PICOSTRAIN

Evaluation Board for Measurements of
Strain and Capacitance

PSA21

Manual

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Precision Time Interval Measurement

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1. Introduction

1.1 General

PICOSTRAIN stands for a new concept in measuring strain gages and capacities. The key features are:
- Digital measuring principle
- Easy realization of complete System-on-Chip solutions
- Standard CMOS process technology
- Very low current consumption
- Programmable resolution
- High temperature stability
- Temperature measurement implemented
- Wide offset span, no need for matching strain gages

1.2 System Overview

- PC supported system
- Modular system:
  - PSA21 main board
  - Three different plug in modules for standard, Wheatstone and capacity measurement.
- Easy to use Windows based configuration software
- User-friendly solder pads (J12, J13) for connecting strain gage load cells
- A serial interface (J18) to connect module to PC when working in system mode
- A test point (TP3) for ground connection
- Two test points (TP1, TP2) to measure PSØ21 supplies HVDD (Vsg) and LVDD (Vcc)

1.3 System Components

The complete PSA21 evaluation system consists of the following components:

- PSA21 main board
- PSA21 mini modules (Standard, Wheatstone and Capacitor)
- CD with complete PSA21 software and documentation
- RS-232-cable
- 12 VDC power supply
- Capacitors 33 nF, 68 nF, 82 nF, 100 nF, 5 x each
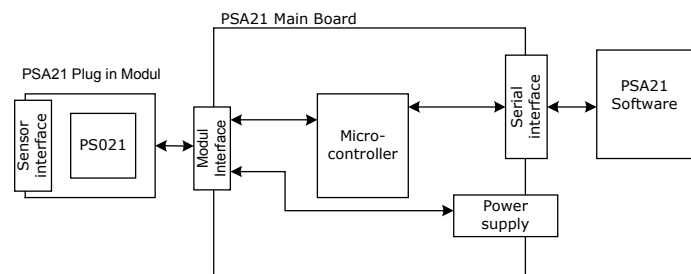
The PSA21 evaluation system is structured as follows:

The main board is connected to the PC's serial port via 9-pin serial cable. Due to the modular system design the main board provides a slot for three different plug in modules. Thus the system can be adapted easily to different measurement applications. For strain gage

The PSA21 evaluation system provides a hardware module, that consists of a main board, up to three plug-in modules and a windows-based software which allows extensive and user-friendly configuration of the system.

For a proper use of the evaluation system it is strongly recommended to refer to the current PSØ21 datasheet. You can download this datasheet from www.acam.de.

- A jumper (J2) to measure SG current for PSØ21 supply HVDD (Vsg)
- A jumper (J8) to measure the core current for PSØ21 supply LVDD (Vcc)
- A serial SPI (J19) interface for connection of an external PSØ21
- A green LED (D2) which signals correct polarity of power supply input
- A red LED (D3) which signals elementary error in user code of µController
- A press-button switch (SW1) which generates a hardware reset for the module

applications a standard and a Wheatstone module is available. Furthermore acam provides a capacity module for the PSA21 system that allows test and evaluation, e. g. with pressure sensors, capacitive sensors.

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1.4 Index

EMI

PSA21 is an evaluation board. It requires the user to assemble a strain gage sensor before operation. This will have a big impact on the electromagnetic behavior of the overall system

2 How to connect the Strain Gages

This chapter will present you the necessary information about how to connect strain gages to the standard- and Wheatstone plug-in module.

Important note!
The PICOSTRAIN measuring principle provides an unprecedented degree of flexibility. For this reason we abstained from assembling fixed discharging capacitors to the strain gage plug-in modules.

2.1 Standard Plug-in Module

The standard plug-in module is designed for strain gage applications that use the full advantage of PICOSTRAIN. It is possible to measure up to 4 half bridges or 2 full bridges. Due to the PICOSTRAIN measurement principle the system does not need a full bridge. Two resistors, below called a halfbridge are sufficient. This makes the PSA21 a powerful tool in developing, analyzing and evaluating custom specific solutions for strain gage applications. The following chapters describe various possibilities to connect the strain gages to the PSØ21 as well as the appropriate operating modes exemplified with a strain gage load cell.

2.1.1 Capacitor Selection and Assembly

Capacitor Choice
The PICOSTRAIN measurement principle is based on measuring the discharge time of a capacitor. For this reason the correct size and material of the capacitors is significant to achieve best measuring results. In general we recommend a discharging time in the range of

$$\tau = 0.7 * R * C = 50 \text{ to } 60 \text{ } \mu s.$$

As material we recommend CFCAP (Multilayer ceramic from Taiyo-Yuden), COG, NPO or Polystyrol.

Table 1 Recommended capacitor values for 1 kΩ strain gages for up to 2 kHz update rate:

	Pads	Value
Bridge 1	CD1, CD2, CD3	68nF to 82nF
Bridge 2	CD4, CD5, CD6	68nF to 82nF

Table 2 Recommended capacitor values for 350 Ω strain gages for up to 2 kHz update rate:

	Pads	Value
Bridge 1	CD1, CD2, CD3	180nF to 220 nF
Bridge 2	CD4, CD5, CD6	180nF to 220 nF

The given values are suitable up to 2 kHz update rate. At higher update rates the discharge time has to be reduced. Please also refer to the PSØ21 datasheet for a better understanding of how to dimension the capacitors for different sensors and operating modes.

Assembly
The discharging capacitors CD1, CD2, CD3, CD4, CD5 and CD6 are not assembled on the plug-in modules as delivered. This has to be done by the customer. The shipment includes a set of typical capacitance values (Tayio-Yuden CFCAP series). This allows free and application specific dimensioning of the capacitor value. The standard plug-in modules supports 2 x 3 paralleled discharging capacitors. Figure 1 shows where to solder them.
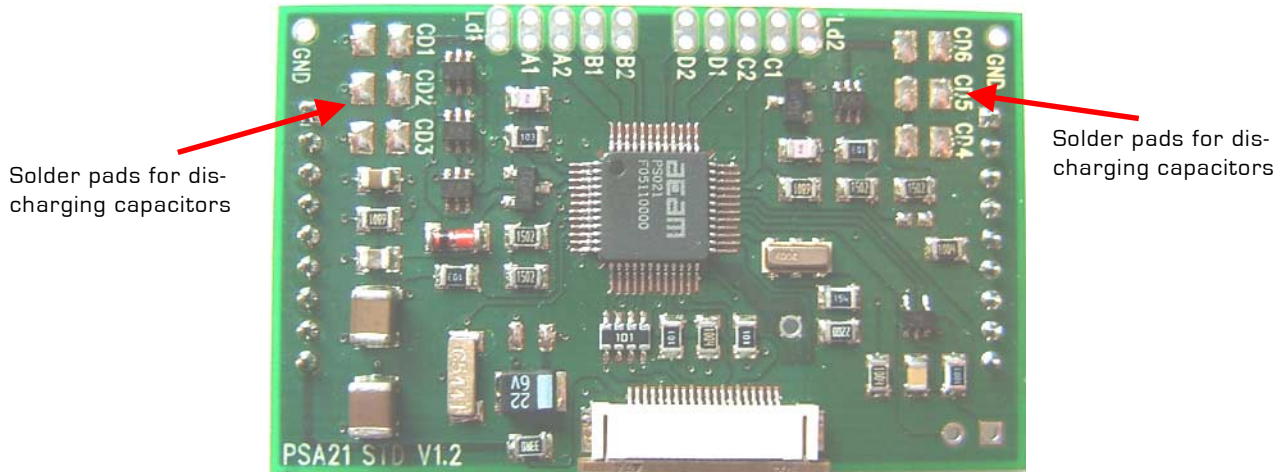
Figure 1 Capacitor pads for standard plug in module

Solder pads for dis-charging capacitors

Solder pads for dis-charging capacitors

2.1.2 Halfbridge

A halfbridge is sufficient to run the PSA21 evaluation system. The following picture shows a halfbridge attached to port 1 (pads A and B). In this case the PSA21 must be configured to run in operation mode "halfbridge 1" (see also 2.1.2 Halfbridge). Of course it is also possible to connect it to with port 2 (pads C and D). Then operation mode "halfbridge 2" has to be selected. Take care that the resistors are connected to two pads in parallel (A1 & A2, B1 & B2).
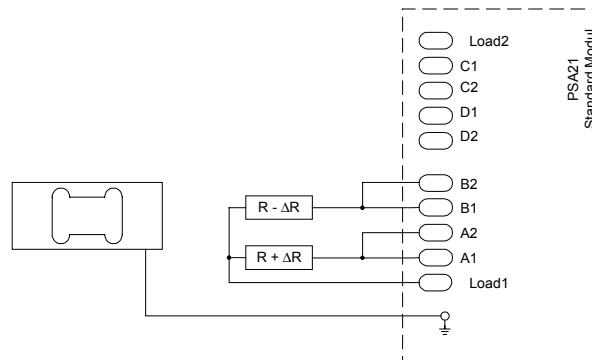

Figure 2 Connecting a half bridge

2.1.3 Fullbridge

This chapter describes how to connect a fullbridge to the PSA21 standard module. Two different modes are available, depending on whether a single comparator is used for both halfbridges or each halfbridge has its own comparator.

2.1.3.1 One-sense Mode

In one-sense mode both halfbridges are connected to the same comparator via Load1 pin. The PSA21 can treat the sensor as one fullbridge or two separate halfbridges. Connecting the strain gages as a fullbridge will be the most common solution because of the lowest temperature drift. This is shown in Figure 3. The connection between Pads A1 & A2, B1 & B2, C1 & C2 and D1 & D2 has to be done by the user. For further information please have a look at PS021 datasheet, Chapter 4.1.
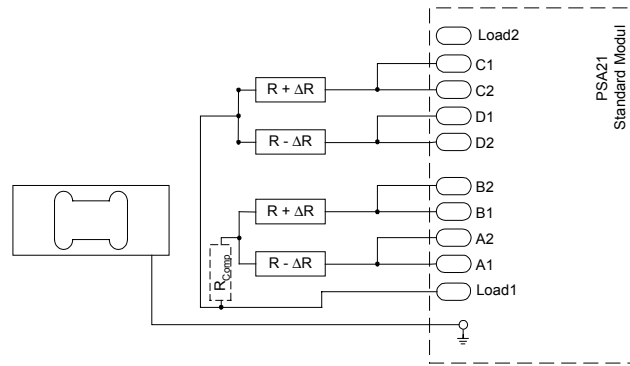
Figure 3 Connecting a fullbridge in One sense mode

2.1.3.2 Alternating Mode

In Alternating Mode every halfbridge is connected to a separate comparator. Main advantage for this operation mode is the redundancy and tolerance against failure. Furthermore it is possible to measure two halfbridges with different resistance values. In general we recommend to use "One sense mode", especially for applications that do not need two comparators. For detailed information please consider the PSO21 datasheet, chapter 4.1.
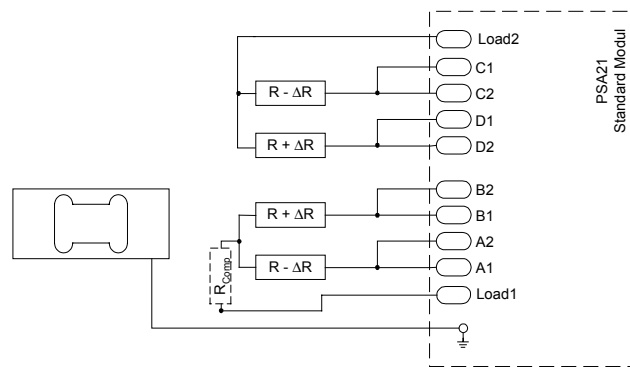

Figure 4 Connecting a fullbridge in Alternating mode

2.1.4 Doublebridge Mode

In Doublebridge mode the PSA21 can measure up to 4 halfbridges and 2 doublebridges. The doublebridge mode also supports One-sense mode and Alternating mode. Regarding One-sense mode as the most common option Figure 5 shows a configuration for the connection of four halfbridges or two fullbridges.

Connecting 4 half-bridges:
R2, R4, R6, R8 = + ΔR
R1, R3, R5, R7 = - ΔR

Connecting 2 full-bridges:
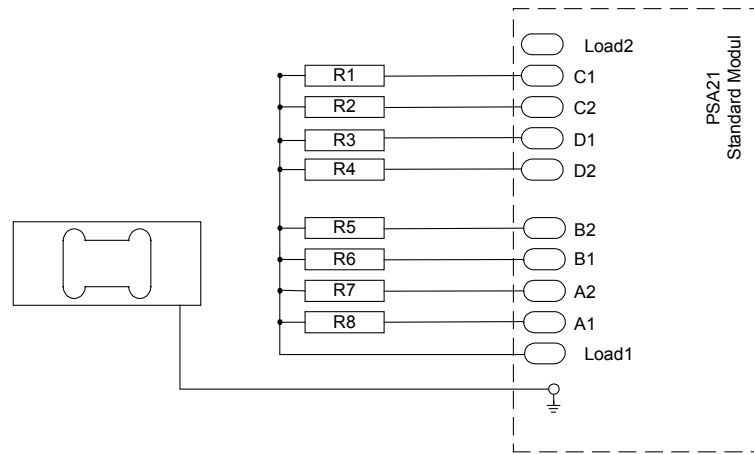R2, R3, R6, R7 = + ΔR
R1, R4, R5, R8 = - ΔR

Figure 5 Connecting four halfbridges or two fullbridges in One sense mode

Furthermore the PSA21 offers two different modes with respect to averaging/resolution (see also 4.3.2 Operation modes). In Mode 1 the fullbridges are measured alternately on the basis of one and the same averaging rate specified in the software's PSØ21 sheet.
In Mode 2 the two fullbridges may have different averaging rates and therefore a different resolution. For further information please refer the PSØ21 data sheet.

2.2 Wheatstone Plug-in Module

The Wheatstone plug-in module is also designed for strain gage applications and is capable of measuring up to 2 Wheatstone bridges. The following chapters describe various wiring facilities for the strain gages to the PSØ21 and the appropriate operating modes, considering a strain gage load cell as an example.

2.2.1 Capacitor / Resistor Selection and Assembly

When using the Wheatstone module it is necessary to select and assemble not only the discharge capacitors CD1, CD2 and CD3 but also the compensation resistors R1 and R2.

Selection
In Wheatstone mode it has to be considered that the strain gage resistance is reduced by 25%. As a consequence the discharge capacitor's value is increased compared to section 2.1.1 as shown in
Table 3. Furthermore the use of one comparator in combination with an analog multiplexer is sufficient for operating in Wheatstone mode. For this reason only three discharging capacitors are needed to run the evaluation system.

Table 3: Recommended capacitor values when using 1kΩ and 350Ω strain gages

Capacitance	Using 350 Ω strain gages	Using 1kΩ strain gages
CD1 + CD2 + CD3	270 nF to 330 nF	82 to 100 nF

The compensation resistors R1 and R2 have a significant influence on the quality of temperature compensation. Therefore the resistance value is application specific and has to be selected carefully. From our experience, choosing a compensation resistor in the range of 75% of the strain gage resistor will be a good choice. Both resistors have to attached even with a signle wheatstone bridge. We recommend the following resistor values:

Table 4: Recommended compensation resistor values

Rcomp	Using 350 Ω strain gages	using 1kΩ strain gages
R1	270 Ω	680 Ω
R2	270 Ω	680 Ω

Note that the discharging capacitors and the compensation resistors are important parts and directly influence the measuring result. Therefore we recommend to refer to the PSØ21 datasheet for a better understanding of how to dimension the compensation resistors and discharging capacitors.

Assembly
Figure 6 shows where to solder the capacitors and resistors.

Solder pads for discharging capacitors

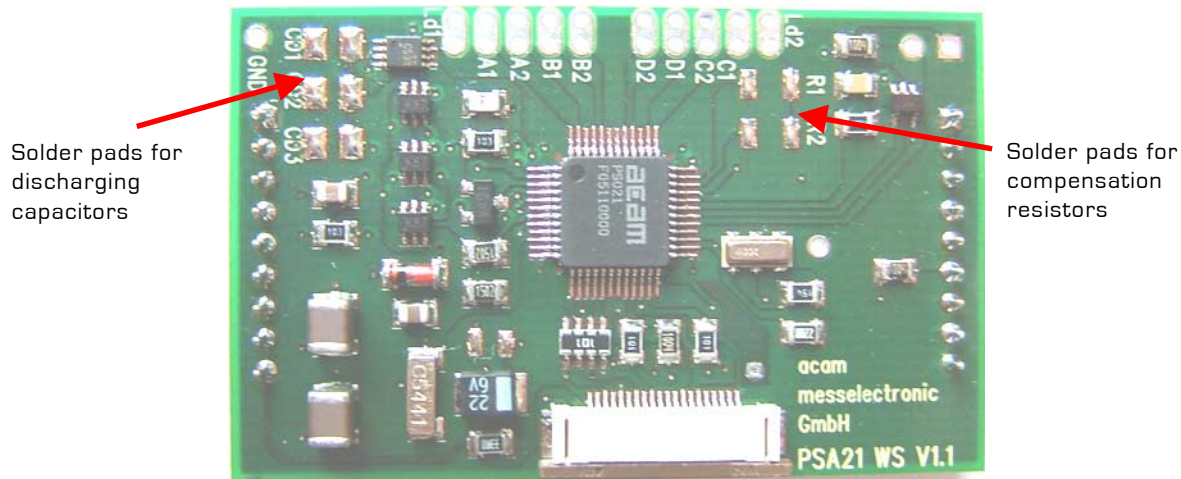Solder pads for compensation resistors

Figure 6 Paralleled solder pads for discharging capacitors and compensation resistors

2.2.2 Connecting Diagram

The Wheatstone module allows connecting a classical Wheatstone bridge to the PSA21. The module is capable of measuring up to 2 full bridges. The configuration options are the same as for the standard module.
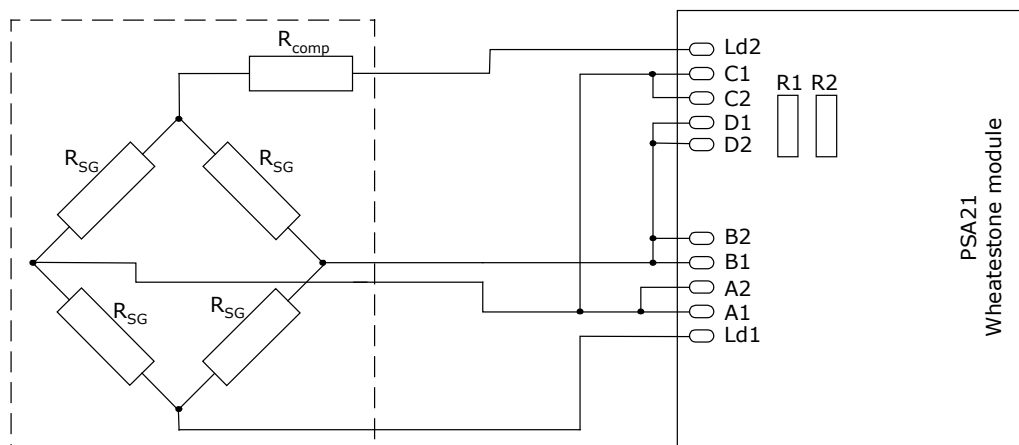The following figures show how to connect the Wheatstone bridge.

Figure 7: Connecting a Wheatstone bridge to the PSA21 Wheatstone module
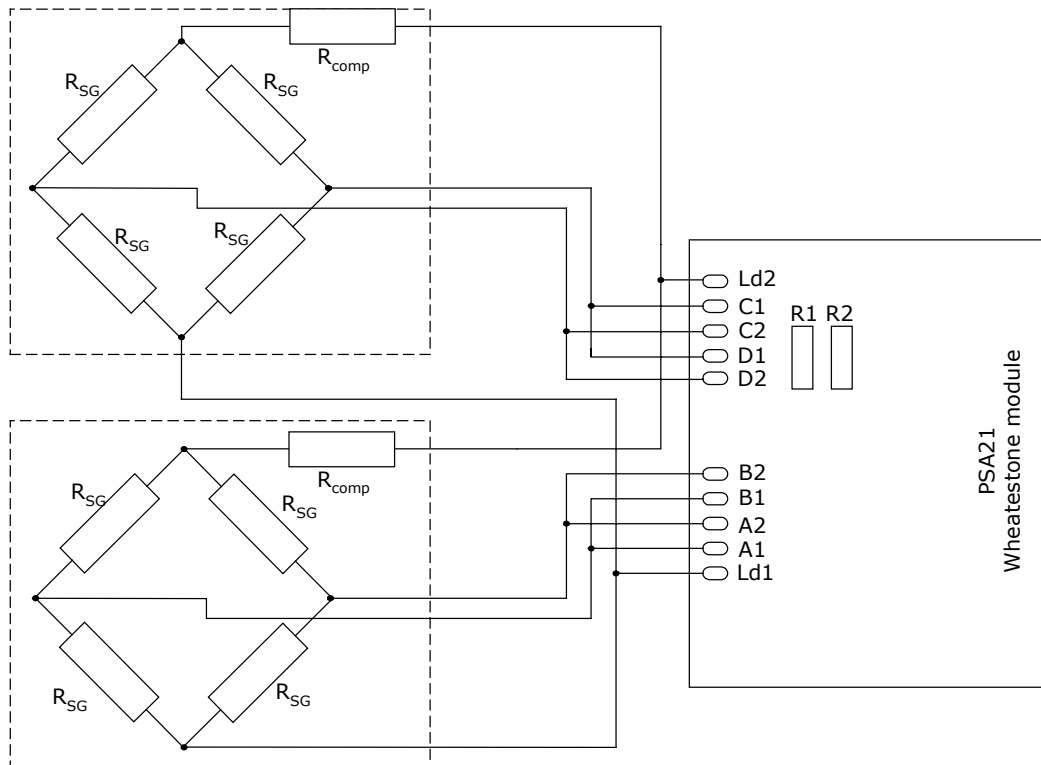
Figure 8 Connecting two Wheatstone bridges

The Wheatstone module allows the evaluation of current Wheatstone bridges without modification. This provides technical advantages when the application needs a long cable between sensor and electronics. In comparison with the standard module, only 66% of the standard performance can be achieved in this mode. Also the resolution is reduced by 0.6 bit.

For further information concerning the Wheatstone module please refer to the PSØ21 datasheet.

2.3 Temperature compensation

The k-factor of strain gages depends on temperature. For this reason the measurement results of the PSØ21 are also temperature sensitive. Therefore the PSA21 offers an additional temperature measurement with an external sensor for error correction. The following figure shows the configuration of the temperature port. Capacitor C43 and the resistor R43 are part of the PSA21 plug-in module.
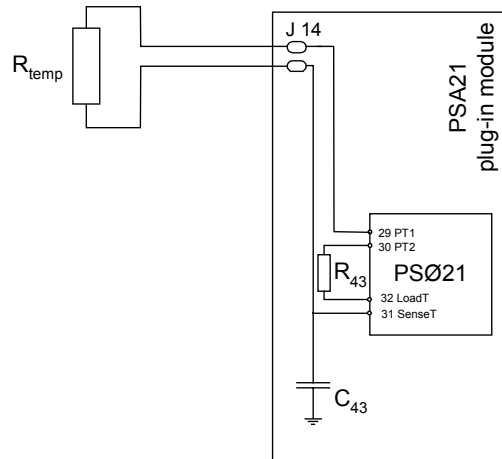

Figure 9 Connecting diagram for temperature measurement

The reference resistor R43 and the temperature dependent resistor (PTC, KTY) should have the same value. The default values of the temperature port of PSA21 are:

Component	Value
C43	6,8 nF
R43	1kOhm

3 Capacitance measurement

In combination with the capacity plug-in module the PSA21 provides a powerful development tool for testing and evaluating capacitance measurement applications. The PSA21 offers two different ways to measure capacities that cover high precision applications as well as for low power systems or very fast systems.
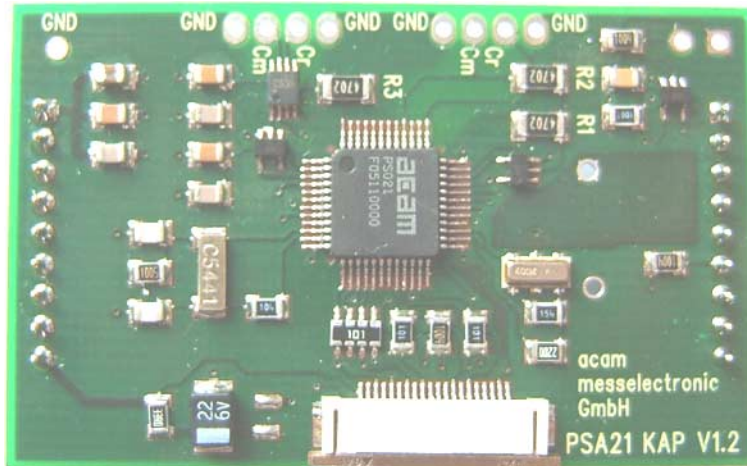

Figure 10 Capacity module

Working with the capacity plug-in module the AVRateRdson has to be switched to "0" (see chapter 3 Capacitance measurement) and the GainCompRate has to be switched off. The system generally works in single-bridge mode. This means that it is possible to measure the ratio C_{sense}/C_{ref} of up to two sensors on port 1 and port 2. Principally the PSØ21 is able two treat up to 4 sensors in double bridge mode, but this is not supported by the evaluation system. See also PSØ21 datasheet, chapter 6.3.2.. For measurements with two sensors port 2 is connected in the same manner as port 1. The residual pins are not used and internally connected to ground.

3.1 Grounded capacitors

Grounded capacitors are used for all applications where the measuring capacitors are directly connected to ground. In this case, the connecting diagram as shown in Figure 11 should be used.
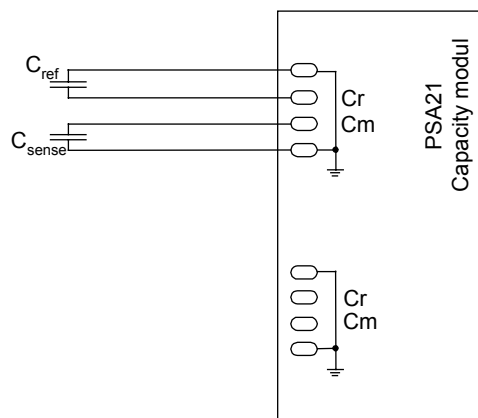

Figure 11 Measuring grounded capacitors

This mode runs like the usual strain gage measurement besides the configuration for AVRateRdson and GainComp-Rate. It doesn't support additional compensation algorithms (Cmeas2 = 0, compensated measurement mode off, see also the following section) and is not recommended for solutions that require high resolution with low offset, gain and temperature drift.

3.2 Compensated capacity measurement

In compensated capacity measurement mode the PSA21 is capable of solving highest resolution applications with low offset and gain drift. Here, too, the capacitors are connected to ground, but now they are switched alternately to a resistor by an analog switch. The PSA21 is able to measure the ratio Csense/Cref of one sensor.
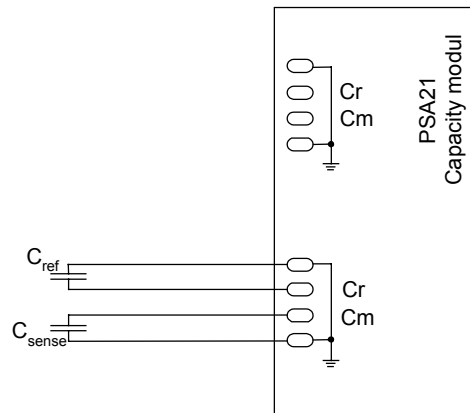
Figure 12 Compensated capacity measurement

This mode offers additional compensation algorithms to correct for parasitic capacities and the comparator propagation delay and is divided in the following submodes:

Cmeas2 = 0	Mode off
Cmeas2 = 1	Mode on, compensation disabled
Cmeas2 = 2	Mode on, compensation enabled

Configuration of these submodes has to be done via configuration software as described in chapter 4.4.10.1 CMeas1.

For further information please refer to the PSØ21 datasheet.

3.3 Temperature compensation

The relative permittivity of capacities also depends on temperature. Therefore the temperature measurement described in chapter

2.3 Temperature compensation is used for error correction, too. For detailed information please refer to this section and also to the PSØ21 datasheet.

For additional information concerning capacity measurement we recommend to consider the PSØ21 datasheet.

4 Evaluation board software

4.1 Installing the PSA21 Software

The PSA21 software is running under the following operating systems
- Windows 95/98
- Windows NT
- Windows 2000
- Windows ME
- Windows XP

To install the PSA21 evaluation board software please follow these instructions:

- Install first the NI VISA drivers, running NIVisa-2.6\visa3260runtime.exe
- IInstall the main software running PSA21 Main\Installer\setup.exe. The window shown in Figure 13 appears.
- Please follow the instructions on screen to install the software.

For further information also refer to the install.txt file on the CD.

Figure 13 Evaluation kit software installation

4.2 Running PSA21 Software

After installation the PSA21 Software is started by selecting "PSA21" from the "PicoStrain PSA21" folder in Windows program menu. The following window appears:
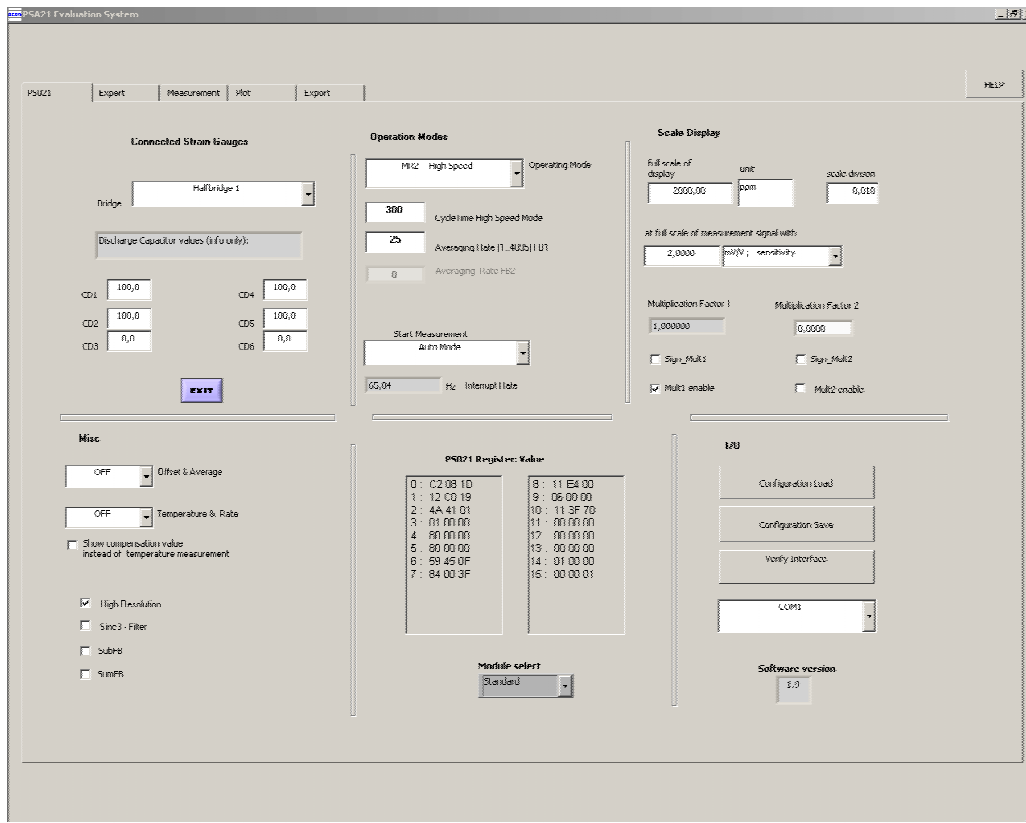
Figure 14 Main window of the PSA21 software

The PSA21 main window is divided into 5 sheets. Every sheet enables the customer to configure a set of parameters:

- PSØ21:   Configuration window for all basic measurement parameters.
- Expert: Setup for advanced measurement parameters.
- Measurement: Enables Start/Stop of measurement and provides a display window for measurement results in alphanumeric numbers.
- Plot: Displays the measurement results in a graphical plot window.
- Export: User interface to export the recorded data into a file.

The user can get a detailed description of each control and indicator element of the window by pressing the "Help"-Button. Then a "Context Help"- window is opened. This window shows a description of the element which has the cursor's focus.

4.3 Configuration of PSØ21

As mentioned the PSØ21 window enables to configure the basic settings of the PSA21 Evaluation system. It is divided into six sections. Every section represents a set of parameters that has to be configured by the customer. The following chapters describe the user specific configuration of this parameters.
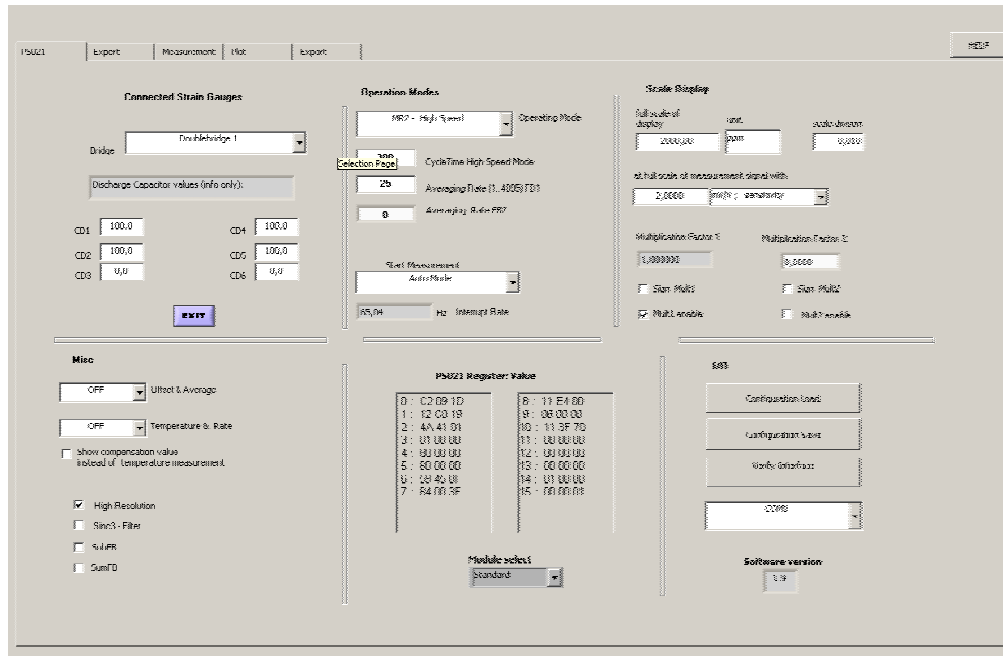
Figure 15 Basic settings of PSØ21

4.3.1 Connecting Sensors

4.3.1.1 Configuration for the standard plug-in module

The standard module can operated in single-bridge or in doublebridge mode. The selection is made in the sheet "Expert settings" as described in chapter 4.4.1.1 Single bridge. Due to the selected operation mode, the following settings have to be made.
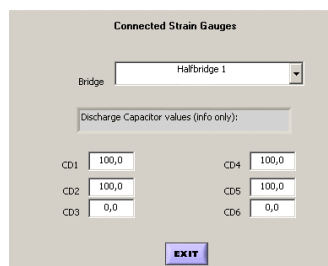

Figure 16
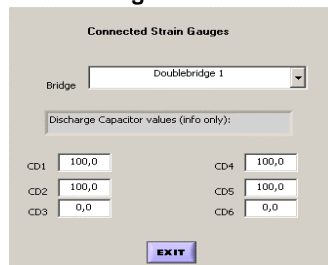
Figure 17

In single-bridge mode the different operation modes are selected with the pull-down menu shown in Figure 16. The customer can select between the following operation modes that are described in chapter 0.
- Halfbridge one
- Halfbridge two
- Halfbridge one/two alternating mode
- Halfbridge one/two one sense mode

Further the values of the discharge capacitors are displayed. Note that the display of these values is only for information. Modification by editing the text fields have no consequences.

For operation in doublebridge mode in combination with the standard module the configuration has to be done as described above. The following operation modes are supported:
- Double bridge one
- Double bridge two
- Double bridge one/two alternating mode
- Double bridge one/two one sense mode

4.3.1.2 Configuration for the Wheatstone module
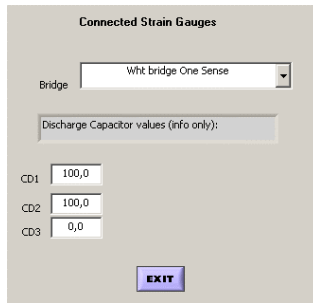
Figure 18

Using a Wheatstone module the PSA21 only supports one-sense mode as shown in Figure 18. In Wheatstone mode only three discharging capacitors are needed. Their values are displayed in the related text fields.
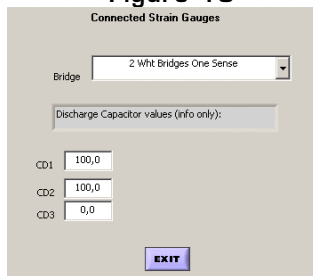
Figure 19

When operating in doublebridge mode in combination with the Wheatstone plug-in module the PSA21 evaluation system provides the following settings:
▪ Wheatstone bridge one
▪ Wheatstone bridge two
▪ Two Wheatstone bridges in one sense mode
This settings are also done by the pull down menu.

4.3.1.3 Configuration for capacity measurement

Figure 20

For capacity measurement the PSA21 only supports single bridge mode. Due to the measuring principle no fixed discharging capacitors are used. Because of that no values are displayed and the settings are disabled.

4.3.2 Operation modes

In this field the user sets parameters that specify the basic operating mode.

Figure 21 Operation Modes

4.3.2.1 Operating mode

Basically the PSØ21 offers two different operating modes with two possible choices of the source for the clock signal. The selection is done with the pull down menu "Operating mode".

Running the PSA21 in measurement range 2 ("MR2")is recommended for applications that require high resolution or low power consumption.

The advantage of measuring rate 1 ("MR1") is that no additional high speed clock is needed when working with a 32kHz reference for cycle clock. This minimizes the number of external components. In measurement range 1 it is further possible to achieve update rates up to 50 kHz. This makes measurement range 1 applicable for applications with low resolution and high measurement frequency or if minimun part number is required.

4.3.2.2 Cycle time high speed mode

The cycle time represents the sum of charging and discharging time. It is defined in multiples of the reference clock CLKHS and can be modified per entry in the text field shown in Figure 21 Operation Modes. As the discharge time is defined by the RC-network it is necessary to guarantuee a long enough recharge time.

Important note!
For a correct operation it is mandatory that the cycle time is not too short!!
As a minimum we recommend Tcycle-min = 1.4 * (0.7*(C+20pF) * R)

The setting for the cycle time defines the number of single measurements per second and as a consequence the precision/update rate of the PSA21 evaluation system. It is therefore a very important value and requires some attention.

4.3.2.3 Averaging Rate FB1

The precision of the measurement results can be internally improved by averaging. The averaging rate of fullbrige 1 is set by value in the appropriate text field, shown in Figure 21 Operation Modes. This measuring principle guarantees that no significant systematic errors affect the result and the standard deviation is improved by the square root of the averaging rate.

4.3.2.4 Averaging rate FB 2

This value sets the averaging rate for fullbridge 2. Modification is only permitted in "doublebridge"-operating mode.

4.3.2.5 Start measurement

This pull down menu, also shown in Figure 21 Operation Modes, provides three different possibilities to configure the start conditions of the PSØ21. In "Autorunning"-mode, the PSA21 automatically restarts for a new measurement after calculating the measurement value and setting an interrupt. Running with "Single Conversion by external start"-mode (BNC- J15 on PSA21 board) the PSA21 enables the synchronization of the PSØ21 update rate with an external device. Of course it is necessary to ensure that the external frequency is lower than the maximum possible update rate of the PSØ21 in its current setup. Operating in "Single Conversion by µC-Timer [ms/sec]"-mode, the automatic restart of a new measurement is disabled. The microcontroller (PIC16874) on the PSA21-board starts the new measurement with the selected timer value that is set with an 8 bit opcode via SPI interface. This mode is for lowest current consumption at very low measurement rates.
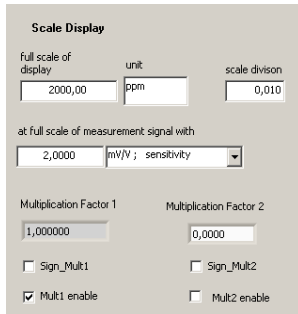
Figure 22

4.3.2.6 Interrupt rate

In auto-mode, the interrupt rate is strictly related to the cycle time and the averaging rate. Additional measurements due to gain compensation (GainCorRate), temperature measurement (TempRate) and fake measurements (MFake) are added. The value is displayed in a text field as shown in Figure 21 Operation Modes. Operating in timer mode and external mode the update rate is given by the timer period which starts a new PSØ21 measurement. Please note that the cycle time of the PSØ21 has to be shorter than this time grid. Otherwise the update rate is limited by the PSØ21 measuring rate to the same as in auto mode.

4.3.3 Scale display

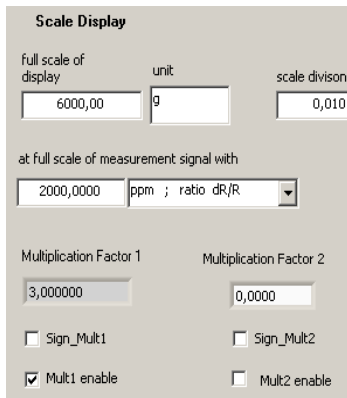The parameters in this section offer user specific scaling of the measurement results that are displayed in the "measurement sheet". The text field "full scale of display" defines the value that will be displayed at max. sensor output signal. Further the customer is able to determine the requested unit of measurement and the step of scale width for his application.

The example below describes an application for a 6000 g scale. The input values for this section strongly depend on the used strain gages. Hence they are described by means of the following example, considering a 6 kg scale.

Gage factor: k = 2
Max. elongation: ε_{max} = 1000 µ
Sensitivity: 2mV/V
At maximum elongation this sensor shows a resistance variation of
$\Delta R/R = k * \varepsilon_{ma}$ = 2000ppm (this would correspond to 10 mV at 5 V supply for a classical bridge).
To achieve direct display of weight, the output data are scaled with the requested resolution of 6000 by entering this value in the "full scale of display"-text field. "Multiplication Factor 1" represents the internally used scaling factor which is 3 in this example.

Figure 23

Note that this application is an example that is only used to describe the scaling functions of the PSA21 software. In real applications noise effects have to be considered. In this case please refer to our application notes or to PSØ21 datasheet, chapter 7.
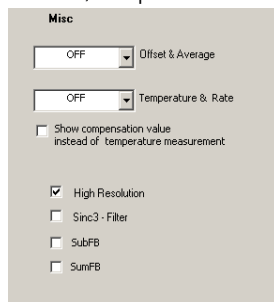
4.3.4 Miscellaneous

In this chapter several parameters concerning offset and temperature compensation will be described.

Figure 24

4.3.4.1 Offset & average
This pull down menu sets the number of measurement cycles used for offset calculation in the PSØ21. The offset compensation improves with the increasing number of measurements used for compensation, but note that the time required will also rise.

4.3.4.2 Temperature & rate
Enables temperature measurement of the PSA21 with an external temperature sensitive resistor. The value selected with the appropriate pull down menu belongs to the frequency of the temperature measurement. The context is shown in the following table.

Table 5 Temp. measurement frequency

Value	Frequency of temperature measurement
OFF	Temp. measurement disabled
1	Temp. measurement at each measurement sequence
2	Temp. measurement at each 6th measurement sequence
3	Temp. measurement at each 9th measurement sequence

Further you can display the compensation value instead of the temperature measurement by activating the checkbox shown in Figure 254.

4.3.4.3 High resolution
Activating this checkbox will double the resolution of the measurement unit of the PSØ21. Depending on measuring mode and discharge time the precision of your measurement will also increase.

4.3.4.4 Sinc3-filter
Activating the sinc3-filter reduces the noise of strain gage values output data. On the other hand the reaction time on changes in strain will slow down.
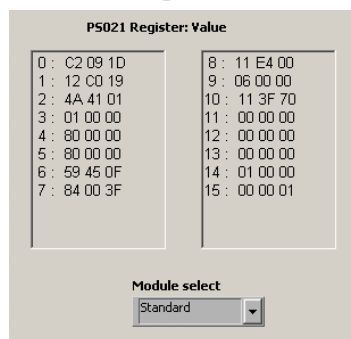
4.3.4.5 SubFB
Enabling this checkbox will cause that the PSØ21 internally calculates the difference HB2-HB1 between the measurement values of both halfbridges.

4.3.4.6 SumFB
If this checkbox is selected, the PSØ21 internally calculates the sum of both measurement value for each half-bridge.

4.3.5 Register values / Module select

Figure 26

PS021 Register: Value

```
0 : C2 09 1D      8 : 11 E4 00
1 : 12 C0 19      9 : 06 00 00
2 : 4A 41 01     10 : 11 3F 70
3 : 01 00 00     11 : 00 00 00
4 : 80 00 00     12 : 00 00 00
5 : 80 00 00     13 : 00 00 00
6 : 59 45 0F     14 : 01 00 00
7 : 84 00 3F     15 : 00 00 01
```

Module select
Standard

PSØ21 Register value
The current configuration of the PSØ21 is shown in the main window. Note that the displayed register configuration will be used for the next start of measurement. Please also note that the display is not affected by configuration changes during a measurement

Module select
This box allows the user to select the PSØ21 plug-in module that is currently connected to the PSA21 main board. The PSA21 software adjusts the configuration settings to a default set of parameters.
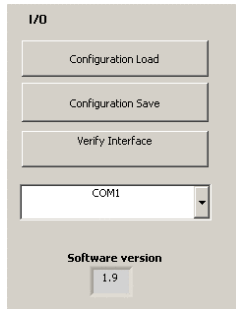
4.3.6 I/O-settings

Figure 27

Configuration load
Pressing this button loads a previously saved configuration set for a certain measurement application from a file.

Config save
Saves a configuration set for a certain measurement in a file.

Verify interface
Shows the status of the communication interface between the PSØ21 plug-in module and the PSA21 main board and displays firmware and software versions.

COM-port
Shows the COM-port of the PC that is connected with the evaluation system.

4.4 Expert settings for PSØ21

The "Expert"-settings represent an advanced level configuration of the evaluation system. Therefore the PSA21 offers various parameter groups as shown in Figure 28. The following chapter describes the setting of these parameters due to custom specific applications. Please also refer to PSØ21 datasheet for more details.

Figure 28 Expert settings

4.4.1 Sensor

4.4.1.1 Single bridge
In single-bridge mode the standard module offers the possibility to measure 1 halfbridge or 2 halfbridges (= 1 full-bridge). The Wheatstone module supports one sensor, connected as a classical Wheatstone bridge as shown in Figure 7. The Capacity module offers the possibility to measure 1 or 2 capacitive sensors.
In single-bridge mode each resistor/capacitor is connected to a pair of pads like A1 & A2 to increase the driver output power.

4.4.1.2 Doublebridge
In doublebridge mode the standard module offers the possibility to measure 4 halfbridges (= 2 fullbridges). The Wheatstone module supports two sensors, connected as a classical Wheatstone bridge.
In doublebridge mode each resistor is connected to only one pad like A1. The driver output power is lower than in single-bridge mode.
It is also possible to measure only one fullbridge in Doublebridge mode, but this option is only implemented for testing. The use in real applications is not recommended.
Please note that double-bridge mode is not available in combination with the capacity module.

4.4.1.3 CLKHS select
Enabling this check box will activate the high-speed oscillator of the PSØ21. The following options are available:

- **External**
  Enables the ceramic oscillator X4 mounted on the PSA21 main board as an external clock source at pin 21 of the PSØ21 for the high speed oscillator .

- **Internal**
  Activating this checkbox switches on the internal oscillator circuit of the PSØ21 and the external ceramic resonator X2. They are running continuously. A measurement starts immediately after receiving opcode "start measurement" or an external trigger.

- **Start delay 640µs**
  The internal oscillator is immediately started after opcode "start measurement" or an external trigger. The measurement starts with a delay of 640µs. At the end of the measurement the oscillator is switched off. The delay guarantees that the oscillator has settled before the measurement starts. Note that the "start delay" option is only available in combination with the use of the 32 kHz oscillator and running the system in single conversion mode.

- **Start delay 1280µs**
  The internal oscillator is immediately started after opcode "start measurement" or an external trigger. The measurement starts with a delay of 1280µs. At the end of the measurement the oscillator is switched off. The delay guarantees that the oscillator has settled before the measurement starts. Note that the "start delay" option is only available in combination with the use of the 32 kHz oscillator and running the system in single conversion mode.

4.4.1.4 High-speed divider
The high-speed divider is used as a prescaler for the external high-speed clock to limit the internal frequency of the PSØ21 in the range of 2 – 10 Mhz. The divisor is selected via pull down menu. Regarding to the maximum divisor the external high-speed clock is limited in the range of 2 – 80 MHz. To achieve best measuring results we recommend an internal frequency between 2 and 5 MHz. In this case the high-speed divider must be set to one.

4.4.1.5 CLKHS frequency
Displays the current high-speed clock frequency.

4.4.2 Rdson and gain compensation

4.4.2.1 AvRateRdson

Sets the averaging rate for the Rdson compensation. Selecting a high averaging rate will decrease the noise of the correction value. But in the same way the adaptation to changes will slow down. We recommend to use the default values.

4.4.2.2 RdsonModify

Speeds up the adaptation of Rdson after initialization. The use of the default value "4" is recommended.

4.4.2.3 AvRateGain

The comparator circuit introduces a propagation delay that is added to the result of measurement and will cause a gain error. The PSØ21 is capable of measuring this delay for gain error correction. For noise reduction the correction data can be averaged.

4.4.2.4 GainCompRate

Defines the frequency of the gain compensation measurement that is done after a measurement. Selecting "1" adds a gain compensation measurement to every measurement, "15 "adds this compensation measurement to every 15th measurement. Selecting "0" switches the gain compensation off.

4.4.3 Measuring Range 2

In measurement range 2 the calibration of the high-speed unit can be controlled through several parameters that are explained in this chapter.

4.4.3.1 CalDel

The calibration measurement is done during the discharging phase. CalDel gives the number of periods of ClkHS between start of discharging and start of calibration. This allows to control the point in time of the calibration measurement.

4.4.3.2 CalcCycle

Gives the number of cycles between the calibration measurements. Note that this number has strong influence on the current consumption. Using high values may reduce the current consumption of the PSØ21 core by 15 – 20 %.

4.4.3.3 Mb2_loaddel

4.4.3.4 AvRate_Cal

The noise of the calibration values can be reduced by averaging. This option is useful to achieve low current consumption in combination with high resolution of strain gage measurement.

4.4.4 Comparator

The comparator can be switched off for applications that require very low current consumption. The following parameters have to be adjusted:

4.4.4.1 Comp_ConOn

Activating this checkbox enables the use of the "switched comparator"

4.4.4.2 Comp_Control

Using the "switched comparator" the behaviour can be controlled like:

0:       The comparator is always switched on
1:       The comparator is switched off during the load phase
2:       Using single conversion mode together with the oscillator running in pulsed mode, the comparator switches on for the time the oscillator is running.

3:      Operating in single-conversion mode with the oscillator running in pulsed mode, the comparator is only active together with the oscillator. Additionally the comparator is switched off during load cycle.

4.4.5 Anti Aliasing

One method to suppress aliasing frequencies using the **PICO**STRAIN principle is to introduce additional noise to the cycle time. This increases the bandwidth of the sampling rate and suppresses sinusoidal interferences. The configuration has to be done by different parameters, described as follows:

4.4.5.1 EN_spread

Enables the internal pseudo-random generator for adding noise to the cycle time.

4.4.5.2 Spread source

This parameter selects the source clock for the random generator.

Spread source	Source clock
0	Each cycle
1	Each 8th cycle
2	Each interrupt
3	Each interrupt

Table 6 Spread source

4.4.5.3 Spread range

The spread range defines the noise range of the cycle time. The selected value will be added to the initial cycle time value.

Spread range	Number of noisy cycles
0	0
1	4
2	8
3	16

Table 7 Spread range

4.4.6 PSØ21 adjustment

4.4.6.1 Warm up

Warm-up function adds dummy measurements directly after initialization or power on reset before the first measurement is done. This "warm up" measurements preload the capacitor to avoid an additional offset at the start of the measurement.

4.4.6.2 Mfake

Both independently working ALU's of the PSØ21 have access to one and the same RAM. To avoid deadlocks it is possible to introduce fake measurements. These measurements are done after a measurement without data post processing.

4.4.6.3 SpeedALU fast

Enabling this option minimizes the calculating time of the arithmetic logic units to achieve highest measuring rates. Generally we do not recommend to use this function especially when operating with low core supply voltage or at highest temperature range because of malfunction.

4.4.6.4 PS021 adjust 1

Internal adjust bits. Recommended values are 17 or 45.

4.4.6.5 PSO21 adjust 2

Internal adjust bits. Recommended values for adjust 2 are 0 or 8.

4.4.7 Miscellaneous

4.4.7.1 NegSens1

Reverses Sense1 input in case of using a inverting preamplifier. Not necessary in PSA21 evaluation system

4.4.7.2 NegSens2

Reverses Sense2 input in case of using a inverting preamplifier. Not necessary in PSA21 evaluation system.

4.4.7.3 NegSensT

Negates the SensT input of the PSØ21in case of using an inverting preamplifier. This function has to be set when using the temperature measurement unit together with a HC14 Schmitt-Trigger as recommended for the PSA21 evaluation system.

4.4.7.4 Rdson Reconfig

Activating this function will provide better start values for Rdson compensation and reduces the ramp-up behaviour following a start measurement.

4.4.7.5 TDC diagnosis

Reads out and displays the TDC parameters.

4.4.8 Working with temperature compensated strain gages

4.4.8.1 Mod Rspan on

Activates the Rspan compensation. If "Replace Rspan by Temp" is not selected the PSØ21 measures the span compensation resistors and multiplies them with the parameters "Mult Rspan 1" and "Mult Rspan 2". Note that "Mult Rspan 2" is only used in double bridge mode as multiplication factor for the second fullbridge.

4.4.8.2 Replace Rspan by temp

Provides a second option for span compensation that uses the result from the separate temperature measurement instead of the compensation register. The span compensation resistor is no longer effective.

4.4.8.3 Fullbridge 1

The elements in this section enable the configuration of a multiplication factor and an offset correction value for Rspan compensation. Both values refer to fullbridge 1. The multiplication factor can be optionally signed.

4.4.8.4 Fullbridge 2

Provides the multiplication factor and offset correction value, as mentioned above, for fullbridge 2. These options are only used for applications running in doublebridge mode.

4.4.9 Port selection

The PSA21 output pins can be freely assigned to the PSØ21 driver ports via four independent port switches. Each port switch corresponds to one PSØ21 driver port. The configuration is shown in the following table.

PortSw_ value	Logical port
0	A1, A2
1	B1, B2
2	C1, C2
3	D1, D2

Table 8 Port assignment

4.4.10 Measurement modes

4.4.10.1 CMeas1
Provides additional compensation algorithms to correct for parasitic capacities and the comparator propagation delay and is divided in the following submodes:

Cmeas2 = 0   Compensated measurement mode off
Cmeas2 = 1   Compensated measurement mode on, compensation disabled
Cmeas2 = 2   Compensated measurement mode on, compensation enabled

Note that this element only appears in the "expert settings"- sheet when the capacity module in "PSØ21" –sheet is selected.

4.4.10.1 CMeas2
This option is used for measuring floating capacities and is not supported by the PSA21 evaluation system.

4.4.10.3 EN_Wheatstone
Enables Wheatstone mode.

4.4.10.4 PP_Separate
Switches on measurement with separate resistors for gain compensation.

4.4.10.5 Quarterbridge
The quarterbridge mode is recommended for the use of halfbridges where only one strain gage resistance is variable. In this case the internal calculation algorithm of the PSØ21 is based on a linear function.

4.4.10.6 Load_Startdel
Activating this checkbox will increase the start delay time of the PSØ21 to 140 ns. Without enabling this option, the start delay time is 25 ns.

4.4.10.7 Start_by_Load
Starts measurement over the "Load"- pin instead of using port pins.

4.5 Controlling the measurement

The 'Measurement'-sheet allows the user to start and stop measuring and displays the measurement results. The appearance of this window depends on whether single-bridge or doublebridge mode is selected. It looks like the following pictures.
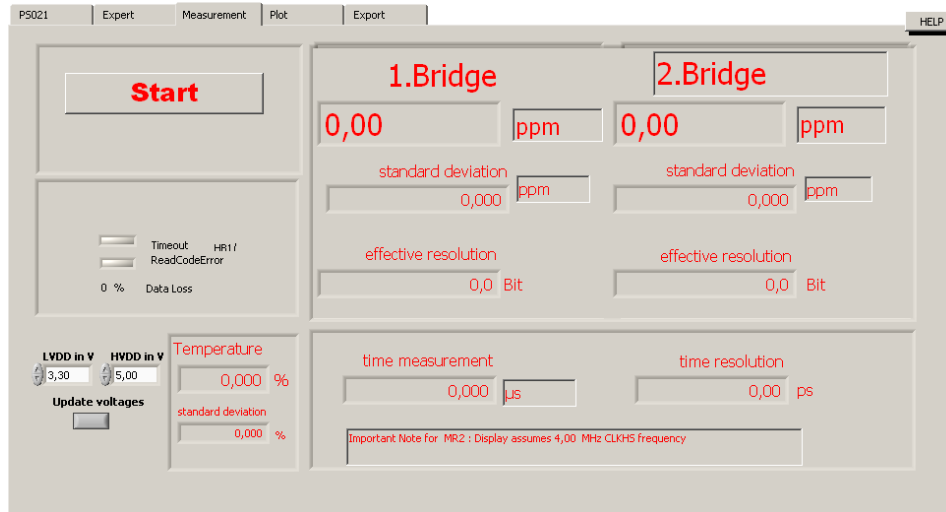
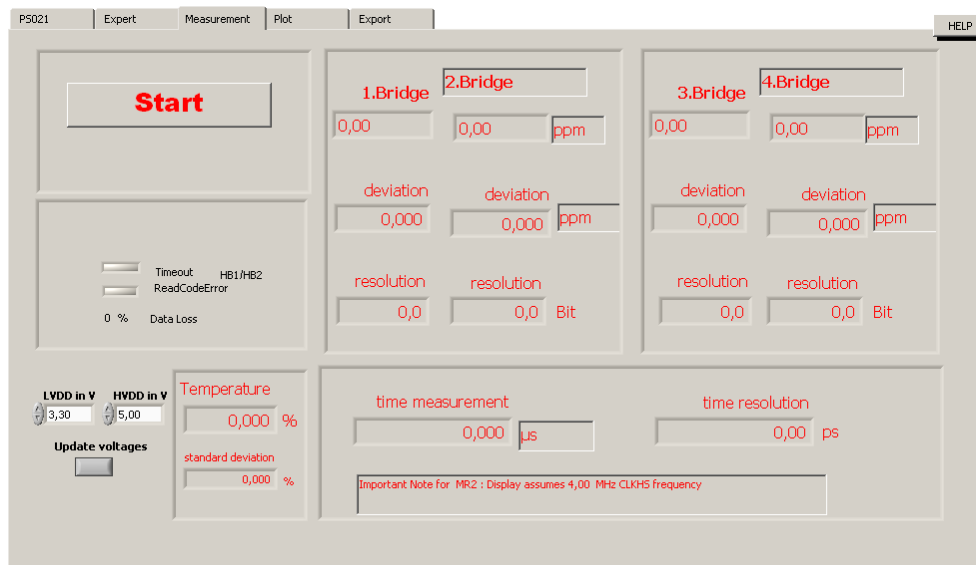
Figure 29 Measurement sheet using Single-bridge-Mode

Figure 30 Measurement sheet using Doublebridge Mode

Start/Stop

Pushing this button controls start and stop of a measurement. Before a measurement starts the current configuration data is downloaded to the PSA21 microcontroller and the PSØ21 is initialized with this new set of configuration data.

Figure 31

Timeout

Indicates a timeout of the PSØ21. A timeout occurs if the measurement range of the TDC unit or the pre-counter are exceeded. Possible reasons may by a wrong dimensioning of the discharging capacitors or a hardware defect which is mainly due to the following components:

- Timeout for halfbridge 1
- Timeout for halfbridge 2
- Timeout of pre-counter
- Timeout of TDC
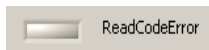
Figure 32

ReadCodeError

Informs about an error in serial data communication via RS232. This can be caused by problems in the serial connection. In this case the software tries to find a new synchronization start in the byte stream. Another reason might be a timeout when receiving data on RS232. The software keeps on waiting for data until the stop button is pressed.
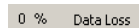
Figure 33

Data loss

Using a very fast PSØ21 interrupt rate (hardware average < 10) a loss of measurement results due to the restricted bandwidth of serial communication occurs.
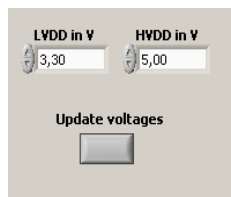
Figure 34

LVDD (Vcc)

The core voltage for the PSØ21 is generated via D/A-converter on the PSA21 main board. It can be adjusted in a range from 0 to 3.6V. When the value of LVDD is changed while there is no measurement running, the PSA21 board automatically adjusts the voltage to the new setting.

HVDD (Vsg)

The voltage for the sensor circuits can also be adjusted via D/A-converter in the range from 0 to 5.5V. When the value of LVDD is changed while there is no measurement running, the PSA21 board automatically adjusts the voltage to the new setting.

Update voltages

Figure 35

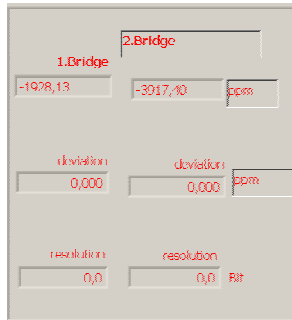Pushing this button sets LVDD and HVDD to the respective values displayed in the window.

Figure 36

1. Bridge/2. Bridge...
Displays the measurement value per halfbridge and the unit selected in PSØ21-sheet. (see chapter 4.3)
Deviation
Shows the standard deviation of the related halfbridge
Resolution
Displays the effective resolution of the related halfbridge. The effective resolution is specified in bits, calculated from the number of LSB's as follows:
$$ENOB = \ln(\text{\# of LSB}) / \ln 2$$
The number of LSB's is determined by the standard deviation of the measurement. For more details please refer to the PSØ21 datasheet sections 3.1 and 7.1.
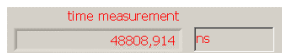
Figure 37

Time measurement
Displays the time measurement result of the PSØ21, provided that the TDC-diagnosis in "Expert-settings" sheet is activated. Running with measuring range 2 result is displayed in microseconds. For a good measuring quality the value should be in the range of 50 µs to 70 µs. Otherwise the discharging capacitor should be adjusted. To display correct results it is necessary to match the CLKHS setting in the "Expert"-Sheet to the value of the resonator, equipped on the PSA21 board. The default value is 4 MHz.
In measuring range 1 the result is displayed as multiple of the time resolution of the TDC, represented as least significant bits (LSB). For proper measurement this time should be adjusted to 160 000 ... 330 000 LSB in normal resolution or 320 000 ... 660 000 LSB in High resolution mode (equal to 8 ... 10 µs) by choosing the appropriate discharging capacity.
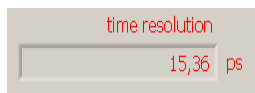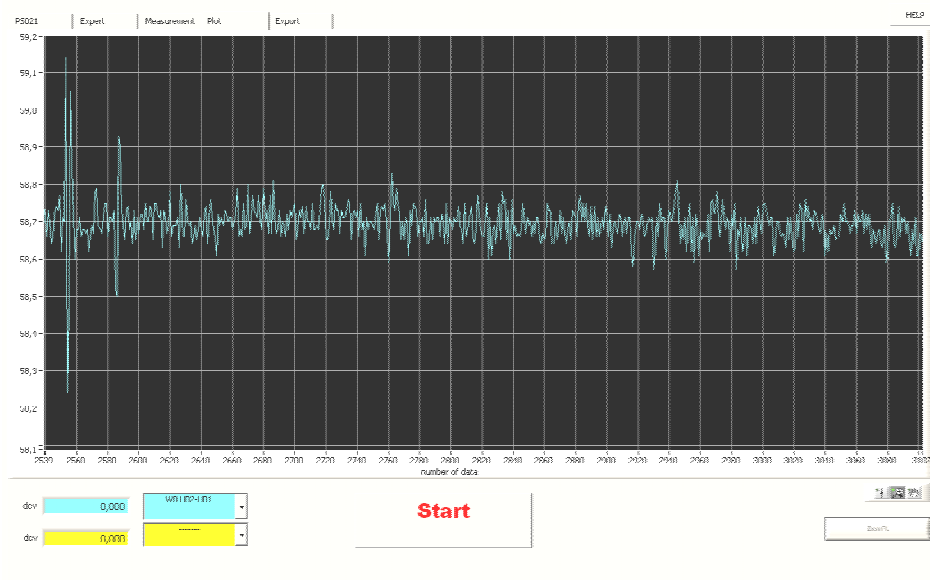

Figure 38

Time resolution
The time resolution represents the quantization step of the build-in time-to-digital converter (TDC) of the PSØ21. This value ranges between 14 to 25 ns in high resolution and 30 to 50 ps in normal resolution, depending on the current supply voltage and device temperature. The display only works in measurement range 2 and needs the correct CLKHS frequency as input. As mentioned before the default value is 4 MHz. In measuring range 1 the time resolution of the TDC is not calculated.

4.6 Plot Data

The "Plot"-sheet is used to indicate the measurement results in a graphical window. Two different output channels can be selected and up to 8000 samples can be displayed while measurement is running or in idle state. When the last field is written during measurement the routine starts from the beginning and overwrites the first field element.

The following elements for controlling and displaying the measurement data are provided:

Figure 39
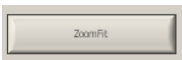
Start/stop
Controls start and stop of the measurement.

Figure 40

Zoomfit
Pressing the ZooFit button zooms the plot in y-scale.

Figure 41

Select displayed data
Opens a setup window that enables plot selection of the graphical display. The appearance of this window depends on the provided measurement data per channel and is specific to the used module and the operation mode. Figure 42 shows the setup windows using a standard module running in single-bridge mode.
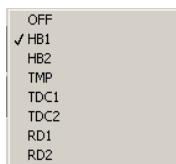
Figure 42

Zoom – tool

The Zoom – tool shows three different buttons that are explained in order from left to right.

- Cursor Movement Tool: Not supported in PSA21 Evaluation System
- Zoom – button: Enables zoom in and out of the display. The zoom button enables several options as shown in Figure 44.
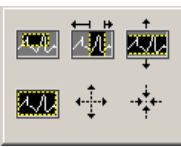- Panning Tool: Use the panning tool to pick up the plot and move it around on the display.

Figure 43

Zoom options

- Zoom to rectangle: This option enable to select a rectangular via mouse pointer. Therefore click a point on the display and drag the tool until the rectangle covers the requested zoom area.
- X-zoom: scales up the display along the x-axis
- Y-zoom: scales up the display along the y-axis
- Zoom out: scales up the display in x- and y- direction, referred to a center that is selected via mouse click.
- Zoom in: scales down the display in x- and y- direction, referred to a selected center.
- Undo zoom: Use this function to return to previous view after zoom in or out

Figure 44

4.7 Export Data

The 'Export'-Sheet is used to store measurement data in a file. The suggested filename is made out of the current date and time and a '*.txt'- extension. Additionally, the user can define a header with some specific information.
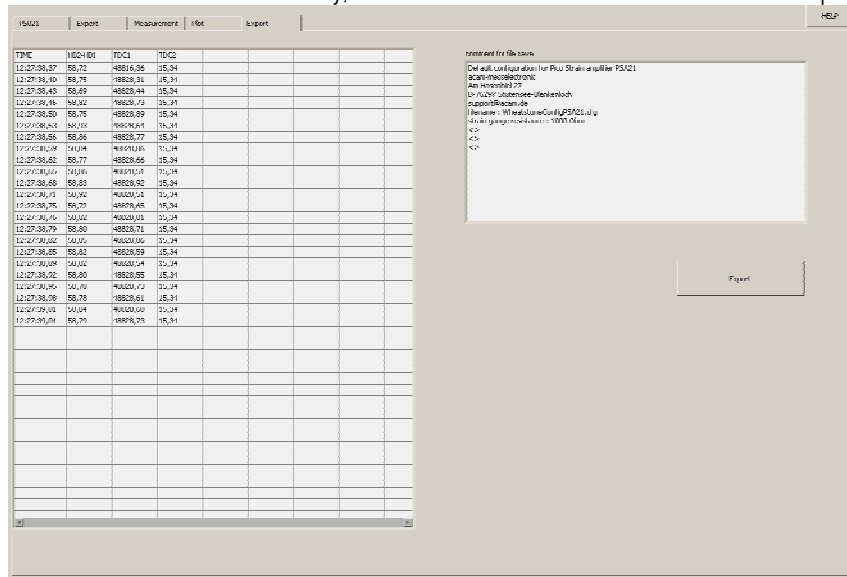

Figure 45 „Export"- sheet

Due to his internal record size the configuration software allows to handle up to 8000 measurement results. These values are used for displaying them in a plot window or for storing them in a file. After stopping a measurement the last records will be displayed in a table together with the user specific header and the configuration settings as shown in Figure 45.

Further the software supports the possibility to handle TDC measurement data. For this case the checkbox for "TDC diagnosis" must be activated.

4.8 Temperature Investigations

When the PSA21 board is used for temperature investigation it is necessary the remove the resistors R34 to R41 (see schematics PS021_SENSOR_IFC) from the board. Otherwise their temperature drift will disturb the measurement.

5 Additional Functions

5.1 Running PSA21-Tools Software

To install the PSA21 Tools software please follow these instructions:
1. Insert the PSA21 Evaluation Kit CD in the CD-ROM drive of your PC and start setup.exe. The window of Figure 46 appears.
2. Please follow the instructions on the screen to install the software.

For further information also refer to the install.txt file on the CD.

Figure 46 Installation window

After installing the PSA21-Tools software invoke it by selecting "PSA21-Tools" from the "PicoStrain PSA21" folder in the Windows Program menu.
The user can get a detailed description of each control and indicator element of the window by pressing the "Help"-Button. Then a "Context Help"- window is opened. This window shows a description of the element that has the cursor focus.
The settings for the serial interface (port, baud rate) has to match with the settings of the PSA21 module. The baud rate should not exceed 57600 baud.

5.2 Upgrading Firmware

The firmware running in the µC of the PSA21 module consists of two parts:
- Bootloader Code with functions for downloading user code (not downloadable by user)
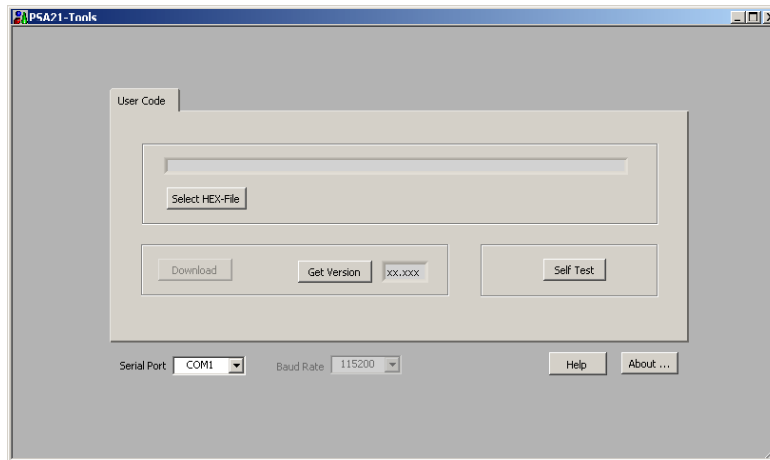- User Code with all functions for measurement purposes

Figure 47 Main window for ´firmware update

The user code can be downloaded to the PSA21 by pressing "Download"-Button after selecting the appropriate "*.HEX"-file. The current user code version in the PSA21 module is available by pressing "Get Version"-Button. The self-test indicates weather the communication with PSØ21 is working.

Please visit our web page http://www.acam.de/ for downloading the latest version of the PSA21 firmware.

6 Troubleshooting

Serial ports COM1, COM … not available
If in the I/O-Port selection field the communication ports COM1, COM2… are missing:
- Make sure that the VISA runtime engine from the CD is properly installed
- The port COM10 is usually a printer port and not suitable for PSA21

Communications cannot be established with the PSA21 software
If you cannot establish communications with the PSA21 software, follow these steps:
- Make a hardware reset by pressing switch SW1.
- Press "Verify Interface" and check whether a firmware version is displayed
- Check the connection between the PSA21 module and the host computer. When using a long RS-232-cable choose a lower baud rate.

The red LED on PSA21 module is blinking
If the red LED on the PSA21 module is blinking a user code error has occurred. Follow these steps:
- Make a hardware reset by pressing switch SW1.
- Start the PSA21-Tools software and download the current user code firmware.

The "Timeout PSØ21"- LED is set in PSA21 software
The "Timeout PSØ21"- LED in PSA21 software is set if a timeout in the PSØ21 has occurred. Follow these steps:
- Make sure that the strain gage load cells are connected correctly to the solder pads.
- Control the charging time constant. Adjust cycle time, if necessary. Also refer to PSØ21 datasheet for more details.

The "Read Code Error"- LED is set in PSA21 software

The "Read Code Error"- LED in PSA21 software is set if the communication between PSA21 module and the host computer is failed. In this case please check the RS232 hardware connection between the PSA21 module and the host computer.

The measurement cannot be restarted in PSA21 software

If the measurement cannot be restarted by PSA21 software execute a hardware reset by pressing switch SW1 and try again. This may occur if the PSA21 software is terminated during a running measurement. The hardware reset stops the currently running measurement before the PSA21 software is terminated.

7 Appendix A: Schematic Diagrams PSA21

This section contains the following schematic diagrams:
- PSA21 main board
- PSA21 standard module
- PSA21 Wheatstone module
- PSA21 capacity module

Top border columns: 1 2 3 4 5 6 7
Left border rows: E D C B A

To PSA21 module

SERIAL-INTERFACE
- TXD
- RXD
- RTS
- CTS

PSA21_CONTROL
- TXD
- RXD
- RTS
- CTS
- PS021_CS
- SPI_SDMO
- SPI_SCK
- SPI_SDMI
- PS021_INT
- SNGL_CONVERSION
- PS021_CLKHS
- AUTODETECT1
- AUTODETECT0

J9-1
J9-2
J9-3
J9-4
J9-5
J9-6
J9-7
J9-8 LVDD
J9-9 LVDD

J6-1 HVDD
J6-2 HVDD
J6-3
J6-4
J6-5
J6-6
J6-7
J6-8
J6-9 VCC

POWER-SUPPLY
- VCC
- LVDD
- HVDD
- HVDD-IO

VCC LVDD HVDD HVDD-IO

VIN

U1
LM340/SOT223
IN Vin   Vout OUT
GND

VCC

C2
100n

C17
100u/10V

R1
4R7

C1
100u/10V

VCC_DAC

R15
4R7

VCC_DAC

R16
56k

C7
100n

R17
56k

C18
10u

SPI_SDMO   1 DIN VDD 8
SPI_SCK   2 SCLK OUT 7
DAC_CS_HV   3 CS REFIN 6
DAC_FS_HV   4 FS AGND 5
U6
TLV5623ID/SO8

R21
1k

U5-A
LM8272/MSOP8
3 +
2 −
1

R5
5k6

C10
100n

C6
100n

R6
5k6

J2-1   J2-2

R4
4R7

C5
ELKO/49MC_D
220u

HVDD

HVDD

J1
BU/ROKA_5202580

D1
SM4002

VIN

VIN_OP

R13
22R

R11
1k5

D2
green
LED/KM23SR
A
K

C12
22u/25V

VCC_DAC

R18
5k6

C13
100n

R19
5k6

C16
10u

SPI_SDMO   1 DIN VDD 8
SPI_SCK   2 SCLK OUT 7
DAC_CS_LV   3 CS REFIN 6
DAC_FS_LV   4 FS AGND 5
U2
TLV5623ID/SO8

R20
1k

U5-B
LM8272/MSOP8
5 +
6 −
7

R2
5k6

C3
100n

C4
100n

R3
5k6

C11
100n

J8-1   J8-2

R12
4R7

LVDD

C14
22u
ELKO/49MC_D

GND

LVDD

VIN_OP

U5-C
8 VCC
4 VSS
LM8272/MSOP8

C9
100n

	1	2	3	4	5	6	7

U10

J18-8	RS232_CTS		R59 100R	17	T1OUT	T1IN	13	R67 100R		RTS
J18-2	RS232_RXD	R61 100R		8	T2OUT	T2IN	12	R68 100R		TXD
J18-3	RS232_TXD		R62 100R	16	R1IN	R1OUT	15	R69 100R		RXD
J18-7	RS232_RTS	R60 100R		9	R2IN	R2OUT	10	R70 100R		CTS

C48 100n — 2 C1+
4 C1−
INVALID 11

C49 100n — 5 C2+
6 C2−

VCC ◄ 14 FORCEON
VCC ◄ 20 FORCEOFF

R63 10k — 1 READY
3 V+
7 V−

C50 1u C51 1u

MAX3225ECA

J18-5
J18-10
J18-11

VCC

R30 470R   C52 + 10u   ELKO/49MC_B

Interface for external PS02 chip

AUTODETECT1	(J19-2) J19-1	▶ LVDD
AUTODETECT0	(J19-4) J19-3	▶ LVDD
PS021_CLKHS	(J19-6) J19-5	
SNGL_CONVERSION	(J19-8) J19-7	
SPI_SCK	(J19-10) J19-9	
SPI_SDMI	(J19-12) J19-11	
SPI_SDMO	(J19-14) J19-13	
PS021_INT	(J19-16) J19-15	
PS021_CS	(J19-18) J19-17	▶ HVDD
VCC	◀ (J19-20) J19-19	▶ HVDD

VCC

R49
47k

R50
470R

SW1
TAS/SMD

VPP

X1

Q/KX13
7,3728 MHz

22p
C40

22p
C39

VCC

VCC

U9

Pin	Signal		Pin	Signal
2	MCLR/VPP	RA0/AN0	3	LED_ERROR
14	OSC1/CLKIN	RA1/AN1	4	DAC_CS_HV
15	OSC2/CLKOUT	RA2/AN2	5	DAC_FS_HV
12	VDD	RA3/AN3/REF	6	CLKEN
35	VDD	RA4/T0CKI	7	
13	VSS	RA5/AN4/SS	8	MC_TRIG
34	VSS	RB0/INT	36	R26 56k
		RB1	37	
		RB2	38	R25-A 100R PS021_CS
		RB3	39	
		RB4	41	R14 100R PS021_INT
		RB5	42	R8 10k
		RB6	43	
		RB7	44	
		RC0/T1OSO/T1CLK	16	
		RC1/T1OSI/CCP2	18	CTS
		RC2/CCP1	19	RTS
		RC3/SCK/SCL	20	R25-D 100R SPI_SCK
		RC4/SDI/SDA	25	SDI_SDMI R25-C 100R SPI_SDMI
		RC5/SDO	26	R25-B 100R SPI_SDMO
		RC6/TX/CK	27	TXD
		RC7/RX/DT	29	RXD
		RD0/PSP0	21	R10 10k Baud Rate
		RD1/PSP1	22	
		RD2/PSP2	23	R9 10k DAC_CS_LV
		RD3/PSP3	24	DAC_FS_LV
		RD4/PSP4	30	
		RD5/PSP5	31	AUTODETECT1
		RD6/PSP6	32	AUTODETECT0
		RD7/PSP7	33	
		RE0/RD/AN5	9	GENERAL1
		RE1/WR/AN6	10	GENERAL2
		RE2/CS/AN7	11	GENERAL3

PIC16LF874

VCC

R51
56k

J16-1 J16-2 J16-3 J16-4 J16-5

GENERAL3
GENERAL2
GENERAL1

ICD flash programmer

	J17-1
	J17-2
	J17-3
GND	J17-4
VCC ◀	J17-5
VPP	J17-6

56k R24

VCC

C34
22u/25V

C41
100n

C42
100n

R65
4k7

R66
4k7

LED_ERROR

R52
330R

LED/KM23 D3
red

VCC   VCCX

R55
4R7

C44
100n

VCC VCC VCC VCC

1k R22
56k R31
56k R7
n.c. R23

22p C15
n.c. C8

VCCX   VCCX   VCCX

CLKEN

U3
74HC1G00GW

U4
74HC1G00GW

PS021_CLKHS

Q/CSTCR_G

X2

R57
33k

R58
100R

SNGL_CONVERSION

R45
10k

J15
BU/BNC_B35N82

Standard Module for PSA21

acam messelectronic GmbH

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TITLE:				DRAWING NO:	
CODE:				SIZE: A3	
SCALE:				SHEET: 1 OF 1	

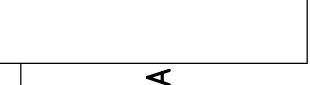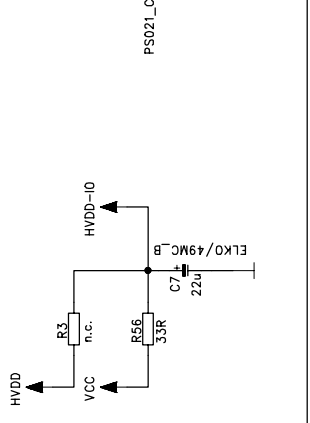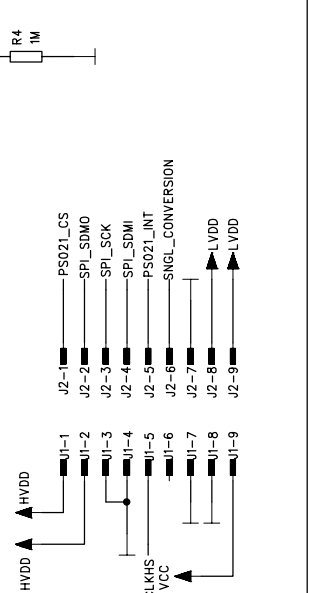| REVISION RECORD			
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1.0			11.02.2005
1.1			4.04.2005
1.2			18.04.2005

UTG

DRAWN:
CHECKED:
QUALITY CONTROL:
RELEASED:

Interface for external PS02 chip

To PSA21 mother board

Wheatstone Module for PSA21

acam messelectronic GmbH

COMPANY:					
	REVISION RECORD			TITLE:	
	ECO NO:	DATE:	APPROVED:		
LTR					
1.0		11.02.2005			
1.1		04.04.2005		UTG	
1.2		18.04.2005			

DRAWN:

CHECKED:

QUALITY CONTROL:

RELEASED:

CODE:

SCALE:

SIZE: A3

DRAWING NO:

REV: 1.02

SHEET: 1 OF 1

Interface for external PS02 chip

Gain Seperate

Platinen Rückseite

To PSA21 mother board

Interface for external PSO2 chip

AUTODETECT1   J19-1 / J19-2
               J19-3 / J19-4
PS021_CLKHS   J19-5 / J19-6
SNGL_CONVERSION J19-7 / J19-8
SPI_SCK   J19-9 / J19-10
SPI_SDMI   J19-11 / J19-12
SPI_SDMO   J19-13 / J19-14
PS021_INT   J19-15 / J19-16
PS021_CS   J19-17 / J19-18
VCC   J19-19 / J19-20

To PSA21 mother board

PS021_CS   J1-1 / J2-1
SPI_SDMO   J1-2 / J2-2
SPI_SCK   J1-3 / J2-3
SPI_SDMI   J1-4 / J2-4
PS021_INT   J1-5 / J2-5
SNGL_CONVERSION J1-6 / J2-6
                J1-7 / J2-7
                J1-8 / J2-8
                J1-9 / J2-9

COMPANY:

REVISION RECORD
ECO NO: LTR   DATE: APPROVED:
           1.0   11.02.2005
           1.1   04.04.2005
           1.2   18.04.2005

acam messelectronic GmbH

TITLE:
Capacitor Module for PSA21

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QUALITY CONTROL:
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SCALE: SHEET: 1 OF 1
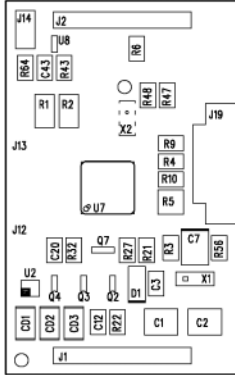
Appendix B: Layout Mainboard

Top Layer
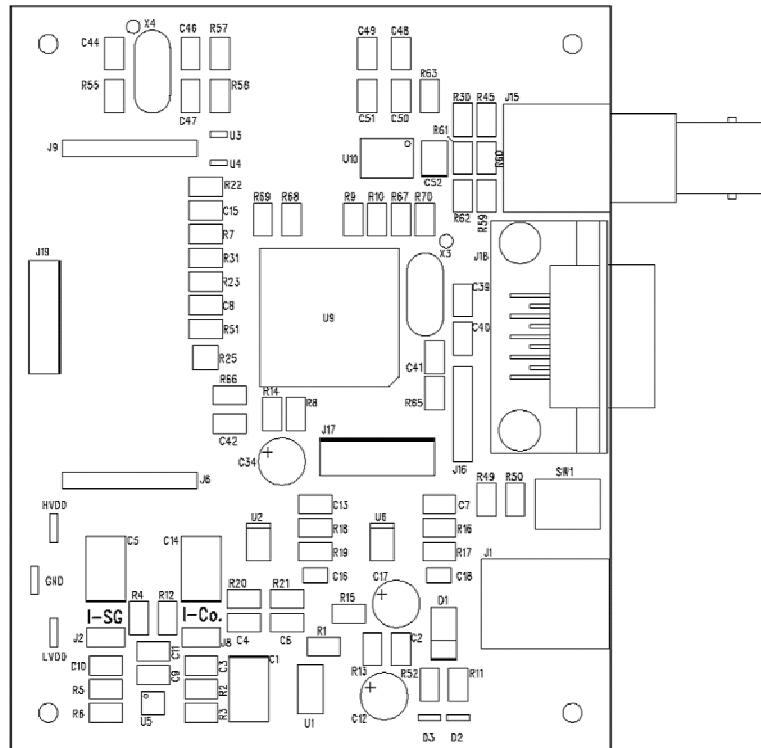
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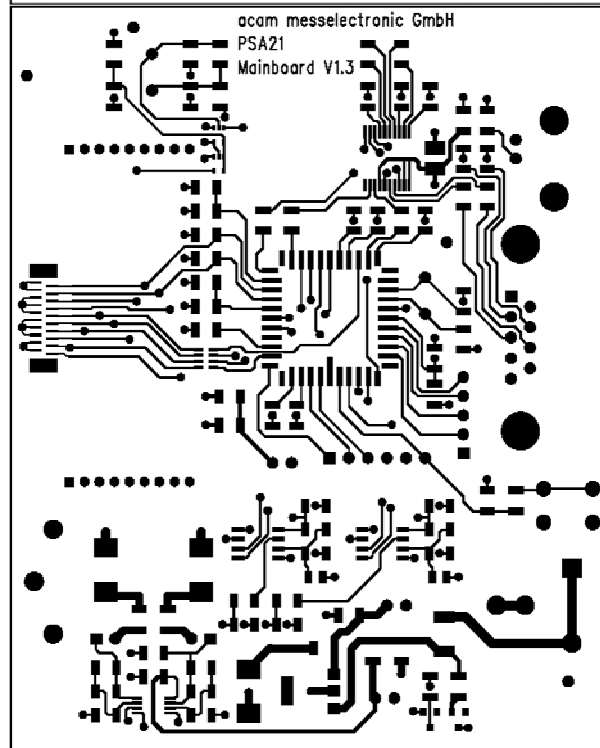
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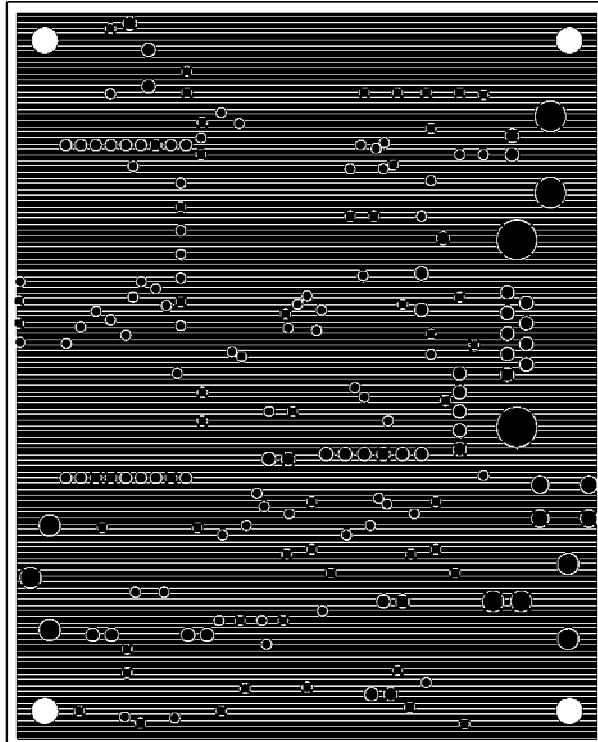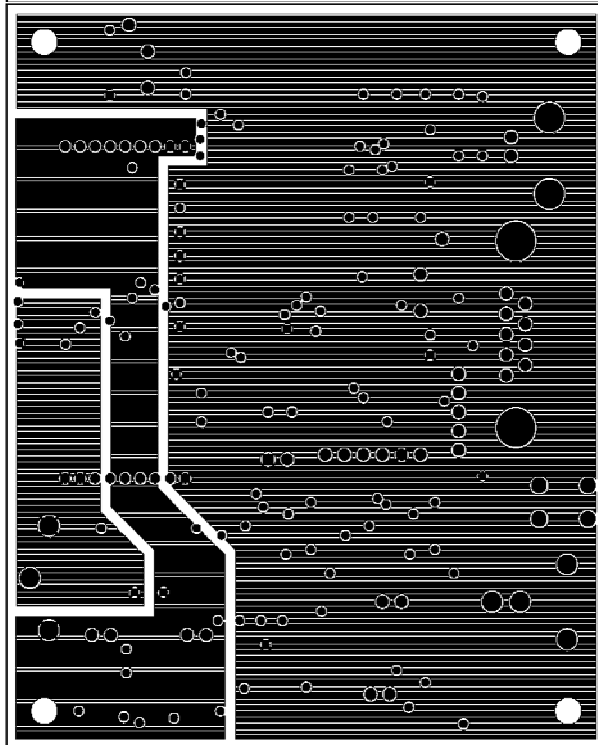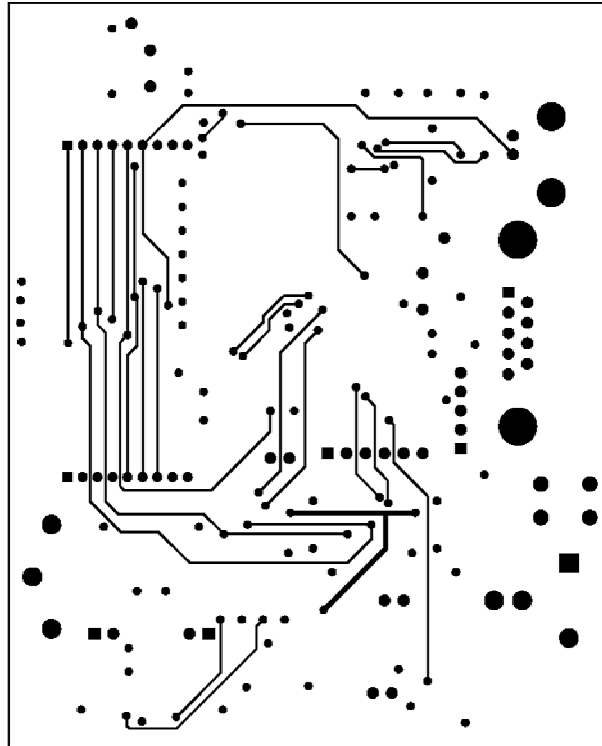
Layer 3

Layer 4

Appendix C: Layout Standard Module
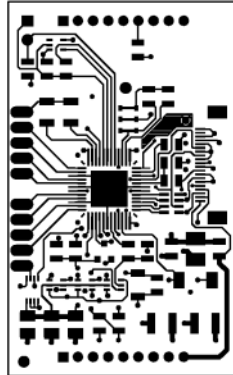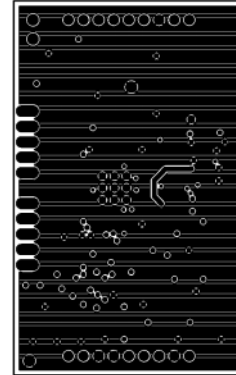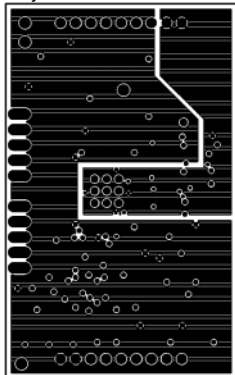
Top Layer

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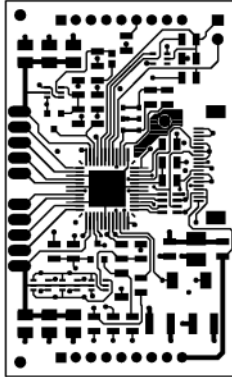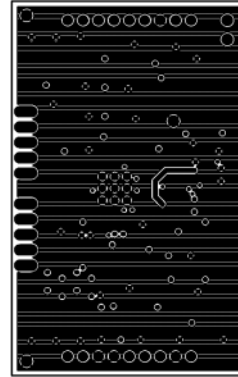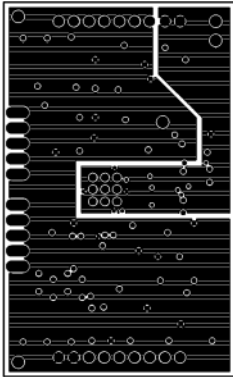
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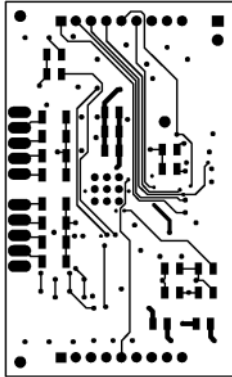
Layer 3

Layer 4
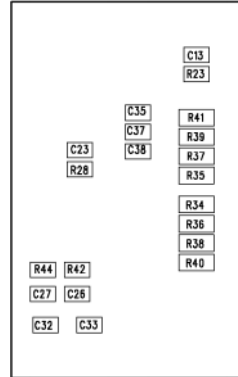
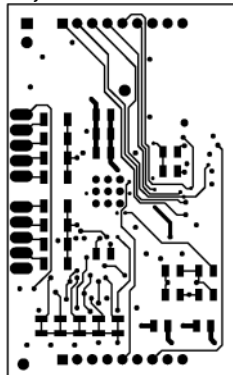Bottom Layer
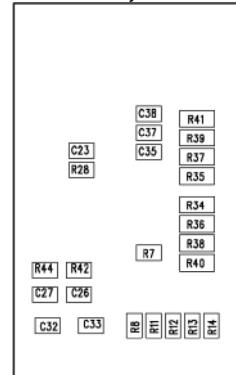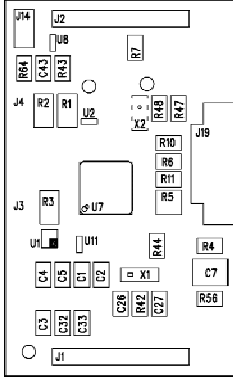
Appendix D: Layout Wheatstone Module

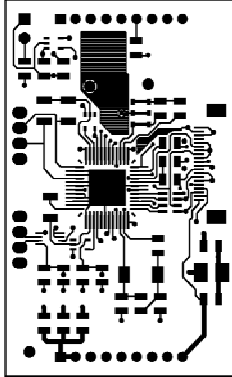Top Layer

Layer 1

Layer 2

Layer 3
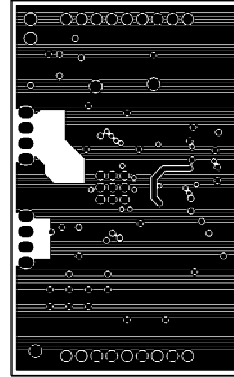

Layer 4

Bottom Layer

Appendix E: Layout Capacity Module
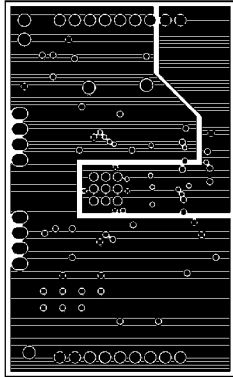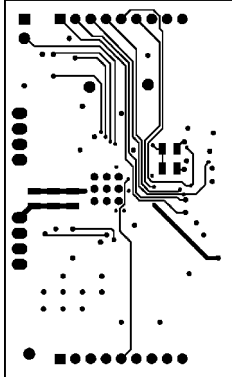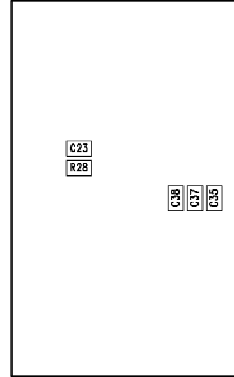
Top Layer

Layer 1

Layer 2

Layer 3

Layer 4

Bottom Layer

Last Changes:

23. June 2005   First release version
02. August 2007   Correction wiring diagrams (pin description)

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