行政院及所屬各機關出國報告
（出國類別： 考察 ）

2003 年歐洲雷射公司參訪出國公差報告

服務機關：國防部中山科學研究院
出 國 人 職　　稱：聘用技正 中校技正
姓　　名：黃繼震　　翁仁彥
出國地區：英國、德國
出國期間：92 年 11 月 19 日 至 28 日
報告日期：93 年 2 月 6 日

CSIPW-93B-F0002

國外公差報告

中山科學研究院

國外公差心得報告

批	示

公差年度	九十二年度	所屬各級主管單位	計品會	政戰部	企劃處
單位	第二研究所工程發展組		本軍通出國案考察液晶面板玻璃切割等技術，此等技術應用於本院專案計畫之精密印刷模板雷射切割機台等。出國報告並針對參觀各項製程技術與產品提出優點與極限，確已達成「考察」工作。	案內資料已完成資料審查，未涉保密範圍。	一、有關建議院內加上商情資訊之建立乙節，請加會設供處。 二、本案請將資料上傳行政院研考會網站，並將報告裝訂五份紙本後送本處技術推廣組三份，一份紙本及電子檔(自行上圖書館網站/工作報告資訊網，進e-doc系統上載留存)送本處科資組，另紙本「科技推廣組」存。
級職	聘用技正 中校技正	第二研究所長蘇玉杰 第二研究所工程發展組長徐玉虎 第二研究所機械總處處長許覺良	計品會任務委員黃明揚 計品會本軍任務委員張起明 計品會資訊通信組長王密 計品會資訊通信組任務委員江秀芬	政治作戰部主任蔣金城 政治作戰部副主任陳海鷹 政治作戰部保防官黃名宏 保防安全組組長劉智勝	企劃處處長蔣雅倫 企劃處科資組組長陳繼元 科技推廣組組長丘炎川
姓名	黃繼震 翁仁彥				

931653

敬會設供處

國外公差人員返國報告主官(管)審查意見表

本院二所翁仁彥先生與黃繼震博士等二員赴英、德公差，行程安排相當緊湊，在短時間內參訪了五家雷射製造廠及雷射應用研究單位，其效益良好值得嘉許，出國公差報告在規定時程內完成，內容詳實，極具參考價值，赴歐洲公差有具體成效。

翁、黃二員 2003 年歐洲雷射公司參訪，確實掌握目前世界液晶面板玻璃雷射切割技術現況，獲得不少寶貴的資訊與資料，在報告中更針對該項應用未來技術發展趨勢提出分析與討論，實為可貴，對本院未來計畫之執行相當有幫助。

另外該二員此次參訪 Spectron Lasers、GSI Lumonics、EdgeWave、Fraunhofer ILT 及 LZH，實地瞭解各公司或研究機構的發展現況及在公司內部的研究發展之情形，並建立聯繫合作管道，對日後執行先進雷射切割工具機技術之研發工作助益甚大。

本所在工具機技術研發方面累積了不少經驗與成果，正積極將所累積的技術推展於本國工業以及國防各項計畫之執行。將鼓勵同仁持續加強研發，迎頭趕上現代之潮流。

依本院 85.11.25((85)蓮菁字 15378 號令，返國報告上呈時應附主管評審意見

報　告　資　料　頁			
1. 報告編號： CSIPW-93B-F0002	2.出國類別： 考察	3.完成日期： 93.02.06	4.總頁數： 33
5.報告名稱： 2003 年歐洲雷射公司參訪出國公差報告			

6.核准文號	人令文號	和程字第０九二０００九二六七號
	部令文號	
7.經　費		新台幣： 貳拾叁萬陸仟零肆拾　元
8.出(返)國日期		九十二年十一月十九日至二十八日
9.公 差 地 點		英國 德國
10.公 差 機 構		英國 GSI Lumonics, Spectron Lasers 德國 Fraunhofer ILT, EdgeWave, LZH
11.附　記		

系統識別號

行政院及所屬各機關出國報告提要

出國報告名稱：2003 年歐洲雷射公司參訪出國公差報告

頁數 33 含附件：☑是□否

出國計畫主辦機關/聯絡人/電話

國防部中山科學院/翁仁彥/(03)4712201-356850

出國人員姓名/服務機關/單位/職稱/電話

黃繼震/中山科學院/工發組/聘用技正/(03)4712201-356850

翁仁彥/中山科學院/工發組/中校技正/(03)4712201-356850

出國類別：☑1 考察□2 進修□3 研究□4 實習□5 其他

出國期間：
92 年 11 月 19 日 至 28 日

出國地區：
英國、德國

報告日期：
93 年 2 月 6 日

分類號/目

關鍵詞：Nd:YAG 雷射、二極體激發固態雷射(DPSS)、新型板條式雷射(INNOSLAB laser)、玻璃雷射切割、多重雷射光束吸收 (MLBA) 、飛秒雷射(Femto-second laser)

內容摘要：(二百至三百字)

為有效達成本院軍通案「新興產業精密機械系統關鍵技術研究發展三年計畫」之「半導體與光電產業製程設備」分項計畫工作，派黃繼震、翁仁彥二員赴英國、德國，參觀 Spectron Lasers、GSI Lumonics、EdgeWave、Fraunhofer ILT 及 LZH 等雷射及研發中心，瞭解先進玻璃雷射切割領域之最新發展動態與產品規格，為執行後續科技專案計畫案規劃及發展依據。

配合液晶面板玻璃切割，目前評估可行之雷射切割技術有三大類，除原先二氧化碳雷射外，尚有 EdgeWave 專利研發成功的二極體激發 Q switch 新型板條式雷射、LZH 的多重雷射光束吸收 (MLBA) 切割及飛秒雷射技術。這些訊息對後續印刷模板雷射切割機台，或液晶面板雷射切割機台相關計畫順利建案及推展，相信有相當助益。

行政院及所屬各機關出國報告審核表

出國報告名稱：2003 年歐洲雷射公司參訪出國公差報告	
出國計畫主辦機關名稱：國防部中山科學研究院	
出國人姓名/職稱/服務單位：黃繼震、翁仁彥/技正/中山科學研究院 等二人	
出國計畫主辦機關審核意見	□1.依限繳交出國報告 □2.格式完整 □3.內容充實完備 □4.建議具參考價值 □5.送本機關參考或研辦 □6.送上級機關參考 □7.退回補正，原因：□①不符原核定出國計畫 □②以外文撰寫或僅以所蒐集外文資料為內容 □③內容空洞簡略 □④未依行政院所屬各機關出國報告規格辦理 □⑤未於資訊網登錄提要資料及傳送出國報告電子檔 □8.其他處理意見：本案屬一般類，呈閱請送紙本四份及電子檔至本組結案。
層轉機關審核意見	□同意主辦機關審核意見 □全部 □部分_____（填寫審核意見編號） □退回補正，原因：_____（填寫審核意見編號） □其他處理意見：

會政戰室 綜管組

第二研究所綜合管理組長 尹靖遠

第二研究所保參官 羅琳

第二研究所處長 鄭昇陽

第二研究所技佐 呂旺金

第二研究所技士 吳典敏

第二研究所保防員 賈智安

說明：

一、出國計畫主辦機關即層轉機關時，不需填寫「層轉機關審核意見」。

二、各機關可依需要自行增列審核項目內容，出國報告審核完畢本表請自行保存。

三、審核作業應於出國報告提出後二個月內完成。

中山科學院公差出國人員報告目錄

壹、出國目的及緣由

為有效達成本院軍通案「新興產業精密機械系統關鍵技術研究發展三年計畫」之「半導體與光電產業製程設備」分項計畫工作，需派黃繼震、翁仁彥二員赴英國、德國，參觀 Spectron Lasers、GSI Lumonics、EdgeWave、Fraunhofer ILT 及 LZH 等雷射切割及液晶製程大廠，與國外專家、學者共同研討平面液晶顯示器製程技術、先進玻璃雷射切割機領域之最新發展動態和最新產品規格，瞭解最新技術及市場狀況，並蒐集、觀摩相關資訊，作為執行後續科專計畫案規劃及發展所需。

貳、公差心得

本次公差任務主要分為五大部份，分別為參訪位於英國 Rugby 的 GSI Lumonics 及 Spectron Lasers，參訪位於德國亞琛(Aachen)的 EdgeWave 及 Fraunhofer ILT(Institut LaserTechnik)，與參訪位於德國漢諾威的 LZH(Laser Zentrum Hannover e.V.)，本心得報告內容即按此順序，就參訪各公司分別簡要說明之：

一、GSI Lumonics 參訪紀要

1. 公司：GSI Lumonics, Rugby
2. 時間：92 年 11 月 20 日下午(英國)
3. 接待人員：
   銷售發展經理 Richard Jessett
4. 討論事項：

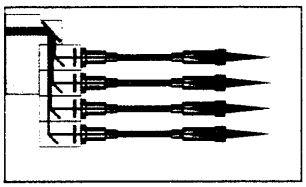
   午餐過後，下午約一點左右到達 GSI Lumonics，在接待人員 Richard Jessett 先生陪同下(如圖一所示)，參觀工廠，主要介紹該公司 JK 系列 Nd:YAG 雷射，應用範圍極廣，包括焊接、切割、切削、鑽孔及研磨拋光等等。

   JK 系列 Nd:YAG 雷射完全支援雷射光束光纖導引，隨插即用，大幅減少空間限制，提高使用彈性且無需做任何光路校準(alignment)。雷射光束傳導採用光纖導引，因為轉接頭內建反射鏡，可大幅縮小空間及使用限制；而且可以作單雷射源對多個雷射頭的應用，將雷射光傳輸分為能量分配、時間分配或能量加時間分配，如圖二所示。

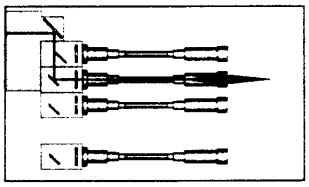
   此外，該公司亦生產 JK700TR 系列，雙晶棒(Twin

Rod)型式之 Nd:YAG 雷射源，透過大幅提升光束品質，可以應付更微細之光纖傳輸應用，平均功率在 800W 以下。另依功率分級類推，則 JK500、JK802 及 JK1002 分別為 500W、800W 及 1000W 之雷射源。由於該公司內部，並不開放拍照，所以無法在報告中附上公司內部生產情形。

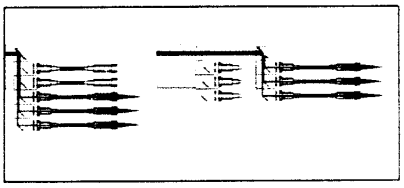
圖一、與接待人員合照於 GSI Lumonics
(由左至右依序為翁仁彥及 Mr. Richard Jessett)



Energy Share



Time Share



Energy Share + Time Share

圖二、單雷射源對多個雷射頭的應用

二、Spectron Lasers 參訪紀要

1. 公司：Spectron Lasers (GSI Lumonics, Rugby)
2. 時間：92 年 11 月 21 日 (英國)
3. 接待人員：
   銷售工程師 Jon Merry 及生產經理 Ian Andrews
4. 討論事項：

上午 9 時左右到達該公司，聽取 Jon Merry 先生所做的多媒體簡報，歷時約 30 分鐘，對 Spectron Lasers 公司所生產的 Nd:YAG 雷射 SL600 等系列作詳細介紹，包含其規格及沿革，對其研發能量有初步的認識。接著在招待人員陪同下，參觀工廠。公司內部，並不開放拍照，所以無法附上公司內部生產情形。

該公司已於 2003 年 8 月正式併入 GSI Lumonics，屬於 GSI Lumonics Laser group，主要生產各式雷射源模組，包括各式二極體激發固態雷射、燈管激發固態雷射、RF 激發二氧化碳雷射及直流激發二氧化碳雷射等。Rugby 廠主要的工作為系統總成組裝、測試及調校。該公司生產線之配置概依雷射模組組成劃分，工廠全景如圖三所示。

此次與 Ian Andrews 先生討論的有印刷模板切割(Brass stencil cutting)、玻璃基板切割(Sheet glass cutting)及鑽石鑽孔(Diamond drilling)等議題。

目前該公司可應用於玻璃切割之雷射源，仍以二氧化碳雷射為主，對於玻璃基板切割應用較為可行者為 SLC200 直流激發二氧化碳雷射，其波長 10.6 微米，輸出功率為 200W。切割玻璃關鍵技術在於輸出功率分布曲線，要使用雙腔式(2-tube)雷射，以產生平頂式分布曲線(top-head profile)。因為一般雷射為單管式，輸出功率形成高斯分佈曲線(Gaussian profile)，採用雙腔使曲線適當疊合後，產生平頂式分布曲線，功率亦加倍。

應用於玻璃切割方面，二氧化碳雷射仍有功率高、價格低及較易為玻璃吸收等優勢，可是有光束品質較差、需多道次處理及需加冷卻水使玻璃脆裂等缺點。所以目前日本研發成功之機台，即以此種雷射源組成。

圖三、Spectron Lasers 工廠全景

圖四、與接待人員合照於 Spectron Lasers
(由左至右依序為 Mr. Jon Merry、黃繼震博士及 Mr. Ian Andrews)

三、EdgeWave 參訪紀要

1. 公司：EdgeWave, Aachen
2. 時間：92 年 11 月 23 日(德國)
3. 接待人員：

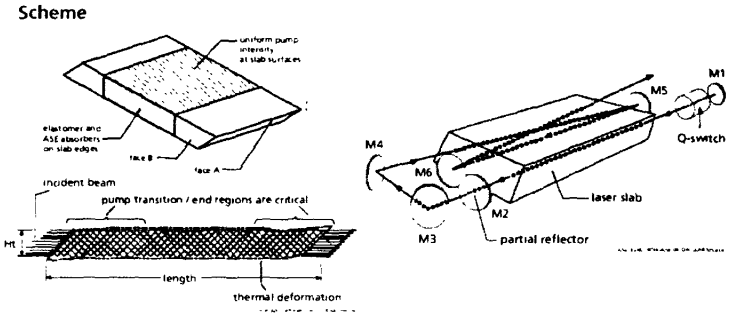
   公司負責人 Dr. Keming Du(杜可明博士)
4. 討論事項：

上午 9 時左右到達該公司，聽取杜可明博士所做的多媒體簡報，歷時約 50 分鐘，對 EdgeWave 公司所生產的新型板條式雷射(INNOSLAB laser)有詳盡解說。隨後即帶領我們參觀該公司的各類雷射源，並進行奇美試片的試切及檢驗作業。

該公司創立於 2001 年 6 月 12 日，自 Fraunhofer ILT 分離(spin-off)，專門從事二極體雷射源之發展、製造及銷售，目前仍位於亞琛雷射技術研究所 Fraunhofer ILT 內部，預計於 2004 年遷出獨立。

傳統的板條式雷射架構如圖五所示，雷射光經二極體激發後，透過 M1~M6 反射鏡，於晶體內部曲折盤旋後射出。此種雷射有以下缺點：

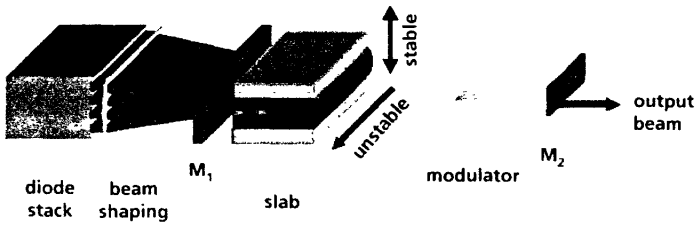
- ◆ 晶體的所有表面多必須經過研磨拋光，增加許多晶體加工程序。
- ◆ 詭譎多變的晶體夾持及冷卻方式。
- ◆ 光束於晶體內部路徑曲折盤旋。
- ◆ 有 parasitar 模式振盪。
- ◆ 過低的效率。
- ◆ 大的相位扭曲，造成低光束品質。



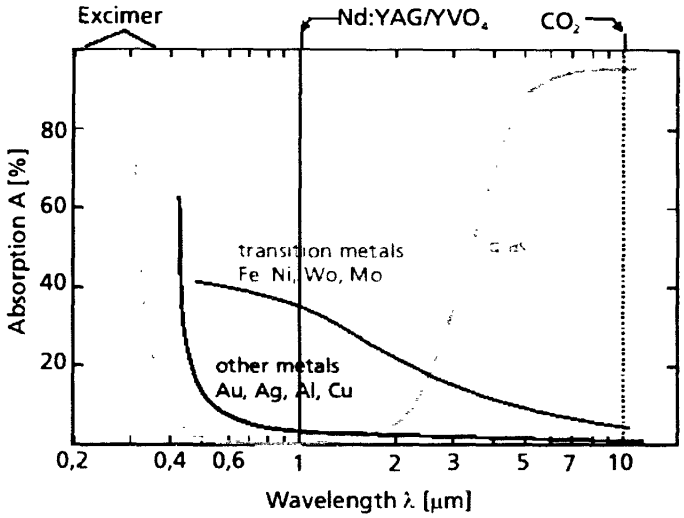
圖五、傳統板條式雷射架構

新型的板條式雷射架構如圖六所示，雷射光經 diode stack 激發，再經光束整形器及透鏡後，即以平行直線前進，因此無傳統板條式雷射的缺點。新型板條式雷射有下列優點：

- 只有二個面須經過研磨拋光，具簡單的晶體幾何。
- 有效率的散熱接面，具大面積的熱傳導。
- 單自由度的熱傳導，具有－
  - 低的退極化損失
  - 低的相位損失
- 光束以單純直線通過晶體，具有－
  - 混合式共振器
  - 無 parasitar 模式振盪。



圖六、新型板條式雷射架構



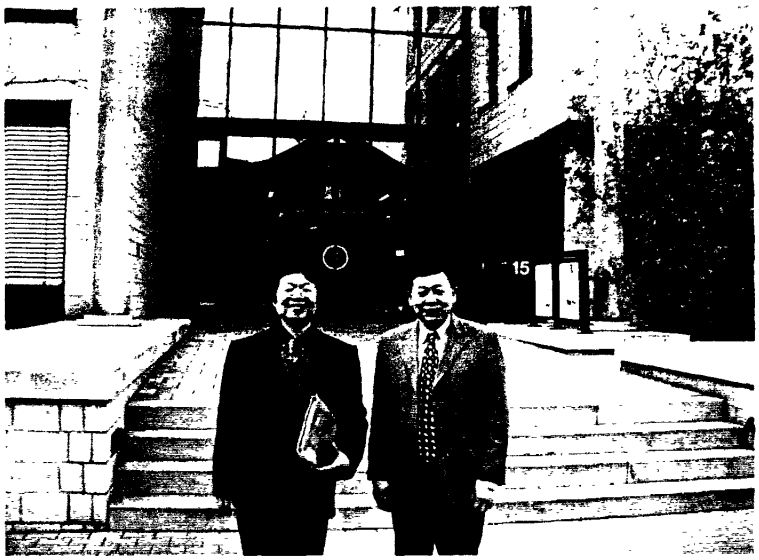
圖七、玻璃對於各種雷射源之吸收特性

玻璃對於各種雷射源之吸收特性如圖七所示，可知玻璃對於二氧化碳雷射吸收率為最高，事實上對於固態雷射 Nd:YAG 或 Nd:YVO4 之吸收率是非常低的，可是新型板條式雷射透過對於強度分布之控制，則可以使得其吸收率快速上升至 80%左右。

該公司生產之二極體雷射應用例證有：

1. 微結構燒結：可達 50 微米
2. 研磨：具高生產率、低成本及可靠度高之優點
3. 大理石地板防滑工程：以雷射進行快速細微打孔，速度可達每秒二萬個 50 微米的凹孔，每步可處理 600 X 600 mm^2。
4. 小型印刷電路板成品加工(移除)
5. 陶瓷鑽孔：厚度 1 mm，直徑 0.4 mm。
6. 玻璃內雕、鑽孔及構型：該公司最引以為傲者。

經過與杜可明博士討論，初步評估得知，可應用於液晶面板玻璃切割之雷射源為 IS 532-15E(Nd:YVO_4)，屬於二極體激發 Q-switch 板條式綠光雷射，波長 532 nm，功率 15W，重複切換頻率 15kHz，售價 56000 歐元。並且已經對奇美公司提供的面板進行實際試切，並以顯微鏡進行檢測，效果不錯，所造成的 micro crack 只有 70~100 um，只是進給速度略顯不足。



圖八、與杜可明博士合照於 EdgeWave

四、Fraunhofer ILT 參訪紀要

1. 公司：Fraunhofer ILT, Aachen(亞琛雷射技術研究所)
2. 時間：92 年 11 月 24 日(德國)
3. 接待人員：
   副所長 Peter Lossen 博士
4. 討論事項：

上午 9 時左右到達該研究所，聽取副所長 Peter Lossen 博士的多媒體簡報，歷時約 40 分鐘，對 Fraunhofer ILT 研究所沿革、組成及研發應用成果，作一簡介；接著便由其帶領我們參觀。

該研究所創立於 1980 年，亞琛雷射技術研究所共分為九大研發部門，共有 230 位研究人員，每個部門各有一位博士負責督導，另外在美國及法國亦各有一分支機構。目前的所長為 Reinhart Poprawe 博士，領導該研究所從事各種雷射源之研發、製造、應用及工程整合工作。經費來源大約 25%來自政府(含歐盟)、25%來自招標及 50%來自工業界，2002 年的研發總經費為 17.1 百萬歐元，該研究所在將雷射應用至工業界的工程上，扮演極為重要的角色。

Fraunhofer ILT 主要核心競爭優勢為雷射元件、固態二極體雷射、雷射量測與測試技術、電漿技術、雷射切割與焊接、雷射表面處理、雷射微技術、雷射建模與模擬以及系統整合技術等。

Fraunhofer ILT 研發之雷射或雷射應用遍及機械工程自動化工業、飛機工業、鐵路工業、精密工程、光學工程、電子工程、微電子、半導體工程、通訊技術、醫學技術、生技、金屬製造工業、塑膠工業、金屬生產工業、工具製造業、造紙工業、玻璃工業、陶瓷工業、量測工業及環境工程等等。許多知名公司像 BMW、BOSCH(博世)、BRAUN(百齡)、VALEO、MULTEK 等，均有與其保持合作關係，而雷射製造廠如 TRUMPF 及 ROFIN 等亦有與其合作。

Fraunhofer ILT 不但可以提供這些公司技術服務、試驗、模擬及設計等等，同時也培育人才提供企業所用，真是一舉數得，由此可看出為何德國工業基礎會如此穩固，產官學絕佳的配合，使理論與實際應用發揮得

淋漓盡致。

在研究廠房內有看到有關於工業焊接及切割應用，尤其應用於機械手臂最多，還有應用於火車鐵軌之雜物去除等等。不過據 Peter Lossen 博士表示，他們目前研發方向已經逐步走向生物科技應用領域，並且已經在進行實驗廠房之重整工作。

圖九、與 Dr. Peter Loosen 合照於 Fraunhofer ILT

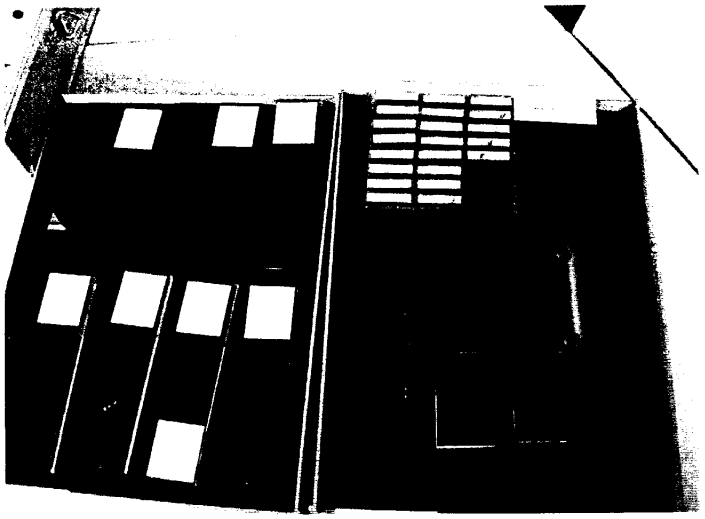
五、LZH MATRA group 參訪紀要

1. 公司：LZH MATRA group, Hannover
2. 時間：92 年 11 月 25 日下午(德國)
3. 接待人員：
   研究人員 Michael Haase
4. 討論事項：

下午到達該公司，聽取 Michael Haase 先生所做的多媒體簡報，歷時約 50 分鐘，介紹 LZH 沿革、組織組成及經費來源等等。

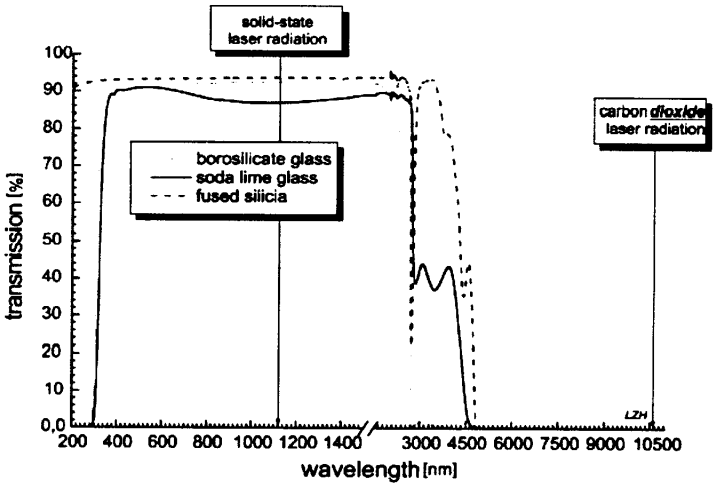
該中心成立於 1986 年 6 月 20 日，目前有將近 250 位職員，包含 120 位研究人員。該中心研發經費自 2001 年開始已連續二年達到 11 百萬歐元，經費來源有近 40%來自工業界、20%來自歐盟及其餘 40%來自其他機構之資助。中心分為四大部門，分別為雷射元件研究部門、雷射發展研究部門、生產與系統研究部門、及材料與程序研究部門。

LZH 的專家們，針對雷射玻璃切割的應用，提出一全新的製程，命名為 MLBA(Multiple Laser Beam Absorption)。所以 Michael Haase 先生還針對 MLBA 技術原理、應用實例等進行詳細介紹；並為我們展示各種不同厚度及外型，以 MLBA 技術切割之玻璃成品，其切口均非常平整，如圖十所示。

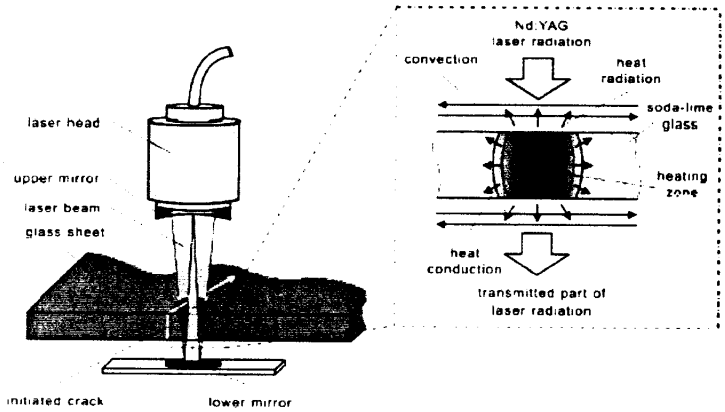


圖十、 MLBA 對各式材質及厚度的玻璃基板試切成品

MLBA 工作原理簡述如下：利用透明物質對低波長雷射光，低吸收率的特性，參見圖十一。在製程上，將雷射光予以多重反射，造成雷射光在物體中，因多重反覆而被多重吸收，進而產生高熱而熔解。由於在物質上、下表面，有自然熱散逸的現象，而內部仍保持高熱，所以外冷內熱造成物質的脆裂，達成切割的目的，參見圖十二。使用此方法，雷射光點與切口的位置距離，約在 20 mm 左右。

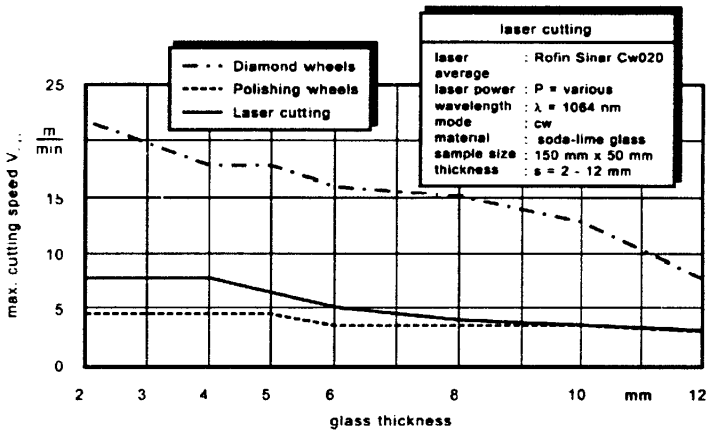


圖十一、雷射波長與物質吸收率

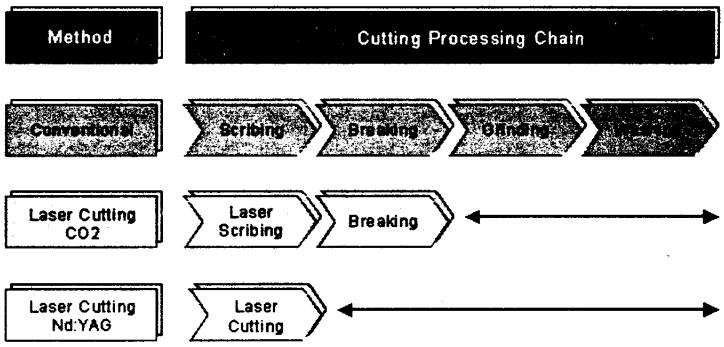


圖十二、MLBA 的工作原理

目前公佈的切割數據，參見圖十三，可達數米每秒的速度，相當可觀。而且，保證能全切斷，對於多層的玻璃試件，也可適用。此外，使用的雷射源，為較便宜的 Nd:YAG，波長 1064 nm 的雷射，大幅提高其可能的實用性。此外 Nd:YAG 雷射在製程整合上，還具有單一製程的強大優勢，參見圖十四，傳統二氧化碳雷射需四個道次，MLBA 二氧化碳雷射需二個道次。

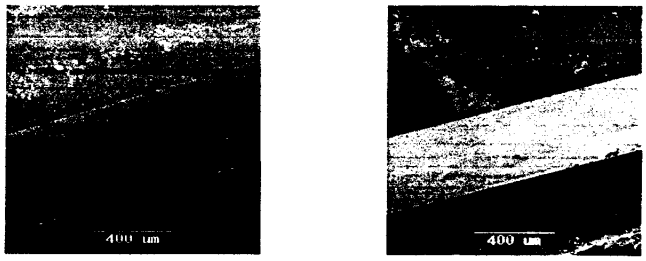


圖十三、使用 MLBA 的切割速度研究數據



圖十四、不同雷射源應用玻璃切割之比較

奇美電子提供的鈹鉻試片的切割結果，參見圖十五(a)與(b)。切割速度約為 1 m/min，速度提昇許多，且切割品質相當不錯。

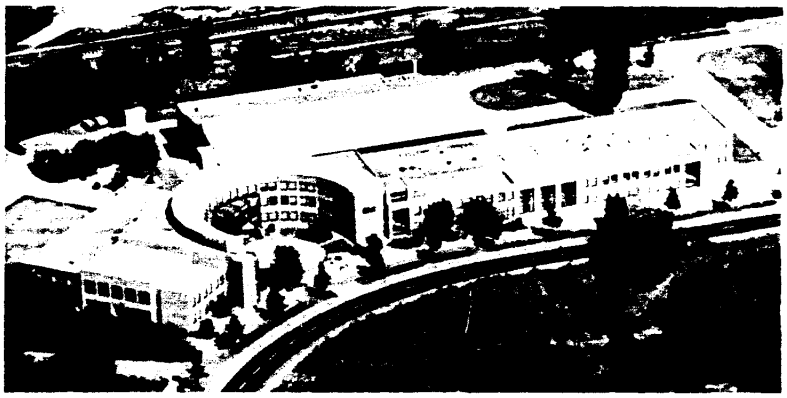


(a) (b)

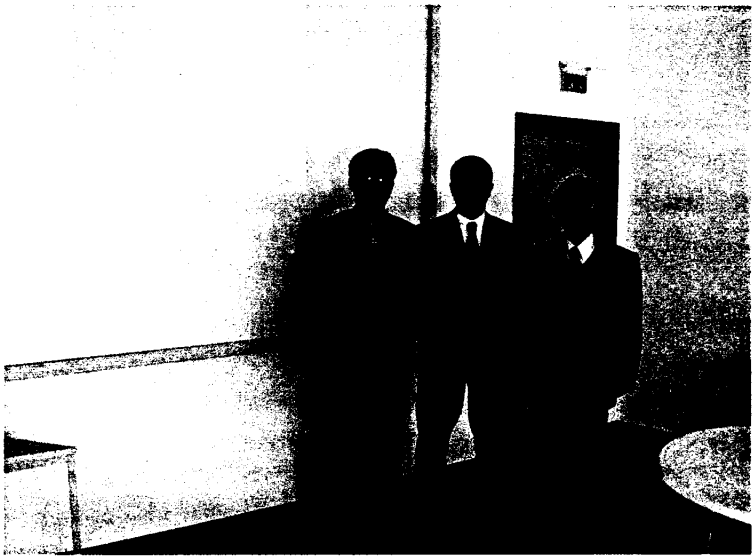
圖十五、使用 MLBA 試切鍍鉻玻璃的切割結果

有關於將 MLBA 應用於液晶面板玻璃切割的技術，目前主要的癥結在於液晶面板成品為二片玻璃夾合，實際切割時，二片(面)的切割線不同，有幾個 mm 的位差。所以液晶面板玻璃切割並非一次完全切斷，而是切割二面後，將其掰斷(breaking)，這與 MLBA 技術要求一次完全切斷相左，因此在製程整合上還有許多問題待解決。

關於 MLBA 技術，目前歐洲各玻璃大廠，已組成研發策略聯盟，正在積極開發新技術，計畫名稱命名為 MATRA (MAchining of TRansparent Materials by Multiple Absorption)。參加的成員，均是歐洲玻璃製作生產，以及雷射研究與應用的知名大廠與機構。本院或國內廠商，若有意在此題目上進行研究，在此時點，是加入的最佳時機。



圖十六、 LZH 雷射研發中心鳥瞰圖



圖十七、與 Mr. Michael Haase 合照於 LZH

六、LZH Short-Pulse laser group 參訪紀要

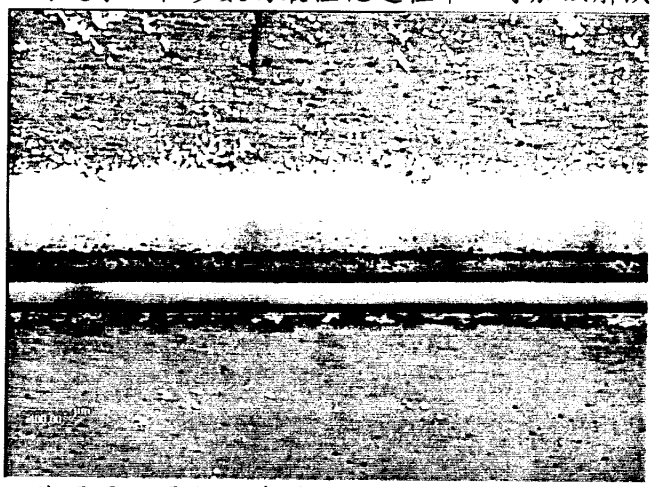
1. 公司：LZH Short-Pulse lasers group, Hannover
2. 時間：92 年 11 月 26 日(德國)
3. 接待人員：
   研究人員 Nico Bärsch
4. 討論事項：

該機構的研發人員，Nico Bärsch 先生，非常熱心的將本組轉寄由奇美電子所提供的玻璃試片，進行試切。截至目前，已提供使用 femto-second 雷射，以及目前正開發的全新製程的試切結果，簡述如下：

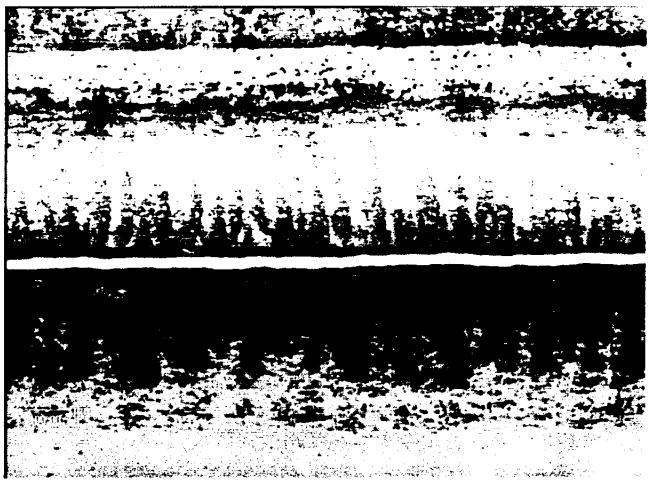
該型雷射利用高速(10^{-9}秒)的快速雷射脈衝，經由破壞物質的電子鍵結，達到切割的目的。由於必須以逐步的"侵蝕"物質，所以雖然理論上可以切開"任何"的物質，但速度會稍慢。

奇美鍍鉻的試片切割結果，參考圖十八與圖十九(均為上視圖)。使用的雷射功率約 800mW，達到的切割速度約 4 mm/min。由於試片較厚 (0.5 mm)，所以切道呈 V 型切口，在入口處的切道寬度約 70 μm，出口寬度約 20-25 μm，至於切道的 V 型切口，認為可以在後續的參數調整中，加以改進。

另外，使用 femto-second laser 對於鍍鉻試片的切割結果，發現在切道週邊約 100 to 200 μm 的範圍內，其鍍鉻的材質，有被雷射侵蝕的現象，並呈現焦黑的顏色。以上的現象，在參數的最佳化過程中，可加以解決。

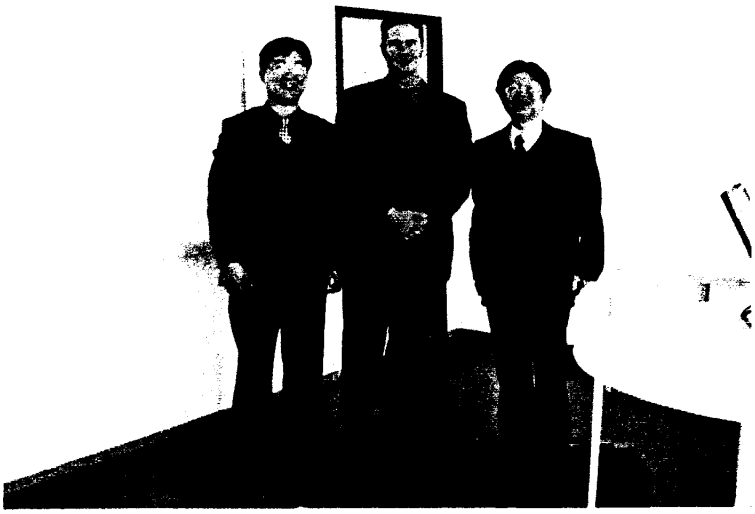


圖十八、使用飛秒雷射對奇美鍍鉻試片的切割結果(入口處)



圖十九、使用飛秒雷射對奇美鍍鉻試片的切割結果(出口處)

於參觀飛秒雷射應用實驗室時，我們看到了第一至第六代飛秒雷射，應用範圍相當廣泛，如生物科技之眼球手術(不用切開眼球表面，而直接聚焦至內部)、植入手術、心導管製作、牙科手術等等。在微機械方面，特別適用於高穿透性材料(如玻璃)、導熱性材料(如金屬)及熱敏感材料(如鑽石、矽晶圓)之切割、鑽孔及構型等等。



圖二十、與 Mr. Nico Bärsch 合照於 LZH

參、效益分析

一、掌握雷射技術發展之最新脈動，可作為將來計畫策訂、發展及執行時之參考

此次參訪歐洲雷射公司及研發機構，可以適時掌握目前各種雷射研發最新動態，了解最新雷射技術，如新型板條式雷射、MLBA 雷射技術、飛秒雷射應用等等，這些資訊對於爾後研發計畫策訂、發展及執行工作均有極其正面之效果。

二、開拓商源，獲得多項計畫所需之產品資訊與商源

經過這次參訪，獲得多項計畫所需之雷射源產品資訊，包括用於印刷模板雷射切割機台研發的 SL600 系列，及可應用於後續玻璃基板切割計畫的新型板條式雷射、MLBA 雷射技術、飛秒雷射應用及雙腔式二氧化碳雷射等等。並且透過這次公差機會，已與歐洲先進雷射研發機構如 Fraunhofer ILT 及 LZH 建立良好互動關係，對於爾後配合計畫推動之轉委託研究及試驗工作，具有相當助益。

三、觀摩新技術與新產品

觀摩各家公司雷射製造及應用實況，得以了解各項新技術，並且獲知其使用限制等等。並藉由奇美公司委託試片，於現場實際切割，了解工作情形，可預知爾後執行機台整合時可能遇到的瓶頸及限制。

四、瞭解雷射切割機之產業應用與建立技術交流的關係

透過對雷射切割機產業應用之更深入了解，可減少將來對於技術溝通時之障礙，同時建立技術交流關係。此次透過向 Spectron Lasers 人員，解說目前本身實際發展雷射切割機台之經驗及現況，並作技術之諮詢，可以減少後續機台發展之困難度。

五、世界觀之建立

此行走訪英國 Rugby 的 GSI Lumonics 公司，以及位於德國亞琛的 EdgeWave 公司、Fraunhofer ILT 研究所與漢諾威的 LZH，對歐洲先進的交通建設及民眾的守法習慣印象深刻。在德國漢諾威地鐵站出入口均未設置閘門，旅客進站後依據自己的需求，至自動售票機構票後搭車，完全採榮譽制度，聽說偶有查票人員，此種公德心之培養值得我們學習。英國各項建設架構傳統而流暢，且深具巧思；另外對於傳統文物建設保存的相當良好，且經營用心，亦是我國需借鏡之處。

肆、國外工作日程表

項次	日期	地點	交往接觸人士及機關（外文名及譯名）				洽談內容紀要	備考
			姓名	國籍	性別	地址		
1	92. 11. 19.	台北 | 荷蘭 阿姆斯特丹 | 英國 曼徹斯特					去程、轉機	
2	92. 11. 20.	英國 曼徹斯特 | Rugby					自曼徹斯特搭火車至 Rugby	
		英國 Rugby	Richard Jessett	英	男	GSI Lumonics Cosford Lane, Swift Valley, Rugby, Warwick-shire, England CV21 1QN	至 GSI Lumonics，參觀 JK 系列 Nd:YAG 雷射，並研討相關技術。	
3	92. 11. 21.	英國 Rugby	Jon Merry Ian Andrews	英 英	男 男	GSI Lumonics Cosford Lane, Swift Valley, Rugby, Warwick-shire, England CV21 1QN	參觀 GSI Lumonics 分支機構 Spectron Lasers，討論參觀 Nd:YAG 雷射 SL600 等系列雷射應用技術，並研討加工技術新趨勢。	宿伯明翰
4	92. 11. 22.	英國 伯明翰 | 德國 亞琛					搭火車前往倫敦，轉搭歐洲之星(Eurostar)至布魯塞爾(04:30)，再轉搭火車至德國亞琛(Aachen)(01:45)。	
5	92. 11. 23.	德國 亞琛	Dr. rer. Nat. Keming Du (杜可明博士)	德	男	EdgeWave GmbH Innovative laser solution Steinbachstrabe 15 D-52074 Aachen	參訪 Edge Wave，蒐集玻璃密雷射切割最新產品規格，研討新型板條式雷射玻璃切割技術。	

6	92. 11. 24.	德　國 亞　琛	Dr.Dipl.-Ing. Physik Peter Loosen 博士	德	男	Fraunhofer Institut Lasetechnik Steinbachstrabe 15 D-52074 Aachen	參訪 Fraunhofer ILT， 蒐集先進玻璃雷射切割機領域最新發展動態及產品規格，並研討關鍵性技術。	
7	92. 11. 25.	德　國 亞　琛 | 德　國 漢諾威					搭火車前往科隆，再轉車前往德國漢諾威(Hannover)	
		德　國 漢諾威	Michael Haase	德	男	LZH Machines and Controls Group Hollerithallee8 D-30419 Hannover	下午參訪 LZH MATRA group，研討 MLBA 技術。	
8	92. 11. 26.	德　國 漢諾威	Niko Bärsch	德	男	LZH Short-Pulsed Lasers Group Hollerithallee8 D-30419 Hannover	參訪 LZH Short-Pulsed Lasers group，研討平面液晶顯示器製程技術、femto-second 雷射玻璃切割應用等。	
9	92. 11. 27.	德　國 漢諾威 | 德　國 法蘭克福					返程、搭火車及轉機	
10	92. 11. 28.	德　國 法蘭克福 | 台北					返程、搭飛機及轉機	

伍、社交活動

➢ 參觀 Rugby

參訪完 GSI Lumonics 後，接受了 Jon Merry 先生的建議，坐車前往該鎮中心的美術館(Rugby Art Gallery)，並拍照留念。當地是橄欖球的發源地，適逢當時世界盃橄欖球賽如火如荼的進行，英國隊即將參加冠亞軍決賽，因此全英國人民都熱血沸騰，讓人深深感受到英國人對於橄欖球運動的熱愛。

接著便到附近的市集逛逛順便用餐，英國的消費很高而且東西的品質不是很好，所以晚餐就隨便打發了。

圖二十一、於 Rugby Art Gallery 留影

➢ 搭乘歐洲之星(Eurostar)

亞琛位於德國西部邊境，我們這次是由伯明翰搭火車至倫敦，從 London Waterloo 車站搭乘歐洲之星(Eurostar)至布魯塞爾(Brussels Midi/Zuid)，再轉搭 Thalys 快車前往德國。耗費將近一整天的時間帶著重重的行囊轉車，真的很辛苦；不過能有搭乘歐洲之星通過英吉利海峽的經驗，享受那份快感，也是相當值回票價。歐洲之星每天從清早五點至晚上十一點左右，在倫敦與布魯塞爾間對開各有十班車次，非常便利，可是費用不貲。

在歐洲搭乘火車作長途旅行，真是非常的便利，尤其是歐洲本土相連的 13 個國家有深耕簽證，有其中一國簽證便可暢遊

各國，所以這次出國考察，就是在倫敦及布魯塞爾的車站內直接通關的。

Brussels Midi/ Zuid 位於比利時境內，為一個國際性車站，月台數目約 30 個，所以車站非常的大，還有地下街可以購物及用餐，非常方便，我們的旅程自此開始使用歐元消費。

圖二十二、於歐洲之星留影

➢ 參觀 Aahen

亞琛是一個滿可愛的小鎮，亞琛(阿亨)工業大學就位在此，當地民風淳樸，而在前一天轉搭 Thalys 快車到達此地時，就遇上一位熱心的小姐，幫我們引領搭車至此，否則我們可能會迷失在異鄉，衷心的感謝她。我們在此二天訪廠後，就到市中心逛街買糖果、禮品及用餐，這裡的巧克力滿不錯的。

➢ 參觀 Hannover

漢諾威的地鐵捷運(歐洲稱為 Underground, 在美國稱為 Subway)四通八達，並且地鐵站出入口均未設置閘門，旅客至自動售票機購票後搭車，票價是以人數及跨越區間數計價，主要營運公司為 GVH(Groβraum-Verkehr Hannover)。

訪問過 LZH 後，搭乘地鐵至漢諾威火車總站內商圈逛逛，因為該車站有將近二十幾個月台，所以也是滿熱鬧的。後來又到站前市區參觀及購物，在歐洲很少看到中國餐館，好不容易在市區找到一家，嚐試後覺得口感怪怪的，猜想可能是為了迎合老外的口味所做的調整吧？或也許有許多食材獲得不易？

陸、建議事項

一、持續執行雷射應用研究

雷射及雷射應用科技日新月異，所以建議本單位應持續推動雷射應用研究。以訪廠、資料查詢、召開研討會等各種方式，與各相關廠家及國外研究單位，進行技術交流，如此才能與最新雷射科技接軌，進而推動先進雷射切割工具機技術研發之進程。

二、院內各組廠的聯合與合作

從此次參訪看到的各式雷射機台上，可以感覺到德國雷射製造及應用研發單位通力合作，致力研發的模式。在德國 Fraunhofer ILT 及 LZH，我們看到政府、研發機構及工業界緊密合作，為發展新型雷射、應用及投注基礎研究，所奉獻的出的心力及成果，保有其他國家所無法取代的地位。

中科院本身就有如一個綜合體，我們是否更應深思，趕快加強院內各組廠的聯合與合作，使我們的戰力倍增，否則我們可能將被時代進步的洪流所吞噬。

三、商情資訊之建立

這次出差前雖然花費許多時間與旅行社溝通，自己上網查詢歐洲火車、飛機及住宿資訊(火機酒)，還有廠商、機構所在位置，可是仍然有許多疏漏，造成旅程上的不便。

建議加強院內各項商情資訊之建立，不但可以使同仁們更具有世界觀，同時在工作上更能得心應手；出外公差時，也可減少時間、金錢及精神上之耗費。

四、新技術之引進、開發與能量建立

建議與德國 Fraunhofer ILT(Institut LaserTechnik)及 LZH(Laser Zentrum Hannover e.V.)建立起長期合作關係，將各類玻璃試片委託其進行各種雷射源之試切，以建立起各種雷射加工經驗，強化後續液晶面板雷射切割機台整合能力，使相關計畫順利建案及推展。

五、鼓勵研發人員參訪國際專業廠或國際大展

這次公差發掘出至少三項雷射技術，可應用於後續玻璃基板切割計畫，如新型板條式雷射、MLBA 雷射技術、飛秒雷射應用及雙腔式二氧化碳雷射等等。而關於 MLBA 技術，目前歐洲歐洲玻璃製作生產，以及雷射研究與應用的知名大廠與機構，已組成 MATRA 研發策略聯盟；本院或國內廠商，若有意在此題目上進行研究，在此時點，是加入的最佳時機。

這些訊息對後續印刷模板雷射切割機台，或液晶面板雷射切割機台相關計畫順利建案及推展，相信有相當助益。所以建議能在預算允許範圍，鼓勵研發人員參訪國際專業廠或國際大展，才能與國際接軌，保有最新的技術及商情資訊。

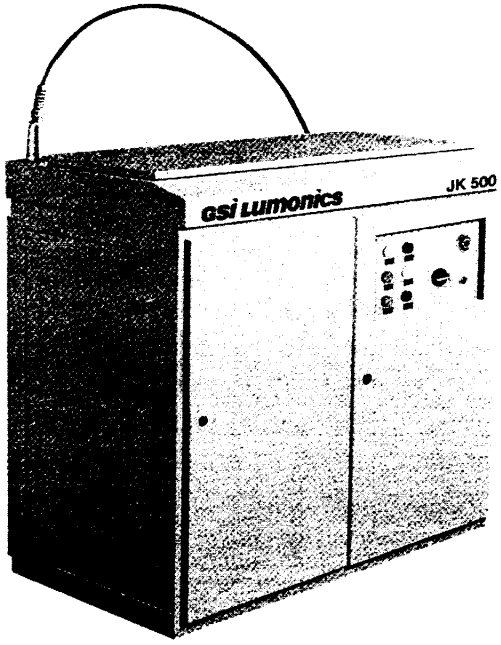
柒、附件

附件

一、GSI Lumonics 公司資料

JK 500

Laser Processing System



- JK 500: the field-proven, flexible, high power YAG laser solution
- Higher speeds, deeper penetration in cutting, welding and surface treatments
- More choice, the right choice — solutions tailored to your specific needs

gsi lumonics

JK Series — the best choice

The *JK 500* offers a wide range of applications from welding thin diaphragms to cutting steel more than 4 mm (.157") thick.

Typical applications

With *JK 500*, the cutting of option holes in automotive "body-in-white" parts can be done right on the production line. The flexible fiber optic cable is easily manipulated by a robot to cut any shape, even in difficult to access locations. *JK 500* easily handles trimming and customizing 3D stampings, such as automotive panels for rapid prototyping and small series runs.

Your investment cost with *JK 500* is lower than for conventional press tools, turnaround is faster and the design options are endless.

Other applications include welding battery lids, sensors and fuel injectors. Cooling rates can be optimized to produce a hermetic seal even with crack sensitive materials. Weld depth is precisely controlled to full or partial penetration by appropriate selection of laser parameters.

JK 500 — an everyday production tool

JK 500 is already field-proven as an industrial workhorse, working "around-the-clock" in the toughest factory environments.

Worldwide service and support

GSI Lumonics maintains a network of service and parts facilities around the world. GSI Lumonics field service technicians are trained in every aspect of maintenance and troubleshooting, and parts are stocked at GSI Lumonics depots in the United States, Japan, Germany, and Hong Kong. Extended warranty and on-site service contracts are available around the world.

Laser Specifications:

Max average power	500 watts
Max peak power	1000 watts
Wavelength	1.064 microns
Output mode	CW, gated, sine & square modulation*
Number of flashlamps	2

Process and Control Features:

- PC user interface
- 24 volt control interface (PLC interface optional)
- Cruise control power stabilizer
- Set maximum and minimum power limits
- Up to 10 sets of parameters stored for instant recall

Facility Requirements (water cooling):

Max water inlet temp.	20°C (68°F)
Flow rate at max temp.	26 liters/min (6.9 US gal/min)
Max inlet pressure	6 bar
Min differential pressure	3.5 bar
Ambient temp.	5-40°C (40-104°F)

**modulation improves fine feature quality in cutting and enhances coupling to reflective metals.*

Fiber Optic Beam Delivery:

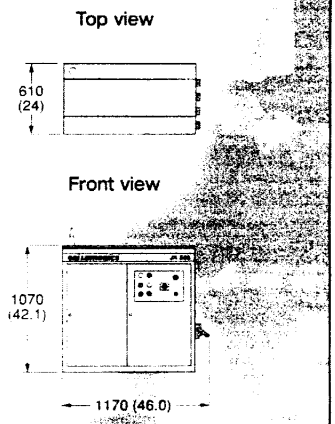
Fiber core diameter	600 micron
Spot size range	0.3mm upwards (0.25mm at reduced power)
Standard fiber lengths	5m, 15m, 30m
Long fiber option	Up to 50m
Time share option	2 way
Max switching time	0.25 seconds
Focus head options	straight/right angled
Viewing options	CCTV
Other ancillaries:	cutting nozzles, auto focus cutting head, cross jet to increase coverslide life when welding

Facility Requirements (electrical):

Voltage/frequency	380-415v/50Hz or 460v/60Hz (factory selected)
Voltage tolerance	± 10%
Supply rating	22 KVA
Max power consumption	20 kW

Physical Characteristics:

Weight	350 kg 771 lbs



dimensions in mm (inches)

GSI Lumonics www.gsilumonics.com 1-800-563-5866

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U.S.A. 48152-1016
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FAX: (734) 591-0045

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FAX: (612) 315-1770

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EU Customer Center
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FAX: 25 1611 22

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68 Connaught Rd. West
Sheung Wan, Hong Kong
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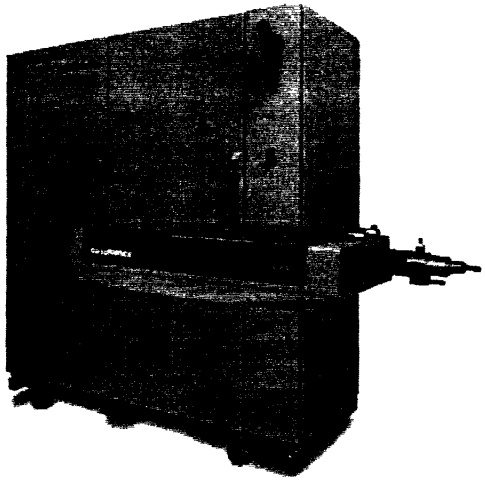
FAX: (852) 2549-5890

Japan
TEL: 03-5714-0380
FAX: 03-5714-0335

JK700TR Series

Models JK715TR, JK730TR, JK745TR, JK760TR



Highest beam quality from a pulsed Nd:YAG laser for reliable cutting, welding, and drilling.

- Combines proven reliability with the latest technology for class leading performance
- TR Technology improves beam quality, average power, and peak power
- Pulse shaping gives you unmatched control of the welding process
- Patented Luminator fiber optics for ease of use and high reliability
- 5 and 10 kW peak power models for spot and seam welding for all industry sectors
- Optional graphical user interface provides simplified access to all laser functions and status

GSI Lumonics

Production proven, with important enhancements

The award-winning *JK700* series of lasers has long been the benchmark by which pulsed Nd:YAG laser performance has been measured. In the new *JK700TR* Series, GSI Lumonics has combined over three decades' experience in producing industrial lasers with enhanced technologies for the best overall cost of ownership for the users of pulsed lasers.

Spanning a range of power levels, the new *JK700TR* series lasers provide the brightest, highest quality beams with the latest technology for class leading performance. Highly versatile, the *JK700TR* series lasers can be used in a variety of applications for welding, cutting, and drilling. Backed by GSI Lumonics' industry leading applications expertise and worldwide support network, these reliable laser systems will work hard for you. For a complete end-to-end solution, GSI Lumonics delivers!

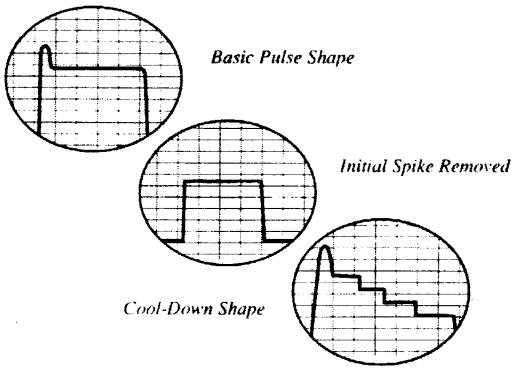
TR Technology for the highest beam quality

GSI Lumonics successfully pioneered our exclusive *TR Technology* with the high peak power *JK704TR* drilling laser. Having proven the technology in production, GSI Lumonics is expanding its use across our range of *JK* welding lasers.

TR Technology uses a twin-rod oscillator design to increase efficiency and decrease heat input into the laser rods. It combines high beam quality with a compact laser head to offer smaller focus spot sizes, greater working distances, and enhanced processing capabilities.

Pulse shaping for precision process control

GSI Lumonics' patented switch-mode power supply enables precise control of all laser parameters, including pulse shape. By using pulse shaping, you can optimize the pulse's peak power, shape and duration to suit your process needs, increasing yield and reducing cost. Pulse shaping can reduce cracking and other defects in difficult-to-weld materials.



Applications data and support

The *JK700TR* series can be used for a broad range of applications, including cutting, drilling, and spot and seam welding. The *JK700TR* series can produce high quality welds up to 2.5 mm deep and up to 2.5 m/min.

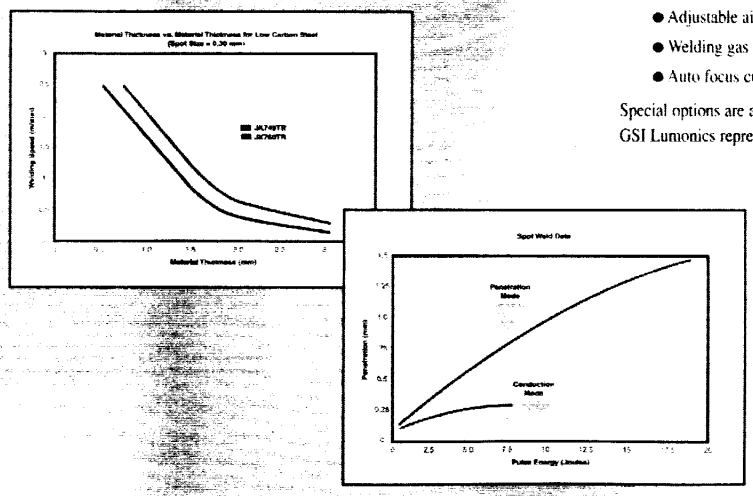
Our fully equipped applications laboratories are available to carry out process trials and demonstrate how laser processing can be applied to your components.

Process tools for versatility

GSI Lumonics offers a range of process tools, including:

- Straight and right-angle focus heads
- CCTV viewing
- Adjustable air knives
- Welding gas delivery systems
- Auto focus cutting nozzles

Special options are also available. Please contact your local GSI Lumonics representative to discuss your requirements.

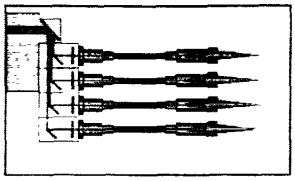


Beam delivery options

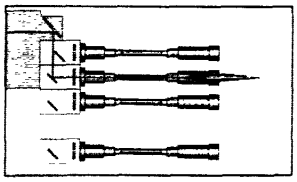
The *JK700TR* series lasers are offered with a range of time share and energy share beam delivery systems

- In energy share format, the beam can be split up to four ways to provide energy simultaneously to the workpiece
- In time share format, the laser output can be directed to a maximum of four sets of output fibers. These outputs can be single fibers or sets of energy shares.

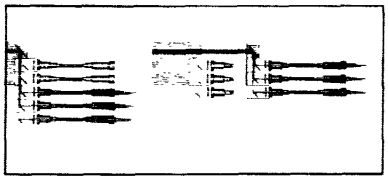
Sample energy share and time share configurations are shown here; contact your local GSI Lumonics representative to learn more about options and configurations.



Energy Share



Time Share

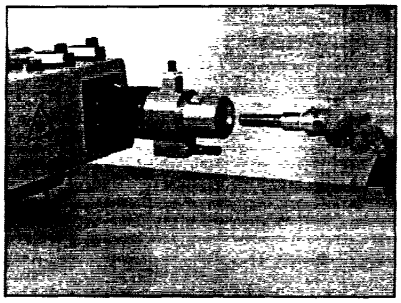


Energy Share + Time Share

Patented fiber-optic beam delivery system

The new *JK700TR* series are offered with our patented *Lumenator* fiber-optic beam delivery. These plug-in pre-aligned (PIPA) fibers allow for rapid set-up and changeout without the need for service intervention

The fiber-optics' patented coupling mechanism virtually eliminates back reflection damage when welding highly reflective materials, and all fibers are fitted with a Fiber Continuity Monitoring system for reliability purposes



Worldwide support and service

Across the globe, our applications engineers develop new solutions in step with evolving application challenges. Their expertise is available to you, from the earliest stages of your project, through process development, to after sales support

Our service technicians are trained in every aspect of maintenance or troubleshooting, and parts are stocked locally in North America, Europe, Hong Kong and Japan.

Control technology

The *JK700TR* series lasers provide the user and integration interfaces required for all applications.

Man-Machine Interface Options:

Control panel with two line display, standard control functions/diagnostics

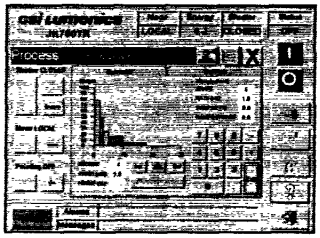
Graphical user interface, local/remote on touchscreen Windows-based PC with additional features including:

- on board process review options
- on-board SPC data collection
- data logging of all laser parameters

Control Software for GUI option with additional safety hardware for customer integration.

Remote Interface Options for Machine Integration:

- Parallel interface – PLC compatible
- Serial interface – RS-232 and RS-422
- OPC interface
- TCP/IP interface



The graphical user interface simplifies access to all system functions

Performance Data

Model	JK715TR	JK730TR	JK745TR	JK760TR
Average Power (W)	150	300	450	600
Peak Power (kW)	5		10	
Max. Pulse Energy (J)	50		100	
Max. Frequency	500 Hz			
Pulse Width Range (ms)	0.5 – > 50 ms			
Beam Quality (mm.mrad)	15	20	25	28
Fiber Diameter (µm)	400	400	400	600
Standard Fiber Lengths (m)	5, 15, 30, 50			
Standard Spot Size (mm)	0.16 – 0.8	0.16 – 0.8	0.20 – 1.0	0.24 – 1.2
Recol Lens (max length, 48mm clear aperture) (mm)	200	200	160	200
Focus Head Options	Straight and right angle with CCTV option (see illustrations below). Custom focus heads are available on request.			

Environmental Data

Cooling Water requirements @ 15°C input	10 l/min US 2.5 gal/min	15 l/min 4.0 US gal/min	22 l/min 5.5 US gal/min	26 l/min 6.9 US gal/min
Cooling Requirement (kW)	6	9.5	13.7	15.3
Max. Pressure Drop (bar min.)	2			
Max. Inlet Pressure (bar max.)	6			
Electricity Requirements	208, 220, 240, 380, 400, 415, 440, 460, 480 V, +/- 6% at 50/60 Hz			
Supply Rating (kVA)	8	11	15	17
Max. Power Consumption (kw)	6	9.5	13.7	15.3
Ambient Temperature (°C)	5 – 40			
Humidity	96% at 15°C to derated to 32% at 35°C			

Physical Data

Weight:

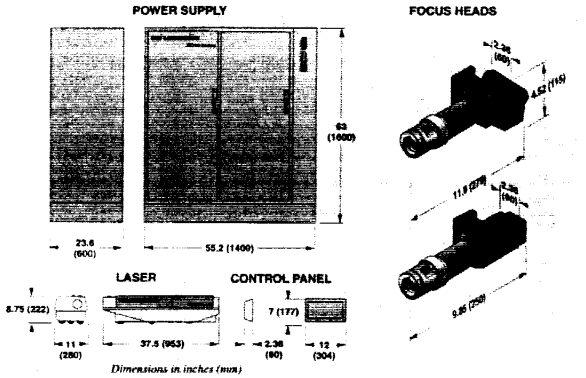
Power Supply Unit

JK715TR, JK730TR	550kg (1210 lbs)
JK745TR, JK760TR	600kg (1320 lbs)
Control Panel	2kg (4.4 lbs)
Laser Head	40kg (88 lbs)

Standard Compliance:

CE, CDRH, CSA,

Sealed to IP55/NEMA 12



Specifications are subject to change. Please consult Product Center for complete details.

GSI Lumonics www.gsilumonics.com/sources

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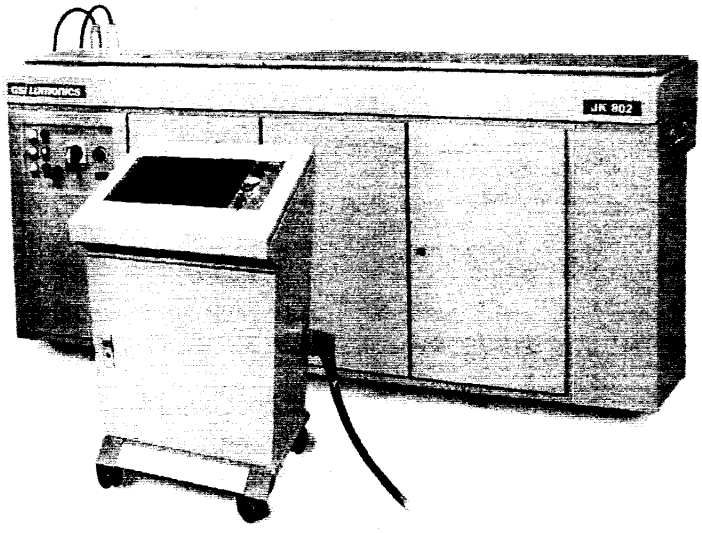
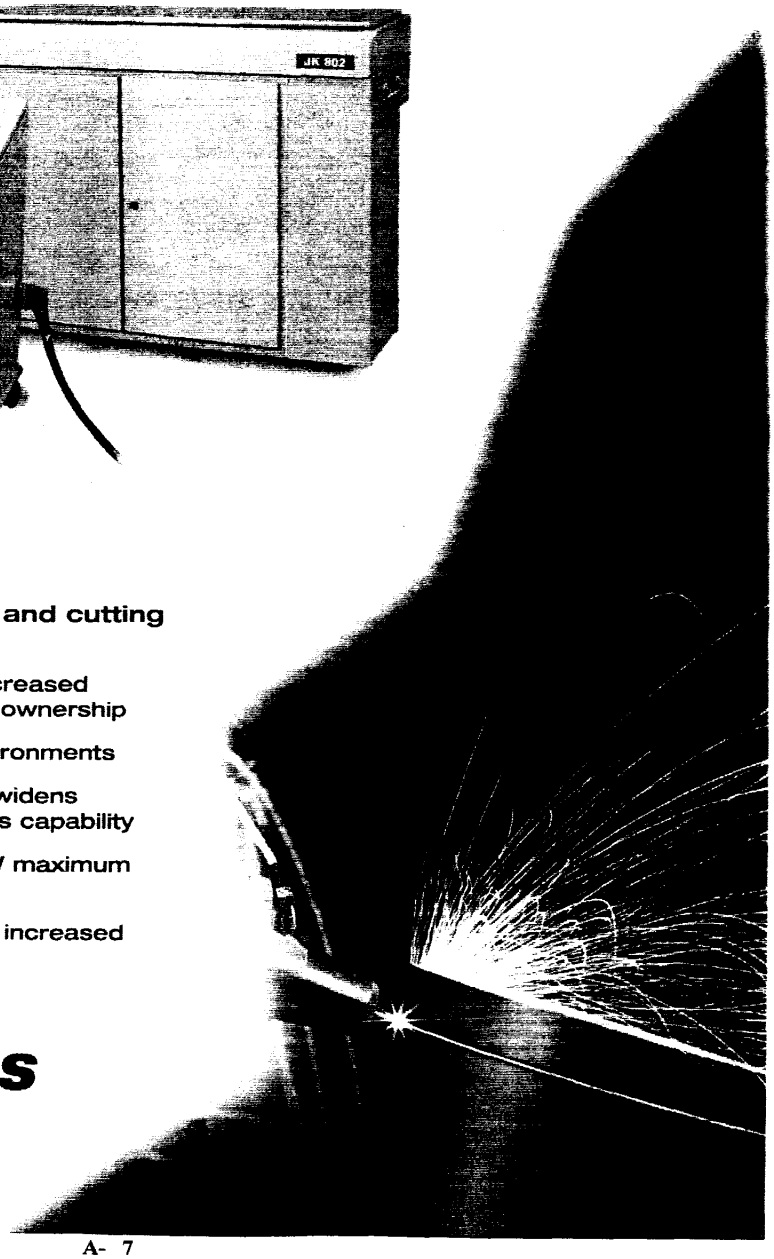
JK802

Industrial Solid-State
Nd:YAG Laser Processing System





High performance welding and cutting with low process cost.

- Next-generation design for increased reliability and reduced cost of ownership
- Tested in 24/7 production environments
- Unique modulation technique widens process window and increases capability
- 800 W average power/1600 W maximum modulated power
- Remote diagnostic access for increased support efficiency

GSI Lumonics

A New Laser, Focused Squarely on Real Needs

The *JK802* laser from GSI Lumonics is a fourth-generation laser system. When we designed it, we made it as dependable, cost-effective, and easy to use as possible. We started with proven technologies and drew upon thousands of hours of operating experience, then refined, simplified, and tested until we got it just right. This new laser will perform from part one and reduce your project costs – both today, and over the full life of the laser.

Modulation: More Speed, More Control

With GSI Lumonics' patent-pending laser power modulation technique, you get more performance from less raw power. Modulation works by momentarily increasing the laser's output intensity from 800 W to up to 1600 W, enabling precise and powerful welding without heat distortion, cleaner and more controlled cutting of complex shapes, better focus on and processing of reflective materials, and other advantages.

Easy to Use, Easy to Care For

With the *JK802*, all major components are now pre-aligned, remote diagnostics and graphical control interfaces are standard equipment, and new patented fiber-optic designs set new standards in robustness.

These improvements address one real need: to maximize your manufacturing potential through the best uptime and easier maintenance. The *JK802* makes parts – period.

Worldwide Support and Service

Across the globe, our applications engineers develop new solutions in step with evolving application challenges. Their expertise is available to you, from the earliest stages of your project, through process development, to after sales support.

Our service technicians are trained in every aspect of maintenance of troubleshooting, and parts are stocked locally in North America, Europe, Hong Kong, and Japan.

Specifications

Laser Specifications

- Average laser power: *800 Watts
- Maximum modulated power: 1600 Watts
- Beam quality: 16 mm.mrads
- Laser response time: 1.5 msec.
- Modulation frequency: 100 Hz - 500 Hz
- Output mode: CW, sine or square modulation

Fiber-Optic Beam Delivery

- Fiber core diameter: 400 microns
- Spot size range: 0.16 mm - 0.9 mm
- Standard fiber lengths: 5 m, 15 m, 30 m and 50 m
- Max. fiber length: 50 m
- Timeshare option: Up to 2-way
- Timeshare switching time: 200 msec.
- Focus head options: straight or right angle
- Process tools including: CCTV viewing, welding nozzles, auto focus cutting nozzles and a wide range of special options

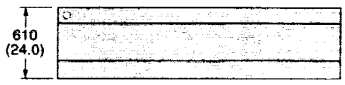
Control Technology

- Remote Interface Options:
  - Parallel PLC compatible
  - Serial interface
  - OPC interface, TCP/IP interface
  - Analog input/output control
  - Shutter interface
  - Emergency stop interface
- Man-Machine Interface Options:
  - Graphical local or remote interface
  - Windows®-based PC
  - Multiple part program storage
  - Full modulation control
  - Data-logging of all laser parameters
  - On-board SPC data collection
  - Over 1000 parameters monitored
  - On board process in view options

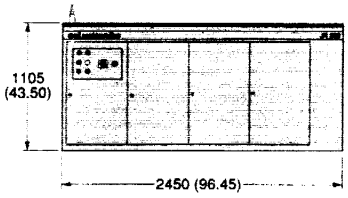
Facility Requirements

- Cooling Water:
  - Temperature: 10° C - 18° C
  - Max. flow rate: 75 litres/min. (19.8 gal/min.)
  - Max. pressure drop: 6.5 bar
  - Max. pressure at inlet: 7.5 bar
  - Cooling capacity: 38 kW
- Electrical and Connection:
  - Voltage/frequency: 380 V - 480 V at 50Hz/60 Hz, +/- 10%
  - Supply rating: 40 kVA
  - Max. power consumption: 38 kW
- Installation:
  - Weight: 600kg (1323 lbs)
  - W x H x D: 2450 mm x 1105 mm x 610 mm
  - Ambient temperature: 5° C - 40° C

Top view



Front view



Dimensions in mm (inches)

*At workpiece at the end of lamplite. Specifications are subject to change. Please consult Product Center for complete details.

GSI Lumonics

www.gsilumonics.com/sources

CE

Patents granted: US 5,179,610, GB 2 255 199, US 5,500,866, US 5,484,380, NL, IT, GB, FR, CH 579367, DE 69308075.7-08
Further patents applied for in US and other territories

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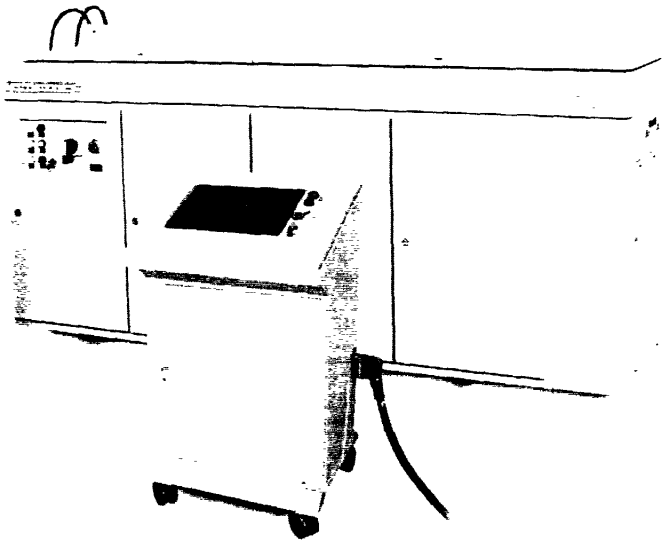
JK1002

Industrial Solid-State
Nd:YAG Laser Processing System



High performance welding and cutting with low process cost.

- Next-generation design for increased reliability and reduced cost of ownership
- Tested in 24/7 production environments
- Unique modulation technique widens process window and increases capability
- 1000 W average power/2000 W maximum modulated power
- Remote diagnostic access for increased support efficiency

GSI Lumonics

A New Laser, Focused Squarely on Real Needs

The *JK1002* laser from GSI Lumonics is a fourth-generation laser system. When we designed it, we made it as dependable, cost-effective, and easy to use as possible. We started with proven technologies and drew upon thousands of hours of operating experience, then refined, simplified, and tested until we got it just right. This new laser will perform from part one and reduce your project costs – both today, and over the full life of the laser.

Modulation: More Speed, More Control

With GSI Lumonics' patent-pending laser power modulation technique, you get more performance from less raw power. Modulation works by momentarily increasing the laser's output intensity from 1000 W to up to 2000 W, enabling precise and powerful welding without heat distortion, cleaner and more controlled cutting of complex shapes, better focus on and processing of reflective materials, and other advantages.

Easy to Use, Easy to Care For

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Specifications

Laser Specifications

- Average laser power: *1000 Watts
- Maximum modulated power: 2000 Watts
- Beam quality: 25 mm.mrads
- Laser response time: 1.5 msec.
- Modulation frequency: 100 Hz - 500 Hz
- Output mode: CW, sine or square modulation

Fiber-Optic Beam Delivery

- Fiber core diameter: 600 microns
- Spot size range: 0.24 mm - 0.9 mm
- Standard fiber lengths: 5 m, 15 m, 30 m and 50 m
- Max. fiber length: 50 m
- Timeshare option: Up to 2-way
- Timeshare switching time: 200 msec.
- Focus head options: straight or right angle
- Process tools including: CCTV viewing, welding nozzles, auto focus cutting nozzles and a wide range of special options

Control Technology

- Remote Interface Options:
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  - Shutter interface
  - Emergency stop interface
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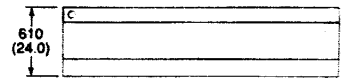
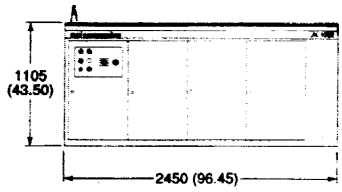
  - Max. pressure at inlet: 7.5 bar
  - Cooling capacity: 38 kW
- Electrical and Connection:
  - Voltage/frequency: 380 V - 480 V at 50 Hz/60 Hz, +/- 10%
  - Supply rating: 40 kVA
  - Max. power consumption: 38 kW
- Installation:
  - 600kg (1323 lbs)
  - W x H x D: 2450 mm x 1105 mm x 610 mm
  - Ambient temperature: 5° C - 40 ° C

Top view



Front view



Dimensions in mm (inches)

*At workpiece at the end of lampite. Specifications are subject to change. Please consult Product Center for complete details.

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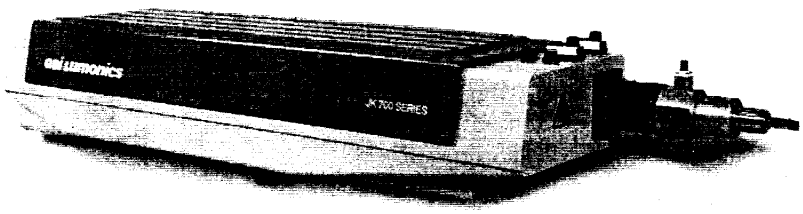
Twin Rod Upgrades

For JK703, JK703H, JK702, JK702H, JK701, JK701H



Complete field upgrade packages featuring TR Technology for enhanced laser system performance.

- Twin rods provide the highest beam quality
- Enables use of smaller diameter fiber-optic cables for smaller diameter focus spots and/or longer working distances
- Dependable TR Technology has been field proven in the high peak power JK704TR drilling laser
- Lets you address new applications not previously possible!

gsi lumonics

More Performance from the Laser You Have Now

In keeping with GSI Lumonics' policy of continuous improvement and long-term support to customers, we now offer complete upgrade packages to enhance the performance of your existing *JK700* series laser. These upgrades bring you the power of GSI Lumonics' *TR Technology* for the highest beam quality.

TR Technology – Proven for Enhanced Performance

GSI Lumonics successfully pioneered our exclusive *TR Technology* with the high peak power *JK704TR* drilling laser. Having proven the technology in production, GSI Lumonics is expanding its use across our range of *JK* welding lasers.

TR Technology uses a twin-rod oscillator design to increase efficiency and decrease heat input into the laser rods. It combines high beam quality with a compact laser head to offer smaller focus spot sizes, greater working distances, and enhanced processing capabilities.

Luminator Fiber-Optic Included

The *TR* Upgrade includes our new, smaller diameter *Luminator* fiber-optic cable. This fiber cabling enables smaller diameter focus spots, longer working distances, or a combination of the two. *Luminator* fibers eliminate alignment during changeout, and their patented coupling offers back reflection protection when welding highly reflective materials.

Worldwide Support and Service

Across the globe, our applications engineers develop new solutions in step with evolving application challenges. Their expertise is available to you, from the earliest stages of your project, through process development, to after sales support.

Our service technicians are trained in every aspect of maintenance of troubleshooting, and parts are stocked locally in North America, Europe, Hong Kong, and Japan

Upgrade Kit Contents

- Replacement laser head, complete with all optics and conduits to power supply unit
- Adapter plates for power supply unit
- Single fiber input module
- 15 m Luminator fiber
- Focus head: 160 or 200 mm recollimation
- Focus lens
- On-site labor for upgrade
- On-site operator training

Upgrades to energy share and time share systems are available. Consult your local GSI Lumonics representative for details.

Performance Data

Product	JK703, JK703H	JK702, JK702H	JK701, JK701H
Current specifiction	150 W, 3.0 kW peak, 600 µm fiber	350 W, 4.5 kW peak, 600 µm fiber	550 W, 7.5 kW peak, 1000 µm fiber
Upgraded specification	150 W, 3.0 kW peak, 400 µm fiber	350 W, 4.5 kW peak, 400 µm fiber	600 W, 7.5 kW peak, 600 µm fiber

Standard Compliance: CE, CDRH, CSA

Specifications are subject to change. Please consult Product Center for complete details.

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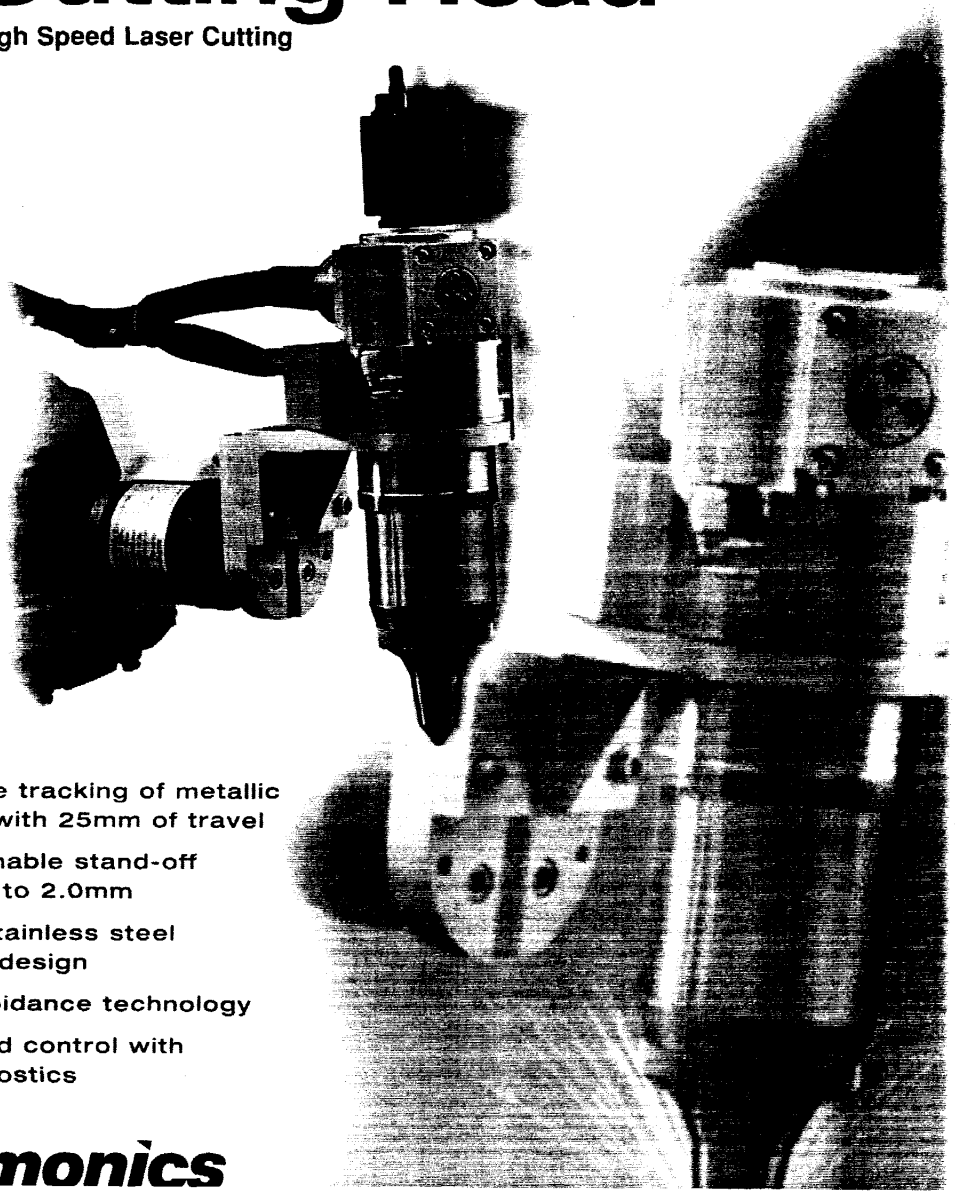
Robotic Cutting Head

High Speed Laser Cutting



- Capacitive tracking of metallic surfaces with 25mm of travel
- Programmable stand-off of 0.5mm to 2.0mm
- Rugged stainless steel industrial design
- Crash avoidance technology
- PLC-based control with self diagnostics

GSI Lumonics

Robotic Cutting Head

The AM series laser cutting head is an auto-focus robotic end-effector designed and manufactured by GSI Lumonics for use with the AM Series and the JK Series of lasers. It is designed for use in automotive or other advanced manufacturing industrial environments where demands on quality and production are extremely high.

The unique right-angle design of the AM series cutting head has many processing benefits. First, the overall height is less than 290mm which allows access within tight areas. Second, there are provisions for an optional CCTV monitoring system that views through the nozzle tip. This feature is a benefit when programming complicated components. Third, stress and wear on the fiber-optic is minimized because the fiber tends to follow up the robot arm. These features combine to form a compact cutting head with capabilities unmatched in the industry.

The cutting head tracks the surface of the part with a capacitive sensing circuit that monitors the tip-to-work distance. The signal from this sensing circuit is fed back to a servo that adjusts the head within its 25mm of travel to maintain laser focus and optimal laser performance. Unaffected by process spatter, debris and plasma, the cutting head provides maximum process stability by compensating for variations in the part and the motion of the robot.

The controller for the AM series cutting head consists of a PLC, drive amplifier and power supplies. (The capacitive sensing circuitry is located remotely in the cutting head which improves sensing performance.) The PLC based control monitors the performance of the cutting head, establishes limits of travel, monitors the temperature of the head in two locations and provides all robot I/O. Patented crash-avoidance features include Z-axis crash, retracted proximity crash, extended and retracted limit crash and tip-contact-while-in-teach crash.

All of the cutting head functions are selected exclusively through the robot interface with no user adjustments or re-calibrations required. Remote monitoring of the cutting head performance, temperature, stand-off, fault conditions and crash conditions are available to the robot with only 8 digital I/O points and a single analog output. Separate dry contacts are available for shutter interlock and robot crash interlock.

Optical Specifications
- Re-collimating lens: 100mm
- Focus lens: 60mm or 80mm
- Focus spot size (calculated):
  - With 600µm fiber: 360µm and 480µm
  - With 400µm fiber: 240µm and 320µm

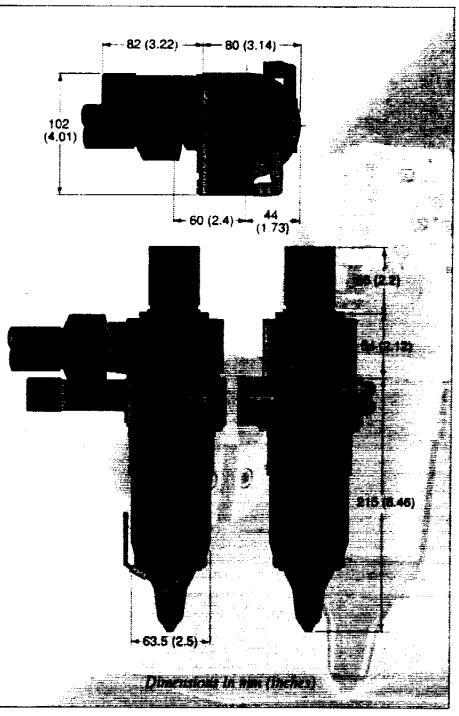
Physical Specifications
- Overall height in teach position
  - (without CCTV option): 272mm
- Cutting head weight:
  - (without mount) 4.0Kg
- Nozzle tip orifice:
  - 1.5mm or 1.75mm
- Compatible with
  - AM Series Lasers
  - JK Series Lasers

Electrical Specifications
- Electrical supply
  - Auto-ranging from 110VAC or 220VAC single phase with earth ground. 85-132VAC (110 range), 170-264VAC (220 range). 47 to 63 Hz.
- Interface inputs
  - 8 sinking or sourcing bi-directional opto-coupler. 20-28VDC, 6mA at 24VDC
- Interface outputs
  - 8 sinking or sourcing hard contact relays, 5-30VDC, 1A max
- Interlocks (shutter and crash)
  - Isolated hard contact relay 12-28VDC, 12-250VAC, 7A max

Performance Specifications
- Stand-off distance: 0.5mm to 2.0mm
- Max travel speed: 100mm/s
- Travel distance: 25mm

External Connections
- Assist gas
  - 6mm tubing or 1/4" NPT fitting
  - Max pressure 120psi
- Purge gas
  - 4mm hose
  - 3psi of filtered, dry air
- Water cooling
  - Water supply available from laser cabinet 6mm polyurethane tubing

Optional Equipment
- Tool kit
- CCTV camera system
- Robot mounting bracket
- External crash detection mount



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附件

二、Spectron Lasers 公司資料

The SL600 series

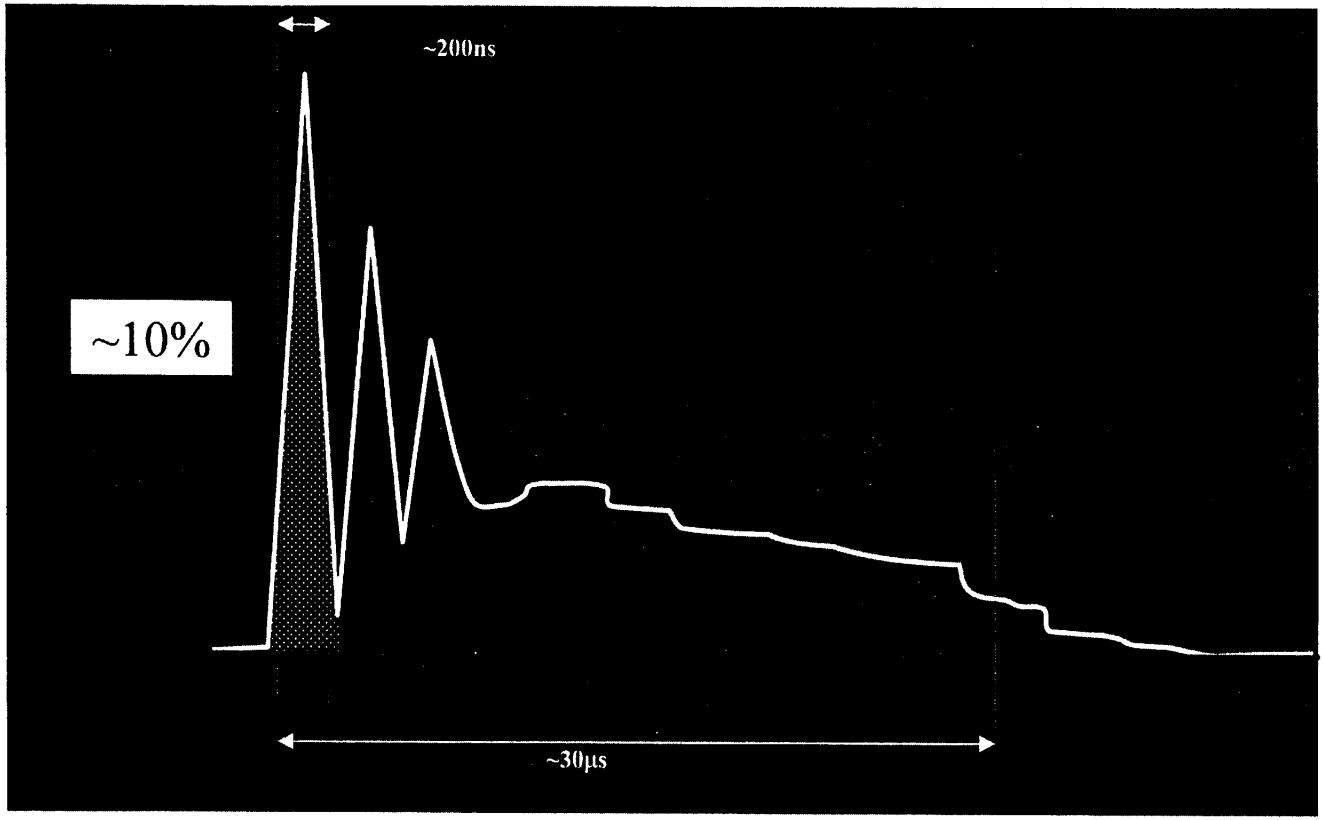
Key Features

- Guaranteed TEMoo output.
- Dedicated micro-cutting & drilling resonator.
- True Gaussian TEMoo beam profile.
- High speed process shutter. (5ms open, 5ms close)
- Unique pulse profile and duration.
- Very stable pulse to pulse output. (2% RMS)
- Proven PSU design.

Power / Energy Stability

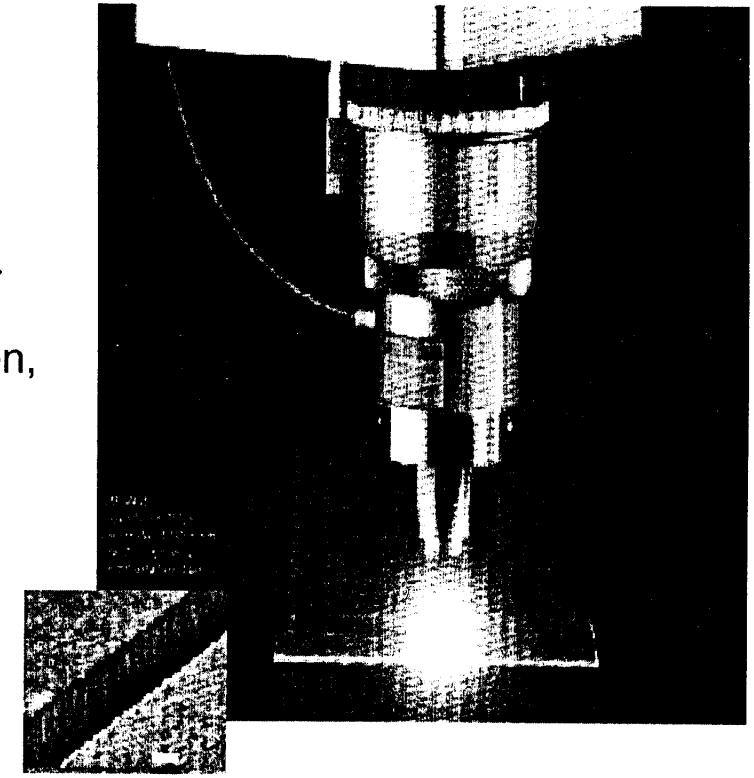
- The SL600's use a unique power supply.
- This produces the 2 major advantages of the laser
  1. Short optical pulse which is good for cutting.
  2. Power stability of 2%
- Short pulse from IBGT fast power switch.
- Stability achieved by measuring the energy delivered to the lamp in every pulse.The Volts and Current are both measured.

The short cut pulse.



SL603T

- 8W TEMoo, the first mainstream product.
- 1000Hz and RS232 with dedicated process shutter
- Shutter cycle is 15ms open, 15ms close.
- Fast shutter is an option.



Performance:

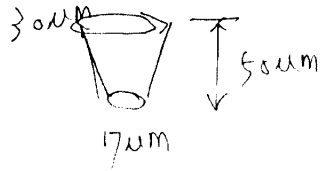
- **SL603T** Performance: based on customer data:

Best cut speed: @1000Hz

600mm/min, 150μm stainless-steel ~35 μm kerf width.

Smallest cut hole: @600Hz

30 μm cut hole in 50 μm stainless-steel. (~17 μm kerf)



SL650T

- 12W TEMoo
- 2000Hz maximum.
- 5 ms shutter open time.
- 5 ms shutter close time.
- 120 x 4.5mm rod.
- New charger design.
- Power factor compensation.

Performance:

- **SL650T** Performance: based on customer data:

Best cut speed: @2000Hz

1000+ mm/min, 150μm stainless-steel ~35 μm kerf.

SL650 (the Multimode one)

- 70W output @ 2000Hz
- 70W output @ 1000Hz
- M2 < 7
- 15ms shutter.
- Cutting <1mm
- Drilling <5mm
- Metal, Ceramic & Silicon.

SL650 cutting speeds

Material	Thickness(mm	Drive Level(J/P	Frequency(Hz	Assist Gas	Speed(mm/mi
Titanium	0.75	5	1000	Argon	1000
Titanium	0.75	5	1000	Nitrogen	1500
Mild Steel	1	2.4	2000	Oxygen	1500
Stainless Steel (316)	1.5	5	1000	Oxygen	500
Stainless Steel (304)	2	5	1000	Oxygen	150
Copper	0.7	5	1000	Oxygen	300
Ceramic (alumina)	1.3	2.6	2000	Compressed Air	500
Aluminium	1	6	800	Oxygen	700

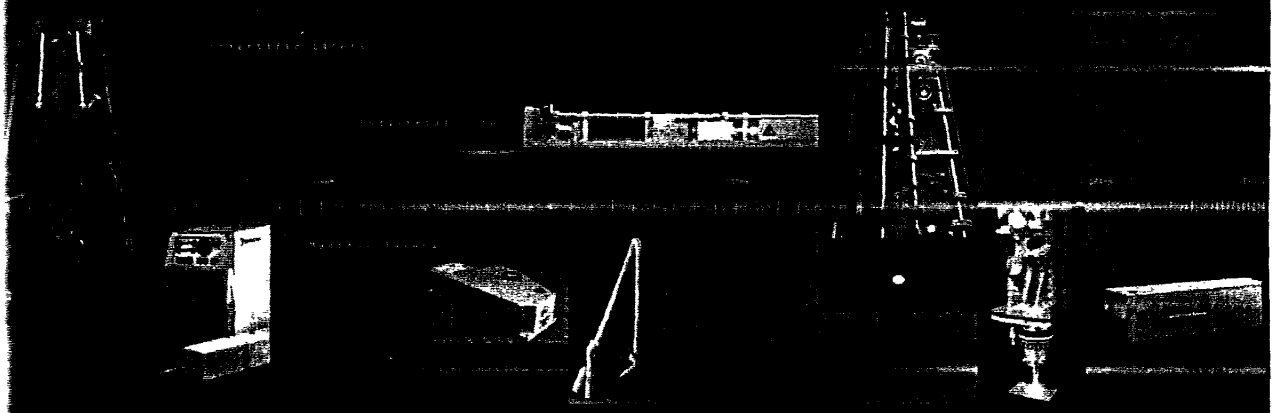
What we can cut

- Stainless steel foil and sheet up to 250μm, quickly.
- 1mm steel and ferrous material, slowly.
- 95% to 99% Alumina ceramics
- Gold
- Tantalum, Titanium & Tungsten
- DIAMOND, Real and CVD
- Silicon up to 1mm and less than 50μm.

What we can not cut!!

- Everything else!
- In particular:
  - Sheet over 2mm
  - Plastics
  - Plastic backed materials.

SPECTRON PRODUCT GUIDE



Spectron Lasers

DIODE PUMPED SOLID STATE LASERS

RANGE HIGHLIGHTS

- **Powers from 10mW to 150 Watts**
- **Exceptional TEM_{00} or Multimode beam quality**
- **Outputs include 1064, 1053, 1047, 532, 527, 523, 473nm**
- **CW and Q-switched operation**
- **Rugged hermetically sealed ultra compact units**
- **YAG, YVO_4 and YLF lasing media**
- **Stable and ultra stable configurations**
- **Single frequency options**
- **Microprocessor and serial link control**
- **Turnkey or OEM options**

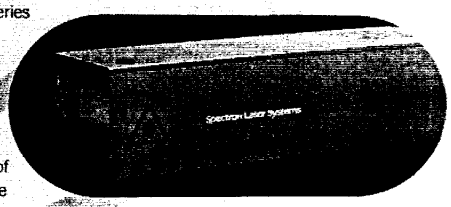
Applications Solutions
Spectron's lasers continue to be utilised in a wide variety of industries, applications and environments.
Fully equipped applications laboratories are available to assist in providing laser solutions to the most demanding of problems.

APPLICATIONS INCLUDE
Ablative Cleaning
Accelerated Aging
Bacterial Analysis
Cutting
Diamond Processing
Disk Texturing
Deep Engraving
Direct to Plate Printing
DNA Sequencing
Drilling
Etching
Film Subtitling
Flow Cytometry
High Speed Printing
Holography
Imaging
Image Recording
Intraglass Marking
Laser Induced Fluorescence
LIBS
LIDAR
Light Displays
Long Term Hair Removal
Marking
Medical Diagnostics
Micro Machining
Non Destructive Testing
Non Linear Optics
Optical Pumping
Optical Trapping
Optical disk masking
Particle Sizing
Perforation
Photo-ablation
Photochemistry
Photoluminescence
Pigmented Lesion Treatment
PIV & ESPI
Plasma Diagnostics
Precision Scribing
Product Coding
Rapid Prototyping
Raman Spectroscopy
Remote Sensing
Sintering
Skin Resurfacing
Tattoo Removal
TOF Mass Spectrometry
Thick and Thin Film Trimming
Vascular Lesion Treatment
Wafer Inspection
Wafer Dicing
Welding
Zone Texturing

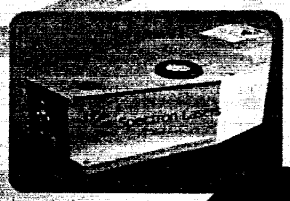
Spectron's comprehensive range of diode pumped solid state lasers provide the exceptional beam quality, performance and reliability required of the toughest applications and environments. Like all Spectron products Spectron's DPSS lasers are available at various levels of integration, from basic OEM to turnkey systems and come as standard with rugged hermetically sealed heads incorporating field replaceable diode modules for straightforward maintenance.

DPSS Series
Spectron's proven side pumped DPSS Nd:YAG lasers set the standard for precision material processing applications. With powers up to 150W in a range of OEM configurations these lasers can be selected and customised to suit particular needs. Field upgradability also ensures that the DPSS series has versatility built in.

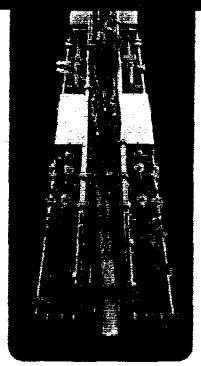
Newly launched and using Spectron's field proven pump modules in a novel twin rod DPSS resonator design, is the very latest DPSS laser technology available today. An ultra efficient design provides for unmatched low order multimode powers of 150 Watts, TEM_{00} powers of 40 Watts plus Q-switching up to 70kHz and pulse durations in the range of 90 and 500ns depending configuration.



Mini DPSS Series
With powers up to 8 Watts, repetition rates up to 100KHz and high peak powers, the Mini DPSS series provides the latest in end pumped DPSS laser technology. Offered in fibre and direct-coupled configurations, together with active and passive Q-switching, these Nd:YAG or Nd:YVO_4 lasers provide exceptional beam quality from compact air cooled single phase packages.



Micro DPSS Series
The Micro DPSS series is the very latest in innovative low power CW DPSS technology. These ultra compact air cooled, low noise, sealed lasers produce exceptional beam quality, stability and range in powers from a few mW to 10 Watts. Available in single frequency as well as at all the fundamental and harmonic wavelengths including 473nm in the blue.



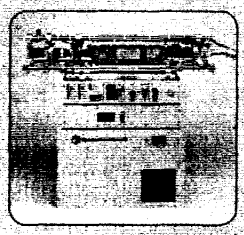
Spectron's range of lamp pumped solid state lasers continue to provide the exceptional performance and reliability for which they have become synonymous over the years. The modular, invar rail space-frame construction gives unsurpassed stability and flexibility making customisation simple and economical. Lamp changes take minutes, without requiring cavity re-alignment and the all-stainless steel and ceramic pumping chambers give indefinite system life.
Packaging options include cased and uncased laser heads, and 19-inch rack mount power supply and cooler units.

LAMP PUMPED SOLID STATE LASERS

CW Nd:YAG LASERS

RANGE HIGHLIGHTS
- **CW powers up to 800 watts multimode**
- **TEM_{00} powers up to 28 Watts**
- **Optional Q-switch and 532nm harmonic generation**

CW and CW Q-switched Lamp Pumped Series
The SL500, SL900, SL1300, SL2500 & SL5500 series CW lamp pumped lasers provide output powers of up to 400 Watts multimode and 28 Watts TEM_{00}. Available options include Q-switching, and second harmonic generation. Custom systems with powers of up to 800 Watts have been delivered.



Pulsed Lamp Pumped Series
The SL600 series delivers up to 70 Watts multimode or 12 Watts TEM_{00} at pulse repetition rates from 500-2000Hz. The high-energy 10-40µs pulses are ideal for micro-machining and micro-cutting applications.

PULSED Nd:YAG LASERS

RANGE HIGHLIGHTS
- **40mJ to 2.75J per pulse at 1064nm**
- **Repetition rates up to 100Hz**
- **Q-switched pulses between 3-25ns**
- **Harmonic generation of 532, 355, 266 & 213nm**
- **Twin head variants**
- **Integrated OPOs with 205nm to 4µm tuning range**

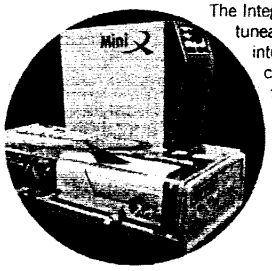
Spectron's pulsed Q-switched Nd:YAG lasers suit all needs and budgets, from the ultra-compact Mini-Q, to the modular, high energy Classic-Q, the SL400-800 series. Twin versions of all models are available for PIV and ESPI studies, while convenient, integrated YAG/Dye and YAG/OPO systems are offered for advanced spectroscopic research.

Classic-Q
Spectron's Classic-Q, SL400-850 series is the laser of choice for those requiring the ultimate in flexibility, stability and performance. The invar-stabilised space-frame construction and modular electronics allow cost-effective customisation and field upgrade. With a choice of Gaussian, Telescopic and TEM_{00} resonators, each laser can be configured to provide the desired combination of beam quality, divergence and pulse duration.

Mini-Q
Ultra compact yet powerful, the high energy Mini-Q delivers up to 300mJ at 1064nm and is available in a wide variety of configurations including telescopic, Gaussian and TEM_{00} resonators, as well as with interchangeable harmonics and a twin head version.

Mini-Q OPO Integra
Fully integrated within a compact stable invar bar frame, the Mini Q and co-mounted OPO, provide the convenience and stability of a tuneable mid & broadband OPO laser all in one small package.

Classic-Q OPO and Dye Integra



The Integra series offers a full range of either tuneable mid & broad-band OPOs or dye lasers integrated within the YAG pump laser for convenience and stability. Fundamental tuning range for BBO models covers 400-2500nm, with optional SHG to 205nm. System outputs are up to 130mJ, with ~5ns pulses at up to 100Hz

SPECIAL LASERS

RANGE HIGHLIGHTS
- **Ruby, Nd:YAG, Er:YAG, Nd:YLF, Alexandrite and CO_2 lasers**
- **Mini IPL**
- **Beam delivery via articulated arm or optical fibre**

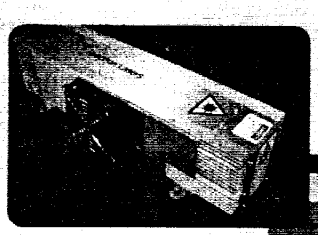
With many hundreds of lasers delivered to medical system OEMs over the years, including Ruby and long pulsed Nd:YAG lasers, Specton's proven specialist knowledge has recently extended to offering the latest in Mini IPL (Intense Pulsed Light) technology. All modules and accessories, including articulated arms and fibre delivery, are fully compliant with the applicable international standards including IEC 601.

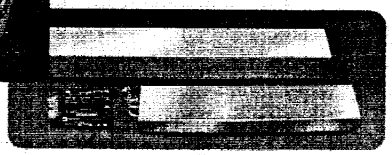
RF & DC EXCITED CO_2 LASERS

RANGE HIGHLIGHTS

- **RF and DC excitation**
- **Proven diffusion cooled designs**
- **Long life sealed technology**
- **Power levels: 12 to 220 Watts**
- **Drop in compatibility**
- **Superpulsing capability for increased performance**
- **Full complement of accessories**
- **Accessories include, diode alignment lasers, power meters, fast shutters, controllers and beam delivery modules**
- **Air cooling as standard for the low power units**
- **AO modulated units for 200 kHz ultra fast switching**
- **OEM kits to out of the box lasers**
- **Standard or custom systems**

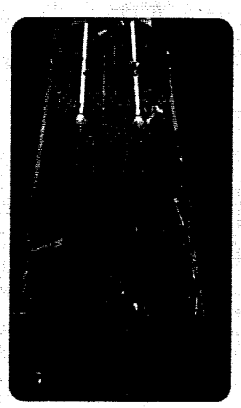
Manufactured in the UK, Spectron's latest range of RF and DC excited CO_2 lasers come from a well proven pedigree and provide rugged and affordable solutions for the most demanding of OEM requirements. As is the case for all Spectron lasers, exceptional beam quality and performance is built in, as is availability in OEM kit form through to complete turnkey laser. These products offer unrivalled value for money.





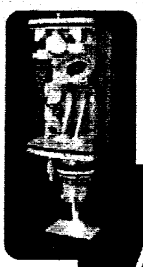
RF CO_2 Lasers

Spectron's new and patented (pending) metal/ceramic SLR series RF-excited CO_2 lasers have been specifically designed for OEMs requiring the ultimate in high quality, compact, reliable lasers with true drop in compatibility and fit & forget performance. Models with output powers from 12 to 50 Watts are available in a variety of configurations from a basic resonator and power supply kit, for cost conscious OEMs, to turnkey lasers which are ready to go straight from the box. The novel laser design allows these lasers to be super-pulsed providing big laser performance capability from the same cost effective unit. A multiplicity of variants and options are available as standard.



DC CO_2 Lasers

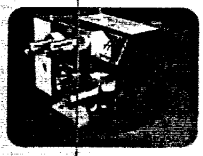
Spectron's SLC series, sealed DC-excited CO_2 lasers, offers unparalleled beam quality, efficiency and longevity at powers up to 220 Watts. Packaging choices include bare tubes and OEM power supplies as well as cased models and accessories offered with the series include power meters, shutters, alignment lasers and basic beam delivery modules. The newest product in the series has the latest in folded resonator, externally AO modulated technology, providing ultra fast modulation capability to 200 kHz making this laser the laser of choice for high quality printing and engraving.



ACCESSORIES INCLUDE

- **Diode pumped podules**
- **Laser controllers/computer interfaces**
- **Chillers & coolers**
- **Harmonic generator assemblies**
- **Integrated and [illegible] energy/power [illegible]**
- **Integrated pulse shape [illegible]**
- **Visible alignment lasers**
- **Amplitude stabilisers**
- **Variable attenuators**
- **Etalons**
- **Injection seeders**
- **Articulated arms**
- **Beam delivery systems**

Laser Accessories



Designed in-house to work seamlessly with Spectron's lasers, the accessories and upgrades are also available as standalone products in their own right. Whether required for a Spectron laser or as a building block for the OEM wanting to build his own lasers, these components offer exceptional value for money.

Lasers for industry, research and medicine

Spectron Lasers has long been established as one of the world's leading manufacturers of solid state and gas lasers. Since its foundation in 1982, thousands of Spectron lasers have been installed around the world, building for Spectron an international reputation as a quality supplier of solid and reliable products offering the highest levels in performance at unparalleled value for money.

A comprehensive and ever-expanding range of leading edge pulsed and CW, solid state and CO_2 lasers is offered, developed specifically for industrial, instrumentation and medical OEMs and systems integrators, as well as academic, governmental and commercial research organisations.

Standard and Custom Solutions from a Partnership Company

Understanding customer needs and operating closely with its customer's is at the forefront of Spectron's philosophy of establishing direct and long-term working relationships. One of the few laser companies to still design, develop and manufacture all the individual parts of its own laser systems, Spectron also provides innovative, bespoke laser solutions for today's demanding applications, at reduced costs and timescales, without compromising product quality or performance.

Quality Built In

Spectron's continued dedication to quality and to meeting the highest of standards has resulted in significant investments over recent years in the latest in manufacturing, operational and test facilities at the Company. As a result all Spectron's products comply with the latest international manufacturing, engineering, laser and safety standards.

Worlwide Support

With world headquarters based in Rugby, UK and subsidiaries in the USA, and Singapore, Spectron is a true global supplier of laser products. In addition, fully trained distributors ensure that support is always close at hand.

Leading Edge Lasers for the Future

Spectron continues to invest heavily in leading edge laser technology. This investment and extensive R&D capabilities will ensure Spectron's continued support of advanced laser applications for many years to come.

England
Germany
USA
Argentina
Brazil
Mexico
Canada
France
Spain
Italy
Switzerland
Benelux
Denmark
Sweden
Finland
Norway
Poland
Israel
India
South Africa
Japan
China
Korea
Hong Kong
Singapore
Taiwan
Malaysia
Australia
New Zealand

Individual brochures and datasheets for all Spectron products are available either printed or as Acrobat PDF files for electronic transfer. For expert advice on the very latest standard and custom solutions, Spectron's Product Specialists are on hand to discuss your needs.

Pulsed and CW Nd:YAG

Diode Pumped Nd:YAG

RF and DC CO_2

Ruby and Alexandrite

Er:YAG and Nd:YLF

Spectron Lasers

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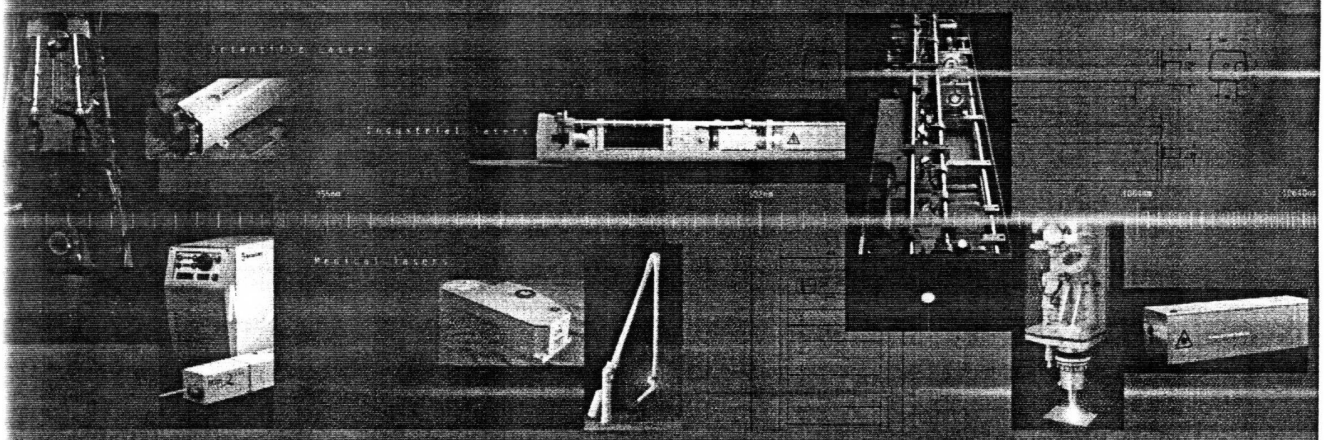
Web: www.spectronlasers.com

PRODUCT SPECIFICATIONS

DPSS Nd:YAG

LASERS



Spectron Lasers

SPECIFICATION

GENERAL

Nd:YAG CW Laser oscillator

Wavelength (nm)	1064	1064	1064	1064	1064	1064
Head - Sealed standard	•				•	•
- Sealed extended		•	•	•		
-Invar						
Stacked diode array pumped	•	•	•	•	•	•
Diffuse ceramic reflectors	•	•	•	•	•	•

CW SPECIFICATION	SLD2102S	SLD2112S	SLD2112TS	SLD2112TSP	SLD2103S	SLD2104S
Mode	**MM**	**MM**	**TEM_{00}**	**TEM_{00}**	**MM**	**MM**
Maximum CW output (W)	20	15	5	6	30	40
Beam quality M^2 at rated input (</=)	6	3.5	1.3	1.3	14	7
Beam product [I/e^2] (mm.mrad)	8	4.5	1.7	1.7	18.5	9
Beam divergence full angle [I/e^2] (mrad)	4	3.5	2.5	2.5	6	4
RMS stability at rated input (%)	1.5	1.5	1.5	1.5	1.5	1.5
Linear polarisation	No	No	No	Optional	No	No

Q-SWITCHED SPECIFICATION	SLD2102QS	SLD2112QS	SLD2112TQS	SLD2112TQSP	SLD2103QS	SLD2104QS
Mode	**MM**	**TEM_{00}**	**TEM_{00}**	**MM**	**MM**	**MM**
Nominal CW output for Q-switching (W)	20	15	5	6	30	40
Beam quality M^2 at rated input	6	3.5	1.3	1.3	14	7
Beam product [I/e^2] (mm.mrad)	8	4.5	1.7	1.7	18.5	9
Beam divergence full angle [I/e^2] (mrad)	4	3.5	2.5	2.5	6	4
Pulse to pulse stability at 5kHz pk-pk% (*RMS%*)	*3(1.5)*	*3(1.5)*	*3(1.5)*	*3(1.5)*	*3(1.5)*	*3(1.5)*
Q-switched frequency range (kHz)	1-50	1-50	1-60	1-60	1-50	1-50

TYPICAL Q-SWITCHED PERFORMANCE						
Mode	**MM**	**TEM_{00}**	**TEM_{00}**	**MM**	**MM**	**MM**
Measured at frequency	**1kHz**	**1kHz**	**1kHz**	**1kHz**	**1kHz**	**1kHz**
Pulse peak power (kW)	70	78	26	26	88.5	202
Pulse energy (mJ)	4.3	3	1	1	6.2	7.7
Pulse width FWHM (ns)	60	40	40	40	70	38
Average power (W)	4.3	3	1	1	6.2	7.7

SERVICES						
Max. ambient temperature (°C)	35	35	35	35	35	35
Electrical consumption at CW spec. power (kW)	2.5	2.5	2.5	2.5	2.5	2.5

ELECTRICAL REQUIREMENT						
System controller unit	CW200	CW200	CW200	CW200	CW200	CW200
Power supply unit	CW100D	CW100D	CW100D	CW100D	CW100D	CW100D
(50/60Hz) 220/240V 1Ø, N & E	10	10	10	10	10	10

COOLING WATER REQUIREMENTS						
Chiller unit (Standard)	CL26HGB	CL26HGB	CL26HGB	CL26HGB	CL26HGB	CL26HGB
Cooler unit (Optional)	CCL100	CCL100	CCL100	CCL100	CCL100	CCL100

DIODE LIFE						
Guaranteed (hrs)	§	§	§	§	§	§
Nominal [cont. running at rated input] (hrs)	10,000	10,000	10,000	10,000	10,000	10,000

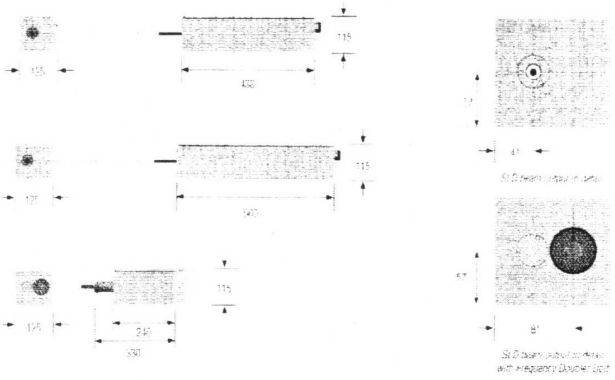
For certain models both Multimode or TEM_{00} outputs are available from the same laser as an option.
§ Contact Sumitomo

Diode Pumped Laser Range

1064	1064	1064	532	1064	1064	1064	1064	1064
•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•
LD2114S	**SLD2114TS**	**SLD2114TSP**	**SLD2114TGS**	**SLD2106S**	**SLD21100S**	**SLD21110S**	**SLD21110TS**	**SLD21110TP**
MM	**TEM_{00}**	**TEM_{00}**	**TEM_{00}**	**MM**	**MM**	**MM**	**MM**	**TEM_{00}**
30	10	12	3	60	100	65	15	18
4	1 3	1.3	1 3	12	16	8	2.5	1.3
5	1 7	1.7	1.7	15	21	10	3.25	2
3.5	2 5	2.5	2 5	5.5	7.5	4 5	2.5	2
1 5	1.5	1 5	1.5	1 5	1.5	1.5	1.5	1.5
No	No	Optional	Yes	No	No	No	No	Optional
LD2140S	**SLD2114TQS**	**SLD2114TQSP**	**SLD2114TQGS**	**SLD2106QS**	**SLD21100QS**	**SLD21100QS**	**SLD21110TQS**	**SLD21110TQP**
TEM_{00}	**TEM_{00}**	**TEM_{00}**	**MM**	**MM**	**MM**	**MM**	**Low MM**	**TEM_{00}**
30	10	12	3	60	90	65	15	18
4	1 3	1.3	1.3	12	16	8	2.5	1.3
5	1 7	1.7	1.7	15	21	10	3.25	2
3.5	2.5	2.5	2.5	5.5	7.5	4 5	2.5	2
3(1 5)	*3(1 5)*	*3(1.5)*	*3(1.5)*	*3(1.5)*	*3(1 5)*	*3(1 5)*	*3(1.5)*	*3(1.5)*
1-50	1-60	1-60	1-60	1-50	1-50	1-50	1-50	1-60
TEM_{00}	**TEM_{00}**	**TEM_{00}**	**MM**	**MM**	**MM**	**MM**	**Low MM**	**TEM_{00}**
1kHz	**1kHz**	**1kHz**	**5kHz**	**1kHz**	**1kHz**	**1kHz**	**1kHz**	**1kHz**
109	52	52	21.2	262	271	197	36	176
4 6	2.2	2.2	0.9	10.6	15 5	9.3	1.7	7.4
42	42	42	46	40	57	47	47	42
4 6	2.2	2.2	3 9	10.5	15 5	9.3	1.7	7.4
35	35	35	35	35	35	35	35	35
2 5	2 5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
CW200	CW200	CW200	CW200	CW200	CW200	CW200	CW200	CW200
CW100D	CW100D	CW100D	CW100D	CW100D	CW100D	CW100D	CW100D	CW100D
10	10	10	10	10	12	12	12	12
CL26HGB	CL26HGB	CL26HGB	CL26HGB	CL26HGB	CL26HGB	CL26HGB	CL26HGB	CL26HGB
CCL100	CCL100	CCL100	CCL100	CCL100	CCL100	CCL100	CCL100	CCL100
§	§	§	§	§	§	§	§	§
10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000

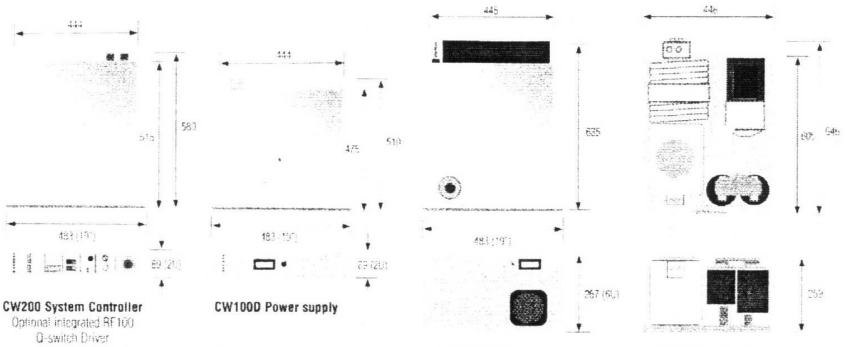
Individual product datasheets on all the products shown here are available as Acrobat PDF files for e-mailing
Contact us with your proposed application and we will give you every assistance

SLD2100 Series Sealed head



SLD2100 Series TEM_{00} Sealed head

SLD2100 Series TEM_{00} Sealed head with Frequency Doubler Unit

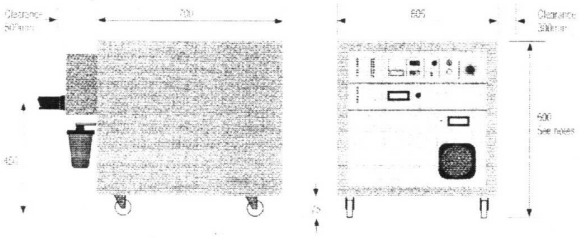


CW200 System Controller
Optional integrated RF100 Qswitch Driver

CW100D Power supply

CL26HGB Chiller (6U)

CCL100 Cooler (6U)



10U Cabinet with Chiller
for SLD/TEM

NOTES

Foot positions are variable.

Rail lengths vary according to exact system and configuration but are available typically as shown.

Other rail lengths are available to special order.

Cabinet height is variable and depends on exact system configuration.

Dimensions are in mm unless otherwise stated.

Individual product datasheets for all the products shown here are available as Acrobat PDF files for e-mailing.

Contact us with your proposed application and we will give you every assistance.

Spectron Lasers

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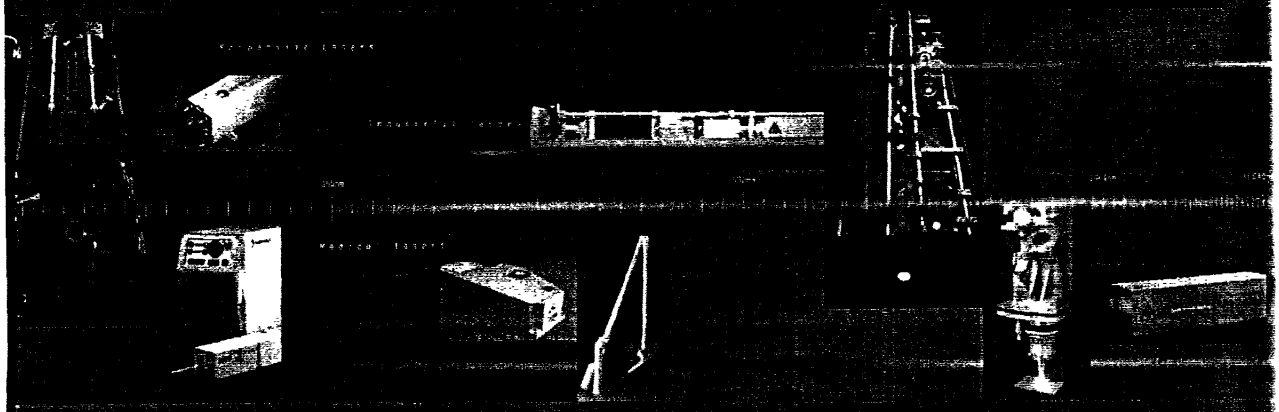
Issue 1 Mar 2001 Printed in England

PRODUCT SPECIFICATIONS

LAMP PUMPED

Nd:YAG LASERS



Spectron Lasers

SPECIFICATION

GENERAL

Nd:YAG CW Laser oscillator						
Wavelength	1064nm	1064nm	1064nm	1064nm	1064nm	1064nm
Single linear krypton arc lamp pumped	•	•	•	•	•	•
Diffuse ceramic reflectors	•	•	•	•	•	•

CW SPECIFICATION	SL502	SL502T**	SL902	SL902T**	SL903T	SL905T
Mode	**MM**	**TEM_{00}**	**MM**	**TEM_{00}**	**TEM_{00}**	**TEM_{00}**
Maximum CW output (W)	35	6	65	16	20	28
Rated lamp input for max. CW output (kW)	2	2	4	4	4	5
Beam quality M^2 at rated input	8	<1.3	8	<1.3	<1.3	<1.3
Beam product [I/e^2] (mm mrad)	10	1.7	11	1.7	1.7	1.7
Beam divergence full angle [I/e^2] (mrad)	3.5	1.5	5.5	2.5	2.5	3
RMS stability at rated input (%)	1.5	1.5	1.5	1.5	1.5	1.5
Linear polarisation	N/A	Optional	N/A	Optional	Standard	Standard

Q-SWITCHED SPECIFICATION	SL502Q	SL502TQ**	SL902Q	SL902TQ**	SL903TQ	SL905TQ
Mode	**MM**	**TEM_{00}**	**MM**	**TEM_{00}**	**TEM_{00}**	**TEM_{00}**
Nominal CW output for Q-switching (W)	35	6	65	16	20	28
Rated lamp input for max. Q-switched output (kW)	2	2	4	4	4	5
Beam quality M^2 at rated input	8	<1.3	8	<1.3	<1.3	<1.3
Beam product [I/e^2] (mm.mrad)	10	1.7	11	1.7	1.7	1.7
Beam divergence full angle [I/e^2] (mrad)	3.5	1.5	5.5	2.5	2.5	3
Pulse to pulse stability at 5kHz pk-pk% *(RMS%)*	*4(1.5)*	*4(1.5)*	*4(1.5)*	*4(1.5)*	*3(1)*	*4(1.5)*
Q-switched frequency range (kHz)	1-20	1-20	1-25	1-25	1-30+	1-30

TYPICAL Q-SWITCHED PERFORMANCE *						
	TEM_{00} 1kHz	**TEM_{00} 1kHz**	**MM 1kHz**	**TEM_{00} 1kHz**	**TEM_{00} 1kHz**	**TEM_{00} 1kHz**
Pulse peak power (kW)	72	14.5	150	40	45	87
Pulse energy (mJ)	8	1.6	15	4	4.5	7
Pulse width FWHM (ns)	110	110	100	100	100	80
Average power (W)	8	1.6	15	4	4.5	7

SERVICES						
Max ambient temperature (°C)	35	35	35	35	35	35
Electrical consumption at CW spec. power (kW)	4.5	4.5	5	5	5	6

ELECTRICAL REQUIREMENT						
System controller unit	CW200	CW200	CW200	CW200	CW200	CW200
Power supply unit	CW600	CW600	CW600	CW600	CW600	CW600
(50/60Hz) 220/240V 1Ø, N & E	21	21				
A (50/60Hz) 340/440V 3Ø & E (A/phase)			9	9	9	11
B (50/60Hz) 180/250V 3Ø & E (A/phase)			17	17	17	22

COOLING WATER REQUIREMENTS						
Chiller/(Cooler) unit	CL30HGB	CL30HGB	(CCL100)	(CCL100)	(CCL100)	(CCL100)
Minimum pressure (bar)			2	2	2	2
Maximum pressure (bar)			5	5	5	5
Water consumption at 20°C (l/min)			7.5	7.5	7.5	9.5
Maximum water temperature (°C)			20	20	20	20

LAMP LIFE						
Guaranteed (hrs)	1500	1500	800	800	800	400
Nominal [cont. running at rated input] (hrs)	2500	2500	1000	1000	1000	600

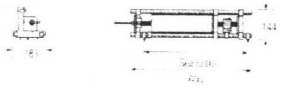
* More data is available in individual product specification sheets.
** Multi mode or TEM_{00} outputs are available from the same laser as an option.

CW Nd:YAG Lamp Pumped Laser Heads

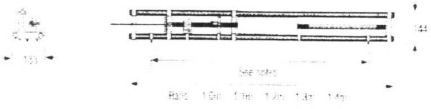
1064nm	532nm	1064nm	1064nm	1064nm	1064nm	1064nm	1064nm
•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•
SL912T		**SL1301**	**SL1302**	**SL1308**	**SL1308T****	**SL2502**	**SL5502**
TEM_{00}		**MM**	**MM**	**MM**	**TEM_{00}**	**MM**	**MM**
9		180	110	90	18	250	400
4		6	6	5	5	7.5	16
<1.3		32	13	8	<1.3	50	35
1.7		43	17.5	11	1.7	67	47
2.1		12	11	6.5	2.5	17	11
1.5		2	3	2	2	3	3
Optional		N/A	N/A	N/A	N/A	N/A	N/A
SL912TQ	**SL905TQG**		**SL1302Q**	**SL1308Q**	**SL1308TQ****	**SL2502Q**	**SL5502Q**
TEM_{00}	**TEM_{00}**		**MM**	**MM**	**TEM_{00}**	**MM**	**MM**
9	5		110	90	18	250	400
4	5		6	5	5	7.5	16
<1.3	<1.3		13	8	<1.3	50	35
1.7	<0.87		17.5	11	1.7	67	47
2.1	3.5		11	6.5	2.5	17	11
4(1.5)	*6(2.0)*		*7(2.5)*	*6(2.0)*	*6(2.0)*	*8.5(3)*	*12(4)*
1-35	4-10		1-25	1-25	1-25	6-25	20-30
TEM_{00}	**TEM_{00}**		**MM**	**MM**	**TEM_{00}**	**MM**	**MM**
1kHz	**4kHz**		**1kHz**	**1kHz**	**1kHz**	**6kHz**	**30kHz**
20	11.4		260	200	40	140	14.6
2.3	1.25		29	20	4	31	12
115	110		110	100	100	220	820
2.3	5		29	20	4	190	360
35	35	35	35	35	35	35	35
5	6	7	7	6	6	8.5	20
CW200	CW200	CW200	CW200	CW200	CW200	CW200	CW202
CW600	CW600	CW600	CW600	CW600	CW600	CW1200	CW1200x2
9	11	12	12	11	11	16	37
17	22	24	24	22	22		
(CCL100)	(CCL100)	(CCL100)	(CCL100)	(CCL100)	(CCL100)	(CCL200)	(CCL200)x2
2	2	2	2	2	2	2	2
5	5	5	5	5	5	5	5
7.5	9.5	10	10	9.5	9.5	15	30
20	20	20	20	20	20	20	20
800	400	400	400	400	400	400	400
1000	600	600	600	600	600	600	600

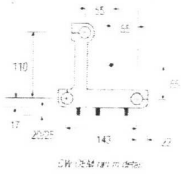
Individual product datasheets on all the products shown here are available as Acrobat PDF files for e-mailing. Contact us with your proposed application and we will give you every assistance.

SL500 Series Rail

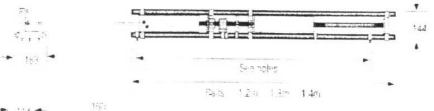


SL900 & SL1300 Series Rail

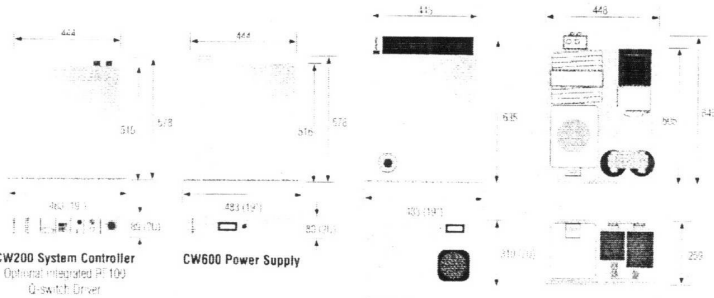




SL905TQB & G Series Rail



Typical Cased Laser Head

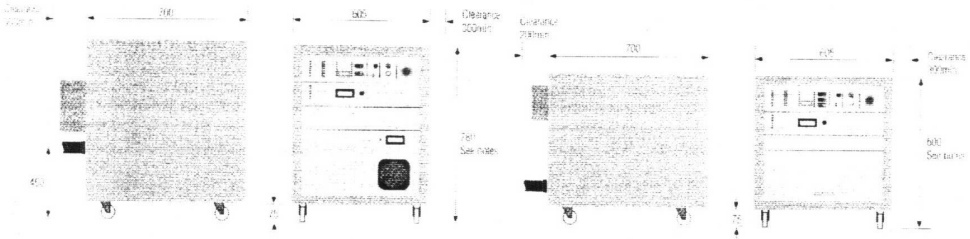


CW200 System Controller
Optional integrated PF100
Q-switch Driver

CW600 Power Supply

CL30HGB Chiller (7U)

CCL100 Cooler (6U)
CCL200 Cooler (6U)



14U Cabinet with Chiller
for SL500

12U Cabinet with Cooler & standard umbilical
for SL900 & SL1300

NOTES

Front panelling are variable.

Rail lengths vary according to exact system and configuration but are available typically as shown.

Other rail lengths are available to special order.

Cabinet height is variable and depends on exact system configuration.

Dimensions are in mm unless otherwise stated.

Individual product datasheets for all the products shown here are available as Acrobat PDF files on request.

Contact us with your proposed application and we will give you every assistance.

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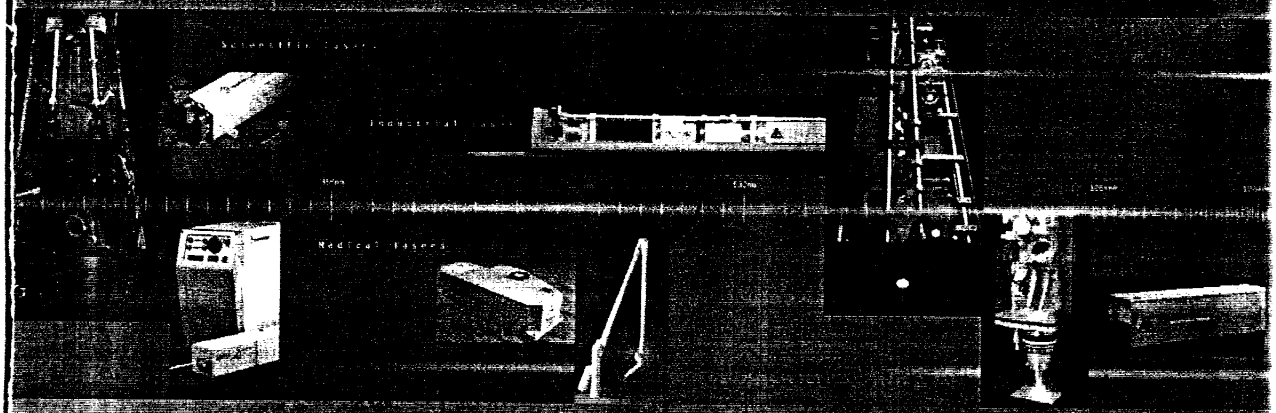
PRODUCT SPECIFICATIONS

PULSED Nd:YAG

LASERS



Spectron Lasers

SPECIFICATION

SERIES	SL400 Series				SL450 Series			SL8
Type - Q-switched Nd:YAG Lasers								
Single rod oscillator	•	•	•	•				
Twin rod oscillator					•	•	•	
Single rod oscillator and single rod amplifier								•
Twin rod oscillator and twin rod amplifier								
Birefringence compensation					•	•	•	
Laser pumping by linear Xenon flashlamp(s)	1	1	1	1	2	2	2	2

Parameter	Rep. Rate	Wavelength (nm)(1)	SL401	SL401T(2)	SL404	SL404T(2)	SL452	SL454	SL803	SL
Resonator - Telescopic multimode			•		•		•		•	
Telescopic TEM_{00}				•		•		•		
Stable multimode										
Pulse Energy (mJ)	Up to 10Hz	1064	170	40	320	80	400	600	850	
		532	55	10	125	25	140	210	320	
		355	20	3	55	10	60	100	140	
		266	15	3	30	8	35	50	80	
	Up to 30Hz	1064	150	30	280	70	350	500	700	
		532	40	7	80	20	120	170	230	
		355	15	2	40	10	50	70	100	
		266	10	2	20	5	25	35	50	
	Up to 50Hz	1064	140	20		60	200	350		
		532	35	5		15	60	90		
		355	10	1		4	25	40		
		266	5	1		3	10	20		
	Up to 100Hz	1064								
		532								
Pulse Duration (ns) (6)	Nominal FWHM, ±2	1064	7	7	13	13	13	13	13	
		532	6	6	12	12	12	12	12	
		355	5	5	11	11	11	11	11	
		266	4	4	10	10	10	10	10	
Beam Divergence (full angle) at 1064nm (mrad)	Multimode		0.8		0.8		0.8	0.8	0.8	
	TEM_{00} (% diffraction limit)			30		30				
M^2			<10	1.3	<10	1.3	<10	<10	<10	
Pointing Stability (±μrad)	90% of shots		50	50	50	50	50	50	50	
Beam Diameter (mm)	Nominal		4	2	6	3	6	8	8	

Parameter	Rep. Rate	Wavelength (nm)	SL404G	SL406G	SL452G	SL454G	SL456G	SL803G
Resonator - Guassian-coupled multimode			•	•	•	•	•	•
Pulse Energy (mJ)	Up to 10Hz	1064	300	450	400	650	800	900
		532	140	200	170	300	320	400
		355	60	80	65	120	160	200
		266	35	50	55	70	80	90
	Up to 30Hz	1064	250		350	500	600	700
		532	90		140	200	220	250
		355	45		55	70	100	120
		266	20		30	35	40	50
	Up to 50Hz	1064			200	300	350	
		532			70	100	120	
		355			30	40	45	
		266			15	25	30	
Pulse Duration (ns) (5)	Nominal FWHM, ±2	1064	6-9	6-9	6-9	6-9	6-9	6-9
		532	5-7	5-7	5-7	5-7	5-7	5-7
		355	4-6	4-6	4-6	4-6	4-6	4-6
		266	3-5	3-5	3-5	3-5	3-5	3-5
Beam Divergence at 1064nm (mrad)	Full angle		0.5	0.5	0.5	0.5	0.5	0.5
Pointing Stability (±μrad)	90% of shots		37	37	37	37	37	37
Beam Diameter (mm)	Nominal		6	8	6	8	9.5	8

Series	SL850 Series					SL2400/2800 Series	
						•	
•							
		•	•	•	•		•
		•	•	•	•	•	•
2	2	4	4	4	4	2	4
4T(2)	SL805	SL852	SL854	SL856	SL8585	SL2400	SL2800
	•	•	•	•	•		
						•	•
50	1100	1250	1500	1750	2000		
50	450	500	600	700	750		
0	170	190	200	250	300		
0	90	100	110	130	150		
0	800	950	1100	1300	1500		
0	260	320	350	430	500		
0	120	140	160	180	200		
0	70	75	80	85	90		
0		700	800	900	1000		
0		200	240	270	300		
5		90	100	120	150		
5		30	40	50	60		
						100	200
						50	100
3	13	13	13	13	13	<25	<25
2	12	12	12	12	12	<25	<25
1	11	11	11	11	11		
0	10	10	10	10	10		
	0.8	0.8	0.8	0.8	0.8	<3	<3
0							
3	<10	<10	<10	<10	<10	12	12
0	50	50	50	50	50	<50	<50
	9.5	9.5	9.5	12	12	4	6

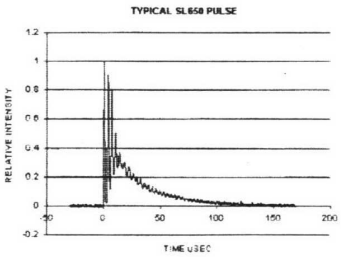
	SL805G	SL852G	SL854G	SL856G	SL858G	
	•	•	•	•	•	
	1100	1250	1500	1750	2000	
	500	600	750	850	1000	
	260	300	370	400	550	
	100	120	140	160	180	
	800	950	1100	1300	1500	
	300	450	550	650	750	
	150	250	280	330	370	
	70	80	80	100	110	
		700	800	900	1000	
		260	320	400	500	
		120	150	200	250	
		35	45	60	75	
	6-9	6-9	6-9	6-9	6-9	
	5-7	5-7	5-7	5-7	5-7	
	4-6	4-6	4-6	4-6	4-6	
	3-5	3-5	3-5	3-5	3-5	
	0.5	0.5	0.5	0.5	0.5	
	37	37	37	37	37	
	9.5	9.5	9.5	12	12	

SPECIFICATION

SERIES	SL600 Series			
Type - Pulsed Nd:YAG Laser with single rod oscillator				
Laser pumping by single linear Xenon flashlamp				
Resonator - TEM_{00}		•		•
Stable multimode	•		•	

Model	SL603	SL603T	SL650	SL650T
Wavelength (nm)	1064	1064	1064	1064
Nominal aver. power @ max. PRF (W)	50	8	70	12
Pulse frequency (Hz)	500-1000	500-1000	800-2000	800-2000
Max. pulse energy @ max. PRF (mJ)	50	8	35	6
Peak power @ max. PRF (MW)	17	3	12	2.5
Pulse to pulse stability RMS (%)	<3	2	<5	2
Beam divergence (mrad)	6	2.3	6	2.5
M^2	<9	<1.2	<7	1.2
Pointing stability (µrad)	<100	<100	<100	<100
Polarisation	Random	Random	Random	Random
Flashlamp life (million shots)				
Guaranteed	>500	>500	>800	>800
Nominal	>800	>800	>1000	>1000
Services				
(50-60Hz) 220/240VAC single phase (kVA)	6.5	6.5	7	7
Minimum pressure (bar)	2	2	2	2
Water consumption @ 20°C (l/min)	9.5	9.5	10	10
Max. water temperature (°C)	20	20	20	20

SL600 Series pulse duration



CVD Diamond.

ALL MODELS (Ex. SL600 Series)

Energy Stability	Pulse to pulse 99% of shots (± %)	1064	<2
		532	<4
		355	<6
		266	<10
Power Drift	Over 8 hours ±3°C(%)	1064	<3
		532	<5
		355	<6
		266 (8)	<10
Polarization	Linear	1064	>98%

ALL MODELS (Ex. SL600 Series)

Linewidth of Fundamental (cm^{-1}) (3) (4)	Normal	1.0
	Telescopic with etalons	0.06
	Gaussian with etalons	0.15
	With SI100 seeder	0.003
Timing Jitter with respect to Q-switch Direct Access (ns) (5)		±0.5
Lamp Life (million shots)	SL400, 450, 800, 850	>10
	SL2400	>50
	SL2800	>150

SL400-850 SERIES PACKAGE OPTIONS

Laser Head Packages	Std	Optional
SL401	C	A,B
SL400 (Other)	D	C
SL400G	B	A,D
SL450	D	C
SL450G	B	A,D
SL800	D	
SL800G	D	B
SL850	D	
SL850G	D	

Power supply Packages	
SL400	a (600mm)
SL450 (10Hz)	a (600mm)
SL800	b (780mm)
SL850 (10Hz)	b (780mm)
SL450 (>10Hz)	c (870mm)
SL850 (>10Hz)	d (1140mm)

SERVICES ALL MODELS (Ex. SL600 Series)

		Up to 10Hz	Up to 50Hz	Up to 100Hz
Electrical Supply Requirements Single phase 220-240VAC 50/60Hz	SL400 Series	2kVA	3.5kVA	
	SL450 Series	3.5kVA	6.5kVA	7.5kVA
	SL800 Series	3.5kVA	6.5kVA	
	SL850 Series	6.5kVA	12kVA	12kVA
Water Supply Requirement <20°C, >2bar	SL400 Series*	1 l/min	2 l/min	
	SL450 Series*	2 l/min	4 l/min	9.5 l/min
	SL800 Series	2 l/min	4 l/min	
	SL850 Series	4 l/min	8 l/min	10 l/min

*1.5kW & 2.5kW chillers available for air-cooled operation.

CONTROLS & INTERFACES

SERIES		SL400/450/800/850	SL2400/2800	SL600
Controls	Manual Control of Laser from Power Supply	•		
	RS232 Interface in lieu of Manual Control	•	•	•
	RS232 Interface with Remote Controller in lieu of Manual Control	•		
Interfaces	Trigger input to Q-switch	•	•	
	Trigger input to flashlamp	•	•	
	Synchronisation output from flashlamp	•	•	•
	Synchronisation output from Q-switch	•	•	

TWIN SYSTEMS

All models are available as twin lasers for flow visualisation (PIV). Twin, seeded versions of the SL400-850 series are also available for vibration analysis (ESPI). Information is available for these systems separately.

NOTES

1. 532nm and 266nm energies are specified with a type II KD*P SHG crystal. 355nm energies are specified with a type I KD*P SHG crystal. (Excludes Micro-Q and 100Hz models.)

2. Suffix 'T' denotes TEM_{00} operation. Available on all telescopic resonator lasers. TEM_{00} outputs are typically 25-35% of the multi-mode energy for oscillators and oscillator/amplifiers respectively, and are approximately half the beam diameter.

3. Single longitudinal mode (SLM) operation is available using Spectron SL100 Injection Seeder DPSS laser (except Micro-Q). SLM operation is available only with TEM_{00} and Gaussian series lasers. Insertion loss with seeder is <10% at 1064nm, while a gain of up to 20% is observed at 355nm.

4. Insertion loss for etalons is 10% and 20% for Telescopic and Gaussian lasers respectively. Energy stability may also be degraded.

5. Timing jitter with the seeder is ±1.0ns.

6. Pulse length specifications apply at up to 10Hz unless otherwise noted. Pulse durations increase at higher PRFs.

7. Standard laser head packages are designed to allow full flexibility to add accessories, but alternatives are available for added compactness. Certain accessory and upgrade restrictions apply to alternative packages: details on request.

8. High power or rep-rate systems require auto-tuning for optimum long term power stability.

Double pulse Q-switch option is available on all SL400-850 series lasers.

SL400 & SL450 series oscillator-only lasers are available as UPG versions that allow for future, field upgrade to oscillator/amplifier configuration. Further details on request.

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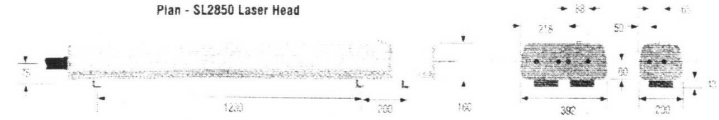
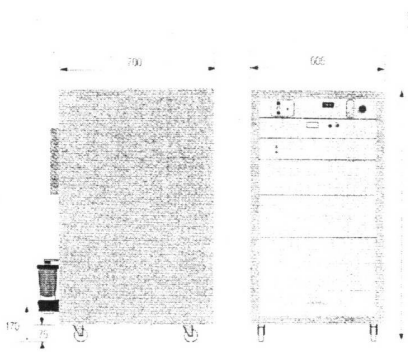
SL2400/2800 SERIES PULSED Nd:YAG LASERS

Plan - SL2450 Laser Head

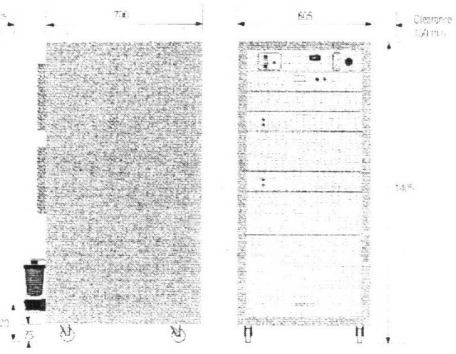
Plan - SL2850 Laser Head



Side - SL2450/2850 Laser Heads

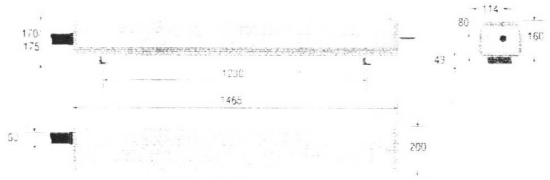


SL2450 Power Supply Unit

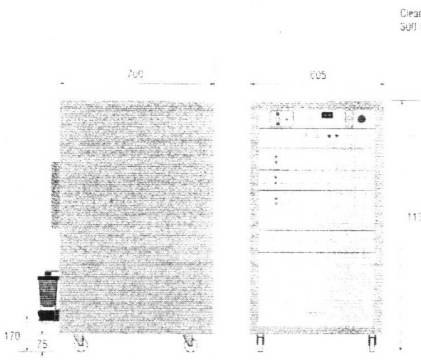


SL2850 Power Supply Unit

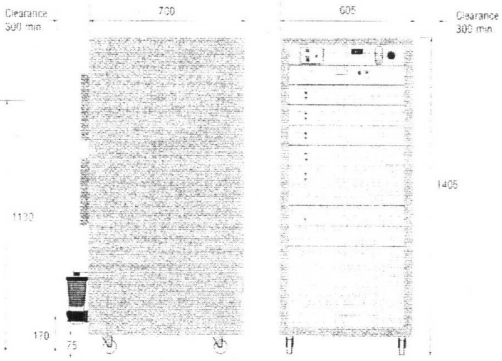
SL600 SERIES PULSED Nd:YAG LASERS



SL603 & SL650 Laser Head



SL603 Power Supply Unit



SL650 Power Supply Unit

NOTES

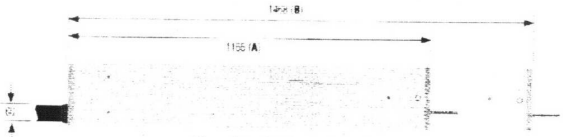
Cabinet height is variable and depends on exact system configuration.

Dimensions are in mm (unless otherwise stated)

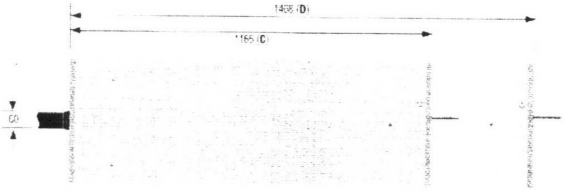
Individual product datasheets for all the products shown here are available as Acrobat PDF files for e-mailing.

Please contact us with your proposed application and we will give you every assistance.

SL400/850 SERIES PULSED Nd:YAG LASERS



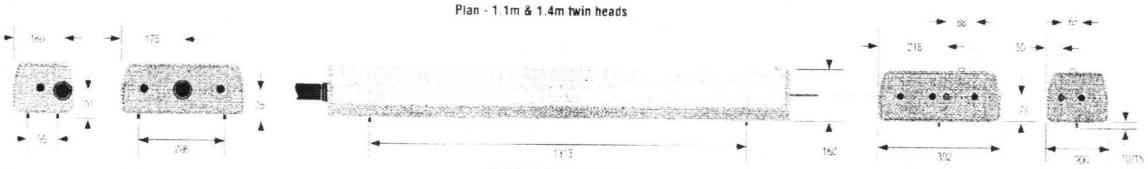
Plan - 1.1m & 1.4m single heads



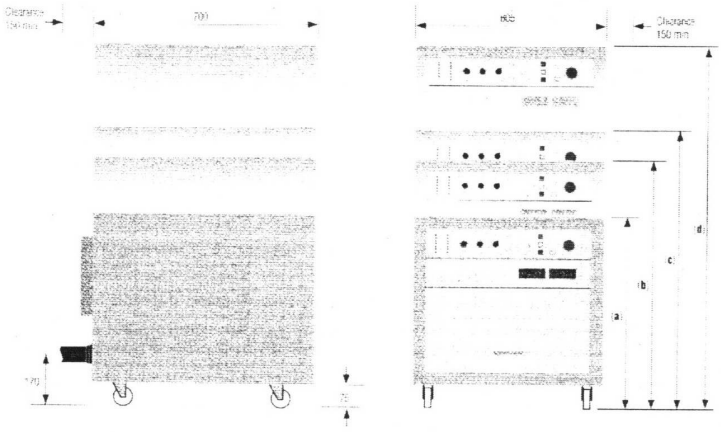
Plan - 1.1m & 1.4m twin heads

SPECIAL NOTE

The SL855S laser head is not covered by this diagram. It is available as a 1.4m rail @ bar 20 Hz (at 6 Bar) only if duration.



SL400/850 Laser Heads



SL400/850 Power Supply Units

All dimensions are in millimetres unless otherwise stated.

As our policy is constantly to improve the design and specification of Spectron Laser products, the details given in this brochure are not to be regarded as binding.

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Website: www.spectronlasers.com

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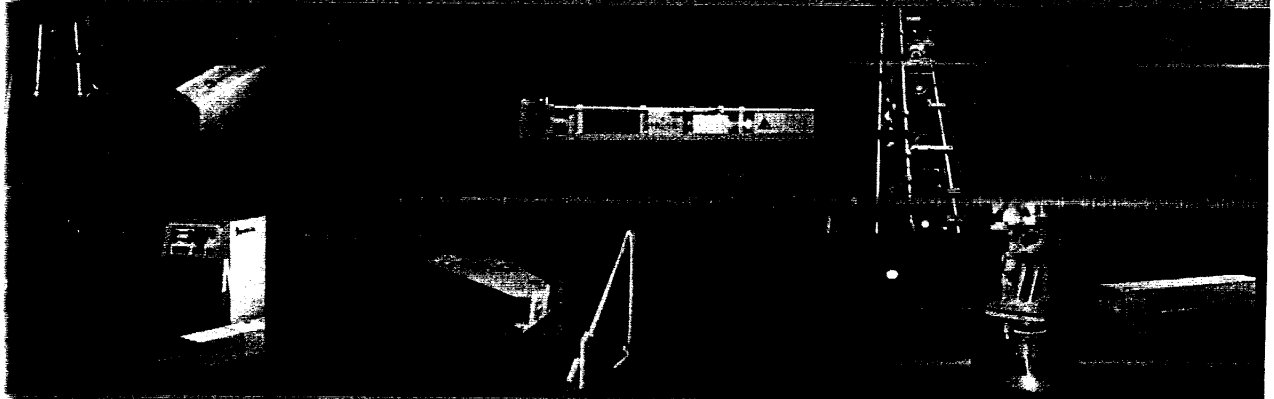
PRODUCT SPECIFICATIONS

DC & RF CO_2 LASERS



Spectron Lasers

Glassutting?

SPECIFICATION

DC CO_2 LASERS	SLC030B&T	SLC040B&T	SLC065B&T	SLC110B&T	SLC100	SLC200
Wavelength (μm)	10.6	10.6	10.6	10.6	10.6	10.6
Output Power (Specified/Max) (W)	30/40	40/50	70/80	110/120	110/120	220/240
Beam quality (M^2)	≤1.1	≤1.1	≤1.1	≤1.1	≤1.1	≤1.1
Beam Waist ($2\omega_0$) (mm)	4.8	4.8	4.8	4.8	4.8	4.8
Beam divergence (mrad full angle)	3.1	3.1	3.1	3.1	3.1	3.1
Beam waist location (m) *measured from output coupler*	1.0	0.97	1.0	1.15	1.15	1.15
Pointing stability (mrad)	≤0.2	≤0.2	≤0.2	≤0.2	≤0.1	≤0.1
Typical power stability (± % after warm up)	5.0	4.0	4.0	4.0	4.0	5.0
Cooling (l/min) (de-ionized water)	1.0	2.8	2.8	3.6	3.6	7.2
Polarisation	random/linear*	random/linear*	random/linear*	random/linear*	random/linear*	crossed
Strike voltage (kV)	21	25	30	<45	<45	<45
Specified operating current/absolute max. (mA)	20/24	32/35	32/35	32/35	32/35	32/35
Dynamic Range (with 5:1 attenuating shutter)	10:1	10:1	8:1	8:1	100:1	105:1
Max pulse frequency (Hz) (cooling fluid dependent) **	5000	5000	5000	5000	5000	5000
ELECTRICAL REQUIREMENT						
SINGLE PHASE						
110V/60Hz (A)	4	6	6	6	7	13
230V/50Hz (A)	2	3	3	3	4	7
COOLING REQUIREMENTS						
Min/max pressure (bar)	2/5	2/5	2/5	2/5	2/5	2/5
Water cooling capacity (W)	200	300	400	650	650	1300
Temperature (°C)	15-25	15-25	15-25	15-25	15-25	15-25
GASES	Sealed unit - no gas consumption					

* Optional ** With derated power

NOT AVAIL YET

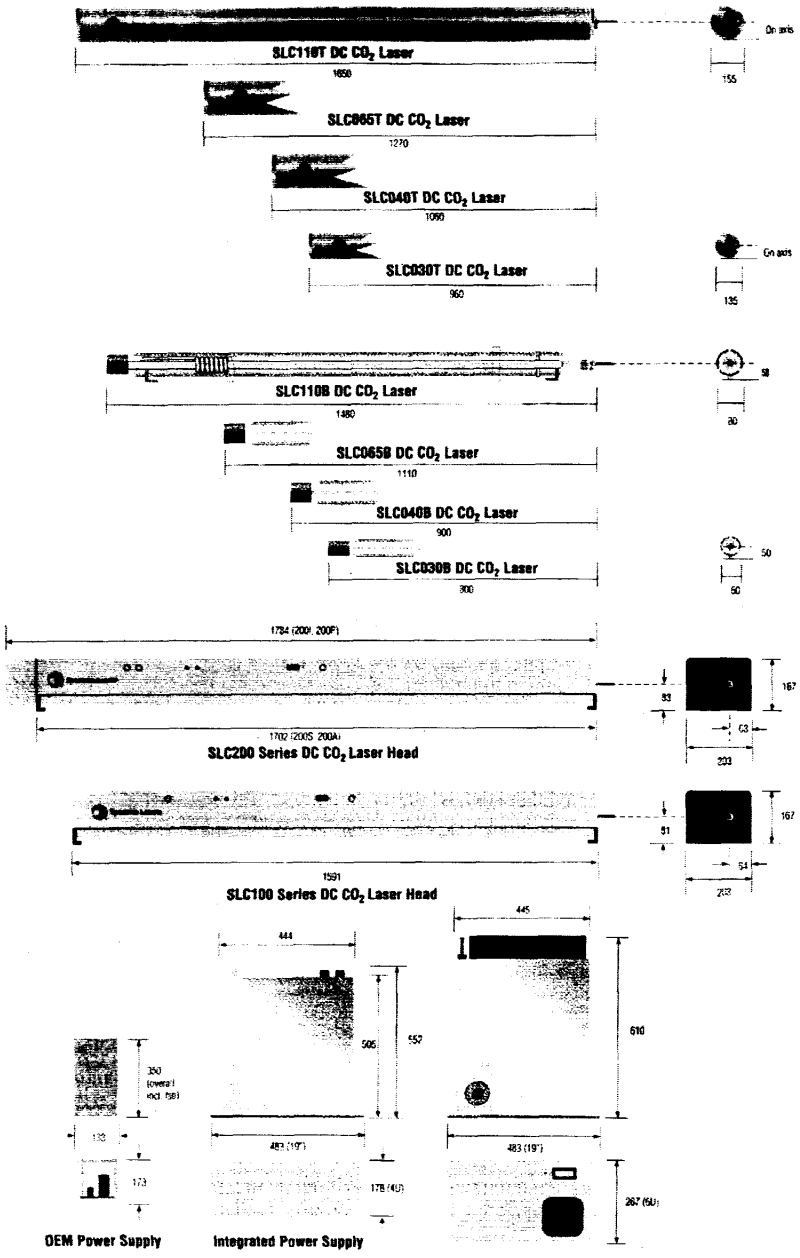
RF CO_2 LASERS	SLR012	SLR012AC	SLR025	SLR025AC	SLR050	SLR050AC
Wavelength (μm)	10.6	10.6	10.6	10.6	10.6	10.6
Output Power (Specified/Max) (W)	12/14	12/14	25/30	25/30	50/60	50/60
Max peak power (W)	25	25	50	50	100	100
Beam quality (M^2) (>% TEM_{00})	1.3(95)	1.3(95)	1.2(98)	1.2(98)	1.2(98)	1.2(98)
Elipticity	1:1	1:1	1:1	1:1	1:1	1:1
Beam Waist at output ($2\omega_0$) (mm)	2.0	2.0	2.0	2.0	2.0	2.0
Beam divergence (mrad - full angle)	7.5	7.5	7	7	7	7
Polarisation	linear (vertical)	linear (vertical)	linear (vertical)	linear (vertical)	crossed	crossed
Typical power stability (± %variation after warm up)	2.0	4.0	2.0	4.0	3.0	5.0
Dynamic power range (%)	0-100	0-100	0-100	0-100	0-100	0-100
MODULATION						
Range (kHz)	0-100	0-100	0-100	0-100	0-100	0-100
Max. frequency (kHz) (100% mod depth)**	5	5	5	5	5	5
Min. frequency (kHz) (0% mod depth)**	25	25	25	25	25	25
Rise/fall time (μsecs)	70	70	70	70	70	70
Cooling Type	water	air	water	air	water	air
ELECTRICAL REQUIREMENT						
DC supply (V/A)	32-48*/8	32-48*/8	32-48*/16	32-48*/16	32-48*/32	32-48*/32
COOLING REQUIREMENTS						
Water consumption (l/min)	2	N/A	3	N/A	6	N/A
Temperature (°C)	15-25	N/A	15-25	N/A	15-25	N/A
GASES	Sealed unit - no gas consumption					

** 50% duty cycle

Note

Spectron also offer custom RF and DC CO_2 lasers. Accessories include high frequency (acousto optic modulated) units, alternative output wavelengths (9.3, 9.6 μm), beam delivery systems, beam expanders and ultra stable output units.

SPECTRON DC CO_2 LASERS



MODEL OPTIONS

SLC000S	•			
SLC000A	•			•
SLC000P	•	•	•	
SLC000I	•	•	•	•

100 = 100 or 200

NOTES

Dimensions are in mm unless otherwise stated.

Chillers contain approximately 4kg of water over the dry weight when in use.

Water to water and water to air coolers are also available as standard.

Contact us with your proposed application and we will give you every assistance.

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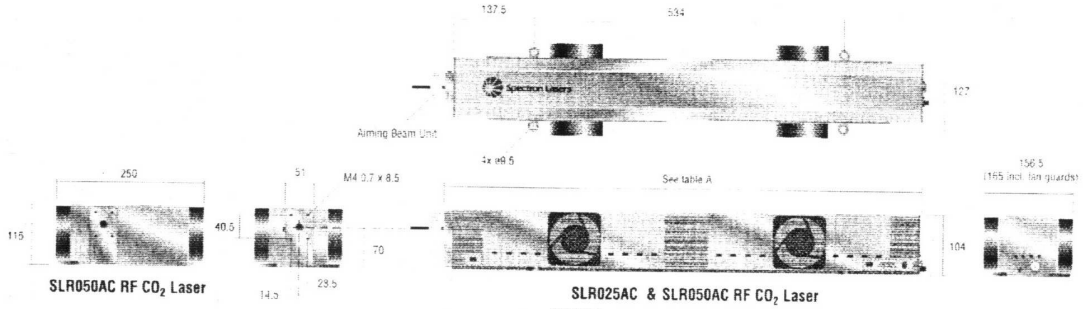
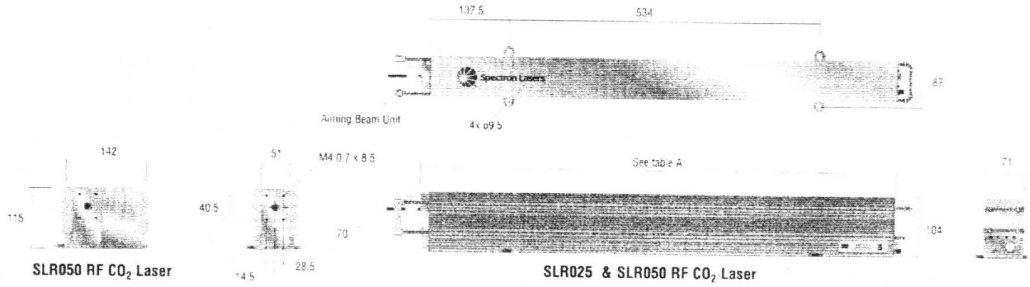
SPECTRON RF CO_2 LASERS



SLR050AC RF CO_2 Laser

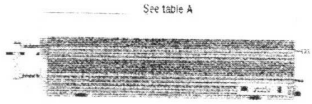
SLR025AC & SLR050AC RF CO_2 Laser

SLR012AC RF CO_2 Laser

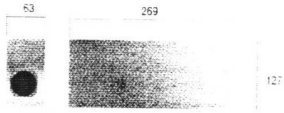


SLR050 RF CO_2 Laser

SLR025 & SLR050 RF CO_2 Laser



SLR012 RF CO_2 Laser



DC Power Supply Unit

TABLE A

Model/option	Overall length		
	Base	α / β	γ
SLR012	444	466	430
SLR025	823	845	809
SLR050	900	922	886

MODEL OPTIONS

Part No.	Water Cooling	Air Cooling	Keyswitch	Shutter	Diode Alignment Laser
SLRXXX	•		•	•	
SLRXXX-α	•		•	•	•
SLRXXX-β	•				•
SLRXXX-γ	•				
SLRXXXAC		•	•	•	
SLRXXXAC-α		•	•	•	•
SLRXXXAC-β		•			•
SLRXXXAC-γ		•			

XXX = 012, 025 or 050

NOTES

Dimensions are in mm (1 inch = 25.4mm)

SLR beam height: 1.5mm (0.05inch) to optical aiming beam centre

All diagrams show turnkey systems. OEM versions exclude the keyswitch and shutter switch.

Contact us with your proposed application and we will give you every assistance.

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Email: sales@spectronlasers.com
Website: www.spectronlasers.com

附件

三、EdgeWave 公司資料

About us

Founded:	12.06.2001 as Spin-Off from ILT
Name:	EdgeWave GmbH (Ltd)
Location:	Laser Application Center Aachen
Members:	Dr. Keming Du, Aclas, FhG-ILT
Business:	Development, Production and Markting of Laser Sources based on Diode Lasers

edgewave

The Name: EdgeWave

Technical Associations:

- Diode Laser = *Edge* Emitter
- Slab Laser - Outcoupling via *Edge* Mirror (Scraper)
- Laser Beam - optical *Wave*

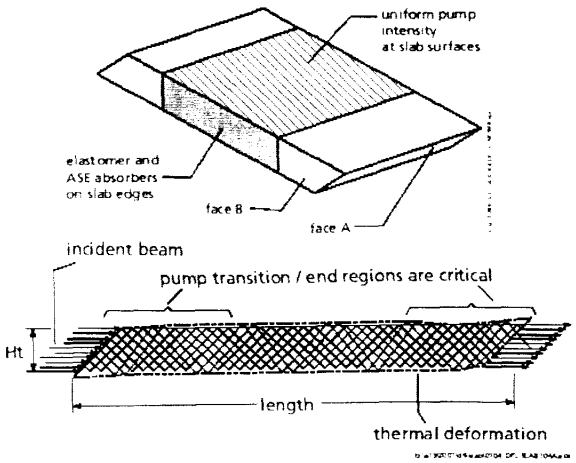
Missions:

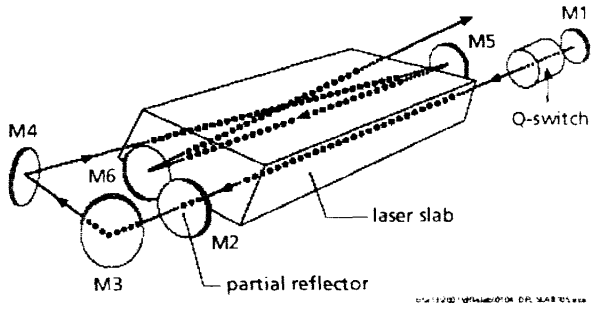
- *Edge* - Leading *Edge* Technology
- *Wave* - Dynamic via continueous Invention und Innovation

edgewave

Conventional Slab Laser

Scheme





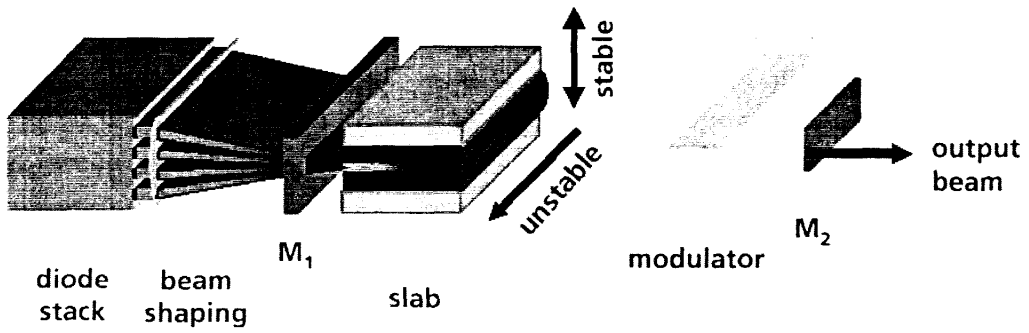
edgewave

Properties of conventional slab lasers

- all surface have to be polished > expansive crystal processing
- sophisticated holding and cooling of the crystal
- complicated Zigzag path through crystal
- parasitar mode oscillation
- no-matching between laser mode and pumped volume > low effciency
- large phase distortion > low beam quality

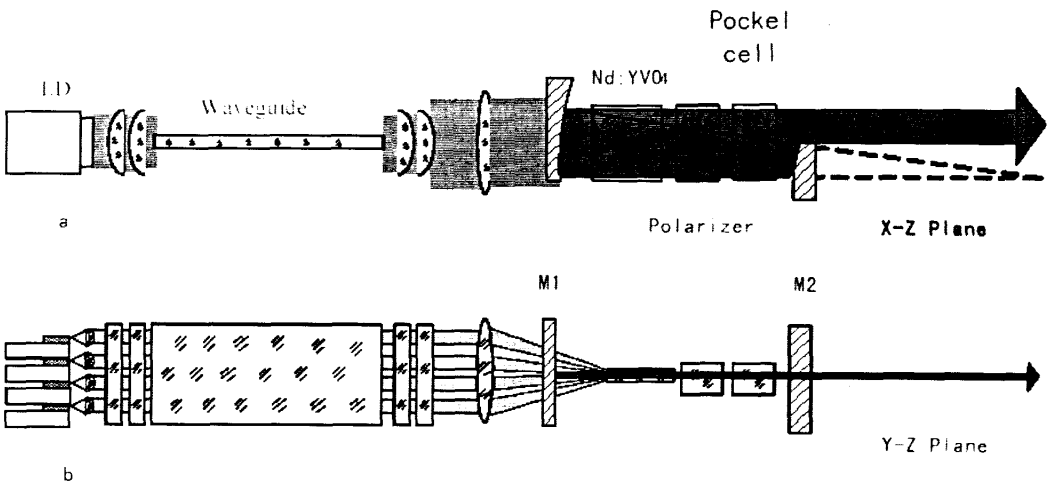
edgewave

Scheme of INNOSLAB



edgewave

INNOSLAB Scheme



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INNOSLAB - Design features

1 simple crystal geometry with only two polished faces

2 effectively thermal contact and conduction via large faces

3 1 dimensional heat conduction
- low depolarisation loss
- low phase distortion

4 straight passing without zigzag
- hybrid resonator
- no parasitare oscillation

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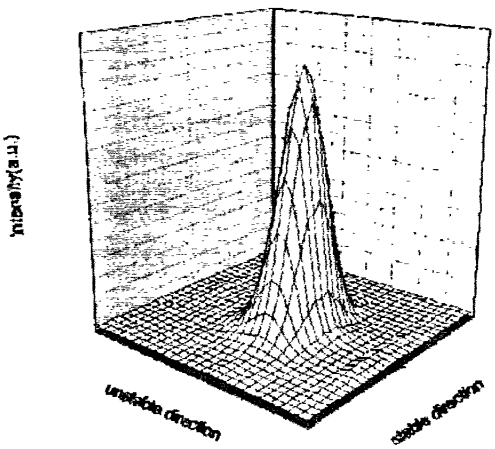
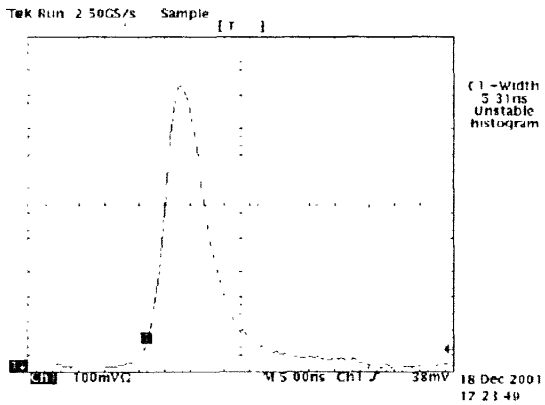
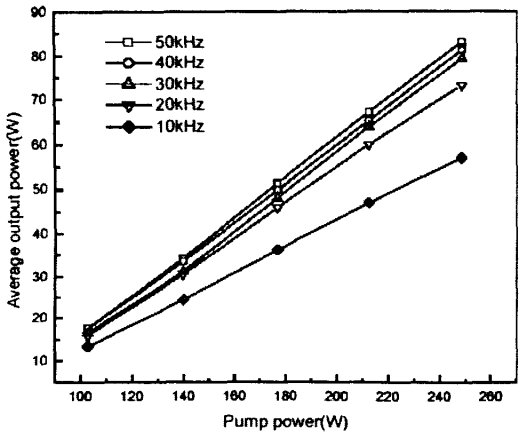
Intensity Distributions and Pulse Shape

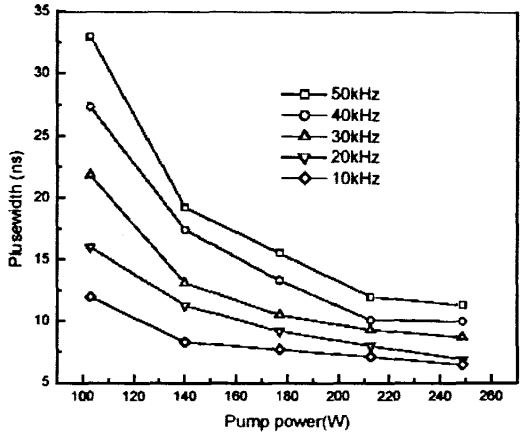




edgewave

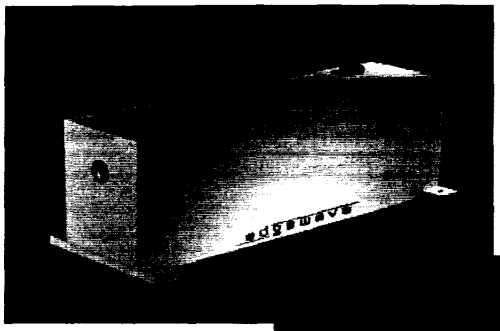
Pulse Behavior of the IS8I-E



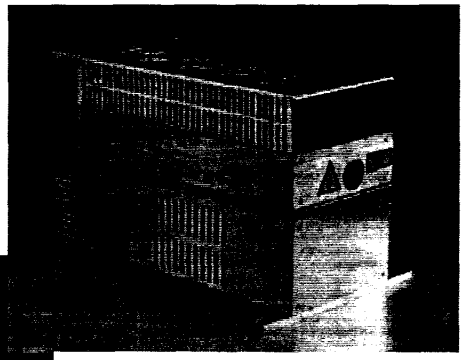


edgewave

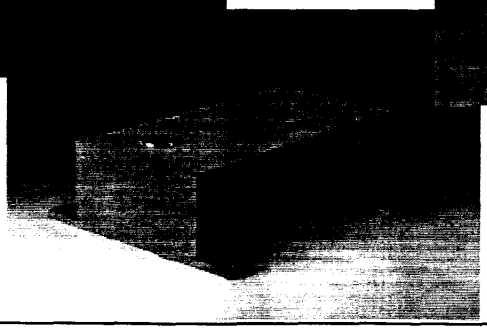
Products Examples IS-, Boxtar- and A-Serie



IS-Serie



A-Serie



Boxtar-Serie

edgewave

Product examples: E/O q-switched Lasers

	IS4I-E	IS8I-E	IS4II-E
Wave length (nm)	1064	1064	532
Average power	40 W	80 W	15
Beam quality (M^2)	< 2	< 2	< 2
Pulse rate	0 – 50 kHz	0 – 50 kHz	0 – 50 kHz
Pulse energy @ 5kHz	4 mJ	6 mJ	2 mJ
Pulse length @ 5 kHz	6 ns	6 ns	5 ns
Polarisation	>100:1	>100:1	>100 1
Beam geometry	< 20% elliptical	< 20% elliptical	10% elliptical
Diameter	2 mm	2 mm	2 mm
Divergence (full)	< 1.2 mrad	< 1.2 mrad	< 0.6 mrad
Energy stability	< 3%	< 3%	< 5%

edgewave

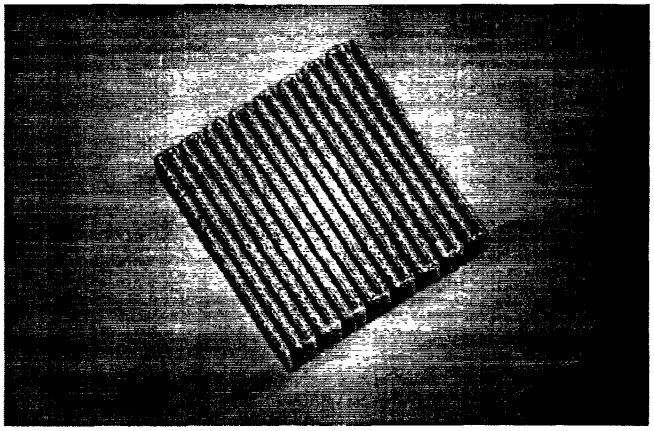
Application Example: Laser selective sintering

Laser parameters:

- Wavelength: 1064nm
- Average power: 20 W
- Beam quality: M2 < 2

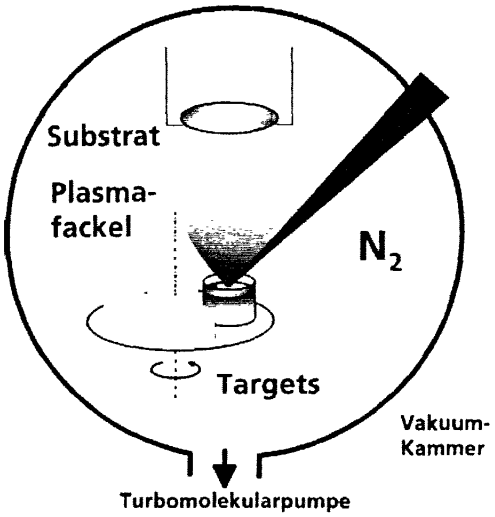
Performances:

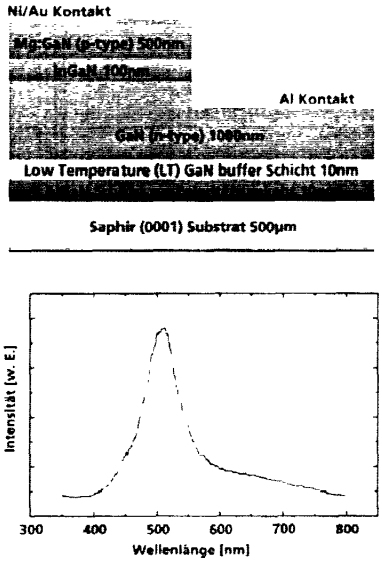
- Structure size down to 50 µm



edgewave

Application Example: Laser induced reactive Epitaxie





edgewave

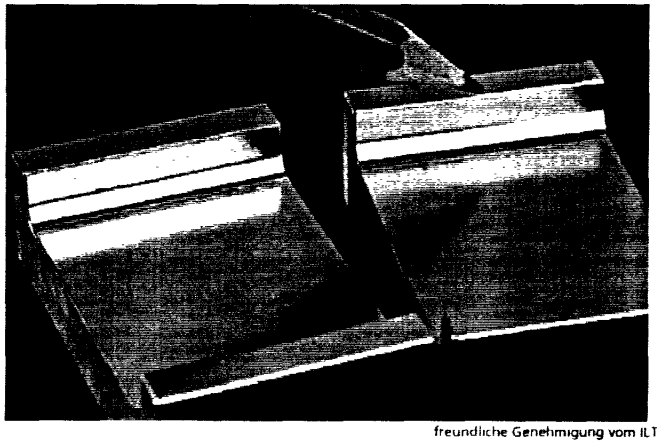
Application Example: Laser Polishing

Short pulse > high glance

high average power > high productivity

high efficiency > low operation cost

long life time > reliability

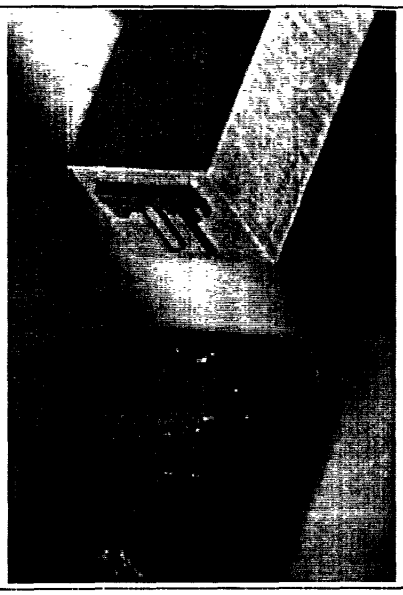


freundliche Genehmigung vom ILT

edgewave

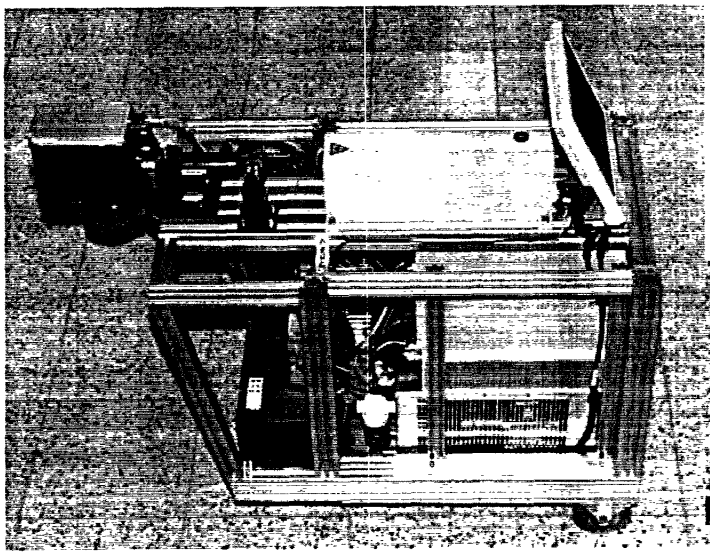
Application Example: Structuring of a connector tool

Material: Steel
Line speed: 200 mm/sec
Layer: 2 µm

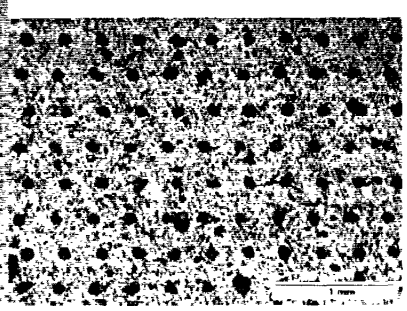


edgewave

Application Example: Microstructures for non-slip finishing of natural stone floors

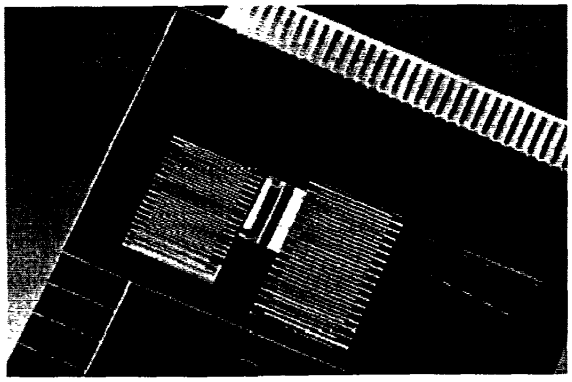


Material: Natural stone
Speed: 20.000 pits/sec
Pit size: 50 µm
Aera/Stop: 600 x 600mm2



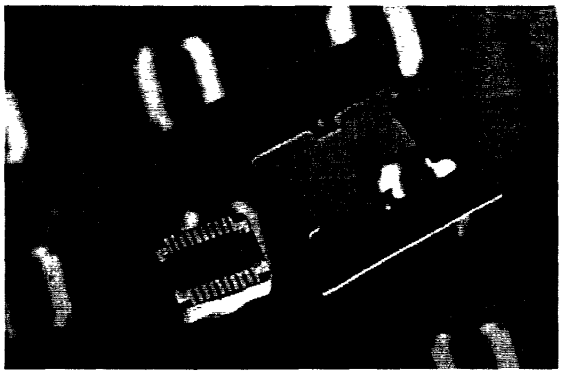
edgewave

Application Example: Removing of lacquer and Separation of PCB-Elements



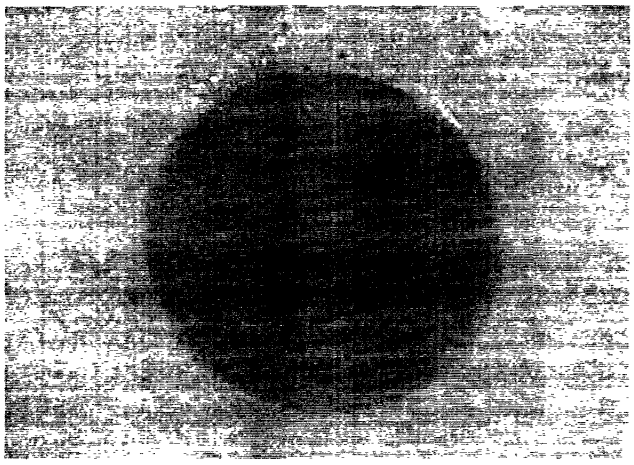
Removing of lacquer for contacting

Separation of PCB components



edgewave

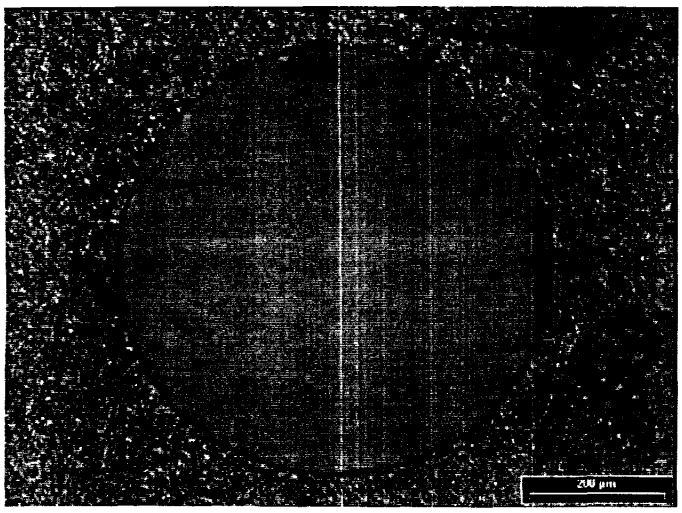
Application Example: Drilling of ceramic



Material: Ceramic
Thickness: 1mm
Diameter: 0,4mm

edgewave

Application Example: Drilling of transparent material

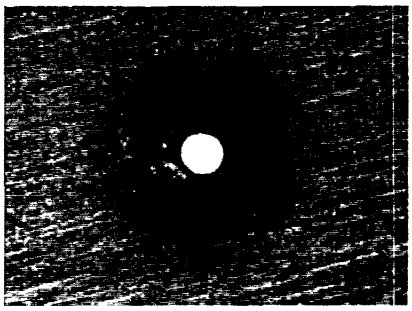


Material: Sapphire
Thickness: 1,2mm
Diameter: 0,6mm

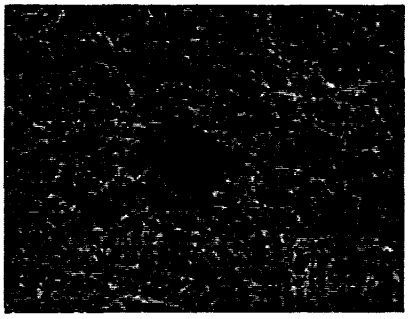
edgewave

Application Example: Drilling of metall

Material: Steel
Thickness: 1mm



entrance 60µm

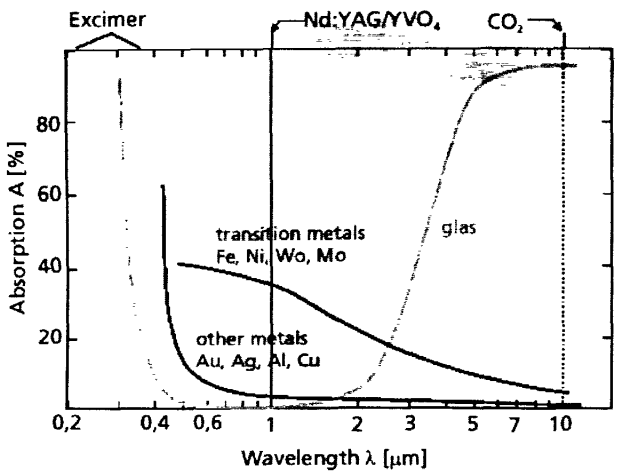


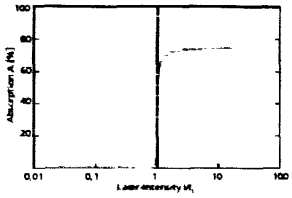
exit 40µm

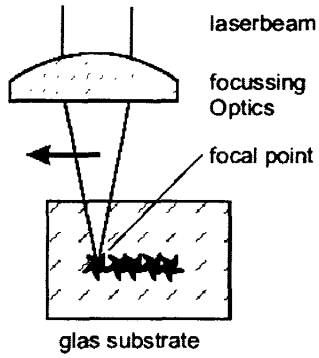
In cooperation with ILT

edgewave

Absorption properties of glass







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Application Example: Laser Engraving

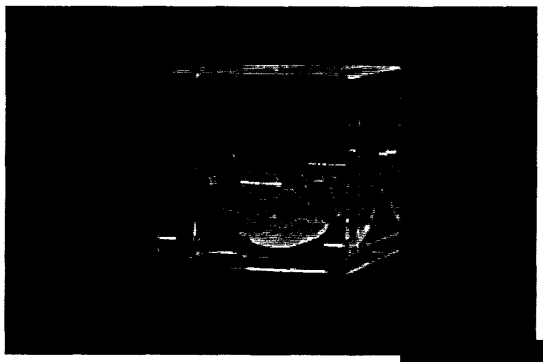
Short pulse >
low threshold energy >

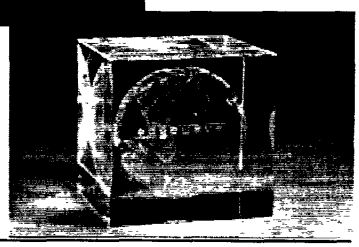
small point > high resolution

high reptition rate > high productivity

high efficiency > low operation cost

long life time > high reliability





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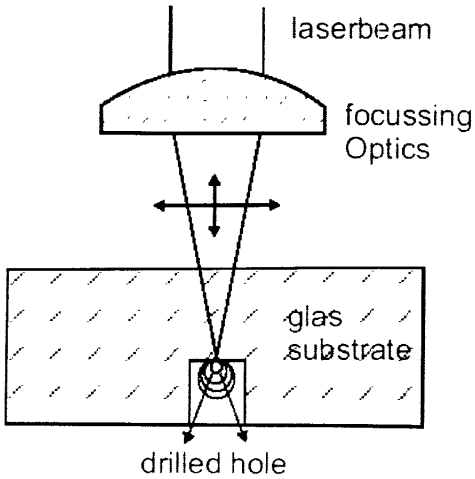
Structuring of glass



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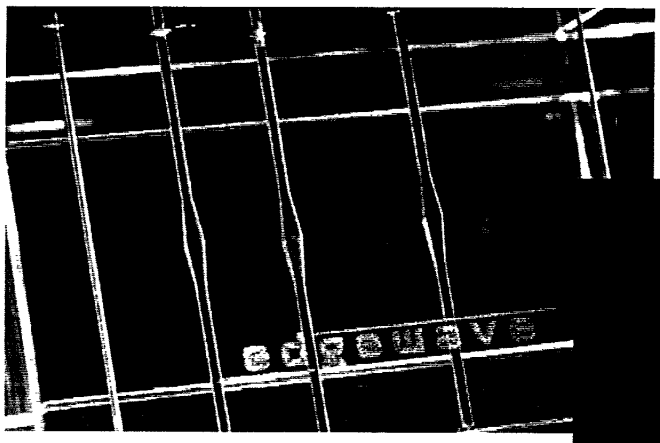
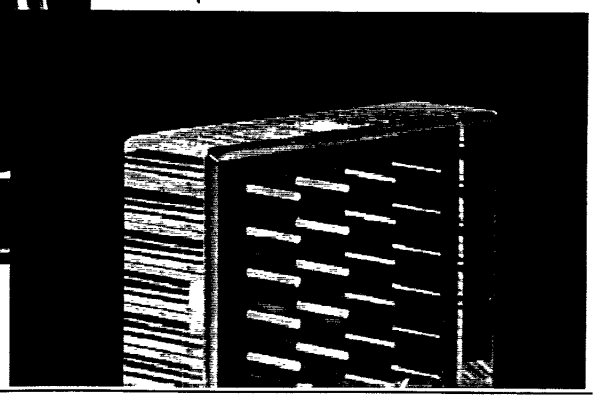
Application Example: Drilling of transparent material



Tested Material:
Flutglas
BK7
Quarz
Duran
Saphire



Material: BK7
Size: 50x50x80mm
Diameter: 0,6mm

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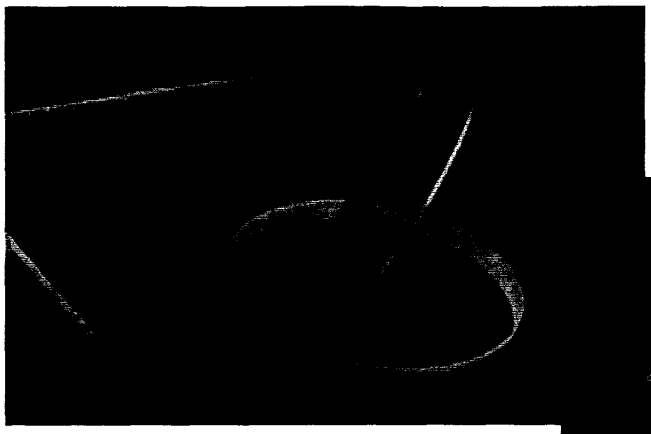
Application Example: Cutting of sheet glass

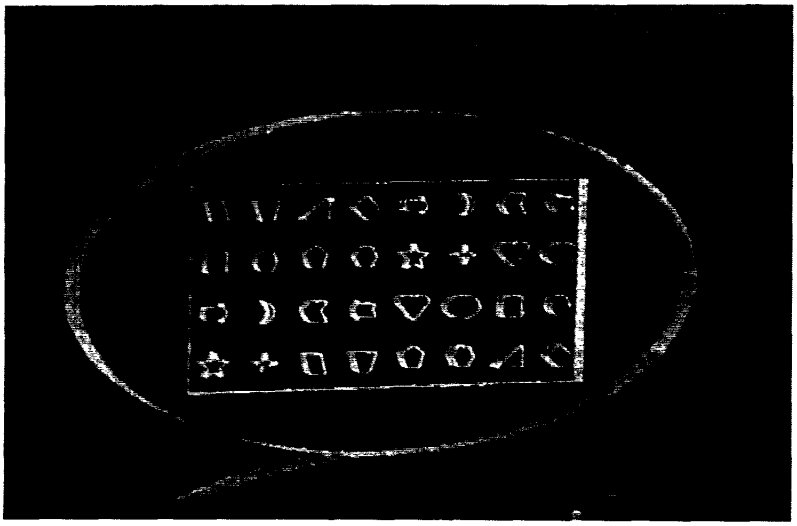


Sheet glass 4mm thick

Glass sheet 0,1 - 0,2mm thick

edgewave

Application Example: Surface Structuring



Material: Glass
Wavelength: 532nm
Pulse rate: 10 kHz
Pulse energy: 1mJ
Layer: 40 µm

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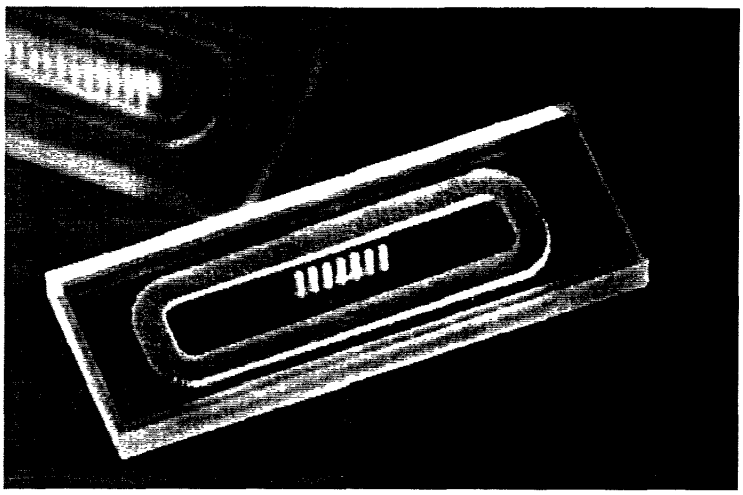
Application Example: A Vacuum Tool

Material: Suprasil
Wavelength: 532nm
Pulse rate: 5 kHz
Pulse energy: 1mJ
Layer: 40 µm



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Summary: Features and Applications

U.S.P. of INNOSLAB

- high beam quality
- short pulse length
- high peak power
- high repetition rate
- compact
- high reliability

Precision applications:

- rapid prototyping
- polishing and cleaning
- structuring and drilling
- marking inside of glass
- glass drilling and cutting
- glass structuring

edgewave

Our references

- Philips
- KLEO for Sputtering
- Vitro Laser for glass engraving
- Cerion for glass engraving
- MicroLaserTech for precision cutting
- IWS in mobile system and drilling
- IPT for structuring
- ILT laser polishing

edgewave

Contact

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Email: info@edge-wave.com

www.edge-wave.com

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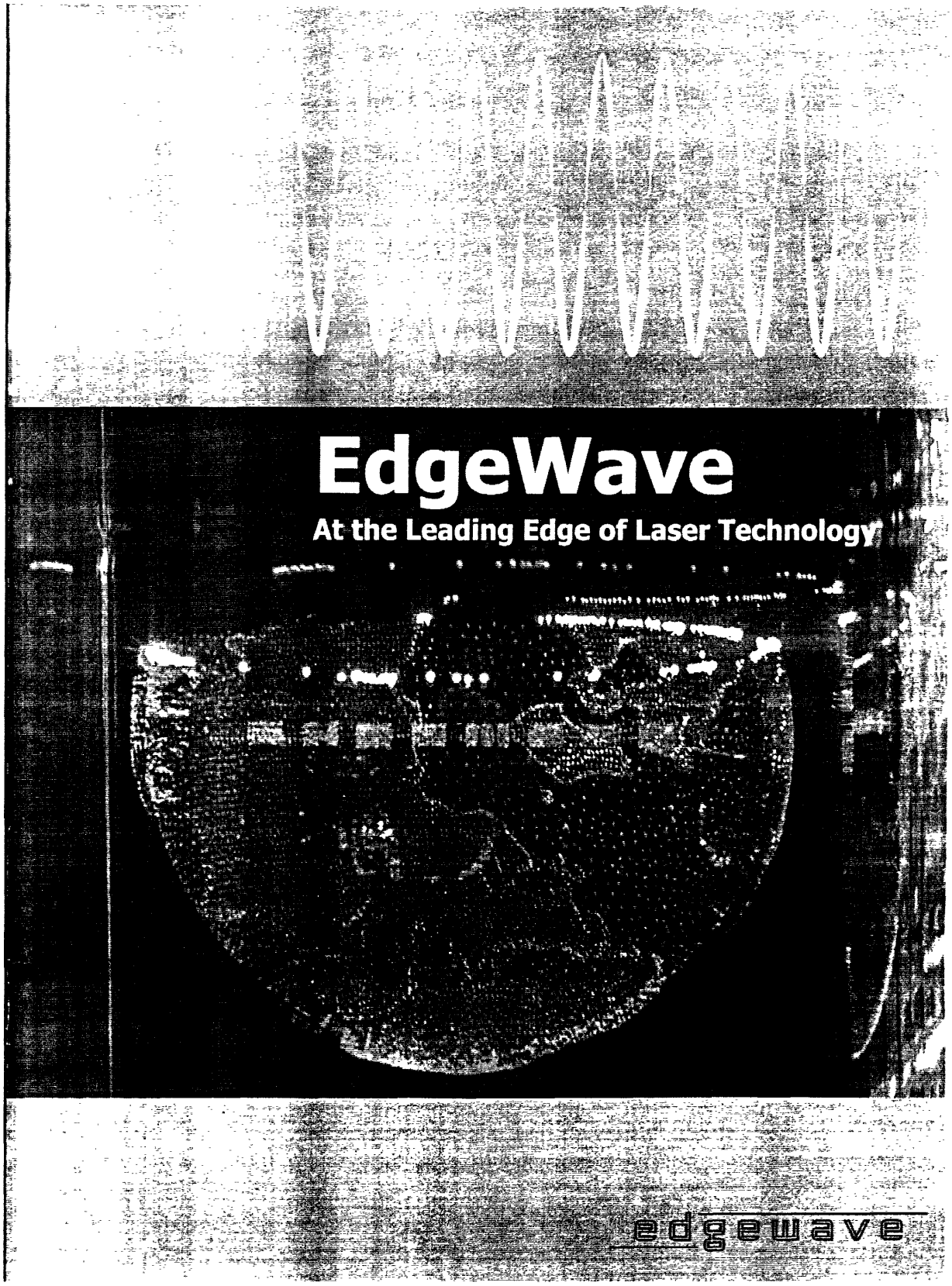

EdgeWave
At the Leading Edge of Laser Technology
edgewave

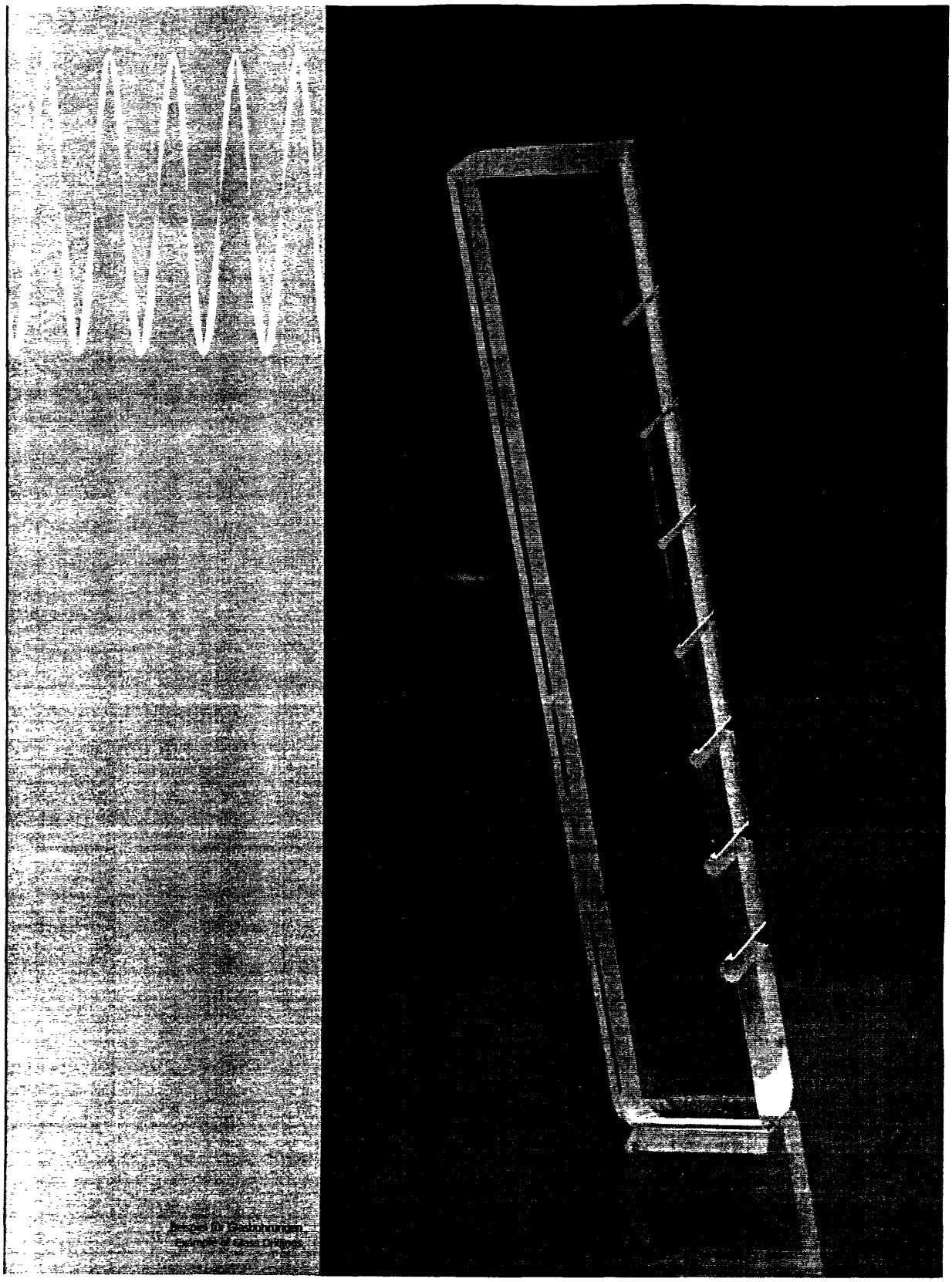


Figure 8 Distribution
Sample of Gas Drops

Die Lasertechnologie gehört zu den zukunftsweisenden Technologien unserer Zeit. Sie fasziniert nicht nur durch die Energie, Präzision und leuchtende Schönheit des Laserstrahls, sondern auch durch ihr enormes Anwendungspotenzial. Die Lasertechnologie ist aus vielen Bereichen des modernen Lebens nicht mehr wegzudenken und prägt nachhaltig die industrielle Fertigung, die Medizin- und Umwelttechnik, die Mikro- und Nanotechnologie sowie die Informations- und Kommunikationstechnologie.

Schon seit 1985 beschäftige ich mich intensiv mit der Lasertechnologie. Am Fraunhofer-Institut für Lasertechnik in Aachen habe ich mit meinem Team aktiv die Entwicklung innovativer Diodenlaser und diodengepumpter Festkörperlaser vorangetrieben. Hier wurde auch der Grundstein für die INNOSLAB-Technologie gelegt. Im Jahr 2001 entschied ich mich zur Ausgründung – EdgeWave war geboren.

Heute sind wir der weltweite Technologieführer in der INNOSLAB-Technologie und arbeiten kontinuierlich an innovativen Konzepten, die unseren Kunden neue Horizonte in der Fertigungstechnik eröffnen. Als Kunde dürfen Sie sich darauf verlassen, dass Ihre Aufgabenstellung bei uns die höchste Priorität genießt. Nutzen Sie die Stärken der INNOSLAB-Technologie zum Vorteil Ihres Unternehmens.

Laser technology is destined to revolutionize the future. Its fascination stems not only from the energy, precision and stunning brilliance of the laser beam, but also from its immense potential in terms of applications. Laser technology has become an indispensable part of many aspects of modern life, and has brought about lasting changes in the fields of industrial manufacturing, medical and environmental engineering, micro- and nanotechnology, and information and communications technology.

My own in-depth involvement in laser technology dates back to 1985. While working at the Fraunhofer Institute for Laser Technology in Aachen, my team played an active part in advancing the development of innovative diode lasers and diode-pumped solid-state lasers. It was here, too, that the first steps were taken toward the invention of INNOSLAB technology. In 2001, I decided to form a company – and EdgeWave was born.

Today, we are world leaders in INNOSLAB technology and continue to work on innovative ideas that promise to open up new horizons in production engineering for our customers. As our customer, you can rely on us to provide you with top-priority treatment for your own particular requirements. Benefit from the strengths of INNOSLAB technology and watch your business grow!

Dr. rer. nat. Keming Du
Geschäftsführer der EdgeWave GmbH
Managing Director of EdgeWave GmbH

Das Unternehmen The Company

EdgeWave – An der Spitze der Lasertechnik

EdgeWave – At the Leading Edge of Laser Technology

EdgeWave ist ein hochinnovativer Anbieter von High-End-Laserstrahlquellen. Das Aachener Unternehmen hat die neuartige INNOSLAB-Technologie entscheidend geprägt und ist in diesem Bereich weltweit Technologieführer. In der Kombination von Spitzenleistung, Pulsfrequenz, Strahlqualität und Skalierbarkeit bieten INNOSLAB-Laser zu den am Markt erhältlichen Fertigungswerkzeugen. Sie helfen den Anwendern eine Verbesserung bestehender Fertigungsprozesse sowie die Erschließung neuer Produkte.

Das Leistungsspektrum von EdgeWave umfasst die Entwicklung, Produktion und den Vertrieb von Festkörperlasern, Diodenlasern und peripheren Komponenten sowie die Beratung zum Einsatz solcher Quellen. Als international ausgerichtetes Unternehmen ist EdgeWave in ein leistungsfähiges Netzwerk von Laseranwendern und Komponentenherstellern eingebunden, die auf neueste Technologien setzen.

EdgeWave ist Lieferant für Systemhersteller und Engineering-Partner sowie für Endanwender, die applikationsspezifische und damit maßgeschneiderte Laser benötigen. Die Anwender der INNOSLAB-Technologie kommen aus der Glas-, Keramik-, Halbleiter- und Automobilindustrie, dem Werkzeug-, Formen- und Möbelbau sowie der Mikro-, Werbe-, Medizin- und Analysetechnik.

EdgeWave is a highly innovative provider of high-end laser beam sources. The Aachen-based company was one of the pioneers in the conception of INNOSLAB technology and now leads the international field in this new area of technology. INNOSLAB lasers count among today's most efficient production tools, with a unique combination of high power output, high pulse frequencies, beam quality and scalability. They allow users to improve existing manufacturing processes and extend them to new types of products.

The range of services offered by EdgeWave includes the development, manufacture and marketing of solid-state lasers, diode lasers and peripheral components, together with consulting on the deployment of such sources. As an internationally oriented company, EdgeWave maintains close ties with a network of experienced laser users and component manufacturers who rely on the latest in advanced technology.

EdgeWave supplies its products to system manufacturers and engineering companies and to end users who need application-specific, tailor-made laser solutions. Users of INNOSLAB technology can be found in many branches of industry, including glass, ceramics, semiconductors, car manufacturing, tool- and die making, cabinet making, microengineering, advertising, medical engineering and analytical tools.

INNOSLAB – Die Technologie der Zukunft
INNOSLAB – The Technology of the Future

Das Kernprodukt von EdgeWave ist ein diodengepumpter Festkörperlaser, der auf dem innovativen SLAB-Konzept basiert – der INNOSLAB-Laser.

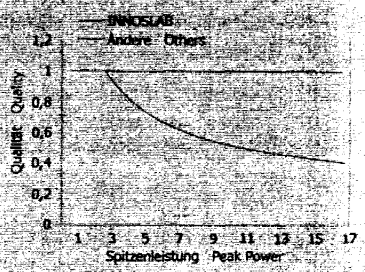
INNOSLAB-Laser verfügen durch die optimale Kombination aus Kristallform, Kühlung und Resonatordesign gegenüber anderen Laserkonzepten über besondere Eigenschaften:

- Kurze Pulsdauer und hohe Pulsspitzenleistung
- Hohe Strahlqualität nahe dem theoretisch möglichen Maximum
- Hohe Leistung und Skalierbarkeit
- Kompaktheit und große Zuverlässigkeit
- Hohe Effizienz

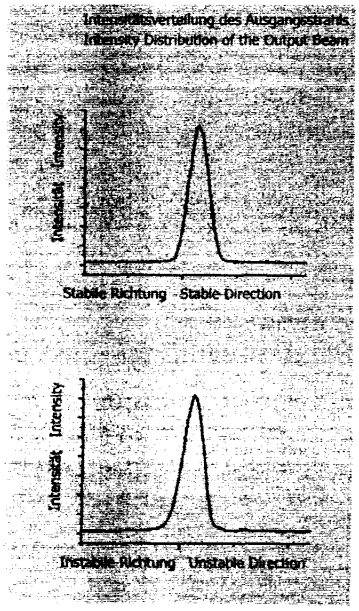
EdgeWave's key product is a diode-pumped solid-state laser, based on the innovative SLAB concept – the INNOSLAB laser.

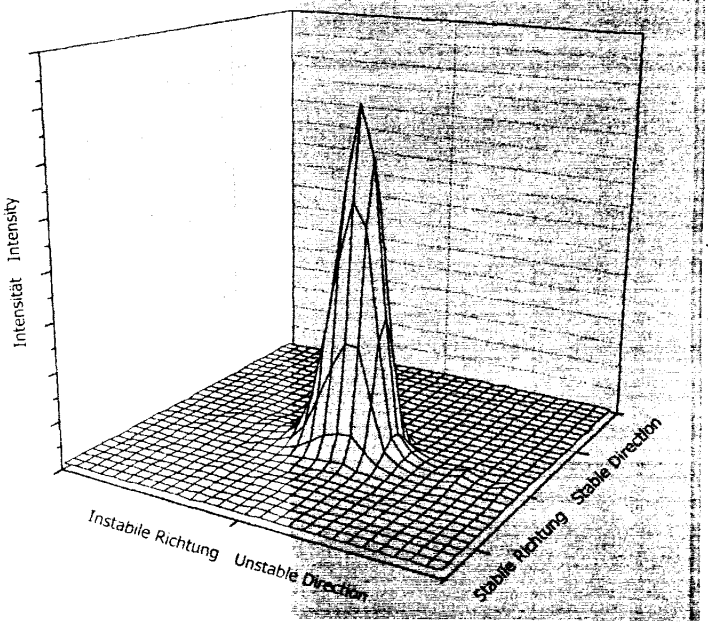
Through an optimal combination of crystal shape, cooling and resonator design, INNOSLAB lasers possess special qualities not found in other types of laser:

- Short pulse duration and high peak output power
- High beam quality approaching the theoretical maximum
- High performance and scalability
- Compact design and outstanding reliability
- High efficiency



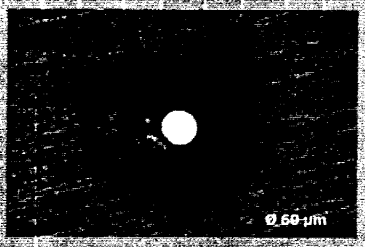
Spitzenleistungsvergleich des INNOSLAB-Lasers mit konventionellen Lasern
The Peak Power Comparison of INNOSLAB laser with conventional lasers



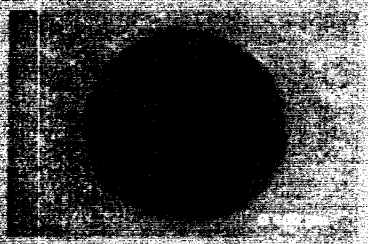


INNOSLAB-Laser – Maßgeschneiderte Laser für die Praxis

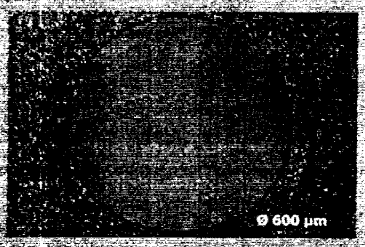
INNOSLAB-Laser – Tailored Lasers for Practical Applications



Laserbohrung in Metall
Laser Drilling in Metal



Laserbohrung in Keramik
Laser Drilling in Ceramics

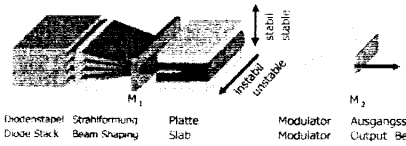


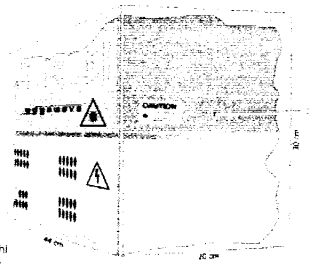
Laserbohrung in Saphir
Laser Drilling in Sapphire

Unser Standard-Produktspektrum umfasst INNOSLAB-Laser mit unterschiedlichen Ausgangsleistungen, in verschiedenen Betriebsarten und mit einer Auswahl von definierten Wellenlängen. Wir unterscheiden grundsätzlich cw-Laser, gepulste Laser, E/O-gütegeschaltete Laser und luftgekühlte Laser.

Our standard product portfolio encompasses INNOSLAB lasers with various output power ratings, a selection of operating modes and a choice of defined wavelengths. A basic distinction is drawn between continuous-wave lasers, pulsed lasers, electro-optical Q-switched lasers and air-cooled lasers.

INNOSLAB-Laser Konzept
INNOSLAB Laser Concept





Der luftgekühlte E/O-gütegeschaltete Laser
The Air Cooled E/O q-switched Laser

Je nach Auslegung eignen sie sich für die Bearbeitung von Glas, Metall, Keramik oder Kunststoff. Die möglichen Bearbeitungsformen sind Bohren und Tiefbohren, Strukturieren, Reinigen, Polieren, Oberflächenbeschriftung, Innengravur, Trennen und Generieren.

Different designs are available for the processing of glass, metals, ceramics, and plastics. Possible machining applications include drilling and deep drilling, structuring, cleaning, polishing, surface marking, sub-surface engraving, cutting and generation.

Basierend auf der Technologie und dem Design der Standardsysteme bieten wir unseren Kunden INNOSLAB-Laser an, die spezifisch auf ihre Bedürfnisse abgestimmt werden können.

We are also able to offer customized INNOSLAB lasers based on the standard system technology and design, tailored to the customer's specific requirements.

Modell Model	E/O q-switched	Pulsed	CW	D-Series*
Wellenlänge (nm) Wavelength (nm)	1064, 532, 355, 266	1064	1064	1062, 532, 355, 266
max. mittlere Leistung max. Average Power	80 W	100 W	200 W	20 W
Strahlqualität (M^2) Beam Quality (M^2)	< 2	< 2	< 2	< 2
max. Wiederholrate max. Repetition Rate	50 kHz	10 kHz	-	50 kHz
min. Pulslänge min. Pulse Length	5 ns	50 µs	-	4 ns
max. Pulsenergie max. Pulse Energy	20 mJ	300 mJ	-	5 mJ
max. Spitzenleistung max. Peak Power	1 MW	1 kW	200 W	1 MW

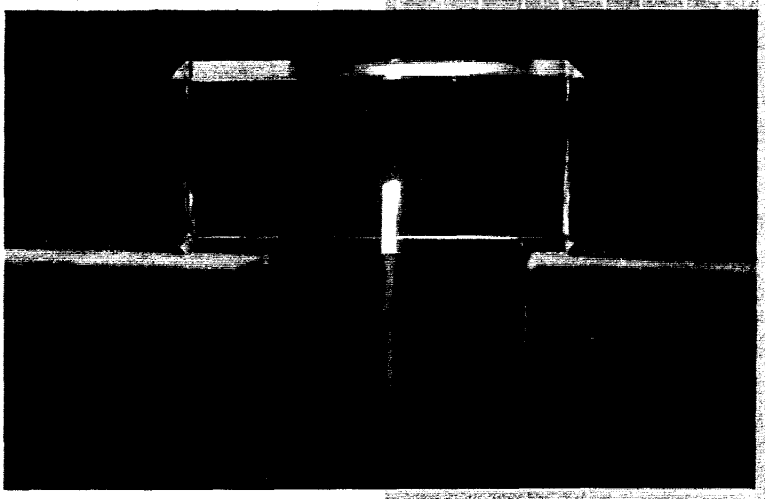
* luftgekühlt air cooled

INNOSLAB – Innovative Technologie für neue Aufgaben
INNOSLAB – Innovative Technology for New Tasks

Absolut neu an der INNOSLAB-Technologie ist die Erzeugung von Bohrungen mit Schachtverhältnissen > 300:1 und Hohlräumen in Glas sowie das Schneiden von Glas. Für die Erzeugung hochpräziser Hohlstrukturen in Glas wird der Laserstrahl von der Rückseite des zu bearbeitenden Werkstückes eingestrahlt und auf die gegenüberliegende Oberfläche fokussiert. Das verdampfte Material strömt ab. Das INNOSLAB-Verfahren ist dabei berührungs- und geräuschlos.

Die Vorteile des INNOSLAB-Lasers bei unterschiedlichen Anwendungen liegen auf der Hand:

- Präzise und reproduzierbare Bohrungen beliebiger Querschnitte
- Variable Querschnitte, z.B. konischer Verlauf
- Skalierbare Bohrungslänge ohne Verlust der Genauigkeit
- Dreidimensionale Strukturen
- Hochgeschwindigkeitsanritzen und -schneiden von Glas, auch für gekrümmte Konturen

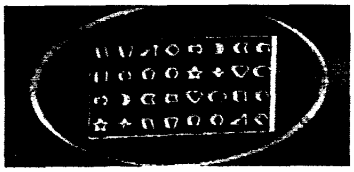


Glasbohrung
Glass Drilling

The outstanding new feature of INNOSLAB technology is its ability to drill fine channels with an aspect ratio > 300:1 and create hollow cavities in glass, and to cut glass. In order to produce accurate hollow structures in glass, the laser beam is directed at the workpiece from behind and focused on the opposite surface, allowing the evaporated material to escape freely. The INNOSLAB process is contact and noise free.

The advantages of the INNOSLAB laser are clearly evident:

- Precise, reproducible drill holes of any cross-section
- Variable cross-sections, e.g. conical
- Scalable drilling depth with no loss of accuracy
- Three-dimensional structures
- High-speed scratching and cutting, even curved contours

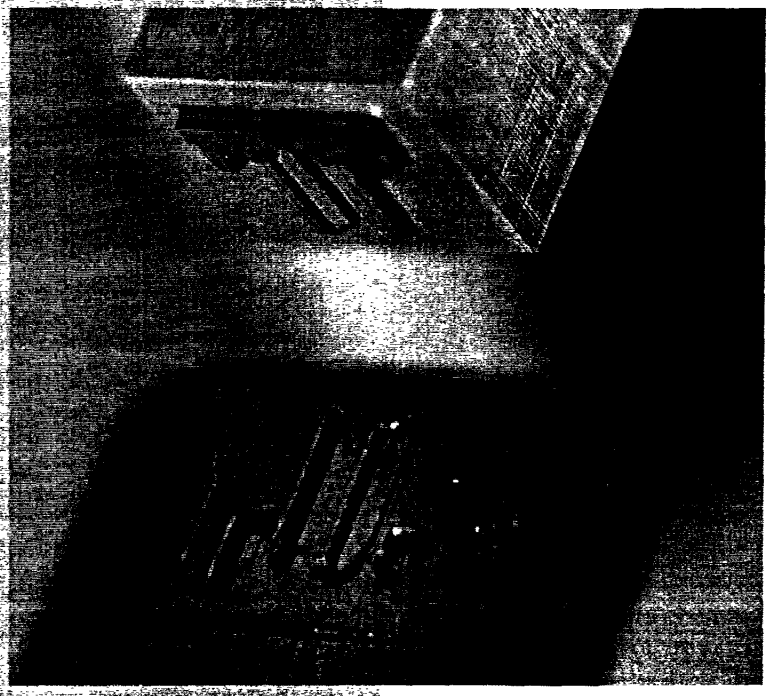


3D-Struktunerung
3D Structuring

	Glas Glass	Metall Metal	Keramik Ceramics	Kunststoff Plastics
Bohren Drilling	•••	••	••	•
Tiefbohren Deep Drilling	•••	••	••	•
Strukturieren (2D & 3D) Structuring (2D & 3D)	•••	•••	•••	•••
Reinigen Cleaning	••	•••	••	—
Polieren Polishing	—	•••	—	—
Oberflächenbeschriftung Surface Marking	•	••	••	—
Innengravur Engraving	•••	—	—	•••
Trennen Cutting	•••	•	•	•
Rapid Prototyping Rapid Prototyping	—	••	—	••

INNOSLAB – High-End Technologie für hochwertige Produkte

INNOSLAB – High-end Technology for High-quality Products



3D-Strukturierung einer Stechergußform
3D-Structuring of a Plugmould

Das Anwendungspotenzial der INNOSLAB-Technologie ist vielseitig. Überall da, wo qualitativ hochwertig, schnell und innovativ gearbeitet werden muss, kommt die Technologie zur Anwendung.

- Elektronikindustrie, z.B. bei der Präzisionsbohrung von Platinen
- Automobilindustrie, z.B. für die Fertigung von Einspritzdüsen
- Werkzeug- und Maschinenbau, z.B. zum 3D-Strukturieren
- Medizintechnik, z.B. für das rapid product manufacturing
- Analysetechnik, z.B. für die Fertigung von Mikrokuvetten
- Dekorative Gestaltung, z.B. 3D-Gravur für hochwertige Geschenkartikel
- Möbelbau, z.B. zum Schneiden und zur Innengravur von Flachglas
- Baugewerbe, z.B. zur rutschhemmenden Ausrüstung polierter Fußboden

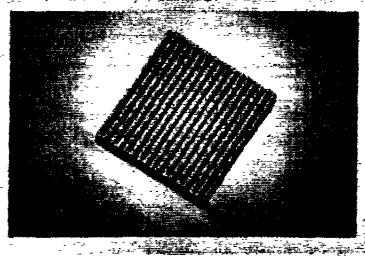
Sprechen Sie uns an. Wir schaffen gemeinsam mit Ihnen neue Perspektiven.

INNOSLAB technology is suitable for an immense variety of applications. Ideally placed wherever there is a need for high-quality results, rapid processing and innovative techniques.

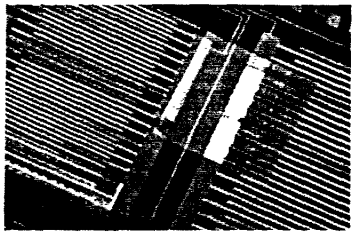
- Electronics industry, e.g. drilling fine holes in printed circuit boards
- Automobile industry, e.g. the manufacture of fuel injection valves
- Toolmaking and mechanical engineering, e.g. 3D structuring
- Medical engineering, e.g. rapid product manufacturing
- Analytical tools, e.g. the fabrication of microreactors
- Decorative design, e.g. 3D engraving of luxury gift items
- Cabinet making, e.g. the cutting and sub-surface engraving of sheet glass
- Construction industry, e.g. application of a non-slip finish to polished flooring

Discuss your needs with us. Together we can create new perspectives.

Schnelle Produktherstellung aus Titanpulver
Rapid Product Manufacturing from Titanium Powder



Entlackung einer Platine
Varnish Removal on a Circuit Board



INNOSLAB – Qualität und Effizienz zu Ihrem Vorteil

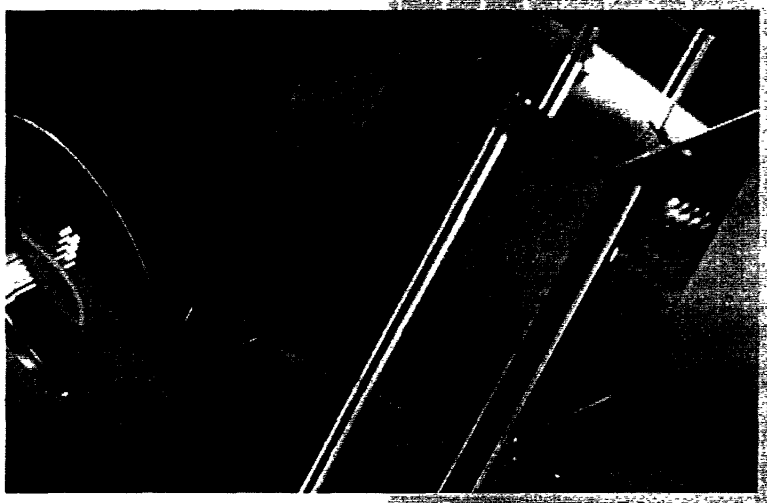
INNOSLAB – Gain by our Quality and Efficiency

INNOSLAB-Laser sind eine neue Generation von Laserstrahlquellen. Sie zeichnen sich gegenüber konventionellen Festkörperlasern durch zahlreiche Eigenschaften aus, die sich für unsere Kunden direkt in einem messbaren Nutzen niederschlagen. Das gleichzeitige Erreichen von hoher Strahlqualität, hoher Effizienz und hoher Leistung bei einem außerordentlich kompakten Aufbau, schafft für Sie:

- **Qualität**
  Die erzeugten Produkte verfügen über eine höhere Qualität. Durch die konzeptbedingte Präzision in der Bearbeitung von Materialien sind z.B. schärfere Konturen und tiefere zylinderförmige Bohrungen möglich.

- **Produktivität**
  Eine schnellere Bearbeitung führt zu höherer Produktivität bestehender Fertigungsprozesse, beispielsweise bei der Innengravur von Glas, dem Strukturieren von Oberflächen oder dem Bohren von Metallen. Das erhöhte Bearbeitungstempo ermöglicht auch den Einsatz neuer Verfahren in der Serienfertigung. Der kompakte und einfache Aufbau begünstigt zusätzlich auch den mobilen Einsatz des Systems.

- **Innovation**
  Das innovative Konzept des INNOSLAB-Lasers ermöglicht neue Fertigungstechniken wie das Tiefbohren oder Trennen von Glas. Das unterstützt Sie bei der Kreation neuer Produktideen.



Tiefbohrungen in Glas
Deep Drillings in Glass

INNOSLAB lasers represent a new generation of laser beam sources. By comparison with conventional solid-state lasers, they have numerous positive characteristics that can be translated into tangible benefits for our customers. The ability to obtain high beam quality, high efficiency and high output simultaneously from an extremely compact unit gives you.

- **Quality**
  The finished products are of superior quality. The intrinsic precision of the system design allows materials to be processed with improved features such as sharper contours and deeper cylindrical drill holes.

- **Productivity**
  The higher processing speed contributes to greater productivity in existing manufacturing processes involving, for instance, the subsurface engraving of glass, surface structuring or drilling into metal. Faster cycle times also allow new techniques to be employed in series production lines. Moreover, the simple compact design also facilitates the system's use in mobile applications.

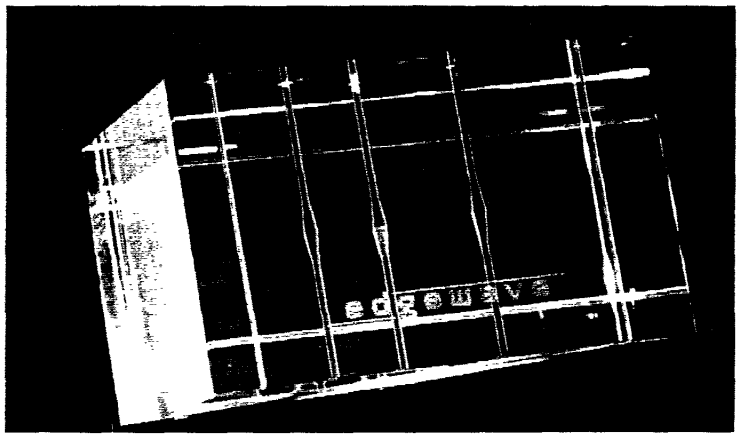
- **Innovation**
  The innovative design of the INNOSLAB laser opens the way to new production techniques such as deep drilling or separation of glass. Such capabilities will enable you to create ideas for new products.

Flachglasschneiden
Cutting of Sheet Glass

Die Kompetenzen: The Expertise

EdgeWave – Wir bieten Kompetenz und Innovation

EdgeWave – A Source of Expertise and Innovation

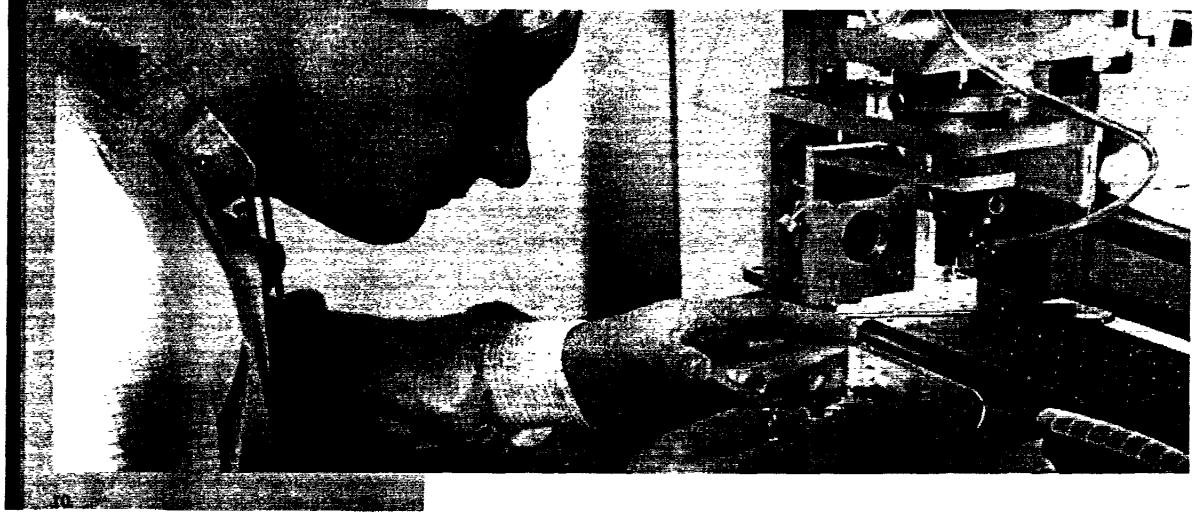


- **Technological Know-how from the Outset**
  EdgeWave was a pioneer in the development of the new INNOSLAB concept, and is a world leader in this area of technology. We remain at the forefront of technological progress in all of our daily activities.

- **Quality Down to the Last Detail**
  Because we at EdgeWave know that the quality of your products depends on the quality of our lasers, we respect the need for quality down to the last detail.

- **You Can Rely on us**
  Place your trust in EdgeWaves expertise. The close relationship we enjoy with our customers is based on our reputation for reliability

- **The Whole is More than the Sum of its Parts**
  EdgeWave is just one company in an international network of experienced laser specialists and component manufacturers Convincing technological results can only be achieved through the integration of skills and resources.



EdgeWave – Wir gestalten die Zukunft

EdgeWave – Shaping the Future

Die ständige Weiterentwicklung von Produkten erfordert auch in Zukunft anspruchsvolle und flexible Werkzeuge und Fertigungsverfahren. Die EdgeWave GmbH stellt sich nicht nur den Entwicklungen, sondern treibt sie zusammen mit ihren Kunden aktiv voran.

Aus dem Trend zur Miniaturisierung, zur Integration komplexer Bauteile und zur individualisierten Massenproduktion sowie durch ein wachsendes ästhetisches Bewusstsein ergeben sich permanent neue Anforderungen an die Produktgestaltung, das Design und die Fertigungstechnologie.

EdgeWave begegnet diesen Anforderungen mit den passenden Lösungen.

Die nachhaltigen Weiterentwicklungen der INNOSLAB-Laser sind somit konsequent und umfassen beispielsweise:

- Skalierung der Leistung in den kW-Bereich,
- zeitliches, räumliches und spektrales Engineering der Laserstrahlen.

EdgeWave unterstützt Sie bei der Gestaltung Ihrer Zukunft.

EdgeWave – We are pushing the edge of laser technology.

The need for constant product evolution will continue to rely on the availability of sophisticated, flexible tools and manufacturing processes. EdgeWave GmbH is not only a provider of solutions but also works in close contact with its customers to futher push the limits of technological progress.

The continuing trends of miniaturization, the integration of complex components, and customized mass production, coupled with a growing aesthetic awareness, give rise to a constant stream of new demands on product design, styling and manufacturing techniques.

EdgeWave's policy is to find the right solutions to satisfy these requirements.

Consequently, we are systematically working on the further development of the INNOSLAB lasers, including:

- Scaling up power output into the kW range,
- Engineering the temporal, spatial and spectral properties of the laser beams.

EdgeWave can help you to shape your future.

EdgeWave – We are pushing the edge of laser technology.

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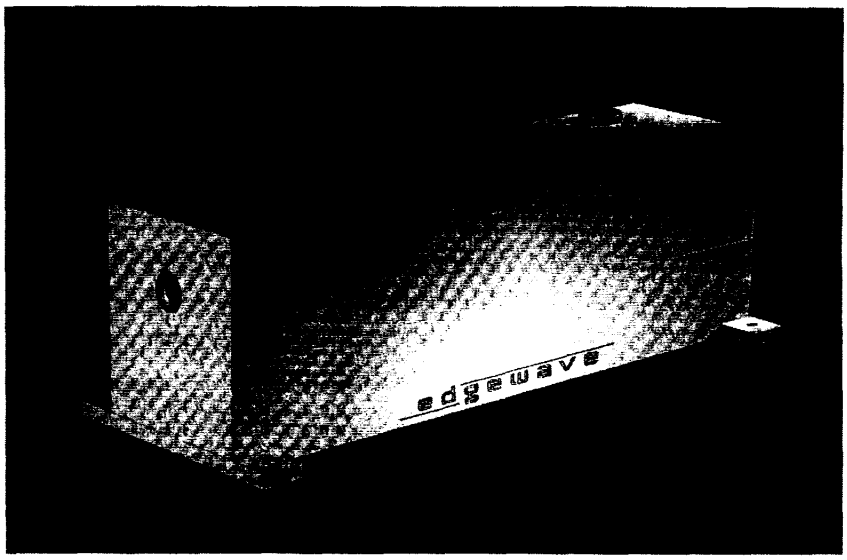
Diode end pumped, cw INNOSLAB lasers

Applications:

- Precision cutting
- Precision welding
- Microprocessing
- Rapid prototyping

Model: IS xxxx-xx C



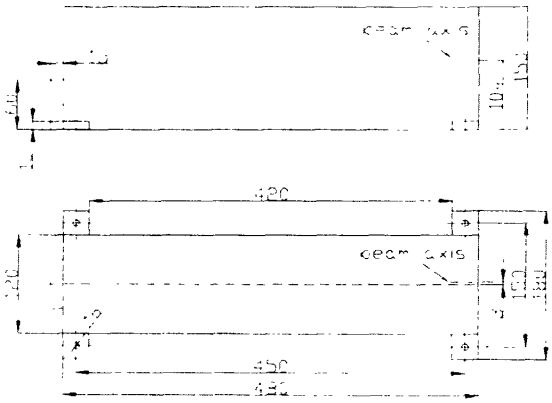
U. S. P. = Novel combination of following performances:

- High efficiency
- High beam quality
- Power scaleability at high beam quality
- Compact setup

IS 1064-50 C Specifications

Output Beam	
Laser medium	Nd:YVO4
Wavelength	1064nm
Beam quality	M2 < 2
Output power	cw 50W
Polarisation	> 1:100
Beam roundness (far field)	< 10% elliptical
Waist location	20mm to window
Diameter at window	2 mm
Divergence full angle	< 900 μrad
Point stability	< 180 μrad
Warm-up time, from cold start	< 5 min
from standby	< 1 min
Utility & Ambient Requirements	
Power supply	230 V, 50 Hz
Power, maximum	700 W
Chiller	230 V, 50 Hz
Power, maximum	450 W
Operating ambient Temperature	15° to 35°C
Relative Humidity, non-condensing	10% to 80%
Dimensions & Weights	
Laser head	180x150x480 mm
Supply incl. Chiller	560x460x700 mm
Laser head	15 kg
Supply incl. Chiller	60 kg

Note Specifications are at factory settings and subject to change without notice



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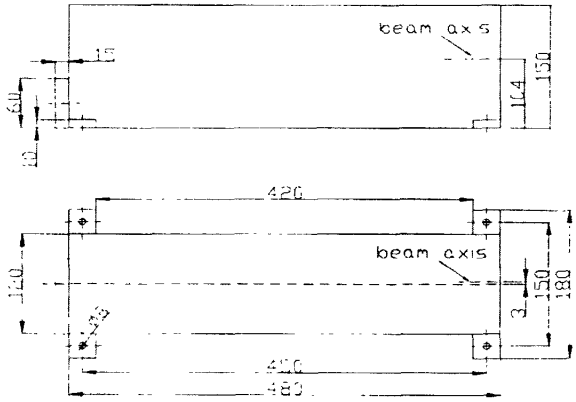
IS 1064-100 C Specifications

Output Beam	
Laser medium	Nd:YVO4
Wavelength	1064nm
Beam quality	M2 < 2
Output power	cw 100W
Polarisation	> 1:100
Beam roundness (far field)	< 10% elliptical
Waist location	20 mm to window
Diameter at window	2 mm
Divergence full angle	< 900 μrad
Point stability	< 180 μrad
Warm-up time, from cold start	< 12 min
from standby	< 4 min
Utility & Ambient Requirements	
Power supply	230 V, 50 Hz
Power, maximum	1,5 kW
Chiller	230 V, 50 Hz
Power, maximum	1 kW
Operating ambient Temperature	15° to 35°C
Relative Humidity, non-condensing	10% to 80%
Dimensions & Weights	
Laser head	180x150x480 mm
Supply incl. Chiller	560x460x700 mm
Laser head	15 kg
Supply incl. Chiller	60 kg

Note. Specifications are at factory settings and subject to change without notice



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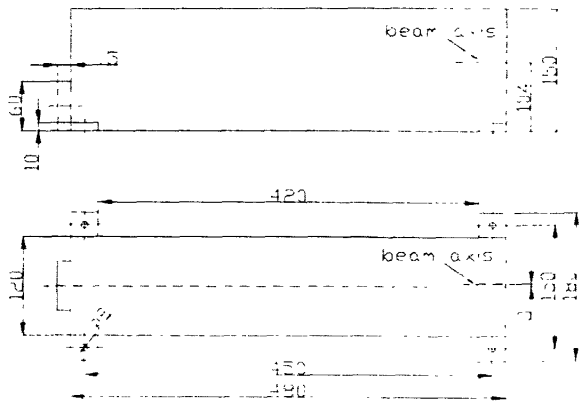
INNOSLAB 1064-200 C Specifications

Output Beam	
Laser medium	Nd:YVO4
Wavelength	1064nm
Beam quality	M2 < 2
Output power	cw 200W
Beam roundness (far field)	< 10% elliptical
Waist location	20 mm to window
Diameter at window	2 mm
Divergence full angle	< 900 μrad
Point stability	< 180 μrad
Warm-up time, from cold start	< 12 min
from standby	< 5 min
Utility & Ambient Requirements	
Power supply	230 V, 50 Hz
Power, maximum	1,5 kW
Chiller	230 V, 50 Hz
Power, maximum	1 kW
Operating ambient Temperature	15° to 35°C
Relative Humidity, non-condensing	10% to 80%
Dimensions & Weights	
Laser head	180x150x480 mm
Supply incl. Chiller	560x460x700 mm
Laser head	18 kg
Supply incl. Chiller	60 kg

Note: Specifications are at factory settings and subject to change without notice



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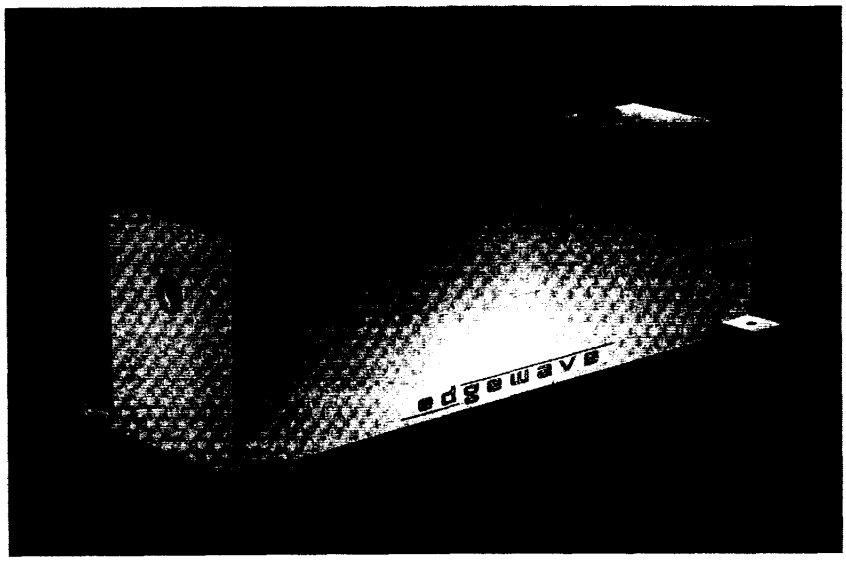
Diode end pumped, pulsed INNOSLAB lasers

Applications:

- Precision cutting
- Precision welding
- Microprocessing
- Rapid prototyping

Model: IS xxxx-xx P



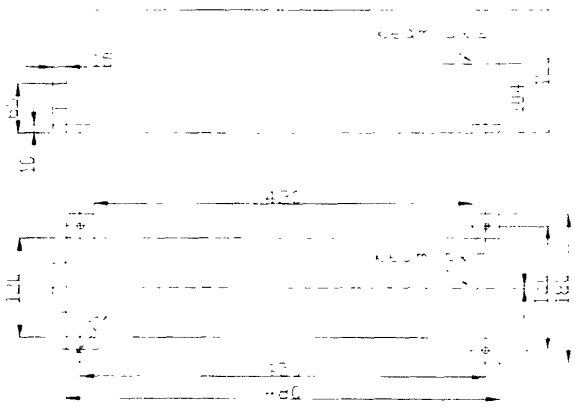
U. S. P. = Novel combination of following performances:

- High efficiency
- High beam quality
- Hower scaleability at high beam quality
- Compact setup

IS 1064-50 P Specifications

Output Beam	
Laser medium	Nd:YVO4
Wavelength	1064nm
Beam quality	M2 < 2
max. Peak power	350 W
Average output power	50W
Polarisation	> 1:100
Beam roundness (far field)	< 10% elliptical
Waist location	20 mm to window
Diameter at window	2 mm
Divergence full angle	< 900 μrad
Point stability	< 180 μrad
Warm-up time, from cold start	< 12 min
from standby	< 2 min
Utility & Ambient Requirements	
Power supply	230 V, 50 Hz
Power, maximum	1,5 kW
Chiller	230 V, 50 Hz
Power, maximum	1 kW
Operating ambient Temperature	15° to 35°C
Relative Humidity, non-condensing	10% to 80%
Dimensions & Weights	
Laser head	180x150x480 mm
Supply incl. Chiller	560x460x700 mm
Laser head	15 kg
Supply incl. Chiller	60 kg

Note: Specifications are at factory settings and subject to change without notice



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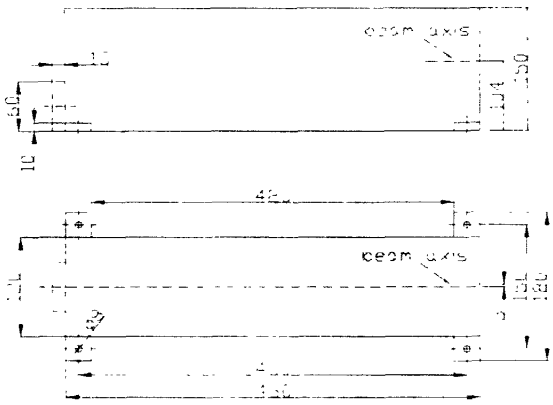
IS 1064-100 P Specifications

Output Beam	
Laser medium	Nd:YVO4
Wavelength	1064nm
Beam quality	M2 < 2
max. Peak power	700 W
Average output power	100W
Polarisation	> 1:100
Beam roundness (far field)	< 10% elliptical
Waist location	20mm to window
Diameter at window	6 mm
Divergence full angle	< 300 µrad
Point stability	< 60 µrad
Warm-up time, from cold start	< 5 min
from standby	< 1 min
Utility & Ambient Requirements	
Power supply	230 V, 50 Hz
Power, maximum	700 W
Chiller	230 V, 50 Hz
Power, maximum	450 W
Operating ambient Temperature	15° to 35°C
Relative Humidity, non-condensing	10% to 80%
Dimensions & Weights	
Laser head	180x150x480 mm
Supply incl. Chiller	560x460x700 mm
Laser head	15 kg
Supply incl. Chiller	60 kg

Note: Specifications are at factory settings and subject to change without notice



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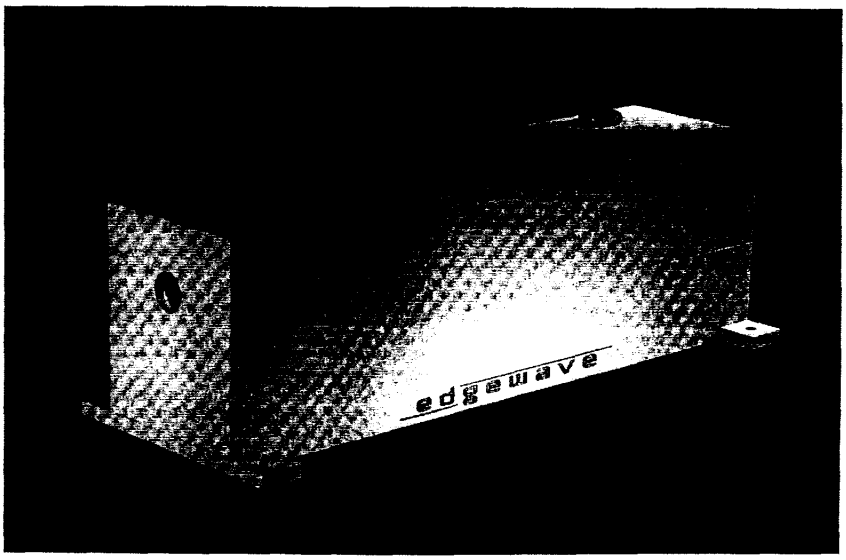
Diode end pumped, electrooptically q-switched INNOSLAB lasers

Applications:

- Glass engraving
- Marking
- Structuring
- Precision drilling
- Glass processing
- Cleaning
- Polishing
- Pumping of Dye-laser or Ti:Sapphire-laser

Model: IS xxxx-xx E



U. S. P. = Novel combination of following performances:

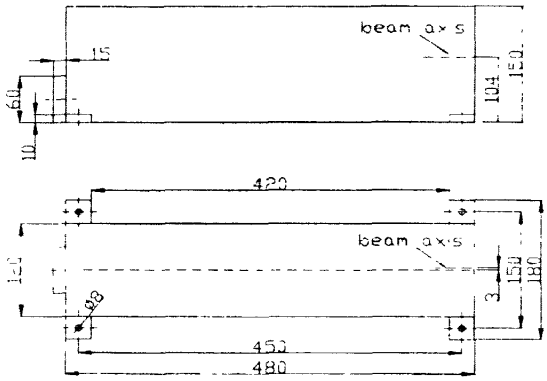
- High repetition rate
- Short pulse length
- High beam quality
- High average power
- Compact setup

IS 1064-40 E Specifications

Output Beam			
Laser medium	Nd:YVO4	Nd:YAG	Nd:YLF
Wavelength	1064nm	1064nm	1047nm
Beam quality	M2 < 2	M2 < 2	M2 < 2
Average power	40W	40W	30W
Repetition rate range	0 - 50 kHz	0 - 40 kHz	0 - 30 kHz
Pulse energy*	> 3 mJ	> 5 mJ	> 8 mJ
Pulse width*	5 - 7 nsec	6 - 9 nsec	9 - 14 nsec
Energy stability*	< 2% rms	< 3% rms	< 3% rms
Timing stability	< 1ns	< 1ns	< 1ns
Polarisation	> 1:100	> 1:50	> 1:100
Beam roundness (far field)		< 10% elliptical	
Waist location		20mm to window	
Diameter at window		6 mm	
Divergence full angle		< 300 μrad	
Point stability		< 60 μrad	
Warm-up time, from cold start		< 10 min	
from standby		< 4 min	
Utility & Ambient Requirements			
Power supply		230 V, 50 Hz	
Power, maximum		700 W	
Chiller		230 V, 50 Hz	
Power, maximum		450 W	
Operating ambient Temperature		15° to 35°C	
Relative Humidity, non-condensing		10% to 80%	
Dimensions & Weights			
Laser head		180x150x480 mm	
Supply incl. Chiller		560x460x700 mm	
Laser head		15 kg	
Supply incl. Chiller		60 kg	

* Nd:YVO4 @ 5 kHz, Nd:YAG @ 2 kHz, Nd:YLF @ 1 kHz

Note: Specifications are at factory settings and subject to change without notice



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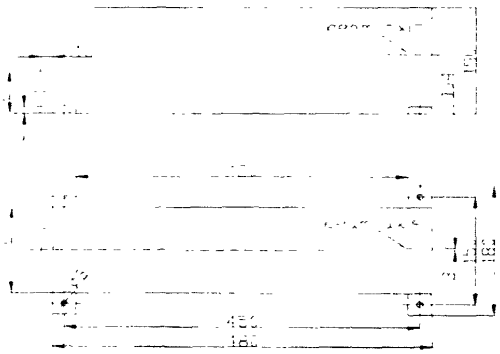
IS 1064-80 E Specifications

Output Beam		
Laser medium	Nd:YVO4	Nd:YAG
Wavelength	1064nm	1064nm
Beam quality	M2 < 2	M2 < 2
Average power	80W	70W
Repetition rate range	0 - 50 kHz	0 - 50 kHz
Pulse energy*	> 3 mJ	> 5 mJ
Pulse width*	9 nsec	10 nsec
Energy stability*	< 3% rms	< 3% rms
Timing stability	< 1ns	< 1ns
Polarisation	> 1:100	> 1:50
Beam roundness (far field)	< 10% elliptical	
Waist location	20mm to window	
Diameter at window	6 mm	
Divergence full angle	< 300 μrad	
Point stability	< 60 μrad	
Warm-up time, from cold start	< 10 min	
from standby	< 4 min	
Utility & Ambient Requirements		
Power supply	230 V, 50 Hz	
Power, maximum	1500 W	
Chiller	230 V, 50 Hz	
Power, maximum	1000 W	
Operating ambient Temperature	15° to 35°C	
Relative Humidity, non-condensing	10% to 80%	
Dimensions & Weights		
Laser head	180x150x480 mm	
Supply incl. Chiller	560x460x700 mm	
Laser head	15 kg	
Supply incl. Chiller	60 kg	

* Nd YVO4 @ 20 kHz, Nd YAG @ 10 kHz

Note Specifications are at factory settings and subject to change without notice



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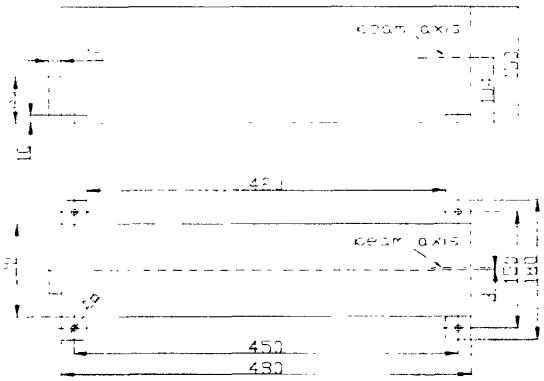
IS 532-15 E Specifications

Output Beam			
Laser medium	Nd:YVO4	Nd:YAG	Nd:YLF
Wavelength	532nm	532nm	523nm
Beam quality	M2 < 1,7	M2 < 1,7	M2 < 1,7
Average power	15W	15W	13W
Repetition rate range	0 - 50 kHz	0 - 40 kHz	0 - 30 kHz
Pulse energy*	> 1,5 mJ	> 2,5 mJ	> 4 mJ
Pulse width*	5 - 6 nsec	5 - 8 nsec	8 - 13 nsec
Energy stability*	< 2% rms	< 3% rms	< 3% rms
Timing stability	< 1ns	< 1ns	< 1ns
Polarisation	> 1:100	> 1:50	> 1:100
Beam roundness (far field)		< 10% elliptical	
Waist location		20mm to window	
Diameter at window		6 mm	
Divergence full angle		< 150 μrad	
Point stability		< 30 μrad	
Warm-up time, from cold start		< 10 min	
from standby		< 4 min	
Utility & Ambient Requirements			
Power supply		230 V, 50 Hz	
Power, maximum		700 W	
Chiller		230 V, 50 Hz	
Power, maximum		450 W	
Operating ambient Temperature		15° to 35°C	
Relative Humidity, non-condensing		10% to 80%	
Dimensions & Weights			
Laser head		180x150x480 mm	
Supply incl. Chiller		560x460x700 mm	
Laser head		15 kg	
Supply incl. Chiller		60 kg	

* Nd YVO4 @ 5 kHz, Nd:YAG @ 2 kHz, Nd:YLF @ 1 kHz

Note Specifications are at factory settings and subject to change without notice



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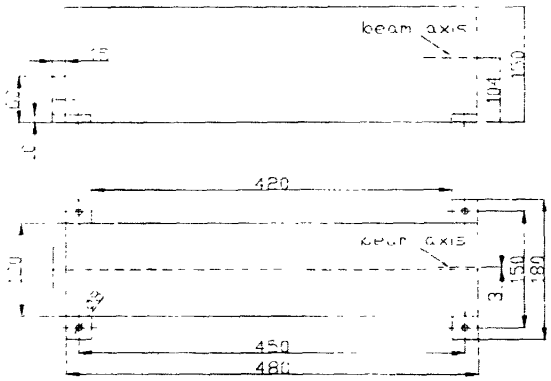
IS 355-7 E Specifications

Output Beam			
Laser medium	Nd:YVO4	Nd:YAG	Nd:YLF
Wavelength	355nm	355nm	349nm
Beam quality	M2 < 1,7	M2 < 1,7	M2 < 1,7
Average power	7W	7W	6W
Repetition rate range	0 - 50 kHz	0 - 40 kHz	0 - 30 kHz
Pulse energy*	> 0,7 mJ	> 1,2 mJ	> 2 mJ
Pulse width*	5 - 6 nsec	5 - 8 nsec	8 - 13 nsec
Energy stability*	< 2% rms	< 3% rms	< 3% rms
Timing stability	< 1ns	< 1ns	< 1ns
Polarisation	> 1:100	> 1:50	> 1:100
Beam roundness (far field)		< 10% elliptical	
Waist location		20mm to window	
Diameter at window		6 mm	
Divergence full angle		< 120 μrad	
Point stability		< 30 μrad	
Warm-up time, from cold start		< 10 min	
from standby		< 4 min	
Utility & Ambient Requirements			
Power supply		230 V, 50 Hz	
Power, maximum		700 W	
Chiller		230 V, 50 Hz	
Power, maximum		450 W	
Operating ambient Temperature		15° to 35°C	
Relative Humidity, non-condensing		10% to 80%	
Dimensions & Weights			
Laser head		180x150x480 mm	
Supply incl. Chiller		560x460x700 mm	
Laser head		15 kg	
Supply incl. Chiller		60 kg	

* Nd:YVO4 @ 5 kHz, Nd:YAG @ 2 kHz, Nd:YLF @ 1 kHz

Note: Specifications are at factory settings and subject to change without notice



edgewave

Innovative Laser Solutions

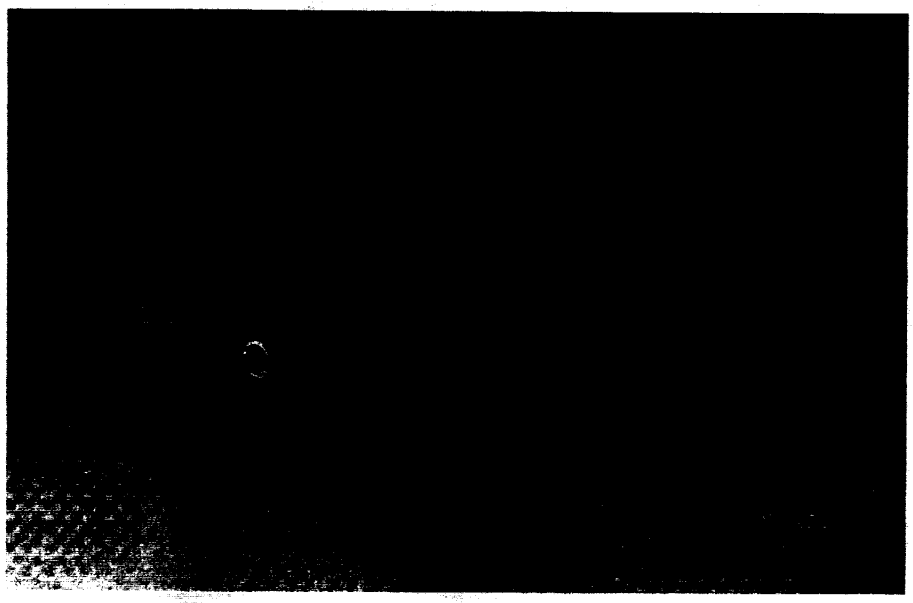
EdgeWave, Steinbachstr. 15, 52074 Aachen, Germany
Tel.: +49+241+8906-151, Fax: +49+241+8906-534
email: info@edge-wave.com, www.edge-wave.com

Diode end pumped, electrooptically q-switched INNOSLAB lasers with double cavity

Applications:

- Measurement technology
- Particle image velocimetry (PIV)
- Pumping of Ti:Sapphire-laser or Dye-lasers

Model: IS xxxx-xx E Dual



U. S. P. = Novel combination of following performances:

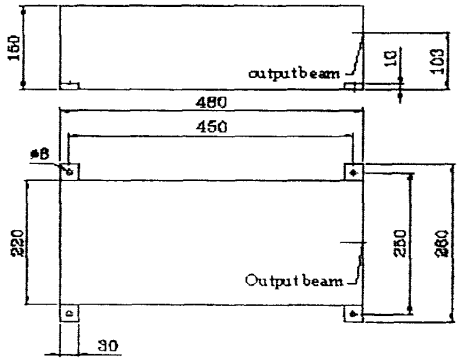
- High repetition rate
- Short pulse length
- High beam quality
- High average power
- Compact setup

IS 532-30 E Dual Specifications

Output Beam			
Laser material	Nd:YVO4	Nd:YAG	Nd:YLF
Wavelength	532nm	532nm	523nm
Beam quality	M2 < 2	M2 < 2	M2 < 2
Average power	2 x 15 W	2 x 10	2 x 10 W
Repetition rate range	0 to 30 kHz	0 to 30 kHz	0 to 30 kHz
Pulse energy*	> 2 x 1,5 mJ	> 2 x 2,5mJ	> 2 x 8mJ
Trigger of both cavities	independently	independently	independently
Pulse width*	5 - 8 nsec	10 - 12 nsec	16 nsec
Energy stability*	< 3% rms	< 3% rms	< 3% rms
Timing stability	< 1ns	< 1ns	< 1ns
Polarisation		2 x linear polarised	
Beam roundness (far field)		< 10% elliptical	
Waist location		30 mm to window	
Diameter at window		6mm	
Divergence full angle		< 60 μrad	
Point stability		< 15 μrad	
Warm-up time, from cold start		15min	
from standby		5min	
Utility & Ambient Requirements			
Power supply		230 V, 50 Hz	
Power, maximum		1,5 kW	
Chiller		230 V, 50 Hz	
Power, maximum		900 W	
Operating ambient Temperature		15° to 35°C	
Relative Humidity, non-condensing		10% to 80%	
Dimensions & Weights			
Laser head		220x150x480 mm	
Supply incl. Chiller		560x460x700 mm	
Laser head		20 kg	
Supply incl. Chiller		60 kg	

* Nd:YVO4 @ 5 kHz, Nd:YAG @ 2 kHz, Nd:YLF @ 1 kHz

Note: Specifications are at factory settings and subject to change without notice



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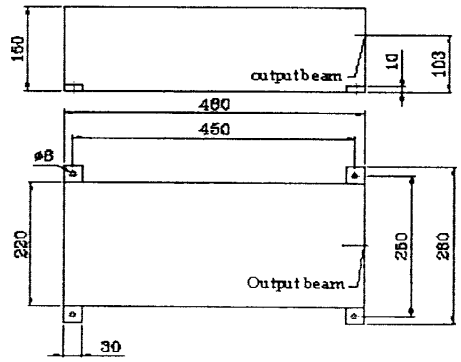
email: info@edge-wave.com, www.edge-wave.com

IS 1064-80 E Dual Specifications

Output Beam			
Laser material	Nd:YVO4	Nd:YAG	Nd:YLF
Wavelength	1064nm	1064nm	1047nm
Beam quality	M2 < 2	M2 < 2	M2 < 2
Average power	2 x 40 W	2 x 40 W	2 x 30 W
Repetition rate range	0 to 30 kHz	0 to 30 kHz	0 to 30 kHz
Pulse energy*	> 2 x 3 mJ	> 2 x 5mJ	2 x 10 mJ
Trigger of both cavities	independently	independently	independently
Pulse width*	5 - 8 nsec	8 - 10 nsec	10 - 12 nsec
Energy stability*	< 3% rms	< 3% rms	< 3% rms
Timing stability	< 1ns	< 1ns	< 1ns
Polarisation		2 x linear polarised	
Beam roundness (far field)		< 10% elliptical	
Waist location		30 mm to window	
Diameter at window		6mm	
Divergence full angle		< 150 μrad	
Point stability		< 30 μrad	
Warm-up time, from cold start		15min	
from standby		5min	
Utility & Ambient Requirements			
Power supply		230 V, 50 Hz	
Power, maximum		1,5 kW	
Chiller		230 V, 50 Hz	
Power, maximum		900 W	
Operating ambient Temperature		15° to 35°C	
Relative Humidity, non-condensing		10% to 80%	
Dimensions & Weights			
Laser head		220x150x480 mm	
Supply incl. Chiller		560x460x700 mm	
Laser head		20 kg	
Supply incl. Chiller		60 kg	

* Nd:YVO4 @ 5 kHz, Nd:YAG @ 2 kHz, Nd:YLF @ 1 kHz

Note: Specifications are at factory settings and subject to change without notice



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email: info@edge-wave.com, www.edge-wave.com

Diode end pumped, electrooptically q-switched INNOSLAB lasers

Applications:

- Glass engraving
- Marking
- Structuring
- Precision drilling
- Glass processing
- Cleaning
- Polishing
- Pumping of Dye-laser or Ti:Sapphire-laser

Model: Boxtar

U. S. P. = Novel combination of following performances:

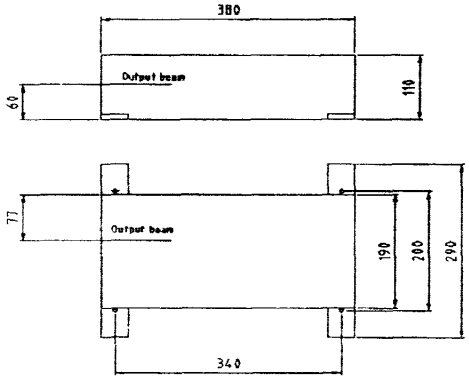
- High repetition rate
- Short pulse length
- High beam quality
- High average power
- Compact setup

Boxtar I Specifications

Output Beam			
Laser medium	Nd:YVO4	Nd:YAG	Nd:YLF
Wavelength	1064nm	1064nm	1047nm
Beam quality	M2 < 2	M2 < 2	M2 < 2
Average power	20W	20W	15W
Repetition rate range	0 - 30 kHz	0 - 30 kHz	0 - 20 kHz
Pulse energy*	> 1,5 mJ	> 2,5 mJ	> 4 mJ
Pulse width*	5 - 7 nsec	6 - 9 nsec	7 - 12 nsec
Energy stability*	< 2% rms	< 3% rms	< 3% rms
Timing stability	< 1ns	< 1ns	< 1ns
Polarisation	> 1:100	> 1:50	> 1:100
Beam roundness (far field)		< 10% elliptical	
Waist location		20mm to window	
Diameter at window		6 mm	
Divergence full angle		< 300 μrad	
Point stability		< 60 μrad	
Warm-up time, from cold start		< 10 min	
from standby		< 4 min	
Utility & Ambient Requirements			
Power supply		230 V, 50 Hz	
Power, maximum		400 W	
Chiller (industrial water)		230 V, 50 Hz	
Power, maximum		230 W	
Operating ambient Temperature		15° to 35°C	
Relative Humidity, non-condensing		10% to 80%	
Dimensions & Weights			
Laser head		180x150x480 mm	
Supply incl. Chiller		560x460x700 mm	
Laser head		15 kg	
Supply incl. Chiller		60 kg	

* Nd:YVO4 @ 5 kHz, Nd:YAG @ 2 kHz, Nd:YLF @ 1 kHz

Note: Specifications are at factory settings and subject to change without notice



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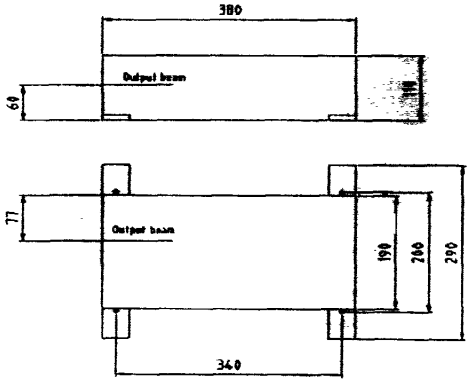
Boxtar II Specifications

Output Beam			
Laser medium	Nd:YVO4	Nd:YAG	Nd:YLF
Wavelength	532nm	532nm	523nm
Beam quality	M2 < 1,7	M2 < 1,7	M2 < 1,7
Average power	10W	10W	8W
Repetition rate range	0 - 50 kHz	0 - 40 kHz	0 - 30 kHz
Pulse energy*	> 1,2 mJ	> 2,0 mJ	> 2 mJ
Pulse width*	4 - 6 nsec	5 - 8 nsec	8 - 13 nsec
Energy stability*	< 2% rms	< 3% rms	< 3% rms
Timing stability	< 1ns	< 1ns	< 1ns
Polarisation	> 1:100	> 1:50	> 1:100
Beam roundness (far field)		< 10% elliptical	
Waist location		20mm to window	
Diameter at window		6 mm	
Divergence full angle		< 150 µrad	
Point stability		< 30 µrad	
Warm-up time, from cold start		< 10 min	
from standby		< 4 min	
Utility & Ambient Requirements			
Power supply		230 V, 50 Hz	
Power, maximum		700 W	
Chiller (industrial water)		230 V, 50 Hz	
Power, maximum		450 W	
Operating ambient Temperature		15° to 35°C	
Relative Humidity, non-condensing		10% to 80%	
Dimensions & Weights			
Laser head		180x150x480 mm	
Supply incl. Chiller		560x460x700 mm	
Laser head		15 kg	
Supply incl. Chiller		60 kg	

* Nd:YVO4 @ 5 kHz, Nd:YAG @ 2 kHz, Nd:YLF @ 1 kHz

Note: Specifications are at factory settings and subject to change without notice



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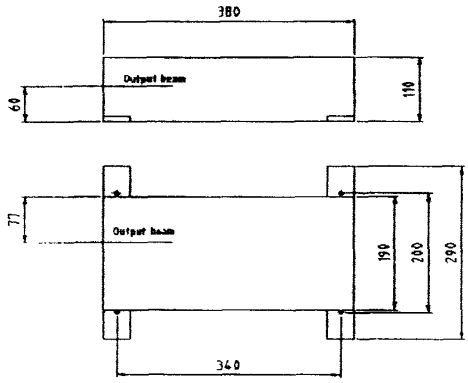
Boxtar III Specifications

Output Beam	
Laser medium	Nd:YVO4
Wavelength	355nm
Beam quality	M2 < 2
Average power	5 W
Repetition rate range	0 to 50 kHz
Pulse energy @ 5 kHz	> 0,3 mJ
Pulse width @ 5 kHz	5 - 8 nsec
Energy stability @ 5 kHz	< 2% rms
Timing stability	< 2ns
Polarisation	> 1:100
Beam roundness (far field)	< 10% elliptical
Waist location	10 mm to window
Diameter at window	1 mm
Divergence full angle	< 240 μrad
Point stability	< 60 μrad
Warm-up time, from cold start	20min
from standby	6min
Utility & Ambient Requirements	
Power supply	230 V, 50 Hz
Power, maximum	700 W
Chiller (industrial water)	230 V, 50 Hz
Power, maximum	450 W
Operating ambient Temperature	15° to 35°C
Relative Humidity, non-condensing	10% to 80%
Dimensions & Weights	
Laser head	180x150x480 mm
Supply incl. Chiller	560x460x700 mm
Laser head	15 kg
Supply incl. Chiller	60 kg

Note: Specifications are at factory settings and subject to change without notice



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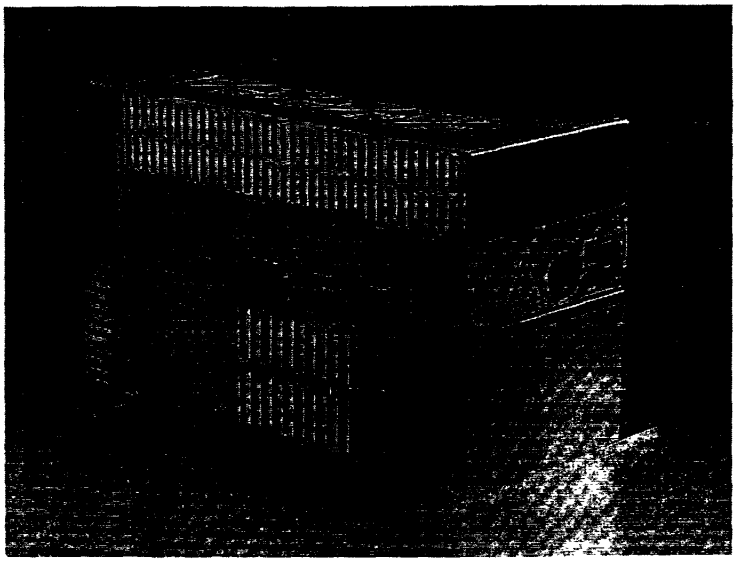
Air cooled, diode end pumped, electrooptically q-switched INNOSLAB lasers

Applications:

- Glass engraving
- Marking
- Structuring
- Precision drilling
- Glass processing
- Cleaning
- Polishing
- Pumping of Dye-laser or Ti:Sapphire-laser

Model: A2



U. S. P. = Novel combination of following performances:

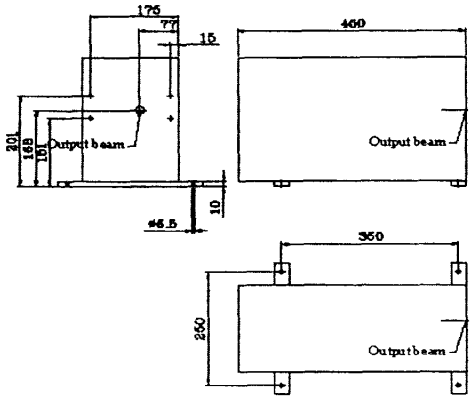
- Air cooled
- High repetition rate
- Short pulse length
- High beam quality
- High reliability
- Compact setup

A2 I (Air cooled) Specifications

Output Beam			
Laser medium	Nd:YVO4	Nd:YAG	Nd:YLF
Wavelength	1064nm	1064nm	1053nm
Beam quality	M2 < 2	M2 < 2	M2 < 2
Average power	20 W	18W	16 W
Repetition rate range	0 - 50 kHz	0 -40 kHz	0 -30 kHz
Pulse energy*	2 mJ	3,5 mJ	5 mJ
Pulse width*	6 nsec	8 nsec	8 nssec
Energy stability*	< 3% rms	< 3% rms	< 3% rms
Timing stability	< 1 ns	< 1 ns	< 1 ns
Polarisation	> 1:100	> 1:50	> 1:100
Beam roundness (far field)		< 10% elliptical	
Waist location		20 mm to window	
Diameter at window		6 mm	
Divergence full angle		< 300 μrad	
Point stability		< 60 μrad	
Warm-up time, from cold start		< 15 min	
from standby		< 4 min	
Utility & Ambient Requirements			
Power supply		230 V, 50 Hz	
Power, maximum		1 kW	
Air cooled			
Operating ambient Temperature		15° to 30°C	
Relative Humidity, non-condensing		10% to 80%	
Dimensions & Weights			
Complete laser incl. power supply & cooler unit		450mmx280mmx200mm	
Complete laser incl. power supply & cooler unit		35 kg	

* Nd:YVO4 @ 5kHz, Nd:YAG @ 2kHz, Nd:YLF @1 kHz

Note: Specifications are at factory settings and subject to change without notice



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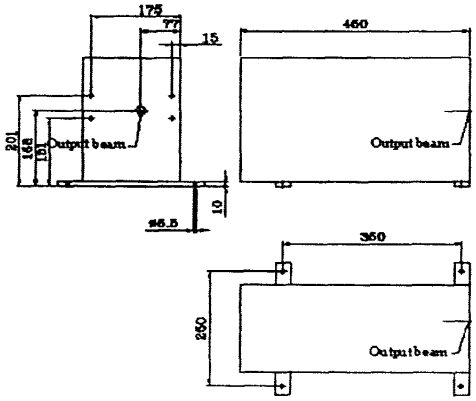
email: info@edge-wave.com, www.edge-wave.com

A2 II (Air cooled) Specifications

Output Beam			
Laser medium	Nd:YVO4	Nd:YAG	Nd:YLF
Wavelength	532nm	532nm	527nm
Beam quality	·M2 < 1,7	M2 < 1,7	M2 < 1,7
Average power	10 W	9W	8 W
Repetition rate range	0 - 50 kHz	0 -40 kHz	0 -30 kHz
Pulse energy*	1 mJ	1,7mJ	2,5 mJ
Pulse width*	5 nsec	7 nsec	7 nssec
Energy stability*	< 3% rms	< 3% rms	< 3% rms
Timing stability	< 1 ns	< 1 ns	< 1 ns
Polarisation	> 1:100	> 1:100	> 1:100
Beam roundness (far field)		< 10% elliptical	
Waist location		20 mm to window	
Diameter at window		6 mm	
Divergence full angle		< 150 μrad	
Point stability		< 30 μrad	
Warm-up time, from cold start		< 15 min	
from standby		< 4 min	
Utility & Ambient Requirements			
Power supply		230 V, 50 Hz	
Power, maximum		1 kW	
Air cooled			
Operating ambient Temperature		15° to 30°C	
Relative Humidity, non-condensing		10% to 80%	
Dimensions & Weights			
Complete laser incl. power supply & cooler unit		450mmx280mmx200mm	
Complete laser incl. power supply & cooler unit		35 kg	

* Nd:YVO4 @ 5kHz, Nd:YAG @ 2kHz, Nd:YLF @1 kHz

Note: Specifications are at factory settings and subject to change without notice



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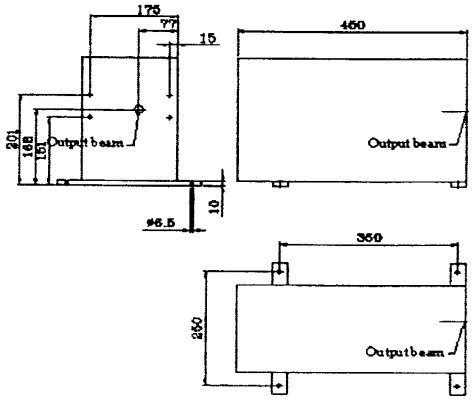
A2 III (Air cooled) Specifications

Output Beam			
Laser medium	Nd:YVO4	Nd:YAG	Nd:YLF
Wavelength	355nm	355nm	351nm
Beam quality	M2 < 1,7	M2 < 1,7	M2 < 1,7
Average power	5 W	4W	4W
Repetition rate range	0 - 50 kHz	0 -40 kHz	0 -30 kHz
Pulse energy*	0,4 mJ	0,8 mJ	1,2 mJ
Pulse width*	6 nsec	7 nsec	8 nssec
Energy stability*	< 3% rms	< 3% rms	< 3% rms
Timing stability	< 1 ns	< 1 ns	< 1 ns
Polarisation	> 1:100	> 1:100	> 1:100
Beam roundness (far field)		< 10% elliptical	
Waist location		20 mm to window	
Diameter at window		6 mm	
Divergence full angle		< 100 μrad	
Point stability		< 30 μrad	
Warm-up time, from cold start		< 15 min	
from standby		< 4 min	
Utility & Ambient Requirements			
Power supply		230 V, 50 Hz	
Power, maximum		1 kW	
Air cooled			
Operating ambient Temperature		15° to 30°C	
Relative Humidity, non-condensing		10% to 80%	
Dimensions & Weights			
Complete laser incl. power supply & cooler unit		450mmx280mmx200mm	
Complete laser incl. power supply & cooler unit		35 kg	

* Nd:YVO4 @ 5kHz, Nd:YAG @ 2kHz, Nd:YLF @1 kHz

Note: Specifications are at factory settings and subject to change without notice



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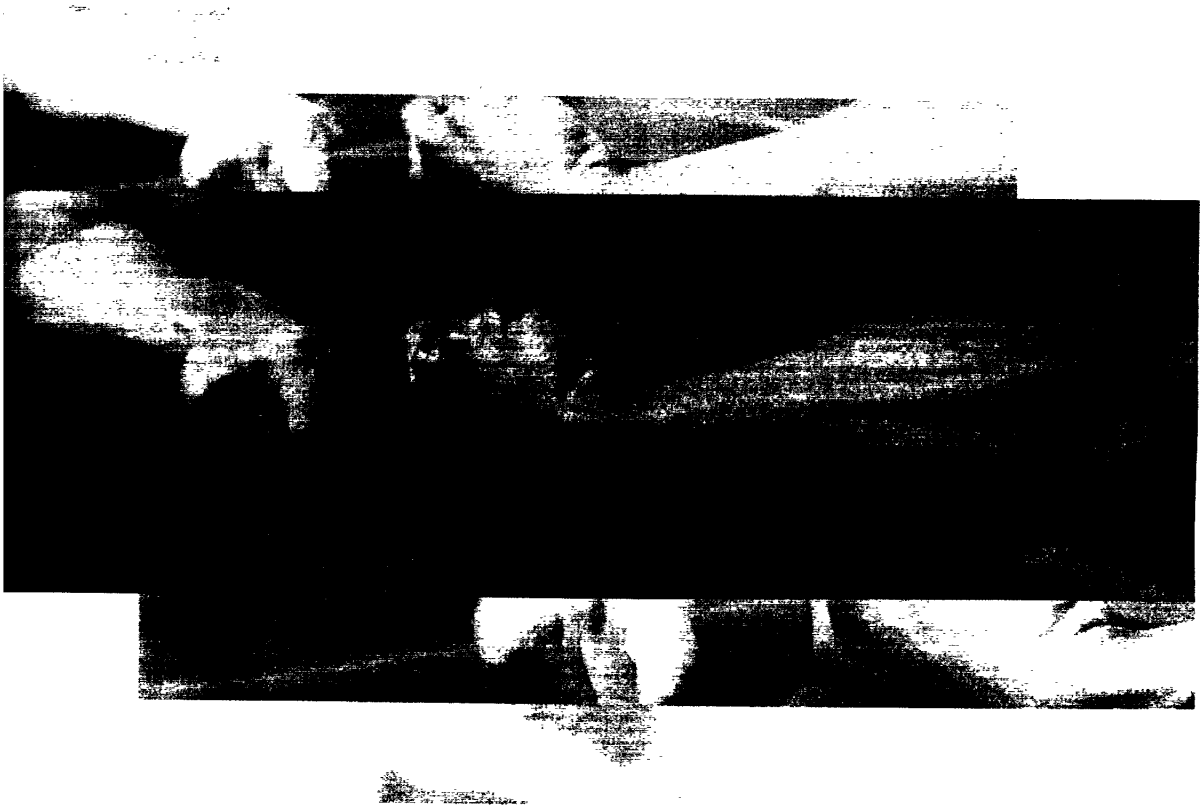
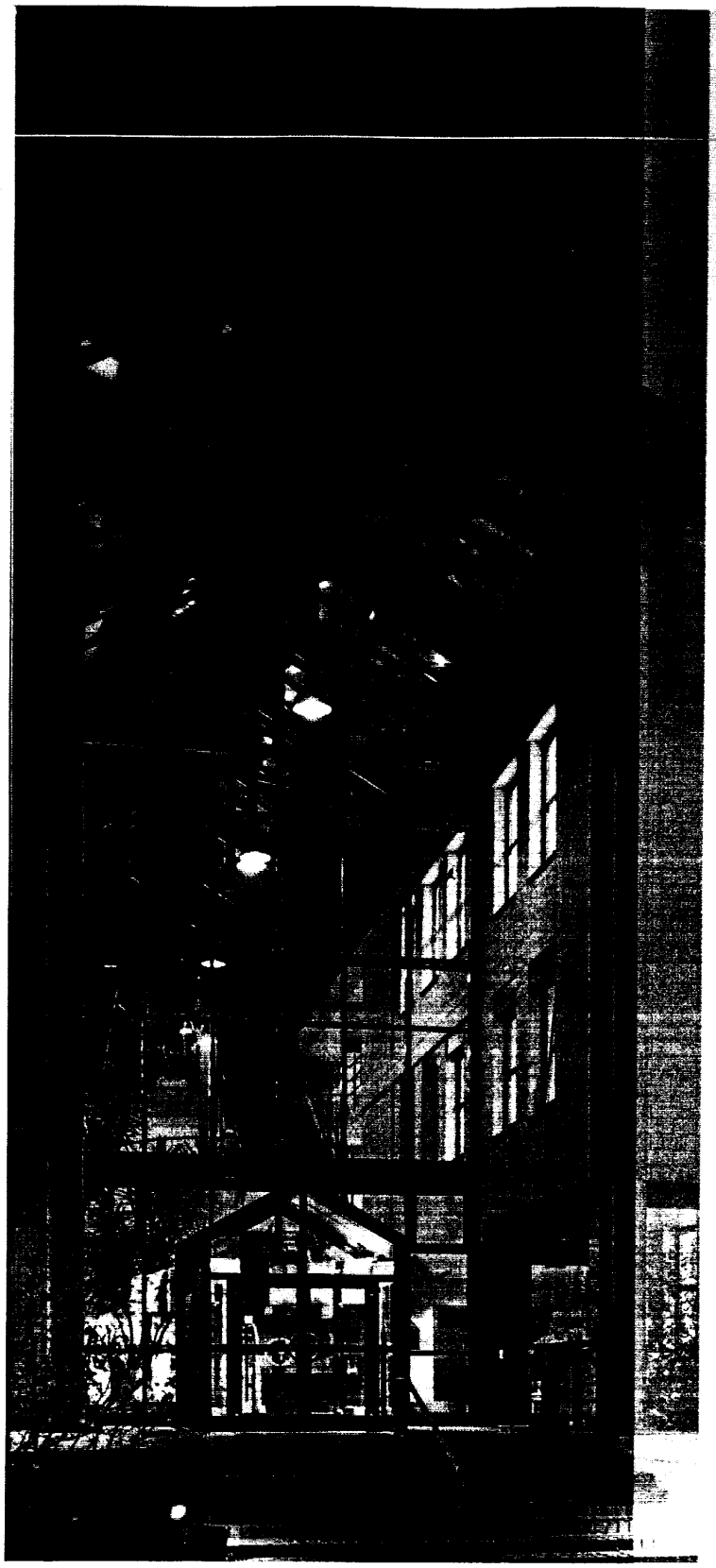
附件

四、Fraunhofer ILT 資料

Fraunhofer Institut Lasertechnik

Your partner for innovation





Profile

Innovation in laser technology - this is the **driving force and central** objective of the **Fraunhofer ILT. A glance** into the future **at the problem-solving** potential of laser **technology implies** that it will play an **increasingly significant** role in the fields of **manufacturing and** production, information **and communications** technology, the life **sciences and environmental** engineering. **The Fraunhofer** ILT holds a leading **international position** in the transfer of **laser technology** to industrial application. **Together with** our innovative partners, we **create tailored solutions** capable of boosting companies into market-leading positions, and act as trend-setters to prepare the way for new generations of technologies and products.

With a staff of some 300 employees and usable floor space totaling more than 10,000 m², the Fraunhofer-Institute for Laser Technology ILT and the Chair for Laser Technology at RWTH in Aachen rank among the most significant institutes for contract research and development in the laser technology sector. The center offers a broad spectrum of services from a single source including R&D, system development, quality assurance, consulting and training. The center is certified in accordance with ISO 9001:2000. More than 200 projects are carried out yearly in cooperation with our industrial partners.

The Fraunhofer ILT also offers efficient instruments to implement more complex R&D projects within the scope of long-term collaborations. The Laser User Center continously hosts about 10 guest companies, providing them with their own, independent laboratories and office space. Our partners have defined access to the technical infrastructure and expert knowledge of the Institute. Naturally, all industrial projects are carried out under strict confidentiality. The innovative atmosphere cultivated at the Fraunhofer ILT is of mutual benefit to all parties involved.

The Fraunhofer ILT cooperates internationally with companies and institutions in Europe, America and Southeast Asia. The Fraunhofer ILT maintains its own development teams in the USA and France. It plays an active role in scientific and industrial developments in the USA through the Fraunhofer Center for Laser Technology CLT in Michigan and cooperates with leading French research institutions in the field of laser-based production processes through the CLFA in Paris.

Core competences

Laser components
Solid-state and diode lasers
Laser measurement and testing technology
Plasma technology
Cutting and joining
Surface treatment
Micro technology
Modeling and simulation
Systems technology

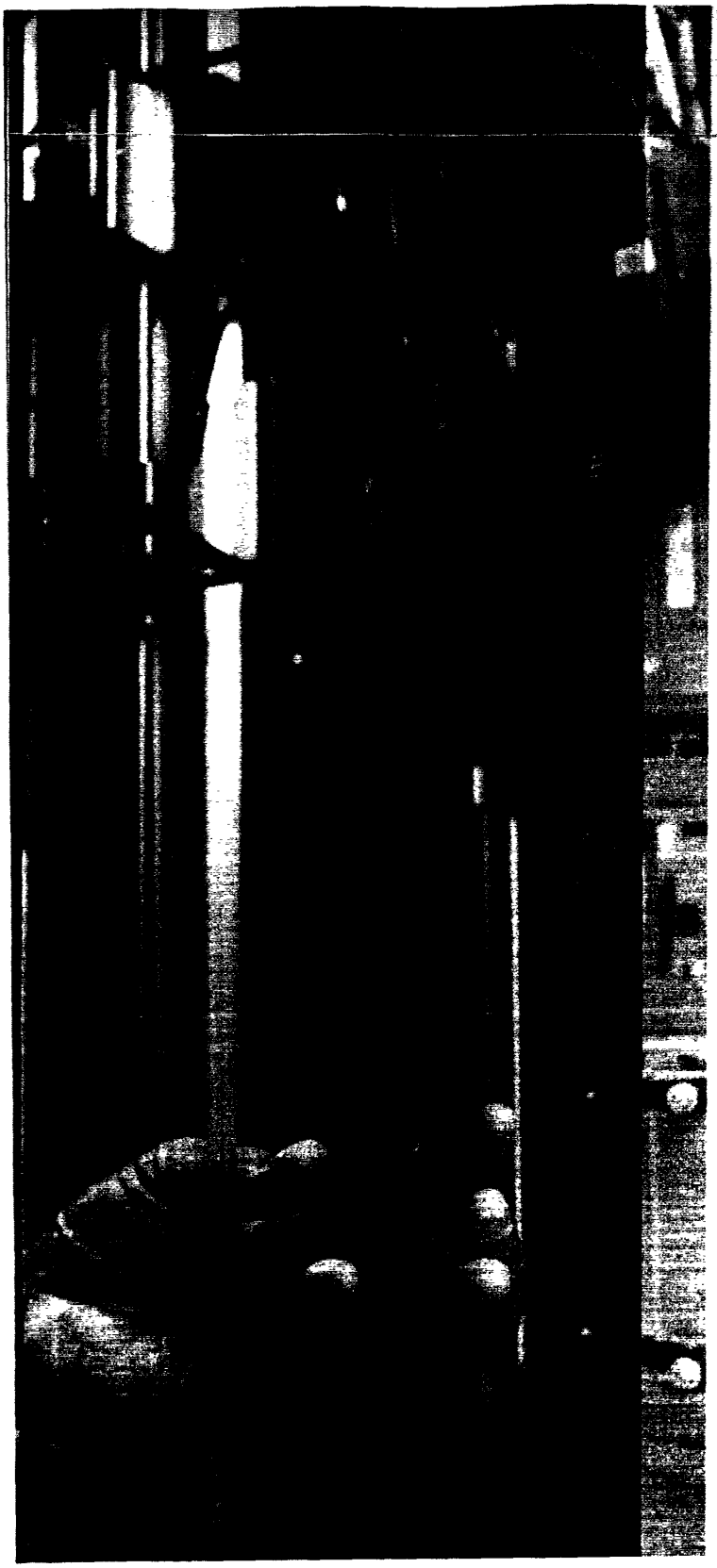
Equipment and infrastructure

Diode-pumped solid-state lasers up to 8 kW
Lamp-pumped Nd:YAG lasers up to 4 kW
Diode-laser systems up to 3 kW
Pulse modulated solid-state lasers
fs and ps short-pulse lasers
Wavelength-adjustable lasers
Frequency-converted solid-state lasers
CO_2 lasers up to 20 kW
Excimer lasers
Fibre lasers

Five-axis gantry systems and side stand facilities
Three-axis processing stations
High-speed systems up to 400 m/min
Beam guiding systems
Robot systems
Scanner systems
Process monitoring sensors for laser material processing
Process diagnosis and high-speed process analysis equipment

Direct-writing and laser-PVD stations
Plasma units for surface cleaning and modification
Clean rooms for diode laser packaging and solid-state laser assembly
Chemical analysis
Life science laboratory (S1)

Laser spectroscopic systems for chemical analysis of solid-, liquid- and gas-phase materials
Systems for laser-fluorescence spectroscopy
Laser-triangulation sensors for distance and contour measurement
Laser coordinate measuring machine



At the cutting edge of innovation

Laser technology embodies the ultimate in potential: Shaping today, transforming tomorrow.

Lasers fascinate us by the power, precision, purity and beauty of the light they emit. Laser technology research explores the benefits of this tool for thousands of applications in almost every sector, for any material - an ideal field for everyone who works with cutting-edge technology, who strives to gain competitive advantage through innovation.

Achieving success through innovation, however, is no simple task. Laser technology persistently challenges the limits of our knowledge. It demands imagination, vision, and shrewd judgment. Risks must be continually scrutinized, assessed and ultimately undergone.

There is no golden path to innovative products, manufacturing technologies and applications. There are no guarantees.

But there are ideal partners.

Partners entirely dedicated to the development of laser technology Whose knowledge extends to the outermost limits of imaginable technological know-how Who have proven themselves as a driving force in the transfer of laser technology in all sectors of industrial application, now and in the future. And who have the potential to realize solutions as yet undreamed of

Partners experienced in transforming knowledge into applications, familiar with the trials and tribulations of working in a competitive marketplace Who recognize that market success must be the central focus of any industrial partnership, and that it must be founded on trust and fairness.

Partners who tailor projects and project structures to suit the needs of your company.

Partners whose forms of cooperation ranges from „one-stop-shopping" to large-scale collaborative projects.

Partners like the Fraunhofer ILT.

Customers of the Fraunhofer ILT - always a step ahead of the field

Our customers have one thing in common. They believe in the innovative potential of laser technology

Each of our customers is unique!

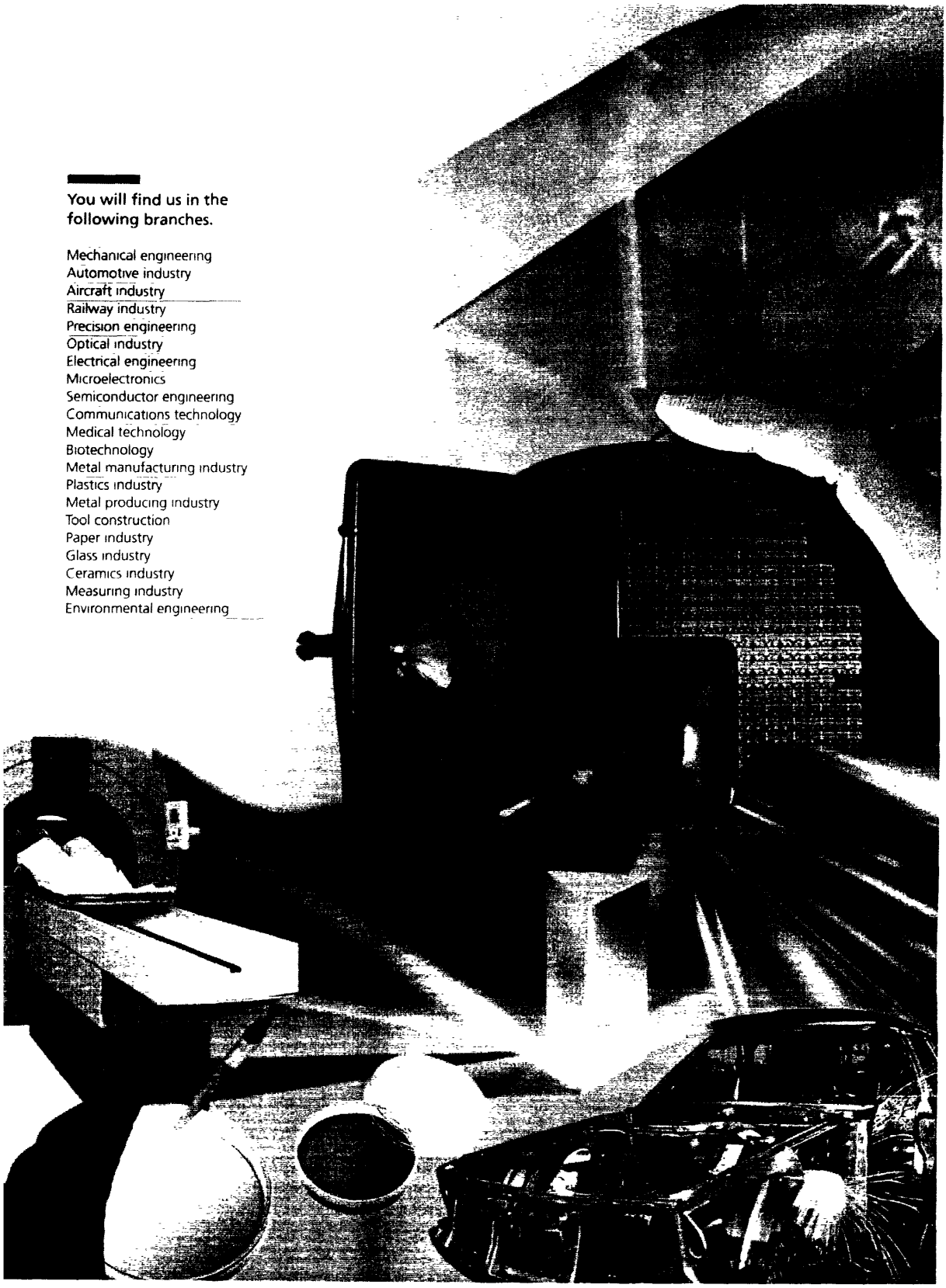
Our customers are
- from all sectors of industry
- small and medium-sized enterprises or large and giant multinational corporations
- manufacturers and service providers
- young startup firms and long-established companies
- from different countries and from every continent

See for yourself:

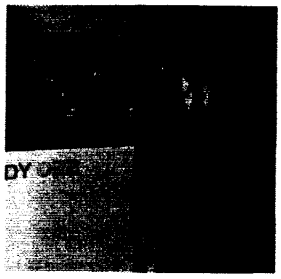
MARQUARDT
WILDEN
INOVAN
ABB ALSTOM POWER
Mubea ENGINEERING FOR MOBILITY
BRAUN
FEV
MAN ROLAND
ZUMTOBEL STAFF DAS LICHT
TRUMPF
MULTEK
NAU
BMW
Raufoss
Siemens Automotive
MESSER igm Steigerwald
LASAG INDUSTRIAL-LASERS A COMPANY OF THE SWATCH GROUP
VYGON Kompetenz für Medical Produkte
Zinser
rofin
Heraeus
Valeo ELECTRONIK
DILLINGER HÜTTE
Radium Die Lichtmarke
Thyssen Laser-Technik Aachen
PROMETEC
MicroLaserTec GmbH
KARCOMA ARMATUREN
BOSCH
JENOPTIK JENA LASERDIODE
Huf Tools
DILAS Diodenlaser GmbH
LAMBDA PHYSIK.

You will find us in the following branches.

Mechanical engineering
Automotive industry
Aircraft industry
Railway industry
Precision engineering
Optical industry
Electrical engineering
Microelectronics
Semiconductor engineering
Communications technology
Medical technology
Biotechnology
Metal manufacturing industry
Plastics industry
Metal producing industry
Tool construction
Paper industry
Glass industry
Ceramics industry
Measuring industry
Environmental engineering



What customers say about the Fraunhofer ILT

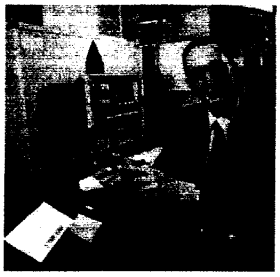


As part of a three-year development program in cooperation with the Fraunhofer ILT, Rofin-Sinar developed a ready-for-market series of industrial diode-pumped high-power Nd:YAG lasers. During this successful collaboration, we once again learned to value the Institute as a partner for technological development and benefited from the expertise and engagement of its scientists.

Dr. Peter Wirth, executive president, Rofin-Sinar Laser GmbH, Hamburg

Vitro Laser GmbH today numbers among the most successful international suppliers of system solutions for sub-surface engraving by laser. The Fraunhofer ILT played a major role in our success.

Rémy Renaud, Andreas Wienkamp, chief executive officers, Vitro Laser GmbH, Minden



Innovation and efficiency in plastic welding ensure our competitive advantage. Working with the Fraunhofer ILT gives us access to a variety of different laser systems and a reliable source of help and information in questions relating to materials and processes. Our collaboration on the project „welding plastics with diode lasers" has been extraordinary.

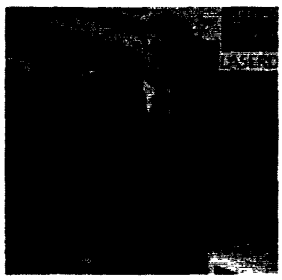
Dr.-Ing. Volker Franke, head of production engineering, Marquardt GmbH, Rietheim-Weilheim

Siemens Dematic in Bruchsal develops innovative Microbeam laser machines for circuit-board manufacture, which we sell throughout the world. The expert knowledge and quality of the laboratory facilities at the Fraunhofer ILT were an ideal complement to the development process. The selection of a suitable CO_2 laser source can to a large extent be attributed to the ILT.

Dr. Eddy Roelants, Siemens N.V., Gent, Belgium

Innovative solutions within the parameters of an overall business concept ensure us a leading position on the international market. Customer satisfaction and product safety are central aspects of such business concepts, to which the Fraunhofer ILT facilities make a significant contribution.

Ralf Buchholz, works manager, Wilhelm Schulz GmbH, Krefeld



JENOPTIK has worked with the Fraunhofer ILT in Aachen for many years in several areas. We have come to value the staff at the institute as exceptionally competent partners in the field of laser beam sources and their applications, and have carried out a number of innovative joint projects

Hermann Voelckel, chief executive of JENOPTIK Laserdiode GmbH

ILT is ideal for helping small companies to develop novel laser-based products. We have been delighted with the cooperation and expertise afforded to us. The facilities are excellent and the genuinely innovative approach make it a pleasure to work with the institute

Malcolm Higgins, managing director, LaserThor Ltd, Winchester, UK

When it comes to widening the scope of laser material processing, TRUMPF considers the Fraunhofer ILT an exceptionally competent partner Cooperative projects enhance both the research carried out by the ILT in new fields of application and the pace of plant engineering at TRUMPF A recent example is our joint work on a process technology for selective laser melting

Dr Joachim Hutfless, head of development of new processes, TRUMPF Werkzeugmaschinen GmbH&Co KG, Ditzingen

The laser cleaning of corroded high-voltage electricity pylons was the central focus of a joint pilot project involving the companies RWE Net AG, Peiniger RöRo and Clean Lasertechnik The Fraunhofer ILT carried out the groundwork that led to the development of a new environmentally friendly process for the treatment of corroded pylon members that also reduces the physical effort required on the part of the maintenance teams

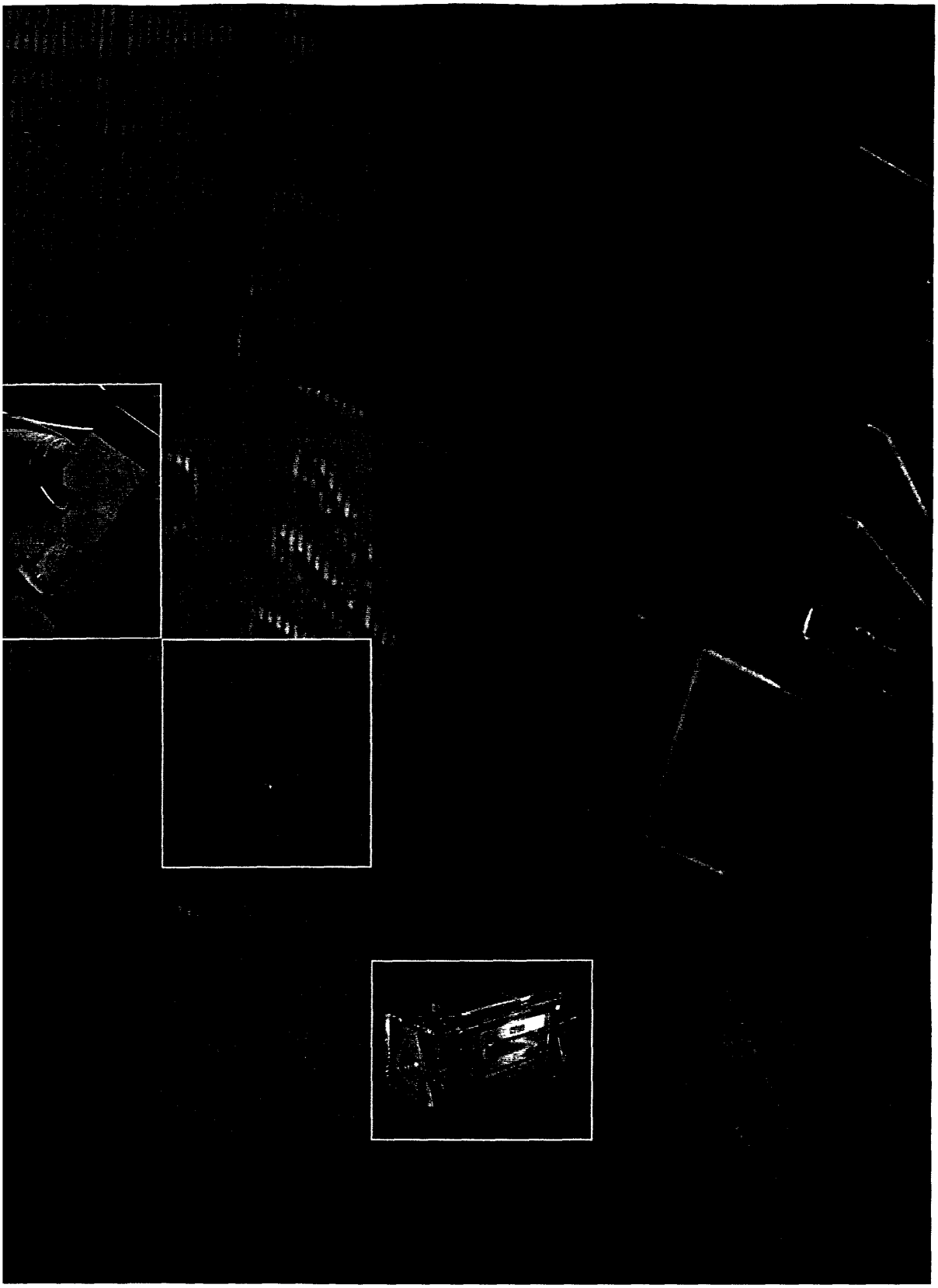
Hubert Bruninghoff, RWE Net AG, Dortmund

Through the introduction of laser deposition welding at Braun, we have been able to achieve decisive cost savings in the maintenance, alteration and modification of injection moulds, as well as reduce machine downtime by a considerable margin The ILT performed excellent work as our source of technology and components

Klaus Eimann, head of diemaking, Braun GmbH, Werk Marktheidenfeld

Since years the Fraunhofer ILT is the international leader in the field of laser-beam cutting As such, it developed the basic process technology and a patented gas nozzle for oxide-free thick-plate cutting Upwards of 5 kW beam output, heavy plates of structural steel and stainless steel are precision cut today almost exclusively with a TLT head based on ILT technology using oxide-free cutting edges TLT scaled up the technology, brought the cutting head to market, implements improvements and manufactures the beam control system

Prof Dr Friedrich Behr, chief executive officer, Thyssen Laser-Technik GmbH, Aachen



High-power beam sources for new tasks

Laser and plasma beam sources are having to meet increasingly exacting requirements. Beam power and quality are rising. To an increasing extent, beam tools are being tailored to specific tasks. The Fraunhofer ILT has achieved milestones in this area, for example with the industrial diode-pumped solid-state laser in the multi-kW range jointly developed with a leading laser manufacturer. The higher beam quality and power have opened up new applications. Prolonged service life, higher productivity and greater precision are the decisive improvements.

The Fraunhofer ILT is driving developments further forward, providing support in the product design of laser beam sources and generating solution families for your requirements. A few of the many scenarios are presented here by way of example.

World record for diode lasers

The outstanding feature of diode lasers is their high output power from an extremely small volume. With a continuous output of 270 W from a single diode laser bar, the Fraunhofer ILT together with the Fraunhofer IAF achieved a world record. Special packaging and cooling techniques had to be applied because the small dimensions call for extremely high precision. The Fraunhofer ILT is present along the entire chain of value-creating activity. From the development of microduct cooling units through the assembly and characterization of diode lasers to the customized development of complete diode laser systems. Through its cooperation with the Fraunhofer IAF in Freiburg, the ILT also has access to the development of the chips at the start of the value chain.

Range of services

Development of solid-state and diode lasers
Design of new diode laser structures
Design and characterization of micro-optical components
Automation of microassembly processes
Excitation systems for plasma technology
Low and high pressure plasmas for cleaning processes and sterilization
Plasma-based EUV sources and X-ray technology
Beam sources for lithography in semiconductor manufacturing

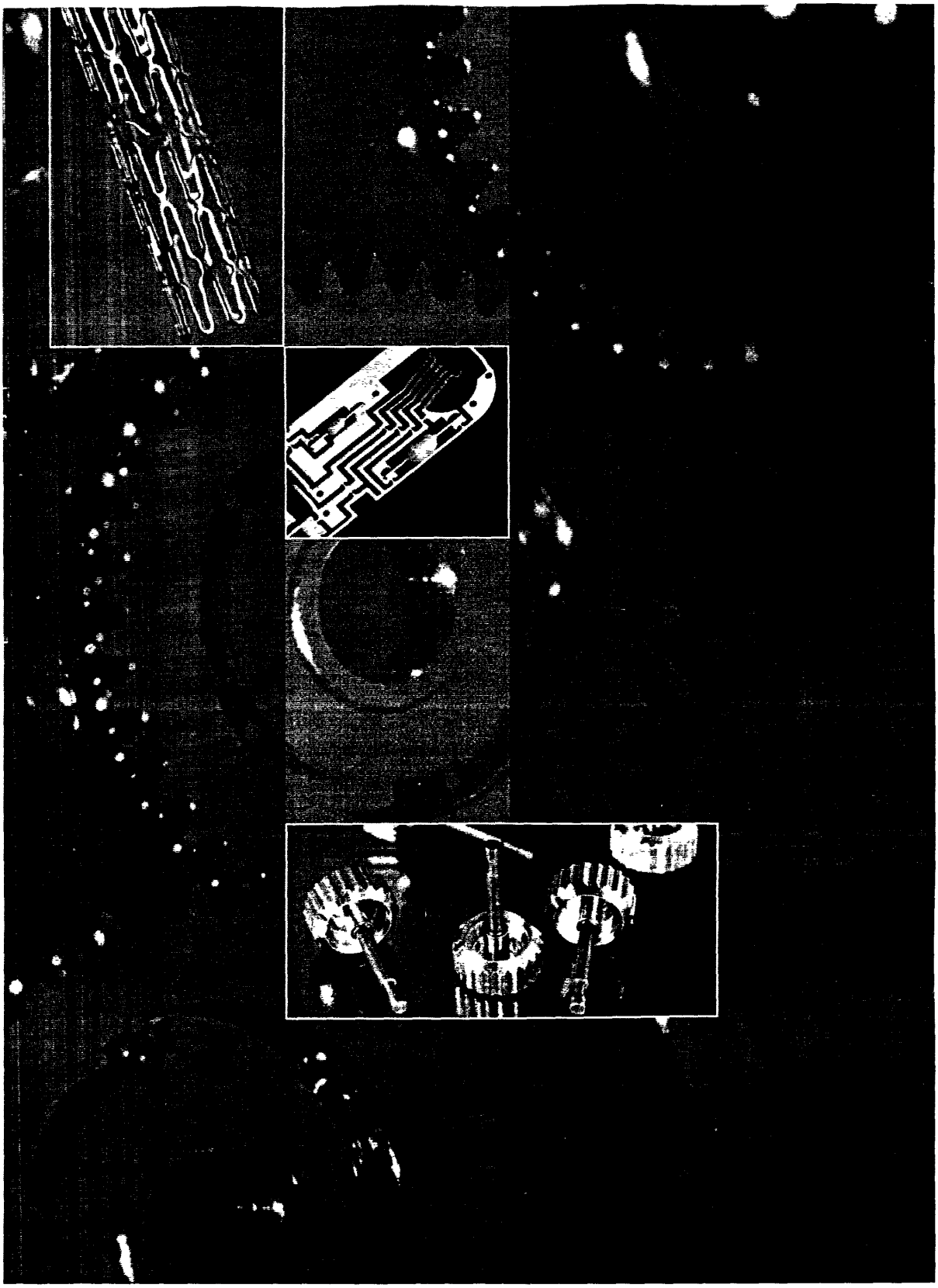
Solid-state lasers with new horizons

The latest evolutionary leap is Innoslab: a plate-shaped laser crystal is pumped directly by a diode laser stack. The laser beam achieves high brilliance performance - also in the physical sense. This paves the way for a wide range of potential applications, e.g. in high speed cutting and car bodywork construction.
Further laser systems with tailor-made pulse forms are being developed at the Fraunhofer ILT especially for applications in biophotonics and material microprocessing, for sub-surface engraving by laser and for the production of 3D waveguide structures in communications technology. Solid-state lasers with tunable wavelengths in a large spectral range are also a speciality of the Institute. These lasers open up new horizons in high-resolution analysis, in safety devices used to determine minute quantities of substances, in the analysis of modified DNA and in the selective processing of composite materials.

EUV technology

Dimensions in semiconductor devices are becoming even smaller. Computer power can be concentrated in less and less space. This process is limited only by the wavelength of the light, which determines the fineness of the structures on the exposed semiconductor components. With EUV lithography, which uses shortwave EUV light (EUV = Extreme Ultra Violet) these limits are being overcome. In a joint venture, the Fraunhofer ILT, as a development partner to industry, is refining the plasma-based EUV light source invented in Aachen for applications in EUV lithography and making it ready for introduction into operating practice.

The Fraunhofer ILT is, however, also thinking beyond the lithographic sector. Areas of application for the EUV technology, which can be pursued with various partners, exist in metrology for the analysis of microstructures, in the life sciences, in production engineering and in the material sciences.



Small is beautiful - precision manufacture by laser!

Technology is getting tinier. What used to fill whole cabinets can now be worn on the wrist. High-powered computers are small enough to be kept in a briefcase and continue to shrink in size.

This is where laser technology comes into its own: Wherever filigree parts, precision components, microengineering, biostructures play a role, lasers can fasten, loosen, fit, join, drill and weld. Here are a few examples.

Medicine: engineering and life sciences merge:

In cooperation with various hospitals, the Fraunhofer ILT is developing processes for the production of surgical implants, for example stents filigree-tubular structures with a precisely defined surface which, when inserted into blood vessels and unfolded at the right place, have a supporting and healing effect. Surface engineering by laser radiation is the key technology behind other medical products Microcavities in metallic, polymer and ceramic surfaces create a friction grip and biocompatible connection between the technical component and the cell structure In chemistry and bioengineering, laser technology shortens development times. Microreactors produced by laser with a high surface-to-volume ratio accelerate chemical processes Laser analysis techniques provide rapid information about biochemical reactions and induce new impetus for research into active agents and pharmaceutical technology by way of high-throughput screening and parallel synthesis

Miniaturization on the advance

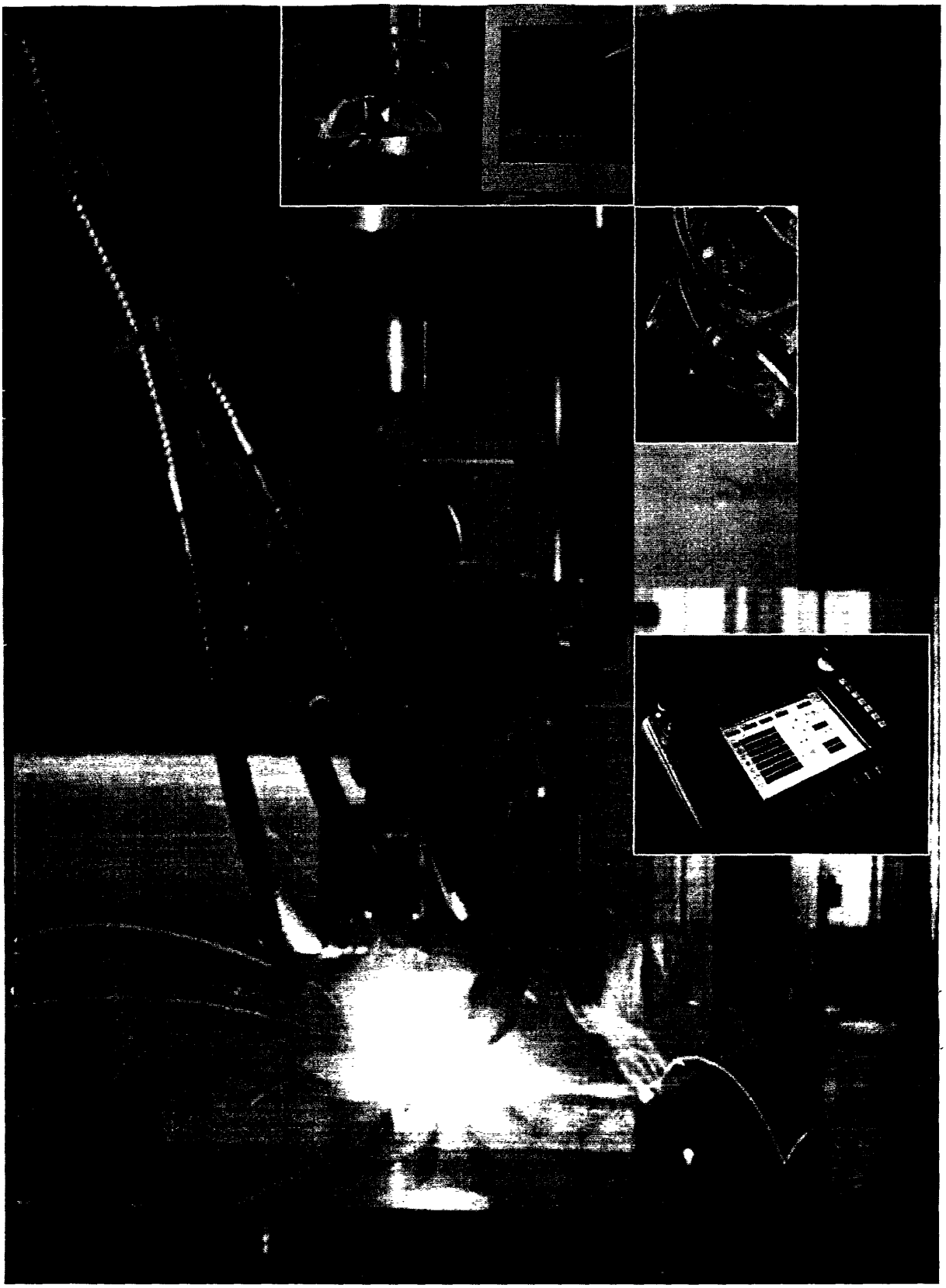
Component miniaturization is the key to increasing functionality while retaining the same product size. Precision laser techniques play a role when it comes to reducing component size to below 100 µm and increasing the requirements in respect of reproducibility and influencing the component Lasers are used to weld sensors with membranes and measuring probes of less than 20 µm Microgrippers with part geometries of less than 10 µm are cut with pulsed laser radiation Laser-based adjustment is replacing the adjusting screw and enables components to be significantly simplified.

Electrical engineering : Integration promotes new production techniques

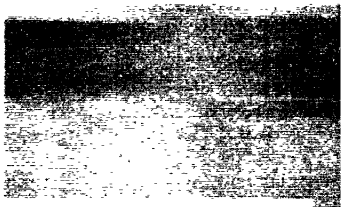
More and more logic accommodated in a smaller and smaller package Multi-layer boards provide the solution and represent the challenge at one and the same time Laser drilling techniques make connection possible through several layers while also reducing the width of the circuit board conductor to below 50 µm New industrial requirements are arising for three-dimensional circuit boards and thermally sensitive components. Here, laser soldering techniques offer individual solutions for highly reliable automated manufacture

Range of services

Laser-beam microsoldering and microwelding
Laser-based bending and adjusting
Precision cutting and drilling of metals, ceramics, semiconductors and diamonds
Microstructuring with excimer and Nd:YAG lasers
Microstamping and embossing
Marking and inscribing



Big and robust - flexible production by laser!



More and more, lasers are taking on the role of an all-round tool. Thanks to their flexibility, they are used in all types of plants and production shops, providing better methods of welding, cutting and hardening. Here are a few examples.

Hybrid welding

Laser welding has its undisputed advantages, but its use is sometimes limited by narrow process windows and high investment costs. By contrast, traditional welding methods such as arc welding are cheap and robust. The combination of both techniques to create hybrid welding technology generates valuable synergies in many applications, which pay off in higher quality and cost efficiency.
The patented hybrid welding head developed at the Fraunhofer ILT is already being used in a range of applications, such as for welding oil tanks and in tube fabrication. Further patented hybrid welding techniques developed by the Fraunhofer ILT are being used in the manufacture of contoured weld seams in tailored blanks for automotive industry. With the Institute's leading know-how in this area, clients of the Fraunhofer ILT benefit from made-to-measure solutions through to support in qualification procedures.

High-speed cutting

The advances in high-speed laser cutting and welding are creating new and hugely promising areas of application for lasers. For example, in the machining of automotive sheet, cutting speeds of 50 m/min and over are possible. In mass production, laser cutting is therefore evolving as an alternative to conventional cutting methods using stamping tools. The non-wearing and flexibly adjustable laser beam increases the quality of the cutting process and opens up new dimensions of flexible automation.
The Fraunhofer ILT is engaged in work to harness the potential of high-speed cutting and welding processes by conducting limit-value-oriented research. The Institute also supports its customers with advice on the design and function of the product to be machined.

Hardening for the highest loads

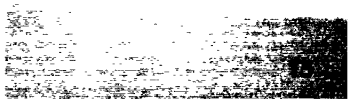
A car door is arrested in several positions by means of a torsion spring which comes under enormous loading at one specific point. Here hardened steel has to be used. Laser radiation leads to rapid heating, self-quenching by the surrounding material and thus to the required hardness: the re-application of an old principle.
Linear guide rails also need to be endowed with hardness and precision. Distortion is minimized by simultaneous hardening of several tracks and laser straightening treatment. The Fraunhofer ILT optimizes all the processes involved, including multi-beam technology, straightening treatment, simulations of temperature fields and lots more: expertise which will ensure precision and protection against wear in many applications.

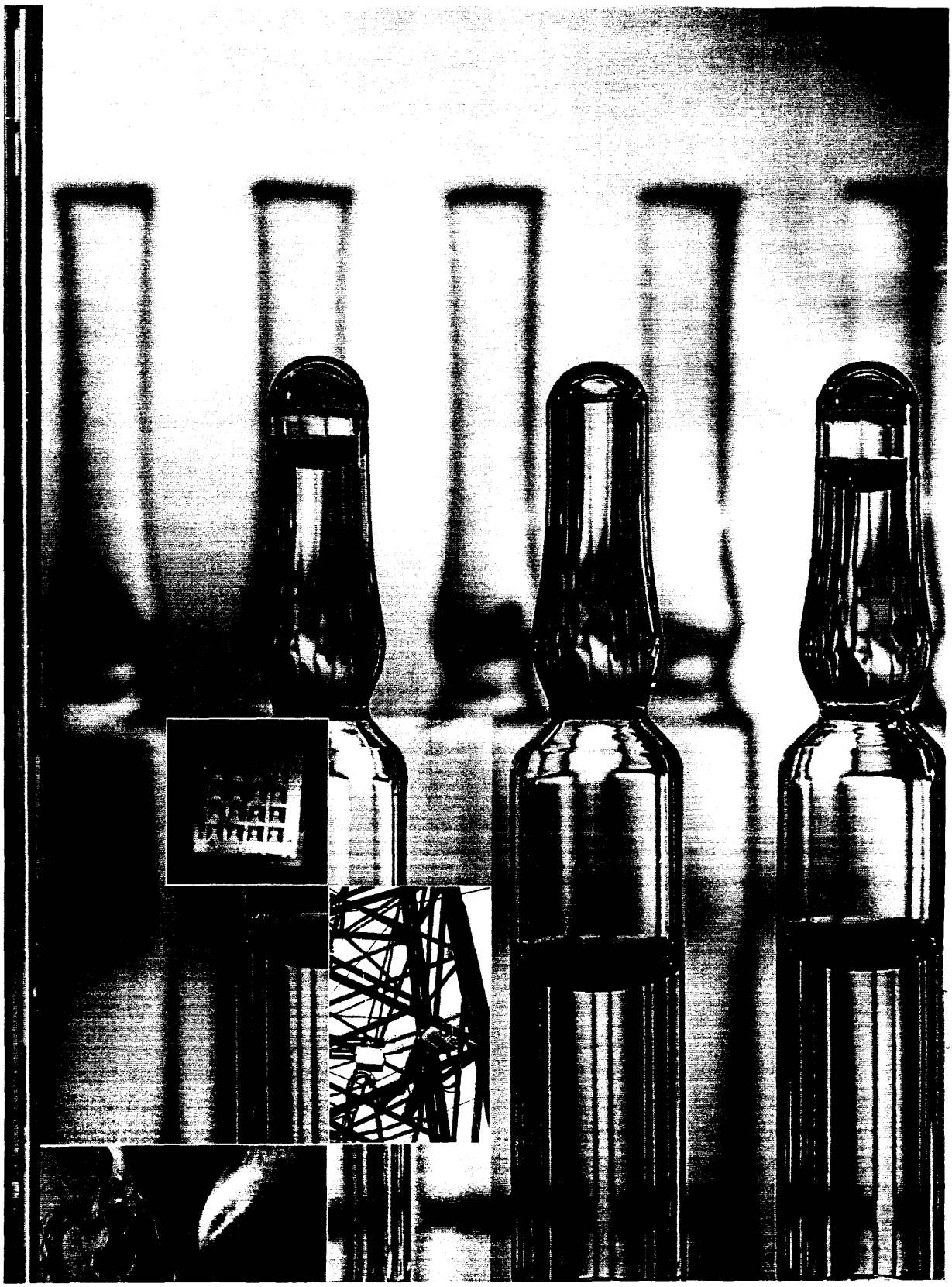
Component development

Laser technology is developing so quickly that the required components are often not available on the market and have to be developed. One example: For laser cutting in the multi-kW range, upwards of 5 kW beam output a special autonomous cutting gas nozzle yields considerable advantages. This development by the ILT is already being marketed through a cooperation partner. As well as modern laser job shops, a shipyard is also using this gas nozzle head for cutting shipbuilding plates. Customers can have key components for laser-welding and laser-cutting applications developed directly by the Fraunhofer ILT. This includes the sensor technology and optimization of machining heads through adaptation of their optical design and flow behavior to the concrete requirements of the product to be manufactured by the customer.

Range of services

- Cutting and joining processes
- Surface treatment
- Hybrid techniques
- High-speed processing
- Design of processing nozzles and optical systems
- Sensor-based process monitoring and control
- Control technology
- Plant design
- Pilot facilities
- Modeling and simulation
- Multimedia training and information systems





Prototypes and series production - efficiency by laser!

Prototypes, small batches, complex structures, defined surfaces: Laser-based machining techniques conjure up a thousand and one possible applications which still belong to the future. The following applications are already reality today

Prototyping in the overtaking lane

With Selective Laser Melting technology, design engineers are overtaking conventional rapid prototyping techniques in the production of series-identical component properties
Thin layers of a commercially available powder material are applied evenly to a substrate plate, melted by lasers with pinpoint accuracy and metallurgically bonded to the base material. Layer by layer, lasers build up the component from the powder - in any required geometry and directly from the CAD model High component densities and the fact that no additional binder materials are required guarantee excellent mechanical properties Selective Laser Melting therefore makes it possible to quickly and cost-efficiently produce functional components in small numbers, and to manufacture series-production tools in record time. Such rapid manufacturing techniques can, for example, be applied in medical engineering and in ultra-lightweight construction, enabling companies to gain a development lead and to respond quickly and flexibly to customer needs

Seamless joining

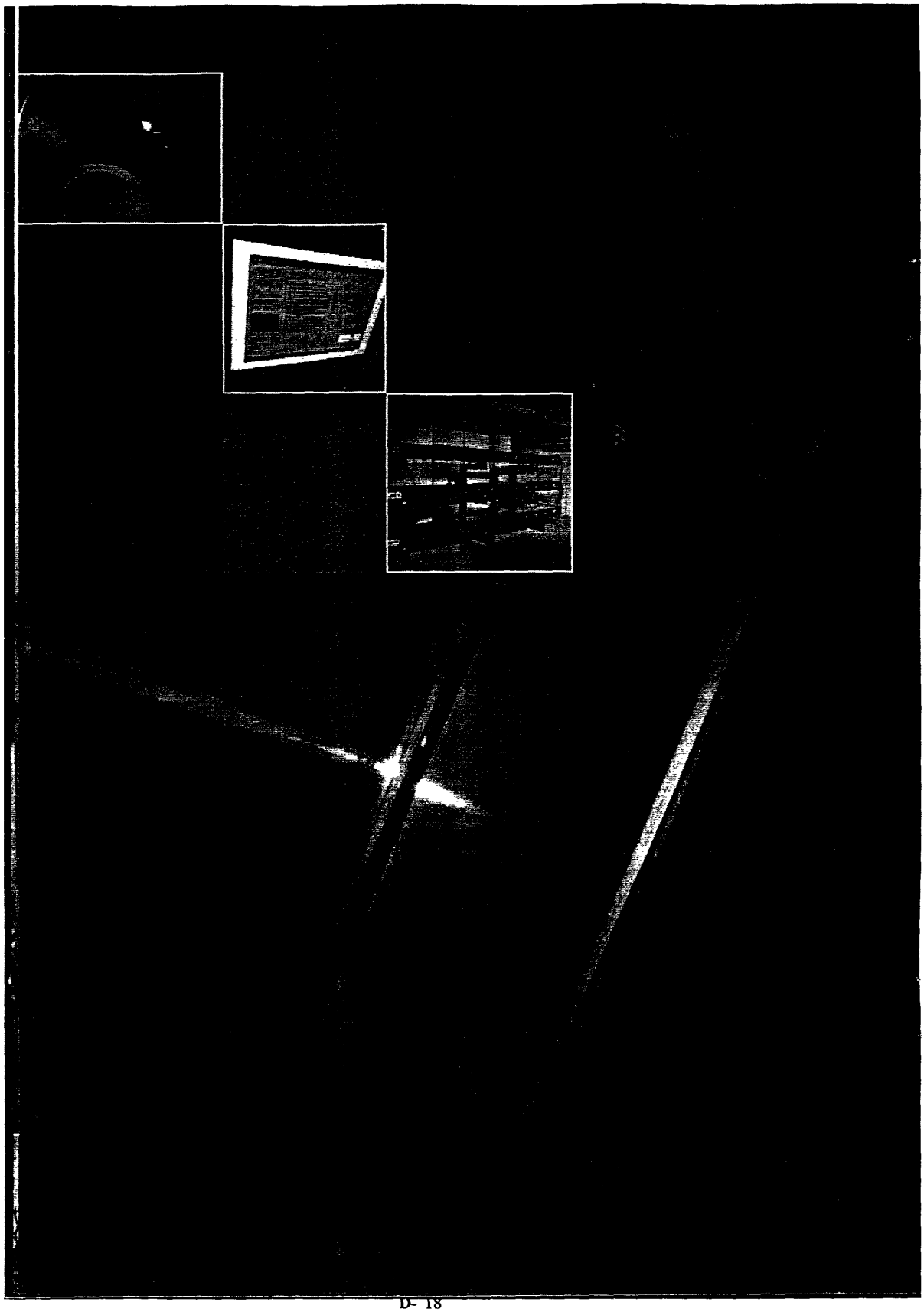
Lasers are an excellent tool for joining plastics, producing optical seams with no traces of a bead for high-quality design. The precise and focused working procedure does not cause any axial tolerances, and the software system enables new contours to be flexibly set To round things off, the pigmentation facility opens up the full spectrum of colors In short: where thermal loading and damage to electronic products by ultrasound processes are to be avoided, where higher demands on quality and flexibility have to be met, the Fraunhofer ILT is creating a new approach to plastic welding

Laser cleaning machines

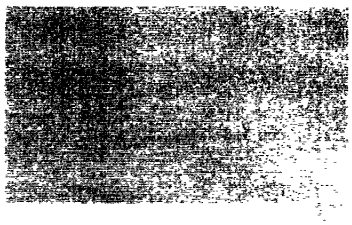
Problems removing rust and endless old coats of paint? Pulsed bundles of laser radiation can be used to remove the tiniest impurities as well as massive amounts of soil in a low-emission process The range of applications extends from microcomponents for the semiconductor and electronics industry through tools and moulds to pylons for power transmission lines Wherever layers have to be selectively and gently removed, lasers provide the speedy, environmentally friendly and highly efficient answer The same applies to another area of action: the polishing of complex shapes What used to take hours of manual work, the laser can polish off in seconds in the future The next development goals include techniques for polishing 3D geometries and for rendering structures according to geometrical specifications

Range of services

Cutting and perforation of paper, plastics and composite materials
Welding of thermoplastics and thermoplastic elastomers
Glass joining and scribing
Surface cleaning and modification such as deburring, polishing, activating and structuring
Rapid prototyping of metallic components and tools



Quality and precision - measuring and testing by laser!



Product quality is the necessary and natural requirement for product success. Laser technology is guaranteeing quality in more and more sectors - and new applications are coming on stream every day. Here are some examples.

Mapping defects in materials

The strength and effectiveness of metallic materials which are subject to extreme stresses and loadings are reduced in particular by oxide inclusions in the matrix. These inclusions can quickly lead to critical component failure, e.g. in steel-belted tires and valve springs. Precise and constantly monitored process control is therefore required in the production of high-purity steels. In a matter of minutes, the laser beam can produce a precise map of the steel surface on which 21 elements are depicted. Compared with conventional techniques for locally resolved material analysis, the testing time is reduced by a factor of 10-50, which makes it possible to introduce comprehensive inline process control Oxide inclusions in the material are detected and the input for optimized process control is provided in real time As a result, the manufacturer benefits from increased transparency and can guarantee customers consistent high quality.

No mix-ups

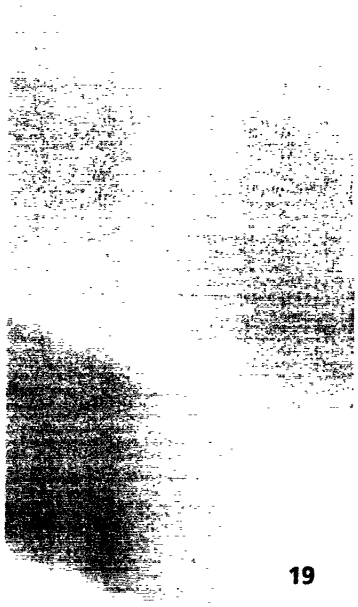
Elemental analysis in industrial production processes prevents component selection errors and also ensures constant high quality of manufacture. In just seconds, the laser testing system can recognize the concentration of nine different elements in pipe components. On the basis of reference data, intelligent software assigns the component to the product series and additionally checks the composition of the material. An inscription applied to the component directly after testing also guarantees its perfect quality to the customer.
The extremely rapid testing times allow measured data to be evaluated in real time and permit complete integration of the system in the production process, performing 100-percent checks.

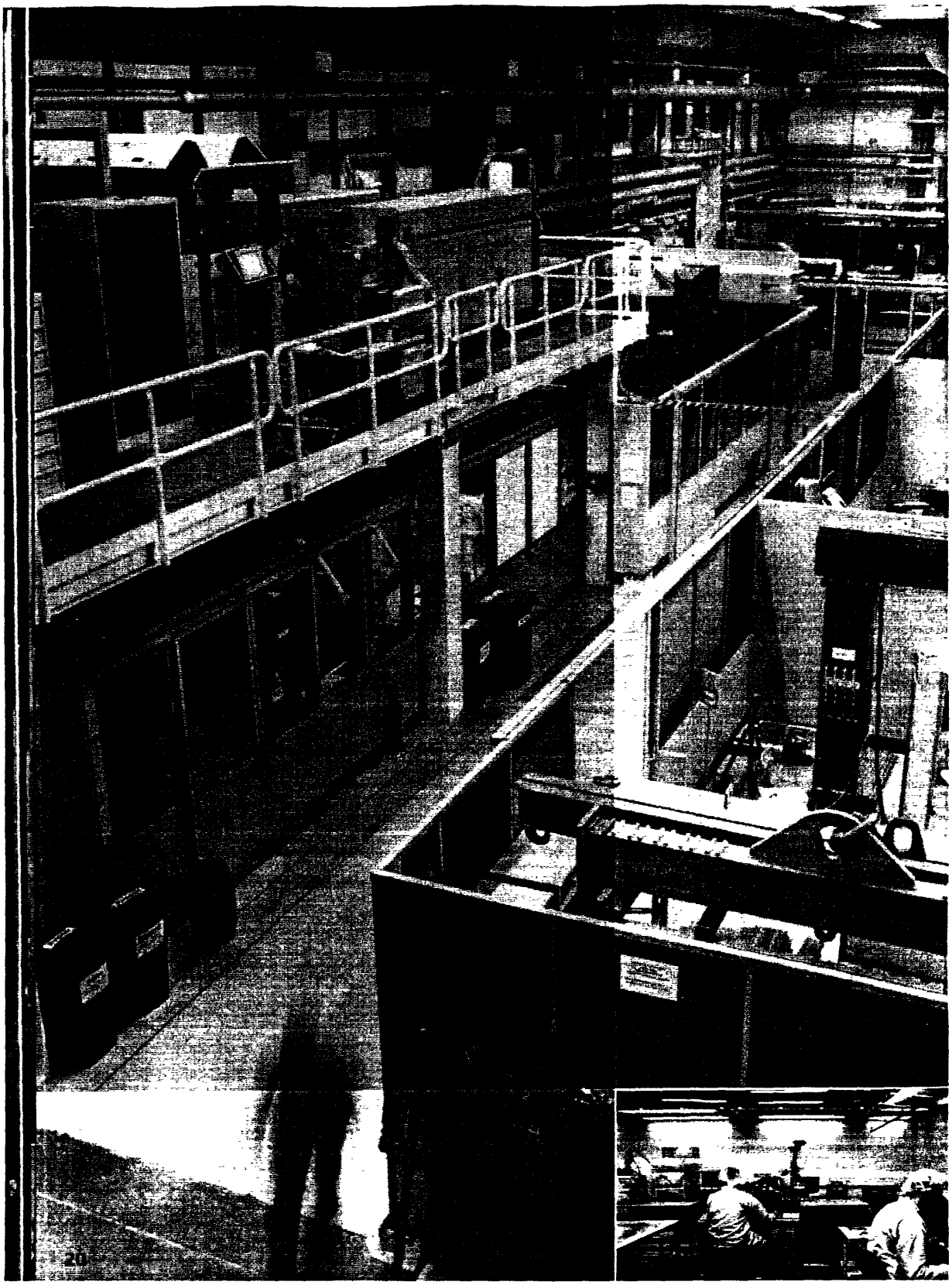
Lasers check surfaces in seconds

Producers of high-tech steel sheets are increasing product stability and efficiency by integrating laser-based measuring systems in the production process. Up to 100 times per second, 30 laser beams measure the surface of a sheet of steel at a temperature of 900°C The operating software visualizes, classifies and assesses any defects. An expert system decides whether and where the sheet can be used and in more than 95 percent of the cases comes to the same decision as the rolling-mill foreman
In future, measurement and production will converge even more closely, optimizing in-line surface engineering and creating new expertise in process control.

Range of services

Development of laser measuring and testing equipment
Chemical analysis of solid-, liquid- and gas-phase materials using laser spectroscopy
Fluorescence spectroscopy
Laser coordinate measurement machines
Surface inspection
Non-destructive testing procedures
Interferometric measurement techniques
Real-time data evaluation





Forms and scale of partnership

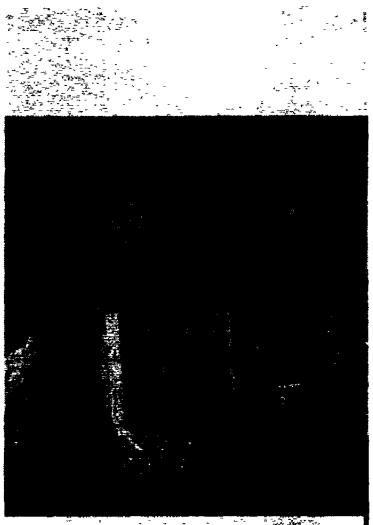
Partnership takes a variety of forms at the Fraunhofer ILT, from small-scale projects to wide collaborative ventures.

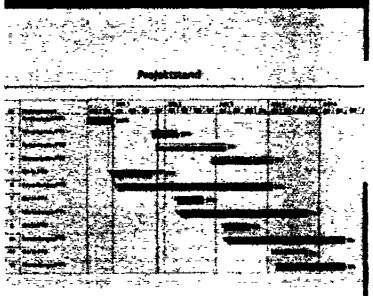
- Bilateral R&D projects tailored to suit the needs of your company, with and without public funding
- Participation in publicly funded joint projects
- Taking care of your test, pilot-scale and low-volume initial production requirements to ensure process safety and minimize start-up risk
- Establishing guest status for your company at the Fraunhofer ILT

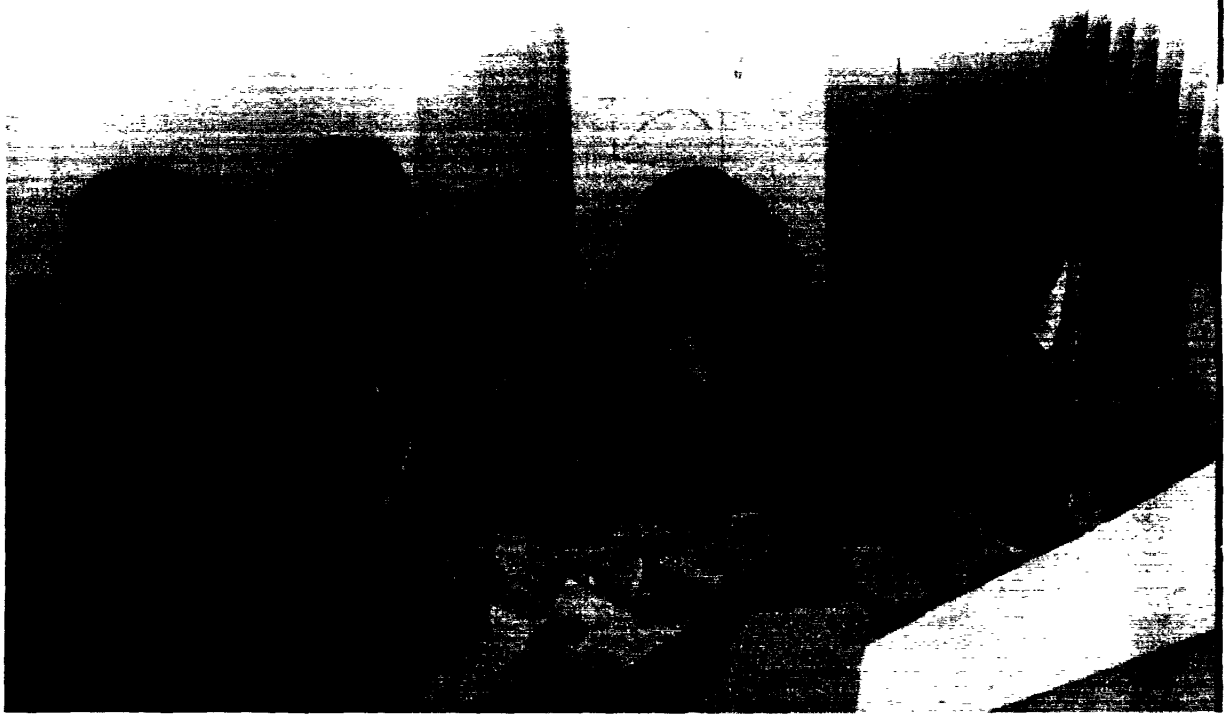
Our range of services includes:

- Development of laser and plasma beam sources
- Development of processes for laser material processing
- Control systems
- Process monitoring and control
- Beam guidance and forming
- Prototype and test series
- Development, installation and testing of pilot systems
- Development of laser measuring and testing systems
- Integration of laser systems into existing and planned production lines
- Training and development seminars and workshops
- Consulting

In each case, our partners can rely on a pool of specialists whose knowledge extends far beyond the purely technological: The Fraunhofer-Gesellschaft offers expertise and consultation on project management, international cooperation, patents, contract law, financing, and much more, all from a single source.







The network

The Fraunhofer ILT places you at the center of a multitude of knowledge networks.

First there is the Fraunhofer-Gesellschaft, the leader in applied research In over 50 Fraunhofer Institutes, products and processes are developed through to industrial maturity. Collaboration among the Institutes provides customers of the Fraunhofer-Gesellschaft access to a vast number of specialists covering a broad range of expertise. Common quality standards and professional project management ensure that all R&D contracts are led through to a successful conclusion Your contact coordinates the whole project and offers the adequate solution

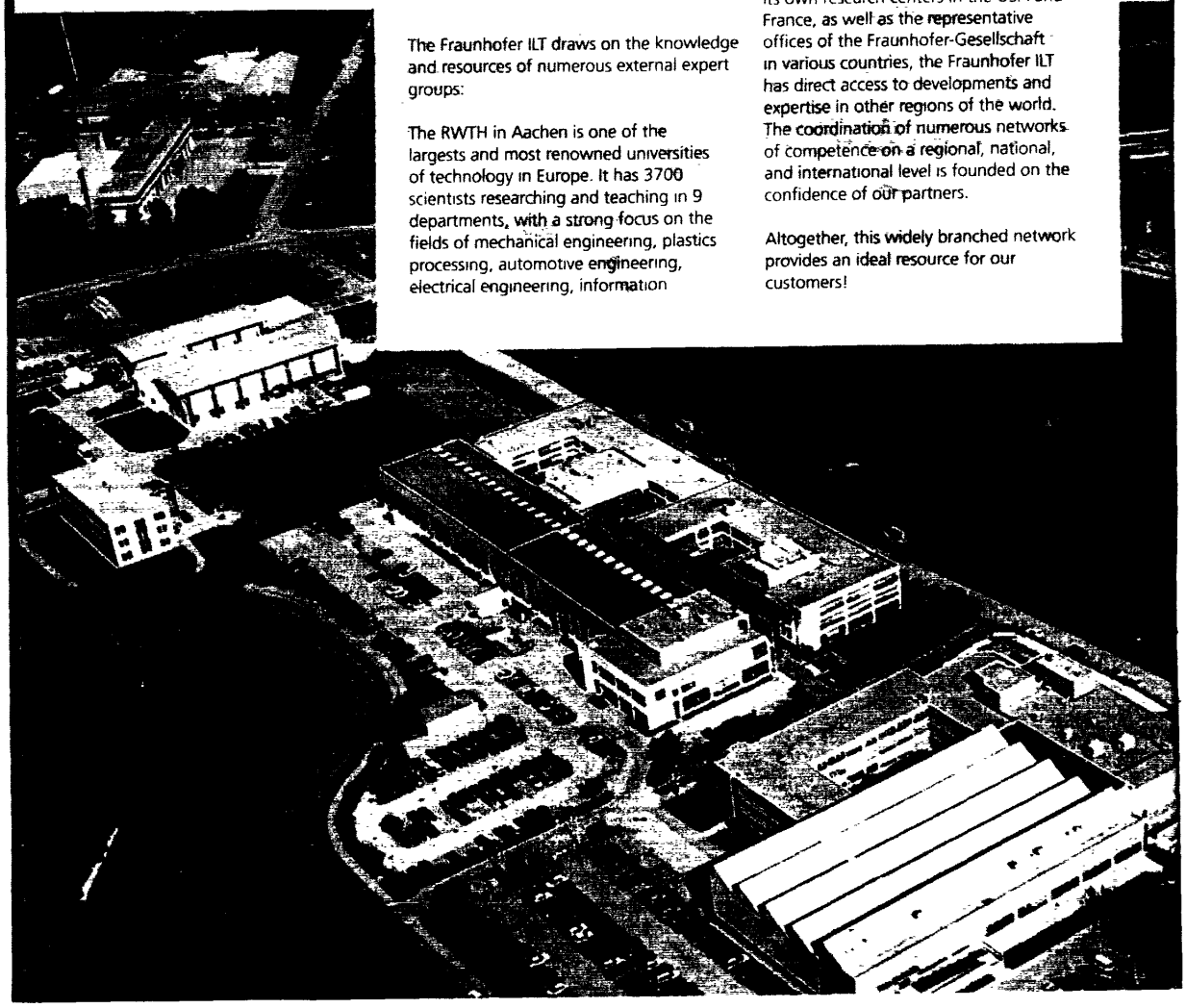
The Fraunhofer ILT draws on the knowledge and resources of numerous external expert groups:

The RWTH in Aachen is one of the largests and most renowned universities of technology in Europe. It has 3700 scientists researching and teaching in 9 departments, with a strong focus on the fields of mechanical engineering, plastics processing, automotive engineering, electrical engineering, information technology and medical engineering The university attracts the highest level of third-party funding in Germany and is privileged to host a large number of state-sponsored special research projects, EU-sponsored projects, multidisciplinary forums and graduate schools. Together with its close collaboration with independent scientific institutions and companies, all this serves to reinforce the university's interdisciplinary approach and practical orientation.

At an international level, the Fraunhofer ILT cooperates with numerous companies and R&D centers and is actively involved in collaborative European projects Through its own research centers in the USA and France, as well as the representative offices of the Fraunhofer-Gesellschaft in various countries, the Fraunhofer ILT has direct access to developments and expertise in other regions of the world. The coordination of numerous networks of competence on a regional, national, and international level is founded on the confidence of our partners.

Altogether, this widely branched network provides an ideal resource for our customers!

Fraunhofer Institute



Location

The city of Aachen boasts a research infrastructure that counts among the 10 most concentrated in the world Here, high-tech firms and the research departments of large multinational corporations transfer knowledge into practice and products.

Aachen has been voted one of the most business-friendly cities, thanks to its successful record of innovative business ideas converted into profitably marketable products Innovative ideas and personal initiative have enabled engineering studios and other small firms to evolve into major engineering companies in toolmaking and plant construction, computer and software companies, chemical engineering firms and retail trading companies Drawing on a highly qualified workforce, a favorable location, the European orientation and open cultural climate, as well as the beneficial energy and community policies, these companies have thrived in Aachen

A city with a tradition of hospitality, Aachen has a great deal to offer visitors - history, culture, joi de vivre - as illustrated by the hundreds of thousands of tourists who visit the city each year.

Plus, practically on the doorstep, the diversity and beauty of the surrounding countryside - the Eifel, the Ardennes, the fertile plains of the Netherlands, the River Maas, the river landscapes of the Ruhr valley, the Hohes Venn natural park extending across the German-Belgian border

An ideal environment for inspiring creative minds!

Fraunhofer Institut
Lasertechnik

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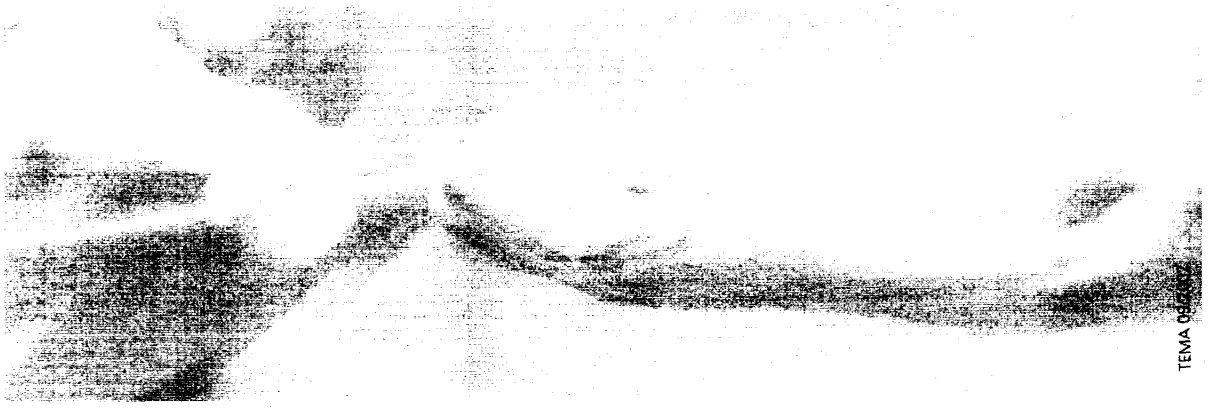

Fraunhofer Institut Lasertechnik

Angebot und Ansprechpartner

Services and contacts

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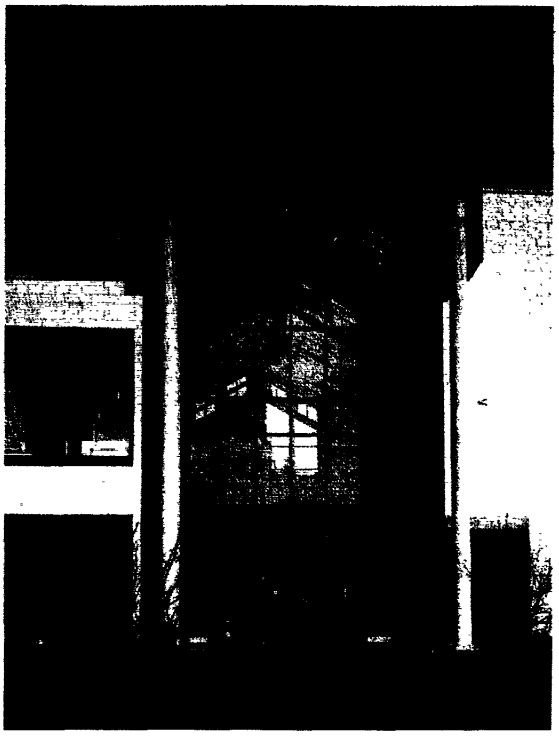

Das Institut im Profil

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Kurzportrait

ILT - dieses Kürzel steht seit über 15 Jahren für gebündeltes Know-how im Bereich Lasertechnik. Innovative Lösungen von Fertigungs- und Produktionsaufgaben, Entwicklung neuer technischer Komponenten, kompetente Beratung und Ausbildung, hochspezialisiertes Personal, neuester Stand der Technik sowie internationale Referenzen: dies sind die Garanten für langfristige Partnerschaften. Die zahlreichen Kunden des Fraunhofer-Instituts für Lasertechnik ILT stammen aus Branchen wie dem Automobil- und Maschinenbau, der Chemie und der Elektrotechnik, dem Stahlbau, der Feinmechanik und der Optik.

Mit über 230 Mitarbeitern und 10.000 m² Nutzfläche zählt das Fraunhofer-Institut für Lasertechnik ILT weltweit zu den bedeutendsten Auftragsforschungs- und Entwicklungsinstituten seines Fachgebietes. Die vier Geschäftsfelder des Fraunhofer ILT decken ein weites, vertikal integriertes Themenspektrum ab. Im Geschäftsfeld »Laser und Plasmastrahlquellen« konzentrieren sich die Entwicklungsaktivitäten auf innovative Dioden- und Festkörperlaser für den industriellen Einsatz sowie auf kompakte EUV-Strahlquellen für die Lithographie in der Halbleiterproduktion. Das Geschäftsfeld »Laserfertigungsverfahren« löst Aufgabenstellungen zum Schneiden, Abtragen, Bohren, Schweißen, Löten sowie zur Oberflächenbearbeitung und Mikrofertigung. Das Anwendungsspektrum reicht von der Makrobearbeitung über die Nanostrukturierung bis hin zur Biophotonik. Im Geschäftsfeld »Laseranlagen und Systemtechnik« werden Prototypanlagen entwickelt, konstruiert und vor Ort installiert. Prozessüberwachung und -regelung sind ebenso Bestandteil der Aktivitäten wie Steuerungen und Systemkomponenten. Im Geschäftsfeld »Lasermess- und Prüftechnik« werden Verfahren und Systeme zur Oberflächeninspektion, zur Stoffanalyse, zur Prüfung der Maßhaltigkeit und Geometrie von Bauteilen sowie zur Analyse statischer und dynamischer Verformungen entwickelt.

Unter einem Dach bietet das Fraunhofer-Institut für Lasertechnik Forschung und Entwicklung, Systemaufbau und Qualitätssicherung, Beratung und Ausbildung. Zur Bearbeitung der Forschungs- und Entwicklungsaufträge stehen industrielle Lasersysteme verschiedener Hersteller sowie eine umfangreiche Infrastruktur zur Verfügung.

Im Anwenderzentrum des Fraunhofer-Instituts für Lasertechnik arbeiten Gastfirmen in eigenen, abgetrennten Labors und Büroräumen. Grundlage für diese spezielle Form des Technologietransfers ist ein langfristiger Kooperationsvertrag mit dem Institut im Bereich der Forschung und Entwicklung. Der Mehrwert liegt in der Nutzung der technischen Infrastruktur und dem Informationsaustausch mit ILT-Experten. Bereits 10 Firmen nutzen die Vorteile des Anwenderzentrums. Neben Tochterfirmen führender Laserhersteller und innovativer Laseranwender finden hier Neugründer aus dem Bereich des Sonderanlagenbaus, der Laserfertigungstechnik und der Lasermesstechnik ein geeignetes Umfeld zur industriellen Umsetzung ihrer Ideen.

Profile of the institute

Short profile

ILT - for the last fifteen years, this abbreviation has stood for extensive know-how in laser technology. Innovative solutions for manufacturing and production problems, development of new technical components, competent advice and training, highly-qualified personnel, the latest technologies and an international reputation. these are the guarantors for long-term business relations The numerous customers of the Fraunhofer Institute for Laser Technology ILT belong to various sectors like automobile industry, mechanical engineering, chemical and electrical engineering, steel construction, precision mechanics and optics.

With more than 230 employees and 10 000 m² of usable floor space the Fraunhofer Institute for Laser Technology is world-wide one of the most important development and contract research institutes of its specific field. The four business areas cover a wide range of actual and vertical integrated topics In the business area »laser and plasma sources« development activities are concentrated on innovative diode and solid state lasers for industrial use as well as compact EUV-sources for lithographic use in semiconductor production. The business area »laser material processing« offers solutions in cutting, ablation, drilling, welding, soldering, surface treatment and micro processing The activities cover a wide range of applications from macro processing via nano structuring to biophotonics.

In the business area »laser plant and system technology« prototypes are developed, built up and installed on site. Process monitoring and control as well as system components and control software are part of the activities. In the business area »laser measurement and testing technology« processes and systems for inspection of surfaces, for chemical analysis, for testing the accuracy of dimensions and geometry of workpieces as well as for analysis of static and dynamic deformations are developed

The comprehensive offer of services of the Fraunhofer Institute for Laser Technology ranges from research and development as well as system construction and quality assurance to advice and training. Industrial laser systems from various manufacturers as well as an extensive infrastructure are available for the work on research and development projects

In the Laser User Centre of the Fraunhofer Institute for Laser Technology guest companies work in their own separated laboratories and offices The basis of this special form of technology transfer is a long-term cooperation agreement with the institute in the field of research and development The surplus value lies in the use of the technical infrastructure and in the information exchange with ILT's experts Already 10 companies profit from the advantages of the Laser User Centre Besides subsidiaries of leading laser manufacturers and innovative laser users, new entrepreneurs from the areas of special machine production, laser processing and laser measurement find a suitable frame to realize their ideas on an industrial scale

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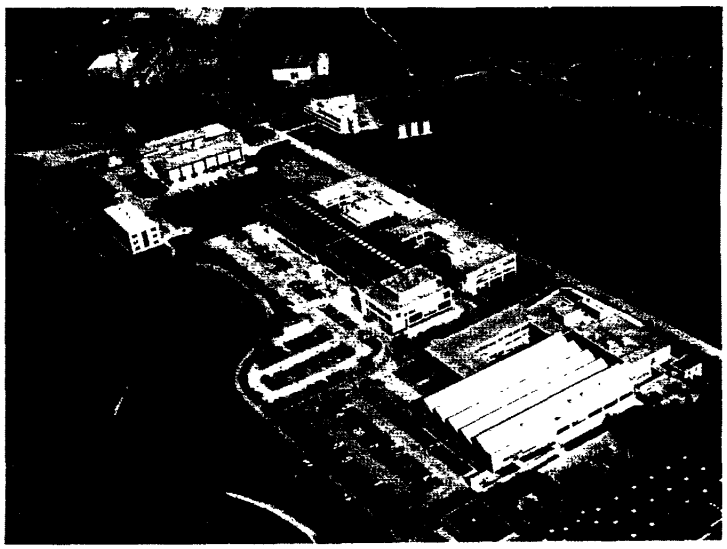
Dipl.-Ing. Martin Jochum



Ansprechpartner
Contacts

Ansprechpartner

Das Fraunhofer-Institut fur Lasertechnik gliedert sich in 9 Fachabteilungen mit entsprechenden Kernkompetenzen. Für Laserhersteller und -anwender werden neue Laserstrahlquellen und -komponenten entwickelt und bestehende Lasersysteme optimiert Darüber hinaus werden Gerate zur Mess- und Prüftechnik geplant, konstruiert und beim Anwender installiert Die Entwicklung von Plasmastrahlquellen und den entsprechenden peripheren Komponenten zahlt ebenfalls zu den Arbeitsschwerpunkten

Im Bereich Lasermaterialbearbeitung umfassen die Kernkompetenzen Verfahrens- und Anlagen-Know-how zum Fügen (Loten und Schweißen verschiedener Materialien), Trennen (Schneiden, Bohren, Abtragen) und Oberflächenbearbeiten (Legieren, Harten, Umschmelzen, Dispergieren, Strukturieren, Rapid Prototyping und Reinigen) In der Mikrotechnik werden verschiedene Verfahren wie das Laserbohren, -schweißen, -loten, -biegen, -trimmen und -beschichten entwickelt, die hauptsächlich in der Elektronikbranche und der Feinmechanik eingesetzt werden Weiterhin werden Verfahren für die Analytik, die Medizintechnik und die Biotechnik maßgeschneidert Die Abteilung Systemtechnik befasst sich mit der Planung, der Entwicklung und der Installation kompletter Laseranlagen sowie mit Steuerungstechnik und Prozesskontrolle

Im folgenden Organigramm sind die Abteilungen und die jeweiligen Ansprechpartner des Fraunhofer-Instituts fur Lasertechnik aufgefunrt

Contacts

The Fraunhofer Institute for Laser Technology is divided into 9 technical departments with corresponding areas of competence For laser manufacturers and users new laser sources and components are developed and already existing laser systems optimized. In addition, measurement and testing devices are designed, constructed and installed at the user's site The main fields of work also include the development of plasma sources and the corresponding components

The areas of competence in laser material processing include process and system know-how for joining (soldering and welding of various materials), cutting, drilling, ablation and surface treatment (alloying, hardening, remelting, dispersing, structuring, rapid prototyping and cleaning) In the department of micro technology processes are developed that are mainly used in electronics and fine mechanics such as laser drilling, soldering, welding, forming, trimming and coating Also processes are tailored for use in analytics, medical- and biotechnologies. The department of system technology deals with the design, the development and the installation of complete laser plants, with control technology for laser machines and with process control.

The departments and the contacts of the Fraunhofer Institute for Laser Technology are listed in the following organization chart

Institutsleitung / *direction*

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Organigramm / *organization chart*

Institutsleitung/*Management*
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Stellvertretender Leiter/*Vice-director*: Dr. rer. nat. Peter Loosen

IT-Management
Dr. Bruno Weikl

Marketing und Kommunikation
Marketing and communications
Dipl.-Phys. Axel Bauer

Qualitätsmanagement
Quality management
Dr. Alexander Drenker

Verwaltung/*Administration*
Dipl.-Ing. Wolfgang Oesterling

Laser-Komponenten
Laser components
Dr. Konstantin Boucke

Festkörper- und Diodenlaser
Solid state and diode lasers
Dipl.-Ing. Dieter Hoffmann

Plasmatechnologie
Plasma technology
Dr. Willi Neff

Trenn- und Fügeverfahren
Cutting and Joining
Dr. Dirk Petring

Oberflächentechnik
Surface treatment
Dr. Konrad Wissenbach

Mikrotechnik
Micro technology
Dr. Arnold Gillner

Systemtechnik
System technology
Dr. Stefan Kaierle

Lasermess- und Prüftechnik
Laser measurement technology
Dr. Reinhard Noll

Modellierung und Simulation
Modelling and simulation
Dr. Wolfgang Schulz

Fraunhofer Center for Laser Technology
CLT, Plymouth, USA
Dr. Stefan Heinemann

Deutsch-Französische Kooperation
French-German cooperation
CLFA, Paris, France
Dr. Wolfgang Knapp

Dienstleistungsangebot

Dienstleistungen

Das Dienstleistungsangebot des Fraunhofer-Instituts für Lasertechnik ILT wird ständig den Erfordernissen der industriellen Praxis angepasst und reicht von der Lösung fertigungstechnischer Problemstellungen bis hin zur Durchführung von Testserien. Im einzelnen umfasst das Angebot

- Laserentwicklung
- Fertigungs- und Montagetechnik
- Pulsnetzteile und Steuerungstechnik
- Strahlführung und -formung
- Entwicklung, Aufbau und Test von Pilotanlagen
- Verfahrensentwicklung
- Modellierung und Simulation
- Prozessüberwachung und -regelung
- Muster- und Testserien
- Integration von Lasertechnik in bestehende Produktionsanlagen
- Röntgen-, EUV- und Plasmasysteme

Kooperationen mit FuE-Partnern

Die Kooperation des Fraunhofer-Instituts für Lasertechnik ILT mit FuE-Partnern kann verschiedene Formen annehmen:

- Durchführung von bilateralen, firmenspezifischen FuE-Projekten mit und ohne öffentliche Unterstützung (Werkvertrag)
- Beteiligung von Firmen an öffentlich geförderten Verbundprojekten (Mitfinanzierungsvertrag)
- Übernahme von Test-, Null- und Vorserienproduktion durch das Fraunhofer ILT zur Ermittlung der Verfahrenssicherheit und zur Minimierung des Anlaufrisikos (Werkvertrag)
- Firmen mit Gaststatus am Fraunhofer ILT (spezielle Kooperationsverträge)

Durch Zusammenarbeit mit anderen Forschungseinrichtungen und spezialisierten Unternehmen bietet das Fraunhofer-Institut für Lasertechnik auch bei fachübergreifenden Aufgabenstellungen Problemlösungen aus einer Hand. Ein besonderer Vorteil ist in diesem Zusammenhang der direkte Zugriff auf die umfangreichen Ressourcen der Fraunhofer-Gesellschaft.

Während der Einführungsphase neuer Laserverfahren oder -produkte können Unternehmen Gaststatus am Fraunhofer-Institut für Lasertechnik erwerben und Geräteausstattung, Infrastruktur und Know-how des Instituts nutzen sowie eigene Geräte installieren.

Ausstattung

Die Nutzflächen des Fraunhofer-Instituts für Lasertechnik ILT betragen über 10 000 m².

Technische Infrastruktur

Zur technischen Infrastruktur des Instituts gehören eine mechanische und eine elektronische Werkstatt, ein Metallographielabor, ein Fotolabor, ein Labor für optische Messtechnik sowie eine Konstruktionsabteilung. Das Fraunhofer ILT verfügt über einen Videokonferenzraum und ein vernetztes Rechnersystem.

Wissenschaftliche Infrastruktur

Zur wissenschaftlichen Infrastruktur zählen u. a. eine mit internationaler Literatur bestückte Bibliothek, Literatur- und Patentdatenbanken sowie Programme zur Berechnung wissenschaftlicher Fragestellungen und Datenbanken zur Prozessdokumentation.

Geräteausstattung

Die Geräteausstattung des Fraunhofer-Instituts für Lasertechnik ILT wird ständig auf dem Stand der Technik gehalten. Sie umfasst derzeit als wesentliche Komponenten:

- CO_2-Laser bis 20 kW
- Nd:YAG-Laser bis 5 kW
- Diodenlasersysteme bis 3 kW
- Diodengepumpte Festkörperlaser bis 5 kW
- Excimerlaser
- Faserlaser
- Fünfachsige Portalanlagen
- Dreiachsige Bearbeitungsstationen
- Strahlführungssysteme
- Robotersysteme
- Sensoren zur Prozessüberwachung für die Lasermaterialbearbeitung
- Direct-writing- und Laser-PVD-Stationen
- Reinräume zur Montage von Diodenlasern, Diodenlasersystemen und diodengepumpten Festkörperlasern
- Geräte zur Verfahrens- und Prozessdiagnostik sowie zur Hochgeschwindigkeits-Prozessanalyse
- Laser-Spektroskopie-Systeme zur chemischen Analyse fester, flüssiger und gasförmiger Stoffe
- Lasertriangulationssensoren zur Abstands- und Konturvermessung
- Laser-Koordinatenmessmaschine
- Einrichtungen zur holographischen Schwingungsanalyse und Speckle-Interferometrie

Services

The services of the Fraunhofer Institute for Laser Technology ILT are continually being adapted to the practical requirements of industry and include the solution of manufacturing problems as well as the realization of test series. In detail this means:

- *laser development*
- *manufacturing and assembling technology*
- *pulsed power supplies and control technology*
- *beam guiding and forming*
- *development, set-up and testing of pilot plants*
- *process development*
- *modelling and simulation*
- *process monitoring and control*
- *model and test series*
- *integration of laser technology into already existing production plants*
- *X-ray, EUV- and plasma systems*

Cooperations with R&D-partners

The Fraunhofer Institute for Laser Technology ILT is cooperating with R&D-partners in different ways.

- *Realization of bilateral, company specific R&D-projects with and without public support (contract for work and services)*
- *participation of companies in public-funded cooperative projects (cofinancing contract)*
- *Production of test, pilot and prototype series by Fraunhofer ILT to determine the reliability of the process and minimize the starting risk (contract for work and services)*
- *companies with guest status at Fraunhofer ILT (special cooperation contracts)*

By means of cooperation with other research organizations and specialized companies the Fraunhofer Institute for Laser Technology offers solutions even in the case of interdisciplinary tasks. A special advantage hereby consists in the direct access to the large resources of the Fraunhofer Society.

During the implementation phase of new laser processes and products, companies can acquire 'guest status' at the Fraunhofer Institute for Laser Technology and use the equipment, infrastructure and know-how of the institute as well as install their own systems.

Facilities

The usable floor space at the Fraunhofer Institute for Laser Technology amounts to more than 10,000 m².

Technical infrastructure
The technical infrastructure of the institute includes a mechanical and electronic workshop, a metallurgic laboratory, a photographic laboratory, a laboratory for optical metrology as well as a department for design and construction. The Fraunhofer ILT also has a video conference room and a computer network.

Scientific infrastructure
The scientific infrastructure includes a library with international literature, patent and literature data bases as well as programmes for calculation of scientific problems and data bases for process documentation.

Equipment
The equipment of the Fraunhofer Institute for Laser Technology ILT is permanently being adapted to the state-of-the-art. At present, essential components are:

- *CO_2-lasers up to 20 kW*
- *Nd:YAG-lasers up to 5 kW*
- *diode laser systems up to 3 kW*
- *diode-pumped solid state lasers up to 5 kW*
- *excimer lasers*
- *fibre lasers*
- *five-axis gantry systems*
- *three-axis processing stations*
- *beam guiding systems*
- *robot systems*
- *sensors for process control in laser material processing*
- *direct-writing and laser-PVD stations*
- *clean rooms for assembly of diode lasers, diode laser systems and diode pumped solid state lasers*
- *devices for process diagnostics and high speed video analysis*
- *laser spectroscopic systems for the chemical analysis of solid, liquid and gaseous materials*
- *laser triangulation sensors for distance and contour measurement*
- *laser coordinate measuring machine*
- *devices for holographic vibration analysis and speckle interferometry*

Laserkomponenten
Laser components

Kurzportrait

Die Abteilung Laserkomponenten befasst sich mit der Kühlung, Konfektionierung und Charakterisierung von Hochleistungs-Diodenlasern. Dabei werden insbesondere die bei der Herstellung und Charakterisierung verwendeten Anlage- und Gerätetechniken sowie die der Konfektionierung zugrunde liegenden Lotprozesse optimiert. Präzisionsanlagen zur Montage von mikro-optischen Systemen werden ebenfalls untersucht. Die Automatisierung einzelner Montage- und Charakterisierungsmethoden bildet einen besonderen Schwerpunkt.

Zu den Kompetenzen zählt die Modellierung grundlegend neuer Diodenlaserstrukturen. Hierbei stehen eine verbesserte Strahlqualität und eine erhöhte Temperaturstabilität der Diodenlaserbarren im Vordergrund.

Die Abteilung Laserkomponenten bietet im wesentlichen die Entwicklung kundenspezifischer Hochleistungs-Diodenlaser an. Dabei können sowohl die Kühltechniken, als auch die elektro-optischen Eigenschaften der Diodenlaser den kundenspezifischen Anforderungen angepasst werden. Zur Qualifizierung können Kleinserien hergestellt werden. Die Charakterisierung von Hochleistungs-Diodenlasern inklusive High-Power-Tests wird als Dienstleistung angeboten. Darüber hinaus werden komplette Montage- und Charakterisierungsanlagen entwickelt und hergestellt. Zu den Kunden der Abteilung Laserkomponenten zählen führende Diodenlasernersteller und -anwender.

Short description

The department of laser components deals mainly with the cooling, mounting and characterization of high power diode lasers. Mounting processes are improved and characterization techniques are optimized. Fabrication and characterization tools for diode lasers are developed as well as precision machines for the mounting of micro-optical systems. The automation of these mounting and characterization techniques is of special interest.

Furthermore, the department deals with the simulation of new diode laser structures. Improved beam quality and higher temperature stability are in the focus of these investigations.

The department of laser components offers the development of customer specified high power diode lasers. The design of the diode laser bar as well as the design of the active or passive cooler and the packaging can be adapted to the special needs of the customers. For qualification, the production of small series is possible. The characterization of high power diode lasers inclusive high power tests are offered as service. Complete mounting and testing apparatus are developed. The customers of the department of laser components include leading diode laser manufacturers and diode laser users.

Ihr Ansprechpartner / *Contact*

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Kernkompetenzen

- Aktive und passive Kühlung von Diodenlasern
- Konfektionierung von Diodenlasern
- Elektro-optische Charakterisierung von Diodenlasern
- Theoretische Modellierung neuer Diodenlaserstrukturen
- Mikromontageprozesse
- Automatisierung von Mikromontageprozessen

Core areas

- *active and passive cooling of diode lasers*
- *mounting of diode laser bars*
- *electro-optical characterization of diode lasers*
- *simulation of new diode laser structures*
- *micromachining techniques*
- *automation of micromachining techniques*

Festkörper- und Diodenlaser
Solid state and diode lasers

Kurzportrait

In der Abteilung Festkörper- und Diodenlaser werden Festkörperlaser für industrielle Anwendungen und Forschung entwickelt, die auf Hochleistungsdiodenlaser basieren. Hierzu zählen Festkörperlaser mit Leistungen von einigen Watt bis 5 kW, gütegeschaltete Festkörperlaser mit Pulsenergien von einigen µJ bis 100 mJ bei einer Pulswiederholrate von einigen 100 Hz bis 100 kHz, ps- und fs-Festkörperlaser, durchstimmbare Laser sowie frequenzkonvertierte VIS/UV-Festkörperlaser bis 100 W. Weiterhin befasst sich die Abteilung mit adressierbaren Diodenlasern, mikrooptischen Komponenten, mit Strahlformung, Faserkopplung und Charakterisierung von Diodenlasern sowie mit kundenspezifischem Design und Bau von Diodenlasermodulen und -systemen.

Die Highlights der Abteilung umfassen die Entwicklung von Verfahren zur Wellenlängen- und Polarisationskopplung, den Messaufbau zur Charakterisierung von Diodenlaserstacks sowie die Entwicklung von fasergekoppelten Diodenlasermodulen hoher Brillanz. Diese werden eingesetzt in der Drucktechnik sowie zum Mikroschweißen und Mikroloten. Highlights im Bereich diodengepumpter Festkörperlaser sind u. a. Slablaser für die Präzisionsbearbeitung sowie als Verstärker für Laser-Displays, gepulste Hochenergielaser zur Erzeugung von EUV-Strahlung sowie gütegeschaltete Laser für die Reinigungstechnik und die Bearbeitung dielektrischer Materialien. Zu den Kunden der Abteilung zählen führende Laserhersteller, Zulieferer optischer Komponenten sowie Endanwender aus verschiedenen Industriesektoren. Hierzu zählen unter anderem die Druckindustrie, die Display produzierende Industrie, die Telekommunikation, die Medizin, die metall- und kunststoffverarbeitende Industrie, die Automobilindustrie sowie die Elektronikindustrie.

Short description

Solid state lasers based on high power diode lasers for industrial use and research activities are being developed in the department of solid state and diode lasers. These comprise diode-pumped solid state lasers with up to 5 kW power, q-switched solid state lasers with pulse energy of µJ up to 100 mJ and frequency of 100 Hz up to 100 kHz, ps- and fs-solid state lasers, tunable lasers as well as frequency converted VIS/UV-solid state lasers with up to 100 W power. Furthermore the department deals with the development of addressable diode lasers and micro-optical components as well as beam forming, fibre coupling, characterization of diode lasers and customer sized design and construction of diode laser modules and systems.

The highlights of the department include the development of concepts for wavelength and polarization coupling, characterization of diode laser stacks as well as the development of fibre coupled diode laser modules with high beam quality. These diode lasers are used in the printing industry as well as for micro-welding and micro-soldering. In the field of diode pumped solid state lasers highlights are among others slab lasers for precision material processing as well as amplifier for laser displays, pulsed high energy lasers for generation of EUV-beams and q-switched lasers for cleaning and processing of dielectric materials. The customers of the department are leading laser manufacturers, suppliers of optical components as well as users from different industrial areas. These include printing industry, display manufacturing industry, telecommunications, medicine, metal and plastics processing industry, automotive industry and electronic industry.

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Kernkompetenzen

- Entwicklung von Festkörper- und Diodenlasern
- Verfahren und Komponenten zur Frequenzkonversion
- Formung von Diodenlaserstrahlen
- Entwicklung von Diodenlasermodulen und -systemen
- Design und Charakterisierung von mikrooptischen Komponenten
- Entwicklung von Komponenten für Festkörper- und Diodenlaser

Core areas

- *development of solid state and diode lasers*
- *methods and components for frequency doubling*
- *forming of diode laser beams*
- *development of diode laser modules and systems*
- *design and characterization of micro-optical components*
- *development of components for solid state and diode lasers*

Lasermess- und Prüftechnik
Laser measurement and testing technology

Kurzportrait

Die Abteilung Lasermess- und Prüftechnik befasst sich mit der Lösung messtechnischer Aufgaben aus Industrie und Umwelttechnik. Der Laser ermöglicht die Messung physikalischer und chemischer Größen mit hoher Geschwindigkeit und Präzision. Die berührungsfreie Messung ist prädestiniert für Online-Prüfaufgaben in Fertigungs- und Prozesslinien. Die Arbeitsschwerpunkte der Abteilung sind: die chemische Analyse von Substanzen mit Laser-Spektroskopie; die Überprüfung der Maßhaltigkeit und Geometrie von Werkstücken, Halbzeugen und Produkten; die Inspektion von Oberflächen sowie Auswerteverfahren für die automatische Analyse und Bewertung von Messdaten. Im Bereich von Biophotonik werden fluoreszenzspektroskopische Verfahren zur Untersuchung von Protein-Protein Wechselwirkungen und für die Einzelmolekuldetektion entwickelt.

Zu den Entwicklungen der Abteilung zählen kundenspezifische Online-Prüfsysteme, die in die Prozess- oder Produktionslinie integriert werden. Damit werden prozessrelevante Größen frühzeitig bestimmt und sind so direkt für Optimierungsaufgaben nutzbar. Die Automation der Prüfabläufe ist dabei unverzichtbar.

Die Leistungen der Abteilung reichen von den Grundlagen neuer Lasermessverfahren, der Erschließung neuer Anwendungsfelder bis zu Entwicklung und Bau kundenspezifischer Prüfgeräte und -maschinen. In Praxis-Workshops informieren wir potentielle Anwender über die Einsatzmöglichkeiten der Lasermesstechnik anhand von Beispielen industrieller Routineapplikationen. Unsere Kunden kommen u. a. aus der Metall- und Kunststoffverarbeitung, der Metallerzeugung, der pharmazeutischen Industrie, der Automobilindustrie und der Umwelttechnik.

Short description

The department of laser measurement and testing technologies deals with solutions for measurement problems in the field of industry and environment. By means of laser measurement technology it is possible to determine physical and chemical data with high speed and precision. The non-contact measurement is suitable for on-line testing in production and process lines. The main fields of work include: the chemical analysis of substances with laser spectroscopy; the testing of the accuracy of dimensions and the geometry of workpieces, semifinished material and products, the inspection of surfaces as well as evaluation processes for the automatic analysis and assessment of measurement data. In the field of biophotonics fluorescence spectroscopic methods to investigate protein-protein interactions and to detect single molecules are developed.

The department develops customer specific on-line testing systems which are integrated into the production line. Thus process relevant data are directly determined and are available for optimization. The automation of testing cycles is indispensable.

The services of the department comprise the basics of new laser measurement techniques, the opening of new fields of application as well as the development and the construction of customer specific testing devices and machines. In practical orientated training courses potential users are informed about the operational possibilities of laser measurement technology by means of industrial standard applications. Our customers belong, among others, to the metal and plastics industry, pharmaceutical industry, automotive industry and environmental technology.

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Kernkompetenzen

- Entwicklung, Bau und Erprobung von Lasermess- und Prüfsystemen
- Chemische Analyse von festen, flüssigen und gasförmigen Substanzen mit Laser-Spektroskopie
- Fluoreszenz-Spektroskopie
- Laser-Koordinatenmesssysteme
- Oberflächeninspektion
- Zerstörungsfreie Prüfverfahren
- Interferometrische Messverfahren
- Echtzeitdatenverarbeitung und Automation

Core areas

- *development, construction and testing of laser measurement and testing equipment*
- *chemical analysis of solid, liquid and gaseous substances with laser spectroscopy*
- *fluorescence spectroscopy*
- *laser coordinate measurement machines*
- *inspection of surfaces*
- *non-destructive test procedures*
- *interferometric measurement*
- *real time operation and automation*

Plasmatechnologie
Plasma technology

Kurzportrait

In der Abteilung Plasmatechnologie werden für die industrielle Oberflächenbehandlung Plasmaverfahren entwickelt, die einen kontinuierlichen Durchlauf in offenen Aufbauten ohne Vakuumsystem ermöglichen. Dazu werden Barrierenentladungen untersucht, die sich als Atmosphärendruckplasmen im direkten Oberflächenkontakt befinden. Je nach Anpassung der Wirkmechanismen wie UV-Licht, Elektronen und chemische Radikale sind sie zum Abtragen dünnster organischer Verunreinigungen, zur Sterilisation, zur Funktionalisierung von Kunststoffoberflächen oder zur Beeinflussung des Oxidationszustandes metallischer Oberflächen geeignet. Ein weiteres Anwendungsfeld der Barrierenentladung ist die plasmachemische Abgasreinigung in der Automobilindustrie und der Energiewirtschaft. Hier haben hohe Wirkungsgrade und kostengünstige Lösungen eine besondere Bedeutung.

Daneben beschäftigt sich die Abteilung mit gepulsten Hochleistungsplasmen. Diese werden zur Erzeugung kurzwelliger elektromagnetischer Strahlung im Bereich des extremen UV und der weichen Röntgenstrahlung eingesetzt. Die Strahlung eignet sich in Kombination mit röntgenoptischen Komponenten wie Linsen, Spiegeln und Detektoren sowohl zur Strukturerzeugung im sub-µm Bereich in der EUV-Lithographie als auch zur Oberflächenanalytik mit hoher Orts- und Zeitauflösung.

Short description

The department of plasma technology develops plasma processes for industrial surface treatment that enable the use of open systems without vacuum chamber and a continuous production flow. Therefore barrier discharges that are as atmospheric pressure plasmas in direct contact with surfaces are being analysed. Depending on the adaptation of effects like UV-radiation, electron beams and chemical radicals these barrier discharges can be used for the removal of the thinnest organic contaminations, for sterilisation, for functionalisation of plastic surfaces or for influencing the oxidation of metallic surfaces. A further field of application is the secondary treatment of exhaust by using plasma chemistry for the automotive and the energy industry. High efficiency and low cost solutions have special significance in these sectors.

In addition the department works on pulsed high power plasmas used for generation of short wave electromagnetic radiation in the field of extreme UV- or X-rays. The radiation combined with X-ray optical components like lenses, mirrors and detectors are well suited for the production of structures in the sub-µm range in EUV-lithography as well as for the analysis of surfaces with high local and temporal resolution.

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Kernkompetenzen

- Anregungssysteme für die Plasmatechnik
- Nieder- und Hochdruckplasmen für Reinigungsverfahren und Sterilisation
- Plasmabasierte EUV- und Röntgenquellen sowie Röntgentechnik
- Kurzzeitmesstechnik
- Photo- und Plasmachemie

Core areas

- *excitation systems for plasma technology*
- *low and high pressure plasmas for cleaning processes and sterilisation*
- *plasma based EUV and soft X-ray sources as well as X-ray technology*
- *short time measurement techniques*
- *photo and plasma chemistry*

Kurzportrait

In der industriellen Fertigung werden Laser bereits seit über 20 Jahren für die unterschiedlichsten Trenn- und Fügeverfahren eingesetzt. Die Abteilung befasst sich mit der Entwicklung von Extremverfahren, die weit über den aktuellen Stand der Technik hinausgehen. Im Bereich des Trennens zählen hierzu u. a. das Hochgeschwindigkeitsschneiden sowie das, im Bedarfsfall oxidfreie, Trennen von dickwandigen Bauteilen aus Stahl und Aluminium. Darüber hinaus führt die Abteilung kundenspezifische Machbarkeitsstudien durch und befasst sich mit der Anpassung, Optimierung und Automatisierung bereits existierender Verfahren und Anlagen. Neben dem Schneiden und Bohren verschiedenster Materialien zählt das Abtragen zu den Arbeitsschwerpunkten der Abteilung.

Im Bereich des Trennens kommen die industriellen Auftraggeber größtenteils aus den Sektoren Metallbearbeitung, Maschinen- und Automobilbau, Anlagen- und Behälterbau sowie Kunststofftechnik. Einerseits werden die Verfahren an die speziellen Bedürfnisse der Auftraggeber angepasst, andererseits plant, konstruiert und installiert die Abteilung komplette Laseranlagen. Zu den Highlights der Abteilung zählen die Verfahrens- und Anlagenentwicklung zum Laserstrahllängsteilen dünner Bleche mit Geschwindigkeiten über 100 m/min sowie die Verfahrensentwicklung zum Hochleistungs-Schmelzschneiden von Edelstahlplatinen bis 40 mm. Darüber hinaus entwickelt die Abteilung Bearbeitungsköpfe und Sensorsysteme, die in kommerzielle Laserschneidanlagen integriert werden. Im Bereich des Schweißens liegen die Schwerpunkte im Fügen verschiedenster Werkstoffe mit CO_2-Lasern bis 30 kW und Nd:YAG-Lasern bis 5 kW unter Berücksichtigung des fertigungstechnischen Umfeldes der industriellen Auftraggeber. Das Dienstleistungsspektrum umfasst die Entwicklung neuer Schweißverfahren wie beispielsweise Hybridverfahren, die Anpassung bestehender Verfahren an neue Produkte, die Erstellung von Pflichtenheften für industriell einsetzbare Schweißanlagen, die Planung und Entwicklung kompletter Laserstrahlanlagen sowie die Unterstützung der Auftraggeber in der Durchführung lasergerechter Konstruktionen. Zu den aktuellen Highlights der Abteilung zählen neben den Fortschritten bei der industriellen Einführung von Hybridschweißverfahren auch die Entwicklung und der weltweit erstmalige Nachweis des Tiefschweißens mit kompakten und hocheffizienten Diodenlasern.

Neben der Entwicklung und dem Einsatz von Laserverfahren und -anlagen zum Schweißen von Rohren, Profilen und Sonderteilen für den Apparatebau hat die Abteilung für verschiedene Industriepartner periphere Komponenten wie schnelle Drahtzufuhr und Prozesskontrollsysteme entwickelt und installiert. Darüber hinaus werden für Auftraggeber aus den Bereichen Schiffbau, Schienenfahrzeugbau, Luft- und Raumfahrt, Rohrleitungs- und Apparatebau Arbeiten zur Zulassung von Laserstrahlschweißverfahren und von lasergeschweißten Bauteilen durchgeführt. In diesen Bereichen kooperiert die Abteilung eng mit den entsprechenden Zulassungsorganen.

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Kernkompetenzen

- Hochgeschwindigkeitsbearbeitung
- Dickblechbearbeitung
- Trennen und Fügen von Sondermaterialien
- Abtragen (Bohren, Caving, Perforieren, Gravieren)
- 3D-Anwendungen
- Schweißen mit Zusatzwerkstoff
- Hybridverfahren
- Design von Bearbeitungsdüsen und -optiken
- Sensorgestützte Prozessüberwachung und -regelung
- Rechnergestützte Prozesssimulation und -optimierung
- Multimediale Ausbildungs- und Informationssysteme

Cutting and Joining

Short description

Lasers have already been used in the manufacturing industry for various cutting and joining processes for over 20 years. The department deals with the development of extreme processes, which go far beyond the current state-of-the-art. In the field of cutting this includes, among others, high speed cutting as well as the, if required oxide free, cutting of steel and aluminium components with high thickness. Furthermore, the department deals with specific feasibility studies for customers as well as adaptation, optimization and automation of already existing processes and systems. In addition to cutting and drilling of different materials, 3-dimensional material removal also belongs to the main fields of work of the department.

In the field of cutting the industrial customers are mainly from the sectors of metal processing, mechanical engineering, car manufacture, plant and vessels construction as well as plastics technology. On the one hand the processes are adapted to the specific requirements of the customers, on the other hand the department plans, constructs and installs complete laser systems. The highlights of the department include process and system development for laser slitting of thin sheets with more than 100 m/min speed, as well as process development for high power laser beam fusion cutting of stainless steel plates up to 40 mm. Furthermore, the department develops processing heads and sensor systems, which are integrated into commercial laser cutting systems.

The main focus in the field of joining is the welding of different materials with CO_2-lasers up to 30 kW and Nd:YAG-lasers up to 5 kW taking the production process of the industrial customers into account. The services include the development of new welding processes, e.g hybrid processes, the adaptation of existing processes to new products, the setting-up of a performance specification for industrial welding systems, the planning and development of complete laser systems as well as the support of customers in the realization of laser specific constructions. Recent highlights include beside the progress in transfering hybrid-welding technologies into industrial applications, the development and world's first evidence of deep penetration welding with highly compact and efficient diode lasers.

Apart from the development and the application of laser processes and systems for welding of pipes, profiles and special components for apparatus engineering, the department has developed and installed peripheral components such as a fast wire feeder and process control systems for different partners in industry. Furthermore, investigations for the classification of laser welding processes and laser welded components are carried out for customers from shipbuilding, railroad construction, aerospace, pipe manufacturing and apparatus engineering industries In these fields the department cooperates closely with the corresponding classification societies.

Core areas

- *high speed processing*
- *thick section processing*
- *cutting and joining of special materials*
- *removal (drilling, caving, perforating, graving)*
- *3D-applications*
- *welding with additional material*
- *hybrid techniques*
- *design of processing nozzles and optics*
- *sensor based process control*
- *computer supported simulation and optimization of processes*
- *multimedia qualification and information systems*

Oberflächentechnik

Kurzportrait

Die Abteilung Oberflächentechnik löst Aufgabenstellungen aus dem Spektrum der thermischen Oberflächenbehandlung. Hierzu zählen Verfahren zur Erzeugung verschleiß-, ermüdungs- und korrosionsbeständiger Randschichten sowie Rapid-Prototyping-Verfahren zur Herstellung metallischer Bauteile und Werkzeuge. Mit dem Selective Laser Melting (SLM) wurde aufbauend auf dem Lasersintern ein neues Verfahren entwickelt, mit dem Bauteile aus serienidentischen Werkstoffen hergestellt werden können. Weitere Verfahren sind das Laserstrahlreinigen und die Modifikation von Oberflächen. Dazu gehören das formgebende Schmelzen (z. B. Entgraten), das Polieren, das Aktivieren, das Strukturieren (z. B. Aufrauen) und das farbgebende Markieren.

Die Arbeitsschwerpunkte der Abteilung umfassen die Erarbeitung verfahrenstechnischer, physikalischer und werkstoffkundlicher Grundlagen, die Modellbildung zur Unterstützung und Optimierung der Verfahrensentwicklung sowie die Entwicklung von Komponenten zur Strahlführung und -formung, zur Pulverzufuhr und zur Prozessüberwachung und -regelung. Darüber hinaus werden von interdisziplinären Teams komplette Pilotanlagen entwickelt und installiert sowie neueste Laserstrahlquellen (z. B. Hochleistungs-Diodenlaser) für die Oberflächenbehandlung qualifiziert.

In enger Kooperation mit den Industriepartnern werden für die vielfältigen Problemstellungen individuelle Systemlösungen erarbeitet, die den kompletten Fertigungsprozess berücksichtigen. Beispiele für die Kompetenz auf den genannten Arbeitsgebieten sind die Entwicklung eines handgeführten Bearbeitungskopfes für ein mobiles Laserstrahlreinigungsgerät, die Verfahrens- und Anlagenentwicklung zum Härten von Torsionsfedern mit Hochleistungsdiodenlasern in Zweistrahltechnik, die Reparatur von Werkzeugen für die Spritzgußtechnik, von Motor- und Triebwerkskomponenten durch Laserauftragsschweißen, die Entwicklung einer Anlage zum Auftragsschweißen und Härten von Werkzeugen in einer Aufspannung sowie verschiedene Anlagen zum großflächigen Reinigen von Oberflächen.

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Kernkompetenzen

- Umwandlungshärten, Umschmelzen, Beschichten, Legieren und Dispergieren zur Herstellung beanspruchungsgerechter Funktionsschichten
- Entwicklung von Pulverzufuhrsystemen
- Biegen von Metallen
- Reinigung und Modifikation von Oberflächen wie Entgraten, Polieren, Aktivieren und Strukturieren
- Rapid Prototyping zur Herstellung metallischer Bauteile und Werkzeuge

Surface treatment

Short description

The department of surface treatment solves problems in the field of thermal surface treatment. This includes processes for the generation of wear, fatigue and corrosion resistant boundary layers as well as rapid prototyping processes for manufacturing of metallic components and tools. On the basis of laser sintering, the new process Selective Laser Melting (SLM) was developed With this technique parts out of serial material can be manufactured. Further processes are laser cleaning and laser induced surface modifications. This includes shape generated melting (e. g. burr removing), polishing, activation and structuring (e g. roughening) and colour generated marking

The main fields of work of the department include process technology, physical basics and material science, modelling to support and optimize process development as well as the development of components for beam guiding and forming, powder feed and process control. Furthermore, complete pilot plants are developed and installed by interdisciplinary teams. They also qualify new generation of lasers (e g high power diode lasers) for surface treatment

Individual system solutions, which consider the complete manufacturing process, are developed for different problems in close cooperation with industrial partners Examples for the competence in the named fields of work are the development of a manually controlled processing head for a mobile laser cleaning device, the process and machine development for hardening of torsions springs with high power diode lasers in two beam technique, the repairing of tools for injection moulding, motor and power engine components by hardfacing, the development of a machine for hardfacing and hardening of tools in one fixing device as well as different machines for large area cleaning of parts.

Core areas

- *transformation hardening, remelting, cladding, alloying and dispersing for the production of load orientated layers*
- *development of powder feeding systems*
- *bending of metals*
- *cleaning and modification of surfaces such as burr removing, polishing, activation and structuring*
- *rapid prototyping for production of metallic parts and tools*

Kurzportrait

In der Abteilung Mikrotechnik werden lasergestützte Verfahren für die Aufbau- und Verbindungstechnik, die Mikrostrukturierung und die Dünnschichttechnik entwickelt. Hierzu zählen das Mikroschweißen und -löten, das Bohren und Feinschneiden, die Herstellung von Mikrobauteilen und Mikrostanzwerkzeugen durch Laserstrahlabtragen mit Excimer- und Nd:YAG-Laser sowie die Herstellung von Funktionsschichten durch Laser-CVD, -PLD und Laser-Galvanik. Im Zuge der Miniaturisierung elektronischer und mechanischer Bauteile insbesondere in der Kommunikations- und Informationstechnologie nimmt die Bedeutung berührungsloser und präziser Fertigungsinstrumente zu. So werden in der Abteilung Mikrotechnik Montage- und Justageverfahren entwickelt, wie beispielsweise das lasergestützte Mikrobiegen, mit denen Bauteilfunktionen mit hoher Präzision und Reproduzierbarkeit eingestellt werden können. Zusammen mit entsprechenden Messsystemen werden diese lasergestützten Fertigungskomponenten in Produktionsanlagen integriert.

Die Kooperationspartner der Abteilung Mikrotechnik kommen großtenteils aus den Bereichen Elektrotechnik und Elektronik, Feinmechanik und Optik, Kommunikations- und Informationstechnologie sowie Medizintechnik und Chemie. So werden gemeinsam mit Medizinern und Unternehmen der Medizintechnik Verfahren und Produkte für operative Eingriffe und die Analytik entwickelt. Schwerpunkte sind die Mikrostrukturierung von Kunststoffbauteilen wie Kathetern, Stents und Mikroimplantaten sowie das Fügen mikromechanischer Bauteile.

Im stark expandierenden Bereich der Mikrochemie und Mikroanalytik stellt die Abteilung Mikroreaktoren und Systeme für die Kapillarelektrophorese wie beispielsweise die DNA-Analyse her. Hierbei kommen Laser sowohl als Fertigungswerkzeug als auch als Analyse- und Syntheseinstrument zum Einsatz. Für Applikationen in der Papiertechnik werden Verfahren und Anlagen zum Schneiden, Abtragen, Perforieren und Markieren bei extrem hohen Geschwindigkeiten entwickelt. Der Schwerpunkt liegt in der Bearbeitung von Sicherheitspapieren und empfindlichen Faserwerkstoffen.

Für die Montage von Kunststoffbauteilen wurde ein neues Verfahren zum Schweißen thermoplastischer Kunststoffe entwickelt. Dieses nutzt die spezifischen Eigenschaften des Lasers wie die selektive Absorption in Bezug auf Wellenlänge und Materialart sowie die örtlich begrenzte Energiedeposition. Mit dem Laserstrahl-Kunststoffschweißen lassen sich unsichtbare Verbindungen kräftefrei bei nahezu allen Thermoplasten, auch in Kombination mit Metallen und thermoplastischen Elastomeren, erzielen. Durch den Einsatz von Diodenlasern kann die Flexibilität des Verfahrens deutlich erhöht werden.

Zusammen mit den industriellen Auftraggebern werden Verfahrensanalysen durchgeführt sowie komplette Prototypanlagen entwickelt, die den Anforderungen an eine moderne Fertigung entsprechen. Die Basis hierfür bilden verfahrenstechnische Grundlagenuntersuchungen und theoretische Simulationen. Die Unterstützung im Bereich der lasergerechten Konstruktion zählt ebenso zu den Dienstleistungen der Abteilung wie die Beratung zur Erstellung von Pflichtenheften für moderne Laseranlagen.

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Kernkompetenzen

- Laserstrahlmikroloten und -mikroschweißen
- Lasergestütztes Biegen und Justieren
- Feinschneiden und Bohren von Metallen, Keramiken, Halbleitern und Diamanten
- Mikrostrukturierung mit Excimer- und Nd:YAG-Lasern
- Mikrostanz- und -prägetechnik
- Markieren und Beschriften
- Laser-CVD und -PVD, Laser-Galvanik
- Schneiden und Perforieren von Papier, Kunststoffen und Verbundwerkstoffen
- Schweißen von Thermoplasten und thermoplastischen Elastomeren

Micro technology

Short description

In the department of micro technology laser processes for packaging and interconnection, microstructuring and thin film technology are being developed. This includes micro welding and soldering, drilling and fine cutting, manufacturing of micro components and micro punching dies by laser ablation with excimer and Nd:YAG-lasers as well as manufacturing of functional layers through laser CVD, PLD and laser-galvanizing. In the course of the miniaturization of electronic and mechanical components, especially in the communication and information industry, the importance of contact free and precise manufacturing instruments increases Assembling and adjustment procedures are being developed in the department of micro technology, e.g. laser supported micro bending, with which the component functions can be adapted with high precision and consistency Together with the corresponding measuring systems these laser assisted manufacturing components are integrated in to production plants.

The cooperation partners of the department of micro technology can mainly be found in the fields of electronics, precision mechanics and optics, communication and information technology as well as medical technology and chemistry. In cooperation with medical experts and manufacturers of medical systems processes and products for surgery and analytic are being developed Core activities are micro structuring of disposable polymer products like catheters, stents and micro implants and joining of micro mechanical devices

In the strongly expanding market of micro chemistry and micro analytic the department develops micro reactors and systems for capillary electrophoresis for example DNA-analysis. In this field lasers are used as production tools as well as for analytic and synthetic purposes. For applications in the paper industry processes and systems for cutting, ablation, perforating and marking at extremely high speeds are being developed Core activities are the processing of security papers and sensitive fibre materials.

For the assembly of plastic parts a new technology for welding thermoplastic polymers has been developed This technology uses the specific advantages of lasers like selective absorption in relation to wavelength and material properties as well as local deposition of energy. Laser polymer welding offers hidden welds without applying forces at almost all thermoplastic materials and also in combination with metals and thermoplastic elastomers By using diode laser systems the flexibility of the process can be distinctly increased.

Together with the customers, processes are analyzed and complete prototype plants are developed and set into industrial surroundings. All this is based on fundamental research of processes and theoretical simulation Support in the field of laser specific construction belongs as well to the services of the department as advice for the setting-up of a performance specification for modern laser systems.

Core areas

- *laser micro soldering and micro welding*
- *laser supported bending and adjustment*
- *precision cutting and drilling of metals, ceramics, semiconductors and diamonds*
- *micro structuring with excimer and Nd:YAG-lasers*
- *micro punching and stamping*
- *marking and lettering*
- *laser CVD and PVD, laser-galvanizing*
- *cutting and perforating of paper, plastics and composite materials*
- *welding of thermoplasts and thermoplastic elastomeres*

Modellierung und Simulation

Kurzportrait

Die Abteilung Modellierung und Simulation führt grundlegende Arbeiten zur Beschreibung von technischen Prozessen sowie deren Überwachung, Steuerung und Regelung durch. Zu den Kernkompetenzen zählen die Modellierung von Strahlquellen – insbesondere Hochleistungslaser und Gasentladungen – sowie deren Anwendung in der Fertigungstechnik. Die beteiligten physikalischen Prozesse erstrecken sich von der Erzeugung, Ausbreitung und Absorption von Strahlung über Transportprozesse bis hin zu Phasenumwandlungen, die von der Strahlung im Werkstoff induziert werden. Um die Messdaten zu analysieren und die Prozesse zu überwachen, werden Methoden der Technischen Informatik angewandt. Hierzu zählen insbesondere numerische Verfahren zur Simulation der Prozesse und deren Visualisierung sowie Algorithmen zur Auswertung von Messdaten.

Das eingespielte Team aus Wissenschaftlern der Disziplinen Angewandte Mathematik, Physik und Technische Informatik bietet modellgestützte Untersuchungen von technischen Aufgabenstellungen an. Ausgehend von den Kenntnissen der Kunden, der eigenen experimentellen Erfahrung und den Eigenschaften vorhandener Modelle werden Lösungswege erarbeitet und analysiert.

Kernkompetenzen

- Design von Hohlkathoden zur Erzeugung von EUV-Strahlung
- Auslegung von Resonatoren für Gas-, Festkörper- und Hochleistungsdiodenlaser
- Optimierung der Strahlführung in optischen Systemen
- Analyse des Strahlungstransports in Prozessgasen während der Bearbeitung
- Analyse von Unter- und Überschallströmungen von Arbeits- und Prozessgasen
- Analyse von Schmelzstromung, Wärmetransport, Schmelzen und Verdampfen
- Dynamische Modelle zum Abtragen, Schneiden, Schweißen und Bohren
- Algorithmen zur Auswertung von Messdaten
- Programmierung graphischer Benutzeroberflächen zur Simulation der Modelle und Visualisierung von Messdaten mit kommerziellen Graphikservern wie OpenGL®
- Numerische Methoden und Berechnungsverfahren, wie z. B Cluster-In-Cell Verfahren (CIC), adaptive Vernetzung in bewegten Gebieten (Hierarchische Basen), Finite Elemente und Finite Volumen Methoden auf zeitlich veränderlichen Gebieten (Level-Set Methode)
- Prozessüberwachung mit räumlich und zeitlich höchstauflösenden, kommerziellen CCD- und CMOS-Kamerasystemen
- Steuerung und Regelung von Fertigungsprozessen

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Modelling and simulation

Short description

The department of modelling and simulation carries out fundamental work to describe technical processes as well as their monitoring and control The core areas include the modelling of beam sources – especially high power lasers and gas discharges – and their application in production technology. The physical processes involved comprise the generation, propagation and absorption of radiation, as well as transport processes and phase transformations which are induced by the radiation in the material. Methods of technical informatics are used for analysing the measured data and monitoring the processes. This especially includes numerical methods for the simulation of the processes and their visualisation as well as algorithms to evaluate measured data.

The experienced team of scientists in the field of applied mathematics, physics and technical informatics offers model based investigations of technical tasks. Based on the knowledge of the customers, our own experimental experience and the characteristic features of already existing models, the department works out solutions and carries out the analysis.

Core areas

- *Design of hollow cathode discharge for generation of EUV-radiation*
- *Design of optical resonators for gas, solid state, and high power diode lasers*
- *Optimisation of beam guidance in optical systems*
- *Analysis of radiation transfer in process gases during processing*
- *Sub- and supersonic gas flow of assist and process gases*
- *Analysis of melt flow, heat transport, and movement of phase boundaries*
- *Dynamical models of cutting, welding and drilling*
- *Data evaluation algorithms*
- *Programming of graphical user surfaces for simulation of the models and visualisation of data using commercial graphic-servers like OpenGL®*
- *Numerical methods and codes, such as Cluster-In-Cell Code (CIC), adaptive meshing domains with moving boundaries (Hierarchical Basis), finite elements and finite volume methods on time dependent domains (Level-Set Method)*
- *Process monitoring using spatial and temporal resolved detectors like commercial CCD- and CMOS-camera systems*
- *Control of processing*

Systemtechnik
System technology

Kurzportrait

Die Abteilung Systemtechnik befasst sich mit der Planung, Entwicklung und Installation kompletter Laseranlagen. Diese Pilotsysteme werden auf die individuellen Anforderungen der industriellen Auftraggeber abgestimmt. Falls eine neue Verfahrensentwicklung erforderlich ist, wird diese in enger Zusammenarbeit mit den anderen Fachabteilungen des Instituts durchgefuhrt Daruber hinaus werden bei Bedarf Prozessuberwachungs- und -regelungssysteme entwickelt, getestet und installiert In diesem Bereich nutzt die Abteilung Systemtechnik ihre langjahrige Erfahrung in dem Einsatz online kontrollierter Laserverfahren. Auch die Anpassung kommerzieller Steuerungssysteme an die Erfordernisse von Spezialanwendungen gewahrleistet die Abteilung mit ihren interdisziplinaren Entwicklungsteams Das Angebot wird durch laserspezifische Netzteile und Elektronikkomponenten abgerundet

Im Erprobungs- und Beratungszentrum des Fraunhofer-Instituts fur Lasertechnik konnen kleine und mittelständische Unternehmen mit Unterstützung des Bundesministeriums fur Bildung und Forschung BMBF eine Erstberatung und praktische Erprobungsversuche in Anspruch nehmen Darüber hinaus bietet die Abteilung Systemtechnik die Durchfuhrung von Machbarkeitsstudien an, in denen neue Ideen hinsichtlich ihrer Umsetzung und Wirtschaftlichkeit gepruft werden Das Dienstleistungsangebot wird durch Aus- und Fortbildungsseminare sowie durch praktische Trainingsworkshops abgerundet

Short description

The department of system technology deals with the planning, development and installation of complete laser plants These pilot systems are adapted to meet the specific requirements of the industrial customers. If a new process is needed to be developed, it will be carried out in close cooperation with the other departments of the institute. Furthermore, process monitoring and control systems are developed, tested and installed, if required In this field the department of system technology makes use of many years of experience gained in on-line controlled laser processes. The department ensures the adaptation of commercially available control systems to the requirements of special applications with its interdisciplinary development team. Laser adapted power supply and electronic components complete the services offered

At the Testing and Consultation Centre of the Fraunhofer Institute for Laser Technology small and medium enterprises can come to a first consultation and practical testing visit with the support of the ministry BMBF Furthermore, the department of system technology offers the implementation of feasibility studies, in which new ideas are tested with regard to their appli-cation and economic feasibility The service offered is rounded off by education and training courses as well as practical training workshops.

Ihr Ansprechpartner / *Contact*

Dr. Stefan Kaierle
Telefon: +49(0)241/8906 -212
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kaierle@ilt fraunhofer.de

Kernkompetenzen

- Pilotanlagen
- Integration von Lasertechnik in Fertigungseinrichtungen
- Entwicklung von Sensoren und Regelungssystemen
- Entwicklung von Diodenlasernetzteilen, Funkenerosionsgeneratoren und Hochspannungs-Impulsgeneratoren
- Nullserien-Applikation
- Anlagenkonzeptionierung
- Steuerungstechnik für Laseranlagen
- Aus- und Weiterbildung

Core areas

- *pilot plants*
- *integration of laser technology into manufacturing systems*
- *development of sensors and control systems*
- *development of power supply for diode lasers, of generators for EDM equipmemt and of high-voltage-puls-generators*
- *small-lot applications*
- *concept and design of plants*
- *control technique for laser plants*
- *education and training*

Auslandsaktivitäten
International activities

Fraunhofer ILT im Ausland

Das Fraunhofer ILT pflegt seit seiner Gründung zahlreiche internationale Kooperationen. Ziel der Zusammenarbeit ist es, Trends und Entwicklungen rechtzeitig zu erkennen und weiteres Know-how zu erwerben. Dieses kommt den Auftraggebern des Fraunhofer ILT direkt zugute. Mit ausländischen Firmen und Niederlassungen deutscher Firmen im Ausland führt das Fraunhofer ILT sowohl bilaterale Projekte als auch internationale Verbundprojekte durch. Die Kontaktaufnahme kann auch mittelbar erfolgen über:

- Niederlassungen des Fraunhofer ILT im Ausland
- ausländische Kooperationspartner des Fraunhofer ILT
- Verbindungsbüros der Fraunhofer-Gesellschaft im Ausland.

Europa

In Europa kooperiert das Fraunhofer ILT mit zahlreichen Firmen und öffentlichen FuE-Zentren. Die Beteiligung an europäischen Verbundprojekten wird seit Jahren erfolgreich betrieben. In Frankreich wurde darüber hinaus eine strategische Kooperation mit führenden FuE-Einrichtungen im Rahmen der Coopération Laser Franco-Allemande CLFA eingegangen. Die CLFA hält in Paris FuE-Kapazitäten vor, die von den französischen Auftraggebern direkt in Anspruch genommen werden können.

USA

Das Fraunhofer Center for Laser Technology CLT wurde 1995 gegründet und hat seinen Sitz in Plymouth, Michigan. Diese Region hat sich als Zentrum für Laserhersteller, Systemintegratoren und industrielle Anwender in den USA etabliert. Wesentliches Ziel des CLT ist die Kooperation mit Industrie und Wissenschaft in den USA. Dabei wird eine enge Zusammenarbeit mit der Universität Michigan und der Wayne State University gepflegt.

Am Fraunhofer CLT sind deutsche sowie amerikanische Mitarbeiter tätig. Deutsche Unternehmen nutzen das Fraunhofer CLT als Demonstrationszentrum für ihre Produkte auf dem amerikanischen Markt. Dem Fraunhofer CLT stehen zur Zeit CO_2-Laser bis 12 kW, Nd:YAG-Laser bis 3 kW (cw), sowie 3-, 5- und 6-Achsen-Bearbeitungsstationen zur Verfügung.

Asien

In Asien können Interessenten über die Verbindungsbüros der Fraunhofer-Gesellschaft mit dem Fraunhofer ILT Kontakt aufnehmen.

Fraunhofer ILT Abroad

Since its foundation, Fraunhofer ILT has been involved in many international cooperations. The objective of these cooperations is to recognize new trends and current developments and to acquire further know-how. The customers of Fraunhofer ILT can directly benefit from this. Fraunhofer ILT carries out bilateral projects as well as international cooperative projects with foreign companies and subsidiaries of German companies abroad. These companies can also contact Fraunhofer ILT through:

- *international subsidiaries of Fraunhofer ILT*
- *foreign cooperation partners of Fraunhofer ILT*
- *liaison offices of the Fraunhofer Society abroad*

Europe

In Europe Fraunhofer ILT is collaborating with numerous companies and public R&D centers. European cooperative projects have been carried out successfully for many years. Furthermore, a strategic cooperation has been established with leading R&D centers in France in form of the Coopération Laser Franco-Allemand CLFA. CLFA has R&D-resources in Paris that can directly be used by the French customers.

USA

The Fraunhofer Center for Laser Technology CLT was founded in 1995 and is located in Plymouth, Michigan. This region has established itself as main spot of laser manufacturers, system integrators and industrial users in the US. Fraunhofer aims to be the premier resource of technology innovation for its US customers in the public and private sector. There are close links with the University of Michigan and Wayne State University.

The Fraunhofer CLT employs German as well as American staff. German companies use the Fraunhofer CLT as a demonstration center for their products on the US market. Presently, the Fraunhofer CLT has CO_2-lasers with up to 12 kW, and Nd:YAG-lasers with up to 3 kW output power (cw) as well as three-, five- and six-axis processing stations.

Asia

In Asia, interested companies can contact the Fraunhofer ILT through representative offices of the Fraunhofer-Gesellschaft.

Wegbeschreibung
Way to the institute

Mit dem Auto

Autobahn A44/A4 bis zum Kreuz Aachen, auf der A4 Richtung Antwerpen bis Ausfahrt Aachen-Laurensberg, Zubringer Richtung Aachen, erste Ausfahrt Richtung RWTH/Klinikum. Direkt nach dem Tunnel die erste Ausfahrt (Richtung RWTH-Melaten/Hörn/ Fraunhofer-Institute), oben rechts abbiegen, dann geradeaus dem Verlauf der Straße folgend (Linkskurve), links auf den ILT-Besucherparkplatz

Mit dem Bus

Ab Aachen Hauptbahnhof 5 Minuten zu Fuß zur Bushaltestelle Theaterstraße/Wallstraße, mit dem Bus Linie 33 bis Haltestelle Forum, dann 10 Minuten zu Fuß.

Mit dem Flugzeug

Ab Flughafen Köln bzw. Düsseldorf mit dem Pendelverkehrsbus "Airport Aixpress" Köln-Aachen oder Düsseldorf-Aachen bis Aachen Zentrum Weiter per Taxi oder mit dem Bus.

By car

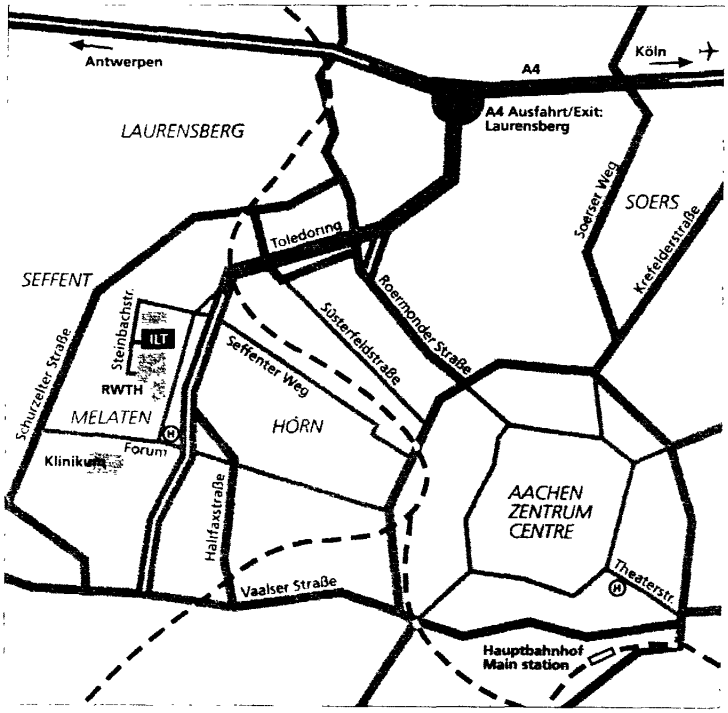
Freeway A44/A4 to freeway junction Aachen, A4 towards Antwerpen until exit Aachen-Laurensberg, feeder road towards Aachen, at first exit turn right towards RWTH/Klinikum. Directly behind the tunnel take the first exit (towards RWTH-Melaten/Horn/ Fraunhofer-Institute), at the top turn right and follow the street (left-hand bend), turn to ILT's visitors car-park on the left

By bus

From Aachen main station walk 5 minutes by foot to bus stop 'Theaterstraße/Wallstraße' and take bus line 33 to stop 'Forum', from there 10 minutes walk

By plane

From Köln or Düsseldorf airport use shuttle bus 'Airport Aixpress' Köln-Aachen or Düsseldorf-Aachen until Aachen Centre. Than take a taxi or the bus



Impressum
Imprint

Weitere Informationen
Further information

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附件

五、LZH 資料

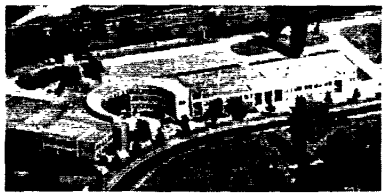
research
development
consulting

LASER ZENTRUM HANNOVER e.V.

Introduction
Laser Zentrum Hannover e.V.

Hannover, November 26, 2003

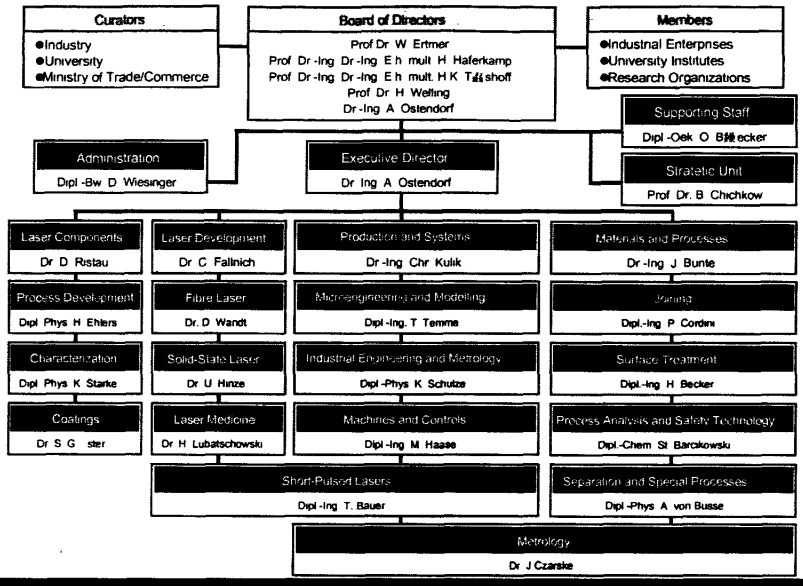
LZH Basics



Field of Work:	Laser Technology
Board of Directors:	Prof. Ertmer, Quantum optics Prof. H. Haferkamp, Material Sciences Dr.-Ing. A. Ostendorf, Chief Executive Officer Prof. H.K. Tönshoff, Production Engineering Prof. H. Welling, Laser Physics
Basics:	Founded June 20th, 1986 250 Employees, incl. 120 Scientists Turnover 2002 approx. 11.28 Mio €

LASER ZENTRUM HANNOVER e.V.

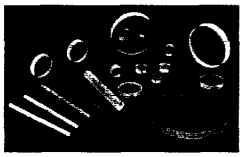
Organization Chart



LASER ZENTRUM HANNOVER e.V.

Departments

laser components



laser development

production and systems

materials and processes

LASER ZENTRUM HANNOVER e.V.

laser components

- Coatings for high power laser systems
- Thin-film process development
- Coatings with lowest optical losses
- Development of special coatings
- Characterization of laser components according to ISO-standards

laser development

- Diode lasers
- Diode pumped solid-state lasers
- Fibre lasers
- Non-linear optics
- Laser sources for metrology
- Ultra short pulse laser
- Laser sources for medicine applications

production and systems

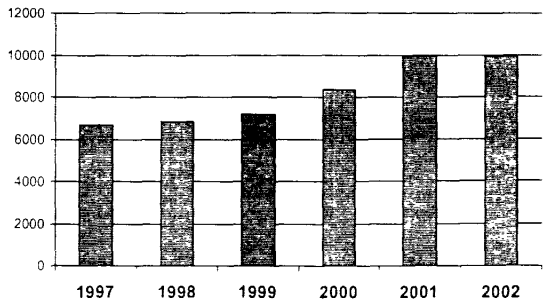
- Systems and control technology
- Process control
- CAD/CAM-technology
- Manufacturing metrology
- Micro-processing with UV-lasers, fibre lasers and fs-laser pulses
- Glass and ceramic processing
- Simulation techniques
- Testing and consulting centre for SME

materials and processes

- Cutting and joining technology
- Surface treatment and wear protection
- Polymer processing and new materials
- Hand-guided laser systems and special processes
- Safety technology and analysis of process-by-products
- Filtration technology
- Process analysis and quality control
- Laser optimised construction and design

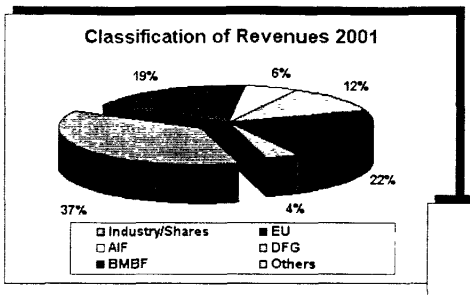
LZH Basics

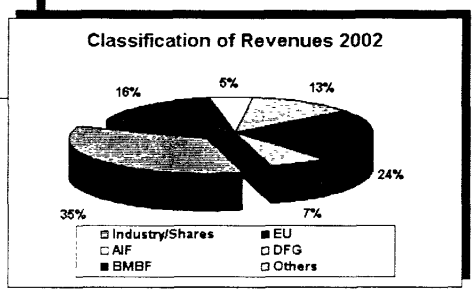
Trading Volume 1997 - 2002
(in T€)



without basic foundation

LZH Basics





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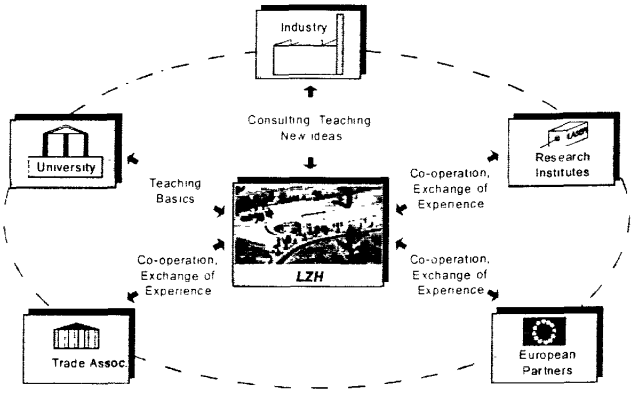
Technology Transfer



LASER ZENTRUM HANNOVER e.V.

Laser Beam Sources at LZH

Lasertyp	Leistung/Pulsenergie	Hersteller/Produkt	Laserperipherie
Excimer-Laser	0,6 J/248 nm	Lambda-Physik Lambda 4000	
	0,8 J (250 Hz) 248 nm	Lambda-Physik LPX 325	wahlweise: Mikrobearbeitungsstationen Elpec- oder Elpec ULT 3 Achsen-Koord -Tisch
	0,6 J (100 Hz) 248 nm	Lambda-Physik LPX 210	
	0,3 J (100 Hz) 351 nm		
	0,3 J (300 Hz) 193 nm	Lambda-Physik LPX 325	Mikrobearb -station ELPEC 193
	30 mJ (200 Hz) 157 nm	Lambda-Physik LPF 220	
	8 mJ 193 nm	TUI-Laser Existar S 500	
	1,5 mJ 157 nm	TUI-Laser Existar S 500	
Titan-Saphir Laser	2 mJ (150 fs, 1 kHz) 0,5 mJ (150 fs, 5 kHz)	Spectra Physics Spitfire	4-Achsen-Koordinatentisch/ Scanner
	0,5 mJ (150 fs, 1 kHz)	BMI Alpha-1000	
	1 mJ (150 fs, 1 kHz)	Clark-MXR CPA 2001	
	0,32 mJ (135 fs, 5 kHz)	Thales Brigth	Scanner/ Präzisionspositioniersystem
	1,5 mJ (<30 fs, 1 kHz)	Femtolaser Femtopower, Comp Pro	
	0,006 mJ (120 fs, 250 kHz)	Coherent REG A	optional Scanner

Laser Beam Sources at LZH

Lasertyp	Leistung/Pulsenergie	Hersteller/Produkt	Laserperipherie
CO_2-Laser	6000 W (DC)	Wegmann Baasel TRIAGON 6000	ww 5-Achsen-Portalsystem oder 3-Achsen-Station
	2500 W (HF)	Rofin Sinar DY 025	4-Achsen-Schneidanlage (Behrens CB2500) 4-Achsen-Station (lineardirekt-angetrieben)/4-Achsen-Station
	500 W (HF)	Coherent K 500	4-Achsen-Station/Scanner 3-Achsen-Schneidanlage
	250 W (HF)	Coherent K 250	4-Achsen-Station/Scanner
	200 W (HF)	Rofin-Sinar SC X20	4-Achsen-Station/Scanner
	50 W (HF)	Synrad	Beschrifter
	25 W (HF)	Synrad	
	6J (TEA)	ALLTEC ALLMARK 880	
Hoch-leistungs-Dioden-laser	1,2 kW cw (808 nm)	Rofin Sinar DL 015	3-Achsen-Station
	300 W (940 nm)	Laserline LDF 600-250	direkter Strahl/ Faserkopplung/Scanner
	250 W (fasergekoppelt)		
	100 W cw (1 kHz, 810 nm)	Fok Diodenlaser Fisba DL 100	6-Achsen-Roboter
	15 W (810 nm)	Fasergekop Diodenl SDL FB 25	2-Achsen-Station
	9 W (1064 nm)	Faserlaser SDL FD 10	Mikrof estation

Laser Beam Sources at LZH

Lasertyp	Leistung/Pulsenergie	Hersteller/Produkt	Laserperipherie
Nd:YAG - Laser	4000 W (cw/pw)	Haas HL 4006 D	er LWL wahlweise Betrieb auf 5 Bearbeitungsstationen oder 2 Roboter
	2200 W (cw)	Rofin-Sinar DY 022 (diodengep.)	
	2000 W (cw/pw)	Rofin-Sinar CW 020	
	1000 W (cw)	GSI Lumonics JK1002	
	500 W (pw)	Rofin-Sinar RSY 500 P	
	600 W (pw)	MLS P 500 (Slablaser)	3-Achsen-Station
	220 W (pw)	Lasag SLS 200 C 60	4-Achsen-Station/LWL
	100 W (pw)	Rofin-Sinar RS Marker 1000 D	Beschrifter
	22 W (pw)	Baasel SC 18	4-Achsen-Station/Scanner
	8 W (1064 nm) 5 W (532 nm) 3 W (355 nm) 1 W (266 nm)	Lambda Physik Starline 2030	2-Achsen-Station Ultrapr[illegible]isionssystem
	7 W (pw) diodengepumpt	Coherent Avia 355-7000	4-Achsen-Pr[illegible]isionsstation/ $ELPEC_{mult}$ 5-Achsen-Koordinatentisch
	1.5 W (pw) diodengepumpt	Coherent Avia 266	
	4 W (pw) diodengepumpt	Adlas Coherent DPY501	

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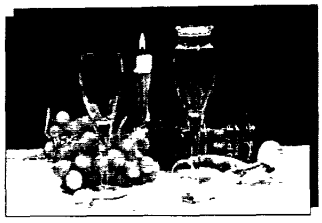
Group of Glass Treatment

Polishing of glass surfaces

Cutting of flat glass

oup
Glass

Sealing of ampoules



Laser blasting of hollow glass

LASER ZENTRUM HANNOVER e.V.

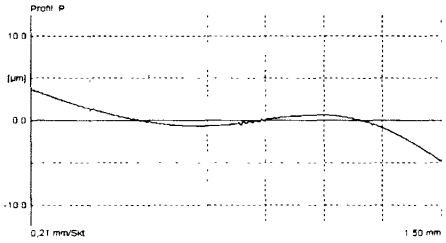
Test and analysis technology, Analysis Laser cut edge ...

Analysis with surface scanning

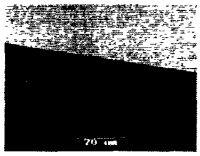
Perthometer Concept

Firma Laser Zentrum Hannover e V
Hollenthallee 8
30419 Hannover

Objekt REM Laser Cut Edge
Prufer bi mb
Datum, Zeit 02 07 2002, 15 22
Dateiname C \PROGRA~1\MAHR\PERTHO~1\KEINNAME PCD



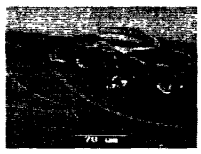
Surface profile analysis SEM (scanning electron microscope)



Floatglass (soda-lime)

Thickness: 1.8 mm

Edge produced with Nd:YAG-Laser



Floatglass (soda-lime)

Thickness: 1.8 mm

Edge produced with metal-cutting wheel

Test and analysis technology

- **thermal camera**
- **digital cameras**
- **high speed camera**
- **video camera**
- **polariscope**
- **sputter facility (gold,coal)**
- **perthometer (roughness profile depth)**
- **tension machine**
- **stereo microscope**
- **SEM scanning electron microscope**
- **metallography**

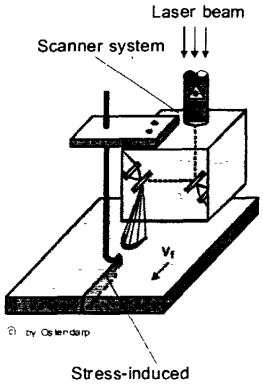
Cutting of Glass with Laser Radiation

Machining of flat glass with FIR and NIR laser radiation

- Laser beam melt cutting
  - CO_2 Laser, λ5 10.6 µ
- Laser beam blasting
  - CO_2 Laser, λ5 10.6 µ
  - Nd:YAG Laser, λ5 1.064 µ

NIR-Near Infrared spectrum area **FIR**-Far Infrared spectrum area

Cutting of Glass with CO_2 Laser Radiation



Process characteristics

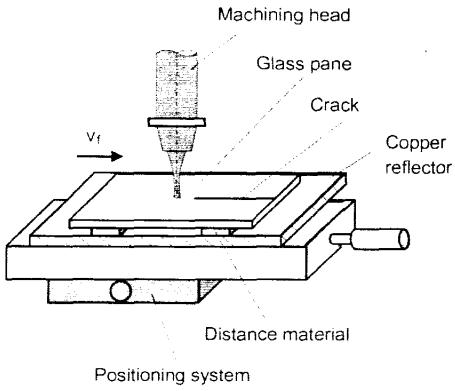
- ❒ v-shaped beam cross-section
- ❒ working one-sided

CO_2 Laser Blasting

+ high cutting speed
+ high accuracy

- second working step (breaking)
- slow cutting speed for full body cut
- cooling process necessary

Cutting of Glass with Nd:YAG Laser Radiation

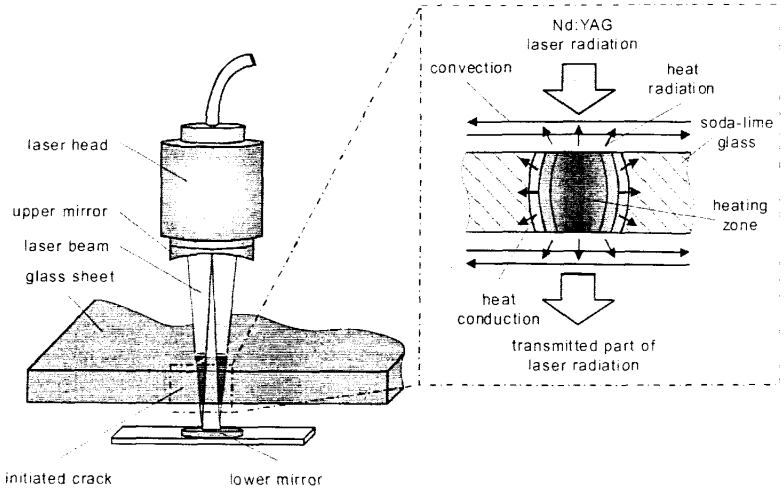


Nd:YAG Laser Blasting

- inhomogeneous volume heating
- high accuracy
- full body cut up to 19 mm
- final product after cutting
- no cooling, no additional material
- current cutting speed slower as for other techniques
- mirror below necessary

LASER ZENTRUM HANNOVER e.V.

MLBA Multiple Laser Beam Absorption Cutting



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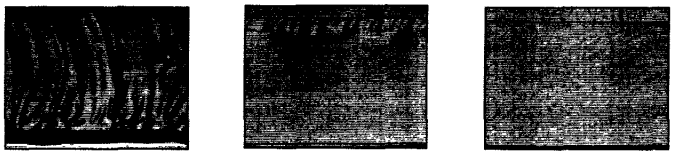
Analysis of Residual Stress

Cutting method

Laser beam melt cutting	Conventional scribing and breaking	Laser beam blasting

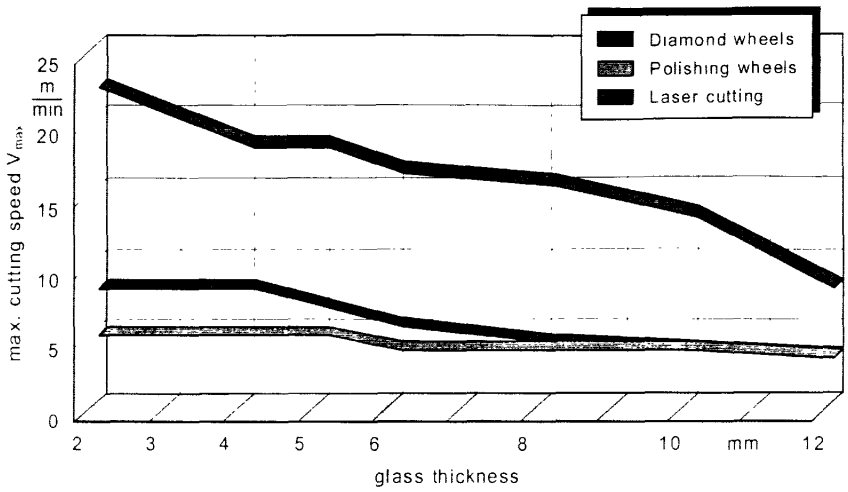


Material: Soda-lime glass
Thickness: s = 2 mm

Laser beam melt cutting		Laser beam blasting	
Laser	WB -Triagon	Laser	Coh K250
Average Power	P_{av} = 2.4 kW	Average Power	P_{av} = 51 W
Feed rate	v_f = 3 m/min	Feed rate	v_f = 0.8 m/min
Focal length	f = 190.5 mm	Focal length	f = 63.5 mm
Focus position	z_f = - 1 mm	Focus position	z_f = 45 mm

LASER ZENTRUM HANNOVER e.V.

Comparative Speed of Laser Cutting, Conventional Grinding and Polishing



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Advantages Laser Cutting of Glass Materials

Method	Cutting Processing Chain			
Conventional	Scribing	Breaking	Grinding	Washing
Laser Cutting CO2	Laser Scribing	Breaking	←	→
Laser Cutting Nd:YAG	Laser Cutting	←		→

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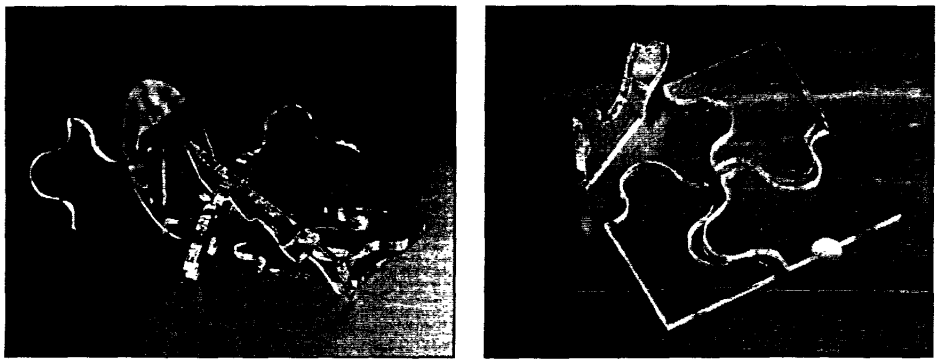
Selection of Laser Cut Contours



12 mm

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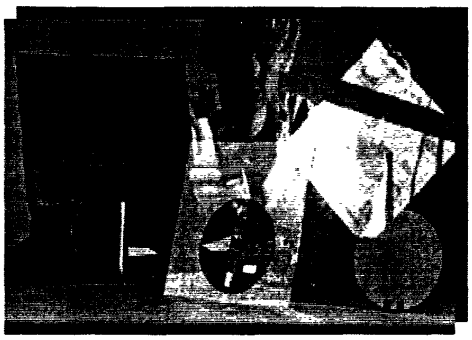
Cutting of Display Glass with Nd:YAG Laser Sources



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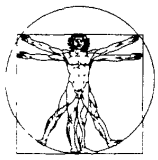
Group of Short-Pulsed Lasers: Fields of Applications

Medicine	Science	Automotive Industry	Electronic Industry	
				•••
• Implants • Surgery	• Electrodes for streak tubes	• Fuel injection nozzles • Sensors	• Mask repair	

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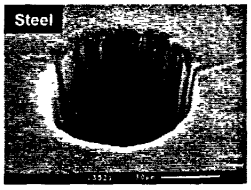
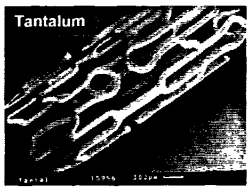
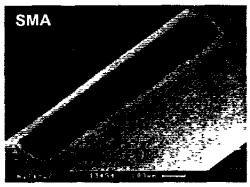
Femtosecond Lasers: Processing Samples

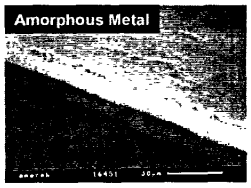
Micromachining
- highly transmitting material (glass)
- heat conducting material (metal)
- temperature critical material

Medicine
- coronary surgery
- eye surgery
- dentistry









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Femtosecond Lasers: Processing Samples

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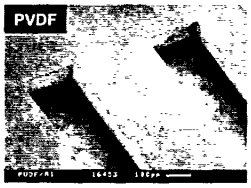

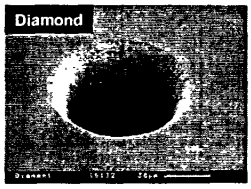

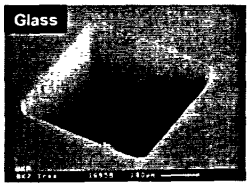

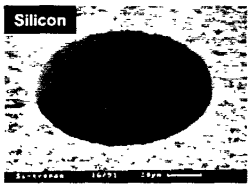

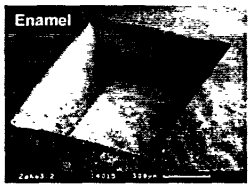

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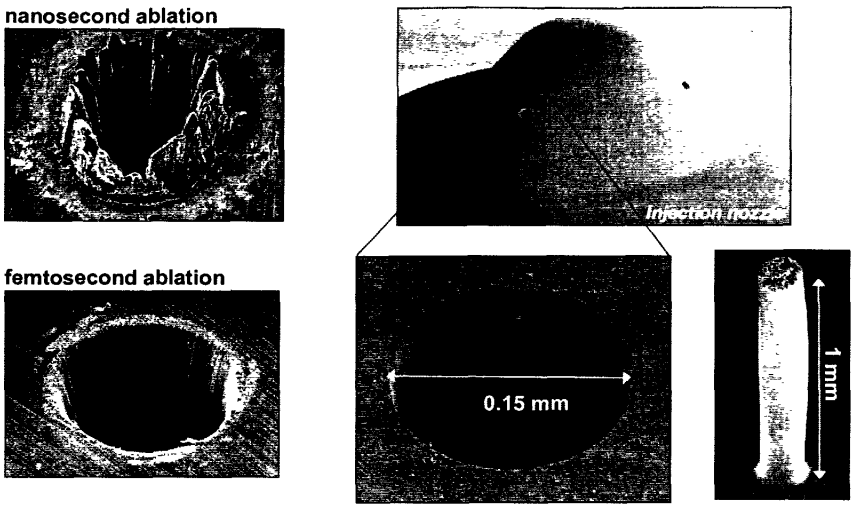
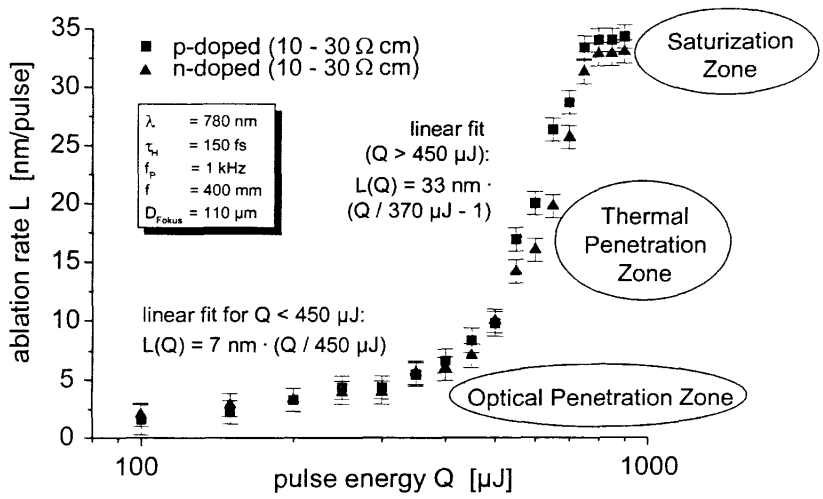
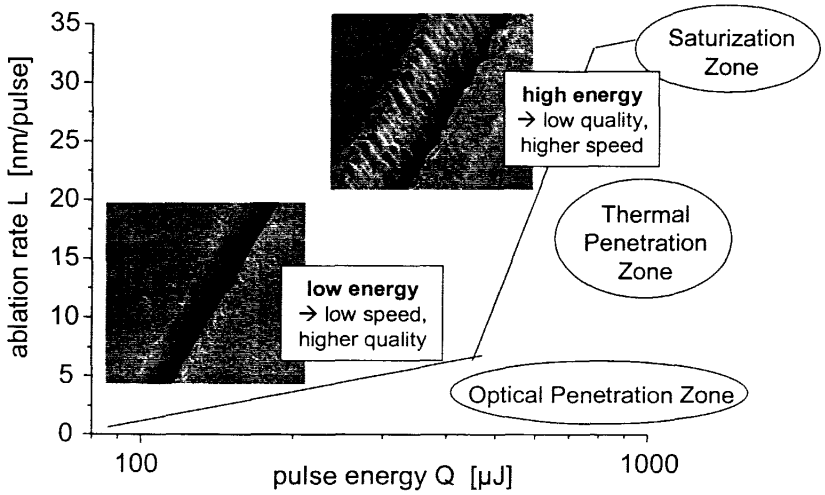
fs Laser Application: Injection Nozzles



fs Lasers: Ablation Rates for Silicon



fs Lasers: Ablation Rates for Silicon



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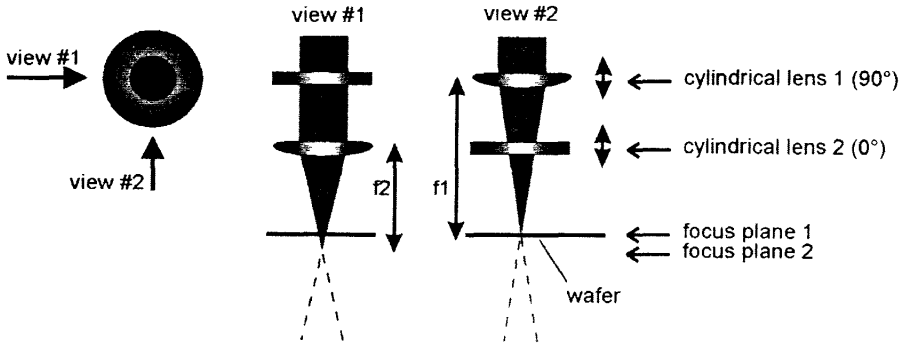
fs Lasers: Cutting with a Line Focus

Flexible focus shape adjustment
by lens distance variation



→ large pulse overlap, good fluence distribution

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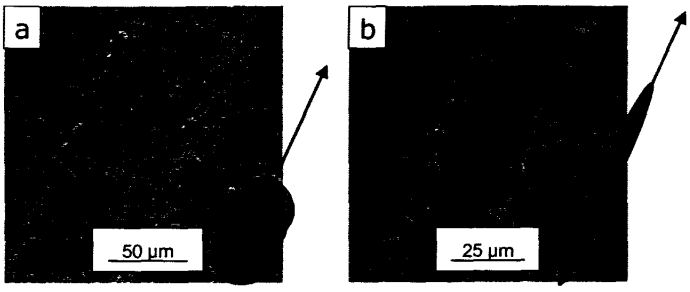
fs Lasers: Cutting with a Line Focus

Cutting speed increase by a factor of five



a	b
spot focus, low overlap → high fluence, but **little ablation**	line focus, large overlap → low fluence, but **higher ablation**

pulse energy:
E_p=900 µJ

focal length:
(a) f=100 mm
(b) f_1=100 mm

focus line length:
(b) l=1 mm

feed rate:
v=500 mm/min

repetitions:
n=4

material:
silicon (mono-crystalline)

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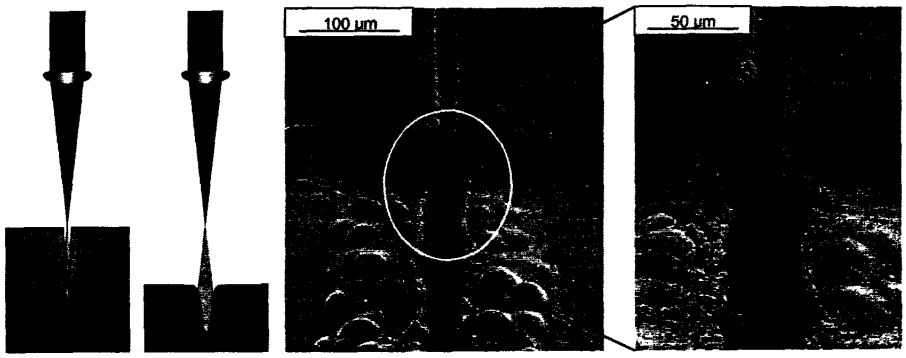
fs Lasers: Cutting of Taped Wafers

Preserving the tape by cutting with optimal speed



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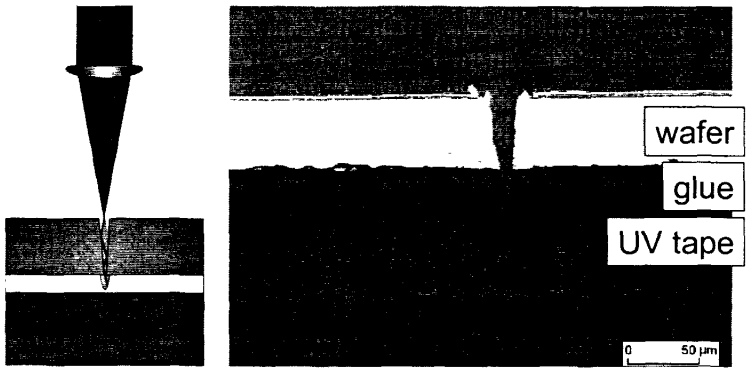
fs Lasers: Cutting of Taped Wafers

Cross section through a taped wafer, cutting depth extending to glue layer



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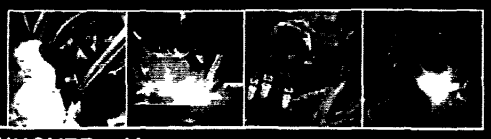
PEOPLE MATTER
research
development
consulting



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Introduction Laser Zentrum Hannover e.V.

Hannover, November 26, 2003