K5/MovingCap CANopen Developer Documentation: Embedded Python / python-on-a-chip / pymite-09

Applies to: ebmpapst Kickstart V3/ fullmo Kickdrive V3or higher

Doc Date/Rev: 2023-11-30 v1.2

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Doc Version History

Doc Date/Rev	Comment
2023-11-30 v1.2	use python while loop instead of blocking sys.wait()
2020-08-20 v1.1	Revised, corrected and amended. Added sys.gc() and sys.time() descriptions. Removed [K5epsSP2] flags
2014-01-14 v0.9 Draft	Debugging: #watch and #step directive
2014-01-06 v0.8 Draft	Minor additions and corrections for #dict directive
2013-11-20 v0.7 Draft	Added specs for [K5epsSP2] additions, in development

NOTE: In the following document, the term **Kickdrive** is used to refer to both **ebmpapst Kickstart** and **fullmo Kickdrive** software editions.

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1 Python-on-a-chip / pymite-09 General Documentation

1.1 Copyright Notice

This documentation contains texts from the original python-on-a-chip / pymite-09 project from http://code.google.com/p/python-on-a-chip/.

The following Copyright Notice applies for the original python-on-a-chip documentation excerpts:

```
.. Copyright 2006 Dean Hall
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   under the terms of the GNU Free Documentation License, Version 1.2
   or any later version published by the Free Software Foundation;
   with no Invariant Sections, no Front-Cover Texts, and no Back-Cover
   Texts.  A copy of the license is in the file docs/LICENSE.
```

NOTE: The python-on-a-chip virtual machine itself, as implemented in Fullmo MovingCap products is licensed under a closed source commercial license to Fullmo GmbH, Mardorf.

1.2 Basic PyMite Features

```
Keywords
~~~~~~~~
PyMite supports the following subset of Python's keywords::
    and         assert      break       class       continue
    def         del         elif        else        for
    from        global      if          import      in
    is          lambda      not         or          pass
    print       raise       return      while       yield
PyMite DOES NOT support these keywords::
    except      exec        finally     try
PyMite supports the typical 32-bit signed integer number type.
A number can be input in any of the following forms:
- Decimal integer: 1234,
- Octal integer: 0177 (begins with a 0)
- Hex integer: 0xFF (begins with 0x or 0X)
```

NOTE: The MovingCap Pymite engine does NOT have float data types enabled. The HAVE_FLOAT definition is “False” in pmfeatures.py.

Operator	Comment
+x, -x, ~x	Unary operators
x**y	Power
x*y x/y x%y	Mult, division, modulo
x+y x-y	Addition, subtraction
x<<y x>>y	Bit shifting
x&y	Bitwise and
x^y	Bitwise exclusive or
x|y	Bitwise or
x<y x<=y x>y x>=y	Comparison
x==y x!=y	Comparison
x is y x is not y	Identity
x in s x not in s ,	Membership
not x	Boolean negation
x and y	Boolean and
x or y	Boolean or

Comparison	Meaning
<	Strictly less than
<=	Less than or equal to
>	Strictly greater than
>=	Greater than or equal to
==	Equal to
!=	Not equal to
is	Object identity
is not	Negated object identity

Val or Op	Evaluates to
``None``, zero	Considered false
Empty sequences	Considered false
Empty mappings	Considered false
All other values	Considered true
not x	True if x is false, else false
x **or** y	If x is false then y, else x
x **and** y	If x is false then x, else y

Built-in Functions

Built-in functions are defined in the module ``__bi`` which is automatically imported.

Function	Result
abs(x)	The absolute value of the number `x`
bytearray(seq)	Constructs a mutable sequence of bytes. This type supports many
bytearray(len)	of the same operations available in strs and lists. The latter
	form sets the size and initializes to all zero bytes.
chr(i)	Returns one-character string whose ASCII code is integer `i`.
eval(co)	Evaluates a given code object (created by Co()).
globals()	Returns a dictionary containing the current global variables.
id(o)	Returns a unique integer identifier for object, `o`.
len(obj)	Returns the length (the number of items) of a sequence or
	dictionary.
locals()	Returns a dictionary containing current local variables.
map(f,s)	Returns a list containing the output of function, `f`, applied
	to every item in sequence, `s`.
ord(c)	Returns integer ASCII value of `c` (a string of len 1).
pow(x,y)	Returns `x` to power `y`. See also ``**`` operator.
range(...)	Returns list of ints from >= start and < end.
	With 1 arg, list from 0..arg-1.
	With 2 args, list from start..end-1.
	With 3 args, list from start up to end by step.
sum(s)	Returns the sum of a sequence of numbers, `s` (not strings).
	Returns ``0`` when the sequence is empty.
type(obj)	Returns an integer representing the `type` of an object.
	See obj.h in PyMite for the value of each type.

Library Modules

PyMite DOES NOT offer any of the library modules from Python. Instead, PyMite offers its own set of library modules, some of which have the same name as a module name from Python.

PyMite offers the following library modules::

    dict   func   list   string   sys

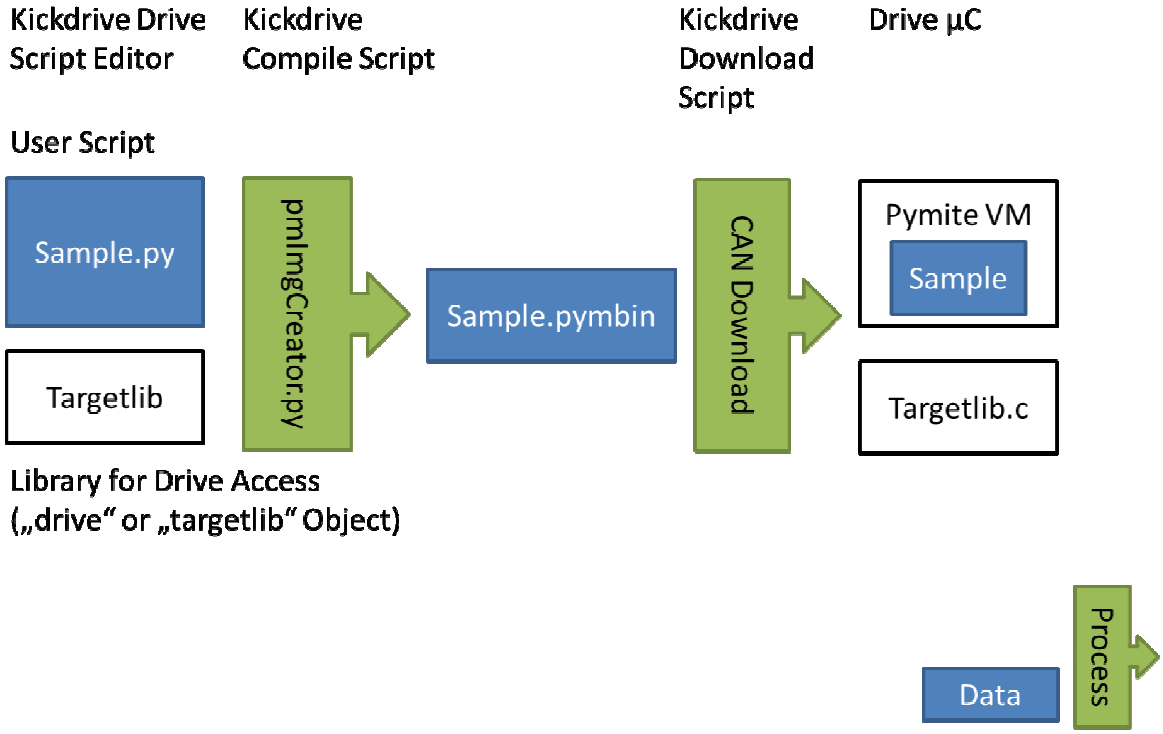
NOTE: The MovingCap Pymite implementation does NOT have string data types enabled. The HAVE_STRING_FORMAT definition is “False” in pmfeatures.py.

1.3 PyMite Runtime Errors Values

PM_RET_OK	0	Everything is ok
PM_RET_RUN	0x01	Interpreter still running
PM_RET_NO_THREAD	0x02	Function Exit
PM_RET_NO	0xFF	General "no result
PM_RET_ERR	0xFE	General failure
PM_RET_STUB	0xFD	Return val for stub fxn
PM_RET_ASSERT_FAIL	0xFC	Assertion failure
PM_RET_FRAME_SWITCH	0xFB	Frame pointer was modified
PM_RET_EX	0xE0	General exception
PM_RET_EX_EXIT	0xE1	System exit
PM_RET_EX_IO	0xE2	Input/output error
PM_RET_EX_ZDIV	0xE3	Zero division error
PM_RET_EX_ASSRT	0xE4	Assertion error
PM_RET_EX_ATTR	0xE5	Attribute error
PM_RET_EX_IMPRT	0xE6	Import error
PM_RET_EX_INDX	0xE7	Index error
PM_RET_EX_KEY	0xE8	Key error
PM_RET_EX_MEM	0xE9	Memory error
PM_RET_EX_NAME	0xEA	Name error
PM_RET_EX_SYNTAX	0xEB	Syntax error
PM_RET_EX_SYS	0xEC	System error
PM_RET_EX_TYPE	0xED	Type error
PM_RET_EX_VAL	0xEE	Value error
PM_RET_EX_STOP	0xEF	Stop iteration
PM_RET_EX_WARN	0xF0	Warning

2 Pymite on MovingCap

2.1 Pymite Bytecode Compiler and MovingCap target µC API



The file is always compiled and transfered using the generic name „sample.py“, but the original file name is available via object „3500h01h Script name“ (type: visible_string).

The Python VM runs in the target's main loop. Script execution times may therefore vary 'by design' and cyclic operation is ensured by additional Python code as described in

2.2 Simple Program

```
import drive
# wait target reached
while ((drive.ReadObjectWord(0x6041, 0x00) & 0x0400) == 0):
    pass
```

NOTE: the „import drive“ statement is automatically added by Kickdrive, if missing. „import targetlib“ as in older versions is also allowed.

2.3 MovingCap Script Control

The pymite VM is controlled via the CANOpen 3500h 02h object:

3500h 02h Script Control	0	Script interpreter paused / stopped
	1	Script interpreter running

NOTE: For restarting a script from the beginning, perform a node reset, or re-download the script into the drive.

2.4 System Functions: sys.gc(), sys.time()

For synchronized, fixed-time execution, use the following commands:

`sys.gc()`	Forced garbage collection. Using this at the beginning of a main loop ensures that the script execution time remains nearly constant for each loop execution.
`sys.time()`	Current system time [milliseconds]

See section 6.3: “Main loop with fixed time-slice / tick / execution time” for an example.

2.5 Wait function / How to add delays or pauses?

NOTE: Avoid the use of sys.wait() in Pymite / MovingCap CANopen applications, since it is a blocking function that also pauses the CAN stack.

Here are two alternative examples for adding delays. The timer based approach will be more accurate for large pauses (> several seconds). For most applications, the simple wait() definition below will be sufficient.

```
import drive
import sys

def wait(waitTime):
    """A delay function that does not require 'import sys'
    for MovingCap CANopen / pymite.
    (On MovingCap Ethernet use sys.wait())

    :param waitTime: delay in milliseconds (approx.)
    :type waitTime: int
    """
    i = 0
    while (i < waitTime):
        i = i + 1

def sleep(milliSec):
    """A timer based delay function for MovingCAP CANopen / pymite
    It forces the timer values to a 16 bit unsigned range to control and
consider overflow.
    (On MovingCap Ethernet use sys.wait())

    :param milliSec: delay in milliseconds, max. 65000
    :type milliSec: int
    """
    start = sys.time() & 0xFFFF
    t = (start + milliSec) & 0xFFFF
    while ((sys.time() & 0xFFFF) > t):
        pass # wait until time overflows
    while ((sys.time() & 0xFFFF) < t):
        pass # wait until time reached

# a test
```

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```
while (1):
    drive.SendEmcyMsg(1)
    wait(10)
    drive.SendEmcyMsg(2)
    wait(100)
    drive.SendEmcyMsg(3)
    wait(1000)
    drive.SendEmcyMsg(4)
    wait(10000)
    drive.SendEmcyMsg(5)

    drive.SendEmcyMsg(11)
    sleep(10)
    drive.SendEmcyMsg(12)
    sleep(100)
    drive.SendEmcyMsg(13)
    sleep(1000)
    drive.SendEmcyMsg(14)
    sleep(10000)
    drive.SendEmcyMsg(15)
```

Test output on the CAN bus monitor:

```
Frame #     t [msec]    ID    Data  Dir   Description
… wait()…
11069 1627002.87  81h   9b 50 00 01 00 00 00 00
11070 1627014.31  81h   9b 50 00 02 00 00 00 00
11071 1627120.46  81h   9b 50 00 03 00 00 00 00
11072 1628137.21  81h   9b 50 00 04 00 00 00 00
11073 1638286.68  81h   9b 50 00 05 00 00 00 00
…sleep()…
11074 1638287.86  81h   9b 50 00 0b 00 00 00 00
11075 1638299.97  81h   9b 50 00 0c 00 00 00 00
11076 1638402.09  81h   9b 50 00 0d 00 00 00 00
11077 1639403.49  81h   9b 50 00 0e 00 00 00 00
11078 1649395.76  81h   9b 50 00 0f 00 00 00 00
```

2.6 Access Functions - Drive/Targetlib calls

For accessing drive functions, use the „import drive“ statement, and the drive. Object functions as listed below. Example

```
import drive
drive.WriteObjectWord(0x6040, 0x00, 128)
```

NOTE: In earlier versions, the drive object was called **targetlib**. Kickdrive V1.9.16 and later automatically upgrades the names to the new **drive** label. Using **targetlib** is valid, but deprecated for new applications.

See section 3: Drive/Targetlib Functions fort the list of available functions.

2.7 Emergency Objects / Debug Information

PyMite runtime errors and additional debug mode output are reported as CANopen emergency objects (EMCY).

Standard CANopen Emergency Object Data

Byte	0	1	2	3	4	5	6	7
Content	Emergency Error Code		Error Register	Manufacturer specific Error Field				

Emergency Error Codes used by fullmo/ebmpapst Embedded Python and usb2drive

Error Code	Meaning	Comments
509bh	drive.SendEmcyMessage old emergency message function	See section 3.9
6200h	PyMite runtime execptions, e.g. „Zero division error“	See section 2.7.1

2.7.1 Pymite Runtime Exception / Emergency 6200h

PyMite runtime errors, Debug-Mode output are reported as CANopen Emergencies using error code 6200h (User Software).

Byte	0	1	2	3	4	5	6	7
Content	6200h		0	Pymite Error Value	0			

NOTE: In Kickdrive V3.0, Pymite Runtime emergencies are displayed in the „Drive“ Status panel including the error description:

```
Warning: Embedded Python Error (e3h, Zero division error)
```

Kickdrive V2.x versions presented the error number in the form “`Warning: Embedded Python Error (ffffffffffffffe3h, )`”)

See section 1.3: PyMite Runtime Errors Values for a list of all errors.

3 Drive/Targetlib Functions

NOTE: The **targetlib.** object provides other internal motor control functions (Power, Speed, Go, …) which have been used for earlier applications. Using internal motor control functions is deprecated for new applications. The recommended approach is via CANopen DS402 objects for all drive specific functions, i.e. state machine control, drive control, i/o control, and the object access functions described below.

NOTE: Simplified read/write access is available via the #dict Directive (see section 4).

3.1 WriteObjectByte(wIndex, bySubindex, byValue)

Writes to a 8 bit object value.

Return value: tCopKernel result code

3.2 WriteObjectWord(wIndex, bySubindex, wValue)

Writes a 16 bit object value.

Return value: tCopKernel result code

3.3 WriteObjectDword(wIndex, bySubindex, dwValue)

Writes a 32 bit object value.

Return value: tCopKernel result code

3.4 ReadObjectByte(wIndex, bySubindex)

Returns a 8 bit object value.

3.5 ReadObjectWord(wIndex, bySubindex)

Returns a 16 bit object value.

3.6 ReadObjectDword(wIndex, bySubindex)

Returns a 32 bit object value.

3.7 SendTxPdo(dwNumber)

Sends TxPDO no. <dwNumber>

3.8 ChkRxPdo(byNumber)

Checks if a new RxPDO no. <byNumber> has been received:

Returns values: 0 – new RxPDO. 1 – no new RxPDO

3.9 SendEmcyMsg(dwValue)

Sends the user specific emergency as Emergency error code 509Bh, error register 10h.

Emergency Object Data:

Byte	0	1	2	3	4	5	6	7
Content	509bh		10h	dwValue				

Example:

```
drive. SendEmcyMsg(3)
```

Resulting CAN bus frame (example for a Node ID = 2)

```
82h     9b 50 10 03 00 00 00 00
```

4 #dict Directive – Object Dictionary support

#dict is a Kickdrive specific preprocessor directive that allows to use simpler SDO read / write access based on XDD device description files as used in the Kickdrive Object Editor.

4.1 Simple Use

```
#dict <myDictionary.xdd>
dict.ReadObject (<index>, <subindex>)
dict.WriteObject (<index>, <subindex>, <value>)
```

Short Read/Write Syntax:

```
dict.r(<index>, <subindex>)
dict.w(<index>, <subindex>, <value>)
```

Example

```
#dict "IEC61800_V2.2.0.0.xdd"
dict.ReadObject(0x6041, 0x00)
dict.w(0x6060, 0x00, 1)
```

NOTE: <index> and <subindex> must be constant hex values in the same format as supported by the Object Editor (e.g. 0x3402, or 3402h). You cannot use expressions/calculations, e.g. (0x3400 + myIndex).

4.2 Extended Syntax

NOTE: This is useful for managing several dictionaries within one script

```
#dict <myDictionary.xdd> as <myObject>
<myObject>.ReadObject (<index>, <subindex>)
<myObject>.WriteObject (<index>, <subindex>, <value>)
```

Example

```
#dict "IEC61800_V2.2.0.0.xdd" as k5
k5.r(0x6041, 0x00)
k5.WriteObject(0x6060, 0x00, 1)
```

5 Kickdrive-based debugging

Debug mode compilation and execution is available for all versions of the MovingCap Pymite interpreter.

5.1 Usage

- Open a Kickdrive project and go to the CANopen Drive – Script panel
- Choose your python script and switch the combo box on the right from **Release** to
  Debug – Simple debug support with current line and watch display (see 5.3)
  Dbg/Single Step – Extended debug support, allows single step execution (see 5.4)
- Use e.g. the **Start** or **Pause** toolbar functions to recompile, download and start the script.

5.2 Limitations

The debug modes described above modify the original script mode and use

- CANopen emergencies for debug feedback and
- The Pymite user variable **340ch,0ah** for debug control and feedback.

The following limitations apply for this approach:

- Debug mode code will only run with 25 – 50% speed of the Release mode code.
- You cannot use the Pymite user variable **340ch,0ah** (see [1], 7.1.3 8Bit Variablen).
- CANopen emergencies are used to indicate source code line numbers and watch values. Depending on the MovingCap firmware version, this is **Emergency Code 509bh** (see 3.9), or **Emergency Code ff60h**. Please avoid collisions with custom emergencies you create. Check the CAN Bus Monitor if in doubt.

5.3 #watch Directive – Define local watch expressions

NOTE: This feature is only active if compilation mode is **Dbg/SingleStep**

`#watch <python expression>`	Defines a python expression which will be watched and every change will be printed in the **Drive Output** window. The **<python expression>** must be valid in the the python code block where the #watch is used. **NOTE:** Only one watch expression can be active at the same time. A second #watch directive overrides the old watch expression.

#endwatch	Ends the watch area defined previously using **#watch**. **NOTE:** Leaving a python code block / indentation level will end the **#watch**, too.

Example:

```
w=1
#watch w
while(w<10):
      w = w+1
#endwatch
i=0
#watch i
i = i + 1
i = i + 2
#endwatch
```

5.4 #step Directive – Single Step Areas

NOTE: This feature is only active if Compilation / Run mode is **Dbg/SingleStep**.

#step	Allows/Starts single step starting from this code line. **NOTE:** When you press the **Pause** or **Step** toolbar function, code execution is only stopped when reaching or when inside a **#step** area.
#endstep	Ends single step area.

6 Example Scripts

6.1 Basic drive control and input handling via SDO

```
import drive


def wait(waitTime):
    """A delay function that does not require 'import sys'
    for MovingCap CANopen / pymite.
    (On MovingCap Ethernet use sys.wait())

    :param waitTime: delay in milliseconds (approx.)
    :type waitTime: int
    """
    i = 0
    while (i < waitTime):
        i = i + 1

#####################################################
# initialize the drive state machine

drive.WriteObjectWord(0x6040, 0x00, 128)
wait(50)
drive.WriteObjectWord(0x6040, 0x00, 0)
wait(50)
drive.WriteObjectWord(0x6040, 0x00, 6)
wait(50)
drive.WriteObjectWord(0x6040, 0x00, 7)
wait(50)
drive.WriteObjectWord(0x6040, 0x00, 15)
wait(50)

#####################################################
# Homing on Block, Left (homing method -19) or
# right (homing method -18).
# (Also resets the target pos. variable to 0)
targetPos = 0
# homing torque is in 0.1% of nominal torque / current
Home_Torque = 300
Home_Speed  = 100
Home_Acc    = 1000
# set operation Mode = homing
drive.WriteObjectByte(0x6060, 0x00, 6)
drive.WriteObjectWord(0x6073,0, Home_Torque)
```

```
drive.WriteObjectDword(0x6099, 0x01, Home_Speed)
drive.WriteObjectDword(0x609A, 0x00, Home_Acc)
# homing direction left or right?
if (0 == 0):
    drive.WriteObjectByte(0x6098, 0x00, -19)
else:
    drive.WriteObjectByte(0x6098, 0x00, -18)
# set home offset to 0, same as targetPos counter
drive.WriteObjectDword(0x607C, 0x00, targetPos)
# go
drive.WriteObjectWord(0x6040, 0x00, 0x001F)
# wait target reached
while ((drive.ReadObjectWord(0x6041, 0x00) & 0x0400) == 0):
    pass

#####################################################
# Endless loop
while (1):

   ####################################################
   # Wait for input (high or low slope)

   # inputs are bit 16.. of object 0x60FD
   bitMask = 1 << (15 + 1)
   # wait for input=low
   while ((drive.ReadObjectDword(0x60FD, 0x00) & bitMask) > 0):
       pass
   # wait for input=high
   while ((drive.ReadObjectDword(0x60FD, 0x00) & bitMask) == 0):
       pass

   ####################################################
   # Go Position

   targetPos = 400000

   Move_Torque = 500
   Move_Speed  = 1000
   Move_Acc    = 2000
   Move_Dec    = 1000
   #Set Mode
   drive.WriteObjectByte(0x6060, 0x00, 1)
   #Set torque
   drive.WriteObjectWord(0x6073,0,Move_Torque)
   #Set acceleration
```

```
drive.WriteObjectDword(0x6083, 0x00, Move_Acc)
#Set deceleration
drive.WriteObjectDword(0x6084, 0x00, Move_Dec)
#Set profile velocity
drive.WriteObjectDword(0x6081, 0x00, Move_Speed)
#Set target position
drive.WriteObjectDword(0x607A, 0x00, targetPos)
#Go
drive.WriteObjectWord(0x6040, 0x00, 0x003F)
# wait target reached
while ((drive.ReadObjectWord(0x6041, 0x00) & 0x0400) == 0):
    pass

#####################################################
# Wait for input (high or low slope)

# inputs are bit 16.. of object 0x60FD
bitMask = 1 << (15 + 1)
# wait for input = high -> low
while ((drive.ReadObjectDword(0x60FD, 0x00) & bitMask) == 0):
    pass
while ((drive.ReadObjectDword(0x60FD, 0x00) & bitMask) > 0):
    pass

#####################################################
# Go Position

targetPos = 100000

Move_Torque = 500
Move_Speed  = 1000
Move_Acc    = 2000
Move_Dec    = 1000
#Set Mode
drive.WriteObjectByte(0x6060, 0x00, 1)
#Set torque
drive.WriteObjectWord(0x6073,0,Move_Torque)
#Set acceleration
drive.WriteObjectDword(0x6083, 0x00, Move_Acc)
#Set deceleration
drive.WriteObjectDword(0x6084, 0x00, Move_Dec)
#Set profile velocity
drive.WriteObjectDword(0x6081, 0x00, Move_Speed)
#Set target position
drive.WriteObjectDword(0x607A, 0x00, targetPos)
```

```
    #Go
    drive.WriteObjectWord(0x6040, 0x00, 0x003F)
    # wait target reached
    while ((drive.ReadObjectWord(0x6041, 0x00) & 0x0400) == 0):
        pass
```

6.2 Similar Example, but using #dict, #watch and #step directives

```
import drive

#dict "mcslave.xdd" as mcslave

def wait(waitTime):
    i = 0
    while (i < waitTime):
        i = i + 1

# ####################################################s
# initialize the drive state machine

mcslave.w(0x6040, 0x00, 128)
wait(50)
mcslave.w(0x6040, 0x00, 0)
wait(50)
mcslave.w(0x6040, 0x00, 6)
wait(50)
mcslave.w(0x6040, 0x00, 7)
wait(50)
mcslave.w(0x6040, 0x00, 15)
wait(50)

# set target pos to current actual pos.
targetPos = mcslave.r(0x6064, 0x00)

drive.SendEmcyMsg(1)

drive.SendEmcyMsg(2)

#####################################################
# Endless loop
while (1):


    drive.SendEmcyMsg(3)
```

```
#####################################################
# Go Position Relative
targetPos = targetPos + -327680
Move_Torque = 500
Move_Speed  = 1000
Move_Acc    = 500
Move_Dec    = 500
# set profile position Mode
mcslave.w(0x6060, 0x00, 1)
# set all target position parameters
mcslave.w(0x6073, 0, Move_Torque)
mcslave.w(0x6083, 0x00, Move_Acc)
mcslave.w(0x6084, 0x00, Move_Dec)
mcslave.w(0x6081, 0x00, Move_Speed)
mcslave.w(0x607A, 0x00, targetPos)
#Go
mcslave.w(0x6040, 0x00, 0x003F)
# wait target reached
while ((mcslave.ReadObject(0x6041, 0x00) & 0x0400) == 0):
    pass



drive.SendEmcyMsg(4)

#####################################################
# Delay
# (not timer based for now, only a simple delay loop.)

# (!) USES EXTRA DEBUGGING DIRECTIVES
waitCount = 2000 / 10
#watch waitCount
#step
while (waitCount > 0):
   waitCount = waitCount - 1
#endstep
#endwatch

drive.SendEmcyMsg(5)

#####################################################
# Go Position Relative
targetPos = targetPos + 327680
Move_Torque = 500
Move_Speed  = 1000
```

```
Move_Acc    = 500
Move_Dec    = 500
# set profile position Mode
mcslave.w(0x6060, 0x00, 1)
# set all target position parameters
mcslave.w(0x6073, 0, Move_Torque)
mcslave.w(0x6083, 0x00, Move_Acc)
mcslave.w(0x6084, 0x00, Move_Dec)
mcslave.w(0x6081, 0x00, Move_Speed)
mcslave.w(0x607A, 0x00, targetPos)
#Go
mcslave.w(0x6040, 0x00, 0x003F)

# wait target reached.

# (!) USES EXTRA DEBUGGING DIRECTIVES
targetLoops = 0
#watch targetLoops
#step
while ((mcslave.r(0x6041, 0x00) & 0x0400) == 0):
   targetLoops = targetLoops + 1
#endwatch
#endstep

drive.SendEmcyMsg(6)

#######################################################
# Delay
# (not timer based for now, only a simple delay loop.)
waitCount = 2000 / 10
while (waitCount > 0):
   waitCount = waitCount - 1
```

6.3 Main loop with fixed time-slice / tick / execution time

```
import sys
import drive

timeSliceMs = 100

oldTick = sys.time()
while (1):
    # before a new time slice starts, use a forced garbage collection so
    # the script engine state is exactly as it was in the last round
    sys.gc()
    nextTick = oldTick + timeSliceMs
    # consider a data type overflow that makes the timer start over again
    while (nextTick < oldTick) and (sys.time() > nextTick):
        pass
    # store the start of the time slice
    oldTick = nextTick
    # wait for the correct start time
    while (sys.time() < nextTick):
        pass

    # TODO: add the actual worker code here.
    # (For now just waste some CPU time. And create emergencies
    # so we can check the resulting timing in the Kickdrive CAN Monitor)
    drive.SendEmcyMsg(1)
    w = 0
    while (w<50):
        w = w + 1
    drive.SendEmcyMsg(2)
```

When executing this example, you can use the CAN Monitor to confirm the timing / accuracy of this approach by checking the time stamps of the CANopen Emergency messages on the CAN bus:

```
Frame #      t [msec]     ID     Data   Dir    Description
32975  376542.09    81h    9b 50 00 01 00 00 00 00
32976  376594.30    81h    9b 50 00 02 00 00 00 00
32977  376643.11    81h    9b 50 00 01 00 00 00 00
32978  376694.21    81h    9b 50 00 02 00 00 00 00
32979  376742.69    81h    9b 50 00 01 00 00 00 00
32980  376794.78    81h    9b 50 00 02 00 00 00 00
32981  376843.11    81h    9b 50 00 01 00 00 00 00
```

7 References

[1] Objektbeschreibung und Betriebsarten CANopen MovingCap, fullmo GmbH, 23. Mai 2013, Fullmo GmbH, Daniel Wetzel
Objektbschreibung_mcv1.0.1.pdf

[2] [OUTDATED] fullmo PYTHON FOR EMBEDDED SYSTEMS, Version: Entwurf 0.1, 2009
movingCap PM_doku_V1.0.pdf