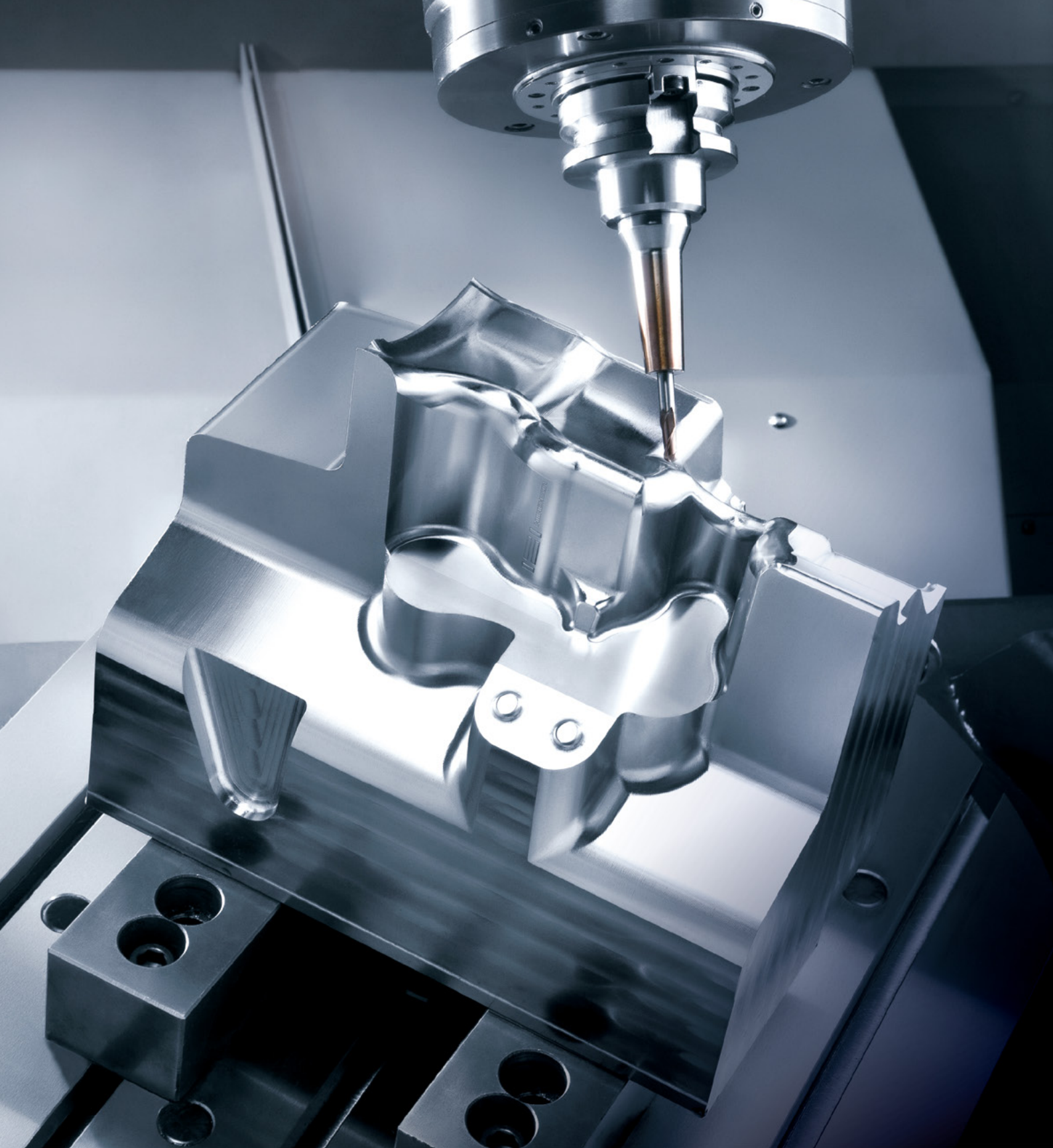
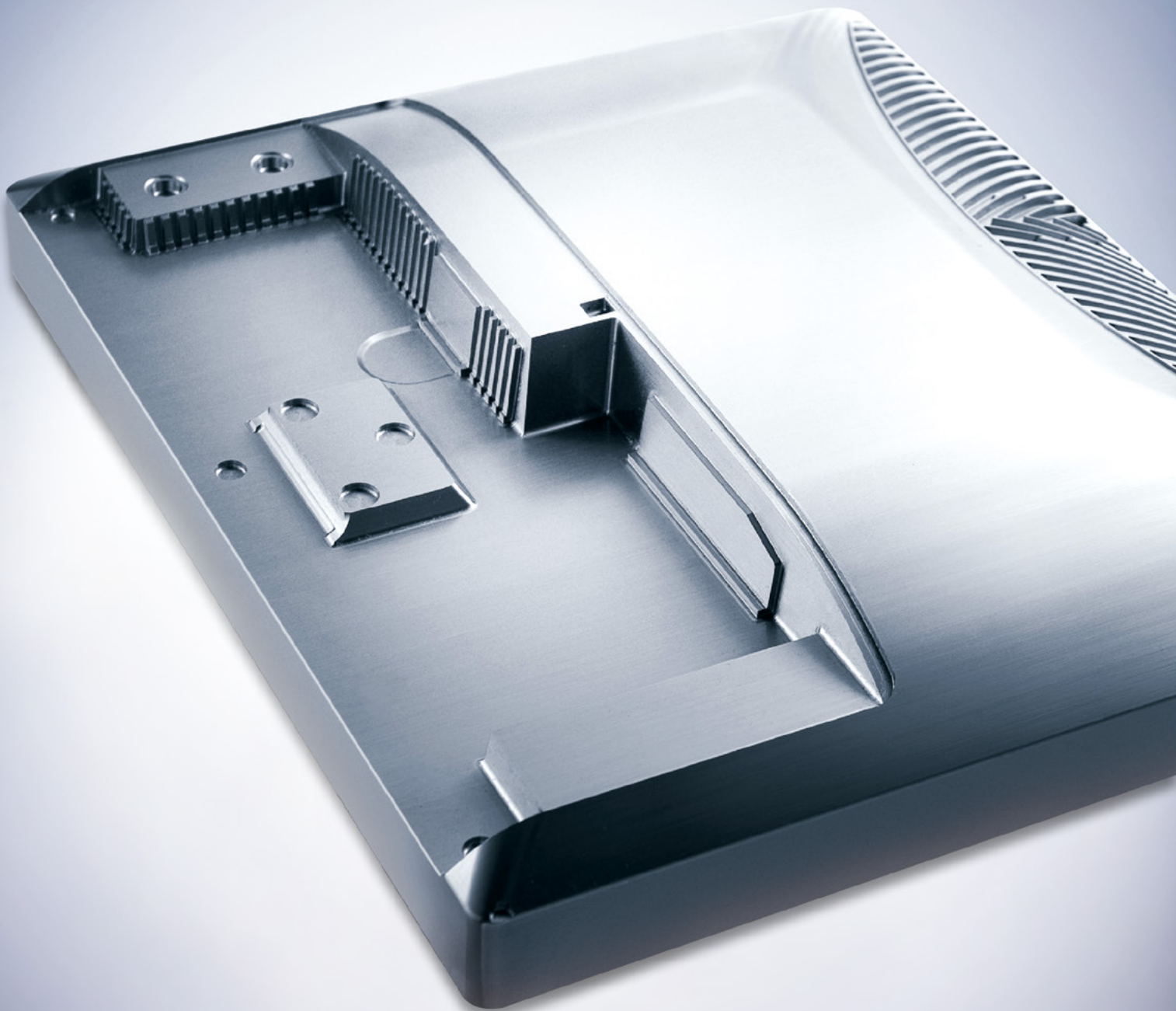




# M2-5AX

Total Solution 5-Axis Universal Machining Center



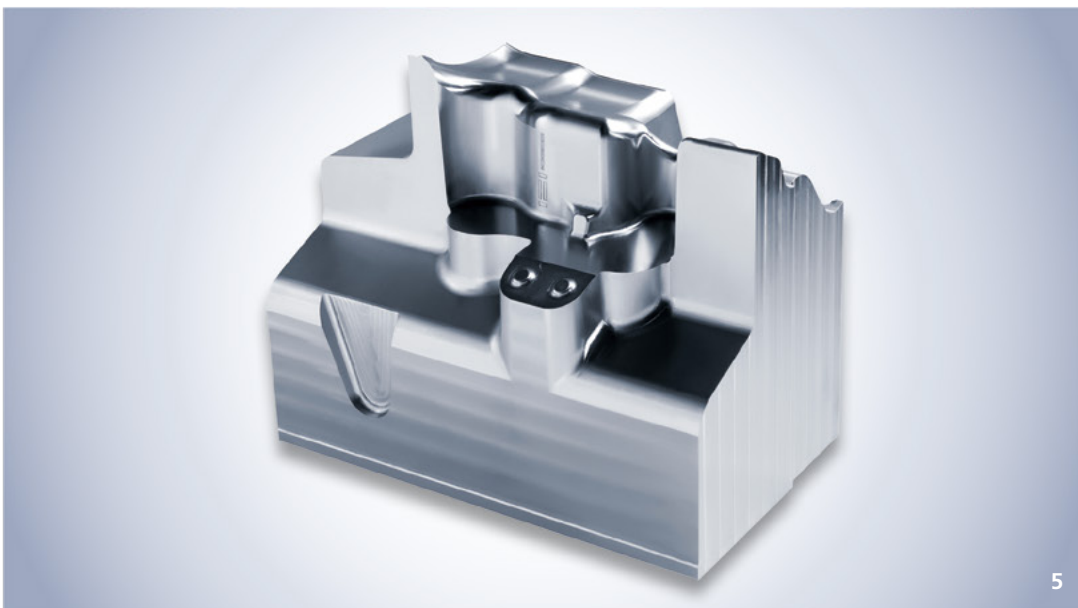


# 5-AXIS UNIVERSAL MACHINING CENTER WITH TOTAL SOLUTION

**This highly precise machining center is capable of performing 5-axis machine on entire production process with a single setting**

Hwacheon M2-5AX can work on a complex workpiece which requires many different production processes with just a single setting. Coupled with the Hwacheon Total Solution, it is the ultra-precision 5-axis production solution you've been looking for everything from tool selection to final product.

1 LCD Back Cover (Core) / Home appliances / NAK80    2 Mission Case / Automobile / KP4M    3 Head Lamp / Automobile / KP4M  
4 Part or Head Light / Automobile / KP4M    5 Slide Core / Automobile / KP4M





# HWACHEON TOTAL SOLUTION MEETS MACHINING EXCELLENCE

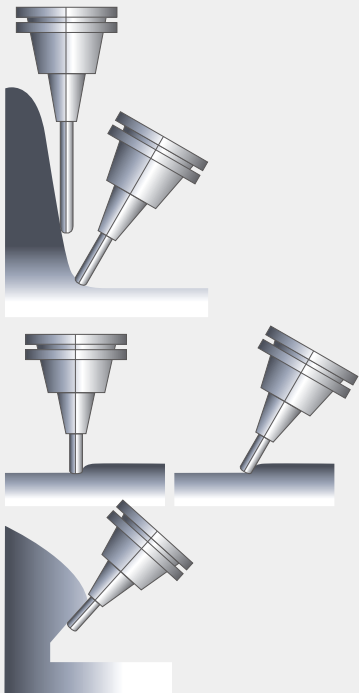
**Find out what we mean by machining optimization**

**Hwacheon's universal 5-axis center gives you the total machining solution- everything from tool selection to final product.**

Also, the Machining Optimization system configures itself to fit your machining condition and application to give you the best product result. The 2-axis rotary table at ø500 lets you create a product either by 5-axis or 3+2 axis processing method.

M2-5AX is built from 3D FEM analysis, and the software components specially created in-house by Hwacheon will increase the machine's productivity and process speed. The machine comes with many functional options that will make your production more efficient.





### Highly efficient multi-axis machining

Not only can a 5-axis machine move in the same three directions of a 3-axis machine, but the cutting tool can also rotate to approach the work from any direction, enabling easy access to the undercuts that a 3-axis machine can't reach. Also, the end mill sweeping provides significant savings in machining time up to one fifth of the time it would take for the ball-end mill to be fed back and forth along a curvilinear path at close intervals when producing complex three-dimensional surfaces. Another benefit behind a 5-axis system is that the length of the tools can be compact, which used to be made longer to match the size and shape of workpieces; and the cutting is done with the side of the ball end mill, not just with the tip of it, which increases the life of the tool and results in the cut surface that is ultra fine.

### Spindle assembly

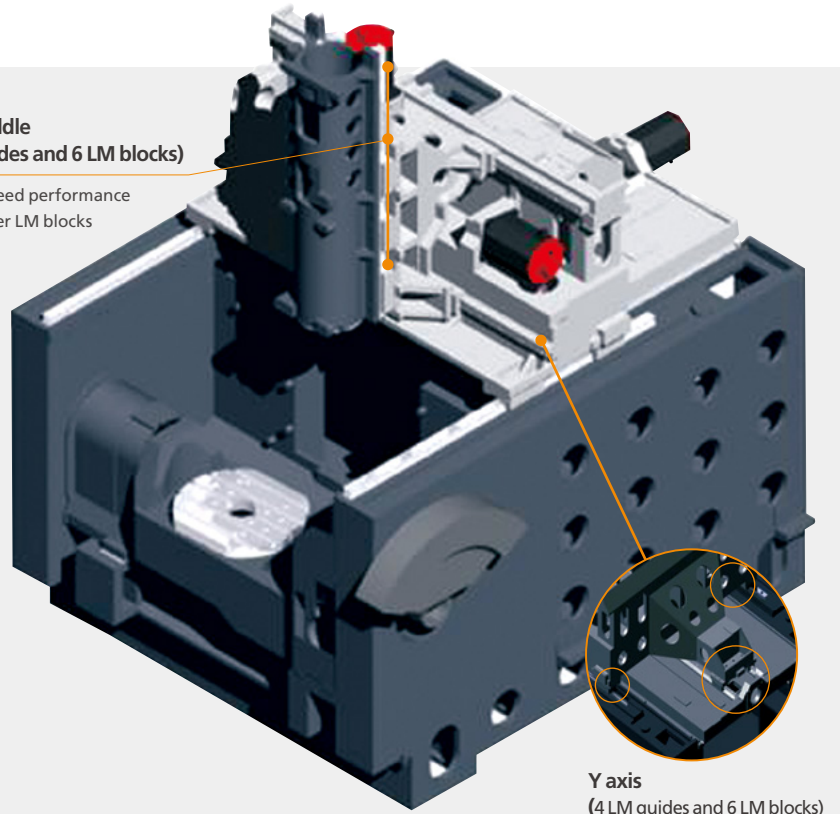
The Hwacheon clean room assembly facility, where the super-precision, super-speed spindle built inside M2 is manufactured, maintains optimal temperature and humidity, and is kept free of any foreign substances. Only the most skilled master engineers are allowed in the assembly facility, in the production of only the best equipment to comply with the toughest quality standard in the industry.

### Oil-jet Cooling System

The jet of oil is injected directly onto the spindle bearing for effective cooling, and the motor and the spindle assembly are jacket-cooled to limit the displacement caused by heat.

### Z-axis saddle (2 LM guides and 6 LM blocks)

Powerful feed performance from 6 roller LM blocks



### Y axis (4 LM guides and 6 LM blocks)

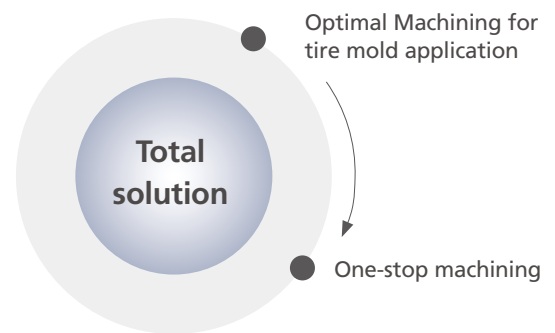
### High-precision gantry design

The base frame includes two wide columns to achieve unibody stability, and the machine has adopted the gantry-type feed drive whose axial system travels over the base frame in three different directions along the X, Y, and Z axes. This design helps the machine to maintain rapid yet precise feedrate, and constant control performance regardless of the workpiece. The Z axis is firmly supported by 6 LM blocks; and for the Y axis, 6 LM blocks are triangle-positioned on 4 rails, in attempt to maximize feed drive rigidity.



# UTILIZATION OF OPTIMAL MACHINING SYSTEM FOR THE CREATION OF TIRE MOLD

"Optimal Machining" is a part of Hwacheon's Total Solutions, and the Optimal Machining System increases the productivity by up to 200%. From setting up a tire mold to quality inspection, the whole process can be achieved in one stop process. This was made possible with the creation of proprietary machining software for the purpose of making tire molds. The result Lowered worker dependency and defect rate; and increased product quality and productivity.



## ① Benefits

Increased productivity with "One-stop Machining."

Set-up is easy even for the most complex shaped workpiece.

Less dependent on the operator's skill

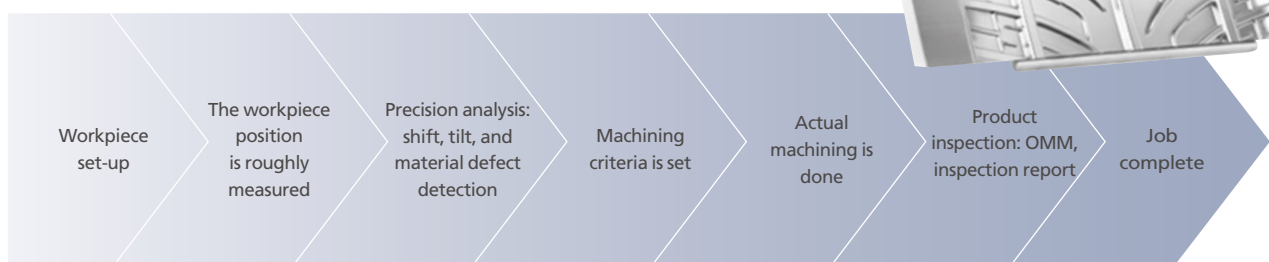
Less work load per worker = increased productivity

Defects are easily identified and found

Reduced product defect

## ② Process

In the tire mold machining process using a 5-axis machine, a casting material is virtually measured, and then the setup deviation is automatically calculated and corrected before actual machining.







# MACHINING SOFTWARE

## The Hwacheon Machining Software Components

The Hwacheon's developed machining software monitors different variables related to the work environment and machining conditions automatically makes adjustments for best quality results and optimum work efficiency.

## + RELIABILITY

### HRCC

#### Hwacheon Rotation Center Calibration System

Hwacheon's Rotation Center Calibration System automatically measures and sets the reference point of pivot in a 5-axis machine in under one minute, to lower the workpiece setup time and increase the machining quality. The system also creates and manages a database of the reference points for different temperature and time to limit the deviation of the rotation center.

**HRCC™**

Hwacheon Rotation Center Calibration System

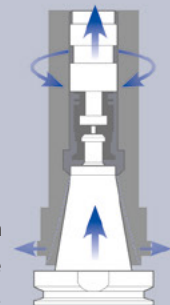
### HSDC

#### Hwacheon Spindle Displacement Control System

When the spindle rotates at high speed, the centrifugal force drives the taper to expand, causing errors in Z axis. HSDC constantly monitors the temperature at each spindle region and makes optimal prediction for thermal displacement. The system then makes necessary adjustments and effectively minimizing thermal displacement.

#### Static displacement compensation

The HSDC system corrects the Z-axis error occurring from the taper expansion during the spindle's high speed rotation.


**HSDC™**

Hwacheon Spindle Displacement Control



## PRECISION +

**HTLD****Hwacheon Tool Load Detect System**

HTLD constantly monitors the tool wear to prevent accidents, which may occur from a damaged tool and help to stop tool wear from deteriorating the workpiece.  
(The load is measured every 8 msec to ensure accuracy)

**HTLD™**  
Hwacheon  
Tool Load Detect

**HECC****Hwacheon High-Efficiency Contour Control System**

HECC offers an easy-to-use programming interface for different work-pieces and different processing modes. The system provides a precise, custom contour control for the selected workpiece, while prolonging the life of the machine and decreasing process time. The customizable display provides real-time monitoring and quick access.

- Program offers different options for different cutting speed accuracy and for roughness and shapes.
- The customizable display provides real-time monitoring and quick, easy access.
- The program is executable on an existing NC DATA system and works with the G Code system.

**HECC®**  
Hwacheon Efficiency  
Contour Control

**OPTIMA****Cutting Feed Optimization System**

OPTIMA utilizes an adaptive control method to regulate the feed rate in real time, to sustain the cutting load during a machining process. As a result the tools are less prone to damage and the machining time is reduced.

**OPTIMA™**  
Cutting Feed  
Optimization



## SPEED +

# USER FRIENDLY DESIGN, A WIDE RANGE OF OPTIONAL FEATURES

M2-5AX offers user friendly design and a wide variety of useful options for practical applications, so you can concentrate on what you do best: creating quality products- without losing your valuable time to the worries of machine failure and safety. A wide variety of performance upgrade options are available for faster, more precise machining.



## **Hwacheon Rotation Center Calibration System-HRCC (Option)**

Hwacheon's Rotation Center Calibration System automatically measures and sets the reference point of pivot in a 5-axis machine in under one minute, to lower the workpiece setup time and increase the machining quality. The system also creates and manages a database of the reference points for different temperature and time to limit the deviation of the rotation center.

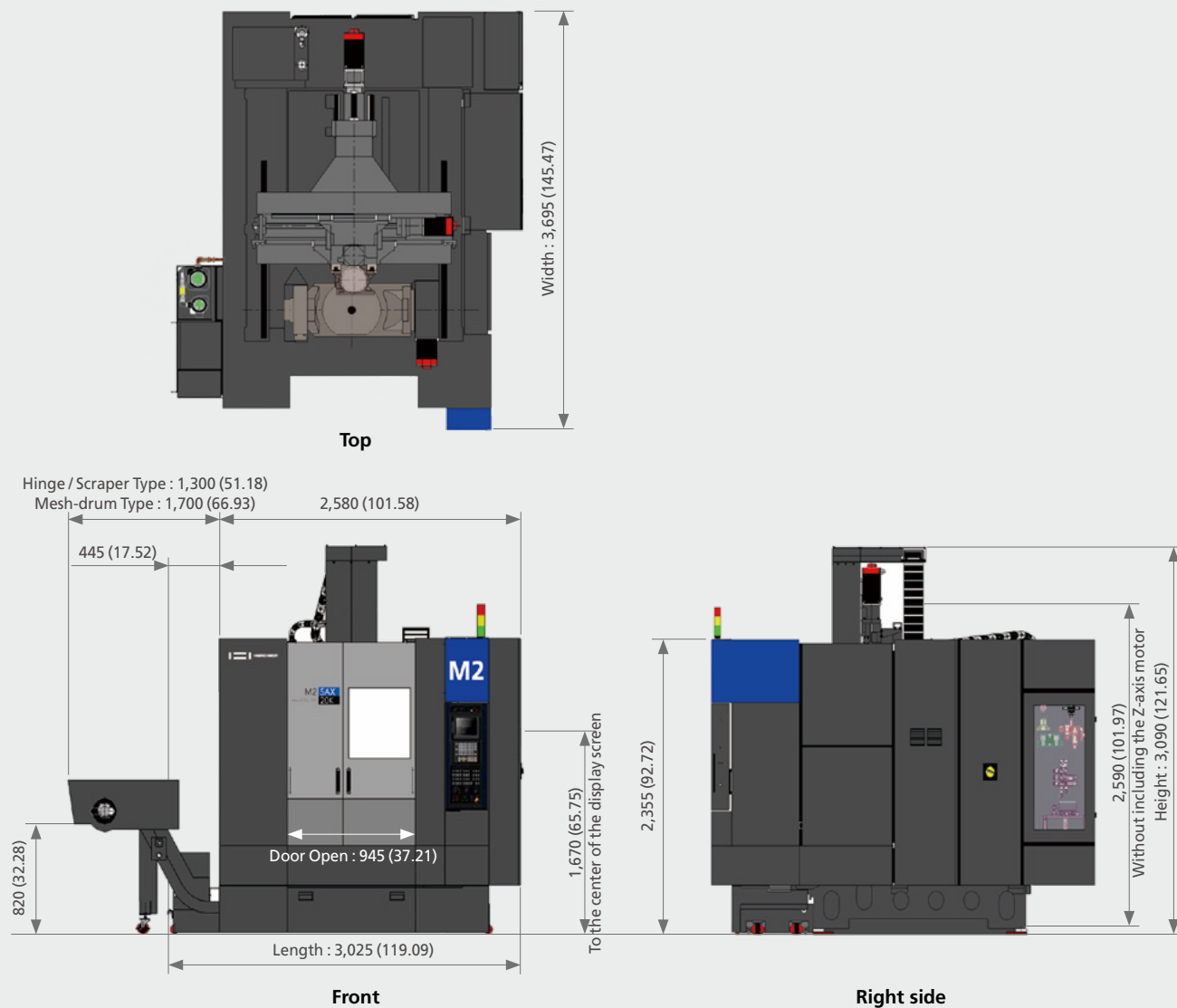


## **2-Axis Tilting rotary table for extra stability**

The 2-axis rotary table secured on top of the base frame is installed separately from the gantry-type X, Y, Z 3-axis feed drive to rotate the workpiece uninterrupted from the rapid on the linear axis. The fixed OTT worm gears and rotary encoder allow for 0.001 degree of high-precision angle division and consecutive rotation cut; and the powerful hydraulic brake system with 4,670Nm of force provides the rigidity more than sufficient for any 3+2 axis job. As an option, the table can incorporate up to 6 grooves for hydraulic and air tubing, to make it easy to integrate gantry robotics to M2-5AX in your automated production line.

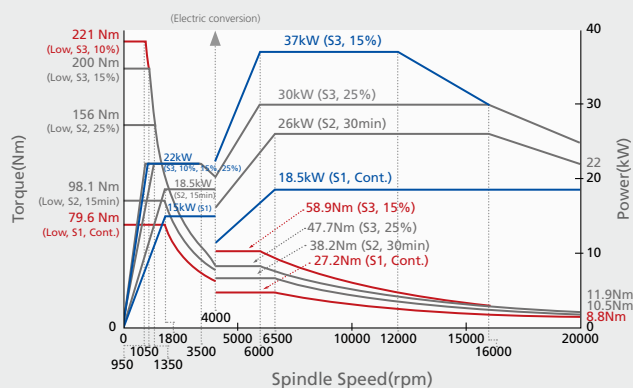
## Product data

\* Unit: mm(inch)

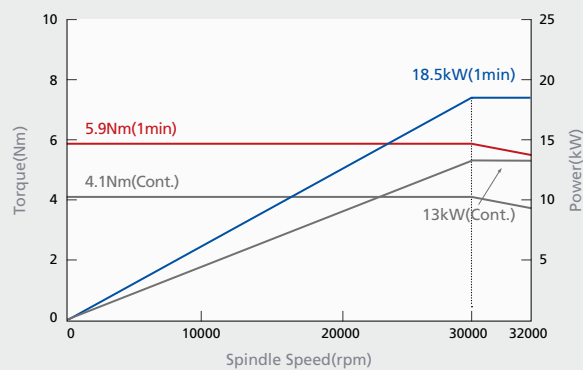


## Spindle power – torque diagram

## Standard (20,000rpm)



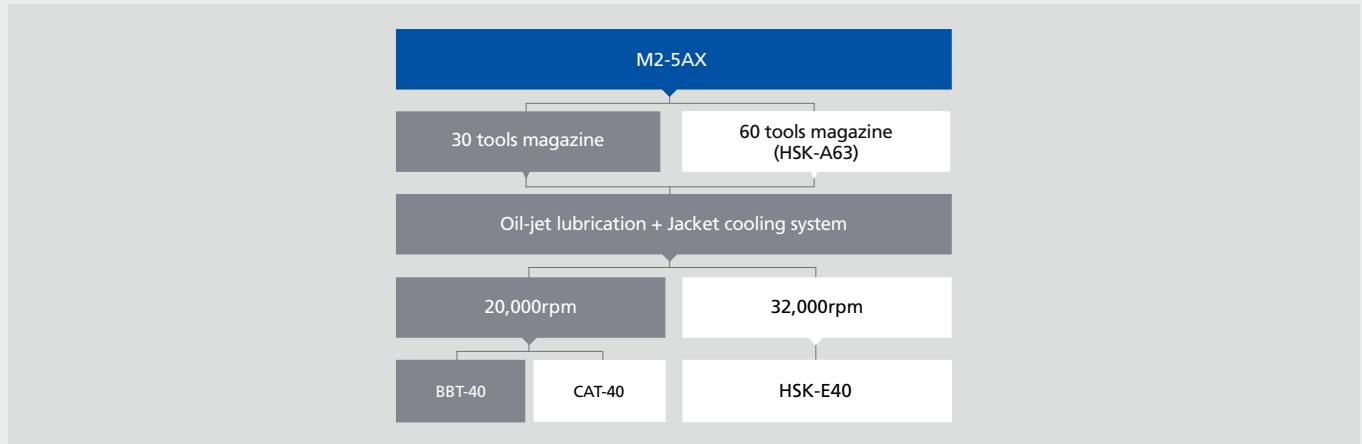
## Option (32,000rpm)





## Product Configuration

Each product can be configured to fit your application.



## Machine Specifications

| ITEM                                                                |                                    | M2-5AX                                                  |                           |
|---------------------------------------------------------------------|------------------------------------|---------------------------------------------------------|---------------------------|
|                                                                     |                                    | 20,000                                                  | 32,000                    |
| Travel                                                              |                                    |                                                         |                           |
| Stroke (X / Y / Z)                                                  | mm(inch)                           | 750 (29.53) / 650 (25.29) / 500 (19.69)                 |                           |
| Tilting(A) / Rotation(C)                                            | degree                             | (+)30 ~ (-)120 / 360                                    |                           |
| Distance from Table Surface to Spindle Gauge Plane (Long nose type) | mm(inch)                           | 75 (2.95) ~ 575 (22.64)                                 |                           |
| Table                                                               |                                    |                                                         |                           |
| Working Surface                                                     | mm(inch)                           | Ø500 (19.69"                                            |                           |
| Table Loading Capacity                                              | kg <sub>f</sub> (lb <sub>f</sub> ) | 300 (661.39)                                            |                           |
| Table Surface Configuration (T slots WxP – No. of slots)            | mm(inch)                           | 14 (0.55) x 80 (3.15) - 5ea                             |                           |
| Spindle                                                             |                                    |                                                         |                           |
| Max. Spindle Speed                                                  | rpm                                | 20,000                                                  | 32,000                    |
| Spindle Motor                                                       | kW(HP)                             | 37 / 18.5 (50 / 25)                                     | 18.5 / 13 (25 / 18)       |
| Feedrate                                                            |                                    |                                                         |                           |
| Rapid Traverse (X / Y / Z)                                          | m/min(ipm)                         | 50 (1,969) / 50 (1,969) / 50 (1,969)                    |                           |
| Rapid Traverse (A / C)                                              | rpm                                | 8.3 / 33.3                                              |                           |
| Cutting Feedrate (X / Y / Z)                                        | mm/min(ipm)                        | 1 (0.04) ~ 24,000 (945)                                 |                           |
| ATC                                                                 |                                    |                                                         |                           |
| Type of Tool Shank                                                  | -                                  | BBT-40 (Standard : 30 tool)<br>(Opt. : CAT-40, HSK-A63) | HSK-E40                   |
| Type of Pull Stud                                                   | -                                  | MAS P40T-1 (45°)                                        | -                         |
| Tool Storage Capacity                                               | ea                                 | 30(Opt. : 60)                                           |                           |
| Max. Tool Diameter [Without Adjacent Tools]                         | mm(inch)                           | Ø80 (3.15) / Ø170 (6.69)                                | Ø60 (2.36) / Ø90 (3.54)   |
| Max. Tool Length                                                    | mm(inch)                           | 300 (11.81)                                             | 250 (9.84)                |
| Max. Tool Weight                                                    | kg <sub>f</sub> (lb <sub>f</sub> ) | 8 (17.64)                                               | 3 (6.61)                  |
| Tool Changing Time (T to T / C to C)                                | sec                                | 1.5 / 4                                                 | 2.5 / 5                   |
| Motor                                                               |                                    |                                                         |                           |
| Feed Motor (X / Y / Z)                                              | kW(HP)                             | 4.0 (5.4) / 7.0 (9.4) / 4.0 (5.4)                       |                           |
| Feed Motor (A / C)                                                  | kW(HP)                             | 4.0 (5.4) / 4.0 (5.4)                                   |                           |
| Coolant Motor (Spindle)                                             | kW(HP)                             | 0.4 (0.54) / 0.9 (1.20)                                 |                           |
| Spindle Cooler (50 / 60Hz): Inverter Type                           | kW(HP)                             | 5.0 (6.70) / 5.6 (7.51)                                 | 8.0 (10.72) / 9.0 (12.06) |
| Power Source                                                        |                                    |                                                         |                           |
| Electric Power Supply                                               | kVA                                | 65                                                      |                           |
| Compressed Air Supply (Pressure x Consumption)                      | -                                  | 0.5 ~ 0.7MPa x 690Nℓ/min                                |                           |
| Tank Capacity                                                       |                                    |                                                         |                           |
| Spindle cooling / Lubrication / Hydraulic                           | ℓ(gal)                             | 60 (15.85) / 12 (3.17) / 20 (5.28)                      |                           |
| Coolant                                                             | ℓ(gal)                             | 400 (105.67)                                            |                           |
| Machine Size                                                        |                                    |                                                         |                           |
| Height                                                              | mm(inch)                           | 3,090 (121.65)                                          |                           |
| Floor Space (length x width)                                        | mm(inch)                           | 3,025 (119.09) x 3,695 (145.47)                         |                           |
| Weight                                                              | kg <sub>f</sub> (lb <sub>f</sub> ) | 11,000 (24,251)                                         |                           |
| NC Controller                                                       |                                    | Fanuc 31i-B5                                            |                           |

## Standard and Optional product components

| Standard Accessories              |                                                                 | Optional Accessories                                                          |                                                                                                  |
|-----------------------------------|-----------------------------------------------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| •Adjust Bolt, Block & Plate       | •Tilted working plane command with guidance for 5 axis          | •Air Dryer                                                                    | •Mist collector                                                                                  |
| •Air Blower                       | •Tool kit & box                                                 | •Air Gun                                                                      | •Oil skimmer                                                                                     |
| •Base around Splash guard         | •Workpiece Coordinate System (48ea)                             | •Auto Door                                                                    | •Oil mist (Semi dry cutting system)                                                              |
| •Coolant System                   | •Work Light                                                     | •Addition of Jig and fixture hydraulic groovings for rotary table (4 / 6part) | •Coolant through spindle (3MPa / 7MPa)<br>: For 7 MPa, only water soluble coolants are available |
| •Data Server (256MB)              | •Hwacheon Efficient Contour Control System (HECC)               | •BBT Spindle                                                                  | •Transformer                                                                                     |
| •Door Interlock                   | •Hwacheon Spindle Displacement Control System (HSDC)            | •Coolant Gun                                                                  | •Tool life management                                                                            |
| •Hydraulic System                 | •Hwacheon Tool Load Detect System (HTLD)                        | •CNC-integrated 3-dimensional interference check system                       | •Tool measuring system-Renishaw / Blum (Touch type, Laser type)                                  |
| •Lubrication System               | •Cutting Feed Optimization System (OPTIMA)                      | •Data server (1,024MB)                                                        | •Tool radius compensation for 5 axis                                                             |
| •MPG Handle (1ea)                 | •Hwacheon Artificial Intelligence Control System(HAI) 600 Block | •Data server Interface                                                        | •Workpiece measuring system-Renishaw / Blum (Touch type)                                         |
| •Operation manual & parts list    | •Smooth Tool Center Point Control                               | •Lift up chip conveyor (Hinge type, Scraper type, Mesh-drum type)             | •Hwacheon Rotation Center Calibration System (HRCC)                                              |
| •Pneumatics System                | •10.4" Color LCD                                                | •NURBS Interpolation                                                          | - Include work measuring system-Renishaw (touch type)                                            |
| •Rigid tapping                    |                                                                 | •Nano Smoothing Interpolation                                                 | •Hwacheon Artificial Intelligence Control System : 1000 Block                                    |
| •Scale (X / Y / Z / A / C)        |                                                                 | •NC Cooler                                                                    |                                                                                                  |
| •Signal Lamp (R / G / Y, 3 color) |                                                                 |                                                                               |                                                                                                  |
| •Spindle cooler                   |                                                                 |                                                                               |                                                                                                  |

## NC Specifications [Fanuc 31i-B5]

※ — : Not available S : Standard O : Option

| ITEM                                                                              | SPECIFICATION                                              |   |
|-----------------------------------------------------------------------------------|------------------------------------------------------------|---|
| Controlled axis                                                                   |                                                            |   |
| Controlled axis                                                                   | 5 - Axes                                                   | S |
| Simultaneously controlled axes                                                    | 5 - Axes                                                   | S |
| Least input increment                                                             | 0.001mm, 0.001deg, 0.0001inch                              | S |
| Least input increment 1 / 10                                                      | 0.0001mm, 0.0001deg, 0.00001inch                           | O |
| Inch/metric conversion                                                            | G20, G21                                                   | S |
| Store Stroke Check 1 / 2                                                          |                                                            | S |
| Mirror Image                                                                      |                                                            | S |
| Operation                                                                         |                                                            |   |
| Automatic & MDI operation                                                         |                                                            | S |
| DNC operation by memory card                                                      | PCMCIA card is required                                    | S |
| Dry Run, Single Block                                                             |                                                            | S |
| Manual handle feed / feed rate                                                    | 1Unit / x1, x10, x100                                      | S |
| Interpolation function                                                            |                                                            |   |
| Positioning / Linear interpolation / Circular interpolation / Dwell (Per seconds) | G00 / G01 / G02,G03 / G04                                  | S |
| Helical interpolation                                                             | Circular interpolation plus max.2axes linear interpolation | S |
| Nano Smoothing                                                                    |                                                            | O |
| Reference position return check / return                                          | G27 / G28, G29                                             | S |
| 2nd reference position return                                                     | G30                                                        | S |
| Skip                                                                              | G31                                                        | S |
| NURBS interpolation (64Bit RISC board is required)                                |                                                            | O |
| Feed function                                                                     |                                                            |   |
| Rapid traverse override                                                           | F0, F25, F50, F100                                         | S |
| Feedrate (mm/min)                                                                 |                                                            | S |
| Feedrate override                                                                 | 0 ~ 150%                                                   | S |
| Jog feed override                                                                 | 0 ~ 4,000mm/min                                            | S |
| Override cancel                                                                   | M48, M49                                                   | S |
| Program input                                                                     |                                                            |   |
| Optional block skip                                                               | 1ea                                                        | S |
| Program number                                                                    | O4 - Digits                                                | S |
| Sequence number                                                                   | N8 - Digits                                                | S |
| Decimal point programming                                                         |                                                            | S |
| Coordinate system setting                                                         | G92                                                        | S |
| Workpiece coordinate system                                                       | G54 - G59                                                  | S |
| Workpiece coordinate system preset                                                |                                                            | O |
| Addition of workpiece coordinate pair                                             | 48ea                                                       | S |
| Addition of workpiece coordinate pair                                             | 300ea                                                      | O |
| Manual absolute on and off                                                        |                                                            | S |
| Chamfering / corner R                                                             |                                                            | S |
| Programmable data input                                                           | G10                                                        | S |
| Sub program call                                                                  | 10 folds nested                                            | S |
| Custom Macro B                                                                    |                                                            | S |
| Addition of custom macro common variables                                         | #100 - #199, #500 - #999                                   | O |
| Canned Cycles for Drilling                                                        |                                                            | S |
| Small-hole peck drilling cycle                                                    |                                                            | O |
| Automatic corner override                                                         |                                                            | O |
| Feedrate clamp based on arc radius                                                |                                                            | S |
| Scaling                                                                           |                                                            | O |
| Coordinate system rotation                                                        |                                                            | S |
| Polar Coordinate System                                                           |                                                            | O |

| ITEM                                                                    | SPECIFICATION                                                                                               |   |
|-------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|---|
| Programmable Mirror Image                                               |                                                                                                             | O |
| Tape format for Fanuc series 15                                         |                                                                                                             | O |
| Spindle speed function                                                  |                                                                                                             |   |
| Spindle override                                                        | 50 - 120%                                                                                                   | S |
| Spindle orientation                                                     |                                                                                                             | S |
| Rigid tapping                                                           |                                                                                                             | S |
| Tool function / compensation                                            |                                                                                                             |   |
| Tool function                                                           | T4 - digits                                                                                                 | S |
| Tool offset pairs                                                       | ±6 - digits 200ea                                                                                           | S |
| Tool offset pairs                                                       | ±6 - digits 400ea, 999ea                                                                                    | O |
| Tool offset memory C                                                    |                                                                                                             | S |
| Cutter compensation C                                                   |                                                                                                             | S |
| Tool life management                                                    |                                                                                                             | O |
| Tool length compensation / Tool length measurement                      |                                                                                                             | S |
| Editing operation                                                       |                                                                                                             |   |
| Part program storage length / Number of register able programs          | 256kB / 500ea                                                                                               | S |
| Part program storage length / Number of register able programs          | 512kB / 1,000ea<br>1MB / 1,000ea, 2MB / 1,000ea                                                             | O |
| Background editing / extended editing functions                         |                                                                                                             | S |
| Play Back                                                               |                                                                                                             | O |
| Setting and display                                                     |                                                                                                             |   |
| Display unit                                                            | 10.4" Color LCD                                                                                             | S |
| Clock function                                                          |                                                                                                             | S |
| Self-diagnosis function / Alarm history display                         |                                                                                                             | S |
| Help function / Graphic function                                        |                                                                                                             | S |
| Run hour and parts count display                                        |                                                                                                             | S |
| Dynamic graphic display                                                 |                                                                                                             | O |
| Multi-language display                                                  | English, German, French, Italian, Chinese, Spanish, Korean, Portuguese, Polish, Hungarian, Swedish, Russian | S |
| Data input / output                                                     |                                                                                                             |   |
| Reader / Puncher interface CH1                                          | RS232C                                                                                                      | S |
| Data server                                                             | 256MB                                                                                                       | S |
| Data server                                                             | 1,024MB                                                                                                     | O |
| Ethernet interface / Memory card interface                              |                                                                                                             | S |
| Auto Data Backup                                                        | SRAM + Part Program                                                                                         | S |
| HWACHEON Machining Software                                             |                                                                                                             |   |
| Hwacheon Artificial Intelligence Control System (HAI) 600 Block Buffer  |                                                                                                             | S |
| Hwacheon Artificial Intelligence Control System (HAI) 1000 Block Buffer |                                                                                                             | O |
| Hwacheon Efficient Contour Control System (HECC)                        |                                                                                                             | S |
| Hwacheon Tool Load Detect (HTLD)                                        |                                                                                                             | S |
| Cutting Feed Optimization System (OPTIMA)                               |                                                                                                             | S |
| Hwacheon Spindle Displacement Control System (HSDC)                     |                                                                                                             | S |
| Hwacheon Rotation Center Calibration System (HRCC)                      |                                                                                                             | O |
| 5-axis native functions                                                 |                                                                                                             |   |
| Smooth tool center point control for 5-axis                             |                                                                                                             | S |
| Tilted working plane command for 5-axis                                 |                                                                                                             | S |
| Workpiece setting error compensation for 5-axis                         |                                                                                                             | S |
| Tool radius compensation for 5 axis                                     |                                                                                                             | O |

## Hwacheon Global Network

 Hwacheon Headquarters  Hwacheon Europe  Hwacheon Asia  Hwacheon America



**HWACHEON**

Please contact us for product inquiries.

**[www.hwacheon.com](http://www.hwacheon.com)**

The product design and specifications may change without prior notice.  
Read the operation manual carefully and thoroughly before operating the product,  
and always follow the safety instructions and warnings labels attached on the surfaces of the machines.

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