



EPMT Show

Wednesday, 18 June 2014

Smart Fiber Lasers for Micro Machining Applications

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Product Manager

- Leading provider of precision laser, medical and motion control technology
- Canadian Company founded in 1968, with U.S. Headquarters in Massachusetts
- ~\$365M in annual revenue and ~\$60M in annual Adjusted EBITDA*
- Approximately 1,400 employees for continuing operations
- Trade on NASDAQ (GSIG)



Leading Technology Franchises

Highly Capable Team

Increased Medical Presence

Global Presence and Reach

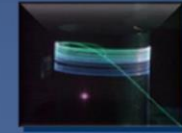
Operational Excellence




Product Ranges include:

- Laser sources
- Scanning and beam delivery products
- Medical visualization and informatics solutions
- Precision motion control products

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Sales Trend (\$M)



	Scanners	Sealed CO ₂	Fiber Lasers
Brands			
Range	Galvanometers Scan Heads	10W to 400W	50W to 2kW
Location	Bedford, MA	Mukilteo, WA	Rugby, UK
Primary Applications	Material Processing Marking Ophthalmology PCB Drilling	Marking, Engraving, Date Coding of non-metals	Metal cutting, welding, drilling



- Founded in 1972
- Previously best known as 'Lumonics'
- Based in Rugby, UK and Suzhou, China
- Global installed base of 1000's of industrial lasers.
- Industrial Fiber Lasers complement lamp pumped Nd:YAG based lasers for Welding, Cutting and Drilling.
 - JK Lasers is able to offer the right laser for each Application.



Company HQ: Rugby, UK



Company Facility: Suzhou, PRC

Tradition as leader in Industrial Lasers

Welding | Cutting | Drilling



JK Lasers founded in Rugby. From the very beginning we set the standard for rugged and reliable lasers for use in industrial applications

JK Lasers develops and installs the world's first fiberoptic delivery system on a solid-state laser. The time and energy share options bring many advantages, e.g.: welding up to four seams on a rotary shaft

Launch of the world's first industrial pulsed solid-state laser, the JK700 Series

Launch of the world's first multiple kilowatt CW and modulated CW lasers

Launch of Luminator Fibers with patented back reflection protection

Introduction of the next generation CW Nd:YAG lasers

JK Lasers launch Industrial Ytterbium Fiber Laser Range

Launch of JK400FL, offering increased processing performance

Launch of the JK System 5000, JK Lasers' customisable workstation

JK Lasers launches its first multi-kiloWatt fiber laser. The JK1000FL delivers new levels of power and control

1970

1980

1990

2000

2010

Launch of the MS-Series - the first Nd:YAG laser system with breakthrough powers for industrial use. Medical device manufacturers are among the first users

Launch of JK706, the first industrial 1kW pulsed Nd:YAG laser. Launch of JK704, a high peak power laser system capable of fine focus and ideally suited to drilling

Launch of the JK704TR - Twin Rod 30kW Peak Power, 60 joule drilling system for the aerospace industry

Latest generation JK HP & P family of pulsed Nd:YAG lasers become available

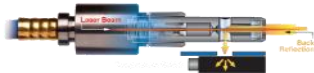
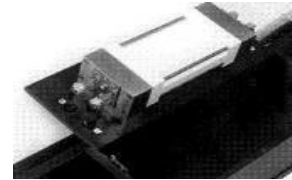
Launch of JK Scanning Head System with integrated controller and software interface

JK100P introduced: a high peak power, short pulse fibre delivered Nd:YAG laser

Launch of JK604D high beam quality aerospace drilling laser

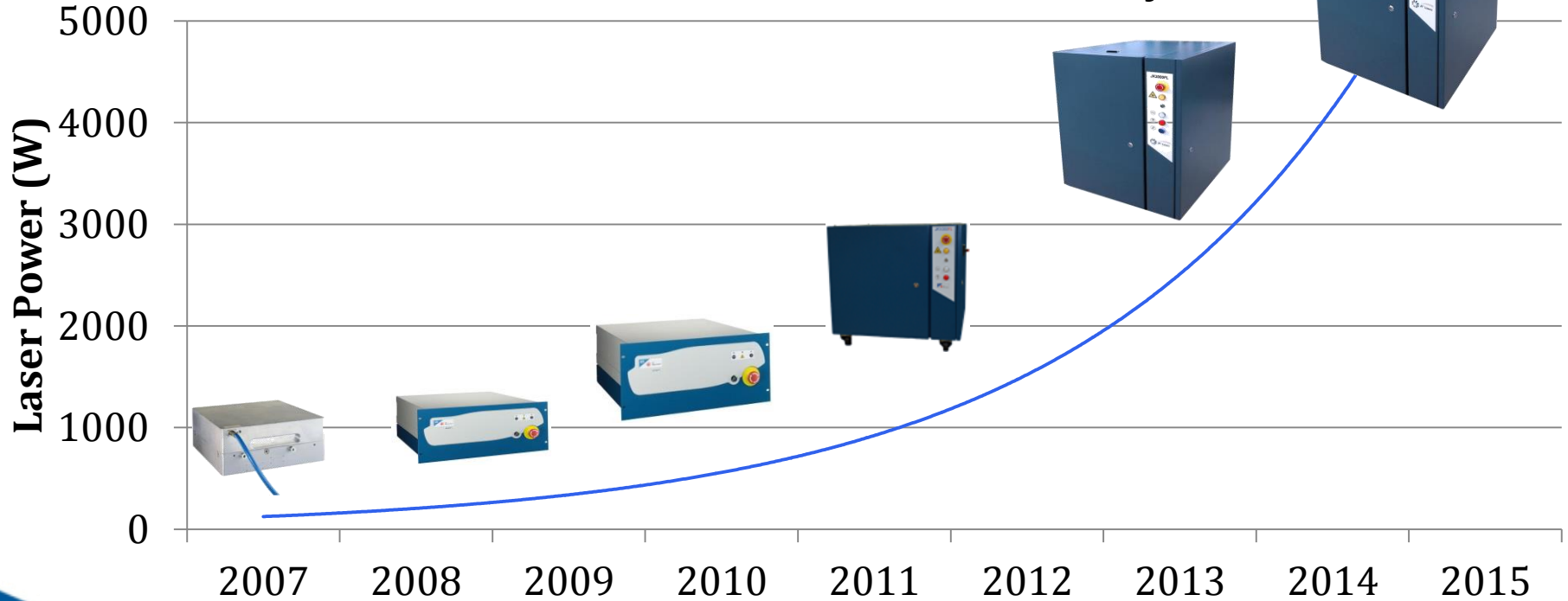
JK500FL becomes available, complementing the JK Fiber Laser range

The high powered 2kW fiber laser (JK2000FL) is introduced



FL Product Range Development

Maximum Power Fiber Laser Product by Year



- JK Fiber Lasers use their own patented technologies and know-how to give unique user advantages.

Beam Delivery/HP Combiner

US2010/0124393 – US pending (near granted)
 EP8750781 – EU pending
 2010-511726 – JP pending
 WO2011/048398 – Application in progress

Fiber Architecture

US7649914 – US granted
 200680037877.1 – CN granted
 EP06794985.9 – EU pending
 US 2009/0251770 – US pending
 EP7824915.8 – EU pending

Fiber Laser System

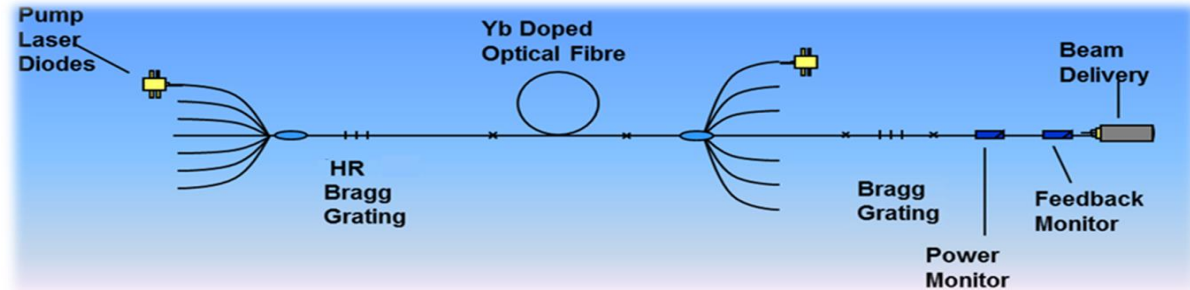
US7839902 - Granted
 EP06795014.7 – EU pending

Combiners

EP2033277 – EU granted
 US7720340 – Granted
 200780029869.7 – CN pending
 2009-517441 – JP pending

Applications/Process

US2009/0296748– US pending
 EP09718580.5 – Application in progress
 PCT/GB2011/051359 – Application.



The 'Smart Laser™' Concept

- JK Lasers have over 40 years experience of designing, manufacturing and processing with our own industrial lasers.
 - This experience has already been 'designed in' to our range of Fiber Lasers.
- JK Lasers now present the 'Smart Laser™' Concept
 - Of course beam quality, reliability etc. are highly important
 - But these are now 'givens' for industrial fiber lasers.
 - Next generation lasers will have features that ensure higher throughput, better process control and save money by eliminating the need for additional external controls and equipment.
 - Now that is a 'Smart Laser™'.

'Smart Laser™' features

- JK Lasers is showcasing a number of our key differentiators and 'Smart Laser™' features.
- This presentation covers:
 - Back Reflection Protection
 - Focus Position optimisation
 - In Process Monitoring

- What is Back-Reflection?
 - Laser light reflected back from the work-piece
 - Can occur when processing reflective materials like Al, Cu, Au, Ag
 - Can occur when 'coupling in' to less reflective materials or being out of focus
- Why is avoiding back-reflection important?
 - At best it will affect the effectiveness of the laser process
 - At worst it can damage an unprotected laser source or delivery fibre
- Generally how is it protected against?
 - By not processing reflective materials!
 - By using non-optimal process head alignments
 - By using additional components to protect the laser source
- Many new laser users don't appreciate the problems that back reflections can pose - until they hit the problem!

A fibre damaged by BR



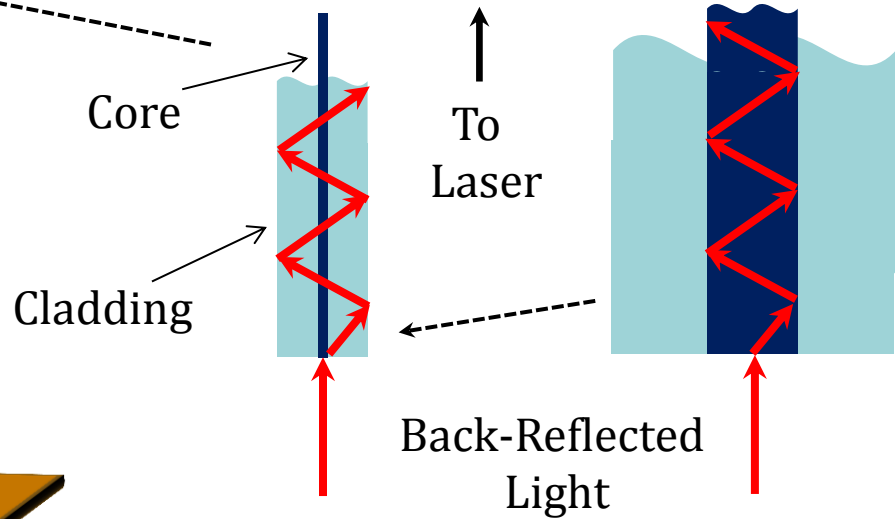
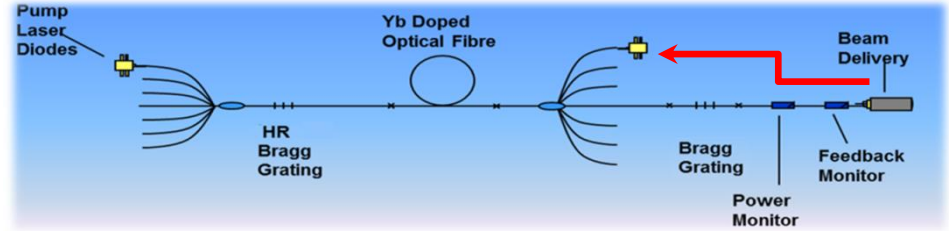


Unprotected
Laser Source

Delivery Fiber

Process Tool

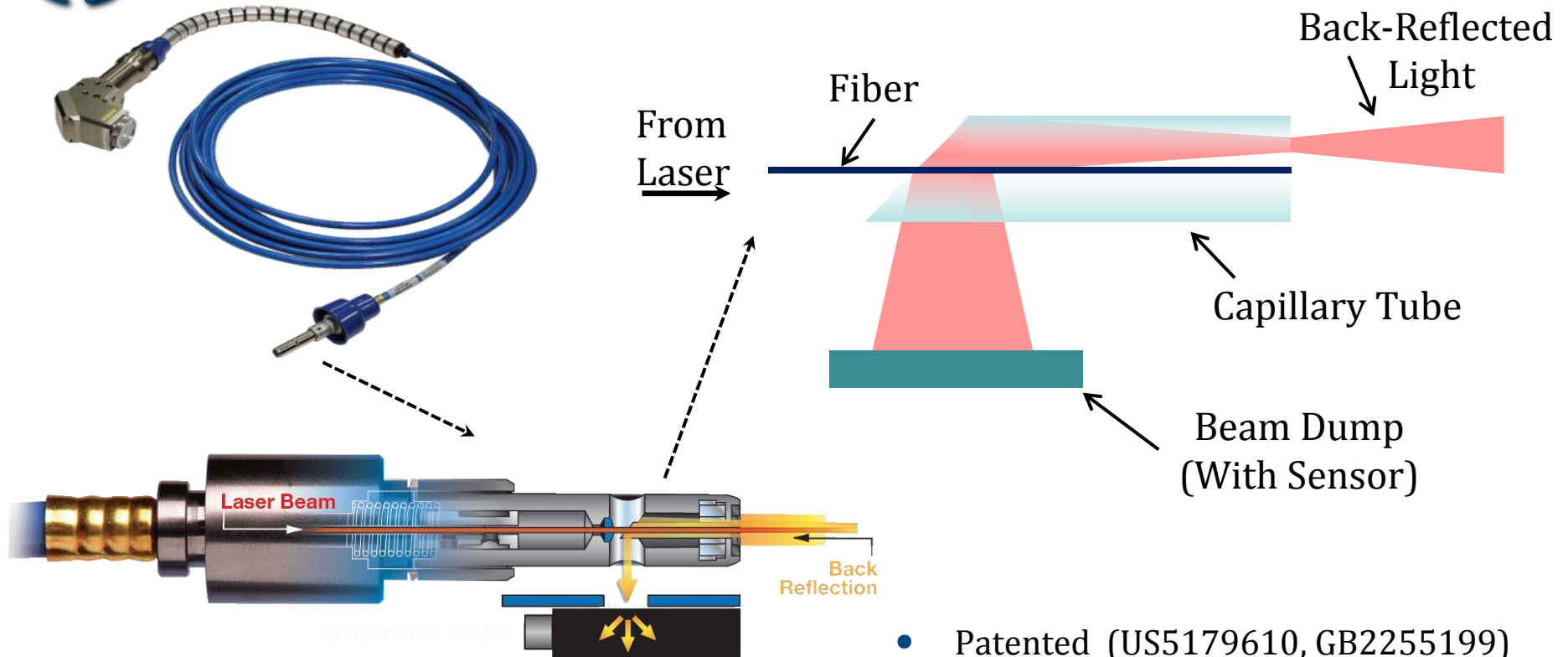
Reflective Material
e.g. Al, Ag, Au, Cu



Protecting Against Back-Reflection

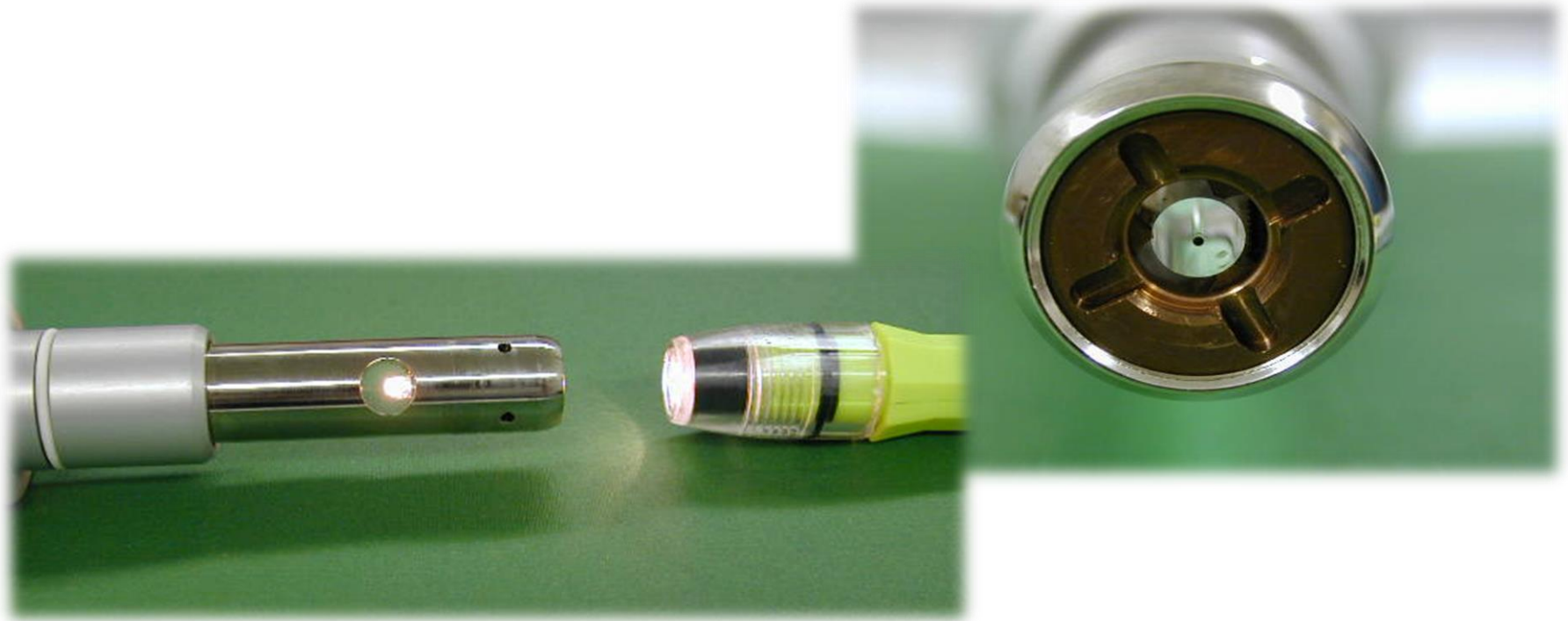
- Faraday isolator
 - Degrades beam quality & power
 - Adds significant extra cost.
 - Bulky, especially for higher powers
- Process at an angle
 - Elliptical spot
 - Material cut becomes thicker
 - Uneven kerf width & cut profile
- JK Lasers' Smart solution
 - Luminator™ fiber

JK Luminator™ Fiber



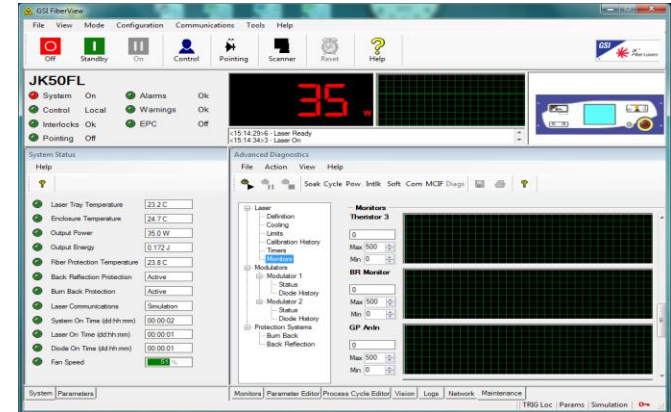
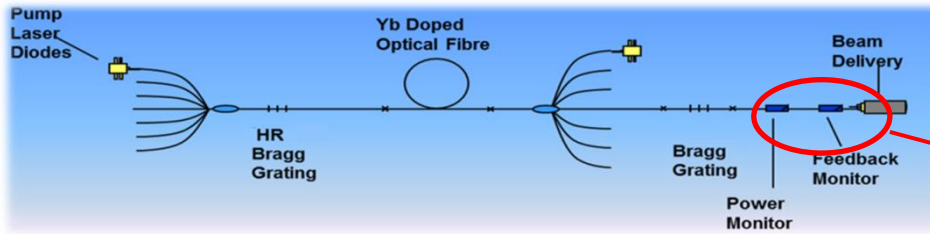
- Patented (US5179610, GB2255199)
- It comes as standard
- Simple, Plug-in – Pre-aligned
- Automatic interlocking with laser

Features of Luminator™ Fibres



Back Reflected light is rejected out of the side of the connector.

- Protection against Back-Reflected light is also designed into laser control system



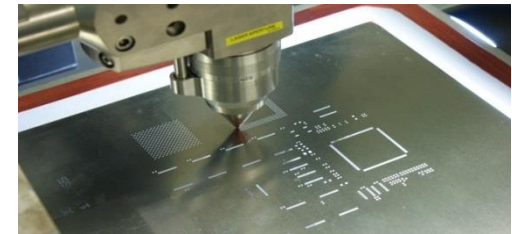
- Back-reflection levels constantly monitored
- Laser protects itself if excessive levels detected
- Very fast embedded control system response time (ns)
- Back-reflection levels may be viewed in FiberView™ GUI
- Short and long response times monitored.

Harnessing Back Reflection

- Back-reflection can actually be a useful thing
 - if we can harness the signal.
- The measured back-reflection levels are available for:
 - Automatic focus finding
 - No additional external control system components needed
 - Saves system cost, improves repeatability and throughput
 - Automatic material pierce detection
 - No additional external components needed
 - Saves system cost, improves throughput
 - Process status monitoring



Focus Finding

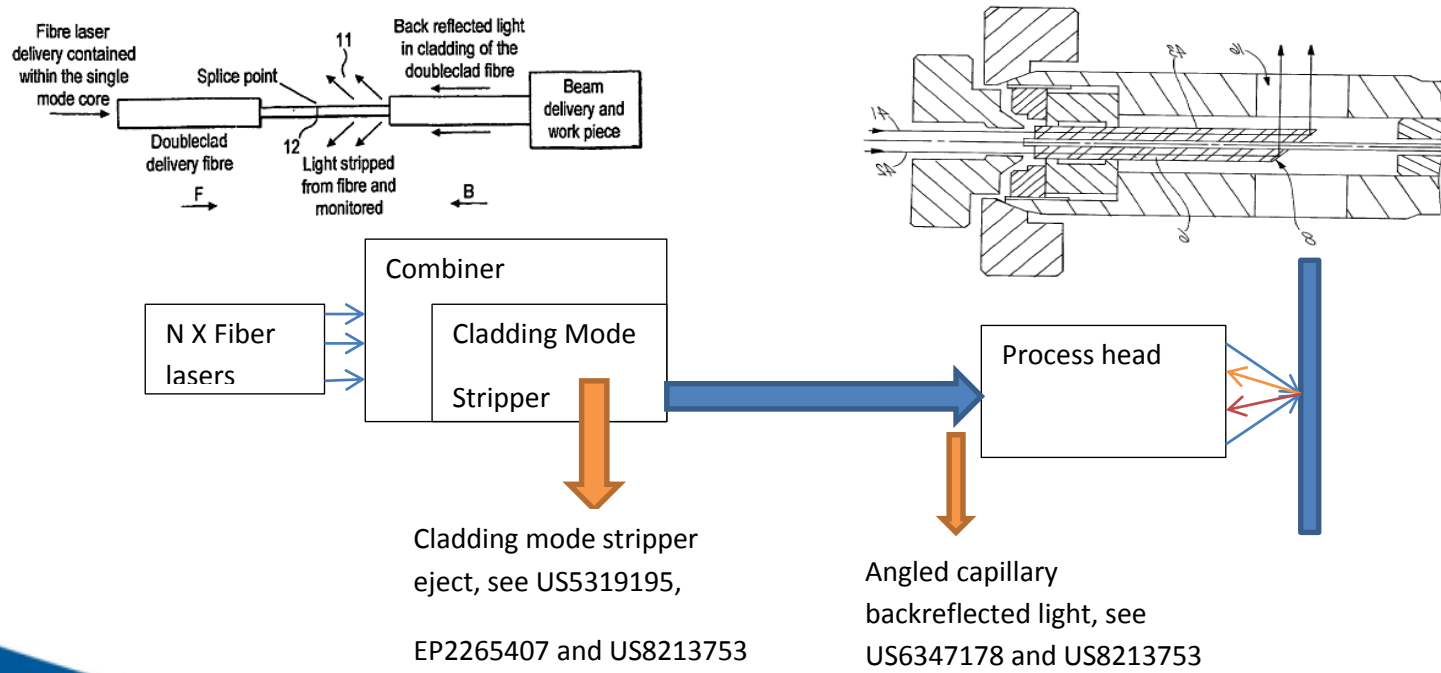


Pierce Detection

Signal Access Points

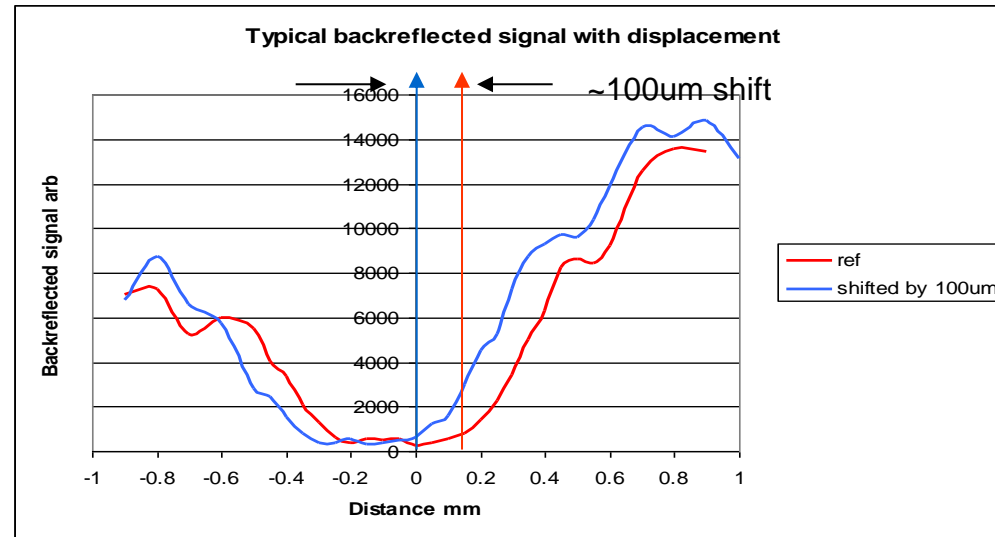
Having Fiber Laser and Beam Delivery system from a single supplier allows for an integrated approach

- using multiple access points to Back Reflected signal.

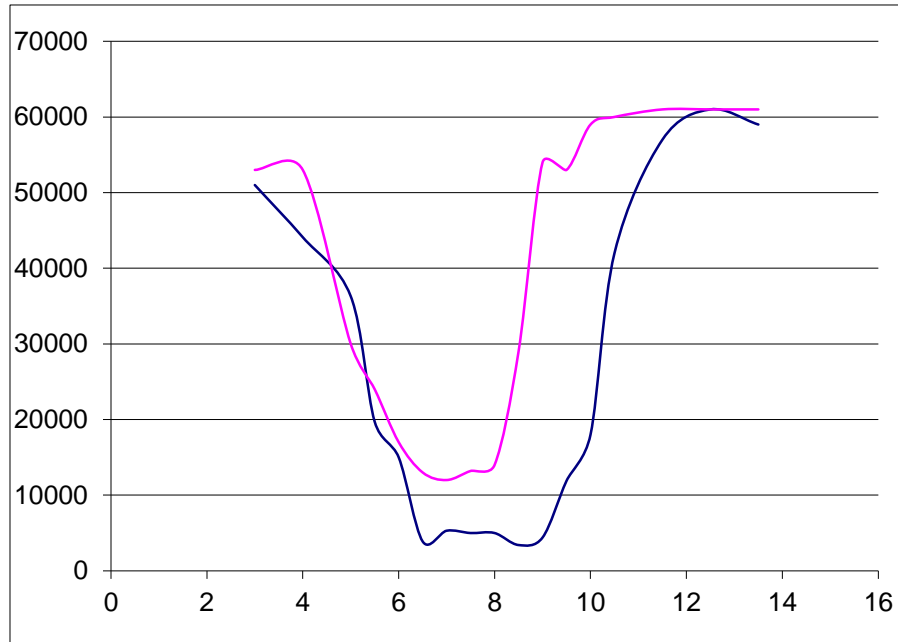


Focus optimisation using BR signal

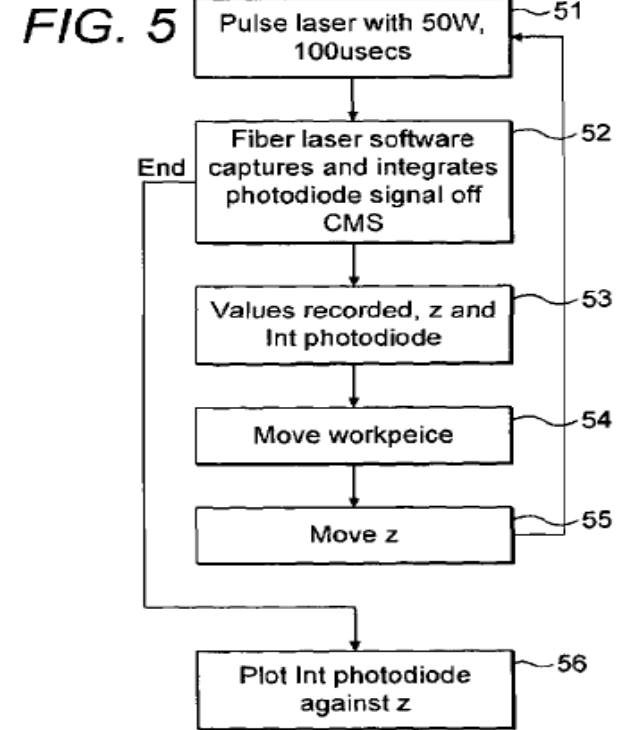
- A null is formed around the focus point
 - around the size of the depth of field of the beam
- Different spot sizes have been tried, all give similar curves
- Finding the vertex of the parabola gives greater accuracy,
- 100 μ m displacement measured
- Possibility of use on welding and galvanometer based scanning systems



Focus Optimisation



Copper (purple curve) & SS (pink curve)
Compared



(10) International Publication Number
WO 2012/022951 A1

EP 2 265 407 B1

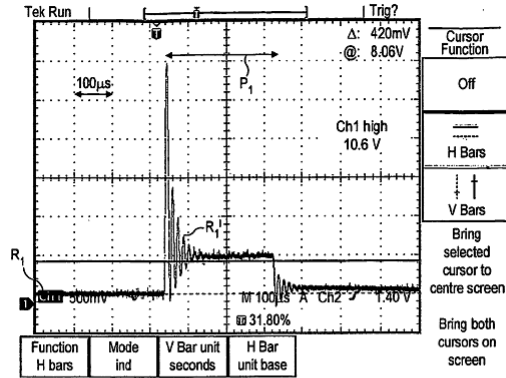


FIG. 3

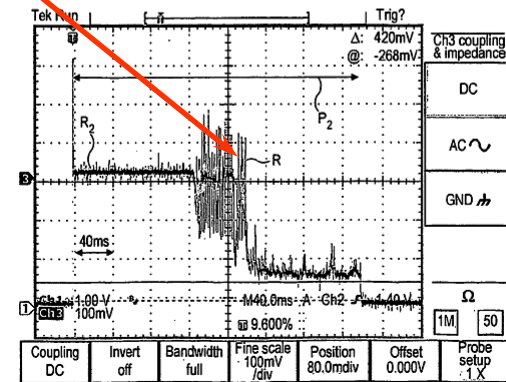


FIG. 4

Process monitoring
Coupling in detection

EP 2 265 407 B1

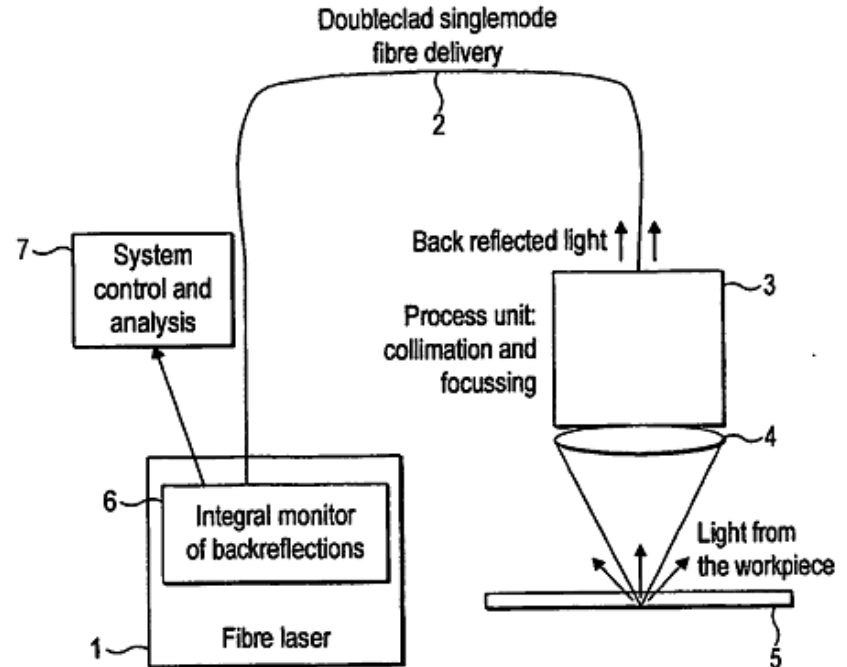
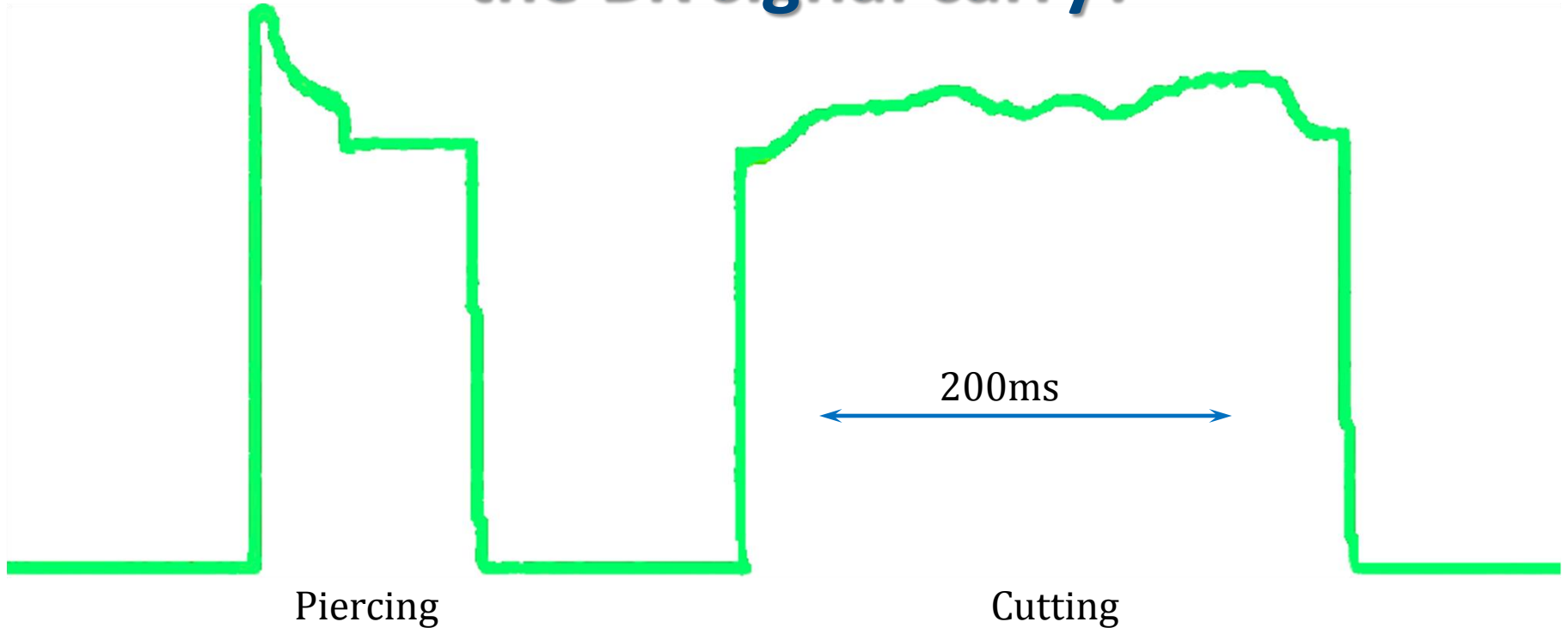


FIG. 1

What information does the BR signal carry?



- Here, half programmed Pierce dwell time was wasted
 - Over complete nested sheet of thick metal, this is appreciable productivity reduction.

Patent Protection

Patent number	Title	International Publication date	Priority date	Expiry date
US5319195	Laser system method and apparatus for performing a material processing operation and for indicating the state of the operation	NA	2/4/1992	2/4/2012
US5850068	Focus Control of Lasers in Material Processing operations	NA	3/6/1997	3/6/2017
US6347178	Optical Fibre apparatus	NA	1/11/1999	1/11/2019
US8213753	System for delivering the output from an optical fibre	20 th May 2010	29/5/2008	8/12/2029
EP2265407 (WO2009/112815)	Process Monitoring	17 th September 2009	13/3/2008	13/3/2028
WO2012/022951	Method of optimising the focus of a fibre laser	23/2/2012	10 th August 2010	NA

- Fiber lasers are generally very similar in terms of being a source of light for materials processing.
- What can differentiate these laser sources is their level of sophistication in terms of “Smart Laser” features
 - Ease of integration
 - User friendliness
 - Remote diagnostics
 - Process improvements
- Back-reflection can be a big problem
 - Protecting against it can be expensive and uses bulky components
 - JK Lasers Luminator™ fibers and smart laser control system are a low cost in-built solution that completely protects against back-reflection.
- Back-reflection can be useful
 - It can be used to monitor the laser process, detect breakthrough and find laser focus.

