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Contact information:

Headquarters:
ams AG
Tobelbaderstrasse 30
8141 Unterpremstaetten, Austria
Tel: +43 (0) 3136 500 0
e-Mail: ams_sales@ams.com

Please visit our website at **www.ams.com** mess • electronic

PICOSTRAIN

Data Sheet

PSØ81

Single Chip Solution for Strain Gauges

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1 Overview

1.1 Features

- RMS noise:
  - 20.1nV fast settle, 5 Hz
  - 11.5 nV SINC3, 5 Hz
  - 8.9 nV SINC5, 5 Hz
- Up to 250,000 peak-peak divisions in weighing applications (2 mV/V strain)
- Scalable udapte rate from < 1 Hz to 1000 Hz
- Current consumption:
  - ~ 0.39 mA PSØ81 itself (at maximum speed)
  - ~ 0.005 mA PSØ81 itself (at low current configuration)
  - ~ 0.001 mA standby current
- Power supply voltage: 2.1 V to 3.6 V
- Converter type: Time-to-digital converter (TDC)
- Resolution: 28 bit ENOB (RMS) or 25.8 bit noise-free (peak-to-peak)
- 24-Bit internal microprocessor with 2 KB reprogrammable EEPROM
- Internal LCD controller for 4x14, 3x15 and 2x16 segments
- 4-wire serial SPI interface
- Internal very low current 10 kHz oscillator
- 6 I/O pins, configurable up to 21 inputs or 5 outputs
- Very high power supply rejection ratio (PSRR)
- Very low gain and offset drift
- Embedded charge pump for driving the LCD
- Embedded bandgap voltage reference for low battery detection
- Watchdog timer

1.2 Advantages

- Single-chip solution for weighing applications
- Converter, microcontroller and LCD controller in one chip
- Extreme low total system current (down to 15µA including strain gages)
- Very low self heating of teh sensor
- Gain and offset correction of the load cell
- Available as dice (115 µm pitch) or packaged (QFN56, 7x7 mm²)

1.3 Applications

Industrial

- Torque wrenches
- Pressure indicators
- Legal for trade scales
- Counting scales

Consumer

- Pure solar driven scales
- Body scales
- Kitchen scales
- Pocket scales
- Hanging scales
- Postal scales
- Package scales

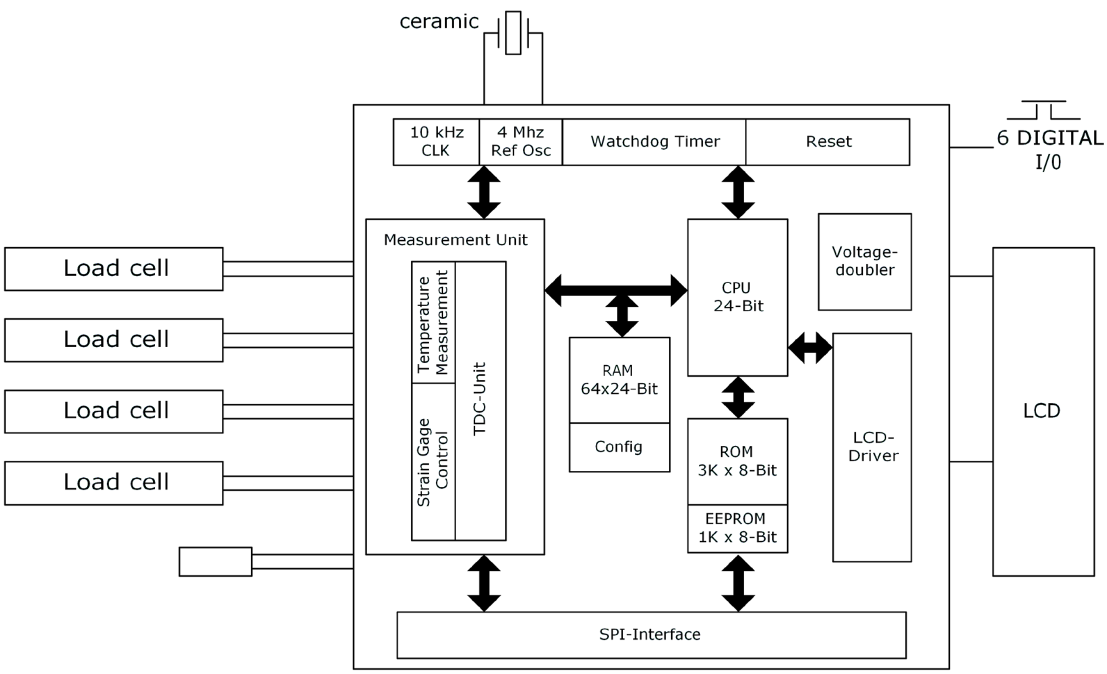
1.4 General Description

The PSØ81 is a system-on-chip for ultra low-power and high resolution applications. It was designed especially for weight scales but fits also to any kind of force or torque measurements based on metal strain gages. It takes full advantage of the digital measuring principle of PICOSTRAIN. Thus, it combines the performance of a 28-Bit signal converter with a 24-Bit microprocessor. Additional elements like an LCD driver, 3K ROM with many complex pre-defined functions,

2K EEPROM program memory and an integrated 10 kHz oscillator round off the device. A small amount of external components is sufficient to build a complete weighing electronic.
The part operates with a power supply from 2.1V to 3.6V and has a very low current consumption. As per configuration the current consumption ranges between 0.005 mA and 0.4 mA approximately. The update rate is scalable in a wide range from < 1 Hz up to 1000 Hz. With a maximum of mor then 1 million internal divisons (28 bit ENOB RMS) the resolution lies in the top range of today's converters. This high resolution is only comparable to the one of high-end AD converters, but at a much lower current consumption. Equipped with these features, a variety of scale electronics can be served with PSØ81. On the resolution side, it allows to build scales with up to 250,000 stable peak-peak divisons (at 2mV/V)! On the other hand, a sophisticiated power management and the special features of the PICOSTRAIN measuring principle can reduce the total current of the system down to 15 µA, including the sensor current. This way, it is the first time possible to build pure solar driven weigh scales based on metal strain gages. Of course, the benefits can be combined, e.g. building a high resolution scale with a low current such as a legal for trade scale that runs more than 1,500 operating hours with 2x AA batteries.
Throwing a glance at further features like software adjustment of the offset and gain compensation or the possibility to operate only one half bridge reveals that the PSØ81 opens the door to new and innovative product solutions.

1.5 Functional Block Diagram

Figure 1.1 Block Diagram



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2 Characteristics and Specifications

2.1 Absolute Maximum Ratings

Table 2.1 Maximum Ratings

Symbol	Parameter	Conditions	Min	Max	Unit
Vcc Vcc_load Vcc_osc Vcc_LCD	Supply voltage	Vcc vs. GND	-0.5	5.0	V
Vin	DC input voltage		-0.5	Vcc + 0.5	V
ESD Rating	FICDM	All pins	2		kV
Tstg	Storage Temperature	Plastic package	-55	150	°C

2.2 Normal Operating Conditions

Table 2.2 Operating Conditions

Symbol	Parameter	Conditions	Min	Max	Unit
Vcc Vcc_load Vcc_osc Vcc_LCD	Supply voltage	Vcc vs. GND (* without EEPROM programming, voltage measurement and LCD)	2.1 (1.5*)	3.6**	V
Vin	DC input voltage		0.0	Vcc	V
Vout	Output voltage		0.0	Vdd	V
Top	Operating temperature		-40	125	°C
Tstg	Storage temperature	Plastic package	-55	150	°C

** 4.5 V for highest resolution within limited temperature range

2.3 Electrical Characterization

Table 2.3 Electrical Characterization

Symbol	Parameter	Conditions	Min	Typ.	Max	Unit
Vil	Input low voltage	CMOS			0.3Vcc	V
Vih	Input high voltage	CMOS	0.7Vcc			
Vhyst	Input hysteresis	Vcc = 3.6 V Vcc = 3.0 V Vcc = 2.7 V Vcc = 2.2 V Vcc = 1.8 V		400 280 225 150 80		mV
Voh	Output high voltage		0.8			V
Vol	Output low voltage				0.2Vcc	V
Vlbat	Low battery voltage detect		2.2		2.9	V
LCD_COM LCD_SEG	LCD driver Voltage stabilized	lcd_vlt = 0 lcd_vlt = 1 lcd_vlt = 2		2.0 2.5 3.0		V
Iq	Quiescent current	No oscillator, no TDC		150		nA
Iosc	Current 4 MHz oscillator continuously on	Vcc = 3.6 V Vcc = 3.0 V Vcc = 2.1 V		200 130 65		µA

2.4 Converter Precision

Table 2.4 Performance at Vcc = 3.3V with external comparator

	ENOB ***dR/R strain resistance***		
Frequency (Hz)	**No filter**	**SINC3**	**SINC5**
500	23.8	24.8	25.2
250	24.4	25.2	25.7
100	25.2	25.8	26.1
50	25.5	26.2	26.5
20	26.0	26.8	27.0
10	26.6	27.4	27.7
5	27.2	27.9	28.3

Table 2.5 Performance at Vcc = 3.3V with external comparator, related to 2 mV/V strain (weigh scale)

	Resolution @ *2 mV/V* max. out, *Fast settle**			
Frequency (Hz)	**ENOB**	**Divisions**	**Noise nV**	**Noise nV**
		effective	rms	peak-peak
500	14.8	28,000	231	1,386
250	15.4	44,000	148	891
100	16.2	74,000	89	535
50	16.5	95,000	69	416
20	17.0	133,000	49	297
10	17.6	200,000	33	198
5	18.2	294,000	22	135

** Fast settle = without filter*

Table 2.6 Performance at Vcc = 3.3V with external comparator, related to 2mV/V strain (weigh scale)
With SINC3 and SINC5 filter (rolling average of 3 respectively 5)

	Resolution @ *2 mV/V* max. out, *SINC3 Filter*				**Resolution @ *2 mV/V* max. out, *SINC5 Filter***			
Frequency (Hz)	**ENOB**	**Divisions**	**Noise nV**	**Noise nV**	**ENOB**	**Divisions**	**Noise nV**	**Noise nV**
		effective	rms	peak-peak		effective	rms	peak-peak
500	15.8	55,000	118	713	16.2	74,000	89	535
250	16.2	74,000	89	535	16.7	105,000	62	376
100	16.8	114,000	57	347	17.1	142,000	46	277
50	17.2	153,000	42	257	17.5	181,000	36	218
20	17.8	222,000	29	178	18.0	266,000	24	149
10	18.4	344,000	19	115	18.7	416,000	15	95
5	18.9	476,000	13	83	19.3	625,000	10	63

Table 2.7 Performance at Vcc = 3.3V with internal comparator

	ENOB ***dR/R strain resistance***			ENOB ***2mV/V*, *Fast settle****
Frequency (Hz)	**No filter**	**SINC3**	**SINC5**	
500	23.0	24.0	24.4	14.0
250	23.6	24.4	25.1	14.6
100	24.4	25.0	25.3	15.4
50	24.7	25.4	25.7	15.7
20	25.2	26.0	26.2	16.2
10	25.8	26.6	26.9	16.8
5	26.4	27.1	27.5	17.4

** Fast settle = without filter*

Table 2.8 General parameters

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
INL	Integral Non-linearity	Supply Voltage 3.0V to 3.6V		0.01*		µV/V
	Offset drift	Total system, 350 Ω SG Full-bridge Wheatstone		 ± 10 < 1		 nV/V/K nV/V/K
	Gain drift over -20°C … +70°C	Total System. 350 Ω SG, 5V		~ 1		ppm/K
PSSR	Power Supply Rejection Ratio Vcc	1.8V or 3.3 V +-0.3 V	106 @1.8V	130 @3.3V		dB

** equals to ± 1.25 ppm of A/D-Converters with PGA setting 128*

*** using full bridge wiring for minimum zero drift*

2.5 Integral Nonlinearity

The integral nonlinearity (INL) of PS081 can be specified to ± 0.01 µV (1.25 ppm). Expressed in divisions this corresponds to ± 1: 200,000. This is a tremendous high linearity compared to the one of nowadays latest A/D converters. Ordinary A/D converts have a linearity in the range of ± 0.12µV/V (15 ppm), better A/D converters reach a linearity of ± 0.4 µV (5ppm).

Of course, you can only determine the linearity of the electronics itself, if you can provide a sensor which is accurate and linear enough to measure it. We used for this purpose the revised version of the acam load cell simulator (ALCS350-V2) which offers comfortable methods to investigate not only the linearity, but also variations over temperature or voltage. The linearity of ALCS350-V2 is ± 0.01 µV/V (1:200,000) with PICOSTRAIN wiring and ± 0.04 µV/V with Wheatstone wiring and therefore much more linear than an ordinary load cell. Linearity investigations with the PS081 and the ALCS350-V2 as a sensor are shown in the following tables. More details about the possibilities and the limitations of the load cell simulator are provided in the ALCS350-V2 datasheet.

Figure 2.1 Non-linearity over supply voltage

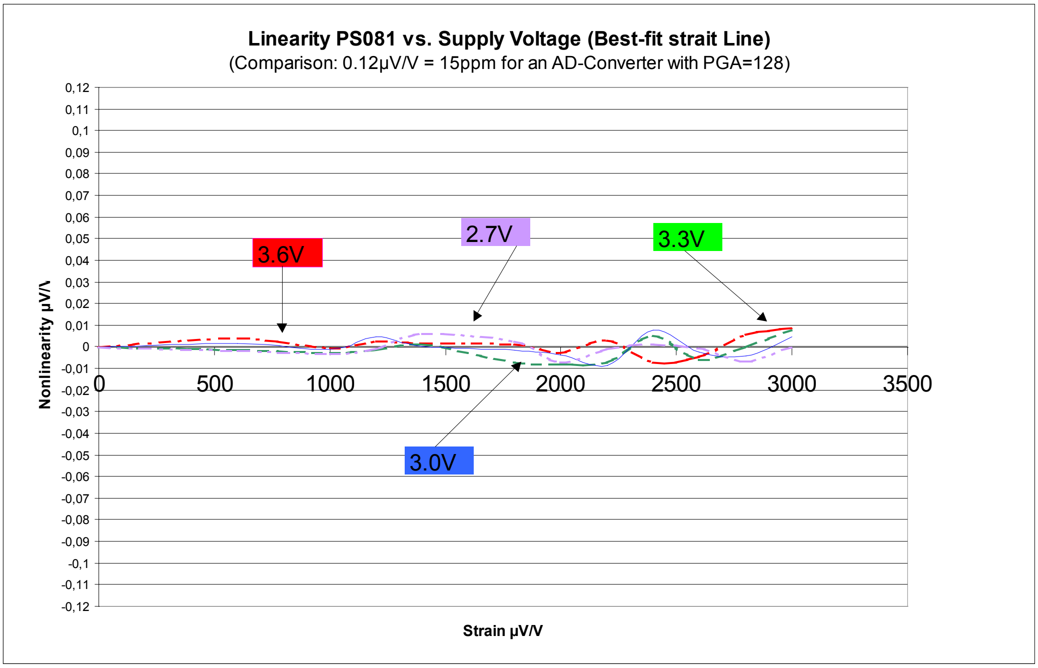
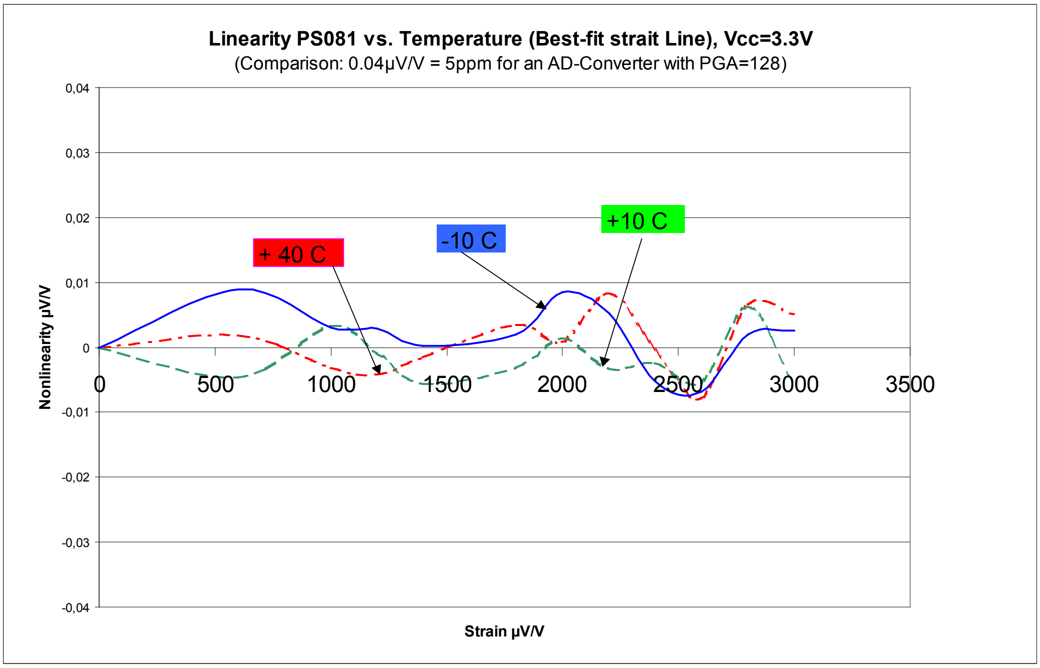


Figure 2.2 Non-linearity over temperature



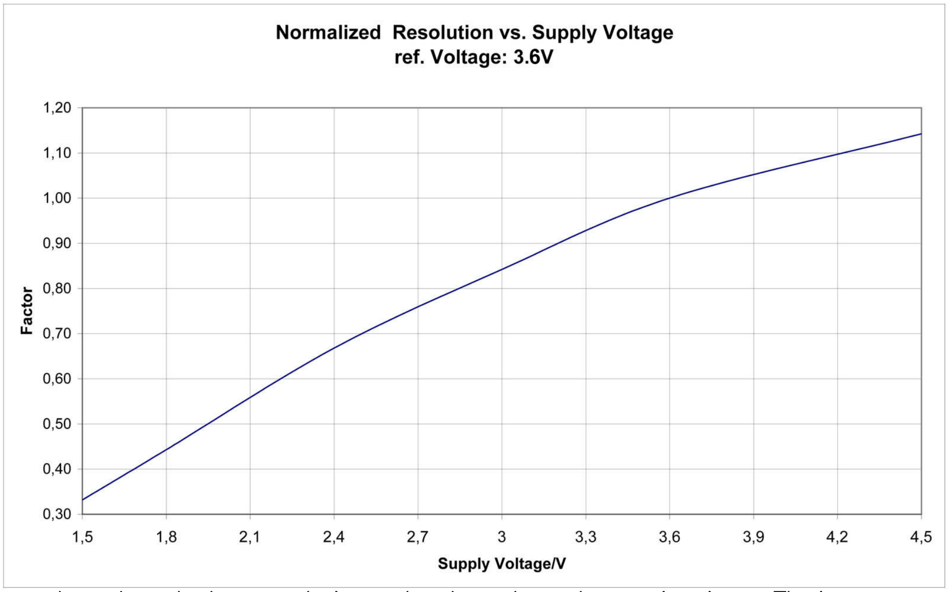
Note:

Best linearity is achieved with a supply voltage in the range of 3.0 V to 3.6 V. The linearity also depends on the setting for the cycle time. The measurements shown above are done with a cycle time setting of cytime = 85 (equals 170 µs).

2.6 Resolution vs. Supply Voltage

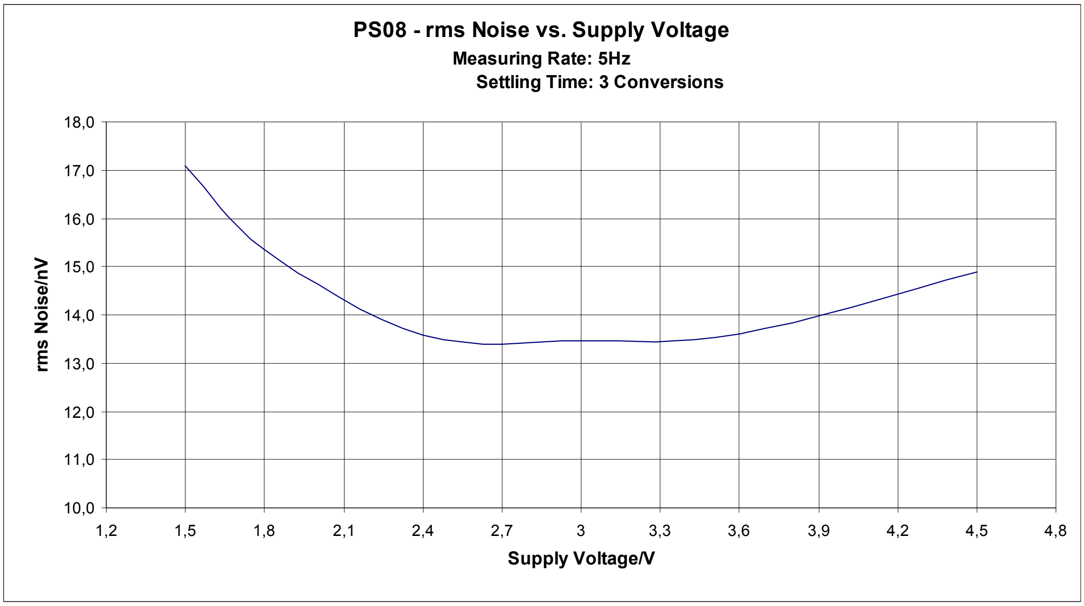
PSØ81 can be driven over a very large supply voltage range. The resolution depends on the supply voltage. The higher the supply voltage the higher the achievable resolution. The diagram below shows the resolution vs. supply voltage which can be achieved with PSØ81. The values refer to 3.6 V.

Figure 2.3 Resolution vs. supply voltage



Following diagram shows how the input equivalent noise depends on the supply voltage. The lowest input noise is archived between 2.4 V and 3.6 V. The maximum differential input voltage (e.g. 6.6 mV @ 2mV/V and 3.3 V supply voltage) divided by the input noise gives the effective resolution.

Figure 2.4 RMS-noise vs. supply voltage



2.7 Current Consumption

The following table shows the total system current of the scale (including current through sensor)

Table 2.9 Current consumption at different resolutions

Divisions *	Update Rate	Double Tara*	Operating Current @ 3V		Scale type	Operating hours
2,000	3 Hz	1 mV/V	1 kOhm	15 µA	Solar	
2,000	5 Hz	1 mV/V	1 kOhm 350 Ohm	30 µA 70 µA	Postal, Body, Kitchen , Pocket	3,000 hours (1xCR2032)
5,000	5 Hz	1 mV/V	1 kOhm 350 Ohm	80 µA 180 µA	High-end postal, Kitchen, Pocket	1,500 hours (1xCR2032)
10,000	5 Hz	1 mV/V	1 kOhm 350 Ohm	300 µA 700 µA	High-end pocket, Coun-ting	2,000 hours (1xCR2430)
80,000	5 Hz	2 mV/V	1 kOhm 350 Ohm	1.9 mA 4.5 mA	Counting	1,500hours 2 x AA

** Divisions are peak-peak values with 5 Sigma (e.g. 80.000 divisions are 400.000 bits of effective resolution)*

2.8 Timings

All timings specified at 3.3V ±0.3V, Ta –40°C to +85°C unless otherwise specified.

Table 2.10 Oscillator timing

Symbol	Parameter	Min	Typ	Max	Units
Clk10kHz	10 kHz reference oscillator		10		kHz
ClkHS	High-speed reference oscillator		4		MHz
toHSst	Oscillator start-up time with ceramic resonator		50	150	µs

Table 2.11 Serial Interface Timing (SPI)

Symbol	Parameter	Min	Typ	Max	Units
f_{clk}	Serial clock frequency			1	MHz
t_{pwh}	Serial clock, pulse width high	500			ns
t_{pwl}	Serial clock, pulse width low	500			ns
t_{sussn}	SSN enable to valid latch clock	500			ns
t_{pwssn}	SSN pulse width between write cycles	500			ns
t_{hssn}	SSN hold time after SCLK falling				
t_{sud}	Data set-up time prior to SCLK falling	30			ns
t_{hd}	Data hold time before SCLK falling	30			ns
t_{vd}	Data valid after SCLK rising				ns

Serial Interface (SPI compatible, Clock Phase Bit = 1, Clock Polarity Bit = 0)

Figure 2.5 SPI - Write access

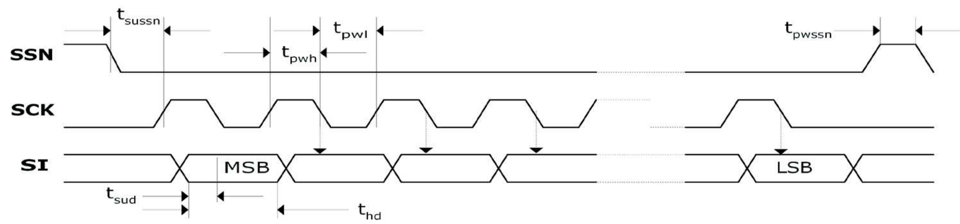
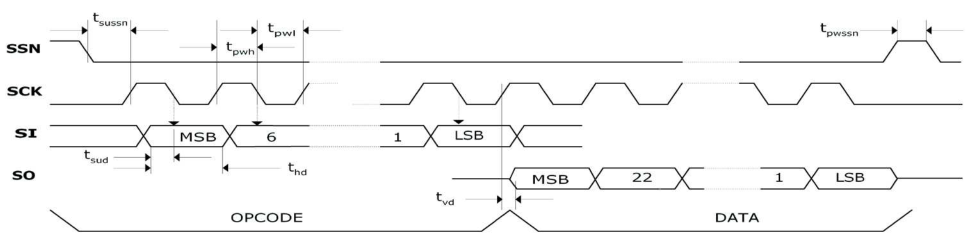


Figure 2.6 SPI-Read access



2.9 Pin Assignment

PSØ81 is avaliable as Die or in QFN56 package. The following pictures and tables show the pin assignment and the pin description.

QFN56

Figure 2.7 Pin assignment QFN56

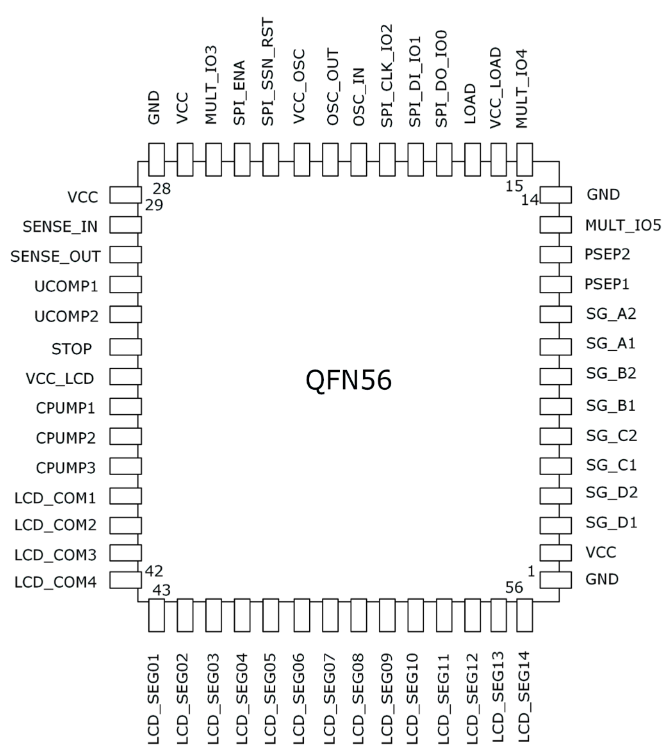


Table 2.12 Pin Description QFN56

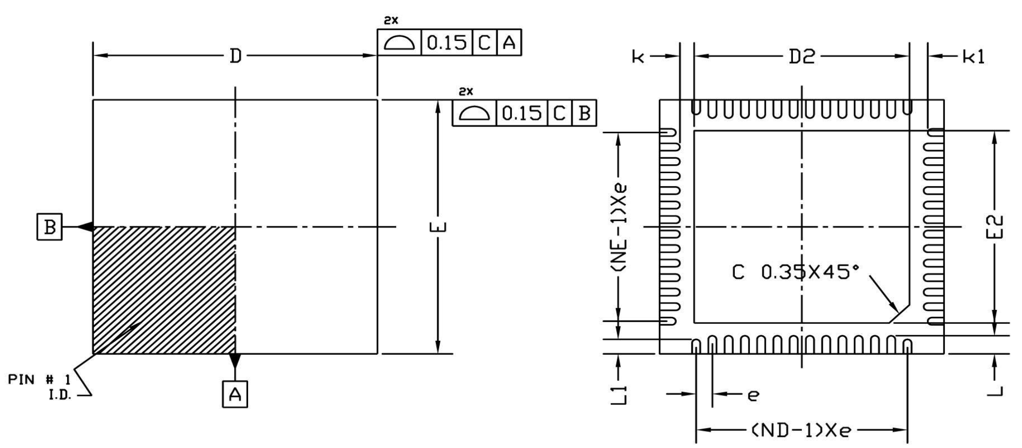
#QFN	Name	Description	Type
1	GND	Ground	
2	Vcc	Supply voltage digital part , I/O, 4MHz-osc.	
3	SG_D1	Port 1 halfbridge D	N Open Drain
4	SG_D2	Port 2 halfbridge D	N Open Drain
5	SG_C1	Port 1 halfbridge C	N Open Drain
6	SG_C2	Port 2 halfbridge C	N Open Drain
7	SG_B1	Port 1 halfbridge B	N Open Drain
8	SG_B2	Port 2 halfbridge B	N Open Drain
9	SG_A1	Port 1 halfbridge A	N Open Drain
10	SG_A2	Port 2 halfbridge A	N Open Drain
11	PSEP1	Port 1 temperature measurement	N Open Drain
12	PSEP2	Port 2 temperature measurement	N Open Drain
13	MULT_IO5	Multi purpose I/O no. 5	Mult-IO
14	GND	Ground	
15	MULT_IO4	Multi purpose I/O no. 4	Mult-IO
16	Vcc_load	Power supply load output pin	
17	Load	Load output to measuring capacitor	P Open Drain
18	SPI_DO_IO0	Output serial SPI interface or IO0	Mult-IO
19	SPI_DI_IO1	Input serial SPI interface or IO1	Mult-IO
20	SPI_CLK_IO2	Clock serial SPI interface or IO2	Mult-IO
21	OSC_IN	Input to 4MHz ceramic resonator	
22	OSC_OUT	Output to 4MHz ceramic resonator	
23	VCC_OSC	4MHz Oscillator supply voltage	
24	SPI_CSN_RST SPI_SSN_RST	Slave select or RST input (High active)	Input with pull-down
25	SPI_ENA	Serial SPI interface enable	
26	MULT_IO3	Select for Wheatstone comparator MUX or Interrupt or Multi purpose I/O no. 3	Wheatstone select Mult-IO
27	Vcc	Supply voltage digital part , I/O, 4MHz-osc.	
28	GND	GND	
29	Vcc	Supply voltage digital part , I/O, 4MHz-osc.	
30	SENSE_IN	Input internal CMOS comparator, connect to Vcc if not used	Analog In
31	SENSE_OUT	Output internal CMOS comparator	Analog Out
32	UCOMP1	External comparator circuit connection	Analog Out
33	UCOMP2	External comparator circuit connection	Analog Out
34	STOP	Stop input measuring signal	
35	VCC_LCD	Supply voltage LCD, 10kHz osc., bandgap	
36	CPUMP1	LCD voltage doubling and stabilization	Analog Out
37	CPUMP2	LCD voltage doubling and stabilization	Analog Out
38	CPUMP3	LCD voltage doubling and stabilization	Analog Out
39	LCD_COM1	LCD line driver for 1/2, 1/3, 1/4 duty	LCD Buffer

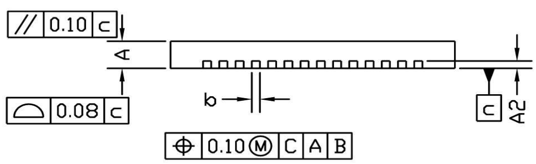
40	LCD_COM2	LCD line driver for 1/2, 1/3, 1/4 duty	LCD Buffer
41	LCD_COM3	LCD line driver for 1/3, 1/4 duty, row driver for 1/2 duty	LCD Buffer
42	LCD_COM4	LCD line driver for 1/4 duty, row driver for 1/2, 1 /3 duty	LCD Buffer
43	LCD_SEG1	LCD row driver	LCD Buffer
44	LCD_SEG2	LCD row driver	LCD Buffer
45	LCD_SEG3	LCD row driver	LCD Buffer
46	LCD_SEG4	LCD row driver	LCD Buffer
47	LCD_SEG5	LCD row driver	LCD Buffer
48	LCD_SEG6	LCD row driver	LCD Buffer
49	LCD_SEG7	LCD row driver	LCD Buffer
50	LCD_SEG8	LCD row driver	LCD Buffer
51	LCD_SEG9	LCD row driver	LCD Buffer
52	LCD_SEG10	LCD row driver	LCD Buffer
53	LCD_SEG11	LCD row driver	LCD Buffer
54	LCD_SEG12	LCD row driver	LCD Buffer
55	LCD_SEG13	LCD row driver	LCD Buffer
56	LCD_SEG14	LCD row driver	LCD Buffer

QFN56 Package Outline

QFN56, 7x7 mm², 0.4mm Pitch

Figure 2.8 Package outline (QFN56)





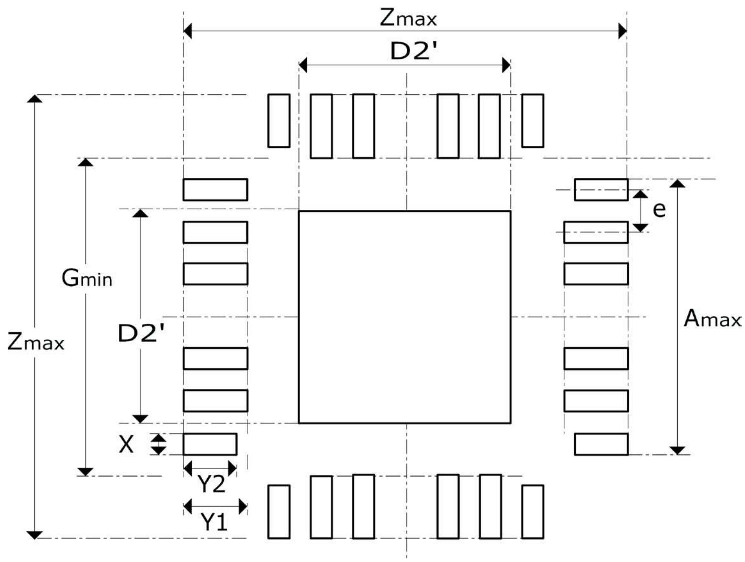
SYMBOL	DIMENSIONS MILLIMETER			DIMENSIONS INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.70	0.75	0.80	0.027	0.029	0.031
A2	0.200 REF.			0.0078 REF.		
b	0.15	0.20	0.25	0.006	0.008	0.010
D	6.90	7.00	7.10	0.271	0.275	0.279
D2	5.20	5.30	5.40	0.205	0.209	0.213
e	0.40 TYP			0.016 TYP		
E	6.90	7.00	7.10	0.271	0.275	0.279
E2	5.20	5.30	5.40	0.205	0.209	0.213
k	0.25	0.35	0.45	0.010	0.014	0.018
k1	0.35	0.45	0.55	0.014	0.018	0.022
L	0.40	0.50	0.60	0.016	0.020	0.024
L1	0.30	0.40	0.50	0.012	0.016	0.020

QFN56 Recommended Pad Layout

		mm	inch
e	=	0.4	0.016
G_{min}	=	6.3	0.248
Zmax	=	8.0	0.315
D2'	=	5.4	0.213
Amax	=	5.45	0.215
X	=	0.25	0.010
Y1	=	0.85	0.033
Y2	=	0.75	0.030

Note: Size of ground plane may not be reduced. It should not contain any vias.

Figure 2.9 Pad Layout



RoHS:	PS081FN in QFN56 is RoHS compliant			
	Material list:	Lead frame		C194 Cu with PPF finish (NiPdAU)
		Die Attach		Ablebond 8600, ABlestik
		Bond wires		Gold
		Mold		CEL9220HF13H, Hitachi
		Marking	Laser	

Moisture Sensitivity Level 1 (JEDEC J-STD-020,033)

Reflow Soldering Profile	Average ramp-up rate (TL to Tp)	3 °C/second max.
	Preheat	
	- Temperature Min (TSmin)	140 °C
	- Temperature Max (TSmax)	200 °C
	- Time (min to max) ts	60 - 120 seconds
	Tsmax to TL	
	- Ramp-up rate	3 °C/second max.
	Time maintained above:	
	- Temperature (TL)	220 °C
	- time (tL)	30 seconds
	Peak Temperature (Tp)	245 +0 -5 °C
	Time within 5°C of actual Peak	10 seconds

Die

Figure 2.10 Pad assignment Die

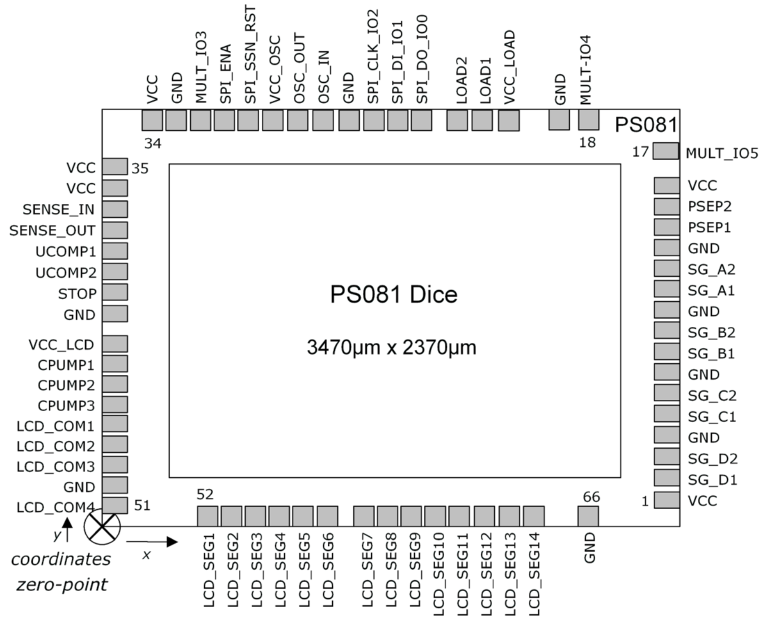


Table 2.13 Pad assignment and location Die

#Pad	**Name**	**Description**	**Type**	**X-Pos Center**	**Y-Pos. Center**
Right					
1	VCC	Supply voltage digital part, I/O, 4MHz-osc.		3392	193.8
2	SG_D1	Port 1 halfbridge D	N Open Drain	3392	316
3	SG_D2	Port 2 halfbridge D	N Open Drain	3392	431
4	GND	Ground		3392	546
5	SG_C1	Port 1 halfbridge C	N Open Drain	3392	661
6	SG_C2	Port 2 halfbridge C	N Open Drain	3392	776
7	GND	Ground		3392	891
8	SG_B1	Port 1 halfbridge B	N Open Drain	3392	1006
9	SG_B2	Port 2 halfbridge B	N Open Drain	3392	1121
10	GND	Ground		3392	1236
11	SG_A1	Port 1 halfbridge A	N Open Drain	3392	1351
12	SG_A2	Port 2 halfbridge A	N Open Drain	3392	1466
13	GND	Ground		3392	1581
14	PSEP1	Port 1 temperature measurement	N Open Drain	3392	1696
15	PSEP2	Port 2 temperature measurement	N Open Drain	3392	1811
16	VCC	Supply voltage digital part , I/O, 4MHz-osc.		3392	1926
17	MULT_IO5	Multi purpose I/O no. 5	Mult-IO	3392	2151
Top					
18	MULT_IO4	Multi purpose I/O no. 4	Mult-IO	2862	2286
19	GND	Ground		2730	2286
20	VCC_LOAD	Power supply load output pins 1 and 2		2115	2286
21	LOAD1	Load output to measuring capacitor	P Open Drain	1976.6	2286
22	LOAD2	Load output to measuring capacitor	P Open Drain	1835	2286
23	SPI_DO_IO0	Output serial SPI interface or IO0	Mult-IO	1656.2	2286
24	SPI_DI_IO1	Input serial SPI interface or IO1	Mult-IO	1544.2	2286

25	SPI_CLK_IO2	Clock serial SPI interface or IO2	Mult-IO	1432.2	2286
26	GND	Ground		1320.2	2286
27	OSC_IN	Input to 4MHz ceramic resonator		1208.2	2286
28	OSC_OUT	Output to 4MHz ceramic resonator		1096.2	2286
29	VCC_OSC	4MHz Oscillator supply voltage		984.2	2286
30	SPI_CSN_RST SPI_SSN_RST	Slave select or RST input (High active)	Input with pull-down	872.2	2286
31	SPI_ENA	Serial SPI interface enable		760.2	2286
32	MULT_IO3	Select for Wheatstone comparator MUX or Interrupt or Multi purpose I/O no. 3	Wheatstone select Mult-IO	648.2	2286
33	GND	Ground		536.2	2286
34	Vcc	Supply voltage digital part , I/O, 4MHz-osc.		424.2	2286
Left					
35	Vcc	Supply voltage digital part , I/O, 4MHz-osc.		83	2003.3
36	Vcc-SENSE	Supply voltage SENSE pins		83	1891.3
37	SENSE_IN	Input internal CMOS comparator, connect to Vcc if not used	Analog In	83	1779.3
38	SENSE_OUT	Output internal CMOS comparator	Analog Out	83	1667.3
39	UCOMP1	External comparator circuit connection	Analog Out	83	1555.3
40	UCOMP2	External comparator circuit connection	Analog Out	83	1443.3
41	STOP	Stop input measuring signal		83	1331.3
42	GND	Ground		83	1219.3
43	VCC_LCD	Supply voltage LCD, 10kHz osc., bandgap		83	1045
44	CPUMP1	LCD voltage doubling and stabilization	Analog Out	83	933
45	CPUMP2	LCD voltage doubling and stabilization	Analog Out	83	821
46	CPUMP3	LCD voltage doubling and stabilization	Analog Out	83	709
47	LCD_COM1	LCD line driver for 1/2, 1/3, 1/4 duty	LCD Buffer	83	597
48	LCD_COM2	LCD line driver for 1/2, 1/3, 1/4 duty	LCD Buffer	83	485
49	LCD_COM3	LCD line driver for 1/3, 1/4 duty, row driver for 1/2 duty	LCD Buffer	83	373
50	GND	Ground		83	261
51	LCD_COM4	LCD line driver for 1/4 duty, row driver for 1/2, 1 /3 duty	LCD Buffer	83	149
Bottom					
52	LCD_SEG1	LCD row driver	LCD Buffer	612.6	83
53	LCD_SEG2	LCD row driver	LCD Buffer	724.6	83
54	LCD_SEG3	LCD row driver	LCD Buffer	836.6	83
55	LCD_SEG4	LCD row driver	LCD Buffer	948.6	83
56	LCD_SEG5	LCD row driver	LCD Buffer	1060.6	83
57	LCD_SEG6	LCD row driver	LCD Buffer	1172.6	83
58	LCD_SEG7	LCD row driver	LCD Buffer	1347	83
59	LCD_SEG8	LCD row driver	LCD Buffer	1459	83
60	LCD_SEG9	LCD row driver	LCD Buffer	1571	83
61	LCD_SEG10	LCD row driver	LCD Buffer	1683	83
62	LCD_SEG11	LCD row driver	LCD Buffer	1795	83
63	LCD_SEG12	LCD row driver	LCD Buffer	1907	83
64	LCD_SEG13	LCD row driver	LCD Buffer	2019	83
65	LCD_SEG14	LCD row driver	LCD Buffer	2131	83
66	GND	Ground		2928	83

Dimensions and Pad Opening

The exact Die size is 2.37 x 3.47 mm, the Wafer thickness 725µm. The IC is expected to be used predominantly as Chip On Board (COB). Therefore it is essential to have a Pad Opening that is suitable for bonding machines:

Width: 90µm

Height: 116µm

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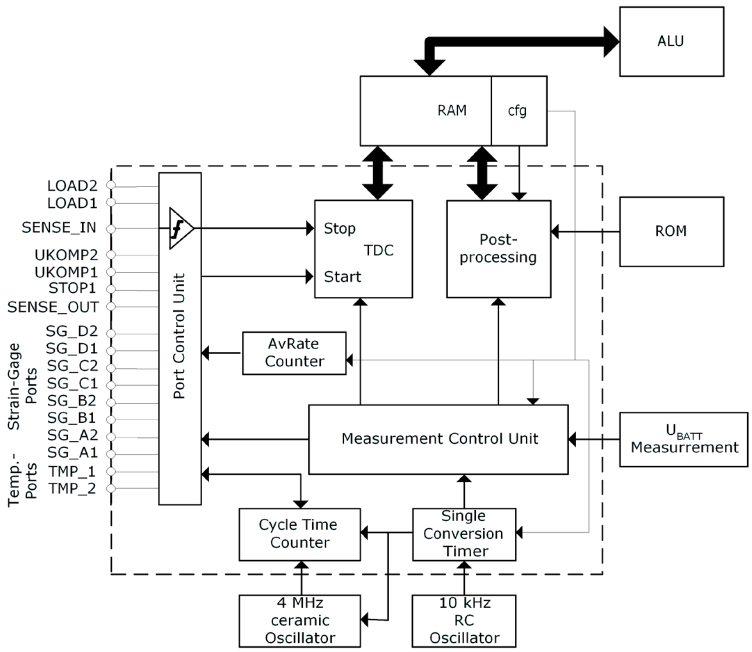
3 Converter Front End

3.1 Overview

Figure 3.1 Overview



The PICOSTRAIN based converter has the strain gage ports (SG_Ax to SG_Dx) to measure:

- 4 independent half bridges (quattro mode)
- 2 half bridges that form a full bridge
- 2 independent half bridges
- 1 classical Wheatstone bridge
- 1 single half bridge

3.2 Measurement Principle

The strain itself is measured by means of discharge time measurements. The discharge time is defined by the strain gauge resistance and the capacitor Cload. Both, the strain gage with positive change and the one with negative change are measured. The ratio of the two discharge times provides the strain information. The precision of the time measurement is done with about 15 ps resolution (0.5 ps with averaging).

Figure 3.2 Measurement Principle