

TB067 (Rev1) - Special Instructions for KOYO-based ATCs

Overview

This document describes special procedures and instructions for setup and use of the Automatic Tool Changers. Included is a description of all special M-codes used with the ATCs, procedures to be used during initial setup and when loading the tool carousel, and notes about operating the ATC.

Special M-Codes for ATC

- M5 - Turns the spindle motor off, even if in orientation mode.
- M6 - The tool change process uses the other M-functions. It is littered with **M1** commands, which will allow single stepping if optional stops are enabled. Will unload tool in spindle and pick up tool designated as **M6T3**. Use **M20** if there is no tool in spindle.
- M15 - Tool unclamp and air blow. Be prepared to catch the tool from the spindle. Will not operate if spindle is turning. Not to be used to manually change tools, use clamp/unclamp button on head.
- M16 - Tool clamp and air blow off, turns off **M15** request.
- M18 - Reset tool counter to tool #1, ensure carousel is at position #1 before issuing.
- M19 - Orient spindle for tool change and hold, cannot be done if **M15** is already active. Note that it turns on the spindle with zero speed.

WARNING: If the spindle motor, spindle encoder, or spindle inverter is changed, or if inverter encoder parameters are changed, the inverter parameters must be checked to ensure proper spindle orientation to prevent a crash. Follow the procedures in the **Special Procedures for setting Fuji Inverter parameters** section.*

- M20 - Pick up a tool. Useful when there is no tool left in the spindle. Cannot be done if **M15** is active. Will pick-up the tool currently facing the spindle.
- M21 - Move head up to Z-Home position.
- M22 - Move head to ATC level, uses a **G30** command that utilizes the **G30** positioning parameters in WCS configuration. **DO NOT** change the **G30** parameters and **DO NOT** use any codes in your programs that will override these parameters.

WARNING: If the Z-axis motor has been reinstalled or Z-Home has been changed in any way or if the Motor revs/in (mm) in the machine configuration for the Z axis have been changed, the G30 parameters must be reset to the correct value (height) to prevent a crash. Follow the procedures in the **Special Procedures for setting G30 parameters** section.

- M80 - Moves the carousel in regardless of Z-axis positioning. Will not accept command if spindle is turning or orientation is started.

WARNING: There is nothing to prevent the carousel from slamming into the head or tool. Ensure sufficient clearance before issuing command.

- M81 - Moves the tool carousel out. Turns off **M80** request.

WARNING: Be sure the tool is **NOT** partially covered by the spindle or tool will be knocked out and carousel fingers may be damaged.

Initial Setup Procedures

Connect the air supply at the rear of the machine frame. The air pressure gauge should read approximately 50-

70 PSI. If air pressure falls below approximately 40 PSI, the warning message "*** Air Pressure Low ***" will be displayed in the CNC7 message window and any running jobs will be canceled. Once power has been applied to the control and machine homing sequence completed, ensure directional rotation of carousel is correct. When the Tool Index + (**or AUX1**) key on the jog panel is pressed, the carousel should rotate up in number. When the Tool Index - (**or AUX3**) key is pressed the carousel should rotate down in number. If rotation is incorrect, two of the incoming 3-phase power lines will need to be switched by a qualified electrician. Once the carousel is rotating correctly, use the Tool Index keys (**or AUX1/AUX3**) to rotate the carousel so the number one tool is positioned to be loaded into the spindle. Once in position, press **F3 - MDI mode** and at the prompt type a **M18** and press the CYCLE START key on the jog panel. The message "--- Tool 1 set in ATC ---" will be displayed in the CNC7 message window. If the message does not appear, there is something wrong, DO NOT operate the tool changer.

Procedures for loading the Tool Carousel

1. Raise the head to the home position by issuing an **M21** command at the MDI prompt and pressing **CYCLE START**.
2. Bring the carousel into the load position by issuing an **M80** command at the MDI prompt and pressing **CYCLE START**.
3. Escape the MDI mode so the carousel can be rotated for loading multiple tools by using the Tool Index keys (**or AUX1/AUX3**).
4. Once all tools are loaded, rotate the carousel to the Tool#1 position and enter the MDI screen again
5. Issue an **M81** command to move carousel back out and be sure there is no tool in the spindle.
6. Issue an **M18** command, followed by an **M20** command to pick up Tool #1.
7. Press **ESC** to exit MDI mode.

General use and operation

The following guidelines should be considered when using the ATC:

***DO NOT** change the Motor Revs/in or encoder counts in the Machine Configuration. The ATC will not function properly if these machine parameters are modified. Doing so will cause misalignment resulting in a crash or damaging the tool holder fingers.

***DO NOT** change the machine home position for the Z-axis; this includes changes to the **G30** Z-axis value, the **G28** Z axis return point, or using an M26/Z command. Doing so will cause misalignment resulting in a crash or damaging the tool holder fingers.

*The default mode for the ATC is automatic mode. To change the mode of operation to manual, choose **F5 - CAM** to access the **F4 - ATC** option. The utility that is run will allow a choice between automatic and manual modes of operation. The tool changer control will respond to a tool change request for tools numbered one to the total number of stations. Trying to change to a tool number outside this range will result in an Emergency Stop condition before the tool change cycle finishes.

General tool changer behavior

A tool change process always places the tool in the spindle back into the tool station from which it was picked up. Manually placing a tool into an empty station from which a tool was picked up from will most likely result in a tool changer crash unless the mistake is realized and the Emergency Stop, ESC, or CANCEL key is pressed. If this happens, follow the procedure outlined below in emergency conditions. The only time that the tool changer will not place a tool back into the currently aligned tool station is when the Tool Index auxiliary keys are used to manually rotate the carousel out of position.

Emergency conditions

The following conditions require special attention:

1. The "*** Air Pressure Low ***" message or other fault message is displayed.
2. The Emergency Stop, ESC key, or **CANCEL** key on the jog panel is pressed when a tool change is in action.
3. A loss of power occurs unexpectedly while a tool change is in progress.

If any of these conditions occur or if there is a possibility that a tool change was in progress and did not finish normally, the correct procedure to follow is to rotate the tool carousel to Tool #1 position and issue an **M18** command. If there is no tool in the spindle, use an **M20** to pick up Tool#1. If there is a tool in the spindle and also one in the Tool#1 carousel position, use the manual unclamp to remove the tool from the spindle and follow the steps in the **Procedures for loading the Tool Carousel** section.

Special Procedures for setting Fuji Inverter parameters

Refer to the Fuji inverter manual on how to set parameters, all parameters should be set to the original factory defaults, except as listed below.

Parameter	Value
P001 - Motor Maximum Speed	4500 or 6000 depends on motor
P002 - Acceleration Time	2.0 for most motors
P003 - Deceleration Time	2.0 for most motors
P038 - DC Injection Time	0.0 sec
P053 - Motor Code	105 or 107 depends on motor
P078 - PE Feedback Control	1 - Use
P079 - NTC Thermister	1 - Use
P106 - ASRP Gain	30
P115 - ASR Integration Time	0
P201 - Spindle/PE ratio	1 - 1:1
P202 - A/B Phase Select	1 - Phase B leading in forward direction
P203 - Pulse Select	0 - encoder lines (1024 default)
P204 - Acc/Dec Mode	1 - Use
P217 - ARP P-Gain	30
P221 - Completion Range	48 pulses
P225 - Re-ORT Mode	1 - after one revolution

After setting all parameters in the previous table, shut off the machine at the disconnect switch and wait 15 minutes for the inverter to reinitialize.

1. Perform machine startup and complete the Homing sequence.
2. Press **F3 - MDI** mode.

WARNING: DO NOT leave the MDI screen until instructed to do so. You could cause a tool crash and you will have to restart the procedure from step 1.

WARNING: Before completing the next step, be sure there is clearance for the tool carousel to be moved into the tool change position so the carousel will not slam into the head when you perform the M80 command.

3. Type **M80** at the MDI prompt and press **CYCLE START**. This should move the carousel into the tool change position.
4. Remove the retention knob from the tool in the carousel directly below the spindle or else the spindle will not be able to be lowered over the tool completely and it will be hard to line up the spindle accurately.
5. Using the Jog buttons, carefully move the Z-axis down over the tool in the carousel. Rotate the spindle by hand until the spindle dog's lineup with the notches in the tool. Be sure the vertically shorter of the two dogs is facing the carousel. The long vertical dog must face away from the carousel to allow clearance for the spindle to come down close enough for clamp to grab the tool.
6. Carefully jog down the spindle so the spindle dog and tool notch match and the taper is fully covered. The spindle should almost, but not quite touch the tool. If you didn't remove the retention knob as previously instructed, you will not be able to fit the dog into the notch.
7. Manually rotate the spindle so the dog is centered approximately in the notch.
8. At the Fuji inverter, change parameter 206 to a 1 and save. This will set the current spindle position into parameter 205.
9. Raise the Z-axis to home (Press **TOOL CHECK**).
10. Type **M19** at the MDI prompt and press **CYCLE START**. The spindle should spin momentarily and stop in the proper orientation to load a tool. If the carousel retracts, use the **M80** command to bring it back in.
11. Replace the retention knob that was removed. Type **M15** at the MDI prompt and press **CYCLE START**.
12. Carefully lower the spindle around the tool and check for dog to notch alignment. If it is aligned, the procedure is complete. If not, you must repeat the entire procedure.
13. If alignment is complete, raise the Z-axis to home (Press **TOOL CHECK**).
14. Enter the following commands at the MDI prompt and press **CYCLE START** after each M-function.

M16 (To clamp the tool and turn off the air blow)

M81 (To retract the tool carousel)

M5 (To disengage the spindle orientation)

(15) If necessary, continue with the procedure to set **G30** parameters.

Special Procedures for setting G30 parameters

1. Perform machine startup and complete the Homing sequence.

2. Press **F3 - MDI**.

WARNING: DO NOT leave the MDI screen until instructed to do so. You could cause a tool crash and you will have to restart procedure from step 1.

3. Type **M19** at the MDI prompt and press **CYCLE START**. The spindle should spin momentarily and stop in the proper orientation to load a tool. If this does not happen, follow the steps in **Special Procedures for setting Fuji Inverter parameters**.

WARNING: Before completing next step, be sure there is no tool loaded in the spindle. If there is a tool in the spindle, unload it using the Clamp/Unclamp button on the head. If the tool remains in the spindle it will be dropped when you perform the M15 command.

4. Type **M15** at the MDI prompt and press **CYCLE START**. This should unclamp the spindle to prepare for tool loading.

WARNING: Before completing the next step, be sure there is clearance for the tool carousel to be moved into the tool change position so the carousel will not slam into the head when you perform the M80 command.

5. Type **M80** at the MDI prompt and press **CYCLE START**. This should move the carousel into the tool change position.

6. Use the Jog buttons to carefully move the Z-axis down over the tool in the carousel. Make sure the spindle dogs lineup with the notches in the tool. If they don't, follow the steps in **Special Procedures for setting Fuji Inverter parameters**.

7. Jog the spindle down so the spindle dog and tool notch match and the taper is fully covered. The spindle face should just barely touch the tool. The spindle should not be pushing the tool down through the carousel fingers or they may be damaged.

8. Set the Jog panel to Incremental mode and carefully jog the Z-axis up and down to ensure there is no pressure being applied to the tool, but that the spindle is positioned so that the tool can be clamped.

WARNING: If the spindle is not positioned properly the next step could damage the tool, carousel or tool holding fingers.

9. Issue an **M16** at the MDI prompt and press **CYCLE START**. The tool should be pulled up into the spindle,

but the tool should only slightly pull the tool holding fingers upward. If the fingers are pulled up too much, release the tool with an **M15** command and try repositioning Z-axis again. **DO NOT** try to move Z-axis while the tool is clamped into the spindle.

10. Once the tool can be clamped and unclamped with only slight movement of the fingers, continue to the next step.

11. Issue an **M16** command and press **CYCLE START** to clamp the tool.

12. Issue an **M81** at the MDI prompt and press **CYCLE START**. The carousel should retract to the parked position and the tool should remain clamped into the spindle.

WARNING: If the preceding steps were not performed correctly the following step could cause a tool crash and this procedure will need to be restarted from step (1). Be prepared to abort the next move by pressing the E-STOP button if the fingers do not align properly with the tool holding groove as the carousel moves in.

13. Issue an **M80** at the MDI prompt and press **CYCLE START**. The carousel should move into the tool change position. The fingers should align with the groove in the tool to properly hold the tool. If further Z-axis adjustments are needed, repeat steps (9)-(12).

14. Once you are fully satisfied with the positioning of Z-axis, be sure the tool is clamped into the spindle and use the M81 command to retract the carousel.

15. Press **ESC** to exit the MDI screen and return to the Main Menu screen.

16. From the Main Menu, press **F1 - Setup**, **F1 - Part**, and **F9 - WCS**.

17. From the WCS Menu, press **F1 - Return** to change the G30 Z axis return position to the number displayed in the Z axis DRO (digital read-out). Make sure you include the negative (-) sign.

18. Press **F10 -Save** to save the changes.

19. Repeatedly press **ESC** until the Main Menu screen appears.

The Z-axis level is now properly set to change tools.

WARNING: If Z-axis motor is removed and reinstalled or position altered, Z-Home is changed in any way, Motor revs/in (mm) in the machine configuration is changed, or any parameter is changed that will affect positioning of the Z-axis, the G30 parameters must be reset to the correct height to prevent a crash.

Document History

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