Corona Supplies Ltd
for all your corona needs

Unit G, Howland Road Business Park, Thame, Oxon. OX9 3GQ. UK.
Telephone: +44 (0) 1844 261779 ~ Fax: +44 (0) 1844 358187 ~ E-mail: sales@coronasupplies co.uk

# CSI75

# POWER SUPPLY

## INCLUDING GENERATOR & ELECTRODE MAINTENANCE

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# CSI Corona Treater Power Supply

## Introduction

### About This Manual

This manual contains information for installation, operation, maintenance and repair. It should be read by all designers, installers, operators and maintenance personnel who will use or service this equipment.

This manual covers the Intelladyne series of corona treater power supplies.
Options are covered in a separate section. Some of the references in the options section may not pertain to your particular equipment configuration. Each part of the power supply system will be individually addressed.

If you have any questions regarding the installation or use of the product, you may contact a Corona Supplies representative for assistance. You may also contact the Service Department directly by telephone or e-mail.

### Corona Treating Process

Gases are normally very good electrical insulators or dielectrics. In the presence of a very strong electrical field, a gas can be forced to break down and lose its insulating capability. During this breakdown the gas molecules begin to ionize. This enables them to provide a conductive path from one molecule to another. In a corona treating system a strong electrical field is generated across an air gap between the electrode assembly and the treater roll. A conductive path between these two electrodes will be completed when a sufficient quantity of gas (usually ambient room air) has become ionized. A sudden discharge across this path will now occur usually resulting in a bright flash or arc. This is very similar to a lightning flash going to earth or the arc between electrodes in a laboratory experiment. In order to prevent this arc from completely developing, a solid dielectric barrier is placed in the path between the electrodes. This barrier partially interrupts the conductive path preventing a complete breakdown of the gas. Instead of a hot, localized arc, a cooler diffused glow will occur. This soft violet colored discharge indicates the incomplete breakdown of the gas and is called a corona. The material the dielectric or barrier is composed of is chosen so that enough current will flow between the electrodes and through it to sustain this corona.

During the treatment process, the web is passed through a high voltage discharge field and is exposed to the bombardment of high-energy particles. This corona field has the potential to break polymer bonds, cause micro-pitting, and deposit an induced surface charge with extremely

high levels of strong oxidizing agents onto the web. Any one of or possibly all of these processes can alter the surface characteristics of the material in a way, which enhances the surface adhesion and its ability to accept printing inks, adhesives, coatings, etc.

## Product Description

This equipment controls the level of power applied to the high voltage transformer for corona treating. Corona treating equipment is used to prepare the surface of a web to allow improved adhesion for inks and other coatings. This is accomplished by passing the material through a high voltage, high frequency electrical discharge. As the web material passes over the ground roll, a high voltage electrode produces a discharge, through the web, and into the ground roll. The surface of the web is modified during this process.

The CSI corona treater power supply does this by means of a high frequency sub-resonant IGBT inverter module and digital controller. The Intelladyne is available in many sizes to handle a wide variety of treating applications. The equipment is designed and built for operation in a non-hazardous atmosphere. The enclosure door is safety interlocked to prevent access to the electrical components when electrically energized.

The power supply is supplied in a NEMA 1 wall mountable painted steel enclosure. The cabinet is forced air-cooled and is provided with a hinged front access door for ease of cleaning and maintenance.

## Features

The Intelladyne corona power supply has some unique features, which differ from previous designs.

- **Full Color 6-inch Touch Screen** - Easy to navigate touch screen display. Display is menu driven allowing easy setup and operation. Operator, Supervisor (password protected), and Factory only accessible menus.

- **Help Screens** – Brief descriptions of menus and features available throughout the menu structure.

- **Data Logging** - Change of state event data logging capable.

- **Job Storage** – "Recipe" storage capabilities.

- **Humidity Compensation Control –** Reliable starting of corona treating equipment in extremely humid conditions.

- **Auto Start Capability –** Automatically starts inverter with internal or external control signal.

- **Auto / Manual Current Trip –** Trip reset can be done automatically to prevent untreated web.

- **Loss of Treatment Alarm** – Alarm circuit for customer use in the event of a loss of treat condition.

## Safety

Equipment Safety Features

The CSI enclosure includes a lockout disconnect switch and a door mounted emergency stop operator switch. There is one customer interlock input, two spare interlocks and an additional external E-Stop interlock input that can be utilized by the customer if desired.

Proper maintenance of the equipment, ***including periodic inspection***, is necessary to maintain the highest degree of safety.

Any moving parts could cause injury if a person comes in contact with them. The web of material moving through the equipment is no exception and caution should be used when working around the equipment during operation.

For your safety, you should never bypass the interlocks or guarding system while the equipment is operating.

. Precautions

Corona Supplies makes every effort to supply equipment that is safe and as free of hazards as technically possible. However, not all hazards can be totally eliminated by design. It is therefore imperative that all personnel who will use or service the equipment become familiar with this manual. Areas in this manual concerning safe operation are identified with one of the following symbols.

**CAUTION**

The corona is produced by the discharge of high voltage, high frequency electricity. Under certain circumstances, such a discharge can leap several inches through the air**.** ***Serious injury, or possibly death***, could occur if a person comes into proximity with components that carry high voltage.

Input power must always be ***disconnected and locked out*** at the source before service or setup of the equipment.

All guards, shields, and barriers must be in place before starting the equipment.

Do not wear neckties, jewelry, loose clothing or other items that can become caught in moving parts or mechanisms.

Do not operate, troubleshoot, or maintain the treater station or power supply while under the influence of any type of drug or alcohol.

Always observe all safety warnings and notices on the equipment and in this manual.

## Installation

Unpacking

Your Corona Supplies CSI corona treater power supply has been completely tested, inspected, and carefully packaged prior to shipment. Please remove packing materials carefully and watch for any visual signs that the equipment may have been damaged. Also ensure that all packing material is carefully inspected for components which may be hidden within them. If upon arrival you find that the equipment has been damaged in route, please do the following:

1. Retain all packing materials in which the equipment was originally shipped for possible inspection by the carrier.

2. Notify the carrier immediately upon confirmation of damage and file appropriate claim.

3. Notify Corona Supplies as soon as possible for instructions regarding the damaged equipment.

**NOTE:**
**Failure to contact the carrier prior to installation of equipment or disposal of packaging materials may result in loss of claim from the carrier.**

Care should be exercised to prevent damage to the high voltage transformer terminals.

Refer to the manual provided with your treater station for its unpacking instructions.

**CAUTION**

**Some circuits and components in this equipment are sensitive to electrostatic discharge. Servicing of internal parts should be performed only at a static safeguarded work area. At the very least, a static dissipative wrist strap should be worn to prevent damage to sensitive electronic components. Do not remove a circuit board or other static sensitive component from its protective bag without taking precautions against static.**

## INSTALLATION

Inverter

**CAUTION**

**It is the customer's responsibility to ensure that all applicable safety code requirements are complied with when installing this equipment.**

The CSI power supply is an air-cooled unit which is designed to operate in ambient temperatures up to 50°C (122°F). The power supply may be mounted in nearly any convenient location but it is very important to remember that the airflow around the cabinet should not be restricted when a mounting location is being considered. A minimum of 1 foot (0,3 m) of clearance is required on both sides of the cabinet for adequate ventilation. It is also necessary to allow for proper service clearance to open the front access door. The cabinet is designed for wall mounting and must be mounted so that the disconnect is between 2.0 and 6.2 feet (0,6 m and 1,9 m) from the floor.

**CAUTION**

**The power supply enclosure is intended for indoor use and provides a minimum degree of protection against falling water and dirt. The enclosure is also air-cooled and requires ventilation on the sides, top, and bottom to ensure adequate cooling. Please locate in an area that provides adequate protection and ventilation.**

High Voltage Transformer

The high voltage transformer is oil filled and should always be mounted in an upright position with the tank cover on top and the wiring terminal to the side. (See the Outline Drawings in the Service Section) It is very important to mount the transformer as close to the treater station as possible to reduce the length of high voltage cable. This will help to reduce the distance over which the special handling of high voltage conductors is required. Refer to the section on wiring for further information. This transformer is also designed to operate in a maximum ambient temperature of 50°C (122°F) and requires a 1 foot (0,3 m) clearance on all sides of the tank. Service clearance must be provided to permit ready and safe access to the equipment for maintenance. Refer to Article 110-32 of N.F.P.A. 70 (National Fire Protection Association -The National Electrical Code) and any other applicable safety codes for specific requirements.

Optional Input Transformer

This optional transformer, when furnished, may be mounted in any convenient location that allows for adequate air flow and service clearance around the transformer. A minimum of 1 foot (0,3 m) of clearance is required around all sides of the cabinet to allow for adequate ventilation and cooling. Service clearances will be predicated by the need to comply with local, State and Federal electrical codes such as N.F.P.A. 70. The transformers are designed to operate in ambient temperatures up to 50°C (122°F) maximum. Operation in temperatures exceeding 50°C (122°F) may cause premature failure of the transformer and possible damage to other components.

Optional Remote Display

The optional remote display is used to control the Intelladyne remotely. Please see the OPTIONAL EQUIPMENT section of this manual for further details.

Wiring

Wiring Practices

The power supply utilizes 24-volt signals for the customer interface. When installing wiring between the power supply and external devices, including the treater station, proper routing and grounding will be necessary. Low voltage lines must not be routed alongside or in the same conduit as AC Mains or power supply output leads. High voltage lines will inject noise into the low voltage lines. Shielded wires are required for the low voltage lines because corona-treating equipment can radiate high frequency noise through the air.

The signal and 120V power wires should be routed through electrical conduits or wire ways. Rigid or flexible conduit or raceway may be used, consistent with all applicable codes. Grounded metallic conduit or wire way must be used to ensure compliance with the European EMC Directive. In all cases, a ground wire whose wire diameter is equal to or larger (wire gauge equal or lower) to the diameter of the largest wire in the conduit, should be used to bond the power supply protective ground to that of the external device. This wire must be insulated to 300V minimum, colored green/yellow and routed through the same conduit or raceway. This ground wire should be terminated in the power supply to one of the green/yellow colored ground terminal blocks on the TB1 DIN rail, and should be terminated to an appropriately marked protective ground terminal on the external device, using a secure termination method.

The conduit or wire way should be affixed to the power supply cabinet in a convenient location. The entry location should be chosen to allow separation of signal wiring from all other wiring inside the cabinet. The best entry location is normally on the bottom of the cabinet near the TB1 terminal strip. The method of attachment must be compliant with all applicable codes.

## INSTALLATION

AC Mains supply

The power supply requires 380-515 VAC 3 phase input (with ground). The customer must provide this supply voltage circuit. If the required AC main voltage is not available, an optional input transformer must be installed to provide for the required voltage. In either case, a fused disconnect should be provided by the customer to insure proper over current and short circuit protection. Connect the VAC supply lines to the disconnect terminals 1L1, 3L2, and 5L3. Connect the input circuit's equipment safety grounding conductor to the grounding terminal labeled "PE" on the TB1 terminal strip or the ground stud on the enclosure wall.

The AC Mains and protective earth wires should be in a separate conduit or wire way from all other wiring. Rigid or flexible conduit or raceway may be used consistent with all applicable codes. The protective earth ground wire must be insulated to 600V, colored green/yellow and should be routed through the same conduit or wire way as the AC Mains wires.

The conduit or wire way should be affixed to the power supply cabinet in a convenient location. The entry location should be chosen to allow separation of Mains wiring away from all other wiring inside the cabinet; the best entry location is normally on the bottom of the cabinet.

High voltage transformer primary wiring

The connection between the power supply output terminals and the high voltage transformer should be accomplished by a twisted pair of wires with insulation rated for 600 VAC. Power supply output wires (1060 and 1070) are connected to terminal block TB1. These wires should be twisted to a minimum of 3 turns per foot (10 turns per meter) and routed inside a non-magnetic conduit or wire way. The ground wire should be connected to the green/yellow ground terminal block adjacent to the TB1 output terminals, and may be routed through the same conduit or wire way as the output wires. This ground wire must be insulated to 600V and colored green/yellow and should be the only wire attached to the high voltage transformer safety ground terminal (located under the protective cover over the input terminals). Refer to the System Interconnect diagram for the minimum wire sizes.

Due to the nature of the high frequency currents carried by the output wires, a standard ferrous (magnetic) conduit or wire way may be inductively heated and may cause the wire's insulation to fail. Electrical metallic tubing (EMT) or steel raceways are *not* suitable for this purpose. Aluminum or PVC conduits or wire ways are recommended for this application. Grounded metallic (non-ferrous) conduit or raceway is required to ensure compliance with the European EMC Directive.

The conduit or wire way should be affixed to the power supply cabinet in a convenient location. The entry location should be chosen to allow separation of the output wiring away from all other wiring inside the cabinet; the best entry location is normally on the bottom of the cabinet, near the TB1 output terminals. The conduit or raceway should attach to the sheet metal cover over the high voltage transformer input and ground terminals. Punch or cut an appropriate hole in the cabinet and high voltage transformer input terminal cover, and attach the conduit or raceway using strain relief clamps or fittings appropriate to the conduit or raceway. The method of attachment must be compliant with all applicable codes.

High voltage transformer secondary wiring

The connection between the high voltage transformer and the treater station electrodes must be installed with extreme care to prevent failure of these connections. The high voltage wire should be rated for a minimum voltage of 20 KVDC. We recommend using silicone wire type insulation routed through a metallic conduit or raceway. The high voltage wire should be centered inside the conduit and a 2 inch (5 cm) clearance should be maintained between the wire and the inside surface of the conduit. Use non-conductive, non-carbon filled material, such as Styrofoam to center the wire inside the conduit. This material should be UL recognized. Failure to suspend the wire away from ground referenced objects may result in arcing or failure of the wire and possible damage to the equipment.

The high voltage transformer has four #10-32 studs located on a 4.62 x 4.62 inch (117 x 117mm) square, suitable for a Hoffman Type 12, 4 x 4 inch (102 x 102mm) wire way. This is the recommended wire way system for this application. If multiple wire way sections are used, the individual wire way sections must be bonded together and to ground using AWG #16 or larger wire.

The high voltage return wire from the treater station should be connected between the treater station frame (near the treater roll grounding brush) and the HIGH VOLTAGE RETURN terminal on the high voltage transformer near the HV1 high voltage terminal. An AWG #10 or larger diameter wire should be used. The HIGH VOLTAGE RETURN terminal is grounded to the high voltage transformer tank, but *is not to be used for grounding the treater station or the high voltage transformer. Only the "protective earth" terminal on the input side of the transformer should be used for the safety ground.* The high voltage return wire should be routed *outside* the high voltage wire conduit. The best routing for this wire is alongside the conduit.

**CAUTION**

**The high voltage transformer should not be operated without proper grounding connections. Prior to operating the equipment, please ensure that the transformer tank is properly connected to an equipment safety grounding conductor and the metal raceway or conduits to which it is attached.**

Grounding Recommendations

The basic components of the corona system which require attention to grounding are the input transformer, power supply, high voltage transformer, and the treater station. The same grounding principles apply regardless of power supply design, but the IGBT designs are more sensitive to proper grounding than its SCR predecessors and are the reason why the earlier designs did not always adhere to portions of the following recommendations. It is important to recognize that the recommendations below are intended to be in accordance with the NEC Article 250 and in all cases the NEC and local regulations should be followed whenever they apply. The following is a list of grounding terms, which will be referenced in this instruction.

Building Ground - A metal water pipe, metal building frame, or ground rod, which provides minimum earth resistance.

Service Ground - The source ground provided by the main grounded service conductor.

Equipment Ground - Grounding of exposed non-current carrying metal of fixed equipment.

Input Transformer

When used, the input isolation transformer enclosure shall be connected to the grounded service conductor or service ground.

Power Supply

The power supply enclosure shall be grounded via a grounding conductor from the input transformer if used, or directly from the grounded service conductor or service ground.

High Voltage Transformer

The enclosure of the high voltage transformer should be grounded via a grounding conductor from the power supply enclosure. The conductor should be connected to the grounded service conductor at the power supply and to the enclosure ground stud provided on the transformer case. One leg of the high voltage secondary of this transformer is internally connected to the transformer enclosure. Since the high voltage secondary of this transformer is connected to ground at the transformer, the connection between the treater station and the transformer is a current carrying conductor. It is required that a separate conductor be routed between the transformer and the treater station ground brush. This connection point will be a separate stud labeled "HIGH VOLTAGE RETURN".

Treater Station

The frame of the treater station should be connected to building ground at the nearest possible location. In addition, a ground brush is provided on each of the treater rolls to bypass the return current from the high voltage transformer past the roll bearings to the treater station frame. A separate conductor should be routed from the treater station frame nearest the ground brush back to the high voltage transformer stud labeled "HIGH VOLTAGE RETURN".

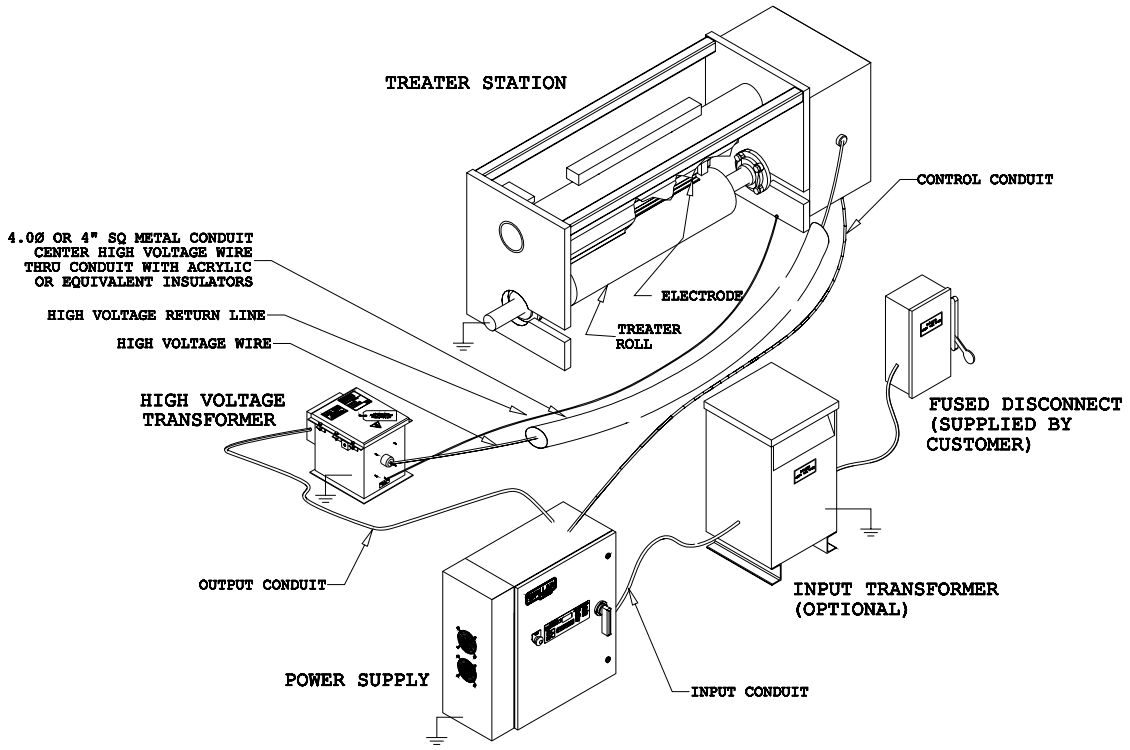



**Figure 1** – Generic Wiring and Conduit Runs

Customer Interfaces

All of the external interfaces described below are via DIN rail mounted terminal block TB1, located on the lower rear panel of the power supply cabinet.

**Treater Station Control Power –** (1 and 2) There is 120 VAC, 100 VA available to power the treater station control circuits. If the treater station control will draw more than 100 VA, or is not 120 VAC, then this control power cannot be used.

**Station Interlocks –** (501 and 502) This is a 24 VDC interlock circuit reserved specifically for the treater station interlocks. This connection must be closed to enable the power supply inverter to turn on.

**Customer Interlocks –** (503 and 504) This is an additional 24 VDC interlock circuit used for customer supplied interlocks. This connection must be closed to enable the power supply inverter to turn on. (Remove the jumper if used.)

**Encoder / Sensor Input –** (601, 602, and 603) Treater line speed encoder or sensor.

**Auto Start Input –** (801 and 802) The auto start input is a 24 VDC input. If enabled the auto start input will start the inverter when the contact is closed and the start button pressed and stop the inverter when the contact is opened. The inverter will then restart when the contact closes again. This is typically wired to a latched contact in the treater station which closes when the treater roll is up to speed.

**External Start –** (1233 and 1234) The external start circuit is a 24 VDC input. Use a momentary normally open contact closure to start the power supply. If the power supply is placed in "PLC Start mode", then a maintained contact closure can be used to start and stop the power supply.

**External Stop –** (1231 and 1232) The external stop circuit is a 24 VDC input. Use a momentary normally open contact closure to stop the power supply. If the power supply is placed in "PLC mode" then this contact is not used to stop. Only the External Start contact is used in "PLC mode".

**External Emergency Stop –** (1235 and 1236) The external emergency stop circuit is a 24 VDC input provided for a customer supplied dedicated emergency stop from another source. This connection must be closed to enable the power supply inverter to turn on. If the contact is opened while running, the inverter will shut off and an interlock fault will occur but power will remain on inside the power supply cabinet.

**Half-Power Signal –** (1237-1238 and 1239-1240) There are two 24 VDC half power inputs. These are used in conjunction with the high voltage switch at the treater station (if equipped). This will limit the power output to one half of the rated power of the inverter when only half of the electrode area is being used to prevent damage. If neither connection is closed, the inverter

will indicate an interlock fault.

**Loss of Treat Alarm Contact –** (803, 804, and 805) A set of normally open/normally closed (N.O./N.C.) relay contacts are available for actuating a customer supplied alarm. Whenever the power supply enters an alarm condition, this relay will be de-energized causing the contacts to change state. It will remain de-energized until the operator silences the alarm. These relay contacts are rated for 5 amps at 120VAC or 5 amps at 24 VDC. If an inductive load is to be connected, please install an arc suppressor across the contact.

**Power Supply Run Contact –** (806, 807, and 808) A set of normally open/normally closed (N.O./N.C.) relay contacts are available for customer use. Whenever the power supply is on, this relay will be energized causing the contacts to change state. These relay contacts are rated for 5 amps at 120VAC or 5 amps at 24 VDC. If an inductive load is to be connected, please install an arc suppressor across the contact.

**Interlock Status Contact –** (809, 810, and 811) A set of normally open/normally closed (N.O./N.C.) relay contacts is available for customer use. Whenever the interlocks are closed, this relay will be energized causing the contacts to change state. These relay contacts are rated for 5 amps at 120VAC or 5 amps at 24 VDC. If an inductive load is to be connected, please install an arc suppressor across the contact.

**Encoder Output –** (2235 and 2236) This output mimics the encoder / sensor input. This is rated for 5-volt TTL logic.

**Computer Interface** – (607, 609, 611, 613, 615, 617) Provides input for the customer to supply a 0-10VDC or 4-20mADC analog signal to control the output power set point. Also provided are 0-10VDC or 4-20mADC analog outputs for the customer to monitor actual output power, voltage, current, and frequency. Please see the OPTIONAL EQUIPMENT section of this manual for more information.

## INSTALLATION

Installation Inspection Checklist

1. Check for damage during shipping or installation.
2. Tighten all wire terminations and hardware.
3. Verify proper grounding to all equipment.
4. Ensure proper wire gauges. Be sure twisted and shielded wire is used as required.
5. Ensure non-magnetic conduit is used for the primary wire run to the high voltage transformer.
6. Ensure that the secondary wire run from the high voltage transformer is enclosed in a 4-inch metallic conduit. The high voltage wire must be suspended in the middle of this conduit.
7. Verify that the high voltage return is terminated at the treater station and the high voltage transformer.
8. Verify the exhaust ducting and the proper rotation of the exhaust blower.
9. Adjust the electrode pitch and gap on the treater station.
10. Apply power and verify all input voltages phase to phase and phase to ground.
11. Verify proper air pressure at the treater station and all control functions.
12. Ensure that the web is thread up properly.
13. Adjust the zero speed to the proper set point.
14. Verify that all the interlocks are adjusted and working properly.
15. Turn the power supply output to zero. Start the power supply. Slowly increase the power while monitoring the station. If you cannot achieve full power, you must re-tap the high voltage transformer.
16. Set up the treater station for the specific application.
17. Check treatment levels and adjust power as needed.

Impedance matching

Taps have been provided on the high voltage transformer primary terminals to match the impedance of the corona treater station electrode to the power supply. The lower voltage taps reflect higher current and lower voltage to the power supply. Always start at the highest voltage tap (X4-X0) when first starting the treater on line and whenever a major change is made to the treating station. Utilize the tap setting in which the required power output is achieved, while being at 80 - 100% on output voltage.

Symptom: Low current, high voltage, low kW:

Change to the next lower primary tap (e.g. change from X0 – X4 to X0 – X3)

Symptom: High Current, low voltage, low kW:

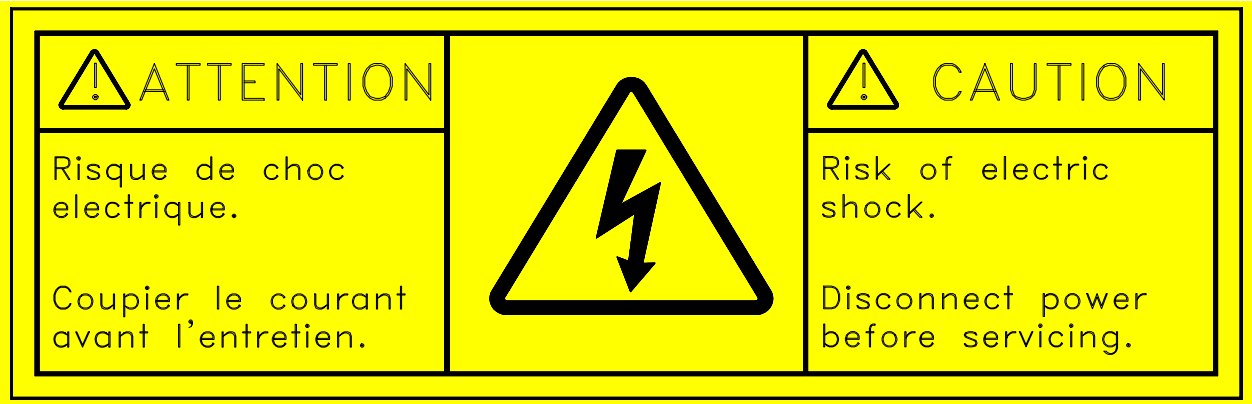
Change to the next higher primary tap (e.g. change from X0 – X1 to X0 – X2)

## Operation

### Inverter

### Power Interlock

Rotate the handle clockwise to the ON ( | ) position to apply AC mains power to the Power Supply. Rotate the handle counter clockwise to the OFF ( 0 ) position to disconnect AC mains power. The Power Supply cabinet door is mechanically interlocked to prevent opening if the power interlock handle is not in the OFF position. The handle is capable of being locked out if necessary. Please wait at least one minute before opening the door to allow residual voltages to discharge.




### Emergency Stop

Pressing the Emergency Stop button removes power from the power supply. A red light in the button indicates that power has been disconnected. Pull the button out to re-apply power to the Power Supply. The red light turns off to indicate that power is re-applied. Emergency stop contacts (1 and 1181 on TB1) are available for customer use after removing the jumper. There are extra emergency stop contacts available for customer use. Please see the electrical schematics for more information.

### Control Panel

The CSI control panel is a 6-inch color touch screen. The screen provides a simple, yet effective means for the operator to control the power supply and ancillary equipment. The touch screen is menu driven with numerous information screens. From the home screen, the operator can start and stop the power supply and control the output power. Navigation to other menus is also accomplished from the home screen.

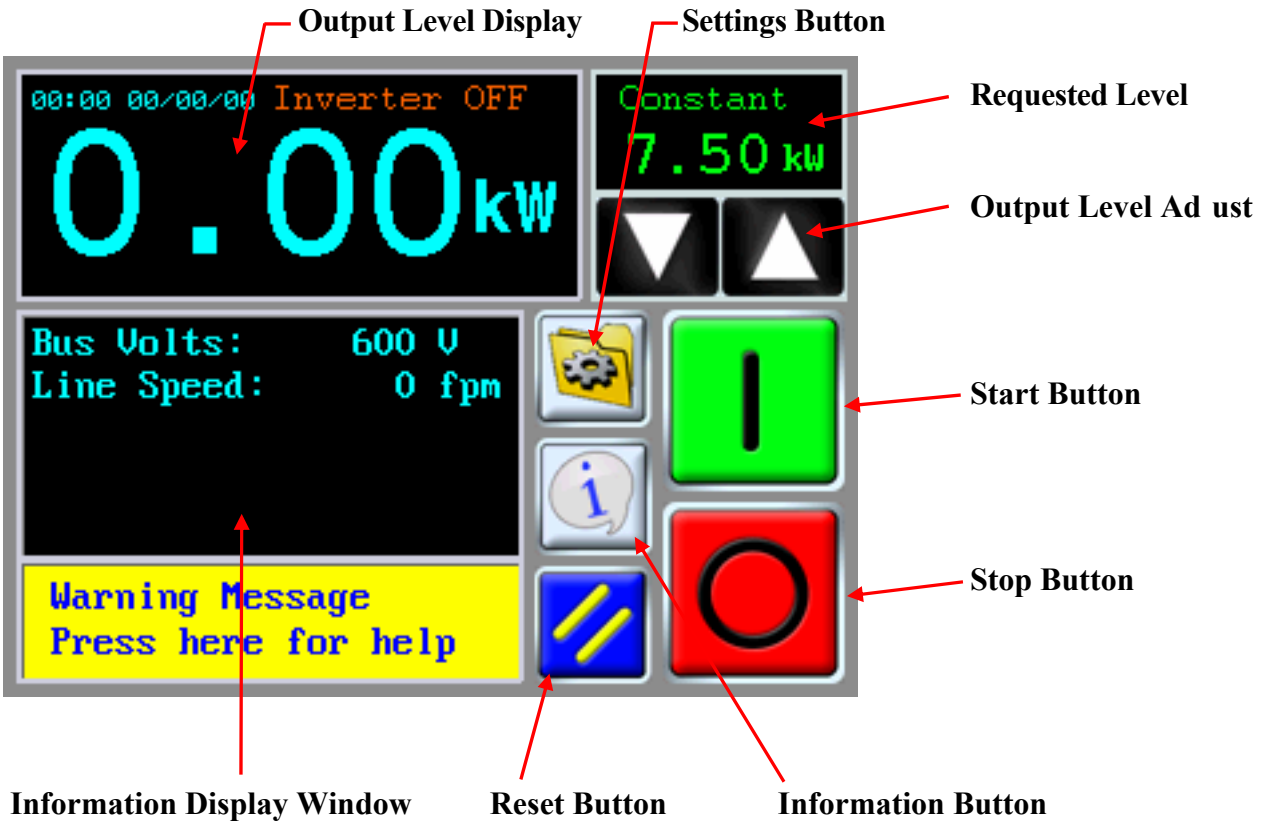



**Figure 2** – Operator Display Layout

Operator Controls

*Caution: Touch screen display may be damaged if sharp objects are used or excessive pressure is applied. Apply light pressure when using the touch screen display.*

**Start -** Energizes the inverter causing the selected power level to be delivered to the treater station.

**Stop –** De-energizes the inverter, stopping power from being delivered to the treater station. This *does not* remove the power from the internal circuitry.

**Reset** - Pressing this button will reset and clear any fault warnings provided that the reason for the fault has been corrected. The reset button will clear the following list of faults and warnings.

| | | |
|---|---|---|
| *Volt Limit* | *Current Limit* | *Frequency Limit* |
| *Loss of Treat Alarm* | *RMS Current Trip* | *Peak Current Trip* |
| *Over Voltage Trip* | *Under Voltage Trip* | *Temperature Fault* |
| *Zero Speed Fault (requires encoder input)* | | *Interlock Fault* |

The reset button also serves as an alarm silence button if the stack light option is equipped. The first push of the reset button will silence the alarm. The second push of the reset button will clear any fault or warning on the display and allow the inverter to be restarted provided the reason for the fault has been corrected.

**Output Level Display** – Displays the power level being delivered to the treater station in kilowatts, the state of the inverter and the date/time.

**Output Level Ad ust** – Sets the level of output power being delivered to the treater station. The output level can be adjusted when the inverter is in the OFF mode as well as when it is in the ON mode. To change the setting, press the up or down arrow buttons until the desired level of output is displayed in the requested level display. If the inverter is running in computer interface mode the Output Level Adjust buttons will not be visible and the power level will be controlled by customer supplied signal.

**Request Level –** Displays the power mode and the level of output power requested in kilowatts. The requested level can be adjusted by using the Output Level Adjust buttons.

**Settings Button** – Pressing the settings button will enable the user to select between Operator, Supervisor, and Factory level settings. The settings button is only active when the inverter is in the OFF mode.

**Information Button –** Pressing this button will display a help screen which gives basic instructions on the current screen being displayed.

**Information Display Window –** This display indicates the bus voltage and line speed (if encoder is installed) in the OFF mode. When the inverter is in the ON mode, the output voltage level, output current level, output frequency, and kilowatt hours of power supplied are displayed. If an encoder is used and enable, the line speed will also be displayed. Any warning or fault messages will be displayed in the window below.

Settings Navigation – Standard Equipment

Throughout the system menus there are several buttons at the bottom of the screen which allow the user to navigate and find information about the menu screen they are currently in.

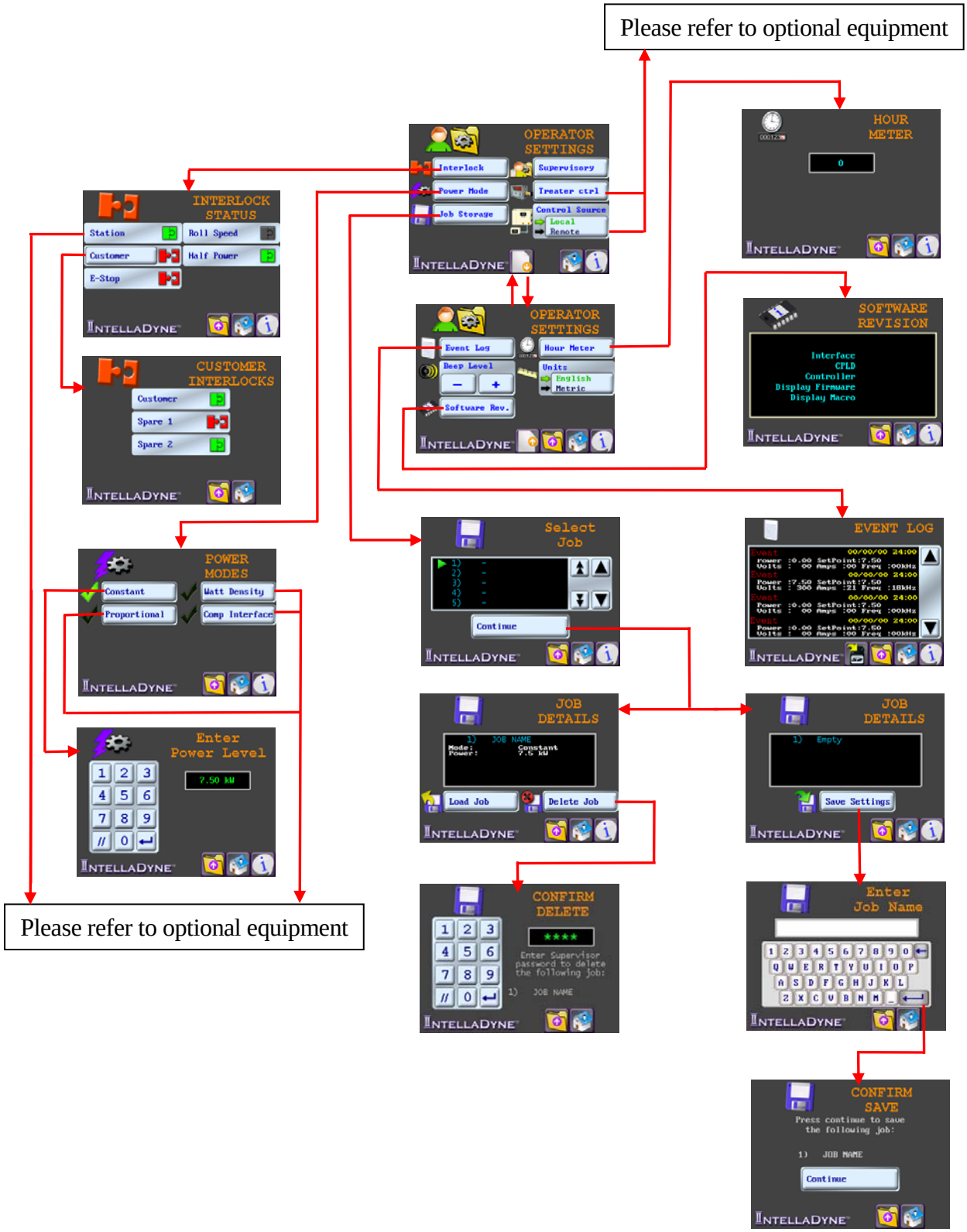
**Page Up/Page Down** – Pressing these buttons will allow the user to navigate up or down a page within a particular menu.

**Pervious Menu** – Pressing this button will allow the user to go back to the pervious menu.

**Return Home** – Pressing this button will return the user to the main home screen.

**Information** – Pressing this button when available will give button descriptions or directions for the particular menu screen.

Operator Settings



**Interlocks –** Pressing this button will navigate to the Interlock Status screen to give a visual indication of the interlocks. From the Interlock Status screen the user can navigate to the Station Interlock screen (if available) or Customer interlock screen to view the status of specific interlocks. The states of the interlocks are represented as follows:

 - Interlock open

 - Interlock closed

 - If there is no encoder installed or the encoder is bypassed then this interlock is not used and will become inactive.

**Power Modes -** Select from the list of available power control functions.

- *Constant* – Inverter output level is entered on the menu numeric pad. The system will use this as the starting power. The Output Level Adjust buttons on the main screen can be used to change the output level in run or stop mode.
- *Proproportional* – Proportional Speed option is required. Please see the OPTIONAL EQUIPMENT section of this manual for more information.
- *Watt Density* – Watt Density option is required. Please see the OPTIONAL EQUIPMENT section of this manual for more information.
- *Computer Interface* – Computer Interface option is required. Please see the OPTIONAL EQUIPMENT section of this manual for more information.

**Job Storage –** Selecting Job Storage will allow the user to view the jobs stored in memory. Empty jobs are represented with a "-". If an empty job is selected the user will be given the option of naming and saving the current job settings into that memory position. If a job is present in the selected position the user can view the details of the job. While viewing the details the job settings can be loaded from memory into the power supply. The job can also be deleted by entering the supervisor level password.

**Event Log –** Displays all start, stop, and fault occurrences and the time and date that each event occurred. Used for process control and advanced diagnostics when required.

**Beep Level –** Adjusts the level of the audible beep that occurs when a button is pressed on the touch screen display.

**Software Revision –** Displays the revision level of all the software versions used in the power supply.

**Hour Meter** – Displays the overall run time of the power supply. This clock can not be reset by the user.

**Units –** Select the type of units you would like to be displayed on the screens. Pressing the button will toggle between English and Metric.

## Supervisor Settings

**Supervisor Password –** Enter your four digit numerical password. The default password from the factory is 1111.

**Set Line Speed** – If an encoder is used to indicate line speed, this menu will allow set up of the line speed. If no encoder is used, the threshold must be set to zero to bypass.

- *Threshold* – The threshold speed is the minimum allowable speed which is required to allow the inverter to start. If using the Auto Start feature, the inverter will start when this line speed is reached and stop when the line speed drops below this threshold.
- *Roll Diameter* – Enter the diameter of the roll that the encoder is mounted on. The power supply will calculate the circumference needed to calculate the line speed.
- *Encoder PPR* – Enter the encoder pulses per revolution. By using the circumference and the encoder pulses per revolution the power supply can calculate the speed of the roll by counting the encoder pulses.

**Humidity Compensation** – The Humidity Compensation Control provides a means of conditioning the treater station high voltage circuit when it is used in a high humidity environment. This feature should be used when the treater station cannot be operated at the desired power level due to repeated breakdown in the treater high voltage circuit under high humidity conditions.

When the Humidity Compensation is set, the power supply initially applies a low power level (10% of the power set point) and then gradually increases it to the power set point. To disable Humidity Compensation, set the time to 0 minutes.

This time period is adjustable from 1 to 30 minutes. If an overload occurs and the control board is set to auto trip, the power will turn off for 1 second and then automatically restart at 2/3 the power it was at when the overload occurred or 10% of the power set point, whichever is greater. If the Autotrip is not selected, the power supply will not restart automatically after an overload, but will require a manual reset. If ten overloads occur or the overload does not go away after two seconds, the inverter will automatically turn off and will require restarting. If the overloads continue, the ramp time should be increased as repeated overloads may damage the treater. Every time an overload occurs, the time it takes to reach the power set point will be increased by the time it takes to get back to the level at which the overload occurred. The rate at which the power increases will remain constant.

**W-HR Reset** – Views the kilowatt-hour meter. This meter can be reset to track kilowatt-hours for a given time.

**AutoStart** – The inverter start command can be controlled by an external customer contact connected between (801 and 802), or can be started when the line speed increases above the low speed threshold when an encoder is used. The start button must be pressed the first time to activate auto start and place the system in standby mode. Once in standby the inverter will start when the line is brought up to speed or the AutoStart contact is closed and stop when the line speed drops below the threshold or the AutoStart contact is opened. Any fault that occurs will interrupt the Auto Start cycle, requiring that the fault be acknowledged, cleared, and the start button pressed again to

restart the cycle.

**Set Date/Time –** Sets the internal date and time clock that is used for a time stamp in the event log. Enter the date in MM/DD/YY format if using English units. If using Metric units, enter the date in DD/MM/YY format. The time is entered in HR:MIN and is in 24 hour format.

**Languages –** Select the preferred language for menu screens. Additional languages can be added by request and uploaded with a software update. As languages are added they will become part of the basic language package.

**Reset Password –** Change the Supervisor password to any four digit numerical combination. Press enter when complete. Confirm password and press enter to finalize the change.

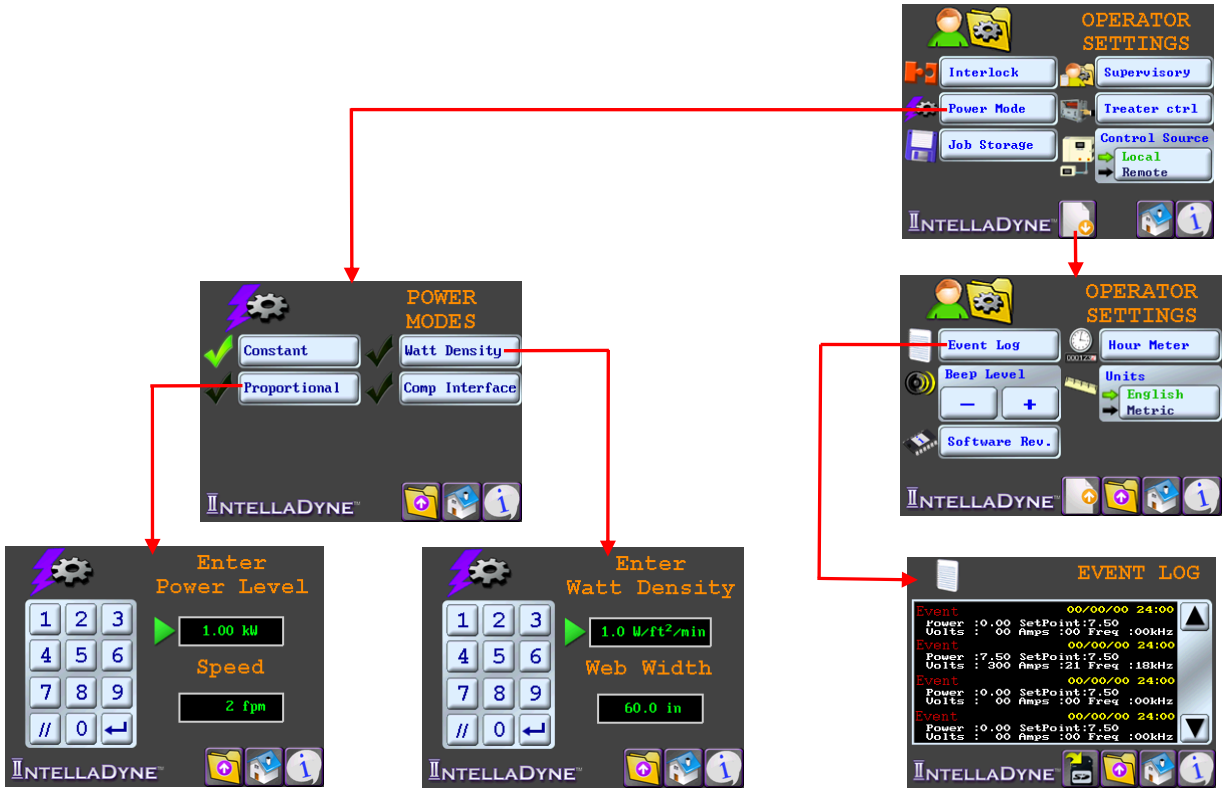
**Upgrade –** This button is used to allow users to add and activate options to the power supply which were not previously present. After contacting Pillar Technologies to receive approval of an upgrade the user will be instructed to navigate to this page and provide the Seed Code. The Pillar representative will then provide the customer with the appropriate Key to enable the desired options.

**PLC Start** – The PLC Start must be enabled if a PLC signal to control the starting and stopping of the inverter with a maintained contact closure wired into the External Start input. Closing the contact will start the inverter and opening the contact will stop the inverter. If you use a momentary contact closure on the External Start input to start the inverter and a momentary contact closure input to the External Stop input to stop the inverter, the PLC start should be disabled.

**AutoTrip** – The AutoTrip feature is typically used in conjunction with the Humidity Compensation feature but may also be used to aid in troubleshooting current trip faults. Enabling AutoTrip will allow the inverter to automatically clear and restart itself in the case of a current trip overload. The AutoTrip will be overridden if the inverter senses ten consecutive current trips without actually firing and will indicate a current trip and require restarting. Repeated current trip overloads may damage the treater.

**SD Upload –** This button is used to load new software upgrades or revisions into the system permanent memory. The power should be removed from the system and the SD card provided by Corona Supplies installed into the SD holder on the I/O board. Power up the system and wait until the main screen comes on. Navigate to the Supervisor Settings menu and press the SD upload button. Pressing the Continue button will initiate reprogramming of the I/O board from the files on the SD card. *Caution: Do Not Remove Power During Download.* This may take up to 30 minutes to complete. When completed, remove power from the system, remove the SD card, and resume normal operation.

Settings Navigation – Optional Equipment



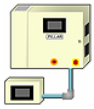

**Power Modes** - Select from the list of available power control functions.

- *Proportional* – Proportional speed option is required. The desired output level is first entered followed by the desired line speed that this power should be reached at. The output power will adjust proportionally to the line speed. The Output Level Adjust buttons on the main screen can be used to change the output level in run or stop mode. Please see the OPTIONAL EQUIPMENT section of this manual for more information.

- *Watt Density* – Watt Density option is required. The desired watt density power concentration is first entered followed by the electrode width. The output power will adjust to maintain the desired watt density based on line speed. The Output Level Adjust buttons on the main screen can be used to change the output level in run or stop mode. Please see the OPTIONAL EQUIPMENT section of this manual for more information.

- *Computer Interface* – Computer Interface option is required. The output level is controlled by an external analog signal provided by the user. Signal level is user selectable and can be 0 - 10 VDC or 4 – 20 mADC. Please see the OPTIONAL EQUIPMENT section of this manual for more information.

**Treater Control** - This option has been reserved for future use of treater controls and switching by serial communication and at the time of this manual printing is not an available option.



**Control Source –** Selects the control source being used to control the output level, START functions and access the menus. This feature is only available when a remote control display is included and enabled.
Note: The STOP function can be activated from both the local and remote location at all times while running.

**SD Log Download** – Allows the user to download the event log to a file on the SD card for further review. While this process is taking place, the log icon at the top of the screen will change to a flashing SD card icon. Do not power down or remove the SD card while this icon is flashing or the log file may become corrupt.


**Skip Treat -** This option has been reserved for future use of skip treat settings and at the time of this manual printing is not an available option.

**Remote Display** – Enables usage of the remote display. If communication between the remote display and local display is broken, the local display will disable the remote as a precaution.

## Optional Equipment

### Proportional Speed Control

Proportional Speed Control causes the power supply output to be proportional to the treater station roll speed. A treater station with Proportional Speed Control includes an encoder whose output frequency is proportional to the treater roll speed.

The proportional speed setup can be accessed through the Operator Menu screen. From the setup screen the desired output level is first entered followed by the desired line speed that this power should be reached at. The output power will adjust proportionally to the line speed.

### Watt Density Control

Watt Density Control is very similar to Proportional Speed Control. The treater station also includes an encoder whose output frequency is proportional to the treater roll speed. The difference is that Watt Density Control takes into account the electrode width. The output power is calculated with the following formulas. (Use the formula with the appropriate units).

**Power [watts] = Watt Density [W-min/ft$^2$] * Speed [ft/min] * Width [ft]** or
**Power [watts] = Watt Density [W-min/m$^2$] * Speed [m/min] * Width [m]**

The watt density control setup can be accessed through the Operator Menu screen. From the setup screen the desired watt density power concentration is first entered followed by the electrode width. The output power will adjust to maintain the desired watt density based on line speed.

### Computer Interface

Computer Interface Control allows power output control via analog signals from the customer's computer or PLC. The analog signals can be either 0-10 VDC or 4-20 mADC depending what was specified at the time of sale. The input signal is to be wired to TB1-607. There are four feedback signals available for the customer to use. The output power signal wired to TB1-609, the output voltage signal wired to TB1-611, the output current signal wired to TB1-613, and the output frequency signal wired to TB1-615. These signals can also be either 0-10 VDC or 4-20 mADC depending on what was specified at the time of sale. The isolated ground for these signals should be connected to TB1-617. Shielded wire must be utilized when making these connections. The maximum distance of the shielded wire should not exceed 500 feet (150 meters).

Remote Control

A remote control is available for controlling the operation of the power supply and displaying operating parameters and indications, from a location that is remote from the power supply. The remote control is available in a NEMA 1 enclosure or a panel mounting configuration. The remote control communicates with the power supply via a RS485 communications cable that may be up to 1000 feet in length.

The customer can select between the local and remote displays to be the control source. When one display is selected as the master source, the other display will be automatically assigned as a slave display. While the master allows full functionality, the slave display will only provide remote metering, fault and warning monitoring, and a stop button to stop the inverter. Some features such as factory settings, SD log download, and SD upload are only available from the local display.

The emergency stop buttons on both the local AND remote panels must be pulled out to turn on the remote control station and enable corona. Pushing in either of these buttons will manually inhibit the power supply, and also remove power from the both the remote and local operator panels. The remote emergency stop button lights when power is supplied from the power supply (the power supply is powered AND its emergency stop button is pushed in), to indicate that corona is manually inhibited by the remote control. Note that the emergency stop button, which is actually inhibiting the corona, will be the one that is illuminated.

Stack Light

A stack light or tower light is available to monitor alarm and run conditions. The stack light consists of a tower of three lights and an audible alarm. These lights and alarm will indicate run, stopped, and warning conditions.

## Service

### Specifications

- Input voltage range of 380 to 515 VAC +/- 10%, 3 phase, 50/60 Hz.
- Input current

| kW Rating | Input Current |
|---|---|
| 5 | 7.5-10.1 |
| 7.5 | 11.2-15.1 |
| 10 | 15.0-20.2 |
| 15 | 22.4-30.3 |

- Output voltage of 600 VAC, 1 phase
- Output current

| kW Rating | Output Current |
|---|---|
| 5 | 28 |
| 7.5 | 41 |
| 10 | 55 |
| 15 | 83 |

- Output frequency is 18 kHz.
- Ambient temperature: 0 to 50$^{o}$C (32 to 122$^{o}$F), allow unrestricted airflow to the power supply cabinet air inlets, outlets, and to the entire high voltage transformer tank.
- Humidity: 20% to 90% non-condensing
- Power display accuracy: +/- 3% of full scale
- Frequency, voltage, and current display accuracy: +/- 10% of full scale
- High voltage transformer taps: four primary taps and one secondary tap

### Inspection

There is no inspection criteria planned for this unit.

### Maintenance

Maintenance is limited to keeping the touch screen and fan filters clean. Use a soft cloth and a mild detergent to clean the touch screen. **Do not use solvent.** Solvent will damage the touch screen. The fan filters should be cleaned with compressed air or vacuumed occasionally. Disconnect input power prior to cleaning.

There are no other items requiring maintenance on the power supply.

Troubleshooting

The Warnings and Fault messages provide diagnostic information for trouble shooting the inverter. Note the messages and the conditions under which they occur prior to contacting the Service Department at Corona Supplies. The more common Warnings and Faults are explained below.

Warnings

**Voltage Limit –** The power supply is delivering the maximum output voltage. Change taps on the output transformer.

**Current Limit –** The power supply is delivering the maximum output current. Change taps on the output transformer.

**Frequency Limit –** The power supply is operating at the maximum output frequency. Change taps on the output transformer.

**Loss of Treat Alarm –** Indicates that the requested output power and the actual output power is not the same. This may indicate that the power supply is in one of the above limit conditions.

Faults

**Current Trip –** Excessive power supply output current detected. This may indicate incorrect high voltage transformer tap, IGBT failure, or treater station dielectric breakdown.

**Over Voltage Trip –** Excessive power supply output voltage detected. This may indicate incorrect high voltage transformer tap or a spike on the input line voltage.

**Under Voltage Trip –** Insufficient voltage on the DC bus usually caused by low input voltage.

**Temperature Fault –** This is typically an indication of excessive heat sink temperature. Let the power supply cool down. This fault may be caused by excessive ambient temperature, clogged fan filters, or failed cooling fans.

**Zero Speed Fault –** Indicates that the treater roll has slowed down to under the zero speed threshold.

**Interlock Fault –** Indicates that the safety interlocks are open. Check the interlocks to see if they are functioning properly.

Spare Parts

A spare parts kit is offered as an option for the power supply. Please contact the Service Department at Corona Supplies for more information.

| Corona Supplies | TITLE<br>**CSI** SPARE PARTS<br>STANDARD KIT 5.0 – 7.5 KW | NUMBER<br>N820-1<br>**SHT.** 1 OF 1 |
|---|---|---|

| QTY | DESCRIPTION | PART NO. |
|---|---|---|
| 1 | 0.5A, 250V Interface PCB fuse | PP210-68 |
| 2 | 2.5A, 600V FNQ-R fuse | PP213-84 |
| 1 | 3.2A, 250V FNM fuse | PP204-118 |
| 4 | Fan Filter | PP307-663 |

| ORIGINATED BY TJH | SUPERSEDES | REVISED |
|---|---|---|
| DATE 7/09 | DATE | |

| Corona Supplies | TITLE<br>CSI SPARE PARTS<br>DELUXE KIT 7.5 KW | NUMBER<br>N820-40<br>SHT. 1 OF 1 |
|---|---|---|

| QTY | DESCRIPTION | PART NO. |
|---|---|---|
| 1 | 0.5A, 250V Interface PCB fuse | PP210-68 |
| 2 | 2.5A, 600V FNQ-R fuse | PP213-84 |
| 1 | 3.2A, 250V FNM fuse | PP204-118 |
| 4 | Fan Filter | PP307-663 |
| 1 | Interface PCB | CB10827-1 |
| 1 | Touch Screen Assembly | B10976 |

| ORIGINATED BY TJH | SUPERSEDES | REVISED |
|---|---|---|
| DATE 7/09 | DATE | |

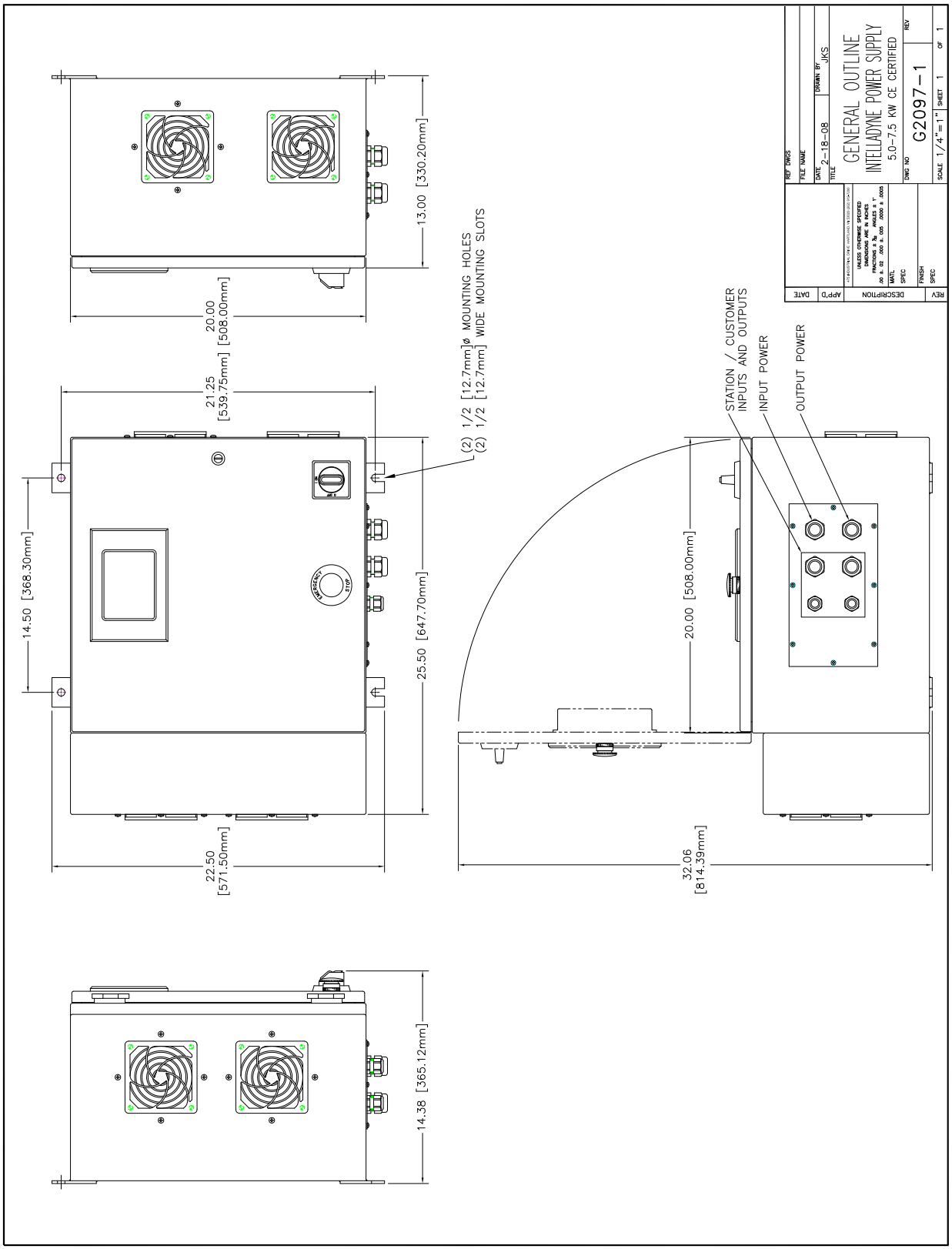



**Figure 3 –** 5.0-7.5 kW CSI Outline Drawing

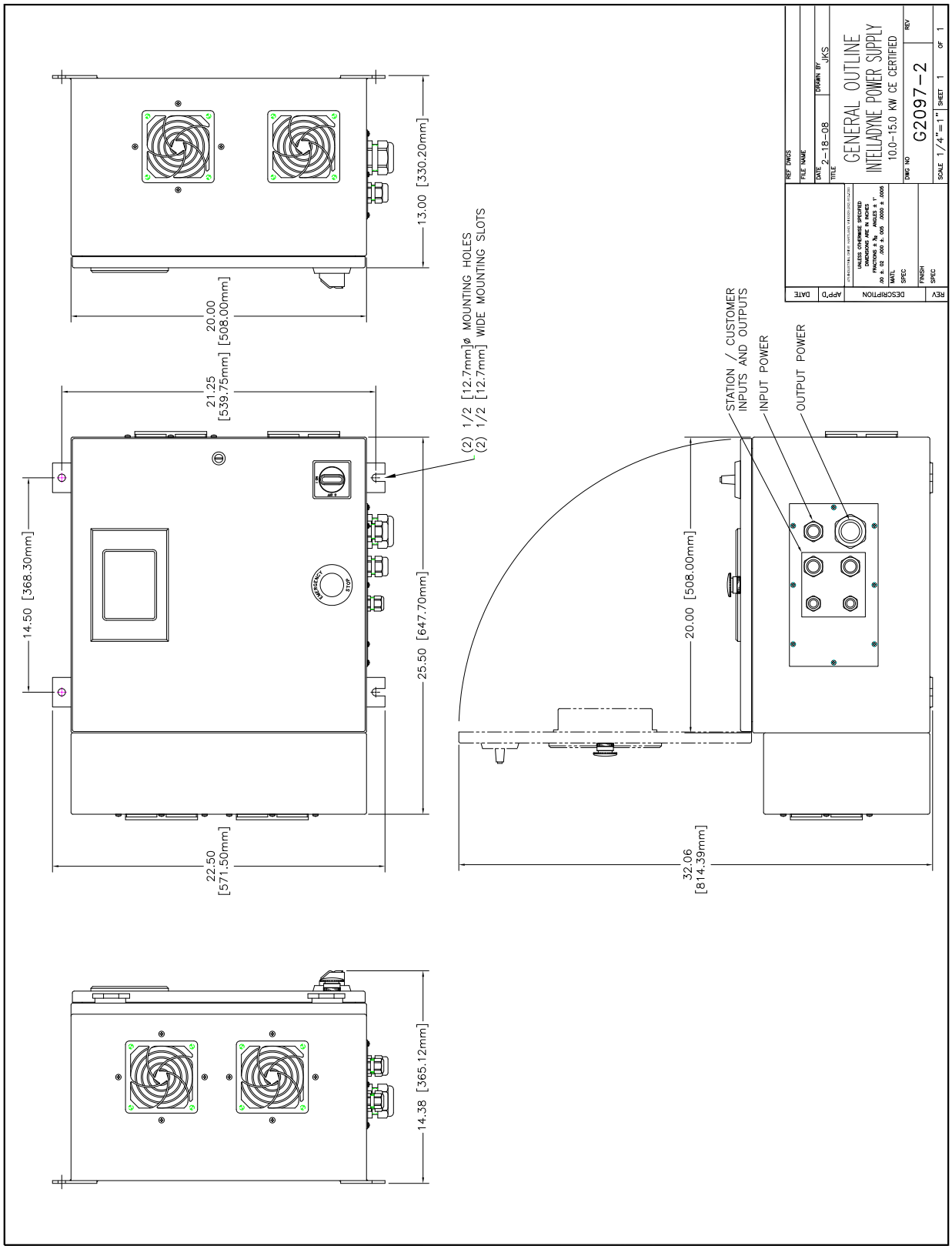



**Figure 4 -**10.0-15.0 kW CSI Outline Drawing

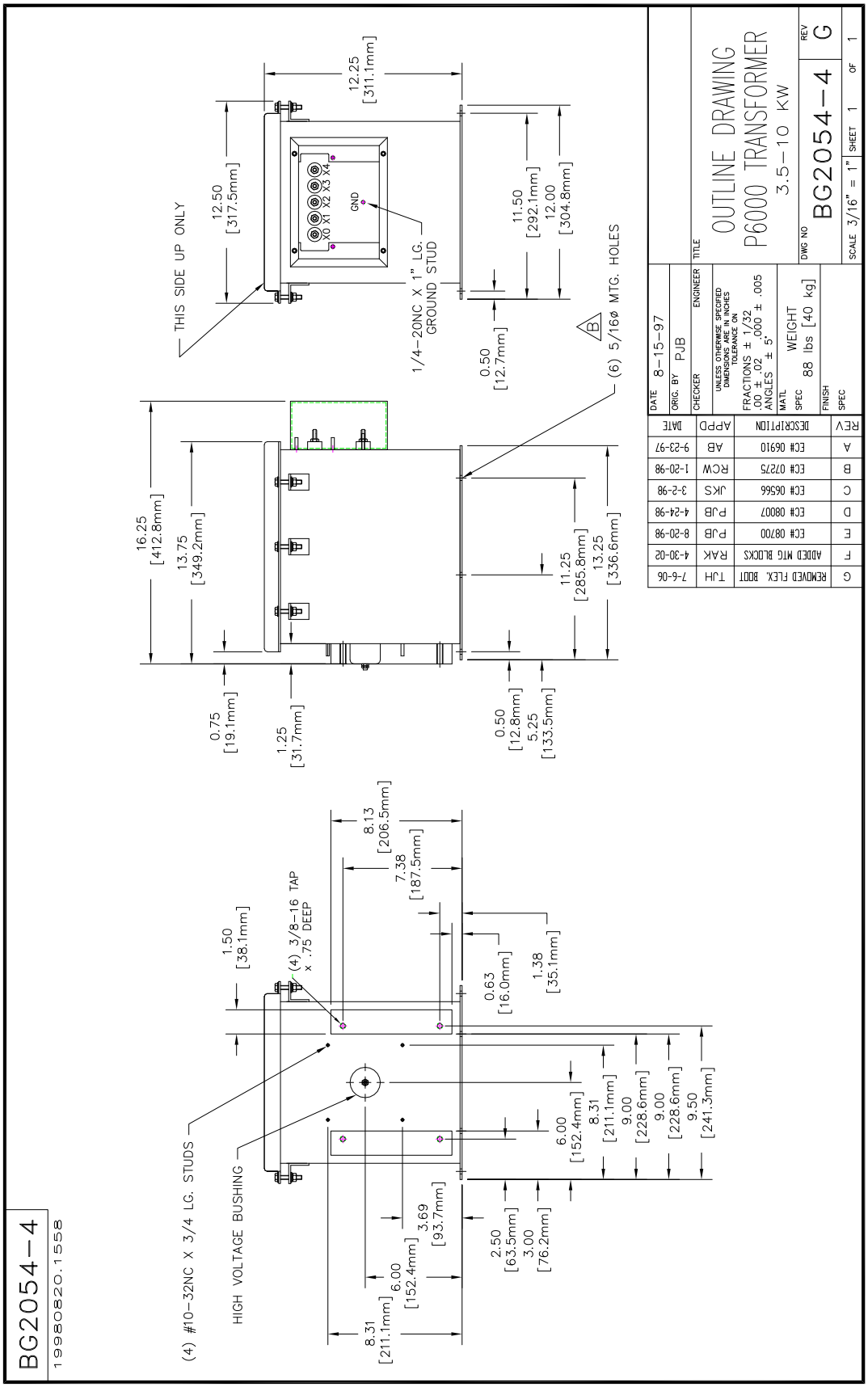



**Figure 5 –** 5.0-10.0 kW CSI High Voltage Transformer Outline Drawing

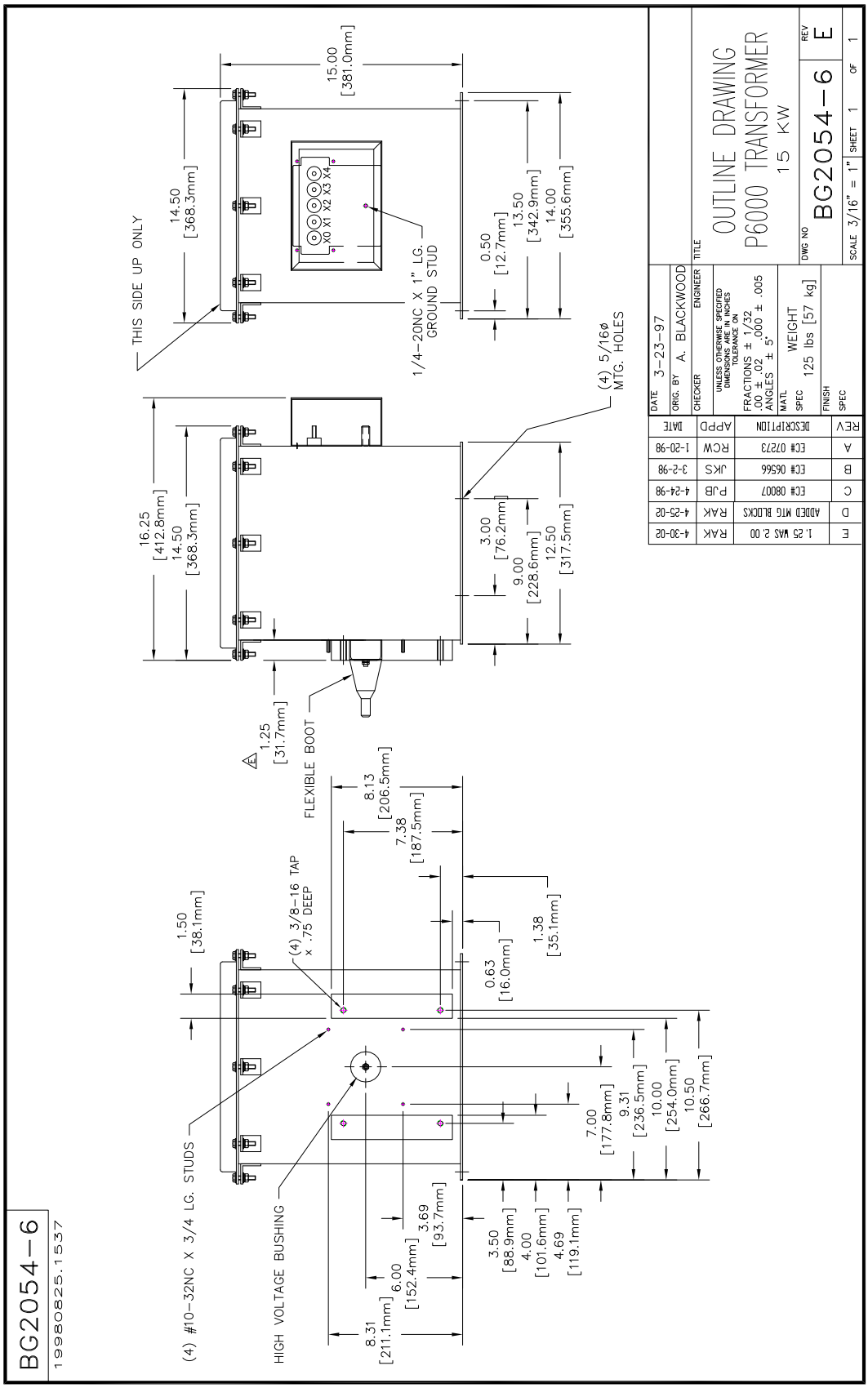



**Figure 6 -** 15.0 kW CSI High Voltage Transformer Outline Drawing

| REV | DESCRIPTION | APP'D | DATE |
|---|---|---|---|
| A | REVISED I/O/SKN OUTPUT | T.J.H | 3-4-09 |
| B | REVISED I/O/SKN OUTPUT | T.J.H | 5-19-09 |
| C | NOTED "FUTURE" FEATURES | T.J.H | 4-30-09 |
| D | UPDATED LINE FILTER | T.J.H | 10-20-09 |
| E | ADDED REMOTE OPTION | T.J.H | 7-28-11 |

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
FRACTIONS ± 1/64 ANGLES ± 1°
.XX ± .02 .XXX ± .005 .XXXX ± .0005
MATL
SPEC
FINISH
SPEC

REF DWGS

| FILE NAME | 3530-1 | | |
|---|---|---|---|
| DATE | 10-17-07 | DRAWN BY | TJH |

TITLE
INTELLADYNE POWER SUPPLY
SCHEMATIC
5.0 – 15.0 kW

DWG NO DE3530-1 REV E

SCALE 1 : 1 SHEET 1 OF 2

NOTE:
REMOVE JUMPERS IF USED
503-504
1235-1236
1237-1238
1239-1240
1241-1242
1243-1244

STATION / CUSTOMER INTERLOCK 1 CONTACT
STATION / CUSTOMER INTERLOCK 1 CONTACT
CUSTOMER INTERLOCK 2 CONTACT
CUSTOMER INTERLOCK 2 CONTACT
ENCODER / SENSOR +VDC
ENCODER / SENSOR SIGNAL
ENCODER / SENSOR COMMON
AUTO START CONTACT
AUTO START CONTACT
EXTERNAL STOP CONTACT
EXTERNAL STOP CONTACT
EXTERNAL START CONTACT
EXTERNAL START CONTACT
EXTERNAL E-STOP CONTACT
EXTERNAL E-STOP CONTACT
HALF POWER 'A' SIGNAL
HALF POWER 'A' SIGNAL
HALF POWER 'B' SIGNAL
HALF POWER 'B' SIGNAL
SPARE CONTACT 2
SPARE CONTACT 2
SPARE CONTACT 1
SPARE CONTACT 1
SKIP TREAT SYNC SENSOR +VDC (FUTURE)
SKIP TREAT SYNC SENSOR SIGNAL (FUTURE)
SKIP TREAT SYNC SENSOR COMMON (FUTURE)

26 INPUTS (24 VDC)

ANALOG INPUT POWER SETPOINT
ANALOG OUTPUT POWER METER
ANALOG OUTPUT VOLTAGE METER
ANALOG OUTPUT CURRENT METER
ANALOG OUTPUT FREQUENCY METER
ANALOG GROUND

ANALOG COMPUTER INTERFACE (0-10 VDC OR 4-20mADC) SOLD AS AN OPTION

INTERFACE PCB

PROGRAMMING PORT

J1 J2 J5 J9 J9

INVERTER ASSY

CE1 CE2 CT

L101 L104

NOTES:
1. THE 5 & 7.5 KW WILL USE ONE INDUCTOR L101.
THE 10 & 15 KW WILL USE TWO INDUCTORS L101 & L104.

K132 CB102 DISC102

LH CAB. STUD
DOOR STUD
RH CAB. STUD
RH PANEL SCREW
LH PANEL SCREW
TO DISCONNECT DISC102 (2T1, 4T2, 6T3)
TO CIRCUIT BREAKER CB102 (1, 3, 5)
LF106
5 – 10 KW USE 32 AMP 15 KW USE 50 AMP
INSTALL LINE FILTER IF REQUIRED

SUPPLIED POWER 380 – 515 VAC, 3Ø
CUSTOMER

CONTROL TRANSFORMER 250VA MATCH PRIMARY TAP TO INCOMING LINE VOLTAGE. USE H1-H2 FOR 208, 220, 230, 240 USE H1-H3 FOR 380, 400, 416 USE H1-H4 FOR 440, 460, 480 H1-H5 WILL NOT BE USED.
SECONDARY VOLTAGE WILL BE 110-130
T111
F111 F112 F114
EMERGENCY STOP PUSH BUTTON
CUSTOMER/REMOTE E-STOP ELSE JUMPERED
E-STOP
EMERGENCY STOP PUSH BUTTON CUSTOMER CONNECTIONS
INTERFACE PCB
INTERFACE PCB134
DOOR STUD
MAIN CONTACTOR 102, 103, 104
HEAT SINK COOLING FANS
CABINET COOLING FAN (ONLY FOR 10 AND 15KW)
CABINET COOLING FAN
TREATER STATION CONTROL POWER 120 VAC, 100 VA MAX
120 VAC CONTROL POWER TO TREATER STATION
LOCAL DISPLAY ASS'Y (DISP132)
TO REMOTE DISPLAY (SOLD AS AN OPTION)
DOOR STUD

LOSS OF TREAT ALARM CONTACT N.O. TB1-803 BLACK J6-15
LOSS OF TREAT ALARM CONTACT COMMON TB1-804 WHITE J6-13
LOSS OF TREAT ALARM CONTACT N.C. TB1-805 ORANGE J6-14

RUN CONTACT N.O. TB1-806 RED J6-09
RUN CONTACT COMMON TB1-807 BROWN J6-10
RUN CONTACT N.C. TB1-808 GREEN J6-11

INTERLOCK STATUS CONTACT N.O. TB1-809 GREY J7-06
INTERLOCK STATUS CONTACT COMMON TB1-810 VIOLET J7-04
INTERLOCK STATUS CONTACT N.C. TB1-811 BLUE J7-05

BLOWER 1 START/STOP CONTACT (FUTURE) TB1-2231 YELLOW J7-01
BLOWER 1 START/STOP CONTACT (FUTURE) TB1-2232 WHITE J7-03
BLOWER 2 START/STOP CONTACT (FUTURE) TB1-2233 ORANGE J6-01
BLOWER 2 START/STOP CONTACT (FUTURE) TB1-2234 BLACK J6-02

ENCODER 1 OUTPUT PULSE (+) TB1-2235 BLUE J7-15
ENCODER 1 OUTPUT PULSE (COM) TB1-2236 GREY J7-16

SPARE CONTACT 1 TB1-2237 VIOLET J6-08
SPARE CONTACT 1 TB1-2238 BLUE J6-12
SPARE CONTACT 2 TB1-2239 GREY J6-03
SPARE CONTACT 2 TB1-2240 YELLOW J6-04
SPARE CONTACT N.O. TB1-2241 RED J7-07
SPARE CONTACT COMMON TB1-2242 BROWN J7-08
SPARE CONTACT N.C. TB1-2243 GREEN J7-02

22 OUTPUTS

INTERFACE PCB

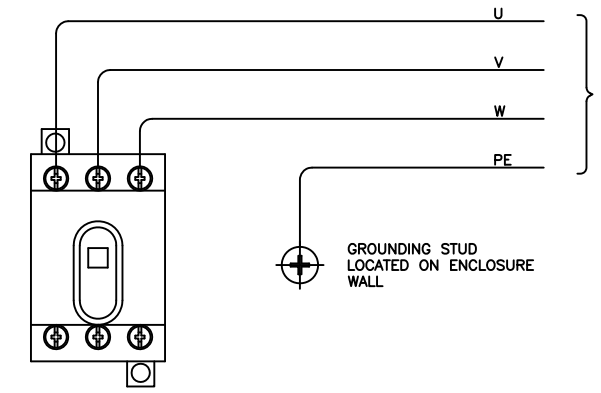
STACK LIGHT OPTION

J1-10 COMMON
J1-9
J1-8
J1-7 +24 VDC
J1-6
J1-5
J1-4 SPARE
J1-3
J1-2
J1-1

ALARM 2
ALARM 1
G
R
A

| REF DWGS | | | |
|---|---|---|---|
| FILE NAME | 3530-1 | | |
| DATE | 10-17-07 | DRAWN BY | TJH |
| TITLE | INTELLADYNE POWER SUPPLY SCHEMATIC 5.0 – 15.0 kW | | |
| DWG NO | DE3530-1 | REV | E |
| SCALE | 1 : 1 | SHEET 2 | OF 2 |

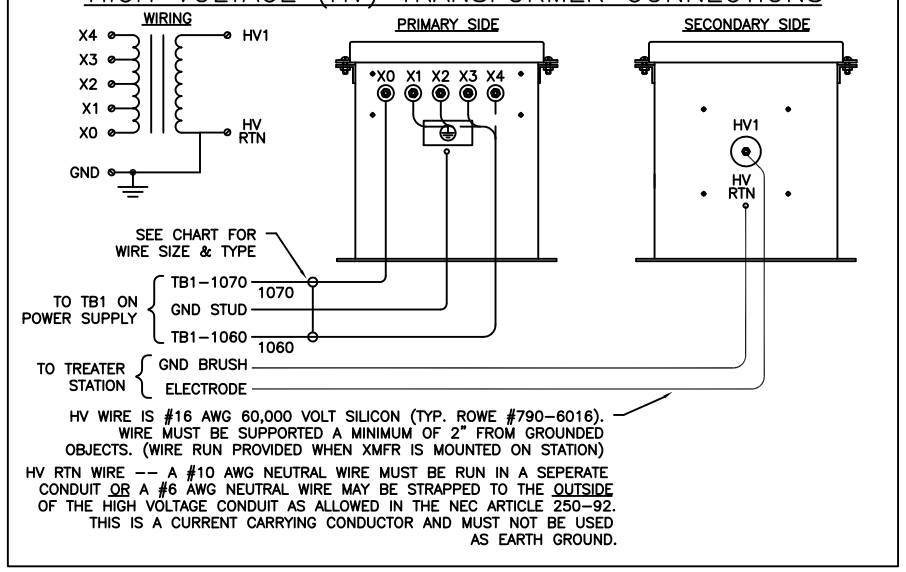
| REV | DATE | APP'D | DESCRIPTION | SEE SHEET 1 |
|---|---|---|---|---|
| | | | UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS ± 1/64 ANGLES ± 1° .XX ± .02 .XXX ± .005 .XXXX ± .0005 MATL SPEC FINISH SPEC | |




TO CUSTOMER'S FUSED DISCONNECT
OR INPUT TRANSFORMER.
380 TO 515 VAC, 50/60 HZ, 3ø
CONNECT GROUND TO ENCLOSURE STUD.
WIRE PER NEC ARTICLE 250.
(SEE CHART FOR FLA, FUSE, AND WIRE SIZE)

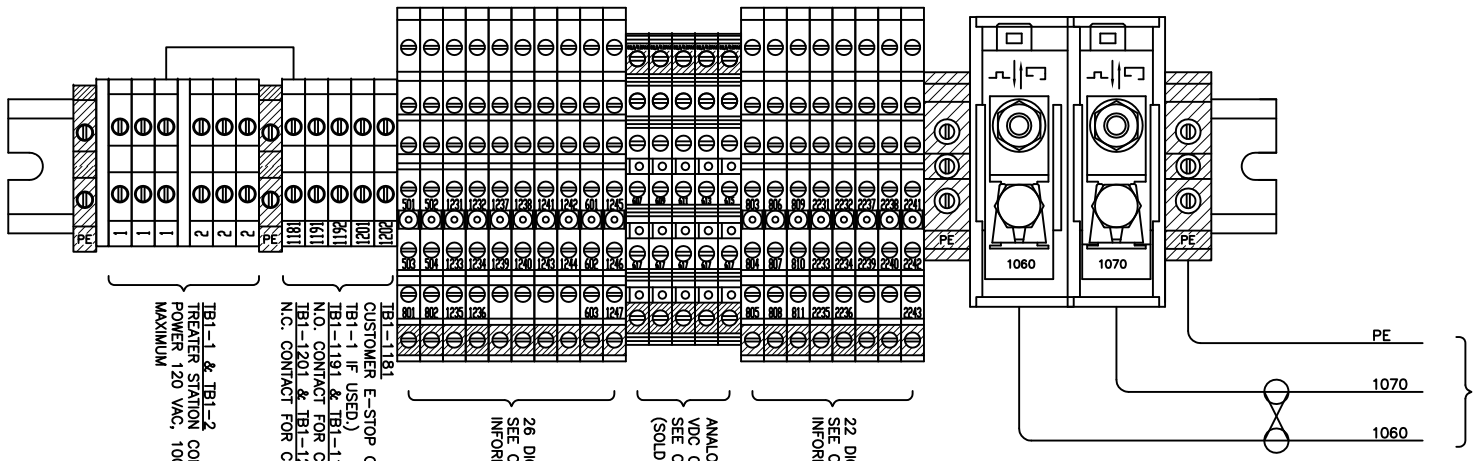
| SIZE (IN KW) | INPUT VOLTAGE (V rms) | CURRENT (FLA) | INPUT POWER WIRE (AWG) | CIRCUIT BREAKER (AMPS) | OUTPUT POWER WIRE (AWG) (SEE NOTE) | OUTPUT GND WIRE (AWG) | OUTPUT VOLTAGE (V rms) | OUTPUT FREQUENCY (KHz) |
|---|---|---|---|---|---|---|---|---|
| 5 | 380–515 | 7.5–10.1 | #10 | 32 | #6 (1,2) | #10 | 600 | 25 |
| 7.5 | 380–515 | 11.2–15.1 | #10 | 32 | #6 (1,2) | #10 | 600 | 25 |
| 10 | 380–515 | 15–20.2 | #10 | 32 | #4 (1,2) | #8 | 600 | 25 |
| 15 | 380–515 | 22.4–30.3 | #8 | 50 | #2/6 (1,2,3) | #8 | 600 | 25 |

## HIGH VOLTAGE (HV) TRANSFORMER CONNECTIONS

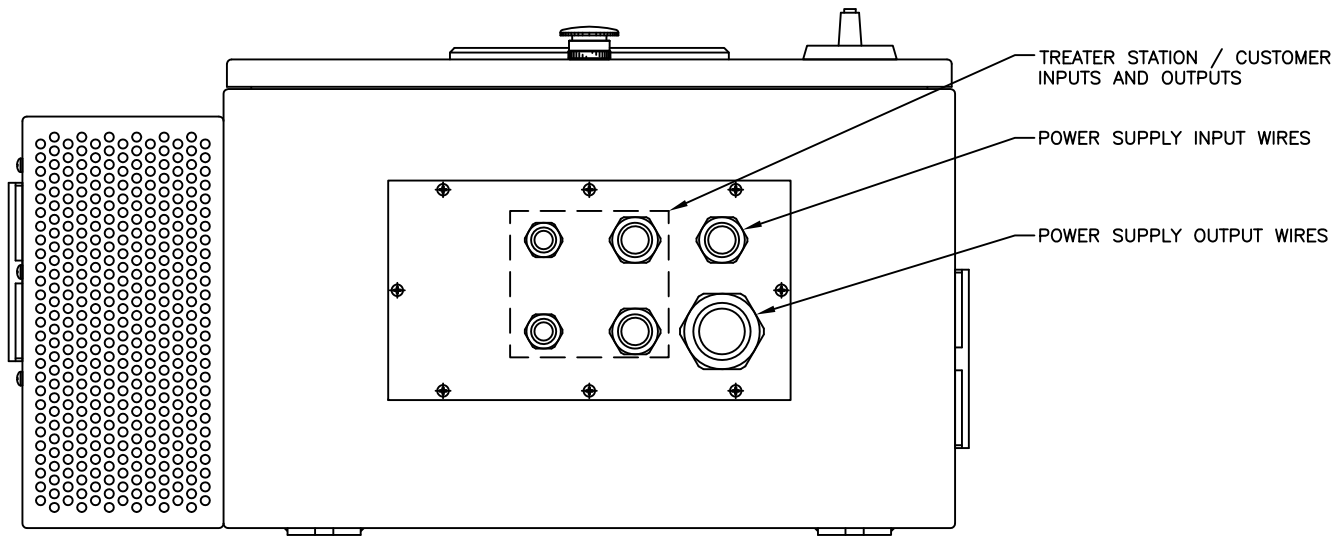



HV WIRE IS #16 AWG 60,000 VOLT SILICON (TYP. ROWE #790–6016).
WIRE MUST BE SUPPORTED A MINIMUM OF 2" FROM GROUNDED OBJECTS. (WIRE RUN PROVIDED WHEN XMFR IS MOUNTED ON STATION)

HV RTN WIRE -- A #10 AWG NEUTRAL WIRE MUST BE RUN IN A SEPERATE CONDUIT OR A #6 AWG NEUTRAL WIRE MAY BE STRAPPED TO THE OUTSIDE OF THE HIGH VOLTAGE CONDUIT AS ALLOWED IN THE NEC ARTICLE 250–92. THIS IS A CURRENT CARRYING CONDUCTOR AND MUST NOT BE USED AS EARTH GROUND.




POWER SUPPLY OUTPUT
TO HIGH VOLTAGE TRANSFORMER
SEE CHART FOR WIRE SIZE
OUTPUT WIRES MUST BE TWISTED.
(TWIST AT LEAST 3 TURNS PER FOOT.)




### IMPORTANT INSTALLATION NOTES:

1. OUTPUT WIRE INSULATION MUST BE RATED FOR 90° C AND 600 VAC.
2. OUTPUT WIRES MUST BE TWISTED A MINIMUM 3 TURNS PER FT, THEN INSTALLED IN A SEPARATE NON–MAGNETIC, (ALUMINUM PREFERRED), CONDUIT.
3. CUSTOMER MAY WANT TO USE TWO PAIRS OF WIRE IN PARALLEL AS ALLOWED IN THE NEC ARTICLE 310–4. (EXAMPLE: #3/8 ONE PAIR OF #3 AWG WIRE OR TWO PAIR OF OF #8 AWG WIRES)



PILLAR TECHNOLOGIES
An ITW Company
411 HOBART INDUSTRIAL DRIVE, HARTLAND, WISCONSIN (262) 367-3700

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
FRACTIONS ± 1/64 ANGLES ± 1°
.00 ± .02 .000 ± .005 .0000 ± .0005
MATL
SPEC
FINISH
SPEC

DATE
APP'D
DESCRIPTION
REV

REF DWGS
FIRST USED ON
DATE 5–6–09
DRAWN BY TJH
TITLE
GENERIC INTERCONNECTION
INTELLADYNE
DWG NO E3532–1
REV
SCALE 1 : 1
SHEET 1 OF 2

## DIGITAL INPUTS (24 VDC)

| SIGNAL | DESCRIPTION | RECOMMENDED WIRE TYPE |
|---|---|---|
| 501 – 502 | TREATER STATION SAFETY INTERLOCK MUST BE CLOSED PRIOR TO STARTING POWER SUPPLY | 18 AWG. 2 CONDUCTOR SHIELDED |
| 503 – 504 | CUSTOMER SAFETY INTERLOCK MUST BE CLOSED PRIOR TO STARTING POWER SUPPLY (REMOVE JUMPER IF USED) | 18 AWG 2 CONDUCTOR SHIELDED |
| 601, 602, 603 | TREATER ROLL SPEED SENSOR | 18 AWG 3 CONDUCTOR SHIELDED |
| 801 – 802 | REMOTE AUTO START CONTACT (REMOVE JUMPER IF USED) MAINTAINED CONTACT | 18 AWG 2 CONDUCTOR SHIELDED |
| 1231 – 1232 | EXTERNAL STOP MOMENTARY CONTACT | 18 AWG 2 CONDUCTOR SHIELDED |
| 1233 – 1234 | EXTERNAL START MOMENTARY CONTACT (CAN BE USED AS A 2–WIRE START /STOP. PLEASE SEE MANUAL FOR MORE INFORMATION.) | 18 AWG 2 CONDUCTOR SHIELDED |
| 1235 – 1236 | EXTERNAL EMERGENCY STOP | 18 AWG 2 CONDUCTOR SHIELDED |
| 1237 – 1238 | HALF POWER SIGNAL "A" (USED WITH HIGH VOLTAGE SWITCHING OPTION) | 18 AWG 2 CONDUCTOR SHIELDED |
| 1239 – 1240 | HALF POWER SIGNAL "B" (USED WITH HIGH VOLTAGE SWITCHING OPTION) | 18 AWG 2 CONDUCTOR SHIELDED |
| 1241 – 1242 | CUSTOMER SPARE INTERLOCK 2 | 18 AWG 2 CONDUCTOR SHIELDED |
| 1243 – 1244 | CUSTOMER SPARE INTERLOCK 1 | 18 AWG 2 CONDUCTOR SHIELDED |
| 1245, 1246, 1247 | SKIP TREAT SYNCHRONIZING SENSOR (FUTURE USE) | 18 AWG 3 CONDUCTOR SHIELDED |

## ANALOG INPUTS / OUTPUTS (COMPUTER INTERFACE IS SOLD AS AN OPTION)

| SIGNAL | DESCRIPTION | RECOMMENDED WIRE TYPE |
|---|---|---|
| 607 – 617 | POWER SETPOINT ANALOG INPUT 0–10VDC OR 4–20mADC | 18 AWG. 2 CONDUCTOR SHIELDED |
| 609 – 607 | OUTPUT POWER ANALOG OUTPUT 0–10VDC OR 4–20mADC | 18 AWG 2 CONDUCTOR SHIELDED |
| 611 – 617 | OUTPUT VOLTAGE ANALOG OUTPUT 0–10VDC OR 4–20mADC | 18 AWG 2 CONDUCTOR SHIELDED |
| 613 – 617 | OUTPUT CURRENT ANALOG OUTPUT 0–10VDC OR 4–20mADC | 18 AWG 2 CONDUCTOR SHIELDED |
| 615 – 617 | OUTPUT FREQUENCY ANALOG OUTPUT 0–10VDC OR 4–20mADC | 18 AWG 2 CONDUCTOR SHIELDED |
| 617 | ANALOG GROUND | 18 AWG 2 CONDUCTOR SHIELDED |

## DIGITAL OUTPUTS

| SIGNAL | DESCRIPTION | RECOMMENDED WIRE TYPE |
|---|---|---|
| 803, 804, 805 | LOSS OF TREAT ALARM 1 SET OF FORM C CONTACTS RATED AT 5 AMPS 120 VAC / 30 VDC | 18 AWG MTW OR EQUIVALENT |
| 806, 807, 808 | POWER SUPPLY RUN CONTACT 1 SET OF FORM C CONTACTS RATED AT 5 AMPS 120 VAC / 30 VDC | 18 AWG MTW OR EQUIVALENT |
| 809, 810, 811 | INTERLOCK STATUS CONTACT 1 SET OF FORM C CONTACTS RATED AT 5 AMPS 120 VAC / 30 VDC | 18 AWG MTW OR EQUIVALENT |
| 2231 – 2232 | EXHAUST BLOWER 1 START / STOP CONTACT (FUTURE USE) | 18 AWG MTW OR EQUIVALENT |
| 2233 – 2234 | EXHAUST BLOWER 2 START / STOP CONTACT (FUTURE USE) | 18 AWG MTW OR EQUIVALENT |
| 2235 – 2236 | TREATER STATION ENCODER OUTPUT (MIRRORS TREATER STATION ENCODER INPUT SIGNAL) | 18 AWG 2 CONDUCTOR SHIELDED |
| 2237 –2238 | SPARE CONTACT 1 (FUTURE USE) | 18 AWG MTW OR EQUIVALENT |
| 2239 – 2240 | SPARE CONTACT 2 (FUTURE USE) | 18 AWG MTW OR EQUIVALENT |
| 2241, 2242, 2243 | SPARE FORM C CONTACT RATED AT 5 AMPS 120 VAC / 30 VDC | 18 AWG MTW OR EQUIVALENT |



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INTELLADYNE

DWG NO E3532-1
REV
SCALE 1 : 1
SHEET 2 OF 2

DATE | APP'D | DESCRIPTION | REV

## MACHINERY SAFETY

1. Corona treatment equipment operates at very high voltages (up to 15000 Volts) at electrodes. It is essential that the utmost caution is taken when operating and maintaining equipment, where dangerous voltages are present they are indicated by the hazardous voltage warning label ISO 3864 No. B.3.6.

No access is permitted to the area indicated by this symbol **UNLESS** the power supply is isolated.


2. The treatment process produces ozone gas as a by product. It is the customerôs responsibility to ensure that the unit is connected to a suitable extraction system and or catalytic converter constructed from corrosion resistant materials.
   Ozone extraction outlets are identified by the above label.
   (See Appendix 1.)

3. The generator is equipped with a dust filtration system indicated by the caution symbol ISO 3864 No. B.3.1 symbol. If this system blocks, see routine maintenance section as the unit may overheat.

4. When isolating the Generator supply a small time delay of <5 seconds is needed for power to drain from capacitors via leakage resistors. Service engineers opening the doors should be aware of this.

5. Care must be taken to avoid injury from moving parts, such as rotating rolls, moving electrode assemblies and sensor probes at roll ends. Where risk is considered high guards are fitted.

6. Some machines are designed to be ópenô construction. It is the customerôs responsibility to ensure access is safe. Fence type guards or other protection can be ordered separately at order placement or subsequently.

NB Sherman treaters cannot specify guarding of interfaces between their machinery and the machinery into which it is to be incorporated because of the unique requirements of each installation. Therefore Sherman Treaters have supplied machinery with residual mechanical and electrical risks which must be safe-guarded by the user. Access to Sherman Treaters machinery must be prevented at all times when the HT electrodes are energised.


**12 Ozone: Health Hazards and Precautionary Methods**

Guidance Note EH38 from the
Health and Safety Executive

# OZONE : Health Hazards and Precautionary Measures

Environmental Hygiene Series 38 (July 1983)

These Guidance Notes are published under five subject headings: Medical, Environmental Hygiene, Chemical Safety, Plant and Machinery and General.

## INTRODUCTION

1. This guidance note contains information on the principal hazards to health from ozone and on potential sources of exposure. General advice on precautionary measures, control techniques and legal requirements is given.

2. Ozone, O3, is a toxic gas possessing a distinctive odour and is a normal constituent of the earthõs atmosphere. Ozone is produced deliberately for a variety of industrial purposes and is also produced naturally from oxygen whenever ultra-violet radiation or electrical discharges occur, e.g. at high altitudes or by the action of lightning. Such natural occurrence is unlikely to produce concentrations hazardous to man.

3. Because of its strong tendency to decompose and to release oxygen, ozone is extremely reactive and is a powerful oxidising agent which reacts explosively with oil and grease. Nevertheless it can be used with safety in industry. For example, since it readily oxidises organic matter, it is used as a bactericide and algaecide.

4. Ozone itself is a distinctly blue coloured gas (bp ï 111.9ºC) and is about one and a half times heavier than air (density 2.144g/l). Ozone is used as ñozonised airò, a colourless gas produced when ozone is generated from part of the oxygen in air (see para 13). Ozone cannot be stored or transported in vessels because it decomposes spontaneously in the presence of oxidisable impurities, humidity and solid surfaces. The rate of decomposition increases with temperature.

5. Background concentrations in our immediate atmosphere vary as a function of season, weather conditions, altitude and humidity.

## EFFECTS OF OZONE

6. Low concentrations of ozone have a significant effect upon textiles, fabrics, organic dyes, metals, plastics and paints and cause the characteristic cracking of stressed rubber, commonly called ñweatheringò. A few substances, however, are resistant to the oxidising effect of ozone and these include glass and some stainless steels.

7. The acute toxicity of ozone to man has long been recognised and is well documented[1-8]. The symptomatic and clinical effects of ozone at various concentrations are summarised in Table 1. Ozone is irritant to mucous membranes of eyes and respirator tract, and high concentrations can cause pulmonary oedema.

8. It is possible that there are secondary sites of reaction to ozone characterised by a defect in oxygen dissociation from oxyhaemoglobin in the tissues. Even at an exposure level of 0.1ppm ozone, premature ageing may result in man if exposure is sufficiently prolonged.

## EXPOSURE LIMITS

9. The Health and Safety at work etc Act 1974 requires every employer to ensure, so far as is reasonably practicable, the health of all his employees and others who may be affected by the work he undertakes. The Act also places duties in respect of health and safety matters on the self-employed. The Factories Act 1961 requires factory occupiers to take all practicable measures to protect employed persons against inhalation of fume. The general policy adopted by the Health and Safety Executive is that exposure to hazardous substances should be kept at low as is reasonably practicable and in any case exposure should be kept within published standards by the application of engineering controls or other suitable control techniques. The Health and Safety Executive publishes, in guidance notes in the RH series, information on exposure limits applied in the UK.

10. The recommended exposure limit for ozone is 0.1ppm (0.2mg/m$^3$) calculated as an 8-hour time-weighted average concentration. There is also a short-term exposure limit for ozone of 0.3ppm (0.6mg/m$^3$) calculated as a 15-minute time-weighted average concentration.

## SOURCES OF EXPOSURE

11. Ozone is made using ultra-violet radiation or electrical discharge either intentionally for the purpose of a specific process or incidentally to a process. It is an unstable substance but is rate of decomposition varies widely according to temperature and humidity. A given ozone output yielding a faint trace of ozone in a workroom atmosphere on a humid day may created an undesirable concentration on a dry day.

## INTENTIONAL PRODUCTION

12. Ozone is usually produced intentionally by silent electrical discharge in air. Alternative means of production such as bombardment of air with ultra-violet or ionising radiation, or electrolysis of cooled sulphuric acid , are uncommon in practice.

13. There are basically three types of ozone generator in use, working at:

(a) Atmospheric pressure ï typically a box through which material to be treated with ozone is passed, and in which a silent electrical discharge is initiated through the air be means of metal electrodes. This system is often used for surface treatment of plastic film.

(b) Reduced pressure ï found in swimming pool disinfection plants whereby dried air is drawn through glass tubes across which is a silent electrical discharge is struck. The reduced pressure is generated by a sidestream from the circulating pool water forming a venturi vacuum.

(c) Positive pressure ï found in potable water treatment plants and throughout industry generally. Dried air is blown through glass tubes across which a silent electrical discharge is struck and this ozonised air emerges at positive pressure.

14. The processes for which ozone is produced are outlined below.

## SURFACE TREATMENT

15. Various industries which manufacture or use plastic packaging in its various forms use ozone to pre-treat the plastic surface immediately before printing.

## ELECTRICAL DISCHARGES

16. Ozone is generally produced around high voltage equipment and by electrical discharges in specific processes e.g.

(a) Arc welding ï reactive metals such as aluminium and titanium, and also stainless steel are arc welded in an inert shield of argon or carbon dioxide. The intense radiation from the arc produces significant quantities of ozone.

(b) Static eliminators are often used in industry to remove static electricity from recently moulded plastic articles, and continuous use of them in a poorly ventilated room could lead to the build-up of an irritating level of ozone above the recommended exposure limit. The main factor which determines the amount of ozone produced is the voltage across the collector plates; the higher the voltage the more ozone is produced.

(c) Electrostatic precipitators are used to remove dust and some airborne contaminants from the air and they produce ozone also. More ozone is produced if there are rough or sharp edges on, for example, new metal parts since intense local voltage gradients are produced.

## VENTILATION

17. Areas into which ozone may escape must be equipped with adequate ventilation and extraction facilities. In ozone plant rooms, it is recommended that ten changes of room air per hour be achieved to enable dangerous accumulations of gas to be dispersed within a few minutes.

18. Ozone should be prevented from entering the workroom air by the use of exhaust appliances placed close to the source of emission. The ozone may then be passed through appropriate filters before discharge to a safe place in the open air. In the case of ozonators operating under negative pressure, the process acts as its own exhaust ventilator. In the case of atmospheric pressure ozonators, effective local exhaust ventilation is necessary because the ozonators are not enclosed. Cinema projection lamps should present no ozone hazard provided adequate mechanical exhaust ventilation is fitted to the lamp housing and the exhausted air is vented to a safe place. Many processes incidentally producing ozone (e.g. welding, ultra-violet curing inks) will have some ventilation provided to deal with other problems from process.

## SAFE SYSTEMS OF WORK

19. In order to ensure that plant and processes are properly operated and controlled to minimise risk to health, satisfactory safe systems f work need to be established and maintained by means of appropriate training and supervision.

20. All people operating ozone plant should be given full training in all aspects of the operation of the ozonator and associated equipment and should be trained in emergency and first aid procedures. Emergency action plans should be prepared for all sites where ozone is generated deliberately in potentially hazardous quantities.

21. Special care may be required when opening sealed plant for maintenance purposes. Guidance Note GS5[10] should be consulted for detailed advice on permit-to-work systems and precautions on entry into confined spaces.

22. Work on ozone plant should only be undertaken by a person specifically authorised to do the work. Such a person should be trained and be competent to do the work in a safe manner. When carrying out repairs or maintenance work on an ozonator, the ozonator transformer must be isolated and locked off, and a permit to work must be issued, to avoid risks from ozone and from electrical hazard.

23. The cleaning materials used for cleaning ozone units and pipework must be free from oil or grease.

24. In the event of an ozone leak a plant restart should not be attempted until the source of leakage has been investigated and rectified. Leak detection by nose is not satisfactory because even slight leaks cause the sense of smell to be numbed and lead to the false conclusion that a leak no longer exists.

25. Appropriate warning signs indicating the presence of a potential toxic gas hazard should be displayed on ozone plant access doors or in passageways leading to the plant room.

## MONITORING

26. Ozone detectors may be used to provide audible and visual warnings of ozone leaks. Such alarm signals may be used to initiate emergency procedures, or to automatically turn on plant room ventilation and shut down the ozonator. Ozone-in-air monitors are essential in plant rooms where ozonators and associated equipment operate under positive pressure, because of the greater risk of ozone leakage outward. The monitors in such situations should actuate automatic ozonator shut down at 0.3ppm ozone or less, while actuating warning alarms at 0.1ppm or less.

27. Minor ozone leaks can be detected and located by means of moist starch/potassium iodide paper which turns blue on exposure to ozone.

28. It is essential to carry out regular testing and calibration of all sensor equipment used.

## EXHAUST EMISSION

29. Process gas venting to atmosphere should pass through an ozone destructor device or be released in such a way as to present no hazard. A destructor is a catalyst filter or other device which causes ozone to decompose in a controlled manner to oxygen. Provided the discharge point allows adequate dilution a destructor device may not be necessary. If a catalyst bed, for example activated carbon, is used as an ozone destructor it is possible that the bed could become exhausted during a period of operation and this should be borne in mind when arranging maintenance schedules.

30. Deflection weather caps are not recommended for discharge stacks since these hinder dispersal. Vertical discharge stacks are recommended with a discharge velocity of 15-20m/s to aid dispersal and avoid re-circulation into buildings. Stacks and extraction vents should be carefully sited so that they do not feed fresh air ventilation intakes.

31. The control of ozone input to a process is crucial since excess ozone can lead to high levels of vented ozone.

32. Activated carbon filters must under no circumstances be exposed to ozone concentrations higher than 20g/m$^3$ since the reaction may become auto-accelerated and lead to an explosion. The automatic shutdown is a safeguard against this risk.

## FIRST AID

33. If a person is overcome by ozone, the following precautions should be adopted:

(a) Remove the patient to a warm uncontaminated atmosphere and loosen tight clothing at the neck and waist.

(b) Keep the patient at rest.

(c) If the patient has difficulty in breathing, oxygen may be administered provided that a suitable apparatus and a trained operator are available.

(d) If breathing is weak or has ceased, artificial respiration should be started. The mouth-to-mouth or mouth-to-nose methods are preferred.

(e) Seek medical aid.

34. Ozone poisoning should be treated symptomatically. This may include bed rest, analgesics to relieve pain, and antibiotics as may be prescribed by a medical practitioner.

## SAMPLING AND ANALYTICAL METHODS

35. Sampling strategies to monitor the extent of exposure to ozone or to assess compliance with exposure limits should be carefully planned and the advice of an occupational hygienist may prove useful. Short-term sampling may be used to identify peak exposures and to assist in the prevention of acute gassing incidents. It may not be valid, however, to use the results of such sampling for the determination of time-weighted average long-term exposures. Personal atmospheric sampling is to be recommended when assessing the actual pattern and duration of exposure. (Further information is contained in Health and Safety Executive guidance notes on Exposure Limits).

36. The traditional method of determining ozone in air may be used[12] but continuous ozone monitors are now available which use a variety of techniques including onemiluminescence, ultra-violet photometry and electro-onemical cells. Relatively inexpensive gas detector tubes are also available. These are ideal for spot check, provided that interfering gases, such as oxidising agents, are known to be absent.

## STATUTORY REQUIREMENTS

37. The general duties of employers, the self-employed, manufacturers, suppliers and of employees at work are contained in the Health and Safety at Work etc Act 1974. Other relevant statutory provisions include the Factories Act 1961, the Offices, Shops and a Railway Premises Act 1963 and the various regulations and orders made under these Acts. The following is a brief summary of the principal requirements with regard to potential ozone health risks:

(a) Health and Safety at work etc Act 1974

s.2 & 3 general duties of employers and the self-employed

s.6 general duties of manufacturers

s.7 general duties of employees

(b) Factories Act 1961

s.4 provision of ventilation

s.30 dangerous fumes

s.63 removal of dust of fumes

(c) Offices, Shops and Railway Premises Act 1963

s.7 provision of ventilation

(d) The Shipbuilding and Ship-Repairing Regulations 1960 ï Regulation 53

The Iron & Steel Foundries Regulations 1953 ï Regulation 7

The Non-Ferrous Metals (Smelting and Founding) Regulations 1962 ï Regulation 11

The Electricity (Factories Act) Special Regulations 1944

The Notification of Accidents and Dangerous Occurrences Regulations 1980
The Health and Safety (First Aid) Regulations 1981.

**NOTE : FOR SAFETY REASONS IT IS RECOMMENDED THAT A CORONA SUPPLIES OZONE DESTRUCT SYSTEM BE FITTED TO ANY TREATER STATION**