User Guide

Cutting Head Control Electronics

IPG Photonics

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Preface:

Please take time to read and understand this User's Guide in its entirety and familiarize yourself with the operating and maintenance instructions that we have compiled for you before you use the product. We strongly recommend that all operators of the product read and pay particular attention to all safety information contained herein prior to operating the product.

This User's Guide should stay with the product to provide you and all future operators, users and owners of the product with important operating, safety and other information.

For technical assistance concerning the product, contact IPG Customer Service.

Table of Contents

1 Safety Information

1.1 Safety Conventions

IPG Photonics use various words and symbols in this User's Guide that are designed to call your attention to hazards or important information. These include:

WARNING: 

Refers to a potential *personal* hazard. **(**  ***Electrical)*** **(**  ***Laser radiation*****)** It requires a procedure that, if not correctly followed, may result in bodily harm to you and/or others. Do not proceed beyond the WARNING sign until you completely understand and meet the required conditions.

CAUTION: 

Refers to a potential *product* hazard. It requires a procedure that, if not correctly followed, may result in minor personal injury or damage or destruction to the product or components. Do not proceed beyond the CAUTION sign until you completely understand and meet the required conditions.

IMPORTANT

Refers to any information regarding the operation of the product. Please do not overlook this information.

1.2 General Safety Instructions

WARNING: 

This product is intended to be used with a laser and cutting head. Read and observe all safety instructions provided with the laser and cutting head.

CAUTION: 

Hot or molten pieces of metal may be present when cutting metal. Exercise caution if debris is being generated in your application.

1.3 Electrical Safety

CAUTION: 

The Cutting Head Control Electronics operates on 24V DC input.

Always Earth Ground the Controller and the mechanical stage that mounts the Cutting Head. Do not open the CHCE enclosure as there may be hazardous switching voltages inside. Do not operate CHCE in a wet environment.

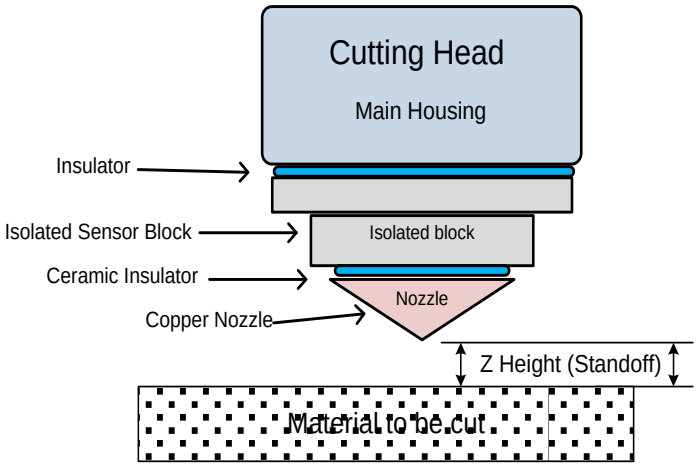
1.4 Scope of Document

This document covers the connection, configuration, calibration, and safe use of the Cutting Head control electronics box. Refer to the specific Laser and Cutting Head user guides for their Safety, operation, mechanical adjustment, and maintenance.

2 Product Description

The Cutting Head Control Electronics when used with an IPG Cutting Head is designed for integration into a laser machine such as a flatbed laser machine for cutting sheet metals or a pipe cutting machine where maintaining a constant working distance is critical to performance.

The primary function of the electronics is to determine standoff height using the capacitance change between the nozzle and isolated block that varies as a function of standoff height from the metal material to be cut. Typical cutting standoff height is 1 mm.



The capacitive measurement is performed thousands of times per second. The controller converts the data to height through a calibration curve and outputs this measured height. The controller provides additional height related status to simplify interface and diagnostics such as tip touch, collision warning, and height above range.
Other Cutting Head features may be implemented depending on the models (e.g. motor focus, window present, window dirty, etc.). In addition the CHCE allows configuration and calibration by the user.

The CHCE provides a variety of interfaces to Customer provided System Control Electronics (e.g. PLC) and Linear Stage Servo Controllers.

2.1 Definition of Terms

Standoff: The height the nozzle tip is above work piece top surface being cut that is to be maintained by height sense electronics. Typically 0.5 to 2 mm.
Focus: The distance above or below the nominal standoff height (1mm below nozzle tip) that the laser is in focus. + Focus is towards the head, - Focus is into the material.
CHCE: Cutting Head Control Electronics.
Calibration: The process of mapping measured signal in the Cutting Head Electronics to Standoff Distance.

2.2 Description

The IPGCut base electronics has connections both to the head and customer equipment. Refer to the Block Diagram.

2.2.1 Head connections

The IPGCut Base Electronics connects to the head electronics with two high flex cables (20m standard length)

- Data Signal: M12x4 position female to M12x4 position female
- Power: M8x4 position female to M8x4 position male

The head electronics varies with head type.
IPGCut Compact head:

- IPGCut Height Sensor Electronics box mounted to head connects two cables to head
- Head power connection: (M8 x 4 position male to M5x4 position female cable provided)
- SMB connection for the height sensor. (SMB RA Plug to SMB RA Plug cable provided)

IPGCut D50 and D30 Motor Focus Heads:

- IPGCut Motor Head Controller box mounted on head connects signals to head.
- SMB connection for the height sensor. (SMB RA Plug to SMB RA Plug cable provided)

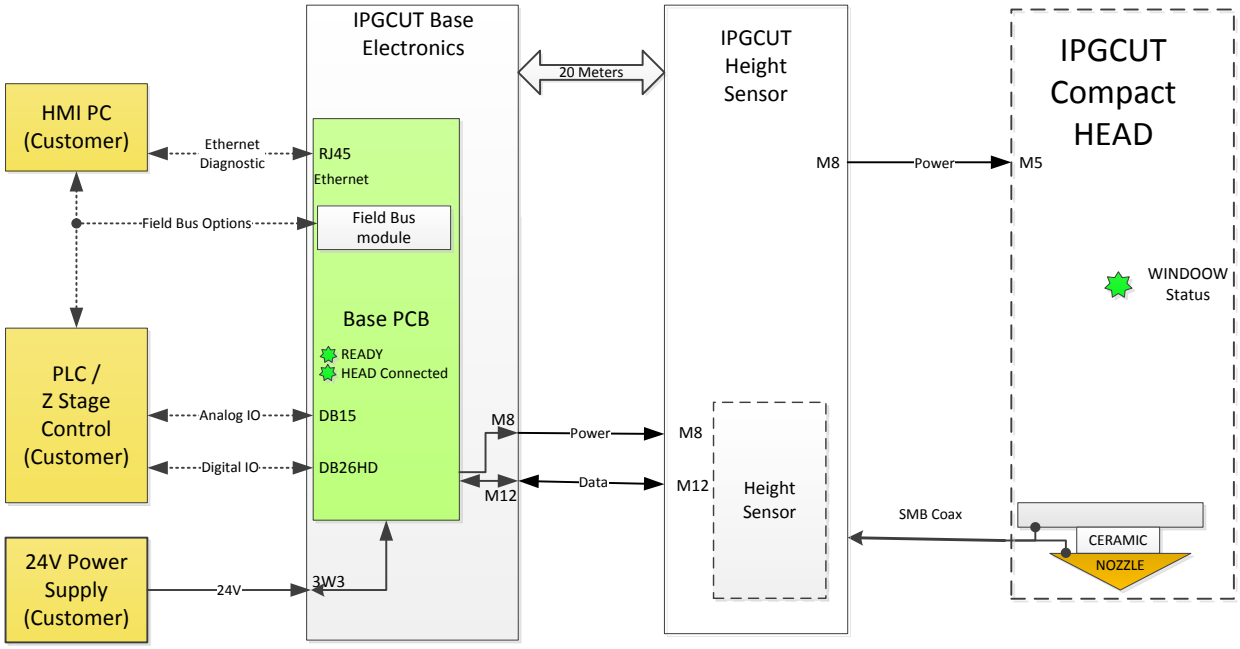
2.2.2 Customer Connections

The customer supplies 24 VDC to the Base Station via 3W3 connector. There are connectors on the controller, one for Analog IO (D15) and one for Digital IO (D26HD). In addition there is a diagnostic Ethernet connector and optional Field Bus Ethernet.

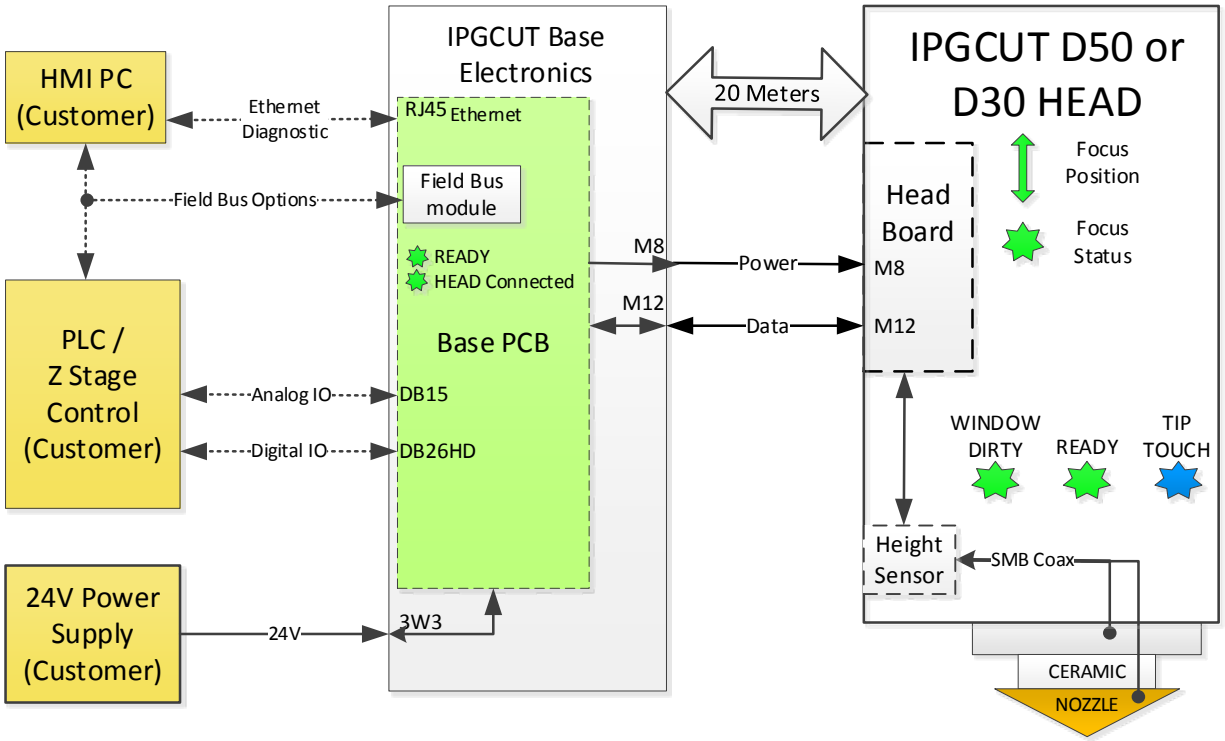
- Power: +24VDC, return, and earth ground on 3W3 connector. (connector and pins provided)
    - Pin 3 is +24VDC, Pin 2 is Earth Ground, Pin 1 is Return
- Ground lug: A screw is provided on the side panel for earth ground attachment
- Analog IO: D15 female connector (break out board provided)
- Digital IO: D26HD female connector (break out board provided)
- Ethernet: RJ45 Ethernet connection – diagnostic use.
- Field Bus: Optional Ethernet based field bus – PROFINET, EtherNet /IP, EtherCAT available.

2.3 Block Diagram and Product Views

Block Diagram IPGCUT Compact Cutting Head and Customer Interface



Block Diagram IPGCUT D50 & D30 Cutting Head and Customer Interface



Views of Base Box and Connector Locations

Figure 1: IPGCut Base with Standard IO (left) and optional field bus IO (right) on top plate panel.

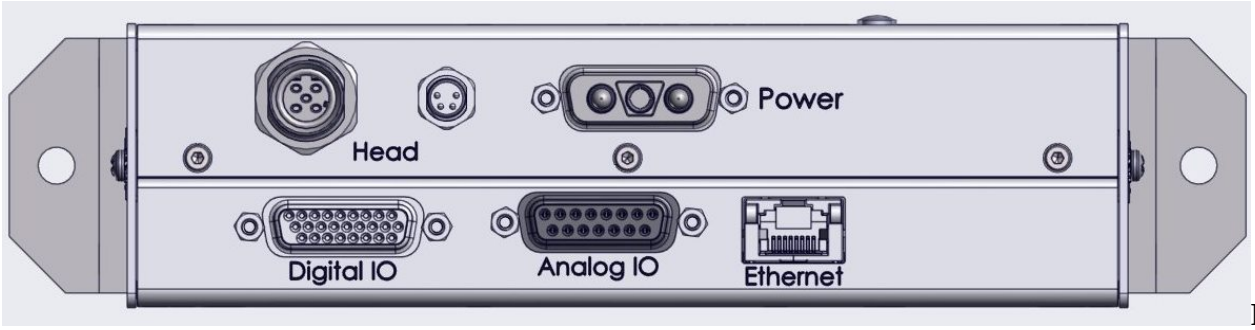


Figure 2: Connectors on front of IPGCut Base.

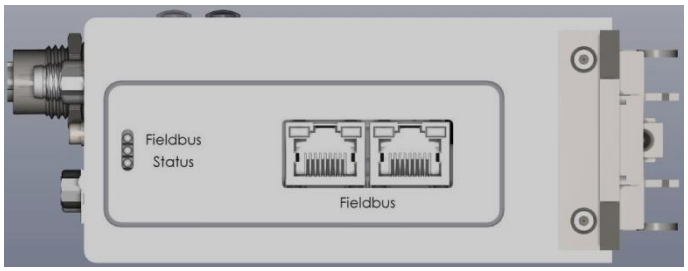


Figure 3: On models with optional field bus, the status LEDs and Field Bus Ethernet connectors are on the top face of box.

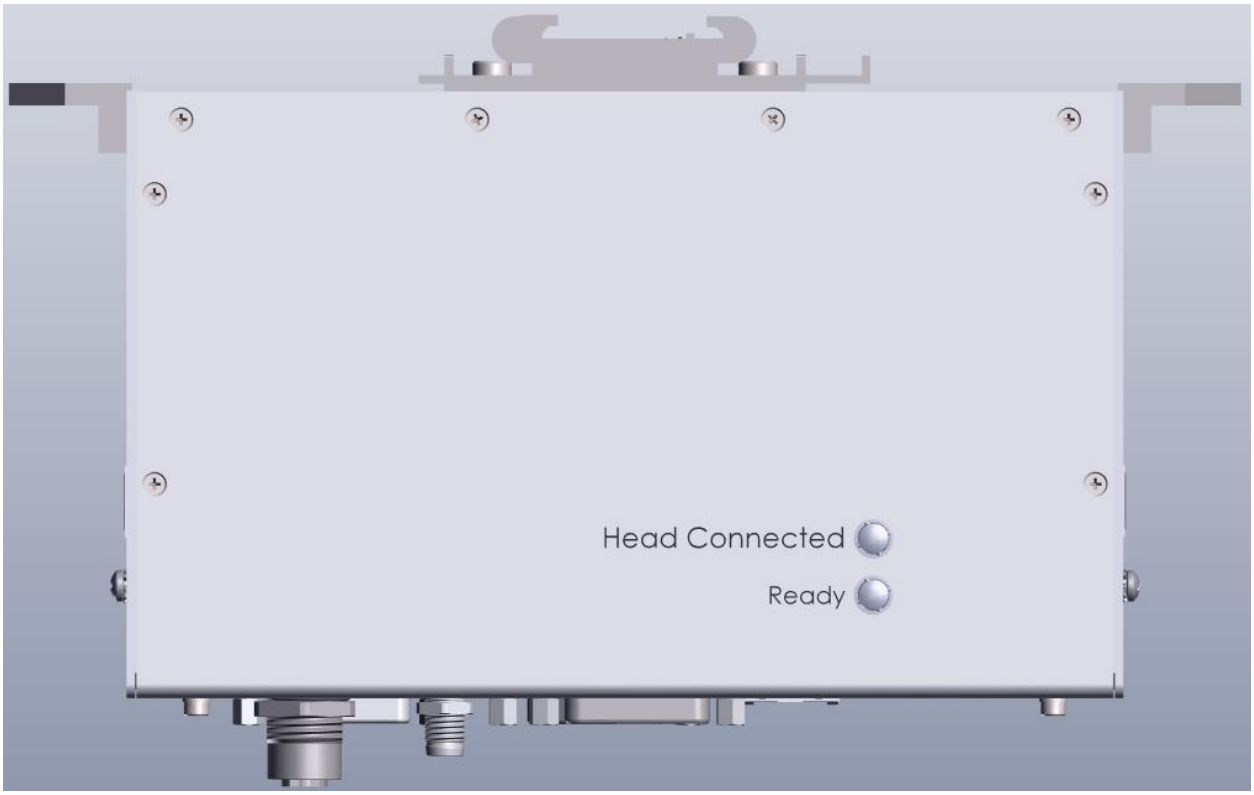


Figure 4: Two status lights- Ready and Head Connected -are on the left side panel.

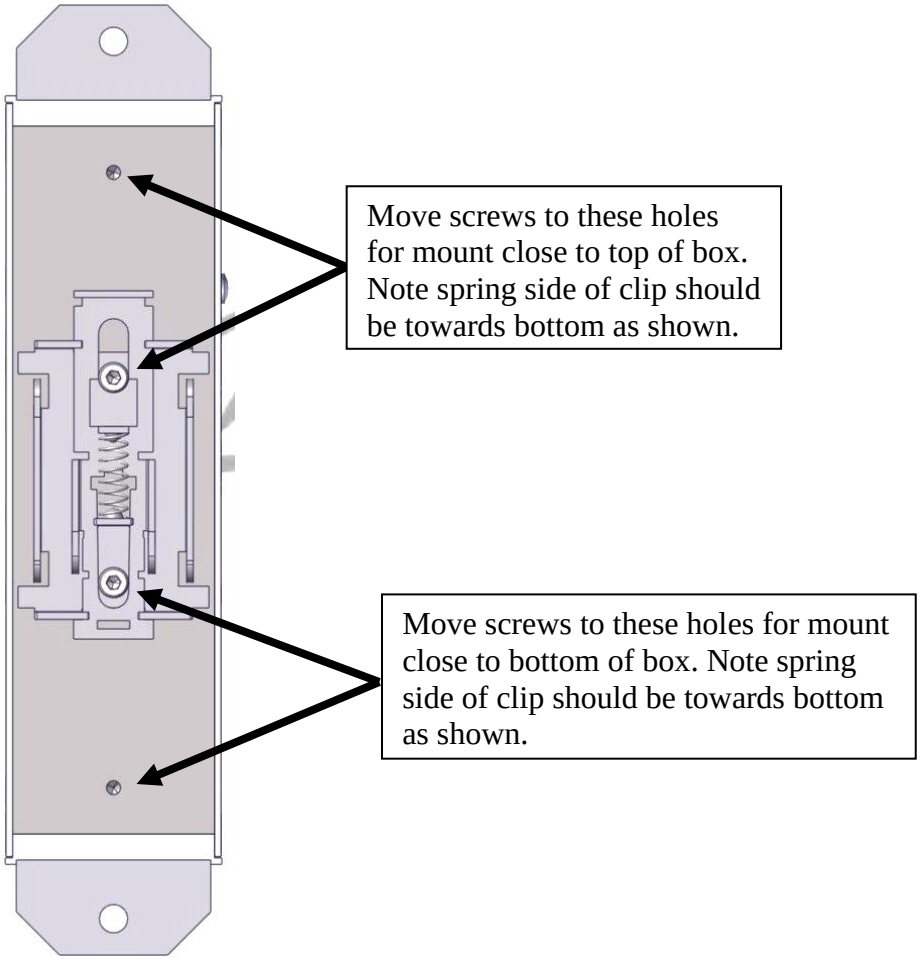


Figure 5 View of rear of base. DIN Rail Mount comes centered but may be adjusted higher or lower by inserting screws in lower or upper set of holes instead of center holes.

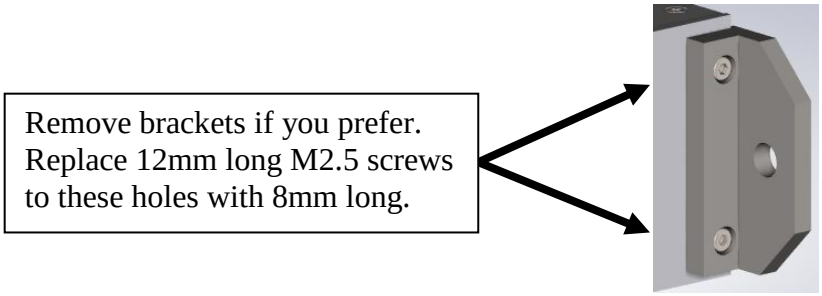
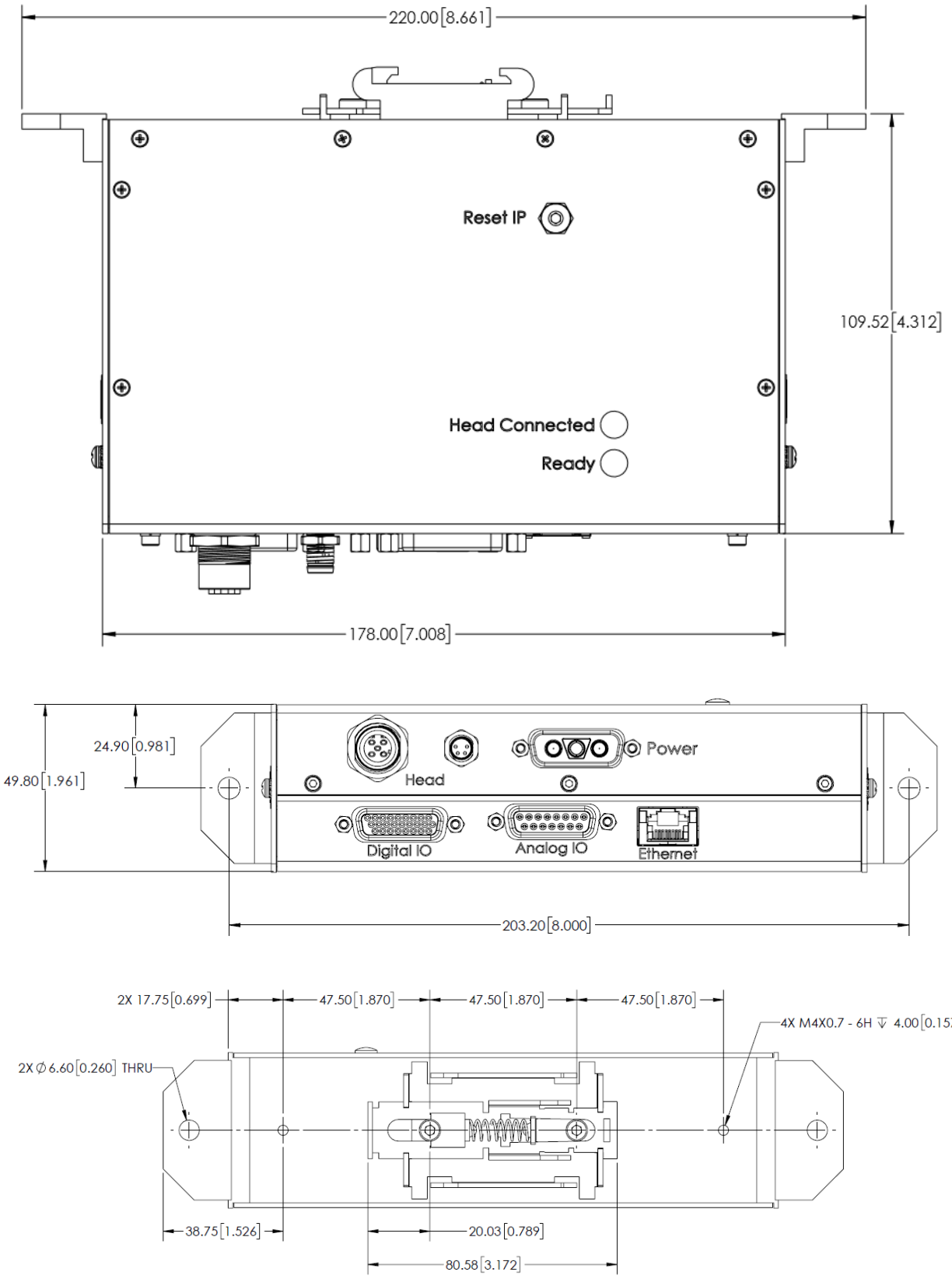


Figure 6: Two mounting tabs may be removed if not used to reduce footprint. Remove the bracket and replace the M2.5 x 12 screws with M2.5 x .45 x 8 screws (not provided).

2.4 Dimensions



2.5 Status LEDs

2.5.1 Ready

The Ready light is lit when the base is in READY state- Powered up and no alarms. Note alarms must be cleared after correction for Ready to return. Alarms may be cleared by command, web page, or digital input.

2.5.2 Head Connected

The Head Connected LED shows status of the communication with the cutting head.

Light	Description	D50 D30 Head	Compact Head
On Solid	Head connected	Yes	Yes
Slow Blink	Base is communicating with Head Controller but there is an issue with height sensor board connection to head controller.	Yes	NA
Fast Blink	D50 & D30: Base is not communicating with Head Controller.	Yes	NA
	Compact: Base is not communicating to height sensor board	NA	Yes
Off	No power to base or base failure	Yes	Yes

2.5.3 Ethernet

There are two small LEDs on the diagnostic Ethernet connector.

LED on Left is Green when there is power to the board.

LED on Right is Yellow when connected to host computer.

2.5.4 Field Bus

On Base models with Field Bus included, there are LEDs on the Field Bus Ethernet Connectors and three LEDs to the left of the connector. See Field Bus Chapter for details.

Ethernet Connectors have Link and Active LEDS

LED / Field Bus	EtherCAT	PROFINET	Ethernet/IP
TOP	ERR	BF	NS
MIDDLE	RUN	SF	MS
BOTTOM	SYS	SYS	SYS

2.6 Configurable IO

The controller has 2 Analog inputs, 4 Analog outputs (3 single ended, one differential), 8 Digital Inputs, and 8 Digital outputs. The functions of these IO lines are configurable by the user as described below. Functions available depend on head type.

2.6.1 Analog Input Configuration Options

The two analog inputs may be configured to one of these options or through web/command.

Config Value	Assignment	Description	D50 D30 Head	Compact Head
0	Focus Setting	Setting focus position	Yes	NA
31	Disabled	Analog input is off	Yes	Yes

2.6.2 Analog Output Configuration Options

The four analog outputs may be configured to one of these options.

For Control mode, only Output #3 can produce positive and negative voltages and should be used for Control output.

NA = Not Available on that head type.

Config Value	Assignment	Description	D50 D30 Head	Compact Head
0	Height	Sensor measured nozzle standoff height	Yes	Yes
1	Pierce PD	Pierce photo diode output (visible plasma)	Yes	NA
2	Window PD	Photodiode senses IR scatter from window	Yes	NA
3	Reserved	Reserved for future use (Collimator temp)	NA	NA
4	Reserved	Reserved for future use (Focus temperature)	NA	NA
5	Window Temp	Window thermal sensor	Yes	NA
6	Reserved	Reserved for future use (Quartz block temp)	NA	NA
7	Reserved	Reserved for future use (PG)	NA	NA
8	Window Seal	Inside Head optical cavity pressure	Yes	NA
31	Disabled	Analog output is off	Yes	Yes

Pin Assignments DB15 Female **Analog IO**

DSUB PIN	ID	I/O
1	AO0	Output
3	AO1	Output
5	AO2	Output
7	AO3+	Output
9	A03-	Output
11	AI0	Input
13	AI1	Input
2,4,6,8,10, 12,14,15	Ground Customer	Return

2.6.3 Digital Input Configuration Options

The four digital inputs may be configured to one of these options or through web/command.

Config Value	Assignment	Description	D50 D30 Head	Compact Head
0	Cal Request	Used in height calibration sequence	Yes	Yes
1	Cal Strobe	Used in height calibration sequence	Yes	Yes
2	Reserved		NA	NA
3	Focus Latch	Holds focus at position set when high	Yes	NA
4	Clear Alarms	Rising edge will clear an alarm	Yes	NA
31	Disabled	Digital input is off	Yes	Yes

Pin assignments DB26HD Female Digital IO connector

DSUB	ID	I/O		DSUB	ID	I/O
1	+V Logic	+24V logic		**14**	DI0	Input
2	DO0	Output		**15**	DI1	Input
3	DO1	Output		**16**	DI2	Input
4	DO2	Output		**17**	DI3	Input
5	DO3	Output		**18**	DI4	Input
6	DO4	Output		**19**	DI5	Input
7	DO5	Output		**20**	DI6	Input
8	DO6	Output		**21**	DI7	Input
9	DO7	Output		**22**	GND Customer	Logic Return
10	GND Customer	Logic Return		**23**	GND Customer	Logic Return
11	GND Customer	Logic Return		**24**	GND Customer	Logic Return
12	GND Customer	Logic Return		**25**	GND Customer	Logic Return
13	GND Customer	Logic Return		**26**	GND Customer	Logic Return

2.6.4 Digital Output Configuration Options

There are eight digital outputs that may be configured with the following choices.

Config Value	Assignment	Description	D50 D30 Head	Compact Head
0	Ready	Head is ready to use (no critical alarms)	Yes	Yes
1	Lens At Focus	Motor focus has reached setting	Yes	NA
2	Cal Ack	Used in calibration sequence.	Yes	Yes
3	Collision Warning	Warning head height is at threshold	Yes	Yes
4	Tip Touch	Head height is touching metal	Yes	Yes
5	Height Above Range	Head height is out of calibrated range	Yes	Yes
6	Nozzle Lost	Nozzle is missing or at high height	Yes	Yes
7	Window In	Protective window is in place	Yes	NA
8	Window Dirty	Protective window is dirty	Yes	NA
9	Reserved		NA	NA
10	Colli Tray In	Protective collimator tray in place	Yes	NA
11	Interlock	Fiber interlock has been opened	Yes	NA
12	Temperature Warning	Temperature above user set threshold	Yes	NA
13	Temperature Alarm	Temperature above maximum	Yes	NA
14	Pressure Warning	Pressure above user set threshold	Yes	NA
15	Pressure Alarm	Pressure above maximum	Yes	NA
16	Cal Error	Problem in calibration process	Yes	Yes
31	Disabled	Digital output off	Yes	Yes

Pin assignments DB26HD Female Digital IO connector

DSUB	ID	I/O		DSUB	ID	I/O
1	+V Logic	+24V logic		**14**	DI0	Input
2	DO0	Output		**15**	DI1	Input
3	DO1	Output		**16**	DI2	Input
4	DO2	Output		**17**	DI3	Input
5	DO3	Output		**18**	DI4	Input
6	DO4	Output		**19**	DI5	Input
7	DO5	Output		**20**	DI6	Input
8	DO6	Output		**21**	DI7	Input
9	DO7	Output		**22**	GND Customer	Logic Return
10	GND Customer	Logic Return		**23**	GND Customer	Logic Return
11	GND Customer	Logic Return		**24**	GND Customer	Logic Return
12	GND Customer	Logic Return		**25**	GND Customer	Logic Return
13	GND Customer	Logic Return		**26**	GND Customer	Logic Return

3 Configuration and Operation

3.1 Maximum length cables

Connection to Base from Customer

Cable	Type	Maximum length
User Ethernet	RJ45-RJ45	23m (75 ft)
Digital I/O	DB 26HD	5m (16 ft)
Analog I/O	DB 15	5m (16 ft)
Power	DB 3W3	5m (16 ft)

Connection to Head from Base

Cable	Type	Maximum length
Data	M12-M12	20m (65 ft)
Power	M8-M8	20m (65 ft)

Connection to Head from head electronics

Use provided cables. Do not extend.
Type and length vary by head type.

3.2 Installation- Connection to the cutting head

- Mechanically install Cutting Head into system. Connect LASER and water connections per Cutting Head User Guide
- With the power off, install the 20m M12 Communication cable to the head and M8 power cables between base and head.

3.3 Installation- connections to the PLC

- Connections may be wired directly into customer provided D15M and D26HDM connectors.
- A breakout board may be used in PLC cabinet to facilitate wiring of digital and analog IO.
    - IPG supplies one such break out board solution with each base station:
        - IPG PN CECOACC3325381PX BREAKOUT BOARD DSUB 15P MALE
        - IPG PN CEMIXXX7445008PX BREAKOUT BOARD DSUBHD 26P MALE

3.4 Installation- Power

- Make up 3 wire power cable for 24VDC, return, and ground using supplied 3W3 connector.
- Pin 3 is +24V. Pin 1 is Return. Pin 2 is Earth Ground.
- Head should also be grounded.

3.5 Installation Field Bus

- Available only on Base Stations models that support field bus protocol.
- Install an RJ-45 cable to the field bus input. Refer to Chapter 6 for details

3.5.1 User Ethernet Interface

The User Ethernet Interface connector is provided to allow bidirectional communication with the CHCE from a Customer supplied Laptop or Computer. The Cutting Head Web Interface is accessed by browsing to the CHCE IP Address. The CHCE uses a fixed IP address that may be later change by the user to a different fixed address. Adding a second Ethernet interface to your PC (such as USB to Ethernet adapter) to connect with the CHCE, will allow the computer to still be on a network if desired. The CHCE may be operated without using the User Ethernet. An Ethernet TCP/IP command protocol is also available.

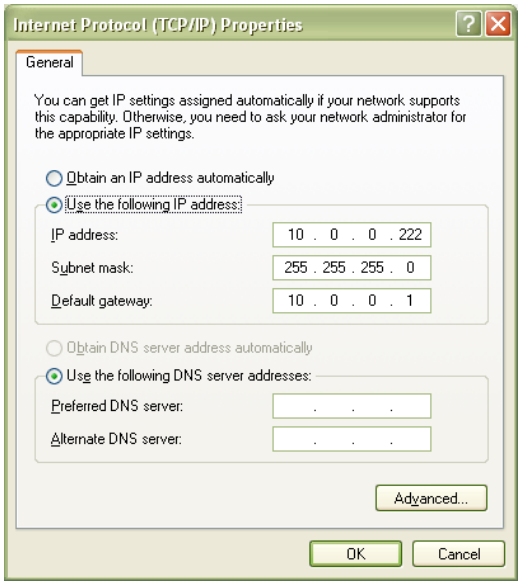
Plug the Ethernet connector from the computer into the "Ethernet" RJ-45 jack and not the optional Ethernet based Field Bus connectors.

3.5.2 User Ethernet Interface Setup

The CHCE User Ethernet has a default fixed IP address of 10.0.0.20 and it is recommended that you use that address unless you need to change it. The process for changing the CHCE IP address to a different IP address is covered in section 3.2.9.

Configure the Ethernet interface of the host computer or laptop Internet Protocol (TCP/IP) properties to have a fixed IP address of 10.0.0.xxx where xxx can be any number between 50 and 230. Example:

IP address:	10.0.0.222
Subnet Mask	255.255.255.0
Default gateway	10.0.0.1



Note a second Ethernet Adapter such as a USB to Ethernet adapter may be necessary or convenient should you want to retain a network connection using the primary port.

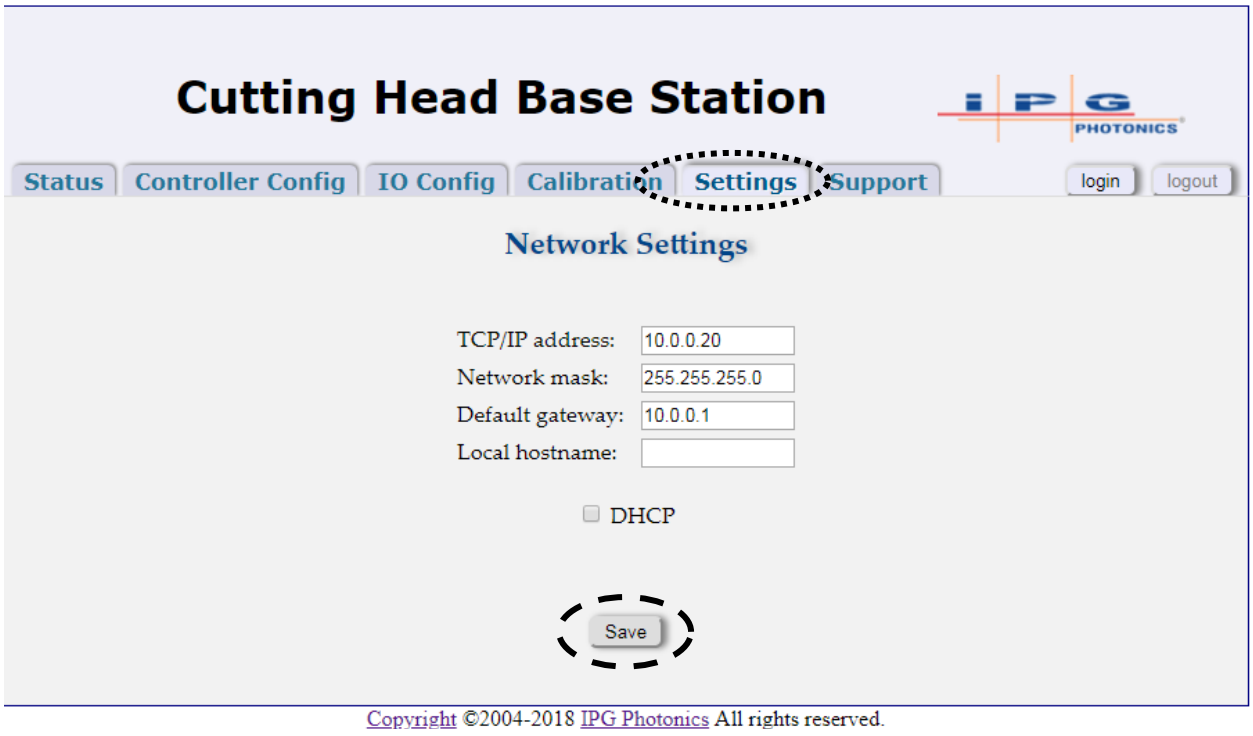
3.5.3 Configuring the CHCE User Ethernet for a different IP Address

It is recommended you stay with the default address 10.0.0.20 unless necessary to change. This section covers modifying the Ethernet address to a user selected value.

When you change the controller IP address of the you must then also change the IP address of the host computer to be in the same range of addresses.

Procedure for changing the EtherNet/IP address on the Cutting Head Controller Electronics.

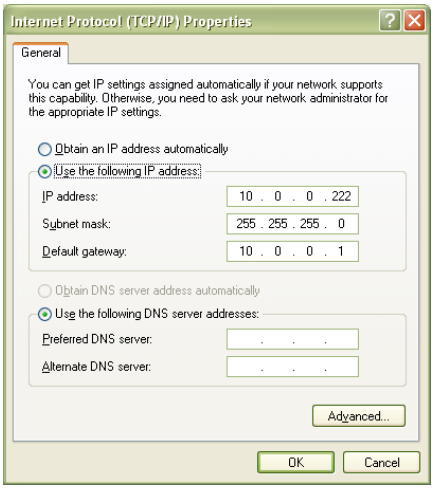
1. Configure PC Ethernet port to communicate with at the Current Ethernet address.
2. Connect Ethernet cable from PC to "User Ethernet" input.
3. Connect Power to controller
4. Open browser (e.g. Internet Explorer or Chrome) web page to http://10.0.0.20 or the current Ethernet Address. The current IP address of the CHCE will be shown on the CHCE display on power up. Enter the current IP address for the CHCE instead of the default 10.0.0.20 if it was previously changed.
5. The WEB server window should open.
6. Select "Settings" tab.

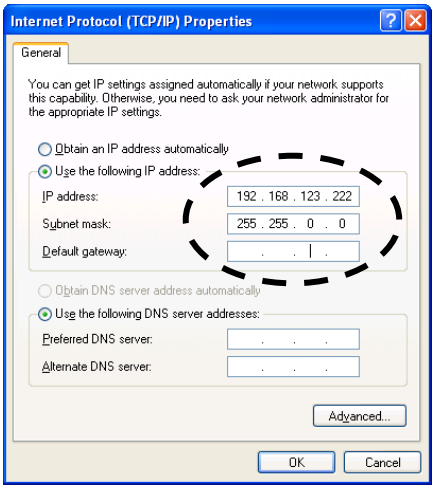


7. Enter new IP parameters, and press the Save button. Set the default gateway to the same as the TCP/IP address with the last digit as 1. A dialog box will open and if ok will say 'New Setting Saved'. Click OK, Exit the Browser. **YOU MUST POWER CYCLE CHCE FOR NEW IP ADDRESS TO TAKE EFFECT.**

Note: Once the IP address of the Controller has been changed via the web interface, you must update the IP address in Internet Explorer to the new address. For example above to see the webpage after making the change you should go to http://196.168.123.89. Should you need to change IP address again you go to the current IP address for the CHCE instead of 10.0.0.20.

8. Be sure to configure the Ethernet interface of the host computer or laptop Internet Protocol (TCP/IP) properties to have a fixed IP address in the range of the newly changed CHCE address:



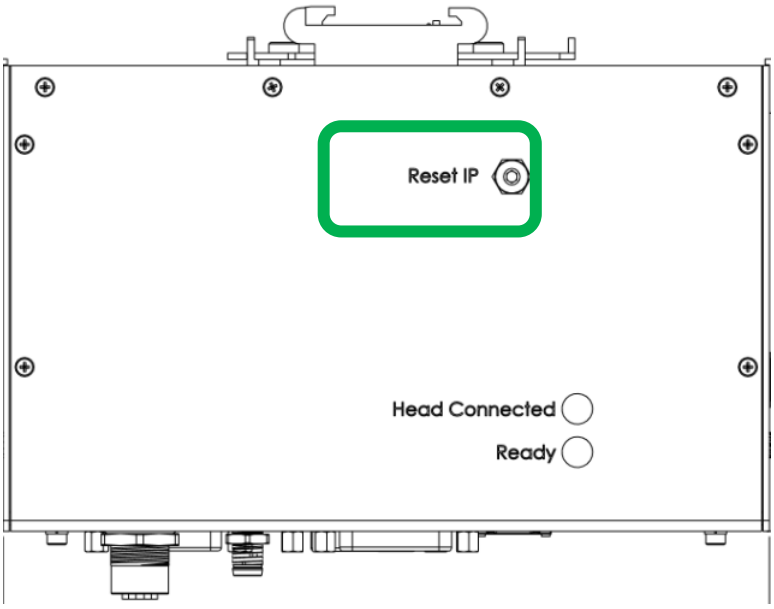


9. Power cycle the CHCE.
10. Open Web browser and enter new IP address to get back to the CHCE web page.

3.6 Resetting the IP Address to Default 10.0.0.20

If you have changed the IP address, but have forgotten what it is set to, you may reset the IP Address to the default 10.0.0.20 using the access port in the base cover (see figure):

- Remove the button head screw from the top cover of the base that is marked IP Reset.
- With power on press and hold the button on the PCB for 10 seconds (use of a small screw driver or plastic or wooden dowel inserted through the tapped hole)
- Power cycle box.
- IP is reset to 10.0.0.20; Make sure the host is in the correct domain to communicate.



3.7 Cutting Head Web Interface

IPG provides a web page with the CHCE available via User Ethernet for CHCE Configuration, Status, and Calibration.

Supported Browsers for Windows:
Internet Explorer 11, Edge; Chrome V.55 and higher; Firefox V. 40 and higher.
Use of unsupported browser versions may show refresh issues or reduced functionality.

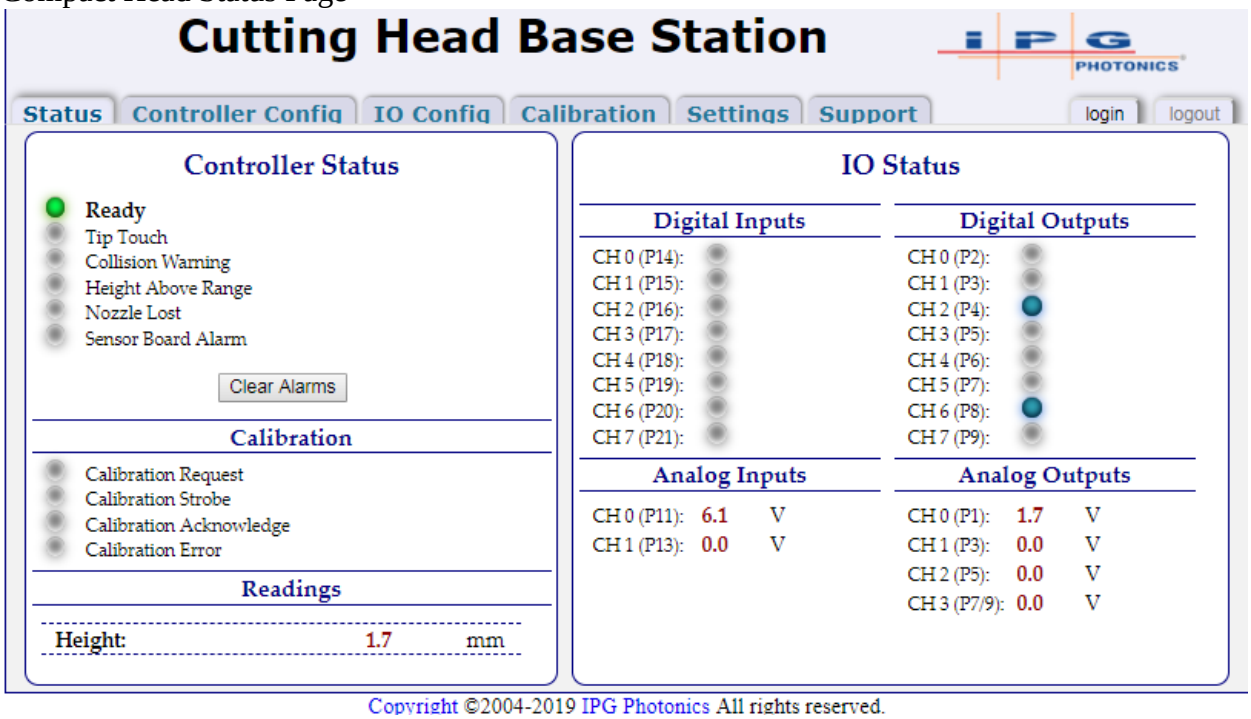
Using a browser such as Internet Explorer or Chrome, the user selects the current IP address of the CHCE. To connect to the web interface:

1. Configure your Ethernet adapter as show in section 3.2.1
2. Start web browser – see supported browsers list.
3. Type **http://10.0.0.20/** into your browser address window

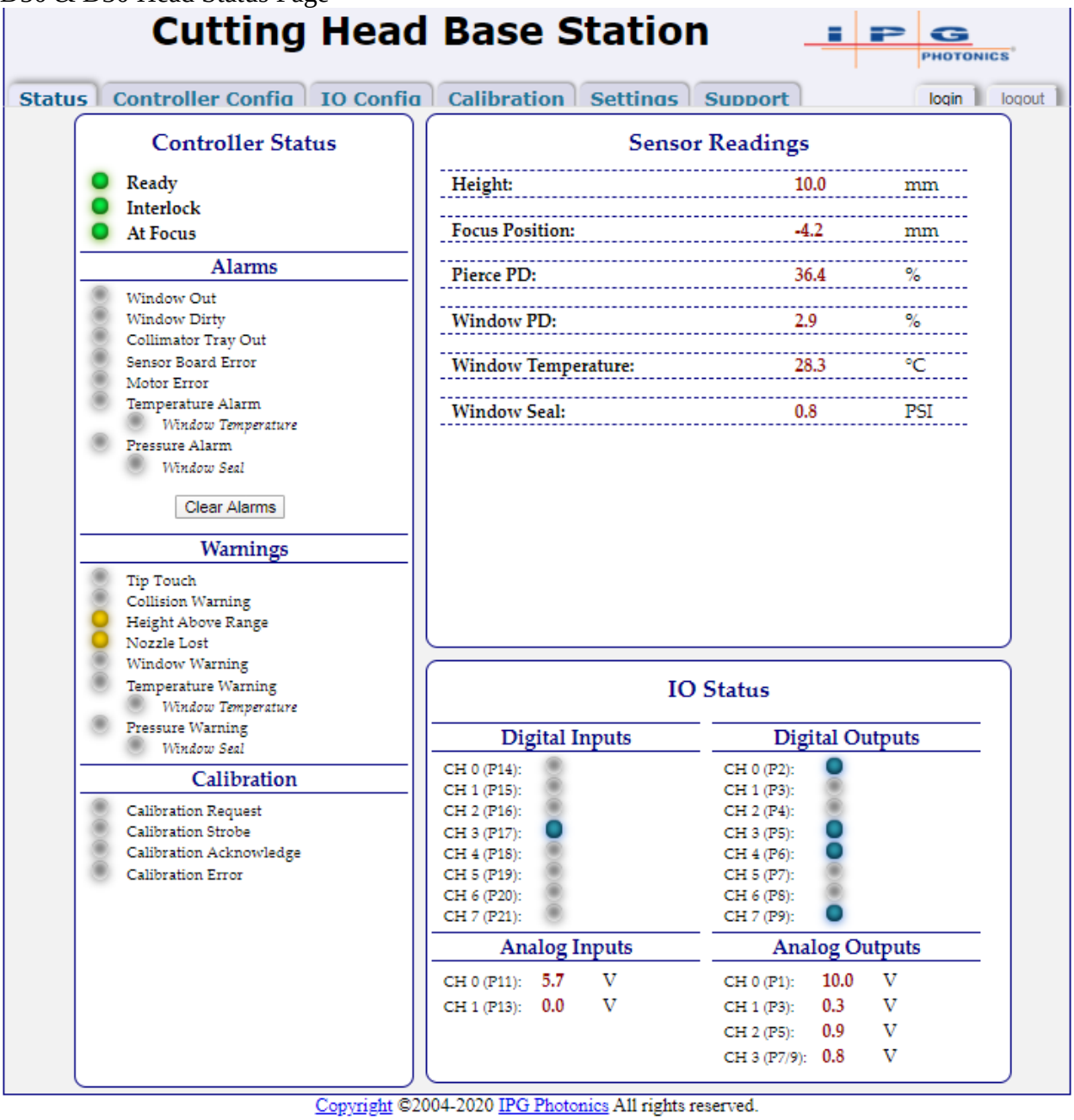
3.7.1 Status Page of Web Interface

The Status page shows Alarms, Warnings, Sensor Readings, and IO status.

Compact Head Status Page



D50 & D30 Head Status Page



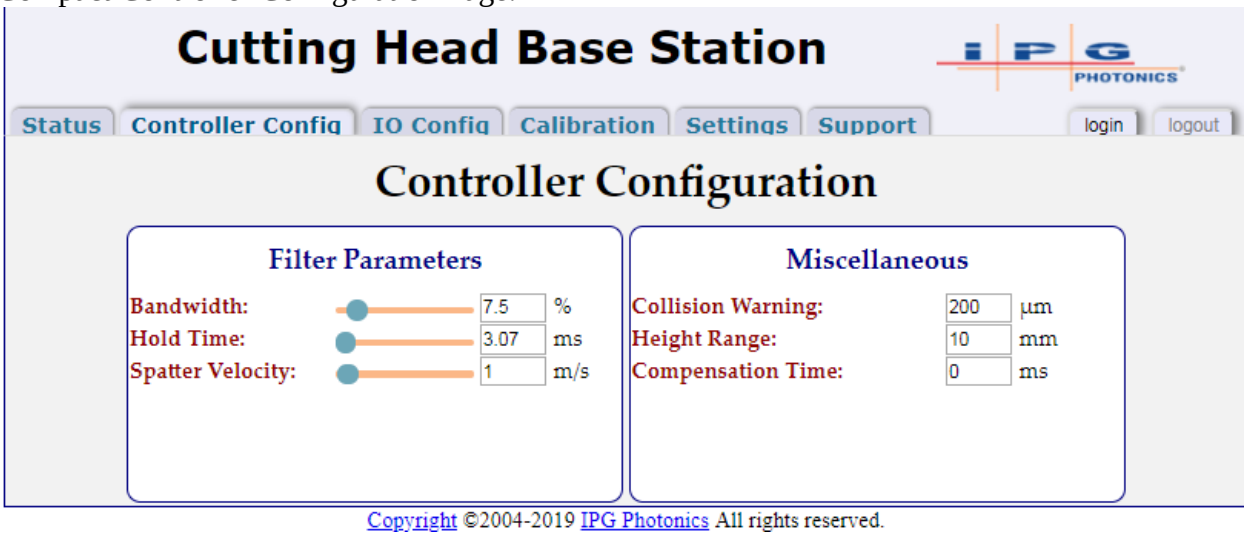
Status items that are illuminated are on or logic 1, Status that are grey are off or logic 0. Ready and Interlock are Green when good and Red when 'not ready' and fiber interlock is open. At Focus is Green when settled and turns yellow when lens is moving.

NOTE: Alarms must be cleared either by pressing web page Clear Alarm, using digital input, or by command. For example, when protective window tray is removed, the Window Out Alarm will remain on after reinstalling window until the Alarm is Cleared. Warnings do not need to be cleared.

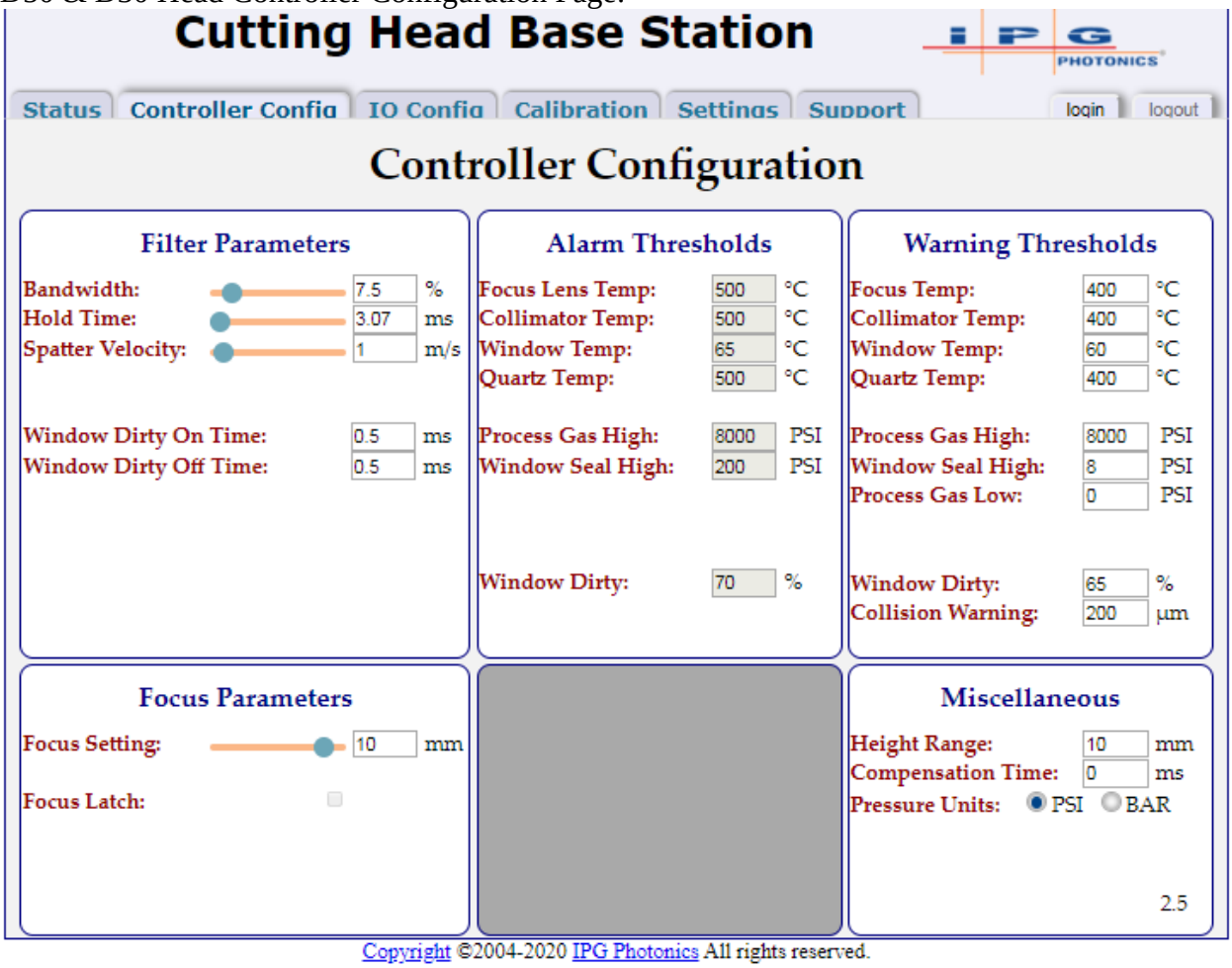
3.7.2 Controller Configuration Page of Web Interface

The Controller Configuration page is used for configuration of various parameters related to head performance and thresholds for warnings or alarms.

Compact Controller Configuration Page:



D50 & D30 Head Controller Configuration Page:

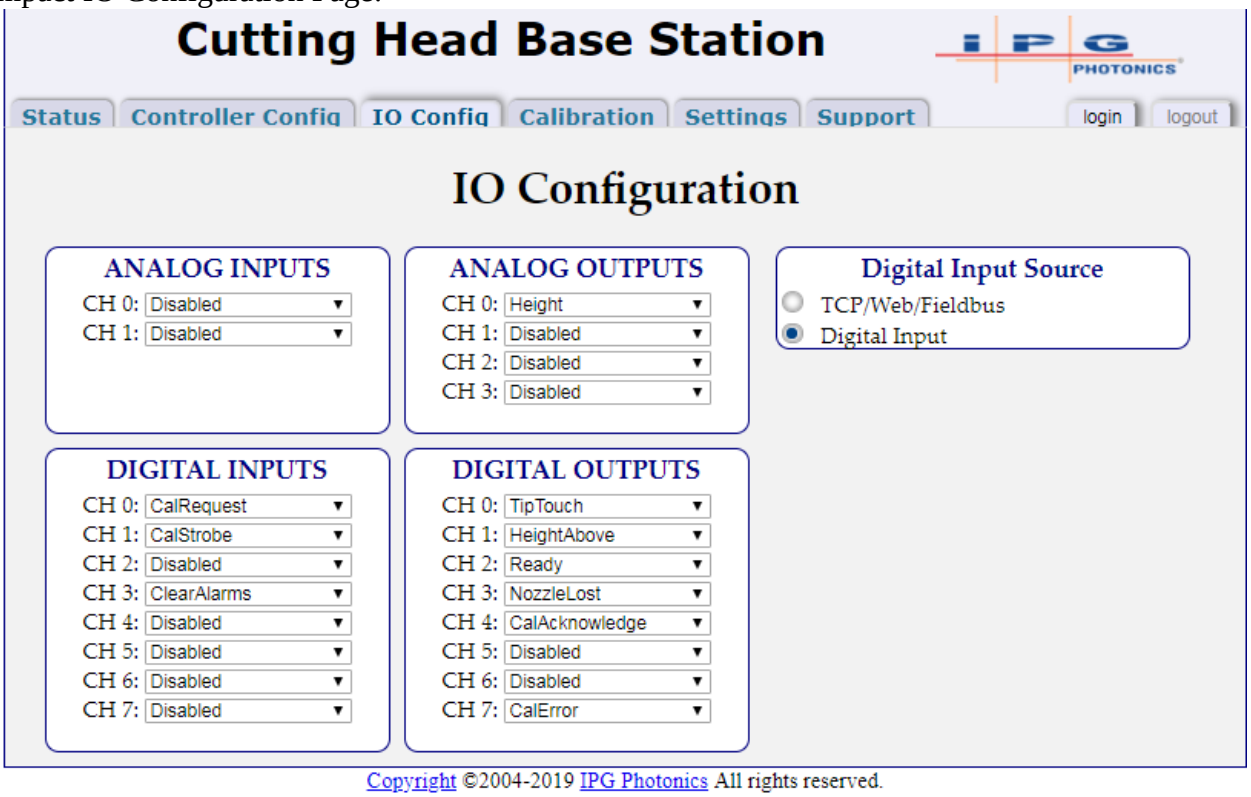


Maximum Height is the desired calibration range. It does not change calibration, it only changes the screen conversion of volts to mm and the prompts for calibration heights.

3.7.3 IO Configuration page of web interface

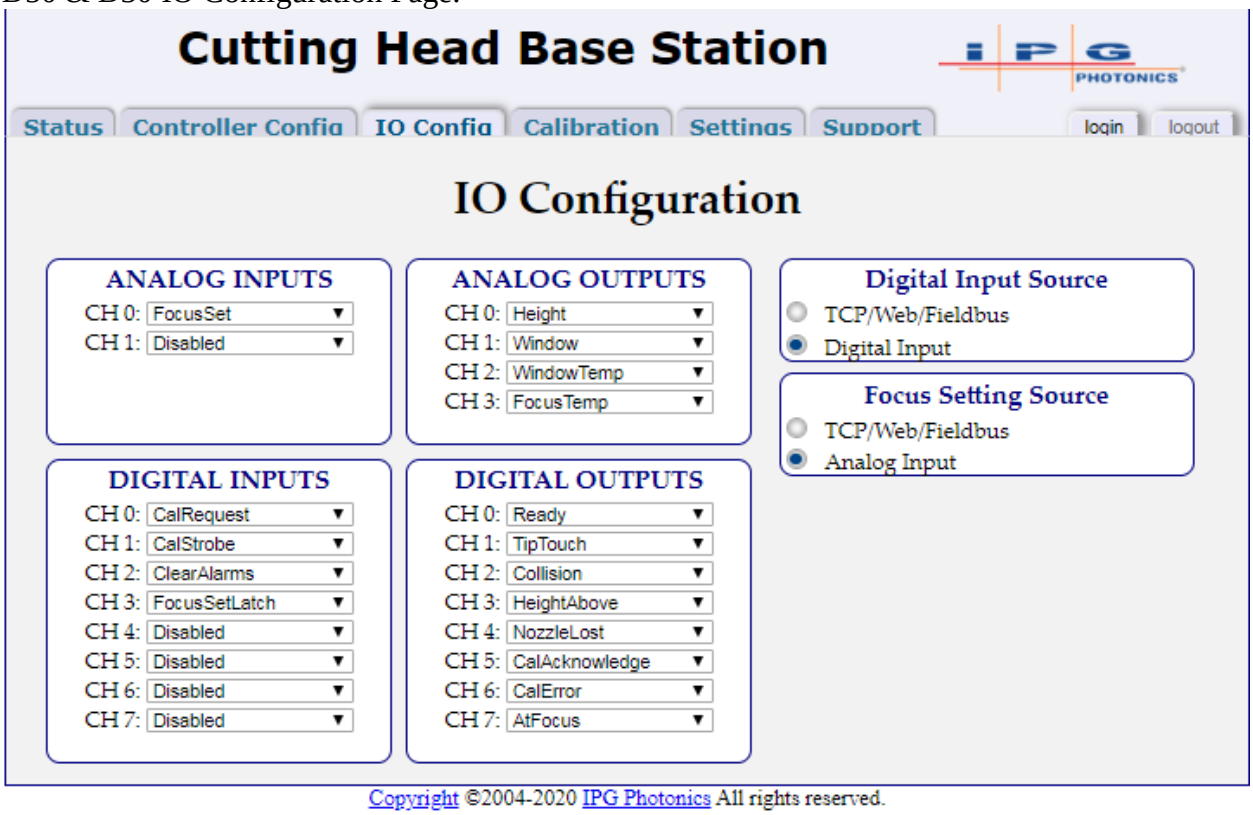
The IO Configuration page is used to assign signals to the analog and digital IO. It is also used to select the source of inputs to be either through web/command or via digital input or analog input.

Compact IO Configuration Page:



Note: When source of input is set to be external hardware (e.g. Digital Input vs TCP/Web/Fieldbus **you will not be able to control those functions on the web page** without switching it to TCP/Web/Fieldbus by example if you want to use the web page calibration. Conversely, be sure to set source to TCP/Web/Fieldbus when you want to use field bus to control Digital inputs.

D50 & D30 IO Configuration Page:



Note: When source of input is set to be external hardware (e.g. Digital Input or Analog input vs TCP/Web/Fieldbus **you will not be able to control those functions on the web page** without switching it to TCP/Web/Fieldbus by example if you want to use the web page calibration, moving focus position on web page. Conversely, be sure to set source to TCP/Web/Fieldbus when you want to use field bus to control Focus or Digital inputs.

Field Bus IP Address and Endianness (Byte Order):

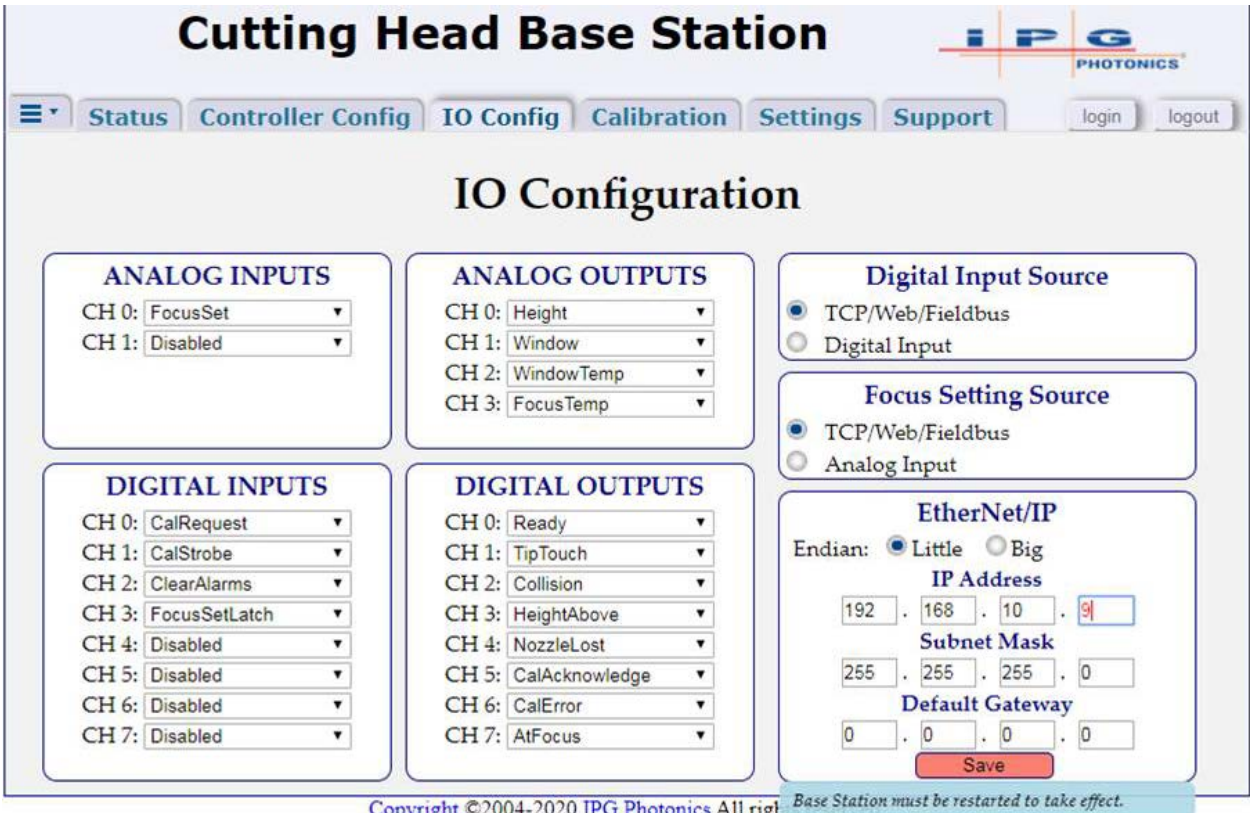
For Field bus models the IO Configuration page includes an additional pane.

IP Address:

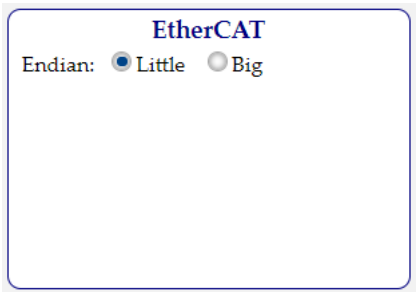
Fixed IP Address for EtherNet/IP and PROFINET are settable on the IO Configuration web page. Default is set to 192.168.10.2. EtherCAT does not have a settable fixed IP addresses. Power cycle after change is required.

Byte Order (Endianness):

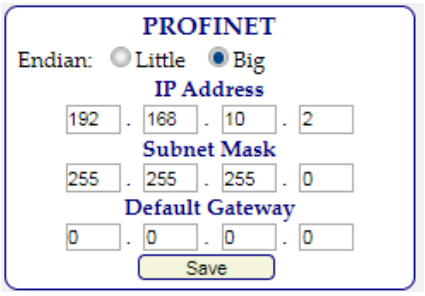
EtherCAT and Ethernet/IP will be set for Little Endian and PROFINET is set for Big Endian. Endianness may be set in the base on the IO Config web page. Power cycle after change is required.



EtherCAT

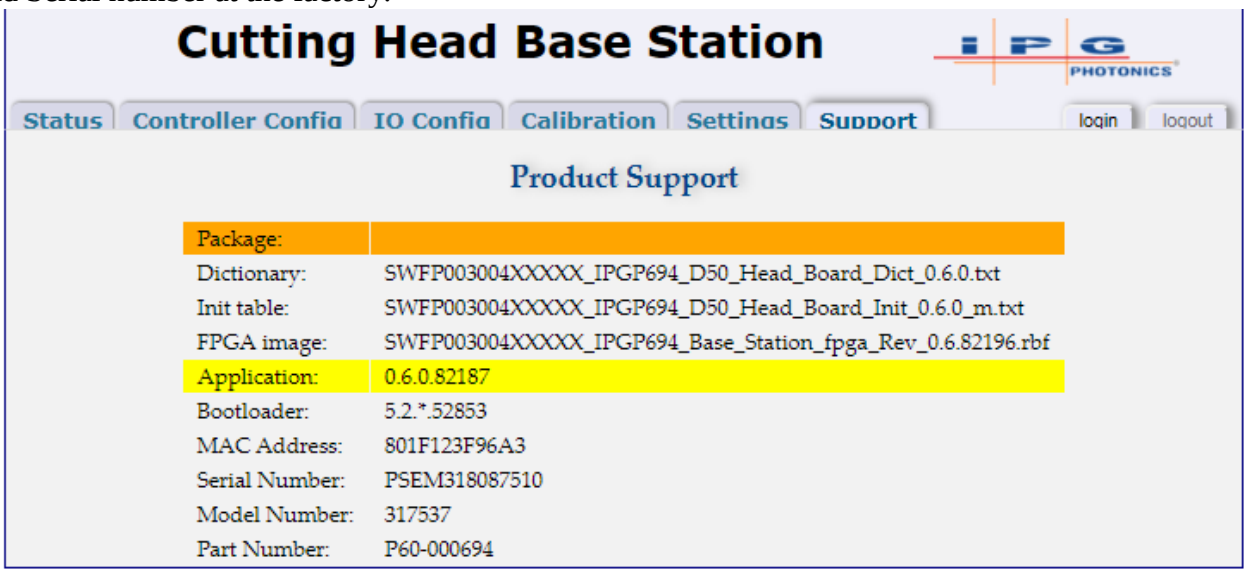


PROFINET



3.7.4 Information Page of Web Interface

The Information Page found under the Settings Menu displays the current software revisions. When contacting IPG for assistance it is recommended to take a screen shot of this page.
The serial number listed should match the Base Station Box. The Model Number is set to the Cutting Head Serial number at the factory.



3.8 Command Interface and Protocol

The controller accepts the operational commands (user commands) through the Command Interface via Ethernet TCP/IP:

Ethernet TCP/IP	
Port	10001
IP Address default	10.0.0.20
IP Address optional	user configurable

3.8.1 Command Format

ASCII Command format	
Syntax	[Cmd Type][Cmd ID][:][Parameters][;]<CR>
Command Type	Two command types supported: 1. SET • Input character: ***** • Description: Sets/modifies a parameter in the controller 2. GET • Input character: **?** • Description: Gets/reads a parameter from the controller
Command ID	The command ID consists of four ASCII characters
Start of parameters	A colon after the command ID marks the start of the parameter portion of the command.
Parameters	0 to N parameters are supported. Parameters are separated by a semicolon ";". A semicolon is required after the last parameter and before the terminator.
Terminator	All commands must be terminated with a carriage return (0x0D)

3.8.2 Optional save

Many of the Set commands have an optional save parameter at the end. The "optional save" parameter is a non-required argument that may be omitted or included. If optional save is set to 1, the input value will be saved in non-volatile memory and preserved after power cycle. If optional save is set to 0 or omitted from command, the changed value will not be preserved after power cycle, however, the changed value will remain until power removed or changed again. Not saving is recommended, due to faster response time of the command.

The response to the Set command will include the optional save value if it was sent in the command. The response will not include the optional save value if it was omitted in the command.

3.8.3 Command Response Format

The controller will send a response to all serial commands that are received.

ASCII Command response format	
Syntax	[Response Type][Cmd ID][:][Parameters/Response code][;]<CR>
Response Type	Two response types are supported, successful command response ($) and unsuccessful command response (#) 1. SUCCESS • Input character: **$** • Description: Command processed and responded successfully 2. FAILURE [1] • Input character: **#** • Description: Command failed
Command ID	The four letter command ID or 'ERR' for command ID error
Start of response code	A colon [:] after the command ID will mark the start of the response code
Response code	Parameters separated by a semicolon or an error code indicating the reason the command failed.
Terminator	All response commands are terminated with a carriage return (0x0D)

3.8.4 Response Codes

The parameter passed back by a # error response is shown below.

ASCII Response Codes	
1	Unknown command
2	Unknown command type
3	Malformed command
4	Command parameter out of range
5	Wrong number of command parameters
6	Operation not supported
7	Operation failed

Tip: Any command response starting with # can be processed to determine the specific reason for command failure. Successful command responses begin with $.

[1] If a command fails the response will begin with '#' instead of '$' and contain a response code. See response code table for more information.

3.8.5 Command Table

ID	TYPE	ARGUMENTS	RETURNS	DESCRIPTION
STAT	GET		[0x########]	Read Controller Status
READ	GET	[id]	[id][val][Header]	Read requested Sensor value
CALM	SET			Clears latched alarms
RANI	GET	[channel]	[channel][voltage]	Read requested analog input channel
RANO	GET	[channel]	[channel][voltage]	Read requested analog output channel
RDIS	GET		[0x#]	Read requested digital input channel
RDOS	GET		[0x##]	Read requested digital output channel
CDIS	SET/GET	[channel][id]<save>	SET:[channel][id]<save> GET:[channel][id][Header]	Configure requested digital input channel
CDOS	SET/GET	[channel][id]<save>	SET:[channel][id]<save> GET:[channel][id][Header]	Configure requested digital output channel
CAIS	SET/GET	[channel][id]<save>	SET:[channel][id]<save> GET:[channel][id][Header]	Configure requested analog input channel
CAOS	SET/GET	[channel][id]<save>	SET:[channel][id]<save> GET:[channel][id][Header]	Configure requested analog output channel
DSEL	SET/GET	[sel]<save>	[set]<save>	Select Digital input source
FSEL	SET/GET	[sel]<save>	[set]<save>	Select Focus Setting source
FOCS	SET/GET	[val]	[val]	Set (software mode) or Get focus setting
FCSL	SET/GET	[val]	[val]	Set/Get Focus Setting latch (software mode)
THRH	SET/GET	[id][val]<save>	SET:[id][val]<save> GET:[id][val][Header]	Configure high warning threshold for sensor (same as THRL if no high threshold)
THRL	SET/GET	[id][val]<save>	SET:[id][val]<save> GET:[id][val][Header]	Configure low warning threshold for sensor (same as THRH if no low threshold)
HRNG	SET/GET	[val]<save>	[val]<save>	Set/Get Height Range setting
CALR	SET/GET	[val]	[val]	Set (software mode) or Get CAL REQUEST
CALS	SET/GET	[val]	[val]	Set (software mode) or Get CAL STROBE
CALT	SET/GET	[val]<save>	[val]<save>	Set/Get calibration type
FBND	SET/GET	[val]<save>	[val]<save>	Set/Get Height filter bandwidth
FHLD	SET/GET	[val]<save>	[val]<save>	Set/Get Height filter hold time
FVEL	SET/GET	[val]<save>	[val]<save>	Set/Get Height filter Spatter velocity
ADDR	GET		[###.###.###.###]	Read Module Address
FBIP	GET		[###.###.###.###]	Read FieldBus Address
RBTV	GET		[BootRev]	Read Bootloader Revision
RFPN	GET		[FirmwarePN]	Read Firmware Part Number
RREV	GET		[FirmwareRev]	Read Firmware Revision

3.8.6 STAT (Status)

The STAT command can be used to obtain the current controller Status. The status returns as an 8-digit hexadecimal number, with each bit representing a specific condition. The mapping of the status is provided in the table below. The bit/hex positions are read from right to left.

SET command:	N/A	**GET command:**	?STAT:;
SET Response:	N/A	**GET Response:**	$STAT:0x########;

The status register is 4-bytes wide. The 1st byte contains warnings. An active warning may indicate something is wrong but the controller is still operational. The 2nd byte contains general status bits. The 3rd byte contains alarms. An active alarm bit indicates an undesirable condition has occurred and the interlock has been opened. The first nibble (4-bits) of the 4th byte provides the active status of the calibration signals. The last 4 bits are extended general status. The status bit mapping is on the next page.

Status Bit Mapping		
Bit	**Status**	**HEX Position**
0	Tip Touch Warning	1 (0x…….#)
1	Collision Warning	
2	Lost Nozzle Warning	
3	Height Above Range Warning	
4	Temperature Warning	2
5	Pressure Warning	
6	Window Dirty Warning	
7	RESERVED	
8-11	RESERVED	3
12	RESERVED	4
13	At Focus	
14	Interlock Closed	
15	Ready	
16	Collimator Tray out Alarm	5
17	Window out Alarm	
18	Temperature Alarm	
19	Pressure Alarm	
20	No Sensor Detected Alarm	6
21	Window Dirty Alarm	
22	Focus Motor Alarm	
23	RESERVED	
24	Calibration Request	7
25	Calibration Strobe	
26	Calibration Acknowledge	
27	Calibration Error	
28	Calibrating	8 (0x#.....)
29-31	RESERVED	

Table 1: Status Bit Mapping

3.8.7 READ (Read Sensor)

The READ command can be used to read the current value of the requested sensor. The sensor is requested via its unique ID defined in the table below. The command will respond back with the given id, requested sensor value, and requested sensor header. The header may be used for validation.

SET command:	N/A	**GET command:**	?READ:[id];
SET Response:	N/A	**GET Response:**	$READ:[id];[value];[header];

Sensor IDs	
ID	**Sensor**
0	Height
1	Pierce Photodetector
2	Window Photodetector
3	Collimator Temperature
4	Focus Lens Temperature
5	Window Temperature
6	Quartz Block Temperature
7	Process Gas Pressure
8	Window Seal(Inside Head) Pressure
15	Focus Position (read)

Table 2: Sensor/Analog Output Source IDs

3.8.8 CALM (Clear Alarms)

The CALM command can be used to reset the alarms on the Controller. The alarms will only clear if the condition that caused the alarm no longer exists.

SET command:	*CALM:;	**GET command:**	N/A
SET Response:	$CALM:;	**GET Response:**	N/A

3.8.9 RANI (Read Analog Input)

The RANI command is used to read the requested analog input channel voltage. The command takes a channel as an argument. The input argument may have values 0 and 1, mapped to the respective analog input channels.

SET command:	N/A	**GET command:**	?RANI:[channel];
SET Response:	N/A	**GET Response:**	$RANI:[voltage];

3.8.10 RANO (Read Analog Output)

The RANI command is used to read the requested analog output channel voltage. The command takes a channel as an argument. The input argument may have values 0-3, mapped to the respective analog output channels.

SET command:	N/A	**GET command:**	?RANO:[channel];
SET Response:	N/A	**GET Response:**	$RANO:`[voltage];`

3.8.11 RDIS (Read Digital Input Status)

The RDIS command is used to read the status of the digital input channels. The return value is a 1-digit hexadecimal number, with each bit position mapped to its respective digital input channel.

SET command:	N/A	**GET command:**	?RDIS:;
SET Response:	N/A	**GET Response:**	$RDIS:`0x#;`

3.8.12 RDOS (Read Digital Output Status)

The RDOS command is used to read the status of the digital output channels. The return value is a 2-digit hexadecimal number, with each bit position mapped to its respective digital input channel.

SET command:	N/A	**GET command:**	?RDOS:;
SET Response:	N/A	**GET Response:**	$RDOS:`0x##;`

3.8.13 CDIS (Configure Digital Input Source)

The CDIS command is used to set or get the source of the requested digital input. The command takes the requested channel, and digital input source id as arguments. Providing the optional <save> argument will preserve the setting after a power cycle. The command returns the requested channel, source id, and if provided, the save acknowledged bit. The GET version of the command also returns the source header. The header may be used for validation. The digital input source ids are provided in the table below.

SET command:	*CDIS:[channel];[id];<save>;	**GET command:**	?CDIS:[channel];
SET Response:	$CDIS:[channel];[id];<save>;	**GET Response:**	$CDIS:[channel];[id];[header];

Digital Input Source IDs	
ID	**Source**
0	Calibration Request
1	Calibration Strobe
2	Reserved
3	Focus Latch
4	Clear Alarms
31	Disabled

Table 3: Digital Input Source IDs

3.8.14 CDOS (Configure Digital Output Source)

The CDOS command is used to set or get the source of the requested digital output. The command takes the requested channel, and digital output source id as arguments. Providing the optional <save> argument will preserve the setting after a power cycle. The command returns the requested channel, source id, and if provided, the save acknowledged bit. The GET version of the command also returns the source header. The header may be used for validation. The digital output source ids are provided in the table below.

SET command:	*CDOS:[channel];[id];<save>;	**GET command:**	?CDOS:[channel];
SET Response:	$CDOS:[channel];[id];<save>;	**GET Response:**	$CDOS:[channel];[id];[header];

Digital Output Source IDs	
ID	**Source**
0	Ready
1	Focus Lens at Position
2	Calibration Acknowledged - Height at Standoff
3	Collision Warning
4	Tip Touch Warning
5	Height Above Range
6	Nozzle Lost
7	Window Out
8	Window Dirty
9	Reserved
10	Collimator Tray Out
11	Interlock Open
12	Temperature Warning
13	Temperature Alarm
14	Pressure Warning
15	Pressure Alarm
16	Calibration Error
31	Disabled

Table 4: Digital Output Source IDs

3.8.15 CAIS (Configure Analog Input Source)

The CAIS command is used to set or get the source of the requested analog input channel. The command takes the requested channel, and analog input source id as arguments. Providing the optional <save> argument will preserve the setting after a power cycle. The command returns the requested channel, source id, and if provided, the save acknowledged bit. The GET version of the command also returns the source header. The header may be used for validation. The analog input source ids are provided in the table below.

SET command:	*CAIS:[channel];[id];<save>;	**GET command:**	?CAIS:[channel];
SET Response:	$CAIS:[channel];[id];<save>;	**GET Response:**	$CAIS:[channel];[id];[header];

Analog Input Source IDs	
ID	**Source**
0	Focus Setting
31	Disabled

Table 5: Analog Input Source IDs

3.8.16 CAOS (Configure Analog Output Source)

The CAOS command is used to set or get the source of the requested analog output channel. The command takes the requested channel, and analog output source id as arguments. Providing the optional <save> argument will preserve the setting after a power cycle. The command returns the requested channel, source id, and if provided, the save acknowledged bit. The GET version of the command also returns the source header. The header may be used for validation. The analog output source ids are the same as the sensor IDs provided at Table 2 above.

SET command:	*CAOS:[channel];[id];<save>;	**GET command:**	?CAOS:[channel];
SET Response:	$CAOS:[channel];[id];<save>;	**GET Response:**	$CAOS:[channel];[id];[header];

3.8.17 DSEL (Digital Input Source Select)

The DSEL command is used to select the source of digital input controls. Selecting source “1” will make the controller ignore digital inputs from the customer interface, and accept inputs from TCP commands, Web Page, and Field Bus. Selecting source “0” will allow controller to accept digital inputs from the customer interface, but ignores other sources.

SET command:	*DSEL:[sel];<save>;	**GET command:**	?DSEL:;
SET Response:	$DSEL:[sel];<save>;	**GET Response:**	$DSEL:[sel];

3.8.18 FSEL (Focus Setting Source Select)

The FSEL command is used to select the source of the focus setting. Selecting source "1" will make the controller ignore the setting from customer analog inputs, and accept the setting from TCP commands, Web Page, and Field Bus. Selecting source "0" will allow controller to accept the analog input for focus setting, but ignores other sources.

SET command:	*FSEL:[sel];<save>;	**GET command:**	?FSEL:;
SET Response:	$FSEL:[sel];<save>;	**GET Response:**	$FSEL:[sel];

3.8.19 FOCS (Focus Setting)

The FOCS command is used to set a new focus setting or get the current focus setting. If the controller is not set to accept focus settings from commands, then the provided setting from the set command will be ignored. The get command will always return the current active focus setting (if in customer interface mode, it will return the focus setting from the analog input). Note that the FOCS command has no save option.

SET command:	*FOCS:[val];	**GET command:**	?FOCS:;
SET Response:	$FOCS:[val];	**GET Response:**	$FOCS:[val];

3.8.20 FCSL (Focus Setting Latch)

The FCSL command is used to set the focus setting latch or get focus setting latch. The setting will be ignored if the controller is not set to accept digital inputs from commands. The get command will return the status of the bit from command sources (tcp, web, Field Bus) at all times. If in customer interface mode, the focus setting latch must be obtained via the RDIS command. Note that the FCSL command has no save option.

SET command:	*FCSL:[val];	**GET command:**	?FCSL:;
SET Response:	$FCSL:[val];	**GET Response:**	$FCSL:[val];

3.8.21 THRH (High Warning Threshold)

The THRH command is used to set a high threshold for the warning bit of the requested sensor, or get the current high threshold for that sensor. The warning bit will activate when the sensor reading exceeds the high threshold. Not all sensors accept a high threshold. In cases where the sensor accepts a low threshold but does not accept a high threshold, this command behaves the same as the THRL command. In cases where the sensor accepts no thresholds, the command responds with error code 7 (Operation failed).

The set command takes a sensor id, threshold value, and optional save as arguments. The get command takes a sensor id as an argument. The response contains the requested sensor id, the threshold value, and for the get command – the sensor header. The header may be used for validation. The sensor IDs may be found in Table 2.

SET command:	*THRH:[id];[val];<save>;	**GET command:**	?THRH:[id];
SET Response:	$THRH:[id];[val];<save>;	**GET Response:**	$THRH:[id];[val];[header];

3.8.22 THRL (Low Warning Threshold)

The THRL command is used to set a low threshold for the warning bit of the requested sensor, or get the current low threshold for that sensor. The warning bit will activate when the sensor reading falls below the low threshold. Not all sensors accept a low threshold. In cases where the sensor accepts a high threshold but does not accept a low threshold, this command behaves the same as the THRH command. In cases where the sensor accepts no thresholds, the command responds with error code 7 (Operation failed).

The set command takes a sensor id, threshold value, and optional save as arguments. The get command takes a sensor id as an argument. The response contains the requested sensor id, the threshold value, and for the get command – the sensor header. The header may be used for validation. The sensor IDs may be found in Table 2.

SET command:	*THRL:[id];[val];<save>;	**GET command:**	?THRL:[id];
SET Response:	$THRL:[id];[val];<save>;	**GET Response:**	$THRL:[id];[val];[header];

3.8.23 HRNG (Height Range Setting)

The HRNG command is used to set the working height range in millimeters. The height range scales the height sensor readings in the sensor to that value (e.g. a 10V analog output from the height sensor will be represented as this value internally in the software). Internal settings that are based in millimeters are also scaled to this setting. NOTE this command does not actually change the physical working height; it is only an internal value scalar for user convenience.

SET command:	*HRNG:[val];<save>;	**GET command:**	?HRNG:;
SET Response:	$HRNG:[val];<save>;	**GET Response:**	$HRNG:[val];

3.8.24 CALR (Calibration Request)

The CALR command is used to set the calibration request bit. The setting will be ignored if the controller is not set to accept digital inputs from commands. The get command will return the status of the bit from command sources (tcp, web, Field Bus) at all times. If in customer interface mode, the state of the calibration request bit may be obtained either from the STAT or RDIS command.

SET command:	*CALR:[val];	**GET command:**	?CALR:;
SET Response:	$CALR:[val];	**GET Response:**	$CALR:[val];

3.8.25 CALS (Calibration Strobe)

The CALS command is used to set the calibration strobe bit. The setting will be ignored if the controller is not set to accept digital inputs from commands. The get command will return the status of the bit from command sources (tcp, web, Field Bus) at all times. If in customer interface mode, the state of the calibration strobe bit may be obtained either from the STAT or RDIS command.

SET command:	*CALR:[val];	**GET command:**	?CALR:;
SET Response:	$CALR:[val];	**GET Response:**	$CALR:[val];

3.8.26 CALT (Calibration Type)

The CALT command is used to set the calibration type to be performed. If an invalid calibration type is provided, the command will respond with error code 4 (Parameter out of range).

SET command:	*CALT:[val];<save>;	**GET command:**	?CALT:;
SET Response:	$CALT:[val];<save>;	**GET Response:**	$CALT:[val];

3.8.27 FBND (Filter Bandwidth)

The FBND command is used to set the bandwidth (in %) of the height filter. A lower bandwidth produces smoother height data. A higher bandwidth produces faster response.

SET command:	*FBND:[val];<save>;	**GET command:**	?FBND:;
SET Response:	$FBND:[val];<save>;	**GET Response:**	$FBND:[val];

3.8.28 FHLD (Filter Hold Time)

The FHLD command is used to set the hold time (in ms) of the height filter. The hold time determines how long the filter should wait before resetting if it cannot recover from a spatter event

SET command:	*FHLD:[val];<save>;	**GET command:**	?FHLD:;
SET Response:	$FHLD:[val];<save>;	**GET Response:**	$FHLD:[val];

3.8.29 FVEL (Filter Spatter Velocity)

The FVEL command is used to set spatter velocity threshold (in m/s) of the height filter. This value is used to determine if the current change in height is caused by a spatter event.

SET command:	*FVEL:[val];<save>;	**GET command:**	?FVEL:;
SET Response:	$FVEL:[val];<save>;	**GET Response:**	$FVEL:[val];

3.8.30 ADDR (Controller IP Address)

The ADDR command can be used to get the current IP address of the controller.

SET command:	N/A	**GET command:**	?ADDR:;
SET Response:	N/A	**GET Response:**	$ADDR:[###.###.###.###]

3.8.31 FBIP (Fieldbus IP Address)

The FBIP command can be used to get the current IP address of the Field Bus Interface (if applicable).

SET command:	N/A	**GET command:**	?FBIP:;
SET Response:	N/A	**GET Response:**	$FBIP:[###.###.###.###]

3.8.32 RBTV (Read Bootloader Version)

The RBTV command can be used to read the installed bootloader version in the controller.

SET command:	N/A	**GET command:**	?RBTV:;
SET Response:	N/A	**GET Response:**	$RBTV:[BootRev]

3.8.33 RFPN (Read Bootloader Version)

The RFPN command can be used to read the installed Firmware part number in the controller.

SET command:	N/A	**GET command:**	?RFPN:;
SET Response:	N/A	**GET Response:**	$RFPN:[FirmwarePN]

3.8.34 RREV (Read Firmware Revision)

The RREV command can be used to read the installed Firmware revision number in the controller.

SET command:	N/A	**GET command:**	?RFPN:;
SET Response:	N/A	**GET Response:**	$RFPN:[FirmwareRev]

3.9 Analog Inputs

There are two analog inputs that may be configured if not in web/command input.

Config Value	Assignment	Description	D50 D30 Head	Compact Head
0	Focus Setting	Setting focus position	Yes	NA
31	Disabled	Analog input is off	Yes	Yes

3.9.1 Focus Setting

Focus positon may be set using the Focus Analog input on heads with motor focus. Analog Focus input is enabled through the web page.

3.10 Analog Outputs

There are 4 analog outputs that may be configured. All are 0 to 10 Volts. Not all heads have all these sensors.

Config Value	Assignment	Description	D50 D30 Head	Compact Head
0	Height	Sensor measured nozzle standoff height or	Yes	Yes
1	Pierce PD	Pierce photo diode output (visible plasma)	Yes	NA
2	Window PD	Photodiode senses IR scatter from window	Yes	NA
3	Reserved	Reserved: Collimator lens temp sensor	NA	NA
4	Reserved	Reserved: Focus lens temp sensor	NA	NA
5	Window Temp	Window thermal sensor	Yes	NA
6	Reserved	Reserved: Quartz block temp sensor	NA	NA
7	Reserved	Reserved: Process gas pressure	NA	NA
8	Window Seal	Window Cavity (Inside Head) pressure	Yes	NA
31	Disabled	Analog output is off	Yes	Yes

3.10.1 Height output

An analog output that is configured for Height is for connection to the customer provided servo controller driving the Z axis stage.

Output level for Height is 0 to 10 Volts corresponding to 0 to 10 mm of height typically or 0 to maximum height range.

3.10.2 Pierce Photo Detector

Analog Output from the Pierce photodetector (if head is equipped with sensor).

3.10.3 Window Photo Detector

Analog Output from the protective Window photodetector. This can be used to evaluate the relative cleanliness of the Window.

3.10.4 Window Temperature

Analog Output from the temperature sensor monitoring the Window. This can be used to evaluate cleanliness of replaceable protective window. Window gets hotter as it gets contaminated and must be replaced if it reaches 65°C.

Scale: 10 volts = 330°C (0.0303 V/°C) e.g. 65°C = 1.97 Volts

3.10.5 Pressure: Window Seal

Analog Output from the Optical Cavity Pressure Sensor which measures if there is a problem with the protective window seal. Check replaceable window tray.
Scale: 10 volts = 25 Bar (363 PSI). 0.4V/Bar or 0.0276 V/PSI

3.11 Digital Inputs

The four digital inputs may be configured to one of these options or through web/command. Digital Inputs are off when in web or command mode.

Config Value	Assignment	Description	D50 D30 Head	Compact Head
0	Cal Request	Used in height calibration sequence	Yes	Yes
1	Cal_Strobe	Used in height calibration sequence	Yes	Yes
2	Reserved		NA	NA
3	Focus Latch	Holds focus at position set on rising edge	Yes	NA
4	Clear Alarms	Rising edge will clear an alarm	Yes	NA
31	Disabled	Digital input is off	Yes	Yes

3.11.1 Cal Request

See calibration section, this starts the calibration sequence and is held high during calibration.

3.11.2 Cal Strobe

See calibration section, this is used to indicate that the head is in correct position to calibrate the next point.

3.11.3 Latch Focus set

This input high will hold the current focus position as set on the Analog input. When low, the Analog input will change the focus setting. Can be used to hold the current focus position in a noisy environment when electrical noise might move focus lens. Motor Focus heads only.

3.11.4 Clear alarms

Clears an alarm condition. Alarms are latched until cleared or by a power cycle. Alarm is only cleared though only if fault condition no longer present.

3.12 Digital Outputs

There are eight configurable digital logic outputs. The output logic level is set by the customer (5 to 24 V). Voltage must be put on connector to enable Digital I/O Outputs require a (2-6kΩ typical) resistor load to Customer Return. Each output may be assigned to a status bit. The bits may be changed through web page or command.

3.12.1 Digital Output Configuration Options

Config Value	Assignment	Description	D50 D30 Head	Compact Head
0	Ready	Head is ready to use (no critical alarms)	Yes	Yes
1	Lens at Focus	Motor focus has reached setting	Yes	NA
2	Cal Ack	Used in calibration sequence.	Yes	Yes
3	Collision Warning	Warning head height is at threshold	Yes	Yes
4	Tip Touch	Head height is touching metal	Yes	Yes
5	Height Above Range	Head height is out of calibrated range	Yes	Yes
6	Nozzle Lost	Nozzle is missing or at high height	Yes	Yes
7	Window In	Protective window is in place	Yes	NA
8	Window Dirty	Protective window is dirty	Yes	NA
9	Reserved		NA	NA
10	Colli Tray In	Protective collimator tray in place	Yes	NA
11	Interlock	Fiber interlock has been opened	Yes	NA
12	Temperature Warn	Temperature above user set threshold	Yes	NA
13	Temperature Alarm	Temperature above maximum	Yes	NA
14	Pressure Warn	Pressure above user set threshold	Yes	NA
15	Pressure Alarm	Pressure above maximum factory set	Yes	NA
16	Cal Error	Problem in calibration process	Yes	Yes
31	Disabled	Digital output is off	Yes	Yes

3.12.2 Ready

Ready will be on (high) when the height sensor is operational and not in a calibration mode. Ready goes off whenever there are any Alarms that indicate the head should not be used such as Window Not Present, Focus Error, Colli Tray is out. Ready is off during Calibration and returned to on at completion of calibration sequence. Ready goes off for damage level Window Dirty, Pressure, and Temperature Alarm conditions but not customer configured warning levels.

It is recommended at a minimum a customer implements the Ready bit into their controller to prevent cutting whenever Ready is not high.

Ready goes off when any of these conditions exist :

- During Calibration sequence
- Window Dirty Alarm
- Collimator Tray out Alarm
- Window out Alarm
- Temperature alarm
- Pressure Alarm
- Motor Focus error
- No height sensor detected

Alarms must be cleared after situation is corrected. Alarms are cleared either by pressing web page Clear Alarm, using digital input, or by command. For example, when protective window tray is removed, the Window Out Alarm will remain on after reinstalling window until the Alarm is Cleared. Warnings do not need to be cleared. Calibration alarm will clear automatically with next calibration attempt.

3.12.3 Lens at Focus

Lens at Focus will be on (high) when the head has arrived at the commanded focus position (motorized focus heads only). It is low when focus is moving. Not valid for manual focus heads.

3.12.4 Cal_Ack

Cal_Ack (Calibration Acknowledge) is used during the calibration sequence as a handshake after a Cal_Strobe.

3.12.5 Collision Warning

Warning indicates that the Sensor Standoff height is less than a user specified height (default is 0.2mm) for a user specified time "Collision Delay" (default 10ms). Typically used as a warning prior to tip touch to prevent actual collision with metal. Collision Warning may also be used as a 'tip touch' if cutting a material with a non-conductive surface such as a plastic coating. Increasing Collision Delay can be used to help prevent spatter from triggering false Collision Warnings. Collision Warning may be set on web page or by command.

3.12.6 Tip Touch Warning

Sensor indicates nozzle is touching a conductive surface. (Standoff = 0mm).

3.12.7 Height Above Range Warning

Height is greater than maximum output value voltage and will remain indicating 10 mm (or 20mm if range is calibrated that way) above this height. Alarm may be used on way down to indicate that the sensor is now in its active range when moving the head downward

3.12.8 Nozzle Lost Warning

Alarm is active when the nozzle has unscrewed and fallen off. It may come on at heights >50mm. Discontinue cutting operation if expected height is in <<30mm and the Lost Nozzle Alarm is indicated.

3.12.9 Window Out Alarm

WARNING: 

Alarm is reported when the Protective Window glass is not fully installed in the cutting head. You could damage the head by operation in this condition. This alarm turns Ready off. Never operate the cutting head with the Window Not Present Alarm active.

3.12.10 Window Dirty Alarms:

Window Dirty occurs when the scattered light from the protective window glass exceeds one of two thresholds.

Customer settable: This Window Dirty level is a user calibrated threshold that may be adjusted and/or turned on or off by customer. Ready is left on for the customer configurable level. Refer to the window dirty calibration section for more details.

Damage Level: The higher level threshold for Window Dirty is always on and is set at a high level indicating a very dirty or cracked window that may cause damage to head with continued use. Ready is removed in the high level case**. Do not operate the head when Ready is off.** Damage Level Window Dirty alarm is latched and will go off after the window is removed and replaced.

3.12.11 Collimator Tray Out Alarm **WARNING:** 

Alarm is reported when the Collimator tray is not fully installed in the cutting head. You could damage the head by operation in this condition. This alarm turns Ready off. Never operate the cutting head with the Collimator Tray Out Alarm active.

3.12.12 Interlock Open

This bit indicates that the controller has opened the fiber interlock connection which should shut off the laser. Similar Conditions to Ready going off (except Ready goes off during calibration and interlock does not open)

Fiber Interlock to laser opens up when these conditions exist:

- Window Dirty Alarm
- Collimator Tray out Alarm
- Window out Alarm
- Temperature alarm
- Pressure Alarm
- Motor Focus error
- No height sensor detected

3.12.13 Temperature Warning

One of the temperature sensors has exceeded the user defined threshold.

3.12.14 Temperature Alarm:

One of the temperature sensors has exceeded the factory defined maximum temperature threshold.

Do not continue to operate the cutting head in this condition. This alarm turns Ready off.

3.12.15 Pressure Warning

One of the Pressure sensors has exceeded the user defined threshold.

3.12.16 Pressure Alarm:

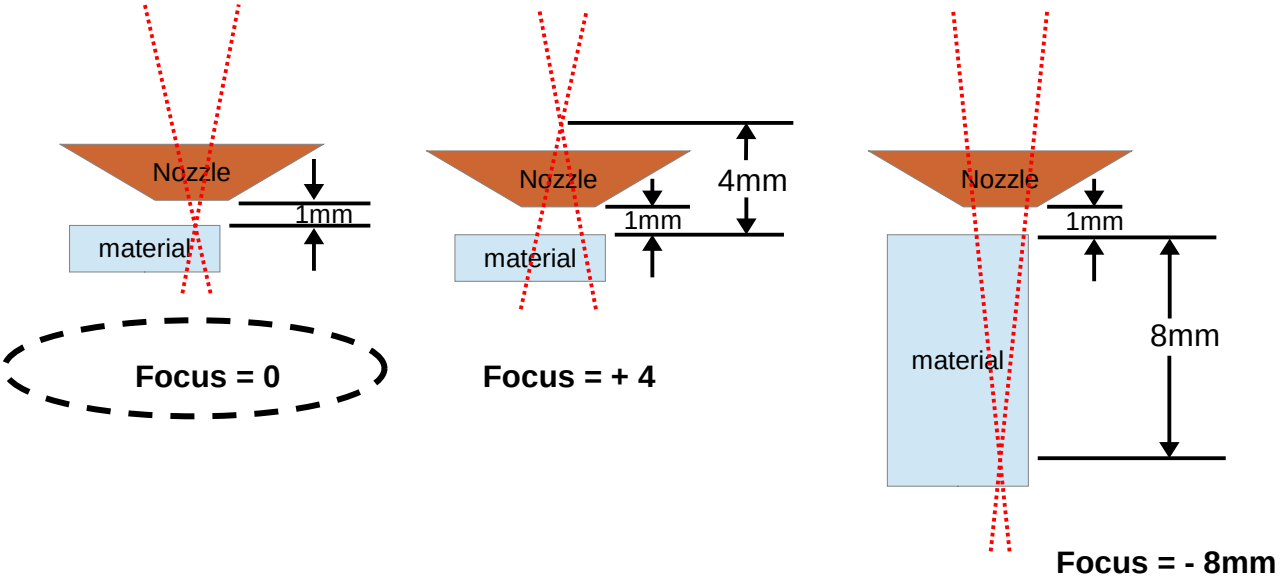
One of the Pressure sensors has exceeded the factory defined maximum temperature threshold. Do not continue to operate the cutting head in this condition. This alarm turns Ready off. Window Seal pressure indicates issue on seal of protective window tray. Be sure window is inserted properly.

3.12.17 Calibration Alarm:

Calibration Error occurs when an issue prevents completion of a Calibration sequence. For example during 16 point calibration the alarm occurs if the values are not increasing in height or if only 15 points are completed. Refer to Calibration Section for details.

3.13 Focus Motion

Motorized Focus settings and status are provided only for cutting heads with motor controlled focus and not manual focus cutting Heads. Focus position may be changed to any legitimate location by Analog input or Ethernet. **Valid Focus Positions vary with head configuration.** Refer to the diagram below. Focus of 0 is 1 mm below the nozzle. Positive focus is up towards nozzle. Negative focus is down into the material.



3.13.1 Focus Change using command

The Focus setting may be changed by web page or by command if the analog input is off.

3.13.2 Focus Change using Analog Input:

The focus positon may be set using the Analog Input instead of web/command.
0 to 10 volts represent the maximum range of your head, for examples +10 to -20mm or +15 to -30mm focus range. The focus position may be latched by using the digital input "Focus Latch". On the rising edge of Focus latch the value will be held until the next rising edge.

For a head that is **-30 to +15** capable. The analog input is 10V/45mm or 222mV per mm. 0 mm of focus is at 6.66 volts. Voltage may be calculated by **$V = 0.222 * (F_{Desired} + 30)$** where $F_{Desired}$ is the desired Focus Position in mm. Examples by mm are in the table below.

Focus (mm)	**-30**	-29	-28	-27	-26	**-25**	-24	-23	-22	-21	**-20**	-19	-18	-17	-16	**-15**
Volts	**0.0**	0.22	0.44	0.67	0.89	**1.11**	1.33	1.55	1.78	2.0	**2.22**	2.44	2.66	2.89	3.11	3.33

Focus (mm)	-14	-13	-12	-11	**-10**	-9	-8	-7	-6	**-5**	-4	-3	-2	-1	**0**
Volts	3.55	3.77	4.00	4.22	**4.44**	4.66	4.88	5.11	5.33	**5.55**	5.77	5.99	6.22	6.44	**6.66**

Focus mm)	1	2	3	4	**5**	6	7	8	9	**10**	11	12	13	14	**+15**
Volts	6.88	7.10	7.33	7.55	**7.77**	7.99	8.21	8.44	8.66	**8.88**	9.10	9.32	9.55	9.77	**10.0**

For a head that is **-20 to +10** capable, the analog voltage is 10V/30mm/10V or 333mV/mm. 0 mm is at 6.66 volts. Voltage may be calculated by **$V = 0.333 * (F_{Desired} + 20)$** where $F_{Desired}$ is the desired Focus Position in mm. Examples by mm are in the table below.

Focus (mm)	**-20**	-19	-18	-17	-16	**-15**	-14	-13	-12	-11	**-10**	-9	-8	-7	-6	**-5**
Volts	0.0	0.33	0.67	1.0	1.33	1.67	2.0	2.33	2.66	3.0	3.33	3.66	4.0	4.33	4.66	5.0

Focus (mm)	**-5**	-4	-3	-2	-1	**0**	1	2	3	4	**5**	6	7	8	9	**10**
Volts	5.0	5.33	5.66	5.99	6.33	6.66	7.0	7.33	7.66	8.0	8.33	8.66	9.0	9.32	9.66	10

3.13.3 Focus Alarm:

The Focus Alarm (only meaningful on heads equipped for motor controlled focus) indicates a problem in positioning the focus motion assembly. Contact customer service for repair of cutting head.

3.13.4 Lens at Focus

Lens at Focus is a status bit available as status or digital output when the lens has reached the commanded position. It is active when the focus has reached the commanded position and low when it is moving to the position.

3.13.5 LEDs on HEAD

The LEDs on the HP Cutting head show the status of the focus.
Green- focus is at commanded position
Yellow- focus is in motion
Red- focus is in alarm condition

In addition the positon of the focus lens is shown by the position of the top LED window. Note that due to the optics relationship, the collimator lens moves up when the focus position is pointed down and vice versa.

3.14 Pierce Monitor (Pierce Detect Heads Only)

Analog output of pierce detector may be monitored. The pierce monitor looks at the visible light seen by the head and can be used in process monitoring or pierce detection. Auto detection of pierce is not available at this time.

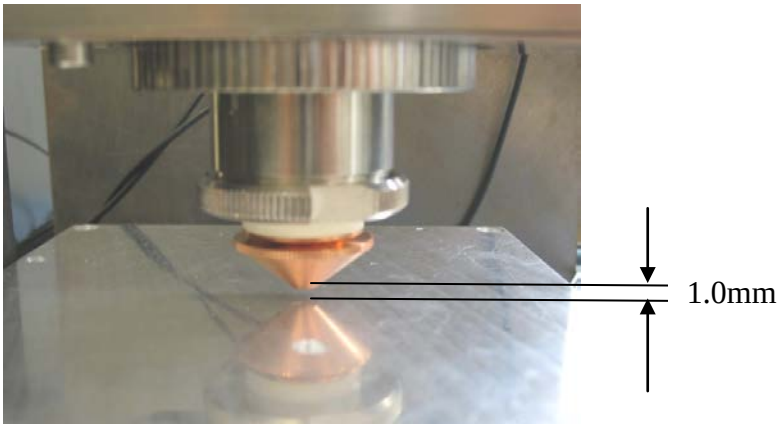
4 Calibration

4.1 Description of Calibration Modes

The cutting head measures height by the capacitance change which varies with standoff distance. Calibration of the cutting head correlates the measured capacitance value to standoff height. Changes to tip from wear, a new tip type, or sheet edge effects are examples of reasons to recalibrate. Calibration of the cutting head is critical to correct performance. There are several optional methods to perform these calibrations –using Digital I/O lines (most common implementation), or by Ethernet using the Web page or commands. The user may select to calibrate the head height range from 0 to 10mm or 0 to 20mm or 0 to Max Range.

Calibration Modes
Single (1) Point Calibration
Two (2) Point Calibration
16 Point Calibration

The preferred calibration is 16 point. It is not necessary to perform 1 and 2 point, they are only provided for rapid setup.



A sixteen point calibration allows for a new calibration curve to be generated. This may provide more linear results than a default curve particularly for different nozzle types. With a sixteen point calibration, most of the points are around the typical standoff range of 0.5 to 3mm with additional points up to 10mm. The user initiates calibration and then steps through 16 points. If automated this entire calibration may be accomplished in seconds.

If there is a problem during calibration, then a Calibration Error Alarm is indicated. Calibration Error is cleared by simply initiating another calibration through digital IO or clearing the alarm on the web interface. The head will not perform a one point calibration during Tip Touch.

A Two Point calibration will set the height properly at 10 and 1 mm. This works fine for many applications and is easier and takes less time than a 16 point calibration. It may be performed via Ethernet or through Digital I/O.

Calibration Tips:

- Allow the head to reach stable operating temperature prior to calibration (>10 minutes recommended).
- Calibration is performed with the cutting head above a flat piece of metal (minimum size 100 x 100 mm) grounded to earth in the same fashion as the metal to be cut.
- Precise height setting can be done by manually adjusting height and measurement with gauge between nozzle and flat piece of metal or moving the head down gently until touch and moving the head back up mm using the stage.
- After a calibration, the values are stored in non-volatile memory and will be retained through power cycle.
- Tip Touch will only alert on conductive material. If cutting material with a nonconductive surface, you can use Collision Alarm calibration to set a threshold that will alert at or above the thickness of the non-conductive coating instead.
- Calibration Error is cleared by simply initiating another calibration through digital IO or web page.
- Use handshake sequence specified to have correct timing.

4.2 Calibration Range

The calibration range is normally 0-10mm of height. Some customers have preferred a larger range and may set the calibration range to 0-20mm for example. In this case, the height used for calibrations are all scaled as the reader will see in the height calibration tables. Calibration range is set on the Config Page. After changing the range perform calibrations. The heights used should be percentage of maximum range.

4.3 Web Page Single Point Calibration

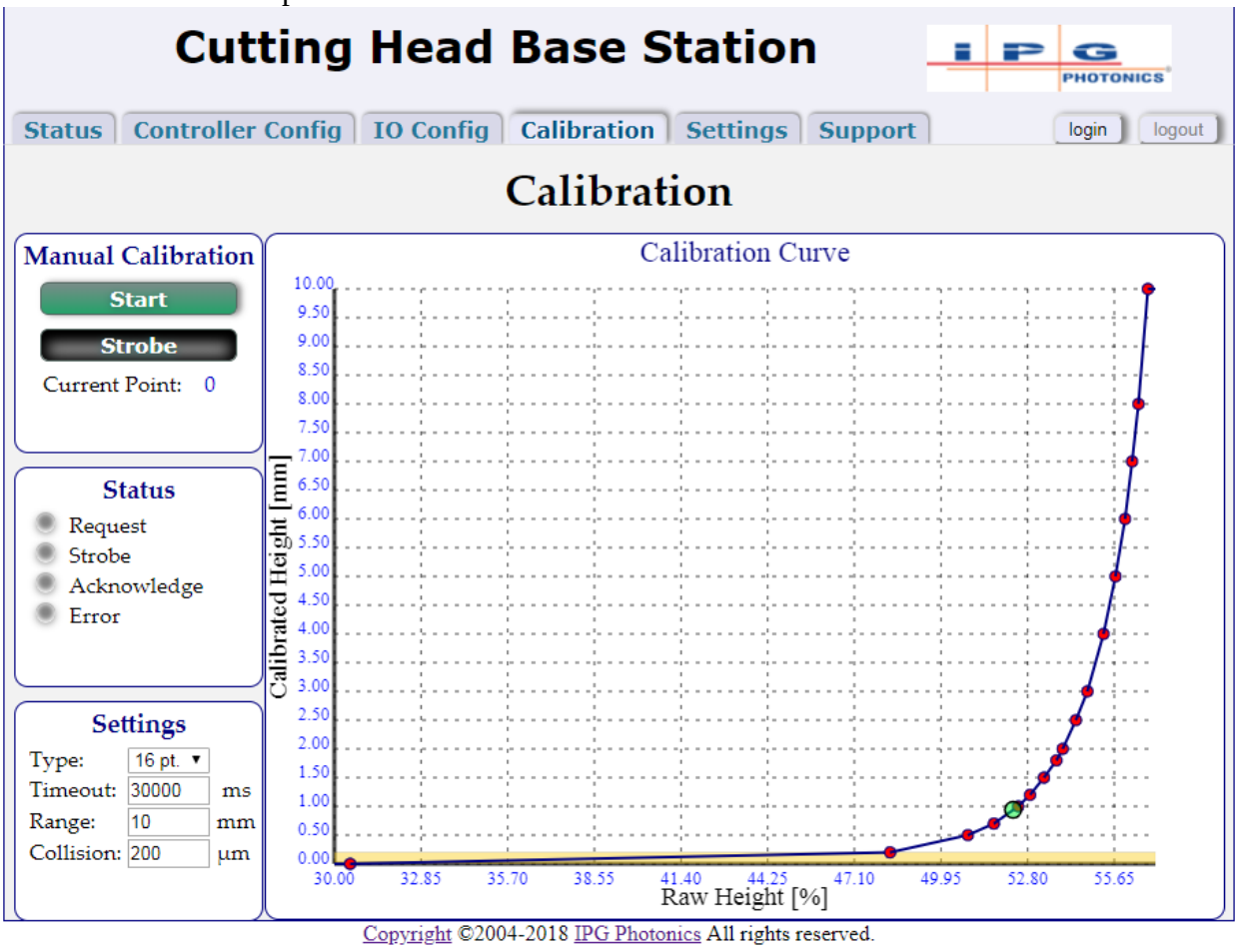
The one point calibration will calibrate the head at maximum range (10 mm typical) then modify the curve. This is a quick method. 16 point calibration is recommended for best linearity.

Reference Point #	1	Range
Distance (mm)	10	0-10mm
	20	0-20mm
	Max Range	0 to MR

Procedure:

Connect to the Cutting Head Web Interface via the User Ethernet Port as described in Chapter 3.
From the "**Calibration**" use the pull down "**Type**" menu in the Settings section to choose 1 Point Calibration.

Press "**Start**" calibration button
Position head to the first Reference Point (Typical Distance = 10 mm) allowing for settling time. This point is the max range positon.
Press "**Strobe**" button under Manual Calibration
The head will complete calibration.



4.4 Web Page Two Point Calibration

The two point calibration will calibrate the head at maximum range (10 mm typical) and 10% max range (1mm typical) then modify the curve. This is a quick method. 16 point calibration is recommended for best linearity.

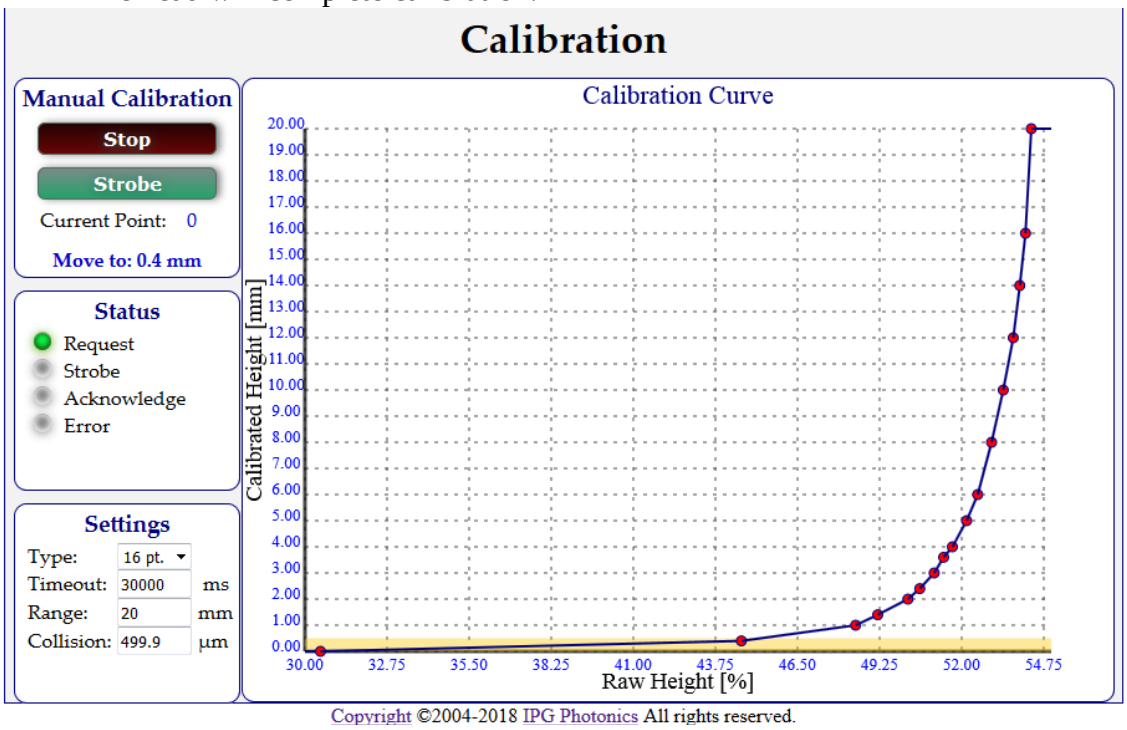
Reference Point #	1	2	Range
Distance (mm)	10	1.0	0-10mm
	20	2.0	0-20mm
	Max Range	10% MR	0 to MR

Procedure:

Connect to the Cutting Head Web Interface via the User Ethernet Port as described in Chapter 3.
From the "**Calibration**" use the pull down "**Type**" menu in the Settings section to choose 2 Point Calibration.

Press "**Start**" calibration button
Position head to the first Reference Point (Typical Distance = 10 mm) allowing for settling time.
This point is the max range positon.
Press "**Strobe**" button under Manual Calibration

Move to the second Reference Point 10% Max Range (Typical Distance = 1mm) allowing for settling time.
Click the "**Strobe**" button.
The head will complete calibration.



4.5 Web Page 16 Point Calibration

Use the points below for 16 point calibration. If doing a maximum range other than 10 or 20mm calculate the heights by percentage of maximum range.

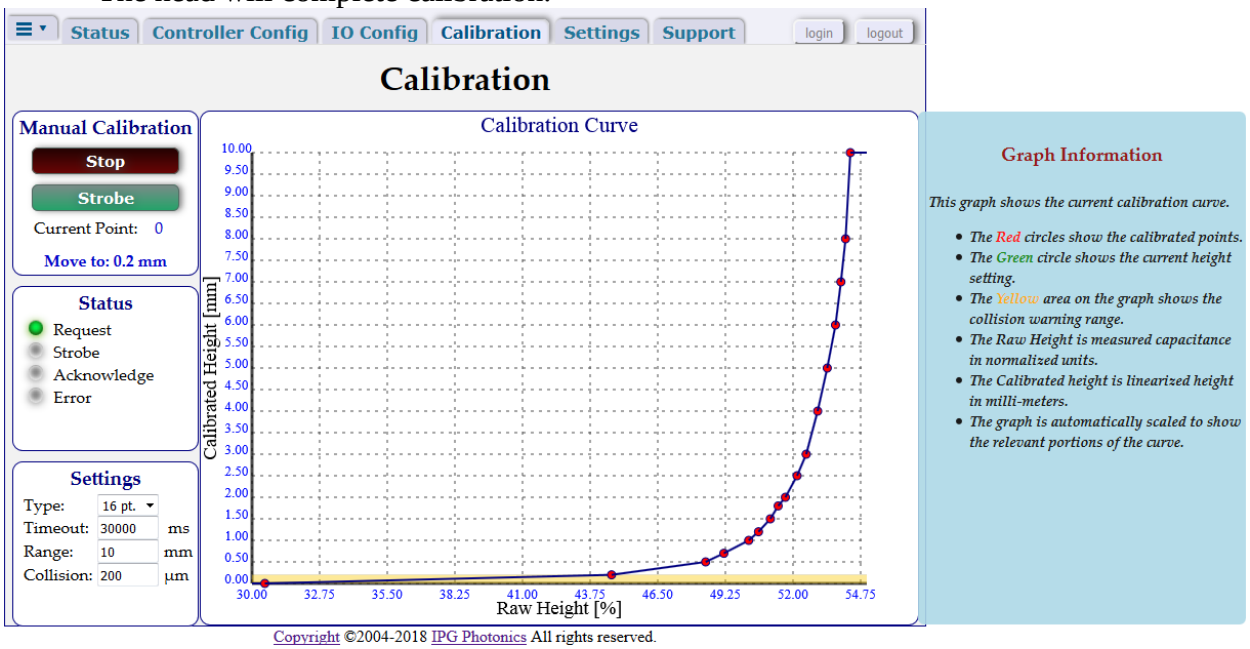
Reference Point #	Range	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Distance (mm)	0-10mm	0.2	0.5	0.7	1.0	1.2	1.5	1.8	2.0	2.5	3	4	5	6	7	8	10
	0-20mm	0.4	0.8	1.4	2.0	2.4	3.0	3.6	4	5	6	8	10	12	14	16	20
	0 to MR	2%	5%	7%	10%	12%	15%	18%	20%	25%	30%	40%	50%	60%	70%	80%	100%

Procedure:

Connect to the Cutting Head Web Interface via the User Ethernet Port as described in Chapter 3. From the "**Calibration**" use the pull down "**Type**" menu in the Settings section to choose 16 Point Calibration.

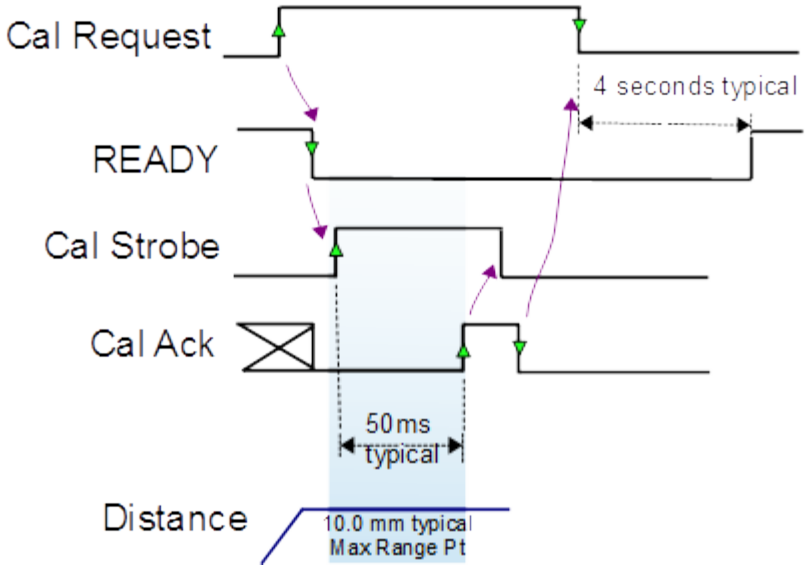
Press "**Start**" calibration button
Position head to the first Reference Point (Typical Distance = 0.2mm) allowing for settling time. This point is the 2% of max range position. Press "**Strobe**" button under Manual Calibration

Move to the second Reference Point (Typical Distance = 0.5 mm) allowing for settling time.
Click the "**Strobe**" button.
Repeat until all points are collected. Hit Stop to abort.
The head will complete calibration.



4.6 Digital I/O or Command Single Point Calibration

[Max Range Calibration]
Same sequence can be initiated through digital IO hardware or Ethernet commands.



Reference Point #	1	Range
Distance (mm)	10	0-10mm
	20	0-20mm
	Max Range	0 to MR

Procedure:

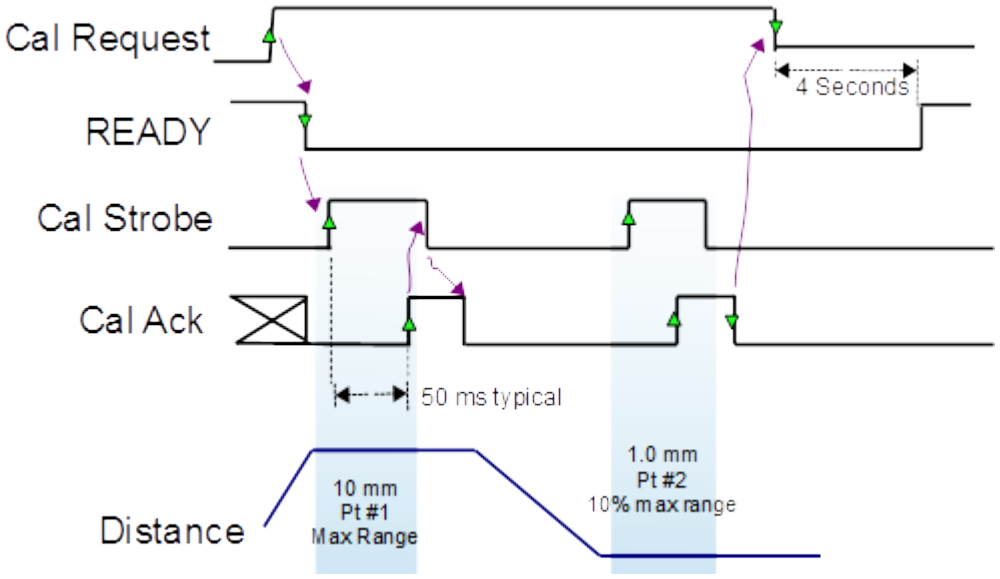
Set Calibration Type to 1 Point if not previously done.
Assert Cal Request High ↑
Wait for Ready to be set Low↓

Position head to Reference Point (Distance = 10 mm) allowing for settling time.
Assert Cal Strobe High↑
Wait for Cal Ack to be set High↑
Set Cal Strobe Low↓

Wait for Cal Ack to be set back Low↓
Assert Cal Request Low↓
Curve modification will be calculated and stored.
Wait for Ready to be set High↑ (calibration is complete after about 4 seconds).

4.7 Digital I/O or Command Two Point Calibration

[Max Range and 10% Max Range Calibration]
Same sequence can be initiated through digital IO hardware or Ethernet commands.



Reference Point #	1	2	Range
Distance (mm)	10	1.0	0-10mm
	20	2.0	0-20mm
	Max Range	10% MR	0 to MR

Procedure:

Set Calibration Type to 2 Point if not previously done.
Assert Cal Request High ↑
Wait for Ready to be set Low↓

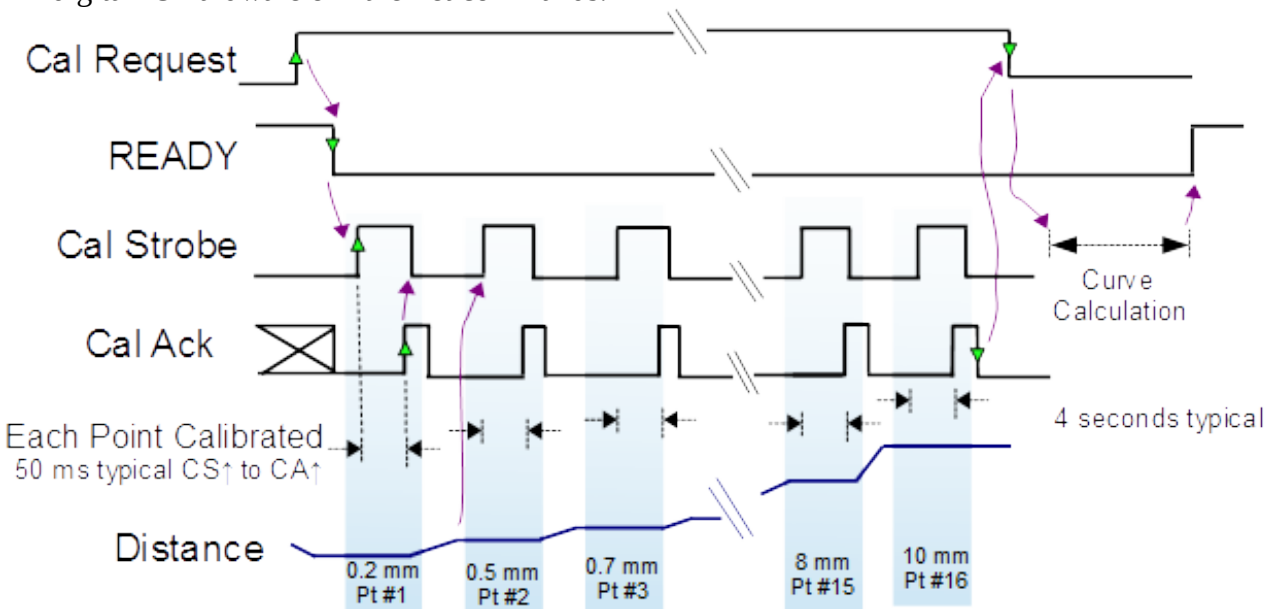
Position head to first Reference Point (Distance = 10 mm) allowing for settling time.
Assert Cal Strobe High↑
Wait for Cal Ack to be set High↑
Set Cal Strobe Low↓

Position head to second Reference Point (Distance = 1.0 mm) allowing for settling time.
Assert Cal Strobe High↑
Wait for Cal Ack to be set High↑
Set Cal Strobe Low↓

Wait for Cal Ack to be set back Low↓
Assert Cal Request Low↓
Curve modification will be calculated and stored.
Wait for Ready to be set High↑ (calibration is complete after several seconds).

4.8 Digital I/O or Command 16 Point Calibration

Use the points below for 16 point calibration. If doing a maximum range other than 10 or 20mm calculate the heights by percentage of maximum range. Same sequence can be initiated through digital IO hardware or Ethernet commands.



Reference Point #	Range	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Distance (mm)	0-10mm	0.2	0.5	0.7	1.0	1.2	1.5	1.8	2.0	2.5	3	4	5	6	7	8	10
	0-20mm	0.4	0.8	1.4	2.0	2.4	3.0	3.6	4	5	6	8	10	12	14	16	20
	0 to MR	2%	5%	7%	10%	12%	15%	18%	20%	25%	30%	40%	50%	60%	70%	80%	100%

Procedure:

Set Calibration Type to 16 Point if not previously done.
Assert Cal Request High ↑
Wait for Ready to be set Low↓
Position head to first Reference Point (Distance = 0.2 mm).

→ Assert Cal Strobe High↑
Wait for Cal Ack to be set High↑ (50ms typical)
Set Cal Strobe Low↓
Move Cutting Head to next Standoff Distance allowing for settling time
Repeat for all points. ┐

After 16th point, wait for Cal Ack to be set back Low↓
Assert Cal Request Low↓
Curve will be calculated.
Wait for Ready to be set High↑ (calibration is complete after several seconds).

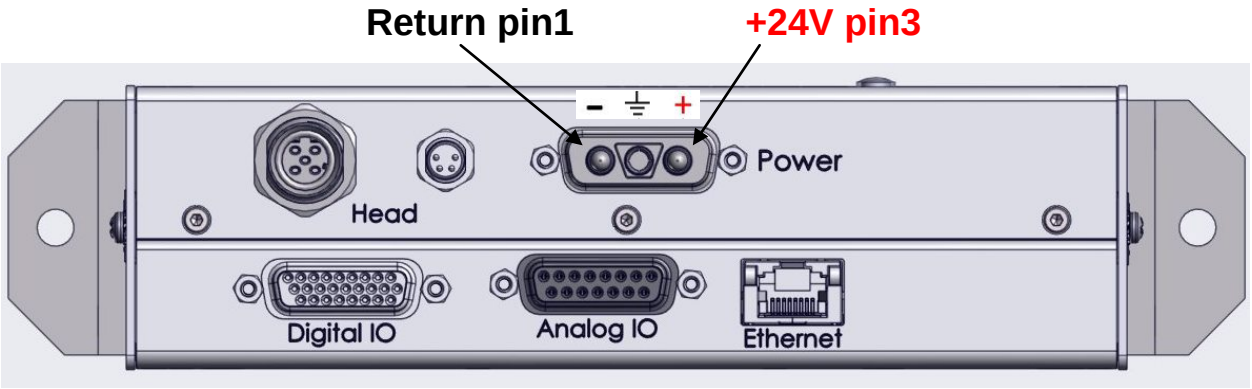
5 Connection Pin Assignments and Technical Information

5.1 Power Input Connector

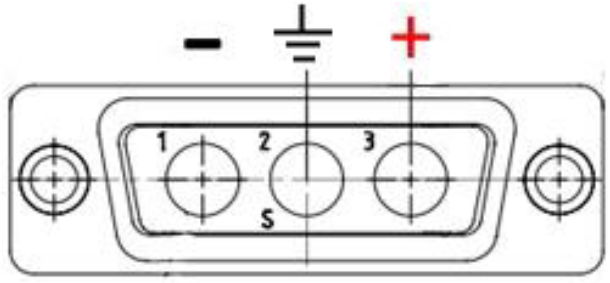
CHCE: **D Sub 3W3p Male**.

Pin#	Name	Function	Current, Maximum Amps
1	– Ground	Return for 24 Volts	
2	CASEGND	Earth Ground	
3	+ 24Volts DC	+24 VDC +/- 10%;	1 Amp maximum
Shield	CASEGND	Earth Ground	

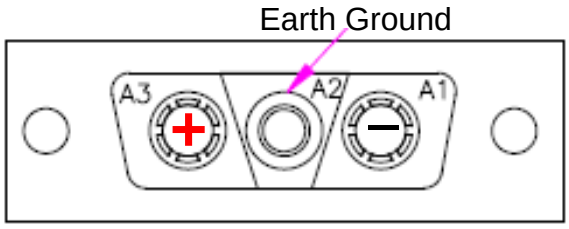
Head should also be attached to Earth Ground.



MATING CONNECTOR: F3W3SC-K121 Molex# 1731070058 with 2X Socket & 1X Pin



MATE CONNECTOR REAR VIEW
Solder Side



MATE CONNECTOR FRONT VIEW

5.2 Analog I/O Connector

CHCE: **D Sub 15 Female**.

DSUB PIN	ID	I/O
1	AO0	Output
3	AO1	Output
5	AO2	Output
7	AO3+	Output
9	A03-	Output
11	AI0	Input
13	AI1	Input
2,4,6,8,10, 12,14,15	Ground Customer	Return

Out is Output from CHCE to Customer PLC. In is input to CHCE from Customer PLC.
A3 is a differential output. Voltage output is between A03+ and A03-. This output can swing -10 to +10 Volts when used in Control mode. Use A03+ and Return for 0 to 10 V signals.

5.3 Digital IO Connector

CHCE: **D Sub 26 HD Female**.

DSUB	ID	I/O		DSUB	ID	I/O
1	+V Logic	+24V logic		**14**	DI0	Input
2	DO0	Output		**15**	DI1	Input
3	DO1	Output		**16**	DI2	Input
4	DO2	Output		**17**	DI3	Input
5	DO3	Output		**18**	DI4	Input
6	DO4	Output		**19**	DI5	Input
7	DO5	Output		**20**	DI6	Input
8	DO6	Output		**21**	DI7	Input
9	DO7	Output		**22**	GND Customer	Logic Return
10	GND Customer	Logic Return		**23**	GND Customer	Logic Return
11	GND Customer	Logic Return		**24**	GND Customer	Logic Return
12	GND Customer	Logic Return		**25**	GND Customer	Logic Return
13	GND Customer	Logic Return		**26**	GND Customer	Logic Return

Out is Output from CHCE to Customer PLC. In is input to CHCE from Customer PLC.

Note: Pin 1 voltage to match desired logic level (5 to 24 Volts) of I/O referenced GND Customer.
+24V input allowed range 4.5 to 26.4 Volts. Maximum Current is 200 mA.

Typical Digital Input

Digital inputs are isolated by opto-coupler with additional reverse bias protection diode and have 10kΩ resistor load. Always hook up at least one Logic Return to use inputs.

Typical Digital Output

Digital Outputs are isolated and are driven by a ST Microelectronics L2293 driver chip that can source or sink current and is short protected. Customer input should have load resistor (typical 2-6k) Always hook up both +V and at least one Logic Return to use digital outputs.

5.4 User Ethernet

RJ-45 Connector Ethernet connection allows connection to computer browser to access web pages in CHCE. Connection requires Ethernet connection to host with fixed IP address in CHCE. See Chapter 3. **Default IP address is 10.0.0.20**. Maximum recommended length cable: 23 meters (75 Feet).

Supported Browsers for Windows:
Internet Explorer 10, 11, Edge; Chrome V.45 and higher; Firefox V. 40 and higher.
Use of unsupported browser versions may show refresh issues or reduced functionality.

Resetting the IP Address to the default 10.0.0.20:

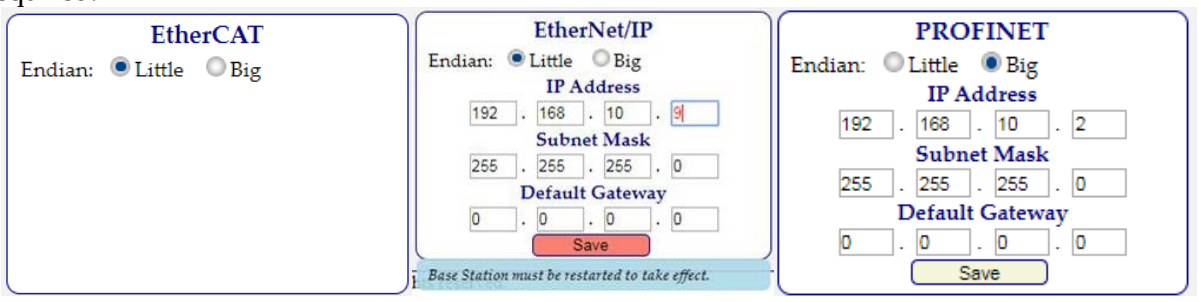
- Remove the button head screw from the top cover of the base that is marked IP Reset.
- With power on press and hold the button on the PCB for 10 seconds (use of a small screw driver or plastic or wooden dowel inserted through the tapped hole)
- Power cycle box.
- IP is reset to 10.0.0.20; Make sure the host is in the correct domain to communicate.

5.5 Field Bus Ethernet

When you purchase a base, you have a choice of Standard I/O, EtherCAT, PROFINET, or EtherNet/IP interfaces. Standard I/O will not have the field bus connector. Field Bus options include RJ45 connector(s) on side of base station. Refer to the IPG Cutting Head Field Bus Interface Guide for the field bus protocol. Refer to the Fieldbus Interface chapter below for Details on field bus interfaces.

IP Address:
Fixed IP Address for EtherNet/IP and PROFINET are settable on the IO Configuration web page. EtherCAT does not have a settable fixed IP addresses. Power cycle after change is required.

Byte Order (Endianness):
EtherCAT and Ethernet/IP will be set for Little Endian and PROFINET is set for Big Endian. Endianness may be set in the base on the IO Config web page. Power cycle after change is required.



6 Fieldbus Interface

IPG provides several fieldbus interface types as an option when purchasing your IPGCut Base; this section of the manual provides information on the interfaces that are available along with available field bus protocols. The CEU45010381A01XU Standard IO version of the base does not include Fieldbus connection.
List of fieldbus cutting head electronics:

IPGCUT BASE ETHERCAT	Part number #CEU45010381B00XU
IPGCUT BASE ETHERNET/IP	Part number #CEU45010381B01XU
IPGCUT BASE PROFINET	Part number #CEU45010381B02XU

Field bus protocol is covered in a second document IPG Cutting Head Field Bus Interface Guide.

6.1 EtherCAT

The IPGCut Base uses a Hilscher embedded module to provide the EtherCAT interface.
Hilscher model: COMX 51CA-RE (Configured as EtherCAT handler)
Located on the media accompanying the base or online, the Hilscher EtherCAT XML file is included. The XML file is located in the following directory on the media.
\Fieldbus\IPGCutBase\EtherCAT\

The Hilscher EtherCAT communication module provides diagnostic LED's to indicate the current status of the module. The diagnostic LED's are visible on the base electronics.
When all three LED's are steady green, the module is communicating to the controller.
The LEDs are viewable on the top side of the base. For EtherCAT, **Use the Left RJ45 connector for Input to Base** and Right side RJ45 connector for output.

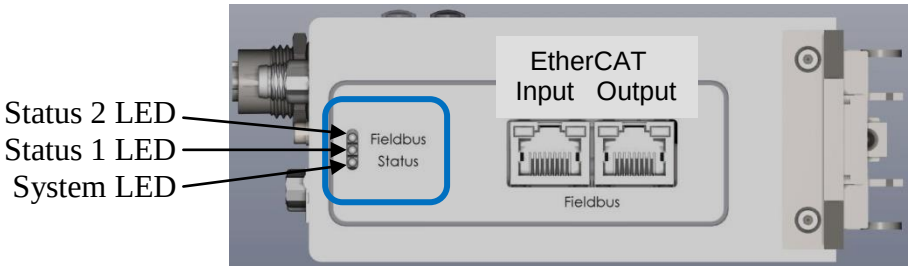


Figure 6-1 EtherCAT Diagnostic LED's

Note: The system LED is the LED at the bottom as shown in the above Figure.

System LED Status Codes		
Color	State	Meaning
	Off	Power supply off, OR hardware defect
	On	Operating system running
	Blinking	Second stage bootloader is waiting for firmware*
	On	Second stage bootloader missing*

Table 6-1 EtherCAT System LED

EtherCAT LED status codes			
LED	Color	State	Meaning
Status 1 (Run)		Off	No Power
		On	Device is operational
		Blinking	Pre-operational state
		Flash	Safe-operational state
Status 2 (Error)		Off	No Power
		Blinking	Invalid configuration*
		1 Flash	Local Error*
		2 Flash	Application watchdog timeout
RJ45		On	Ethernet connection is established
		Flashing	Device sending and receiving Ethernet frames
		Off	No Connection
RJ45			

Table 6-2 EtherCAT Status LED's

*Contact IPG for assistance

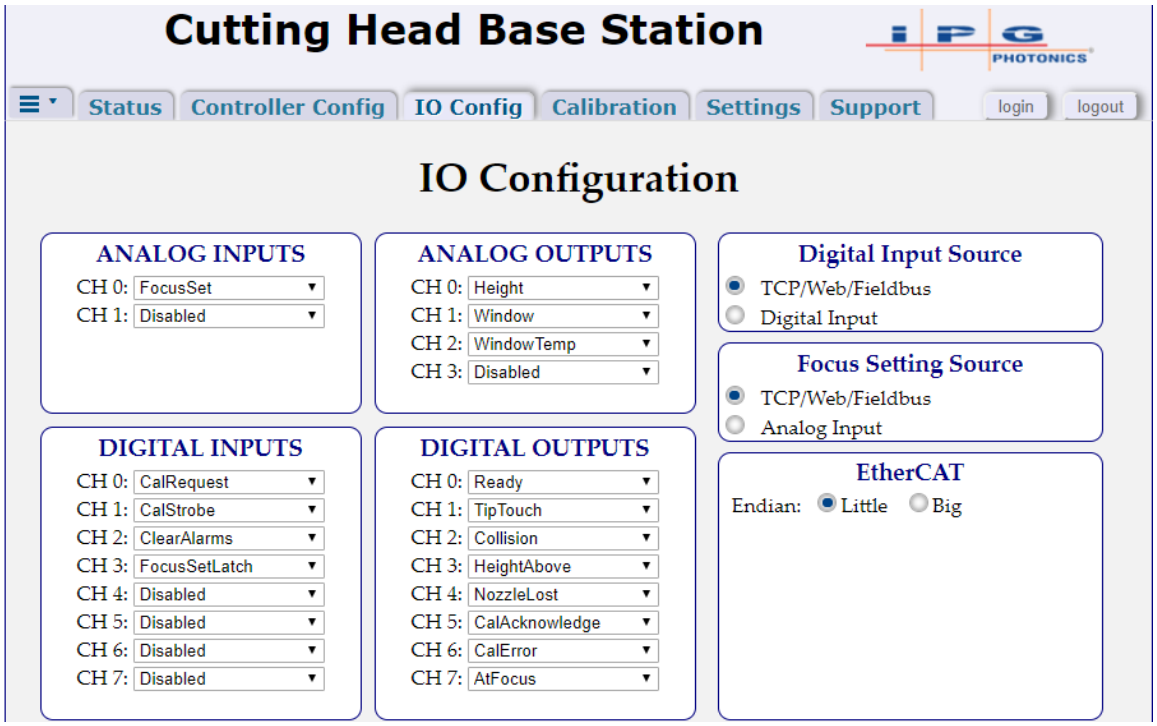
6.1.1 Notes on wiring EtherCAT

- **Use the Left RJ45 connector for Input to Base and Right side RJ45 connector for output.**
- Use shielded Ethernet cables that meet the requirements of at minimum category 5 (CAT 5) as indicated in EN50173 or ISO/IEC 11801.
- Do not use hubs in an EtherCAT network.
- Use switches only between EtherCAT controller and first EtherCAT receiver device (100 Mbit/s, Full Duplex).
- The cable length between two EtherCAT devices must not exceed 100 meters.
- Order of connection and power up of devices must match what is specified in controller.

6.1.2 Endianness (Byte Order) and IP Address

The Endianness for is settable on the IO Configuration web page.
When the EtherCAT option is detected, the IO Configuration page will include a pane for viewing and setting the configuration. EtherCAT is typically Little Endian.
Power cycle the Base Station to have the endian change take effect.

EtherCAT handler IP address is dynamic and not fixed in EtherCAT in the base and therefore there is no setting option shown for EtherCAT



IO Configuration Page for EtherCAT controller
Power cycle the Base Station to have the endian change take effect.

6.2 EtherNet/IP

The IPGCut Base uses a Hilscher embedded module to provide the EtherNet/IP interface.
Hilscher model: COMX 51CA-RE (Configured as EtherNet/IP client handler)
Located on the media accompanying the base or online, the Hilscher EtherNet/IP EDS file is included. The EDS file is located in the following directory on the media.
\Fieldbus\IPGCutBase\EtherNet-IP\

The Hilscher EtherNet/IP communication module provides diagnostic LED's to indicate the current status of the module. The diagnostic LED's are visible on the base electronics.
When all three LED's are steady green, the module is communicating to the controller server.
The LEDs are viewable on the top side of the base.

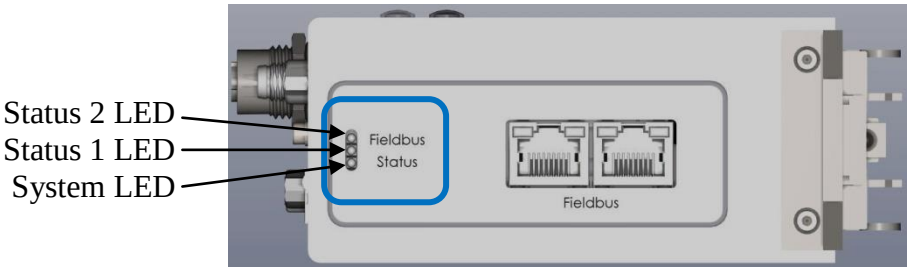


Figure 6-2 EtherNet/IP Diagnostic LED's

Note: The system LED is the LED at the bottom as shown in the above figure.

System LED Status Codes		
Color	State	Meaning
	Off	Power supply off, OR hardware defect
	On	Operating system running
	Blinking	Second stage bootloader is waiting for firmware*
	On	Second stage bootloader missing*

Table 6-3 EtherNet/IP System LED

EtherNet/IP LED status codes			
LED	Color	State	Meaning
Status 1		Off	No Power
		On	Device operational
		Flashing	Standby: Device not configured
		On	Major Fault: non-recoverable fault *
		Flashing	Minor Fault: recoverable fault
		Flashing	Self-Test: Power up test
Status 2		Off	No communication to master
		On	Connected: Device has established a network connection
		Flashing	No Connection
		On	Duplicate IP: Another device has same IP address
		Flashing	Connection timeout
		Flashing	Self-Test: Power up test

RJ45 Link		On	Ethernet connection is established
		Off	No Connection
RJ45 Activity		Flashing	Transmitting and Receiving data

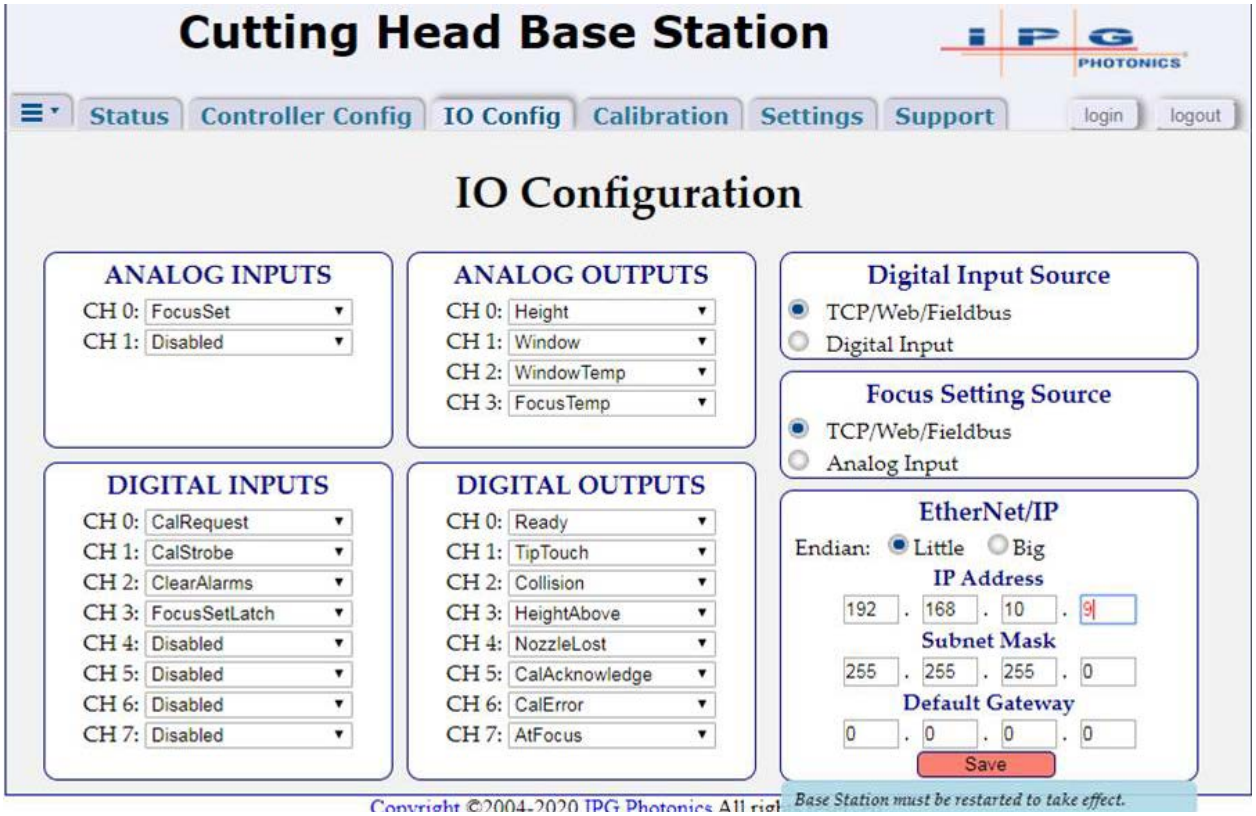
Table 6-4 EtherNet/IP Status LED's

*Contact IPG for assistance

6.2.1 IP Address Setting and Endianness

The Default IP address for Ethernet/IP is 192.168.10.2. The Ethernet/IP IP address is configurable. When the EtherNet/IP option is detected, the IO Configuration page will include a pane for viewing and setting the configuration. Enter the desired IP address and click Save and then power cycle the base. **Save then power cycle required to change IP Address.**

The Endianness (Byte Order) is also selectable. EtherNet/IP is typically Little Endian. **Power cycle required to change Endianness.**



Save the new Ethernet address after entering values.
Power cycle the Base Station to have the address or endian change take effect.

6.3 PROFINET

The IPGCut Base uses a Hilscher embedded module to provide the PROFINET interface.
Hilscher model: COMX 51CA-RE (Configured as PROFINET device handler)
Located on the media accompanying the base or online, the Hilscher PROFINET EDS file is included. The EDS file is located in the following directory on the media.
\Fieldbus\IPGCutBase\PROFINET\

The Hilscher PROFINET communication module provides diagnostic LED's to indicate the current status of the module. The diagnostic LED's are visible on the base electronics. When all three LED's are steady green, the module is communicating to the controller. The LEDs are viewable on the top side of the base.

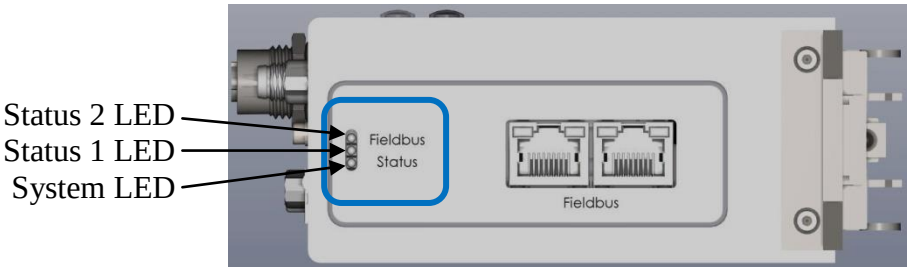


Figure 6-3 PROFINET Diagnostic LED's

Note: The system LED is the LED at the bottom as shown in the above figure.

System LED Status Codes		
Color	State	Meaning
	Off	Power supply off, OR hardware defect
	On	Operating system running
	Blinking	Second stage bootloader is waiting for firmware*
	On	Second stage bootloader missing*

Table 6-4 PROFINET System LED

PROFINET LED status codes			
LED	Color	State	Meaning
Status 1		Off	No error
		On	Watchdog timeout*
		Flashing	DCP signal service initiated
Status 2		Off	No error
		On	No configuration*
		Flashing	No data exchange
RJ45		On	Ethernet connection is established
		Off	No Connection
RJ45		Flashing	Device sending/receiving Ethernet packets

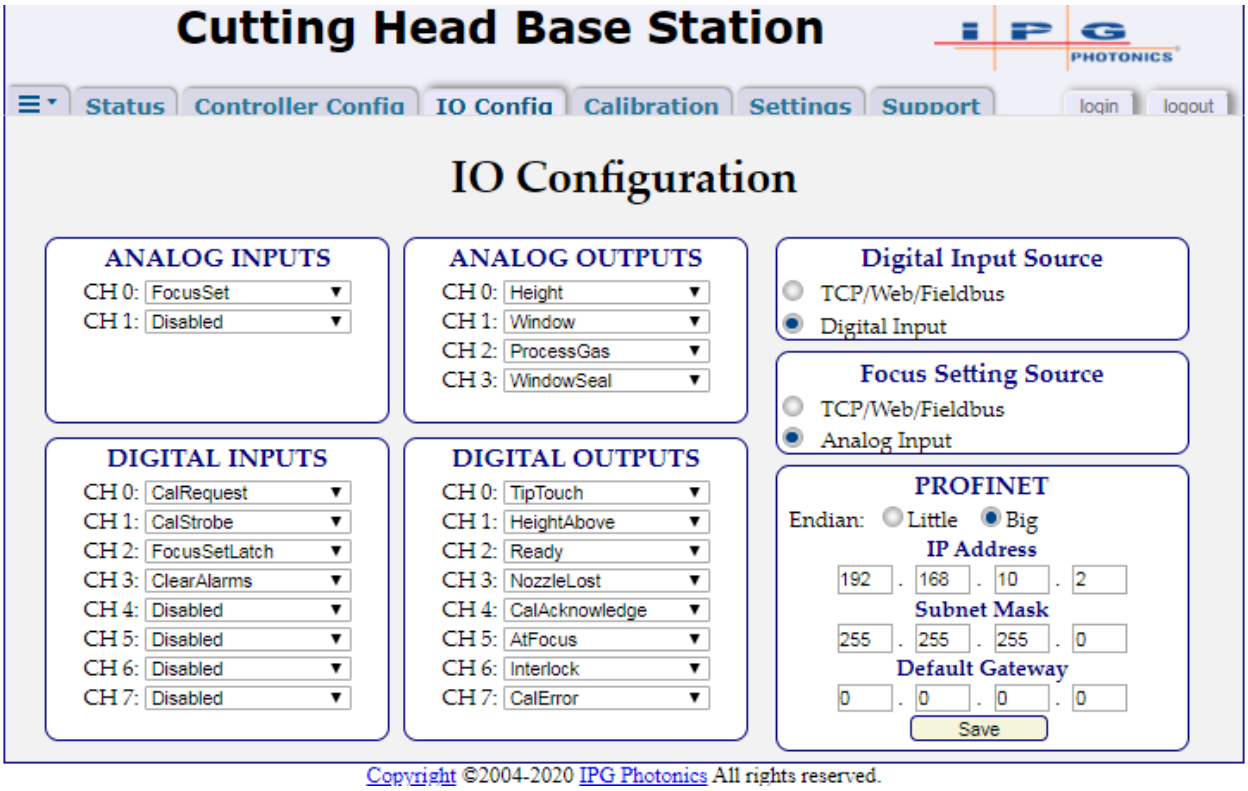
Table 6-5 PROFINET Status LED's

*Contact IPG for assistance

6.3.1 IP Address Setting and Endianness (Byte Order)

The default IP address for PROFINET in the base is 192.168.10.2. The PROFINET IP address is configurable. When the PROFINET option is detected, the IO Configuration page will include a pane for viewing and setting the configuration. Enter the desired IP address and click Save and then power cycle.

The Endianness is selectable. PROFINET is typically Big Endian.



Save the new Ethernet address after entering values.
Power cycle the Base Station to have the address or endian change take effect

7 Regulatory Specifications

7.1 Environmental (operating, non-operating)

Operating temperature:	0 to 50 °C
Storage Temperature:	-20 to +70 °C
Humidity:	30 to 90% non-condensing

7.2 Agency Approval (Safety, EMC, RoHS)

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8.5 Product Return

Product Returns

Returns to the United States

All product returns require a Return Merchandise Authorization (RMA) from IPG.

To obtain an RMA, call the Customer Service department of IPG Photonics Corporation at 508-373-1100 (US) or +49 2736 44 20 451 (Germany).

If you return a product with a RMA, perform the following procedure:

1. Products must be carefully packed in a suitable shipping container(s). Buyer assumes all responsibility for products damaged in shipment to IPG.
2. Buyer must issue a purchase order for the value of the replaced parts/service items and IPG will issue credit or invoice when the parts/service is received. Speak to IPG Service Manager for the amount authorized under the required purchase order.
3. All requests for repair or replacement under this warranty must be made to IPG within 30 days after discovery of the defect (but not later than 7 days after warranty expiration).
4. All products returned to IPG but which meet applicable specifications, not defectively manufactured or used not in accordance with this User's Guide, will result in the Buyer being charged IPG's standard examination charge.
5. Complete packing list with product model and serial number will ensure prompt repair.
6. Be sure to include with the returned product your 'ship to' address for the return of the serviced product.

Product Returns
Returns to the United States

Shipping Instructions:

Warranty Returns

Domestic & International Buyers* pay for one-way freight costs and insurance to IPG. IPG will pay for freight return cost and insurance back to the Buyer.

Non-Warranty Returns

Domestic & International Buyers* pay for two-way freight costs and insurance to IPG. If shipment consists of returns that are both warranty and non-warranty, the shipment will be considered as non-warranty.

Shipping Address for Returns to US

IPG Photonics Corporation
50 Old Webster Road
Oxford, MA 01540
Attn: Product Returns
Tel: 508-373-1100

Returns to Germany

Shipping address for returns to Germany:
IPG Laser GmbH
Siemensstrasse 7
D-57299 Burbach, Germany
Attn: Product Returns
Tel: +49-(0)2736-44-20-451

1. IPG Laser GmbH will only accept returns for which an approved Return Material Authorization (RMA) has been issued by IPG Laser GmbH. You should address to the customer support team at +49-(0)2736-44-20-451 or support.europe@ipg-photonics.com to discuss the return and request an RMA number. You must return defective products freight prepaid and insured to IPG Laser at the address shown herein. All products which have returned to IPG Laser but which are found to meet all previously applicable specifications for such products or which indicate damage to the fiber connectors not resulting from defect manufacturing, shall be subject to IPG Laser' standard examination charge in effect at the time and these costs shall be charged to the Buyer. All products returned to IPG Laser which are not accompanied by an itemized statement of defects, shall be returned to the Buyer at the Buyer's expense and IPG Laser shall not carry out any evaluation of such products. IPG Laser warrants to Buyer that its services, labor and replacement parts, assemblies and modules will be free of defects in material and workmanship for ninety (90) days from the date of shipment or performance of services.
2. Warranty Returns - Domestic & *International Buyers should pay for one-way freight costs to IPG Laser. IPG Laser will reimburse Buyers for applicable reasonable third-party freight costs and IPG Laser will pay for freight return cost back to the Buyer.
3. Non-Warranty Returns - Domestic & *International Buyers are responsible for two-way freight costs. If shipment consists of returns that are both warranty and non-warranty, the shipment will be considered as non-warranty. Any UNAUTHORIZED shipments billed to IPG Laser without authorization will be re-invoiced to the Buyer. Confirming purchase orders are required for non-warranty returns.

Product Returns
Returns to Germany

4. *International Returns must include applicable DUTIES AND TAXES, and you must mark air bills with "RETURNED FOR REPAIR." In any event, where IPG Laser accepts a shipment, IPG Laser will invoice to the Buyer for any charges as stated above.
5. Returns for credit will not be accepted unless authorized in advance, in writing by IPG Laser, in accordance with IPG Laser' Terms and Condition, including the warranty provisions. In most cases, restocking fees will apply.
6. All returns must be packaged adequately to avoid damage during shipment.
7. Complete packing list with product model and serial number will insure prompt repair, if the other terms of this form are followed.
8. See the IPG Terms and Conditions for the applicable warranty for the products before you request the return of the products.
9. RMA number will expire 31 days after the date of issue. Thereafter, units received in under the expired RMA number will result in a longer turnaround time. Include a copy of the completed RMA form with the return of your unit(s).

To learn more, visit www.ipgphotonics.com

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