APPZONE PYTHON API REFERENCE GUIDE

80378ST10106A 2016-08-05

APPLICABILITY TABLE

PRODUCTS

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SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

CONTENTS

1 Introduction

1.1. Scope

Aim of this document is to give an overview of the Easy Script Extension feature, which lets the developer to drive the modem internally, writing the controlling application directly in a high level language such as Python.

1.2. Audience

This document is intended for Telit customers developing functionalities on their applications.

1.3. Contact Information, Support

For general contact, technical support services, technical questions and report documentation errors contact Telit Technical Support at:

TS-EMEA@telit.com

TS-AMERICAS@telit.com

TS-APAC@telit.com

Alternatively, use:

http://www.telit.com/support

For detailed information about where you can buy the Telit modules or for recommendations on accessories and components visit:

http://www.telit.com

Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.

Telit appreciates feedback from the users of our information.

1.4. Text Conventions

⚠	Caution or Warning – Alerts the user to important points about integrating the module, if these points are not followed, the module and end user equipment may fail or malfunction.

ℹ	Tip or Information – Provides advice and suggestions that may be useful when integrating the module.

All dates are in ISO 8601 format, i.e. YYYY-MM-DD.

1.5. Document Organization

This document contains the following chapters:

- Chapter 1: "Introduction" provides a scope for this document, target audience, contact and support information, and text conventions.
- Chapter 2: "Easy Script Extension – Python interpreter" gives a broad overview about the extension.
- Chapter 3: "Python script operations" deals with the execution of the scripts operatively.
- Chapter 4: "Python built-in custom modules" explains in detail the single custom built-in modules.
- Chapter 5: "Python standard functions" provides a description of Python language supported features.
- Chapter 6: "Python non standard functions" provides a description of non-standard functions added to Python language.
- Chapter 7: "Python notes" deals with some Python limits that should be considered while developing scripts.

1.6. Related Documents

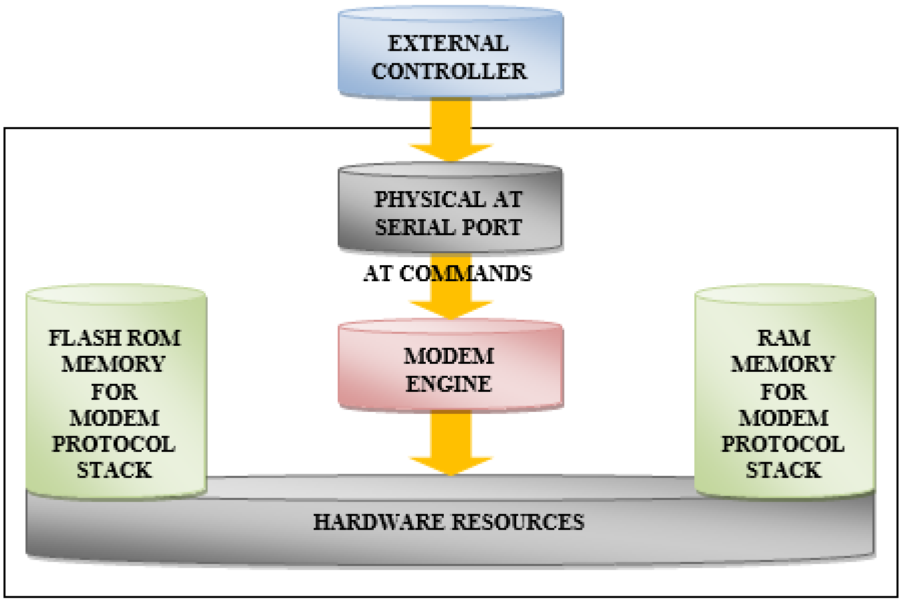
- HE910 AT Commands Reference Guide, 80378ST10091A (12.xx.xxx)
- HE Family Ports Arrangements User Guide, 1vv0300971 (12.xx.xxx)
- AT Commands Reference Guide, 80000ST10025A (13.xx.xxx)
- Telit Modules Software User Guide, 1vv0300784 (12.xx.xxx, 13.xx.xxx)
- CE910 Family AT Commands Reference Guide, 80399ST10110A (18.xx.xxx)
- CE910 Family Software User Guide, 1vv0301011 (18.xx.xxx)

2 Easy Script Extension – Python interpreter

2.1 Overview

The Easy Script Extension is a feature that allows driving the modem *internally*, writing the controlling application directly in the Python high level language. A typical application usually consists of a microcontroller managing data transfer and several I/O pins on the module through the AT command interface.

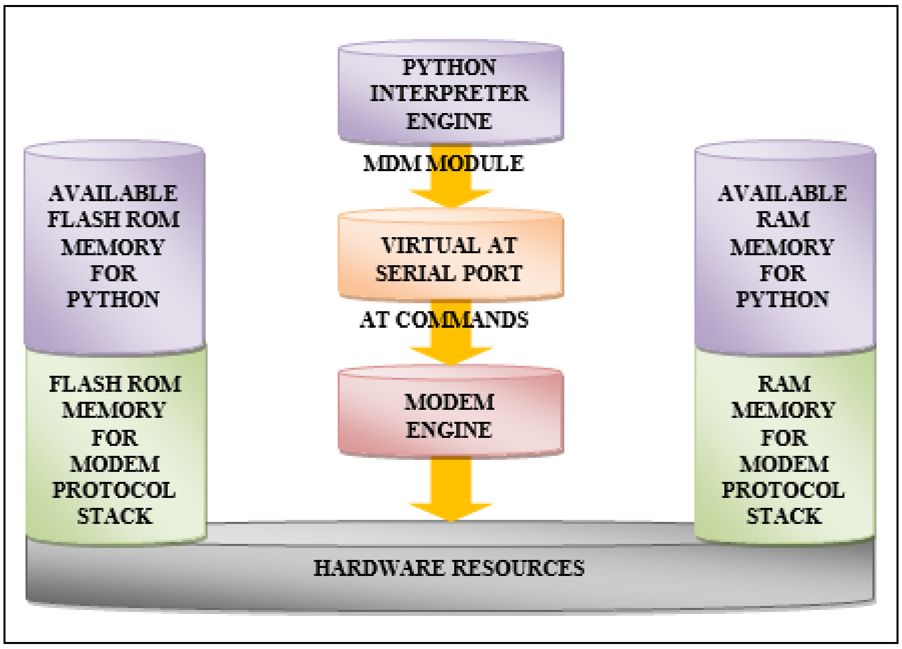
A schematic of such a configuration can be the following:



The Easy Script Extension functionality lets the developer to get rid of the external controller and further simplify the programmed sequence of operations. The equipped Python version features the following:

- Python script interpreter engine version 2.7.2
- 2 MB of Non Volatile Memory space for user scripts and data files (12.xx.xxx, 13.xx.xxx and 18.11.004)
- 2 MB RAM available for the Python engine(12.xx.xxx, 13.xx.xxx and 18.11.004)

The following depicts a schematic of this approach:


PYTHON INTERPRETER ENGINE
MDM MODULE
VIRTUAL AT SERIAL PORT
AT COMMANDS
MODEM ENGINE
AVAILABLE FLASH ROM MEMORY FOR PYTHON
FLASH ROM MEMORY FOR MODEM PROTOCOL STACK
AVAILABLE RAM MEMORY FOR PYTHON
RAM MEMORY FOR MODEM PROTOCOL STACK
HARDWARE RESOURCES

2.2 Python 2.7.2 Copyright Notice

Copyright (c) 2001-2011 Python Software Foundation.

All Rights Reserved.

Copyright (c) 2000 BeOpen.com.

All Rights Reserved.

Copyright (c) 1995-2001 Corporation for National Research Initiatives.

All Rights Reserved.

Copyright (c) 1991-1995 Stichting Mathematisch Centrum, Amsterdam.

All Rights Reserved.

Please refer to http://www.python.org/doc/copyright/

2.3 Python

Python is a dynamic object-oriented multipurpose high level programming language.

Python interpreter implemented version is 2.7.2.

Refer to

http://www.python.org/

and

http://www.python.org/download/releases/2.7.2/

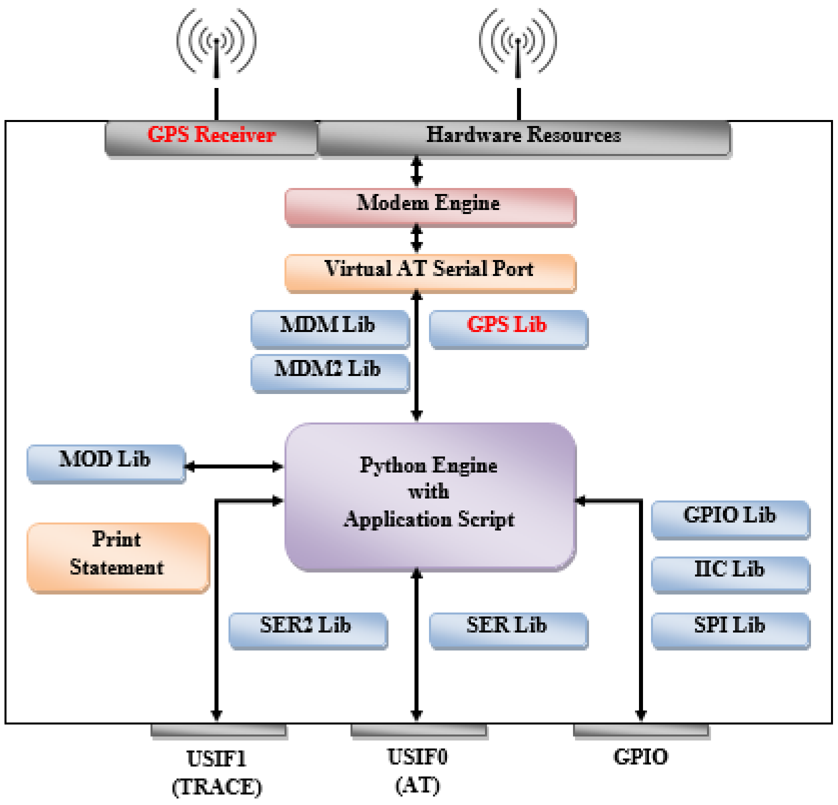
for any information about Python and Python interpreter version 2.7.2.

2.4 Python implementation description

Python scripts are text files stored in the **Telit module NVM** (Non Volatile Memory). There's a file system inside the module that allows to write and read text and binary files with different names on one single level (no subdirectories are supported).

The Python script is executed in a task with the lowest priority on the **Telit module**, so its execution won't interfere with GSM/GPRS/WCDMA/CDMA-1xRTT normal operations. Furthermore, this allows serial ports, protocol stack etc. to run independently from the Python script.

The Python script interacts with the **Telit module** functionalities through several built-in interfaces, as depicted below:



Note: Antenna GPS, GPS receiver and GPS Library are available exclusively for the GPS modules.

The MDM interface is the most important one. It allows the Python script to send AT commands, receive responses and unsolicited indications, send data to the network and receive data from the network during connections. It is quite similar to the regular serial port interface on the **Telit module**. The only difference being that this interface is an internal software bridge between Python and module internal AT command handling engine, and not a physical serial port. All AT commands working on the **Telit module** are working with this software interface as well. Some of them have no meaning for this interface, such as those regarding serial port settings, while others, such as the concept of hardware flow control, keeps its meaning but it's managed internally.

The MDM2 interface is the second interface between Python and the module internal AT command handling. Its purpose is to send AT commands from the Python script to the module and receive AT responses from the module to the Python script when the regular MDM built-in module is already in use.

The SER interface lets the Python script to read from and write to the physical serial port USIF0, usually the default port to send AT commands to the module (e.g.: to read information from an external device). When Python is running, this serial port is free to be used by the Python script since it is not used as the AT command interface; the AT parser, in fact, is mapped into the internal virtual serial port. In default configuration no flow control is available from Python on this port. From version

12.00.xx4, version 13.00.xx5 and version 18.11.004 it is possible to enable
flow control from Python on this port.

The SER2 interface lets the Python script to read from and write to the physical serial port USIF1, usually the default port for trace and debug (only available from version 12.00.xx4, version 13.00.xx5 and version 18.11.004).

The GPIO interface lets the Python script to handle general purpose input output faster than through AT commands, skipping the command parser and controlling directly the pins.

The GPS interface is the interface between Python and the module's internal GPS controller. Its purpose is to handle the GPS controller without the use of dedicated AT commands through the MDM built-in module (not available for version 18.11.004).

The IIC interface is an implementation on the Python core of the IIC bus Master based on GPIO pins (only available from version 12.00.xx4, version 13.00.xx5 and version 18.11.004).

The SPI interface is an implementation on the Python core of the SPI bus Master based on GPIO pins (only available from version 12.00.xx4 and version 13.00.xx5).

The MOD interface is a collection of useful functions (only available from version 12.00.xx4 and version 13.00.xx5).

The USB0 interface lets the Python script to read from and write to the first mini USB port USB0 (only available from version 12.00.xx5 and version 13.00.xx6).

The Python print statement, for debugging purposes, is directly forwarded to second serial port USIF1**.**

2.5 Python supported features

Python implemented version is a smaller part than the original: core Python interpreter is mostly supported but only a few Python modules are supported.

The core Python interpreter version is 2.7.2. All Python statements and almost all Python built-in types and functions are available for development. Refer to chapter PYTHON STANDARD FUNCTIONS for more details.

3 Python Script Operations

3.1 Executing the Python script

The steps required to have a script executing by the Python engine on the **Telit module** are:

- write the Python script, in case splitting it in more than one file;
- optionally compile the Python script;
- download the, optionally compiled, Python script into the module NVM;
- enable the Python script;
- run the Python script.

3.1.1. Write the Python script

A Python script is a simple text file with .py extension, it can be written with any text editor.

In case of large application it is useful to split it in more than one file.

The following is the "Hello Word" short Python script example that sends the simplest AT command to the AT command parser, immediately reads response and then ends.

```
import MDM
print 'Hello World!'
result = MDM.send('AT\r', 0)
print result
c = MDM.read()
print c
```

3.1.2. Compile the Python script

It is an optional operation.

Compiling the Python script on PC before downloading to module saves time at Python script execution start.

The following procedure allows to compile .py Python files into .pyc Python compiled files:

Install Python version 2.7.2 on your PC (as an example in directory C:\Python27)

Use compileall.py library Python script on your PC to compile all .py files in your working directory (as an example in directory C:\pytemp)

```
cd C:\Python27
python -v -S .\Lib\compileall.py -l -f C:\pytemp
```

3.1.3. Download the Python script

Use the following AT command:

```
AT#WSCRIPT="<script_name>",<size>[,<know-how>]
```

where

<script_name>: file name

<size>: file size (number of bytes)

<know-how>: (optional) know how protection, 1 = on, 0 = off (default)

The script, the compiled script, any text or binary file, can be downloaded to the module using the AT#WSCRIPT command. In order to guarantee your company know-how, you have the option to hide

the script text so that the AT#RSCRIPT command does not return the text of
the script and keeps it "confidential", you can see the name of the script only using the AT#LSCRIPT command.

In order to download the, optionally compiled, Python script you have to choose a name for your script on the module, taking care of the following:

- the extension for scripts is .py;
- the extension for compiled scripts is .pyc;
- any or no extension is permitted for generic text or binary file;
- the maximum file name length allowed is 16 characters;
- file names are case sensitive.

Then you have to find out the exact size in bytes of the script or compiled script, or generic text or binary file. For example, right clicking on the file and selecting “size” in “properties” (attention: this is different from selecting “size on disk”).

It is important for large files, compared to module serial port buffer size of 4096 bytes, to activate hardware flow control on your terminal emulator.

It is possible to overwrite an existing file, there is no need to delete old one first.

When using standard Windows terminal emulator *Hyper Terminal* refer to “Send Text file” function.

In *Hyper Terminal* application select “Hardware” flow control in serial settings.

In ASCII Setup set “Send line ends with line feeds” and “Append line feeds to incoming line ends”.

Type for example

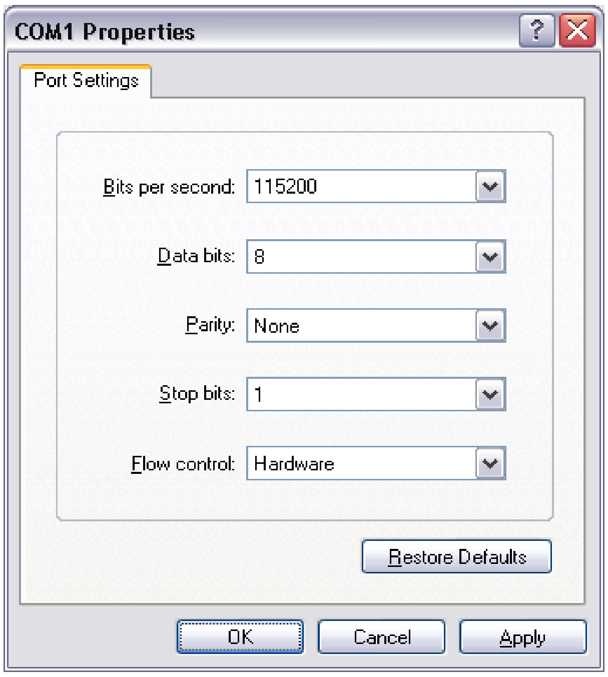
```
AT#WSCRIPT=”a.py”,110
```

wait for the prompt

```
>>>
```

and use “Send Text file” selecting the proper file.

Wait for the result: OK or ERROR.


COM1 Properties

Port Settings

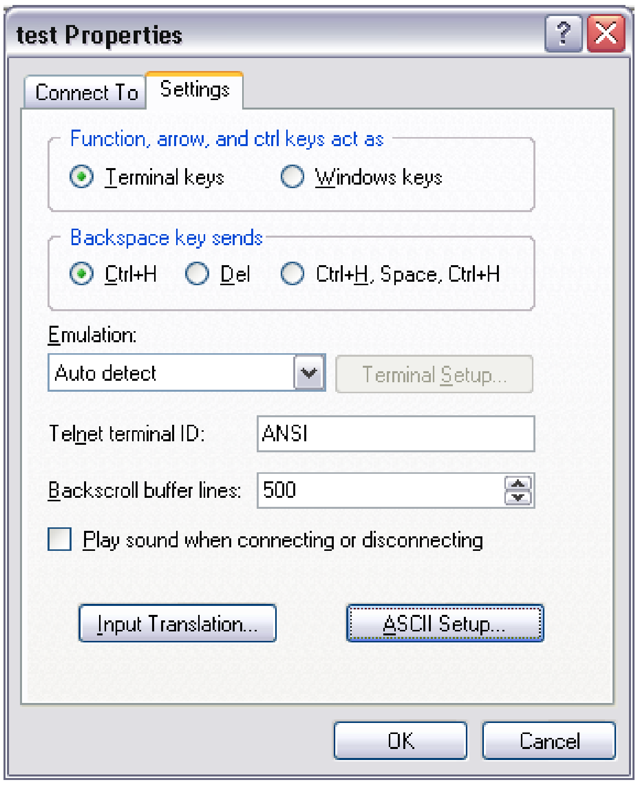
Bits per second: 115200

Data bits: 8

Parity: None

Stop bits: 1

Flow control: Hardware


test Properties

Connect To | Settings

Function, arrow, and ctrl keys act as: [✓ Terminal keys] Windows keys

Backspace key sends: [✓ Ctrl+H] Del Ctrl+H, Space, Ctrl+H

Emulation: Auto detect

Terminal Setup...

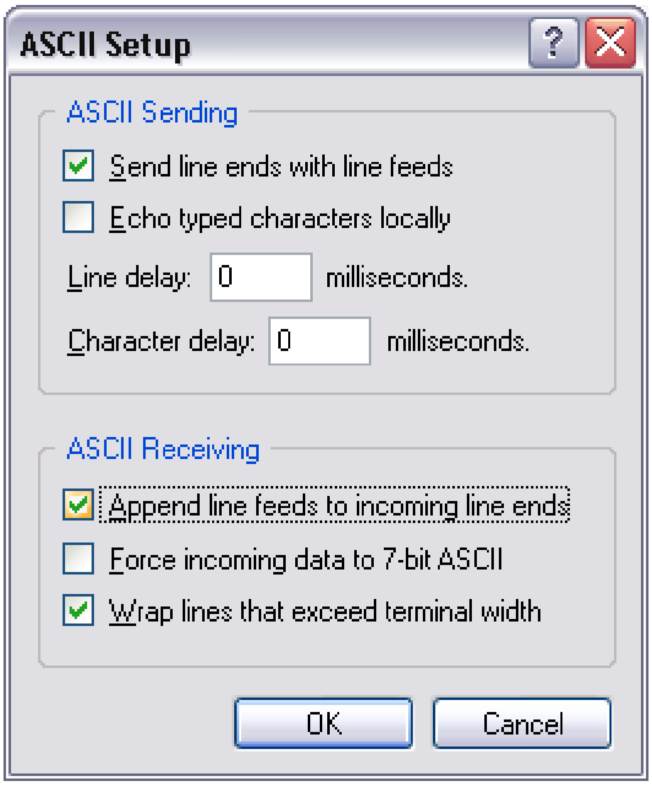
Telnet terminal ID: ANSI

Backscroll buffer lines: 500

☐ Play sound when connecting or disconnecting

Input Translation... ASCII Setup...

OK Cancel


ASCII Setup

ASCII Sending

✓ Send line ends with line feeds

☐ Echo typed characters locally

Line delay: 0 milliseconds.

Character delay: 0 milliseconds.

ASCII Receiving

✓ Append line feeds to incoming line ends

☐ Force incoming data to 7-bit ASCII

✓ Wrap lines that exceed terminal width

OK Cancel

3.1.4. Enable the Python script

Use the following AT command:

```
AT#ESCRIPT="<script_name>"
```

where

<script_name>: script name to be executed

Using the AT#ESCRIPT command select the Python script which will be
executed from the next start-up and in every future start-up or after AT#EXECSCR command. It can be either a .py Python script or a .pyc compiled Python script. In case the application consists of more than one file only the main script must be enabled for execution.

When selecting the script to enable between the ones downloaded to the module:

AT#LSCRIPT - can help checking the names of the scripts;

AT#ESCRIPT? - can help checking the name of the script that is enabled at the moment.

Note: There is no error return value for non-existing script name in the module memory typed in command AT#ESCRIPT. For this reason it's recommended to double check the name of the script that you want to execute. On the other hand this characteristic permits additional possibilities like enabling the Python script before downloading it on the module or not having to enable the same script name every time the script has been changed, deleted and replaced with another script but with the same name.

Type for example

```
AT#ESCRIPT="a.py"
```

Wait for the result: OK or ERROR.

3.1.5. Run the Python script

In default configuration the Python script downloaded to module and enabled is executed at every module power on if the DTR line is sensed LOW (2.8V at the module DTR pin - RS232 signals are inverted) on USIF0 at start-up (this means that no AT command interface is connected to the modem serial port), and if the script name enabled matches with one of the script names of the scripts downloaded.

For example the Python script correctly downloaded and enabled is executed when the module is powered on and the serial cable was previously disconnected from USIF0.

In order to block Python script execution and control the module through the AT command interface on the serial port (for example to update locally a new script) the module shall be powered on with the DTR line HIGH (0V at the module DTR pin). In this condition the Python engine is not started and the script is not executed.

The real execution of the .py Python script is delayed from the power on due to the time needed by Python to parse the script. The larger is the script, the longer is this delay.

The execution of .pyc compiled Python script is faster because there is no parsing of the script, just reading the file from NVM.

Another possibility is to run the correctly downloaded and enabled Python script from terminal emulator using the following AT command:

AT#EXECSCR

Another possibility is to select a second way of executing the Python script at every module power on using the following AT command:

AT#STARTMODESCR=<script_start_mode>[,<script_start_to>]

where

<script_start_mode>: mode (default 0)

<script_start_to>: timeout (default 10)

If the mode is set to 1 than the Python script downloaded to module and enabled is executed at every module power on if the user does not send any AT command on the serial port for the time interval specified in <script_start_to> parameter (default 10s).

3.1.6. Read the Python script

Use the following AT command:

```
AT#RSCRIPT="<script_name>"
```

where

<script_name>: file name

Using the command AT#RSCRIPT read a saved script, compiled script, generic text or binary file. If know-how protection is activated than AT#RSCRIPT will return only OK: no Python script source code will be returned. In this way no one will be able to read your Python script from the module serial port.

It is important for large files, compared to PC serial port buffer size, to activate hardware flow control on your terminal emulator.

Type for example

```
AT#RSCRIPT="a.py
```

Wait for the prompt

```
<<<
```

Receive file data and wait for the result: OK or ERROR.

3.1.7. List saved Python scripts

Use the following AT command:

```
AT#LSCRIPT
```

This command shows the list of the file names currently saved, their size and the number of free bytes in memory.

3.1.8. Delete the Python script

Use the following AT command:

```
AT#DSCRIPT="<script_name>"
```

where

<script_name>: file name

Using the AT#DSCRIPT command delete from the module memory a saved script, compiled script, generic text or binary file.

Type for example

```
AT#DSCRIPT="a.py"
```

Wait for the result: OK or ERROR.

3.2 Debug Python script

The debug of the running Python script can be done on the second serial port USIF1 of the module.

For product versions 12.xx.xxx the following configuration must be set.

Use the following AT command:

```
AT#PORTCFG=3
```

to configure ports properly.

Reboot module to make #PORTCFG configuration working.

In #PORTCFG: 3 configuration Python standard output and standard error, including print statements, are redirected to USIF1 at 115200.

In this configuration AT2 parser instance on USIF1 is not available.

In this configuration Python scripts can be debugged with or without USB inserted.

For product versions 13.xx.xxx there is no need of configuration.

Default #PORTCFG: 0 is the proper configuration.

In #PORTCFG: 0 configuration Python standard output and standard error, including print statements, are redirected to USIF1 at 115200.

For product version 18.11.004 there is no need of configuration.

AT #PORTCFG is not available in version 18.11.004.

In default configuration Python standard output and standard error, including print statements, are redirected to USIF1 at 115200.

For every product version (12.xx.xxx, 13.xx.xxx and 18.11.004) proceed in the following way.

- Connect to the second module serial port USIF1 at 115200.
- Collect Python standard output and standard error:
- Python information messages (for example the version);
- Python error information;
- Results of all Python “print” statements.

4 Python Build-in Custom Modules

Several built-in custom modules have been included in the Python core, specifically developed keeping in mind the hardware environment of the module.

The built-in modules included are:

MDM	interface between Python and the module AT command handling
MDM2	second interface between Python and the module AT command handling
SER	interface between Python and the module serial port USIF0 direct handling
SER2	interface between Python and the module serial port USIF1 direct handling
GPIO	interface between Python and the module internal general purpose input output direct handling
GPS	interface between Python and the module internal GPS controller
IIC	interface between Python and the IIC bus Master
SPI	interface between Python and the SPI bus Master
MOD	collection of useful functions
USB0	interface between Python and the module USB port USB0 direct handling

The built-in modules supported in each product family are summarized in the following table:

	UE910/HE910	***GE910***	***CE910***
MDM	Y	Y	Y
MDM2	Y	Y	Y
SER	Y	Y	Y
SER2	Y	Y	Y
GPIO	Y	Y	Y
GPS	Y	Y	N
IIC	Y	Y	Y
SPI	Y	Y	N
MOD	Y	Y	N
USB0	Y	Y	N

4.1 MDM built-in module

The MDM built-in module is the interface between Python and the module AT commands parser engine.

You need to use the MDM built-in module if you want to send AT commands and data from the Python script to the network and receive responses and data from the network during connections.

In the default configuration, echo (ATE0) is disabled and the response format of result codes is set to verbose (ATV1).

If you want to use MDM built-in module you need to import it:

```
import MDM
```

then you can use its methods as in the following example:

```
a = MDM.send('AT', 0)
b = MDM.sendbyte(0x0d, 0)
c = MDM.read()
```

which sends 'AT' and reads 'OK' response.

More details about MDM built-in module methods can be found in the following paragraphs.

4.1.1. MDM.send(string, timeout)

This command sends a string to the AT command interface.

The first input parameter *string* is a Python string to send to the AT command interface.

The second input parameter *timeout* is a Python integer, measured in 1/10s, and is important in online mode when flow control is activated. In fact it represents the maximum time to wait for the string to be sent to the AT command interface when buffer is full and flow control blocks further data. The timeout range is (0 ÷ 32767).

This method returns immediately after the string has been sent to the AT interface or after the timeout period if the whole string could not be sent to the AT interface. The return value is a Python integer which is -1 if the timeout period has expired, 1 otherwise.

Example:

```
a = MDM.send('AT', 5)
```

sends the string 'AT' to AT command handling, waiting up to 0.5 s, assigning the return value to a.

Note: The buffer available for the MDM.send command is 32768 bytes for product versions 12.xx.xxx or 4096 bytes for product versions 13.xx.xxx and 18.11.004.

4.1.2. MDM.read()

This command receives a string from the AT command interface.

It has no input parameter.

The return value is a Python string which contains the data received and stored in buffer at the moment of command execution. The value might be empty if no data is received.

Example:

```
a = MDM.read()
```

Receives a string from AT command handling, assigning the return value to a.

Note: The buffer available for MDM.read command is 32768 bytes for product versions12.xx.xxx or 4096 bytes for product versions 13.xx.xxx and 18.11.004. The maximum number of bytes returned by each MDM.read is 1023.

Note: It is up to Python script to keep empty MDM.read buffer.

4.1.3. MDM.sendbyte(byte, timeout)

This command sends one byte to the AT command interface.

The first input parameter *byte* can be zero or any Python byte to send to the AT command interface.

The second input parameter *timeout* is a Python integer, measured in 1/10s, and is important in online mode when flow control is activated. In fact it represents the maximum time to wait for the byte to be sent to the AT command interface when buffer is full and flow control blocks further data. The timeout range is (0 ÷ 32767).

This method returns immediately after the byte has been sent to the AT interface or after the timeout period if the byte could not be sent to the AT interface. The return value is a Python integer which is -1 if the timeout expired, 1 otherwise.

Example:

```
b = MDM.sendbyte(0x0d, 0)
```

Sends the byte 0x0d (carriage return <CR>) to the AT commands handling, without waiting and assigning the return value to b.

4.1.4. MDM.readbyte()

This command receives a byte from the AT command interface.

It has no input parameter.

The return value is a Python integer which is the byte value received and stored in buffer at the moment of command execution or is -1 if no data is received. The return value can also be zero.

Example:

```
b = MDM.readbyte()
```

receives a byte from AT command handling, assigning the return value to b.

4.1.5. MDM.sendavail()

This command queries the number of bytes available to send to MDM buffer.

It has no input parameter.

The return value is a Python integer which is the number of bytes available to send to MDM buffer.

Example:

```
n = MDM.sendavail()
```

queries the number of bytes available to send, assigning the return value to n.

4.1.6. MDM.getDCD()

This command gets Carrier Detect (DCD) from the AT command interface.

It has no input parameter.

The return value is a Python integer which is either 0 if DCD is OFF or 1 if DCD is ON.

Example:

```
cd = MDM.getDCD()
```

gets DCD from AT command handling, assigning the return value to cd.

4.1.7. MDM.getCTS()

This command gets Clear to Send (CTS) from the AT command interface.

It has no input parameter.

The return value is a Python integer which is either 0 if CTS is set to OFF or 1 if CTS is set to ON.

Example:

```
cts = MDM.getCTS()
```

gets CTS from AT command handling, assigning the return value to cts.

4.1.8. MDM.getDSR()

This command gets Data Set Ready (DSR) from the AT command interface.

It has no input parameter.

The return value is a Python integer which is either 0 if DSR is OFF or 1 if DSR is ON.

Example:

```
dsr = MDM.getDSR()
```

gets DSR from AT command handling, assigning the return value to dsr.

4.1.9. MDM.getRI()

This command gets Ring Indicator (RI) from the AT command interface.

It has no input parameter.

The return value is a Python integer which is either 0 if RI is set to OFF or 1 if RI is set to ON.

Example:

```
ri = MDM.getRI()
```

gets RI from AT command handling, assigning the return value to ri.

4.1.10. MDM.setRTS(RTS_value)

This command sets Request to Send (RTS) in the AT command interface.

The input parameter *RTS_value* is a Python integer which is either 0 if setting RTS to OFF or 1 if setting RTS to ON.

No return value.

Example:

```
MDM.setRTS(1)
```

sets RTS to ON in AT command handling.

4.1.11. MDM.setDTR(DTR_value)

This command sets Data Terminal Ready (DTR) in the AT command interface.

The input parameter *DTR_value* is a Python integer which is either 0 if setting DTR to OFF or 1 if setting DTR to ON.

No return value.

Example:

```
MDM.setDTR(0)
```

sets DTR to OFF in AT command handling.

4.2 MDM2 built-in module

MDM2 built-in module is the second interface between Python and the module internal AT command handling. It is used to send AT commands from Python script to module and receive AT responses from module to Python script when the classic MDM built-in module is already in use.

Though MDM2 built-in module is independent from activation of CMUX protocol, it works on the second instance of AT parser in the same way the second CMUX port does. So the rules on AT commands that apply on the first and second CMUX ports (AT parser instances) apply on MDM and MDM2 as well.

See "AT Commands Reference Guide" and "CMUX User Guide" for details on availability of AT commands on all instances and for the rules on parallel execution of AT commands on two instances.

In the default configuration, echo (ATE0) is disabled and the response format of result codes is set to verbose (ATV1).

If you want to use MDM2 built-in module you need to import it:

```
import MDM2
```

than you can use its methods like in the following example:

```
a = MDM2.send('AT', 0)
b = MDM2.sendbyte(0x0d, 0)
c = MDM2.read()
```

which sends 'AT' and reads 'OK' response.

More details about MDM2 built-in module methods can be found in the following paragraphs.

4.2.1. MDM2.send(string, timeout)

This command sends a string to the AT command interface.

The first input parameter *string* is a Python string to send to the AT command interface.

The second input parameter *timeout* is a Python integer, measured in 1/10s, and is important in online mode when flow control is activated. In fact it represents the maximum time to wait for the string to be sent to the AT command interface when buffer is full and flow control blocks further data. The timeout range is (0 ÷ 32767).

This method returns immediately after the string has been sent to the AT interface or after the timeout period if the whole string could not be sent to the AT interface. The return value is a Python integer which is -1 if the timeout period has expired, 1 otherwise.

Example:

```
a = MDM2.send('AT', 5)
```

sends string 'AT' to AT command handling, possibly waiting for 0.5 s, assigning the return value to a.

Note: The buffer available for MDM2.send command is 32768 bytes for product versions 12.xx.xxx or 4096 bytes for product versions 13.xx.xxx and 18.11.004.

4.2.2. MDM2.read()

This command receives a string from the AT command interface.

It has no input parameter.

The return value is a Python string which contains the data received and stored in buffer at the moment of command execution. The value might be empty if no data is received.

Example:

```
a = MDM2.read()
```

receives a string from AT command handling, assigning the return value to a.

Note: The buffer available for MDM2.read command is 32768 bytes for product versions 12.xx.xxx or 4096 bytes for product versions 13.xx.xxx and 18.11.004. The maximum number of bytes returned by each MDM2.read is 1023.

Note: It is up to Python script to keep empty MDM2.read buffer.

4.2.3. MDM2.sendbyte(byte, timeout)

This command sends a byte to the AT command interface.

The first input parameter *byte* can be zero or any Python byte to send to the AT command interface.

The second input parameter *timeout* is a Python integer, measured in 1/10s, and is important in online mode when flow control is activated. In fact it represents the maximum time to wait for the byte to be sent to the AT command interface when buffer is full and flow control blocks further data. The timeout range is (0 ÷ 32767).

This method returns immediately after the byte has been sent to the AT interface or after the timeout period if the byte could not be sent to the AT interface. The return value is a Python integer which is -1 if the timeout expired, 1 otherwise.

Example:

```
b = MDM2.sendbyte(0x0d, 0)
```

sends byte 0x0d, that is <CR>, to AT command handling, without waiting, assigning the return value to b.

4.2.4. MDM2.readbyte()

This command receives a byte from the AT command interface.

It has no input parameter.

The return value is a Python integer which is the byte value received and stored in buffer at the moment of command execution or is -1 if no data is received. The return value can also be zero.

Example:

```
b = MDM2.readbyte()
```

receives a byte from AT command handling, assigning the return value to b.

4.2.5. MDM2.sendavail()

This command queries the number of bytes available to send to MDM2 buffer.

It has no input parameter.

The return value is a Python integer which is the number of bytes available to send to MDM2 buffer.

Example:

```
n = MDM2.sendavail()
```

queries the number of bytes available to send, assigning the return value to n.

4.2.6. MDM2.getDCD()

This command gets Carrier Detect (DCD) from the AT command interface.
It has no input parameter.
The return value is a Python integer which is 0 if DCD is set to OFF or 1 if DCD is set to ON.

Example:

```
cd = MDM2.getDCD()
```

gets DCD from AT command handling, assigning the return value to cd.

4.2.7. MDM2.getCTS()

This command gets Clear to Send (CTS) from the AT command interface.
It has no input parameter.
The return value is a Python integer which is either 0 if CTS is set to OFF or 1 if CTS is set to ON.

Example:

```
cts = MDM2.getCTS()
```

gets CTS from AT command handling, assigning the return value to cts.

4.2.8. MDM2.getDSR()

This command gets Data Set Ready (DSR) from the AT command interface.
It has no input parameter.
The return value is a Python integer which is either 0 if DSR is set to OFF or 1 if DSR is set to ON.

Example:

```
dsr = MDM2.getDSR()
```

gets DSR from AT command handling, assigning the return value to dsr.

4.2.9. MDM2.getRI()

This command gets Ring Indicator (RI) from the AT command interface.
It has no input parameter.
The return value is a Python integer which is 0 if RI is set to OFF or 1 if RI is set to ON.

Example:

```
ri = MDM2.getRI()
```

gets RI from AT command handling, assigning the return value to ri.

4.2.10. MDM2.setRTS(RTS_value)

This command sets Request to Send (RTS) in the AT command interface.

The input parameter *RTS_value* is a Python integer which is 0 if setting RTS to set to OFF or 1 if setting RTS to set to ON.

No return value.

Example:

```
MDM2.setRTS(1)
```

sets RTS to ON in AT command handling.

4.2.11. MDM2.setDTR(DTR_value)

This command sets Data Terminal Ready (DTR) in the AT command interface.

The input parameter *DTR_value* is a Python integer which is 0 if setting DTR to set to OFF or 1 if setting DTR to set to ON.

No return value.

Example:

```
MDM2.setDTR(0)
```

sets DTR to OFF in AT command handling.

4.3 SER built-in module

The SER built-in module is an interface between the Python core and the device serial port over the RXD/TXD pins direct handling. You need to use the SER built-in module if you want to send data from the Python script to the serial port USIF0 and to receive data from the serial port USIF0 to the Python script. This serial port handling module can be used, for example, to interface the module with an external device (such as a GPS) and read/send its data (e.g. NMEA). If flow control is not enabled (default) the SER built-in module will also allow to control physical lines used as GPIO. If flow control is enabled, only available from version 12.00.xx4, version 13.00.xx5 and version 18.11.004, it will not be possible to control physical lines used as GPIO.

If you want to use SER built-in module you need to import it:

```
import SER
```

then you can use its methods, like in the following example:

```
a = SER.set_speed('9600')
```

```
b = SER.send('test')
c = SER.sendbyte(0x0d)
d = SER.read()
```

which sends 'test' followed by <CR> and receives data.

More details about SER built-in module methods can be found in the following paragraphs.

4.3.1. SER.send(string, <timeout>)

This command sends a string to the serial port TXD/RXD.

The first input parameter *string* is a Python string to send to the serial port USIF0.

The second input parameter <*timeout*> is optional, is only available from version 12.00.xx4, version 13.00.xx5 and version 18.11.004, is a Python integer, measured in 1/10s, and is only used when flow control is enabled. In fact it represents the maximum time to wait for the string to be sent to the serial port USIF0 when buffer is full and flow control blocks further data. The timeout range is (0 ÷ 32767).

This method returns immediately after the string has been sent to the serial port USIF0 or, when flow control is enabled, after the timeout period if the whole string could not be sent to the serial port USIF0. The return value is a Python integer which is -1 if the timeout period has expired, 1 otherwise.

Example:

```
a = SER.send('test')
```

sends the string 'test' to the serial port USIF0 handling, assigning the return value to a.

Note: The buffer available for the SER.send command is 4096 bytes.

4.3.2. SER.read()

This command receives a string from the serial port TXD/RXD.

It has no input parameter.

The return value is a Python string which contains the data received and stored in buffer at the moment of command execution. The value might be empty if no data is received.

Example:

```
a = SER.read()
```

receives a string from the serial port USIF0 handling, assigning the return value to a.

Note: The buffer available for the SER.read command is 4096 bytes. The maximum number of bytes returned by each SER.read is 1023.

Note: It is up to Python script to keep empty SER.read buffer.

4.3.3. SER.sendbyte(byte, <timeout>)

This command sends a byte to the serial port TXD/RXD.

The first input parameter *byte* can be zero or any Python byte to send to the serial port USIF0.

The second input parameter <*timeout*> is optional, is only available from version 12.00.xx4, version 13.00.xx5 and version 18.11.004, is a Python integer, measured in 1/10s, and is only used when flow

control is enabled. In fact it represents the maximum time to wait for the byte
to be sent to the serial port USIF0 when buffer is full and flow control blocks further data. The timeout range is (0 ÷ 32767).

This method returns immediately after the byte has been sent to the serial port USIF0 or, when flow control is enabled, after the timeout period if the byte could not be sent to the serial port USIF0. The return value is a Python integer which is -1 if the timeout period has expired, 1 otherwise.

Example:

```
b = SER.sendbyte(0x0d)
```

sends the byte 0x0d, that corresponds to <CR>, to the serial port USIF0 handling, assigning the return value to b.

4.3.4. SER.readbyte()

This command receives a byte from the serial port TXD/RXD.

It has no input parameter.

The return value is a Python integer which is the byte value received and stored in buffer at the moment of command execution or is -1 if no data is received. The return value can also be zero.

Example:

```
b = SER.readbyte()
```

receives a byte from serial port USIF0 handling, assigning the return value to b.

4.3.5. SER.sendavail()

This command queries the number of bytes available to send to SER buffer.

It has no input parameter.

The return value is a Python integer which is the number of bytes available to send to SER buffer.

Example:

```
n = SER.sendavail()
```

queries the number of bytes available to send, assigning the return value to n.

4.3.6. SER.set_speed(speed, <char format>, <flow control>)

This command sets the serial port TXD/RXD speed. The default serial port TXD/RXD speed is 115200.

The first input parameter *speed* is a Python string which is the value of the serial port speed. It can assume values in the range from '300' to '115200'.

The second optional parameter <*char format*> is a Python string that represents the character format to be used:

the first character is the number of bits per char (7 or 8), then the parity setting (N - none, E- even, O-odd) and in the end the number of stop bits (1 or 2). The default value is "8N1". For version 18.11.004 only "8N1" value is available

The third optional parameter <*flow control*> is only available from version 12.00.xx4, version 13.00.xx5 and version 18.11.004 and is a Python string that represents the flow control mode to be used:

"none" set no flow control enabled,

"hw" set hardware flow control enabled.

The default value is "none".

The return value is a Python integer which is -1 if an error occurred otherwise is 1.

Example:

```
b = SER.set_speed('9600')
```

sets the serial port USIF0 speed to 9600, assigning the return value to b.

Note: Sending the +IPR command to the device does not affect the physical serial port, you must use this function to set the speed of the port when using the Python engine.

4.3.7. SER.setDCD(DCD_value)

This command sets Carrier Detect (DCD) on the serial port USIF0.

From version 12.00.xx4, version 13.00.xx5 and version 18.11.004 this command has no effect if flow control is enabled.

The input parameter *DCD_value* is a Python integer which is either 0 if DCD is set to OFF or 1 if DCD is set to ON.

No return value.

Example:

```
SER.setDCD(1)
```

sets DCD to ON in USIF0.

4.3.8. SER.setCTS(CTS_value)

This command sets Clear to Send (CTS) on the serial port USIF0.

From version 12.00.xx4, version 13.00.xx5 and version 18.11.004 this command has no effect if flow control is enabled.

The input parameter *CTS_value* is a Python integer which is either 0 if CTS is set to OFF or 1 if CTS is set to ON.

No return value.

Example:

```
SER.setCTS(1)
```

sets CTS to ON in USIF0.

4.3.9. SER.setDSR(DSR_value)

This command sets Data Set Ready (DSR) on the serial port USIF0.

From version 12.00.xx4, version 13.00.xx5 and version 18.11.004 this command has no effect if flow control is enabled.

The input parameter *DSR_value* is a Python integer which is either 0 if DSR is set to OFF or 1 if DSR is set to ON.

No return value.

Example:

```
SER.setDSR(1)
```

sets DSR to ON in USIF0.

4.3.10. SER.setRI(RI_value)

This command sets Ring Indicator (RI) on the serial port USIF0.

From version 12.00.xx4, version 13.00.xx5 and version 18.11.004 this command has no effect if flow control is enabled.

The input parameter *RI_value* is a Python integer which is either 0 if RI is set to OFF or 1 if RI is set to ON.

No return value.

Example:

```
SER.setRI(1)
```

sets RI to ON in USIF0.

4.3.11. SER.getRTS()

This command gets Request to Send (RTS) from the serial port USIF0.

It has no input parameter.

The return value is a Python integer which is either 0 if RTS is set to OFF or 1 if RTS is set to ON.

Example:

```
rts = SER.getRTS()
```

gets RTS from USIF0, assigning the return value to rts.

4.3.12. SER.getDTR()

This command gets Data Terminal Ready (DTR) from the serial port USIF0.

It has no input parameter.

The return value is a Python integer which is either 0 if DTR is set to OFF or 1 if DTR is set to ON.

Example:

```
dtr = SER.getDTR()
```

gets DTR from USIF0, assigning the return value to dtr.

4.4 SER2 built-in module

SER2 built-in module is available only for product versions from 12.00.xx4, from 13.00.xx5 and from 18.11.004.

The SER2 built-in module is an interface between the Python core and the device trace serial port over the RX_AUX/TX_AUX pins direct handling. You need to use the SER2 built-in module if you want to send data from the Python script to the serial port USIF1 and to receive data from the serial port USIF1 to the Python script. This serial port has not the flow control physical lines.

This module is available for all products.

It is Python script developer responsibility to use it properly.

In fact serial port USIF1 is usually dedicated to trace and debug purposes and importing this module will make trace and debug unavailable. Moreover importing this module might interfere with device serial port configuration (see HE910 UE910 Family Ports Arrangements User Guide from version 12.xx.xx4, GE910 Family Ports Arrangements User Guide from version 13.xx.xx5 or CE Family Ports Arrangements User Guide for version 18.11.004).

If you want to use SER2 built-in module you need to import it:

```
import SER2
```

then you can use its methods, like in the following example:

```
a = SER2.set_speed('9600')
b = SER2.send('test')
c = SER2.sendbyte(0x0d)
d = SER2.read()
```

which sends 'test' followed by <CR> and receives data.

More details about SER2 built-in module methods can be found in the following paragraphs.

4.4.1. SER2.send(string)

This command sends a string to the serial port USIF1.

The input parameter *string* is a Python string to send to the serial port USIF1.

The return value is a Python integer which is -1 if the timeout period has expired, 1 otherwise.

Example:

```
a = SER2.send('test')
```

sends the string 'test' to the serial port USIF1 handling, assigning the return value to a.

Note: The buffer available for the SER2.send command is 4096 bytes.

4.4.2. SER2.read()

This command receives a string from the serial port USIF1.

It has no input parameter.

The return value is a Python string which contains the data received and stored in buffer at the moment of command execution. The value might be empty if no data is received.

Example:

```
a = SER2.read()
```

receives a string from the serial port USIF1 handling, assigning the return value to a.

Note: The buffer available for the SER2.read command is 4096 bytes. The maximum number of bytes returned by each SER2.read is 1023.

Note: It is up to Python script to keep empty SER2.read buffer.

4.4.3. SER2.sendbyte(byte)

This command sends a byte to the serial port USIF1.

The input parameter *byte* can be zero or any Python byte to send to the serial port USIF1.

The return value is a Python integer which is -1 if the timeout period has expired, 1 otherwise.

Example:

```
b = SER2.sendbyte(0x0d)
```

sends the byte 0x0d, that corresponds to <CR>, to the serial port USIF1 handling, assigning the return value to b.

4.4.4. SER2.readbyte()

This command receives a byte from the serial port USIF1.

It has no input parameter.

The return value is a Python integer which is the byte value received and stored in buffer at the moment of command execution or is -1 if no data is received. The return value can also be zero.

Example:

```
b = SER2.readbyte()
```

receives a byte from serial port USIF1 handling, assigning the return value to b.

4.4.5. SER2.sendavail()

This command queries the number of bytes available to send to SER2 buffer.

It has no input parameter.

The return value is a Python integer which is the number of bytes available to send to SER2 buffer.

Example:

```
n = SER2.sendavail()
```

queries the number of bytes available to send, assigning the return value to n.

4.4.6. SER2.set_speed(speed, <char format>)

This command sets the serial port USIF1 speed. The default serial port USIF1 speed is 115200.

The first input parameter *speed* is a Python string which is the value of the serial port speed. It can assume the values in the range from '300' to '115200'.

The second optional parameter <*char format*> is a Python string that represents the character format to be used:

The first character is the number of bits per char (7 or 8), then the parity setting (N - none, E- even, O-odd) and in the end the number of stop bits (1 or 2). The default value is "8N1".

The return value is a Python integer which is -1 if an error occurred otherwise is 1.

Example:

```
b = SER2.set_speed('9600')
```

sets the serial port USIF1 speed to 9600, assigning the return value to b.

4.5 GPIO built-in module

The GPIO built-in module is an interface between the Python core and the module internal general purpose input output direct handling. The GPIO built-in module is used to set GPIO values and to read GPIO values from the Python script. You can control the GPIO pins also by sending internal 'AT#GPIO' commands using the MDM module, but using the GPIO module is faster because no command parsing is involved, therefore its use is recommended.

Note: The Python core does not verify if the pins are already used for other purposes by other functions, it's the customer responsibility to ensure that no conflict over pins occurs.

If you want to use the GPIO built-in module you need to import it:

```
import GPIO
```

then you can use its methods as in the following example:

```
a = GPIO.getIOvalue(5)
b = GPIO.setIOvalue(4, 1)
```

this reads the GPIO 5 value and sets GPIO 4 to the output with value 1.

More details about GPIO built-in module methods are in the following paragraphs.

4.5.1. GPIO.setIOvalue(GPIOnumber, value)

This method sets the output value of a GPIO pin.

The first input parameter *GPIOnumber* is a Python integer which is the number of the GPIO.

The second input parameter *value* is a Python integer which is the output value. It can be 0 or 1.

The return value is a Python integer which is -1 if an error occurred otherwise is 1.

Example:

```
b = GPIO.setIOvalue(4, 1)
```

sets GPIO 4 to output with value 1, assigning the return value to b.

Note: For versions up to 12.00.xx5 this method returns -1 if the *GPIOnumber* is not set to output.

4.5.2. GPIO.getIOvalue(GPIOnumber)

This method gets the input value of a GPIO.

The input parameter *GPIOnumber* is a Python integer which is the number of the GPIO.

The return value is a Python integer which is -1 if an error occurred otherwise it is the input value. It can be either 0 or 1.

Example:

```
b = GPIO.getIOvalue(5)
```

gets the GPIO 5 input value, assigning the return value to b.

Note: For versions up to 12.00.xx5 this method returns -1 if the *GPIOnumber* is not set to input.

4.5.3. GPIO.setIOdir(GPIOnumber, value, direction)

This method sets the direction of a GPIO.

The first input parameter *GPIOnumber* is a Python integer which is the number of the GPIO.

The second input parameter *value* is a Python integer which is the output value. It can be either 0 or 1. It is only used if the *direction* value is 1, it has no meaning if the *direction* value is 0.

The third input parameter *direction* is a Python integer which is the direction value. It can be either 0 for input or 1 for output. Other values are available for alternate functions. Refer to AT#GPIO command in product "AT Commands Reference Guide" for further notes (value is called mode).

The return value is a Python integer which is -1 if an error occurred otherwise is 1.

Example:

```
c = GPIO.setIOdir(4, 0, 0)
```

sets GPIO 4 to input with the *value* parameter having no meaning, and assigning the return value to c.

Note: When the *direction* value is not 1, although the parameter *value* has no meaning, it is necessary to assign it one of the two possible values: 0 or 1.

Note: For version 18.11.004 the *direction* values for alternate functions are not supported.

4.5.4. GPIO.getIOdir(GPIOnumber)

This method gets the direction of a GPIO.

The input parameter *GPIOnumber* is a Python integer which is the number of the GPIO.

The return value is a Python integer which is -1 if an error occurred otherwise is direction value. It is 0 for input or 1 for output. Other values are available for alternate functions. Refer to AT#GPIO command in product "AT Commands Reference Guide" for further notes.

Example:

```
d = GPIO.getIOdir(7)
```

gets GPIO 7 direction, assigning the return value to d.

Note: For version 18.11.004 the return values for alternate functions are not supported.

4.5.5. GPIO.getADC(adcNumber)

This method gets ADC value. It is equivalent to the AT#ADC command.

The input parameter *adcNumber* is a Python integer which represents the ADC number that will be read and converted in voltage.

The return value is a Python integer which is -1 if an error occurred otherwise the converted voltage is returned in mV.

Example:

```
mV = GPIO.getADC(2)
```

gets ADC number 2 input voltage, assigning the return value in mV.

Note: For version 18.11.004 the only available value for *adcNumber* is 1.

4.5.6. GPIO.setDAC(enable, value)

This method sets the DAC value. It is equivalent to the AT#DAC command.

The first input parameter *enable* is a Python integer and can assume values 0 or 1. If it is set to 1 enables DAC output otherwise if it is set to 0 disabled DAC output.

The second input parameter *value* is a Python integer and represents the scale factor of output voltage and can assume values in the range 0-1023.

The return value is a Python integer that has value -1 if an error occurred otherwise it has value 1.

Example:

```
res = GPIO.setDAC(1, 512)
```

sets DAC output voltage at half the range, assigning the return value to res.

Note: For version 18.11.004 the only available value for *adcNumber* is 1. For version 18.11.004 this method is not available.

4.5.7. GPIO.setVAUX(vauxNumber, enable)

This method enables or disables the VAUX. It is equivalent to the AT#VAUX command.

The first input parameter *vauxNumber* is a Python integer that represents VUAX number that will be enabled or disabled.

The second input parameter *enable* is a Python integer that can assume value 1 in order to enable VAUX output or 0 if VAUX output should be disabled.

The return value is a Python integer that has value -1 if an error occurred otherwise it has the value 1.

Example:

```
res = GPIO.setVAUX(1, 1)
```

enables VAUX number 1 output, assigning the return value to res.

Note: For version 18.11.004 the only available value for *vauxNumber* is 1.

4.5.8. GPIO.getAXE()

This method gets the hands free status value. It is equivalent to the AT#AXE command.

It has no input parameter.

The return value is a Python integer that is either 0 if a hand free is not connected or 1 if a hand free is connected.

Example:

```
hf = GPIO.getAXE()
```

gets the AXE value, assigning the return value to hf.

Note: For version 18.11.004 this method has no effect.

4.5.9. GPIO.setSLED(status, onDuration, offDuration)

This method sets the status led configuration values. It is equivalent to the AT#SLED command.

The first input parameter *status* is a Python integer that represents the configuration of status led and can assume the following values:

```
0 - ALWAYS OFF
1 - ALWAYS ON
2 - AUTO
3 - BLINKING
```

The second input parameter *onDuration* is a Python integer which is the period of ON configuration of status led measured in 1/10s.

The third input parameter *offDuration* is a Python integer which is the period of OFF configuration of status led measured in 1/10s.

The return value is a Python integer which is -1 if an error occurred otherwise it is 1.

Example:

```
res = GPIO.setSLED(3, 10, 90)
```

sets status led configuration to blinking with 1s in ON period and 9s in OFF period, assigning the return value to res.

4.5.10. GPIO.getCBC()

This method gets the charger status and battery voltage. It is equivalent to the AT#CBC command.

It has no input parameters.

The return value is a Python tuple formatted in the following way:

(chargerStatus, batteryVoltage).

First element of tuple is a Python integer which is charger status:

0 - charger not connected

1 - charger connected and charging

2 - charger connected and charging process completed

Second element of tuple is a Python integer which is battery voltage in mV.

Example:

```
cbc = GPIO.getCBC()
```

gets charger status and battery voltage values, assigning the return value to cbc tuple.

Note: For version 18.11.004 the return values 1 and 2 for charger status are not supported.

4.6 GPS built-in module

GPS built-in module is available only for product versions 12.xx.xxx and from 13.00.xx4.

GPS built-in module is the interface between Python and module internal GPS controller. It is used in order to handle GPS controller without dedicated AT commands through MDM built-in module.

If you want to use GPS built-in module you need to import it:

```
import GPS
```

then you can use its methods like in the following example:

```
position = GPS.getActualPosition()
```

gets a string with position information formatted in the same way as AT$GPSACP response.

More details about GPS built-in module methods can be found in the following paragraphs.

4.6.1. GPS.powerOnOff(newStatus)

This method powers ON/OFF GPS controller. It is equivalent to the AT$GPSP command.

The input parameter *newStatus* is a Python integer and can have the following values:

0 - to power OFF GPS controller

1 - to power ON GPS controller.

There is no return value.

Example:

```
GPS.powerOnOff(0)
```

GPS controller is powered OFF.

4.6.2. GPS.getPowerOnOff()

This method gets GPS controller current power ON/OFF status.

It has no input parameter.

The return value is a Python integer which is 0 if GPS controller is powered off or 1 if GPS controller is powered on.

Example:

```
status = GPS.getPowerOnOff()
```

gets GPS controller current power ON/OFF status, assigning the return value to status.

4.6.3. GPS.resetMode(mode)

This method resets GPS controller. It is equivalent to the AT$GPSR command.

The input parameter *mode* is a Python integer and can have the following values:

0 - Hardware reset

1 - Coldstart (No Almanac, No Ephemeris);

2 - Warmstart (No Ephemeris);

3 - Hotstart (with stored Almanac and Ephemeris)

The return value is a Python integer which is -1 if an error occurred otherwise is 1.

This method is available only for product versions from 12.00.xx6 and from 13.00.xx7.

Example:

```
res = GPS.resetMode(1)
```

executes a cold restart of GPS controller, assigning the return value to res.

4.6.4. GPS.getActualPosition()

This method gets GPS last position information. It is equivalent to the AT$GPSACP command.

It has no input parameter.

The return value is a Python string which is the last position information formatted in the same way as for AT$GPSACP command response.

Example:

```
lastPosition = GPS.getActualPosition()
```

gets GPS last position information, assigning the return value to lastPosition.

4.6.5. GPS.powerSavingMode(mode, pushToFixPeriod)

This method sets GPS controller power saving mode. It is equivalent to the AT$GPSPS command.

The first input parameter *mode* is a Python integer and can have the following values:

0 - Power Saving disabled – Continuous Power (default);

1 - Trickle Power activated;

2 - Push To Fix Mode enabled.

The second input parameter *pushToFixPeriod* is a Python integer which is the value of push to fix period in seconds used when mode=2. If mode= 0 or mode= 1 this parameter has no meaning and can be set to any value.

The return value is a Python integer which is -1 if an error occurred otherwise is 1.

TeseoII-based GNSS receiver currently does not support power saving.

This method is available only for product versions from 12.00.xx6 and from 13.00.xx7.

Example:

```
res = GPS.powerSavingMode(2, 15)
```

sets GPS controller in power saving mode 2 with push to fix period of 15 seconds, assigning the return value to res.

4.6.6. GPS.powerSavingWakeUp()

This method wakes up GPS controller while in power saving mode. It is equivalent to the AT$GPSWK command.

It has no input parameter.

The return value is a Python integer which is -1 if an error occurred otherwise is 1.

TeseoII-based GNSS receiver currently does not support power saving.

This method is available only for product versions from 12.00.xx6 and from 13.00.xx7.

Example:

```
res = GPS.powerSavingWakeUp()
```

wakes up GPS controller while in power saving, assigning the return value to res.

4.6.7. GPS.getLastGGA()

This method gets GPS last GGA NMEA sentence stored.

It has no input parameter.

The return value is a Python string which is the last GGA NMEA sentence formatted according to NMEA specification.

Example:

```
gga = GPS.getLastGGA()
```

gets last GGA NMEA sentence, assigning the return value to gga.

4.6.8. GPS.getLastGLL()

This method gets GPS last GLL NMEA sentence stored.

It has no input parameter.

The return value is a Python string which is the last GLL NMEA sentence formatted according to NMEA specification.

Example:

```
gll = GPS.getLastGLL()
```

gets last GLL NMEA sentence, assigning the return value to gll.

4.6.9. GPS.getLastGSA()

This method gets GPS last GSA NMEA sentence stored.

It has no input parameter.

The return value is a Python string which is the last GSA NMEA sentence formatted according to NMEA specification.

Example:

```
gsa = GPS.getLastGSA()
```

gets last GSA NMEA sentence, assigning the return value to gsa.

4.6.10. GPS.getLastGSV()

This method gets GPS last GSV NMEA sentence stored.

It has no input parameter.

The return value is a Python string which is the concatenation of the last GSV NMEA sentences formatted according to NMEA specification.

Example:

```
gsv = GPS.getLastGSV()
```

gets last GSV NMEA sentence, assigning the return value to gsv.

4.6.11. GPS.getLastRMC()

This method gets GPS last RMC NMEA sentence stored.

It has no input parameter.

The return value is a Python string which is the last RMC NMEA sentence formatted according to NMEA specification.

Example:

```
rms = GPS.getLastRMC()
```

gets last RMC NMEA sentence, assigning the return value to rmc.

4.6.12. GPS.getLastVTG()

This method gets GPS last VTG NMEA sentence stored.

It has no input parameter.

The return value is a Python string which is the last VTG NMEA sentence formatted according to NMEA specification.

Example:

```
vtg = GPS.getLastVTG()
```

gets last VTG NMEA sentence, assigning the return value to vtg.

4.6.13. GPS.getPosition()

This method gets GPS last position stored in numeric format.

It has no input parameter.

The return value is a Python tuple formatted in the following way:

(latitude, latNorS, longitude, lonEorW)

where:

the first element of tuple *latitude* is a Python integer which is latitude in (degrees * 10000000), that is in degrees with 10000000 scale factor

the second element of tuple *latNorS* is a Python string which is 'N' for north or 'S' for south

the third element of tuple *longitude* is a Python integer which is longitude in (degrees * 10000000), that is in degrees with 10000000 scale factor

fourth element of tuple *lonEorW* is a Python string which is 'E' for east or 'W' for west.

If GPS controller has no position information the following tuple will be returned:

(0, '', 0, '').

This method is available only for product versions from 12.00.xx6 and from 13.00.xx7.

Example:

```
pos = GPS.getPosition()
```

gets last position stored, assigning the return value to pos.

4.7 IIC built-in module

IIC built-in module is available only for product versions from 12.00.xx4, from 13.00.xx5 and from 18.11.004.

IIC built-in module is an implementation on the Python core of the IIC bus Master (No Multi-Master) based on general purpose input output (GPIO) using the bit-banging technique.

IIC built-in module allows creating one or more IIC bus Python objects on the available GPIO pins. These IIC bus Python objects are each mapped on creation on two GPIO pins that will be dedicated to the Serial Data and Serial Clock pins of each IIC bus.

If you want to use IIC built-in module you need to import it:

```
import IIC
```

then you can use its methods like in the following example:

```
IICbus = IIC.new(3, 4, 0x50)
IICbus.init()
rec = IICbus.readwrite('\x08'+'test', 10)
```

creates a new IIC bus object using GPIOs 3 and 4, with address 0x50, and then sends 08 hex byte followed by 'test' and receives a string of 10 bytes assigning it to rec.

More details about IIC built-in module methods can be found in the following paragraphs.

Note: An external pull-up must be provided on SDA line since the line is working as open collector, on the other hand SCLK is driven with a complete push pull.

4.7.1. IIC.new(SDA_pin, SCL_pin, ADDR)

This command creates a new IIC bus Python object linked to given GPIO pins and with specified address.

The first two input parameters *SDA_pin* and *SCL_pin* are Python bytes, which are the GPIO pin numbers the SDA (Serial DAta) and SCL (Serial CLock) lines are mapped to.

The third input parameter *ADDR* is a Python integer and represents the address of IIC bus device. It is the address value of the IIC bus device without the less significant bit required by IIC bus protocol for R/W (read/write) command. It can be a 7 bit address or a 10 bit address. It can be zero.

The return value is the IIC bus Python object which shall then be used to interface to the IIC bus device.

Note: All GPIO pins are available pins for the IIC bus.

It is Python script developer responsibility to avoid conflicts between GPIO pins, no automatic check of GPIO pins already used for other purposes (GPIO module, IIC module, SPI module) is available.

Note: Python core implementation takes the third input parameter ADDR, shifts it left by one bit and sets R/W (read/write) bit on the less significant bit of the less significant byte.

Example:

```
IICbus = IIC.new(3, 4, 0x50)
```

creates a new IIC bus object using GPIO 3 for SDA, GPIO 4 for SCL and with address 0x50.

4.7.2. init()

This IIC bus Python object method initializes the IIC bus.

No input value.

No return value.

Example:

```
IICbus.init()
```

initializes IIC bus object.

4.7.3. readwrite(string, <read_len>)

This IIC bus Python object method sends a string to and/or receives a string from the IIC bus device linked to the IIC bus Python object at its creation.

The first input parameter *string* is a Python string to send to the IIC bus device.

The second optional parameter <*read_len*> is a Python integer which represents the length of the data to be received from the IIC bus device. Default value if omitted is 0. *read_len* value range is (0 ÷254).

The return value is a Python integer with value -1 if an error occurred or is a Python string which contains the data received, in the last case the value might be empty if no data is received.

<u>If the address *ADDR* set at IIC bus Python object creation is not 0:</u>

if *string* is not empty it will be sent to IIC bus device (Write);

if *read_len* is greater than 0 a string will be received from IIC bus device (Read);

if *string* is not empty and *read_len* is greater than 0 first *string* will be sent to IIC bus device (Write) and then a string will be received from IIC bus device (Read).

<u>If the address *ADDR* set at IIC bus Python object creation is 0:</u>

if *string* is not empty and it is at least 2 bytes long and *read_len* is 0 it will be sent to a generic IIC bus device (Write) whose address and W bit must be set properly by Python script developer in first byte of *string*;

if *string* is not empty and it is at least one byte long and *read_len* is greater than 0 it will be sent to a generic IIC bus device whose address and R bit must be set properly by Python script developer in first byte of *string* and then a string will be received from IIC bus device (Read);

it is not possible a Write and Read operation in the same *readwrite* call.

Examples:

```
IICbus = IIC.new(3, 4, 0x50)
IICbus.init()
rec = IICbus.readwrite('\x08'+'test', 10)
```

sends 08 hex byte followed by 'test' and then receives a string of 10 bytes assigning it to rec.

```
rec = IICbus.readwrite('\x08'+'test', 0)
```

sends only 08 hex byte followed by 'test'.

```
rec = IICbus.readwrite('\x08', 10)
```

sends 08 hex byte and then receives a string of 10 bytes assigning it to rec.

```
rec = IICbus.readwrite('', 10)
```

receives only a string of 10 bytes assigning it to rec.

4.8 SPI built-in module

SPI built-in module is available only for product versions from 12.00.xx4 and from 13.00.xx5.

SPI built-in module is an implementation on the Python core of the SPI bus Master based on general purpose input output (GPIO) using the bit-banging technique.

SPI built-in module allows creating one or more SPI bus Python objects on the available GPIO pins. These SPI bus Python objects are each mapped on creation on three GPIO pins that will be dedicated to the Master Input Slave Output, Master Output Slave Input, Serial Clock pins of each SPI bus and optionally on up to 8 other GPIO pins as Chip Select/Slave select pins.

If you want to use SPI built-in module you need to import it:

```
import SPI
```

then you can use its methods like in the following example:

```
SPIbus = SPI.new(3, 4, 5, 6, 7)
SPIbus.init(0, 0, 0, 0)
rec = SPIbus.readwrite('test', 4)
```

creates a new SPI bus object using GPIOs 3, 4, 5, 6 and 7, and then sends 'test' and receives a string of 4 bytes assigning it to rec.

More details about SPI built-in module methods can be found in the following paragraphs.

4.8.1. SPI.new(SCLK_pin, MOSI_pin, MISO_pin, <SS0>,<SS1>,…,<SS7>)

This command creates a new SPI bus Python object linked to given GPIO pins.

The first three input parameter *SCLK_pin*, *MOSI_pin* and *MISO_pin* are Python bytes, which are the GPIO pin numbers the SCLK (Serial CLocK), MOSI (Master Output Slave Input) and MISO (Master Input Slave Output) lines are mapped to.

The following up to 8 optional parameters <*SSi*> are Python bytes, which are the GPIO pin numbers the *SSi* (ith Slave Select) lines are mapped to. The *SSi* parameter are optional because not all SPI devices have a Slave Select (SS) line, called Chip Select (CS) line as well. The *SSi* parameters must be used for those SPI devices that needs to be selected by Slave Select line.

The return value is the SPI bus Python object which shall then be used to interface to the SPI bus device.

Note: All GPIO pins are available pins for the SPI bus.

It is Python script developer responsibility to avoid conflicts between GPIO
pins, no automatic check of GPIO pins already used for other purposes (GPIO module, IIC module, SPI module) is available.

Example:

```
SPIbus = SPI.new(3, 4, 5, 6, 7)
```

creates a new SPI bus object using GPIO 3 for SCLK, GPIO 4 for MOSI, GPIO 5 for MISO, GPIO 6 for SS0, GPIO 7 for SS1.

4.8.2. init(CPOL, CPHA, <SSPOL>, <SS>)

This SPI bus Python object method initializes the SPI bus.

The first input parameter *CPOL* is a Python byte, represents Clock polarity and can have the following values:

0 for polarity low;

1 for polarity high.

The second input parameter *CPHA* is a Python byte, represents Clock phase transmission and can have the following values:

0 for data bit clocked/latched on the first edge of SCLK;

1 for data bit clocked/latched on the second edge of SCLK

The third optional parameter *<SSPOL>* is a Python byte, represents the Slave Select polarity and can have the following values:

0 for polarity low (default value if omitted);

1 for polarity high.

The fourth optional parameter *<SS>* is a Python byte, represents the default Slave Select line number to be used among those linked to the SPI bus Python object at its creation and can have values from 0 to 7.

Default behavior if omitted is that, unless SS parameter present in *readwrite*, no SS line will be used.

Behavior if present is that, unless SS parameter present in *readwrite*, this SS line will be used.

The return value is a Python integer, which is -1 if an error occurred, otherwise is 1.

Example:

```
SPIbus.init(0, 0, 0)
```

initializes SPI bus object: no SS line is defined as default and no SS line will be used unless set in *readwrite*.

```
SPIbus.init(0, 0, 0, 1)
```

initializes SPI bus object: SS line 1 is defined as default and second SS line assigned in *SPI.new* will be used unless set in *readwrite*.

4.8.3. readwrite(string, <read_len>, <SS>)

This SPI bus Python object method sends a string to and/or receives a string from the SPI bus device linked to the SPI bus Python object at its creation.

The first input parameter *string* is a Python string to send to the SPI bus device.

The second optional parameter <*read_len*> is a Python integer which represents the length of the data to be received from the SPI bus device. Default value if omitted is 0. *read_len* value range is (0 ÷254).

The third optional input parameter <*SS*>, is a Python byte, represents the Slave Select line number to be used among those linked to the SPI bus Python object at its creation and can have values from 0 to 7

Default behavior if omitted is that SS default line specified in *init* will be used, if any.

Behavior if present is that this SS line will be used regardless of what set in *init*.

The return value is a Python integer with value -1 if an error occurred or is a Python string which contains the data received, in the last case the value might be empty if no data is received.

<u>If the length of data to be received *read_len* is less than the string to send *string* length:</u>

only the first *read_len* bytes will be saved during the transmission of *string* bytes.

<u>If the length of data to be received *read_len* is greater than the string to send *string* length:</u>

all the *read_len* bytes will be saved during transmission of *string* bytes plus the number of 0x00 bytes necessary to complete the receive.

Example:

```
rec = SPIbus.readwrite('test', 4)
```

sends 'test' and receives a string of 4 bytes assigning it to rec.

4.9 MOD built-in module

MOD built-in module is available only for product versions from 12.00.xx4 and from 13.00.xx5.

MOD built-in module is the interface between Python and the module miscellaneous functions.

If you want to use MOD built-in module you need to import it:

```
import MOD
```

then you can use its methods like in the following example:

```
MOD.watchdogEnable(60)
```

starts software watchdog protection.

More details about MOD built-in module methods can be found in the following paragraphs.

4.9.1. MOD.watchdogEnable(timeout)

This method activates the software watchdog protection of the system against script blocking by performing an automatic reboot of the module when the watchdog reaches a determined value. To avoid system reboot *MOD.watchdogReset()* command must be called periodically.

The input parameter *timeout* is an integer, which is measured in seconds and represents the time to wait before executing the system reboot. The timeout range is (1 ÷ 36000 (10 hours)).

No return value.

Example:

```
MOD.watchdogEnable(60)
```

activates watchdog that after 60sec from execution of this command will reboot the module unless *MOD.watchdogReset()* is called.

4.9.2. MOD.watchdogReset()

This method restarts the software watchdog counter that has been previously activated with the command *MOD.watchdogEnable(timeout)* preventing in this way the reboot of the module. It should be added in every part of the script that can cause a script blocking (loops, etc.) and is used only when Python watchdog is enabled.

No input value.

No return value.

Example:

```
MOD.watchdogReset()
```

restarts watchdog counter.

4.9.3. MOD.watchdogDisable()

This method disables the software watchdog protection that has been previously activated with the command *MOD.watchdogEnable(timeout).* Software watchdog should be disabled before scripts critical lines such as *import,* since it takes a long time, and then enabled again after.

No input value.

No return value.

Example:

```
MOD.watchdogDisable()
```

disables watchdog.

4.9.4. MOD.powerSaving(timeout)

This method blocks script execution and sets the system in power saving mode for a given time interval or until an external event occurs (e.g. incoming call RING). Blocking script execution is necessary for power saving conditions to be achieved. Setting power saving mode is equivalent to AT+CFUN=0 command (see Telit Modules Software User Guide for further details).

The input parameter *timeout* is an integer, which is measured in seconds and represents the maximum time the Python script remains blocked. The Python script will exit power saving mode when the given value of timeout is reached or when an external event occurs (e.g. incoming call RING). If the timeout value is -1 the Python script will exit from power saving mode only when an external event occurs. The timeout value can be -1 or in the range (0 ÷ 1800000 (500 hours)).

The return value is a Python integer which is 0 if the Python script has exited power saving mode because an external event has occurred otherwise it is 1 if the Python script has exited power saving mode because the timeout has expired.

Example:

```
cause = MOD.powerSaving(100)
```

blocks Python script and enters power saving mode for a maximum of 100 sec or until an external event occurs.

4.10 USB0 built-in module

USB0 built-in module is available only for product versions from 12.00.xx5 and from 13.00.xx6.

The USB0 built-in module is an interface between the Python core and the device first mini USB port USB0. You need to use the USB0 built-in module if you want to send data from the Python script to the first mini USB port USB0 and to receive data from the first mini USB port USB0 to the Python script. This USB port handling module can be used, for example, to interface the module with an external device and read/send its data.

If you want to use USB0 built-in module you need to import it:

```
import USB0
```

then you can use its methods, like in the following example:

```
b = USB0.send('test')
c = USB0.sendbyte(0x0d)
d = USB0.read()
```

which sends 'test' followed by <CR> and receives data.

More details about USB0 built-in module methods can be found in the following paragraphs.

4.10.1. USB0.send(string, <timeout>)

This command sends a string to the first mini USB port USB0.

The first input parameter *string* is a Python string to send to the first mini USB port USB0.

The second input parameter <*timeout*> is optional and is a Python integer, measured in 1/10s. It represents the maximum time to wait for the string to be sent to the first mini USB port USB0 when buffer is full and further data is blocked. The timeout range is (0 ÷ 32767).

This method returns immediately after the string has been sent to the first mini USB port USB0 or after the timeout period if the whole string could not be sent to the first mini USB port USB0. The return value is a Python integer which is -1 if the timeout period has expired, 1 otherwise.

Example:

```
a = USB0.send('test')
```

sends the string 'test' to the first mini USB port USB0 handling, assigning the return value to a.

Note: The buffer available for the USB0.send command is 32767 bytes.

4.10.2. USB0.read()

This command receives a string from the first mini USB port USB0.

It has no input parameter.

The return value is a Python string which contains the data received and stored in buffer at the moment of command execution. The value might be empty if no data is received.

Example:

```
a = USB0.read()
```

receives a string from the first mini USB port USB0 handling, assigning the return value to a.

Note: The buffer available for the USB0.read command is 32767 bytes. The maximum number of bytes returned by each USB0.read is 8191.

Note: It is up to Python script to keep empty USB0.read buffer.

4.10.3. USB0.sendbyte(byte, <timeout>)

This command sends a byte to the first mini USB port USB0.

The first input parameter *byte* can be zero or any Python byte to send to the first mini USB port USB0.

The second input parameter <*timeout*> is optional and is a Python integer, measured in 1/10s. It represents the maximum time to wait for the byte to be sent to the first mini USB port USB0 when buffer is full and further data is blocked. The timeout range is (0 ÷ 32767).

This method returns immediately after the byte has been sent to the first mini USB port USB0 or after the timeout period if the byte could not be sent to the first mini USB port USB0. The return value is a Python integer which is -1 if the timeout period has expired, 1 otherwise.

Example:

```
b = USB0.sendbyte(0x0d)
```

sends the byte 0x0d, that corresponds to <CR>, to the first mini USB port USB0 handling, assigning the return value to b.

4.10.4. USB0.readbyte()

This command receives a byte from the first mini USB port USB0.

It has no input parameter.

The return value is a Python integer which is the byte value received and stored in buffer at the moment of command execution or is -1 if no data is received. The return value can also be zero.

Example:

```
b = USB0.readbyte()
```

receives a byte from first mini USB port USB0 handling, assigning the return value to b.

4.10.5. USB0.sendavail()

This command queries the number of bytes available to send to USB0 buffer.

It has no input parameter.

The return value is a Python integer which is the number of bytes available to send to USB0 buffer.

Example:

```
n = USB0.sendavail()
```

queries the number of bytes available to send, assigning the return value to n.

5 Python standard functions

In this paragraph you can find detailed description of Python language supported features in **Telit module**. Note that all the functions listed below are available in the Python version 2.7.2.

5.1 Technical characteristics

5.1.1. General

All Python statements and almost all Python built-in types and functions are supported. See in the table below the features not supported:

complex
unicode
docstring
packages

Available standard built-in modules are:

marshal
imp
_ast
__main__
__builtin__
sys
exceptions
gc
_warnings
_md5
binascii
_sre
_weakref
_symtable
_functools

_socket
time
posix
thread
signal
errno
cStringIO
math

All others are not supported.

A small collection of standard Python modules written in Python (not built-in) is available. These .py files are mostly identical to the ones available for PC with minor changes.

5.2 Python supported features

Refer to the documents available online such as: Python 2.7.2 Tutorial, Python 2.7.2 Reference Manual or Python 2.7.2 Library Reference for details about all the features listed in the paragraphs below.

5.2.1. Operators, statements, functions

List of supported operators, statements, functions:

comments #

line joining \

operators +, -, *, /, **, %

operators <<, >>, &, |, ^, ~

parentheses

assignment

comparison operators <, >, ==, <=, >=, !=, <>

comparison operators in, not in

print statement

if, elif, else statement

indentation

and, or, not keywords

for in statement

while statement

range() function

break and continue statements

pass statement

functions (without docstrings) (def)

return statement

lambda forms

objects

object methods

del statement

modules

import statement

from statement

exceptions

try except finally statements

raise statement

classes (class)

class instances

global statement

is, is not tests

exec statement

iterators

generators

yield statement

with statement

5.2.2. Built-in Functions

The following built-in functions are supported:

abs
all
any
basestring
bin
bool
bytearray
callable
chr
classmethod
cmp
compile
complex   (raises exception)
delattr
dict

dir
divmod
enumerate
eval
execfile
filter
float
format
frozenset
getattr
globals
hasattr
hash
help
hex
id
input
int
isinstance
issubclass
iter
len
list
locals
long

map
max
memoryview
min

next
object
oct
open
ord
pow
print
property
range
raw_input
reduce
reload
repr
reversed
round
set
setattr
slice
sorted
staticmethod
str
sum
super
tuple
type
vars
xrange
zip
__import__
apply

buffer
coerce
intern

5.2.3. Built-in Constants

The following built-in constants are supported:

False
True
None
NotImplemented
Ellipsis
__debug__

5.2.4. Truth Value Testing

Truth value testing is supported.

5.2.5. Boolean Operations

The following Boolean operations are supported:

x or y
x and y
not x

5.2.6. Comparisons

The following comparisons are supported:

<
<=
>
>=
==
!=
is
is not

5.2.7. Numeric Types: Integer, Long Integer and Floating Point

The following operations are supported with the integer, long integer and floating point type:

x + y
x - y
x * y
x / y
x // y
x % y
-x
+x
abs(x)
int(x)
long(x)
float(x)
divmod(x, y)
pow(x, y)
x ** y
round(x[, n])

5.2.8. Numeric Types: Integer and Long Integer

The following bit-string operations and methods are supported with the integer and long integer type:

x | y
x ^ y
x & y
x << y
x >> y
~x
bit_length()

5.2.9. Numeric Types: Floating Point

The following methods are supported with the floating point type:

as_integer_ratio()
is_integer()
hex()
fromhex(s)

5.2.10. Numeric Types: Complex

Complex numbers are not supported.

5.2.11. Iterator Types

The following methods are supported with the iterator type:

__iter__()
next()

5.2.12. Generator Types

Generator types are supported.

5.2.13. Sequence Types: String, List, Tuple, Bytearray, Buffer and Xrange

The following operations are supported with the string, list, tuple, bytearray, buffer and xrange types:

x in s
x not in s
s + t
s * n, n * s
s[i]
s[i:j]
s[i:j:k]
len(s)
min(s)
max(s)
s.index(i)
s.count(i)

Xrange type supports only indexing, iteration and len().

5.2.14. Sequence Types: Unicode

Unicode is not supported.

5.2.15. Sequence Types: String

The following methods are supported with the string types:

capitalize
center
count
decode
encode
endswith
expandtabs
find
format
index
isalnum
isalpha
isdigit
islower
isspace
istitle
isupper
join
ljust
lower
lstrip
parition
replace
rfind
rindex

rjust
rpartition
rsplit
rstrip
split
splitlines
startswith
strip
swapcase
title
translate
upper
zfill

5.2.16. Mutable Sequence Types: List and Bytearray

The following additional operations are supported with the lists and bytearray types:

s[i] = x
s[i:j] = t
del s[i:j]
s[i:j:k] = t
del s[i:j:k]
s.append(x)
s.extend(x)
s.count(x)
s.index(x[, i[, j]])
s.insert(i, x)
s.pop([i])
s.remove(x)
s.reverse()
s.sort([cmp[, key[, reverse]]])

5.2.17. Set Types: Set and Frozenset

The following methods are supported with the set and frozenset types:

len(s)
x in s
x not in s
isdisjoint()
issubset()
set <= other()
set < other()
issuperset
set >= other()
set > other()
union
set | other | …()
intersection
set & other & …()
difference
set - other - …()
symmetric_difference
set ^ other()
copy()

The following methods are supported with the set type:

update
set |= other | …()
intersection_update
set &= other & …()
difference_update
set -= other | …()
symmetric_difference_update

set ^= other()
add
remove
discard
pop
clear

5.2.18. Mapping Types: Dictionary

The following operations are supported with the dictionaries:

len(d)
d[key]
d[key] = value
del d[key]
key in d
key not in d
iter(d)
clear()
copy()
fromkeys(seq,[value])
get(key,[default])
has_key(key)
items()
iteritems()
iterkeys()
itervalues()
keys()
pop(key,[default])
popitem()
setdefault(key,[default])
update([other])

values()
viewitems()
viewkeys()
viewvalues()

5.2.19. File Objects

The following methods are supported with the file objects:

close()
flush()
fileno()
isatty()
next()
read([size])
readline([size])
readlines([sizehint])
xreadlines()
seek(offset[, whence])
tell()
write(str)
writelines(seq)

The following attributes are supported with the file objects:

closed
encoding
errors
mode
name
newlines
softspace

Note: For product versions 12.xx.xxx.

Root directory for Python scripts and in general for text and binary files is:

/sys

and cannot be changed.

Files path name in Python scripts shall contain the root directory.

Path separator is /.

Example:

```
f = open('/sys/example.txt', 'rb')
```

From product versions 12.00.xx4 absolute and relative path names have been added.

Root directory for Python scripts and in general for text and binary files is still:

/sys

and cannot be changed.

Files *absolute* path name (path beginning with /) in Python scripts shall still contain the root directory.

Path separator is /.

Example:

```
f = open('/sys/example.txt', 'rb')
```

Files *relative* path name (path not beginning with /) in Python scripts will automatically refer to the root directory /sys and shall not contain it.

Example:

```
f = open(‘example.txt’, ‘rb’)
```

Note: For product versions 13.xx.xxx.

Root directory for Python scripts and in general for text and binary files is empty and cannot be changed.

Files path name in Python scripts will refer to the empty root directory.

Example:

```
f = open(‘example.txt’, ‘rb’)
```

Note: For product versions 18.11.004.

Root directory for Python scripts and in general for text and binary files is empty and cannot be changed.

Files path name in Python scripts will refer to the empty root directory.

Example:

```
f = open(‘example.txt’, ‘rb’)
```

5.2.20. Memoryview Objects

The following methods are supported with the memoryview objects:

tobytes()
tolist()

The following attributes are supported with the memoryview objects:

format
itemsize
shape
ndim
strides
readonly

5.2.21. Module Objects

Module objects are supported.
The following attributes are supported:

__dict__
name

5.2.22. Classes and Class Instances

Classes and class instances are supported.

5.2.23. Function Objects

Function objects and function call are supported.

5.2.24. Method Objects

Method objects are supported.

5.2.25. Code objects

Code objects are supported.

5.2.26. Type Objects

Type objects are supported.

5.2.27. Null Object

Null object is supported.

5.2.28. Ellipsis Object

Ellipsis object is supported.

5.2.29. NotImplemented Object

NotImplemented object is supported.

5.2.30. Internal Types: Frame Objects

Frame objects are supported.

5.2.31. Internal Types: Traceback Objects

Traceback objects are supported.

5.2.32. Slice Objects

Slice objects are supported.

5.2.33. Built-in Exceptions

The following built-in exceptions are supported:

BaseException
Exception
StandardError
ArithmeticError
BufferError
LookupError
EnviromentError
AssertionError
AttributeError
EOFError

FloatingPointError
GeneratorExit
IOError
ImportError
IndexError
KeyError
KeyboardInterrupt
MemoryError
NameError
NotImplementedError
OSError
OverflowError
ReferenceError
RuntimeError
StopIteration
SyntaxError
IndentationError
TabError
SystemError
SystemExit
TypeError
UnboundLocalError
UnicodeError
ValueError
ZeroDivisionError

5.2.34. Built-in Modules: marshal

Built-in marshal module is supported with the following functions:

dump
load
dumps
loads

The following constant is supported:

version

5.2.35. Built-in Modules: imp

Built-in imp module is supported with the following functions:

find_module
get_magic
get_suffixes
load_module
new_module
lock_held
acquire_lock
release_lock

The following constants are supported:

PY_SOURCE
PY_COMPILED
C_BUILTIN
PY_FROZEN

5.2.36. Built-in Modules: _ast

Built-in _ast module is supported.

5.2.37. Built-in Modules: __main__

Built-in __main__ module is supported.

5.2.38. Built-in Modules: __builtin__

Built-in __builtin__ module is supported.

5.2.39. Built-in Modules: sys

Built-in sys module is supported with the following functions:

_clear_type_cache
_current_frames
displayhook
exc_info
exc_clear
expethook
exit
getrefcount
getrecusionlimit
getsizeof
_getframe
setcheckinterval
getcheckinterval
setprofile
getprofile
setrecusionlimit
settrace
gettrace
call_tracing

The following variables are supported:

stdin
stdout
stderr
__stdin__

__stdout__
__stderr__
__diplayhook__
__excepthook__
version
hexversion
subversion
_mercurial
on’t_write_bytecode
api_version
copyright
platform
executable
prefix
exec_prefix
maxsize
maxint
py3kwarning
float_info
long_onfo
builtin_module_names
byteorder
warnoptions
version_info
flags

float_repr_style
argv
exitfunc
last_type

last_value
last_traceback
modules
meta_path
path
path_hooks
path_importer_cache
tracebacklimit

5.2.40. Built-in Modules: exceptions

Built-in exceptions module is supported.

See Built-in Exceptions paragraph.

5.2.41. Built-in Modules: gc

Built-in gc module is supported with the following functions:

enable
disable
isenabled
collect
set_debug
get_debug
get_objects
set_threshold
get_count
get_threshold
get_referrers
get_referents
is_tracked

The following variable is supported:

garbage

The following constants are supported:

DEBUG_STATS
DEBUG_COLLECTABLE
DEBUG_UNCOLLECTABLE
DEBUG_INSTANCES
DEBUG_OBJECTS
DEBUG_SAVEALL
DEBUG_LEAK

5.2.42. Built-in Modules: _warnings

Built-in _warnings module is supported.

5.2.43. Built-in Modules: _md5

Built-in _md5 module is supported.

It is imported by hashlib.py module.

5.2.44. Built-in Modules: binascii

Built-in binascii module is supported with the following functions:

a2b_uu
b2a_uu
a2b_base64
b2a_base64
a2b_qp
b2a_qp
a2b_hqx
rledecode_hqx
rlecode_hqx
b2a_hqx

crc_hqx
crc32
b2a_hex
hexlify
a2b_hex
unexlify

The following exceptions are supported:

Error
Incomplete

5.2.45. Built-in Modules: _sre

Built-in _sre module is supported.

5.2.46. Built-in Modules: _weakref

Built-in _weakref module is supported.

5.2.47. Built-in Modules: _symtable

Built-in _symtable module is supported.

5.2.48. Built-in Modules: _functools

Built-in _functools module is supported.

It is imported by functools.py.

5.2.49. Built-in Modules: _socket

Built-in _socket module is only supported in product versions 12.xx.xxx, from 13.00.xx5 and from 18.11.004 with the following functions:

socket
gethostbyname
gethostbyname_ex
gethostbyaddr
ntohs
ntohl
htons

htonl
inet_aton
inet_ntoa
getaddrinfo
getnameinfo
getdefualttimeout
setdefualttimeout

The following exceptions are supported:

error
herror
gaierror
timeout

The following constants are supported:

has_ipv6
AF_INET
AF_UNSPEC
INADDR_ANY
INADDR_BROADCAST
IPPROTO_IP
IPPROTO_TCP
IPPROTO_UDP
IP_HDRINCL
IP_TOS
IP_TTL
MSG_DONTWAIT
SHUT_RD
SHUT_RDWR
SHUT_WR
SOCK_STREAM

SOCK_DGRAM
SOCK_RAW
SOL_SOCKET

SO_ACCEPTCONN
SO_BROADCAST
SO_ERR
SO_KEEPALIVE
SO_LINGER
SO_RCVBUF
SO_RCVTIMEO
SO_REUSEADDR
SO_SNDBUF
SO_TYPE
TCP_MAXSEG
TCP_NODELAY
AI_ADDRCONFIG
AI_ALL
AI_CANONNAME
AI_DEFAULT
AI_MASK
AI_NUMERICHOST
AI_PASSIVE
AI_V4MAPPED
AI_V4MAPPED_CFG
EAI_ADDRFAMILY
EAI_AGAIN
EAI_BADFLAGS
EAI_BADHINTS
EAI_FAIL

EAI_FAMILY
EAI_MEMORY
EAI_NODATA
EAI_NONAME
EAI_PROTOCOL
EAI_SERVICE
EAI_SOCKTYPE
EAI_SYSTEM
NI_DGRAM
NI_MAXHOST
NI_MAXSERV
NI_NAMEREQD
NI_NOFQDN
NI_NUMERICHOST
NI_NUMERICSERV

The following non standard constant is supported in product versions 12.xx.xxx and from 13.00.xx5 but it is not supported in version 18.11.004:

SO_CONTEXTID

Socket objects support the following methods:

accept
bind
close
connect
connect_ex
fileno
getpeername
getsockname
getsockopt
listen

recv
recv_into
recvfrom
recvfrom_into
send
sendall
sendto
setblocking
settimeout
gettimeout
setsockopt
shutdown

Socket objects support the following attributes:

family
type
proto
timeout

Built-in _socket module is imported by socket.py.

5.2.50. Built-in Modules: time

Built-in time module is supported with the following functions:

time
clock
sleep

5.2.51. Built-in Modules: posix

Built-in posix module is supported with the following functions:

stat
unlink

remove
rename
open
close
closerange
lseek
read
write
fstat
isatty
strerror

The following variable is supported:

environ

The following exception is supported:

error

The following constants are supported:

F_OK
R_OK
W_OK
X_OK

5.2.52. Built-in Modules: thread

Built-in thread module is supported with the following functions:

start_new_thread
exit
allocate_lock
get_ident
stack_size (raises exception)

Lock objects support the following methods:

acquire
release
locked

The following exception is supported:

error

Built-in thread module is imported by threading.py.

Note: It is strongly recommended to terminate main thread only after all secondary threads are terminated.

5.2.53. Built-in Modules: signal

Built-in signal module is supported with the following functions:

signal
getsignal

The following constants are supported:

SIG_DFL
SIG_IGN

The following non-standard constants are supported:

SIGMDM
SIGMDM2

5.2.54. Built-in Modules: errno

Built-in errno module is supported with the following variable:

errorcode

5.2.55. Built-in Modules: cStringIO

Built-in cStringIO module is supported with the following function:

StringIO

The following objects are supported:

InputType
OutputType

5.2.56. Built-in Modules: math

Built-in math module is only supported in product versions from 12.00.xx4 and from 13.00.xx5 with the following functions:

acos
acosh
asin
asinh
atan
atan2
atanh
ceil
copysign
cos
cosh
degrees
erf
erfc
exp
expm1
fabs
factorial
floor
fmod
frexp
fsum
gamma
hypot

isinf
isnan
ldexp
lgamma
log
log1p
log10
modf
pow
radians
sin
sinh
sqrt
tan
tanh
trunc

The following constants are supported:

e
pi

5.2.57. Library Modules

A small collection of standard Python modules written in Python (not built-in) is available. These .py files are mostly identical to the ones available for PC with minor changes.

os.py

posixpath.py

stat.py

genericpath.py

socket.py

functools.py

types.py

threading.py

hashlib.py

6 Python non-standard functions

6.1 Socket non-standard functions

Only supported in product versions 12.xx.xxx and from 13.00.xx5.

Built-in _socket module is imported by socket.py.

6.1.1. Non-standard socket option flag: SO_CONTEXTID

The following non standard constant is supported:

```
SO_CONTEXTID
```

It is the socket option flag used to link a socket object to a context identifier after PDP Context Activation procedure.

Note: PDP Context Activation procedure can be obtained using AT+CGDCONT and AT#SGACT commands on MDM or MDM2 interface.

All socket objects must be linked to a context identifier.

In the following example

```
import socket
s = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
s.setsockopt(socket.SOL_SOCKET, socket.SO_CONTEXTID, 1)
```

a socket object is created and then linked to context identifier number one.

Note: There is a firewall always active on module.

Without firewall proper configuration socket methods might not work as expected.

Firewall can be configured using AT#FRWL command on MDM or MDM2 interface.

Sockets used by standard functions (e.g. gethostbyname) are silently linked to context identifier number one.

6.2 Signal non-standard functions

6.2.1. Non-standard signal: SIGMDM

The following non standard constant is supported:

SIGMDM

It is the signal number linked to the event of presence of data in MDM.read buffer.

Example:

```
signal.signal(signal.SIGMDM, MDMReadHandler)
```

6.2.2. Non-standard signal: SIGMDM2

The following non standard constant is supported:

SIGMDM2

It is the signal number linked to the event of presence of data in MDM2.read buffer.

Example:

```
signal.signal(signal.SIGMDM2, MDM2ReadHandler)
```

7 Python Notes

7.1 Memory Limits

In order to prevent *memory error,* in phase of execution of the script, we advise you to consider the following limits:

allocated memory for each variable;

number of the variables.

The memory available on modules includes:

2 MB of Non Volatile Memory for the user scripts and data files (12.xx.xxx, 13.xx.xxx and 18.11.004);

2 MB RAM available for Python engine usage (12.xx.xxx, 13.xx.xxx and 18.11.004).

Some limits of the available NVM that affect file saving procedures and need to be considered are listed below:

max number of files open contemporary	16
max length of file name	16 characters

It is highly recommended not to use the module as a data logger since all flash memories have limited number of writing and deleting cycles.

Other useful information for NVM usage in application development are:

writing full size NVM cause a decrees of writing speed; check free space returned by AT#LSCRIPT and keep about 100KB free space;

AT#LSCRIPT command might not always show the exact number of bytes that can be used for NVM due to dynamic memory reorganization process.

7.2 Other Limits

Some other Python limits that should be considered while developing your Python script in order to find an appropriate solution are listed below:

Python scripts should not interfere with GSM/GPRS/WCDMA/CDMA-1xRTT standard operations, for this reason Python scripts run at lower priority;

GPIO polling frequency from Python scripts might be slower than expected.

8 Python Script Emulation on PC

8.1 Executing the Python script on PC

The steps required to have a script executing by the Python engine on PC in a similar way as on the **Telit module** are:

install Python on PC;

install optional serial package on PC;

copy on PC Python modules that emulates custom built-in modules (MDM, MDM2, SER, GPIO, GPS);

run the Python script.

8.1.1. Install Python

Download Python 2.7.2 installation from

http://www.python.org/

http://www.python.org/download/releases/2.7.2/

and install it.

8.1.2. Install optional serial package

Download PythonWin installation related to Python 2.7 from

http://sourceforge.net/projects/pywin32/files/pywin32/

and install it.

Download pyserial package installation from

http://sourceforge.net/projects/pyserial/files/pyserial/

and install it.

8.1.3. Copy Python modules

A collection of Python modules written in Python (not built-in) that emulates custom built-in modules is available.

MDM.py

MDM2.py

SER.py

SER2.py

GPIO.py

GPS.py

USB0.py

Copy these files on PC.

These modules make the difference between running the script on PC and on module.

8.1.4. Run the Python script

Run the Python script on PC.

Main differences between executing the Python script on PC compared to module are:

script speed execution;

different behaviour between emulating modules and custom built-in modules.

DOCUMENT HISTORY

Revision	Date	Changes
0	2012-02-27	First issue
1	2012-10-29	New title and changes for GE910 product family
2	2013-05-29	Implementation of new functionalities on UE/HE910 series (power saving, watchdog, IIC, SPI, SER2, SER flow control, math module, absolute/relative path)
3	2013-07-26	Porting of the new functionalities on GE910 product family
4	2014-05-07	Implementation of new functionalities on UE/HE910 and GE910 series (USB0) Changes for CE910 product family
5	2015-03-03	Updated GPS section Updated Applicability Table
6	2016-02-23	Revised to accommodate new template and integrated development environment

Design Review
120°
180°
Process Validation
240°
RF/EMC Pre-Certification
Module Selection
60°
300°
Approvals Support
360°
Value Added Services & Connectivity Enterprise Integration & Application Enablement
m2mair