

OpenCNC[®]

The future of CNC controls is here - and it's software.

MDSI 5 Axis

Req	0	Range	LOW	FREE	650
Cur	0				
Rpm	0				
Tool	0				
New	0				
Coolant	AUTO	OpStop	OFF		
Ppm%	100				
Rpm%	100				
Rap%	100				
Jog%	100				
Cycle	OFF	Hold	OFF		
Mode	JOG				

MDSI 12 POSITION

Axis	MachCoord	DistToGo
X	2.0000	0.0000
Y	2.0000	0.0000
Z	-0.6734	0.0000
A	8.2966	0.0000
B	0.0000	0.0000

MDSI 17 TOOL OFFSETS

NUM	Z	Sum
2	440	0.5000
3	8934	1.3750
4	1.9800	0.2500
5	7.1000	
6	3.892	

MDSI 17 MESSAGE

```
15:41:39
15:36:39
15:36:48 RUN mode
15:36:48 seMode 1
15:36:40 JOG mode set
15:36:40 seMode 0
```



Manufacturing Data Systems, Inc.

OpenCNC[®]

SOFTWARE CNC

OpenCNC At a Glance

- Servo loop entirely closed in software running on a standard computer
- Over a half-million hours in production. Running successfully at customer sites since 1993
- Soft CNC, soft PLC and HMI in one application
- No proprietary hardware or motion control cards required
- Microsoft[®] Windows NT[®] operating system
- Runs on a wide variety of lathes, machining centers, and gear hobs
- Collects, updates and shares real-time data automatically, without operator intervention, without specialty hardware
- Features open Application Programming Interface (API) for integration of third-party software

OpenCNC[®] software is a production-proven, unbundled, software CNC control built on an open architecture that enables manufacturers to integrate off-the-shelf hardware and software technologies to achieve flexible and agile world-class manufacturing. Unlike proprietary CNC controls, OpenCNC requires no proprietary hardware or motion control cards. Combining a soft CNC and soft PLC in a single application, OpenCNC is well suited for new equipment as well as machine control replacements.





The value of software-based control

OpenCNC software utilizes a minimal amount of off-the-shelf hardware to maximize your flexibility and manufacturing process creativity. An unbundled software CNC approach provides the end user and machine tool builder maximum choice. OpenCNC provides choice in hardware, software, data access/distribution and integration. This enables you to optimize the CNC control configuration for your unique manufacturing and machine tool application.

Only a robust, production-proven CNC control can meet the rigorous demands of manufacturing. OpenCNC has proven its reliability on the plant floor since 1993. OpenCNC offers several significant benefits including:

- lower control and life-cycle costs
- increased machine tool up-time and productivity
- incremental upgrades of control systems with technology advances
- integrated diagnostic tools
- simple and common approach to communication and networking
- reduced operator learning time
- increased return on manufacturing assets

Breadth of machine tool control applications

OpenCNC software provides the performance, functionality, reliability and accuracy for controlling and managing a wide variety of production machine tools, including two- and four-axis lathes; mills; three-, four-, and five-axis machining centers; millturns; hobs; and grinders. It can be used to control 'n' number of spindles, 'n' number of axes, 'n' number of inputs and outputs and 'n' number of Independent Job Streams.

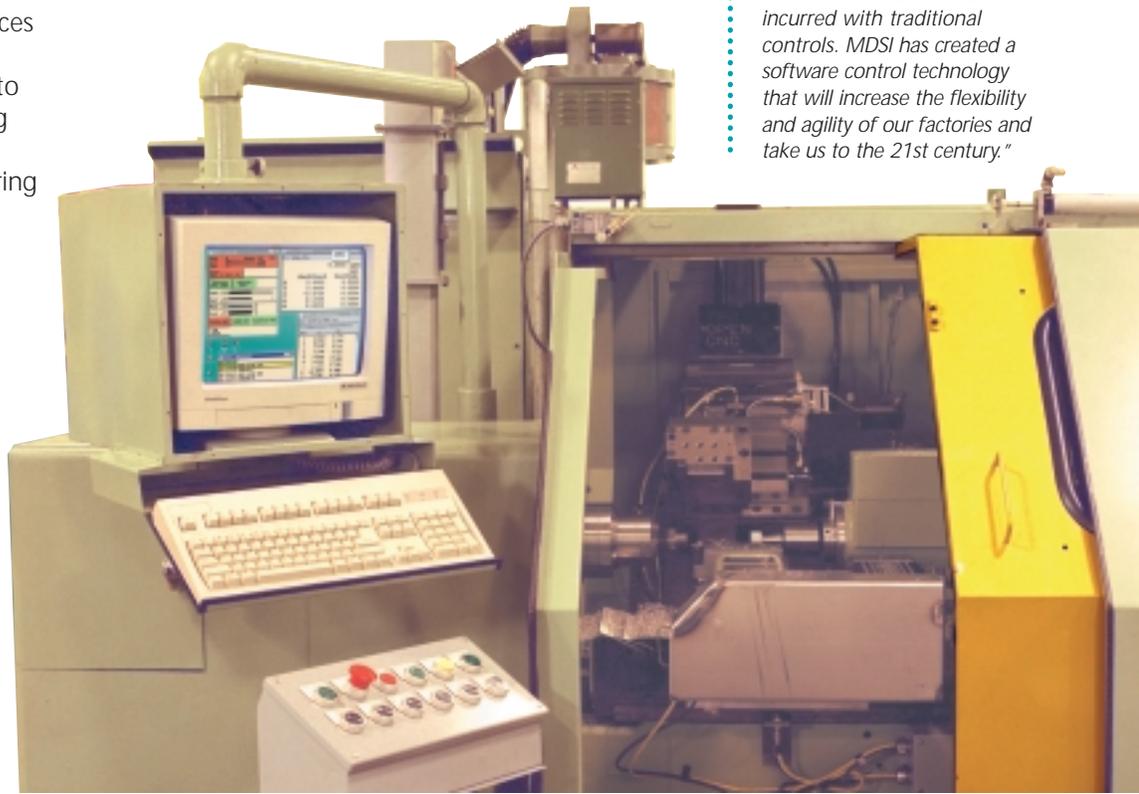
OpenCNC applications span virtually every industry that utilizes metal cutting or metal forming machine tools, including:

- consumer products
- automotive
- aerospace
- construction and agricultural equipment
- mechanical machinery

Tecumseh Products Company standardizes on OpenCNC

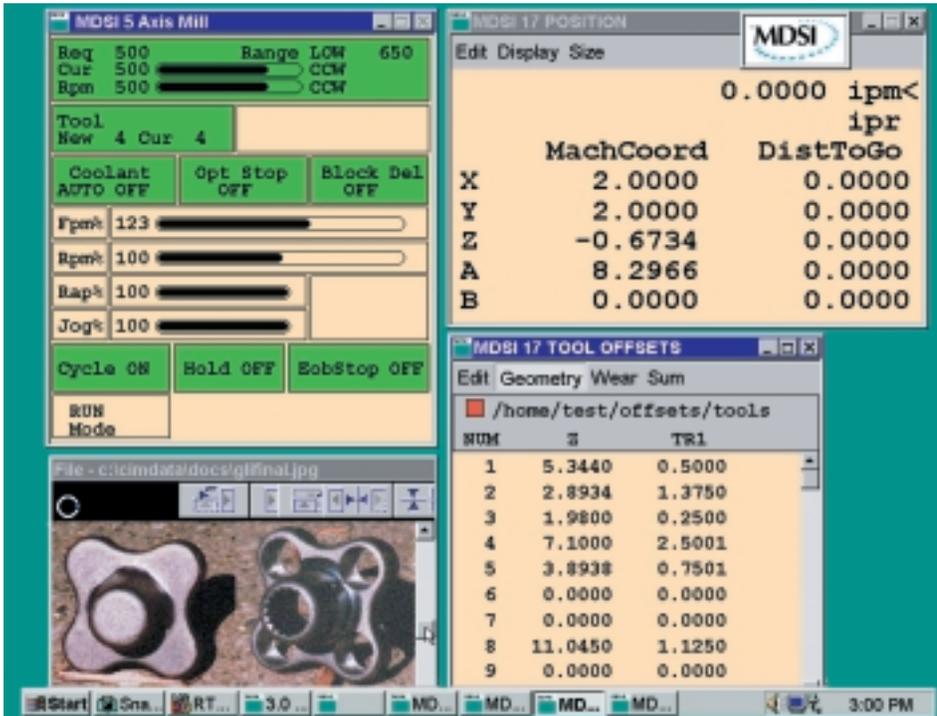
Tecumseh Products Company first put OpenCNC on a three-axis VMC in 1995. Three years and a dozen machines later, Tecumseh, a \$2 billion global manufacturer with 17,000 employees and 31 plants worldwide, chose to standardize its control technologies with OpenCNC. They will replace proprietary NCs and PLCs on new and existing machine tools - including lathes, mills, grinders, dial machines, and transfer lines, worldwide.

"OpenCNC has run tens of thousands of hours in Tecumseh plants," said James F. Curley, corporate director, manufacturing engineering, "and has proven to be a reliable, quality product. Because OpenCNC's open architecture allows us to standardize across all types of machines, we'll cut costs to a fraction of those incurred with traditional controls. MDSI has created a software control technology that will increase the flexibility and agility of our factories and take us to the 21st century."



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From backlash and leadscrew compensation to cutter radius compensation, OpenCNC has the tools to get the job done.

The functionality manufacturers need

OpenCNC provides the breadth and depth of machine control functionality required by manufacturers. It supports RS-274D standard part programming and is fully compatible with all major NC programming systems. Support for turrets and tool changers is standard.

OpenCNC incorporates a soft CNC and soft PLC in one application. It includes the following modules:

- human-machine interface (HMI)
- machine diagnostics tools
- soft PLC
- software motion control
- real-time data collection and distribution

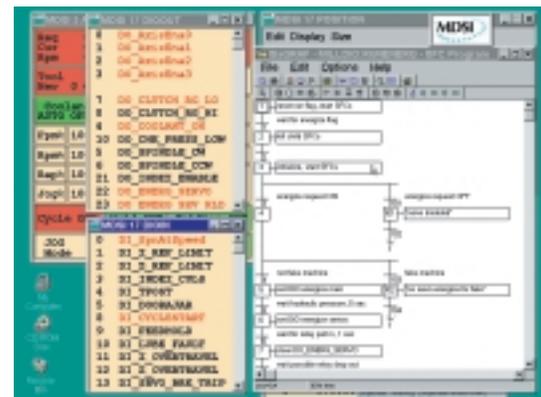
It performs all of the real-time tasks such as linear, circular and helical interpolation, cutter radius compensation, velocity feed forward and 'S' curve velocity profiling in software.

Standards reduce machine control costs

There are several benefits to an open architecture approach based on the PC platform. Because so many applications are developed for or interface to the PC, you can mix and match hardware and software options from different vendors. This gives you the flexibility to adjust your control platform incrementally.

OpenCNC on Microsoft[®] Windows NT[®] with real-time extensions allows users to access the thousands of Windows-based software applications and link them directly to the machine tool, providing the data and tools necessary to improve manufacturing processes and productivity. And, unlike other CNC controls, it does this all on a single operating system — Windows NT — running with a single Intel[®] processor, in a single PC.

The use of commercially available computer technology enables MDSI to reduce machine control system and life cycle costs and increase reliability and expandability. As the performance of PCs continues to increase, so will your machine tool — without any changes to the software.



Programming standards IEC-1131-3 and RS-274D are supported by OpenCNC.



Easy for any operator to learn or use

OpenCNC software supports a range of operator control interfaces: color touch screen, keyboard, machine buttons, or pendant. The machine can run completely from the touch screen, or it can be supplemented by additional hardware buttons or pendants.

Optimized for ease of learning and use, the interface lets users customize or add functions to the software without adding hardware. The interface can also be tailored for the type of operator: production, set up, machinist, or maintenance.

You can use the standard machine control user interface provided with OpenCNC, or you can modify it to meet your needs. In addition, you can decide the presentation of machine control functionality. You can also select which functions are available to individual users.

Maintenance and diagnostics tools keep machine tools in operation

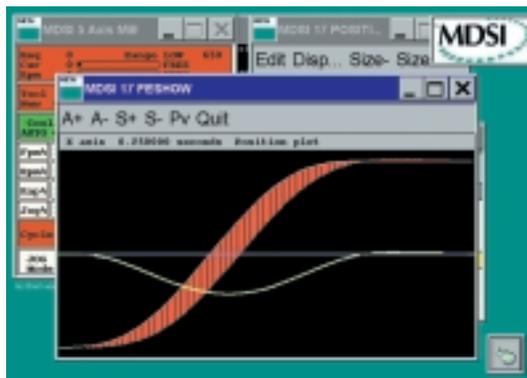
With today's pressures to reduce costs, increase quality and reduce time to market, the time required to design, integrate, and maintain machine tool control systems has a significant impact on a company's ability to compete. Manufacturers can't wait days or weeks for an outside service organization to get their machine tool control operational. They need to solve the problem immediately and get the machine back into production.

With OpenCNC, hardware components conform to industry-standard PC interfaces. As a result, control hardware among machine tools is interchangeable; there's no machine-specific firmware on any component.



The touch screen operator interface leverages the concept of soft control buttons versus hardware buttons.

OpenCNC also provides software tools to perform system integration, maintenance and diagnostics. The ability to use these tools while running a part program helps you find and solve problems that occur only when the machine tool is cutting a part. This allows you to get the optimal machine tuning and thereby improve part quality and reduce cycle times.



OpenCNC's diagnostic tools can be used during start-up or while the machine tool is running to debug or troubleshoot electrical and mechanical problems.

NUCON chose OpenCNC for complicated parts

NUCON Corporation, a specialty manufacturer of parts for the aerospace industry, is one of the few manufacturers in the world capable of machining complex impellers and turbines. Machining times are typically measured in weeks. OpenCNC was installed on a Sundstrand five-axis Omnimill in 1996. Thanks to OpenCNC's robustness and reliability, there have been no control-related down-times during the long machining cycles.

"We have very specific requirements for our manufacturing process," said David L. Stormont, NUCON's president. "OpenCNC was able to meet those requirements. By virtue of its openness and design, where functions are in software rather than hardware, OpenCNC provides the flexibility we need to grow and to integrate our other unique technologies. You can change a software program easier than hardware. OpenCNC is a technology door to the future."

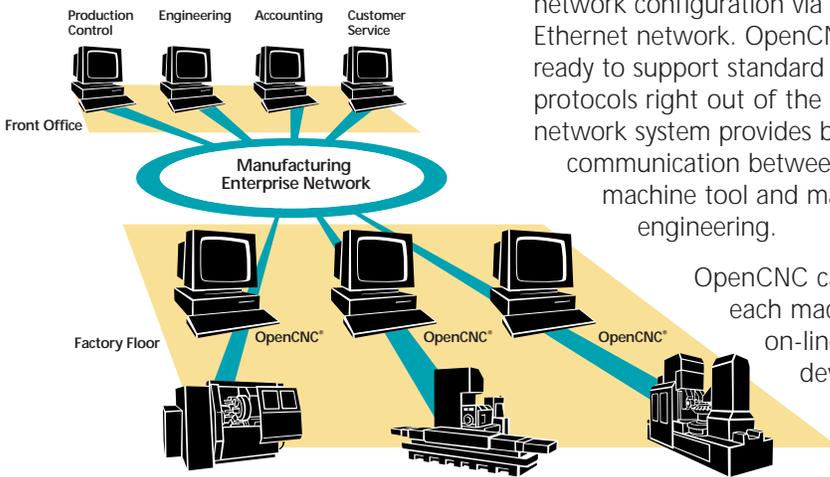
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Network distributed machine control

OpenCNC can be implemented as a network or stand-alone control system. You can start with a stand-alone configuration and later create an OpenCNC network configuration via a standard Ethernet network. OpenCNC comes ready to support standard networking protocols right out of the box. The network system provides bi-directional communication between the machine tool and manufacturing engineering.

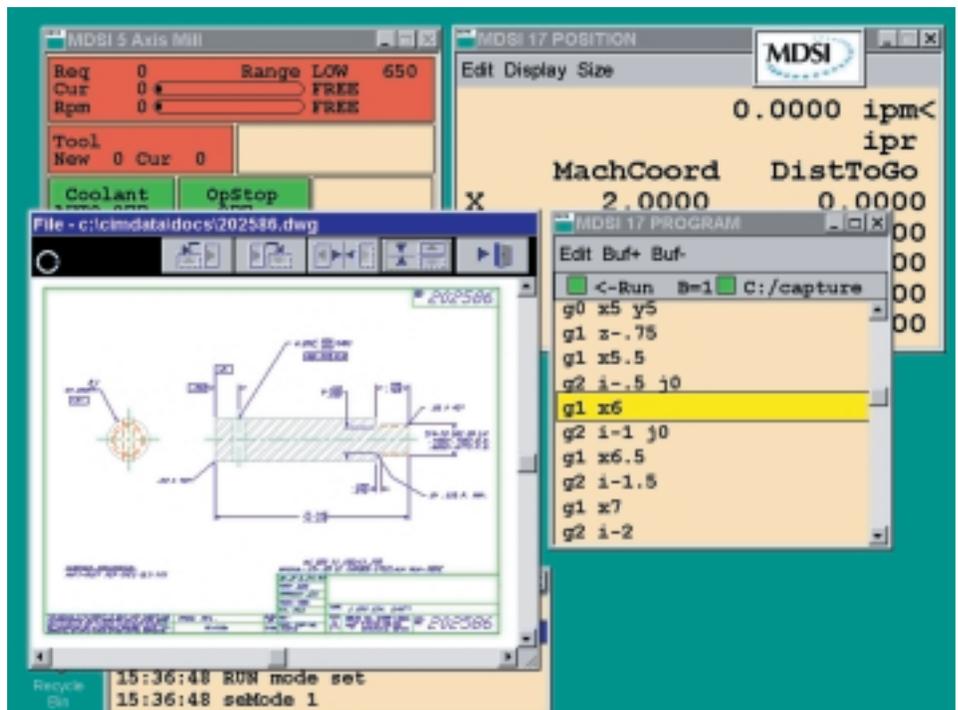
OpenCNC can make each machine tool an on-line peripheral device of a PC



or workstation. This can be networked to a server PC, other engineering and manufacturing management PCs, and other machine tools, to enable flexible and agile manufacturing.

An integrated DNC capability gives your operators the ability to download part programs and associated tool and fixture offsets. No longer will they have to wait to be given the next part program.

In a network implementation, each machine tool can communicate to a server, providing feedback related to machine tool performance. By integrating machine tools in an open network environment, real-time manufacturing process improvements can be achieved.



Network users can download part programs or CAD drawings or upload machine status information.



Real-time machine event reporting

Only with timely and accurate information can manufacturers take corrective action to improve production processes and increase productivity. If you cannot measure it, you cannot manage it.

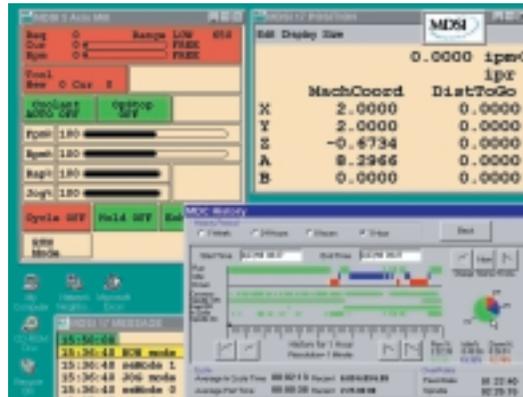
With OpenCNC, manufacturing management, engineers and machine operators can collect and distribute machine tool manufacturing process information in real time — automatically, without human intervention, without specialty hardware — and make it available across a company network.

With its patented real-time database technology, OpenCNC collects an unlimited range of data types or Significant Events™ from the machine tool during its operation. This includes production, quality and maintenance data, which can be transferred automatically to product planning and scheduling or computerized maintenance management systems.

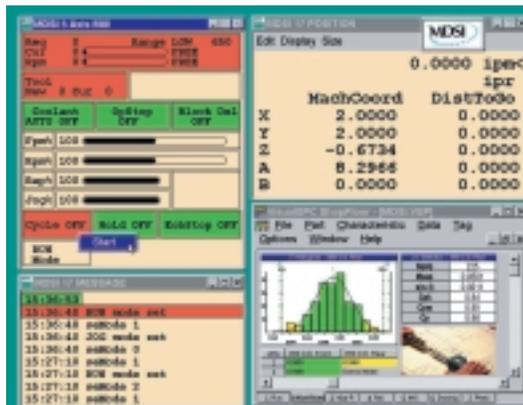
Flexibility to add new functionality

With OpenCNC's modular architecture, MDSI can rapidly add new capabilities and deliver regular functionality updates to all supported machines. The open architecture also allows users to easily add or upgrade controller functionality. As a result, all OpenCNC controls will work the same regardless of when they were installed — unlike proprietary "black-box" CNC controls.

Through the OpenCNC Application Programming Interface (API), users can easily add new functionality or customize OpenCNC for your specific machine tool application. In addition, the user can



OpenCNC includes robust real-time event reporting.



With OpenCNC's API, you can automate manufacturing processes, integrate third-party applications or develop new machine tool applications.

tailor or build a new graphical user interface with Microsoft® Visual Basic®.

The control logic can be developed or modified with an integrated off-the-shelf PLC logic editor. The control PLC can be programmed with any or all of the IEC-1131-3 standard languages.

This includes:

- ladder logic
- sequential function charts
- instruction list
- function block diagram
- structured text

On the cutting edge of technology

Dana Corporation's Spicer Clark-Hurth Off-Highway Components Division installed MDSI's OpenCNC on a Warner Swasey 2SC two-axis lathe as a result of persistent problems with the machine tool's former proprietary black box CNC control. Satisfaction with performance after OpenCNC is 100%. Dana Corporation has since started a multi-year program to upgrade numerous machines in the Statesville, NC plant to OpenCNC.

"With OpenCNC, I can manipulate the machine any way I want," said Thomas N. Payne, CNC electronics technician. "I can add value and function. I'm not closed out as I was before. It gives me a chance to be right on the cutting edge of where technology is. When they talk about Bill Gates, Java, Internet, I know I'm there. And so are my operators. This is where it starts."

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Service, support and training

MDSI is dedicated to meeting your application support needs and is constantly upgrading the OpenCNC software and documentation to better serve you. With more than a quarter century of experience in CNC technology, nobody understands the needs of manufacturing better. We want to be your supplier today and tomorrow—and you can be assured that the quality of our service will reflect this commitment to a long-term business relationship.

MDSI provides a variety of training options, including classroom training or user-paced multi-media training tools to build customer independence and confidence. The training includes installation, soft logic development, software configuration, diagnostics and networking.

For more information on OpenCNC, contact Manufacturing Data Systems, Inc. Or, visit our Web site at www.mdsi2.com.