

Laser Soldering

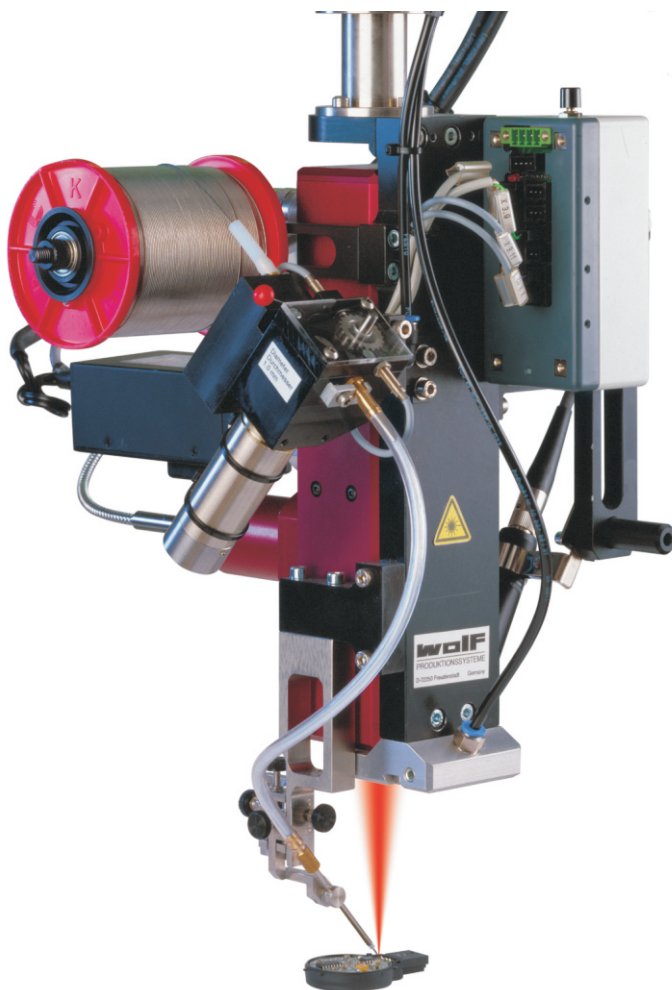
with
**High-Power
Diode Laser**

■ **Contact free**

■ **Highest
soldering quality
with
precise and repeatable
heating**

■ **High-precision
soldering**

■ **Maintenance free**



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Principle

To have a good heat transfer a high absorption rate of laser radiation at the solder spot is necessary. The share of absorbed radiation is highest for short wavelengths. Having a wavelength of 808 nm, near visible light, high-power diode lasers are superior to other lasers. ND:YAK or Co₂ lasers have longer wavelengths and therefore the absorption rate is insufficient.

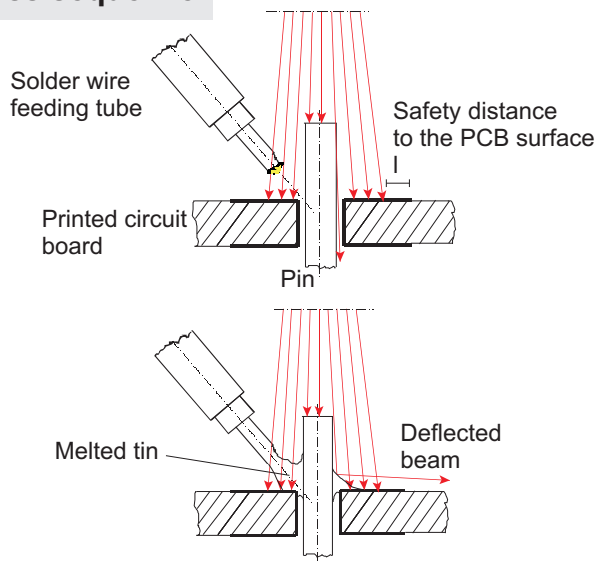
Different laser soldering processes are possible:

- Soldering with solder wire feeding using solder wire with flux core
- Reflow soldering with solder paste
- Reflow soldering of a solder depot

Diode lasers for soldering applications should meet following requirements:

- at least 30 W power and
- a focus point smaller than 0.8 mm.

Process sequence



Step 1: Pre-heating

The solder wire enters the range of the laser beam. The direct radiating heats the wire up close to melting temperature, not more. Otherwise the surface tension causes a "tin droplet" at the end of the wire.

If the laser beam hits the PCB outside the solder pad the surface of the PCB may get burned.

Step 2: Tin feeding

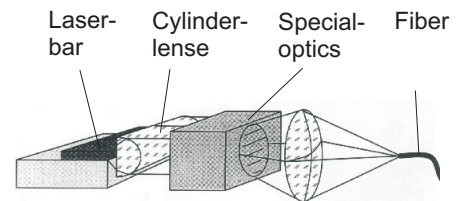
The solder wire which is close to melting temperature hits the solder spot and melts at the preheated solder pad and the preheated pin. If the solder pad and pin are not warm enough, the wire gets burred or bend and is not melted properly.

Step 3: Hold time

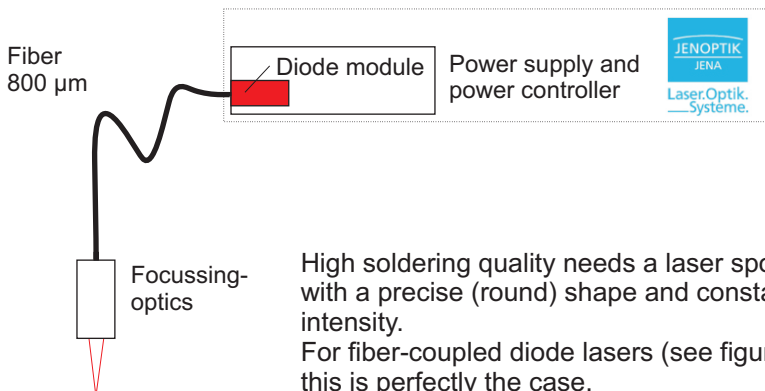
The solder wire is already melted. It now spreads to build the typical shape of a solder spot. Liquid solder has a significant lower absorption rate. It acts like a mirror. In this phase of the soldering process the laser beam can be partially deflected and can damage possible neighboring components or the plastic housing.

Diode laser

To focus the energy of approximately 30 W to a focus point of 0.8 mm diameter the beams of many single diodes must be bundled to the focus point. This is only possible with complex optics (see figure)

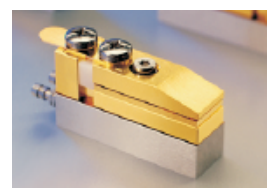


The beam of the laser diodes is at first collimated in one axis by a cylinder lens. In a second step the beam is coupled into the fiber by special optics.



High soldering quality needs a laser spot with a precise (round) shape and constant intensity. For fiber-coupled diode lasers (see figure) this is perfectly the case.

Laser diode bar assembly with Water cooling



Advantages

... Compared to iron soldering

- + Contact free
- + Low maintenance (no solder tip change)
- + Short soldering time
- + Precision soldering of very small solder spots possible

... Compared to selective soldering

- + Soldering from above - not from underneath. In many cases the part need not be turned
- + Higher flexibility
- + Separate pre-heating and flux application is not necessary
- + Nitrogen atmosphere not necessary in each case

Machines

Wolf laser soldering machines use high-power diode lasers from Jenoptik AG, Jena, which is one of the leading laser-diode producer. The laser soldering machines can have different structures:

- fully automatic in-line soldering cells
- stand alone soldering cell with manual loading.

All machines base on standardized Wolf production modules (see separate product info "Production Modules").

Depending on the specific soldering task Wolf laser soldering machines are custom made rather than multi purpose.

All machine components need little maintenance. The machines have a complete safety cover (laser class 1).

Wolf laser soldering machines meet the following specifications:

- Rigid machine structure and at the same time an outstanding machine appearance
- Easily programmable, precise motion axes
- Modulare structure
- Fume extraction integrated
- Control of important process-parameters
- Comfortable human machine interface (Teach-In of soldering positions possible)

Soldering tool

The main component of laser soldering machines is besides the laser source itself the soldering tool.

Since it is fiber coupled a very compact and leightweight soldering tool could be designed. The main components of the soldering tool are:

- Focussing optics have an integrated CCD-camera to set-up and observe the soldering process.
Additionally a pyrometer can be built in to monitor the temperature at the solder spot (Option).
- Solder wire feeder driven by a DC-Motor. with encoder to contol the feeding rate. The feeding length and feeding rate are programmable.
- Air-knife in front of the optics to prevent contamination by solder fumes and thereby a loss of laser power.
- Precision slides to adjust the critical "wire hits the solder spot" point.



Comfortable human machine interface with touch-screen



Safety cover (Laser Class 1) with observation window

Example



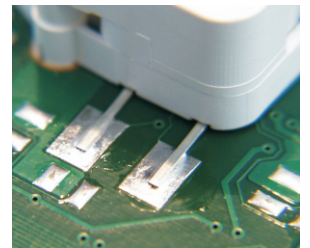
Synopsis of a custom made machine:

- Product: Winding of DC-motor (picture)
- Cycle time: 2,5s per solder spot
- Manually turned rotary index table
- Human machine interface with text display and touch panel
- Pre-heat station with hot air (Temperatur control with Phyrometer)



Further application examples:

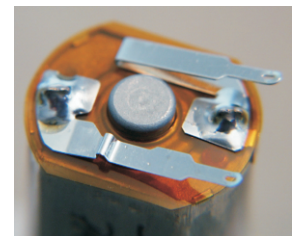
Odd component on PCB:
Reflow soldering of tin depot



Trough-hole component in PCB



Motor connectors



For more application examples please see our website

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Special Soldering

**Assembly
Automation**