



acontis technologies GmbH

SOFTWARE

EC-Master

Python Programming Interface

Version 3.2

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1 Introduction

The Python Wrapper provides a Python interface to use EC-Master, EC-Simulator and RAS Client/Server.

1.1 Requirements

Python v3.7 and above

- Python Pause. Required for ticked timing with `pause.until(...)` to lower JobTask's drift, e.g. for Distributed Clocks
`$ pip install pause`
- PyQt5 (v5.15.1). Only required to run the GUI demo
`$ pip install pyqt5`

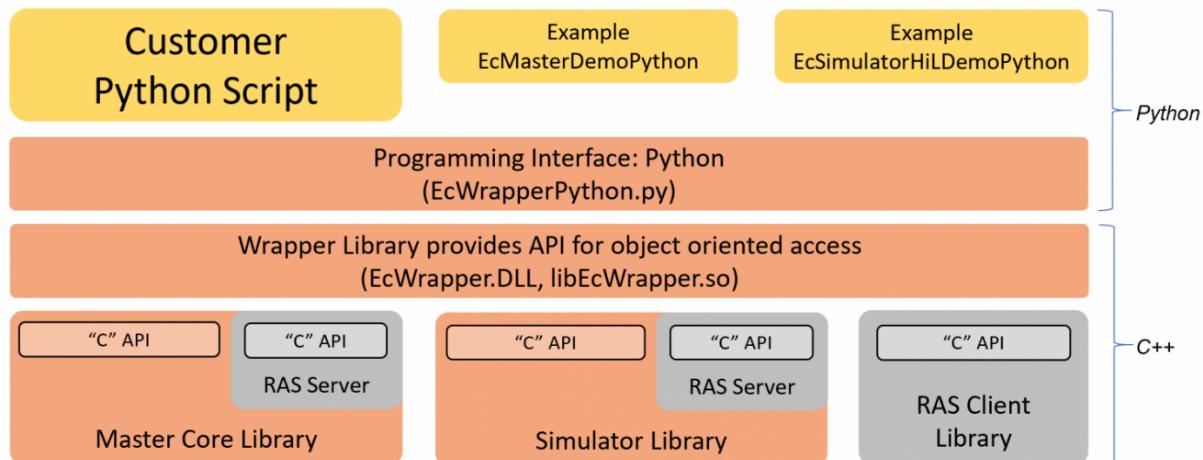
Windows (x86/x64)

- Microsoft Windows 7 and above
- Microsoft Visual C++ 2010 Runtime

Linux (x86/x64/ARM)

- Ubuntu 12.04 and above

1.2 Architecture



The architecture contains 4 basic layers:

Customer Python Script or our examples (EcMasterDemoPython, ...)

- Demo application, written in Python

Programming Interface (EcWrapperPython)

- Provides an object oriented API written in Python

Wrapper Library (EcWrapper)

- Native wrapper library, which provides API for object oriented access

Native Libraries

- Master Core Library
- Simulator Library
- RAS Client Library

2 Programmers Guide

2.1 Sample Scripts

There are currently 2 scripts available:

EcMasterDemoPython.bat

Starts the console demo application

EcMasterDemoPythonInteractive.bat

Starts the interactive demo application

The scripts will start the demo application. The interactive demo application waits for user input where the user can enter the following commands:

```
# Write variable
demo.processImage.variables.Slave_1005__EL2008_.Channel_1.Output.set(1)

# Read variable
demo.processImage.variables.Slave_1005__EL2008_.Channel_1.Output.get()

# Print properties of variable
demo.processImage.variables.Slave_1005__EL2008_.Channel_1.Output.dmp()

# Stop the demo:
demo.stopDemo()
```

2.2 Sample Code

The Python demo application contains of 3 modules:

EcDemoApp.py:

Console demo application

EcDemoAppGui.py:

Gui demo application, based on Qt5

EcDemoAppInteractive.py:

Interactive demo application

2.3 Wrapper

2.3.1 Modules

The Python Wrapper contains of 5 modules:

EcWrapperPython.py

```
class CEcWrapperPython
    EC-Wrapper base class
```

```
class CEcMasterPython
    EC-Master
```

```
class CEcMasterMbxGatewayClientPython
    Mailbox Gateway Client for EC-Master
```

```

class CEcMasterMbxGatewayServerPython
    Mailbox Gateway Server for EC-Master

class CEcSimulatorPython
    EC-Simulator

class CEcSimulatorRasServerPython
    RAS Server for EC-Simulator

class CEcRasClientPython
    RAS Client for EC-Master / EC-Simulator

```

EcMotionPython.py

```

class CEcMotionPython
    EC-Motion interface

EcWrapperPythonTypes.py
    Python types

EcWrapper.py
    CPython interface (internal)

EcWrapperTypes.py
    CPython types (internal)

```

2.3.2 Return code vs. exception handling

The most of all API functions returns a return code for error handling. This behaviour can be changed to throw an exception in error case by simply setting:

```
CEcWrapperPython.EnableExceptionHandling = True # default is False
```

2.3.3 API with “out” or “ref” parameters

The Python Wrapper API is based on C# code. C# supports `out` and `ref` keywords for parameters. This is not supported in Python and is solved by simply submitting `CEcWrapperPythonOutParam` or `CEcWrapperPythonRefParam` to those functions:

```

# This function has an "out" parameter "out_oSbStatus"
def GetScanBusStatus(self, out_oSbStatus):
    # ...
    return

# Create "out" parameter
out_oStatus = CEcWrapperPythonOutParam()
# Call function
pythonWrapper.GetScanBusStatus(out_oStatus)
# Get the "out" parameter value
oStatus = out_oStatus.value
# Now, the "oStatus" object can be used
print(oStatus.dwresultCode)

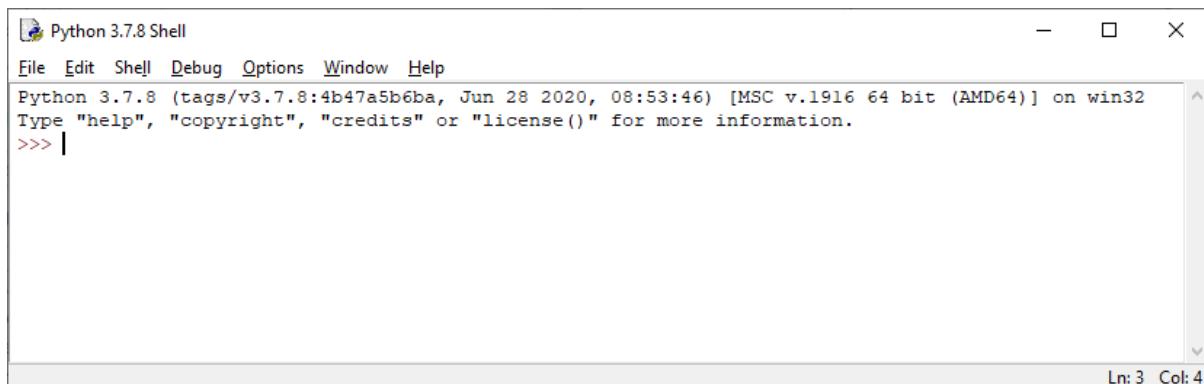
```

2.4 Supported IDEs

2.4.1 Python Shell IDLE

This is the default IDE.

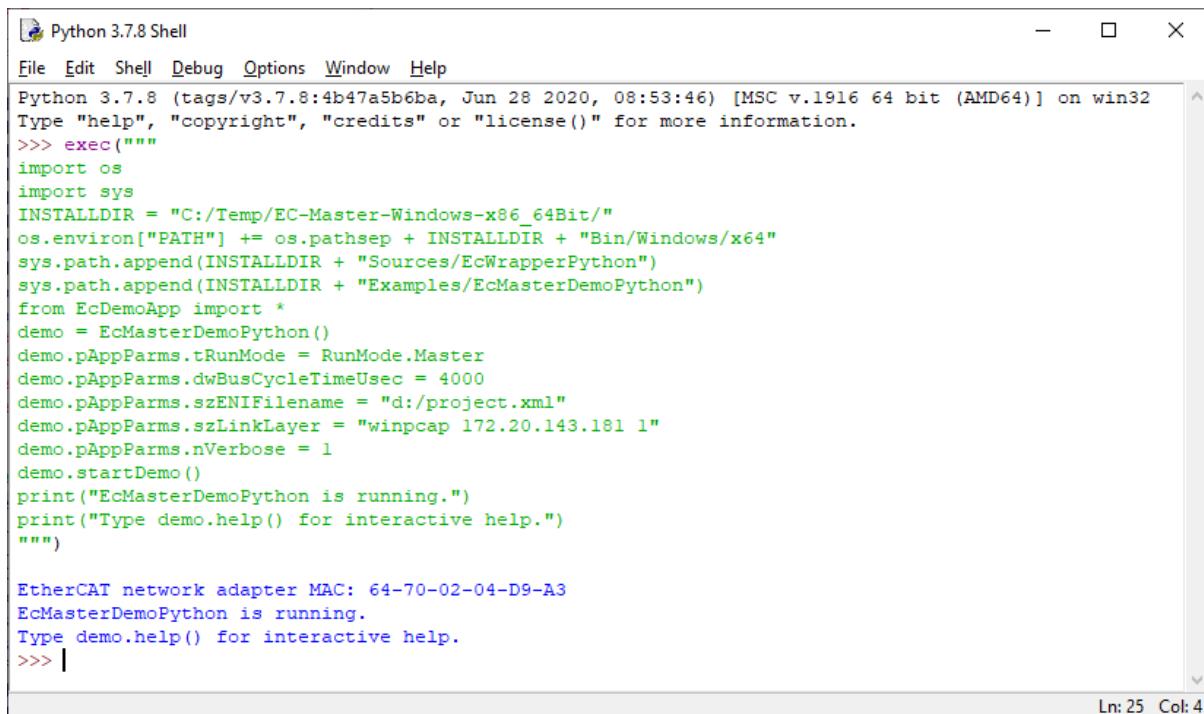
It can be started from Windows Start Menu or by calling **C:/Python/Lib/idlelib/idle.py**:



In this shell, the user can simply copy&paste the sample code from: **Examples/EcMasterDemoPython/EcDemoAppInteractive.py**

```
exec"""
import os
import sys
INSTALLDIR = "C:/Program
Files/acontis_technologies/EC-Master-Windows-x86_64Bit/"
os.environ["PATH"] += os.pathsep + INSTALLDIR + "Bin/Windows/x64"
sys.path.append(INSTALLDIR + "Sources/EcWrapperPython")
sys.path.append(INSTALLDIR + "Examples/EcMasterDemoPython")
from EcDemoApp import *
demo = EcMasterDemoPython()
demo.pAppParms.tRunMode = RunMode.Master
demo.pAppParms.dwBusCycleTimeUsec = 4000
demo.pAppParms.szENIFilename = "ENI.xml"
demo.pAppParms.szLinkLayer = "winpcap 127.0.0.0 1"
demo.pAppParms.nVerbose = 3
demo.startDemo()
print("EcMasterDemoPython is running.")
print("Type demo.help() for interactive help.")
"""
```

... and the demo is running.



```

Python 3.7.8 Shell
File Edit Shell Debug Options Window Help
Python 3.7.8 (tags/v3.7.8:4b47a5b6ba, Jun 28 2020, 08:53:46) [MSC v.1916 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>> exec("""
import os
import sys
INSTALLDIR = "C:/Temp/EC-Master-Windows-x86_64Bit/"
os.environ["PATH"] += os.pathsep + INSTALLDIR + "Bin/Windows/x64"
sys.path.append(INSTALLDIR + "Sources/EcWrapperPython")
sys.path.append(INSTALLDIR + "Examples/EcMasterDemoPython")
from EcDemoApp import *
demo = EcMasterDemoPython()
demo.pAppParms.tRunMode = RunMode.Master
demo.pAppParms.dwBusCycleTimeUsec = 4000
demo.pAppParms.szENIFilename = "d:/project.xml"
demo.pAppParms.szLinkLayer = "winpcap 172.20.143.181 1"
demo.pAppParms.nVerbose = 1
demo.startDemo()
print("EcMasterDemoPython is running.")
print("Type demo.help() for interactive help.")
""")

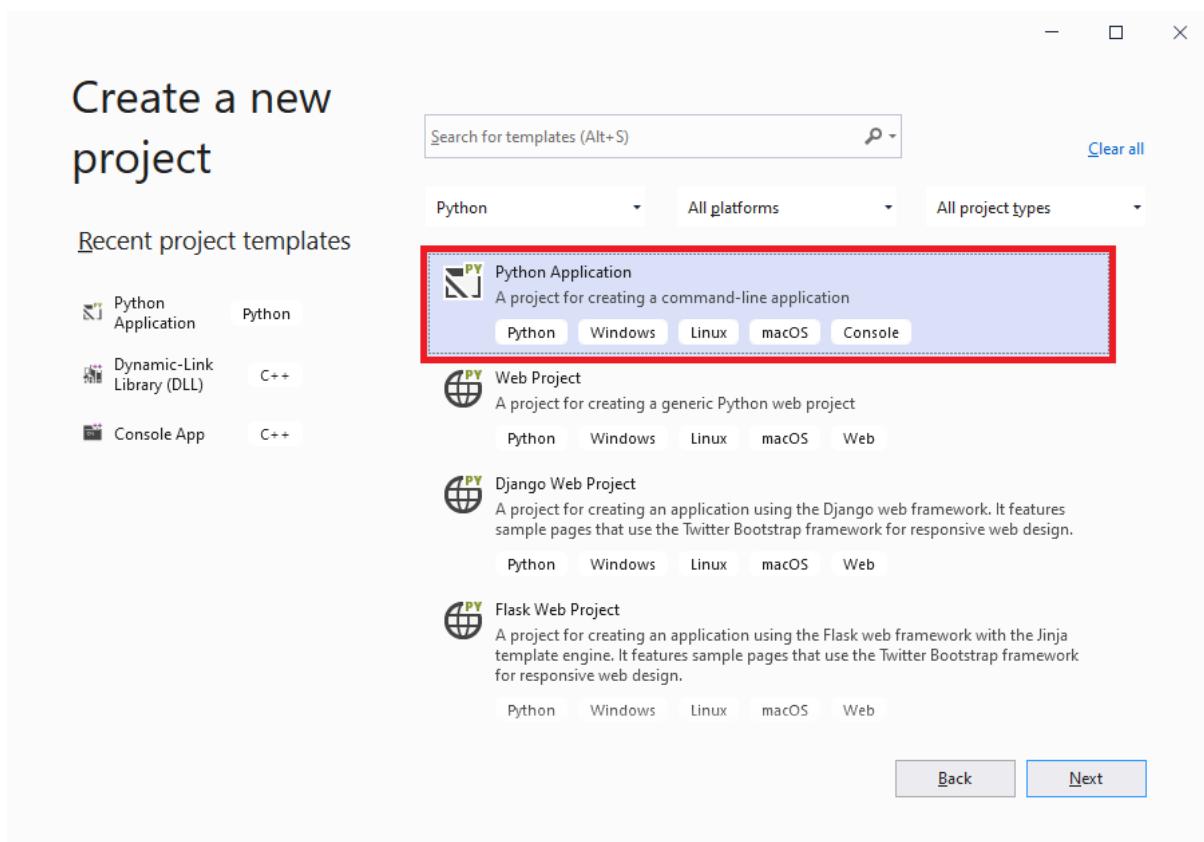
EtherCAT network adapter MAC: 64-70-02-04-D9-A3
EcMasterDemoPython is running.
Type demo.help() for interactive help.
>>> |

```

Ln: 25 Col: 4

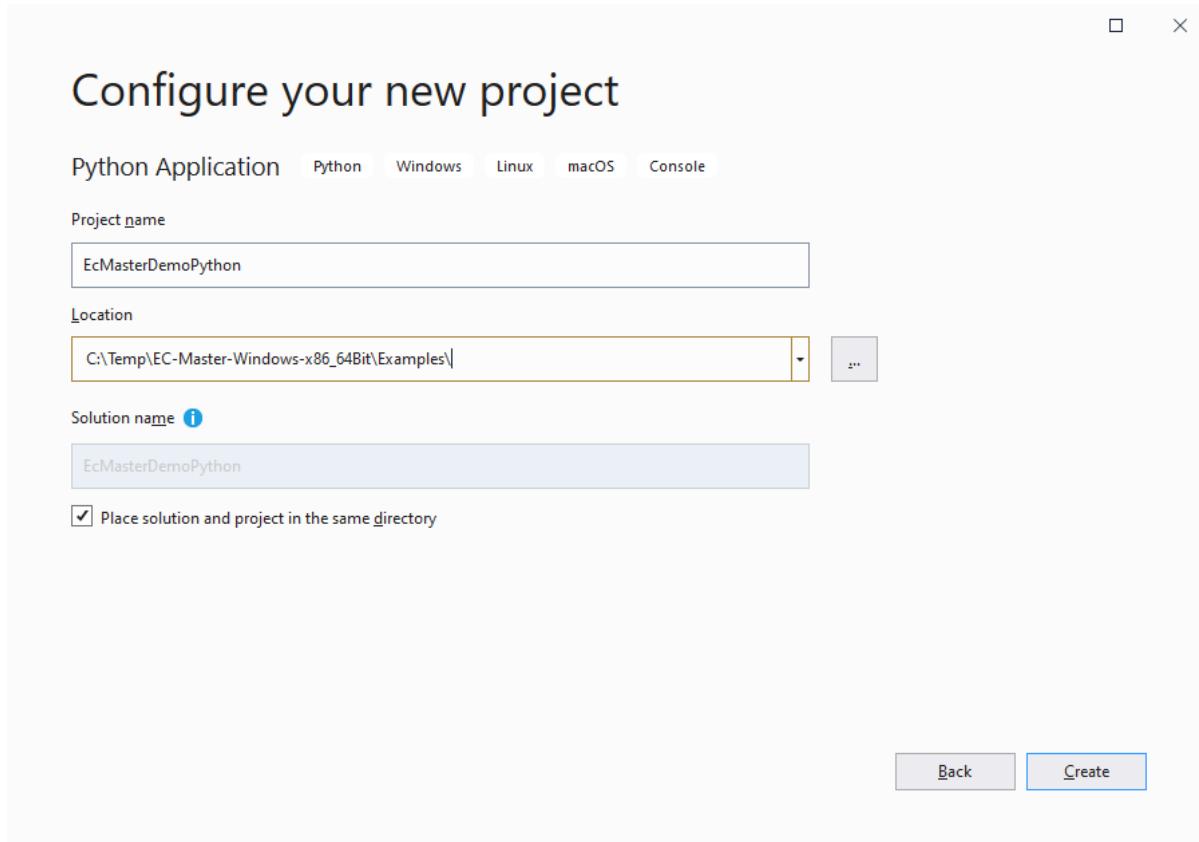
2.4.2 Visual Studio 2019

Create a new project:

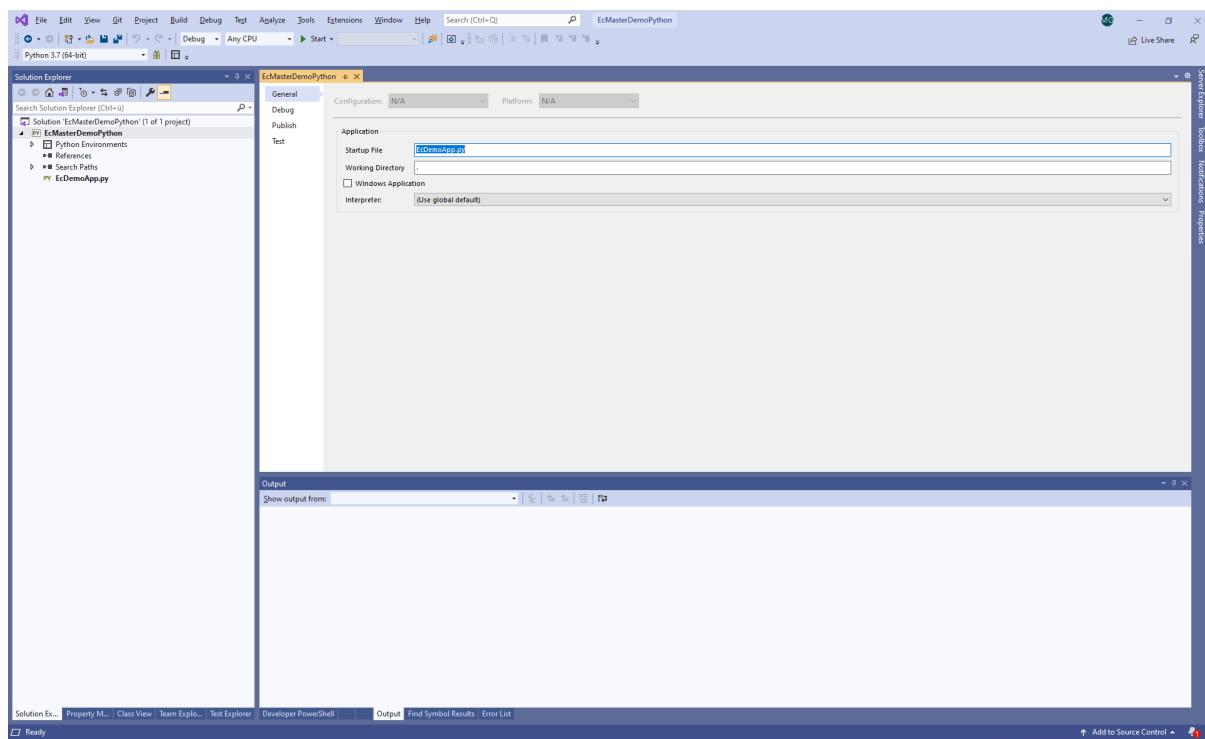


Configure the project:

- Replace the generated file EcMasterDemoPython.py with the existing EcDemoApp.py.

**Configure project *General* settings:**

- Startup File: EcDemoApp.py



Configure project **Debug settings:**

- Search Paths:

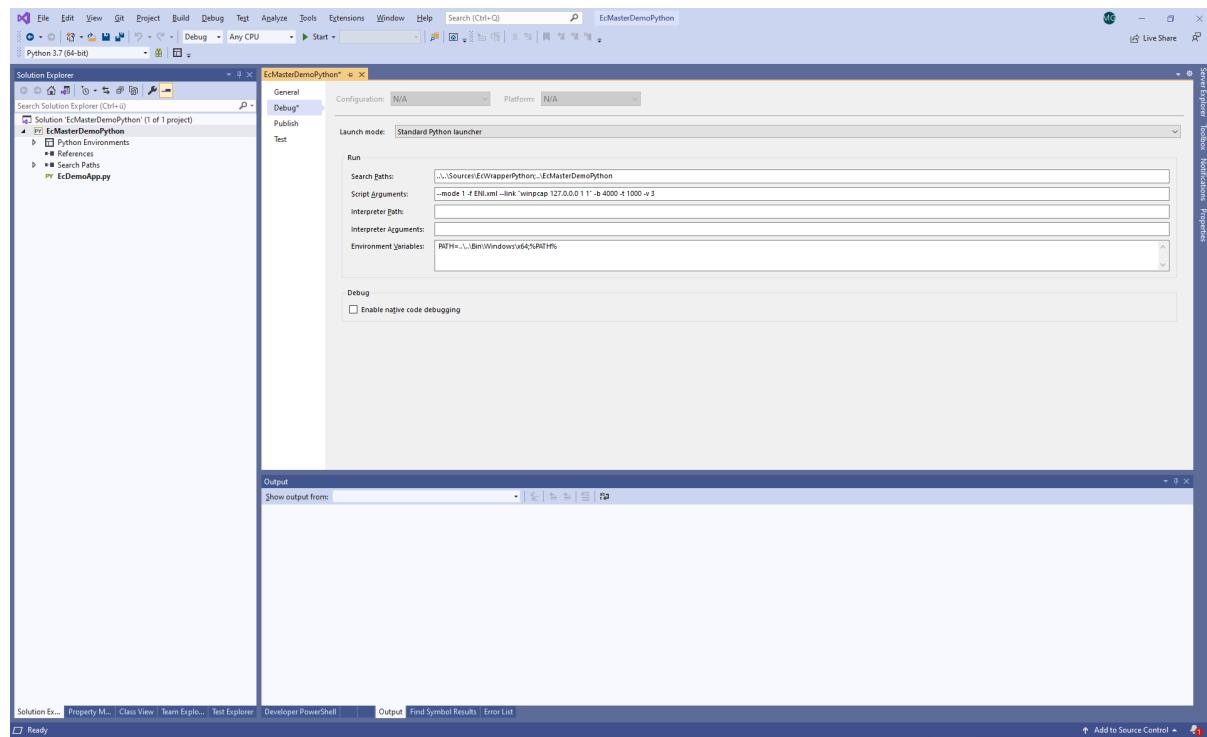
```
.../.../Sources/EcWrapperPython;../EcMasterDemoPython
```

- Script Arguments:

```
--mode 1 -f ENI.xml --link "winpcap 127.0.0.0 1 1" -b 4000 -t 1000 -v 3
```

- Environment Variables:

```
PATH=.../.../Bin/Windows/x64;%PATH%
```

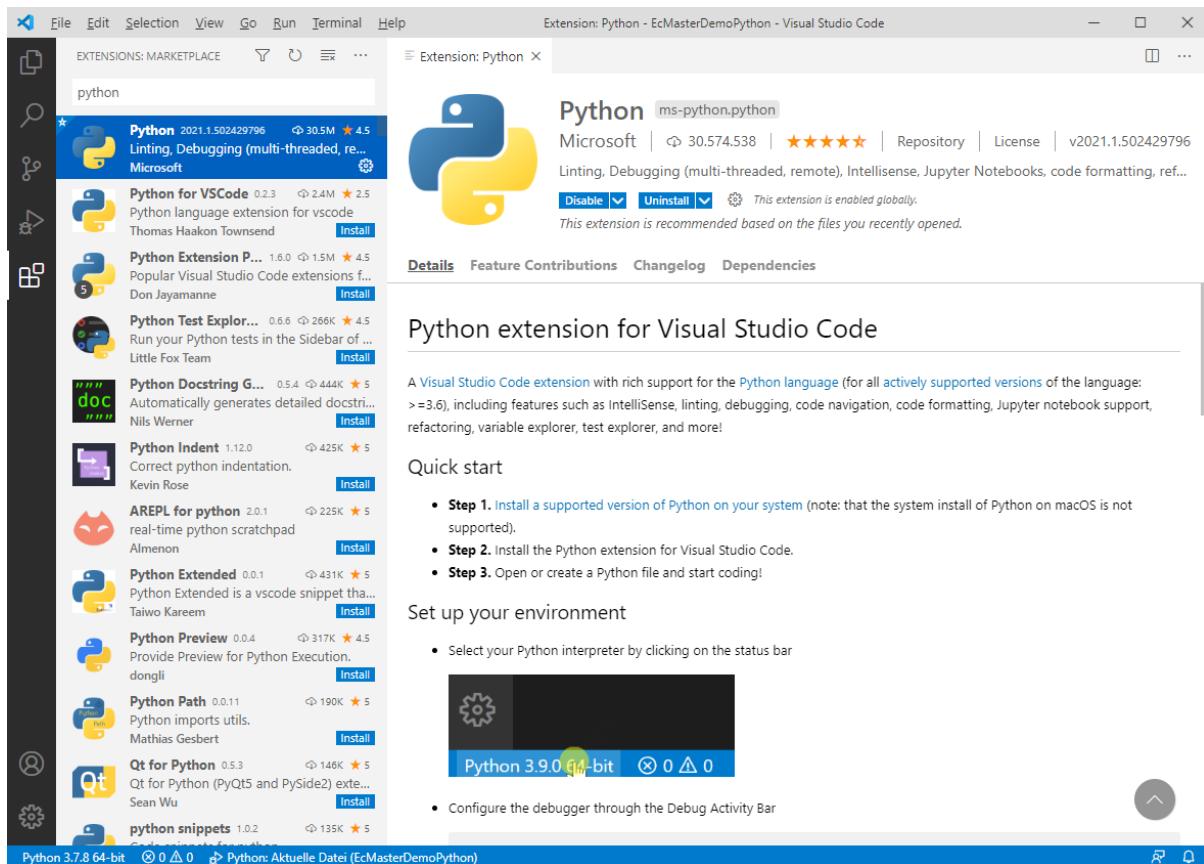


Press Start and the demo is running:

```
C:\Program Files (x86)\Microsoft Visual Studio\Shared\Python37_64\python.exe
Connection at Port D: no (to 0xFFFFFFFF)
Connection at Port B: no (to 0xFFFFFFFF)
Connection at Port C: no (to 0xFFFFFFFF)
Line Crossed.....: no
Line Crossed Flags..: 0x00
Cfg Station Address.: 0x03F4 (1012)
PD IN  Byte.Bit offset: 0.0.0  Size: 160 bits
PD OUT Byte.Bit offset: 0.0.0  Size: 160 bits
*****
Slave ID.....: 0x0000000C
Bus Index.....: -65524
Bus AutoInc Address.: 0xFF4 (65524)
Bus Station Address.: 0x03F5 (1013)
Bus Alias Address...: 0x03F3 (1011)
Vendor ID.....: 0x0000AFFE = VIPA Gesellschaft fuer Visualisierung und Prozessautomatisierung mbH
Product Code.....: 0x0531EC00 = Unknown
Revision.....: 0x00000012  Serial Number: 1260
ESC Type.....: Beckhoff ET1100 (0x11)  Revision: 0  Build: 2
Connection at Port A: yes (to 0x00000007)
Connection at Port D: no (to 0xFFFFFFFF)
Connection at Port B: no (to 0xFFFFFFFF)
Connection at Port C: no (to 0xFFFFFFFF)
Line Crossed.....: no
Line Crossed Flags..: 0x00
Cfg Station Address.: 0x03F5 (1013)
PD IN  Byte.Bit offset: 20.0.0  Size: 1112 bits
PD OUT Byte.Bit offset: 20.0.0  Size: 1016 bits
*****
EcMasterDemoPython runtime: 1.0s ...
Press any key to continue . . .
```

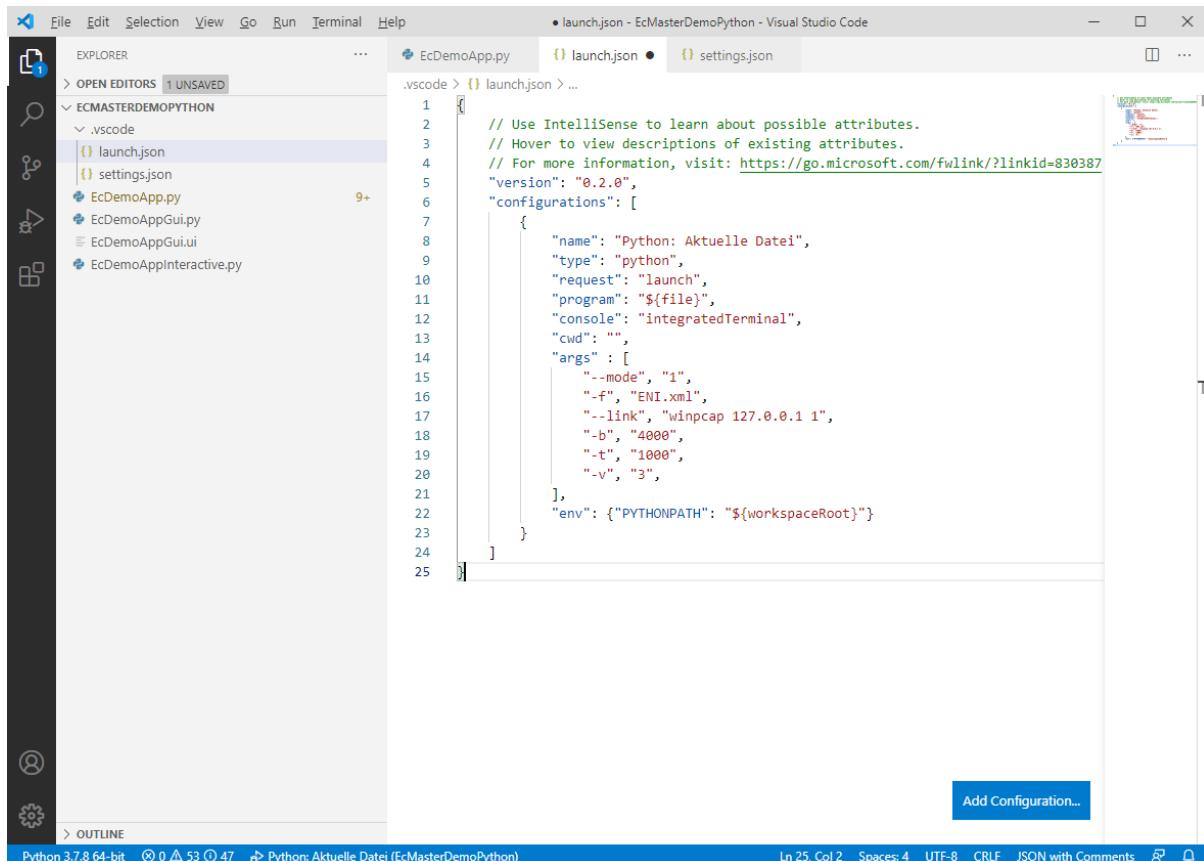
2.4.3 Visual Studio Code

Install python extension by open extension tab and enter *python*:



Open folder **Examples/EcMasterDemoPython** and configure the `launch.json`:

```
{
  "version": "0.2.0",
  "configurations": [
    {
      "name": "Python: Aktuelle Datei",
      "type": "python",
      "request": "launch",
      "program": "${file}",
      "console": "integratedTerminal",
      "cwd": "",
      "args": [
        "--mode", "1",
        "-f", "ENI.xml",
        "--link", "winpcap 127.0.0.1 1",
        "-b", "4000",
        "-t", "1000",
        "-v", "3"
      ],
      "env": { "PYTHONPATH": "${workspaceRoot}" }
    }
  ]
}
```



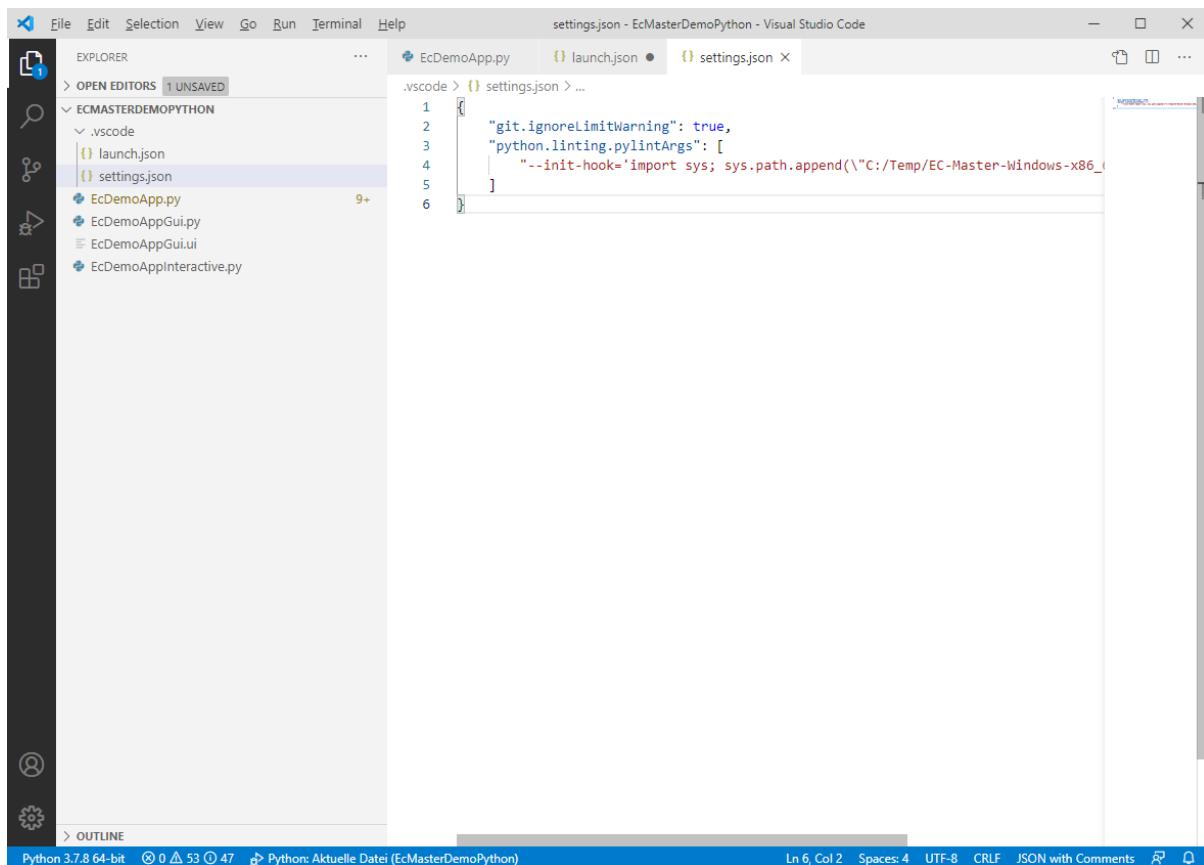
The screenshot shows the Visual Studio Code interface with the following details:

- File Bar:** File, Edit, Selection, View, Go, Run, Terminal, Help.
- Explorer:** Shows the project structure under .vscode:
 - launch.json (selected)
 - settings.json
 - EcDemoApp.py
 - EcDemoAppGui.py
 - EcDemoAppGui.ui
 - EcDemoAppInteractive.py
- Editor:** The launch.json file is open, showing its contents. The file defines a configuration for a Python application named "Python: Aktuelle Datei". It specifies the type as "python", the request as "launch", and the program as "\${file}". The console is set to "integratedTerminal", and the cwd is empty. The args section contains command-line arguments: "-mode", "1", "-f", "ENI.xml", "--link", "winpcap 127.0.0.1 1", "-b", "4000", "-t", "1000", and "-v", "3". The env section sets PYTHONPATH to \${workspaceRoot}.

```
// Use Intellisense to learn about possible attributes.
// Hover to view descriptions of existing attributes.
// For more information, visit: https://go.microsoft.com/fwlink/?LinkId=830387
"version": "0.2.0",
"configurations": [
    {
        "name": "Python: Aktuelle Datei",
        "type": "python",
        "request": "launch",
        "program": "${file}",
        "console": "integratedTerminal",
        "cwd": "",
        "args": [
            "-mode", "1",
            "-f", "ENI.xml",
            "--link", "winpcap 127.0.0.1 1",
            "-b", "4000",
            "-t", "1000",
            "-v", "3"
        ],
        "env": {"PYTHONPATH": "${workspaceRoot}"}
    }
]
```
- Bottom Status Bar:** Python 3.7.8 64-bit, 0 errors, 47 warnings, Python: Aktuelle Datei (EcMasterDemoPython), Line 25, Column 2, Spaces: 4, UTF-8, CRLF, JSON with Comments.
- Buttons:** Add Configuration...

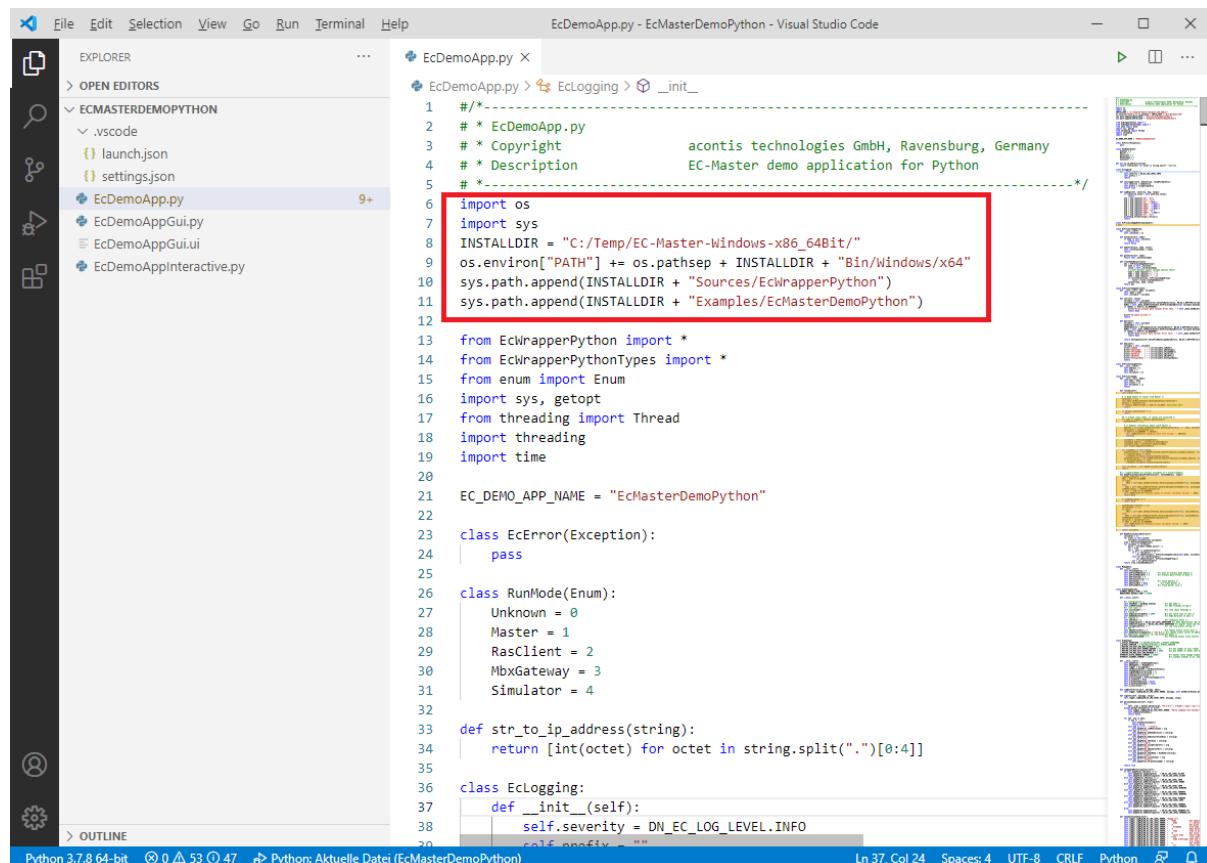
Configure linter in `settings.json`:

```
{
    "git.ignoreLimitWarning": true,
    "python.linting.pylintArgs": [
        "--init-hook='import sys; sys.path.append(\"C:/Temp/EC-Master-"
        "Windows-x86_64Bit/Sources/EcWrapperPython\")'"
    ]
}
```



Open **EcDemoApp.py** and the following lines to set environment:

```
import os
import sys
INSTALLDIR = "C:/Temp/EC-Master-Windows-x86_64Bit/"
os.environ["PATH"] += os.pathsep + INSTALLDIR + "Bin/Windows/x64"
sys.path.append(INSTALLDIR + "Sources/EcWrapperPython")
sys.path.append(INSTALLDIR + "Examples/EcMasterDemoPython")
```

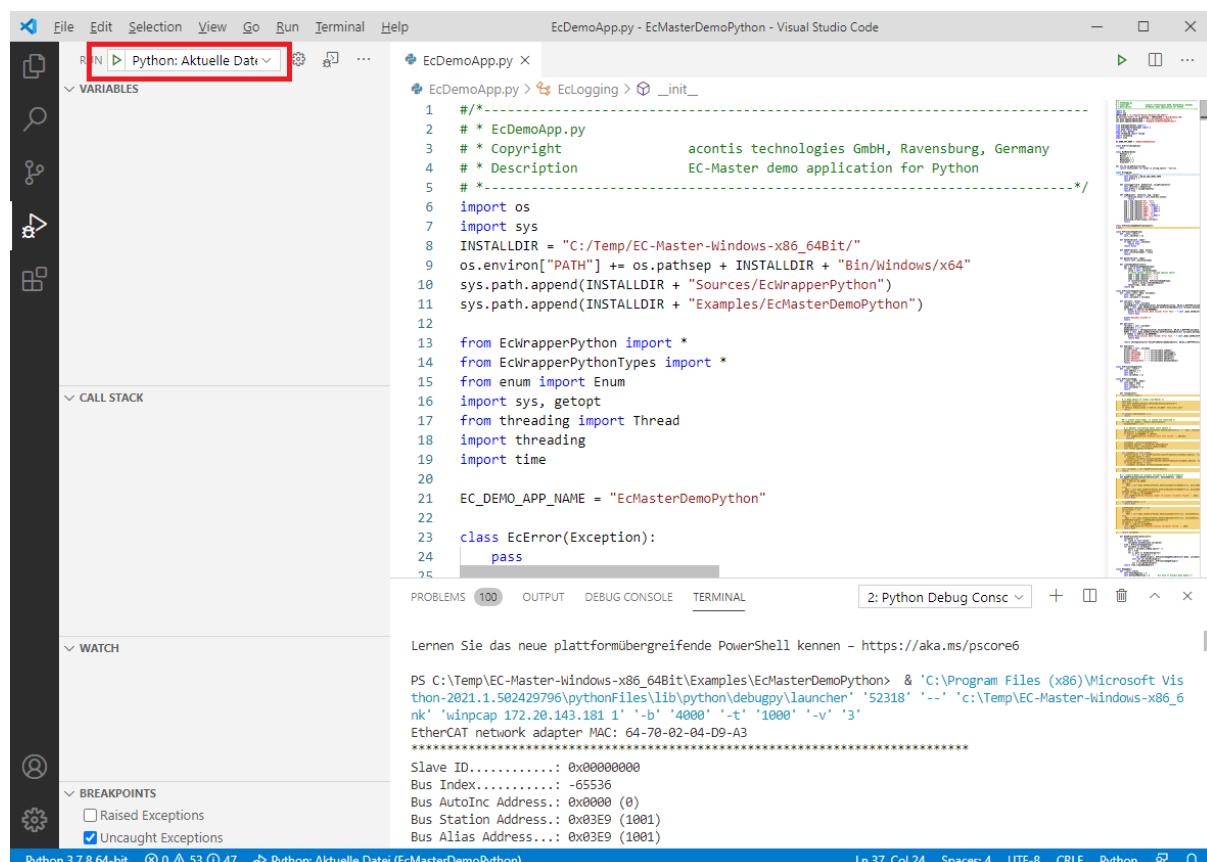


```

1  #!/*
2  # * EcDemoApp.py
3  # * Copyright      acontis technologies GmbH, Ravensburg, Germany
4  # * Description    EC-Master demo application for Python
5  # */
6  import os
7  import sys
8  INSTALLDIR = "C:/Temp/EC-Master-Windows-x86_64Bit/"
9  os.environ["PATH"] += os.pathsep + INSTALLDIR + "Bin/Windows/x64"
10 sys.path.append(INSTALLDIR + "Sources/EcWrapperPython")
11 sys.path.append(INSTALLDIR + "Examples/EcMasterDemoPython")
12
13 from EcWrapperPython import *
14 from EcWrapperPythonTypes import *
15 from enum import Enum
16 import sys, getopt
17 from threading import Thread
18 import threading
19 import time
20
21 EC_DEMO_APP_NAME = "EcMasterDemoPython"
22
23 class EcError(Exception):
24     pass
25
26 class RunMode(Enum):
27     Unknown = 0
28     Master = 1
29     RasClient = 2
30     MbxGateway = 3
31     Simulator = 4
32
33 def str_to_ip_address(string):
34     return [int(octet) for octet in string.split(".")[0:4]]
35
36 class EcLogging:
37     def __init__(self):
38         self.severity = DN_EC_LOG_LEVEL.INFO
39         self.prefix = ""
40

```

Start debugging and the demo output will be written into the terminal:



```

Lernen Sie das neue plattformübergreifende PowerShell kennen - https://aka.ms/pscore6
PS C:\Temp\EC-Master-Windows-x86_64Bit\Examples\EcMasterDemoPython> & 'C:\Program Files (x86)\Microsoft Visual Studio\2021.1.582429\96\python\files\lib\python\debugpy\launcher' '52318' '--' 'c:\Temp\EC-Master-Windows-x86_64Bit\Examples\EcMasterDemoPython\EcDemoApp.py'
EtherCAT network adapter MAC: 64-70-02-04-D9-A3
*****
Slave ID.....: 0x00000000
Bus Index.....: -65536
Bus AutoInc Address.: 0x0000 (0)
Bus Station Address.: 0x03E9 (1001)
Bus Alias Address...: 0x03E9 (1001)

```

3 FAQ

PyQt5 cannot be installed on Ubuntu 14.04 x64, because it requires Python 3.5. How can I install it?

It can be installed by calling

```
$ sudo apt-get install python3-pyqt5
```

I installed Python and the demo crashes with strange errors. What can I do?

This might be a problem of mixing x86 with x64 binaries. Verify that if you have installed the Python runtime for x64 bit, please install also EC-Master for x64 bit.