CO₂ – Laser

High Reliability and Performance

FANUC Drives & Motors
GE Fanuc is a world leader in CNC technology and has long-term experience in developing complete control solutions for machine tools. GE Fanuc has also developed high performance and high reliability laser sources for industrial applications, featuring the latest radio frequency (RF) excitation technology. The main application of GE Fanuc laser sources is the integration into laser cutting or welding machines. Worldwide, there are now over 7,000 installations of GE Fanuc laser technology.

To enable customers to develop high performance laser machine tools, the GE Fanuc laser sources are supplied together with GE Fanuc CNC and servo motors as an integrated package.

The CNC controls all parameters of the laser source such as output power and pulse frequency. Operating conditions of the laser are closely monitored to assure highest reliability and ease of maintenance. As the CNC also controls servo motors and all functions of the machine tool, this has enabled the development of high speed, highly accurate laser cutting machines.

GE Fanuc lasers are compact, high performance and highly reliable CO₂ lasers with an output power range from 1 to 6 kW. They have been developed specifically for industrial applications like cutting and welding. Laser pumping by 2MHz RF discharge excitation has enabled size reduction, enhanced efficiency and power output stability. The sophisticated resonator design leads to a superior beam quality particularly suitable for laser cutting applications.
High Reliability Design Factors

Using radio frequency (RF) discharge excitation instead of conventional DC excitation leads to improved oscillation efficiency and output power stability.

Due to the discharge electrodes being attached to the outside of the discharge tubes, no contamination of the laser gas by electrode erosion can take place. Electrodes and discharge tubes are protected by ceramic coatings, which ensure long lifetime.

The RF power supply units are semiconductor based, using high power MOSFETs. They operate at 2MHz excitation frequency and produce excellent pulsing characteristics. Intelligent protection circuits, monitoring all discharge conditions, contribute to the outstanding reliability of GE Fanuc laser sources.

Photo catalytic elements and cyclone cleaner units are integrated counter-measures against contamination of the laser vacuum system. All kinds of gaseous and solid contamination are effectively removed by applying this sophisticated but simple technology.

GE Fanuc laser sources conform to all the latest international safety standards.

Ease of Maintenance

Historical data for maintenance purposes is logged and can be accessed via the CNC screen. This includes power compensation coefficient, current/voltage of laser PSU, status of laser, and run-time/maintenance-due-time of critical components.

The automatic aging function eliminates the deteriorated laser gas when the oscillator is not used for a long time or when the resonator has been opened.

The automatic leakage check function exhausts the resonator chamber to a vacuum and displays the change of internal pressure over time.

After switching on the laser, any decrease of output power is monitored. If it exceeds a preset level, a warning is displayed on the CNC screen to urge mirror cleaning.
High Performance and Functionality

The Package Solution

As the leading manufacturer of CNCs and servo motors, GE Fanuc offers a “laser-package” solution. Laser source, CNC and servo motors are integrated and interfaced as a complete system to optimize the machine performance.

All necessary laser control and diagnostics are integrated into the CNC. The laser source does not need a separate control. It communicates with the CNC by means of an optical bus system.

Advantages of such a consistent package solution are obvious:

- Very efficient start-up of laser machines. Interface problems are already solved ex-factory. No additional work to establish communication between CNC and laser source is necessary. All laser control screens are available on the CNC.

- Direct control of the laser source by the CNC allows simplified handling for operation and maintenance purposes. Special functions can be activated by digital switches. Laser parameters can be filled in by direct CNC commands. Upgrading the laser source with new functions can be realized by a simple software update.

- Control of laser and machine are always synchronized as this is carried out by only one processor. With this real-time connection between laser and CNC, many special functions, which represent a lot of expert laser application knowledge, are integrated into the laser package. Also, extremely high-speed cutting, for example when used with linear motors, can be achieved.

- Machine tool builders and users have only one contact for laser source, CNC and servo motors. GE Fanuc’s worldwide presence guarantees local access to application and service support.
**One Control System**

As the laser source is integrated into the CNC’s bus system, very efficient and secure communication has been achieved. This secure connection between laser source and CNC allows the integration of many useful laser processing functions. As a result, the “Laser CNC Series 16i-L” already contains a lot of expert laser knowledge ex-factory.

These special laser functions, here some examples, can be divided into three groups as follows:

1) Numerous diagnostic functions
   - Screens for all relevant laser source data (internal pressure, discharge voltages, output power...)
   - Automatic calculation and display of laser power coefficient

2) Processing parameter controls
   - Laser power as a function of feedrate
   - High speed piercing
   - Edge machining function

3) Special functions for efficient processing
   - Tracing axis control by means of an analog input
   - Sensor controlled piercing time
   - Beam length compensation

Although the 16i-L CNC is customized for laser applications, all the features of standard GE Fanuc CNCs can be utilized. Machine tool builder and user have access to all the tools of the world’s leading CNC manufacturer.

**Open CNC Option**

This option enables the connection of a personal computer (PC) to the Open CNC via a serial high-speed optical fiber interface, enabling the transfer of large volumes of data. The machine tool builder can easily implement unique functions and be flexible to the demands of individual customers.

The PC operates with Windows® or Windows® CE. The compact Windows CE operating system works without a hard disk, providing extreme reliability in harsh deployment conditions. Application software can be developed in a Windows® environment. The use of a PC enables individual operator control of CNC machine tools via a graphical user interface (GUI), and the interchange of large volumes of machine data on a plant network.
Control of Cutting Process

**Edge Machining Function**

The edge machining function is a very good example of the benefits of an integrated package solution. As soon as the CNC detects a sharp corner (the angle can be set as a parameter) laser parameters and feedrate are simultaneously adjusted. The edge machining function not only reduces power and feedrate but also performs an intelligent procedure. As a result, very sharp corners, especially in thick material, can be machined with high reliability.

**Total Power Control Function**

As the edge machining function has been designed to process sharp edges when cutting thick material, so the total power control function was developed to reduce thermal load when cutting thin material. Compared to a standard power control function, this function not only adjusts power, but also frequency and duty. This provides uniform and clean laser processing of corner radii especially in pulse operation.

**Tracing Function**

Effective laser cutting requires the application of a height sensing system to keep the gap between the cutting nozzle and workpiece surface constant. A height sensor can easily be connected to the laser machine as the Series 16i-L CNC provides an analog input to directly control a tracing axis.

Integrating the tracing circuit into the CNC offers several advantages:

- Activation of tracing mode by G-command
- Measurement of Z-axis position stays active during tracing
- Nozzle clearance is programmable
- Control characteristics can be changed by parameter settings
Beam Length Compensation

Different beam properties and diameters are a standard problem to cope with when designing a laser machine. Trombone mirror systems have been found to be the most efficient countermeasure against such problems. Unfortunately a purely mechanical realization of a trombone system can only compensate one axis.

GE Fanuc has developed a comprehensive CNC algorithm to control an additional trombone axis by means of a servo motor. Thus as many axes as are needed can be compensated for by only one compensation axis.

3-Dimension Processing Systems Option

To enable the configuration of a laser machine tool for 3-D machining, it is necessary to expand the number of CNC axes to control the nozzle attitude. With the GE Fanuc laser package it is possible to simultaneously control up to 6 axes. Nozzle attitude control can be achieved with both zero-offset and offset processing heads.

Other CNC functions that enable highly efficient 3-D laser processing include:

- Interaction control
- Teaching function
- Spacial circular and helical interpolation
- 3-dimensional coordinate conversion
- Spacial corner R insertion
- Proximity point search
- W-axis tracing control
- Manual operation in a hand coordinate system
GE Fanuc is one of the largest suppliers of motion control and metal cutting control technology in the world. To support our customers, we have created an extensive global support and service network. We offer a variety of support services and programs to help you get your GE Fanuc Laser and CNC up and running and keep it running at maximum productivity.

We staff our Telephone Help line with factory-trained engineers to answer your questions, isolate problems, and take the necessary steps to help correct them. With our after-hours and emergency support option, the help you need is available all day, every day. GE Fanuc service engineers provide a variety of custom, on-site services from system start-up, to custom service contracts.

GE Fanuc helps you get the most from your control products by providing expert training for your work force. From on-site application-specific training to customized training at one of our training facilities, all programs are staffed by experienced, factory-trained engineers.