



# ***Stradus™ Laser User Manual***





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# 3.0 Symbols



**ESD** – This symbol is used to alert the user of hazards associated with Electro-static Discharge.



**Laser Radiation** – This symbol is used to alert the user of hazards associated with optical radiation emitted from the laser.



**CE Mark** – This symbol represents the European Directive "Conformite Europeenne" to certify that a product has met EU health, safety, and environmental requirements, which ensure consumer safety. Manufacturers in the European Union (EU) and abroad must meet CE marking requirements where applicable in order to market their products in Europe.



**Ground** – This symbol represents electrical ground.



**USB** – This symbol is used to reference Universal Serial Bus Communication.

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B

# 4.0 Laser Safety

## 4.1 Compliance Standards

The Vortran Stradus™ Laser complies with CDRH safety requirements, based on EN60825-1. The compliance is based on use with the Vortran Stradus™ Control box. The control box contains the key switch, interlock and Emission LED required for compliance. Secondary power and laser emission indicators are located on the laser rear plate. The Vortran Laser CDRH accession number is on file and available upon request.

The Vortran Laser has been tested and certified by an outside testing agency, to comply with the following directives:

### **EMI Standard EN61326-1 Including:**

- EN55011 Class A radiated emissions
- EN55011 Class A conducted emissions
- EN61000-3-2 Power Line Harmonics
- EN61000-3-3 Power Line Flicker

### **EMC Standard EN61326-1 Including:**

- EN61000-4-2 ESD
- EN61000-4-3 Radiated Immunity
- EN61000-4-4 Electrical Fast Transient
- EN61000-4-5 Electrical Surge (L-L and L-E)
- EN61000-4-6 Conducted Immunity (Power / I/O Lines)
- EN61000-4 11 Power Line Dips and Brown Outs

### **LVD – Low Voltage Directive 73/23/EEC Including:**

- IEC61010-1 Standard for Electrical Equipment

### **LVD – Radiation Safety for Laser Products Including:**

- IEC 60825-1 Safety Standard for Laser Products



## 4.2 Vortran Laser Classification

The Vortran laser conforms to Class IIIb requirements as specified by the Center for Device and Radiological Health (CDRH). The Vortran laser emits visible or invisible laser radiation from the aperture located in the front of the laser head. The emitted wavelength and maximum power level are specified on the laser safety label. The typical divergence for all Vortran Stradus™ lasers is 0.5mrad.

## 4.3 Observations

If the equipment is used in a manner not specified by Vortran Laser Technology, the protection provided by the equipment may be impaired.

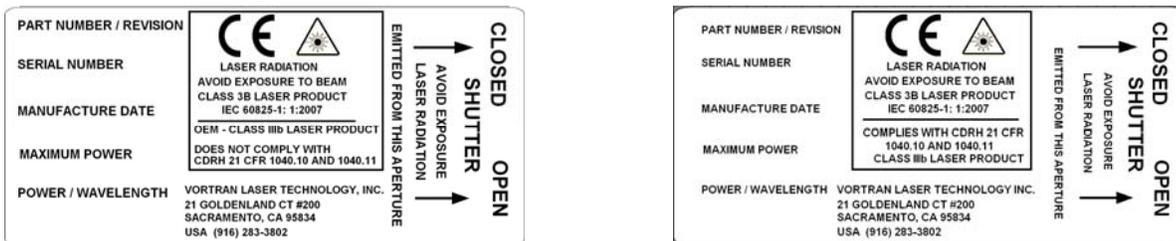
## 4.4 Laser Safety Labels

### Laser Head Top View



Figure 1  
Laser Safety Label Location

### Compliant Laser Serial Number Label



OEM Non-Compliant

Standard Compliant System

Figure 2  
Laser Head Serial Number Label

## 4.5 Electrical Safety

No hazardous voltages are contained in the Vortran laser head. The system does not contain any user accessible components within the laser head or control box. The warranty will void if the laser head or control box enclosures are disassembled.



**ESD**

Vortran Laser Technology recommends proper ESD precautions are taken when handling the laser head and control box. The Vortran Stradus™ Laser System is designed with internal safeguards for protection from ESD. Even with the tested design safeguards in place, high energy ESD discharge events may cause damage to the laser system. Vortran Laser Technology recommends handling and operating the laser system on a grounded work bench or optical table.

## 4.6 Optical Safety



Based on the properties associated with laser light, special optical safety precautions are recommended by Vortran Laser Technology. Direct eye exposure from the laser light emitted from the output aperture located on the front of the laser head is considered dangerous. Vortran Laser Technology recommends the use of proper laser safety eyewear when operating the laser system. Please verify the wavelength of the laser being used and the wavelength of laser eyewear is appropriate for the laser. The laser output should be contained in a secure beam path. The user should be aware of propagation associated with reflective and refractive optical components to be known prior to laser exposure. The laser emission indicators located on the control box and laser head, emit wavelength visible when using the proper laser safety eyewear.

Exercise caution when operating the laser with laser safety eyewear in place. The use of laser safety eyewear provides additional protection to the user. This use can eliminate the ability to see the beam path when the laser shutter is open. Vortran Laser Technology recommends that all optical setups are constructed at levels well below eye level for optical safety reasons.

## 4.7 Vortran Laser Safety Features

**4.7.1 Protective Housing** – The Vortran Laser Head and Control box include a protective housing. These housings are not intended to be removed by the user and the warranty will be voided if user removal occurs. If the housing is removed, the user may be exposed to laser radiation or line voltage. Please return the laser or control box to the factory for any required repair or service. The factory contact information is located at the end of this manual.

**4.7.2 Power Indicator** – Power indicators are located on both the laser head and control box. With the laser head connected to the control box, power indicators will illuminate with the control box power switch in the “On” position. These indicators are visible when using laser safety eyewear. Please note the location of the power indicators on the following images.

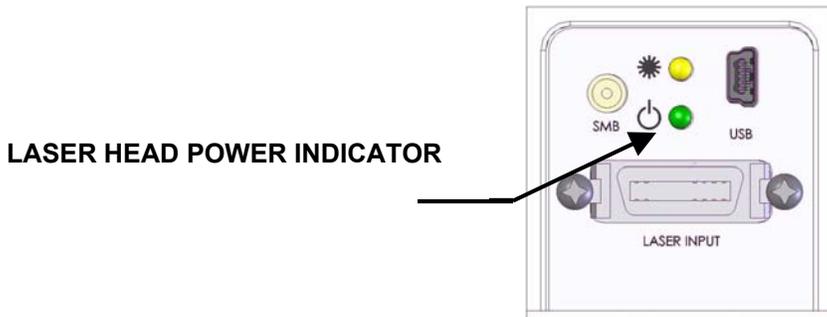


Figure 3  
Laser Head Power Indicator

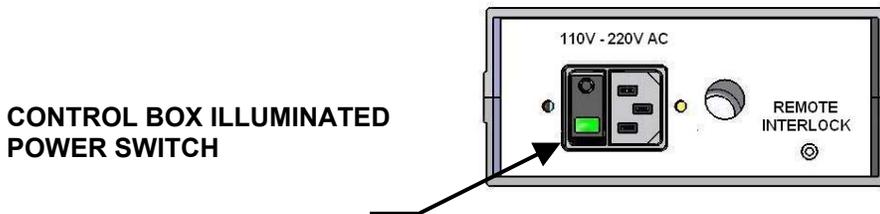


Figure 4  
Control Box Power Indicator

**4.7.3 Interlock Indicator** – Two types of laser emission indicators are provided by Vortran Laser Technology. The Vortran Stradus™ Control Box Includes an Interlock Indicator. When the power switch is in the “ON” position **and** the key switch is set to the “ON” position, the interlock indicator will be illuminated. This is an indicator of interlock status **only** and may not be a direct indicator of active laser emission. When the indicator is active, laser emission is possible and the laser head should be considered dangerous.

**Laser emission is not possible if the key switch is in the “OFF” position.**

The interlock status is constantly monitored and reported by the microprocessor in the laser head.

Computer accessible interlock status can be monitored continuously with the Vortran Stradus™ Control software (Review the Software Section for additional information). The interlock status is also accessible with the **?IL** query via RS-232 or USB.

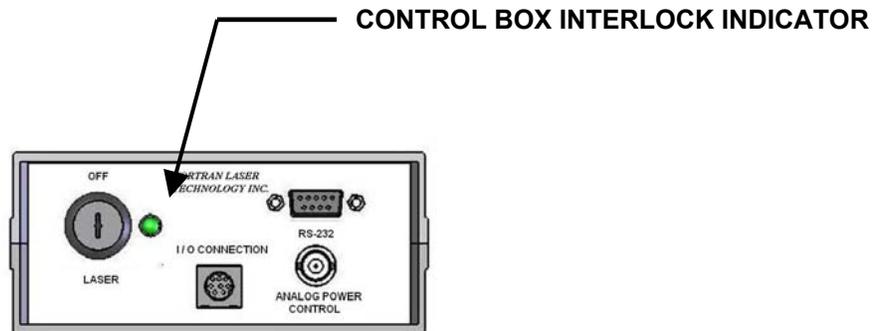
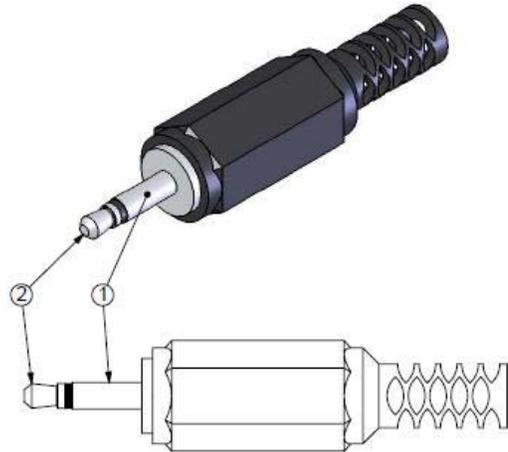


Figure 5  
Control Box Interlock Indicator

**4.7.4 Remote Interlock Operation** – The laser control box includes a jack on the rear panel for remote interlock operation. The Vortran Stradus™ Laser System is shipped with a mating plug for a remote interlock connection. When the plug is installed **and** the plug connection is **open**, laser emission is not possible. When the plug connection is installed and **closed and** the key switch is in the “ON” position, laser emission is possible.

**THE REMOTE INTERLOCK PLUG IS NOT REQUIRED FOR NORMAL LASER OPERATION**



TYPICAL MONO JACK SCHEMATIC\*

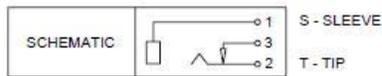


Figure 6  
Remote Interlock Plug

**A remote interlock device can be soldered to the Mono Plug center (Tip Connection) and sleeve (Base Connection)**

### 4.7.5 Interlock Diagram

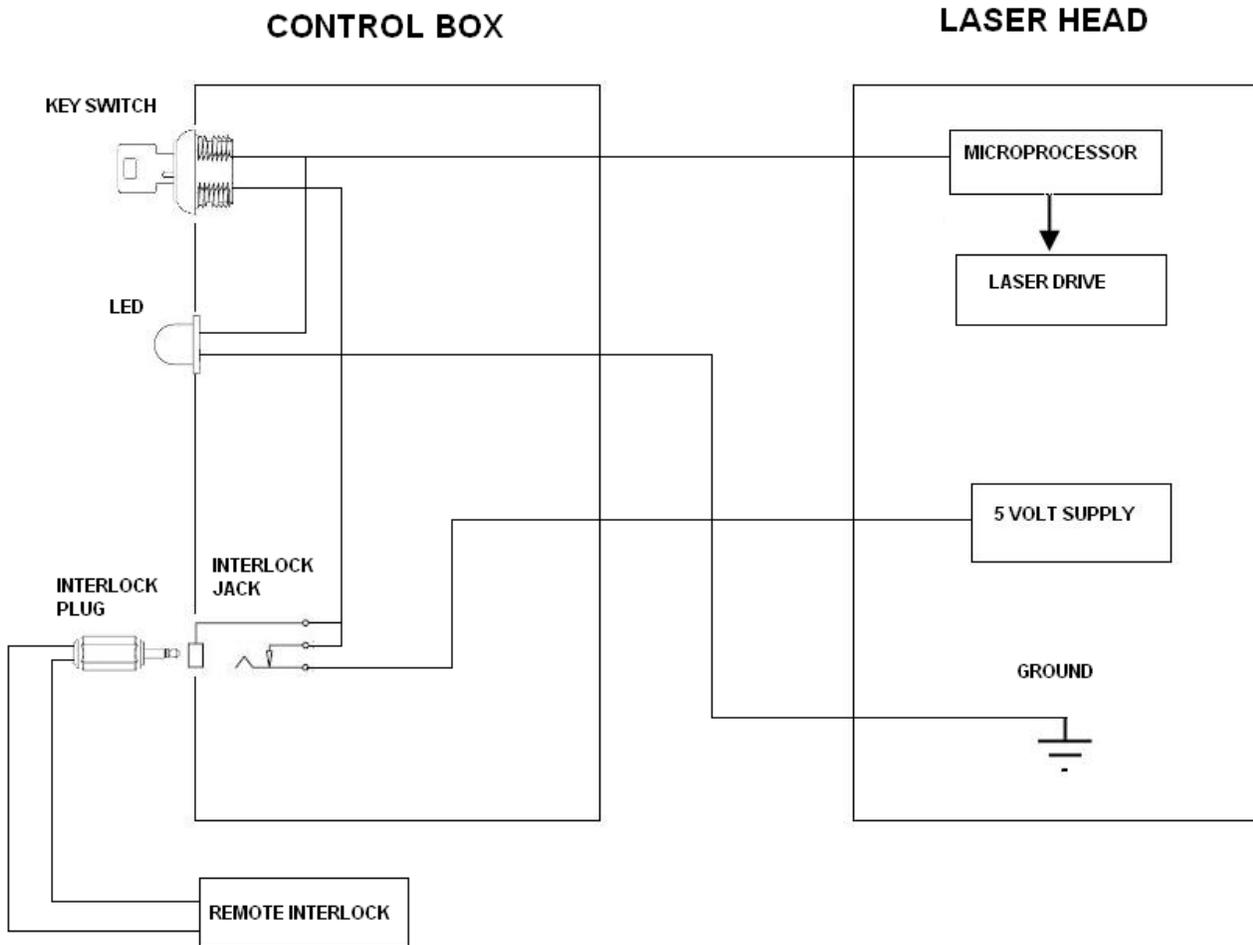


Figure 7  
Interlock Diagram

**4.7.6 Laser Emission Indicator** – The Vortran Laser Head includes a laser emission indicator. The wavelength of the indicator allows it to be viewed when using laser safety eyewear. The laser emission indicator is



controlled by the Vortran Laser microprocessor in the laser head and will illuminate prior to laser emission, when the 5 second CDRH delay is active. The indicator will be active when power is applied **and** the interlock is closed **and** no fault conditions exist. Unlike the Interlock Indicator, the Laser Emission Indicator **does** provide a direct indication of laser emission and the laser head should be considered dangerous when the indicator is active.

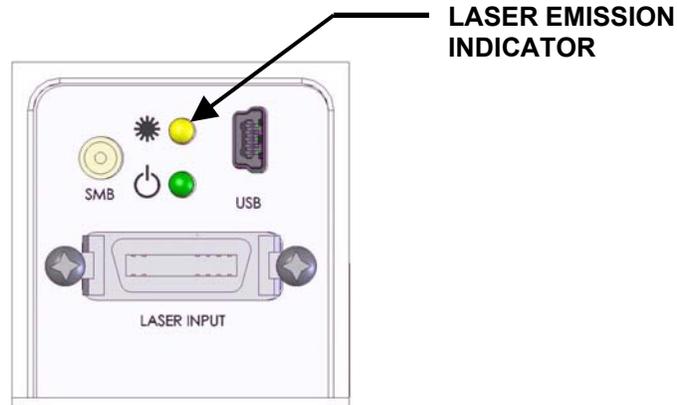


Figure 8  
Laser Emission Indicator

**4.7.7 Shutter** – The slide operation of the Vortran Laser Shutter, provides the ability to block the laser output when the emission status is active. The shutter includes a detent to ensure the shutter remains in the fully open or closed position. The shutter design ensures no laser light will be emitted in the closed position. The laser top label provides indication for the open and closed position. The shutter operates with a horizontal sliding motion.

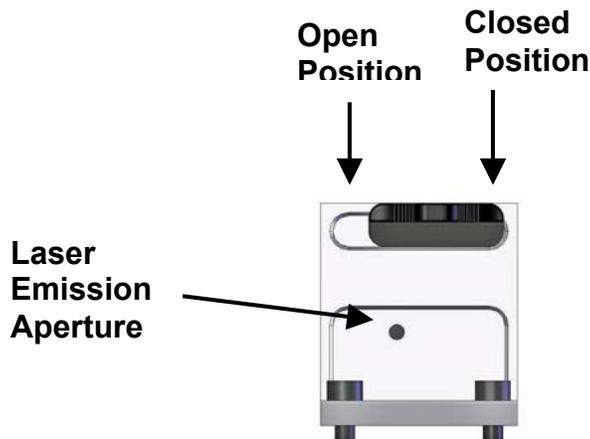


Figure 9  
Laser Shutter Positions

**4.7.8 Key Switch** – The Vortran Laser Key Switch provides the ability to initiate, halt or prevent laser emission. With the power on and the key switch in the “ON” position, laser emission is possible. Possible laser emission

is indicated when the “Green” LED is illuminated. With laser emission active, the key switch can halt laser emission when switched to the “OFF” position. The key switch can prevent laser emission when removed. The key can be removed only when the switch is in the “OFF” position.

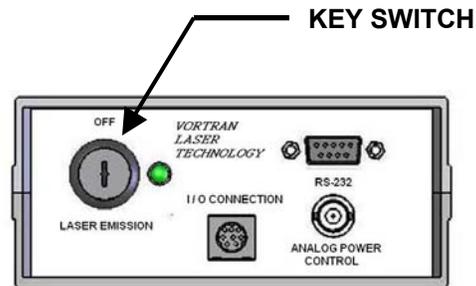


Figure 10  
Control Box Key Switch

**4.7.9 Laser Emission Delay** – The Vortran Laser provides a microprocessor controlled laser emission delay. When the laser is turned on, a 5 second delay is applied prior to laser emission. If a fault conditions exists and is resolved, the delay will be applied prior to laser emission. If the interlock is opened then closed, the delay will be applied prior to laser emission. For OEM applications, the delay can be disabled with a firmware command.

**4.7.10 Computer Control** – The Vortran Laser can be controlled by a computer via USB or RS-232. The command set includes provisions for remote operation. Computer controlled safeguards can be applied in a remote operation configuration. Please contact Vortran Laser Technology for recommendations on safeguards that can be implemented in a remote control configuration.

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# 5.0 System Information

## 5.1 System Features

- **Compact full-featured laser head. OEM installation does not require the control box for operation.**
- **USB or RS-232 remote communication**
- **External analog power control**
- **Laser control box to interface all laser features**
- **Sealed optical cavity to ensure performance and reliability**
- **Consistent beam diameter and divergence across entire laser family**

## 5.2 System Description

Vortran Laser Technology provides a compact full-feature laser system. The laser head is microprocessor controlled with a powerful ARM-7 processor. The modular electronic design ensures optimum performance and reliability. The optical cavity is sealed, for long-term performance and reliability. The proprietary optical laser power control configuration reduces susceptibility to optical contamination and retro-reflection from external optical components. The laser head includes indicators for power and laser emission.

## 5.3 Power Supply Ratings and Protection

Input: 100V – 240V, 50Hz – 60Hz, 1.0 Amp Maximum

Output: 12VDC, 3.7 Amp Maximum

The Vortran Laser power supply provides protection from transient voltages and electrostatic discharge.

## 5.4 Environmental Operating Conditions

The Vortran Stradus™ Laser system is designed for indoor or enclosed use only. Typical operating temperatures range from 10°C to 40°C, based on the heat sink used to maintain base plate temperatures at or below 50°C. The Vortran Stradus™ laser can operate at altitudes up to 2000 meters. Maximum relative humidity is 80% for ambient temperatures up to 31°C, with a linear decrease to 50% at 40°C. The laser system does not emit any type of pollution.

## 5.5 Block Diagram

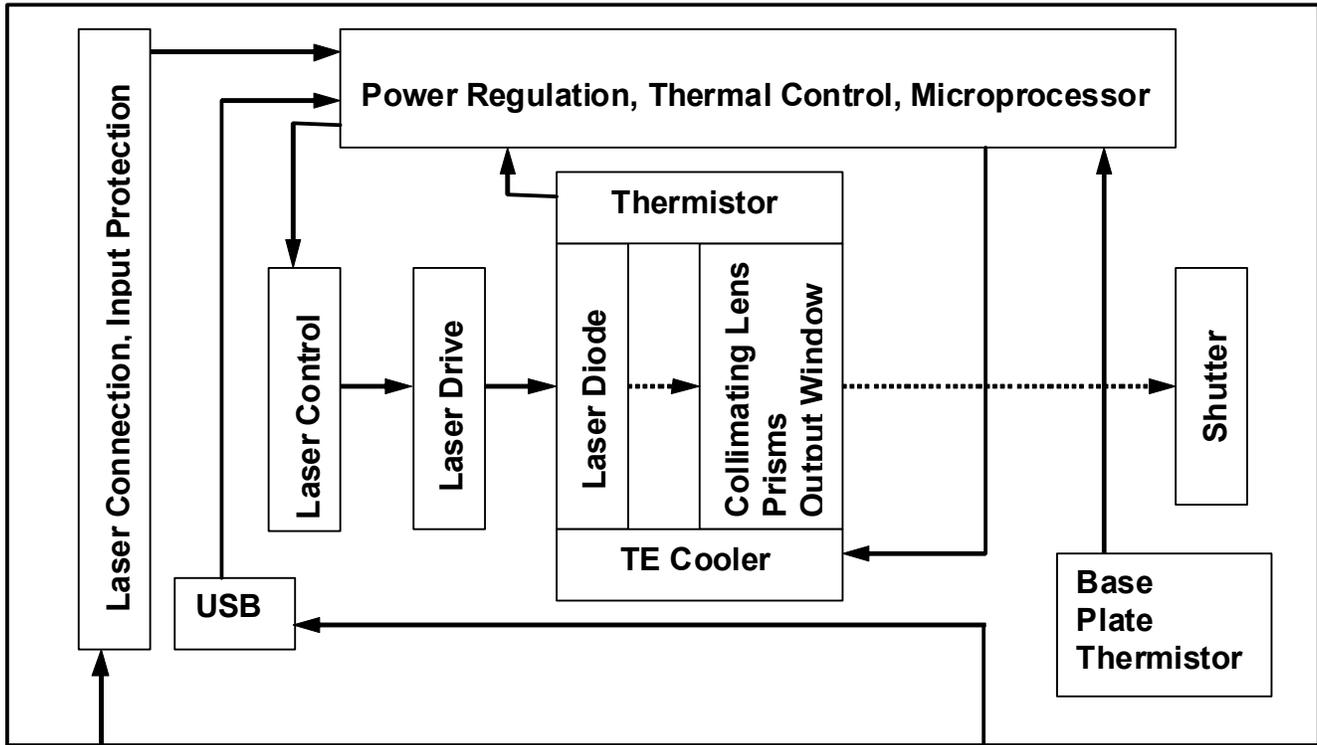
See Next Page

Figure 11



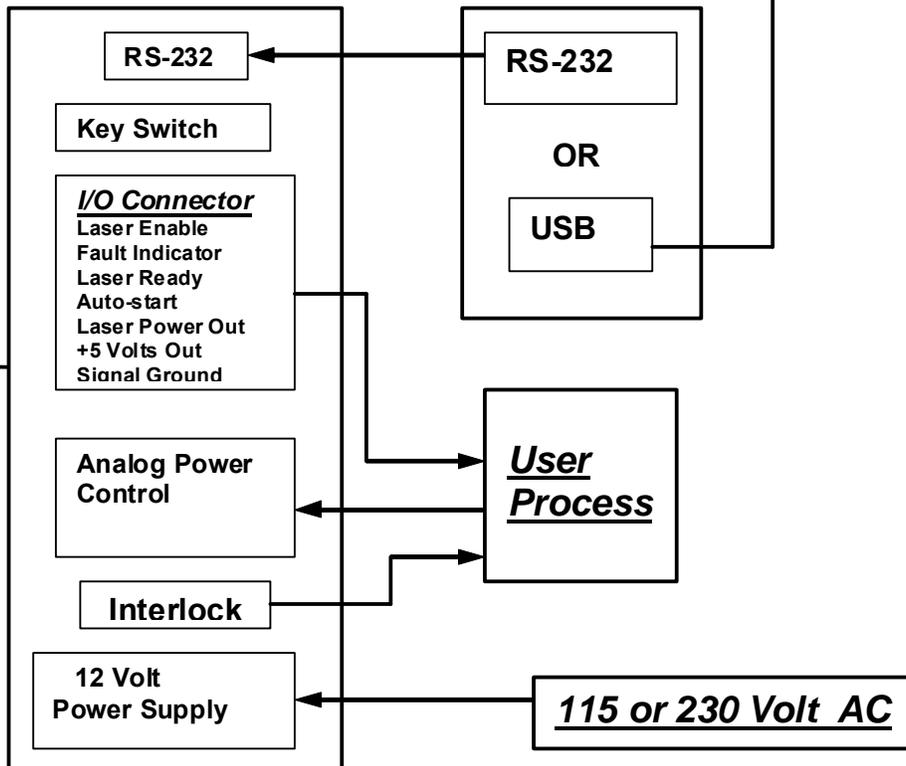
Electrical  $\longrightarrow$   
 Optical  $\dashrightarrow$

# Laser Head



## Laser Control Center

## Host Computer



# 6.0 Installation

## 6.1 System Installation Checklist

- ✓ Unpack and Inspect Laser Head and Control Box
- ✓ Use Supplied Mounting Screws to Secure Laser Head to an appropriate Heat Sink
- ✓ Torque Laser Head to Heat Sink at 20 in-lbs, Using a Progressively Increasing Cross Torque Pattern
- ✓ Connect Laser Control Box to Laser Head
- ✓ Connect USB or RS-232 Cable if Computer Control is Desired
- ✓ If Computer Control is Desired, Install Vortran Stradus™ Control Software
- ✓ Connect AC Power to Laser Control Box
- ✓ Proceed to Operation Section for Additional Information

## 6.2 Unpacking and Inspection

Upon receipt of your new Vortran laser, inspect the contents of the shipping box for potential damage from mishandling during shipment. Immediately report any damage to Vortran Laser Technology.

A CDRH compliant laser system shipment will include the following items:

<b>Description</b>	<b>Part Number</b>	<b>Quantity</b>
Laser Head	See Packing List	1
Laser M4 x 10mm Screws	10068	4
Mounting Screw Washers	10069	4
3mm Hex Driver	10070	1
Laser Control Box	10067	1
USA Power Cord	10066	1
Laser Control Software CD	10049	1
User Manual	10048	1
Mini B USB Cable	10126	1
Remote Interlock Plug**	10039	1
Mini DIN I/O Connector Plug**	10091	1

\*\*Packaged separately and not required for normal operation

Table 1  
Packing List



## 6.3 Laser Head Mounting

### 6.3.1 Laser System Drawings

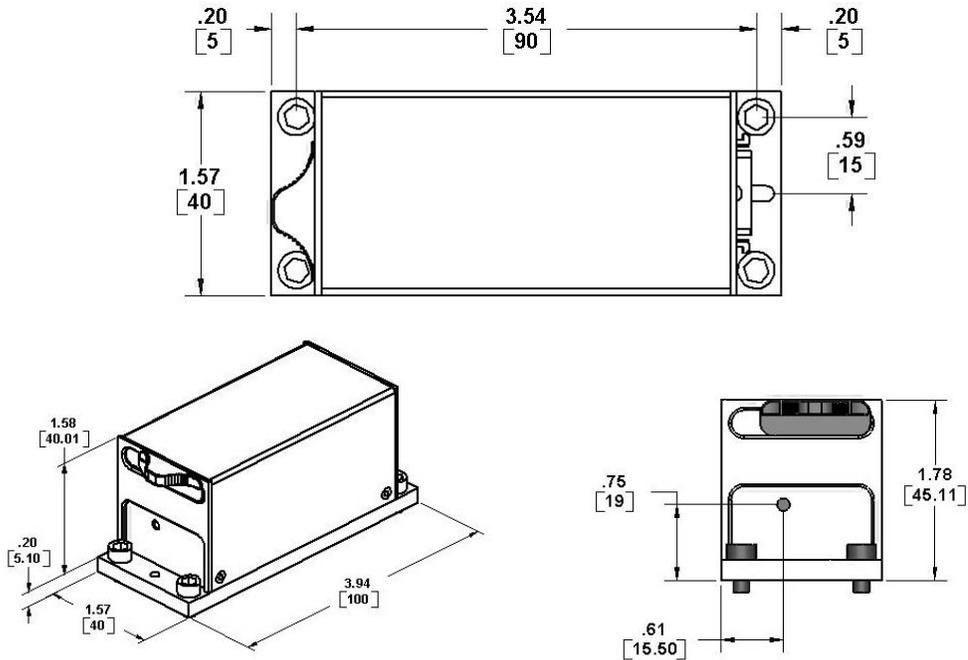


Figure 12  
Laser Head Dimensions

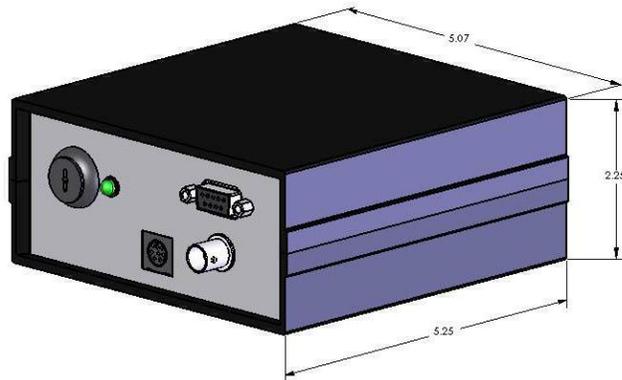


Figure 13  
Control Box Dimensions

**Note: The values shown for the Control Box height does not include the rubber feet. Add 0.15" for the Rubber Feet.**

**Note: The Laser Cable length is 2 feet.**

**6.3.2 Heat Sink Requirements** The Vortran Laser head is conduction cooled and requires a heat sink for operation.

- ***Failure to use a heat sink will overheat the laser head.***
- ***Heat sink compound is not required or recommended for laser head mounting.***
- ***A heat sink capable of dissipating 15 Watts is required for laser mounting.***
- ***A 32 finish is recommended for the laser mounting surface, to ensure optimum thermal transfer.***
- ***A high tolerance heat sink surface flatness is recommended for laser head mounting.***

**6.3.3 Laser Mounting Hardware** Each Vortran Stradus™ Laser System is shipped with M4 x 10mm laser head mounting screws and washers. If ASE mounting hardware is desired, the laser head can be mounted with 6-32 x 1/2" socket head screws.

- ***Always use washers for laser head mounting, to reduce base plate stress and avoid damage to the mounting holes.***

**6.3.4 Torque Specifications** Normal mounting can be accomplished by using the provided hex key to secure the laser head to the heat sink, by tightening the screws gradually in a progressing cross pattern. This method should provide stable thermal and pointing performance.

Optimum thermal and pointing performance is accomplished by securing the laser head to the heat sink, with a precision torque driver. Torque the laser head to the heat sink by using a cross torque pattern and progressively increasing torque from 10in-lbs to 15-in-lbs to 20in-lbs. Torque the laser in the sequence shown below.

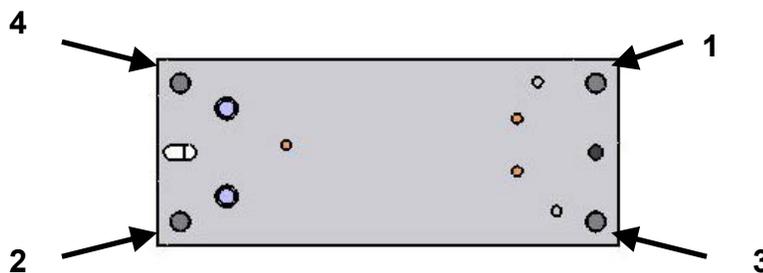


Figure 14  
Laser Head Torque Pattern

- 6.3.5 USB Connection** The Vortran Laser includes USB communication capability and a cable is supplied with each standard laser system. The included cable is specified as a Mini-B USB cable and they are readily available at many consumer electronic stores. Refer to sections 10 and 11 for computer controlled operation.
- 6.3.6 Laser Control box** Standard Vortran Lasers are shipped with a full-feature laser control box. The laser control box allows the user to access all input and output functions available with the laser system.
- 6.3.7 Power Supply Connection** A standard Vortran Stradus™ Laser System includes a power cable. The power cable is a standard IEC version with 18 gauge wires. This cable is available at most consumer electronic stores.
- 6.3.8 RS-232 Connection** The DE-9 connector on the laser control box provides access to the laser RS-232 input and output. The control box pin functions are shown below. Refer to sections 10 and 11 for computer controlled operation.

**A null-modem cable will not operate a Vortran Laser. Use a standard RS-232 cable for remote communication.**

Function	Control Box DE9
RS-232 Transmit	Pin 2
RS-232 Receive	Pin 3
Signal Ground	Pin 5

Table 2  
RS-232 Connections

**6.3.9 I/O Connection** Access the laser Input / Output functions on the front of the laser control box. The I/O connector is a standard 8 pin Mini-DIN. A mating connector is provided with each standard laser system and allows the user to build interface cable that can access some or all I/O pin functions.

Mini-DIN Plug Specification – KOBICONN Part Number 171-2608

Disassemble the plug and solder to the desired pin solder cups and insulate with shrink tube. The plug assembly and dimensional information is shown below.

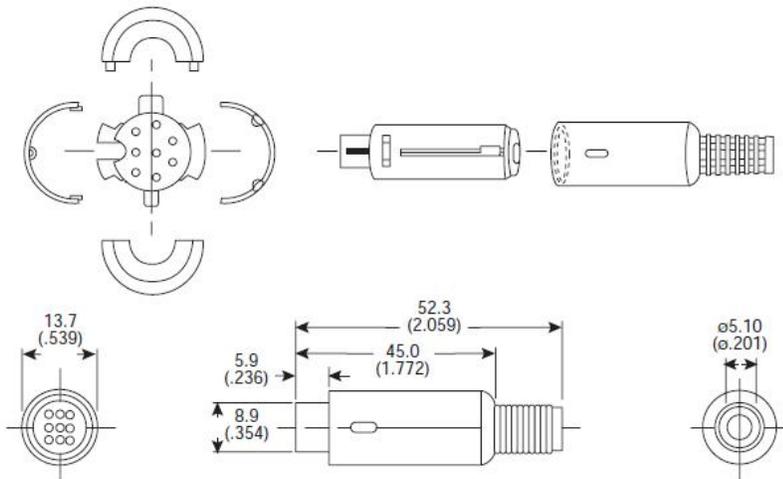
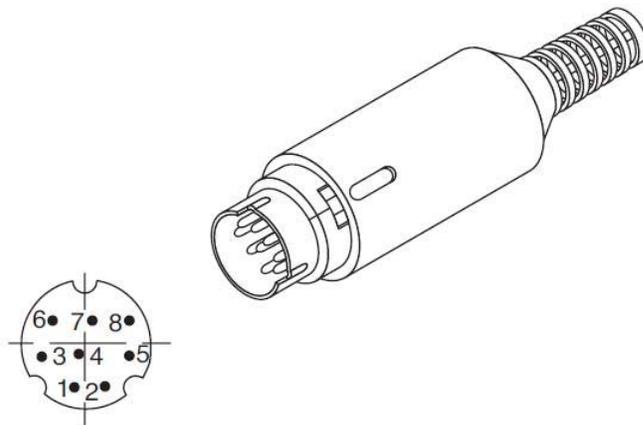


Figure 15  
Mini-DIN Plug



Pin Numbers from  
Front Plug View

Figure 16  
I/O Pin Diagram



Function	PIN #	Description
Fault Indicator	1	TTL Signal for Fault Status. TTL High = Fault Condition
Laser Enable	2	TTL Signal to Toggle Laser Emission On and Off
Auto-start	3	Ground pin to require computer initiated laser emission. (LE=1) This pin is normally TTL High
5 Volts	4	5 Volt Reference
Laser Ready	5	TTL Signal for Laser Emission Status. TTL High indicates laser emission. Indicator High when CDRH delay count begins.
N/C	6	No Connection
Signal Ground	7	
Laser Power Out	8	0-2 Volt output signal represents 0-100% laser power

**The Auto-start Laser Enable Pins are considered inputs. All other pins are considered outputs.**

Table 3  
Control Box I/O Pin Descriptions

**6.3.10 BNC Connector** The BNC connector located on the front of the control box is used to input an analog signal for direct laser power control. A 0-5 volt input signal will directly control 0-100% of the present laser set power.

**The EPC=1 software command must be issued for External Laser Power Control.**

**6.3.11 Remote Interlock Plug** Each standard Vortran Stradus™ Laser System is shipped with an Interlock Plug.

**The Interlock Plug is Not Required for Normal Operation.**

For remote interlock operation, connect to the supplied plug to a remote interlock switch. When the interlock plug is installed into the control box and the connection is “Open,” laser emission is not possible. When the connection is “Closed” **and** no fault conditions are present, the CDRH delay will start, followed by active laser emission. Plug wiring information is shown below.

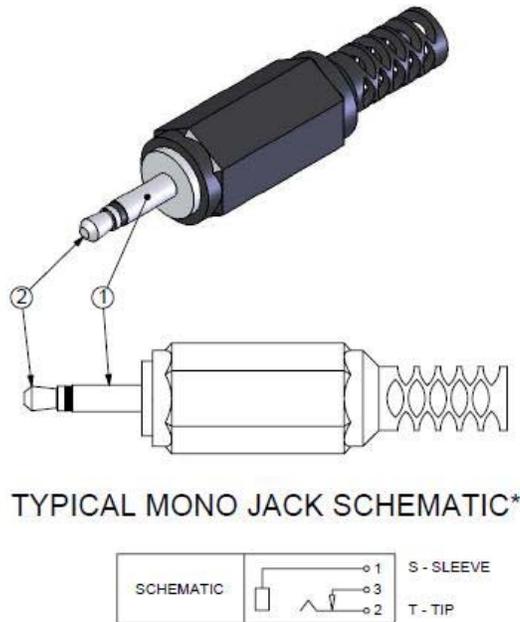


Figure 17  
Remote Interlock Plug

# 7.0 OEM Laser Installation

## 7.1 OEM Laser Installation Checklist

- ✓ Unpack and Inspect Laser Head
- ✓ Use Supplied Mounting Screws to Secure Laser Head to Heat Sink
- ✓ Torque Laser Head to Heat Sink at 20 in-lbs, Using a Progressively Increasing Cross Torque Pattern
- ✓ Configure Laser Control Cable with Desired Operational Connections
- ✓ Connect Laser Control Cable to Laser Head
- ✓ Proceed to Operation Section for Additional Information

## 7.2 Laser Head Drawings

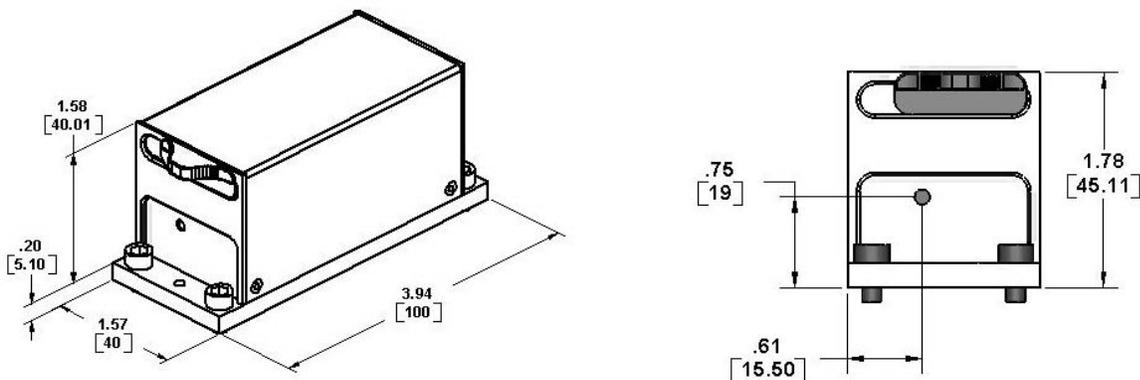


Figure 18  
Laser Head Dimensions

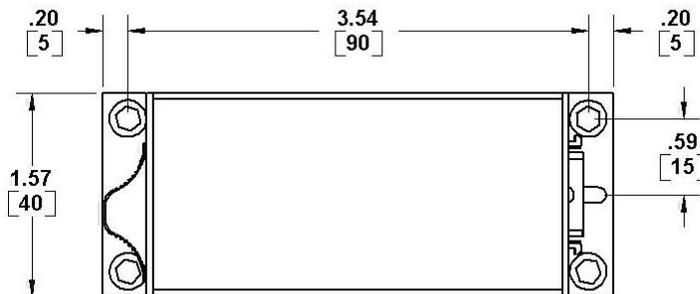


Figure 19  
Laser Mounting Dimensions



### 7.3 Heat Sink Requirements

The Vortran Laser head is conduction cooled and requires a heat sink for operation.

- **Failure to use a heat sink will overheat the laser head.**
- **Heat sink compound is not required or recommended for laser head mounting.**
- **A heat sink capable of dissipating 15 Watts is required for laser mounting.**
- **A 32 finish is recommended for the laser mounting surface, to ensure optimum thermal transfer.**
- **A high tolerance heat sink surface flatness is recommended for laser head mounting.**

### 7.4 Laser Mounting Hardware

Each Vortran Stradus™ Laser System is shipped with M4 x 10mm laser head mounting screws and washers. If ASE mounting hardware is desired, the laser head can be mounted with 6-32 x 1/2 " socket head screws.

- **Always use washers for laser head mounting, to reduce base plate stress or damage to the mounting holes.**

### 7.5 Torque Specifications

Normal mounting can be accomplished by using the provided hex key to secure the laser head to the heat sink, by tightening the screws gradually in a progressing cross pattern. This method should provide stable thermal and pointing performance.

Optimum thermal and pointing performance is accomplished by securing the laser head to the heat sink, with a precision torque driver. Torque the laser head to the heat sink by using a cross torque pattern and progressively increasing torque from 10 in-lbs to 15 in-lbs to 20in-lbs. Torque the laser in the sequence shown below.

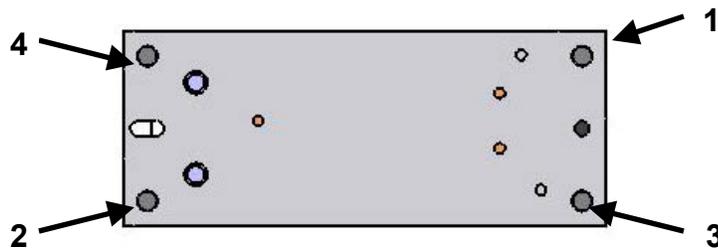


Figure 20  
Laser Mounting Torque Pattern

## 7.6 Input Connector Specifications

The Vortran Stradus™ Laser System input connector is a 3M Mini-D 20 pin connector. For OEM applications, Vortran Laser Technology recommends the solder connector described below. A solder-type connector will allow for connections to only the pins required for custom applications without connecting to unneeded pins.

### Vortran Stradus™ Laser Mating Connector and Shell

\*\*These connectors are normally available from Digi-Key

### Insulation Displacement (IDC) Ribbon Cable Connection

IDC Ribbon Cable Connector – 3M Part Number 10120-6000EC

IDC Metal Shell – 3M Part Number 10320-A200-00

### Solder Connection

Solder Connector – 3M Part Number 10120-3000PE

Plastic Solder Connector Shell – 3M Part Number 10320-52F0-008

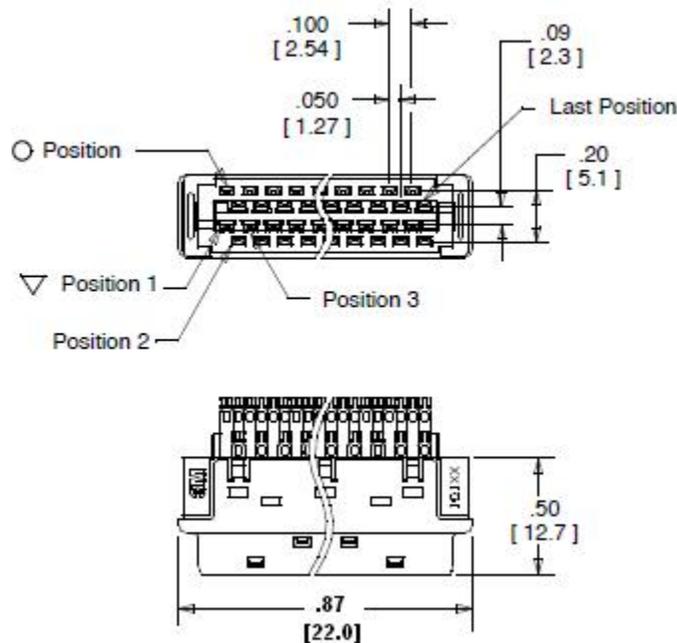


Figure 21  
Laser Solder Connections

## 7.7 Power Supply Requirements

The Vortran Stradus™ laser requires a 12 volt DC power supply for operation. The DC voltage must be 10.8 to 13.2 volts for laser operation. A minimum of 3 amps is required to operate the laser over the entire specified temperature range (10°C – 40°C). At room temperature much less current is required for normal operation.



## 7.8 Laser Head Pin Numbering

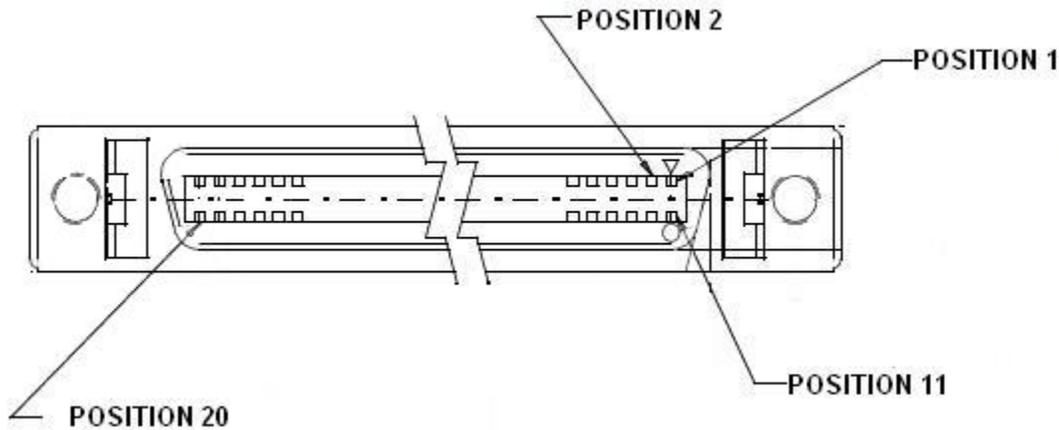


Figure 22  
Laser Head Pin Numbers

### Laser Head Pin Descriptions

**Note:** For normal operation, connect 12 volts to pins 1,2,3 (positive) and 11,12,13 (ground). Jumper pin 5 to pin 15 to close interlock.

PIN #	Function	PIN #	Function
1	12 Volt Supply (+)	11	Power Supply Ground
2	12 Volt Supply (+)	12	Power Supply Ground
3	12 Volt Supply (+)	13	Power Supply Ground
4	No Connection	14	Signal Ground
5	Interlock	15	5 Volt Reference
6	Laser Enable	16	Computer Control
7	Fault Indicator	17	Laser Power Out
8	Laser Ready	18	Chassis Ground
9	RS-232 Transmit	19	RS-232 Receive
10	Modulation Input	20	Modulation Ground

Table 4  
Laser Head Pin Descriptions

**Power Input +12 Volts from Vortran Stradus™ Control Box or OEM Power Supply.**

**\*Note: Laser Power connector supports 1 Amp per pin. 3 power inputs are required to deliver 3 amps to the laser head. This includes the Power Supply Ground.**



**Interlock** – The Interlock is an input pin, providing laser interlock status. A TTL high signal level represents “INTERLOCK CLOSED.”

**Laser Enable** – The Laser Enable pin is an input pin, providing external emission control. A TTL high laser input will turn the laser on. A TTL low signal will disable the laser output. A maximum digital modulation bandwidth of 50 KHz is available with this pin.

**Fault Indicator** – The Fault Indicator pin is an output pin that is set to a TTL high state when a laser fault is present. A fault condition also includes the interlock open and when the user turns the TE cooler off. Review the RS-232 communication section for a complete list of fault conditions.

**Laser Ready** – The Laser Ready pin is an output pin used to indicate when laser emission is active. When the pin is TTL high, laser emission is active.

**RS-232 Transmit** – Connect this pin to a DE-9 connection pin 2 for RS-232 communication.

**Modulation Input** – The Modulation Input pin is used to control the laser power with an external analog input signal. A zero to 5 volt input signal will correspond to a zero to full power laser output. Use the LP command to set the maximum laser output represented with a 5 volt input. The laser output can be continuously varied with maximum bandwidth of 500 KHz. Review the Tutorial section for an example of external laser power control.

**Do not use the Signal or Chassis Ground with the Modulation Input.**

**\*Note: Laser Power connector supports 1 Amp per pin. 3 power inputs are required to deliver 3 amps to the laser head. This includes the Power Supply Ground.**

**Signal Ground** – The signal ground pin is used as a reference for all laser signals **Except Modulation Input.** Connect this pin to DE-9 connector pin 5 as a ground for RS-232 communication.

**5 Volt Reference** – The Vortran Laser microprocessor provides a 5 volt output reference signal, which can be used for a variety of laser control functions such as interlock operation.

**Auto-start** – When this pin is pulled low, a computer is required to initiate laser emission. When no connection is made to the Auto-start Pin, it is pulled up to allow for stand-alone laser operation.

**Laser Power Out** – The laser power output pin is a voltage representation of the present laser output power. A zero volt signal represents no laser output. A 2



volt signal represents full laser power. Intermediate voltage levels are scaled in a linear fashion.

**Chassis Ground** – The Chassis Ground is used provide an additional level of ESD protection. Connect the Chassis Ground to a known Earth Ground for additional ESD protection for the laser head.

**RS-232 Receive** – Connect this pin to a DE-9 connection pin 3 for RS-232 communication.

**Modulation Ground** – This pin is required as a ground reference for the Modulation Input.

**Do not use the Signal or Chassis Ground with the Modulation Input.**

**Power Supply** –The Vortran Stradus™ laser input connector supports a maximum of 1 amp per input pin. For this reason, the power supply and power supply ground pins are spread between 3 inputs each.

**Failure to provide sufficient current or voltage to the laser head may result in damage.**

## 7.9 USB Connection

The Vortran Stradus™ Laser Head includes a standard Mini B USB connector for computer controlled operation. The 5 volts supply provided by the USB connection is not utilized by the laser head in any way. The Vortran Laser Head supports USB 1.0 or 2.0. For additional USB operational information, please refer to section 7.0 and 8.0.

## 7.10 USB Drivers

The Vortran Stradus™ Laser USB interface is supported by a Human Interface Device (HID). This driver is supported by all operating systems currently operating a USB configuration. This type of driver does not require updates. The driver installation does not require the software CD or other human intervention. The device installs automatically.



## 7.11 RS-232 Connection

The Vortran Stradus™ Laser supports USB or RS-232 communication. Refer to the table below for information on connecting a computer serial port directly to a Vortran Stradus™ laser head.

**The Vortran Laser will not operate with a null-modem cable. A standard RS-232 cable is required for serial computer controlled operation.**

Function	Computer DE9	Laser Mini-D
RS-232 Transmit	Pin 2	Pin 9
RS-232 Receive	Pin 3	Pin 19
Signal Ground	Pin 5	Pin 14

### Communication Protocol

Baud Rate	19200
Parity	None
Data Bits	8
Stop Bits	1
Flow Control	None

Table 5  
RS-232 Laser Head Connections

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# 8.0 Laser Operation

## 8.1 Laser Operation Checklist

- ✓ Toggle Power Switch on Laser Control Box or Apply 12 Volts to Laser Head Power and Ground Pins
- ✓ Turn Control Box Key Switch to the “ON” Position or Apply 5 Volts to the Laser Enable Pin 6
- ✓ Allow Thermal Stabilization (Warm-up) and CDRH Delay to Complete
- ✓ If Computer Control Is Desired, Launch Vortran Stradus™ Control Software
- ✓ Ensure All Laser Safety Precautions Are Taken
- ✓ Open Shutter

## 8.2 Auto-start vs Manual Start

The Vortran Stradus™ Laser is configured for auto-start operation at the time of shipment. When power is applied, the thermal control circuits will stabilize the diode temperature at 25°C. When the optical block temperature is within 3°C of the 25°C set temperature, the 5 second CDRH emission delay will start. Following the 5 second delay, laser emission will be active.

Manual Start requires a computer initiated LE=1 command for laser emission. To configure the laser for Manual Start operation, ground the Auto-start Pin. In this configuration, a computer initiated LE=1 command is required for laser emission.

Control Box Auto-start	I/O Pin 5
OEM Laser Auto-start	Laser Mini-D Pin 16



### 8.3 Laser Warm-up and Standby

When power is first applied to the laser head, the microprocessor instructs the thermal control circuit to set the optical block temperature at 25°C. When the optical block temperature is within 3°C of the 25°C set temperature, laser emission is possible. If auto-start is active, the CDRH delay will initiate, followed by laser emission. When the optical block temperature reaches 22°C, the laser warm-up process is complete.

**The optical block temperature must be 25°C to maintain all of the optical specifications.**

When manual mode is active or laser emission is interrupted, the microprocessor will maintain the 25°C optical block temperature. The condition with no laser emission and stable optical block temperature is known as “Standby.” Under this condition, laser emission can be initiated and all optical specifications will be maintained.

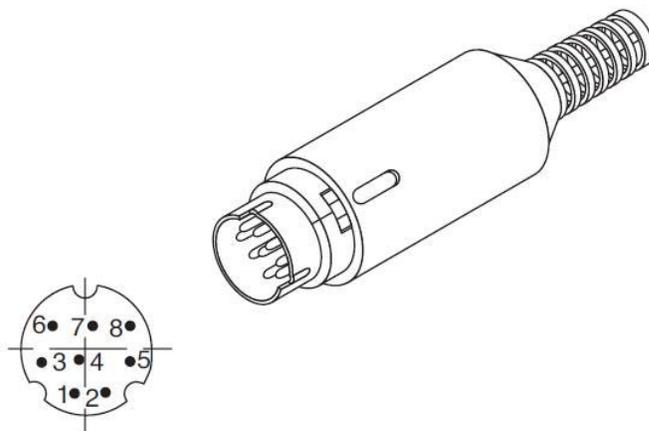
### 8.4 Electrical Input / Output Functions

The Vortran Stradus™ Laser provides capability to accept and provide a number of electrical input and output signals.

**All Electrical Input and Output Signals available with the Control Box are available directly from the Laser Head.**

When using the Control Box, the Input/Output signals are available with the 8 pin Mini-DIN connector located on the front of the box. Please refer to the diagram and table below for input and output operational information.

#### I/O Pin Numbers



**Pin Numbers from  
Front Plug View**

**Figure 23  
I/O Pin Diagram**



Function	PIN #	Description
Fault Indicator	1	TTL Signal for Fault Status. TTL High = Fault Condition
Laser Enable	2	TTL Signal to Toggle Laser Emission On and Off
Auto-start	3	Ground pin to require computer initiated laser emission. (LE=1) This pin is normally TTL High
5 Volts	4	5 Volt Reference
Laser Ready	5	TTL Signal for Laser Emission Status. TTL High indicates laser emission. Indicator High when CDRH delay count begins.
N/C	6	No Connection
Signal Ground	7	
Laser Power Out	8	0-2 Volt output signal represents 0-100% laser power

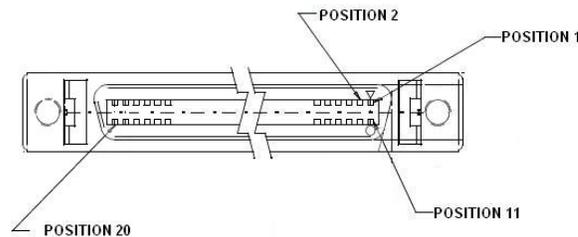


Figure 24  
Laser Head Pin Numbers

### Laser Head Mini-D Connector

**Note:** For normal operation, connect 12 volts to pins 1,2,3 (positive) and 11,12,13 (ground). Jumper pin 5 to pin 15 to close interlock.

PIN #	Function	PIN #	Function
1	12 Volt Supply (+)	11	Power Supply Ground
2	12 Volt Supply (+)	12	Power Supply Ground
3	12 Volt Supply (+)	13	Power Supply Ground
4	No Connection	14	Signal Ground
5	Interlock	15	5 Volt Reference
6	Laser Enable	16	Computer Control
7	Fault Indicator	17	Laser Power Out
8	Laser Ready	18	Chassis Ground
9	RS-232 Transmit	19	RS-232 Receive
10	Modulation Input	20	Modulation Ground

**The Auto-start, Interlock and Signal Ground Pins are considered inputs.**

Table 6  
Laser Head Pin Descriptions



## 8.5 Laser Emission

### 8.5.1 Shutter Operation

The shutter on the Vortran Stradus™ Laser Head operates with a simple sliding motion. A detent is included at both the open and closed positions. For proper shutter operation, ensure the detent is engaged. The shutter positions are labeled on the top of the laser head and shown below.

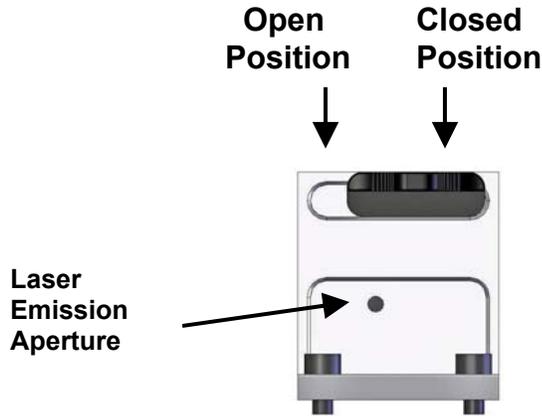


Figure 25  
Laser Head Shutter Position

### 8.5.2 Near-field Beam Quality

Based on the propagation characteristics of laser diode modules, the appearance of the beam in the near-field is different from the appearance of the beam in the far-field. Structure in the beam occurring in the near-field will propagate away from the beam and not appear in the far-field. Most applications utilizing the Vortran Stradus™ Laser involve the use of a focused beam. In this case, the focused beam represents a far-field image. A near-field image taken at 0.5 Meters is shown below.

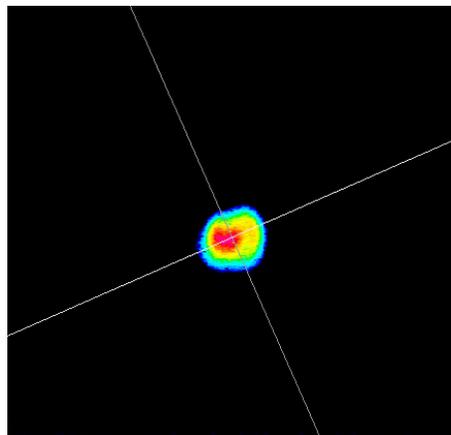


Figure 26  
Near-Field Beam Image

### 8.5.3 Far-field Beam Quality

The typical Rayleigh range for a Vortran Stradus™ Laser is greater than 2 meters. When measuring beam quality with a camera, the image should be collected at a distance of 4 meters or greater. A true representation of beam quality occurs in the Far-field and directly relates to a focused beam application. The image below represents the far-field and was taken at a distance of 5 meters.

***M<sup>2</sup> is a measure of the beam quality in the far-field. Camera images taken in the near-field do not represent the measured M<sup>2</sup> or the focused beam quality.***

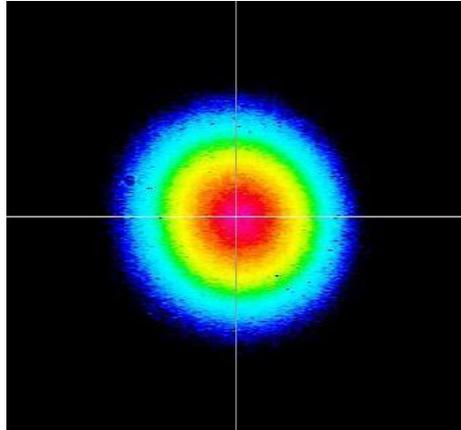


Figure 27  
Far-field Beam Image

### 8.5.4 Analog Power Control

The Vortran Stradus™ Laser provides the capability to control the laser power at a maximum bandwidth of 500KHz. A dedicated Analog Modulation Ground is required to meet specified performance. When using a Vortran Stradus™ Control Box, the BNC connector on the front panel is used for Analog Modulation Input. If using the laser in a OEM configuration, Analog Modulation is available with the Mini-D pin 10 (+) and pin 20 (ground). A zero volt signal will represent no laser output power and a 5 volt signal will represent 100% of the present laser set power. If the laser power is set to 100mW, a 5 volt analog modulation signal will represent a 100mW laser output. If the laser is set to 50mW, a 5 volt analog modulation signal will represent a 50mW laser output.

## 8.6 Digital Modulation

The Vortran Stradus™ is available with optional digital modulation. By inputting standard TTL voltage levels into the SMB connector, the laser output can be modulated from DC to 200MHz. Computer control is required to set the laser in “Pulse Mode”. Please refer to section 9 for instructions on computer controlled operation.

### 8.6.1 Digital Modulation Specifications for Standard Single Mode Lasers

	Min	Typical	Max
Optical Rise Time (nsec)	1.0	1.3	2.0
Optical Fall Time (nsec)	1.0	1.6	2.0
Laser Off Input Voltage			0.8
Laser On Input Voltage	3.5		5.0
-3dB Bandwidth (MHz)	200	250	

Table 7  
Digital Modulation Specifications

### 8.6.2 SMB Connection

The Vortran Stradus™ laser includes digital modulation, a SMB connector will be located on the rear panel. The location of this connector is shown below.

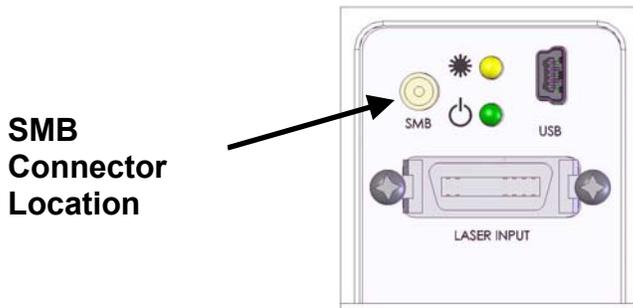


Figure 28

SMB Connector Location

**\*\*The SMB connectors require a 50Ω termination\*\***

### 8.6.3 Operation

To operate the Stradus™ laser in pulse mode, install the Vortran Stradus™ software and USB drivers. If RS-232 operation is required, refer to section 9.2. Activate “Digital Modulation” by clicking the “On” button in the “Digital Modulation” section of the “Home Screen”.

Enter the desired power level in mW, to represent the Peak Power of the laser output. Enter values between 1mW and the Nominal Power of the connected laser. As a reference, the nominal power is displayed in the title bar. Click the “Setr” button and then click the “OK” button

to initiate modulation.

**\*\*Digital Modulation Mode is not Stored When the Laser is Powered Down\*\***

**\*\*Initiate Digital Modulation Each Time the Laser is Powered On\*\***



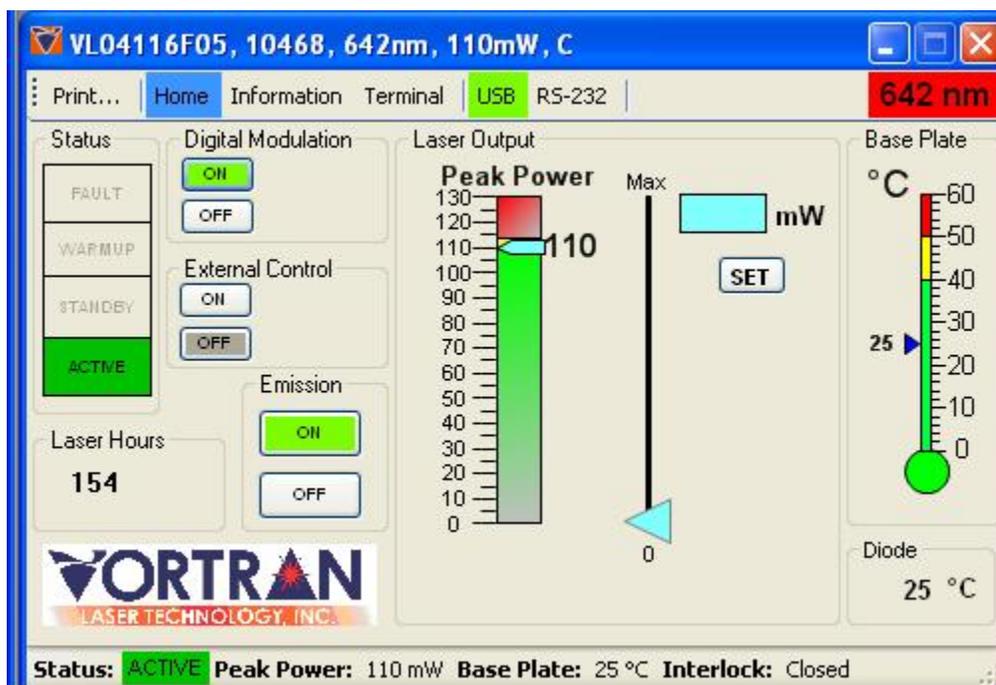


Figure 29  
Pulse Mode Example

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# 9.0 Computer Controlled Operation

## 9.1 USB Connection



The Vortran Stradus™ Laser System provides capability for remote USB communication. The laser rear panel includes a Mini-B USB connector. This connector does not provide or utilize 5 volts for external or internal use.

**Mini-B USB Connector**

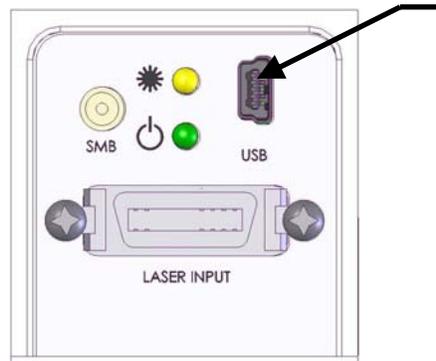


Figure 30  
USB Connector Location

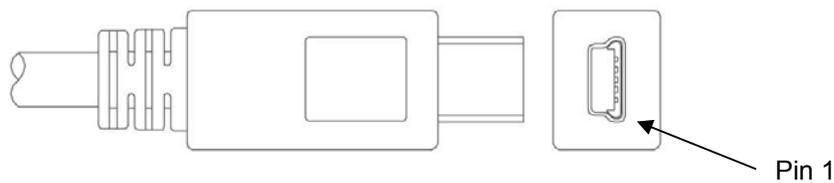


Figure 31  
USB Connector Diagram

Contact Number	Signal Name
1	VBUS
2	D-
3	D+
4	ID
5	GND

Table 8  
USB Pin Descriptions

## 9.2 RS-232 Connection and Setup

Along with the capability for remote USB communication, the Vortran Stradus™ Laser System provides the capability for remote RS-232 communication. The control box includes a DE-9 connector for direct connection to a remote computer. The Vortran Stradus™ Control software supports both USB and RS-232 communication. The pin connections and communication protocol requirements are shown below.

**A Null-modem cable will not operate a Vortran Laser. Use a standard RS-232 cable for remote communication.**

<b>Function</b>	<b>Computer DE9</b>	<b>Laser Mini-D</b>
RS-232 Transmit	Pin 2	Pin 9
RS-232 Receive	Pin 3	Pin 19
Signal Ground	Pin 5	Pin 14

### **Communication Protocol**

Baud Rate	19200
Parity	None
Data Bits	8
Stop Bits	1
Flow Control	None

Table 9  
RS-232 Pin Descriptions and Protocol

## 9.3 Command and Query Summary

### 9.3.1 Commands

<u>Command</u>	<u>Function</u>	<u>Range</u>	<u>Description</u>
<b>C</b>	Laser Drive Control Mode	0/1	Sets Power or Current Control (1 = Current Control)
<b>DELAY</b>	5 Sec. Delay On/Off	0/1	Toggle 5 Second Laser Emission Delay On and Off
<b>ECHO</b>	Echo ON-OFF	0/1	Turns RS-232 Terminal ECHO ON-OFF
<b>EPC</b>	External Power Control	0/1	Enables External Power Control (1= External Control)
<b>LC</b>	Laser Current Control	0 - Max	Sets Laser Diode Current directly
<b>LE</b>	Toggle Laser Emission	0/1	Toggles Laser Emission On and Off (1 = On)
<b>LP</b>	Laser Power	0 - Max	Sets Laser Power
<b>PROMPT</b>	Prompt ON-OFF	0/1	Turns Terminal Prompt ON-OFF

### 9.3.2 Queries

<u>Query</u>	<u>Function</u>	<u>Range</u>	<u>Description</u>
-	-	-	-
?BPT	Request Base Plate Temp.	0-55°C	Returns Present Base Plate Temperature
?C	Request Laser Drive Control Mode	0/1	Returns Present Laser Drive Control Mode
?CC	Request Computer Control	0/1	Returns Present State of Computer Control Pin
?DELAY	Request 5 Second Emission Delay Status	0/1	Returns Present Emission Delay Status
?EPC	Request External Power Control Status	0/1	Returns Present External Power Control Status
?FC	Request Fault Code (BINARY) & Status	0 - 32	Returns Laser Status and Fault Codes
?FD	Request Fault Description	Information	Returns Fault Description in English
?FP	Request Firmware Protocol		Returns Firmware Protocol Version
?FV	Request Firmware Version		Returns the Loaded Firmware Version
?H	Display Help File	Information	
?IL	Request Interlock Status	0/1	Returns Actual Interlock Status: 1 = Closed
?LC	Request Laser Current	0 - 1000ma.	Returns Present Laser Diode Current
?LCS	Request Laser Current Setting		
?LE	Request Laser Emission Status	0/1	Returns Present Laser Emission Status
?LH	Request Laser Operating Hours	0 - 100,000	Returns Present Laser Diode Hours
?LI	Request Laser Identification	Information	Returns Unique Laser Information
?LP	Request Laser Power	0 - Max	Returns Present Measured Laser Power
?LPS	Request Laser Power Setting	0 - Max	Returns Present Laser Power Setting
?LS	Request Laser Status	Information	Returns Laser Settings
?LW	Request Laser Wavelength		Returns Actual Measured Laser Wavelength
?MAXP	Request Maximum Laser Power		Returns Maximum Output Power
?OBT	Request Optical Block Temperature	15 - 35 (°C)	Returns Optical Block Temperature (°C)
?OBTS	Request Optical Block Temp. Setting	15 - 35 (°C)	Returns Optical Block Set Temperature (°C)
?RP	Request Rated Laser Power		Returns Standard Laser Power Rating

Table 9  
Command and Query Summary

## 9.4 Command Detail

<b>C</b>	
<b>Function</b>	Laser Drive Control Mode
<b>Description</b>	As a command it is used to toggle the laser diode drive control mode between the light loop and a user entered current setting. (0 = Power Control, 1 = Current Control)
	As a query, it returns the present laser diode drive control mode.
<b>Command/Query</b>	Both
<b>Syntax:</b>	
<b>Command</b>	C=0, C=1
<b>Query</b>	?C
<b>Example:</b>	
<b>Normal Operation:</b>	Laser is running normally in power control mode. User enters C=1.
	Laser switches to current control mode, using the stored laser current value.
	Return value C=1
<b>Not Allowed:</b>	Fault condition exists. User enters C=1.
	The laser will not change to current control mode when fault condition is cleared.
	Return value C=0
<b>Range</b>	0,1
<b>Resolution</b>	N/A
<b>Stored on Set</b>	Yes
<b>Default</b>	0
<b>Dependencies</b>	The command function will write a new value only when a no fault condition exists.
<b>Conditional Information</b>	The query is available any time.

<b>DELAY</b>	
<b>Function</b>	5 sec. Delay On/Off
<b>Description</b>	Toggles 5 second laser emission delay on and off
<b>Command/Query</b>	Both
<b>Syntax:</b>	
<b>Command</b>	DELAY=0, DELAY=1
<b>Query</b>	?DELAY
<b>Range</b>	0,1
<b>Resolution</b>	N/A
<b>Stored on Set</b>	Yes
<b>Default</b>	1
<b>Dependencies</b>	The command function will write a new value only when a no fault condition exists.
<b>Conditional Information</b>	The query is available any time.

<b>EPC</b>	
<b>Function</b>	External Power Control
<b>Description</b>	Enables External Power Control Input Port (1= External Control)
<b>Command/Query</b>	Both
<b>Syntax:</b>	
<b>Command</b>	EPC=0, EPC=1
<b>Query</b>	?EPC
<b>Example:</b>	
<b>Normal Operation:</b>	Laser emission 100mW in power control mode (C=0). 2.5 volts on laser connector pin 10.
	User enters EPC=1. Laser power drops to 50mW. Return value EPC=1.
<b>Not Allowed:</b>	Fault condition is present. User enters EPC=1. Return Value EPC=0.
<b>Range</b>	0,1
<b>Resolution</b>	N/A
<b>Stored on Set</b>	Yes
<b>Default</b>	0
<b>Dependencies</b>	Operation is based on the operating mode (Power or Current Control). See below.
<b>Conditional Information</b>	0-5 volts on the external control pin will control the corresponding laser output 0-100%. Input Impedance 550Ω. The output is based on the present laser power or current setting

<b>LC</b>	
<b>Function</b>	Laser Current Control
<b>Description</b>	Sets Laser Diode Current Directly
<b>Command/Query</b>	Both
<b>Syntax:</b>	
<b>Command</b>	LC=###.# ( ma.)
<b>Query</b>	?LC
<b>Example:</b>	
<b>Normal Operation:</b>	Laser Emission is active, with laser running at 50mA. User enters LC=100.
	Laser Emission remains active and the measured value is retruned LC=99.8
	Laser Emission is active, with laser running at 50mA. User enters LC=10000
<b>Not Allowed:</b>	Fault condition exists or laser emission is not active. User enters LC=100. The new value is not written.
<b>Range</b>	Zero to Maximum Current Setting Plus 30%
<b>Resolution</b>	###.# ( ma.)
<b>Stored on Set</b>	Yes
<b>Default</b>	Command is only allowed when C=0, TEC=1 and no fault greater than 16.
<b>Dependencies</b>	The initial default value will be the stored following the initial laser calibration.
<b>Conditional Information</b>	The command function will write a new value only when laser emission is active.
	The query is available any time
	In a fault condition, the command will not write a value.
	The light regulator is always connected so if the user asks for a current that will over power the output, the light loop will clamp the output at MAXP. The return value in this condition will be the measured current when the power is set at MAXP.

<b>LE</b>	
<b>Function</b>	Toggle Laser Emission On/Off
<b>Description</b>	Toggles Laser Emission On and Off (1 = On, 0 = Off)
<b>Command/Query</b>	Both
<b>Syntax:</b>	
<b>Command</b>	LE=0, LE=1
<b>Query</b>	?LE
<b>Example:</b>	
<b>Normal Operation:</b>	LE=1 Response LE=1
<b>Not Allowed:</b>	Fault Condition LE=1 Response LE=0
<b>Range</b>	0,1
<b>Resolution</b>	N/A
<b>Stored on Set</b>	No
<b>Dependencies</b>	No fault 32 or greater

<b>LP</b>	
<b>Function</b>	Laser Power
<b>Description</b>	As a command, it sets laser power through USB and RS-232 interface. As a query, it will return the laser power measured by the light loop.
<b>Command/Query</b>	Both
<b>Syntax:</b>	
<b>Command</b>	LP=###.# (mW)
<b>Query</b>	?LP
<b>Example:</b>	
<b>Normal Operation:</b>	Laser Emission is active, with laser running at 50mW. User enters LP=100. Laser Emission remains active and the measured value is returned LP=99.8.
<b>Not Allowed:</b>	Laser Emission is active, with laser running at 50mW. User enters LP=10000. No change in laser power is made for the excessive value. The measured return value is LP=49.9. Fault condition exists or laser emission is not active. User enters LP=100. The new value is not written. The measured returned value is LP=0.00.
<b>Range</b>	Zero to the maximum power the laser system is calibrated to.
<b>Resolution</b>	###.#
<b>Stored on Set</b>	Yes
<b>Default</b>	Calibrated Laser Power
<b>Dependencies</b>	Command is only allowed when C=0.
<b>Conditional Information</b>	The default value will be stored following initial laser calibration. The command function will write a new value only when laser emission is active. The query is available any time. If laser emission is not active, the query will return the measured laser power. In a fault condition, the query will return the measured laser power. In a fault condition, the command will not write a value. Values greater than MAXP, will not change present set value.

<b>PROMPT</b>	
<b>Function</b>	Prompt ON-OFF
<b>Description</b>	Turns RS-232 Prompt ON-OFF (Prompt=1 is Prompt on)
<b>Command/Query</b>	Command Only
<b>Syntax</b>	PROMPT=0, PROMPT=1
<b>Range</b>	0,1
<b>Resolution</b>	N/A
<b>Store on Set</b>	Yes
<b>Dependencies</b>	None
<b>Default</b>	1

<b>PP</b>	
<b>Function</b>	Pulse Power
<b>Description</b>	As a command, it sets pulse laser power through USB and RS-232 interface. As a query, it will return the pulse laser power measured by the light loop.
<b>Command/Query</b>	Both
<b>Syntax:</b>	
<b>Command</b>	PP=###.# (mW)
<b>Query</b>	?PP
<b>Example:</b>	
<b>Normal Operation:</b>	Laser Emission is active, with laser running at 50mW. User enters PP=100.
	Laser Emission remains active and the measured value is returned PP=99.8.
<b>Not Allowed:</b>	Laser Emission is active, with laser running at 50mW. User enters PP=10000. No change in laser power is made for the excessive value. The measured return value is PP=49.9.
	Fault condition exists or laser emission is not active. User enters PP=100.
	The new value is not written. The measured returned value is PP=0.00.
<b>Range</b>	Zero to the maximum power the laser system is calibrated to.
<b>Resolution</b>	###.#
<b>Stored on Set</b>	Yes
<b>Default</b>	Calibrated Laser Power
<b>Dependencies</b>	Command is only allowed when C=0.
<b>Conditional Information</b>	<p>The default value will be stored following initial laser calibration.</p> <p>The command function will write a new value only when laser emission is active.</p> <p>The query is available any time. If laser emission is not active, the query will return the measured laser power.</p> <p>In a fault condition, the query will return the measured laser power.</p> <p>In a fault condition, the command will not write a value.</p> <p>Values greater than MAXP, will not change present set value.</p>

<b>PUL</b>	
<b>Function</b>	Digital Modulation Mode
<b>Description</b>	As a command it is used to toggle the laser diode drive control mode between CW and Digital Modulation. (0 = CW, 1 = Digital Modulation)
	As a query, it returns the present laser diode drive control mode.
<b>Command/Query</b>	Both
<b>Syntax:</b>	
<b>Command</b>	PUL=0, PUL=1
<b>Query</b>	?PUL
<b>Example:</b>	
<b>Normal Operation:</b>	Laser is running normally in CW mode. User enters PUL=1.
	Laser switches to current Digital Modulation mode.
	Return value PUL=1
<b>Not Allowed:</b>	Fault condition exists. User enters PUL=1.
	The laser will not change to Digital Modulation mode when fault condition is cleared.
	Return value PUL=0
<b>Range</b>	0,1
<b>Resolution</b>	N/A
<b>Stored on Set</b>	No
<b>Default</b>	0
<b>Dependencies</b>	The command function will write a new value only when a no fault condition exists.
<b>Conditional Information</b>	The query is available any time.

Table 11  
Command Detail

## 9.5 Query Detail

<b>?BPT</b>	
<b>Function</b>	Request Base Plate Temp.
<b>Description</b>	Returns Present Base Plate Temperature
<b>Command/Query</b>	Query
<b>Syntax</b>	?BPT
<b>Example</b>	?BPT Response BPT=35
<b>Range</b>	0-55°C
<b>Resolution</b>	Whole Numbers
<b>Dependencies</b>	Base Plate Temperature is valid even in a fault conditon.
<b>Conditional Information</b>	

<b>?CC</b>	
<b>Function</b>	Request Computer Control
<b>Description</b>	Returns Present State of Computer Control Input Pin. 0 = Computer Control Only , 1 = Internal Control
<b>Command/Query</b>	Query
<b>Syntax</b>	?CC
<b>Example</b>	?CC Response CC=0
<b>Range</b>	0,1
<b>Resolution</b>	N/A
<b>Dependencies</b>	Only applied at power up.
<b>Default</b>	0

<b>?FC</b>		
<b>Function</b>	Request Fault Code <b>**<i>Fault Codes are Displayed then Cleared. The displayed value represents a sum of all active faults. Type ?FC again to get present fault status. Use the ?RF query to recall previously stored faults and the CF command to clear stored faults.</i></b>	
<b>Description</b>	Returns Fault Code as a Whole Number	
<b>Command/Query</b>	Query	
<b>Syntax</b>	?FC	
<b>Example</b>	?FC Response FC=0	
<b>Range</b>	32 Error Codes Maximum	
<b>Resolution</b>	Binary Values	
<b>Dependencies</b>	None	
<b>Note</b>	<b>Value</b>	<b>Description</b>
Laser State	0	LASER EMISSION ACTIVE
Laser State	1	STANDBY
Laser State	2	WARMUP
Syntax Error	4	VALUE OUT OF RANGE
Syntax Error	8	INVALID COMMAND
Fault Condition	16	INTERLOCK OPEN
TEC Status	32	TEC OFF
Fault Condition	64	DIODE OVER CURRENT
Fault Condition	128	DIODE TEMPERATURE FAULT
Fault Condition	256	BASE PLATE TEMPERATURE FAULT
Fault Condition	512	BUFFER OVERFLOW
Fault Condition	1024	EEPROM ERROR
Fault Condition	2048	I2C ERROR
Fault Condition	4096	COMMAND TIME OUT
Fault Condition	8192	WATCH DOG ERROR
Fault Condition	16384	FATAL ERROR
Warning Condition	32768	Diode End of Life Warning Indicator

<b>?FD</b>	
<b>Function</b>	Request Fault Description <b>**<i>Fault descriptions are displayed then cleared. This will allow the user to see faults that may have occurred and been resolved. Type ?FD again to get present fault status.</i></b>
<b>Description</b>	Returns Fault as descriptive text
<b>Command/Query</b>	Query
<b>Syntax</b>	?FD
<b>Example</b>	?FD Response FD=LASER EMISSION ACTIVE
<b>Range</b>	35 Characters Maximum
<b>Resolution</b>	N/A
<b>Dependencies</b>	
<b>Conditional Information</b>	Values greater than 32 will stop laser emission and Set I/O Fault Pin (Control Box Mini-DIN Pin 2, Laser Head Mini-D Pin 7) High for Values of 16 or Greater
<b>Value</b>	<b>Description</b>
0	LASER EMISSION ACTIVE
1	STANDBY
2	WARMUP
4	VALUE OUT OF RANGE
8	INVALID COMMAND
16	INTERLOCK OPEN
32	TEC OFF
64	DIODE OVER CURRENT
128	DIODE TEMPERATURE FAULT
256	BASE PLATE TEMPERATURE FAULT
512	BUFFER OVERFLOW
1024	EEPROM ERROR
2048	I2C ERROR
4096	COMMAND TIME OUT
8192	WATCH DOG ERROR
16384	FATAL ERROR
32768	Diode End of Life Warning Indicator

<b>?FP</b>	
<b>Function</b>	Request Firmware Protocol
<b>Description</b>	Returns Firmware Protocol Version
<b>Command/Query</b>	Query
<b>Syntax</b>	?FP
<b>Example</b>	?FP Response 1.01.01
<b>Range</b>	N/A
<b>Resolution</b>	###.###
<b>Dependencies</b>	None

<b>?FV</b>	
<b>Function</b>	Request Firmware Version
<b>Description</b>	Returns the Loaded Firmware Version
<b>Command/Query</b>	Query
<b>Syntax</b>	?FV
<b>Example</b>	?FV Response FV=1.01.01
<b>Range</b>	N/A
<b>Resolution</b>	###.###
<b>Dependencies</b>	None

<b>?H</b>	
<b>Function</b>	Display Help File
<b>Description</b>	Returns Help File Text from Laser EEPROM
<b>Command/Query</b>	Query
<b>Syntax</b>	?H
<b>Example</b>	?H
	<b>Response Shown Below</b>
LP	SET AND REQUEST LASER POWER
C	SET AND REQUEST LASER DRIVE CONTROL MODE
LC	SET AND REQUEST LASER CURRENT
EPC	SET AND REQUEST LASER CURRENT
DELAY	SET AND REQUEST 5 SECOND CDRH DELAY STATUS
ECHO	TOGGLE TERMINAL ECHO ON AND OFF
PROMPT	TOGGLE TERMINAL PROMPT ON AND OFF
LE	TOGGLE LASER EMISSION ON AND OFF
?LPS	REQUEST LASER POWER SETTING
?OBTS	REQUEST OPTICAL BLOCK TEMPERATURE SETTING
?OBT	REQUEST OPTICAL BLOCK TEMPERATURE
?BPT	REQUEST BASE PLATE TEMPERATURE
?FC	REQUEST FAULT CODE
?FD	REQUEST FAULT DESCRIPTION
?LH	REQUEST LASER OPERATING HOURS
?LI	REQUEST LASER IDENTIFICATION
?FV	REQUEST FIRMWARE VERSION
?FP	REQUEST PROTOCOL VERSION
?CC	REQUEST COMPUTER CONTROL STATUS
?MAXP	REQUEST MAXIMUM LASER POWER
?RP	REQUEST RATED LASER POWER
?LW	REQUEST LASER WAVELENGTH
?IL	REQUEST INTERLOCK STATUS
?LS	REQUEST LASER STATUS

<b>?IL</b>	
<b>Function</b>	Request Interlock Status
<b>Description</b>	Returns Actual Interlock Status: 1 = Closed, 0 = Open
<b>Command/Query</b>	Query
<b>Syntax</b>	?IL
<b>Example</b>	?IL Response IL=1
<b>Range</b>	0,1
<b>Resolution</b>	N/A
<b>Dependencies</b>	None

<b>?LH</b>	
<b>Function</b>	Request Laser Operating Hours
<b>Description</b>	Returns Present Laser Diode Hours (Clock only runs when laser emission is active)
<b>Command/Query</b>	Query
<b>Syntax</b>	?LH
<b>Example</b>	?LH Response LH=1423.2
<b>Range</b>	0 – 100,000
<b>Resolution</b>	12 Minutes (.2Hrs)
<b>Dependencies</b>	None

<b>?LI</b>	
<b>Function</b>	Request Laser Identification
<b>Description</b>	Returns Unique Information (S/N, Part Number, Nom. $\lambda$ , Nom. Power, C/E for circular or elliptical)
<b>Command/Query</b>	Query
<b>Syntax</b>	?LI
<b>Example</b>	?LI Response LI= VL1008025, 10010, 405nm, 100mW, C
<b>Range</b>	Vlmmyy####, #####, ###nm, ###mW, C
<b>Resolution</b>	N/A
<b>Dependencies</b>	None

<b>?LPS</b>	
<b>Function</b>	Request Laser Power Setting
<b>Description</b>	Returns Present Laser Power Setting
<b>Command/Query</b>	Query
<b>Syntax</b>	?LPS
<b>Example</b>	?LPS Response LPS=95
<b>Range</b>	0-1000mW
<b>Resolution</b>	Whole Numbers
<b>Dependencies</b>	None

<b>?LS</b>	
<b>Function</b>	Request Present Laser Status
<b>Description</b>	Returns the following Laser Status Values.
<b>?C</b>	Laser Drive Control Mode
<b>?LP</b>	Laser Power
<b>?LC</b>	Laser Current Control
<b>?EPC</b>	External Power Control
<b>?DELAY</b>	5 sec. Delay On/Off
<b>Command/Query</b>	Query
<b>Syntax</b>	?LS
<b>Example</b>	?LS Response C=0, LP=95.5, LC=107.5, EPC=0, DELAY=1
<b>Range</b>	N/A
<b>Resolution</b>	N/A
<b>Dependencies</b>	None

<b>?LW</b>	
<b>Function</b>	Request Laser Wavelength
<b>Description</b>	Returns Actual Measured Laser Wavelength
<b>Command/Query</b>	Query
<b>Syntax</b>	?LW
<b>Example</b>	?LW Response LW=406
<b>Range</b>	N/A
<b>Resolution</b>	###
<b>Dependencies</b>	None

<b>?MAXP</b>	
<b>Function</b>	Request Maximum Laser Power
<b>Description</b>	Returns Maximum Output Power Available from the Laser
<b>Command/Query</b>	Query
<b>Syntax</b>	?MAXP
<b>Example</b>	?MAXP Response MAXP=106.5
<b>Range</b>	0-1000mW
<b>Resolution</b>	###.#
<b>Dependencies</b>	None

<b>?OBT</b>	
<b>Function</b>	Optical Block Temperature
<b>Description</b>	Request Optical Block Temperature in °C
<b>Command/Query</b>	Query
<b>Syntax</b>	?OBT
<b>Example</b>	?OBT Response OBT=25
<b>Range</b>	10 to 35
<b>Resolution</b>	###.#
<b>Dependencies</b>	None

<b>?RP</b>	
<b>Function</b>	Request Rated Laser Power
<b>Description</b>	Returns Standard Laser Power Rating
<b>Command/Query</b>	Query
<b>Syntax</b>	?RP
<b>Example</b>	?RP Response RP=100
<b>Range</b>	0-1000mW
<b>Resolution</b>	###
<b>Dependencies</b>	None

Table 12  
Query Detail

## 9.6 Fault Codes

The RS-232 command prompt provides vital laser status information. When the laser is operating normally and emission is active, the prompt will return a value of zero. Status information, syntax errors and faults are reported as binary values. If multiple issues occur, they will be added and the prompt will reflect the sum of all reported issues. A list of faults is shown below. For details on resolving fault issues, refer to the troubleshooting section. If a fault code is set then resolved, it will not be shown on the subsequent prompt. Fault codes are stored and can be recalled with the ?RF query. Stored faults can be cleared with the CF command.

### Fault Codes

Note	Value	Description
Laser State	0	LASER EMISSION ACTIVE
Laser State	1	STANDBY
Laser State	2	WARMUP
Syntax Error	4	VALUE OUT OF RANGE
Syntax Error	8	INVALID COMMAND
Fault Condition	16	INTERLOCK OPEN
TEC Status	32	TEC OFF
Fault Condition	64	DIODE OVER CURRENT
Fault Condition	128	DIODE TEMPERATURE FAULT
Fault Condition	256	BASE PLATE TEMPERATURE FAULT
Fault Condition	512	BUFFER OVERFLOW
Fault Condition	1024	EEPROM ERROR
Fault Condition	2048	I2C ERROR
Fault Condition	4096	COMMAND TIME OUT
Fault Condition	8192	WATCH DOG ERROR
Fault Condition	16384	FATAL ERROR
Warning Condition	32768	Diode End of Life Warning Indicator

Table 13  
Fault Codes

# 10.0 Vortran Stradus™ Software

Each standard Vortran Stradus™ Laser System includes a CD with laser control software. This software provides access to all computer controlled laser functions. The software allows the user to control the laser and evaluate custom remote control capabilities. The Vortran Stradus™ Control Software displays up to 4 lasers simultaneously.

## 10.1 Supported Operating System

- Windows 2000
- Windows XP
- Windows Vista
- Windows 7

## 10.2 CD Contents

- USB Drivers (For Legacy Laser Systems)
- USB Driver Installation Utility(For Legacy Laser Systems)
- .pdf version of the User Manual
- Readme File
- Vortran Stradus™ Control Software Installation

## 10.3 USB Driver Installation

Beginning in January 2012, Vortran Stradus lasers use a Human Interface Device (HID) USB driver. This type of driver is automatically supported by all current USB compatible operating systems. The main advantage of an HID driver type is that Vortran Laser Technology will no longer support the laser USB driver as new computer operating systems are released. The required USB drivers are contained within the operating system, rather than being supplied by the device manufacturer. No CD is required for USB driver installation. Simply connect a USB cable between the Stradus laser and the host computer. When you power up the Stradus laser, the USB drivers will be installed automatically.



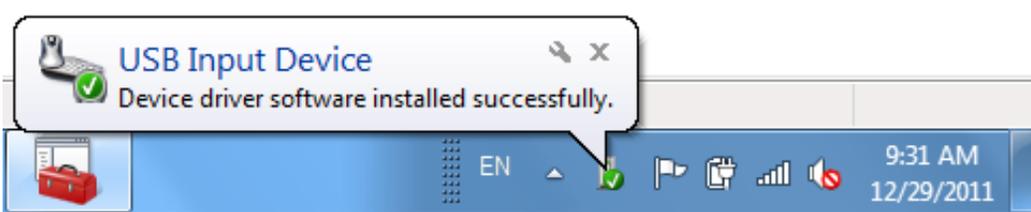


Figure 32  
Initial USB Connection Message

When the Vortran Stadius™ laser is first connected via USB, Windows will detect the laser and display the screen above.



Figure 33  
Restart Request Window

It is often necessary to restart the computer following the USB driver installation process. Once the computer restart is complete, the lasers will automatically connect.



Figure 34  
Windows Device Manager

When the driver is properly installed, the Windows Device Manager for the Stradus laser will contain the information as shown above.

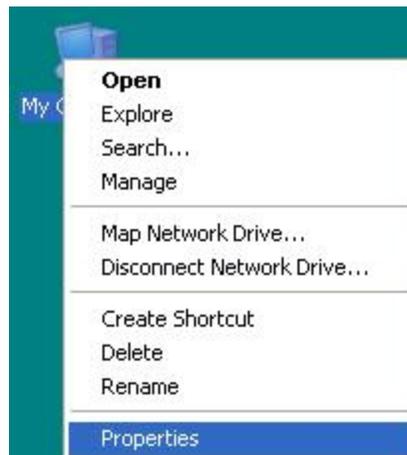


Figure 35  
Computer Properties

To access the Windows Device Manager, Right Click the “My Computer” or “Computer” icon on the host computer desk top and select “Properties”.



Figure 36  
System Properties

From the “System Properties” Screen, select “Hardware” to show the “Device Manager” button.

## 10.4 Software Installation

The Vortran Stradus software installation is configured for an auto-run process if available. For security reasons, this may not occur in many cases. If the Vortran Stradus software CD is installed into the CD drive and the installation process does not initiate, manually select the computer CD drive and double-click on the Vortran Stradus software icon. When the installation process begins, the following screen will appear.

If a Vortran Laser Software upgrade is required, use the “Add and Remove Programs” function to remove the existing software prior to upgrade. The “Add and Remove Programs” function is contained within the Windows Control Panel.



Figure 37  
Initial Software Installation Screen

Click “Next” to continue the installation process and the following screen will appear.



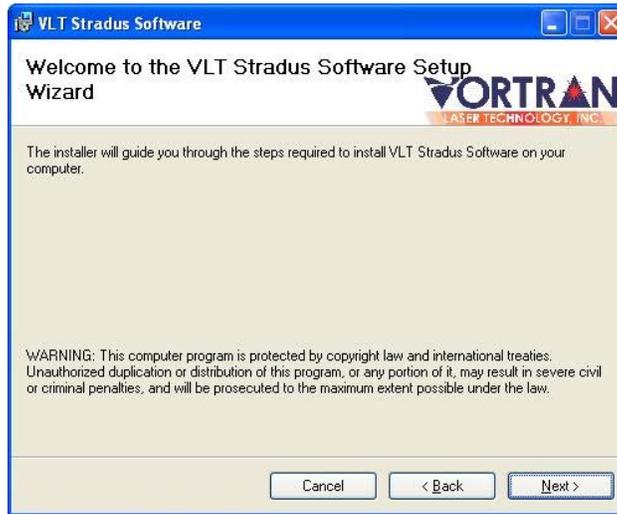


Figure 38  
Software Installation Welcome Screen

The “Welcome” screen provides a preview of the software installation process. This screen also provides warnings associated with copyright protection. Click “Next” to continue the installation process.



Figure 39  
Software Installation Location Screen

The default software installation location will be displayed. An alternate installation location can be selected by clicking on the “Browse” button and navigating to a desired installation location. The user can also select security privileges associated with the software use by clicking the “Just me” or everyone radio button. Click “Next” to continue the installation process.



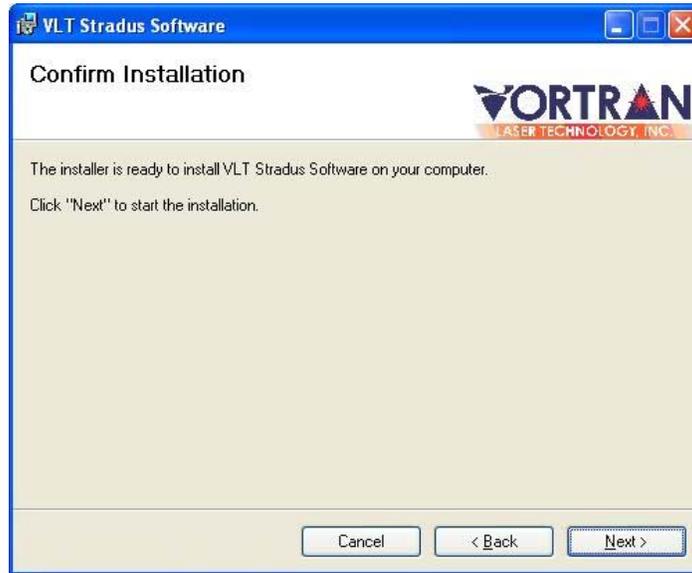


Figure 40  
Software Installation Confirmation Screen

Click “Next” to initiate the actual software installation process.

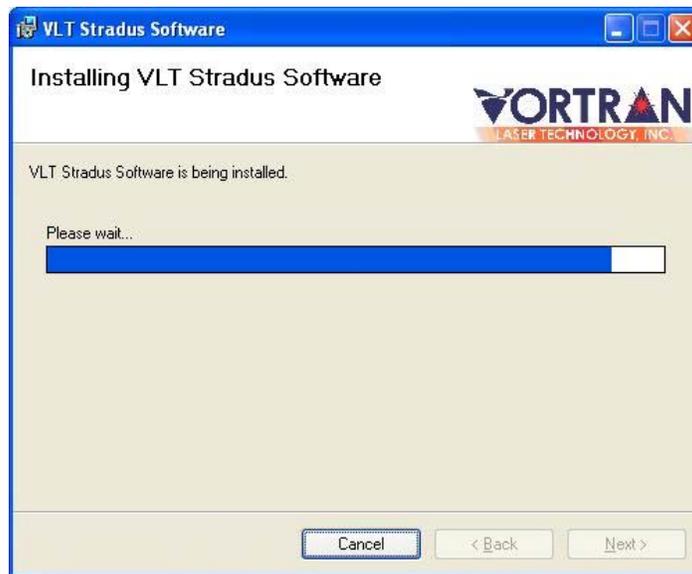


Figure 41  
Software Installation Progress Screen

A progress indicator will be displayed during the software installation process.



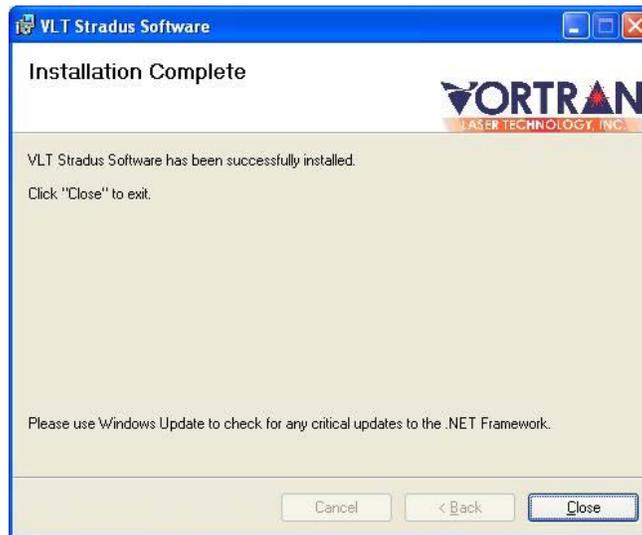


Figure 42  
Software Installation Complete Screen

When the software installation is complete, the screen above will be displayed. Click “Close” to complete the software installation process.

## 10.5 Menu Items

The Vortran Stradus™ Control Software includes global menu items with functions that are applied to application functions. Each connected laser displays a window with controls and functions that are applied to individual lasers only. The following information relates to the global application functions only. Individual laser window functions will be described later in this section.

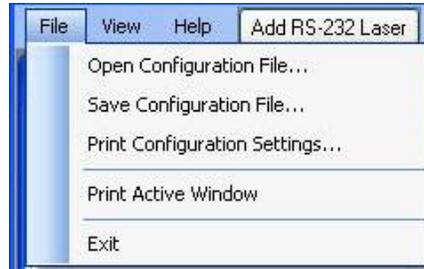


Figure 43  
File Menu

**10.5.1 Open Configuration File** – The Open Configuration File function allows the user to recall a previous set of laser settings. Each configuration file can only be applied to a single laser serial number to ensure incorrect values are not applied to a different laser type. The configuration file contains a unique laser serial number and the settings will be applied to that laser only.

**10.5.2 Save Configuration File** – When the user saves a new configuration file, all laser specific settings will be saved, based on the unique laser serial number. The following parameters will be saved with each configuration file. For additional information, review each parameter in the RS-232 command section.

<u>Command</u>	<u>Function</u>	<u>Range</u>	<u>Description</u>
<b>C</b>	Laser Drive Control Mode	0/1	Sets Power or Current Control (1 =Current Control)
<b>DELAY</b>	5 sec. Delay On/Off	0/1	Toggle 5 second laser delay on and off
<b>EPC</b>	External Power Control	0/1	Enables External Power Control (1 External Control)
<b>LC</b>	Laser Current Control	0 - Max	Sets Laser Diode Current directly
<b>LE</b>	Toggle Laser Emission	0/1	Toggles Laser Emission On and Off (1 = On)
<b>LP</b>	Laser Power	0 - Max	Sets Laser Power
<b>TEC</b>	TE Cooler/Heater On/Off	0/1	Toggles TE Cooler/Heater On and Off (1 = On)

Table 14  
Configuration File Settings

**10.5.3 Print Configuration Settings** – The Print Configuration Settings function allows the user to select and print the unique configuration functions associated with the desired .cfg file. A standard “Print” dialog will be displayed and allow the user to select normal Windows based print options and functions.

**10.5.4 Print Active Window** – The Print Active Window function will capture the status of a selected laser window and print exactly as it shows. The Properties button within the Print dialog will allow you to configure printer settings and optimize the printout.

**10.5.5 View Menu** The view menu provides the capability to navigate between the Vortran Stradus™ Control screens and adjust multiple laser views. The Home, Information and Terminal Screen items are used to switch between the selected screens. The Tile functions arrange multiple laser views with standard windows tile functions. The Auto-Arrange function will locate multiple laser windows at each of four corners within the application window.

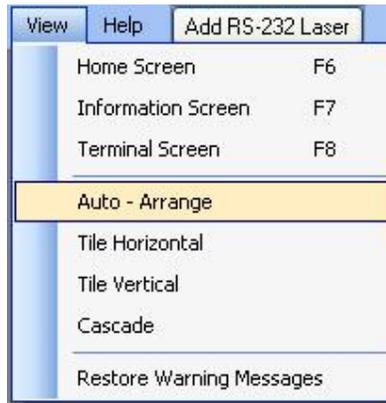


Figure 44  
View Menu

**10.5.6 Help Menu** The Help Menu provides a variety of information to assist with the Vortran Stradus™ Laser and Software. Use the Help menu to launch interactive Help with a variety of tools to access Stradus™ Software information contained in the user manual.

The “**About Vortran Stradus™ Software**” menu item displays version information associated with the software application. The version information displayed can be compared to the current version listed on the Vortran Laser web site.

The “**Contact Vortran Laser**” menu item provides a complete list of Vortran Laser contact information. Feel free to contact Vortran Laser Technology Inc. with any questions or special application needs.



Figure 45  
Help Menu

**10.5.7 Add RS-232 Laser Button** The “Add RS-232 Laser” button is required to initialize additional RS-232 lasers, connected after the Vortran Stradus™ Software is running. Lasers connected via RS-232 do not have the capability to initialize without the host computer sending the appropriate queries. If the Vortran Stradus™ software is running and a new laser is connected via RS-232, the “Add RS-232 Laser” button must be used to display a new laser window in the application. When a new laser is connected via USB, it will initialize automatically.

The Vortran Stradus™ software supports simultaneous USB and RS-232 laser control.

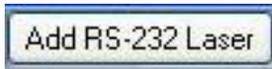


Figure 46  
Add RS-232 Laser Button

## 10.6 Home Screen

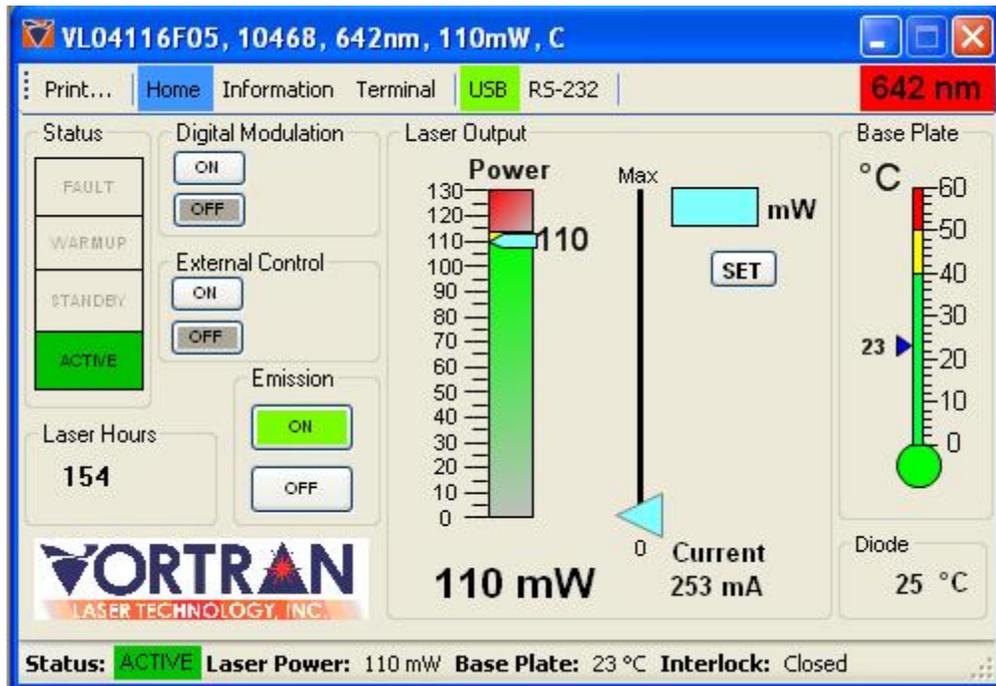


Figure 47  
Home Screen



When the Vortran Stradus™ Software is initialized or a new laser is connected, the Home Screen will be displayed for each laser. The Vortran Stradus™ Software will display up to 4 lasers simultaneously. Each Home screen has individual display and control parameters unique to each connected laser.

**10.6.1 Status** The Status indicator shows the present laser operating condition. When laser emission is active, a green “ACTIVE” indicator is shown. When the laser is operating normally and emission is stopped, the “STANDBY” indicator will be shown. When power is first applied to the laser and the optical block temperature has yet to stabilize, the “WARMUP” indicator will be shown. If a fault condition exists, the red “FAULT” indicator will be displayed.

**If a fault condition exists, type ?FD in the Terminal Window to display specific fault information.**

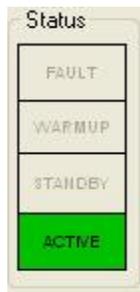


Figure 48  
Laser Status Indicator

**10.6.2 Laser Hours** The Laser Hours display will show the actual hours of active laser emission. The clock will not run if the laser is in a fault condition, warm-up or standby mode.



Figure 49  
Laser Hours

**10.6.3 Digital Modulation** The Vortran Stradus™ Laser operates in a CW or Digital Modulation mode. These modes are selectable with the “Digital Modulation” Button. When “On” is selected the laser output is modulated as a function of the TTL voltage level input at the SMB connector.

When the Digital Modulation “On” button is selected, a dialog box will appear to allow the user to set the amplitude of the pulse output. Enter the desired peak power in mW and the laser will use the photocell to calibrate the peak pulse power to the user entered value.

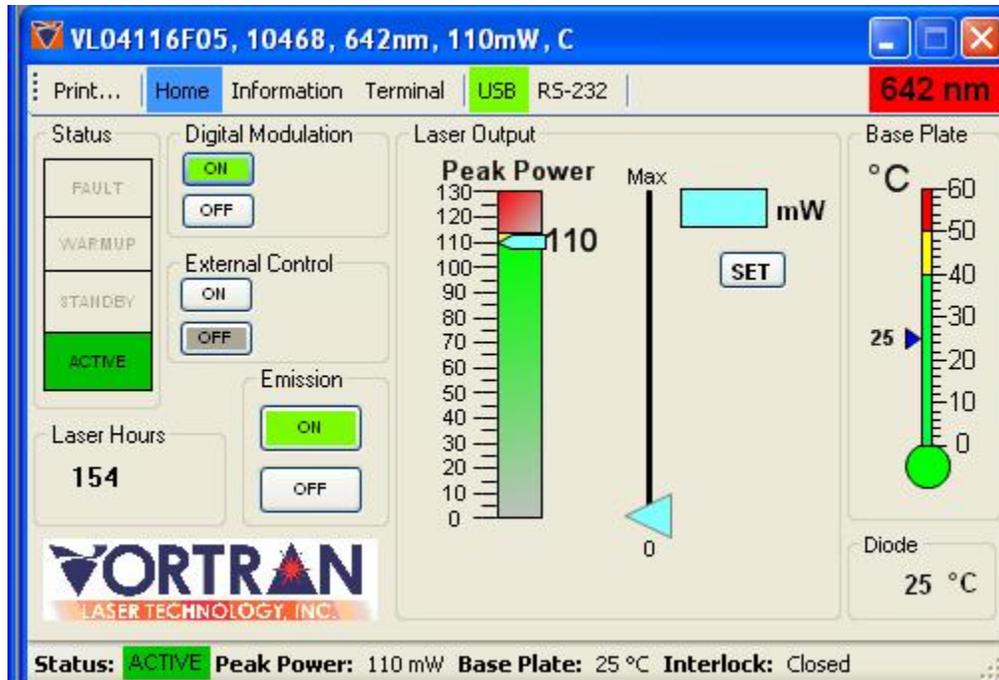


Figure 50  
Digital Modulation

**10.6.4 External Control** The External Control function provides the ability to control the laser power directly with an analog voltage. When “OFF” is selected, the laser operates in a constant power mode, based on the present power setting. When “ON” is selected, the laser power is directly controlled by the voltage applied to the Control Box BNC connector. The output power is based on the voltage applied. A zero volt input will produce no output. A 5 volt input will provide 100% of the maximum laser power.

***If connecting directly to the laser, power control is accomplished with voltage applied to the 20 pin Mini-D connector pin 10 (+) and pin 20 (-).***

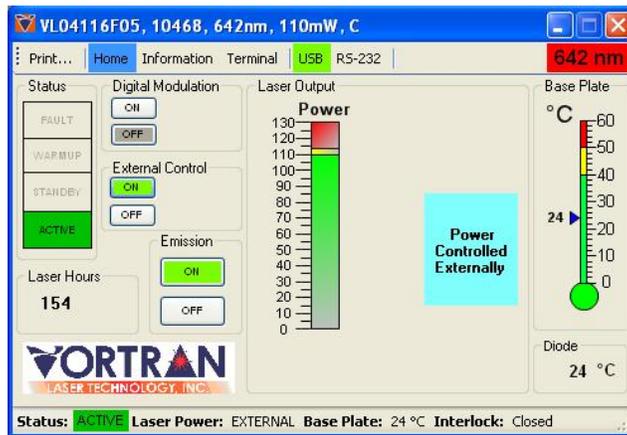


Figure 51  
External Control

**10.6.5 Emission** The Emission indicator provides the capability to start and stop laser emission. When “ON” is selected, laser emission will be established following the 5 second CDRH delay. If the interlock is open or a fault condition exists, laser emission is not possible. Under these conditions, if “ON” is selected, the “OFF” condition will be shown until the fault condition is resolved.

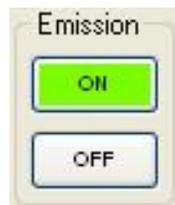


Figure 52  
Laser Emission Indicator

**10.6.6 Laser Output** The Laser Output function allows the user to set the power directly. To make a change, type a new value in the entry box and click “SET.” The Blue triangle can be used as a slider to allow the use of a mouse to drag and set the laser power. **If dragging the Blue triangle to a desired power setting, the “SET” button must be clicked to set the laser power.** The value shown next to the scale represents the present set value and the value shown below the power scale represents the value measured by the Vortran Laser microprocessor and is updated continuously. The scale values represent both nominal and maximum values unique to the laser that is connected. The green scale represents the normal laser operating range. The yellow section represents a range of values that are available for setting but not necessarily recommended for normal operation. The yellow scale represents the power level between the nominal rated laser power and the maximum calibrated laser power available for setting. Values in the Red section of the scale are not available for setting.

The value of the displayed laser current represents the value measured by the Stradus microprocessor and is updated continuously.

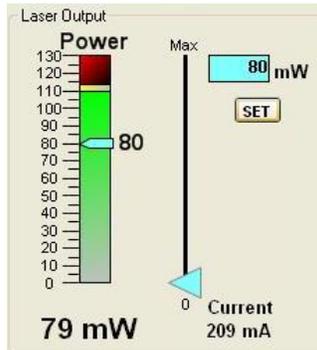


Figure 53  
Laser Power and Current Indicators

**10.6.7 Base Plate Temperature** The base plate temperature gauge displays the present measured base plate temperature. The base plate temperature is measured by the microprocessor and is updated continuously. Once again, green represents the normal and safe operating range. Yellow indicates a level of temperature that will allow the laser to operate, but is not recommended as a level to be maintained for the long-term. Red represents excessive temperature. In the red range, the microprocessor will stop laser emission to protect the laser diode.

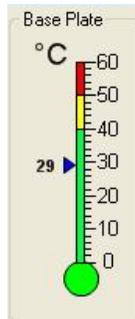


Figure 54  
Base Plate Temperature Indicator

**10.6.8 Diode Temperature** The present diode temperature is displayed as a numerical value with no associated scale. The base plate temperature is measured by the microprocessor and is updated continuously. This value is set at the factory to ensure long-term reliability and maintain the specified optical propagation parameters.

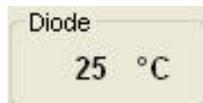


Figure 55  
Diode Temperature

## 10.7 Information Screen

The Information Screen displays a list of both static and measured laser parameters. This screen allows the user to view calibrated laser information and present operating status. The laser information section displays a list of values unique to the connected laser head. These values are static values, set at the factory. The Laser Status values are measured parameters that are constantly monitored and displayed, based upon queries to the Vortran Laser microprocessor. For detailed information on a specific parameter, feel free to contact Vortran Laser Technology.

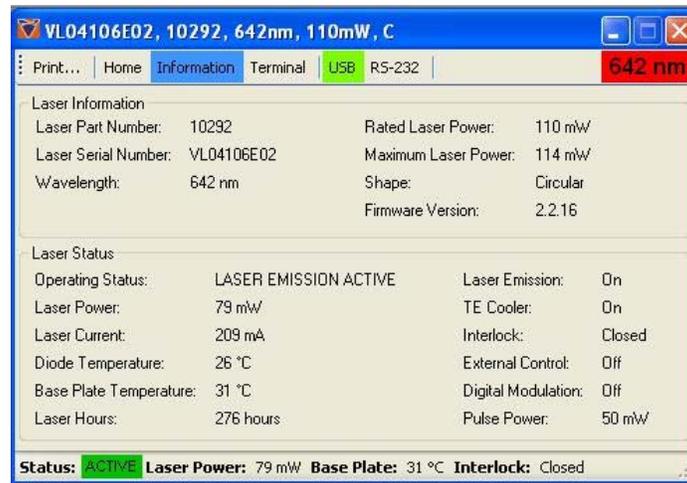


Figure 56  
Information Screen

## 10.8 Terminal Screen

The terminal screen allows the user to communicate directly with the Vortran Stradus™ Laser System. This screen provides flexibility to set or query specific laser parameters. As a secondary function, the user can test custom laser applications, by using a script containing a string of parameters.

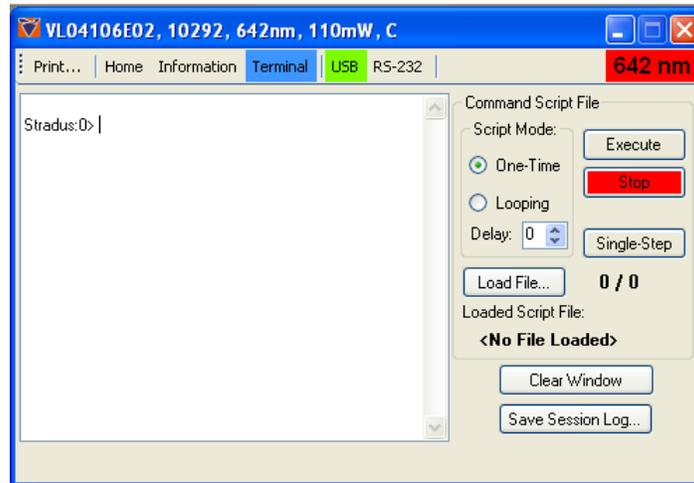


Figure 57  
Terminal Screen

**10.8.1 Script Mode** The Script Mode radio button allows the user to execute a single pass through a string of commands and queries. By selecting the “Looping” function the command and query string will continue to be executed in sequence until the “Stop” button is selected.

**When Looping a Script, a maximum of 32,000 lines will be executed. The Script will stop running at that point.**



Figure 58  
Script Mode

**10.8.2 Control Buttons** The control buttons allow the user to execute or stop the list of commands and queries displayed in the script window. The “Execute Script” button will sequence through the entire list of script commands and queries in the script window. The “Stop” button will interrupt the current execution of script commands and queries. The “Single Step” button will execute the next command or query listed in the script window each time the button is clicked.



Figure 59  
Execute Script

**10.8.3 Load Script File** The Load Script File function allows the user to recall a previously saved script file. When the “Load File” button is selected, a standard Windows “Open” dialog will appear. Select the desired script file and click “Open.” The contents of the file will be loaded into the script window. The file name will also be displayed. The default script file location is C:\Program Files\Vortran Laser\Script Files

**Script files are saved as .txt This will allow the user to view them with a standard text editor.**



Figure 60  
Load Script File

**10.8.4 Clear Window and Save Session File Log** The “Clear Window” button will clear the contents of the script window when clicked. The “Save Session Log” button will display a standard Windows “Save As” dialog when clicked. The user can enter a file name and save the list of commands and queries displayed in the Script Window as a new script file.

**Script Files are Saved as .txt. This will allow the user to view the file contents with a standard text editor.**



Figure 61  
Clear Window / Save Session Log

**10.9 Tool Bar** Each displayed laser window has a tool bar to control functions for individual lasers. The “Print” button will display a standard Windows “Print” dialog and print an image of the **Active Laser Window**. The “Home,” “Information” and “Terminal” buttons are navigation buttons. When one of these buttons is clicked, the associated screen will be displayed. Each button is also highlighted when the associated active screen is displayed. The Tool Bar also displays the communication method for each connected laser.

**Vortran Stradus™ Software can display both USB and RS-232 connected lasers simultaneously.**



Figure 62  
Tool Bar

**10.10 Status Bar** Each displayed laser window contains a status bar at the bottom of the window, to display important laser parameters. The emission status is shown on the left side of the status bar. If a fault condition exists, the “Active” display will display as red with “Fault” to replace the green active status. The present laser power is also displayed. If laser emission is not active, the laser power will display 0mW. The present laser base plate temperature is also displayed, along with the present interlock status.



Figure 63  
Status Bar

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# 11.0 Tutorials

## 11.1 External Laser Power Control

The Vortran Stradus™ Laser has the capability of external power control with a voltage source. A 0V to 5V input signal will provide a corresponding laser output from 0% to 100%. The control box supplied with the CDRH compliant laser system includes a BNC connector for external laser power control. The control box Analog Power Control Input is shown below. The BNC connector input impedance is 550Ω.

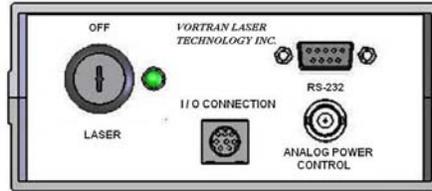


Figure 64  
Control Box Front View

A computer is required to initiate external laser power control. The computer can be connected directly to the laser with a USB connection or to the control box with a RS-232 connection. The Vortran Stradus™ laser will support a USB 1.0 or 2.0 connection. For RS-232 communication, a standard serial cable is required.

***The Vortran Stradus™ Laser System will not communicate with a null modem cable.***

The RS-232 pin connections are shown below.

Function	Control Box DE9
RS-232 Transmit	Pin 2
RS-232 Receive	Pin 3
Signal Ground	Pin 5

The following RS-232 communication parameters are required with the Vortran Stradus™ Laser System.

Baud Rate	19200
Parity	None
Data Bits	8
Stop Bits	1
Flow Control	None

Table 15

RS-232 Connections and Communication Protocol



Once computer communication is established with the laser system, the "EPC=1" command will enable External Laser Power Control. External Laser Power Control can also be enabled with Vortran Stradus™ software. The External Power Control button is located on the software Home Screen.

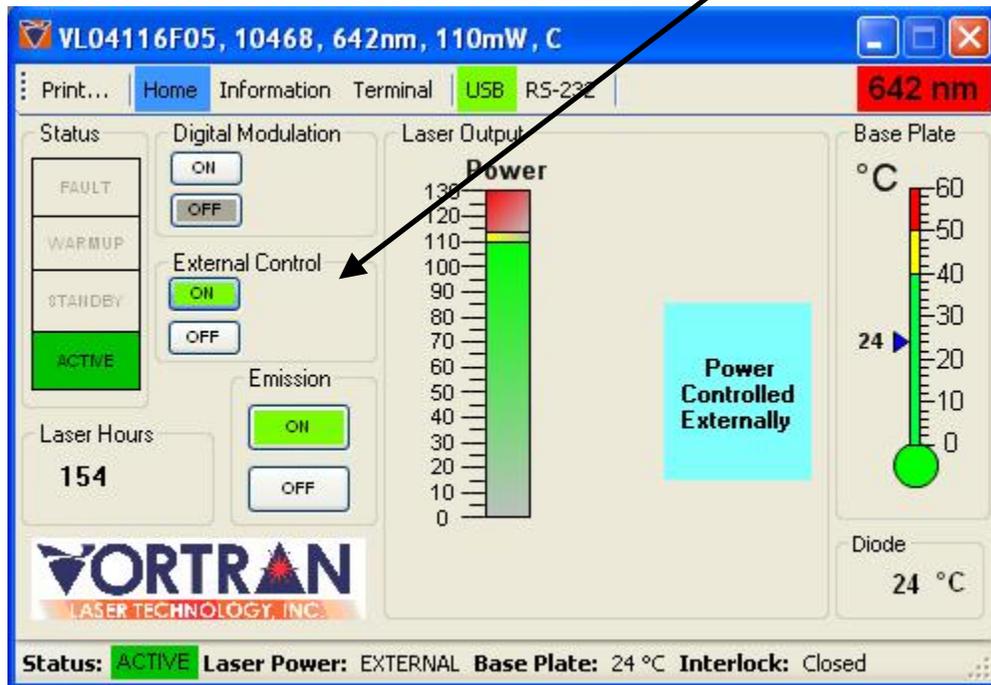


Figure 65  
External Control Setting

Once External Power Control is enabled with a computer, the laser output is directly proportional to the input voltage.

**A 0-5 Volt input will correspond to a 0%-max laser power regardless of the present laser set power.**

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## 11.2 Laser Enable Modulation

The Vortran Stradus™ Laser has a laser enable input. This input allows a TTL signal to toggle the laser emission on and off. The laser enable signal is fed directly to the microprocessor and is able to switch the laser on and off at a maximum rate of 50KHz.

To achieve the proper rate of modulation, the CDRH delay must be disabled. This requires computer communication with USB or RS-232. Review the previous External Power Control section for information on establishing USB or RS-232 communication. When using a terminal program with RS-232 communication, enter the command CDRH=0 to disable the 5 second emission delay. If using Vortran Stradus™ software, use the terminal screen to enter the DELAY=0 command. When you enter the command, click “Execute Script” button to send the command. A Stradus™ Software example is shown below.

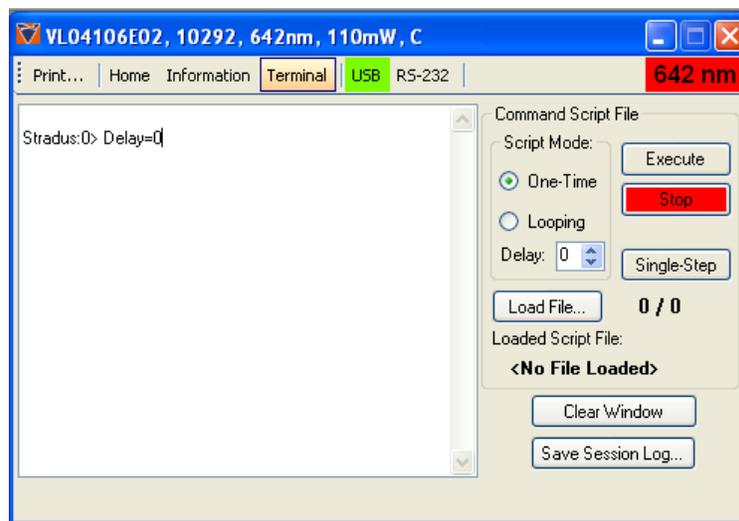


Figure 66  
Delay Script

Once the delay is disabled, you can connect the TTL signal to the laser. Connect the TTL signal to the Laser Control Box Mini-DIN connector pin 2(+) and pin 7(-).

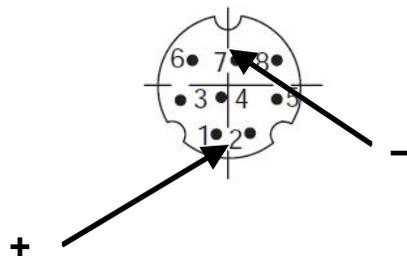


Figure 67  
Laser Enable I/O Pins

If connecting directly to the laser, use Mini-D Pin 6 (+) and Pin 14 (-).

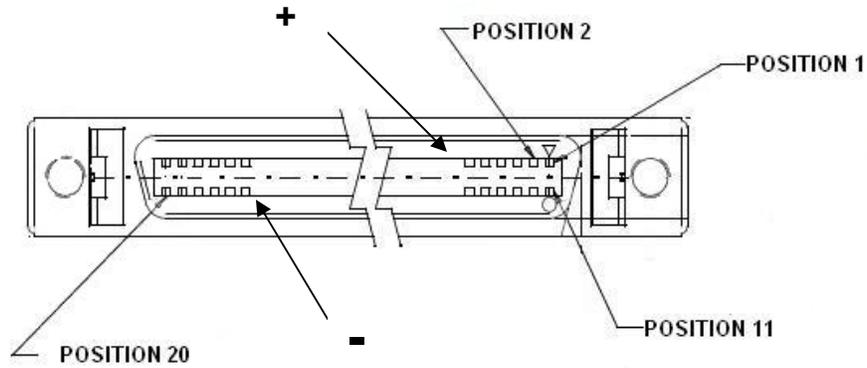


Figure 68  
Laser Enable Pins

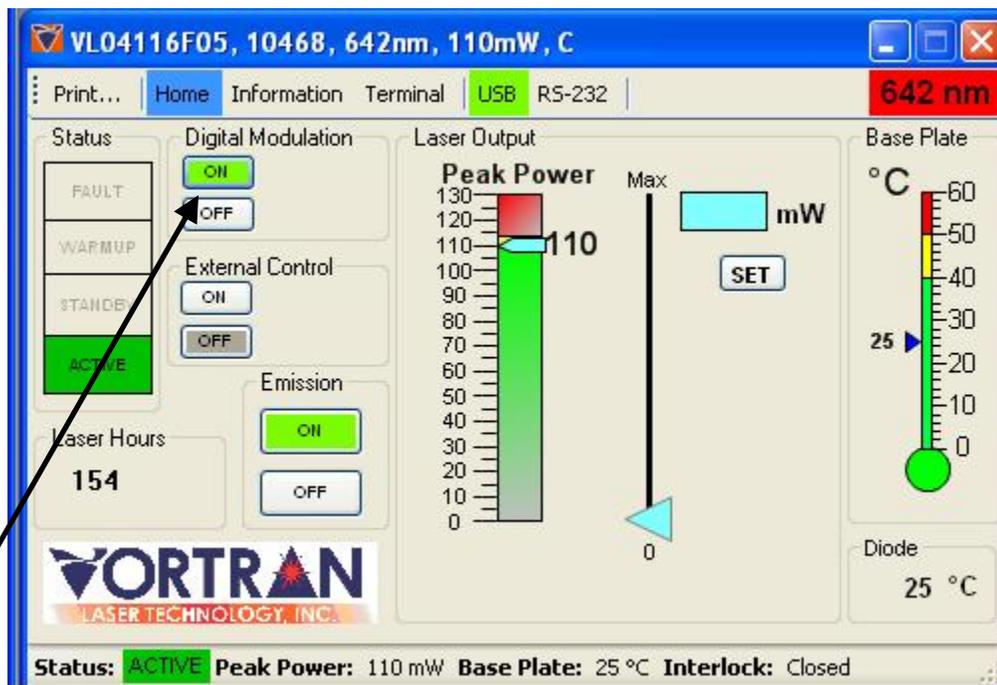
With the delay disabled, the TTL input will modulate laser emission on and off at the laser set power. The laser output amplitude can also be controlled with the Analog input simultaneously. For additional information on Analog Power control, refer to the previous section.

### 11.3 Digital Modulation

The output of the Stradus™ Laser System can operate in a Continuous Wave or Digital Modulation mode. Prior to setting the laser into Digital Modulation mode, the voltage levels of the input to the SMB connector should be verified using an oscilloscope terminated at 50 ohms.

**External Sources Designed to Drive High Impedance Loads Will Not Provide TTL Voltage Levels When Terminated at 50 Ohms**

The required voltage levels are less than 0.2 volts for a laser off condition and greater than 3.2 volts for laser on. Inputs to the SMB connector do not provide direct control of the amplitude of the pulsed laser output. When the Digital Modulation Radio Button is selected, a dialog will appear to allow the user to set the peak power of the laser output. Enter a value in mW and the laser will automatically calibrate the peak output power using the power control photocell. The peak power can be changed by using the PP command via USB or RS-232. See the Command Detail section for additional information on the PP command.



Digital Modulation Control

Figure 69 Digital Modulation Control

# 12.0 Troubleshooting Guide

## 12.1 Resolving Faults

If a fault occurs, the Vortran Stradus™ laser microprocessor will halt laser emission and set the Fault Pin to a TTL high level. The fault pin is accessed with the Control Box I/O connector pin 1 or laser connector pin 7. The associated ground reference is found on the I/O connector pin 7 and the laser connector pin 14.

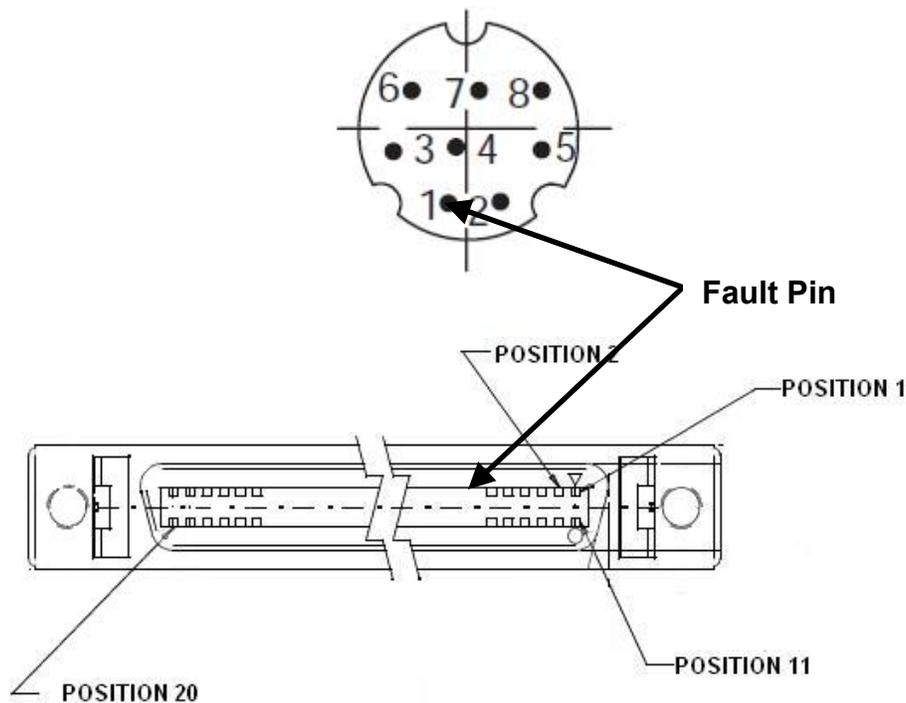


Figure 70  
Fault Pin

If a fault occurs, the user can use RS-232 or Vortran Stradus™ software to determine the actual fault condition. When communicating with RS-232, use the query ?FC to obtain a binary representation of all existing fault conditions. If using Vortran Stradus™ software, use the terminal screen to enter the ?FC query and click on the “Execute Script” button. The binary response will be in the same binary sum format as RS-232 serial communication.

**Please review the information below on fault conditions and potential resolutions.**

<b>Fault Code Resolution</b>		
<b>Value</b>	<b>Description</b>	<b>Resolution</b>
0	LASER EMISSION ACTIVE	Normal Operation, Laser Emission Active
1	STANDBY	Normal Operation, Laser Emission Not Active.
2	WARMUP	Normal Operation, Laser Start-up
4	VALUE OUT OF RANGE	Normal Operation, Invalid Command Value
8	INVALID COMMAND	Normal Operation, Syntax Error
16	INTERLOCK OPEN	Normal Operation, Key Switch in Off Position
32	TEC OFF	Laser Power On, TEC Turned Off. Turn on TEC or restart laser.
64	DIODE OVER CURRENT	Fault Condition, Laser Over Current, Contact Vortran Laser Technology for Repair.
128	DIODE TEMPERATURE FAULT	Fault Condition, If environment is excessively cold or hot, adjust environment temperature to normal room conditions. (20-30 degrees C) System will recover automatically.
256	BASE PLATE TEMPERATURE FAULT	Fault Condition If environment is excessively cold or hot, adjust environment temperature to normal room conditions (20-30 degrees C). System will recover automatically.
512	BUFFER OVERFLOW	Fault Condition. Excessive number of commands sent. Turn off power to the laser and restart.
1024	EEPROM ERROR	Fault Condition. Restart Laser. If not resolved, return laser for repair.
2048	I2C ERROR	Fault Condition. Restart Laser. If not resolved, return laser for repair.
4096	COMMAND TIME OUT	Fault Condition. Repeat previously entered command or query.
8192	WATCH DOG ERROR	Fault Condition. Restart Laser. If not resolved, return laser for repair.
16384	FATAL ERROR	Fault Condition. Restart Laser. If not resolved, return laser for repair.
32768	Laser End of Life Indicator	Warning Condition: Laser current has increased by 20%. Service Laser Soon.

Table 16



## 12.2 Temperature Faults

A temperature fault can exist with static temperatures below 10°C or greater than 40°C. If the laser is not properly mounted, or the heat sink is insufficient, a temperature fault could result. Rapid changes in temperature may cause laser emission to be interrupted until the diode temperature stabilizes.

**The Vortran Stradus™ Laser provides temperature protection for the laser diode. If a temperature fault occurs, laser emission will be interrupted until the temperature returns to a safe range.**

When a temperature fault occurs, the fault pin is set to TTL high and laser emission will stop. When the temperature returns to a safe range, laser emission will resume. A optical block temperature fault will occur when the measured temperature is less than 20°C or greater than 24°C.

## 12.3 Laser at Half Power

If the laser is running at half power, it could be a result of the External Power Control being active with no connection to the control box BNC connector. The laser internal resistor will provide voltage to the External Power Control circuit with no external connection. This voltage would result in approximately ½ of the rated laser power.

## 12.4 Poor Beam Quality

The Vortran Stradus™ Laser is a precision optical assembly designed and built to provide the best beam quality. All of the critical optical components are sealed inside the laser housing. This is done to ensure maximum long-term beam quality and reliability. Under normal conditions the only thing that would affect beam quality would be obstructions to the beam path. These would include material stuck in the laser output aperture, the laser shutter not completely retracted or beam clipping outside of the laser housing. Poor beam quality could also result when the laser was dropped or the laser diode failed. Both of these conditions can be diagnosed and resolved at the factory.



## 13.0 Glossary

°C	Degrees Celsius
µm	Micrometers (10 <sup>-6</sup> Meters)
µrad	Microradians (10 <sup>-6</sup> Radians)
AC	Alternating Current
A	Amp
BNC	Bayonet Neill Concelman Connector
CDRH	Center for Devices and Radiological Health
ESD	Electrostatic Discharge
KHz	Kilohertz (10 <sup>3</sup> Cycles per Second)
LED	Light Emitting Diode
mA	Milliamps (10 <sup>-3</sup> Amps)
mm	Millimeter (10 <sup>-3</sup> Meters)
mrاد	Milliradian (10 <sup>-3</sup> Radians)
mW	Milliwatt (10 <sup>-3</sup> Watts)
nm	Nanometer (10 <sup>-9</sup> Meters)
OEM	Original Equipment Manufacturer
RMS	Root Mean Squared
RMA	Return Material Authorization
TEC	Thermal Electric Cooler
TTL	Transistor Transistor Logic <0.8V Low >2.0V High Input <0.8V Low >3.3V High Output
V	Volts
VAC	Volts Alternating Current
VDC	Volts Direct Current
W	Watts

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## 14.0 Warranty

Vortran Laser Technology, Inc. provides a warranty for a period of 12 months from the original shipment date. This warranty applies only to the original purchaser and covers material defects, workmanship and adherence to published specifications. If a replacement unit is provided, the warranty is based on the shipment date of the original unit.

The Vortran Laser Technology Warranty will be void under the following conditions:

- Removing the Protective Housing from the Laser Head
- Removing the Protective Housing from the Control Box
- Not Providing Correct Input AC Voltage
- Insufficient Heat Sink
- Improper Mounting
- Not Providing Environmental Requirements
- Incorrect User Supplied Interface Components
- Visible Damage or Misuse of the Laser System

If the user provides custom interface components, Vortran Laser Technology does not support the warranty without factory approval.

Following repair, the Vortran Stradus™ Laser System Warranty is based on the date of original shipment.



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## 15.0 Returning Laser for Service

### Return Material Authorization (RMA) Instructions

The Vortran Stradus™ Laser System does not require interval calibration or factory maintenance. If service is required, contact Vortran Laser Technology. Be ready with the laser part number, serial number and problem description when contacting the factory. The factory will provide an RMA number and shipping instructions. Please follow the packaging and shipping instructions for Laser System factory returns.

### Repacking Instructions

Please return the laser to Vortran Laser Technology in the original shipping containers if possible. Package the laser head and control box with ESD protective bags. For non-warranty events, only return the system components suspected of having problems. For warranty events, please return all items originally shipped with the Laser System. Please write the RMA number on the outside of the shipping box. A complete list of factory shipped laser system items is shown below.

Description	Part Number	Quantity
Laser Head	See Packing List	1
Laser M4 x 10mm Screws	10068	4
Mounting Screw Washers	10069	4
3mm Hex Driver	10070	1
Laser Control box	10067	1
Power Cord	10066	1
Laser Control Software CD	10049	1
User Manual	10048	1
Mini B USB Cable	10126	1
Remote Interlock Plug**	10039	1
Mini DIN I/O Connector Plug**	10091	1

\*\*Packaged separately and not required for normal operation

Table 17  
Repacking Parts List



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## **16.0 Contact Vortran Laser Technology**

**Vortran Laser Technology, Inc.  
21 Goldenland Court, #200  
Sacramento, California 95834**

**Phone  
(916) 283-8208**

**Fax  
(916) 648-9751**

**E-mail**

**Sales  
[sales@vortranlaser.com](mailto:sales@vortranlaser.com)**

**Service  
[service@vortranlaser.com](mailto:service@vortranlaser.com)**

**Web Site  
[www.vortranlaser.com](http://www.vortranlaser.com)**



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