ACORN gray-code with 1 motor output based tool turret. It will use the state of up to 4 bits to determine the current tool position of the turret.

This is a pre-programmed ACORN Lathe tool turret PLC program and supporting files that facilitates the operation of a typical Lathe tool turret that has up to 4 inputs that are used to determine the current tool position of the turret. Based on the state of the inputs, the control uses that bit pattern to determine the BCD, Binary Coded Decimal, value of that pattern. This PLC program also only uses 1 motor output to rotate the turret in one direction. When that output is turned off, the turret will rotate in the opposite direction.
Please wire the system based on the included gray-code with 1 motor output turret ACORN hookup schematic as the schematic matches the included PLC/macro files.

Installation:

1.) Set the following CNC12 parameters. From the main screen press F1(Setup)→F3(Config)→F3(Params).

A) Parameter #6 = 1

B) Parameter #160 = 1

C) Parameter #161 = Maximum number of tool positions.

D) Parameters #831 - #846 = The BCD values that the PLC program uses to determine the current tool position based on the state of the inputs. Please see below for a detailed explanation or use the BCD Calculator Spreadsheet included.

E) 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.

F) 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.

2.) Copy all of the files contained in the ACORN_v4.14_Lathe_Gray_Code_1_Motor_Output_Turret.zip file into the c:\cnct directory.(Note: No need to compile the PLC. Just copy the files from the .zip file. The PLC program is already compiled and all the supporting files are included.)

3.) Shut down CNC12 and power cycle ACORN for new PLC program to be loaded onto the ACORN properly. Restart CNC12.

4.) (OPTIONAL, Not required if you input parameters manually) See “Using turret-tool-settings.txt” below for settings. Once the settings are correctly set in the turret-tool-settings.txt file for the turret, home the machine. Once the machine has been homed, load the turret-tool-settings.txt file, and run the file in order to correctly set the appropriate parameters. This step is needed as with CNC12 v4.12 or older, parameters 831 thru 838 are not accessible. If using CNC12 v4.14 or newer, one can set the parameters accordingly during step 1.

Wiring: Below is a recap of the I/O definitions that match this Lathe turret PLC program. Wire ACORN like this and it will match the PLC program attached.

Inputs

1. ToolTurretPosBit1
2. ToolTurretPosBit2
3. ToolTurretPosBit3
4. ToolTurretPosBit4
5. DriveOk
6. HomeAll
7. SpindleOk
8. EStopOk

Outputs

1. NoFaultOut
2. RotateToolTurret
3. OUTPUT3
4. SpinFWD
5. SpinREV
6. DriveResetOut
7. Flood
8. Lube

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

Using turret-tool-settings.txt to set parameters 831-838:

Open the turret-tool-settings.txt file. It can be done either through Windows or through the CNC12 software using the following steps. From the main screen press F7(Utility)→F5(File Ops). By default, the control will be in the c:\cnct\ncfiles directory. Highlight the [Up] in the upper left corner and press ENTER to get into the main c:\cnct directory. Highlight the turret-tool-settings.txt file and either press ENTER or F4(Edit). You will see logic similar to the following

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G10 P1831 R1   ; Tool 1 - Bit1 is ON,  Bit2 is OFF, Bit3 is OFF, Bit4 is OFF
G10 P1832 R3   ; Tool 2 - Bit1 is ON,  Bit2 is ON,  Bit3 is OFF, Bit4 is OFF
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The P1831 thru P1838 are associated with parameters 831 thru 838 which are directly associated with tool positions 1 thru 8. That means that parameter 831 is associated with tool 1, parameter 832 is associated with tool 2, and so on. Simply replace the R value with the appropriate BCD value for your turret positions.

Indexing the turret:

The AUX11 button is used to index the turret. When the AUX11 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.