# Turn the PicoPi — Lesson 2

Learn how to move your PicoPi motors at different speeds. Then you can make it drive in circles of different size or even in a *Figure-8*. This is called a *Differential Drive* — where the left and right wheels turn at different speeds to each other.

Main Activity:

Control the PicoPi with the PicoFlow Alpha software & determine 3 speeds between 0-255 and use a combination of these speeds in forward turning.
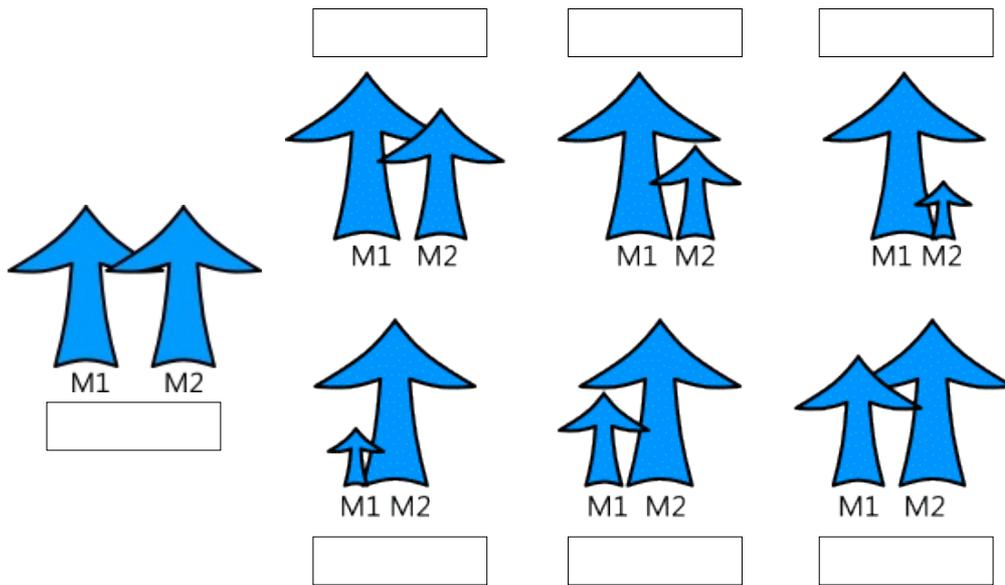

TIPS:

- Use an Output Tool (page 2) and set it to drive the PicoPi forward with one pin High and Low for each Motor.
- Add a File and a Motor Tool, then set them up (pages 3 & 4). Try different values in the File Tool, test, & record your settings on the diagrams above.
- As you find each motor direction, Annotate & copy the Motor Tool to a new place in the Designer window.

HINT:

- The File tool transfers the *Speed value* (0-255) to the Motor Tool by storing it in a common location called a General Purpose Register (GPR).
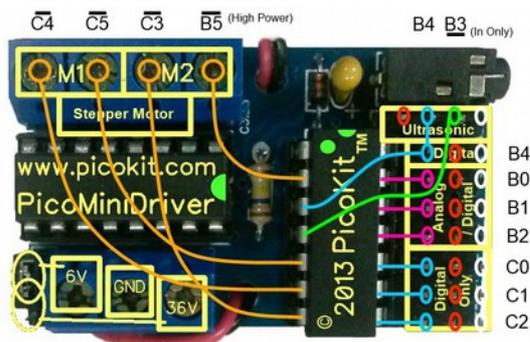
PicoMiniDriver — Control Board

PicoPi—Robot   (designed by David Oswald & Philip Tallents)
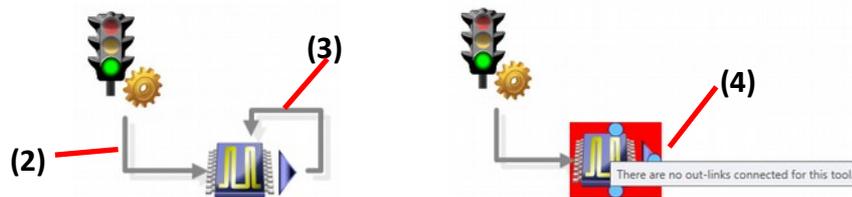
Output Tool

About the Output Tool:

The Output Tool can control the states of all the pins on the selected PIC Micro-controller.

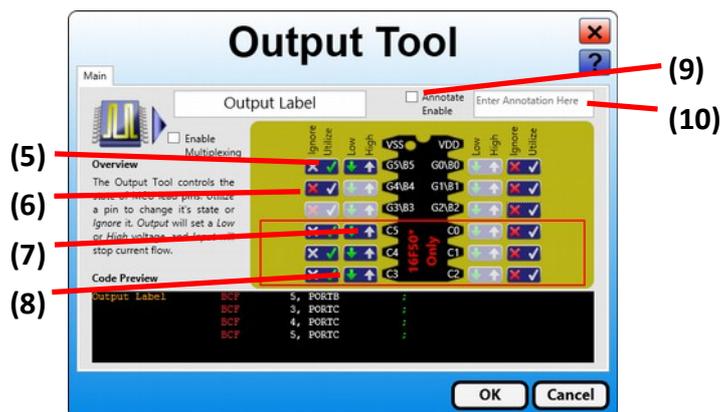## Selecting a PIC for your project:

(1)

The PicoPi uses a PIC called the PIC16F506[1]. This device can be selected in PicoFlow Alpha on

Linking the Output Tool:

(3)

(4)

(2)

The Output Tool must be linked up[2] from the Start Tool and at the end the links must loop[3] back to the Output Tool. If you don't link it up at the end, then you will receive an error[4].

Output Tool Settings:

(9)

(10)

(5)

(6)

(7)

(8)

The diagram above shows the black PIC microchip with all its pins. These pins are labeled with a letter and a number, such as B5. Each pin has two buttons to control what it does.

Button 1 [5] controls if the pin can also be Utilized (tick), or Ignored (cross).

While button 2 [8] sets the pin of the PIC with a *Low* (0V) or *High* (5.5V) voltage :

- Utilize [5]
- Ignore [6]
- High [7]
- Low [8]

Both High and Low are considered outputs because they pass electrical *current* through the pin. High *sources* (puts) current onto the pin and Low *sinks* (takes) current away from the pin.

TIPS:
- Tick the pins you want to use, and Cross the pins you don't.
- Tick the Annotate Enable checkbox[9] and then write a comment in the Annotation textbox[10] to say the direction the PicoPi moves in.
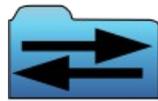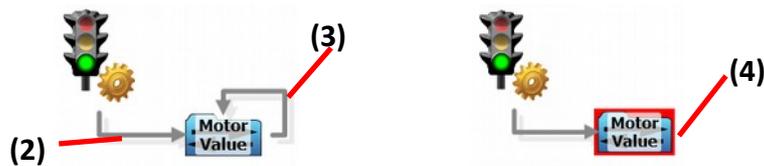
File Tool

About the File Tool:

The File Tool transfers number values into memory Registers of your selected PIC Micro-controller. Different PIC Micro-controllers have different amounts of memory Registers.

Selecting a PIC for your project:

(1)

The PicoPi uses a PIC called the PIC16F506[1]. This device can be selected in PicoFlow Alpha on the Programming Panel of the Ribbon Bar.

Linking the File Tool:

(3)
(4)
(2)

Generally, the File Tool is used after the Start Tool or whenever a value must be changed. Link the File Tool up from the Start Tool[2] and at the end the links must loop[3] back to the File Tool. If you don't link it up at the end, then you will receive an error[4] when programming.

File Tool Settings:

(5) (6) (7) (8) (9) (10) (11) (12) (11) (12) (13) (14)
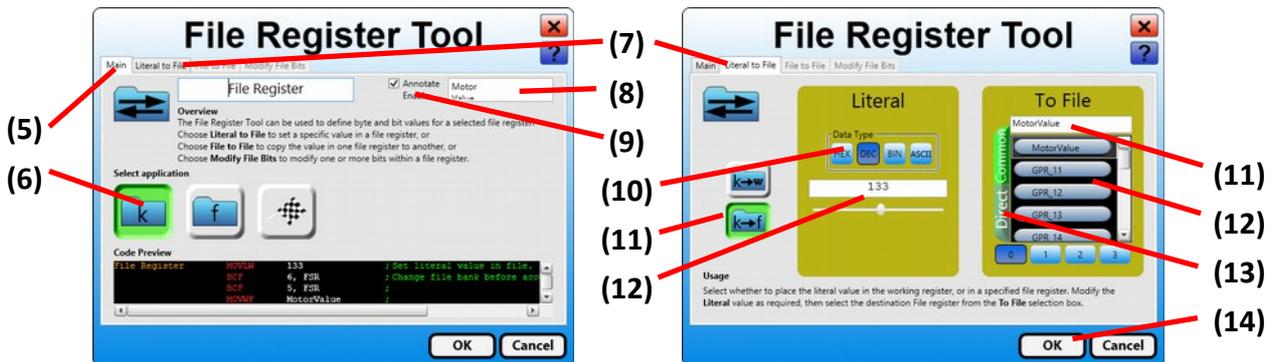
The diagrams above show two tabs of the File Register Tool. On the Main tab[5] select the [k] button[6] then choose the Literal to File tab[7].

On the Literal to File tab[7] the [k→f] button[11] lets you to transfer a number constant to a file register.

Choose the DEC button[10] on the **Literal** panel and then enter a value (0-255) in the textbox[12]. On the **To File** panel, choose the Direct memory button[13], then any available blue General Purpose Register[12] eg. GPR_12 and rename it in the textbox[11] to something memorable eg. *MotorValue*; **Note**: spaces are not allowed here.

Click OK[14] to save your changes and exit back to the Designer window.

The File Tool doesn't do so much by itself because you can't see it working until it is connected to the Motor Tool on the next page.

TIPS:
- Go back into the File Tool Settings and update the Annotation. Tick the Annotate Enable checkbox[9] and then write a comment in the Annotation textbox[8] to indicate the affect of the tool. In this case you could use the name and new value of the File Register. eg. Motor[(enter)] =150
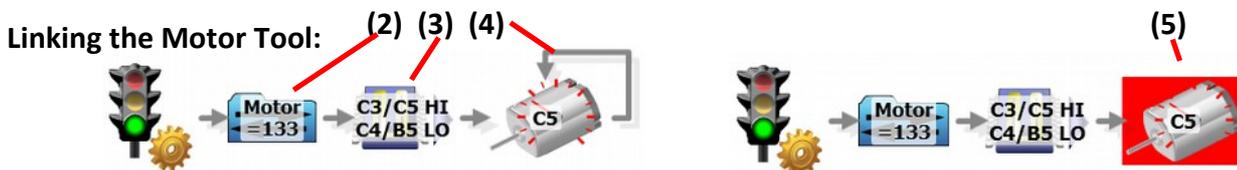
Motor Tool

About the Motor Tool:

The Motor Tool can control the average voltage at one pin on the PIC Micro-controller using PWM (Pulse Width Modulation). Examples 25% 50% 75%

Selecting a PIC for your project:

(1)

The PicoPi uses a PIC called the PIC16F506[1]. This device can be selected in PicoFlow Alpha on the Programming Panel of the Ribbon Bar.

Linking the Motor Tool:

(2) (3) (4) **(5)**

Generally, the Motor Tool must be used with an Output Tool[3] and File Tool[2] all linked up from the Start Tool and at the end the links must loop[4] back to the Motor Tool. If you don't link it up at the end, then you will receive an error[5].

Motor Tool Settings:
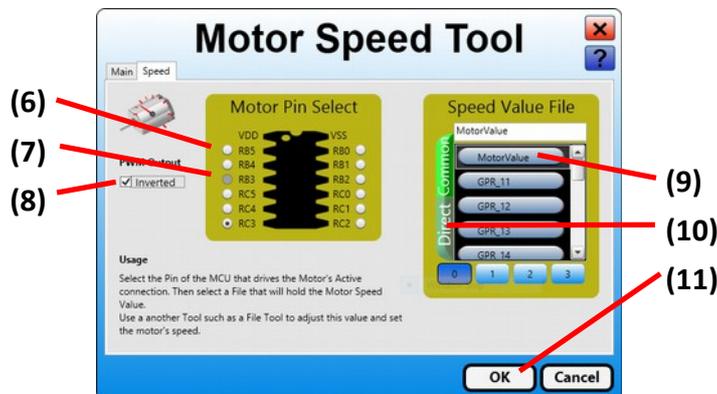
(6)
(7)
(8)

(9)
(10)
(11)

The diagram above shows the black PIC microchip with all its pins. These pins are labeled with a letter and a number, such as B5. Any output pin[6] can be selected (input pins[7] are greyed out). You will also need to choose the same Speed Value File that you used in the File Tool by selecting the **Direct** memory button[10], then the blue **MotorValue** GPR[9].

Click **OK**[11] to save your changes and exit back to the Designer window.

Both High and Low are considered outputs because they pass electrical *current* through the pin. High *sources* (puts) current onto the pin and Low *sinks* (takes) current away from the pin.

TIPS:
- Check a pin that controls the L293D Motor Driver (B5, C3, C5, or C4). One of these pins will control either motor (M1 or M2) and its direction.
- If a large number in the File Tool makes the Motor drive slowly, then you can check the Inverted Checkbox[8] to invert the speed.
- Plug in the PicoFlow USB Programmer to the PicoPi and Program[1] it.

2. Turn the PicoPi—Worksheet

Revision Questions:

What does PWM stand for and explain in your own words how it works?

Explain what Differential Drive is and how it works.

How does the Motor Tool get the *Speed Value* and where does it come from?

What does the Invert checkbox do to the speed of your motor?

How does the Output Tool affect each of the motors when turning?

Explore Further:

Use the PicoFlow Alpha Help to find out about the Cycle Tool. Hint: Place the Tool and press F1. Note: Motor tools use a Cycle Tool instead of a Delay Tool.

Add a Cycle Tool between multiple Output & Motor Tools to make the PicoPi drive in a figure 8. **Warning**: Recheck all File Registers as these tools allocate their own.

How many blue General Purpose Registers are in the PIC16F506? Check all of the Direct Memory banks 0 1 2 3 as well as Common memory.