



Evaluation Software for PICOCAP Devices

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1 Evaluation Software

1.1 Installing the Software

The PCapØ2plus Evaluation software runs under the following operating systems

- Windows 2000
- Windows XP
- Windows Vista (please use the software/drivers for Windows 7)
- Windows 7/8

Please follow the described procedure to install the software and driver:

NOTE: Ensure that the PicoProg V2.0 programmer is disconnected before starting the procedure.

The steps are slightly different for Windows XP and Windows 7/8. Please note as follows.

Installation on Windows 7/8 systems:

- Install the PCapØ2plus Evaluation software from PCapO2plus_Evaluation_Software\ setup.exe from the CD. This .exe file installs the evaluation software and the respective drivers for the PicoProg V2,0 programmer too.
- At the end of step 1, a batch file comes up in a separate window. Eventually, it will ask you to unplug the PicoProg V2.0 programmer. Please follow further the instructions on the window.
- The driver will be installed; a windows message may pop up asking you to install the driver though it is not signed. Please install it anyway.
- The batch file asks you to plug in the programmer and it is now enumerated.
- You will be asked to restart the system at this point, please do so. After restart connect the evaluation board to the PicoProg V2.0 programmer.

Installation on Windows XP systems:

- Install the PCapØ2plus Evaluation software from PCapO2plus_Evaluation_Software\ setup.exe from the CD. This .exe file installs the evaluation software and the respective drivers for the PicoProg V2.0 programmer too.
- At the end of step 1, a batch file comes up in a separate window. It will ask you to reconnect the PicoProg V2.0 programmer.
- You will then be asked to restart the system at this point, please do so.



- On restart, Found New Hardware wizard comes up. Please select 'No, not this time' and continue further with 'automatic installation'.
- The driver will be installed; a windows message may pop up asking you to install the driver though it is not signed. Please install it anyway.

1.2 The Graphical User Interface

The software comes up with a small window offering selections for the operating mode. In general, start with the standard mode as it offers all options.

Next, the main front panel comes up. Overall, the graphical user interface offers various windows for on-line configuration, for parameter and calibration data setting, and of course for the graphical and numerical display of the measurement data. The various windows will be explained in this chapter.



Figure 1-1: GUI Overview

1.3 Front Panel

This is the major window. On the right side, the front panel shows five general buttons:

Open Graph	Open a window for graphic representation of measurement data			
Start Measurement	Start or stop a running measurement			
Write Config.	Transfer once more, the present settings in the evaluation software to the chip (in case of doubt)			
Power up Reset	After Power up reset, 'Write Config.' may be necessary.			
Init Reset	With a init reset, the chip is re-initialized with respect to its frontend and processor.			

1.3.1 Setup Page

acam PicoCap02plus v	PCap02		
File Memory Tools Help			
Setup CDC Frontend CDC	RDC PDM/PWM DSP/G	PIO Clock Expert	Open Graph
	Select Device		Start Measurement
	PCapC 💌		Write Config
			Power Up Reset
Configurations	ready to use with Evaluation	System	Init Reset
		Î	C1/C0 💌
Standard	Humidity	Pressure	Filter
Duro conscitance ratios	Tomporature in °C at PESO	Temperature in °C at PESO	Std Dev Eff. Resolution
- Pure resistance ratios	- Humidity in rh% at Res1	- Humidity in rh% at Res1	0
 Takes care of the configured capacitance measure mode 	- Humidity linearization: Capacitance is linearized by	- Pressure linearization: Capacitance is linearized by	
and compensation	polynomial of 3rd degree,	polynomial of 3rd degree,	PT2/PTref
	then compensated for temperature by polynomial of	then compensated for temperature by polynomial of	0 Filter
	2nd degree	1st/2nd degree	Std Dev Eff. Resolution
			0
) Runbit
			Combined Error
	Verify Interface		OLF Clock: 50kHz
			OCF Freq.: 5,00kHz
			PICOCAP
5			

Figure 1-2: Setup page

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Options on 'Setup' page:

Select Device	Select the PICOCAP device which you use.
Standard	Opens the <i><selected device="">_</selected></i> standard.prj project file with Configuration and Firmware.
Humidity	Opens the <i><selected device="">_</selected></i> humidity.prj project file with Configuration and Firmware.
Pressure	Opens the <i><selected device="">_</selected></i> pressure.prj project file with Configuration and Firmware.
Verify Interface	When everything is in order, then pressing this button will indicate the release version number of the software and of the PicoProg V2.0 Firmware. It also confirms with 'SRAM read/write: OK' if a supported PICOCAP device is present.

1.3.2 CDC Frontend Page

acam PicoCap02plus	v1.01		PC	ap02					
File Memory Tools H	lelp								
Setup CDC Frontend	CDC	RDC	PDM/PWM	DSP/GPIO	Clock	Expert		-	Open Graph
Capa	citance to	Digi	tal Conversio	n Frontend				St	art Measurement
Capacitance Measurer	nent Schen	ne	Cap. Port Sele	ct	Stray C	Compensa	ation		Write Config
Grounded Single	-		0000	000]	Intern	al			Power Up Reset
			0123	5 7					Init Reset
			00000	999				C1/C0	
			Port Error					0	Filter
Discharge Resistance	e Port 03	Dis	scharge Resistar	nce Port 47	Charge	Resistance	e 📕	Std Dev	Eff. Resolution
30k	- 2	30	k	• 2	180k		• 0	0	0
								-	
C Pafaranaa Salaat	Internal	Can						PT2/PT	ref 💌
external	0	DF.						0	Filter
								Std Dev	Eff. Resolution
								0	0
								'	Runbit 🔵
									Combined Error
									OLF Clock: 50kHz
									OCF Freq.: 5,00kHz
								PI	

Figure 1-3: CDC Frontend page



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Options on 'CDC Frontend page:

Capacitance Measurement Scheme	 Grounded Single – Single capacitive sensor connected between a port and ground. Grounded Differential – Differential capacitive sensor connected between 2 ports with the middle tap of the sensor connected to ground. Floating Single – Single capacitive sensor connected between 2 ports. Floating Differential – Differential capacitive sensor connected between 2 ports.
Cap. Port Select	another 2 ports. Select which capacitive ports have to be measured (Ports 0-7), i.e. at which ports the sensors have been connected in hardware.
Stray Compensation	None – No compensation Internal – One additional measurement performed through only the chip- internal stray capacitance with respect to ground. External – One additional measurement per port pair, performed through a parallel connection of the capacitance at the two ports with respect to ground. Both – Both internal and external compensation together.
Discharge Resistance Port 03	Selects the value of the internal resistance (1000k, 180k, 90k, 30k, 10k) for measurements on port PCO to PC3 through which the discharge cycles during measurement are to be performed. This value has to be selected in accordance with the capacitance value of the sensor.
Discharge Resistance Port 47	Selects the value of the internal resistance (180k, 90k, 30k, 10k) for measurements on port PC4 to PC7 through which the discharge cycles during measurement are to be performed. This value has to be selected in accordance with the capacitance value of the sensor.
Charge Resistance	Choice of one out of 4 on-chip charging resistors (180k, 90k, 30k, 10k) for the CDC. Permitting to limit the charging current and avoiding transients.
C Reference Select	Switching between external and internal reference capacitance.
Internal Cap	Selection of internal reference capacitance value. (031pF)



1.3.3 CDC Page



Figure 1-4: CDC page

Options on 'CDC page:

Cycle Control

Precharge Time	Time to charge via resistor for current limitation, can be set in multiples of the cycle clock
Fullcharge Time	Time for final charge without current limitation, can be set in multiples of the cycle clock
Discharge Time	Time to discharge the capacitor, can be set in multiples of the cycle clock
C_FAKE	Number of fake measurements per measurement cycle. Performing fake measurements may help in reducing noise.
C_AVRG	Enables averaging the measurement results over multiple measurement cycles. Setting to 1 \rightarrow No averaging, Setting to any number N, will result in averaging over N measurement cycles for generating one measurement result. (08191)

Cycle Clock Select	 50,0kHz Low Power - Single capacitive sensor connected between a port and ground. 1,00MHz High Speed/4 - Differential capacitive sensor connected between 2 ports with the middle tap of the sensor connected to ground. 4,00MHz High Speed - Single capacitive sensor connected between 2 ports.
TDC_MR2	Select the measure mode, On = Measure range 2
Conversion Duration	Displays the entire conversion duration per cycles for averaging and fake measurements.
C_TRIG_SEL	Selects the source that triggers the start of a capacitance measurement Off Stretched – Started by SPI Command Ox8C Continuous – Continuous measurement, self-triggering. Recommended when no temperature measurement is made in parallel. Conversion timer – Depending on the setting the 'Conversion Time'. Generally recommended setting → less prone to error conditions. Pin triggered- Triggered by external Pin, selectable from option ext.Trigger- Pin
Ext. Trigger-Pin	Used to select the pin to be used as the source of trigger for the capacitance measurement. NOTE: In the delivered EVA module, the pins DSP_INO and DSP_IN1 are part of the SPI communication interface, hence only DSP_IN2 and DSP_IN3 selections are relevant.

Conversion Control

CONV_TIME	Sets the conversion time in multiples of twice the period of the low- frequency clock
Conversion Time	Displays the entire conversion time per measurement.
Measuring rate	Displays the frequency at which capacitive measurement data is transferred from the DSP to the interface (SPI or I2C).



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1.3.4 RDC Page



Figure 1-5: RDC page

Options on 'RDC' page:

Temp.SensorO (RO)	To select a thermistor connected to port PTO for temperature measurement. This could be e.g. an external PT1000.
Temp.Sensor1 (R1)	To select a thermistor connected to port PT1 for temperature measurement.
Temp.Sensor2 (R2)	To select either the internal aluminum thermistor or an external reference resistor at port PT2REF for temperature measurement.
Temp. Reference	To select either the internal Poly or external resistor at port PT2REF as the reference resistance to be used in temperature measurement.

Cycle Control

Precharge Time	Displays the precharge time. It depends on R_OLF_DIV.
Fullcharge Time	Displays the fullcharge time It depends on R_OLF_DIV.

Discharge Time	Set the discharge time. It depends on R_OLF_DIV.
R_AVRG	Set averaging for temperature measurement.
R_FAKE	Set number of fake measurements per temperature measurement cycle.
Conversion Duration	Displays the entire conversion duration per cycles for averaging and fake measurements.

Conversion Control

Temp. Trigger Select	 Selects the source that triggers the start of a temperature measurement Off: Default setting when no temperature measurement is wanted. In this case, a temperature measurement can still be started by SPI Command 0x8E. OLF_CLK: Triggered by Low-frequency oscillator. Pin-Triggered: Triggered by external Pin, selectable from option ext. Trigger-Pin CDC asynchronous: Depending on the setting in the 'T_TRIG_PREDIV' counter on the RDC page. The DSP is triggered by the RDC end of conversion. If RDC rate is less than CDC rate the DSP is triggered directly from the CDC for inactive RDC conversions. CDC synchronous: Depending on the setting in the 'T_TRIG_PREDIV' counter on the RDC page. The DSP is triggered by the RDC end of conversion. If RDC rate is less than CDC rate the DSP is triggered directly from the CDC for inactive RDC conversions. CDC synchronous: Depending on the setting in the 'T_TRIG_PREDIV' counter on the RDC page. The DSP is triggered by the RDC end of conversion. Assuming that RDC rate is less than the CDC rate, the inactive RDC conversions are replaced by a delay. 	
R_TRIG_PREDIV	For CDC and OLF options the RDC measure rate can be reduced by setting a divider.	
Conversion Time	Displays the entire conversion time per measurement.	
Measuring Rate	Displays the frequency at which capacitive measurement data is transferred from the DSP to the interface (SPI or I2C).	
Ext. Trigger-Pin	Used to select the pin to be used as the source of trigger for the capacitance measurement. NOTE: In the evaluation module, the pins DSP_INO and DSP_IN1 are part of the SPI communication interface, hence only DSP_IN2 and DSP_IN3 selections can be used.	



1.3.5 PDM / PWM Page

etup CDC Frontend CDC RDC	PDM/PWM DSP/GPIO Clock Exp	ert Open Graph
Pulse Interface 0	Pulse Interface 1	Start Measurement
Pulse Interface Enable	Pulse Interface Enable	Write Config Power Up Reset
Resolution	Resolution	Init Reset
10 bits 0 Clock Select	10 bits 0	0 Filter
off 💽 0	off 🗾 0	Std Dev Eff. Resoluti
Depending on Firmware	Depending on Firmware	PT2/PTref
Signal Source	Signal Source	0 Filter
none 💽 0 Slope Offset	none 💌 0 Slope Offset	Std Dev Eff. Resoluti
		, Runbit Combined Error
	Load Example Setti	OLF Clock: 50kHz

Figure 1-6: PDM/PWM page

Options on 'PDM / PWM' Page:

Pulse Interface Enable	Select the pulse interface – Pulse Width Modulated Output (PWM) or Pulse Density Modulated (PDM) Output. Of the two, the PDM is the recommended interface. With PWM option, 100 kHz clock and 10-bit resolution the resulting PWM output frequency = (100 kHz / 1024) ~ 100 Hz.
Resolution	Resolution of the output in bits. This resolution also determines the pulsed output range.
Clock_select	Selects the clock frequency to be used for the PWM/PDM generation.
Signal source	Select the measurement result which has to be given out as pulsed output – any of the capacitance or temperature measurement results.
Slope	Used to set the slope (m) of the linearization function used to scale the range of the PWM / PDM output generation.

Offset	Used to set the offset (b) of the linearization function. This value determines the range of the PWM / PDM output in the y direction.
Load Example Settings	Used to load example settings of PDM/PWM parameters.

1.3.6 DSP/GPIO Page

	chor i		000	0014/014/14	DCD/CDIO		F 1		i
etup	CDC Fronten		RDC	PDM/PWM	D3P/GPIO	Clock	Expert		Open Graph
SP								SI	ta <mark>rt Measurement</mark>
DSI	P_SPEED					WD_	TIME		Write Config
Fa	stest	• 0		Watchdog Tim	er 0	s ×0			Power Up Reset
DS	P_CLK_MODE			V DSP_SPRA	M_SEL	DSP_S	TART_EN		Init Reset
Rin	ng Oscillator	▼ 0		DSP_STAR	Т	000	000	C1/C0	
						COC	PINER NITER	0	Filter
DS	P_FF_IN	DSP_MOFL	O_EN	DSP_STARTO	NPIN	TRU	TRIG	Std Dev	Eff. Resolutio
						EN EN	EEE	0	0
10	466	SH		RRAR		Z		DTO (D)	
								PT2/P	Firef
PIO								0	none
PG	DIR IN	PG PU						Std Dev	Eff. Resolutio
0	000	0000		PG0xPG2	> PG2	INT2	PG2		
PGO	Pag	ନ୍ତ୍ରନ୍ତ୍ର	Da	PG1xPG3					Runbit 🥘
	GPIO Assir	nment		Pulse1	> PG3				Combined Error
	01107030	Juncin							OLF Clock: 50kHz OCF Freq.: 5,00kHz

Figure 1-7 DSP/GPIO page

Options on 'DSP/GPIO' Page:

DSP

DSP_SPEED	Select the DSP Speed. Choose between Fastest, Fast, Slow and Slowest.
DSP_CLK_MODE	Select the clock source for the DSP. Choose between Ring Oscillator, LF Clock and HF Clock.
Watchdog Timer	Normally in multiples of 50 milliseconds, provided OCF is tuned to 5 kHz as it should. Watchdog is started together with DSP and designed



	to be reset by a DSP command before the watchdog time is reached. Otherwise a power-up reset is initiated.
WD_TIME	Displays the Watchdog Time as a hex value (4 Byte)
DSP_FF_IN	Pin mask for latching flip-flop activation (PGO to PG3)
DSP_MOFLO	Activates anti-bouncing filter in PGO and PG1 lines
DSP_STARTONPIN	Not supported by standard firmware The DSP can be started externally by a signal on a pin; these buttons select the pin that has to be sensed for detecting the start signal.
DSP_START_EN	Mask for activating various trigger sources for starting the DSP

GPIO

PG_DIR_IN	To configure the ports PGO-PG3 as input (otherwise output)
PG_UP	To enable the internal pull up on the ports PGO-PG3
PGO_X_PG2	Possible only when the selected interface for communication is IIC. Interchange PortGO with PortG2. This is useful when the Pulsed output is needed on Port PGO instead of PG2.
PG1_X_PG3	Possible only when the selected interface for communication is IIC. Interchange PortG1 with PortG3. This is useful when the Pulsed output is needed on Port PG1 instead of PG3.
INT2PG2	Map the Interrupt output from chip, INTN to Port PG2. This setting is useful for 24 pin QFN package, because the dedicated INTN pin is absent in this version.
GPIO Assignment	Opens the window with the 5 general purpose ports and their assignment.



1.3.7 Clock Page

tup CDC Frontend C	DC RDC	PDM/PWM	DSP/GPIO	Clock	Expert		_	Open Graph
Clock OLF_CTUNE	OLF_FTU	HF Clo	ock X_RUN				Sta	rt Measurement Write Config
50kHz 2 OLF_CLK_SEL LF Clock 0	5 OCF_TIM 5		off]OX_AUTOST(]OX_STOP]OX_DIV4 HF_CLK_SEL IF-Osc.1	▼ DP_DIS ■ 0) ■ 0) ■ 0) ▼ 1	O (_AMP_TH (_DIS (_CLK32K	ยM HZ_EN	P C1/C0 O Std Dev O PT2/PTr	ower Up Reset Init Reset Filter Filter Eff. Resoluti 0 ef
RTC_EN RTC_CLK_SEL OLF Clock							0 Std Dev 0	Filter none (Eff. Resoluti
LBD_CLK_SEL OLF Clock							00	Runbit Combined Error LF Clock: 50kHz CF Ereg : 5 00kH

Figure 1-8 Clock page

Options on 'Clock' Page:

LF Clock

OLF_CTUNE	Coarse-tune the low frequency clock. (10kHz, 50kHz, 100kHz, 200kHz)
OLF_CLK_SEL	Select the low frequency clock. (LF Clock, external OX)
OLF_FTUNE	Fine-tune the low frequency clock. (015)
OCF_TIME	Controls the OCF frequency, serving the EEPROM, must be adjusted so that f_ocf=5kHz. OCF is derived from OLF via a counter. (063)
HF Clock	

OX_RUN	Controls the permanency or the latency of the OX generator. Latency means an oscillator settling time before a measurement starts.
OX_AUTOSTOP_DIS	Disables the automatic stop function of the OX generator between the individual measure sequences.



OX_STOP	Stop the OX-generator
OX_DIV4	OX clock frequency := raw freq./4
OX_AMP_TRIM	Trim the OX clock feedback gain.
OX_DIS	Disable the OX clock.
OX_CLK32KHZ_EN	Enable the 32 kHz quartz clock generator.
OHF_CLK_SEL	Choice of HF clock source; if no HF quartz or ceramic oscillator is connected, nor any other off-chip HF clock signal available, chooses "internal". HF-Osc. 1 – internal clock source #1 HF-Osc. 2 – internal clock source #2 External OX – external clock source
RTC_EN	Enable clock for real time counter
RTC_CLK_SEL	Select clock for real time counter (OLF Clock, ext. HF Osz.)
LBD_CLK_SEL	Clock source selection for the low battery detection (OLF Clock, OLF Clock/16)

1.3.8 Expert Page

Please modify the settings on the Expert page only in consultation with acam Support team.

1.4 Front Panel Menus

1.4.1 File Menu



Figure 1-9: File Menu

Open Config	Open configuration file *.cfg that contains the content for the configuration registers.
Save Config	Here you can save your own configuration.
Open Projekt	Open project file *.prj that subsumed the firmware and configuration filenames and the settings and EEPROM data
Save Projekt	Here you can save your own project file.
Close	Close the evaluation software

1.4.2 Memory Menu



Figure 1-10: Memory Menu

OTP / SRAM	Opens the window to download the firmware. (section 3.5.1.)				
Read Config from OTP	Reads back the configuration in the OTP.				
EEPROM	Opens the EEPROM window (section 3.5.2)				



1.4.3 Tools Menu

File Me	mory	Tools	Help		
Setup CDC		Run	Measurement	Strg+R	WIN
		Grap	h	Strg+G	
		Diag	nostics	Strg+D	vice
		Regi	sters	Strg+F	
		Para	meter	Strg+P	
		Inter	face	•	ith E

Figure 1-11: Tools Menu

Run Measurement	Start the measurement
Graph	Opens the window for graphical display of the various measurement results (section 3.5.4)
Diagnostics	Opens the window for numerical display of the various measurement results (section 3.5.3)
Register	Opens the Register window (section 3.5.5)
Parameter	Opens the Parameter/Calibration window (section 3.5.6)
Interface	Select between SPI and I2C interface

PICOCAP[®]

1.4.4 Help Menu

File Me	mory Tools	Help			
Setup	CDC Fronten	Help Conte Check Error USB Com	Help Contents F1 Check Errors USB Com		
		About	F12		

Configurations ready to use with Ev-

Figure 1-12: Help Menu

Help Contents	Opens the help window
Check Errors	Opens the error message window if there is an inconsistency after plausibility check.
USB Com	Opens the USB Communications window with PicoProg V2.0 Settings and the possibility to send opcodes
About	Version

After each change in settings, the evaluation software automatically performs a plausibility check in the background. If a setting is not allowed or doesn't fit with the setting of the other parameters, the faulty setting is highlighted in red color.

For example, changing TDC_MR2 into MR2 shows following window:



Figure 1-12b: Error Message MR2



Highlighted parameter: What doesn't fit with the setting of the other parameters? If you want to know, please open the window under ' $Help' \rightarrow$ 'Check Errors'.

can	×
Following Config-Settir • MR2 = 1 AND OX_RU	ngs are not allowed: N = Off
ОК	

Figure 1-12c: Error Message

Explanation: Measurement range 2 requires the high frequency clock.



Figure 1-12d: Error Message OX_RUN

Solution: Turn HF clock on, then the highlighting disappears.

1.5 Special Windows

1.5.1 SRAM/OTP Communications Window

In the 'SRAM/OTP Communications' Window the write data can be edited.

If the SRAM or OTP is read ('Read SRAM' or 'Read OTP' buttons), the content is automatically compared with the 'Write Data' window content. If contents are equal this will be indicated by a green illuminated LED.

	Mri	te D	ata	_	DCa	0	-		l he	~		_	_				0
	122		utu	220	Cu		1000	2222		^ 	15.2	2.07	2.25	1928	255	52.52.73	-
Open File	00	00	00	7A	CO	CF	FF	FO	D2	43	7A	DO	34	62	63	00	-
Reload File	65	7A	C4	DI	43	/A	DO	33	AB	47	42	SC	48	BO	01	20	-
Reload The	50	BI	02	78	20	48	BZ	01	20	50	83	11	7A	C1	D1	43	
Demous 'EE' at End	/A	DA	33	AB	00	71	/A	014	43	7A	24	44	20	48	00	87	
	72	C0	20 D1	40	77	DA	20	ND	001	75	22	TE	00	01	20	AP	
	20	78	43	50	71	CO	D1	43	63	C0	44	73	C4	DI	43	73	
Address Length	DO	32	25	06	66	67	76	77	66	20	12	63	DO	41	AD	10	
d128	74	CO	CO	CO	CB	D2	43	74	DE	44	74	CO	co	CI	D1	D2	
	43	7A	DD	44	78	CO	CO	CO	CB	D2	41	25	4D	64	DI	43	
Deed CDAMA	ZA	D9	44	6A	D2	43	7A	DA	44	6A	D3	43	7A	DB	44	20	
Kead SKAIM	D4	70	60	71	61	66	67	76	77	66	6A	DO	41	AA	02	7B	
Write SRAM	20	48	7A	C1	D1	43	7A	DA	33	AB	00	7F	7A	D4	43	7A	
	E4	44	20	48	7A	D5	43	7A	C7	D1	41	6A	EB	45	5A	22	
	F1	46	46	46	46	7A	DD	44	7A	CO	CO	CO	C8	D2	43	55	-
Read OTP	Rea	d D	ata											Dat	a eq	ual	
Write OTP	00	00	00	7A	CO	CF	FF	FO	D2	43	7A	DO	34	62	63	00	
	65	7A	C4	D1	43	7A	DO	33	AB	47	42	5C	48	BO	01	20	
Write Config to OTP	50	B1	02	78	20	48	B2	01	20	50	B3	11	7A	C1	D1	43	
	7A	DA	33	AB	00	7F	7A	D4	43	7A	E4	44	20	48	00	B7	
Firmware Version	02	78	20	48	84	01	25	0B	01	00	00	00	00	00	20	1A	
Innivare version	7A	CO	D1	43	7A	DA	33	AB	00	7F	22	F6	84	01	25	OB	
Product Group	20	7B	43	58	7A	CO	D1	43	6A	CO	44	7A	C4	D1	43	7A	
	DO	3A	25	06	66	67	76	77	66	20	1A	6A	DO	41	AA	10	
Program Type																	
Version																	
0																	

Figure 1-13: SRAM/OTP Communications



Open File	Select and open a firmware file (.hex). The content is shown in the 'Write Data' window.
Reload File	Reload the last opened firmware file (.hex). The content is shown in the 'Write Date' window again.
Read SRAM	Pressing this button, the content of the SRAM is read and shown in the 'Read Data' window. In 'Address' and 'Length' you can specify how many bytes you want read, starting at which address.
Write SRAM	Writes the firmware into the chip's SRAM. The status of the write process is indicated by the green bar. The successful end is indicated by a pop-up window. For verification we recommend to read back the SRAM afterwards and compare it with the source.
Read OTP	Pressing this button the content of the OTP is read and shown in the 'Read Data' window. In 'Address' and 'Length' you can specify how many bytes you want read, starting at which address.
Write OTP	Writes the firmware into the chips OTP. Attention: This option should be used only if you really want to test the OTP functionality. The status of the write process is indicated by the green bar. The successful end is indicated by a pop-up window. For verification we recommend to read back the OTP afterwards and compare it with the source.
Write Config to OTP	Writes to current content of the configuration registers into the reserved OTP space.
Firmware Version	In the firmware, a specific address is reserved to save 3 byte information about the application and the version of the software. The coding is specified in the header file of the supported PICOCAP device, for example: <i>PCapO1a.h</i> . The header file is found in the library directory of the assembler.

1.5.2 EEPROM Window

The EEPROM provides the possibility to store data like linearization coefficients, division steps, alert levels etc.. This way, one and the same firmware can be used for various types of sensors.

The EEPROM data are part of the project file. After opening a project, the EEPROM data need to be written manually. Therefore please open the "Memory / EEPROM" menu and then press "Write".

PICOCAP[®]

PCapØ2plus

alibration A	dvanced				
l <u>o. of</u> Calibratic)	on Values			No. of Calc 0	ulation Va
Name	dec	fpp	hex	Name	dec
				-	
				3	
			-		
			-	-	_
		0 0		-	
			-	-	
			-		
				_	
			-		
		_			
				Re	ad
				W	rite
		_		4	
		8 8	-	-	
			-		
				-	
				_	
				_	
				-	
		_		-	
				-	
		-	-	-	
				-	

Figure 1-14: EEPROM Window



EEPROM		
Calibration Advanced		۲
Address d127	Write Data × 00 Length for Read/Erase d1 Read Data	Write Erase Read
Block Erase Data for Block Write ×00 Block Write	BG_TRIM1 7 OCF_TIME 5	EE_ON EE_DISABLE EE_WR_EN EE_SINGLE_WR_EN

Figure 1-15: EEPROM Window

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1.5.3 Diagnostics Window

acan	Diagnostics												e 83
#	Name		Results		Shift	Factor	Offset		Span	Final Result	Mean 20	Std Dev	SNR [bit]
0	MW0	<470>	00F319	U	0	1	0	AO	1	62,233k	62,225k	10,8385	-3,438
1	C1/C0	<470>	1FEE3A	U	-21	1	0	AO	1	997,83m	997,735m	187,664u	12,38
2	C2/C0	<230>	203C06	U	-21	1	0	AO	1	1,00733	1,00734	209,913u	12,22
3	C3/C0	<230>	203463	U	-21	1	0	AO	1	1,00639	1,00665	213,548u	12,19
4	C4/C0	<230>	000000	U	-21	1	0	AO	1	0	0	0	Inf
5	C5/C0	<230>	000000	U	-21	1	0	AO	1	0	0	0	Inf
6	C6/C0	<230>	000000	U	-21	1	0	AO	1	0	0	0	Inf
7	C7/C0	<230>	000000	U	-21	1	0	AO	1	0	0	0	Inf
8	PT0/PTref	<230>	000000	U	-21	1	0	AO	1	0	0	0	Inf
9	PT1/PTref	<230>	000000	U	-21	1	0	AO	1	0	0	0	Inf
10	PT2/PTref	<230>	1A0991	U	-21	1	0	AO	1	813,668m	813,71m	55,3413u	14,14
11	FR11	<230>	0062AD	U	0	1	0	AO	1	25,261k	25,2602k	3,86992	-1,952

Figure 1-16: Diagnostics Window

The 'Diagnostics' window is used for real-time numerical display of the measurement results. In principal it shows the content of the read registers. The content itself depends on the firmware. Figure 1-16 shows the content as it is given with the standard firmware. The first eight rows show the capacitance ratios, the last two rows show the temperature result (resistance ratio or linearized temperature).

The 'Diagnostics' window has 12 columns of information, defining labels, data format, resolution specification (white background) and results (grey background). The information in the white fields increase convenience of reading and is stored in the project files (*.prj). All number may get a character to indicate the well-known prefixes for denoting the factor in thousands ('p', 'f', 'a', 'k'...).

Name	Label for the register content, depends on the firmware.
Results	Raw hex data display of the result register content. The column before shows the width. The button column after shows whether the result is signed or unsigned.
Shift	This column shows the size of the fractional part of the fixed point number and the necessary shift. Depends on the firmware.
Factor	The factor is a scaling factor that allows to scale the result according to the reference capacitor. Factor = '1' gives back the initial capacitance ratio in column 'Final result'.
Offset	Offset to be added or subtracted in the evaluation software.
Span	Number that defines the maximum span of the sensor. Is relevant only for the calculation of the resolution in column SNR [bit].



Final Result	Display of the final result, scaled by 'Factor' and the 'Offset' added.
Mean	Display of the mean value. The sample size can be selected.
Std.Dev	Standard deviation of the 'Final Result'.
SNR [bit]	Signal-to-Noise ratio in bit, calculated as 'Span'/ 'Std.Dev.'

1.5.4 Graph Window



Figure 1-17: Graph Window

The data to be displayed are selected in the field at the bottom right. The labels in the buttons are the same as in the diagnostics window. To display data press the corresponding button so that it gets green. Top right of the 'Graph' Windows are various options for automatic zoom in/out, center or scale in other ways. Below the graph are various automatic zoom functions for the x-axis and the y-axis.

Y-Zoom will be chanced with the keys [+], [-] and X-Zoom with the keys [*], [/]. With the cursor control keys [\leftarrow], [\rightarrow], [\uparrow], [\downarrow] is it possible to move the graph.

The data displayed can be stored into a text file. For long-term investigations it is possible to reduce the data displayed and stored. The field 'Data Reduction' allows to define the level of data reduction.

1.5.5 Registers Window

These windows display the configuration data in hexadecimal format as they are currently used. Also the result registers' content is shown in hexadecimal format, but updated only when the button is pressed. Finally, the various status bits are shown.



Registers	
Write Registers	Results
	Register
Register 2, 1, 0	× 01000F
Register 5, 4, 3	× 058094
Register 8, 7, 6	× A80401
Register 11, 10, 9	× 001000
Register 14, 13, 12	× 00010F
Register 17, 16, 15	× D00000
Register 20, 19, 18	× 000007
Register 23, 22, 21	× 020000
Register 26, 25, 24	× 000108
Register 29, 28, 27	× 054002
Register 32, 31, 30	× 000005
Register 35, 34, 33	× 054300
Register 38, 37, 36	× 340000
Register 41, 40, 39	× 000000
Register 44, 43, 42	× 004400
Register 47, 46, 45	× 00FF00
Register 50, 49, 48	× 013007
Register 53, 52, 51	× 000000
Register 56, 55, 54	× 000000
Register 59, 58, 57	× 000000
Register 62, 61, 60	× 000000
Register 65, 64, 63	× 000000
Register 68, 67, 66	× 000000
Register 71, 70, 69	× 010000
Register 74, 73, 72	× 000000
Register 77, 76, 75	× 012800

Write Registers	Results
	Results
Res 0 <470>	× 00F319
Res 1 <470>	× 1FEE3A
Res 2 <230>	× 203C06
Res 3 <230>	× 203463
Res 4 <230>	× 000000
Res 5 <230>	× 000000
Res 6 <230>	× 000000
Res 7 <230>	× 000000
Statusreg	× 000001
Res 8 <230>	× 000000
Res 9 <230>	× 000000
Res 10 <230>	× 1A0991
Res 11 <230>	× 0062AD
ſ	Read Results
Statusreg	
Port Error	000000
Runbit	COMB_ERR
CDC active	
RDC ready	MUP_ERRO
EEPROM busy	
Autoboot busy	SENSE_TES
RES_FLAG_SRAN	1 🔘 TESTMODE
	2020
RES_FLAG_PART	Y

Figure 1-18: Write and Read Registers

1.5.6 Parameter Window

This window shows the content of the parameter registers. The meaning of the content strongly depends on the firmware.

The parameter registers are used e.g. to scale the pulse output interfaces, to set the gain correction factor or to tell the firmware whether differential sensors are used.

PICOCAP[®]

PCapØ2plus

ran Parameter					
Parameter Flags in PARA8					
#	Name		#	Name	
0	Config Bit 0	\odot	12	Config Bit 12	\odot
1	Config Bit 1	\odot	13	Config Bit 13	\odot
2	Config Bit 2	\odot	14	Config Bit 14	\odot
3	Config Bit 3	\bigcirc	15	Config Bit 15	\bigcirc
4	Config Bit 4	\odot	16	Config Bit 16	\odot
5	Config Bit 5	\odot	17	Config Bit 17	\bigcirc
6	Config Bit 6	\odot	18	Config Bit 18	\odot
7	Config Bit 7	\odot	19	Config Bit 19	۲
8	Config Bit 8	\bigcirc	20	Config Bit 20	\bigcirc
9	Config Bit 9	\odot	21	Config Bit 21	۲
10	Config Bit 10	\bigcirc	22	Config Bit 22	\bigcirc
11	Config Bit 11	\bigcirc	23	Config Bit 23	\bigcirc

Para	ameter	Flags	in PA	RA8		
#	Name			#	Name	1
0	Config E	Bit O	0	12	Config Bit 12	C
1	Config E	Bit 1	0	13	Config Bit 13	0
2	Config E	Bit 2	0	14	Config Bit 14	0
3	Config E	Bit 3	0	15	Config Bit 15	0
4	Config E	Bit 4	0	16	Config Bit 16	C
5	Config E	Bit 5	0	17	Config Bit 17	0
6	Config E	Bit 6	0	18	Config Bit 18	0
7	Config E	Bit 7	0	19	Config Bit 19	0
8	Config E	Bit 8	0	20	Config Bit 20	C
9	Config E	Bit 9	0	21	Config Bit 21	0
10	Config E	Bit 10	0	22	Config Bit 22	0
11	Config E	Bit 11	0	23	Config Bit 23	0

Figure 1-19: Parameter Window

1.6 First Measurement: Step-by-Step

Configuration files, Firmware, Settings and EEPROM data are subsumed in a project file. When opening a project file then automatically the configuration and firmware data will be transferred to the chip and the chip is initialized.

Step 1: The first to do after starting the evaluation software is to select the supported PICOCAP device on the setup page. In the initial phase start with our standard firmware that calculates the capacitance ratios and resistance ratios. It automatically recognizes the operation mode and takes care of the set number of capacitors and the kind of connection. But it does no further processing.

Step 2: If you want to change from the default SPI to I2C interface, please select under *Tools* \rightarrow *Interface* \rightarrow *I2C*. The LED on the PicoProg V2.0 programmer should now turn red. When the LED does not glow at all, then it indicates that the interface is faulty.

Step 3: By pressing the 'Standard'-button, the standard project file will be open. That means the standard firmware is loading into the SRAM of the device and loads the configuration file. The project file contains the configuration and parameter registers content and the settings of the Evaluation software.

You also may load your own project file. In case the project uses the EEPROM it will be necessary to open the EEPROM window and press 'write' to write the EEPROM data into the chip.

Step 4: Open Graph window and press 'Start Measurement'.



2 Miscellaneous

2.1 Literature Guide

Data Sheets

Title	Document-No
PCapØ2A Single Chip Solution for Capacitance Measurement Volume 1: General Data and Front-End Description	DB_PCapO2A_Vol1_en.pdf
PCapØ2Ax-DSP Single Chip Solution for Capacitance Measurement Volume 2: Digital Signal Processor	DB_PCapO2A_Vol2_en.pdf
PCapØ2-EVA-Kit Evaluation System for PCapØ2	DB_PCapO2-EVA-Kit_en.pdf
PCapØ2plus Evaluation Software for PICOCAP Devices	DB_PCapO2plus_en.pdf
PCap Assembler Assembler Software for PICOCAP Devices	DB_PCap-Assembler_en.pdf

White Papers

Title	Document-No

Application Notes

Title	Document-No

The latest versions of the available documents can be downloaded from the acam website at:

http://www.acam.de/download-center/picocap



2.2 Document History

19.01.2013 First release





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