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Application Note

AN000568



Assembler Programming

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1 Overview

1.1 Setup

The setup consists of a computer with the PCap04 GUI installed. The computer connects using the PicoProg USB - SPI/I²C interface which is then connected to the PCap motherboard. The PCap motherboard serves as the host for the PCap04 evaluation board. The PCap04 evaluation board can communicate via I²C or SPI. The elements of the set-up are illustrated below.

Figure 1 : Evaluation Board Setup



The **ams** GUI provides an easy to use interface to exercise the multiple options and features of the PCap04.

1.2 Ordering Information

Ordering Code	Description
PCAP04-BQFN-24	PCap04
PCAP04-EVA-KIT V1.0	PCap04 Eval-Kit

2 Introduction

2.1 Preparation of Software and Hardware

2.1.1 Installing the Software

The software can be downloaded from www.ams.com/PCap04 and is a LabView based GUI that enables full access to the chips register settings.

It is crucial to install the software before connecting the evaluation kit to your computer. It is possible that a default driver configuration of your OS will interfere with correct installation.

- Download the latest zipped software installation package to the desired directory.
- Unzip the package to the desired directory.
- Open "setup.exe" from the unzipped directory.
- Follow the instructions on the screen.

2.1.2 Connecting the Hardware

- Connect your computer with the PICOPROG V3.0 using USB cable.
- Connect PICOPROG V3.0 and the evaluation kit motherboard using the DB15 interfaces
- Mount the plug-in board on the corresponding socket on the motherboard.



Figure 2: Mother Board



- Set the power supply unit to 7.5 V output.
- Connect the motherboard to power via the power supply unit. The green LED on the Eval kit motherboard should be on.

3 Eval Software vs. Assembler

3.1 Files Description



Information

Please do not make any changes in the system folder. Copy the system folder files to your private folder for making changes if desired.

- .asm files are assembler files which contains the programming code.
- .dat files are the configuration files for Pcap04.
- .h files are headers containing the register descriptions of the device.

3.2 How to Handle Assembler Files

3.2.1 Load & Compile Existing Assembler Files

• Launch PCap04 eval software and select Assembler in Tools menu.

Figure 3 : Tools Menu

🕼 ams	PCap04		
File M	lemory	Tools Interface H	Help
Setup	CDC F	Run Measuremen	t Ctrl+R
		Graph	Ctrl+G
		Registers	Ctrl+F
		Linearize	Ctrl+L
		Assembler	Ctrl+A

• Next, go to open in File menu

PCap04 Eval Software vs. Assembler

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Figure 4: File Menu

UT .	Assem	bler - C	:\Program Fi	les (x86
File	Edit	Find	Assembler	Help
N	ew		Ctrl+N	
0	pen		Ctrl+O	

• As an example, select PCap04_standard_v1.1.asm file click OK to load it. For sure, you can choose here another assembler file.

Figure 5 : Assembler File

0pen Assembler-File		×
\leftarrow \rightarrow \checkmark \uparrow \square \ll ams \Rightarrow PC	ap04 > Examples > PCap04_standard_v1	✓ ♂ Search PCap04_standard_v1
Organize 🔻 New folder		III 🕶 🛄 💡
 Downloads Music Pictures Videos 	Name PCap04_standard_v1.asm	Date modified Type 07.06.2016 10:31 ASM Source File
File <u>n</u> ame:	V <	<pre>> asm-File; Header-File (*.asm; *. OK Cancel</pre>

After this, you should see the PCap04standard assembler source code.



Figure 6 : Assembler Source Code



Most of the command lines already commented in green for better understanding.

• To Compile and run this code go to Compile in the Assembler.

Figure 7: Assembler Menu

Assembler	Help	
Compile		F5
Compile	Options	Ctrl+F5
Downloa	d	F6
Assemble	er Info	

The compiled code will be automatically downloaded to PCap04.



Figure 8 : Downloaded Output

<				>
Output				
INFO: Program Size: 548 Byte INFO: C:\Program Files (x86)\am	<pre>\PCap04\Examples\PCa</pre>	ap04_standard_v1\PCap04_sta	ndard_v1.asm: Processin	g was successful
Download successful!				

• RUNBIT needs to be enable before a measurement can be started.

Figure 9: Enabling RUNBIT

i ams PCap04 File Memory Tools	nterface Help					-		×
Setup CDC Frontend	CDC RDC	PDM/PWM	DSP/GPIO	Misc	Expert	a	n	
		Band	igap			Op	en Graph	,
	×0	[BG_PERM	BG_T	RIM 🖨	Start N Wr	leasuren ite Confi	g

3.2.2 Edit Assembler Files

Double click the #include files to show them on the menu tab.

Figure 10 : Edit Assembler Files



The pcap_standard.h header file contains major address mappings and names for the PCap04. This file should be always included. With the help of the code comments in green, you should be able to edit the code for your own. Alternatively, it is possible to edit existing code samples.

Therefor select Examples in the Help menu.



Figure 11:

Help Menu



Here you can select the linearized example code as well as the standard firmware load.

Examples of Linearize and Standard Firmware

Select I	Example
PCap04 Standard Firmware	PCap04 Linearize Firmware
Description	Description
The PCap04 standard firmware provides capacitance and temperature measurement results as raw ratio. Thereby, the firmware considers the configuration settings and delivers the results accordingly. The following modes/features are supported (not exhaustive): • Capacitance ratio (C_ratio) • Temperature (R_ratio) • Pulse output (PWM/PDM) • Stray compensation Result registers (see comments in header): RES0 5 : Capacitance Ratios for Capacitance Ports PC05 RES6: Resistance Ratio for External Sensor at Port PT1, w.r.t. Internal or External reference RES7: Resistance Ratio for Internal sensor, w.r.t. Internal or External reference PULSE0 & PULSE1: Pulse Outputs	The PCap04 linearization firmware helps to linearize a sensor by capturing the inverted capacitance ratios at several points to apply then a polynomial (3rd order) correction. Similarly, the temperature sensor's non-linearity can be compensated. For given coefficients, a two-point calibration can be performed. The following features are supported (not exhaustive): • Inverted capacitance ratio (ci_out) • Temperature (r_out) • Final result with correction (Z-result) • Pulse output with correction (Pulse_Z) Result registers (excerpt, full set see comments in header): RES0: Z-result RES1: theta RES2: ci_out RES3: r_out RES6: Pulse_Z

We recommend choosing one of these examples for your project. After that, you can easily customize the code to your needs.



Information

You can get an overview of the standard Opcode commands in the help menu.

• This can be found under "Opcode Help" in the "Help" menu

Figure 12 :



Figure 13: Opcode Help



Figure 14 : Opcode Overview

ያ Opcode Help				- 0	×
Hide Back Print Options					
<u>Contents</u> Index <u>Search</u> Type in the <u>w</u> ord(s) to search for:	Opcode Ov	erview			_
List Topics Display Select topic: Found: 0 Title Location Rank	Simple Arithmetic • add • sign • sub • inc	Miscellaneous resetWDG powerOnReset nop stop	RAM access • rad • clear • load • load2exp • move • push	Bitwise operation • not • and • or • xor	
	Complex Arithmetic • div • mult	Shift operation • shiftL • shiftR	Unconditional jump • goto • jsb • jrt	Bitwise • bitC • bitS	
Search previous res <u>u</u> lts ☑ <u>M</u> atch similar words	Conditional Jump • jcd • jCarC • jCarS • jEQ • jNE • jNE • jOffC • jOffS • jPOS				



For further information, please refer to the following documents:

Device specific Opcodes can be found in the PCap04 datasheet.

4 Store Your Code Permanently

Finally, you can store permanently your firmware in the non-volatile flash memory.



Warning

You have to power PCap04 with at least 3.0V for this operation. Under voltage during flashing the device can permanently damage PCap04 !

Follow these steps to accomplish this:

- Compile and download your code
- Switch to main window and go to Firmware in Memory menu.

Figure 15 : Memory Menu

File Memory Tools Interface Help Setu Firmware Ctrl+M I/PWM DS Calibration Read Config from NVRAM rt Device PCap04v1 V	() ams	ns PCap04					
Setu Firmware Ctrl+M Calibration Read Config from NVRAM ct Device PCap04v1	File M	Memory	Tools	Interface	Help		_
Calibration Read Config from NVRAM ct Device PCap04v1 ~	Setu	Firmwa	re		Ctrl+N	1	I/PWM DS
Read Config from NVRAM ct Device		Calibrat	ion				
PCap04v1 🗸		Read Co	onfig fro	om NVRAM			ct Device
	_					PCa	ap04v1 ~

• Then push "Store" button in the "Complete Memory" tab



Figure 16 : Complete Memory Tab



Now your new compiled firmware is permanently stored in the NVRAM.

Test your operation by power cycling the device

• Click the "Power On Reset" Button in the main screen to enable power cycling.



Figure 17 : Expert Menu

File Mer	mory Tools li	nterface	Help						
Setup	CDC Frontend	CDC F	RDC PDM/PWM	DSP/GPIO	Misc	Expert	(n
Genera I2 0	IRUNBIT	MEM_LO ×0 WD_DIS ×5A	rize Ban OCK [] [igap]BG_PERM]DSP_TRIG_I]INT_TRIG_E	BG 7 3G 8G	G_TIME 0		Ope Start M Write Powe In	en Graph easurement te Config complete r On Reset it Reset

• Now your measurements can be started without compiling and downloading.

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5 Revision Information

Changes from previous version to current revision v1-00

Page

Initial version

• Page and figure numbers for the previous version may differ from page and figure numbers in the current revision.

• Correction of typographical errors is not explicitly mentioned.

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6 Legal Information

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