C-DIAS Analog Input Module CAI 042

4 x resistance measurement bridges ±2mV / V

The calibratable CAI 042 DMS module is used to record data from resistance measurement bridges (e.g. load cells). With an 18-bit resolution, measurement values with an accuracy of ±0,01% are available.

Technical Data

Analog Channel Specifications

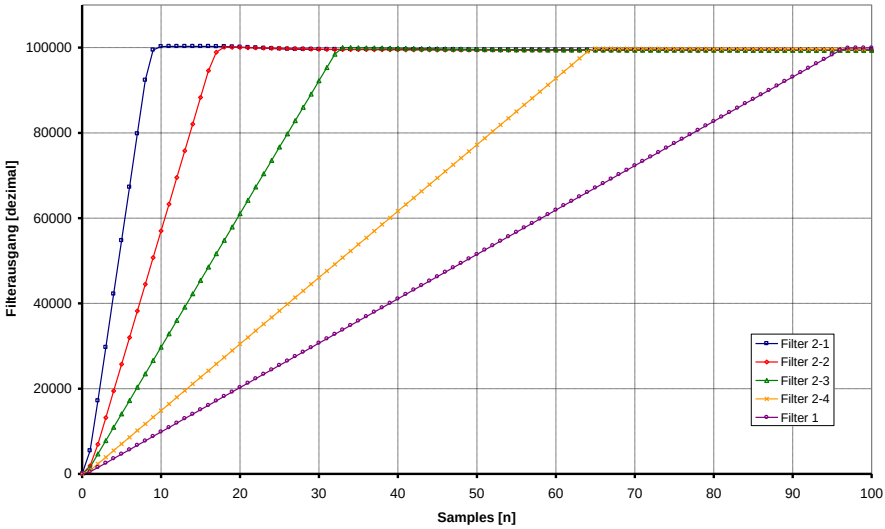
Number of channels	1,2 or 4
Load cells parameter	2mV / V
Measurement range	±20 mV
Measurement value	±105000 d
Resolution	Internal 24 bit (From the 18 bit measurement value)
Conversion time for all channels	14ms / 4 Channel drive 8ms / 2 Channel drive 4ms / 1 Channel drive
Bridge supply voltage	10V
Maximum load of the voltage supply (entire supply)	135mA
Maximum resistance per channel (using all 4 channels)	300Ohm to 5000Ohm
Allowable resistance (parallel circuit of all 4 bridges)	75Ohm to 5000Ohm
Analog channel measurement accuracy	±0,01% of maximum measurement value (With an operating temperature from 0 to +40°C)

Number of filters per channel	2 (1 fix, 2. 4-step settable)
Calibratable	Yes
Serial interface	Analysis with hyper terminal possible

So that the maximum load for the reference voltage is not exceeded, a maximum of 4 bridges with a minimum resistance of 300Ohms can be connected to the CAI 042. Here, it doesn't matter if 4 bridges are connected parallel with one channel or if each channel is connected to a single bridge.

Afin de ne pas dépasser la charge maximale de la tension de référence, au maximum 4 ponts d'une résistance supérieure ou égale à 300 ohms peuvent être connectés à la CAI 042. Il est sans importance si quatre ponts sont connectés en parallèle avec un canal ou si chaque canal est connecté à un seul pont.

Step response of the analog and digital filters (20mV steps)



Electrical Requirements

Supply from C-DIAS Bus	+5V and +24V	
Current consumption of the C-DIAS Bus (+5 V supply)	Typically 50mA	Maximum 70mA
Current consumption of the C-DIAS Bus (+24 V-supply)	Typically 200mA	Maximum 250mA

IMPORTANT:
This module exceeds the standard current consumption for C-DIAS modules!
(+5V: 150mA and +24V: 150mA)

If this C-DIAS module is mounted on an 8x module carrier (CMB 08x), the total current of the modules used must be determined and tested.
The specification for the current consumption is found in the technical document of the respective module under “Electrical Requirements”
The total current of the +5V supply cannot exceed 1.2A (150mA/slot).
This also applies to the total current of the +24V supply, which also cannot exceed 1.2A (150mA/slot).

IMPORTANT:
La consommation de courant de ce module dépasse les valeurs typiques pour les modules C-DIAS!
(+5 V: 150 mA et +24 V: 150mA)

Si ce module C-DIAS est monté sur un fond de panier de taille 8 (CMB 08x), le courant total des modules utilisés doit être déterminé et vérifié.
Les données de la consommation de courant sont mentionnées dans la documentation technique du module respectif dans le paragraphe "Spécifications électriques"
Le courant total de l'alimentation +5 V ne peut pas dépasser 1,2A (150mA/module).
Cela vaut également pour le courant total de l'alimentation +24 V, lequel ne peut également pas dépasser 1,2A (150mA/module).

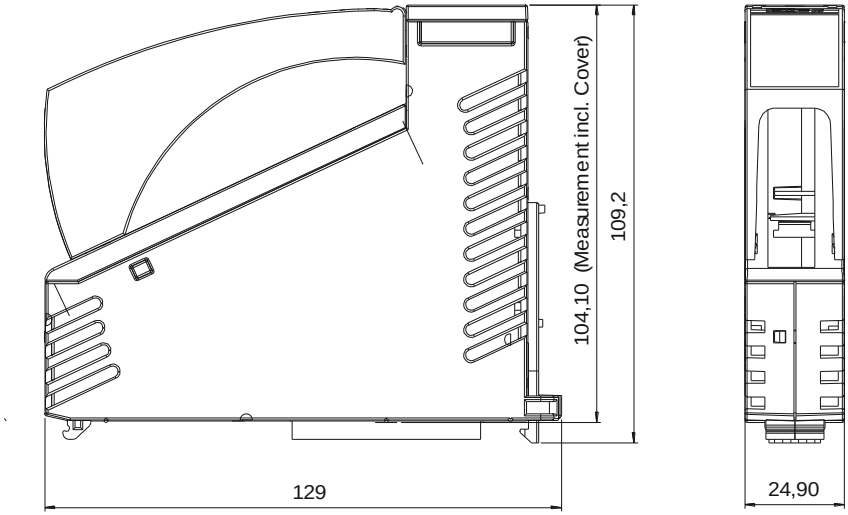
Miscellaneous

Article number	12-009-042
Hardware version	1.x
Standardization	UL (E247993)

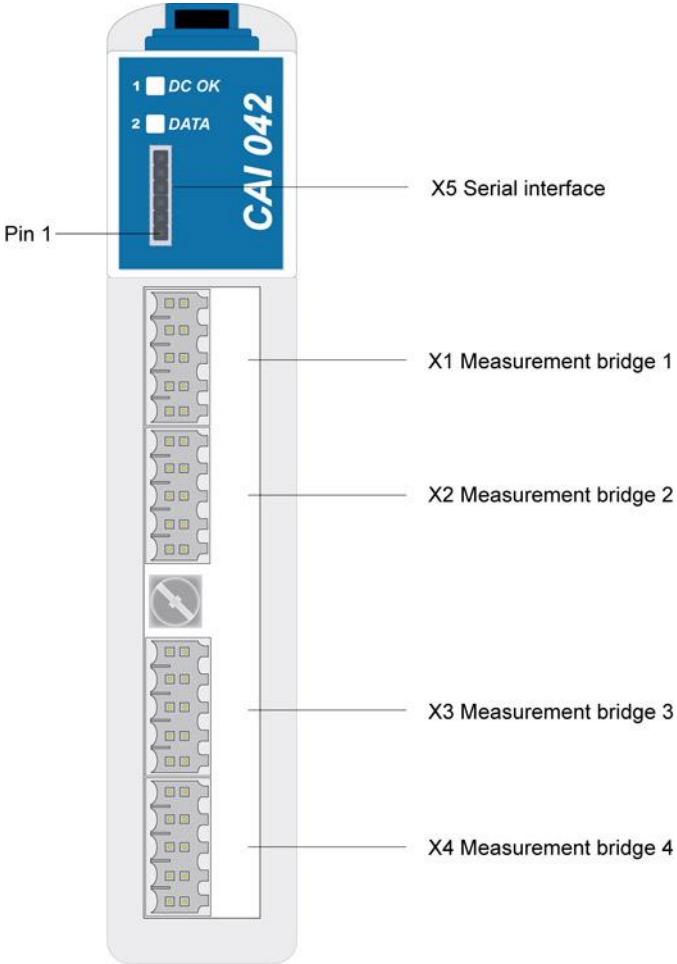
Environmental conditions

Storage temperature	-20 – +85°C	
Operating temperature	0 – +40°C	
Humidity	0 – 95%, uncondensed	
EMV stability	Per EN 61000-6-2 (Industrial area)	
Shock resistance	EN 60068-2-27	150m/s²
Protection type	EN 60529	IP 20

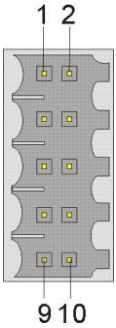
Mechanical Dimensions



Terminal Assignment

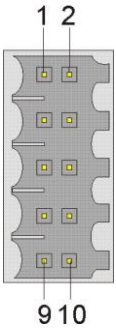


X1: Measurement bridge 1



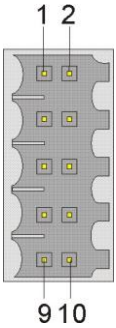
Pin	Function
1	Signal input 1-
2	Signal input 1+
3	Reference Input 1-
4	Reference Input 1+
5	Reference Output 1- (GND)
6	Reference Output 1+
7	Reference Output 1- (GND)
8	Reference Output 1+
9	Earth connection 1 (shield)
10	Earth connection 1 (Shield)

X2: Measurement bridge 2



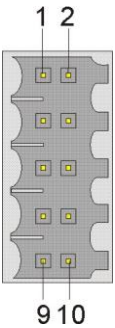
Pin	Function
1	Signal input 2-
2	Signal input 2+
3	Reference Input 2-
4	Reference Input 2+
5	Reference Output 2- (GND)
6	Reference Output 2+
7	Reference Output 2- (GND)
8	Reference Output 2+
9	Earth connection 2 (Shield)
10	Earth connection 2 (Shield)

X3: Measurement bridge 3



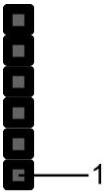
Pin	Function
1	Signal input 3-
2	Signal input 3+
3	Reference Input 3-
4	Reference Input 3+
5	Reference Output 3- (GND)
6	Reference Output 3+
7	Reference Output 3- (GND)
8	Reference Output 3+
9	Earth connection 3 (Shield)
10	Earth connection 3 (Shield)

X4: Measurement bridge 4



Pin	Function
1	Signal input 4-
2	Signal input 4+
3	Reference Input 4-
4	Reference Input 4+
5	Reference Output 4- (GND)
6	Reference Output 4+
7	Reference Output 4- (GND)
8	Reference Output 4+
9	Earth connection 4 (Shield)
10	Earth connection 4 (Shield)

X5: Serial interface



Pin	Function
1	+5 V
2	Rx / TTL
3	Tx / TTL
4	-
5	GND
6	-

The signals of the serial interfaces are TTL signals. To connect the serial interface to a RS232 interface a TTL/RS232 converter is necessary.

Applicable Connector

X1 – X4: 10-pin. Weidmüller connector B2L/B2CF 3,5/10
X5: 6-pin socket board RM2,54 (not included in connector set CKL 042!)

The complete C-DIAS connector set CKL 045 with spring terminals is available from SIGMATEK under the article number 12-600-045

Status Display

LED Nr.	LED color	Description
1	Green	Output 1 DC OK
2	Green	Output 2 DATA

Wiring Guidelines

General

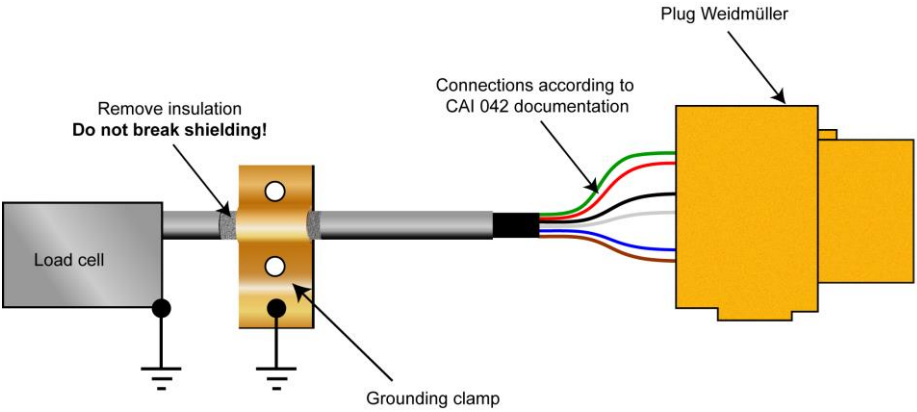
The 0V connection for the voltage supply must be wired to the 0V collection point over the shortest route possible.

Wiring and Cable Shielding

The analog signals received by the module are very small in comparison to the digital signals. To ensure error-free operation, a careful wiring method should be followed.

The analog connection lines must be as short as possible and avoid parallel wiring with digital signal lines.

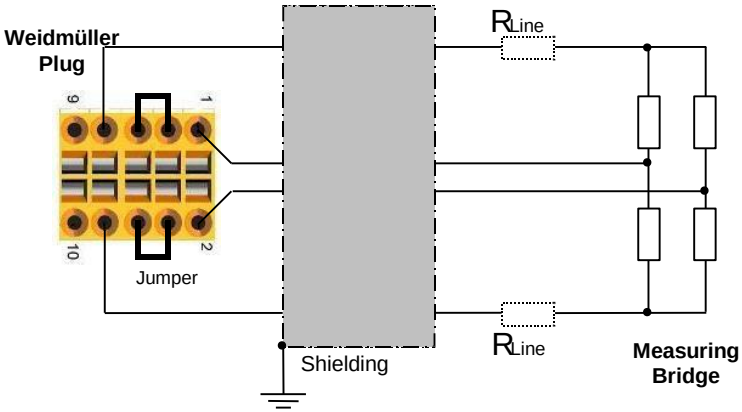
The signal lines should be shielded or at the very least, twisted (see below).



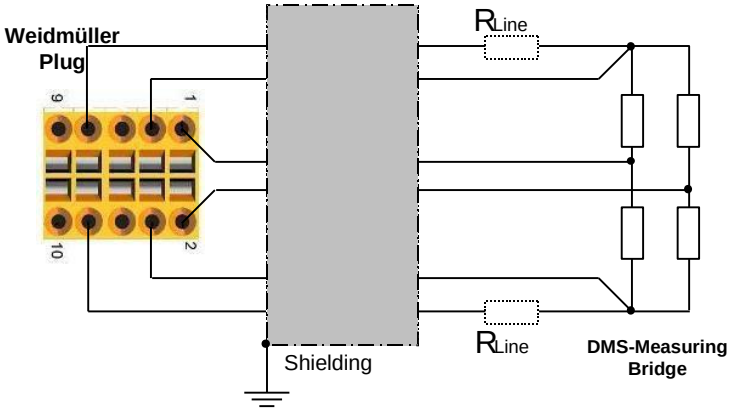
Wiring Variations

There are two connection types available for measuring with the resistive wire strain:

- 4-wire measurement: The advantage of this variation is that a four-pole connection cable can be used for the DMS; however, the voltage drop on the circuit for the bridge supply voltage cannot be compensated.



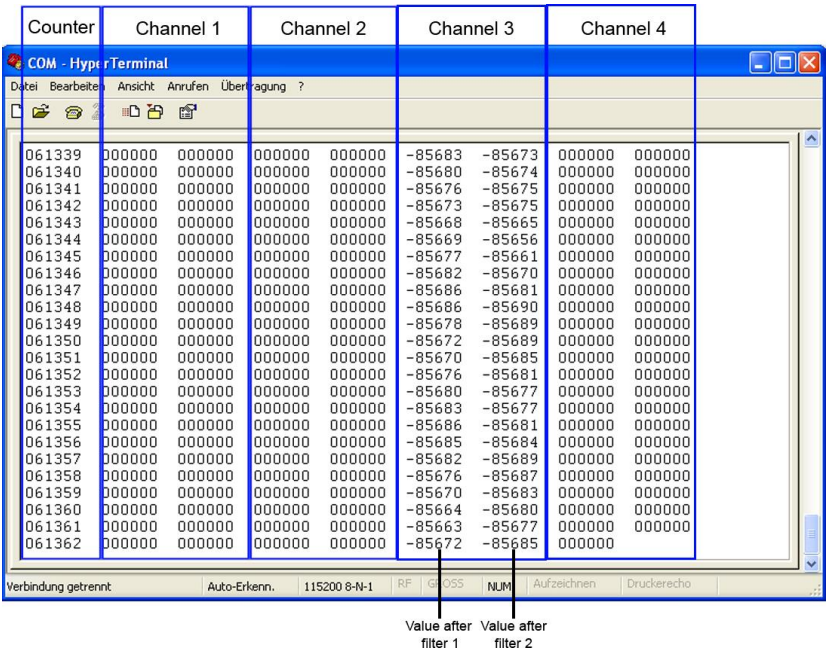
- 6-wire measurement: This method has the advantage of voltage compensation through direct measurement of the bridge supply voltage on the DMS.



Analysis of the serial interface with Hyper terminal

Settings:

Baud rate:	115,2k
Data bits:	8
Parity:	None
Stop bits:	1
Flow control:	None



Counter: Shows how often measuring values are written to the serial interface. The measuring values are updated in about 13ms intervals. After each reset the counter reading is reset.

Filter 1: This value corresponds to the filtered measurement value of the voltage on the resistor measuring bridge with 18-bit resolution.
Filter frequency: $f_g = f_{Samp} / 96$

Filter 2: This value corresponds to the filtered measurement value of the voltage on the resistor measuring bridge with 18-bit resolution.
Filter frequency: $f_g = f_{Samp} / x$; x … [8, 16, 32, 64]
The setting of the filter frequency for filter 2 takes place with the configuration register of the respective channel.
The description of the configuration register can be found under **Configuration register for Channel x – CFGRx**.

Communication (CDIAS)

Over the C-DIAS bus, the operating parameters and data can be read and written. Up to 256, 8-bit addresses can be accessed. The data transfer is divided it two register groups.

- Status, instruction and configuration registers.
- Data registers

Note:
Registers not mentioned below cannot be used as they are used by the CAI042 internally.

Remarque:
Registres exploités par la CAI042 en interne ne sont pas mentionnés ci-dessous et ne peuvent pas être utilisés.

Data over the hardware can be read from the serial EEProm (LASAL EEProm) can be read.

Status, instruction and configuration registers

These registers can be addressed directly.

Data registers

To avoid bus conflicts between the controller and C-DIAS bus with 32-bit data transfers, the data are stored in 2 pages. A flag in STATUSR always points to the page with the most current values.

Process for Reading Data from the C-DIAS Bus

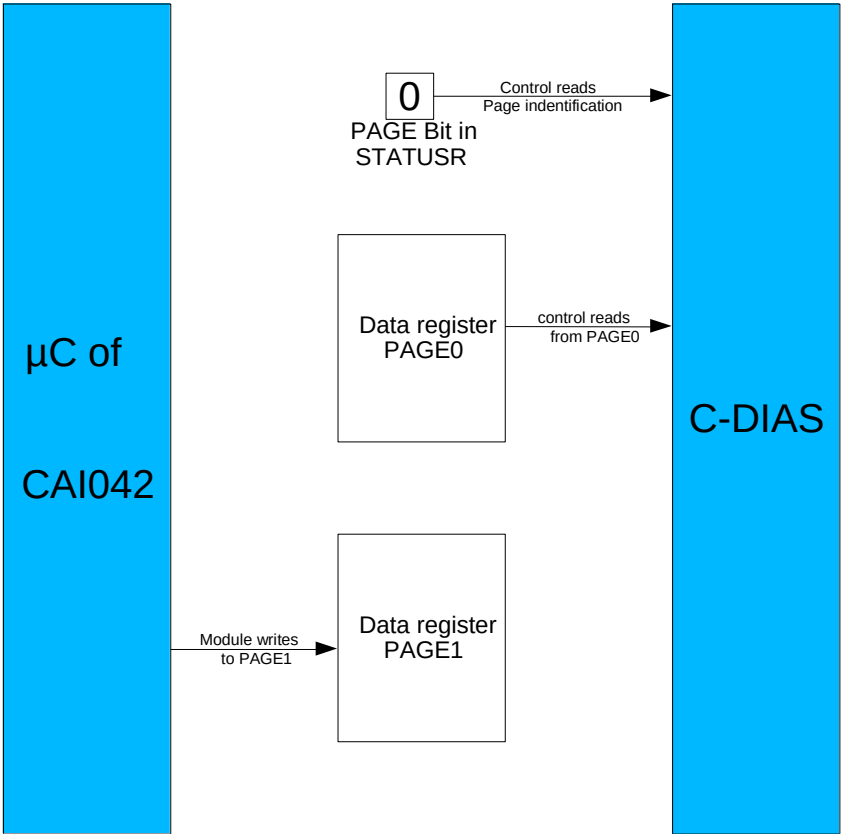
The control reads the PAGE bit in STATUSR. If this bit is cleared, the current data is stored in PAGE0. If the bit is set, the current data is in PAGE1. Data can be read from the actual page.

Process for Writing Data from the CAI 042 µC

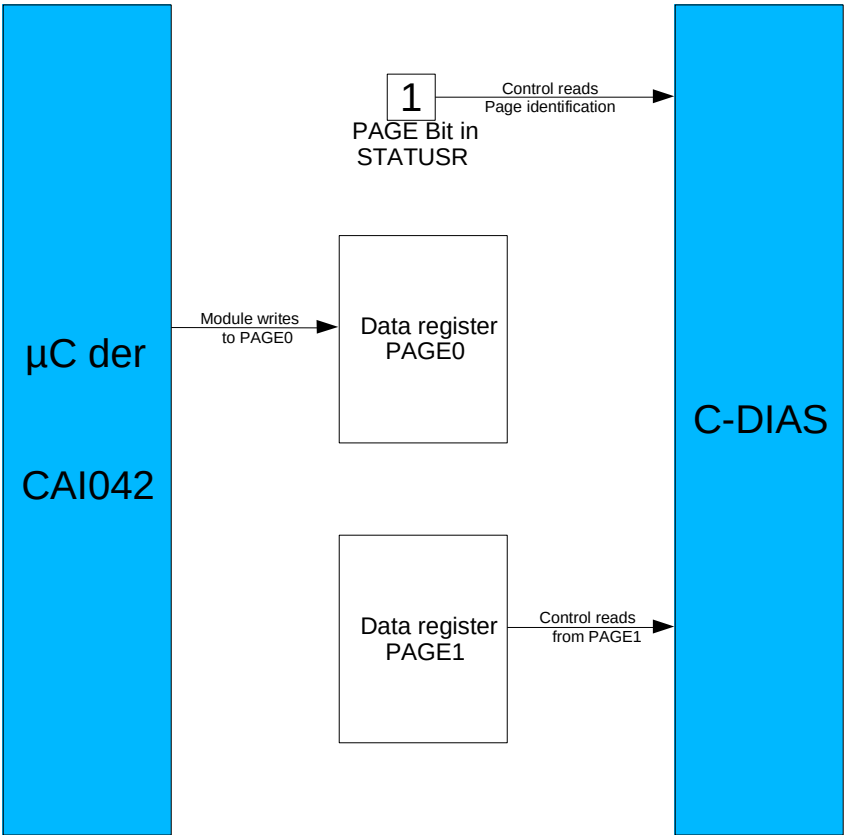
The µC reads the PAGE bit in STATUSR. If it is cleared, the data is written to PAGE1. If the PAGE bit is set, the data is written to PAGE0. The PAGE BIT is then inverted.

Schematic Process Diagram of Communication over the C-DIAS bus

Data is read from PAGE0



Data is read from PAGE1



Registers used in Communication over the C-Dias bus

Register overview

Register	Description	Address
STATUSR	Module status (error messages, operating status)	0x00
CMDR	Instruction register (operating mode settings)	0x01
CFG	Global configurations register	0x02
VER	Firmware version	0x04 – 0x06
CFGR1	Configuration for channel 1	0x10
CFGR2	Configuration for channel 2	0x11
CFGR3	Configuration for channel 3	0x12
CFGR4	Configuration for channel 4	0x13
SR1	Error status for channel 1	0x18
SR2	Error status for channel 2	0x19
SR3	Error status for channel 3	0x1A
SR4	Error status for channel 4	0x1B
DATA1_P0_F1	Data for filter output 1 Channel1 Page 0	0x20 – 0x23
DATA1_P0_F2	Data for filter output 2 Channel1 Page 0	0x24 – 0x27
DATA2_P0_F1	Data for filter output 1 Channel2 Page 0	0x28 – 0x2B
DATA2_P0_F2	Data for filter output 2 Channel2 Page 0	0x2C – 0x2F
DATA3_P0_F1	Data for filter output 1 Channel3 Page 0	0x30 – 0x33
DATA3_P0_F2	Data for filter output 2 Channel3 Page 0	0x34 – 0x37
DATA4_P0_F1	Data for filter output 1 Channel4 Page 0	0x38 – 0x3B
DATA4_P0_F2	Data for filter output 2 Channel4 Page 0	0x3C – 0x3F
DATA1_P1_F1	Data for filter output 1 Channel1 Page 1	0x40 – 0x43
DATA1_P1_F2	Data for filter output 2 Channel1 Page 1	0x44 – 0x47
DATA2_P1_F1	Data for filter output 1 Channel2 Page 1	0x48 – 0x4B
DATA2_P1_F2	Data for filter output 2 Channel2 Page 1	0x4C – 0x4F
DATA3_P1_F1	Data for filter output 1 Channel3 Page 1	0x50 – 0x53
DATA3_P1_F2	Data for filter output 2 Channel3 Page 1	0x54 – 0x57
DATA4_P1_F1	Data for filter output 1 Channel4 Page 1	0x58 – 0x5B
DATA4_P1_F2	Data for filter output 2 Channel4 Page 1	0x5C – 0x5F

Status Register – STATUSR

Bit	7	6	5	4	3	2	1	0
STAUSR	MOD3	MOD2	MOD1	MOD0	ERR	-	-	PAGE
R/W	R	R	R	R	R	R	R	R
Initial Value	0	0	0	0	0	0	0	0

- **BIT 7 – MOD3: Modus Bit 3**
  See Mode bits table.

- **BIT 6 – MOD2: Modus Bit 2**
  See Mode bits table.

- **BIT 5 – MOD1: Modus Bit 1**
  See Mode bits table.

- **BIT 4 – MOD0: Modus Bit 0**
  See Mode bits table.

- **BIT 3 – ERR: Error Bit**
  When this bit is set, an error has occurred. The error register should be checked.

- **BIT 0 – PAGE: Page**
  If this bit is cleared, the last valid data is stored in the address range 0x20 to 0x3F.
  If it is set, the last valid data is stored in the address range 0x40 to 0x5F.

  This flag is valid only in connection with the RDY bit.

Mode bits table

MOD3	MOD2	MOD1	MOD0	Description
0	0	0	0	*Warm-up phase* The module is in the warm-up phase. The data registers contain no valid data and no instruction can be sent except for the configuration mode.
0	0	0	1	*Operating mode* The module is in operating mode. The data registers now contain valid data.

Instruction Register - CMDR

Bit	7	6	5	4	3	2	1	0
CMDR	CMDR[7..0]							
R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Initial Value	0	0	0	0	0	0	0	0

Instruction register for controlling the module.
The module is set to 0 after this instruction is executed.

Table of instructions

Value	Instruction
0x01	Normal operation (Skip warm-up phase)
0x02	Assume and save configurations

Global Configurations Register – CFG

Bit	7	6	5	4	3	2	1	0
CFG							CHAN1	CHAN0
R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Initial Value	0	0	0	0	0	0	0	0

Global Configuration of CAI042

- **BIT1 – CHAN1** Channel configuration bit
- **BIT0 – CHAN0** Channel configuration bit

With the CHAN1:CHAN0 bits, it is possible to select 1, 2 and 4-channel operation. The conversion time changes according to the settings.

CHAN1	CHAN0	Number of channels (active channels)	Conversion time for all channels
0	0	1 (connector X1)	4ms
0	1	2 (connector X1 & X2)	8ms
1	0	4 (connector X1, X2, X3 & X4)	14ms

VER –Version register

Bit	7	6	5	4	3	2	1	0
VER0	VER[7..0]							
VER1	VER[15..8]							
VER2	VER[23..16]							
R/W	R	R	R	R	R	R	R	R

Version number of the Firmware:

- VER[7..0] Revision number (binary)
- VER[15..8] Subversion number (binary)
- VER[24..16] Main version number (binary)

Example:

VER2	VER1	VER0	Version
1	9	14	V01.09.14

Configuration register for Channel x – CFGRx

Bit	7	6	5	4	3	2	1	0
CFGRx	EN	-	-	-	-	-	FIL1	FIL0
R/W								
Initial Value	1	0	0	0	0	0	0	0

x...[1..4]

- **BIT7-EN: Enable**

  The channel is active when this bit is set and inactive when cleared.

- **BIT1-FIL1: Filter selection for filter 2**

  See filter table

- **BIT0-FIL0: Filter selection for 2**

  See filter table

Filter table

FIL1	FIL0	Filter frequency for Filter 2	
0	0	$f_g = f_{Samp} / 8$	Filter 2-1
0	1	$f_g = f_{Samp} / 16$	Filter 2-2
1	0	$f_g = f_{Samp} / 32$	Filter 2-3
1	1	$f_g = f_{Samp} / 64$	Filter 2-4

Filter 1 (fixed value filter) has a filter frequency of $f_g = f_{Samp} / 96$.

Status register for Channel x – SRx

Bit	7	6	5	4	3	2	1	0
SRx	-	-	-	-	-	-	-	SIGOF
R/W						R	R	R
Initial Value	0	0	0	0	0	0	0	0

x ... [1..4]

- **BIT 0 – SIGOV: Signal Overflow**

  If this bit is set, the measured value of the input signal is too high.
  When cleared, the measured value is within range.

Data Register - DATAx_Py

Bit	7	6	5	4	3	2	1	0
DATAx_Py_Fz	DATAx_Py_Fz [7..0]							
DATAx_Py_Fz	DATAx_Py_Fz [15..8]							
DATAx_Py_Fz	DATAx_Py_Fz [23..16]							
DATAx_Py_Fz	DATAx_Py_Fz [31..24]							
R/W	R	R	R	R	R	R	R	R
Initial Value	0	0	0	0	0	0	0	0

x ... [1 … 4], y ... [0, 1], z ... [1, 2]

32 Bit Data register for channel x, page y and filter z.

LASAL EEProm Data

Calibration data CAI042 (24C02 is organized by byte):

Address	Data	Description
$00	$xx	Check sum
$01	123	Identification
$02	5	Module group 5=CAI
$03	4	Module version 4=CAI042
$04	4	Number of channels
$05	10	Hardware version $10=HW 1.0
$06-$3F	0	FILL
$10		Serial number

AI calibration data

$40	$xxxx	Check sum
$42	12345	Identification
$44	9	Length of the following data block in WORD
$46	4	Number of channels
$48-$57	„xxxxxx“	Serial number as 16-byte string. E.G.: „31333_01_0019___“
$58-$AF	0	FILL
$B0-$B3	xxx*	Head1 (CalibrateCounter)
$B4-$B7	xxx*	Head1 (ZeroLevel)
$B8-$BB	xxx*	Head1 (CalibrateLevel)
$BC-$BF	xxx*	Head1 (CalibrateWeight)
$C0-$C3	xxx*	Head1 (MaxWeight)
$C4-$D7	xxx*	Head2 (partitioned the same as Head1)
$D8-$EB	xxx*	Head3 (partitioned the same as Head1)
$EC-$FF	xxx*	Head4 (partitioned the same as Head1)

* Customer specific data (not require for the operating of the module).