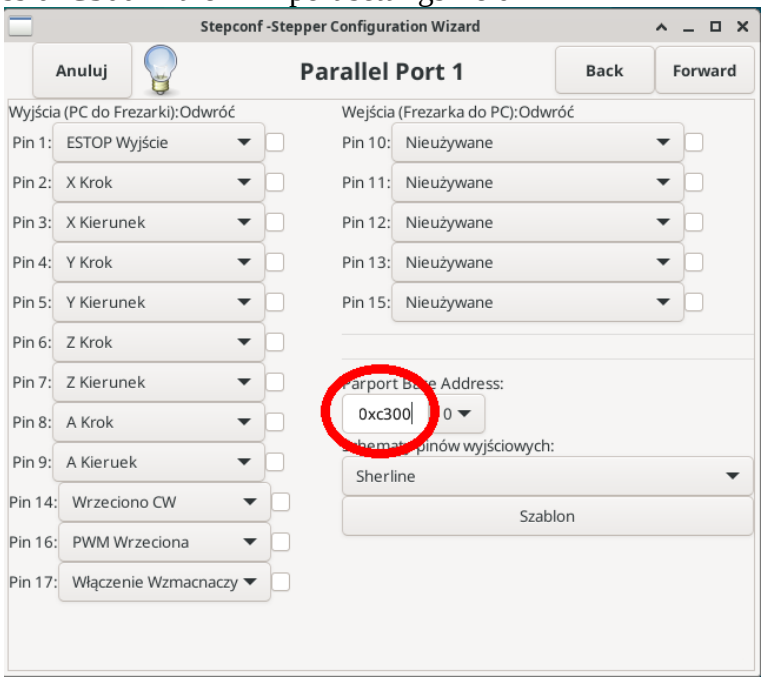
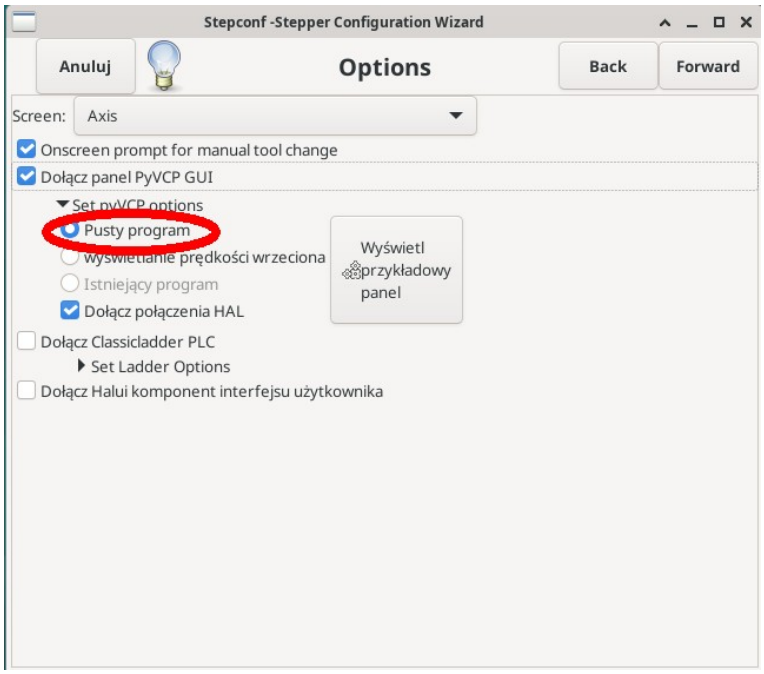
Linumeric-LPT V3 – LinuxCNC configuration EN

Creating the machine configuration will be described based on the **LinuxCNC Stepconf Wizard**. The entire configuration process will not be described in detail because there are many instructions on how to do it on the Internet. Only issues important from the point of view of configuration to support **Linumeric-LPT V3** will be described. The description will be carried out for the configuration with the Axis panel.

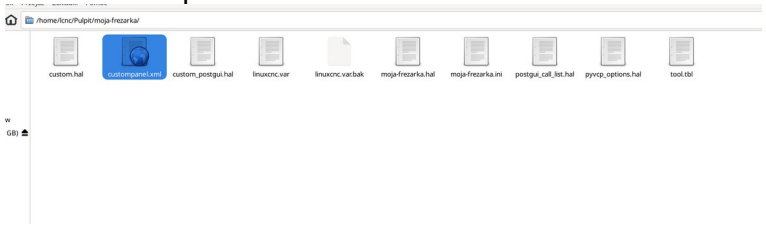
1. Launch **LinuxCNC Stepconf Wizard** and enter the configuration for your machine step by step
2. Set the address 0xC300 in the LPT port settings field



3. Include an empty PyVCP panel if another one is not needed



4. After creating the configuration, go to the folder with configuration settings and open the file in a text editor: custompanel.xml



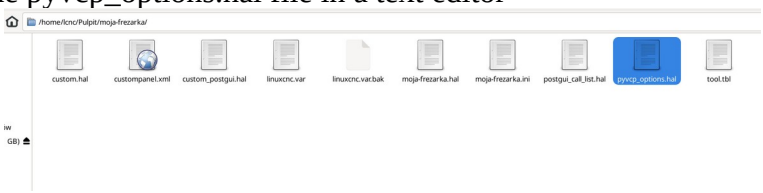
5. Enter the following code in the file:
(If other panels are already created, they should be added to the existing file)

```
<pyvcp>
	<vbox>
	<relief>GROOVE</relief>
	<bd>5</bd>
		<label>
		    <text>"Linumeric-LPT 0xC300"</text>
		    <font>("Helvetica",16)</font>
		</label>

		<vbox>
		<relief>GROOVE</relief>
		<bd>3</bd>
			<hbox>
				<label>
					<text>"Communication:"</text>
					<font>("Helvetica",16)</font>
				</label>
			</hbox>
			<hbox>
				<label>
					<text>"Con"</text>
					<font>("Helvetica",12)</font>
				</label>
				<led>
					<halpin>"linumeric_C300_connection_status"</halpin>
					<size>25</size>
					<on_color>"green"</on_color>
					<off_color>"red"</off_color>
				</led>
				<label>
					<text>"Stab"</text>
					<font>("Helvetica",12)</font>
				</label>
				 <led>
					<halpin>"linumeric_C300_stabilization_status"</halpin>
					<size>25</size>
					<on_color>"green"</on_color>
					<off_color>"red"</off_color>
				</led>
				<u32>
					<halpin>"linumeric_C300_min_fifo_buff_diff"</halpin>
					<font>("Helvetica",12)</font>
					<format>"d"</format>
				</u32>
				<u32>
					<halpin>"linumeric_C300_max_fifo_buff_diff"</halpin>
					<font>("Helvetica",12)</font>
					<format>"d"</format>
				</u32>
			</hbox>
		</vbox>

		<vbox>
		<relief>GROOVE</relief>
		<bd>3</bd>
			<hbox>
				<label>
					<text>"Process delay:"</text>
					<font>("Helvetica",16)</font>
```

```
                </label>
                <button>
                        <halpin>"linumeric_C300_delay_reset"</halpin>
                        <text>"Reset"</text>
                 </button>
        </hbox>
        <hbox>
                <label>
                        <text>"Min             Act             Max"</text>
                        <font>("Helvetica",12)</font>
                </label>
        </hbox>
        <hbox>
                <number>
                        <halpin>"linumeric_C300_delay_min"</halpin>
                        <font>("Helvetica",12)</font>
                        <format>"2.3fms"</format>
                </number>
                <number>
                        <halpin>"linumeric_C300_delay"</halpin>
                        <font>("Helvetica",14)</font>
                        <format>"2.3fms"</format>
                </number>
                <number>
                        <halpin>"linumeric_C300_delay_max"</halpin>
                        <font>("Helvetica",12)</font>
                        <format>"2.3fms"</format>
                </number>

        </hbox>
    </vbox>
</vbox>
</pyvcp>
```

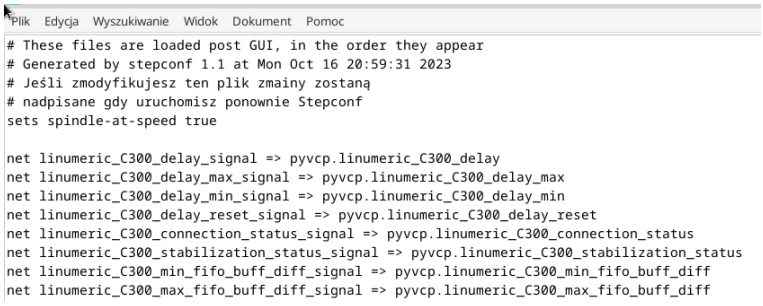
A sample file can be downloaded at:
https://www.machmaker.pl/data/files/custompanel.xml

6. Then open the pyvcp_options.hal file in a text editor

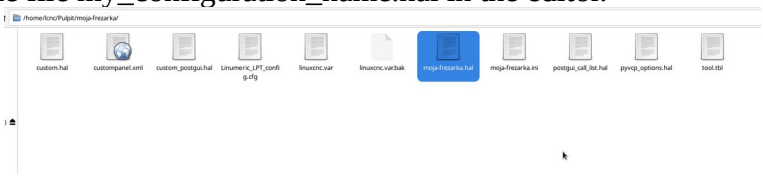


and add connections of hal pins used to read the operating status of Linumeric-LPT V3 with address 0xC300

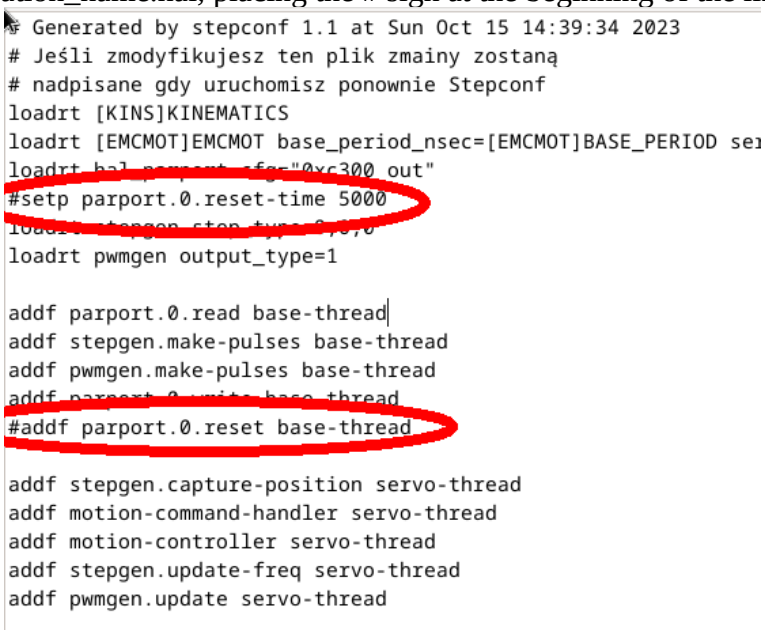
```
net linumeric_C300_delay_signal => pyvcp.linumeric_C300_delay
net linumeric_C300_delay_max_signal => pyvcp.linumeric_C300_delay_max
net linumeric_C300_delay_min_signal => pyvcp.linumeric_C300_delay_min
net linumeric_C300_delay_reset_signal => pyvcp.linumeric_C300_delay_reset
net linumeric_C300_connection_status_signal => pyvcp.linumeric_C300_connection_status
net linumeric_C300_stabilization_status_signal => pyvcp.linumeric_C300_stabilization_status
net linumeric_C300_min_fifo_buff_diff_signal => pyvcp.linumeric_C300_min_fifo_buff_diff
net linumeric_C300_max_fifo_buff_diff_signal => pyvcp.linumeric_C300_max_fifo_buff_diff
```



7. Then open the file my_configuration_name.hal in the editor.



Stepconf Wizard, when creating the configuration, sets the DoubleStep option which doubles the frequency of output control in relation to input reading. This feature is supported by the device, but it is recommended to disable it as it lowers the minimum BASE_PERIOD value for Linumeric-LPT V3.
To disable this function, comment out the following lines in the file my_configuration_name.hal, placing the # sign at the beginning of the line:



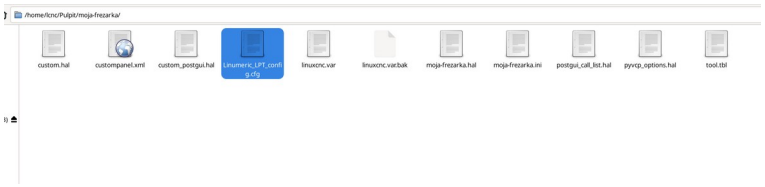
```
# Generated by stepconf 1.1 at Sun Oct 15 14:39:34 2023
# Jeśli zmodyfikujesz ten plik zmainy zostaną
# nadpisane gdy uruchomisz ponownie Stepconf
loadrt [KINS]KINEMATICS
loadrt [EMCMOT]EMCMOT base_period_nsec=[EMCMOT]BASE_PERIOD se
loadrt hal_parport cfg="0xc300 out"
#setp parport.0.reset-time 5000
loadrt stepgen step_type=0,0,0
loadrt pwmgen output_type=1

addf parport.0.read base-thread
addf stepgen.make-pulses base-thread
addf pwmgen.make-pulses base-thread
addf parport.0.write base-thread
#addf parport.0.reset base-thread

addf stepgen.capture-position servo-thread
addf motion-command-handler servo-thread
addf motion-controller servo-thread
addf stepgen.update-freq servo-thread
addf pwmgen.update servo-thread
```

and below, comment stepspace 0 for each stepgen

```
setp stepgen.0.position-scale [JOINT_0]SCALE
setp stepgen.0.steplen 1
#setp stepgen.0.stepspace 0
setp stepgen.0.dirhold 35000
setp stepgen.0.dirsetup 35000
setp stepgen.0.maxaccel [JOINT_0]STEPGEN_MAXACCEL
net xpos-cmd joint.0.motor-pos-cmd => stepgen.0.position-cmd
net xpos-fb stepgen.0.position-fb => joint.0.motor-pos-fb
net xstep <= stepgen.0.step
net xdir <= stepgen.0.dir
net xenable joint.0.amp-enable-out => stepgen.0.enable

setp stepgen.1.position-scale [JOINT_1]SCALE
setp stepgen.1.steplen 1
#setp stepgen.1.stepspace 0
setp stepgen.1.dirhold 35000
setp stepgen.1.dirsetup 35000
setp stepgen.1.maxaccel [JOINT_1]STEPGEN_MAXACCEL
net ypos-cmd joint.1.motor-pos-cmd => stepgen.1.position-cmd
net ypos-fb stepgen.1.position-fb => joint.1.motor-pos-fb
net ystep <= stepgen.1.step
net ydir <= stepgen.1.dir
net yenable joint.1.amp-enable-out => stepgen.1.enable

setp stepgen.2.position-scale [JOINT_2]SCALE
setp stepgen.2.steplen 1
#setp stepgen.2.stepspace 0
setp stepgen.2.dirhold 35000
setp stepgen.2.dirsetup 35000
setp stepgen.2.maxaccel [JOINT_2]STEPGEN_MAXACCEL
net zpos-cmd joint.2.motor-pos-cmd => stepgen.2.position-cmd
net zpos-fb stepgen.2.position-fb => joint.2.motor-pos-fb
net zstep <= stepgen.2.step
net zdir <= stepgen.2.dir
net zenable joint.2.amp-enable-out => stepgen.2.enable
```

More information about this option:
http://linuxcnc.org/docs/html/hal/parallel-port.html

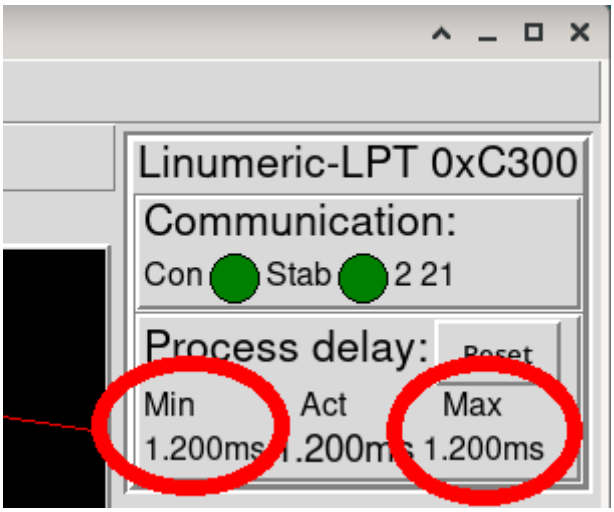
8. *Add the Linumeric_LPT_config.cfg file to the directory where the machine configuration is located*



The file is available for download at the link:
https://www.machmaker.pl/data/files/Linumeric_LPT_config.cfg
The file contains several settings for Linumeric-LPT V3 operation:

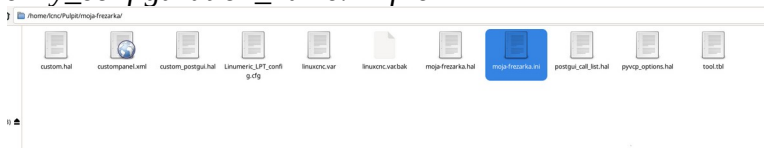
BUFF_TIME_US - Buffering time expressed in us - one of the main parameters affecting the operation of the device. The buffering time has a direct impact, together with the BASE_PERIOD period (set in the .ini file), on the overall latency of the operation. The minimum value for Linumeric-LPT V3 is 240 us which, with a BASE_PERIOD period of 30 us, gives 8 buffering samples. The minimum buffer amount is 5 samples, the maximum is 100.
The method of configuring this parameter will be presented later in this manual.
First, set the BUFF_TIME_US value to 500
DEBUG_PRINT_NS – debug option, should not be changed without consulting the manufacturer.
MAX_IN_OUT_DELAY_US – maximum value of the system operation delay in us (time between reading the input and the appearance of the reaction to this input at the output). This time is measured and displayed, but if it exceeds this maximum value, an error will be displayed. This value should be selected experimentally based on the delay parameters that can be obtained. First, set the MAX_IN_OUT_DELAY_US value to 5000.

ETH_STABILIZATION_VALUE - minimum value of the stable connection buffer. This is the value of the minimum number of samples in the buffer, set after the connection optimization procedure at the beginning of the program. If, during LinuxCNC operation, the values of the indicated maximum and minimum delays differ significantly and this is undesirable for various reasons



then you can increase this value. However, at the beginning you can leave it at 1-2.
ETH_OPTIMALIZATION_PERIOD_S – Connection optimization period – should not be changed without consulting the manufacturer. If for some reason the operating system does not handle the Ethernet interrupt in time, the system will automatically shift the buffer and the delay in the operation of the device will automatically increase. To ensure that the delay does not remain permanently increased, the software constantly checks and optimizes the connection and reduces the delay to a minimum. This value is the period of checking the quality and stability of the connection.

9. *Then open the my_configuration_name.ini file*

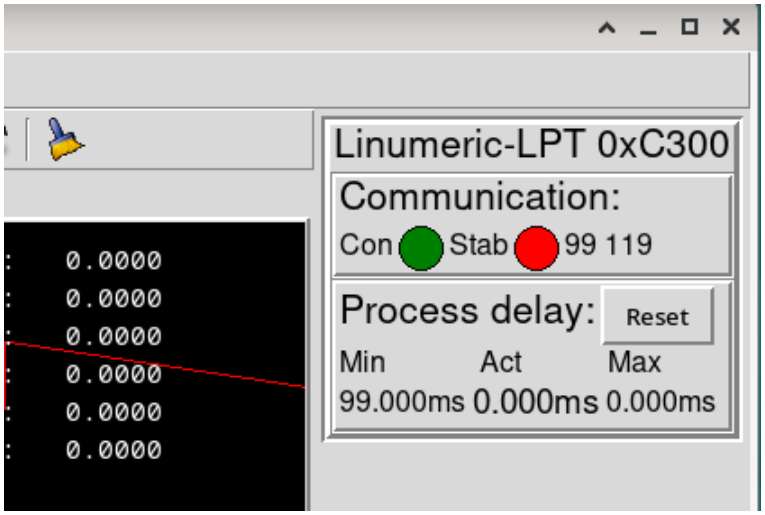


and find two key parameters:
BASE_PERIOD – base period with which the LPT port handling process is invoked. This value is expressed in ns and is set by the Stepconf Wizard based on the base period deviation (Jitter) entered during configuration. This value is very important when using a physical LPT port, but the Linumeric-LPT device has a jitter elimination mechanism and you can afford to lower this value.
The minimum value is 30us, so 30000ns. First, set this value to 50000.
SERVO_PERIOD – the period of the slower, superior process in which complex calculations take place. This value is also expressed in ns and Stepconf Wizard sets it to 1ms. This value cannot actually be less than 2 times BASE_PERIOD. Unless there is a special reason, there is no need to lower this value and it can remain 1ms (1000000ns), however, when using the device e.g. in a lathe, where low delays for synchronous movements are required, it is also recommended to lower the SERVO_PERIOD period to the lowest possible value . When setting this value, you should take into account the increased CPU load, so it should be done by monitoring the CPU load (e.g. using the htop tool), monitoring the core that handles the rt process (the last core). It is recommended to

leave this value at 1 ms to start with, tuning this value to a lower value should be done at the very end.

```
[EMCMOT]
EMCMOT = motmod
COMM_TIMEOUT = 1.0
BASE_PERIOD = 30000
SERVO_PERIOD = 1000000

[HAL]
HALFILE = moja-frezarka.hal
HALFILE = custom.hal
POSTGUI_HALFILE = postgui_call_list.hal
```

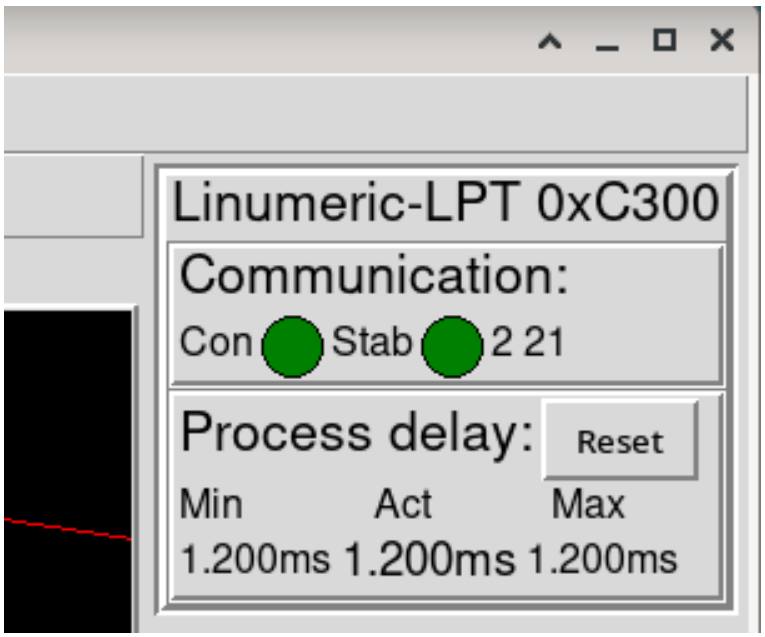
10. When the configuration is ready, the device is connected and authorized, you can run Linuxcnc by clicking on the icon with the name of the configuration that the Stepconf Wizard will create on the desktop.
    After startup, the following information will be displayed on the Linumeric-LPT V3 status panel



The **Communication** section informs about the communication status.
The Con indicator should turn green immediately after connection, and the red ERR diode on the device should go off, while the green ETH diode should be on.
The Stab light shows the status of the connection stabilization process. As long as the light is red, it means that the connection is not stable and is being optimized. Stabilization of the connection may take from several to several dozen seconds after turning on the software - do not make any movements with the machine during this time.

The **Process delay** section informs about the current delay of the control process - the actual delay between reading the input state and controlling the output. This value results directly from the connection quality, buffering time and base period. This value can be read after connection stabilization is completed.
The **Reset** button is used to minimize delay and **can only be used when the machine is standing still and not making any movements.**

The device is ready for operation when the **Con** and **Stab** LEDs light up green, the ERR LED on the device is off, the ETH LED is blinking and LinuxCNC does not display any errors.



If errors are displayed, go to instructions: **9 - Error signaling** to verify the cause.

11. If the device works properly, you can proceed to optimize the settings.
    Delay optimization is carried out in order to establish such operating parameters that the delay is as small as possible. This makes sense and is applicable when synchronous movements are used in the machine, such as rigid threading; the device allows you to select settings, depending on the equipment, so that the delay is in the range of 1-1.5ms.
    If the machine does not perform this type of synchronous movements, it is recommended to select the settings so that the delay is within the range of 2-5ms.

    The main parameters to be optimized are:
    BASE_PERIOD (in .ini file)
    BUFF_TIME_US (in Linumeric_LPT_config.cfg)

    Optimization involves changing settings and checking the correct operation of the device. Tests should be carried out in the short term (a few minutes) and after selecting the final settings, a long-term check should be performed (several hours).

    At the beginning of optimization, you should gradually lower BASE_PERIOD and check whether the device works properly and does not report any errors in operation or communication.
    The minimum value declared by the manufacturer is 30 us, although you can try lower at your own risk.

    If the minimum stable **BASE_PERIOD** value is selected, proceed to reducing the **BUFF_TIME_US** buffering time.
    You should gradually lower **BUFF_TIME_US** and check whether the device works properly and does not report any errors in operation or communication.
    The minimum value declared by the manufacturer is 240 us, although you can try lower at your own risk.

Please note that the **BUFF_TIME_US** value (in us units) cannot be less than 5 times the **BASE_PERIOD** setting and cannot be greater than 100 times the **BASE_PERIOD** setting (converted to us).

12. After correctly selecting the parameters and long-term testing, enter the **MAX_IN_OUT_DELAY_US** value in the Linumeric_LPT_config.cfg file to the appropriate value, according to your needs.

    The parameters should be selected individually for your computer.
    When using a Raspberry Pi computer, you can use pre-tested parameters because it is a standardized computer and if you buy the same model, everyone should achieve the same parameters.
    The proven configuration on **Raspberry Pi 4B 4GB** is:
    BUFF_TIME_US=240
    BASE_PERIOD=30000