Mitsubishi CNC "E80 Series" to Meet Needs of Emerging Markets

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1. Introduction

In recent years, the demand for processing smartphone parts has been increasing in Asia and sales of midpriced machine tools, such as tapping centers and machining centers, have increased. Mitsubishi Electric Corporation's CNC has been well received and its market share has grown. Mitsubishi Electric aims to develop products that match market needs and has been developing CNC machines for high-grade and moderatepriced machine tools as well as mid-priced machine tools.

In 2014, we released the CNC M800/M80 series. For this series, we developed high-value-added functions (e.g., 5-axis machining and combined machining functions) for high-grade machine tools by leveraging its functional expandability. The series is highly reputed by users for processing performance and operability, including in the mid-priced machine market. Meanwhile, in the moderate-priced machine tool market, there is high demand for cost-effective machine tools with a simple configuration. To satisfy such needs, we have developed the CNC E80 series.

This paper describes the functions of the E80 series.

2. E80 Series

2.1 Positioning of the E80 series

Mitsubishi Electric provides various models in the CNC series: high-performance CNC M800 series for 5axis machines and combined lathes that are used for complicated processing (e.g., processing of aircraft parts) and standard CNC M80 series for machining centers and multi-system lathes that are used to process dies and precision parts. The E80 series is a highly costeffective CNC that is optimum for machine tools with a simple configuration, such as simple machining centers that process smartphone cases and 2-axis lathes and lathes with milling function that are used to process automotive parts (Fig. 1).

2.2 E80 series system configuration

The E80 series is a control unit with an integrated display and is a successor to the conventional model of the E70 series. As shown in Fig. 2, the E80 series provides high-speed optical communications with Mitsubishi Electric's high-performance drive units as is the case with the M800/M80 series. The E80 unit can

also drive a spindle through analog connection to an inverter. In addition, the series features a secure digital (SD) card slot as standard and provides two types of sheet keyboards: one for lathes and one for machining centers (Fig. 3). The thickness of both display and keyboard is just 9.5 mm, which expands the possibility of machine tool design thanks to the flat shape.

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2.3 Performance of the E80 series

The E80 series equipped with a CPU specific for CNC with high-speed processing capability equivalent to that of the M800/M80 series offers the following: high processing capability for processing programs to boost



Fig. 1 Positioning of E80 series

productivity; and programmable logic controller (PLC) processing capability for processing large ladder programs at high speed. These capabilities reduce the cycle time and deliver high-accuracy processing. Compared to the E70 series, the segment processing capability of the E80 series is double that of the E70 series, the PLC processing capability is nine times, and

the communication capacity between the NC and drive unit is three times, as shown in Fig. 4.

3. Characteristic Functions of the E80 Series

This section describes the functions that contribute to the high performance of the E80 series: improved

E80 series







Fig. 3 Display and sheet keyboard size



[k blocks/min]

Fig. 4 Performance comparison between E80 series and E70 series

cost-effectiveness of machine tools, ease of use, and IoT compatibility.

3.1 Expanded analog interface spindle function

In the moderate-priced machine tool market, the cost of some machine tools is reduced by installing spindles that are driven by inverters that are connected by analog in place of drive units (Fig. 5). Previously, when this type of machine was used for tapping, the feed axis for driving the drive unit could not be synchronized with the analog interface spindle and so a tool with a special expansion and contraction mechanism was required. The E80 series can perform high-accuracy synchronized tapping even with analog interface spindles thanks to the improved analog output commands. This improvement makes machine tools highly cost-effective.

3.2 Development of a function for multi-head processing machines

Multi-head processing machines are highly costeffective machine tools that can process multiple works of the same type at the same time (Fig. 6). For the E80 series, a multiple-axis synchronization control function has been developed for multi-head processing machines. Previously, only two feed axes could be controlled in synchronization, whereas this new function enables synchronization control of three axes or more. In addition, the tool length of each axis can be corrected for operation based on the tool length of each Z axis, which makes it possible to process each work highly accurately.

3.3 Functions for various machine specifications

Recently, in the moderate-priced machine tool market, high-quality and high-accuracy processing has been demanded. Such needs are naturally high for simple machining centers and lathes with a milling function. The E80 series has high-accuracy control, Super Smooth Surface (easySSS) control, and tolerance control functions as user-friendly functions for highly accurate processing to ensure excellent ease of use.

The high-accuracy control function prevents a corner from rounding and a circular arc from becoming smaller than the commanded one by reducing differences between a path commanded by a processing program and the actual machining path (Table 1).

The easySSS control is a function that can utilize the SSS control provided on the M800/M80 series by performing simple setting operations. The control judges a processing program globally to reduce vibration due to local changes on the path and moves the tool smoothly, which realizes high-quality processing (Fig. 7).

For the tolerance control, only the tolerance needs to be specified. The tool then moves smoothly within the processing scope. Even if a processing program contains



Fig. 5 Inverter drive spindle connection

unnecessary level differences of segments and noise, the control realizes smooth processing (Fig. 8). In addition, since the function moves the tool while removing such unnecessary levels, the cycle time is reduced.



Fig. 6 Same shape processing with multi-head processing machine

3.4 Expansion of program editing and customization functions

The interactive cycle insertion function improves ease of use. This function supports work planning by making the operations as intuitive as possible. Simply specify the processing shape and dimensions on the screen, and the function automatically creates a processing program. This function has many cycles and so can cope with various types of processing. It can also be customized, for example, by adding a cycle insertion screen unique to a machine manufacturer and by hiding unnecessary cycles (Fig. 9). This function makes machine tools easier to use.





Fig. 7 Processing path and processing result when easy SSS control is enabled and disabled

3.5 Functions that support optimization of manufacturing

FA systems are rapidly becoming IoT-enabled. Mitsubishi Electric has been proposing "e-F@ctory," which optimizes the entire manufacturing by connecting all equipment and facilities to the IoT and analyzing and using data. The E80 series has many functions that support IoT; this section describes field networks and a function for email notification to operators.

3.5.1 Field networks

CC-Link that can be used for many types of

products, from wire-saving to safety equipment, and CC-Link IE that links control systems at high speed and high capacity, have been used at manufacturing sites with e-F@ctory. The E80 series is also compatible with these field networks (Fig. 10). The series is also EtherNet/IPenabled, and so can be combined with various generalpurpose Ethernet devices and CC-Link IE Field that can transmit large volumes of data at high speed.

3.5.2 Function of email notification to operators

The function of email notification to operators emails the operation status of a machine from numerical control







Fig. 9 Interactive cycle insertion and customization.



Fig. 10 CC-Link connection



Fig. 11 Email notification to operator

(NC) automatically at the time preset on the NC (Fig. 11). By specifying transmission conditions (e.g., time and alarm), destinations (email addresses) are automatically registered. Therefore, the status can be checked on PCs, smartphones, and various other terminals. Since the function requires only a simple network environment and Simple Mail Transfer Protocol (SMTP) server, environment settings are easy and the machine operation status can be monitored from anywhere, thus reducing downtime in an emergency.

4. Conclusion

This paper described the CNC E80 series. Although the needs for machine tools are continuously evolving, the E80 series satisfies such needs and provides a foundation for manufacturing around the world. We will keep developing products that match market needs in the future.