

Choice of Laser Sources for Micromachining Applications ...From a Control Systems Perspective

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GMP

**GENERAL
MICROTECHNOLOGY
& PHOTONICS**

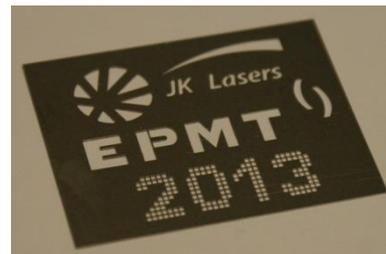
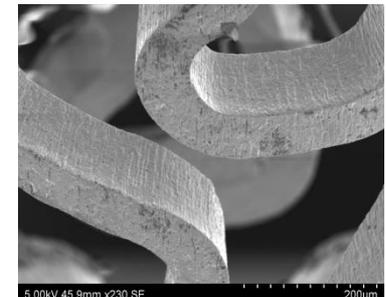
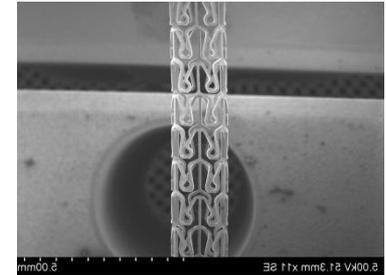
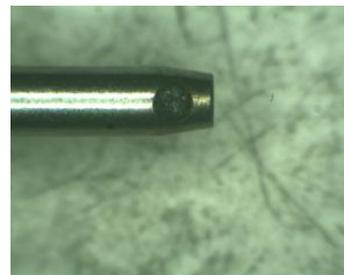
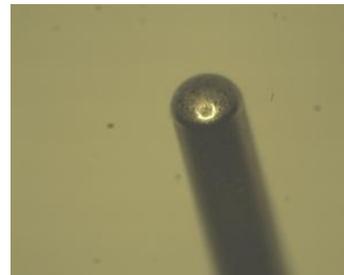
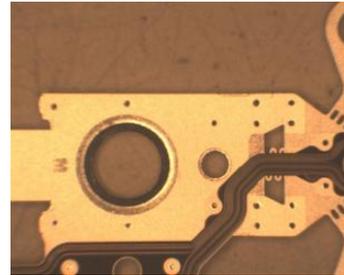
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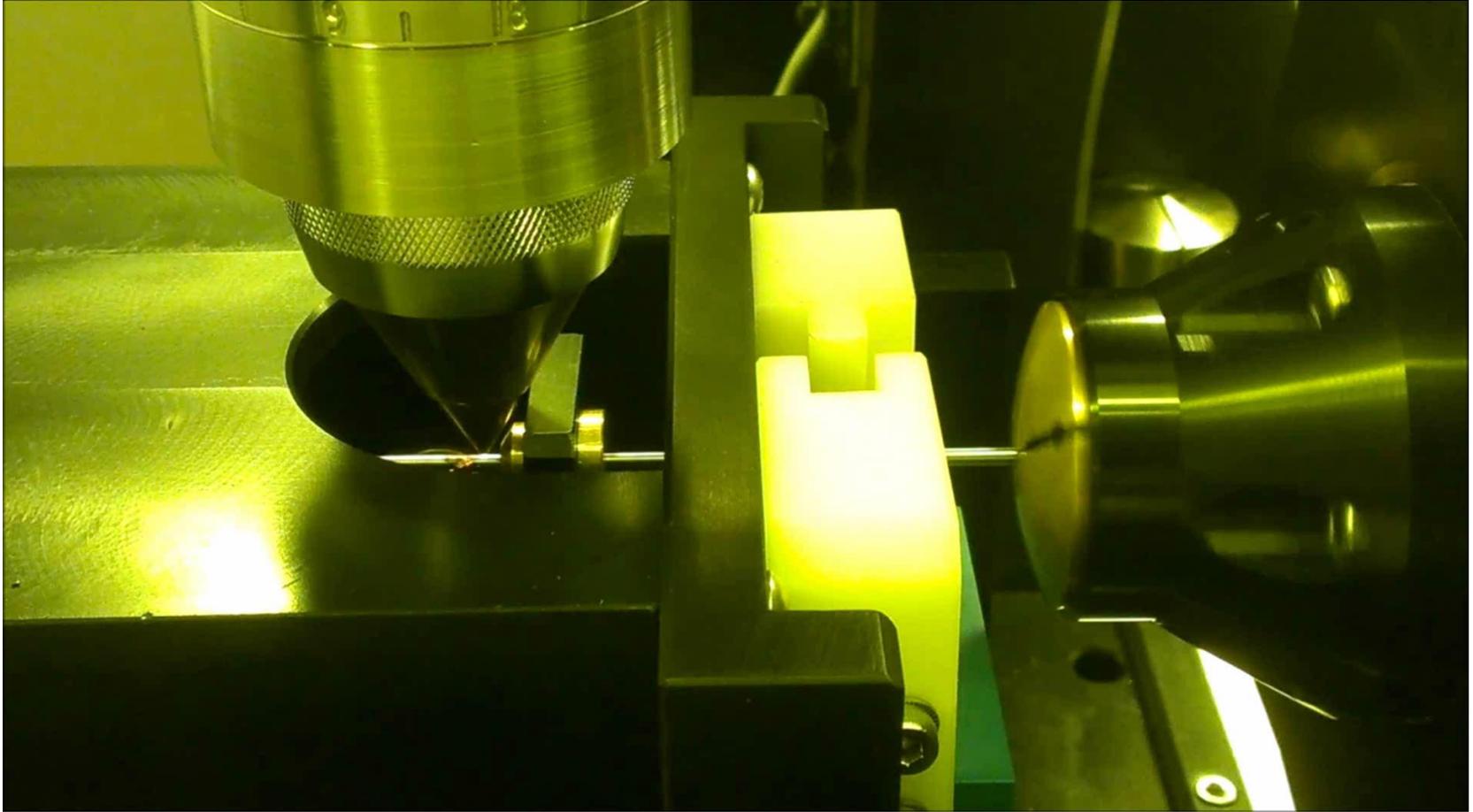
- Introduction
- Pulse Shaping
 - For welding and cutting
- Scan Heads
 - For welding
- Software
- Position Synchronised Output
 - For cutting
- Putting It All Together
 - Integrated Solutions



Micromachining Applications

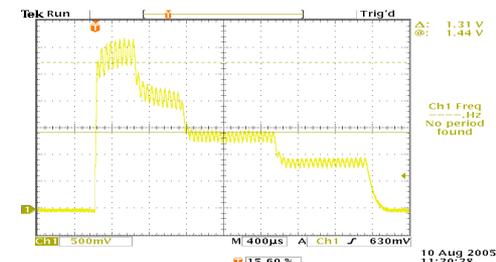
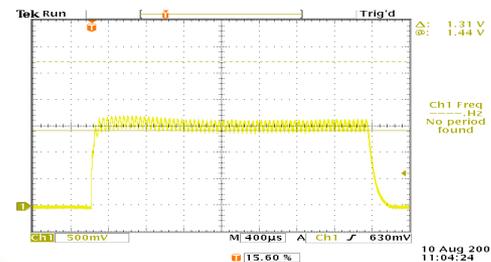
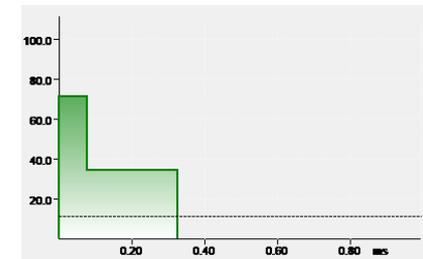
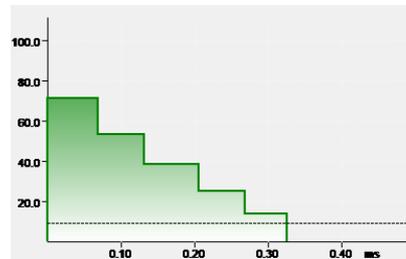
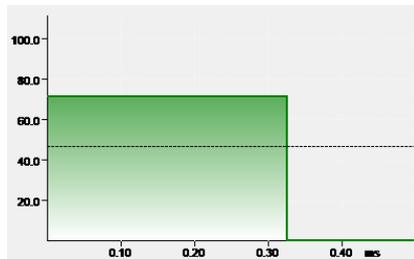
- To Be Discussed
 - Microwelding
 - Pulse Shaping
 - Process Optimisation
 - Consistency
 - Microcutting
 - Process Optimisation
 - Microdrilling
 - Ablation
 - Microstructuring





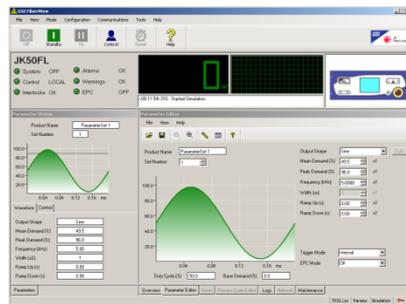
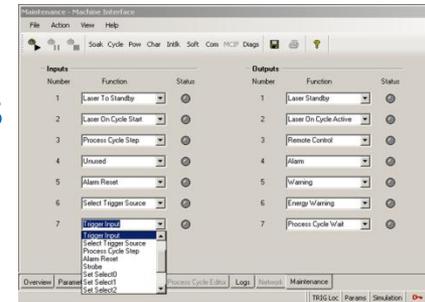
Pulse Shaping

- Why is pulse shaping important for micromachining?
 - Prevent splatter when microwelding.
 - Controlled heat input
 - Prevent cracking when joining dissimilar materials or crack sensitive alloys.
 - Controlled cooling
 - Increase piercing speed when microcutting.
 - Pre-pulsing



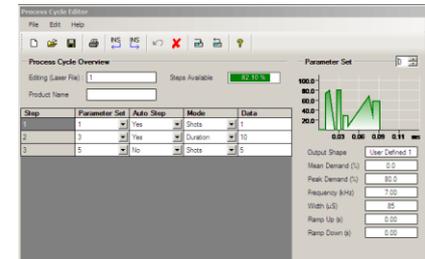
Pulse Shaping

- Laser source requirements for pulse shaping
 - Ease of programming
 - Graphical user interface
 - In built pulse generator
 - Quick changeover to different shapes
 - Local storage of pulse shapes in laser
 - Switchover through machine interface or via software control
 - Ability to program canned cycles for welding processes
 - Stored within laser source and automatically sequencing

The screenshot shows a software window with a table of inputs and outputs. The table has columns for Number, Function, and Status. The inputs are: 1 Laser To Standby, 2 Laser On Cycle Start, 3 Process Cycle Step, 4 Unused, 5 Alarm Reset, 6 Fault Trigger Source, 7 Emergency Stop. The outputs are: 1 Laser Standby, 2 Laser On Cycle Active, 3 Remote Control, 4 Alarm, 5 Warning, 6 Energy Warning, 7 Process Cycle Wait.

Number	Function	Status
1	Laser To Standby	
2	Laser On Cycle Start	
3	Process Cycle Step	
4	Unused	
5	Alarm Reset	
6	Fault Trigger Source	
7	Emergency Stop	

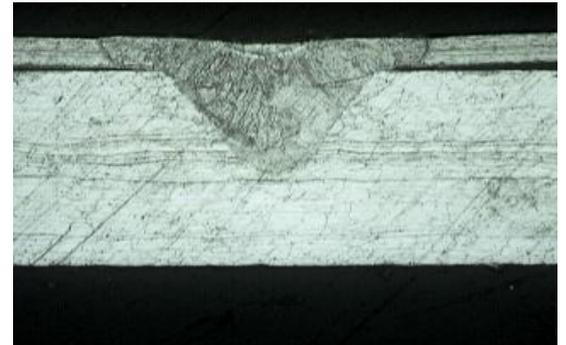
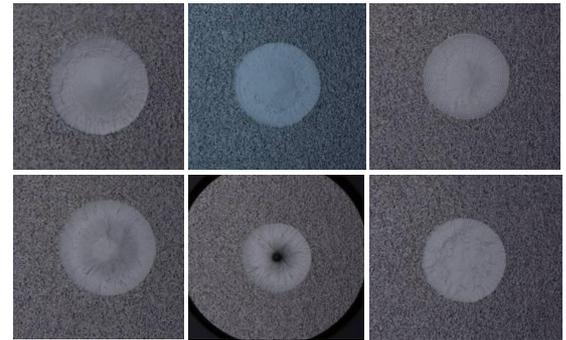
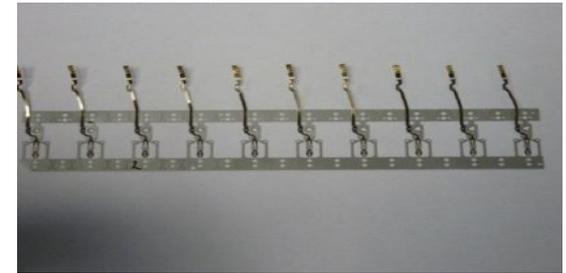
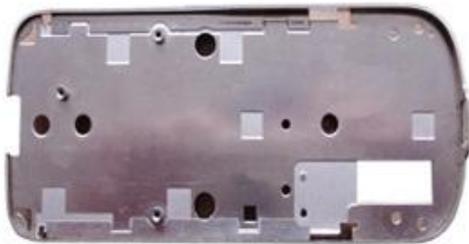


The screenshot shows a software window with a process cycle overview table and a parameter set. The table has columns for Step, Parameter Set, Auto Stop, Mode, and Data. The parameter set includes fields for Peak Demand, Peak Demand, Frequency, Width, Ramp Up, and Ramp Down.

Step	Parameter Set	Auto Stop	Mode	Data
1	1	Yes	Shots	1
2	3	Yes	Duration	10
3	5	No	Shots	5

Scanning Heads

- Key Requirements
 - Fast programming
 - Eliminate operator error
 - Fastest processing time
 - Precision
 - Thermal stability
 - Closed loop vision
 - Integrated solution
 - Ability to simulate process



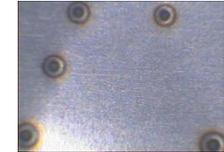
Spot welding thin 304SS for flexural arm welding applications

Scanning Solution

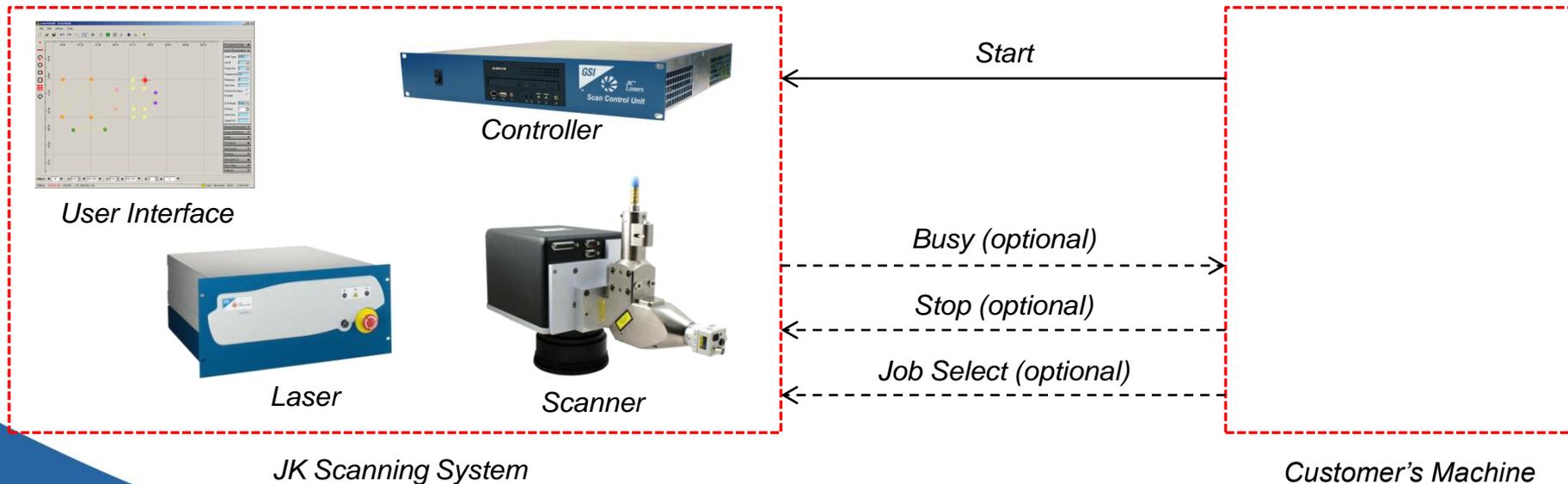
- Self Optimising and Pre-Emptive Scanning Solution
 - Very quick product set-up
 - Very easy integration (single input from external machine)
 - Eliminates operator error (no missed or 'fish-tail' welds)
 - Highest possible speed (seamlessly linked to laser control)
 - User interface specifically designed for microwelding
 - Ability to simulate process



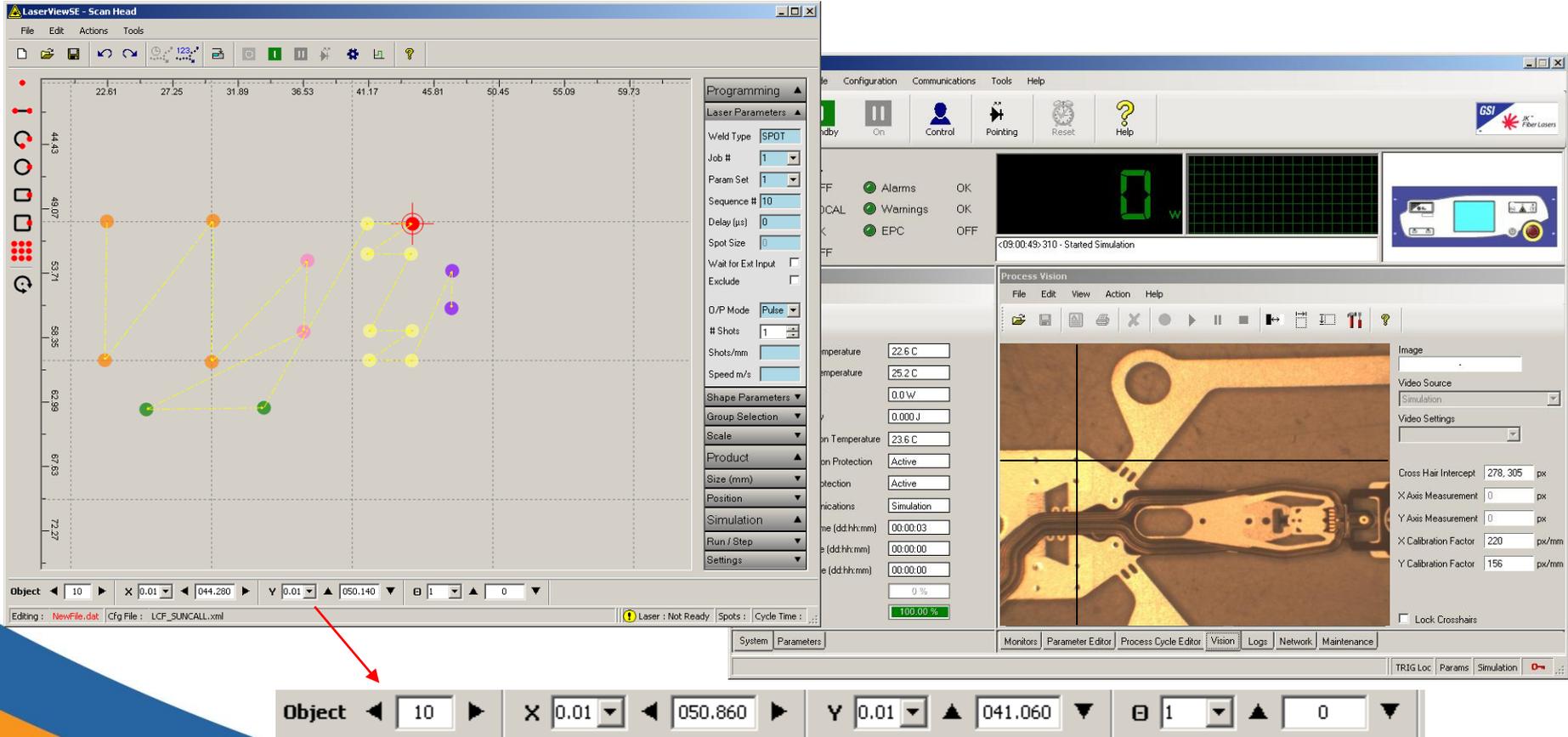
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X



Weld Location Adjustment



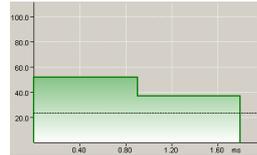
The screenshot displays the LaserViewSE - Scan Head software interface. The main window shows a 2D coordinate system with a grid. A yellow line represents a weld path, starting from the origin and moving through several points. A red dot is positioned at the end of the path, indicating the current weld location. The X-axis values are 22.81, 27.25, 31.89, 36.53, 41.17, 45.81, 50.45, 55.09, and 59.73. The Y-axis values are 44.43, 49.07, 53.71, 58.36, 62.99, 67.63, and 72.27.

The interface includes several panels and controls:

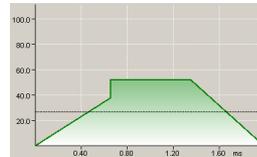
- Programming Panel:** Contains settings for Laser Parameters (Weld Type: SPOT, Job #: 1, Param Set: 1, Sequence #: 10, Delay (us): 0, Spot Size: 0), D/P Mode (Pulse), # Shots (1), Shots/mm, Speed m/s, Shape Parameters (Scale, Product, Size (mm), Position), Simulation (Run / Step, Settings), and a status indicator (Laser: Not Ready).
- Process Vision Panel:** Displays a live video feed of the workpiece being welded. It includes a video source selection, video settings, and measurement data (Cross Hair Intercept: 278,305 px, X Axis Measurement: 0 px, Y Axis Measurement: 0 px, X Calibration Factor: 220 px/mm, Y Calibration Factor: 156 px/mm).
- Control Panel:** Features buttons for On, Control, Pointing, Reset, and Help, along with status indicators for Alarms, Warnings, and EPC.
- Object Control Panel:** Located at the bottom, it allows for manual adjustment of the weld location. The Object field is set to 10, X to 0.01, Y to 0.01, and the angle to 1. A red arrow points from the Object field in the main interface to this control panel.

Typical Flexure Scan Sequence

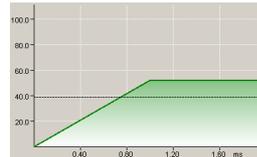
Parameter Set 1
1.8 ms wide shaped



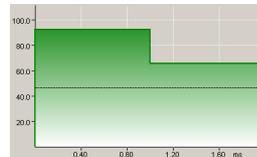
Parameter Set 2
2.0 ms wide shaped



Parameter Set 3
2.0 ms wide shaped



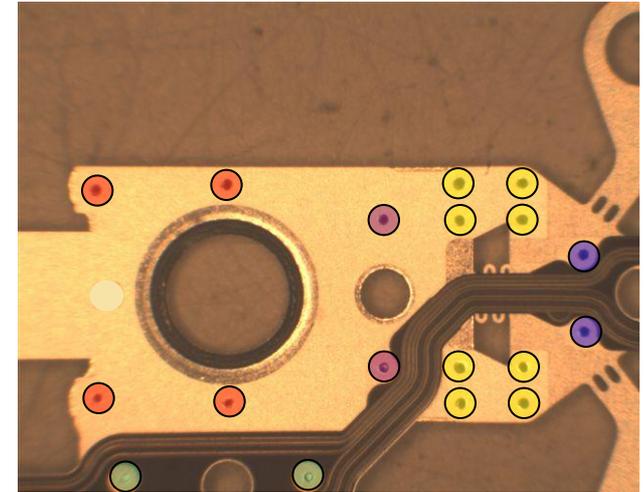
Parameter Set 4
2.0 ms wide shaped



Parameter Set 5
1.6 ms wide shaped



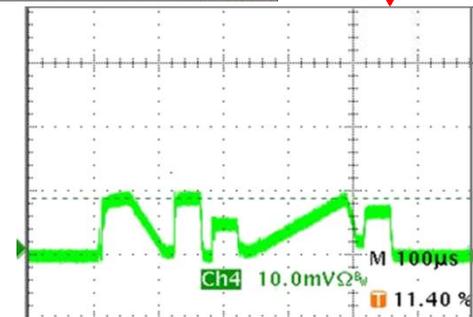
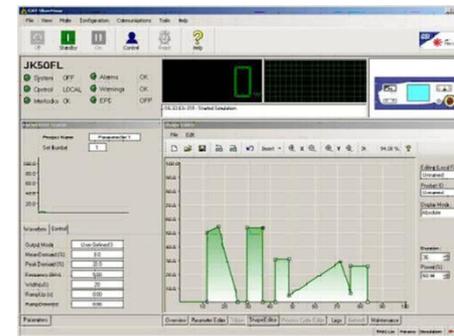
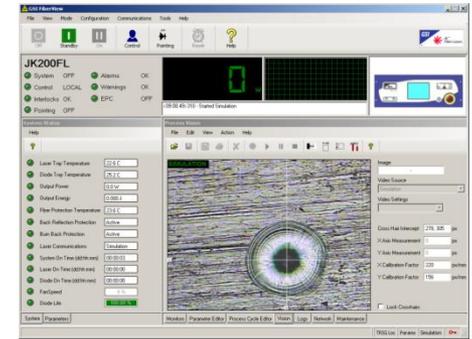
Pulse shaping may not be required but has been shown to yield improved results for micro welding.



Self optimising and pre-emptive system allows this 18 spot weld process to be completed in under 75ms including weld parameter changes with JK Fiber or LPSS Laser.

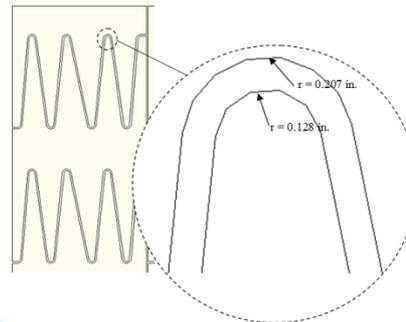
Software Solutions – Laser GUI

- FiberView™ GUI (Fiber Laser UI)
 - In built camera view
 - Comprehensive data logging
 - Full diagnostics and laser metrics monitoring
 - Low level communications support dlls aids integration
 - Operator access level control
 - In built pulse shaping
 - Remote access
- LaserViewSE GUI (LPSS Laser UI)
 - Similar features to FiberView



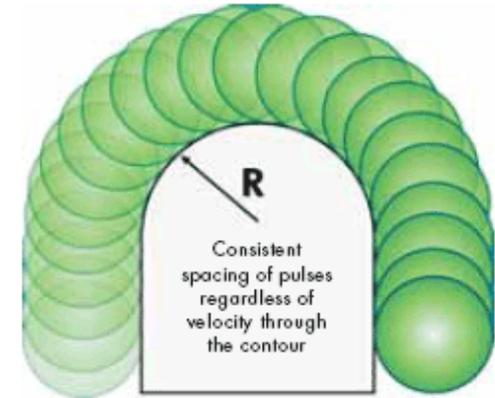
Position Synchronised Output

- Higher motion system speeds may be achieved for large geometries than those possible for fine detail.
 - Acceleration and deceleration requirements mean that you can never achieve the maximum specified motion system speed.
- To prevent heating affects when moving more slowly, the laser power must be controlled proportional to the velocity (PSO).
- Without PSO, the whole part would need to be cut at the power level and speed for the most detailed geometry.
- PSO maximises throughput by dynamically controlling the laser power demand in sympathy with the motion system.

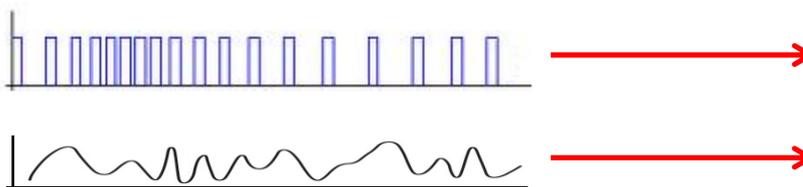


Position Synchronised Output

- For cutting thin section, a pulsed regime is typically used.
 - Laser source is required to have an input to allow the external motion system to control the laser pulse rate.
- For thicker section material, a CW regime is more typical.
 - Laser source is required to have an input to allow the external motion system to control the average laser power.



Single- or multiple-pulse output as a function of up to 3 axes' position feedback.
Minimizes heat-affected zone in welding and cutting.



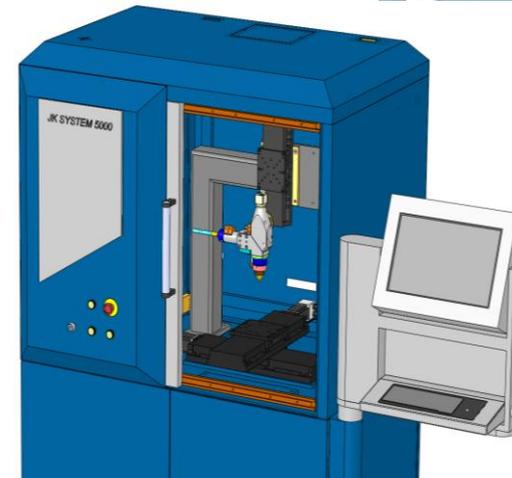
Complete Micromachining Solutions

- Fully integrated and self contained workstation
- Single source supply for complete micromachining solution.
- Up to 5 axis.
- Scan head option.
- Customisation available.
- Capability to achieve all micromachining specific solutions detailed in this presentation



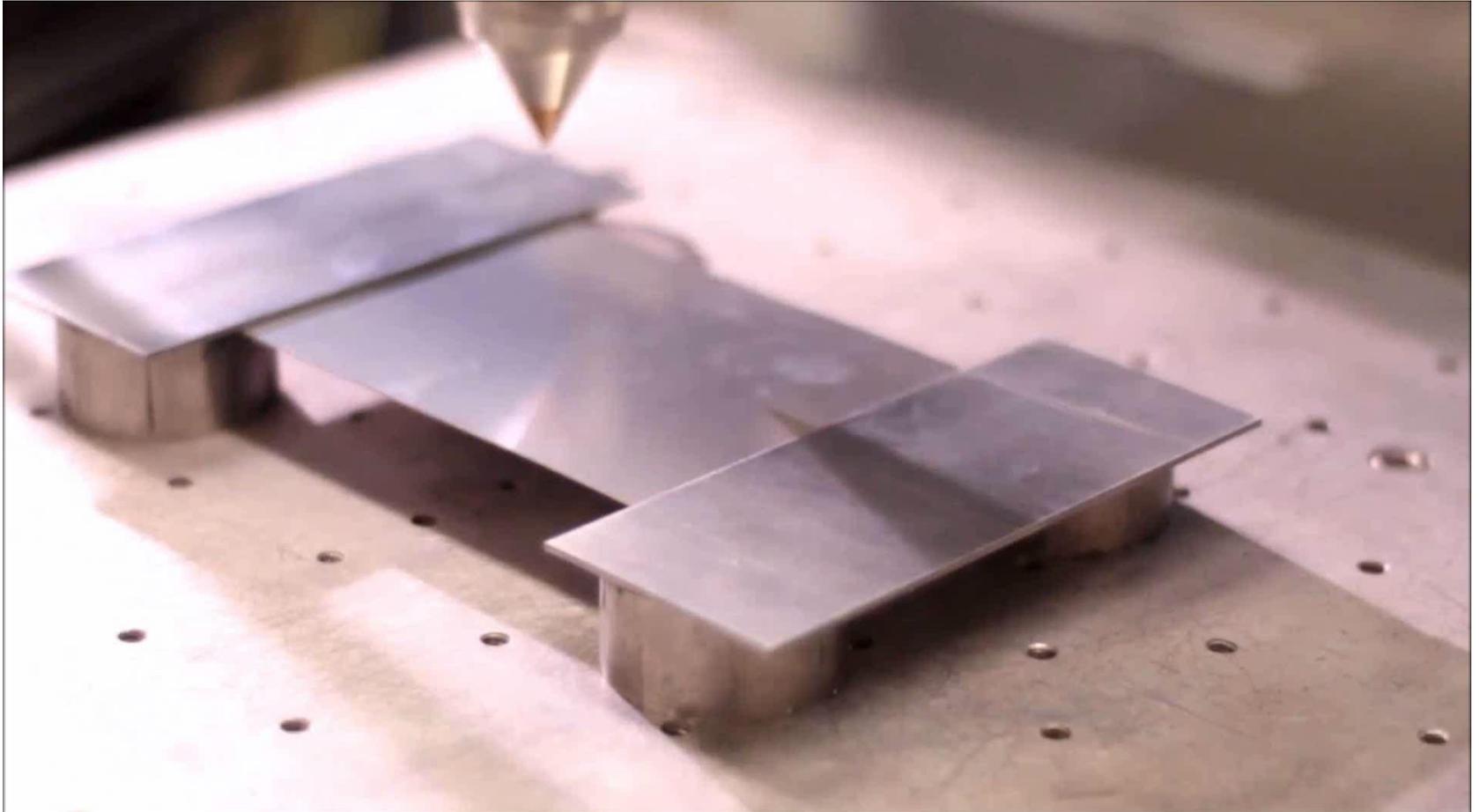
System 5000 Options

- Right to left opening or half height vertical door.
- Dual monitor
- Gas control/monitoring.
- Fume extraction.
- Operator knee recess.
- T-slot plate.
- Precision rotary chuck.
- Joystick.
- Ball-screw or linear motor slides.
- Base mounted or split X,Y.
- Rotary stages. Geared or linear drive.
- Scanning head mounted to Z axis.
- Some additional customisation.



Conclusions

- Selection of a laser source for micromachining isn't just about laser type beam quality, wavelength etc.
 - There are other important considerations to be made
 - Is the laser source easily capable of a wide range of pulse shaping?
 - Can the solution be easily optimised to achieve highest throughput with highest quality?
 - Does the laser source offer all of the control interfaces necessary to achieve best speed at highest quality?
 - Can the laser source be easily integrated to the customer machine?
- OR
- Is a complete solution available from a single source?



Thank You Any Questions?

Please visit us at booth F102 to see
a live microcutting demonstration
and receive a free sample and
useful tool!

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