CNC SYSTEM

OSP-P300MA

MA-12500H
U-AXIS TOOL SPECIFICATIONS

INSTRUCTION MANUAL

（1st Edition）

OKUMA

TABLE OF CONTENTS

1. Overview

U-axis tools perform U-axis connection ON/OFF operation in tool mounting to and removal from the spindle by ATC.

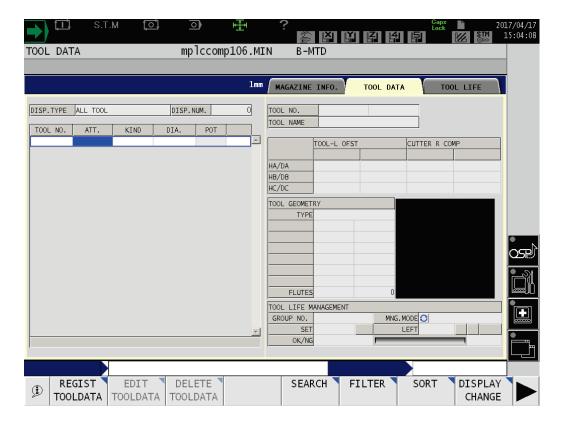U-axis drive unit

U-axis tool

Spindle

2. Setting Method

2-1. Setting from the Pot-Tool Correspondence Table

After registering U-axis tool data, set at the pot-tool correspondence table.

Procedure : ───────────────────────────────

1 Press tool data setting key to display the Tool data setting screen.
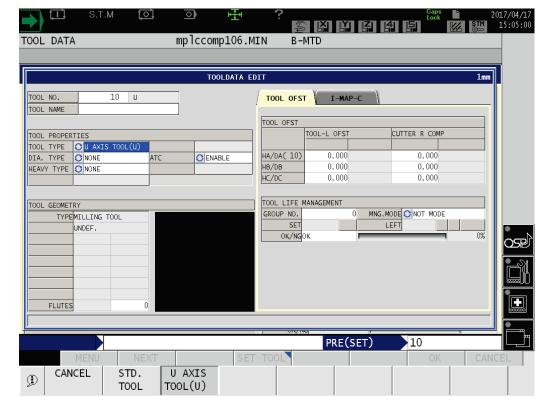If the tool data setting screen does not appear, press [F8] (CHANGE DISPLAY) to select the tool data setting screen.

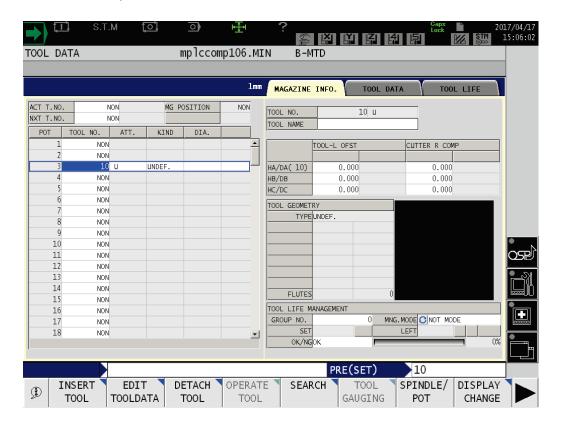**2** Select the TOOL DATA sheet and then press [F1] (REGIST TOOLDATA).

3 A TOOLDATA EDIT screen appears. Enter the tool number for the U-axis tool in TOOL NO.

4 Align the cursor with TOOL TYPE, and then set U AXIS TOOL(U) using either of the following methods.

☐ Press [F1] (MENU [*]) and then select U AXIS TOOL(U) from the list of tool types displayed on the function keys.

☐ Press [F2] (NEXT) and set U AXIS TOOL(U).

5 Press [F7] (OK) to complete tool data registration.

6 Select the MAGAZINE INFO. sheet.

7 Align the cursor with the U-axis tool attachment pot from the pot-tool correspondence table (left side of screen).

8 Press [F1] (INSERT TOOL), align the cursor with the registered tool data from the displayed tool list, and then press [F7] (OK).
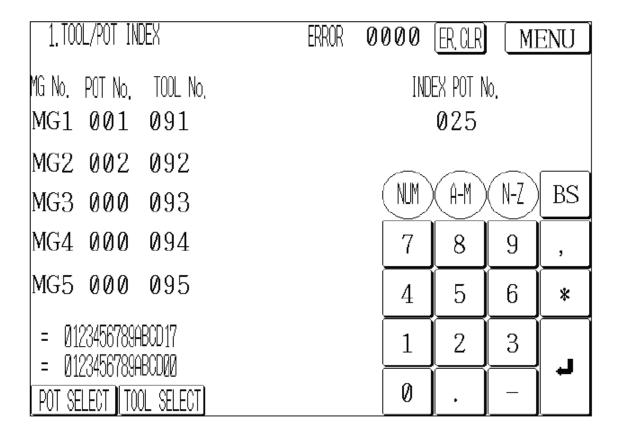
2-2. Setting from the ATC Sub Operation Panel

After registering U-axis tool data at the OSP (machine), set the TOOL No. from the ATC sub operation panel TOOL DATA SET UP-1 screen. (There is no need to set tool properties.)

Procedure :

   1 Perform steps 1 to 5 in the [2-1. Setting from the Pot-Tool Correspondence Table] to register U-axis tool data.

   2 Set the tool data registered in the target pot from the ATC sub operation panel TOOL DATA SET UP-1 screen.

```
┌─────────────────────────────────────────────────────────────┐
│ 1.TOOL/POT INDEX        ERROR  0000 [ER.CLR]  [MENU]          │
│                                                               │
│ MG No. POT No.  TOOL No.          INDEX POT No.               │
│ MG1  001  091                         025                     │
│ MG2  002  092                                                 │
│ MG3  000  093              (NUM)(A-M)(N-Z)  [BS]              │
│ MG4  000  094                 7    8    9    ,                │
│ MG5  000  095                 4    5    6    *                │
│                               1    2    3                     │
│   = 0123456789ABCD17                               ↵          │
│   = 0123456789ABCD00          0    .    -                     │
│ [POT SELECT][TOOL SELECT]                                     │
└─────────────────────────────────────────────────────────────┘
```

For details on how to operate the ATC sub operation panel, refer to SECTION 28 ATC SUB-OPERATION PANEL SPECIFICATIONS in OSP-P300S/P300M SPECIAL FUNCTIONS MANUAL No. 2.

3. U-axis Connection ON Operation

When the next tool is the U-axis tool, U-axis connection ON operation is performed after the next tool is mounted to the spindle with the M6 command.
U-axis connection ON operation is performed during ATC cycle with the M6 command.

The following operations are performed in series for U-axis connection ON operation.

(1) Positioning to HP16

(2) Positioning to HP5

(3) Spindle indexing to U-axis connection position

(4) U-axis shifter advance, U-axis air blow

4. U-axis connection OFF operation

When the current tool is the U-axis tool, U-axis connection OFF operation is performed when the U-axis tool is removed from the spindle with the M6 command.
U-axis connection OFF operation is performed during ATC cycle with the M6 command.

The following operations are performed in series for U-axis connection OFF operation.

(1) Positioning to HP15

(2) Positioning to HP5

(3) Spindle indexing to U-axis connection position

(4) U-axis shifter retract, U-axis air blow

5. M Code Command

5-1. U-axis connection ON/OFF

U-axis connection ON/OFF operation is normally performed during ATC cycle with the M6 command. However, U-axis connection ON/OFF can be operated independently by using the M code commands described below.
Use the following M codes when regular M6 command cannot be used due to machine restoration or similar reason.

M code	Content	Axis travel Simultane- ous /after	Machine lock ON	Sequence restart
M315	U-axis connection OFF	After travel	Immediate answer No operation	Immediate answer No operation
M316	U-axis connection ON	After travel	Immediate answer No operation	Immediate answer No operation

☐ The answer is returned when the operation with the M code above is completed.

☐ The M codes above can be specified only when the current tool is the U-axis tool.
   When the current tool is not the U-axis tool, the following alarm occurs.
   "2727 ALARM-B Improper M code ***"
   315: M315 command was issued with the spindle tool not being U-axis one.
   316: M316 command was issued with the spindle tool not being U-axis one.

5-2. U-axis air blow ON/OFF

U-axis air blow ON/OFF can be specified independently by using the following M code commands.

M code	Content	Axis travel Simultane- ous /after	Machine lock ON	Sequence restart
M317	U-axis air blow OFF	After travel	Immediate answer No operation	Immediate answer No operation
M318	U-axis air blow ON	After travel	Immediate answer No operation	Immediate answer No operation

☐ With the M codes above, the answer is returned immediately after the command.

☐ U-axis air blow is turned off with reset, alarm A occurrence, and power save mode ON.

6. Parameter

Set the spindle indexing position at U-axis connection at the following parameter.

Machine user parameter	No. 18	ADDITIONAL AXIS
5 U-AXIS ORIENTATION POSITION 　　　　Command : SET, ADD 　　Initial value : 0 　　Minimum value : 0 　　Maximum value : 360000 　　Setting unit : 0.001 degree		

For the parameter above, set the position with the spindle indexing position at 0 degree for ATC.

7. Special operation at restart

☐ If the U-axis is stopped halfway during U-axis shifter operation due to alarm A occurrence or power OFF, operation may not be restored by regular M315/M316 commands because required conditions such as travel to HP5 and spindle indexing to the U-axis connection position are not met.
In such a case, specify the M315 command and display the ATC operation screen by pressing the "MACHINE OPERATION" key on the machine panel and pressing the ATC button on the right of the screen. By then pressing [F2] (INT LOCK RELEASE), operation is completed by performing only U-axis shifter retract and air blow discharge without checking the HP5 movement and spindle indexing to the U-axis connection position.

☐ When U-axis connection operation is required while stopping the operation during ATC cycle, specify M315/M316 to perform U-axis connection ON/OFF operation.

8. Interlock

8-1. Spindle Rotation Interlock

In this interlock function, spindle rotation is enabled under the following conditions.

☐ When the current tool is not the U-axis tool, the U-axis shifter is retracted.
☐ Positioning to HP5 is complete with U-axis connection OFF.
☐ U-axis connection ON

When the above conditions are not met, a machine diagnosis message is displayed if a spindle rotation command is specified.
For the detail of machine diagnosis message, refer to 9. Machine Diagnosis Message List.

If the above conditions are not met during spindle rotation, the following alarm occurs.
"1707 ALARM-A Spindle rotation interlock *****"
*****: alarm code (hexadecimal of diagnosis number)

8-2. U-axis Interlock

U-axis operation is enabled only when U-axis connection is ON.
When the condition is not met, a machine diagnosis message appears.
For the detail of machine diagnosis message, refer to 9. Machine Diagnosis Message List.

If this interlock remains for 5 seconds or more in the automatic operation mode (single block OFF), the following alarm occurs.
"1703 ALARM-A Axis interlock *****"
*****: alarm code (hexadecimal of diagnosis number)

9. Machine Diagnosis Message List

The diagnosis messages displayed in this specification are listed below.

Diagnosis no.	Diagnosis message
15342	U-axis shifter ADVANCE LS is not ON.
15343	U-axis shifter RETRACT LS is not OFF.
15344	U-axis EXIST LS is not ON.
15346	U-axis shifter ADVANCE or RETRACT SOL is not ON
15435	U-axis shifter ADVANCE LS is not ON.
15436	U-axis shifter RETRACT LS is not OFF.
15437	U-axis EXIST LS is not ON.
15438	U-axis shifter RETRACT LS is not ON.
15439	U-axis shifter ADVANCE LS is not OFF.
15440	U-axis EXIST LS is not OFF.
15441	HP 5 is not completed.
15442	U-axis shifter ADVANCE or RETRACT SOL is not ON
15506	U-axis shifter RETRACT LS is not ON.
15507	U-axis shifter ADVANCE LS is not ON.
15508	U-axis EXIST LS is not OFF.
15509	U-axis EXIST LS is not ON.
15510	HP 5 is not completed.
15530	HP15 is not completed.
15531	HP16 is not completed.
16026	U-axis EXIST LS is not ON.
16027	U-axis shifter RETRACT LS is not ON.
16028	U-axis shifter ADVANCE LS is not OFF.
16029	U-axis EXIST LS is not OFF.

10. ATC Logic Data

10-1. Matrix Magazine

MA-12500H
ATC (matrix magazine) logic table　　　MAP029A

Input logic 1/8

Column groups (bit weights): 1: 80 40 20 10 08 04 02 01 | 2: 80 40 20 10 08 04 02 01 | 3: 80 40 20 10 08 04 02 01 | 4: 80 40 20 10 08 04 02 01 | 5: 80 40 20 10 08 04 02 01 | 6: 80 40 20 10 08 04 02 01

Input logic signal names (left to right):
- Tool pot spindle side confirmation ON
- Tool pot magazine side confirmation ON
- Tool pot unclamp confirmation ON
- Tool pot clamp confirmation ON
- Change arm tool unlock confirmation ON
- Change arm tool lock confirmation ON
- Tool pot retraction confirmation ON
- Tool pot advance confirmation ON
- Tool pot tool present
- No tool pot tool
- U-axis spindle indexing position
- MG manual interruption OFF
- ATC shutter open confirmation normal
- ATC shutter close confirmation OFF
- ATC shutter close confirmation
- ATC shutter open confirmation OFF
- ATC shutter open confirmation
- Tool present in transfer pot
- No tool pot tool
- Movement to pot vertical retract position complete
- Movement to pot vertical position complete
- Movement to pot unlocking horizontal position complete
- Movement to pot locking horizontal position complete
- Vertical movement to tool change position complete
- Horizontal movement to tool change position complete
- Spindle tool present clamp confirmation OFF
- No spindle tool interlock
- Not in manual tool chage cycle
- APC pallet cleaning sequence OFF
- TS axis servo ON confirmation
- Cylinder unclamp outside spindle
- Cylinder clamp outside spindle
- Cylinder clamp outside spinde OFF
- APC start position
- MG manual operation command storing
- MG manual operation command calling
- Not MG manual operation command
- Change arm B gripper tool present
- Tool breakage inside MG detection in standby position confirmation
- Tool breakage inside MG detection in measurement position confirmation

Op. seq. No.	Operation	Op. seq. No.
1	Writing next tool	1
2	Operation selection	2
3	Next tool locking position (horizontal, vertical)	3
4	Pot advance	4
5	Tool lock	5
6	Next tool unlocking position (horizontal)	6
7	Tool change standby ready position (vertical)	7
8	Tool change standby ready position (horizontal)	8
9	Tool change standby complete position (horizontal, vertical)	9
10	Pot retract	10
11	Transfer unit on MC side	11
12	Change arm tool unlock	12
13	AT-axis transfer unit tool grip position (90 mm) (90 mm)	13
14	Change arm tool lock	14
15	Transport unit tool unlock	15
16	TI-axis in standby position (170 mm) (0 mm)	16
17	AT-axis in standby position (90 mm) (0 mm)	17
18	Waiting for MC cycle end	18
19	Spindle indexed/U-axis connection OFF	19
20	HP1 (simultaneous movement 1)	20
21	ATC shutter open (simultaneous movement 1)	21
22	TI-axis spindle tool grip position (220 mm) (220 mm)	22
23	TS-axis A grip spindle tool grip position (270-degree rotation)	23
24	Change arm tool unlock	24
25	AT-axis spindle tool grip position (810 mm) (-810 mm)	25
26	Change arm tool lock/Cylinder unclamp outside spindle	26
27	Spindle tool unclamp	27
28	TI-axis spindle tool extraction position (170 mm) (390 mm)	28
29	TS-axis B grip spindle tool grip position (180-degree rotation)	29
30	TI-axis spindle tool grip position (170 mm) (220 mm)	30
31	Spindle tool clamp	31
32	Change arm tool unlock/Cylinder clamp outside spindle	32
33	AT-axis in standby position (810 mm) (0 mm)	33
34	Change arm tool lock/AT-axis (240 mm (-570 mm)) Simultaneous movement 2 affter movement	34
35	TS-axis A grip transport unit tool grip position (90-degree rotation)/AT-axis simultaneous movement 2	35
36	TI-axis in standby position (220 mm) (0 mm)	36
37	ATC shutter close/U-axis connection ON	37
38	AT-axis transport unit tool grip position (90 mm)/U-axis connection ON	38
39	TI-axis transport unit tool grip position (170 mm) (-170 mm)	39
40	Transport unit tool lock	40
41	Change arm tool unlock	41
42	AT-axis in standby position (90 mm) (0 mm)	42
43	Change arm tool lock	43
44	Transport unit on MG side	44
45	TS-axis B grip transport unit tool grip position (0-degree rotation)	45
46	Pot advance	46
47	Return tool unlocking ready position (vertical)	47
48	Return tool unlocking ready position (horizontal)	48
49	Return tool unlocked position (vertical)	49
50	Return tool locking position (horizontall)	50

ATC (matrix magazine) logic table   MAP029A

Input logic 2/8

Column groups (hex weights): 7 (80 40 20 10 08 04 02 01), 8 (80 40 20 10 08 04 02 01), 9 (80 40 20 10 08 04 02 01), 10 (80 40 20 10 08 04 02 01), 11 (80 40 20 10 08 04 02 01), 12 (80 40 20 10 08 04 02 01)

Input signal column headers (left to right):

1. Return tool determination complete
2. Spindle tool unclamp LS OFF
3. Spindle tool clamp LS OFF
4. Spindle tool clamp LS ON
5. Spindle tool unclamp LS ON
6. Spindle tool present clamp confirmation ON
7. Spindle stop
8. Spindle indexing complete
9. M64 Next tool storage cycle
10. Next/return tool present
11. No next/return tool
12. Normal cycle (change arm rotation present)
13. No next tool ready operation return
14. No next tool ready operation input
15. Next tool ready operation
16. Active tool writing complete
17. TS-axis 90 degrees
18. TS-axis 180 degrees
19. TS-axis 270 degrees
20. TS-axis 0 degrees
21. No recovery NG tool
22. Recovery NG tool present
23. Tool change position (HP1)
24. Tool rack search complete
25. Operation door lock confirmation ON
26. AT-axis MG side
27. AT-axis spindle side
28. AT-axis in standby position
29. Change arm rotation complete
30. Step reverse interlock
31. Step advance interlock
32. TS-axis 135 degrees
33. Tool breakage detection cycle complete
34. Tool breakage detection cycle
35. Not in tool breakage detection cycle
36. TT-axis transport unit tool grip position
37. TT-axis spindle tool extraction position
38. TT-axis spindle tool grip position
39. TT-axis in standby position
40. Return tool to be returned to next tool ready ST
41. Next tool in next tool ready ST
42. U-axis connection complete
43. U-axis shifter retraction confirmation LS
44. U-axis shifter retraction confirmation LS OFF
45. U-axis present LS OFF
46. TS-axis rotating position

Op No.	Operation	Op No.
1	Writing next tool	1
2	Operation selection	2
3	Next tool locking position (horizontal, vertical)	3
4	Pot advance	4
5	Tool lock	5
6	Next tool unlocking position (horizontal)	6
7	Tool change standby ready position (vertical)	7
8	Tool change standby ready position (horizontal)	8
9	Tool change standby complete position (horizontal, vertical)	9
10	Pot retract	10
11	Transfer unit on MC side	11
12	Change arm tool unlock	12
13	AT-axis transfer unit tool grip position (90 mm) (90 mm)	13
14	Change arm tool lock	14
15	Transport unit tool unlock	15
16	TI-axis in standby position (170 mm) (0 mm)	16
17	AT-axis in standby position (90 mm) (0 mm)	17
18	Waiting for MC cycle end	18
19	Spindle indexed/U-axis connection OFF	19
20	HP1 (simultaneous movement 1)	20
21	ATC shutter open (simultaneous movement 1)	21
22	TI-axis spindle tool grip position (220 mm) (220 mm)	22
23	TS-axis A grip spindle tool grip position (270-degree rotation)	23
24	Change arm tool unlock	24
25	AT-axis spindle tool grip position (810 mm) (-810 mm)	25
26	Change arm tool lock/Cylinder unclamp outside spindle	26
27	Spindle tool unclamp	27
28	TI-axis spindle tool extraction position (170 mm) (390 mm)	28
29	TS-axis B grip spindle tool grip position (180-degree rotation)	29
30	TI-axis spindle tool grip position (170 mm) (220 mm)	30
31	Spindle tool clamp	31
32	Change arm tool unlock/Cylinder clamp outside spindle	32
33	AT-axis in standby position (810 mm) (0 mm)	33
34	Change arm tool lock/AT-axis (240 mm (-570 mm)) Simultaneous movement 2 after movement	34
35	TS-axis A grip transport unit tool grip position (90-degree rotation)/AT-axis simultaneous movement 2	35
36	TI-axis in standby position (220 mm) (0 mm)	36
37	ATC shutter close/U-axis connection ON	37
38	AT-axis transport unit tool grip position (90 mm)/U-axis connection ON	38
39	TI-axis transport unit tool grip position (170 mm) (-170 mm)	39
40	Transport unit tool lock	40
41	Change arm tool unlock	41
42	AT-axis in standby position (90 mm) (0 mm)	42
43	Change arm tool lock	43
44	Transport unit on MG side	44
45	TS-axis B grip transport unit tool grip position (0-degree rotation)	45
46	Pot advance	46
47	Return tool unlocking ready position (vertical)	47
48	Return tool unlocking ready position (horizontal)	48
49	Return tool unlocked position (vertical)	49
50	Return tool locking position (horizontall)	50

MA-12500H
ATC(matrix magazine)logic table　　　MAP029A

Input logic 3/8

Column headers (left-to-right, grouped by byte weight 80 40 20 10 08 04 02 01):

Group 0: Tool pot spindle side confirmation ON (80) · Tool pot magazine side confirmation ON (40) · Tool pot unclamp confirmation ON (20) · Tool pot clamp confirmation ON (10) · Change arm tool unlock confirmation ON (08) · Change arm tool lock confirmation ON (04) · Tool pot retraction confirmation ON (02) · Tool pot advance confirmation ON (01)

Group 1: Tool pot tool present (80) · No tool pot tool (40)

Group 2: U-axis spindle indexing position · MG manual interruption OFF · ATC shutter open confirmation normal · ATC shutter close confirmation OFF · ATC shutter close confirmation · ATC shutter open confirmation OFF · ATC shutter open confirmation

Group 3: Tool present in transfer pot · No tool pot tool

Group 4: Movement to pot vertical retract position complete · Movement to pot vertical position complete · Movement to pot unlocking horizontal position complete · Movement to pot locking horizontal position complete · Vertical movement to tool change position complete · Horizontal movement to tool change position complete · Spindle tool present clamp confirmation OFF · No spindle tool interlock

Group 5: Not in manual tool chage cycle · APC pallet cleaning sequence OFF · TS axis servo ON confirmation · Cylinder unclamp outside spindle · Cylinder clamp outside spindle · Cylinder clamp outside spindle OFF · APC start position

Group 6: MG manual operation command storing · MG manual operation command calling · Not MG manual operation command · Change arm B gripper tool present · Tool breakage inside MG detection in standby position confirmation · Tool breakage inside MG detection in measurement position confirmation

No.	Operation	Marked input-logic columns
51	Tool unlock	Tool pot spindle side conf ON; Tool pot magazine side conf ON; Tool pot clamp conf ON; Change arm tool unlock conf ON; Tool pot retraction/advance conf ON; Not in manual tool chage cycle; (last col)
52	Pot retract	spindle side; magazine side; clamp; unlock; No tool pot tool; Not in manual tool chage cycle
53	Tool transfer complete	spindle side; magazine side; clamp; unlock; No tool pot tool; ATC shutter close/open conf; Not in manual tool chage cycle
54	TI-axis transport unit tool grip position/U-axis connection ON	Tool pot spindle side conf ON; Tool pot unclamp conf ON; clamp; unlock; Not in manual tool chage cycle
55	Transport unit on MG side	spindle side; magazine side; clamp; unlock; No tool pot tool; Not in manual tool chage cycle
56	TS-axis B grip transport unit tool grip position (0-degree rotation)	spindle side; magazine side; clamp; unlock; No tool pot tool; Not in manual tool chage cycle; TS axis servo ON confirmation
57	Tool transfer complete	spindle side; magazine side; clamp; unlock; No tool pot tool; ATC shutter conf; Not in manual tool chage cycle
58	Operation selection	spindle side; magazine side; clamp; unlock; No tool pot tool; Not in manual tool chage cycle
59	Next tool ready return tool locking position (horizontal, vertical)	spindle side; magazine side; clamp; unlock; No tool pot tool; Movement to pot vertical position complete; unlocking/locking horizontal position complete; Not in manual tool chage cycle
60	Pot advance	spindle side; magazine side; clamp; Tool pot retraction/advance conf ON; Not in manual tool chage cycle
61	Tool lock	spindle side; unclamp; clamp; retraction/advance conf ON; Not in manual tool chage cycle
62	Next tool ready return tool unlocking position (horizontal)	spindle side; magazine side; clamp; unlock; Movement to pot vertical position complete; unlocking/locking horizontal; Not in manual tool chage cycle
63	Return tool unlocking ready position (vertical)	spindle side; magazine side; clamp; unlock; Movement to pot vertical retract position complete; Not in manual tool chage cycle
64	Return tool unlocking ready position (horizontal)	spindle side; magazine side; clamp; unlock; Movement to pot vertical retract; unlocking horizontal; Not in manual tool chage cycle
65	Return tool unlocked position (vertical)	spindle side; magazine side; clamp; unlock; Spindle tool present/No spindle tool; unlocking/locking horizontal; Not in manual tool chage cycle
66	Return tool locking position (horizontal)	spindle side; magazine side; clamp; retraction/advance; Movement to pot vertical position complete; unlocking/locking; Not in manual tool chage cycle
67	Tool unlock	spindle side; magazine side; clamp; unlock; retraction/advance; Not in manual tool chage cycle
68	Pot retract	spindle side; magazine side; clamp; unlock; No tool pot tool; Not in manual tool chage cycle
69	Tool transfer complete	spindle side; magazine side; clamp; unlock; No tool pot tool; Not in manual tool chage cycle
70	Operation selection	spindle side; magazine side; clamp; unlock; No tool pot tool; Not in manual tool chage cycle
71	Next tool, input tool locking position (horizontal, vertical)	spindle side; magazine side; clamp; unlock; No tool pot tool; Movement to pot vertical position; unlocking/locking; Not in manual tool chage cycle
72	Pot advance	spindle side; magazine side; clamp; retraction/advance; Not in manual tool chage cycle
73	Tool lock	spindle side; unclamp; clamp; unlock; retraction/advance; Not in manual tool chage cycle
74	Next tool, input tool unlocking position (horizontal)	spindle side; magazine side; clamp; unlock; Movement to pot vertical position; unlocking/locking; Not in manual tool chage cycle
75	Next tool ready input tool unlocking ready position (vertical)	spindle side; magazine side; clamp; unlock; Movement to pot vertical retract; Not in manual tool chage cycle
76	Next tool ready input tool unlocking ready position (horizontal)	spindle side; magazine side; clamp; unlock; Movement to pot vertical retract; unlocking horizontal; Not in manual tool chage cycle
77	Next tool ready input tool unlocked position (vertical)	spindle side; magazine side; clamp; unlock; Spindle/No spindle; unlocking/locking; Not in manual tool chage cycle
78	Next tool ready input tool locking position (horizontal)	spindle side; magazine side; clamp; retraction/advance; Movement to pot vertical position; unlocking/locking; Not in manual tool chage cycle
79	Tool unlock	spindle side; magazine side; clamp; unlock; retraction/advance; Not in manual tool chage cycle
80	Pot retract	spindle side; magazine side; clamp; unlock; No tool pot tool; Not in manual tool chage cycle
81	Tool transfer complete	spindle side; magazine side; clamp; unlock; No tool pot tool; Not in manual tool chage cycle
82	Operation selection	spindle side; magazine side; clamp; unlock; No tool pot tool; Not in manual tool chage cycle; MG manual operation command storing
83	Calling tool locking position (horizontal, vertical)	spindle side; magazine side; clamp; unlock; No tool pot tool; Movement to pot vertical position; unlocking/locking; Not in manual tool chage cycle
84	Pot advance	spindle side; magazine side; clamp; retraction/advance; Not in manual tool chage cycle
85	Tool lock	spindle side; unclamp; clamp; retraction/advance; Not in manual tool chage cycle
86	Calling tool unlocking position (horizontal)	spindle side; magazine side; clamp; unlock; No spindle tool interlock; unlocking/locking; Not in manual tool chage cycle
87	MG manual change unlocking ready position (vertical)	spindle side; magazine side; clamp; unlock; Movement to pot vertical retract; Not in manual tool chage cycle
88	MG manual change unlocking ready position (horizontal)	spindle side; magazine side; clamp; unlock; Movement to pot vertical retract; unlocking horizontal; Not in manual tool chage cycle
89	MG manual change unlocked position (vertical)	spindle side; magazine side; clamp; unlock; Spindle/No spindle; unlocking/locking; Not in manual tool chage cycle
90	MG manual change locking position (horizontal)	spindle side; magazine side; clamp; retraction/advance; No spindle tool interlock; unlocking/locking; Not in manual tool chage cycle
91	Tool unlock	spindle side; magazine side; clamp; retraction/advance; Not in manual tool chage cycle
92	Pot retract	spindle side; magazine side; clamp; unlock; No tool pot tool; Not in manual tool chage cycle
93	Tool transfer complete	spindle side; magazine side; clamp; unlock; No tool pot tool; Not in manual tool chage cycle
94	Operation selection	spindle side; magazine side; clamp; unlock; No tool pot tool; Not in manual tool chage cycle; MG manual operation command calling
95	MG manual change locking position (horizontal, vertical)	spindle side; magazine side; clamp; unlock; No tool pot tool; Movement to pot vertical position; unlocking/locking; Not in manual tool chage cycle
96	Pot advance	spindle side; magazine side; clamp; retraction/advance; Not in manual tool chage cycle
97	Tool lock	spindle side; unclamp; clamp; retraction/advance; Not in manual tool chage cycle
98	MG manual change unlocking position (horizontal)	spindle side; magazine side; clamp; unlock; No spindle tool interlock; unlocking/locking; Not in manual tool chage cycle
99	Storing tool unlocking ready position (vertical)	spindle side; magazine side; clamp; unlock; Movement to pot vertical retract; Not in manual tool chage cycle
100	Storing tool unlocking ready position (horizontal)	spindle side; magazine side; clamp; unlock; Movement to pot vertical retract; unlocking horizontal; Not in manual tool chage cycle

Input logic 4/8

Column header legend (hexadecimal weight = input logic signal):

Group 7 — 80: Return tool determination commplete / 40: Spindle tool unclamp LS OFF / 20: Spindle tool clamp LS OFF / 10: Spindle tool clamp LS ON / 08: Spindle tool unclamp LS ON / 04: Spindle tool present clamp confirmation ON / 02: Spindle stop / 01: Spindle indexing complete

Group 8 — 80: M64 Next tool storage cycle / 40: Next/return tool present / 20: No next/return tool / 10: Normal cycle (change arm rotation present) / 08: No next tool ready operation return / 04: No next tool ready operation input / 02: Next tool ready operation / 01: Active tool writing complete

Group 9 — 80: TS-axis 90 degrees / 40: TS-axis 180 degrees / 20: TS-axis 270 degrees / 10: TS-axis 0 degrees / 08: No recovery NG tool / 04: Recovery NG tool present / 02: Tool change position (HP1) / 01: Tool rack search complete

Group 10 — 80: Operation door lock confirmation ON / 40: AT-axis MG side / 20: AT-axis spindle side / 10: AT-axis in standby position / 08: Change arm rotation complete / 04: Step reverse interlock / 02: Step advance interlock / 01: TS-axis 135 degrees

Group 11 — 80: Tool breakage detection cycle complete / 40: Tool breakage detection cycle / 20: Not in tool breakage detection cycle / 10: TI-axis transport unit tool grip position / 08: TT-axis spindle tool extraction position / 04: TT-axis spindle tool grip position / 02: TT-axis in standby position / 01: Return tool to be returned to next tool ready ST

Group 12 — 80: Next tool in next tool ready ST / 40: U-axis connection complete / 20: U-axis shifter retraction confirmation LS / 10: U-axis shifter retraction confirmation LS OFF / 08: U-axis present LS OFF / 04: TS-axis rotating position / 02: — / 01: —

No.	Operation sequence	Marked input logic (group-weight)
51	Tool unlock	9-10, 10-10, 11-10
52	Pot retract	9-10, 10-10, 11-10
53	Tool transfer complete	9-10, 10-10, 10-02, 11-10
54	TI-axis transport unit tool grip position/U-axis connection ON	8-01, 10-10, 11-10, 12-08
55	Transport unit on MG side	10-10, 11-10
56	TS-axis B grip transport unit tool grip position (0-degree rotation)	9-80, 10-10, 11-10
57	Tool transfer complete	9-80, 10-10, 10-04, 11-10
58	Operation selection	8-01, 10-08
59	Next tool ready return tool locking position (horizontal, vertical)	
60	Pot advance	
61	Tool lock	
62	Next tool ready return tool unlocking position (horizontal)	
63	Return tool unlocking ready position (vertical)	
64	Return tool unlocking ready position (horizontal)	
65	Return tool unlocked position (vertical)	
66	Return tool locking position (horizontal)	
67	Tool unlock	
68	Pot retract	
69	Tool transfer complete	
70	Operation selection	8-01
71	Next tool, input tool locking position (horizontal, vertical)	
72	Pot advance	
73	Tool lock	
74	Next tool, input tool unlocking position (horizontal)	
75	Next tool ready input tool unlocking ready position (vertical)	
76	Next tool ready input tool unlocking ready position (horizontal)	
77	Next tool ready input tool unlocked position (vertical)	
78	Next tool ready input tool locking position (horizontal)	
79	Tool unlock	
80	Pot retract	
81	Tool transfer complete	10-08
82	Operation selection	
83	Calling tool locking position (horizontal, vertical)	
84	Pot advance	
85	Tool lock	
86	Calling tool unlocking position (horizontal)	
87	MG manual change unlocking ready position (vertical)	
88	MG manual change unlocking ready position (horizontal)	
89	MG manual change unlocked position (vertical)	
90	MG manual change locking position (horizontal)	
91	Tool unlock	
92	Pot retract	
93	Tool transfer complete	9-40, 10-04
94	Operation selection	10-04
95	MG manual change locking position (horizontal, vertical)	
96	Pot advance	
97	Tool lock	
98	MG manual change unlocking position (horizontal)	
99	Storing tool unlocking ready position (vertical)	
100	Storing tool unlocking ready position (horizontal)	

ATC (matrix magazine) logic table MAP029A

Input logic 5/8

Column legend (bit groups 80 40 20 10 08 04 02 01):

#	Bit	Signal name
1	80	Tool pot spindle side confirmation ON
2	40	Tool pot magazine side confirmation ON
3	20	Tool pot unclamp confirmation ON
4	10	Tool pot clamp confirmation ON
5	08	Change arm tool unlock confirmation ON
6	04	Change arm tool lock confirmation ON
7	02	Tool pot retraction confirmation ON
8	01	Tool pot advance confirmation ON
9	80	Tool pot tool present
10	40	No tool pot tool
11	20	
12	10	
13	08	U-axis spindle indexing position
14	04	MG manual interruption OFF
15	02	ATC shutter open confirmation normal
16	01	ATC shutter close confirmation OFF
17	80	ATC shutter close confirmation
18	40	ATC shutter open confirmation OFF
19	20	ATC shutter open confirmation
20	10	Tool present in transfer pot
21	08	No tool pot tool
22	04	Movement to pot vertical retract position complete
23	02	Movement to pot vertical position complete
24	01	Movement to pot unlocking horizontal position complete
25	80	Movement to pot locking horizontal position complete
26	40	Vertical movement to tool change position complete
27	20	Horizontal movement to tool change position complete
28	10	Spindle tool present clamp confirmation OFF
29	08	No spindle tool interlock
30	04	Not in manual tool chage cycle
31	02	APC pallet cleaning sequence OFF
32	01	TS axis servo ON confirmation
33	80	Cylinder unclamp outside spindle
34	40	Cylinder clamp outside spindle
35	20	Cylinder clamp outside spindle OFF
36	10	APC start positon
37	08	MG manual operation command storing
38	04	MG manual operation command calling
39	02	Not MG manual operation command
40	01	Change arm B gripper tool present
41	02	Tool breakage inside MG detection in standby position confirmation
42	01	Tool breakage inside MG detection in measurement position confirmation

No.	Operation	O positions (column #)
101	Storing tool unlocked position (vertical)	2, 4, 6, 22, 23, 30, 41
102	Storing tool locking position (horizontal)	2, 4, 21, 23, 25, 30, 41
103	Tool unlock	2, 3, 5, 7, 8, 30, 41
104	Pot retract	2, 3, 5, 9, 30, 41
105	Tool transfer complete	2, 3, 5, 6, 9, 30, 41
106	Tool change standby complete position (horizontal, vertical)	2, 3, 5, 6, 13, 30, 35, 36, 41
107	Transport unit on MC side	1, 3, 5, 6, 13, 30, 41
108	TI-axis in standby position (170 mm) (0 mm)	1, 3, 5, 6, 13, 30, 41
109	TI-axis transport unit tool grip position (170 mm) (−170 mm)	1, 3, 5, 6, 30, 41
110	Transport unit on MG side	2, 3, 5, 6, 9, 30, 41
111	Tool transfer complete	2, 3, 5, 6, 9, 19, 20, 30, 41
112	TS-axis B grip transport unit tool grip position (0-degree rotation) (for SEQ22 return)	41
113	TS-axis A grip spindle tool grip position (270-degree rotation) (for SEQ28 return)	41
114	TS-axis B grip spindle tool grip position (180-degree rotation) (for SEQ34 return)	41
115	TS-axis A grip transport unit tool grip position (90-degree rotation) (for SEQ44 return)	41
116	TS-axis A grip transport unit tool grip position (90-degree rotation) (for SEQ55 return)	41
117	TI-axis transport unit tool grip position (170 mm) (−170 mm) (for SEQ107 return)	41
118	Operation selection (for SEQ110 return)	41
119	AT-axis instandby position (90 mm) (0 mm)/TI-axis in standby position (170 mm) (0 mm) (for SEQ37 return)	41
120	AT-axis in MG position (900 mm) (0 mm)	1, 3, 5, 28, 30, 41
121	Change arm tool lock/AT-axis (240 mm) (−570 mm) Simultaneous movement 3 affter movement	1, 3, 5, 6, 28, 30, 41
122	TS-axis A grip tool breakage inside MG measurement position (135-degree rotation)/AT-axis simultaneous movement 3	1, 3, 5, 6, 28, 30, 34, 41
123	TI-axis in standby position (220 mm) (0 mm)	1, 3, 5, 6, 28, 30, 41
124	ATC shutter close/U-axis connection ON	1, 3, 5, 6, 30, 41
125	AT-axis transport unit tool grip position (170 mm) (−170 mm)/U-axis connection ON	1, 3, 5, 6, 30, 41
126	Measurement unit preparation (down)	1, 3, 5, 6, 30, 42
127	Tool breakage detection cycle	1, 3, 5, 6, 30, 42
128	Measurement unit retract (up)	1, 3, 5, 6, 30, 41
129	TI-axis in standby position (170 mm) (0 mm)	1, 3, 5, 6, 30, 41
130	TS-axis A grip transport unit tool grip position (90-degree rotation)	1, 3, 5, 6, 30, 34, 41
131	TI-axis in standby position (170 mm) (0 mm) (for SEQ124 return)	
132	TS-axis A grip tool breakage inside MG measurement position (135-degree rotation) (for SEQ129 return)	
133	Tool change standby complete position (horizontal, vertical)	2, 3, 5, 6, 13, 30, 35, 36, 41
134	Transport unit on MC side	1, 3, 5, 6, 13, 30, 41
135	Transport unit on MG side	2, 3, 5, 6, 9, 30, 41
136	Tool transfer complete	2, 3, 5, 6, 9, 19, 20, 30, 41
137	TI-axis in standby position (for SEQ130 return)	
138	Transport unit on MC side (for SEQ54 return)	
139	Operation selection (for SEQ56 return)	
140	Transport unit on MG side (for SEQ106, 133 return)	
141	AT-axis transfer unit tool grip position (90 mm) (90 mm) (for SEQ16 return)	41
142	AT-axis in standby position/TI-axis in standby position/U-axis connection OFF (for SEQ37 return)	41
143	TI-axis transport unit tool grip position (for SEQ128 return)	41
B test data		1, 2, 3, 4, 5, 6, 7, 8, 41, 42
AB mode		

MA-12500H
ATC (matrix magazine) logic table   MAP029A

Input logic 6/8

Column bit weights per byte: 80 40 20 10 08 04 02 01 (bytes 7, 8, 9, 10, 11, 12)

Column headers (left → right):

Byte 7: Return tool determination complete (80) · Spindle tool unclamp LS OFF (40) · Spindle tool clamp LS OFF (20) · Spindle tool clamp LS ON (10) · Spindle tool unclamp LS ON (08) · Spindle tool present clamp confirmation ON (04) · Spindle stop (02) · Spindle indexing complete (01)

Byte 8: M64 Next tool storage cycle (80) · Next/return tool present (40) · No next/return tool (20) · Normal cycle (change arm rotation present) (10) · No next tool ready operation return (08) · No next tool ready operation input (04) · Next tool ready operation (02) · Active tool writing complete (01)

Byte 9: TS-axis 90 degrees (80) · TS-axis 180 degrees (40) · TS-axis 270 degrees (20) · TS-axis 0 degrees (10) · No recovery NG tool (08) · Recovery NG tool present (04) · Tool change position (HP1) (02) · Tool rack search complete (01)

Byte 10: Operation door lock confirmation ON (80) · AT-axis MG side (40) · AT-axis spindle side (20) · AT-axis in standby position (10) · Change arm rotation complete (08) · Step reverse interlock (04) · Step advance interlock (02) · TS-axis 135 degrees (01)

Byte 11: Tool breakage detection cycle complete (80) · Tool breakage detection cycle (40) · Not in tool breakage detection cycle (20) · TI-axis transport unit tool grip position (10) · TI-axis spindle tool extraction position (08) · TI-axis spindle tool grip position (04) · TI-axis in standby position (02) · Return tool to be returned to next tool ready ST (01)

Byte 12: Next tool in next tool ready ST (80) · U-axis connection complete (40) · U-axis shifter retraction confirmation LS (20) · U-axis shifter retraction confirmation LS OFF (10) · U-axis present LS OFF (08) · TS-axis rotating position (04) · (02) · (01)

No.	Operation sequence description	7	8	9	10	11	12	No.
101	Storing tool unlocked position (vertical)							101
102	Storing tool locking position (horizontal)							102
103	Tool unlock							103
104	Pot retract							104
105	Tool transfer complete				O(10) O(02)			105
106	Tool change standby complete position (horizontal, vertical)			O(10)	O(10)			106
107	Transport unit on MC side			O(10)	O(10)			107
108	TI-axis in standby position (170 mm) (0 mm)			O(10)	O(10) O(04)		O(40)	108
109	TI-axis transport unit tool grip position (170 mm) (−170 mm)			O(10)	O(10)	O(08)		109
110	Transport unit on MG side			O(10)	O(10)			110
111	Tool transfer complete			O(10)	O(10) O(04)	O(08)		111
112	TS-axis B grip transport unit tool grip position (0-degree rotation) (for SEQ22 return)							112
113	TS-axis A grip spindle tool grip position (270-degree rotation) (for SEQ28 return)							113
114	TS-axis B grip spindle tool grip position (180-degree rotation) (for SEQ34 return)							114
115	TS-axis A grip transport unit tool grip position (90-degree rotation) (for SEQ44 return)							115
116	TS-axis A grip transport unit tool grip position (90-degree rotation) (for SEQ55 return)							116
117	TI-axis transport unit tool grip position (170 mm) (−170 mm) (for SEQ107 return)							117
118	Operation selection (for SEQ110 return)							118
119	AT-axis instandby position (90 mm) (0 mm)/TI-axis in standby position (170 mm) (0 mm) (for SEQ37 return)							119
120	AT-axis in MG position (900 mm) (0 mm)	O(80) O(20) O(10)		O(10)		O(01)	O(04)	120
121	Change arm tool lock/AT-axis (240 mm (−570 mm)) Simultaneous movement 3 after movement	O(80) O(20) O(10)		O(10)		O(01)		121
122	TS-axis A grip tool breakage inside MG measurement position (135-degree rotation)/AT-axis simultaneous movement 3	O(80) O(20) O(10)			O(40)	O(20) O(01)		122
123	TI-axis in standby position (220 mm) (0 mm)	O(80) O(20) O(10)			O(40)	O(20)	O(10)	123
124	ATC shutter close/U-axis connection ON	O(80) O(20) O(10)			O(40)	O(20)	O(10)	124
125	AT-axis transport unit tool grip position (170 mm) (−170 mm)/U-axis connection ON				O(40)	O(20) O(08)	O(20)	125
126	Measurement unit preparation (down)				O(40)	O(40) O(10)		126
127	Tool breakage detection cycle				O(40)	O(40) O(20) O(10)		127
128	Measurement unit retract (up)				O(40)	O(20) O(10)		128
129	TI-axis in standby position (170 mm) (0 mm)				O(40)	O(20)	O(10)	129
130	TS-axis A grip transport unit tool grip position (90-degree rotation)		O(01)		O(40)	O(01)		130
131	TI-axis in standby position (170 mm) (0 mm) (for SEQ124 return)							131
132	TS-axis A grip tool breakage inside MG measurement position (135-degree rotation) (for SEQ129 return)							132
133	Tool change standby complete position (horizontal, vertical)			O(10)	O(10)			133
134	Transport unit on MC side			O(10)	O(10) O(04)			134
135	Transport unit on MG side			O(10)				135
136	Tool transfer complete			O(10)	O(10) O(04)			136
137	TI-axis in standby position (for SEQ130 return)							137
138	Transport unit on MC side (for SEQ54 return)							138
139	Operation selection (for SEQ56 return)							139
140	Transport unit on MG side (for SEQ106, 133 return)							140
141	AT-axis transfer unit tool grip position (90 mm) (90 mm) (for SEQ16 return)							141
142	AT-axis in standby position/TI-axis in standby position/U-axis connection OFF (for SEQ37 return)							142
143	TI-axis transport unit tool grip position (for SEQ128 return)							143

B test data

AB mode

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MA-12500H

ATC (matrix magazine) logic table　　　MAP029A

Input logic 7/8

Column groups and bit weights:

Grp	Bit	Signal
1	80	Tool pot spindle side confirmation ON
1	40	Tool pot magazine side confirmation ON
1	20	Tool pot unclamp confirmation ON
1	10	Tool pot clamp confirmation ON
1	08	Change arm tool unlock confirmation ON
1	04	Change arm tool lock confirmation ON
1	02	Tool pot retraction confirmation ON
1	01	Tool pot advance confirmation ON
2	80	Tool pot tool present
2	40	No tool pot tool
2	01	U-axis spindle indexing position
3	80	MG manual interruption OFF
3	40	ATC shutter open confirmation normal
3	20	ATC shutter close confirmation OFF
3	10	ATC shutter close confirmation
3	08	ATC shutter open confirmation OFF
3	04	ATC shutter open confirmation
3	02	Tool present in transfer pot
3	01	No tool pot tool
4	80	Movement to pot vertical retract position complete
4	40	Movement to pot vertical position complete
4	20	Movement to pot unlocking horizontal position complete
4	10	Movement to pot locking horizontal position complete
4	08	Vertical movement to tool change position complete
4	04	Horizontal movement to tool change position complete
4	02	Spindle tool present clamp confirmation OFF
4	01	No spindle tool interlock
5	80	Not in manual tool chage cycle
5	40	APC pallet cleaning sequence OFF
5	20	TS axis servo ON confirmation
5	10	Cylinder unclamp outside spindle
5	08	Cylinder clamp outside spindle
5	04	Cylinder clamp outside spindle OFF
5	02	APC start positon
6	80	MG manual operation command storing
6	40	MG manual operation command calling
6	20	Not MG manual operation command
6	10	Change arm B gripper tool present
6	08	Tool breakage inside MG detection in standby position confirmation
6	04	Tool breakage inside MG detection in measurement position confirmation

Auto branch data

Op. seq. No.	Description	Branch	Op. sequence No.
2	Operation selection (M63 command (no next tool))	⇒106	2
2	Operation selection (Chage arm B gripper tool present)	⇒133	2
2	Operation selection (operatio ready for next tool)	⇒58	2
2	Operation selection (MG manual calling)	⇒82	2
2	Operation selection (MG manual storing)	⇒94	2
6	Next tool unlocking position (horizontal) (Next tool in ready ST for next tool)	⇒9	6
18	Waiting for MC cycle end (next tool present in M64 operation)	⇒38	18
18	Waiting for MC cycle end (no next tool in M64 operation)	⇒109	18
18	Waiting for MC cycle end (during MG manual interruption call operation)	⇒135	18
18	Waiting for MC cycle end (during MG manual interruption storage operation)	⇒135	18
37	ATC shutter close/U-axis connection ON (no return tool operation)	⇒54	37
46	Pot advance (return tool in next tool ready ST)	⇒49	46
53	Tool transfer complete	⇒1	53
57	Tool transfer complete	⇒1	57
58	Operation selection (no next tool ready return)	⇒70	58
69	Tool transfer complete (no next tool ready input)	⇒1	69
81	Tool transfer complete	⇒1	81
93	Tool transfer complete	⇒1	93
93	Tool transfer complete	⇒2	93
105	Tool transfer complete	⇒1	105
33	AT-axis in standby position (810 mm) (0 mm)	⇒34	33
108	TI-axis in standby position （170 mm) (0 mm)	⇒18	108
111	Tool transfer complete	⇒1	111
136	Tool transfer complete	⇒82	111
136	Tool transfer complete	⇒94	111
32	Change arm tool unlock/Cylinder clamp outside spindle (during tool breakage inside MG)	⇒120	32
130	TS-axis A grip transport unit tool grip position (90-degree rotation)	⇒39	130
120	AT-axis in MG position (900 mm) (0 mm)	⇒121	120
134	Transport unit on MC side	⇒18	134

ATC (matrix magazine) logic table　　　MAP029A

Input logic 8/8

Column groups (bit values): 7 / 8 / 9 / 10 / 11 / 12, each with sub-columns 80 40 20 10 08 04 02 01

Column headers (left to right):

- Group 7: Return tool determination commplete / Spindle tool unclamp LS OFF / Spindle tool clamp LS OFF / Spindle tool clamp LS ON / Spindle tool unclamp LS ON / Spindle tool present clamp confirmation ON / Spindle stop / Spindle indexing complete
- Group 8: M64 Next tool storage cycle / Next/return tool present / No next/return tool / Normal cycle (change arm rotation present) / No next tool ready operation return / No next tool ready operation input / Next tool ready operation / Active tool writing complete
- Group 9: TS-axis 90 degrees / TS-axis 180 degrees / TS-axis 270 degrees / TS-axis 0 degrees / No recovery NG tool / Recovery NG tool present / Tool change position (HPI) / Tool rack search complete
- Group 10: Operation door lock confirmation ON / AT-axis MG side / AT-axis spindle side / AT-axis in standby position / Change arm rotation complete / Step reverse interlock / Step advance interlock / TS-axis 135 degrees
- Group 11: Tool breakage detection cycle complete / Tool breakage detection cycle / Not in tool breakage detection cycle / TI-axis transport unit tool grip position / TI-axis spindle tool extraction position / TI-axis spindle tool grip position / TI-axis in standby position / Return tool to be returned to nezt tool ready ST
- Group 12: Next tool in next tool ready ST / U-axis connection complete / U-axis shifter retraction confirmation LS / U-axis shifter retraction confirmation LS OFF / U-axis present LS OFF / TS-axis rotating position

Auto branch data

Op seq No.	Description	Branch	O marks (column : header)	Op seq No.
2	Operation selection (M63 command (no next tool))	⇒106	Next/return tool present; TS-axis 90 degrees; AT-axis in standby position	2
2	Operation selection (Chage arm B gripper tool present)	⇒133	TS-axis 90 degrees; AT-axis in standby position	2
2	Operation selection (operatio ready for next tool)	⇒58	No next tool ready operation input; TS-axis 90 degrees; AT-axis in standby position	2
2	Operation selection (MG manual calling)	⇒82	TS-axis 90 degrees; AT-axis in standby position	2
2	Operation selection (MG manual storing)	⇒94	TS-axis 90 degrees; AT-axis in standby position	2
6	Next tool unlocking position (horizontal) (Next tool in ready ST for next tool)	⇒9	TS-axis 90 degrees; AT-axis in standby position; TI-axis spindle tool grip position; Next tool in next tool ready ST	6
18	Waiting for MC cycle end (next tool present in M64 operation)	⇒38	Spindle tool unclamp LS OFF; Spindle tool clamp LS ON; Spindle tool unclamp LS ON; M64 Next tool storage cycle; Next/return tool present; TS-axis 90 degrees; AT-axis in standby position; Return tool to be returned to nezt tool ready ST	18
18	Waiting for MC cycle end (no next tool in M64 operation)	⇒109	Spindle tool unclamp LS OFF; Spindle tool clamp LS ON; Spindle tool unclamp LS ON; M64 Next tool storage cycle; No next/return tool; TS-axis 90 degrees; AT-axis in standby position; Return tool to be returned to nezt tool ready ST	18
18	Waiting for MC cycle end (during MG manual interruption call operation)	⇒135	Spindle tool unclamp LS OFF; Spindle tool clamp LS ON; Spindle tool unclamp LS ON; TS-axis 90 degrees; AT-axis in standby position; Return tool to be returned to nezt tool ready ST	18
18	Waiting for MC cycle end (during MG manual interruption storage operation)	⇒135	Spindle tool unclamp LS OFF; Spindle tool clamp LS ON; Spindle tool unclamp LS ON; TS-axis 90 degrees; AT-axis in standby position; Return tool to be returned to nezt tool ready ST	18
37	ATC shutter close/U-axis connection ON (no return tool operation)	⇒54	Spindle tool unclamp LS OFF; Spindle tool clamp LS ON; Spindle tool unclamp LS ON; Next/return tool present; Active tool writing complete; AT-axis in standby position; Return tool to be returned to nezt tool ready ST	37
46	Pot advance (return tool in next tool ready ST)	⇒49	Return tool determination commplete; TS-axis 90 degrees; AT-axis in standby position; TI-axis spindle tool grip position; Return tool to be returned to nezt tool ready ST	46
53	Tool transfer complete	⇒1	TS-axis 90 degrees; AT-axis in standby position; TI-axis spindle tool grip position	53
57	Tool transfer complete	⇒1	TS-axis 90 degrees; AT-axis in standby position; TI-axis spindle tool grip position	57
58	Operation selection (no next tool ready return)	⇒70	Normal cycle (change arm rotation present); No next tool ready operation input	58
69	Tool transfer complete (no next tool ready input)	⇒1	No next tool ready operation return	69
81	Tool transfer complete	⇒1		81
93	Tool transfer complete	⇒1	AT-axis spindle side	93
93	Tool transfer complete	⇒2	Change arm rotation complete	93
105	Tool transfer complete	⇒1		105
33	AT-axis in standby position (810 mm) (0 mm)	⇒34	TS-axis 90 degrees; AT-axis in standby position; TI-axis in standby position	33
108	TI-axis in standby position (170 mm) (0 mm)	⇒18	TS-axis 90 degrees; AT-axis in standby position; Return tool to be returned to nezt tool ready ST	108
111	Tool transfer complete	⇒1	TS-axis 90 degrees; AT-axis in standby position; TI-axis spindle tool extraction position	111
136	Tool transfer complete	⇒82	TS-axis 90 degrees; AT-axis in standby position	111
136	Tool transfer complete	⇒94	TS-axis 90 degrees; AT-axis in standby position	111
32	Change arm tool unlock/Cylinder clamp outside spindle (during tool breakage inside MG)	⇒120	Spindle tool unclamp LS OFF; Spindle tool clamp LS ON; Spindle tool unclamp LS ON; Active tool writing complete; AT-axis MG side; TI-axis transport unit tool grip position; TI-axis spindle tool grip position	32
130	TS-axis A grip transport unit tool grip position (90-degree rotation)	⇒39	TS-axis 90 degrees; AT-axis MG side; Return tool to be returned to nezt tool ready ST	130
120	AT-axis in MG position (900 mm) (0 mm)	⇒121	Spindle tool unclamp LS OFF; Spindle tool clamp LS ON; Spindle tool unclamp LS ON; TS-axis 90 degrees; AT-axis MG side; TI-axis spindle tool grip position	120
134	Transport unit on MC side	⇒18	TS-axis 90 degrees; AT-axis in standby position	134

ATC（matrix magazine）logic table　　　MAP029A

Output logic 1/6

Column header groups (each group has sub-columns: 80 40 20 10 08 04 02 01):

Group 1: Tool pot on MC side | Tool pot on MG side | Tool pot unclamp | Tool pot clamp | Change arm tool unlock | Change arm tool lock | Tool pot retract | Tool pot advance

Group 2: Tool breakage inside MG detection command memory accepted | Tool breakage inside MG detection cycle start | Tool breakage inside MG detection in standby position | Tool breakage inside MG detection in measurement position | TS-axis 135 degrees | M6 command inhibited | Tool breakage detection start | Transport pot brake release | Coolant OFF command

Group 3: Magazine manual interruption available | ATC air blow check | Chage arm check | ATC door open inhibited

Group 4: Check for pot presence | Tool change position command | Magazine pot vertical complete command | Magazine pot horizontal complete command | Magazine pot vertical retract command | Magazine pot unlock command | Magazine pot lock command | Return tool command | Next tool command

Group 5: Manual return ATC shutter close | ATC shutter open command | Cylinder unclamp inside spindle command | Determining chage arm B gripper tool present | M64 command inhibited | Return cycle inhibited | Retractable

Group 6: Cylinder unclamp outside spindle command | TI-axis transport unit tool grip position | TI-axis spindle tool extraction position | TI-axis spindle tool grip position | TI-axis in standby position | TS-axis 90 degrees | TS-axis 180 degrees | TS-axis 270 degrees | TS-axis 0 degrees

No.	Operation sequence	No.
1	Writing next tool	1
2	Operation selection	2
3	Next tool locking position （horizontal, vertical）	3
4	Pot advance	4
5	Tool lock	5
6	Next tool unlocking position （horizontal）	6
7	Tool change standby ready position （vertical）	7
8	Tool change standby ready position （horizontal）	8
9	Tool change standby complete position （horizontal, vertical）	9
10	Pot retract	10
11	Transfer unit on MC side	11
12	Change arm tool unlock	12
13	AT-axis transfer unit tool grip position （90 mm） （90 mm）	13
14	Change arm tool lock	14
15	Transport unit tool unlock	15
16	TI-axis in standby position （170 mm） （0 mm）	16
17	AT-axis in standby position （90 mm） （0 mm）	17
18	Waiting for MC cycle end	18
19	Spindle indexed/U-axis connection OFF	19
20	HP1 （simultaneous movement 1）	20
21	ATC shutter open （simultaneous movement 1）	21
22	TI-axis spindle tool grip position （220 mm） （220 mm）	22
23	TS-axis A grip spindle tool grip position （270-degree rotation）	23
24	Change arm tool unlock	24
25	AT-axis spindle tool lock/Cylinder unclamp outside spindle	25
26	Change arm tool lock/Cylinder unclamp outside spindle	26
27	Spindle tool unclamp	27
28	TI-axis spindle tool extraction position （170 mm） （390 mm）	28
29	TS-axis B grip spindle tool grip position （180-degree rotation）	29
30	TI-axis spindle tool grip position （170 mm） （220 mm）	30
31	Spindle tool clamp	31
32	Change arm tool unlock/Cylinder clamp outside spindle	32
33	AT-axis in standby position （810 mm） （0 mm）	33
34	Change arm tool lock/AT-axis （240 mm （-570 mm）） Simultaneous movement 2 affter movement	34
35	TS-axis A grip transport unit tool grip position （90-degree rotation）/AT-axis simultaneous movement 2	35
36	TI-axis in standby position （220 mm） （0 mm）	36
37	ATC shutter close/U-axis connection ON	37
38	AT-axis transport unit tool grip position （90 mm）/U-axis connection ON	38
39	TI-axis transport unit tool grip position （170 mm） （-170 mm）	39
40	Transport unit tool lock	40
41	Change arm tool unlock	41
42	AT-axis in standby position （90 mm） （0 mm）	42
43	Change arm tool lock	43
44	Transfer unit on MG side	44
45	TS-axis B grip transport unit tool grip position （0-degree rotation）	45
46	Pot advance	46
47	Return tool unlocking ready position （vertical）	47
48	Return tool unlocking ready position （horizontal）	48
49	Return tool unlocked position （vertical）	49
50	Return tool locking position （horizontall）	50

Output logic 2/6

Op. No.	Operation	7:80 Spindle rotation inhibited	7:40 Manual axis advance inhibited	7:20 RS air blow	7:10 Spindle air blow	7:08 Manual tool change	7:04 Next tool cancelled	7:02 AT-axis MG side	7:01 AT-axis spindle side	8:80 AT-axis in standby position	8:40 Active tool removal command	8:20 Next tool installation and active tool storage command	8:10 Active tool writing	9:80 A, B mode invalid	9:40 Change arm rotation command	9:20 continuous step command	9:10 Step reverse inhibited	9:08 NC answer back	9:04 Auto branch	9:02 Step timer No.2	9:01 Step timer No.1	10:80 ATC start position	10:40 C-axis travel inhibited	10:20 B-axis travel inhibited	10:10 A-axis travel inhibited	10:08 Z-axis travel inhibited	10:04 Y-axis travel inhibited	10:02 X-axis travel inhibited	11:80 Same T command valid	11:40 U-axis connection OFF command	11:20 U-axis connection ON command	11:10 Determining NG tool	11:08 TS-axis braking command	11:04 Determining return tool	12:80 MG manual operation storing cycle	12:40 MG manual operation calling cycle	12:20 Tool ready return cycle	12:10 Tool ready input cycle	12:02 Tool change position command (HP7)	12:01 Tool change position command (HP1)	Op. No.
1	Writing next tool															○						○							○											○	1
2	Operation selection														○																	○								○	2
3	Next tool locking position (horizontal, vertical)																																							○	3
4	Pot advance			○																																				○	4
5	Tool lock																																							○	5
6	Next tool unlocking position (horizontal)														○																									○	6
7	Tool change standby ready position (vertical)																																							○	7
8	Tool change standby ready position (horizontal)																																							○	8
9	Tool change standby complete position (horizontal, vertical)																																								9
10	Pot retract																																								10
11	Transfer unit on MC side																																								11
12	Change arm tool unlock																																							○	12
13	AT-axis transfer unit tool grip position (90 mm) (90 mm)							○																																○	13
14	Change arm tool lock																																							○	14
15	Transport unit tool unlock																																							○	15
16	TI-axis in standby position (170 mm) (0 mm)		○																																					○	16
17	AT-axis in standby position (90 mm) (0 mm)									○																														○	17
18	Waiting for MC cycle end					○										○																								○	18
19	Spindle indexed/U-axis connection OFF					○																								○										○	19
20	HP1 (simultaneous movement 1)					○																																	○	○	20
21	ATC shutter open (simultaneous movement 1)	○	○																					○	○	○	○	○												○	21
22	TI-axis spindle tool grip position (220 mm) (220 mm)	○	○																					○	○	○	○	○													22
23	TS-axis A grip spindle tool grip position (270-degree rotation)	○	○																					○	○	○	○	○													23
24	Change arm tool unlock	○	○																					○	○	○	○	○													24
25	AT-axis spindle tool grip position (810 mm) (-810 mm)	○	○						○															○	○	○	○	○													25
26	Change arm tool lock/Cylinder unclamp outside spindle	○	○																					○	○	○	○	○													26
27	Spindle tool unclamp	○	○																					○	○	○	○	○													27
28	TI-axis spindle tool extraction position (170 mm) (390 mm)	○	○		○						○													○	○	○	○	○													28
29	TS-axis B grip spindle tool grip position (180-degree rotation)	○	○		○							○		○										○	○	○	○	○													29
30	TI-axis spindle tool grip position (170 mm) (220 mm)	○	○		○								○											○	○	○	○	○													30
31	Spindle tool clamp	○	○																					○	○	○	○	○													31
32	Change arm tool unlock/Cylinder clamp outside spindle	○	○													○								○	○	○	○	○													32
33	AT-axis in standby position (810 mm) (0 mm)	○	○						○							○								○	○	○	○	○													33
34	Change arm tool lock/AT-axis (240 mm (-570 mm)) Simultaneous movement 2 affter movement	○	○						○															○	○	○	○	○													34
35	TS-axis A grip transport unit tool grip position (90-degree rotation)/AT-axis simultaneous movement 2	○	○						○															○	○	○	○	○													35
36	TI-axis in standby position (220 mm) (0 mm)	○	○																					○	○	○	○	○													36
37	ATC shutter close/U-axis connection ON													○	○																		○							○	37
38	AT-axis transport unit tool grip position (90 mm)/U-axis connection ON							○						○																										○	38
39	TI-axis transport unit tool grip position (170 mm) (-170 mm)		○											○																										○	39
40	Transport unit tool lock													○																										○	40
41	Change arm tool unlock													○																										○	41
42	AT-axis in standby position (90 mm) (0 mm)								○					○																										○	42
43	Change arm tool lock													○																											43
44	Transport unit on MG side													○																											44
45	TS-axis B grip transport unit tool grip position (0-degree rotation)													○																											45
46	Pot advance													○	○																								○		46
47	Return tool unlocking ready position (vertical)													○																										○	47
48	Return tool unlocking ready position (horizontal)													○																										○	48
49	Return tool unlocked position (vertical)													○																										○	49
50	Return tool locking position (horizontall)													○																										○	50

Output logic 3/6

Column legend (left → right), in hex-weight order 80 40 20 10 08 04 02 01 within each group:

Group 1: 80 Tool pot on MC side · 40 Tool pot on MG side · 20 Tool pot unclamp · 10 Tool pot clamp · 08 Change arm tool unlock · 04 Change arm tool lock · 02 Tool pot retract · 01 Tool pot advance

Group 2: 80 Tool breakage inside MG detection command memory accepted · 40 Tool breakage inside MG detection cycle start · 20 Tool breakage inside MG detection in standby position · 10 Tool breakage inside MG detection in measurement position · 08 TS-axis 135 degrees · 04 M6 command inhibited · 02 Tool breakage detection start · 01 Transport pot brake release

Group 3: 80 Coolant OFF command · 40 Magazine manual interruption available · 20 ATC air blow check · 10 Chage arm check · 08 ATC door open inhibited · 04 (—) · 02 (—) · 01 Check for pot presence

Group 4: 80 Tool change position command · 40 Magazine pot vertical complete command · 20 Magazine pot horizontal complete command · 10 Magazine pot vertical retract command · 08 Magazine pot unlock command · 04 Magazine pot lock command · 02 Return tool command · 01 Next tool command

Group 5: 80 Manual return ATC shutter close · 40 ATC shutter open command · 20 Cylinder unclamp inside spindle command · 10 Determining chage arm B gripper tool present · 08 M64 command inhibited · 04 Return cycle inhibited · 02 Retractable · 01 Cylinder unclamp outside spindle command

Group 6: 80 TT-axis transport unit tool grip position · 40 TT-axis spindle tool extraction position · 20 TT-axis spindle tool grip position · 10 TT-axis in standby position · 08 TS-axis 90 degrees · 04 TS-axis 180 degrees · 02 TS-axis 270 degrees · 01 TS-axis 0 degrees

(○ = output, ◎ = momentary/strobe output)

No.	Output logic 3/6	Grp1	Grp2	Grp3	Grp4	Grp5	Grp6	No.
51	Tool unlock	MG○, arm-unlock○, arm-lock○, pot-advance◎	M6-inhibited○			Retractable○		51
52	Pot retract	MG○, arm-unlock○, arm-lock○, pot-retract◎	M6-inhibited○	Check for pot presence○		Retractable○		52
53	Tool transfer complete	MG○, arm-unlock○, arm-lock○	M6-inhibited○			Retractable○		53
54	TT-axis transport unit tool grip position/U-axis connection ON	MC◎, MG○, arm-unlock○, arm-lock○	M6-inhibited○			Retractable○	TT-axis transport unit tool grip position○	54
55	Transport unit on MG side	MC○, MG◎, arm-unlock○, arm-lock○	M6-inhibited○	ATC door open inhibited○		Retractable○		55
56	TS-axis B grip transport unit tool grip position (0-degree rotation)	MG○, arm-unlock○, arm-lock○	M6-inhibited○			Retractable○	TS-axis 0 degrees○	56
57	Tool transfer complete	MG○, arm-unlock○, arm-lock○	M6-inhibited○			Retractable○		57
58	Operation selection	MG○, arm-unlock○, arm-lock○	M6-inhibited○			Retractable○		58
59	Next tool ready return tool locking position (horizontal, vertical)	MG○, arm-unlock○, arm-lock○, pot-retract◎	M6-inhibited○		Tool change position cmd○, Mag pot vertical complete○, Mag pot vertical retract○, Mag pot lock○	Retractable○		59
60	Pot advance	MG○, arm-unlock○, pot-advance◎	M6-inhibited○	Check for pot presence○	Tool change position cmd○	Retractable○		60
61	Tool lock	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○			Retractable○		61
62	Next tool ready return tool unlocking position (horizontal)	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○		Mag pot horizontal complete○, Mag pot vertical retract○, Mag pot lock○	Retractable○	TT-axis transport unit tool grip position○, TT-axis spindle tool extraction position○	62
63	Return tool unlocking ready position (vertical)	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○		Mag pot vertical retract○, Mag pot unlock○, Mag pot lock○	Retractable○	TT-axis transport unit tool grip position○, TT-axis spindle tool extraction position○	63
64	Return tool unlocking ready position (horizontal)	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○		Mag pot horizontal complete○, Mag pot vertical retract○	Retractable○		64
65	Return tool unlocked position (vertical)	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○		Mag pot unlock○, Mag pot lock○	Cylinder unclamp inside spindle cmd○, Retractable○		65
66	Return tool locking position (horizontal)	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○		Mag pot horizontal complete○, Mag pot unlock○, Mag pot lock○	Retractable○		66
67	Tool unlock	MG○, arm-unlock○, arm-lock○, pot-advance◎	M6-inhibited○			Retractable○		67
68	Pot retract	MG○, arm-unlock○, arm-lock○, pot-retract◎	M6-inhibited○	Check for pot presence○		Retractable○		68
69	Tool transfer complete	MG○, arm-unlock○, arm-lock○	M6-inhibited○			Retractable○		69
70	Operation selection	MG○, arm-unlock○, arm-lock○	M6-inhibited○			Retractable○		70
71	Next tool, input tool locking position (horizontal, vertical)	MG○, arm-unlock○, arm-lock○, pot-retract◎	M6-inhibited○		Tool change position cmd○, Mag pot vertical complete○, Mag pot vertical retract○, Mag pot lock○	Retractable○		71
72	Pot advance	MG○, arm-unlock○, pot-advance◎	M6-inhibited○	Check for pot presence○	Tool change position cmd○	Retractable○		72
73	Tool lock	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○			Retractable○		73
74	Next tool, input tool unlocking position (horizontal)	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○		Mag pot horizontal complete○, Mag pot vertical retract○, Mag pot lock○	Retractable○	TT-axis transport unit tool grip position○, TT-axis spindle tool extraction position○	74
75	Next tool ready input tool unlocking ready position (vertical)	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○		Mag pot vertical retract○, Mag pot unlock○, Mag pot lock○	Retractable○	TT-axis transport unit tool grip position○, TT-axis spindle tool extraction position○	75
76	Next tool ready input tool unlocking ready position (horizontal)	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○		Mag pot horizontal complete○, Mag pot vertical retract○	Retractable○		76
77	Next tool ready input tool unlocked position (vertical)	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○		Mag pot unlock○, Mag pot lock○	Cylinder unclamp inside spindle cmd○, Retractable○		77
78	Next tool ready input tool locking position (horizontal)	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○		Mag pot horizontal complete○, Mag pot unlock○, Mag pot lock○	Retractable○		78
79	Tool unlock	MG○, arm-unlock○, arm-lock○, pot-advance◎	M6-inhibited○			Retractable○		79
80	Pot retract	MG○, arm-unlock○, arm-lock○, pot-retract◎	M6-inhibited○	Check for pot presence○		Retractable○		80
81	Tool transfer complete	MG○, arm-unlock○, arm-lock○	M6-inhibited○			Retractable○		81
82	Operation selection	MG○, arm-unlock○, arm-lock○	M6-inhibited○	ATC door open inhibited○		Retractable○		82
83	Calling tool locking position (horizontal, vertical)	MG○, arm-unlock○, arm-lock○, pot-retract◎	M6-inhibited○	ATC door open inhibited○	Tool change position cmd○, Mag pot vertical complete○, Mag pot vertical retract○, Mag pot lock○	Retractable○		83
84	Pot advance	MG○, arm-unlock○, pot-advance◎	M6-inhibited○	ATC door open inhibited○, Check for pot presence○	Tool change position cmd○	Retractable○		84
85	Tool lock	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○	ATC door open inhibited○		Retractable○		85
86	Calling tool unlocking position (horizontal)	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○	ATC door open inhibited○	Mag pot horizontal complete○, Mag pot vertical retract○, Mag pot lock○	Retractable○	TT-axis transport unit tool grip position○, TT-axis spindle tool extraction position○	86
87	MG manual change unlocking ready position (vertical)	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○	ATC door open inhibited○	Mag pot vertical retract○, Mag pot unlock○, Mag pot lock○	Retractable○	TT-axis transport unit tool grip position○, TT-axis spindle tool extraction position○	87
88	MG manual change unlocking ready position (horizontal)	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○	ATC door open inhibited○	Mag pot horizontal complete○, Mag pot vertical retract○	Retractable○		88
89	MG manual change unlocked position (vertical)	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○	ATC door open inhibited○	Mag pot unlock○, Mag pot lock○	Cylinder unclamp inside spindle cmd○, Retractable○		89
90	MG manual change locking position (horizontal)	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○	ATC door open inhibited○	Mag pot horizontal complete○, Mag pot unlock○, Mag pot lock○	Retractable○		90
91	Tool unlock	MG○, arm-unlock○, arm-lock○, pot-advance◎	M6-inhibited○	ATC door open inhibited○		Retractable○		91
92	Pot retract	MG○, arm-unlock○, arm-lock○, pot-retract◎	M6-inhibited○	ATC door open inhibited○, Check for pot presence○		Retractable○		92
93	Tool transfer complete	MG○, arm-unlock○, arm-lock○	M6-inhibited○	ATC door open inhibited○		Retractable○		93
94	Operation selection	MG○, arm-unlock○, arm-lock○	M6-inhibited○	ATC door open inhibited○		Retractable○		94
95	MG manual change locking position (horizontal, vertical)	MG○, arm-unlock○, arm-lock○, pot-retract◎	M6-inhibited○	ATC door open inhibited○	Tool change position cmd○, Mag pot vertical complete○, Mag pot vertical retract○, Mag pot lock○	Retractable○		95
96	Pot advance	MG○, arm-unlock○, pot-advance◎	M6-inhibited○	ATC door open inhibited○, Check for pot presence○	Tool change position cmd○	Retractable○		96
97	Tool lock	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○	ATC door open inhibited○		Retractable○		97
98	MG manual change unlocking position (horizontal)	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○	ATC door open inhibited○	Mag pot horizontal complete○, Mag pot vertical retract○, Mag pot lock○	Retractable○	TT-axis transport unit tool grip position○, TT-axis spindle tool extraction position○	98
99	Storing tool unlocking ready position (vertical)	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○	ATC door open inhibited○	Mag pot vertical retract○, Mag pot unlock○, Mag pot lock○	Retractable○	TT-axis transport unit tool grip position○, TT-axis spindle tool extraction position○	99
100	Storing tool unlocking ready position (horizontal)	MC○, unclamp○, arm-unlock○, pot-retract○	M6-inhibited○	ATC door open inhibited○	Mag pot horizontal complete○, Mag pot vertical retract○	Retractable○		100

Output logic 4/6

Column groups (byte.bit): 7 / 8 / 9 / 10 / 11 / 12, each with bits 80 40 20 10 08 04 02 01

No.	Operation	Spindle rotation inhibited	Manual axis advance inhibited	RS air blow		Spindle air blow		Manual tool change	Next tool cancelled	AT-axis MG side	AT-axis spindle side	At-axis in standby position	Active tool removal command	Next tool installation and active tool storage command	Active tool writing			A, B mode invalid	Change arm rotation command	continuous step command	Step reverse inhibited	NC answer back	Auto branch	Step timer No.2	Step timer No.1	ATC start position	C-axis travel inhibited	B-axis travel inhibited	A-axis travel inhibited	Z-axis travel inhibited	Y-axis travel inhibited	X-axis travel inhibited		Same T command valid	U-axis connection OFF command	U-axis connection ON command	Determining NG tool	TS-axis braking command	Determining return tool	MG manual operation storing cycle	MG manual operation calling cycle	Tool ready return cycle	Tool ready input cycle			Tool change position command (HP7)	Tool change position command (HP1)			No.
51	Tool unlock																				O																O													51
52	Pot retract		O																		O																O													52
53	Tool transfer complete									O											O	O	O														O													53
54	TI-axis transport unit tool grip position/U-axis connection ON																				O																													54
55	Transport unit on MG side																				O																													55
56	TS-axis B grip transport unit tool grip position (0-degree rotation)																				O																													56
57	Tool transfer complete									O											O	O	O														O													57
58	Operation selection																					O															O													58
59	Next tool ready return tool locking position (horizontal, vertical)																																				O									O				59
60	Pot advance		O																																		O									O				60
61	Tool lock																																				O									O				61
62	Next tool ready return tool unlocking position (horizontal)																																				O									O				62
63	Return tool unlocking ready position (vertical)																																				O									O				63
64	Return tool unlocking ready position (horizontal)																																				O									O				64
65	Return tool unlocked position (vertical)																																				O									O				65
66	Return tool locking position (horizontal)																																				O									O				66
67	Tool unlock																																				O									O				67
68	Pot retract		O																																		O									O				68
69	Tool transfer complete									O												O															O									O				69
70	Operation selection																					O															O													70
71	Next tool, input tool locking position (horizontal, vertical)																																				O										O			71
72	Pot advance		O																																		O										O			72
73	Tool lock																																				O										O			73
74	Next tool, input tool unlocking position (horizontal)																																				O										O			74
75	Next tool ready input tool unlocking ready position (vertical)																																				O										O			75
76	Next tool ready input tool unlocking ready position (horizontal)																																				O										O			76
77	Next tool ready input tool unlocked position (vertical)																																				O										O			77
78	Next tool ready input tool locking position (horizontal)																																				O										O			78
79	Tool unlock																																				O										O			79
80	Pot retract		O																																		O										O			80
81	Tool transfer complete									O												O															O										O			81
82	Operation selection																					O															O													82
83	Calling tool locking position (horizontal, vertical)																																				O				O									83
84	Pot advance		O																																		O				O									84
85	Tool lock																																				O				O									85
86	Calling tool unlocking position (horizontal)																																				O				O									86
87	MG manual change unlocking ready position (vertical)																																				O				O									87
88	MG manual change unlocking ready position (horizontal)																																				O				O									88
89	MG manual change unlocked position (vertical)																																				O				O									89
90	MG manual change locking position (horizontal)																																				O				O									90
91	Tool unlock																																				O				O									91
92	Pot retract		O																																		O				O									92
93	Tool transfer complete									O												O														O	O				O									93
94	Operation selection																					O															O													94
95	MG manual change locking position (horizontal, vertical)																																				O			O										95
96	Pot advance		O																																		O			O										96
97	Tool lock																																				O			O										97
98	MG manual change unlocking position (horizontal)																																				O			O										98
99	Storing tool unlocking ready position (vertical)																																				O			O										99
100	Storing tool unlocking ready position (horizontal)																																				O			O										100

Output logic 5/6

Column legend (left → right, grouped 1–6, bit weights 80 40 20 10 08 04 02 01):

#	Signal
1	Tool pot on MC side
2	Tool pot on MG side
3	Tool pot unclamp
4	Tool pot clamp
5	Change arm tool unlock
6	Change arm tool lock
7	Tool pot retract
8	Tool pot advance
9	Tool breakage inside MG detection command memory accepted
10	Tool breakage inside MG detection cycle start
11	Tool breakage inside MG detection in standby position
12	Tool breakage inside MG detection in measurement position
13	TS-axis 135 degrees
14	M6 command inhibited
15	Tool breakage detection start
16	Transport pot brake release
17	Coolant OFF command
18	Magazine manual interruption available
19	ATC air blow check
20	Chage arm check
21	ATC door open inhibited
22	Check for pot presence
23	Tool change position command
24	Magazine pot vertical complete command
25	Magazine pot horizontal complete command
26	Magazine pot vertical retract command
27	Magazine pot unlock command
28	Magazine pot lock command
29	Return tool command
30	Next tool command
31	Manual return ATC shutter close
32	ATC shutter open command
33	Cylinder unclamp inside spindle command
34	Determining chage arm B gripper tool present
35	M64 command inhibited
36	Return cycle inhibited
37	Retractable
38	Cyliner unclamp outside spindle command
39	TI-axis transport unit tool grip position
40	TI-axis spindle tool extraction position
41	TI-axis spindle tool grip position
42	TI-axis in standby position
43	TS-axis 90 degrees
44	TS-axis 180 degrees
45	TS-axis 270 degrees
46	TS-axis 0 degrees

Data table (○ = output, ◎ = memorized/latched output). Active signals listed by legend number:

Seq	Operation	Active outputs
101	Storing tool unlocked position (vertical)	2○ 5○ 8○ 16○ 21○ 37○
102	Storing tool locking position (horizontal)	2○ 4○ 6○ 7○ 16○ 21○ 26○ 27○ 37○
103	Tool unlock	2○ 3○ 5○ 8○ 16○ 21○ 37○
104	Pot retract	2○ 3○ 5○ 16○ 21○ 22○ 37○
105	Tool transfer complete	2○ 3○ 5○ 7○ 16○ 21○ 37○
106	Tool change standby complete position (horizontal, vertical)	2◎ 5○ 7○ 16○ 24○ 25○ 26○ 37○
107	Transport unit on MC side	1◎ 2○ 5○ 7○ 16○ 31○ 37○
108	TI-axis in standby position (170 mm) (0 mm)	2○ 5○ 7○ 16○ 37○ 42○
109	TI-axis transport unit tool grip position (170 mm) (−170 mm)	1◎ 2○ 5○ 7○ 16○ 37○ 39○
110	Transport unit on MG side	2◎ 5○ 7○ 16○ 37○
111	Tool transfer complete	2○ 5○ 7○ 16○ 37○
112	TS-axis B grip transport unit tool grip position (0-degree rotation) (for SEQ22 return)	1○ 2○ 5○ 7○ 14○ 16○ 17○ 33○ 35○ 36○ 37○ 46○
113	TS-axis A grip spindle tool grip position (270-degree rotation) (for SEQ28 return)	1○ 2○ 5○ 7○ 14○ 16○ 17○ 33○ 34○ 35○ 37○ 45○
114	TS-axis B grip spindle tool grip position (180-degree rotation) (for SEQ34 return)	1○ 2○ 5○ 7○ 14○ 16○ 17○ 33○ 35○ 37○ 44○
115	TS-axis A grip transport unit tool grip position (90-degree rotation) (for SEQ44 return)	2◎ 3○ 5○ 7○ 16○ 37○ 45○
116	TS-axis A grip transport unit tool grip position (90-degree rotation) (for SEQ55 return)	2◎ 5○ 7○ 16○ 37○ 45○
117	TI-axis transport unit tool grip position (170 mm) (−170 mm) (for SEQ107 return)	1◎ 2○ 5○ 7○ 16○ 37○ 39○
118	Operation selection (for SEQ110 return)	2○ 5○ 7○ 16○ 37○
119	AT-axis instandby position (90 mm) (0 mm)/TI-axis in standby position (170 mm) (0 mm) (for SEQ37 return)	2○ 5○ 7○ 16○ 21○ 37○ 43○
120	AT-axis in MG position (900 mm) (0 mm)	2○ 4○ 5○ 7○ 16○ 33○ 37○
121	Change arm tool lock/AT-axis (240 mm (−570 mm)) Simultaneous movement 3 affter movement	2○ 5○ 7○ 14○ 16○ 33○ 37○
122	TS-axis A grip tool breakage inside MG measurement position (135-degree rotation)/AT-axis simultaneous movement 3	2○ 5○ 7○ 13○ 14○ 16○ 33○ 37○ 45○
123	TI-axis in standby position (220 mm) (0 mm)	2○ 5○ 7○ 16○ 21○ 33○ 37○ 42○
124	ATC shutter close/U-axis connection ON	2○ 5○ 7○ 16○ 21○ 31○ 37○
125	AT-axis transport unit tool grip position (170 mm) (−170 mm)/U-axis connection ON	2○ 5○ 7○ 15○ 37○ 40○
126	Measurement unit preparation (down)	2○ 5○ 7○ 12○ 37○
127	Tool breakage detection cycle	2○ 5○ 7○ 10○ 12○ 37○
128	Measurement unit retract (up)	2○ 5○ 7○ 11○ 37○
129	TI-axis in standby position (170 mm) (0 mm)	2○ 5○ 7○ 16○ 37○ 42○
130	TS-axis A grip transport unit tool grip position (90-degree rotation)	2○ 5○ 7○ 16○ 37○ 43○
131	TI-axis in standby position (170 mm) (0 mm) (for SEQ124 return)	2○ 5○ 7○ 13○ 16○ 37○
132	TS-axis A grip tool breakage inside MG measurement position (135-degree rotation) (for SEQ129 return)	2○ 5○ 7○ 13○ 16○ 37○
133	Tool change standby complete position (horizontal, vertical)	2◎ 5○ 7○ 16○ 24○ 25○ 26○ 37○
134	Transport unit on MC side	1◎ 2○ 5○ 7○ 16○ 31○ 37○
135	Transport unit on MG side	2◎ 5○ 7○ 16○ 37○
136	Tool transfer complete	2○ 5○ 7○ 16○ 37○
137	TI-axis in standby position (for SEQ130 return)	2○ 5○ 7○ 16○ 22○ 37○ 42○
138	Transport unit on MC side (for SEQ54 return)	1◎ 2○ 5○ 7○ 16○ 31○ 37○
139	Operation selection (for SEQ56 return)	2○ 5○ 7○ 16○ 37○ 44○
140	Transport unit on MG side (for SEQ106, 133 return)	2◎ 5○ 7○ 16○ 31○ 37○
141	AT-axis transfer unit tool grip position (90 mm) (90 mm) (for SEQ16 return)	2○ 5○ 7○ 16○ 20○ 37○
142	AT-axis in standby position/TI-axis in standby position/U-axis connection OFF (for SEQ37 return)	2○ 5○ 7○ 16○ 21○ 37○ 45○
143	TI-axis transport unit tool grip position (for SEQ128 return)	2○ 5○ 7○ 15○ 37○ 42○

ABモード

Output logic 6/6

Op. seq. No.	Description	Spindle rotation inhibited	Manual axis advance inhibited	RS air blow	Spinde air blow	Manual tool change	Next tool cancelled	AT-axis MG side	AT-axis spindle side	At-axis in standby position	Active tool removal command	Next tool installation and active tool storage command	Active tool writing	A.B mode invalid	Change arm rotation command	continuous step command	Step reverse inhibited	NC answer back	Auto branch	Step timer No.2	Step timer No.1	ATC start position	C-axis travel inhibited	B-axis travel inhibited	A-axis travel inhibited	Z-axis travel inhibited	Y-axis travel inhibited	X-axis travel inhibited	Same T command valid	U-axis connection OFF command	U-axis connection ON command	Determining NG tool	TS-axis braking command	Determining return tool	MG manual operation storing cycle	MG manual operation calling cycle	Tool ready return cycle	Tool ready input cycle	Tool change position command (HP7)	Tool change position command (HP1)	Op. seq. No.
101	Storing tool unlocked position (vertical)																																	O					O		101
102	Storing tool locking position (horizontal)																																	O					O		102
103	Tool unlock																																	O					O		103
104	Pot retract			O																														O					O		104
105	Tool transfer complete						O													O														O					O		105
106	Tool change standby complete position (horizontal, vertical)																			O														O							106
107	Transport unit on MC side																																	O							107
108	TI-axis in standby position (170 mm) (0 mm)																			O														O							108
109	TI-axis transport unit tool grip position (170 mm) (-170 mm)																	O																O							109
110	Transport unit on MG side																	O																O							110
111	Tool transfer complete						O											O	O	O														O							111
112	TS-axis B grip transport unit tool grip position (0-degree rotation) (for SEQ22 return)																	O																							112
113	TS-axis A grip spindle tool grip position (270-degree rotation) (for SEQ28 return)										O				O																										113
114	TS-axis B grip spindle tool grip position (180-degree rotation) (for SEQ34 return)																	O																							114
115	TS-axis A grip transport unit tool grip position (90-degree rotation) (for SEQ44 return)																	O																							115
116	TS-axis A grip transport unit tool grip position (90-degree rotation) (for SEQ55 return)																	O																							116
117	TI-axis transport unit tool grip position (170 mm) (-170 mm) (for SEQ107 return)																	O																O							117
118	Operation selection (for SEQ110 return)																	O												O				O							118
119	AT-axis instanby position (90 mm) (0 mm)/TI-axis in standby position (170 mm) (0 mm) (for SEQ37 return)								O																									O							119
120	AT-axis in MG position (900 mm) (0 mm)	O	O				O											O					O	O	O	O	O														120
121	Change arm tool lock/AT-axis (240 mm (-570 mm)) Simultaneous movement 3 affter movement	O	O				O																O	O	O	O	O														121
122	TS-axis A grip tool breakage inside MG measurement position (135-degree rotation)/AT-axis simultaneous movement 3	O	O				O																O	O	O	O	O														122
123	TI-axis in standby position (220 mm) (0 mm)	O	O																				O	O	O	O	O														123
124	ATC shutter close/U-axis connection ON																	O													O										124
125	AT-axis transport unit tool grip position (170 mm) (-170 mm)/U-axis connection ON																	O																							125
126	Measurement unit preparation (down)																	O																							126
127	Tool breakage detection cycle																	O																							127
128	Measurement unit retract (up)																	O																							128
129	TI-axis in standby position (170 mm) (0 mm)																	O																							129
130	TS-axis A grip transport unit tool grip position (90-degree rotation)																	O	O																						130
131	TI-axis in standby position (170 mm) (0 mm) (for SEQ124 return)																																								131
132	TS-axis A grip tool breakage inside MG measurement position (135-degree rotation) (for SEQ129 return)																																								132
133	Tool change, standby complete position (horizontal, vertical)																																	O							133
134	Transport unit on MC side																	O																O							134
135	Transport unit on MG side																																	O							135
136	Tool transfer complete																O		O															O							136
137	TI-axis in standby position (for SEQ130 return)			O																																					137
138	Transport unit on MC side (for SEQ54 return)																																								138
139	Operation selection (for SEQ56 return)																	O												O											139
140	Transport unit on MG side (for SEQ106, 133 return)																	O																O							140
141	AT-axis transfer unit tool grip position (90 mm) (90 mm) (for SEQ16 return)							O										O																O							141
142	AT-axis in standby position/TI-axis in standby position/U-axis connection OFF (for SEQ37 return)									O								O																O							142
143	TI-axis transport unit tool grip position (for SEQ128 return)																	O																							143

ABモード

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Manual interlock 1/8

Op. seq. No.	Description	Step reverse	Return cycle	Tool pot spindle side confirmation ON	Tool pot magazine side confirmation ON	Tool pot unclamp confirmation ON	Tool pot clamp confirmation ON	Change arm tool unlock confirmation ON	Change arm tool lock confirmation ON	Tool pot retraction confirmation ON	Tool pot advance confirmation ON	Tool pot tool present	No tool pot tool	U-axis spindle indexing position	MG manual interruption OFF	ATC shutter open confirmation normal	ATC shutter close confirmation OFF	ATC shutter close confirmation	ATC shutter open confirmation OFF	ATC shutter open confirmation	Tool present in transfer pot	No tool pot tool	Movement to pot vertical retract position complete	Movement to pot vertical position complete	Movement to pot unlocking horizontal position complete	Movement to pot locking horizontal position complete	Vertical movement to tool change position complete	Horizontal movement to tool change position complete	Spindle tool present clamp confirmation OFF	No spindle tool interlock	Not in manual tool chage cycle	APC pallet cleaning sequence OFF	TS axis servo ON confirmation	Cylinder unclamp outside spindle	Cylinder clamp outside spindle	Cylinder clamp outside spindle OFF	APC start position	MG manual operation command storing	MG manual operation command calling	Not MG manual operation command	Change arm B gripper tool present	Tool breakage inside MG detection in standby position confirmation	Tool breakage inside MG detection in measurement position confirmation	Op. seq. No.
1	Writing next tool	1	1			○	○	○	○			○																				○	○								○				1
2	Operation selection	53	53		○										○																	○	○								○				2
3	Next tool locking position (horizontal, vertical)	52	53								○										○			○	○						○	○												3
4	Pot advance	51	52							○	○																				○	○												4
5	Tool lock	50	51				○					○																			○	○												5
6	Next tool unlocking position (horizontal)	49	50																○						○						○	○												6
7	Tool change standby ready position (vertical)	48	49																				○								○	○												7
8	Tool change standby ready position (horizontal)	47	48																												○	○												8
9	Tool change standby complete position (horizontal, vertical)	46	47																								○	○			○	○												9
10	Pot retract	44	46							○																					○	○												10
11	Transfer unit on MC side	43	44	○																											○	○												11
12	Change arm tool unlock	42	43					○																							○	○												12
13	AT-axis transfer unit tool grip position (90 mm) (90 mm)	41	42																												○	○												13
14	Change arm tool lock	40	41						○																						○	○												14
15	Transport unit tool unlock	39	40				○																								○	○												15
16	TI-axis in standby position (170 mm) (0 mm)	141	39																												○	○												16
17	AT-axis in standby position (90 mm) (0 mm)	37	38																												○	○												17
18	Waiting for MC cycle end	119	37												○	○			○												○	○												18
19	Spindle indexed/U-axis connection OFF	37	37											○	○			○													○	○									○			19
20	HP1 (simultaneous movement 1)	37	37												○			○													○	○									○			20
21	ATC shutter open (simultaneous movement 1)	36	37													○		○													○	○												21
22	TI-axis spindle tool grip position (220 mm) (220 mm)	112	36																												○	○												22
23	TS-axis A grip spindle tool grip position (270-degree rotation)	34	35																												○	○												23
24	Change arm tool unlock	33	34					○																							○	○												24
25	AT-axis spindle tool grip position (810 mm) (-810 mm)	32	33																												○	○												25
26	Change arm tool lock/Cylinder unclamp outside spindle	31	32						○																						○	○		○											26
27	Spindle tool unclamp	30	31																												○	○												27
28	TI-axis spindle tool extraction position (170 mm) (390 mm)	113	30																												○	○												28
29	TS-axis B grip spindle tool grip position (180-degree rotation)	28	29																												○	○												29
30	TI-axis spindle tool grip position (170 mm) (220 mm)	27	30																												○	○												30
31	Spindle tool clamp	26	31																												○	○												31
32	Change arm tool unlock/Cylinder clamp outside spindle	25	32					○																							○	○				○								32
33	AT-axis in standby position (810 mm) (0 mm)	24	33																												○	○												33
34	Change arm tool lock/AT-axis (240 mm (-570 mm)) Simultaneous movement 2 affter movement	114	34						○																						○	○												34
35	TS-axis A grip transport unit tool grip position (90-degree rotation)/AT-axis simultaneous movement 2	22	35																												○	○												35
36	TI-axis in standby position (220 mm) (0 mm)	21	36																												○	○												36
37	ATC shutter close/U-axis connection ON	142	37																	○											○	○												37
38	AT-axis transport unit tool grip position (90 mm)/U-axis connection ON	16	38																												○	○												38
39	TI-axis transport unit tool grip position (170 mm) (-170 mm)	15	39																												○	○												39
40	Transport unit tool lock	14	40				○																								○	○												40
41	Change arm tool unlock	13	41					○																							○	○												41
42	AT-axis in standby position (90 mm) (0 mm)	12	42																												○	○												42
43	Change arm tool lock	11	43						○																						○	○												43
44	Transport unit on MG side	115	44	○																											○	○												44
45	TS-axis B grip transport unit tool grip position (0-degree rotation)	10	45																												○	○												45
46	Pot advance	9	46							○																					○	○												46
47	Return tool unlocking ready position (vertical)	8	47																			○									○	○												47
48	Return tool unlocking ready position (horizontal)	7	48																					○							○	○												48
49	Return tool unlocked position (vertical)	6	49																			○	○								○	○												49
50	Return tool locking position (horizontall)	5	50								○											○									○	○												50

Manual interlock 2/8

Column groups (each with sub-columns 80 40 20 10 08 04 02 01): 7, 8, 9, 10, 11, 12

Column headers (left to right):
Return tool determination complete; Spindle tool unclamp LS OFF; Spindle tool clamp LS OFF; Spindle tool clamp LS ON; Spindle tool unclamp LS ON; Spindle tool present clamp confirmation ON; Spindle stop; Spindle indexing complete; MK4 Next tool storage cycle; Next/return tool present; No next/return tool; Normal cycle (change arm rotation present); No next tool ready operation return; No next tool ready operation input; Next tool ready operation; Active tool writing complete; TS-axis 90 degrees; TS-axis 180 degrees; TS-axis 270 degrees; TS-axis 0 degrees; No recovery NG tool; Recovery NG tool present; Tool change position (HP1); Tool rack search complete; Operation door lock confirmation ON; AT-axis MG side; AT-axis spindle side; AT-axis in standby position; Change arm rotation complete; Step reverse interlock; Step advance interlock; TS-axis 135 degrees; Tool breakage detection cycle complete; Tool breakage detection cycle; Not in tool breakage detection cycle; TT-axis transport unit tool grip position; TT-axis spindle tool extraction position; TT-axis spindle tool grip position; TI-axis in standby position; Return tool to be returned to next tool ready ST; Next tool in next tool ready ST; U-axis connection complete; U-axis shifter retraction confirmation LS; U-axis shifter retraction confirmation LS OFF; U-axis present LS OFF; TS-axis rotating position

Operation sequence No.	Description	Step reverse	Return cycle
1	Writing next tool	1	1
2	Operation selection	53	53
3	Next tool locking position (horizontal, vertical)	52	53
4	Pot advance	51	52
5	Tool lock	50	51
6	Next tool unlocking position (horizontal)	49	50
7	Tool change standby ready position (vertical)	48	49
8	Tool change standby ready position (horizontal)	47	48
9	Tool change standby complete position (horizontal, vertical)	46	47
10	Pot retract	44	46
11	Transfer unit on MC side	43	44
12	Change arm tool unlock	42	43
13	AT-axis transfer unit tool grip position (90 mm) (90 mm)	41	42
14	Change arm tool lock	40	41
15	Transport unit tool unlock	39	40
16	TI-axis in standby position (170 mm) (0 mm)	141	39
17	AT-axis in standby position (90 mm) (0 mm)	37	38
18	Waiting for MC cycle end	119	37
19	Spindle indexed/U-axis connection OFF	37	37
20	HP1 (simultaneous movement 1)	37	37
21	ATC shutter open (simultaneous movement 1)	36	37
22	TI-axis spindle tool grip position (220 mm) (220 mm)	112	36
23	TS-axis A grip spindle tool grip position (270-degree rotation)	34	35
24	Change arm tool unlock	33	34
25	AT-axis spindle tool grip position (810 mm) (-810 mm)	32	33
26	Change arm tool lock/Cylinder unclamp outside spindle	31	32
27	Spindle tool unclamp	30	31
28	TI-axis spindle tool extraction position (170 mm) (390 mm)	113	30
29	TS-axis B grip spindle tool grip position (180-degree rotation)	28	29
30	TI-axis spindle tool grip position (170 mm) (220 mm)	27	30
31	Spindle tool clamp	26	31
32	Change arm tool unlock/Cylinder clamp outside spindle	25	32
33	AT-axis in standby position (810 mm) (0 mm)	24	33
34	Change arm tool lock/AT-axis (240 mm (-570 mm) Simultaneous movement 2 affter movement	114	34
35	TS-axis A grip transport unit tool grip position (90-degree rotation)/AT-axis simultaneous movement 2	22	35
36	TI-axis in standby position (220 mm) (0 mm)	21	36
37	ATC shutter close/U-axis connection ON	142	37
38	AT-axis transport unit tool grip position (90 mm)/U-axis connection ON	16	38
39	TI-axis transport unit tool grip position (170 mm) (-170 mm)	15	39
40	Transport unit tool lock	14	40
41	Change arm tool unlock	13	41
42	AT-axis in standby position (90 mm) (0 mm)	12	42
43	Change arm tool lock	11	43
44	Transport unit on MG side	115	44
45	TS-axis B grip transport unit tool grip position (0-degree rotation)	10	45
46	Pot advance	9	46
47	Return tool unlocking ready position (vertical)	8	47
48	Return tool unlocking ready position (horizontal)	7	48
49	Return tool unlocked position (vertical)	6	49
50	Return tool locking position (horizontall)	5	50

MA-12500H
ATC(matrix magazine)logic table　　MAP029A

Manual interlock 3/8

Column legend (group : binary weight):

- Group 1 — 80: Tool pot spindle side confirmation ON; 40: Tool pot magazine side confirmation ON; 20: Tool pot unclamp confirmation ON; 10: Tool pot clamp confirmation ON; 08: Change arm tool unlock confirmation ON; 04: Change arm tool lock confirmation ON; 02: Tool pot retraction confirmation ON; 01: Tool pot advance confirmation ON
- Group 2 — 80: Tool pot tool present; 40: No tool pot tool; 01: U-axis spindle indexing position
- Group 3 — 80: MG manual interruption OFF; 40: ATC shutter open confirmation normal; 20: ATC shutter close confirmation OFF; 10: ATC shutter close confirmation; 08: ATC shutter open confirmation OFF; 04: ATC shutter open confirmation; 02: Tool present in transfer pot; 01: No tool pot tool
- Group 4 — 80: Movement to pot vertical retract position complete; 40: Movement to pot vertical position complete; 20: Movement to pot unlocking horizontal position complete; 10: Movement to pot locking horizontal position complete; 08: Vertical movement to tool change position complete; 04: Horizontal movement to tool change position complete; 02: Spindle tool present clamp confirmation OFF; 01: No spindle tool interlock
- Group 5 — 80: Not in manual tool chage cycle; 40: APC pallet cleaning sequence OFF; 20: TS axis servo ON confirmation; 10: Cylinder unclamp outside spindle; 08: Cylinder clamp outside spindle; 04: Cylinder clamp outside spindle OFF; 02: APC start position
- Group 6 — 80: MG manual operation command storing; 40: MG manual operation command calling; 20: Not MG manual operation command; 10: Change arm B gripper tool present; 08: Tool breakage inside MG detection in standby position confirmation; 04: Tool breakage inside MG detection in measurement position confirmation

Op No.	Description	Step reverse	Return cycle	1:80	1:40	1:20	1:10	1:08	1:04	1:02	1:01	2:80	2:40	2:01	3:80	3:40	3:20	3:10	3:08	3:04	3:02	3:01	4:80	4:40	4:20	4:10	4:08	4:04	4:02	4:01	5:80	5:40	5:20	5:10	5:08	5:04	5:02	6:80	6:40	6:20	6:10	6:08	6:04	Op No.
51	Tool unlock	4	51			O																									O	O												51
52	Pot retract	2	52							O		O																			O	O												52
53	Tool transfer complete	1	53	O	O					O		O						O	O												O	O												53
54	TI-axis transport unit tool grip position/U-axis connection ON	138	54																												O	O												54
55	Transport unit on MG side	116	55	O																											O	O												55
56	TS-axis B grip transport unit tool grip position (0-degree rotation)	139	56																												O	O												56
57	Tool transfer complete	1	57	O	O					O		O						O	O												O	O												57
58	Operation selection	69	69		O							O																			O	O												58
59	Next tool ready return tool locking position (horizontal, vertical)	68	69																			O		O	O					O	O												59
60	Pot advance	67	68							O	O	O																			O	O												60
61	Tool lock	66	67				O					O																			O	O												61
62	Next tool ready return tool unlocking position (horizontal)	65	66																			O		O							O	O												62
63	Return tool unlocking ready position (vertical)	64	65																				O	O							O	O												63
64	Return tool unlocking ready position (horizontal)	63	64																				O	O							O	O												64
65	Return tool unlocked position (vertical)	62	65																				O		O						O	O												65
66	Return tool locking position (horizontal)	61	66									O										O			O						O	O												66
67	Tool unlock	60	67					O																							O	O												67
68	Pot retract	59	68							O		O																			O	O												68
69	Tool transfer complete	58	69	O	O					O		O																			O	O												69
70	Operation selection	81	81		O							O																			O	O												70
71	Next tool, input tool locking position (horizontal, vertical)	80	81																			O		O	O					O	O												71
72	Pot advance	79	80							O	O	O																			O	O												72
73	Tool lock	78	79				O					O																			O	O												73
74	Next tool, input tool unlocking position (horizontal)	77	78																			O		O							O	O												74
75	Next tool ready input tool unlocking ready position (vertical)	76	77																				O	O							O	O												75
76	Next tool ready input tool unlocking ready position (horizontal)	75	76																				O	O							O	O												76
77	Next tool ready input tool unlocked position (vertical)	74	77																				O		O						O	O												77
78	Next tool ready input tool locking position (horizontal)	73	78									O										O			O						O	O												78
79	Tool unlock	72	79					O				O																			O	O												79
80	Pot retract	71	80							O		O																			O	O												80
81	Tool transfer complete	70	81	O	O					O		O																			O	O												81
82	Operation selection	93	93		O							O																			O	O									O				82
83	Calling tool locking position (horizontal, vertical)	92	93																			O		O	O					O	O												83
84	Pot advance	91	92							O	O	O																			O	O												84
85	Tool lock	90	91				O					O																			O	O												85
86	Calling tool unlocking position (horizontal)	89	90																			O		O							O	O												86
87	MG manual change unlocking ready position (vertical)	88	89																				O	O							O	O												87
88	MG manual change unlocking ready position (horizontal)	87	88																				O	O							O	O												88
89	MG manual change unlocked position (vertical)	86	89																				O		O						O	O												89
90	MG manual change locking position (horizontal)	85	90									O										O			O						O	O												90
91	Tool unlock	84	91					O																							O	O												91
92	Pot retract	83	92							O		O																			O	O												92
93	Tool transfer complete	82	93	O	O					O		O																			O	O												93
94	Operation selection	105	105		O							O																			O	O									O				94
95	MG manual change locking position (horizontal, vertical)	104	105																			O		O	O					O	O												95
96	Pot advance	103	104							O	O	O																			O	O												96
97	Tool lock	102	103				O					O																			O	O												97
98	MG manual change unlocking position (horizontal)	101	102																			O		O							O	O												98
99	Storing tool unlocking ready position (vertical)	100	101																				O	O							O	O												99
100	Storing tool unlocking ready position (horizontal)	99	100																				O	O							O	O												100

Manual interlock 4/8

Interlock condition column legend (headers 7–12, bit weights 80 40 20 10 08 04 02 01):

1. Return tool determination complete
2. Spindle tool unclamp LS OFF
3. Spindle tool clamp LS OFF
4. Spindle tool clamp LS ON
5. Spindle tool unclamp LS ON
6. Spindle tool present clamp confirmation ON
7. Spindle stop
8. Spindle indexing complete
9. Mk4 Next tool storage cycle
10. Next/return tool present
11. No next/return tool
12. Normal cycle (change arm rotation present)
13. No next tool ready operation return
14. No next tool ready operation input
15. Next tool ready operation
16. Active tool writing complete
17. TS-axis 90 degrees
18. TS-axis 180 degrees
19. TS-axis 270 degrees
20. TS-axis 0 degrees
21. No recovery NG tool
22. Recovery NG tool present
23. Tool change position (HP1)
24. Tool rack search complete
25. Operation door lock confirmation ON
26. AT-axis MG side
27. AT-axis spindle side
28. AT-axis in standby position
29. Change arm rotation complete
30. Step advance interlock
31. Step reverse interlock
32. TS-axis 135 degrees
33. Tool breakage detection cycle complete
34. Tool breakage detection cycle
35. Not in tool breakage detection cycle
36. TI-axis transport unit tool grip position
37. TI-axis spindle tool extraction position
38. TI-axis spindle tool grip position
39. TI-axis in standby position
40. Return tool to be returned to next tool ready ST
41. Next tool in next tool ready ST
42. U-axis connection complete
43. U-axis shifter retraction confirmation LS
44. U-axis shifter retraction confirmation LS OFF
45. U-axis present LS OFF
46. TS-axis rotating position

(Only columns bearing an O mark are shown below; all other interlock columns are blank for these rows.)

Op. seq. No.	Description	Step reverse	Return cycle	20 TS-axis 0°	30 Step advance interlock	31 Step reverse interlock	36 TI-axis transport unit tool grip position	42 U-axis connection complete	Op. seq. No.
51	Tool unlock	4	51						51
52	Pot retract	2	52						52
53	Tool transfer complete	1	53		O				53
54	TI-axis transport unit tool grip position/U-axis connection ON	138	54		O		O	O	54
55	Transport unit on MG side	116	55						55
56	TS-axis B grip transport unit tool grip position (0-degree rotation)	139	56	O					56
57	Tool transfer complete	1	57		O				57
58	Operation selection	69	69		O				58
59	Next tool ready return tool locking position (horizontal, vertical)	68	69						59
60	Pot advance	67	68						60
61	Tool lock	66	67						61
62	Next tool ready return tool unlocking position (horizontal)	65	66						62
63	Return tool unlocking ready position (vertical)	64	65						63
64	Return tool unlocking ready position (horizontal)	63	64						64
65	Return tool unlocked position (vertical)	62	65						65
66	Return tool locking position (horizontal)	61	66						66
67	Tool unlock	60	67						67
68	Pot retract	59	68						68
69	Tool transfer complete	58	69		O	O			69
70	Operation selection	81	81		O				70
71	Next tool, input tool locking position (horizontal, vertical)	80	81						71
72	Pot advance	79	80						72
73	Tool lock	78	79						73
74	Next tool, input tool unlocking position (horizontal)	77	78						74
75	Next tool ready input tool unlocking ready position (vertical)	76	77						75
76	Next tool ready input tool unlocking ready position (horizontal)	75	76						76
77	Next tool ready input tool unlocked position (vertical)	74	77						77
78	Next tool ready input tool locking position (horizontal)	73	78						78
79	Tool unlock	72	79						79
80	Pot retract	71	80						80
81	Tool transfer complete	70	81		O	O			81
82	Operation selection	93	93		O				82
83	Calling tool locking position (horizontal, vertical)	92	93						83
84	Pot advance	91	92						84
85	Tool lock	90	91						85
86	Calling tool unlocking position (horizontal)	89	90						86
87	MG manual change unlocking ready position (vertical)	88	89						87
88	MG manual change unlocking ready position (horizontal)	87	88						88
89	MG manual change unlocked position (vertical)	86	89						89
90	MG manual change locking position (horizontal)	85	90						90
91	Tool unlock	84	91						91
92	Pot retract	83	92						92
93	Tool transfer complete	82	93		O	O			93
94	Operation selection	105	105		O				94
95	MG manual change locking position (horizontal, vertical)	104	105						95
96	Pot advance	103	104						96
97	Tool lock	102	103						97
98	MG manual change unlocking position (horizontal)	101	102						98
99	Storing tool unlocking ready position (vertical)	100	101						99
100	Storing tool unlocking ready position (horizontal)	99	100						100

Manual interlock 5/8

Op seq No.	Description	Step reverse	Return cycle	Tool pot spindle side confirmation ON	Tool pot magazine side confirmation ON	Tool pot unclamp confirmation ON	Tool pot clamp confirmation ON	Change arm tool unlock confirmation ON	Change arm tool lock confirmation ON	Tool pot retraction confirmation ON	Tool pot advance confirmation ON	Tool pot tool present	No tool pot tool	U-axis spindle indexing position	MG manual interruption OFF	ATC shutter open confirmation normal	ATC shutter close confirmation OFF	ATC shutter close confirmation	ATC shutter open confirmation OFF	ATC shutter open confirmation	Tool present in transfer pot	No tool pot tool	Movement to pot vertical retract position complete	Movement to pot vertical position complete	Movement to pot unlocking horizontal position complete	Movement to pot locking horizontal position complete	Vertical movement to tool change position complete	Horizontal movement to tool change position complete	Spindle tool present clamp confirmation OFF	No spindle tool interlock	Not in manual tool chage cycle	APC pallet cleaning sequence OFF	TS axis servo ON confirmation	Cylinder unclamp outside spindle	Cylinder clamp outside spindle OFF	APC start position	MG manual operation command storing	MG manual operation command calling	Not MG manual operation command	Change arm B gripper tool present	Tool breakage inside MG detection in measurement position confirmation	Tool breakage inside MG detection in standby position confirmation	Op seq No.
101	Storing tool unlocked position (vertical)	98	101																				O								O	O											101
102	Storing tool locking position (horizontal)	97	102									O												O							O	O											102
103	Tool unlock	96	103		O																										O	O											103
104	Pot retract	95	104					O				O																			O	O											104
105	Tool transfer complete	94	105	O	O			O				O																			O	O											105
106	Tool change standby complete position (horizontal, vertical)	140	111																								O	O			O	O											106
107	Transport unit on MC side	117	110	O																											O	O											107
108	TI-axis in standby position (170 mm) (0 mm)	37	109																												O	O											108
109	TI-axis transport unit tool grip position (170 mm) (-170 mm)	107	109	O																											O	O											109
110	Transport unit on MG side	118	110	O																											O	O											110
111	Tool transfer complete	1	111	O	O			O				O														O	O				O	O											111
112	TS-axis B grip transport unit tool grip position (0-degree rotation) (for SEQ22 return)	112	112																												O	O											112
113	TS-axis A grip spindle tool grip position (270-degree rotation) (for SEQ28 return)	113	113																												O	O											113
114	TS-axis B grip spindle tool grip position (180-degree rotation) (for SEQ34 return)	114	114																												O	O											114
115	TS-axis A grip transport unit tool grip position (90-degree rotation) (for SEQ44 return)	115	115																												O	O											115
116	TS-axis A grip transport unit tool grip position (90-degree rotation) (for SEQ55 return)	116	116																												O	O											116
117	TI-axis transport unit tool grip position (170 mm) (-170 mm) (for SEQ107 return)	117	117																												O	O											117
118	Operation selection (for SEQ110 return)	118	118			O						O																			O	O											118
119	AT-axis instandby position (90 mm) (0 mm)/TI-axis in standby position (170 mm) (0 mm) (for SEQ37 return)	119	119	O																											O	O											119
120	AT-axis in MG position (900 mm) (0 mm)	24	120																												O	O											120
121	Change arm tool lock/AT-axis (240 mm) (-570 mm) Simultaneous movement 3 affter movement	114	121				O																								O	O											121
122	TS-axis A grip tool breakage inside MG measurement position (135-degree rotation)/AT-axis simultaneous movement 3	22	122																												O	O											122
123	TI-axis in standby position (220 mm) (0 mm)	21	123																												O	O											123
124	ATC shutter close/U-axis connection ON	131	124															O													O	O											124
125	AT-axis transport unit tool grip position (170 mm) (-170 mm)/U-axis connection ON	128	125																												O	O											125
126	Measurement unit preparation (down)	127	126																												O	O										O	126
127	Tool breakage detection cycle	126	127																												O	O											127
128	Measurement unit retract (up)	143	128																												O	O									O		128
129	TI-axis in standby position (170 mm) (0 mm)	132	129																												O	O											129
130	TS-axis A grip transport unit tool grip position (90-degree rotation)	137	130																												O	O											130
131	TI-axis in standby position (170 mm) (0 mm) (for SEQ124 return)	131	131												O																O	O											131
132	TS-axis A grip tool breakage inside MG measurement position (135-degree rotation) (for SEQ129 return)	132	132																												O	O											132
133	Tool change standby complete position (horizontal, vertical)	140	133																								O	O			O	O											133
134	Transport unit on MC side	37	134	O																											O	O											134
135	Transport unit on MG side	118	135	O																											O	O											135
136	Tool transfer complete	1	136	O	O			O				O														O	O				O	O											136
137	TI-axis in standby position (for SEQ130 return)	137	137																												O	O											137
138	Transport unit on MC side (for SEQ54 return)	138	138	O																											O	O											138
139	Operation selection (for SEQ56 return)	139	139			O									O																O	O								O			139
140	Transport unit on MG side (for SEQ106, 133 return)	140	140	O																											O	O											140
141	AT-axis transfer unit tool grip position (90 mm) (90 mm) (for SEQ16 return)	141	141																												O	O											141
142	AT-axis in standby position/TI-axis in standby position/U-axis connection OFF (for SEQ37 return)	142	142	O											O																O	O											142
143	TI-axis transport unit tool grip position (for SEQ128 return)	143	143																												O	O											143

Manual interlock 6/8

Column groups (bit values): 7 (80 40 20 10 08 04 02 01) · 8 (80 40 20 10 08 04 02 01) · 9 (80 40 20 10 08 04 02 01) · 10 (80 40 20 10 08 04 02 01) · 11 (80 40 20 10 08 04 02 01) · 12 (80 40 20 10 08 04 02 01)

Op seq No.	Description	Step reverse	Return cycle	Op seq No.
101	Storing tool unlocked position (vertical)	98	101	101
102	Storing tool locking position (horizontal)	97	102	102
103	Tool unlock	96	103	103
104	Pot retract	95	104	104
105	Tool transfer complete	94	105	105
106	Tool change standby complete position (horizontal, vertical)	140	111	106
107	Transport unit on MC side	117	110	107
108	TI-axis in standby position (170 mm) (0 mm)	37	109	108
109	TI-axis transport unit tool grip position (170 mm) (-170 mm)	107	109	109
110	Transport unit on MG side	118	110	110
111	Tool transfer complete	1	111	111
112	TS-axis B grip transport unit tool grip position (0-degree rotation) (for SEQ22 return)	112	112	112
113	TS-axis A grip spindle tool grip position (270-degree rotation) (for SEQ28 return)	113	113	113
114	TS-axis B grip spindle tool grip position (180-degree rotation) (for SEQ34 return)	114	114	114
115	TS-axis A grip transport unit tool grip position (90-degree rotation) (for SEQ44 return)	115	115	115
116	TS-axis A grip spindle tool grip position (90-degree rotation) (for SEQ55 return)	116	116	116
117	TI-axis transport unit tool grip position (170 mm) (-170 mm) (for SEQ107 return)	117	117	117
118	Operation selection (for SEQ110 return)	118	118	118
119	AT-axis instandby position (90 mm) (0 mm)/TI-axis in standby position (170 mm) (0 mm) (for SEQ37 return)	119	119	119
120	AT-axis in MG position (900 mm) (0 mm)	24	120	120
121	Change arm tool lock/AT-axis (240 mm) (-570 mm) Simultaneous movement 3 affter movement	114	121	121
122	TS-axis A grip tool breakage inside MG measurement position (135-degree rotation)/AT-axis simultaneous movement 3	22	122	122
123	TI-axis in standby position (220 mm) (0 mm)	21	123	123
124	ATC shutter close/U-axis connection ON	131	124	124
125	AT-axis transport unit tool grip position (170 mm) (-170 mm)/U-axis connection ON	128	125	125
126	Measurement unit preparation (down)	127	126	126
127	Tool breakage detection cycle	126	127	127
128	Measurement unit retract (up)	143	128	128
129	TI-axis in standby position (170 mm) (0 mm)	132	129	129
130	TS-axis A grip transport unit tool grip position (90-degree rotation)	137	130	130
131	TI-axis in standby position (170 mm) (0 mm) (for SEQ124 return)	131	131	131
132	TS-axis A grip tool breakage inside MG measurement position (135-degree rotation) (for SEQ129 return)	132	132	132
133	Tool change standby complete position (horizontal, vertical)	140	133	133
134	Transport unit on MC side	37	134	134
135	Transport unit on MG side	118	135	135
136	Tool transfer complete	1	136	136
137	TI-axis in standby position (for SEQ130 return)	137	137	137
138	Transport unit on MC side (for SEQ54 return)	138	138	138
139	Operation selection (for SEQ56 return)	139	139	139
140	Transport unit on MG side (for SEQ106, 133 return)	140	140	140
141	AT-axis transfer unit tool grip position (90 mm) (90 mm) (for SEQ16 return)	141	141	141
142	AT-axis in standby position/TI-axis in standby position/U-axis connection OFF (for SEQ37 return)	142	142	142
143	TI-axis transport unit tool grip position (for SEQ128 return)	143	143	143

Manual interlock 7/8

Column header groups (1–6), each with bit columns: 80 40 20 10 08 04 02 01

Condition columns (left to right):
Step reverse · Return cycle · Tool pot spindle side confirmation ON · Tool pot magazine side confirmation ON · Tool pot unclamp confirmation ON · Tool pot clamp confirmation ON · Change arm tool unlock confirmation ON · Change arm tool lock confirmation ON · Tool pot retraction confirmation ON · Tool pot advance confirmation ON · Tool pot tool present · No tool pot tool · U-axis spindle indexing position · MG manual interruption OFF · ATC shutter open confirmation normal · ATC shutter close confirmation OFF · ATC shutter close confirmation · ATC shutter open confirmation OFF · ATC shutter open confirmation · Tool present in transfer pot · No tool pot tool · Movement to pot vertical retract position complete · Movement to pot vertical position complete · Movement to pot unlocking horizontal position complete · Movement to pot looking horizontal position complete · Vertical movement to tool change position complete · Horizontal movement to tool change position complete · Spindle tool present clamp confirmation OFF · No spindle tool interlock · Not in manual tool chage cycle · APC pallet cleaning sequence OFF · TS axis servo ON confirmation · Cylinder unclamp outside spindle · Cylinder clamp outside spindle · Cylinder clamp outside spindle OFF · APC start position · MG manual operation command storing · MG manual operation command calling · Not MG manual operation command · Change arm B gripper tool present · Tool breakage inside MG detection in standby position confirmation · Tool breakage inside MG detection in measurement position confirmation

manual step branch

Op seq No.	Description	Step reverse	Op seq No.
2	Operation selection (next tool present)	⇒3	2
2	Operation selection (M63 command (no next tool))	⇒106	2
2	Operation selection (Chage arm B gripper tool present)	⇒133	2
2	Operation selection	⇒58	2
2	Operation selection (MG manual calling)	⇒82	2
2	Operation selection (MG manual storing)	⇒94	2
18	Waiting for MC cycle end (next tool present in M64 operation)	⇒38	13
18	Waiting for MC cycle end (no next tool in M64 operation)	⇒109	13
18	Waiting for MC cycle end (during MG manual interruption call operation)	⇒135	13
18	Waiting for MC cycle end (during MG manual interruption storage operation)	⇒135	13
37	ATC shutter close (no return tool operation)	⇒54	17
53	Tool transfer complete	⇒1	34
57	Tool transfer complete	⇒1	39
58	Operation selection	⇒70	40
69	Tool transfer complete	⇒1	51
81	Tool transfer complete	⇒1	63
93	Tool transfer complete	⇒1	75
105	Tool transfer complete	⇒1	87
108	TI-axis in standby position (170 mm) (0 mm)	⇒18	108
111	Tool transfer complete	⇒1	111
32	Change arm tool unlock/Cylinder clamp outside spindle (during tool breakage inside MG)	⇒120	32
130	TS-axis A grip transport unit tool grip position (90-degree rotation)	⇒39	130
134	Transport unit on MC side	⇒18	134
136	Tool transfer complete	⇒1	136

manual step back

Op seq No.	Description	Step reverse	Op seq No.
2	Operation selection	⇒1	2
18	Waiting for MC cycle end	⇒108	37
38	AT-axis transport unit tool grip position (90 mm)	⇒18	38
54	TI-axis transport unit tool grip position (170 mm) (-170 mm)	⇒37	54
58	Operation selection	⇒1	58
70	Operation selection	⇒1	70
82	Operation selection	⇒1	82
94	Operation selection	⇒1	94
106	Tool change standby complete position (horizontal, vertical)	⇒2	106
109	TI-axis transport unit tool grip position (170 mm) (-170 mm)	⇒18	109
120	AT-axis in MG position (900 mm) (0 mm)	⇒32	120
133	Tool change standby complete position (horizontal, vertical)	⇒2	133
135	Transport unit on MG side	⇒18	135

Manual interlock 8/8

Column headers (groups 7–12, each 80 40 20 10 08 04 02 01):

Step reverse | Return cycle | Return tool determination complete | Spindle tool unclamp LS OFF | Spindle tool clamp LS OFF | Spindle tool clamp LS ON | Spindle tool unclamp LS ON | Spindle tool present clamp confirmation ON | Spindle stop | Spindle indexing complete | M64 Next tool storage cycle | Next/return tool present | No next/return tool | Normal cycle (change arm rotation present) | No next tool ready operation return | No next tool ready operation input | Next tool ready operation | Active tool writing complete | TS-axis 90 degrees | TS-axis 180 degrees | TS-axis 270 degrees | TS-axis 0 degrees | No recovery NG tool | Recovery NG tool present | Tool change position (HP1) | Tool rack search complete | Operation door lock confirmation ON | AT-axis MG side | AT-axis spindle side | AT-axis in standby position | Change arm rotation complete | Step reverse interlock | Step advance interlock | TS-axis 135 degrees | Tool breakage detection cycle complete | Tool breakage detection cycle | Not in tool breakage detection cycle | TI-axis transport unit tool grip position | TI-axis spindle tool extraction position | TT-axis spindle tool grip position | TI-axis in standby position | Return tool to be returned to next tool ready ST | Next tool in next tool ready ST | U-axis connection complete | U-axis shifter retraction confirmation LS | U-axis shifter retraction confirmation LS OFF | U-axis present LS OFF | TS-axis rotating position

manual step branch

Op. No.	Description	Step reverse	Circle (O) column(s)	Op. No.
2	Operation selection (next tool present)	⇒3	Next/return tool present	2
2	Operation selection (M63 command (no next tool))	⇒106	No next/return tool	2
2	Operation selection (Chage arm B gripper tool present)	⇒133		2
2	Operation selection	⇒58	No next tool ready operation input	2
2	Operation selection (MG manual calling)	⇒82		2
2	Operation selection (MG manual storing)	⇒94		2
18	Waiting for MC cycle end (next tool present in M64 operation)	⇒38	M64 Next tool storage cycle; Next/return tool present	13
18	Waiting for MC cycle end (no next tool in M64 operation)	⇒109	M64 Next tool storage cycle; No next/return tool	13
18	Waiting for MC cycle end (during MG manual interruption call operation)	⇒135		13
18	Waiting for MC cycle end (during MG manual interruption storage operation)	⇒135		13
37	ATC shutter close (no return tool operation)	⇒54	No next/return tool	17
53	Tool transfer complete	⇒1		34
57	Tool transfer complete	⇒1		39
58	Operation selection	⇒70	No next tool ready operation return; No next tool ready operation input	40
69	Tool transfer complete	⇒1	No next tool ready operation input	51
81	Tool transfer complete	⇒1		63
93	Tool transfer complete	⇒1		75
105	Tool transfer complete	⇒1		87
108	TI-axis in standby position (170 mm) (0 mm)	⇒18	TI-axis in standby position	108
111	Tool transfer complete	⇒1		111
32	Change arm tool unlock/Cylinder clamp outside spindle (during tool breakage inside MG)	⇒120	Not in tool breakage detection cycle	32
130	TS-axis A grip transport unit tool grip position (90-degree rotation)	⇒39	TS-axis 90 degrees	130
134	Transport unit on MC side	⇒18		134
136	Tool transfer complete	⇒1		136

manual step back

Op. No.	Description	Step reverse	Circle (O) column(s)	Op. No.
2	Operation selection	⇒1		2
18	Waiting for MC cycle end	⇒108	No next/return tool; AT-axis in standby position; Next tool in next tool ready ST	37
38	AT-axis transport unit tool grip position (90 mm)	⇒18	Next/return tool present; Next tool in next tool ready ST	38
54	TI-axis transport unit tool grip position (170 mm) (-170 mm)	⇒37		54
58	Operation selection	⇒1		58
70	Operation selection	⇒1		70
82	Operation selection	⇒1		82
94	Operation selection	⇒1		94
106	Tool change standby complete position (horizontal, vertical)	⇒2		106
109	TI-axis transport unit tool grip position (170 mm) (-170 mm)	⇒18		109
120	AT-axis in MG position (900 mm) (0 mm)	⇒32		120
133	Tool change standby complete position (horizontal, vertical)	⇒2		133
135	Transport unit on MG side	⇒18		135