

## Acorn Gray-Code with 2 Motor Output Tool Turret Instructions

This is a “universal” ACORN lathe tool turret PLC program and supporting files that facilitates the operation of a lathe tool turret. This document covers the gray-code based turrets that use up to four position inputs for tool position and two outputs for rotating the turret.

V4.60+ Allows the use of the wizard for those who wish to use the beta ATC PLC. The wiring diagram for previous beta PLC's is still included as a guide on how to generally wire the Acorn, however inputs and outputs can be assigned to any input or output via the wizard.

### Installation:

1. Install ACORN CNC12 V4.60+ on PC System.
2. (Optional) If upgrading restore report from previous version to retain Parameter settings.
3. Extract all files from centroid\_acorn\_v460\_lathe\_universal file into the [c:\cnc1](#) directory and overwrite all files.
4. Start CNC12 and open the Acorn Wizard. Assign Drive Type and Required I/O for your system and ATC. See the **Inputs and Outputs** section below for I/O that is used by this particular turret setup. Write Changes to CNC and follow on screen prompts.
5. Set the following CNC12 parameters. From the main screen press F1(Setup)→F3(Config)→137(Or User specified password)→F3(Params).
  - A. Parameter #6 = 1
  - B. Parameter #160 = 1 (Sets ATC to non-random type meaning it puts tools back into same positions)
  - C. Parameter #161 = Maximum number of tool positions
  - D. Parameter #820 = 1 (Sets Machine type to Lathe)
  - E. Parameter #830 = 3 **\*\*NEW\*\*** (Sets what type of ATC you have for PLC and macros, values are subject to change in future so ensure to check documentation on every update)
  - F. Parameters #831- #846 = The BCD values that the PLC program uses to determine the current tool position based on the state of the Bit 1-4 inputs. Please see below for a detailed explanation of BCD values or use the BCD Calculator Spreadsheet included with this document.
  - G. Parameter #848 = Amount of time in seconds that the turret will need to reverse to lock into position. If the parameter is set to 0, it will default to 1.5s.
  - H. Parameter #849 = Amount of time in seconds to wait before faulting the tool change cycle. If the parameter is set to 0, it will default to 10s.
  - I. Parameter #851 = Amount of time in seconds to go past the tool counter input before the turret reverses into the locked position. This is done so that the turret reverses into the correct tool location instead of the previous tool location. If the parameter is set to 0, it will default to 0.75 seconds.

**Inputs and Outputs:** Below is a Summary of the I/O that can be assigned that will be used by the 2 Output PLC and Macros.

### Inputs

1. ToolTurretPosBit1
2. ToolTurretPosBit2
3. ToolTurretPosBit3
4. ToolTurretPosBit4 (Optional, Does not need assigned if turret is 3 Bit)

### Outputs

1. RotateToolTurret
2. ReverseToolTurret
3. ToolTurretEnable (Optional)

### Gray Code Setup:

With the “bit” inputs correctly wired, open the PLC Diagnostic menu in the CNC12 software by pressing ALT+I at the main screen. Manually rotate the turret to a particular tool position and take note of the state of the inputs. When an input is GREEN in the PLC Diagnostic menu, it means that bit is ON and if an input is RED, it means that bit is OFF. This will be needed in order to determine the appropriate BCD value that will be entered into parameters 831 to 846. These parameters correspond to the turret positions, so 831 is tool position 1, 832 is tool position 2, and so on.

In order to determine the BCD value of the bit logic, a little math will have to be done. Below is a table that shows the BCD value based on the input that is ON.

Bit Number	BCD Value
1	1
2	2
3	4
4	8

If a bit is off or not used then that BCD value of that particular bit is 0. For example, the diagnostic screen shows that bit 1, which is input 1, is the only bit that is ON. That means that the BCD value for bit 1 is 1. Since all of the other bits are OFF, that means that the BCD value for the other bits are 0. In order to determine the BCD value of the parameter for that particular tool position. All of the BCD values for each bit will be added. So, for this example, the BCD value for tool position 1 will be  $1 + 0 + 0 + 0$  which is 1. Therefore, the value of parameter 831 needs to be set to 1. Using that same logic, when the turret is at tool position 2, bits 1 and 2 are ON while bits 3 and 4 are OFF. That means that the BCD value for tool position 2 will be  $1 + 2 + 0 + 0$  which is 3. Therefore, the parameter value of 832 needs to be set to 3. When the turret is at tool position 3, the only bit that is ON is bit 2 while all of the other bits are OFF. That means that the BCD value for tool position 3 will be  $0 + 2 + 0 + 0$  which is 2. Therefore, the value of parameter 833 needs to be 2. Once all tool positions are submitted into the parameters, save the parameters and restart CNC12 and power cycle the Acorn.

### Using Truth Tables to determine BCD:

Truth Tables can be used to determine the correct Value for Parameters 831-846 as well. Below I show a truth table with 0 being the input is OFF (False) and 1 being the input is ON (True).

Bit Number	BCD Value	Tool 1	Tool 2	Tool 3	Tool 4	Tool 5	Tool 6	Tool 7	Tool 8
1	1	1	0	0	0	1	1	0	1
2	2	0	1	0	0	1	0	1	1
3	4	0	0	1	0	0	1	1	1
4	8	0	0	0	0	0	0	0	0

After determining the bits that are ON for each turret position, we can now do some math to calculate the Parameter values. Take the BCD value of each row and multiply it with the true and false values in its own row.

Bit Number	BCD Value	Tool 1	Tool 2	Tool 3	Tool 4	Tool 5	Tool 6	Tool 7	Tool 8
1	1	1	0	0	0	1	1	0	1
2	2	0	2	0	0	2	0	2	2
3	4	0	0	4	0	0	4	4	4
4	8	0	0	0	0	0	0	0	0

Then simply add the numbers for each Tool Column. The resulting value will become the value for Parameters 831 (Tool 1), 832 (Tool 2), and so on.

Bit Number	BCD Value	Tool 1	Tool 2	Tool 3	Tool 4	Tool 5	Tool 6	Tool 7	Tool 8
1	1	1	0	0	0	1	1	0	1
2	2	0	2	0	0	2	0	2	2
3	4	0	0	4	0	0	4	4	4
4	8	0	0	0	0	0	0	0	0
Param Value		1	2	4	0	3	5	6	7

### Indexing the turret:

The Index Turret button is used to index the turret. When the Index Turret button is pressed, the PLC program will see what the current tool position of the turret is and move to the following. If it's at the maximum tool position then it will move the turret to tool position 1.

**How the turret motor works:**Single Winding 12VDC Motor:

12VDC is applied for forward motion. To reverse it, the 12VDC polarity is flipped and a current limiting resistor is used so the motor doesn't over heat while holding the tool position against the pawl.

Single Winding 24VDC Motor:

24VDC is used to move the turret motor forward and 12VDC is used to move the motor backwards. The 12VDC needs the polarity flipped in order to reverse the direction of the motor. The lower voltage is used so the motor doesn't over heat while holding the tool position against the pawl.

Dual Winding Motor:

Turret motor has both the forward and reverse winding often with lower voltage on the reverse coil. The lower voltage is used so the motor doesn't over heat while holding the tool position against the pawl.