Robot Expansion Unit
Class Library Reference

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Revision History

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1. Getting Started

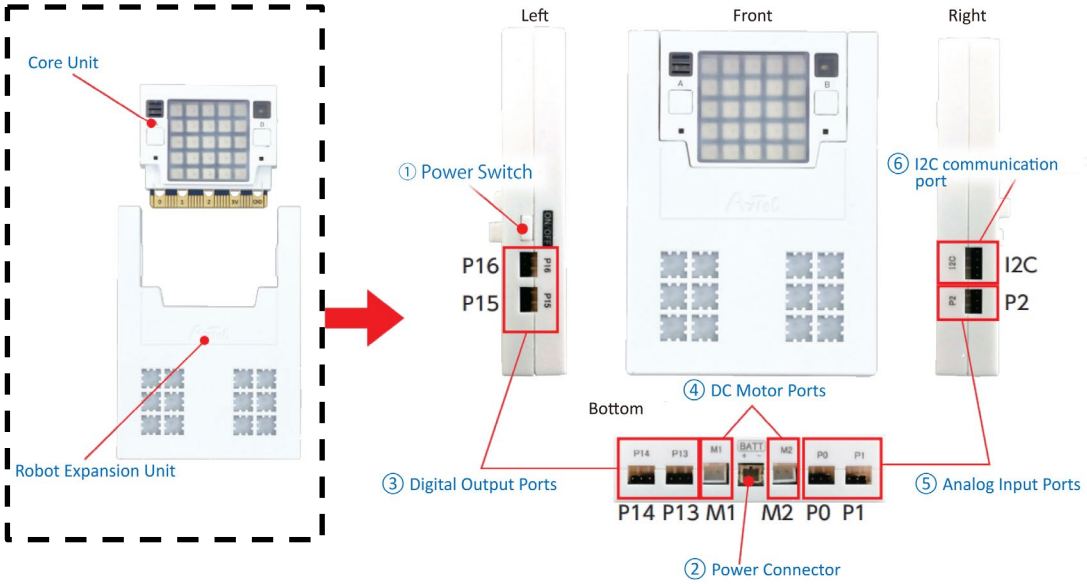
This manual is a reference guide for the ArtecRobo 2.0 class library. Using this manual requires some prior understanding of the basics of Python.

2. ArtecRobo2.0

ArtecRobo 2.0 consists of the Core Unit (Studuino:bit) and the Robot Expansion Unit. MicroPython is one of the programming environments compatible with Studuino:bit.

2.1. Robot Expansion Unit Layout

The layout of the Robot Expansion Unit is shown below.



The Robot Expansion Unit provides additional ports you can use to attach sensors and motors to your robot. It contains digital output ports, DC Motor ports, analog input ports, and an I2C communications port. Consult the table below to see which parts are usable with which ports.

Port	Parts
Digital Output Ports	LEDs, Buzzers, Servomotors
DC Motor Ports	DC Motors
Analog Input Ports	Light Sensors, Sound Sensors, Touch Sensors, IR Photoreflectors
I2C Communication Port	Accelerometers

2.2. MicroPython

MicroPython is a version of Python developed specifically for use with microcontrollers. The programming syntax is identical to Python 3.0, but some Python libraries are not usable in MicroPython because they're not designed to work with the limited memory and CPU of a microcontroller. However, some MicroPython-specific libraries (such as the library for GPIO microcontrollers) are included as standard.

MicroPython has been widely ported to different microcontrollers, and the Studuino:bit library utilizes a Studuino:bit specific version.

3. Development Environment

uPyCraft is one development environment used for MicroPython. See section **6.2** in the **Core Unit Class Library Reference** manual for instructions on how to use uPyCraft.

4. ArtecRobo 2.0 Class Library

The ArtecRobo 2.0 class library is structured as follows.

Package	Module	Class	Parts
pyatcrobo2	parts	DCMotor	DC Motors
		Servomotor	Servomotors
		Buzzer	Buzzers
		LED	LEDs
		LightSensor	Light Sensors
		SoundSensor	Sound Sensors
		TouchSensor	Touch Sensors
		Temperature	Temperature Sensors
		Accelerometer	Accelerometers

4.1. The DCMotor Class

This class is used to control DC Motors.

4.1.1. Constructors

Use this to make objects that control DC Motors plugged into a specified DC Motor port (M1 or M2) on the Robot Expansion Unit.

```
from pyatcrobo2.parts import DCMotor
m1 = DCMotor('M1')
```

4.1.2. Controlling a DC Motor

Use the **cw()** method to make a DC Motor spin clockwise and the **ccw()** method to make it spin counter-clockwise. The **stop()** method will stop making the DC Motor spin, while the **brake()** method will bring the DC Motor's movement to a full stop. The **power(power)** method can be used to adjust a DC Motor's speed. Set the **power** parameter to a number between **0** and **255** to pick a speed.

```
from pyatcrobo2.parts import DCMotor
import time
m1 = DCMotor('M1')
m2 = DCMotor('M2')
m1.power(100)
m2.power(100)
m1.cw()
m2.cw()
time.sleep_ms(1000)
m1.stop()
m2.stop()
```

This will make the DC Motors connected to ports M1 and M2 spin clockwise at speed 100 for 1 second before stopping.

4.2. The Servomotor Class

This class is used to control Servomotors.

4.2.1. Constructors

Use this to make objects that control Servomotors plugged into a specified port (P13, P14, P15 or P16) on the Robot Expansion Unit.

```
from pyatcrobo2.parts import Servomotor
sv13 = Servomotor('P13')
```

4.2.2. Controlling Servomotors

Use the **set_angle(degree)** method to set a Servomotor's angle.

```
from pyatcrobo2.parts import Servomotor
import time
sv13 = Servomotor('P13')
sv13.set_angle(0)
time.sleep_ms(1000)
sv13.set_angle(180)
```

This will make the Servomotor connected to port P13 turn to 0°, then turn to 180° 1 second later.

4.2.3. Releasing PWMs

The Studuino:bit uses PWM to set Servomotor angles. It can use up to four PWMs simultaneously. If you're using 5 or more parts that utilize PWMs, you will be unable to use any Servomotor objects you make. You can resolve this by using the **release()** method to release a PWM assigned to a different Servomotor object.

4.3. The Buzzer Class

This class is used to control Buzzers.

4.3.1. Constructors

Use this to make objects that control Buzzers plugged into a specified port (P13, P14, P15 or P16) on the Robot Expansion Unit.

```
from pyatcrobo2.parts import Buzzer
bz13 = Buzzer('P13')
```

4.3.2. Controlling Buzzers

You can use the method **on(sound, *, volume=None, duration=None)** to play sound from Buzzers. Use the **sound** parameter to set the frequency of the sound using a MIDI note number or note name. For a list of usable note numbers and names, see section **5.1**. The **volume** parameter lets you set the volume from 0 to 100. The **duration** parameter is used to set the length of the sound output in milliseconds. If the **duration** parameter is left unspecified, the **off()** method can be used to stop the buzzer.

```
from pyatcrobo2.parts import Buzzer
bz13 = Buzzer('P13')
bz13.on('C4', duration=1000)
```

This will make the Buzzer plugged into port P13 on the Robot Expansion Unit play the note C4 for 1 second.

4.3.3. Releasing PWMs

The Studuino:bit uses PWM for its sound output. It can use up to four PWMs simultaneously. If you're using 5 or more parts that utilize PWMs, you will be unable to use any Buzzer objects you make. You can resolve this by using the **release()** method to release a PWM assigned to a different Buzzer object.

4.4. The LED Class

This class is used to control LEDs.

4.4.1. Constructors

Use this to make objects that control LEDs plugged into a specified port (P13, P14, P15 or P16) on the Robot Expansion Unit.

```
from pyatcrobo2.parts import LED
led13 = LED('P13')
```

4.4.2. Controlling LEDs

Use the **on()** method to switch an LED on and the **off()** method to switch it off.

```
from pyatcrobo2.parts import LED
import time
led13 = LED('P13')
while True:
    led13.on()
    time.sleep_ms(500)
    led13.off()
    time.sleep_ms(500)
```

This will make the LED connected to port P13 on the Robot Expansion Unit turn on and off in 500 millisecond intervals.

4.5. The IRPhotoReflector Class

This class is used to control IR Photoreflectors.

4.5.1. Constructors

Use this to make objects that control IR Photoreflectors plugged into a specified port (P0, P1, P2, or P3) on the Robot Expansion Unit.

```
from pyatcrobo2.parts import IRPhotoReflector
sensor0 = IRPhotoReflector('P0')
```

4.5.2. Finding IR Photoreflector Values

Use the method **get_value()** to find the analog value of an IR Photoreflector. It will be formatted as an integer from 0 to 4095.

```
from pyatcrobo2.parts import IRPhotoReflector
import time
sensor0 = IRPhotoReflector('P0')
while True:
    print(sensor0.get_value())
    time.sleep_ms(500)
```

This will display the value of the IR Photoreflector plugged into port P0 on the Robot Expansion Unit through the terminal every 500 milliseconds.

4.6. The LightSensor Class

This class is used to control Light Sensors.

4.6.1. Constructors

Use this to make objects that control Light Sensors plugged into a specified port (P0, P1, P2, or P3) on the Robot Expansion Unit.

```
from pyatcrobo2.parts import LightSensor
sensor0 = LightSensor('P0')
```

4.6.2. Finding Light Sensor Values

Use the method **get_value()** to find the analog value of a Light Sensor. It will be formatted as an integer from 0 to 4095.

```
from pyatcrobo2.parts import LightSensor
import time
sensor0 = LightSensor('P0')
while True:
    print(sensor0.get_value())
    time.sleep_ms(500)
```

This will display the value of the Light Sensor plugged into port P0 on the Robot Expansion Unit through the terminal every 500 milliseconds.

4.7. The SoundSensor Class

This class is used to control Sound Sensors.

4.7.1. Constructors

Use this to make objects that control Sound Sensors plugged into a specified port (P0, P1, P2 or P3) on the Robot Expansion Unit.

```
from pyatcrobo2.parts import SoundSensor
sensor0 = SoundSensor('P0')
```

4.7.2. Finding Sound Sensor Values

Use the method **get_value()** to find the analog value of a Sound Sensor. It will be formatted as an integer from 0 to 4095.

```
from pyatcrobo2.parts import SoundSensor
import time
sensor0 = SoundSensor( 'P0' )
while True:
    print(sensor0.get_value())
    time.sleep_ms(500)
```

This will display the value of the Sound Sensor plugged into port P0 on the Robot Expansion Unit through the terminal every 500 milliseconds.

4.8. The TouchSensor Class

This class is used to control Touch Sensors.

4.8.1. Constructors

Use this to make objects that control Touch Sensors plugged into a specified port (P0, P1, P2 or P3) on the Robot Expansion Unit.

```
from pyatcrobo2.parts import TouchSensor
sensor0 = TouchSensor( 'P0' )
```

4.8.2. Finding Touch Sensor Values

Use the method **get_value()** to find the digital value of a Touch Sensor. The value will be either **0** or **1**. Using the **is_pressed()** method will return a **True**/**False** to tell you whether the Touch Sensor is being pressed.

```
from pyatcrobo2.parts import TouchSensor
import time
sensor0 = TouchSensor( 'P0' )
while True:
    print(sensor0.get_value())
    print(sensor0.is_pressed())
    time.sleep_ms(500)
```

This will state whether the Touch Sensor plugged into port P0 on the Robot Expansion Unit is being pressed or not through the terminal every 500 milliseconds. If the Touch Sensor is being pressed, it will display 0 and True. If not, it will display 1 and False.

4.9. The Temperature Class

This class is used to control Temperature Sensors.

4.9.1. Constructors

Use this to make objects that control Temperature Sensors plugged into a specified port (P0, P1, P2 or P3) on the Robot Expansion Unit.

```
from pyatcrobo2.parts import Temperature
sensor0 = Temperature( 'P0' )
```

4.9.2. Finding Temperature Sensor Values

Use the method **get_value()** to find the analog value of a Temperature Sensor. It will be formatted as an integer from 0 to 4095. The **get_celsius()** method can be used to find a Temperature Sensor's value in degrees Celsius.

```
from pyatcrobo2.parts import Temperature
import time
sensor0 = Temperature( 'P0' )
while True:
    print(sensor0.get_value())
    print(sensor0.get_celsius())
    time.sleep_ms(500)
```

This will display the analog value and the temperature in Celsius from the Temperature Sensor plugged into port P0 through the terminal every 500 milliseconds.

4.10. The Accelerometer Class

This class is used to control Accelerometers.

4.10.1. Constructors

Use this to make objects that control Accelerometers plugged into the I2C port on the Robot Expansion Unit.

```
from pyatcrobo2.parts import Accelerometer
sensor0 = Accelerometer( 'I2C' )
```

The Accelerometer has a full scale (maximum measurable acceleration) of ± 2G, shown in units of G.

4.10.2. Finding Accelerometer Values

Use the **get_values()** method to find your Accelerometer's values. The values will be returned in a tuple (x, y, z) format. The **get_x()**, **get_y()** and **get_z()** methods can each be used to find the acceleration along the x-axis, y-axis and z-axis separately.

```
from pyatcrobo2.parts import Accelerometer
import time
sensor0 = Accelerometer( 'I2C' )
while True:
    print(sensor0.get_values())
    time.sleep_ms(500)
```

This will display the values of the Accelerometer plugged into the I2C port on the Robot Expansion Unit through the terminal every 500 milliseconds.

5. Appendices

5.1. Sound Output

The MIDI note numbers and note names used in the **Buzzer** class are as follows.

MIDI	Note	MIDI	Note	MIDI	Note	MIDI	Note	MIDI	Note	MIDI	Note	MIDI	Note
48	C3	60	C4	72	C5	84	C6	96	C7	108	C8	120	C9
49	CS3	61	CS4	73	CS5	85	CS6	97	CS7	109	CS8	121	CS9
50	D3	62	D4	74	D5	86	D6	98	D7	110	D8	122	D9
51	DS3	63	DS4	75	DS5	87	DS6	99	DS7	111	DS8	123	DS9
52	E3	64	E4	76	E5	88	E6	100	E7	112	E8	124	E9
53	F3	65	F4	77	F5	89	F6	101	F7	113	F8	125	F9
54	FS3	66	FS4	78	FS5	90	FS6	102	FS7	114	FS8	126	FS9
55	G3	67	G4	79	G5	91	G6	103	G7	115	G8	127	G9
56	GS3	68	GS4	80	GS5	92	GS6	104	GS7	116	GS8		
57	A3	69	A4	81	A5	93	A6	105	A7	117	A8		
58	AS3	70	AS4	82	AS5	94	AS6	106	AS7	118	AS8		
59	B3	71	B4	83	B5	95	B6	107	B7	119	B8		

5.2. Class Table

The full ArtecRobo2 class library is as follows.

Function	Class/Module	Method/Attribute	Instructions
DC Motors	DCMotor	_init_(pin)	Use the **pin** parameter to specify pin M1 or M2 and create a DC Motor instance. dcm = DCMotor('M1')
		cw()	Spin a DC Motor clockwise.
		ccw()	Spin a DC Motor counter-clockwise.
		stop()	Cease spinning a DC Motor.
		brake()	Completely stop the rotation of a DC Motor.
		power(power)	Set the **power** parameter to a number 0-255 to change a DC Motor's speed.
Servomotors	Servomotor	_init_(pin)	Use the **pin** parameter to specify pin P13, P14, P15 or P16 and create a Servomotor instance. sv = ServoMotor('P13')
		set_angle(degree)	Set the **degree** parameter to an angle 0-180 to change a Servomotor's angle. sv.set_angle(90)
		release()	Release a PWM assigned to a Servomotor object.
Buzzers	Buzzer	_init_(pin)	Use the **pin** parameter to specify pin P13, P14, P15 or P16 and create a Buzzer instance. bzr = Buzzer('P13')

		on(sound, *,
		volume=-1,
		duration=-1)
			Set the Buzzer's sound in the **sound**, **duration**, and **volume** parameters. Sound can be set using note names (C3-G9), MIDI note numbers (48-127), or frequency (as an integer), volume can be set 1-100, and duration can be set in ms. If the **duration** parameter is left unspecified, the Buzzer will keep playing until you call the **off** method. If the **volume** parameter is left unspecified, the volume will be adjusted according to the pitch of the sound.
			bzr.on('50', duration=1000) # The buzzer will play the note corresponding to MIDI note number 50 for 1 second.
			bzr.on('C4', volume=1, duration=1000) # The buzzer will play note C4 at volume 1 for 1 second.
			bzr.on(440)

		off()	Make the Buzzer stop playing sound. bzr.off()
		release()	Release a PWM assigned to a **Buzzer** object.
LEDs	LEDs	_init_(pin)	Use the **pin** parameter to specify pin P13, P14, P15 or P16 and create an LED instance. led = LED('P13')
		on()	Switch an LED on. led.on()
		off()	Switch an LED off. led.on()

IR Photoreflectors	IRPhotoReflector	_init_(pin) get_value()	Use the **pin** parameter to specify pin P0, P1 or P2 and create an IR Photoreflector instance. irp = IRPhotoReflector('P0') Retrieve the sensor's value (0–4095). irp.get_value()
Light Sensors	LightSensor	_init_(pin)	Use the **pin** parameter to specify pin P0, P1 or P2 and create a Light Sensor instance. ls = LightSensor('P0')
		get_value()	Retrieve the sensor's value (0–4095). ls.get_value()
Temperature Sensor	Temperature	_init_(pin)	Use the **pin** parameter to specify pin P0, P1 or P2 and create a Temperature Sensor instance. ts = Temperature('P0')
		get_value()	Retrieve the sensor's value (0–4095). ts.get_value()
		get_celsius()	Retrieve the value of the Temperature Sensor in degrees Celsius. ts.get_celsius()
Sound Sensors	SoundSensor	_init_(pin)	Use the **pin** parameter to specify pin P0, P1 or P2 and create a Sound Sensor instance. ss = SoundSensor('P0')
		get_value()	Retrieve the sensor's value (0–4095). ss.get_value()
Touch Sensors	TouchSensor	_init_(pin)	Use the **pin** parameter to specify pin P0, P1 or P2 and create a Touch Sensor instance. ss = TouchSensor('P0')
		get_value()	Retrieve the sensor's value (0 or 1). ss.get_value()
		is_pressed()	Find the current state of the sensor. Returns **True** if the Touch Sensor is being pressed.
Accelerometers	Accelerometer	_init_(pin)	Use the **pin** parameter to specify pin I2C and create an Accelerometer instance. acc = Accelerometer('I2C')
		get_values()	Find the acceleration along the x, y, and z axes. The maximum measurement range is ±2G and the units are in G. acc.get_values()
		get_x	= get_values()[0]
		get_y	= get_values()[1]
		get_z	= get_values()[2]