

# USER MANUAL CALIBRATION SOFTWARE PTC04 PROGRAMMER



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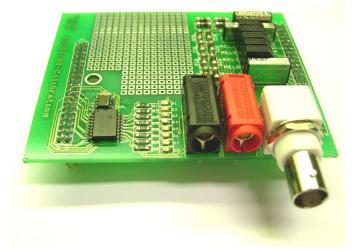
User Manual

Figure 1: PTC04-DB-Calib.

# Introduction

In this document you'll find a description of:

- The Calibration Setup.
- How to proceed with the calibration check.
- What if the calibration check fails?
- How does the calibration work?
- What do we calibrate?



# **Calibration Setup**

# Requirements

For the calibration test you need:

- A high accuracy voltmeter;
- A PTC04 calibration board (**PTC04-DB-Calib** Supporting daughter board for calibration of PTC04 programmer).

The software has an automatic calibration feature. For this you need a Keithley 2000 or an Agilent (HP) 34401A multimeter. The Agilent 34401A multimeter is supported in the PTC04 User Interface revision 1.35 or higher.



If you use the automatic calibration feature, all channels will be calibrated with the multimeter as reference meter.

If a manual approach is used, only the first sensing line is calibrated with the external reference meter. For all the other channels the first sensing line will be used as reference.

# Connections

- 1. Replace the daughter board of the PTC04 with the calibration board:
  - Remove the cover of the PTC-04;
  - Remove the PTC04 Daughter Board of the MLX device;
  - Plug in the PTC04 Calibration Board.
- 2. Connect the reference voltmeter to the BNC connector **or** 4mm PCB Plugs (Both connections are in parallel).
- 3. Connect the RS232 or USB cable to the PTC04 and the PC.
- 4. Connect the power supply of the PTC04.

Figure 2: Connections

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#### RS232 settings

The RS232 communication of the multimeter has to be configured as follows:

Keithley 2000	multimeter	Agilent (HP) 34	4401A multimeter	r		
BAUD:	19.2 K	BAUD:	9600		BAUD:	4800
FLOW:	NONE	PARITY:	EVEN: 7BITS	OR	PARITY:	NONE: 8BITS
TX TERM:	CR	LANGUAGE:	SCPI		LANGUAGE:	SCPI

For configuration instructions, please consult the user's manual of your multimeter. All other settings are set by the software via RS232 commands.

# Check Calibration of the programmer

Now your PTC programmer is connected and you can start-up the MPT software. When the software is started, double click on PTC-04 in the UI modules list or select from the menu "Tools  $\rightarrow$  Search devices  $\rightarrow$  AII"

X 1	Melexis P	rogrammable Toolb	ox	_	
i E	ile <u>V</u> iew	<u>T</u> ools <u>H</u> elp			
	F 🔛 🗶	Search <u>d</u> evices	Q AII		
		modules MLX90275 MLX90280 MLX90264 PTC-04 MLX90244 MLX90216BAD	<b>Serial</b> Parallel USB		
	Be ∎ , Ch				
×	Туре	Date	Time	Description	
😋 System Log					
Log					
	<				>
	🗐 Syste	m Log 📄 Data Log 📗			
Scan	for all devi	ces			

Figure 3: Melexis Programmable Toolbox.



The software will search for all available devices. When a PTC programmer is found it will be initialized. Otherwise the software will display a notification that no PTC devices have been found and will enter the disconnected state.

🔣 User Interface PTC-04	Z
Test programmer	Calibrate
Configuration	Firmware commander
Upload firmware	

If the connection failed, check the serial cable and power connection or change the settings if you have connected the programmer to a different serial port.

To open the Calibration test module, press the button **Calibrate** on the PTC04 User Interface.

Figure 4: User Interface PTC-04.

## Calibration check

This module of the PTC-04 User Interface is used to verify if the calibration parameters of the programmer are within tolerance. The software will check the power drivers (DAC) and the voltmeter (ADC), and compare its results with the calibration parameters. If the calibration parameters are out of tolerance, they **can** be corrected.

## Before starting the calibration check

- It is advised to leave the programmer powered up for minimum 30 to 60 minutes before starting the calibration. For the accuracy of the calibration, it is important that the programmer is at operating temperature.
- Very important: do not connect any load on the connectors of the calibration board during the calibration check. Any additional load will corrupt the calibration parameters and lead to an unusable set-up. If this should happen, restart the calibrate check without a load connected to the programmer.
- If you have a Keithley 2000 or an Agilent (HP) 34401A Multimeter, select the correct multimeter from the selection box (1) before you start the calibration check. The multimeter has to be connected to the PC used for the calibration check. The default COM-port for the multimeter is COM2. One can change the selected COM-port in the "COM port #" Edit-box (2).



User Manual

💑 Calibrat	ion Check	
Me	easurement ADC or DAC Vs. reference Meter.	
65,000 -		
60,000 -		
55,000 -		
50,000 -		
45,000		
臣 월 40,000		
40,000 He 40,000 35,000 M 30,000 He 25,000	Diffe	
≌ ≚_ 30,000 -	Difference Q	
ຍ ຍຸ 25,000 -		
20,000		
15,000		
10,000		
5,000		
0		
	0 Reference Meter	
	Difference - Measured	
Manual input	of measurements COM port # 2 Verify Calibration	
	1 2	

Figure 5: Calibration Check.

• Press Verify Calibration to start the calibration.

You are reminded to leave your PTC04 powered up for minimum 30 to 60 minutes before starting the calibration.

Calibrat	ion Check
⚠	You are about to start the calibration check of your Melexis Programmer. For this calibration check, a high precision voltmeter is required. The accuracy of the calibration check depends on the precision of the voltmeter.
	For the automatic calibration check, a Keithley 2000 or Agilent 34401A Multimeter is required.
	Important note: It is advised to leave the programmer powered up for minimum 30 to 60 minutes before starting the calibration.
	Start Check?
	Yes No

Figure 6: Start Check?

• Press **yes** to continue.



If you **don't use** a Keithley 2000 or Agilent 34401A multi meter, you have to use a high accuracy voltmeter. The accuracy of the calibration depends on the precision of the voltmeter and the number of digits entered. With a manual voltmeter, the program will start with calibrating the internal voltmeter which will be used to check the PTC04 programmer.

Calibrat	tion Check 🛛 🔀
⚠	You chose a manual voltmeter. Remember, the accuracy of the calibration check depends on the precision of the voltmeter.
	Proceed Check?
	Yes No

Figure 7: Proceed Check?

• Press **yes** to continue.

At this stage the software will check if the calibration board and, if selected, the Keithley 2000 or Agilent 34401A Multimeter are connected. If the calibration board is not detected, a message is shown.

Calibrat	ion Check 🛛 🛛
1	Please check if the Calibration board for the PTC04 is inserted in the programmer and if the reference voltmerer is connected!
	Are they connected?
	Yes No

Figure 8: Check setup

• If the setup is not complete, press No, switch of the programmer, check your setup and restart the program.



#### Manual voltmeter

If the *Keithley 2000 or Agilent 34401A multimeter* feature is **not** selected the program will ask you to put in a few values from your voltmeter manually. These are used to calibrate the first sensing line of the PTC-04. This sensing line will be used as reference meter for the calibration check.

**Note:** the accuracy of the calibration depends on the precision of the voltmeter and the number of digits you enter.

Calibrat	ion Check 🛛 🔀
2	The calibration check will now start with measuring the internal reference channel. For this test, a few measurements will have to be inserted manually.
	OK Cancel

Figure 9: Manual calibration internal reference meter.

• Press **OK** to continue.

For the calibration of the internal reference meter, two series of 32 values are required. Once the internal reference meter is calibrated the software will continue with the calibration check.

Note: the decimal separator of the software is "." not ",". If one uses a "," as decimal separator, the calculated parameters will be incorrect.

Input Box Manual Voltmeter 🛛 🛛 🔀
Give new value from voltmeter in VOLT
OK Cancel

Figure 10: Input Box Manual Voltmeter.

• Insert the value from the voltmeter in volt [V] and press OK.

Note: If you entered a wrong value, press Cancel. Two error messages are shown.

Calibrat	ion Check 🛛 🔀
8	Check Measuring Line 1 failed
	ОК

Figure 11: Check Measuring line 1 Failed

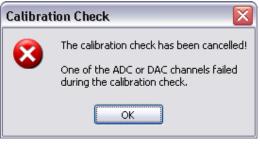


Figure 12: The calibration check has been cancelled.

• Press **OK** on both messages to continue.

Now the calibration check is terminated, you can restart the calibration check.



# The calibration check

Now the calibration software will perform a number of measurements on all the ADC and DAC channels of the programmer. This can take several minutes. At the end of the calibration check the program verifies if a correction of the calibration parameters is needed.

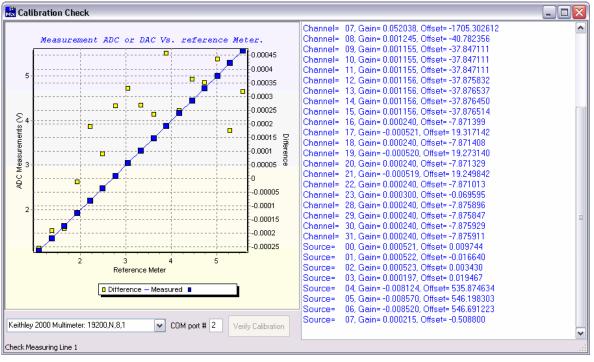


Figure 13: Calibration Check

## There are three possible outcomes

1. The program notifies you that the current calibration is out of tolerance and ask you if you want to corrected the calibration parameters or not.

Calibrat	ion Check 🛛 🛛
1	The current calibration of the Programmer is out of tolerance! If you would like to correct the calibration parameters (Calibrate), press YES. Calibrate?
	<u>Y</u> es <u>N</u> o

Figure 14: Calibrate?

- If you press **yes**, the new calibration parameters are written into the PTC04.
- If you press **no**, there are no modifications done.



2. The program notifies you that the current calibration is within tolerance! No Correction of the calibration parameters (Calibration) is needed.

Calibration Check 🛛 🛛		
2	The current calibration of the Programmer is within tolerance! No correction of the calibration parameters (Calibration) is needed.	
	Would you like to correct the calibration parameters anyway?.	
	Yes No	

Figure 15: Calibrate Anyway?

If no calibration is needed you can still choose to calibrate or not.

- If you press **yes**, the new calibration parameters are written into the PTC04.
- If you press **no**, there are no modifications done.
- 3. At the end of the calibration, the software verifies if the programmer was at temperature when the calibration started. If the programmer was not at temperature, the following message is given.

Warning	
	The current calibration of the programmer is out of tolerance! Important note: The programmer is not completely warmed up. It is advised to leave the programmer powered up for minimum 30 minutes before starting the calibration. If you would like to correct the calibration parameters (Calibrate), press YES. Calibrate? Yes No

Figure 16: Programmer is not at temperature.

It is advised not to calibrate (store the new calibration parameters in the programmer) when the programmer is not at operating temperature. This is important for the accuracy of the PTC04 programmer.

- If you press **yes**, the new calibration parameters are written into the PTC04.
- If you press **no**, there are no modifications done.



When you choose to calibrate (press **yes**), the new calibration parameters are written into the PTC04. Afterwards the software verifies if the writing of the calibration data in the PTC04 was done correctly.

			Verifying written calibration parameters to PTC:
	Measurement ADC or DAC Vs. reference Meter.		Channel= 00, Gain= 0.001155, Offset= -37.849731
- 1			Channel= 01, Gain= 0.077207, Offset= -2527.810547
34 🛔			Channel= 02, Gain= 0.001155, Offset= -37.849266
32 1			Channel= 03, Gain= 0.077195, Offset= -2527.424561
. 1			Channel= 04, Gain= 0.001155, Offset= -37.849270
30			Channel= 05, Gain= 0.077156, Offset= -2526.145264
28			Channel= 06, Gain= 0.001155, Offset= -37.846298
26			Channel= 07, Gain= 0.052049, Offset= -1705.671509
20 1			Channel= 08, Gain= 0.001245, Offset= -40.785049
24 -			Channel= 09, Gain= 0.001155, Offset= -37.849731
1			Channel= 10, Gain= 0.001155, Offset= -37.849731
22 20 18 16			Channel= 11, Gain= 0.001155, Offset= -37.849731
20 -		₽	Channel= 12, Gain= 0.001156, Offset= -37.879642
18 1		ŧ	Channel= 13, Gain= 0.001156, Offset= -37.879635
1	0	Difference	Channel= 14, Gain= 0.001156, Offset= -37.879547
6		ä	Channel= 15, Gain= 0.001156, Offset= -37.879814
14			Channel= 16, Gain= 0.000240, Offset= -7.871121
_			Channel= 17, Gain=-0.000516, Offset=19.157436
12			Channel= 18, Gain= 0.000240, Offset= -7.871174
10 -			Channel= 19, Gain= -0.000515, Offset= 19.087780
8			Channel= 20, Gain= 0.000240, Offset= -7.871073
			Channel= 21, Gain=-0.000515, Offset= 19.110796
6			Channel= 22, Gain= 0.000240, Offset= -7.870821
41			Channel= 23, Gain= 0.000300, Offset= -0.156248
1			Channel= 28, Gain= 0.000240, Offset= -7.875516 Channel= 29, Gain= 0.000240, Offset= -7.875570
2			Channel= 23, Gain= 0.000240, Offset= -7.675570 Channel= 30, Gain= 0.000240, Offset= -7.875609
01			Channel= 31, Gain= 0.000240, Offset= -7.875636
			Source= 00, Gain= 0.000521, Offset= 0.009803
	Reference Meter		Source= 01, Gain= 0.000522, Offset= 0.003003
			Source= 02, Gain= 0.000523, Offset= 0.002263
	Difference - Measured		Source= 03, Gain= 0.000197, Offset= 0.019446
			Source= 04, Gain=-0.008131, Offset= 536.057678
			Source= 05, Gain=-0.008575, Offset= 546,299988
		_	Source= 06, Gain=-0.008524, Offset= 546.902527
зу 2	2000 Multimeter: 19200,N,8,1 🛛 🔽 COM port # 2 Verify Calibratio	n	Source= 07, Gain= 0.000215, Offset= -0.508800
			3001084 07, Gaine 0.000213, Olisete 10.300000

Figure 17: The Calibration check has been ended successfully.

Now the calibration check is completed.

The END status of the calibration check is shown in the status bar of the calibration window.



#### What if the Calibration check failed

When the calibration fails, it is usually caused by a bad connection, measurement or incorrect input of measured data. If this occurs, check the setup and redo the calibration check.

#### Very important:

- If the calibration check is done with a manual voltmeter, you have to take extra care that the measurements are done correctly. These measurements are used to calibrate the first sensing line of the PTC-04. This sensing line will be used as reference meter for the calibration check.
- The accuracy of the calibration also depends on the precision of the voltmeter and the number of digits you enter for each measurement.
- The connection of the calibration board and the voltmeter are very imported. A bad connection or any additional load will corrupt the calibration parameters.
- The decimal separator of the software is "." Not ",". If one uses a "," as decimal separator, the calibration of the first sensing line will not be done correctly.

#### Measurement failed

The following error message is shown during the calibration procedure;

- If there is a bad connection in the setup. For example: between the PTC04 main board and the calibration board.
- When using a Keithley 2000 multimeter for the calibration, the failure can also be caused by a wrong measurement of the Keithley. For example: communication error.
- When you are using the manual calibration procedure. The software will perform a check on the data you enter. If there is a large deviation from the expected data. The check will fail and the calibration check is ended.

Calibration Check	
8	Check Measuring Line 1 failed
	ОК

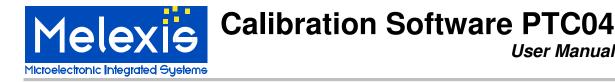
Figure 18: Check Measuring line 1 Failed

Calibration Check 🛛 🔀		
8	The calibration check has been cancelled! One of the ADC or DAC channels failed during the calibration check.	
	ОК	

Figure 19: The calibration check has been cancelled.

To determine this:

- Press **OK** on both messages to cancel the calibration check.
- Remove the calibration board, place it back and check the connections with the voltmeter. The connection of the calibration board and the voltmeter are very imported. A bad connection or any additional load will corrupt the calibration parameters.
- After checking the setup, restart the calibration check. If the same channel fails again it is possible that there is hardware damaged on the PTC04.



#### Large deviation

When all the measurements are completed, the software calculates the new calibration parameter. After the calculation of the calibration parameters, the software verifies if there is a large deviation with the standard (expected) calibration parameters. If the deviation is too large the following warning message is shown.

Warning!	
⚠	The calculated Calibration parameters show a large deviation from the standard values. It is advised to redo the Calibration Check.
	OK

Figure 20: Large deviation of the calibration parameters.

In the main window you get a list of the channels that have a large deviation from the default values.

Measurement ADC or DAC Vs. reference Meter.     34     34     35     36     37     38     39     39     30     30     31     32     32     33     34     35     36     37     38     39     39     30     30     31     32     32     33     34     35     36     37     38     39     39     30     31     32     32     33     34     35     34     35     34     35     35     36     36     37     38     39     39     39 <

Figure 21: List of channels that have a large deviation.

The large deviation could be a result of incorrect reference measurements. If it occurs:

- Remove the calibration board, place it back and check the connections with the voltmeter. The • connection of the calibration board and the voltmeter are very imported. A bad connection or any additional load will corrupt the calibration parameters.
- After checking the setup, restart the calibration check. If the same channel(s) fail(s) again it is possible that there is hardware damaged on the PTC04.



## Loggings

Each time a calibration check is performed and the new correction parameters are saved in the PTC-04 programmer, the old and the new parameters are logged in a file called "Calibration Log.txt". This file is for information purpose only and **is not used by the PTC-04 programmer.** 

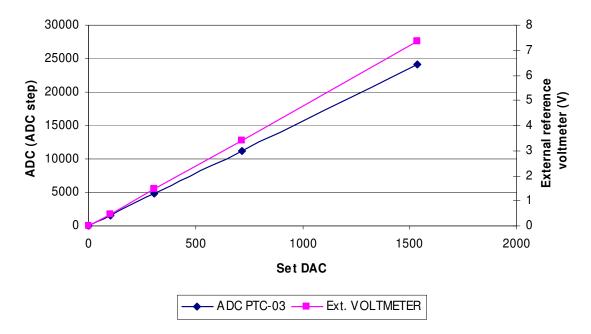
# **Calibration details**

#### How does the calibration work?

## ADC

In the graph below, you have two curves: the measurements of the ADC (left Y-axis) and the reference measurements of the external voltmeter (the right Y-axis). The internal voltage source is used as supply (Set DAC X-axis). The purpose of the calibration check is to compare the ADC with the external high precision voltmeter.

For the check, a number of voltage values are measured to calculate the difference between the ADC of the PTC04 and the External Voltmeter which results in to correction parameters for offset and gain.



## **Calibration check ADC**

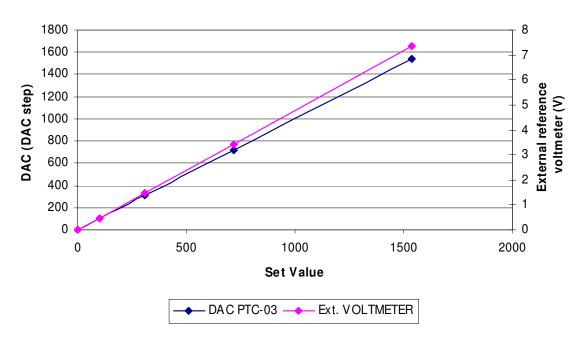
Graph 1



# DAC

In the 2nd graph, you have agene two curves: the Set DAC (left Y-axis) and the reference measurements of the external voltmeter (the right Y-axis). The purpose of the calibration check is to compare the DAC with the external high precision voltmeter.

Also for this check, a number of values are measured to calculate the difference between the DAC of the PTC04 and the External Voltmeter which results in to correction parameters for offset and gain.



# **Calibration check DAC**

Graph 2

At the end of the calibration check these values, of the ADC channels and the DAC, are compared with the values stored in the PTC. If the parameters for offset and gain, that are currently stored in the PTC04, are out of specifications in comparison with the new correction parameters, the software gives a warning and asks if the new correction parameter may be saved.



#### What do we calibrate?

#### Sensing lines:

There are four sensing lines with independent ground connection. The source and reference that are used to calibrate the sensing lines are PPS 1 and the external voltmeter.

Sensing line 1	channel 12 and Channel 28 (High sensitivity) of the ADC;
Sensing line 2	channel 13 and Channel 29 (High sensitivity) of the ADC;
Sensing line 3	channel 14 and Channel 30 (High sensitivity) of the ADC;
Sensing line 4	channel 15 and Channel 31 (High sensitivity) of the ADC.

#### **PPS1:**

For each PPS, the software checks the ADC first then the DAC and then the additional channels that are connected to that source.

Voltmeter on the PPS1 PPS1	channel 0 and Channel 16 (High sensitivity) of the <b>ADC</b> ; channel 0 of the <b>DAC</b> ;
Current meter on the PPS1	channel 1 of the <b>ADC</b> ;
PPS 5: IDD limiter PPS1	channel 4 of the <b>DAC</b> .

#### **PPS2:**

Voltmeter on the PPS2	channel 2 and Channel 18 (High sensitivity) of the ADC;
PPS2 Current meter on the PPS2	channel 1 of the <i>DAC</i> ; channel 3 of the <b>ADC</b> ;
PPS 6: IDD limiter PPS2	channel 5 of the <b>DAC</b> .

#### PPS3:

Voltmeter on the PPS3	channel 4 and Channel 20 (High sensitivity) of the ADC;
PPS3	channel 2 of the <i>DAC</i> ;
Current meter on the PPS3	channel 5 of the <b>ADC</b> ;
PPS7: IDD limiter PPS3	channel 6 of the <i>DAC</i> .

#### PPS4:

Voltmeter on the PPS4	channel 6 and Channel 22 (High sensitivity) of the <b>ADC</b> ; channel 3 of the <b>DAC</b> :
Current meter on the PPS4	channel 7 of the <b>ADC</b> ;
PPS8: IDD limiter PPS4	channel 7 of the <b>DAC</b> .



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