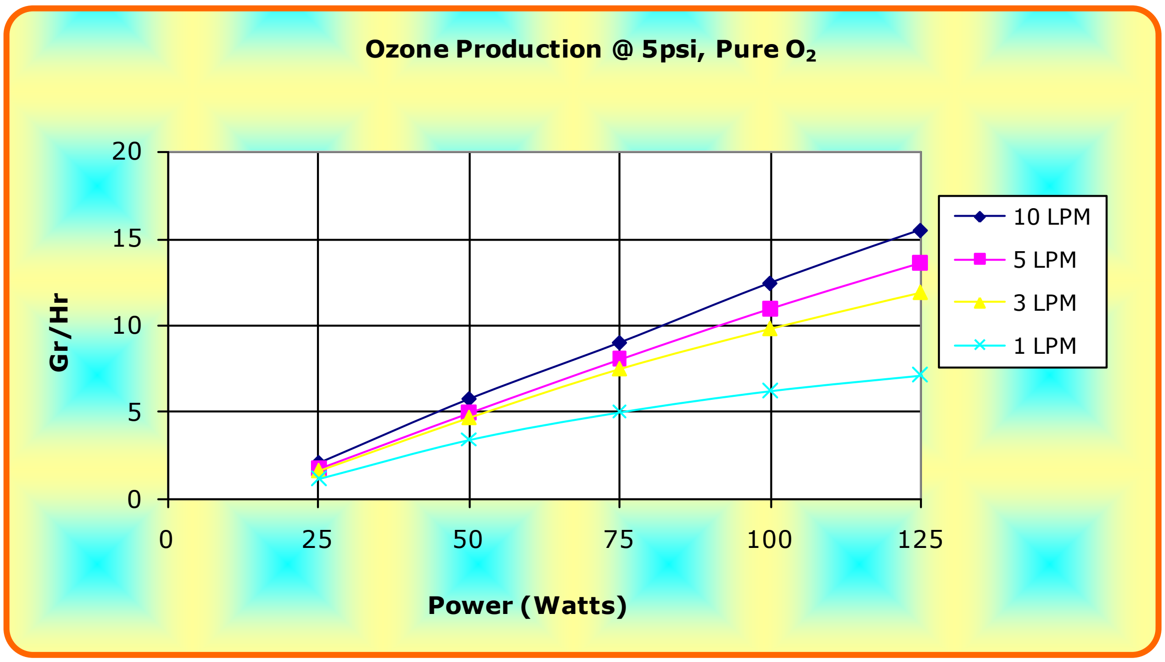
Actual **S**tandard **L**iters/**M**inute ≅ Rotameter flow * (Air to Oxygen flow meter coefficient) * √(14.7+psi)/14.7

Example: Inlet pressure = **10 psi**; Rotameter flow from test system or performance curves = **12 lpm**

Actual standard Liters/Min ≅ 12 * .95 * √(14.7+10)/14.7
≅ 11.4 * √ 1.68
≅ **14.78 lpm**

Note that temperature correction is generally neglected at typical room temperatures.

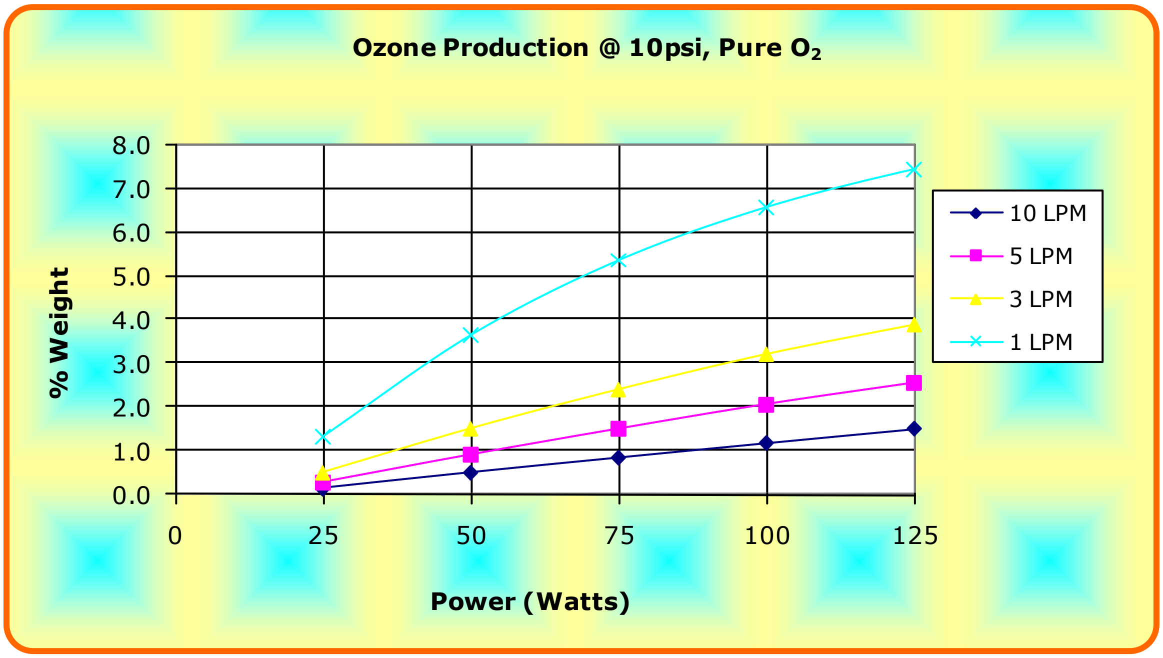


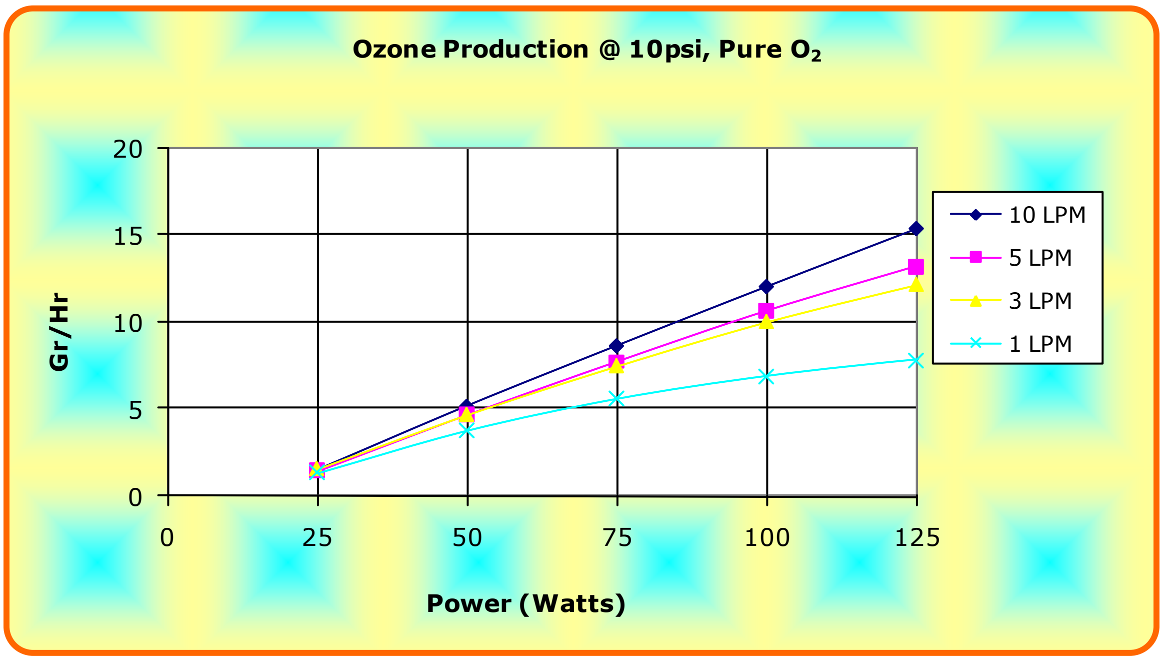


Normal factory POWER set point: 125 watts at FULL PDM (10vdc or 20ma).

Published production-ozone output level (10gr/hr) based on 5% concentration.
Tests conducted at 72°F, 700' MSL: all pressure readings in psig. Ozone in g/nm^3.
Flow measured in **LPM** via **uncorrected** Rotameter at inlet port. Ozone at 0 psi from side stream.
Fan and power supply burden of 17 watts is included in above chart.
Extrapolate lines below 25w for low power ozone output.

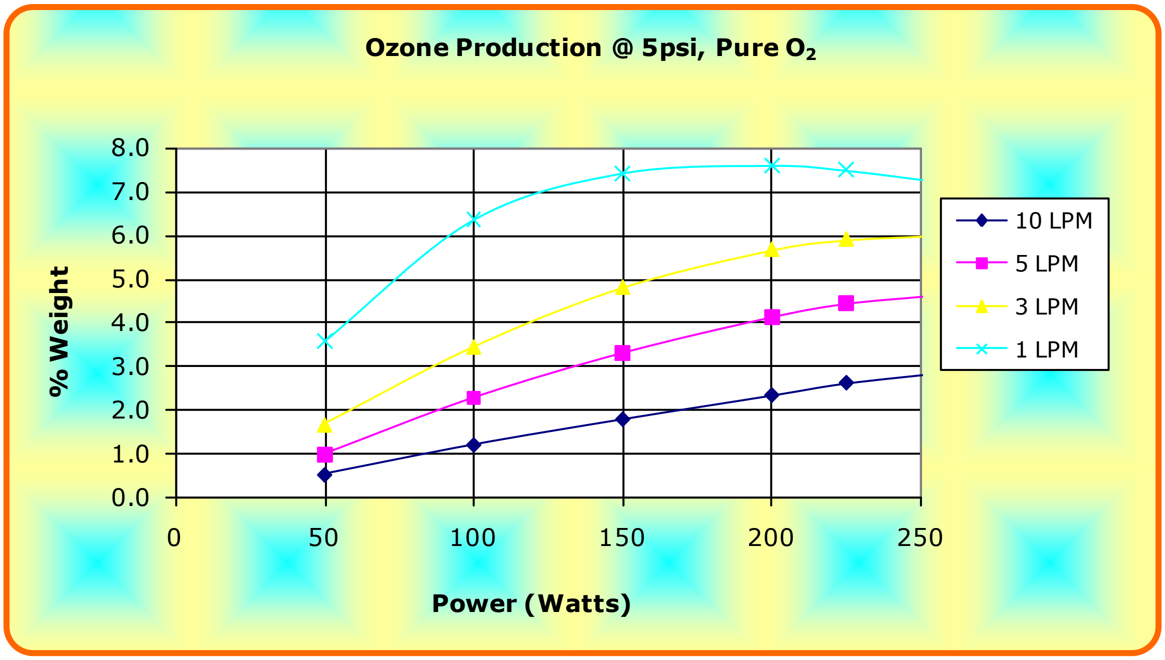
10g Plasma Block®

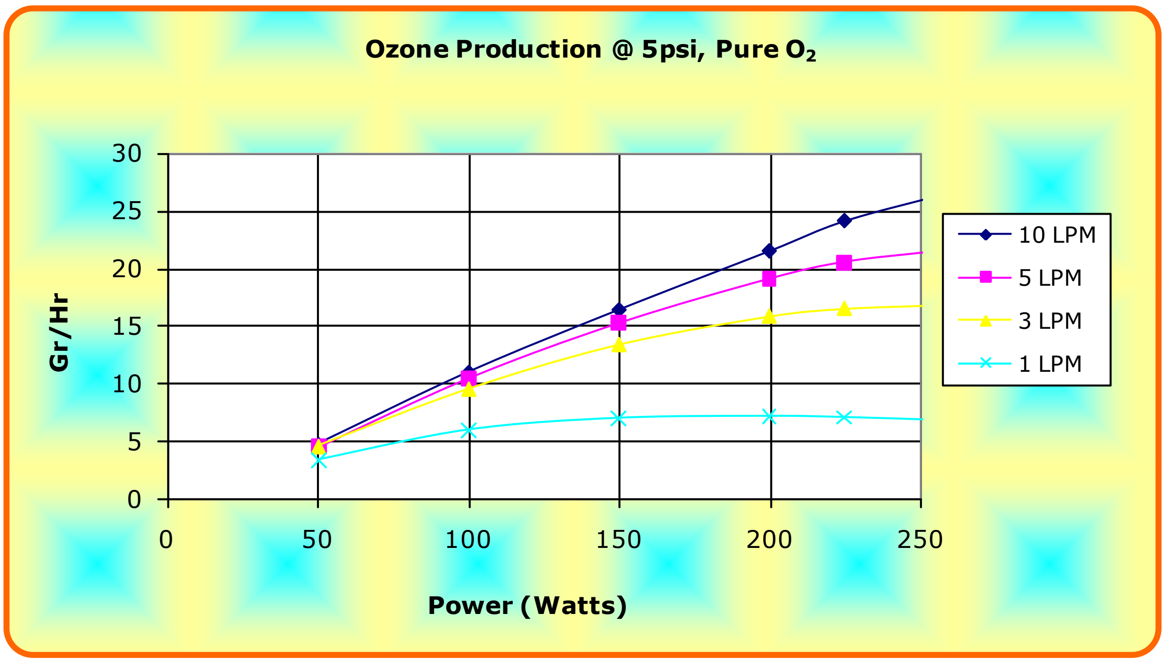




Normal factory POWER set point: 125 watts at FULL PDM (10vdc or 20ma).

Published production-ozone output level (10gr/hr) based on 5% concentration.
Tests conducted at 72°F, 700' MSL: all pressure readings in psig. Ozone in g/nm^3.
Flow measured in **LPM** via **uncorrected** Rotameter at inlet port. Ozone at 0 psi from side stream.
Fan and power supply burden of 17 watts is included in above chart.
Extrapolate lines below 25w for low power ozone output.

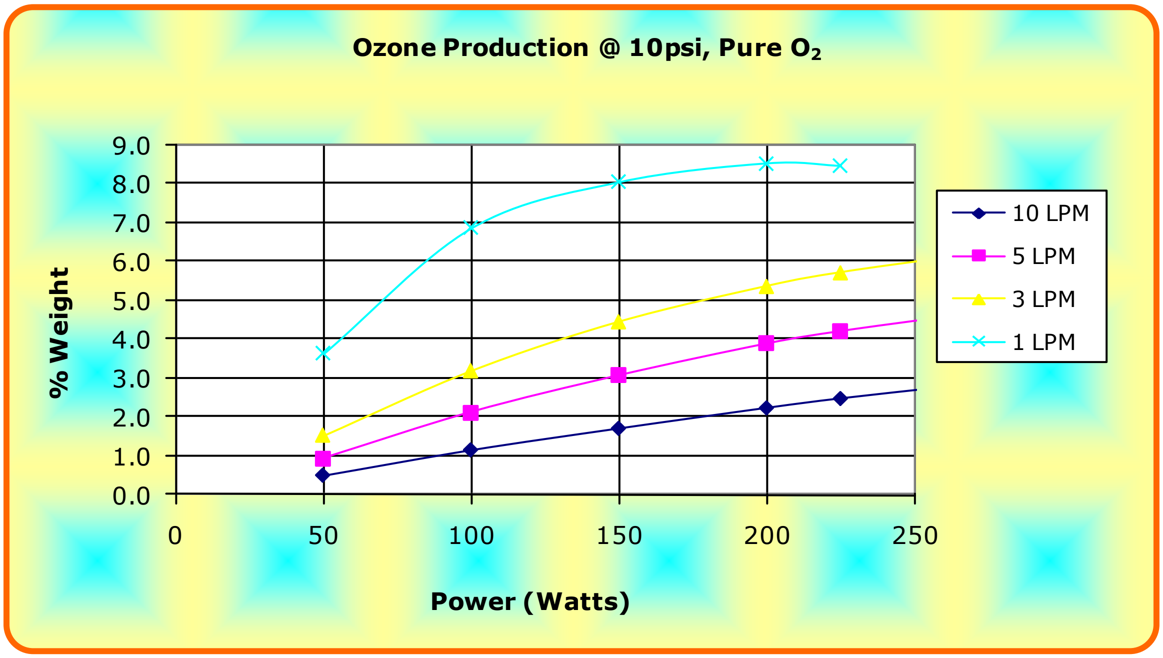


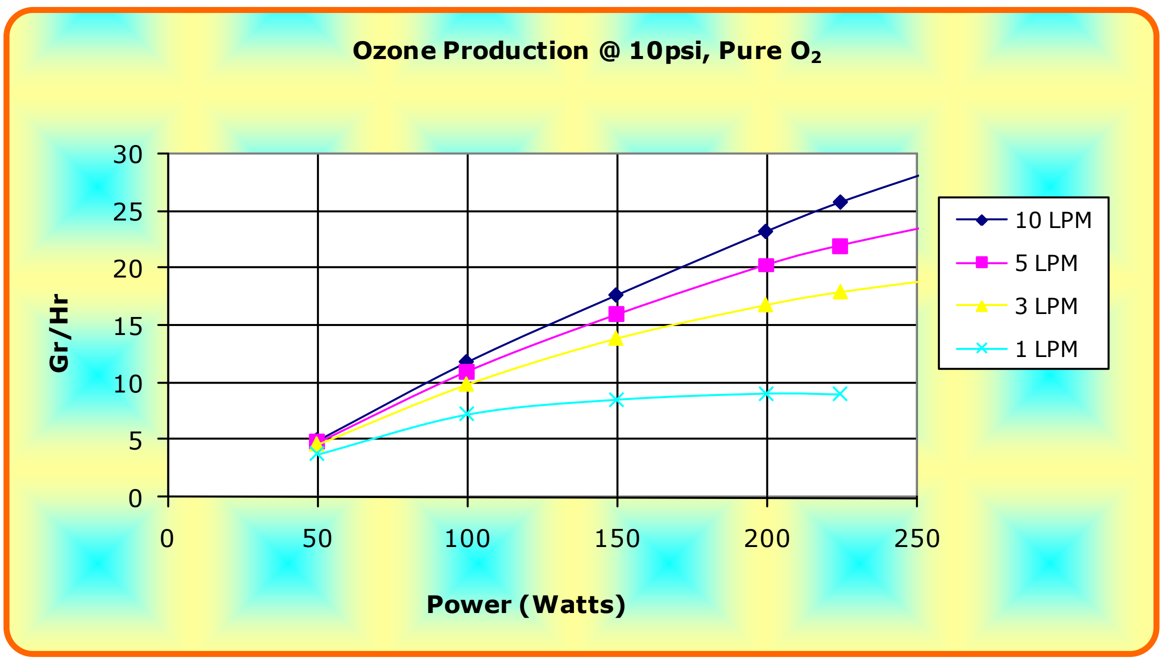


Normal factory POWER set point: 250 watts at FULL PDM (10vdc or 20ma).

Published production-ozone output level (20gr/hr) based on 5% concentration.
Tests conducted at 72°F, 700' MSL: all pressure readings in psig. Ozone in g/nm^3.
Flow measured in **LPM** via **uncorrected** Rotameter at inlet port. Ozone at 0 psi from side stream.
Fan and power supply burden of 20 watts is included in above chart.
Extrapolate lines below 50w for low power ozone output.

20g Plasma Block®



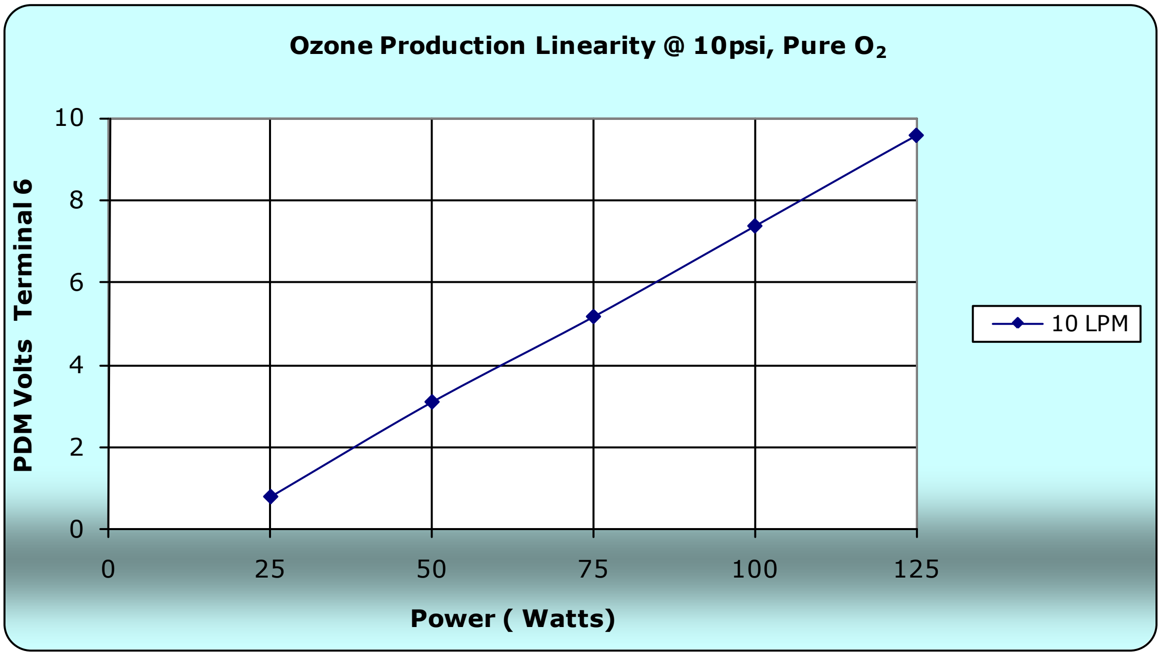


Normal factory POWER set point: 250 watts at FULL PDM (10vdc or 20ma).

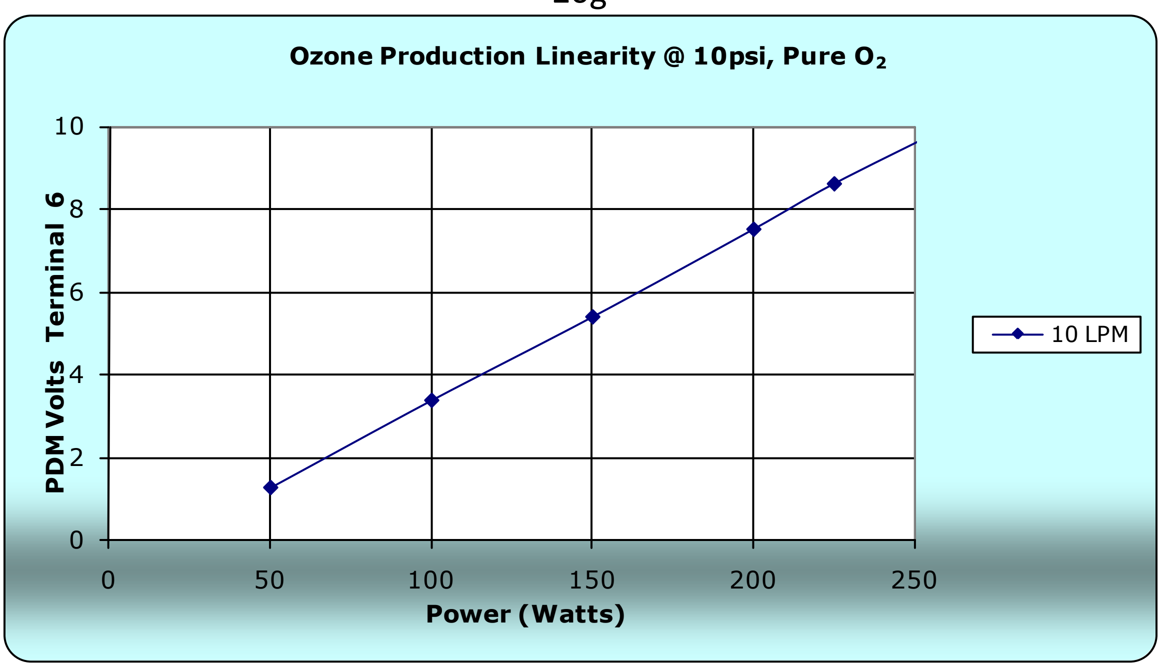
Published production-ozone output level (20gr/hr) based on 5% concentration.
Tests conducted at 72°F, 700' MSL, Gas: 'Standard' In; 'Normal' Out.
Tests conducted at 72°F, 700' MSL: all pressure readings in psig. Ozone in g/nm^3.
Flow measured in **LPM** via **uncorrected** Rotameter at inlet port. Ozone at 0 psi from side stream.
Extrapolate lines below 50w for low power ozone output.

Ozone Linearity vs PDM Command Signal

10g



20g



PTI 1900 William Street Racine, WI 53404-1875 Tele: (262) 637-7180
Fax: (262) 637-7157
Web Page: http://www.plasmatechnics.com
http://www.plasmablock.com
E-Mail: sales@plasmatechnics.com

NOTES & GENERAL INFORMATION

Enhanced product features include

1. **Soft** and **Hard fault reporting**. **Soft fault** will signal that attention is required. The system is still functional; perhaps at a reduced ozone output level. A **Hard Fault** is signaled when the Plasma Block has disabled itself. In both cases fault LED's will continue to display the problem until serviced. Reset is accomplished simply by an OFF followed by an ON command.

2. **Constant temperature mode**. If for some reason the cell or electronics cooling is compromised, the processor will reduce PDM automatically to maintain a functionally high cell temperature, all the while generating a Soft Fault. This limp along mode will be at reduced ozone levels.

3. Optionally selectable **High / Low current** fault reporting. This enables a latched fault if the cell current excursion is beyond a normal operational window. PDM level has no effect on enunciation. The tolerance window is easily field set to one of three levels.

4. **Easy troubleshooting**. Extensive fault reporting and fault latching, even if the output is stopped by the user or internal stop, preserves the fault condition indefinitely as long as AC power is applied.

5. **Longer fan life**. Fan speed unaffected by line voltage changes, and is temperature and time controlled. When ozone is commanded off the fan cools down the cell and turns off automatically, thereby **saving energy and extending fan life.**

6. PDM start up ramp rate is automatically controlled by cell temperature to reduce the chance of inadvertent thermal shock under extreme cold temperature conditions.

7. Extended PDM control methods include: 0 – 10vdc via Pot or PLC, 0 / 20ma, 4 / 20ma (with OFF below 2ma). All PDM modes utilize dynamic slew rate limiting for smooth and stable control.

8. 0 – 5vdc analog output for **bus current** and **bus voltage** enables simple PLC monitoring of real power without expensive CT's and complex interfaces.

9. Plasma Block will **engage when AC power is applied** if continuous ON command is present and jumper 8 is installed, thereby simplifying restart in simple, controlled environments.

10. All established operational parameters are **permanently saved in memory** even if power is removed. **No backup power or batteries** are used. Future firmware will likely include histograms of important performance data. On board RS232 interface, for future direct computer data interface.

11. Power on LED marquee verifies LED operation and displays **firmware revision level**.

12. Operating firmware is fully **encrypted** and field **upgradable**.

Firmware Version Information

Date ID only – Basic operational adjustments only, no LED status.

10008.001 – Added current window, PDM temperature control for cell and electronics with fault display, fan ramp, 100% fan ON select, fan controlled by time and temperature.

10008.002 – Added push button current adjustment, and power recording. Selectable Soft Fault output, 4/20ma selectable with shut down, improved fan ramp.

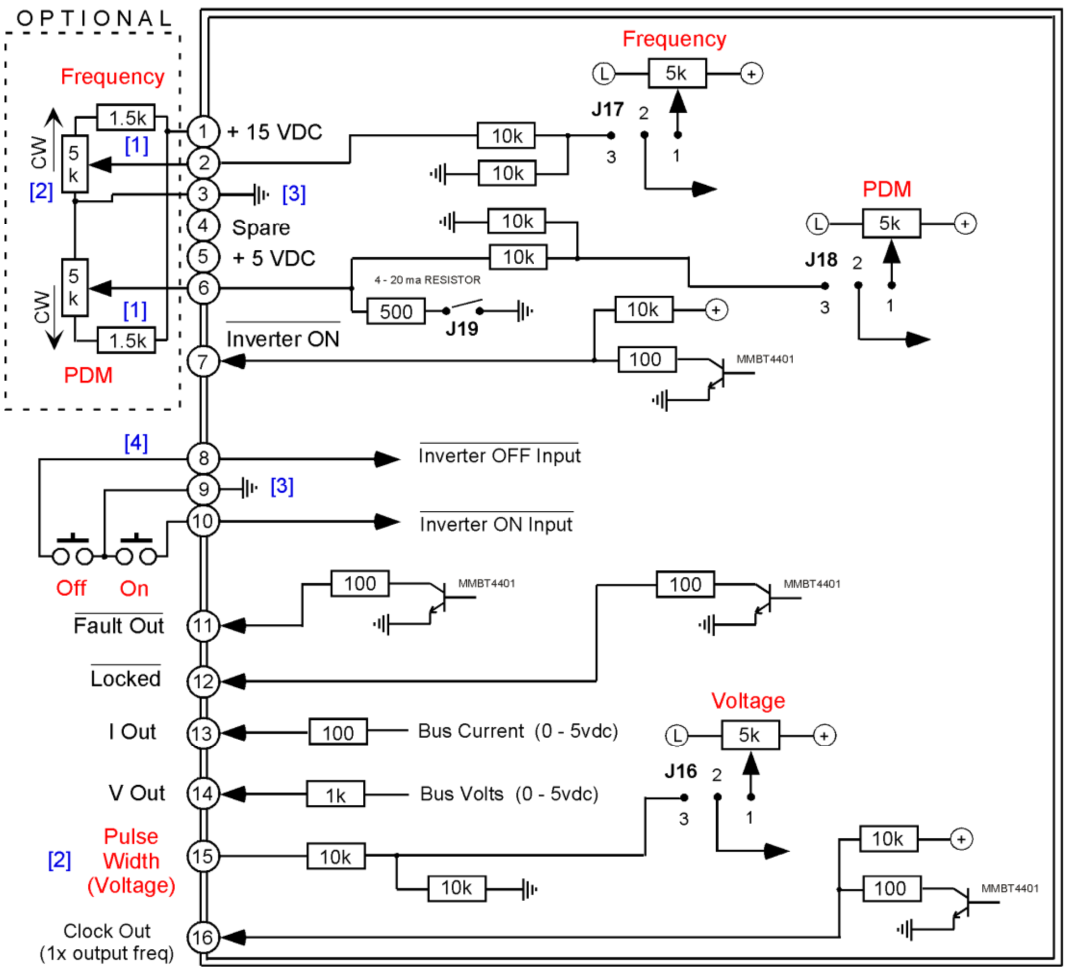
10008.003 - Added full automatic and semi-automatic tuning modes, Cell Fault diagnostics and enunciation. Changed J15 jumper assignment to select auto-tune.

10008.004 – Added 'Start' switch functions: Power setting via LED window, extended tuning sweep. Recall of factory defaults via 'Op_OK' switch. Manual control adjustment limits by product type.

EXTERNAL CONNECTIONS

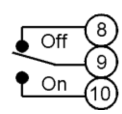
Note that the older 10/20 g/hr models may have the DAT 300 inverter board. The newer DAT 310 is very similar to the DAT 300. This section gives the user the information to make allowances for those few differences.

DAT300 Connections



- Grounding either #3 or #9 is not necessary and usually controlled by PLC.
- External pots for frequency and voltage should be multi-turn, cermet substrate types for stability and precision. Rating of 1/4 watt.
- Shielded cable recommended for connection runs of 2' or more.

[1] Optional but recommended (1/4w) to obtain full use of potentiometer range.
[2] External pot 5k, 1500 ohm resistor recommended as per note 1.
[3] Ground symbol represents circuit board floating common, not earth grounded. Best to leave floating or allow PLC to establish the ground relationship.
[4] Optional SPDT toggle switch or relay.



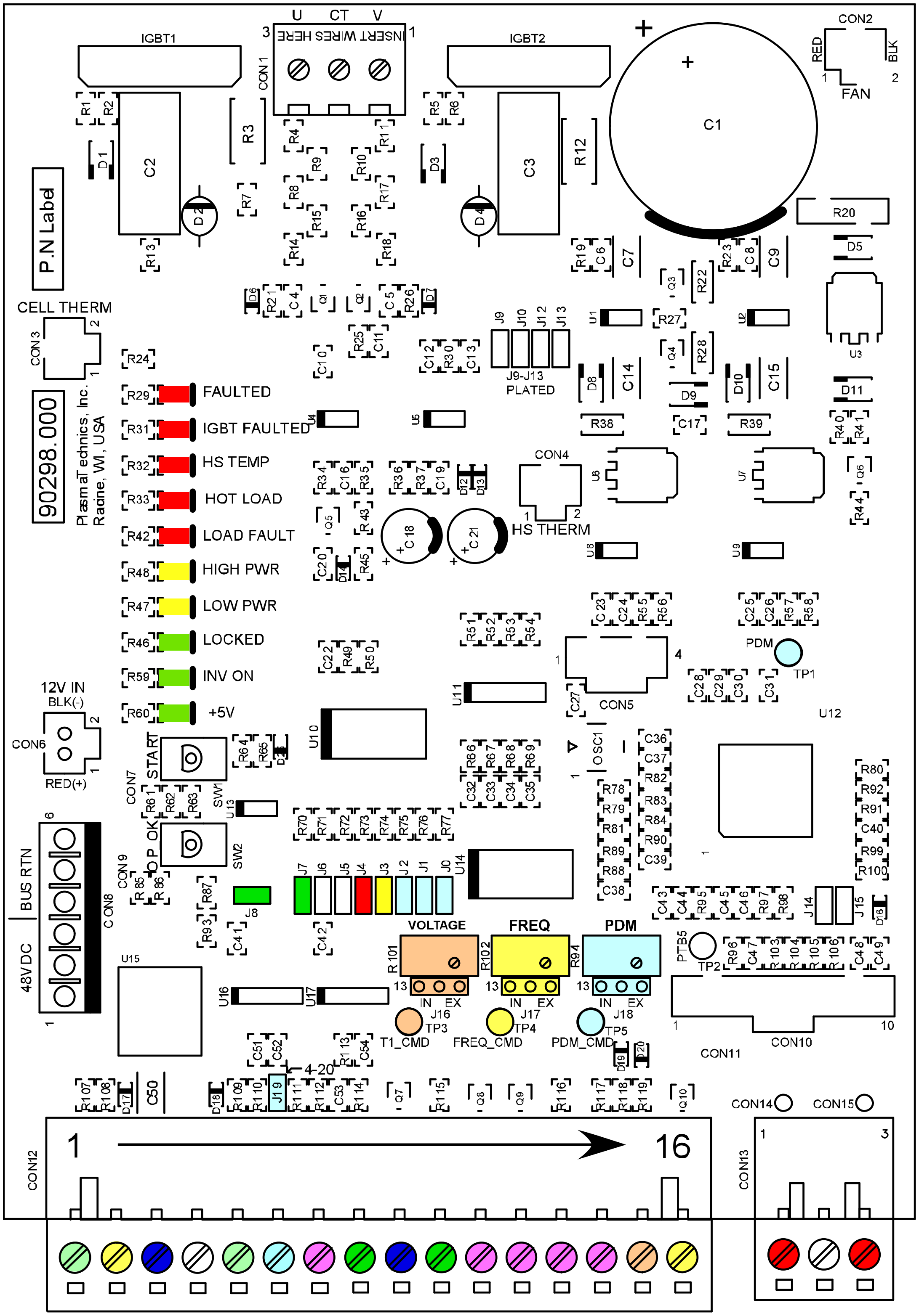
PTI 1900 William Street Racine, WI 53404-1875 Tele: (262) 637-7180
Fax: (262) 637-7157
Web Page: http://www.plasmatechnics.com
http://www.plasmablock.com
E-Mail: sales@plasmatechnics.com

DAT 300 Information

The DAT 300 (Digital Auto-Tuning) inverter board was used on earlier models of the 10/20 g/hr ozone generators. Most of the features and external connections are the same as the newer DAT 310 inverter board. Configuration switches and jumper blocks are different however. The following table can be used to cross reference to the DAT 310 information.

DAT 300/310 JUMPER CHART

DAT 300 Jumpers	DAT 310 SWITCH SW1	DEFAULT/STOWD D OR S	NAME	FUNCTION IF INSTALLED
J0	S1	D	PDM Enable	If PDM is remotely commanded, remove to test 100% output level. This is especially useful if the unit is hard wired to a PLC or ORP controller.
J1	S2		Alternate LOW PDM	Lower PDM period than 30 Hz
J2	S3		Alternate PDM	Alternate PDM
J3	S4	S	HIGH/LOW current fault	A window of normal operating current. This will cause a fault if either the LOW or HIGH value is exceeded.
J4	S5		Soft fault	Produces a wink in fault line #11 if one or more operational windows are exceeded beyond the factory limit. Will not shut down the inverter like a hard fault but attention is needed.
J5	S6			Spare
J6	S7			Spare
J7	S8		4/20 ma.	Configuration for 4 - 20 ma. control 0 - 100% ozone output. At 2 ma the INV_ON LED will flash. At 3 ma. The output is reinabled. If the jumper is removed, 0 - 10 (0 - 100%) volts controls the ozone output.
	JUMPER			
J8	J101		ON on power up	ON-OFF command change. The inverter will turn ON 5 seconds after power is applied and turned OFF when power is removed. This is not recommended because it eliminates gas purge.
J9 - 13	J1, 2 & 3		Factory use	
J14	J4		Manual fan	Fan goes on when power is applied and off when removed.
J15	J5	D	Full AUTO-TUNE	Voltage and frequency pots are not active. These parameters are controlled automatically. In SEMI-AUTO mode, the voltage pot controls total power but frequency control is automatic.
J16	J9	D	Voltage control pot	1 - 2 jumper = internal control. 2 - 3 = external
J17	J101	D	Frequency control pot	1 - 2 jumper = internal control. 2 - 3 = external
J18	J11	D	PDM control pot	1 - 2 jumper = internal control. 2 - 3 = external
J19	J12	S	4/20 ma. or 0 - 10 VDC	Adds 500 ohm resistor to control input.



Plasma Technics, Inc. DAT300 (rev0)

Control I/O (low voltage)

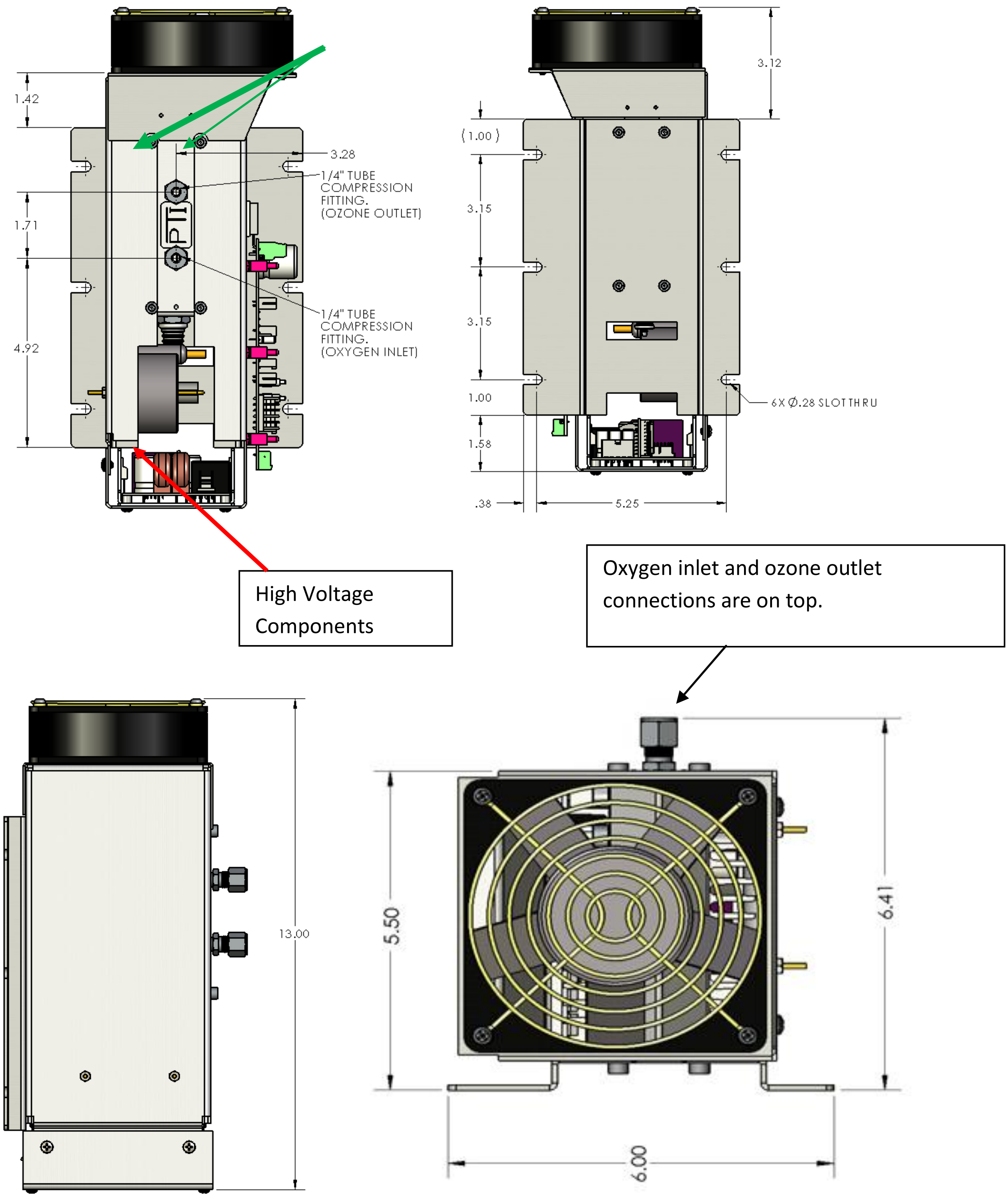
AC Power Input

PTI
1900 William Street Racine, WI 53404-1875
Tele: (262) 637-7180
Fax: (262) 637-7157
Web Page: http://www.plasmatechnics.com
http://www.plasmablock.com
E-Mail: sales@plasmatechnics.com

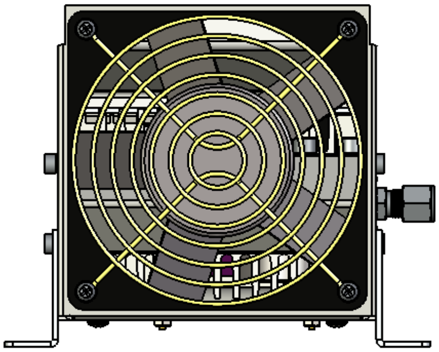
MECHANICAL DRAWINGS

Section 11

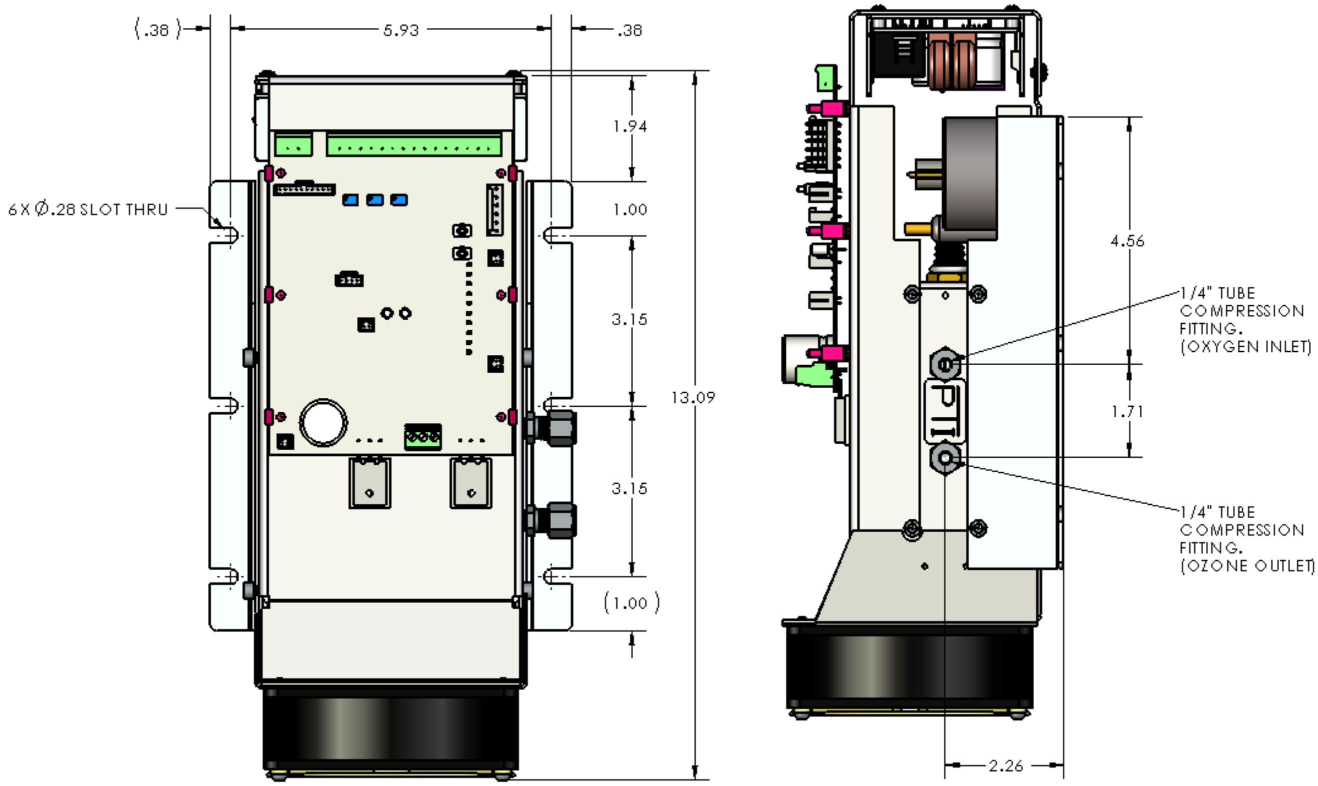
Mounting Option 1 (inches)



Mounting Option 2 (Inches)



Oxygen inlet and ozone output connections on the side. Both connections are ¼" tube compression fittings.



PTI Plasma Block®

Limited Warranty

The PTI Plasma Block unit is warranted by Plasma Technics, Inc., to the original purchaser to be free from defects in material and workmanship under normal use and service for a period of **FOUR (4) years** from the date of purchase under the following terms and conditions:

The obligation of Plasma Technics, Inc. is expressly limited to repairing or replacing, at the option of Plasma Technics, Inc., any PTI Plasma Block returned to it during the warranty period, which is determined by PTI to be defective in material or workmanship.

Any improper use /operation or installation other than in accordance with the published application materials, instructions and specifications established by Plasma Technics, Inc. shall void this warranty.

The obligation of Plasma Technics, Inc. Shall not include any transportation charges, costs of removal or installation, labor charges or any direct, indirect, consequential or delay damages.

Attachment or use of components or accessories not compatible with the PTI Plasma Block shall void this warranty.

Any alteration not authorized by Plasma Technics, Inc. in writing, accident, misuse, abuse or damage to the PTI Plasma Block shall void this warranty.

The Plasma Block subject to this warranty is not warranted as suitable for any particular purpose or use of the purchaser. The suitability of any PTI Plasma Block for any purpose particular to the purchaser is for the purchaser in the purchaser's sole judgment, to determine. Plasma Technics, Inc. assumes no responsibility for the selection or furnishing of a Plasma Block suitable to the purchaser's needs or the purposes of any particular purchaser.

This warranty is in lieu of any other warranty express or implied, including specifically but without limitation warranties of merchantability or efficacy and of all other obligations or liabilities in connection with the sale or use of the PTI Plasma Block.