

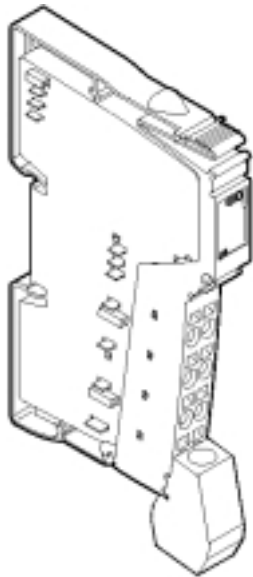
VersaPoint I/O Module

Analog In 15 Bit Voltage/Current 2 Channels IC220ALG220

GFK-1906

April 2001

Module IC220ALG220 is used to measure analog voltage or current signals.



Module with the I/O Terminal Strip plugged in

Module IC220ALG220 requires one (1) I/O Terminal Strip, IC220TBK061, ordered separately. See the ordering information below.

Features

- Two analog single-ended inputs for either voltage or current signals
- Connection of 2- and 3-wire sensors
- Three current ranges: 0 to 20mA, ± 20 mA, 4 to 20mA
- Two voltage ranges: 0V to 10V, ± 10 V
- Configuration of the independent channels
- Measured values can be represented in two formats
- Resolution independent of representation format and measuring range
- Process data update of both channels in 1.5mS, max.
- Diagnostic indicators

Ordering Information

IC220ALG220 Analog In 15 Bit Voltage/Current 2 Channels

IC220TBK061 I/O Terminal Strip with Shield, quantity 5

Module Specifications

Housing dimensions (width x height x depth)	12.2mm x 120mm x 71.5mm (0.49in. x 4.8in. x 2.86in.)
Connection style	2- and 3-wire
Power for sensors	External power supply
Operating temperature	-25°C to +55°C (-13°F to +131°F)
Storage temperature	-25°C to +85°C (-13°F to +185°F)
Operating humidity	75% on average. Take appropriate measures against increased humidity (> 85%).
Storage humidity	75% on average
Degree of protection	IP 20 according to IEC 60529
Class of protection	Class 3 according to VDE 0106, IEC 60536

Power Consumption

Communications power UL	7.5V
Current consumption from local bus UL	Approximately 45 mA, typical
I/O supply voltage UANA	24VDC
Current consumption from analog bus UANA	Approximately 12mA, typical
Total power consumption	Approximately 0.63W, typical

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Installation Instructions

High current flowing through the segment and main power busses raises the temperature of the components within the module. To keep the current flowing through the power busses of the analog modules as low as possible, **a separate main circuit should be used for analog modules**. If analog modules must be used in a main circuit together with other modules place the analog modules to the right of the standard modules, at the end of the main circuit.

Connections

Connect sensors using shielded, twisted-pair cables. Connect the shielding of the cable to the shield connector clamp. With the clamp, the shield is connected with high-resistance and capacitance to FE GND on the module. Additional wiring is not necessary.

Do not connect voltages above $\pm 5V$ to a current input. This can damage the module electronics by exceeding the maximum current of $\pm 100mA$.

Use a connector with shield connection when installing the sensor. The following diagrams show the connection schematically (without the shield connector).

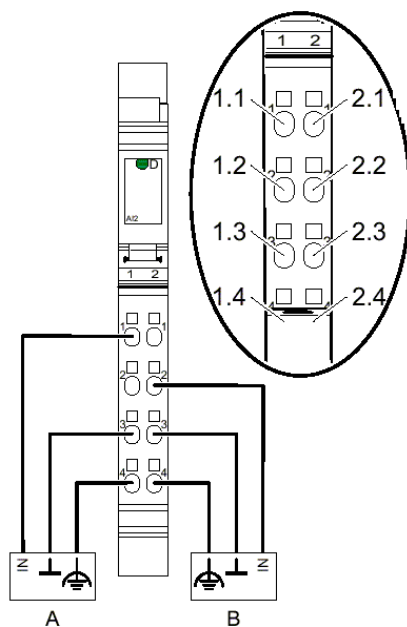
CAUTION: Do not simultaneously apply current and voltage signals to an input channel.

Terminal	Signal	Assignment
1.1	+U1	Voltage input channel 1
2.1	+U2	Voltage input channel 2
1.2	+I1	Current input channel 1
2.2	+I2	Current input channel 2
1.3	-1	Return for channel 1 (common for current and voltage)
2.3	-2	Return for channel 2 (common for current and voltage)
1.4, 2.4	Shield	Shield connection

LED	Color	Meaning
D	Green	Bus diagnostics

Example: Connection of Active Sensors

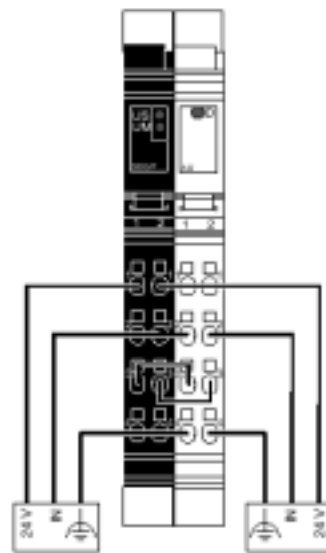
Connection of active sensors with 2-wire technology with shield connection:



- A. Active sensor with voltage output (channel 1)
- B. Active sensor with current output (channel 2)

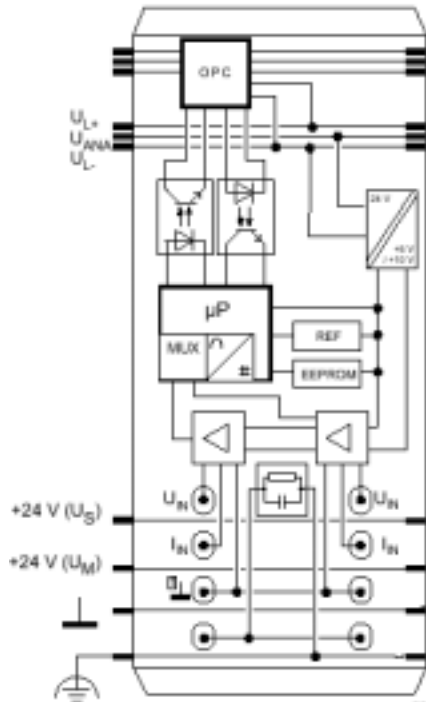
Example: Connection of Passive Sensors


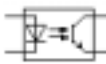






Connection of two passive sensors with 2-wire technology with shield connection, showing the passive sensor supply.



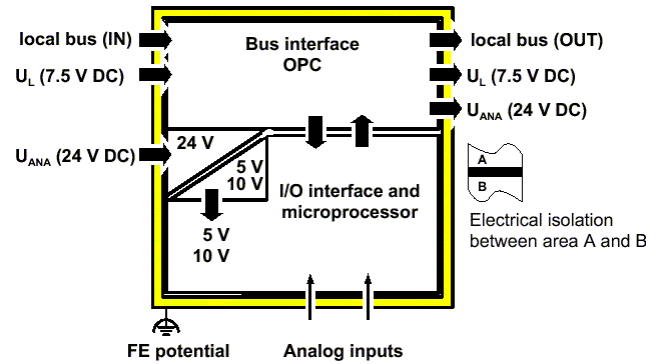
The sensors are powered by a Segment Terminal module (left). They can also be supplied from an external power supply.

Internal Circuit Diagram



-  Protocol chip (bus logic including voltage conditioning)
-  Optocoupler
-  DC/DC converter with electrical isolation
-  Microprocessor with multiplexer and analog/digital converter
-  Reference voltage
-  Electrically erasable programmable read-only memory
-  Amplifier
-  Coupling network

Electrical Isolation



Programming Data

ID code	7F hex (127 decimal)
Length code	02 hex
Input address area	4 bytes
Output address area	4 bytes
Parameter channel (PCP)	0 bytes
Register length (bus)	4 bytes

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Output Data Words for Channel Configuration

The module receives two output data words. These data words are used to configure the module. The module's default configuration can be used without change, or each channel can be configured independently. This configuration setting is not saved, and must be transmitted in each logic scan.

Default channel configuration:

Measuring range: 0 to 10 V
Averaging: On, 16-fold
Output format: Signed 15-bit

The following parameters can be configured:

- The measuring range for the input signal. (Selection of current or voltage operation is determined by the physical wire connection of the module's input terminals).
- Averaging on/off
- Format of the input data

After powerup, the message "measured value invalid" (error code 8004 hex) appears in the input data. After 1 second (maximum) the preset configuration is accepted and the first measured value is available.

If the channel configuration is changed, the corresponding channel is re-initialized. The message "measured value invalid" (error code 8004 hex) appears in the input data for 100mS.

Process Data Output Format

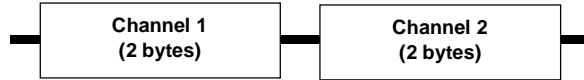
Each channel has one process data output word associated with it. You must set bit 15 of the corresponding output word to 1 to reconfigure the channel. **If bit 15 = 0, the default configuration is used.**



Bit	Assignment	Code	Description
15	Configuration	0	Default
		1	Configuration data
9, 8	Filter	00	16-fold average
		01	No filter
		10, 11	Reserved
5, 4	Format	00	Signed, 15-bit resolution
		01, 10	Not used
		11	Standardized representation
3 - 0	Measuring Range (Voltage)	0000	0V to 10V
		0001	$\pm 10V$
		0010 to 0111	Reserved
	Measuring Range (Current)	1000	0mA to 20mA
		1001	$\pm 20mA$
		1010	4mA to 20mA
		1011 to 1111	Reserved

Process Data Input Words

The measured input values are transmitted, per channel, to the controller. The figure below shows the sequence of the input data words.



For each channel, the format of the input data can be independently configured in two input data formats, as shown below. For both formats, the measured value is represented in bits 14 to 0. An additional bit (bit 15) is available as a sign bit.

Default Input Data Format

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Sign	Analog Value														

Standardized Representation Input Data Format

In this format, the measured data is standardized to represent the corresponding value without conversion. One bit has the value of 1 mV or 1 μA. (depending on which module terminals are used).

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Sign	Analog Value														

Comparing Data Values in Both Formats

These data formats handle the same measured input values in different ways, as shown by the example below. On the pages that follow, the input data formats are described in greater detail.

Example measurement range: 0mA to 20mA

Example measured value: 10mA

Format	Measured Value	HEX Input Value	Decimal Input Value
Default	10mA	3A98	15000
Standardized Representation	10mA	2710	10000

Channel Error Codes

In both formats, values greater than 8000H indicate an error.

Hex	Decimal	Error
8001	-32767	Over range
8002	-32766	Open circuit
8004	-32764	Measured value invalid/no valid measured value available
8010	-32752	Configuration invalid
8040	-32704	Module defective
8080	-32640	Under range

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Significant Measured Values

The tables below summarize significant values in both data formats.

Significant Values in Default Data Format

Input Data Word (Two's Complement)		Measuring range 0mA to 20mA or 0V to 10V		Measuring range -20mA to +20mA / -10V to +10V		Measuring range 4mA to 20mA
		0mA to 20mA Input	0V to 10V Input	-20mA to +20mA Input	-10V to +10V Input	4mA to 20mA Input
Hex	Decimal	mA	V	mA	V	mA
8001	overrange	+21.6746	+10.837	> +21.6746	> +10.837	> +21.339733
7F00	32512	+21.6746	+10.837	+21.6746	+10.837	+21.339733
7530	30000	+20.0	+10.0	+20.0	+10.0	+20.0
0001	1	+0.66667µA	+333.33µV	+0.66667µA	+333.33µV	+4.00053333
0000	0	0	0			+4.0 to 3.2
0000	0	<0	<0			
0000	0			0	0	
FFFF	-1			-0.66667µA	-333.33µV	
8002	Open circuit					<+3.2
8AD0	-30000			-20.0	-10.0	
8100	-32000			-21.6746	-10.837	
8080	Underrange			<-21.6746	<-10.837	

Significant Measured Values in Standardized Representation Format

In Standardized Representation format, one bit has the value of 1 mV or 1 µA. Because of the standardization not all of the possible codes are used.

Input Data Word (Two's Complement)		Measuring range 0mA to 20mA or 0V to 10V		Measuring range -20mA to +20mA / -10V to +10V		Measuring range 4mA to 20mA
		0mA to 20mA Input	0V to 10V Input	-20mA to +20mA Input	-10V to +10V Input	4mA to 20mA Input
Hex	Decimal	mA	V	mA	V	mA
8001	overrange	>+21.674	>+10.837	>+21.674	>+10.837	>21.339
54AA	21674	+21.674		+21.674		
4E20	20000	+20.0		+20.0		
43BB	17339					21.339
3E80	16000					20.00
2A55	10837		+10.837		+10.837	
2710	10000		+10.0		+10.0	
0001	1	+0.001	+0.001	+0.001	+0.001	4.001
0000	0	≤0	≤0	0	0	4.0 to 3.2
FFFF	-1			-0.001	-0.001	
B1E0	-20000			-20.0		
AB56	-21674			-21.674		
D8F0	-10000				-10.0	
D5AB	-10837				-10.837	
8080	Under range			<-21.674	<-10.837	
8002	Open circuit					< 3.2

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Technical Data

Deviations From Common Technical Data That Are Indicated in the User Manual	
Noise Immunity Test According to EN 50082-2	
Electrostatic discharge (ESD) according to IEC 61000-4-2	Criterion B 6kV contact discharge 6kV air discharge

Mechanical Demands	
Shock test according to IEC 60068-2-27	15g load for 11ms, half sinusoidal wave, three shocks in each space direction and orientation 25g load for 6 ms, half sinusoidal wave, three shocks in each space direction and orientation

Analog Inputs			
Number	2 analog single-ended inputs		
Input design	According to EN 61131-2, Type 1		
Voltage	0 to 10V	0 to 10.837V (Default format)	0.333mV/LSB
		0 to 10.837V (Standardized repres.)	1.000mV/LSB
	±10V	±10.837V (Default format)	0.333mV/LSB
		±10.837V (Standardized repres.)	1.000mV/LSB
Current	0 to 20mA	0 to 21.6746mA (Default format)	0.6666µA/LSB
		0 to 21.6746mA (Standardized repres.)	1.000µA/LSB
	±20mA	±21.6746mA (Default format)	0.6666µA/LSB
		±21.6746mA (Standardized repres.)	1.000µA/LSB
	4mA to 20mA	4 to 21.339mA (Default format)	0.533µA/LSB
		4 to 21.339mA (Standardized repres.)	1.000µA/LSB
Measuring value representation	Default	(15 bits with sign bit)	
	Standardized repres.	(15 bits with sign bit, one bit = 1mV or 1mA)	
Mean value generation	Over 16 measured values (switchable)		
Conversion time of the A/D converter	Approximately 120µs		

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Analog Inputs	
Voltage inputs	
Input resistance	> 220kΩ
Limit frequency (-3 dB) of the input filter	40Hz
Process data update of both channels	< 1.5ms
Behavior upon sensor failure	Goes to 0V
Maximum permissible voltage between analog voltage inputs and analog reference potential	±32V
Common mode rejection (CMR) Reference: Voltage input signal, valid for permissible DC common-mode voltage range	90dB, minimum 110dB, typical
Permissible DC common-mode voltage for CMR	40V between voltage input and FE
Current inputs	
Input resistance	50Ω (shunt)
Limit frequency (-3dB) of the input filter	40Hz
Process data update of both channels	< 1.5ms
Behavior upon sensor failure	Goes to 0mA / 4mA
Maximum permissible voltage between analog current inputs and analog reference potential	±5V (corresponding with 100mA across the sensor resistances)
Common mode rejection (CMR) Reference: Current input signal, valid for permissible DC common-mode voltage range	90dB, minimum 110dB, typical
Permissible DC common-mode voltage for CMR	40V between current input and FE
Permissible current, maximum	±100mA

Tolerance and Temperature Response				
	Voltage Inputs		Current Inputs	
	<i>Typical</i>	<i>Maximum</i>	<i>Typical</i>	<i>Maximum</i>
Error at 23°C (73.4°F)				
Offset error	±0.03%	±0.06%	±0.03%	±0.06%
Gain error	±0.05%	±0.10%	±0.10%	±0.10%
Differential non-linearity	±0.10%	±0.20%	±0.10%	±0.30%
Total error of the inputs at 23°C (73.4°F) Offset error + gain error + linearity error	±0.15%	±0.30%	±0.20%	±0.40%
Temperature response at -25°C to +55°C (-13°F to +131°F)				
Offset drift	±6ppm/K	±12ppm/K	±6ppm/K	±12ppm/K
Gain drift	±30ppm/K	±50ppm/K	±30ppm/K	±50ppm/K
Total voltage drift = Offset drift + Gain drift	±36ppm/K	±62ppm/K	±36ppm/K	±62ppm/K
Total error of the inputs (-25°C [-13°F] to +55°C [+131°F]) Offset error + gain error + linearity error + drift error	±0.30%	±0.50%	±0.35%	±0.650%

For voltage inputs, the error indications refer to the measuring range final value of 10V

For current inputs, the error indications refer to the measuring range final value of 20mA

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Additional Tolerances Influenced by Electromagnetic Fields				
Type of electromagnetic interference	Typical deviation of the measuring range final value (voltage input)		Typical deviation of the measuring range final value (current input)	
	Relative	Absolute	Relative	Absolute
Electromagnetic fields; field strength 10V/m according to IEC 61000-4-3	< ±2%	< ±200mV	< ±2%	< ±400µA
Conducted interference Class 3 (test voltage 10V) according to IEC 61000-4-6	< ±1%	< ±100mV	< ±1%	< ±100µA
Fast transients 4kV supply, 2kV input according to IEC 61000-4-4	< ±1%	< ±100mV	< ±1%	< ±100µA

Safety Devices	
Surge voltage	Suppressor diodes in the analog inputs

Electrical Isolation	
To provide electrical isolation between the logic level and the I/O area it is necessary to supply the bus module and the sensors using a power terminal from separate power supplies. Interconnection of power supply units in the 24V range is not allowed. (For detailed information refer to the <i>NIU User's Manual</i> .)	
Common potentials	
24V main power, 24V segment voltage, and GND have the same potential. FE (functional earth ground) is a separate potential area.	
Separate system potentials consisting of bus module/power terminal and I/O module	
- Test distance	- Test voltage
5V supply incoming remote bus / 7.5V supply (bus logic)	500VAC, 50Hz, 1min.
5V supply outgoing remote bus / 7.5V supply (bus logic)	500VAC, 50Hz, 1min.
7.5V supply (bus logic) / 24V supply UANA / I/O	500VAC, 50Hz, 1min.
7.5V supply (bus logic) / 24V supply UANA / functional earth ground	500VAC, 50Hz, 1min.
I/O / functional earth ground	500VAC, 50Hz, 1min.

Error Messages to the Control System	
Breakdown of the internal voltage supply	Yes
I/O error/user error	Yes, error message through the process data input words