IPGpulser Overview

The IPGpulser package consists of both a hardware interface box and software to provide a number of control features for the IPG laser. The IPGpulser, as its name implies, provides a pulse generator coupled to the IPG. Not only can the unit provide pulse or cw control of the laser, you can also control power levels and ramping of those values. Lastly, the IPGpulser also provides a timeshare control system, allowing you to have up to 4 CNC workstations with it's own fiber, to timeshare the laser source.

Communications with your CNC

Communicating between the CNC and the IPGpulser software is done through RS-232 ports on the CNC and the PC where the IPGpulser software is running. Currently the software will support up to 4 CNC systems. You can use IPGpulser as a simple RS-232 interface to a non-timeshared laser.

You can also just configure the system to run with simple M-functions from your system, but you do lose the ability to remotely set the parameters. In this simple form, you can set the laser parameters manually via the IPGpulser software, then control the on/off functions by use of your CNC system's M-functions. A step further along this line, you can also run IPGpulser programs that can be synchronized with your CNC again with a simple M-function. You can use a Wait command that will halt your program until you activate the Remote Continue line, synchronizing your motion with a laser control program.

How timeshare works

After the laser has started up and IPGpulser is running, any of the workstations can request the laser by simply sending the command "Laser Request" (or by typing it into the command box). Once a workstation requests the laser, the ACTIVE indicator will be displayed in that workstation's window showing it has control of the laser. The beam switch will select the appropriate fiber and all other workstations will then be locked out from trying to access the timeshare until the workstation that currently has control releases the laser. The controlling workstation simply needs to send the command "Laser Release" when it is done to give up control to any other workstation.

Should a workstation try and request the laser while it is owned by another workstation, a message will be returned stating the laser is busy. Your CNC program would simply test whether an "OK" was returned after issuing the "Laser Request" command.
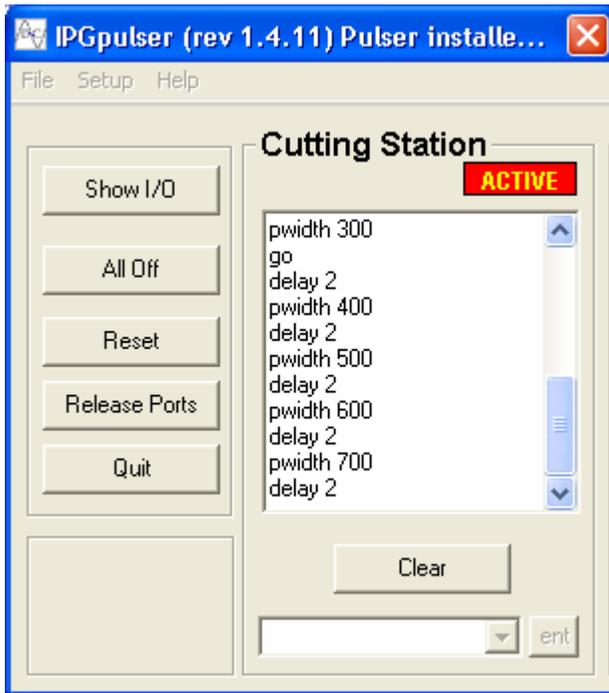
What the hardware does

The IPGpulser controls a number of the external controls on the IPG laser. It also provides an analog signal that is connected directly into the power control of the laser. This analog power command can be pulsed and ramped at the same time. The sketch below shows that the system is capable of varying the power in both pulsed and CW modes..
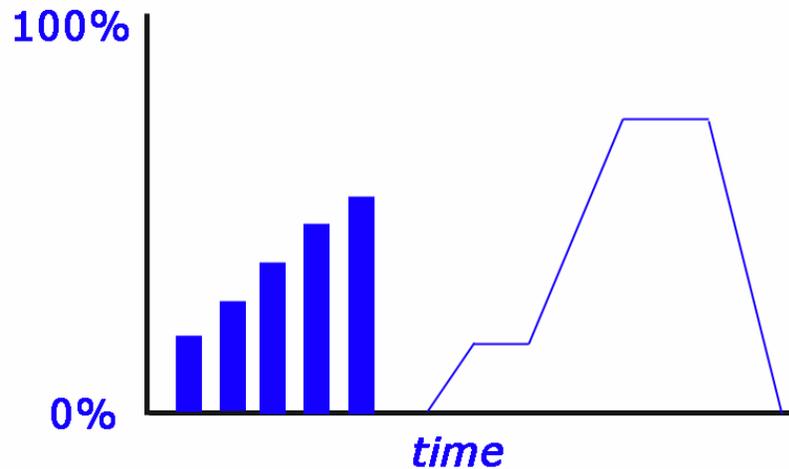
Output similar to this could be produced using the following commands:

Power 10	;set the initial laser power to 10%
Prate 300, Pwidth 1000	;set the pulse width to 1 ms and the pulse rate to 300 hz.
Pulser On	;enable the pulser
Pgm Start	;IPG actually produces output here
Power 50 3	;the pulse train ramps up to 50% in 3 seconds
Pgm Stop	;turn the laser's output off.
Power 0	;set the laser power to 0%
Delay 1	;this is the gap between pulsing and cw in sketch
CW ON	;put laser in CW mode (automatically cancels pulser)
Power 10 1	;ramp the power up to 10% in 1 second
Delay 1	;hold this power for 1 second
Power 78 1.25	;ramp the power to 78% in 1.25 seconds
Delay 1.5	;hold this power for 1.5 seconds
Power 0 1.3	;ramp power to 0% in 1.3 seconds.

The Software

![IPGpulser window screenshot]

IPGpulser (rev 1.4.11) Pulser installe...

File   Setup   Help

Cutting Station   **ACTIVE**

```
pwidth 300
go
delay 2
pwidth 400
delay 2
pwidth 500
delay 2
pwidth 600
delay 2
pwidth 700
delay 2
```

Show I/O
All Off
Reset
Release Ports
Quit

Clear

ent

File Menu:

|	
Exit	shuts off all I/O and exits IPGpulser
Echo Mode	allows you to test the RS-232 connection by simply returning each character you send IPGpulser. No commands are actually executed. For test purposes only.

Setup Menu:

External ESTOP Enable   allows you to use the remote Estop input on the IPGpulser. When the laser power supply shuts down for whatever reason, this input will disable and reset the IPGpulser. When in Estop, the ESTOP Indicator will be displayed.

![ESTOP indicator screenshot]

Clear

ESTOP   ent
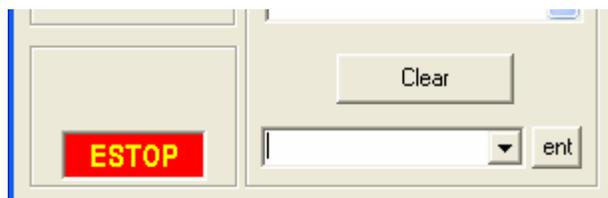
Number of Wkst's   configures the IPGpulser to match your laser system. It allows you to select 1,2,3 or 4 workstations. To rename your workstation window's title, simply double-click on the workstation name and enter a new name:
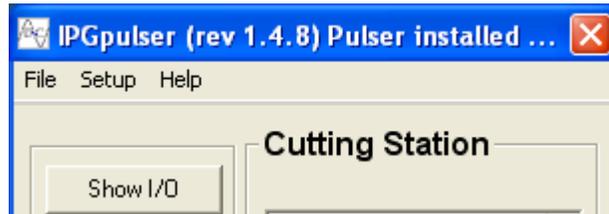
Comm Ports   use this menu to set up the RS-232 communications port number and parameters for each workstation. Setting the COMM Port field to 0 (zero) tells the system there is no port associated with that workstation. If you try to select a port number that doesn't exist in your PC, or is being used by some other device, you will get an error. If you select RTS, then hardware handshaking will be used (CTS/RTS). Be sure you have cabling that supports this type of handshaking.
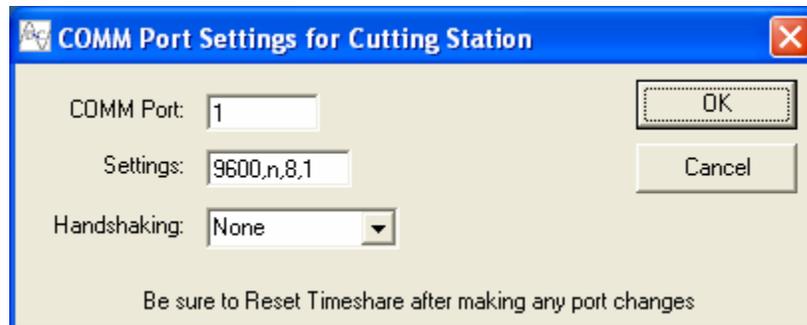
Note: The communications used between the IPGpulser and CNC systems consists of very short conversations. The use of hardware handshaking will probably have no effect on performance. Increasing your baud rate to its maximum while still maintaining a reliable connection will provide better performance.
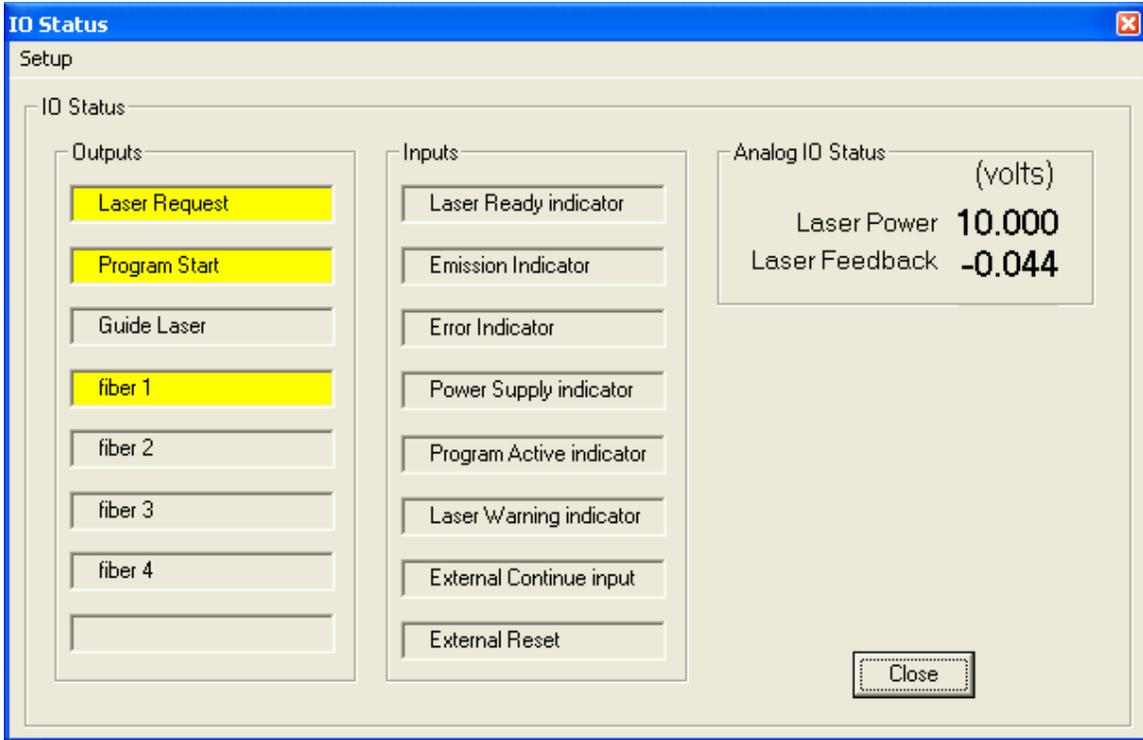

Help Menu:

**Syntax and stuff**   brings up a simple syntax reference page.

IPGpulser

The Buttons

> **Show I/O** brings up the IO Status window. This window can remain open while the IPGpulser is running.


This shows the current input and output status of the IPGpulser. The Laser Power and Laser Feedback fields show the current analog values generated and monitored by the system. **Note:** the Laser Power is the value that was sent to the D/A output on the system, not the actual measured voltage at that output.   You can edit the names of the inputs or outputs in the tables by simply clicking and typing. Typically, you may wish to rename the fiber outputs as real workstation names.
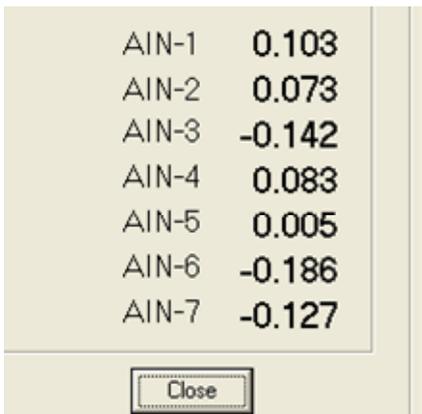
If you do wish to use the additional analog inputs, you can display them by selecting "Show analog inputs" from the Setup menu on the IO Status window. You can also access these inputs using the command ?AI*n*, where *n* is a number between 0 and 7.

All Off   turns all the outputs off, sets the analog power output to zero and aborts any IPGpulser program that may be running.

Reset   simply resets the system to it's start-up state.

Release/Enable Ports   closes and releases ownership of the RS-232 ports on the PC. This button will change to Enable Ports when activated. Use this feature if you need to temporarily use the comm ports (as in downloading to your CNC), then re-enabling when that task is done.

Quit   exits the program, shutting down all outputs and analog signals before it does.

Clear   the clear button simply erases the log box.

The Command Box and Ent
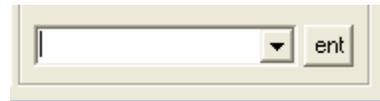
Allows you to enter commands manually. This is essential if you are using the IPGpulser as a simple, single workstation system. It is also useful when you are doing testing and diagnostics. By typing commands, you can simulate the commands being sent from your CNC system. All your commands and IPGpulser responses will be displayed in the log box above.

Each command you type also gets remembered. Click on the down-arrow on the list box and you will get a list of commands you have typed. To execute one you select, either press the <enter> key on your keyboard, or click the **Ent** button. You can recall a command, then edit it, then press <enter> to execute the command.

Using IPGpulser

In your CNC program, you first need to gain access to the laser. This is true whether you are using a time shared system or a standalone one. To attempt to gain access to the laser, the remote command LASER REQUEST must be sent to IPGpulser. For example, on the S94W CNC, it would look like this:

> G84C
> G83Laser Request
> G84

The G84 command waits for data to be returned from IPGpulser. If the laser is available (not being used by another workstation), then IPGpulser will return the following:

> OK

As long as the response is "OK", your program will continue from there. If the laser happens to be busy, then IPGpulser will return the following message:

> Laser Busy (1, 2, 3 or 4 signifying which station has the laser)

Or, if an error condition exits, the message Laser Error will be returned.

Remote Queries
You can test the values of certain inputs on the IPGpulser directly with the following commands:

```
AIn?                    Returns the value (in volts) of the
                        corresponding analog input you specify
                        with the n parameter. Range 0-7

DIn?                    Returns ON or OFF depending on the
                        state of the digital input. Range 0-7
```

Since the IPGpulser has 7 spare analog inputs and a few spare digital inputs (depending on your configuration) we give you basic access those values from your remote system.

If you wish to simply test the state of the laser (if it is busy or not), you can do a query of various laser states by using the following commands.

```
FREE?                   Timeshare (laser) is free
READY?                  Laser is ready
ERROR?                  Laser error

WARNING?                Laser warning
ACTIVE?                 Laser program is active
EMISSIONON?             Emission status

PWRSUPPLYON?            Power Supply status
POWER?                  Returns Laser Power (0-100%)
```

Each of the above return a message indicating the state of the requested function as "YES" or "NO".

FREE? Is a special case, it will return NO 1, NO 2 or Laser Error.
NO 1 means workstation 1 has the laser,
NO 2 means its workstation 2.
Laser Error means that there is an error condition on the laser.

As an example of simply testing to see if the laser is free…

> G83 Free?   ;send the string FREE?
> G84   ;wait for IPGpulser to respond
> If $S0 = "OK" GOTO N100
> GOTO N101
>
> N100 G58 Laser is free
> M2
>
> N101 G58 Laser is not free
> M2

Remote Commands

The following table lists the commands available to control the laser through IPGpulser:

```
LASER   REQUEST         sets timeshare to this workstation if available
        RELEASE         frees up laser for other workstations
        RESET           resets any errors on the IPG power supply

DUMP    ON              laser fires into dump.
        OFF             disables dump mode.

GUIDE   ON              turns guide laser on
        OFF             turns guide laser off

PGM     START           starts executing laser program
        STOP            stops any active laser program

REMOTE ON               enables remote control from the CNC
        OFF

CLEAR   1               clears the log window for wkst 1
        2               clears the log window for wkst 2
                        CLEAR with no parameter clears both windows
```

RUN **<filename>** executes a text file containing any of these commands. If you do not provide a filename, you will be prompted to select one from a browser. Pressing the **All Off** button will cancel a program.

The following commands are also available and only function in a program:

END Signifies the end of a program, execution stops on this line.

DELAY **<seconds>** Causes a delay of <seconds>. Delay is typically used when running a program.

WAIT Will stop executing the program and wait for the External Continue input to go ON then OFF at which time program execution will continue. Use this to synchronize your motion system and the IPGpulser. **Note:** You can also click on the WAIT indicator to manually override the external input or send a GO command.

GO if the system is running a program and a WAIT command is executing, you can send a GO command to terminate the WAIT.

RESTART Restarts the current program. This will run until aborted by **All Off** or **Timeshare Reset**.

IPGpulser

Pulser/CW functions

The IPGpulser allows you to run the laser in either pulsed or CW modes. In pulse mode, the following parameters define the limits of the hardware or laser:

Minimum pulse width   100 uSec   Maximum pulse width   4000 uSec
Minimum pulse rate   183 hz   Maximum pulse rate   5000 hz.

The following commands are used to set the pulsing and power parameters:

Power <value>   sets the laser power in percent (0-100%)

Power <value> <time>   sets the laser power in percent (0-100%) and ramps to this new value in <time> seconds.

Pwidth <value>   sets the laser pulse width in uSec (100 to 3000)

Prate   <value>   sets the laser pulse rate in hz (200 to 4000)

Pulser ON   the pulser is turned on
        OFF   the pulser is turned off
        EXTERNAL   the pulser is gated by an external signal. When toggled, this line will generate a single pulse at the current pulse width setting.

CW   ON   the laser is turned on CONTINUOUS
        OFF   the laser is turned off

Spot   fires a single spot at the current pulse width setting.

Miscellaneous Commands

There are a few additional commands that the IPGpulser will recognize:

DO*n* ON/OFF   sets **D**igital **O**utput ***n*** either ON or OFF. Use caution, this will turn on whatever output you tell it, including the beam switch outputs. You should not enter these commands without knowing what will happen.

AO*n* <voltage>   sets **A**nalog **O**utput ***n*** to <voltage>. Again, use caution when using this command. AO0 is the Laser Power signal. AO1 can be safely used to output a steady voltage of 0-10v.

Executing IPGpulser programs on the PC

You can execute commands automatically by placing them in a text file and using the Run command. Using any text editor (Notepad for example), create a file containing any of the IPGpulser commands. You can send multiple commands to the software by using a "," to separate your commands. e.g. Prate 200, Pwidth 1000, Pulser ON can all be sent on the same line, which can speed up the whole process since you don't need your CNC to output 3 separate lines.

For example, you could have a specific pierce program you wish to use whenever you start a cut. That program may look like the following:

```
Power 0        ;start with power at 0%
Prate 300      ;set pulse rate to 300 hz.
Pwidth 400     ;set pulse width to 400 uSec
Pulser ON
Power 30 2   ;ramp to 30% in 2 seconds
Pulser OFF
```

Lets say we saved it under the name Pierce300.txt and you saved it in the MyPrograms directory. You would simply program the following line whenever you wanted to run the pierce program:

RUN C:\MyPrograms\Pierce300.txt

You can use the ";" character as a comment in these files. You may use the END command to terminate the program or simply leave nothing at the end of the file and it will stop. If you want to cycle forever, put the command RESTART at the end of your file.

Using the WAIT command

There may be times when you need to synchronize things between IPGpulser and your CNC program. You can use the WAIT command to pause a program and have it wait for some external signal before continuing. There are 3 ways to continue from a paused situation:

Putting 24v onto the External Continue input (must turn on then off)
Sending a GO command from your CNC via RS-232
Clicking on the **WAIT** indicator on the IPGpulser window.

Using the IPGpulser without an RS-232 connection

The IPGpulser can be set up to operate from a simple M-function based CNC system if you do not have, or wish to use the RS-232 capabilities.

In the first configuration, it is a simple 1 relay connection to control the IPGpulser. You would simply connect your M-function to TB1-1 of the IPGpulser Opto board (see Hardware Layout) and the common side of your relay to TB7-1 or 2. If you have a 24v output, instead of a relay on your M-function, then simply tie that output to TB1-2 and tie your 24v common to TB1-9.

The other configuration requires 2 M-functions and gives you a little more flexibility. This configuration allows you to change parameters using one of your M-functions. It does this by using a program and utilizing the WAIT command. There is an External Continue input that is designed to be operated from a CNC's M-functions. If you connect your M-function between TB3-9 and TB3-8 on the IPGpulser Opto board, you can control the wait/continue function via your M-function.

For example, lets say we want to do a pierce / cut program, where we pierce using the pulser, then we want to cut using the laser in CW mode. We would first write a program that might look like the following.

```
; TheProgram.txt  (just the name we called this)
Power 0
Prate 1000, Pwidth 400, Pulser On
Power 30
Wait
Power 85
CW ON
```

If we follow this through, you would first do a Laser Request to get the laser prepared. You could then type Run TheProgram.txt. The power will be set to 0%, the pulser will get set up and turned on. The power will be set to 30% and the software will sit there at the Wait command.

In your CNC program, you would now use the Pgm Start M-function to turn the beam on and begin drilling at the pulsing parameters that you have set. After your delay, you would then switch on your External Continue M-function then off, which will pulse the External Continue input, causing the Wait step to end. As soon as that happens, the laser power will be set to 85% and the beam control will be set to CW mode, turning off the pulser. To turn the beam back off, simply clear the Pgm Start M-function.

It is important to understand when the beam is actually being turned on. Although the pulser can be firing away, and the power can be set to some value greater than 0%, there will be no laser emission until you activate the Pgm Start line to the IPG. So, in a simple M-function control configuration, you would have one M-function as your Beam ON/OFF command which is tied to the Pgm Start signal going to the IPG interface. The other M-function could be tied to the External Continue input which would allow you to synchronize your motion program and an IPGpulser program.