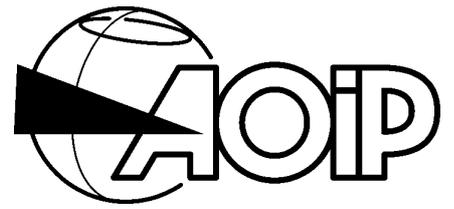


**Data acquisition systems
DATALOG 20 – 90 – 140**

Boards Manual



DATA ACQUISITION SYSTEMS

DATALOG 20 – 90 – 140



Specifications indicated in the present Boards Manual may be changed without prior notice.

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Notes

1.1 Specifications

There are two types of analog input boards: one board AN 5900 and one board AN 5885. Board AN 5900, usable with the DATALOG 20 – 90 – 140, does not allow strain gauge measurements and specifications when measuring low level voltage are slightly lower. Board AN 5885 is usable with the DATALOG 20 – 90 – 140 for an optimum accuracy.

These boards switch 10 measurement channels by means of relays (3 contacts per channel ensuring optimum insulation and resistance between channels).

Each channel has 3 unassigned wires, which can be configured according to the quantity to be measured.

The analog input boards are equipped with a Pt 100 RTD sensor measuring the temperature of the 32 terminals of the associated removable connector. This provides the reference junction compensation function necessary for temperature measurements using thermocouples.

Each channel configuration is determined by the Analog-to-Digital converter module (digital voltmeter) located in the system, which is microprocessor based and fully programmable for function, range and scanning speed.

1.1.1 Scanning speed

Four scanning speeds are programmable: 7, 20, 50 and 200 measurements per second. For the most sensitive range of some functions, the display capacity is reduced to 7 measurements per second: see detailed specifications.

Max. scanning speed	Integration time	Max. display capacity (electrical quantities)	Max. number of measured counts (electrical quantities)	Representation Unit (RU) ①
7 meas/s	100 ms	690 000	690 000	1
20 meas/s	20 ms	69 000	69 000	1
50 meas/s	1 ms	6 900	6 900	1
200 meas/s	②	6 144	2 048	3

① **RU = Representation Unit**, i.e.: minimal deviation between two displayed values.

Example: for a decimal display progressing 3 by 3 counts, RU = 3.

② 12-bit Analog-to-Digital converter with successive approximations. Not available for strain gauges.

NOTE: Execution of a measurement cycle by a task includes the scanning of the inputs as well as their processing. Scanning is performed at the rate indicated in the table above. Depending on the processing procedures programmed over the measurement results, the average scanning speed for several successive scanning cycles may be lower than the maximal measurement speed.

The indicated accuracy expressions applied to a system placed in the reference conditions defined elsewhere, after 30 minutes of warming-up and at a temperature of $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$. They are expressed in $\pm (n \% \text{rdg} + C)$ with rdg = reading and C = Constant. These values include the influence of the analog inputs board.

1.1.2 DC voltage

1.1.2.1 General specifications

Range	Measurement resolution unit			
	7 meas/s	20 meas/s	50 meas/s	200 meas/s
60 mV	1 μV	1 μV	10 μV	30 μV
600 mV	1 μV	10 μV	100 μV	300 μV
6 V	10 μV	100 μV	1 mV	3 mV
60 V	100 μV	1 mV	10 mV	30 mV
100 V	1 mV	10 mV	100 mV	300 mV

- Accuracy of the AN 5900 inputs board

Range	7 meas/s		20 meas/s	
	90 days	1 year	90 days	1 year
60 mV	0.03 % + 5 μV	0.06 % + 7 μV	0.03 % + 5 μV	0.06 % + 7 μV
600 mV	0.03 % + 5 μV	0.06 % + 7 μV	0.03 % + 50 μV	0.06 % + 70 μV
6 V	0.03 % + 20 μV	0.06 % + 40 μV	0.03 % + 200 μV	0.06 % + 400 μV
60 V	0.03 % + 200 μV	0.06 % + 400 μV	0.03 % + 2 mV	0.06 % + 4 mV
100V	0.03 % + 2 mV	0.06 % + 4 mV	0.03 % + 20 mV	0.06 % + 40 mV

- Accuracy of the AN 5885 inputs board

Range	7 meas/s		20 meas/s	
	90 days	1 year	90 days	1 year
60 mV	0.008 % + 5 μV	0.01 % + 7 μV	0.03 % + 5 μV	0.02 % + 7 μV
600 mV	0.008 % + 5 μV	0.01 % + 7 μV	0.01 % + 50 μV	0.02 % + 70 μV
6 V	0.008 % + 20 μV	0.01 % + 40 μV	0.01 % + 200 μV	0.01 % + 400 μV
60V	0.008 % + 200 μV	0.01 % + 400 μV	0.01 % + 2 mV	0.01 % + 4 mV
100V	0.008 % + 2 mV	0.01 % + 4 mV	0.01 % + 20 mV	0.01 % + 40 mV

Relay noise: $\pm 5 \mu\text{V}$ (included in the accuracy above).

For 50 meas/s, 60 mV to 100 V ranges, accuracy over 1 year: 4 RU.

For 200 meas/s, 60 mV to 100 V ranges, accuracy over 1 year: 12 RU.

Repeatability between two different channels: $\leq C$.

Input resistance: $> 100 \text{ M}\Omega$ over ranges $\leq 6 \text{ V}$, $10 \text{ M}\Omega$ over 60 V and 100 V ranges.

Input current: $< 300 \text{ pA}$.

Max. permissible normal mode voltage (all ranges): The peak value of the signal must correspond to:

$V_c + V_a < 130 \%$ of range to 7 meas/s.

$V_c + V_a < 130 \%$ of range to 20 meas/s.

$V_c + V_a < 130 \%$ of range to 50 meas/s.

$V_c + V_a < 102 \%$ of range to 200 meas/s.

where V_c = DC measured voltage and V_a = spurious AC peak voltage.

Normal mode rejection (60 mV range):

$> 60 \text{ dB}$ at 50 and 60 Hz to 7 meas/s,

$> 60 \text{ dB}$ at 50 Hz to 20 meas/s.

Max. permissible common mode voltage: 75 VDC or AC peak.

Common mode rejection (60 mV range, one analog inputs boards):

$> 140 \text{ dB}$ in AC, 50 and 60 Hz $\pm 0.1\%$ to 7 meas/s,

$> 140 \text{ dB}$ in AC, 50 Hz $\pm 0.1\%$ to 20 meas/s.

Max. permissible voltage between two different channels: 150 VDC or AC peak.

Temperature coefficient:

- from 0 to 35°C: $(0.001 \% + 0.5 \text{ RU})/^\circ\text{C}$,
- from 35 to 50°C: $(0.001 \% + 1 \text{ RU})/^\circ\text{C}$.

1.1.2.2 PROCESS ranges 1-5 V, 0-10 V

See paragraph 1.1.8.

1.1.3 AC voltage

T-RMS value with possible DC component taken in account (AC + DC mode).
The accuracies are given for a sine voltage without DC component.

Range	Measurement resolution unit
60 mV	10 μ V
600 mV	100 μ V
6 V	1 mV
60 V	10 mV
100 V	100 mV

- Accuracy of the AN 5900 and AN 5885 inputs boards

Range	1 meas/s	
	90 days	1 year
60 mV	0.3 % + 100 μ V	0.5 % + 100 μ V
600 mV	0.3 % + 1 mV	0.5 % + 1 mV
6 V	0.3 % + 10 mV	0.5 % + 10 mV
60 V	0.3 % + 100 mV	0.5 % + 100 mV
100 V	0.3 % + 1 V	0.5 % + 1 V

Measurement minimum scanning time: 2 seconds.

Measurement range: from 4 % to 110 % of range, from 40 Hz to 400 Hz.

Crest Factor influence (CF): 1 % for CF = 3.

Repeatability between two different channels: $\leq C$.

Input resistance: > 100 M Ω over ranges \leq 6 V, 10 M Ω over 60 V and 100 V ranges.

Input current: < 300 pA.

Max. permissible common mode voltage: 75 VDC or AC peak.

Max. permissible voltage between different channels: 150 VDC or AC peak.

Temperature coefficient: (0.05 % + 0.5 RU)/ $^{\circ}$ C.

1.1.4 DC current

1.1.4.1 General specifications

The current ranges are determined by the external range used.

Each channel must be programmed for the shunt's rated voltage and for the corresponding scaling factor (conversion algorithm).

Example: For a 20 A, 100 mV shunt, use the range 600 mV and program the conversion algorithm $CONV=X/5$ to display the current in A.

Accuracy and other specifications: Those of the programmed voltage range in terms of the displayed value. Additionally, take account of the accuracy of the shunt used.

Max. permissible common mode voltage: 75 VDC or AC peak.

1.1.4.2 PROCESS ranges 0-20 mA, 4-20 mA

Refer to paragraph 1.1.8.

1.1.5 Resistance

Wire the resistance to be measured according to the program mode:

- balanced 3-wire measurement,
- 4-wire measurement (the fourth wire is common to the different channels of the same board).

Range	Measurement resolution unit				Measurement range (7 meas/s)
	7 meas/s	20 meas/s	50 meas/s	200 meas/s	
60 Ω	1 mΩ	1 mΩ	10 mΩ	30 mΩ	0.000 Ω to 69.000 Ω
600 Ω	1 mΩ	10 mΩ	100 mΩ	300 mΩ	0.000 Ω to 690.000 Ω
3 kΩ	10 mΩ	100 mΩ	1 Ω	3 Ω	0.00000 kΩ to 3.90000 kΩ
30 kΩ	100 mΩ	1 Ω	10 Ω	✓	0.0000 kΩ to 39.0000 kΩ
300 kΩ	2 Ω	10 Ω	100 Ω	✓	0.000 kΩ to 390.000 kΩ

✓The range does not exist.

- 4-wire measurement accuracy, AN 5900 board

Range	7 meas/s		20 meas/s	
	90 days	1 year	90 days	1 year
60 Ω	0.03 % + 6 mΩ	0.06 % + 7 mΩ	0.03 % + 6 mΩ	0.06 % + 7 mΩ
600 Ω	0.03 % + 6 mΩ	0.06 % + 7 mΩ	0.03 % + 60 mΩ	0.06 % + 70 mΩ
3 kΩ	0.03 % + 40 mΩ	0.06 % + 60 mΩ	0.03 % + 400 mΩ	0.06 % + 600 mΩ
30 kΩ	0.03 % + 400 mΩ	0.06 % + 600 mΩ	0.03 % + 4 Ω	0.06 % + 6 Ω
300 kΩ	0.03 % + 4 Ω	0.06 % + 6 Ω	0.03 % + 40 Ω	0.06 % + 60 Ω

- 4-wire measurement accuracy, AN 5885 board

Range	7 meas/s		20 meas/s	
	90 days	1 year	90 days	1 year
60 Ω	0.01 % + 5 mΩ	0.02 % + 7 mΩ	0.03 % + 5 mΩ	0.06 % + 7 mΩ
600 Ω	0.01 % + 5 mΩ	0.02 % + 7 mΩ	0.01 % + 50 mΩ	0.02 % + 70 mΩ
3 kΩ	0.01 % + 40 mΩ	0.02 % + 60 mΩ	0.01 % + 400 mΩ	0.02 % + 600 mΩ
30 kΩ	0.01 % + 400 mΩ	0.02 % + 600 mΩ	0.01 % + 4 Ω	0.02 % + 6 Ω
300 kΩ	0.01 % + 4 Ω	0.02 % + 6 Ω	0.01 % + 40 Ω	0.02 % + 60 Ω

For 50 meas/s, 60 Ω to 3 kΩ ranges, accuracy over 1 year: 4 RU.

For 200 meas/s, 60 Ω to 3 kΩ ranges, accuracy over 1 year: 12 RU.

Accuracy in balanced 3-wire measurement: Increase the values mentioned above by 100 mΩ plus any value attributable to an unbalanced line.

Measurement current: 1 mA for 60 Ω, 600 Ω, 3 kΩ and 10 μA for 30 kΩ, 300 kΩ.

Repeatability between two different channels:

	AN 5885	AN 5900
• 4-wire measurement:	≤ (10 mΩ + 3 RU)	≤ (10 mΩ + 3 RU)
• 3-wire measurement:	≤ (100 mΩ + 3 RU)	≤ (100 mΩ + 3 RU)

Max. voltage in open circuit: 10 V.

Permissible line resistance (3- or 4-wire): ≤ 100 Ω per wire.

Broken line test or measured resistance test: programmable with error message display.

Max. permissible voltage: 75 VDC or AC peak to the terminals of current and/or voltage circuits.

Temperature coefficient:

- from 0°C to 35°C: (0.002 % + 0.5 RU)/°C.
- from 35°C to 50°C: (0.002 % + 1 RU)/°C.

1.1.6 RTD

Connecting the sensor according to the programmed mode:

- 3-wire balanced connection (**Warning:** an unbalance leads to a temperature error).
- 4-wire connection (the fourth wire is common to the different channels of the same board).

Range	Measurement range	Measurement resolution unit			
		7 meas/s	20 meas/s	50 meas/s	200 meas/s
Pt 25	- 220°C + 1 200°C	0.01°C	0.1°C	1°C	1°C
Pt 50	- 220°C + 1 200°C	0.01°C	0.1°C	1°C	1°C
Pt 100	- 220°C + 1 200°C	0.01°C	0.1°C	1°C	1°C
Pt 1000	- 220°C + 600°C	0.01°C	0.1°C	1°C	1°C
Ni 100	- 60°C + 180°C	0.01°C	0.1°C	1°C	1°C

- 4-wire measurement accuracy, AN 5900 board

Range	7 meas/s		20 meas/s	
	90 days	1 year	90 days	1 year
Pt 25	0.03 % + 0.05°C	0.06 % + 0.07°C	0.03 % + 0.5°C	0.06 % + 0.7°C
Pt 50	0.03 % + 0.03°C	0.06 % + 0.04°C	0.03 % + 0.3°C	0.06 % + 0.4°C
Pt 100	0.03 % + 0.01°C	0.06 % + 0.02°C	0.03 % + 0.1°C	0.06 % + 0.2°C
Pt 1000	0.03 % + 0.01°C	0.06 % + 0.02°C	0.03 % + 0.1°C	0.06 % + 0.2°C
Ni 100	0.03 % + 0.01°C	0.06 % + 0.01°C	0.03 % + 0.1°C	0.06 % + 0.1°C

- 4-wire measurement accuracy, AN 5885 board

Range	7 meas/s		20 meas/s	
	90 days	1 year	90 days	1 year
Pt 25	0.01 % + 0.05°C	0.02 % + 0.07°C	0.01 % + 0.5°C	0.02 % + 0.7°C
Pt 50	0.01 % + 0.03°C	0.02 % + 0.04°C	0.01 % + 0.3°C	0.02 % + 0.4°C
Pt 100	0.01 % + 0.01°C	0.02 % + 0.02°C	0.01 % + 0.1°C	0.02 % + 0.2°C
Pt 1000	0.01 % + 0.01°C	0.02 % + 0.02°C	0.01 % + 0.1°C	0.02 % + 0.2°C
Ni 100	0.01 % + 0.01°C	0.02 % + 0.01°C	0.01 % + 0.1°C	0.02 % + 0.1°C

For 50 meas/s, accuracy over 1 year: 2 RU.

For 200 meas/s, accuracy over 1 year: 3 RU.

Accuracy for balanced 3-wire measurement: Increase the values in the above table by 0.25°C plus any line unbalance value converted into °C.

Additionally, take account of the RTD sensor error and its connections.

Measurement current: 1 mA.



Repeatability between two different channels:

- 4-wire measurement: $\leq 0.05^{\circ}\text{C}$,
- 3-wire measurement: $\leq 0.2^{\circ}\text{C}$

Permissible line resistance (3- or 4-wire): $\leq 100 \Omega$ per wire.

Broken line test or sensor test: programmable, with error message display.

Temperature displayed in $^{\circ}\text{F}$ by programming the following conversion algorithm: $T(^{\circ}\text{F}) = 1.8 T(^{\circ}\text{C}) + 32$.

Max. permissible voltage: 75 VDC or AC peak to the current and/or voltage circuit terminals.

Temperature coefficient: $(0.002 \% + 0.0025^{\circ}\text{C})/^{\circ}\text{C}$.

1.1.7 Thermocouple

Temperature measurement can be programmed:

- without temperature compensation of the system terminals (reference junction at 0°C).
- with temperature compensation of the system terminals (one per board).
- with remote reference junction compensation (one Pt 100 RTD per board, 4-wire connection).
- Accuracy of the AN 5900 board

S e n s.	Measurement range	Resolution unit				Accuracy			
		7 meas/s	20 meas/s	50 meas/s	200 meas/s	7 meas/s		20 meas/s	
						90 days	1 year	90 days	1 year
K	- 250°C - 200°C	0.5°C	0.5°C	1°C	1°C	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 1.5°C)	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 1.5°C)
	- 200°C - 100°C	0.2°C	0.2°C	1°C	1°C	+ (0.03 % rdg + 0.5°C)	+ (0.06 % rdg + 0.7°C)	+ (0.03 % rdg + 0.5°C)	+ (0.06 % rdg + 0.7°C)
	- 100°C + 1 370°C	0.1°C	0.1°C	1°C	1°C	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.3°C)	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.3°C)
T	- 250°C - 200°C	0.5°C	0.5°C	1°C	1°C	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 2°C)	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 2°C)
	- 200°C - 100°C	0.2°C	0.2°C	1°C	1°C	+ (0.03 % rdg + 0.5°C)	+ (0.06 % rdg + 0.6°C)	+ (0.03 % rdg + 0.5°C)	+ (0.06 % rdg + 0.6°C)
	- 100°C + 400°C	0.1°C	0.1°C	1°C	1°C	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.3°C)	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.3°C)
J	- 210°C - 120°C	0.2°C	0.2°C	1°C	1°C	+ (0.03 % rdg + 0.4°C)	+ (0.06 % rdg + 0.5°C)	+ (0.03 % rdg + 0.4°C)	+ (0.06 % rdg + 0.5°C)
	- 120°C + 1 100°C	0.1°C	0.1°C	1°C	1°C	+ (0.03 % rdg + 0.2°C)	+ (0.06 % rdg + 0.3°C)	+ (0.03 % rdg + 0.2°C)	+ (0.06 % rdg + 0.3°C)
S	- 50°C + 550°C	1°C	1°C	1°C	1°C	+ (0.03 % rdg + 1.5°C)	+ (0.06 % rdg + 2°C)	+ (0.03 % rdg + 1.5°C)	+ (0.06 % rdg + 2°C)
	+ 550°C + 1 768°C	0.5°C	0.5°C	1°C	1°C	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 1°C)	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 1°C)
B	+ 400°C + 900°C	1°C	1°C	1°C	1°C	+ (0.03 % rdg + 1.5°C)	+ (0.06 % rdg + 2°C)	+ (0.03 % rdg + 1.5°C)	+ (0.06 % rdg + 2°C)
	+ 900°C + 1 820°C	0.5°C	0.5°C	1°C	1°C	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 1°C)	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 1°C)
N	- 250°C - 200°C	1°C	1°C	1°C	1°C	+ (0.03 % rdg + 1.5°C)	+ (0.06 % rdg + 2.5°C)	+ (0.03 % rdg + 1.5°C)	+ (0.06 % rdg + 2.5°C)
	- 200°C - 120°C	0.5°C	0.5°C	1°C	1°C	+ (0.03 % rdg + 0.7°C)	+ (0.06 % rdg + 1°C)	+ (0.03 % rdg + 0.7°C)	+ (0.06 % rdg + 1°C)
	- 100°C + 0°C	0.2°C	0.2°C	1°C	1°C	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.4°C)	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.4°C)
	- 0°C + 1 300°C	0.1°C	0.1°C	1°C	1°C	+ (0.03 % rdg + 0.2°C)	+ (0.06 % rdg + 0.3°C)	+ (0.03 % rdg + 0.2°C)	+ (0.06 % rdg + 0.3°C)
E	- 250°C + 1 000°	0.1°C	0.1°C	1°C	1°C	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 1.5°C)	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 1.5°C)
C	- 20°C + 2 320°C	0.2°C	0.2°C	1°C	1°C	+ (0.03 % rdg + 0.4°C)	+ (0.06 % rdg + 0.6°C)	+ (0.03 % rdg + 0.4°C)	+ (0.06 % rdg + 0.6°C)
Mo	+ 0°C + 1 375°C	0.1°C	0.1°C	1°C	1°C	+ (0.03 % rdg + 0.2°C)	+ (0.06 % rdg + 0.2°C)	+ 0.03 % rdg + 0.2°C)	+ (0.06 % rdg + 0.2°C)
R	- 50°C + 550°C	1°C	1°C	1°C	1°C	+ (0.03 % rdg + 1.5°C)	+ (0.06 % rdg + 2°C)	+ (0.03 % rdg + 1.5°C)	+ (0.06 % rdg + 2°C)
	+ 550°C + 1 768°C	0.5°C	0.5°C	1°C	1°C	+ (0.03 % rdg + 0.8°C)	+ (0.06 % rdg + 0.8°C)	+ (0.03 % rdg + 0.6°C)	+ (0.06 % rdg + 0.8°C)
L	- 200°C + 900°C	0.1°C	0.1°C	1°C	1°C	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.4°C)	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.4°C)
U	- 200°C - 100°C	0.2°C	0.2°C	1°C	1°C	+ (0.03 % rdg + 0.4°C)	+ (0.06 % rdg + 0.5°C)	+ (0.03 % rdg + 0.4°C)	+ (0.06 % rdg + 0.5°C)
	- 100°C + 600°C	0.1°C	0.1°C	1°C	1°C	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.3°C)	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.3°C)
PI	- 100°C + 1 400°C	0.1°C	0.1°C	1°C	1°C	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.4°C)	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.4°C)

- Accuracy of the AN 5885 board

S e n s.	Measurement range	Resolution unit				Accuracy			
		7 meas/s	20 meas/s	50 meas/s	200 meas/s	7 meas/s		20 meas/s	
						90 days	1 year	90 days	1 year
K	- 250°C - 200°C	0.5°C	0.5°C	1°C	1°C	+ (0.008 % rdg + 1°C)	+ (0.01 % rdg + 1.5°C)	+ (0.01 % rdg + 1°C)	+ (0.02 % rdg + 1.5°C)
	- 200°C - 100°C	0.2°C	0.2°C	1°C	1°C	+ (0.008 % rdg + 0.4°C)	+ (0.01 % rdg + 0.6°C)	+ (0.01 % rdg + 0.4°C)	+ (0.02 % rdg + 0.6°C)
	- 100°C + 1 370°C	0.1°C	0.1°C	1°C	1°C	+ (0.008 % rdg + 0.2°C)	+ (0.01 % rdg + 0.3°C)	+ (0.01 % rdg + 0.2°C)	+ (0.02 % rdg + 0.3°C)
T	- 250°C - 200°C	0.5°C	0.5°C	1°C	1°C	+ (0.008 % rdg + 1°C)	+ (0.01 % rdg + 1.5°C)	+ (0.01 % rdg + 1°C)	+ (0.02 % rdg + 1.5°C)
	- 200°C - 100°C	0.2°C	0.2°C	1°C	1°C	+ (0.008 % rdg + 0.4°C)	+ (0.01 % rdg + 0.5°C)	+ (0.01 % rdg + 0.4°C)	+ (0.02 % rdg + 0.5°C)
	- 100°C + 400°C	0.1°C	0.1°C	1°C	1°C	+ (0.008 % rdg + 0.2°C)	+ (0.01 % rdg + 0.3°C)	+ (0.01 % rdg + 0.2°C)	+ (0.02 % rdg + 0.3°C)
J	- 210°C - 120°C	0.2°C	0.2°C	1°C	1°C	+ (0.008 % rdg + 0.3°C)	+ (0.01 % rdg + 0.4°C)	+ (0.01 % rdg + 0.3°C)	+ (0.02 % rdg + 0.4°C)
	- 120°C + 1 100°C	0.1°C	0.1°C	1°C	1°C	+ (0.008 % rdg + 0.2°C)	+ (0.01 % rdg + 0.3°C)	+ (0.01 % rdg + 0.2°C)	+ (0.02 % rdg + 0.3°C)
S	- 50°C + 550°C	1°C	1°C	1°C	1°C	+ (0.008 % rdg + 1.5°C)	+ (0.01 % rdg + 2°C)	+ (0.01 % rdg + 1.5°C)	+ (0.02 % rdg + 2°C)
	+ 550°C + 1 768°C	0.5°C	0.5°C	1°C	1°C	+ (0.008 % rdg + 0.6°C)	+ (0.01 % rdg + 0.8°C)	+ (0.01 % rdg + 0.6°C)	+ (0.02 % rdg + 0.8°C)
B	+ 0°C + 900°C	1°C	1°C	1°C	1°C	+ (0.008 % rdg + 1.5°C)	+ (0.01 % rdg + 2°C)	+ (0.01 % rdg + 1.5°C)	+ (0.02 % rdg + 2°C)
	+ 900°C + 1 820°C	0.5°C	0.5°C	1°C	1°C	+ (0.008 % rdg + 1°C)	+ (0.01 % rdg + 1°C)	+ (0.01 % rdg + 1°C)	+ (0.02 % rdg + 1°C)
N	- 250°C - 200°C	1°C	1°C	1°C	1°C	+ (0.008 % rdg + 1.5°C)	+ (0.01 % rdg + 2°C)	+ (0.01 % rdg + 1.5°C)	+ (0.02 % rdg + 2°C)
	- 200°C - 120°C	0.5°C	0.5°C	1°C	1°C	+ (0.008 % rdg + 0.6°C)	+ (0.01 % rdg + 0.8°C)	+ (0.01 % rdg + 0.6°C)	+ (0.02 % rdg + 0.8°C)
	- 100°C + 0°C	0.2°C	0.2°C	1°C	1°C	+ (0.008 % rdg + 0.3°C)	+ (0.01 % rdg + 0.4°C)	+ (0.01 % rdg + 0.3°C)	+ (0.02 % rdg + 0.4°C)
	- 0°C + 1 300°C	0.1°C	0.1°C	1°C	1°C	+ (0.008 % rdg + 0.2°C)	+ (0.01 % rdg + 0.3°C)	+ (0.01 % rdg + 0.2°C)	+ (0.02 % rdg + 0.3°C)
E	- 250°C + 1 000°C	0.1°C	0.1°C	1°C	1°C	+ (0.008 % rdg + 0.8°C)	+ (0.01 % rdg + 1°C)	+ (0.01 % rdg + 0.8°C)	+ (0.02 % rdg + 1°C)
C	- 20°C + 2 320°C	0.2°C	0.2°C	1°C	1°C	+ (0.008 % rdg + 0.4°C)	+ (0.01 % rdg + 0.6°C)	+ (0.01 % rdg + 0.4°C)	+ (0.02 % rdg + 0.6°C)
Mo	+ 0°C + 1 375°C	0.1°C	0.1°C	1°C	1°C	+ (0.008 % rdg + 0.2°C)	+ (0.01 % rdg + 0.2°C)	+ (0.01 % rdg + 0.2°C)	+ (0.02 % rdg + 0.2°C)
R	- 50°C + 550°C	1°C	1°C	1°C	1°C	+ (0.008 % rdg + 1.5°C)	+ (0.01 % rdg + 2°C)	+ (0.01 % rdg + 1.5°C)	+ (0.02 % rdg + 2°C)
	+ 550°C + 1 768°C	0.5°C	0.5°C	1°C	1°C	+ (0.008 % rdg + 0.5°C)	+ (0.01 % rdg + 0.7°C)	+ (0.01 % rdg + 0.5°C)	+ (0.02 % rdg + 0.7°C)
L	- 200°C + 900°C	0.1°C	0.1°C	1°C	1°C	+ (0.008 % rdg + 0.2°C)	+ (0.01 % rdg + 0.3°C)	+ (0.01 % rdg + 0.2°C)	+ (0.02 % rdg + 0.3°C)
U	- 200°C - 100°C	0.2°C	0.2°C	1°C	1°C	+ (0.008 % rdg + 0.3°C)	+ (0.01 % rdg + 0.4°C)	+ (0.01 % rdg + 0.3°C)	+ (0.02 % rdg + 0.4°C)
	- 100°C + 600°C	0.1°C	0.1°C	1°C	1°C	+ (0.008 % rdg + 0.2°C)	+ (0.01 % rdg + 0.3°C)	+ (0.01 % rdg + 0.2°C)	+ (0.02 % rdg + 0.3°C)
PI	- 100°C + 1 400°C	0.1°C	0.1°C	1°C	1°C	+ (0.008 % rdg + 0.3°C)	+ (0.01 % rdg + 0.4°C)	+ (0.01 % rdg + 0.3°C)	+ (0.02 % rdg + 0.4°C)

The accuracy above is warranted for a reference junction at 0°C. Additionally, take account of any temperature sensor and cabling error.

If using an internal reference junction compensation, add 0.5°C to the values for the AN 5900 board and ± 0.2°C for the AN 5885 board.

If using a remote reference junction compensation, add 0.1°C to the values plus sensor and cabling error.

Repeatability between two different channels:

Example for a RJ at 0°C and a thermocouple at room temperature.

	Over the same board
RJ	Thermocouple K
at 0°C	0.1°C

Input resistance: > 100 MΩ.

Input current: < 300 pA.

Permissible line resistance: ≤ 1 kΩ per wire.

Repeatability between two channels of different boards: ≤ C + RJ.



Broken line test and sensor test: programmable, with display of an error message.

Temperature display in °F by programming the appropriate conversion algorithm: $T(^{\circ}\text{F}) = 1.8 T(^{\circ}\text{C}) + 32$.

Max. permissible normal mode voltage: 20 mV peak to peak.

Normal mode rejection (1 $\mu\text{V}/\text{mV}$, 50 or 60 Hz, 7 meas/s):

- thermocouple K: $0.025^{\circ}\text{C}/\text{mV}$,
- thermocouple S: $0.2^{\circ}\text{C}/\text{mV}$.

Max. permissible common mode voltage: 75 VDC or AC peak.

Common mode rejection (1 $\mu\text{V}/\text{V}$, 50 or 60 Hz, 7 meas/s):

- thermocouple K: $< 0.025^{\circ}\text{C}/\text{V}$,
- thermocouple S: $< 0.2^{\circ}\text{C}/\text{V}$.

Temperature coefficient:

RJ	from 0 to 35°C		from 35 to 50°C	
	Thermocouple K	Thermocouple S	Thermocouple K	Thermocouple S
at 0°C	$(0.001 \% + 0.015^{\circ}\text{C})/^{\circ}\text{C}$	$(0.001 \% + 0.1^{\circ}\text{C})/^{\circ}\text{C}$	$(0.001 \% + 0.025^{\circ}\text{C})/^{\circ}\text{C}$	$(0.001 \% + 0.2^{\circ}\text{C})/^{\circ}\text{C}$
internal and remote	$(0.001 \% + 0.025^{\circ}\text{C})/^{\circ}\text{C}$	$(0.001 \% + 0.1^{\circ}\text{C})/^{\circ}\text{C}$	$(0.001 \% + 0.04^{\circ}\text{C})/^{\circ}\text{C}$	$(0.001 \% + 0.2^{\circ}\text{C})/^{\circ}\text{C}$

1.1.8 Process

This heading includes the CURRENT 0-20 mA, 4-20 mA ranges from telemetering loop or 4-wire transmitters or equivalent and VOLTAGE 1-5 V, 0-10 V ranges.

Each range can be associated to a pair of high and low values (corresponding to signal variation limits) programmable by the operator with the unit of measurement (4 characters as a maximum).

100 different PROCESS can be specified.

1.1.8.1 0-20 mA and 4-20 mA current signals

Use a 50 Ω , 0.1 % shunt per channel, optionally supplied as an accessory, part number ER 44007-024 (rated voltage drop 1 VDC, max. permissible current 100 mA, temperature coefficient 0.0025 %/°C).

Max. measurement capacity: 24 mA.

Max. display capacity: 8 digits including the sign and decimal point.

Max. display resolution (theoretical):

The display resolution can be programmed by the ACCU instruction (see chapter 2 from the Reference Manual).

Range	7 meas/s	20 meas/s	50 meas/s	200 meas/s
0-20 mA	0.0002 % Δ	0.001 % Δ	0.02 % Δ	0.3 % Δ
4-20 mA	0.00025 % Δ	0.0012 % Δ	0.025 % Δ	0.4 % Δ

Δ = High value – Low value.

Accuracy and other specifications: those concerning DC current.

1.1.8.2 1-5 V and 0-10 V voltage signals

Max. measurement capacity: 6 V (1-5 V range) or 12 V (0-10 V range).

Max. display capacity: 8 digits including the sign and decimal point.

Min. display resolution:

Range	7 meas/s	20 meas/s	50 meas/s	200 meas/s
1-5 V	0.0005 % Δ	0.0025 % Δ	0.05 % Δ	0.5 % Δ
0-10 V	0.0002 % Δ	0.001 % Δ	0.02 % Δ	0.2 % Δ

Δ = High value – Low value.

Other specifications: same as the 60 VDC range.

NOTE: Sending messages below and/or above the measured signal permissible range of variation is handled by the Error function.

1.1.9 Contact (Go/No go)

Connecting a zero voltage contact to an analog input enables the operator to check its open (level 0) or closed (level 1) state as soon as the corresponding channel relay is closed.

Measurement current: 1 mA.

Max. voltage in open circuit: 10 V.

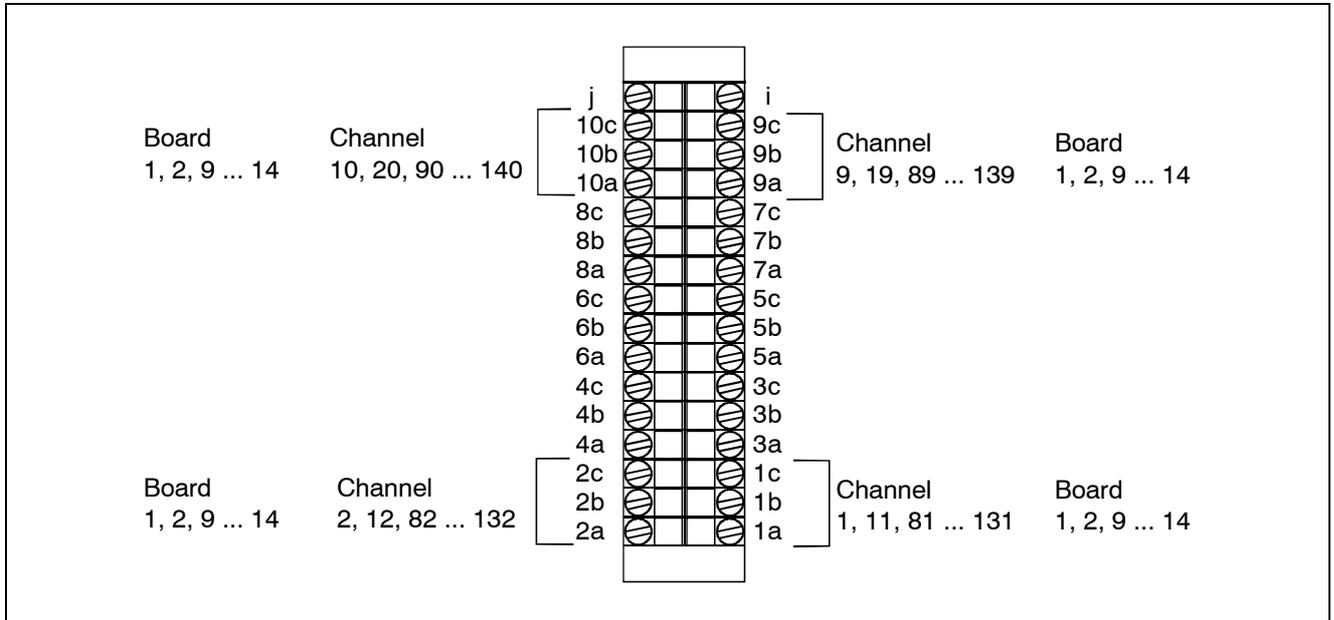
Level 0: line resistance $R_0 \geq 100 \text{ k}\Omega$.

Level 1: line resistance $R_1 \leq 1 \text{ k}\Omega$.

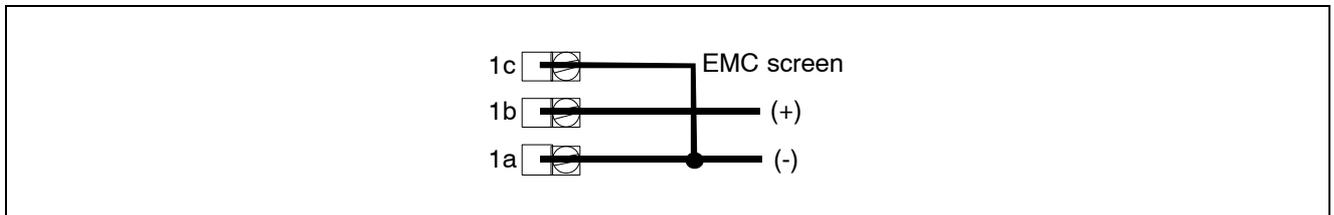
The contact function can be confirmed by an opto-electronic isolator output if the specifications R_0 and R_1 are respected.

1.2 Connection

The I/O 32-pin screw terminal connector blocks are identified by marks directly on the connector as shown below.

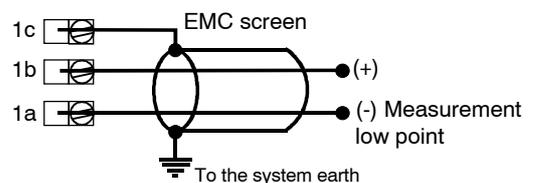


1.2.1 DC voltage, AC voltage

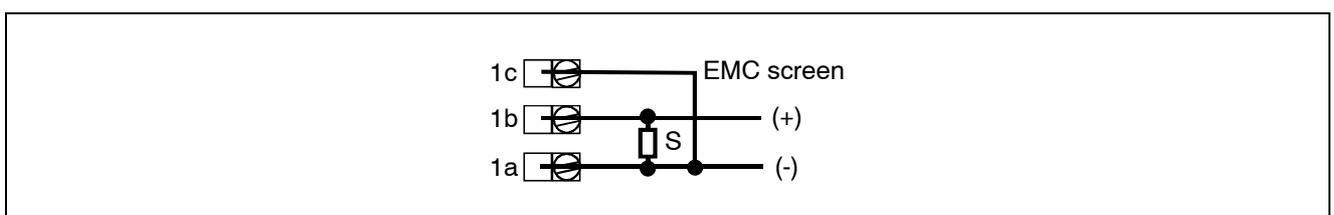


NOTES:

- When measuring voltage, it is advisable to use, for each measurement channel, an insulated and shielded two-wire lead and to connect it to the system earth.



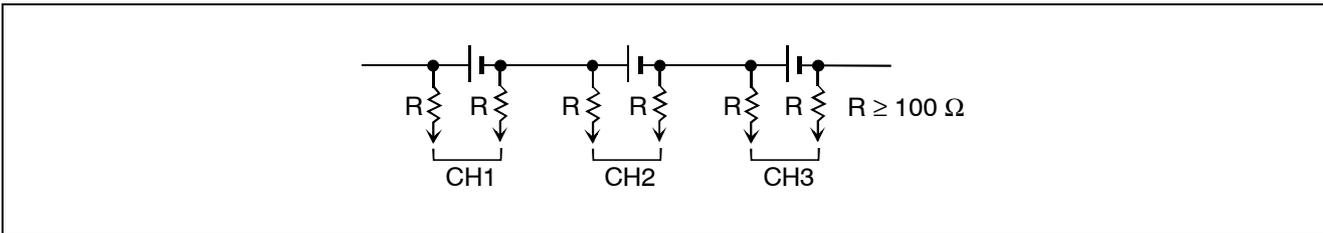
1.2.2 DC current



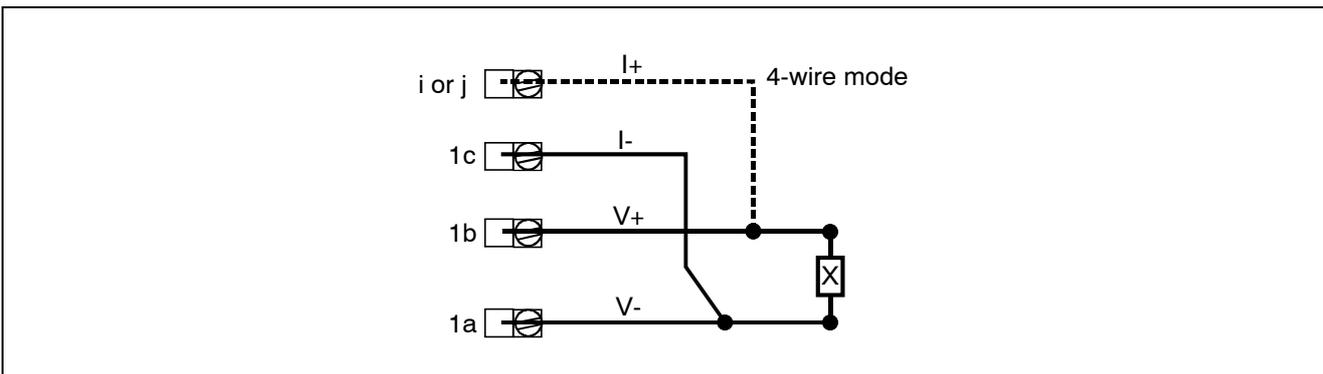
S = External Shunt for current measurement (50 Ω , 0.1 % for 0-20 mA or 4-20 mA current, part number ER 44006-024).

2. The channel switching principle is based on Reed relays which are top-range components specially well suited to this type of application. Unfortunately, as for any such device, troubles may occur which lead to a temporary short-circuit between two or more channels.

So, when performing voltage measurements on sources able to supply high energy (such as batteries), it is advisable to protect the inputs by inserting resistors as shown on diagram below or by ordering our board specially manufactured with built-in protections, part number AN 5900SP.



1.2.3 Resistance and RTD

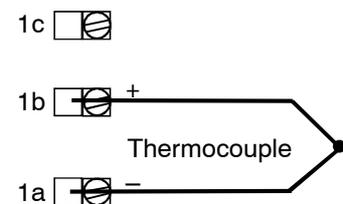


In 3-wire mode, take care to balance the resistance of the connection wires.

In 4-wire mode, each X component is connected by a wire to the i or j connector terminal.

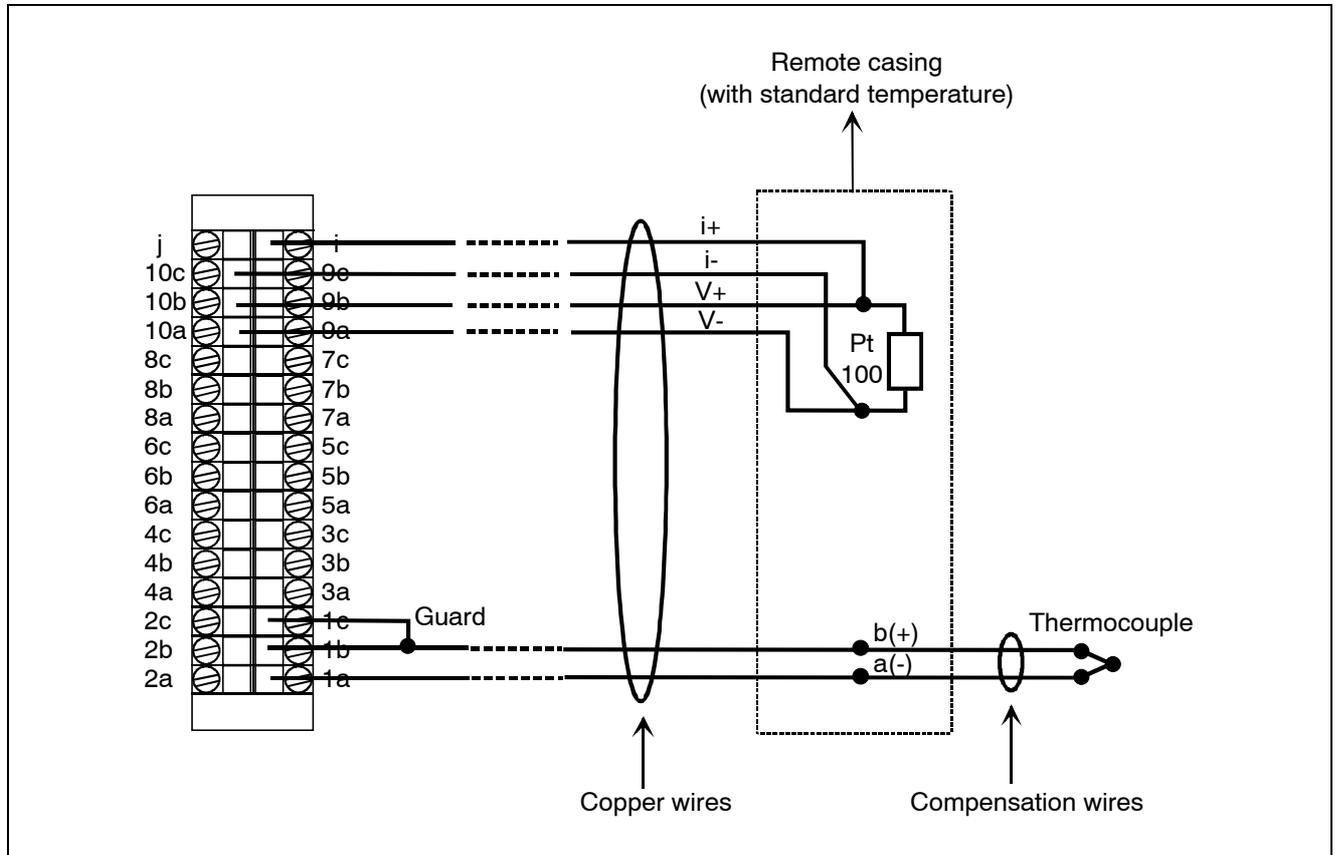
1.2.4 Thermocouple

For an internal reference junction compensation (one per analog inputs board), the system must be connected by thermocouple wires or by equivalent compensation wires on the a (-) and b (+) inputs as described opposite.

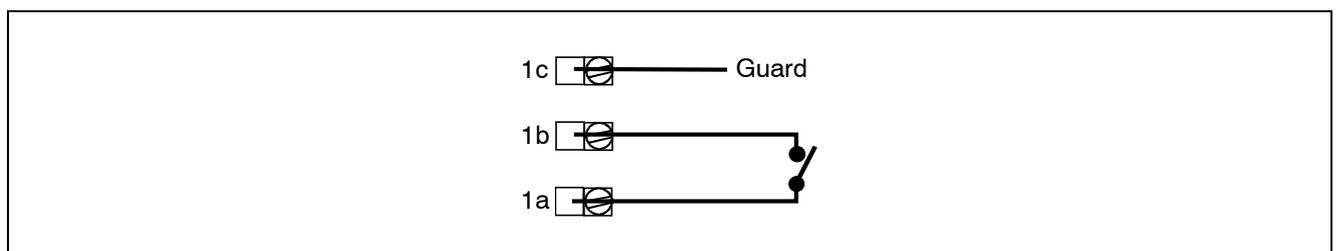


If a remote reference junction compensation is used, connect a Pt 100 probe over the channel 10 of the board in 4-wire mode (see hereafter) and use copper wires for the thermocouple inputs between the remote connector and the system.

The Pt 100 RTD compensation module is a 100 Ω at 0°C Platinum probe placed as near as possible to the thermocouple's connecting terminals or compensation wires in order to be at the same temperature.



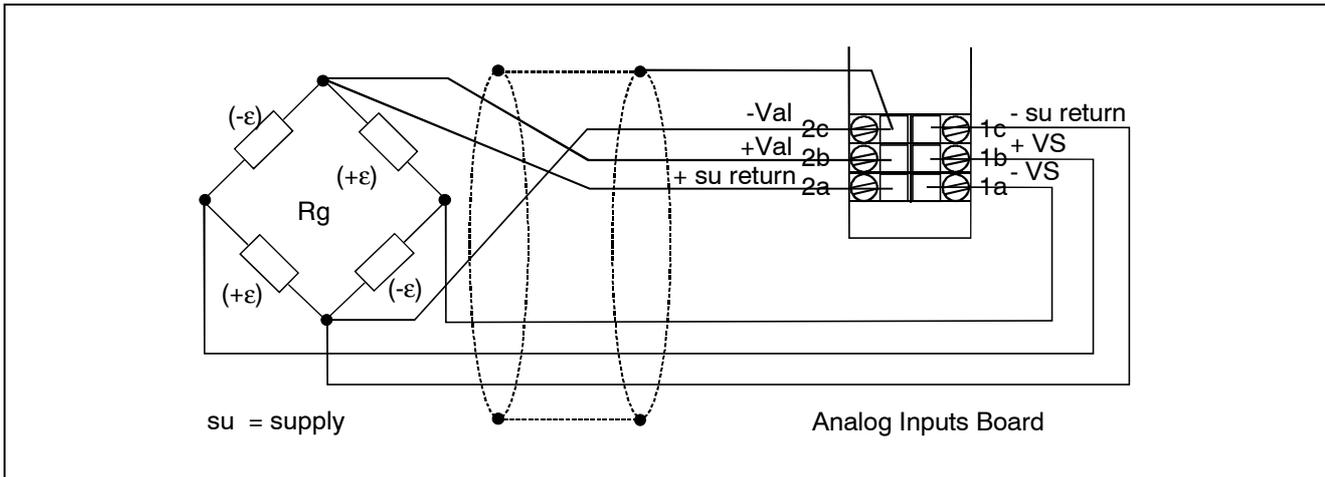
1.2.5 Contact (Go/No go)



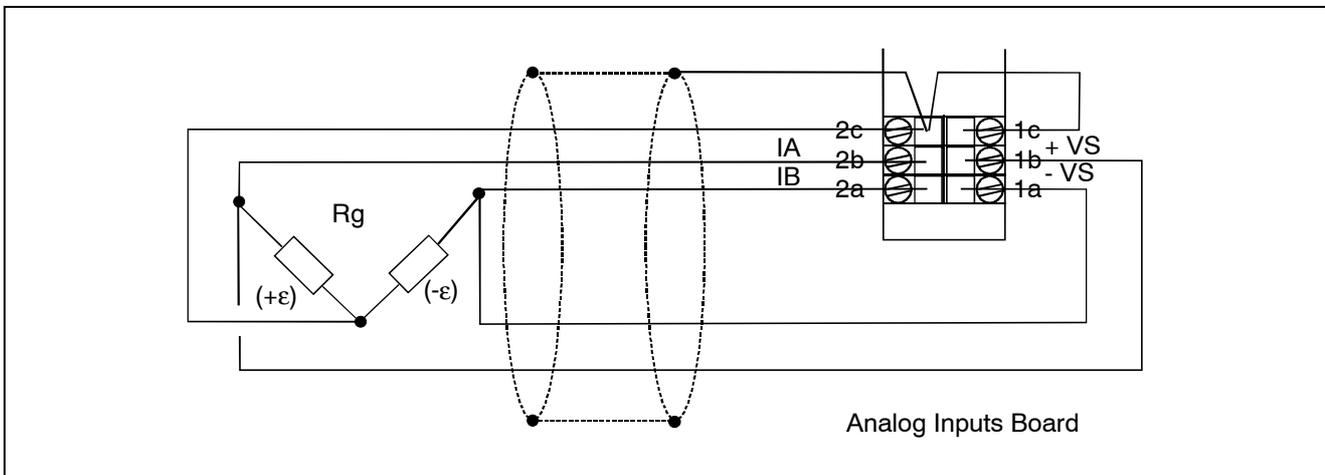
1.2.6 Gauge

1.2.6.1 Wiring full bridge configurations

A full bridge must be wired on an odd channel of the system and the immediate even channel following.

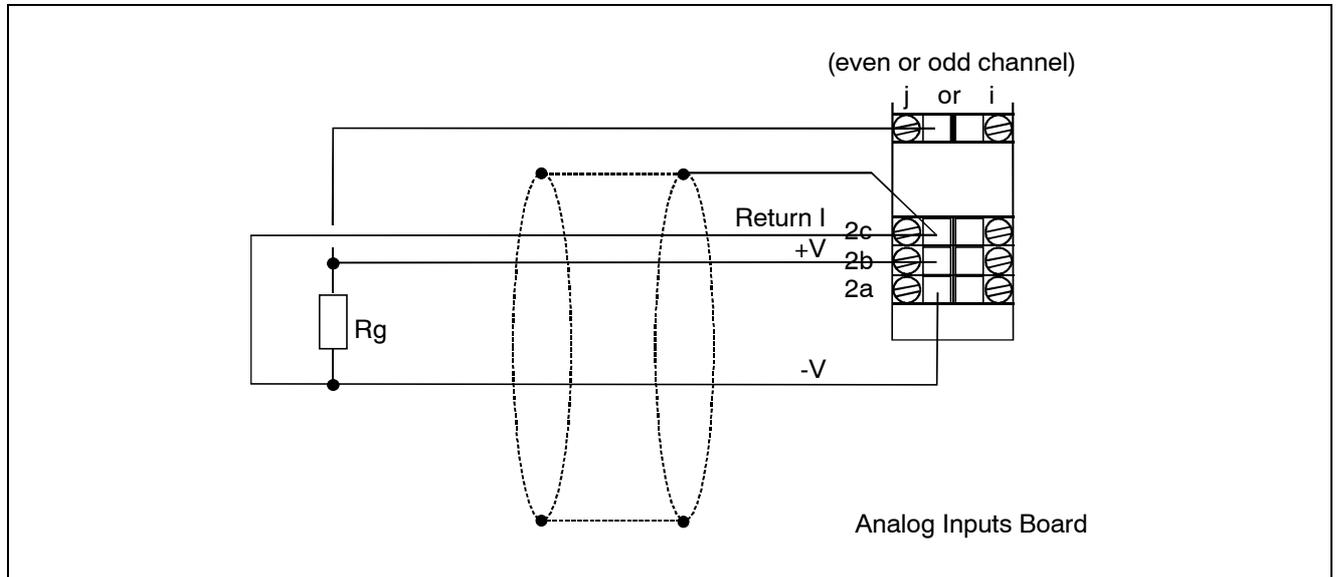


1.2.6.2 Wiring half-bridge configurations



1.2.6.3 Wiring quarter-bridge configurations

- Wiring active gauges



1.3 Exploitation

1.3.1 Operating principle – Operating modes

The different channels to be measured are successively applied to the inputs of the Analog-to-Digital converter. Controlling the switching relays and driving the converter are managed by microprocessors from the CPU board.

1.3.2 Programming by keywords

- Use the range programming instruction to declare the type of measurement to be performed over each channel of the board.

CH <number list> **RA** <range keyword>

Example: CH11-20 RA 60MV

- Use the task channel programming instruction to assign the channels to the task in charge of their scanning.

T <task number> **CH** <channel list>

Keywords	Corresponding ranges
CONTACT (Go/No go)	Contact closing test. Value 1 if contact closed, value 0 if contact opened.
60MV	60 mVDC.
600MV	600 mVDC.
6V	6 VDC.
60V	60 VDC.
100V	100 VDC.
60MVAC	60 mVAC.
600MVAC	600 mVAC.
6VAC	6 VAC.
60VAC	60 VAC.
100VAC	100 VAC.
THK	Thermocouple K.
THT	Thermocouple T.
THJ	Thermocouple J.
THS	Thermocouple S.
THB	Thermocouple B.
THN	Thermocouple N.
THC	Thermocouple C.
THR	Thermocouple R.

Keywords	Corresponding ranges
THE	Thermocouple E.
THMO	Thermocouple Mo.
THL	Thermocouple L
THU	Thermocouple U.
THPL	Thermocouple PL.
THSPE	Special thermocouple to be loaded using LOGIDAT software.

Keywords	Corresponding ranges
PROCESS <i>number</i>	<p>The PROCESS ranges are as follows:</p> <ul style="list-style-type: none"> • 4-20 mA, • 0-20 mA, • 1-5 V and • 0-10 V. <p>They are programmed in two stages as indicated in paragraph below. The PROCESS <i>number</i> defines the measurement range selected from the four ranges available with both low and high values.</p>

Keywords	Corresponding ranges
60OHM3	60 Ω, 3-wire configuration.
600OHM3	600 Ω, 3-wire configuration.
3KOHM3	3 kΩ, 3-wire configuration.
30KOHM3	30 kΩ, 3-wire configuration.
300KOHM3	300 kΩ, 3-wire configuration.
60OHM4	60 Ω, 4-wire configuration.
600OHM4	600 Ω, 4-wire configuration.
3KOHM4	3 kΩ, 4-wire configuration.
30KOHM4	30 kΩ, 4-wire configuration.
300KOHM4	300 kΩ, 4-wire configuration.
PT25-3	25 Ohms at 0°C Pt RTD, 3-wire configuration.
PT50-3	50 Ohms at 0°C Pt RTD, 3-wire configuration.
PT100-3	100 Ohms at 0°C Pt RTD, 3-wire configuration.
PT1000-3	1 000 Ohms at 0°C Pt RTD, 3-wire configuration.
NI100-3	100 Ohms at 0°C Ni RTD, 3-wire configuration.
PT25-4	25 Ohms at 0°C Pt RTD, 4-wire configuration.
PT50-4	50 Ohms at 0°C Pt RTD, 4-wire configuration.
PT100-4	100 Ohms at 0°C Pt RTD, 4-wire configuration.
PT1000-4	1 000 Ohms at 0°C Pt RTD, 4-wire configuration.
NI100-4	100 Ohms at 0°C Ni RTD, 4-wire configuration.

For channels of analog inputs boards EA(10 channels) and ES (10 simplified channels), when the system is equipped with a JG board (gauges power supply board):

Keywords	Corresponding ranges
BG	full Bridge Gauge, measurement over 60 mV range.
EBG	Extended full Bridge Gauge, measurement over 600 mV range.
HBG	Half-Bridge Gauge, measurement over 60 mV range.
EHBG	Extended Half-Bridge Gauge, measurement over 600 mV range.
QBG1	Quarter-Bridge Gauge, measurement over 60 mV range. Using the compensation gauge No 1.
EQBG1	Extended Quarter-Bridge Gauge, measurement over 600 mV range. Using the compensation gauge No 1.
QBG3	Quarter-Bridge Gauge, measurement over 60 mV range. Using the compensation gauge No 3.
EQBG3	Extended Quarter-Bridge Gauge, measurement over 600 mV range. Using the compensation gauge No 3.
QBG5	Quarter-Bridge Gauge, measurement over 60 mV range. Using the compensation gauge No 5.
EQBG5	Extended Quarter-Bridge Gauge, measurement over 600 mV range. Using the compensation gauge No 5.

1.3.3 Programming by means of the LOGIDAT software

1.3.3.1 Declaring the type of board

When creating a new program document, it is advisable to select the option "Re-read the boards set of a connected DATALOG", thus enabling LOGIDAT to identify itself the type of the boards inside the system. However, if the system is not connected to a PC the operator can manually define the type of each board:

- Select the board number in the screen left window (tree).
- Click the mouse right button to open the context menu.
- Select **Properties...**
- A window opens. Select the desired board type, i.e.:

EA	10 analog inputs board	AN 5885
ES	Simplified 10 analog inputs boards	AN 5900

- Press **OK**.

1.3.3.2 Configuring the channel

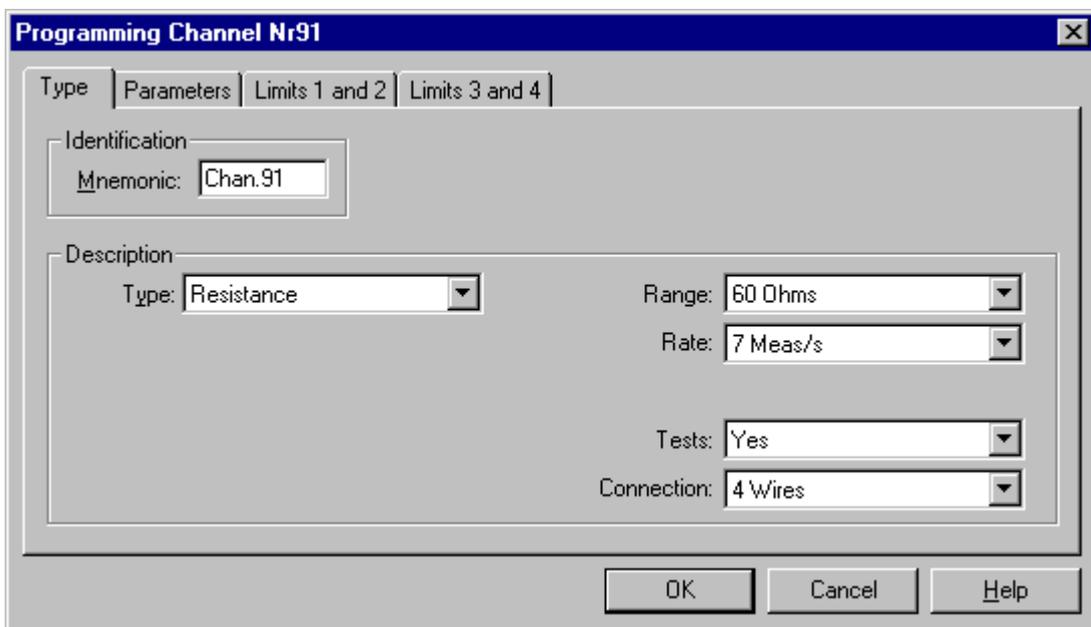
- Select a channel from the board in the screen left window (tree).
- Click the mouse right button to open the context menu.
- Select **Configure...**

- A window opens: **Programming channel Nr x**
- Using the **Type** tab, select:
 - The channel mnemonic if desired.
 - The programming type (voltage, resistance, RTD, thermocouple, process, Go/No go (contact)).
 - The range associated to the measurement type previously selected.

Some ranges need additional parameters, such as:

- Rate: Measurement scanning speed over the channel.
- Connection: 3- or 4-wire when measuring resistance or RTD.
- Tests: Checking for periodical sensor wire cut-off.
- RJC: Measuring a thermocouple with reference junction correction.

Channel programming example



To define the parameters of the other tabs, refer to the Instruction Manual, chapter 6.

1.3.4 Operation

The channels to be measured must be declared in the channel list of at least one task.

Programming the task enables the operator to define its execution and results recording conditions.

For the tasks to be executed, the system must be set to RUN position.

1.4 Calibrating the voltmeter

To maintain the specified accuracy, the voltmeter should be periodically calibrated. This operation is rendered easier because it does not need any internal manipulation due to the permanent storage of automatically computed correction ratios which compensate for the difference between the measured value and the standard value applied to the system terminals during the calibration procedure.

Calibration should be done every year.

Calibrating the voltmeter needs highly accurate instruments: voltage and resistance standards with a minimal accuracy of 10^{-5} .

If such standards are not available, it is advisable to return the system to AOIP for professional calibration.

The system is calibrated in air-conditioned rooms at $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$.

1.4.1 Material required

- A voltage divider with a ratio of 1/10 or 1/100, with an internal resistance of at least 1 000 Ω and an accuracy better than 0.001 %.
- A set of standard resistors including:
 - a resistor of 60 Ω . Known value better than 0.005 %.
 - a resistor of 600 Ω . Temperature coefficient better than 0.0005 %/ $^{\circ}\text{C}$.
 - a resistor of 3 k Ω
 - a resistor of 30 k Ω .
 - a resistor of 300 k Ω .
- A DC voltage standard for values included between:
 - 1 V and 6 V with an accuracy better than 0.001 %.
 - 10 V and 100 V with an accuracy better than 0.001 %.

NOTE: For every voltage value lower than 1 V, a voltage divider 1/10 or 1/100 will be used.

1.4.2 Adjustable ranges

DC voltage ranges: 60 mV, 600 mV, 6 V, 60 V and 100 V; resistance ranges: 60 Ω , 600 Ω , 3 k Ω , 30 k Ω and 300 k Ω ; AC voltage ranges: 60 mV, 600 mV, 6 V, 60 V and 100 V. Each of these ranges can be adjusted separately from each other.

1.4.3 Adjustment procedure

Before adjusting a range, place the system for 12 h minimum in an air-conditioned room at $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$. The system should be programmed to the range 60 mV, 7 meas/s, in order to ensure a good thermal stability for all system components.

- Set the system to **STOP**.
- Program the range to be adjusted on one of the system channels.
As the system adjusts simultaneously at all four rates, the programmed rate does not matter.
- Apply to this channel a reference corresponding to 1 % of the full scale approximately (E.g.: 60 mV for the range 6 V) and enter the following command:
ADJ1 (*applied value*) **CH** *adjustment channel number*
in expressing the *applied value* in the range unit.

Example:

If applying 60 mV on the channel 1 to adjust the range 6 V, type: ADJ1 (0.06) CH1.
The system gives the measurement of the applied reference on the four rates 7, 20, 50 and 200 meas/s, then displays the message: **OK TO CONTINUE**.

- Apply a reference corresponding approximately to the full scale of the range and enter the following command:
ADJ2(*applied value*) **CH** *adjustment channel number*
in expressing the *applied value* in the range unit.

Example: ADJ2 (6) CH1

The system measures, computes and stores the correction coefficients, then display the message ending the calibration: **OK**

- Program the next range to be adjusted.

NOTES:

1. The resistance ranges must be adjusted in 4-wire mode.
2. After each resistor and/or wiring cords manipulation, wait for 5 minutes before setting up a new ADJX, to ensure the thermal stabilization of calibration components.

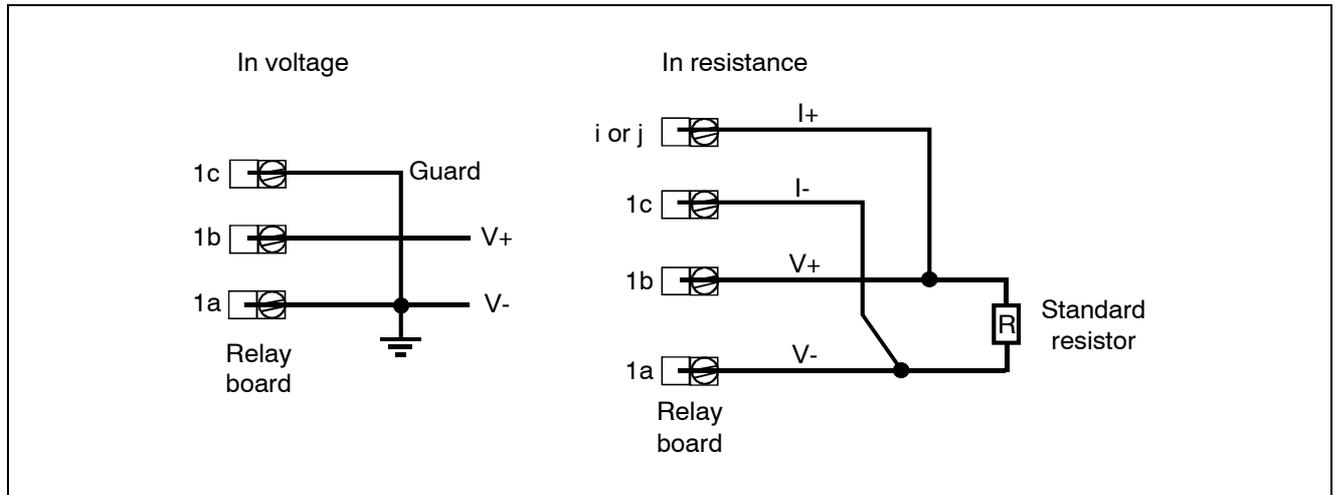
1.4.4 Table of recommended adjustment values for the different ranges

Adjusted range	Programmed range	Advised adjustment values and corresponding values to be declared			
		Phase 1		Phase 2	
DC voltage					
60 mVDC	60MV	0.6 mV	ADJ1(0.6)	60 mV	ADJ2(60)
600 mVDC	600MV	6 mV	ADJ1(6)	600mV	ADJ2(600)
6 VDC	6V	60 mV	ADJ1(0.06)	6 V	ADJ2(6)
60 VDC	60V	600 mV	ADJ1(0.6)	60 V	ADJ2(60)
100 VDC	100V	1 V	ADJ1(1)	100 V	ADJ2(100)
AC voltage					
60 mVAC	60MVAC	0.6 mV	ADJ1(0.6)	60 mV	ADJ2(60)
600 mVAC	600MVAC	6 mV	ADJ1(6)	600mV	ADJ2(600)
6 VAC	6VAC	60 mV	ADJ1(0.06)	6 V	ADJ2(6)
60 VAC	60VAC	600 mV	ADJ1(0.6)	60 V	ADJ2(60)
100 VAC	100VAC	1 V	ADJ1(1)	100 V	ADJ2(100)
Resistance					
60 Ω	60OHM4	short-circuit	ADJ1(0)	60 Ω	ADJ2(60)
600 Ω	600OHM4	short-circuit	ADJ1(0)	600 Ω	ADJ2(600)
3 kΩ	3KOHM4	short-circuit	ADJ1(0)	3 kΩ	ADJ2(3)
30 kΩ	30KOHM4	short-circuit	ADJ1(0)	30 kΩ	ADJ2(30)
300 kΩ	300KOHM4	short-circuit	ADJ1(0)	300 kΩ	ADJ2(300)

During calibration in ohmmeter and in particular for ranges 60 Ω and 600 Ω in phase 1, enter on the keypad the real value of the short-circuit, this being seldom equal to 0.000 Ω.

NOTE: Calibrating the ohmmeter must be done in 4-wire mode.

1.4.5 Calibration connections



Connections are made to the relay board connector corresponding to the selected channel (example: CH1).



Notes

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Notes

2.1 Specifications

The board is usable with the DATALOG 20, 90 and 120. It switches 20 measurement channels by means of optomos ensuring optimum insulation between channels.

Each channel can be configured depending on the quantity to be measured.

It enables:

- Voltage measurements.
- Thermocouple measurements.
- 0 – 10 V, 1 – 5 V, 4 – 20 mA, 0 – 20 mA process.
- Go/No go contact tests.

It does not enable:

- Strain gauge measurements.
- Resistance measurements.

The analog input boards are equipped with a Pt 100 RTD sensor measuring the temperature of the associated removable connector. This provides the reference junction compensation function necessary for temperature measurements using thermocouples.

2.1.1 Scanning speed

Max. scanning speed	Integration time	Max. display capacity (electrical quantities)	Max. number of measured counts (electrical quantities)	Representation Unit (RU) ①
7 meas/s	100 ms	690 000	690 000	1
20 meas/s	20 ms	69 000	69 000	1
50 meas/s	1 ms	6 900	6 900	1
200 meas/s	②	6 144	2 048	3

① **RU = Representation Unit**, i.e.: minimal deviation between two displayed values.

Example: for a decimal display progressing 3 by 3 counts, RU = 3.

② 12-bit Analog-to-Digital converter with successive approximations.

NOTE: Execution of a measurement cycle by a task includes the scanning of the inputs as well as their processing. Scanning is performed at the rate indicated in the table above. Depending on the processing procedures programmed over the measurement results, the average scanning speed for several successive scanning cycles may be lower than the maximal measurement speed.

The indicated accuracy expressions applied to a system placed in the reference conditions defined elsewhere, after 30 minutes of warming-up and at a temperature of $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$. They are expressed in $\pm (n \% \text{rdg} + C)$ with rdg = reading and C = Constant. These values include the influence of the analog inputs board.

2.1.2 DC voltage

2.1.2.1 General specifications

Range	Measurement resolution unit			
	7 meas/s	20 meas/s	50 meas/s	200 meas/s
60 mV	1 μV	1 μV	10 μV	30 μV
600 mV	1 μV	10 μV	100 μV	300 μV
6 V	10 μV	100 μV	1 mV	3 mV
60 V	100 μV	1 mV	10 mV	30 mV

- Accuracy of the inputs board

Range	7 meas/s		20 meas/s	
	90 days	1 year	90 days	1 year
60 mV	0.03 % + 5 μV	0.06 % + 7 μV	0.03 % + 5 μV	0.06 % + 7 μV
600 mV	0.03 % + 5 μV	0.06 % + 7 μV	0.03 % + 50 μV	0.06 % + 70 μV
6 V	0.03 % + 20 μV	0.06 % + 40 μV	0.03 % + 200 μV	0.06 % + 400 μV
60 V	0.03 % + 200 μV	0.06 % + 400 μV	0.03 % + 2 mV	0.06 % + 4 mV

For 50 meas/s, 60 mV to 60 V ranges, accuracy over 1 year: 4 RU.

For 200 meas/s, 60 mV to 60 V ranges, accuracy over 1 year: 12 RU.

Input resistance: > 100 M Ω over ranges \leq 6 V, 10 M Ω over 60 V range.

Input current: < 300 pA.

Normal mode rejection (60 mV range):

> 60 dB at 50 and 60 Hz to 7 meas/s.

> 60 dB at 50 Hz to 20 meas/s.

Max. permissible common mode voltage: 60 VDC or AC peak.

Common mode rejection (60 mV range, one analog inputs board):

> 140 dB in AC, 50 and 60 Hz \pm 0.1% to 7 meas/s,

> 140 dB in AC, 50 Hz \pm 0.1% to 20 meas/s.

Max. permissible voltage between different channels: 60 VDC or AC peak.

Temperature coefficient:

- from 0 to 35°C: (0.001 % + 0.5 RU)/°C,
- from 35 to 50°C: (0.001 % + 1 RU)/°C.

2.1.2.2 PROCESS ranges 1-5 V, 0-10 V

Refer to paragraph 2.1.6.2.

2.1.3 AC voltage

T-RMS value with possible DC component taken in account (AC + DC mode).

The accuracies are given for a sine voltage without DC component.

Range	Measurement resolution unit
60 mV	10 μ V
600 mV	100 μ V
6 V	1 mV
60 V	10 mV

• Accuracy of the inputs board

Range	1 meas/s	
	90 days	1 year
60 mV	0.3 % + 100 μ V	0.5 % + 100 μ V
600 mV	0.3 % + 1 mV	0.5 % + 1 mV
6 V	0.3 % + 10 mV	0.5 % + 10 mV
60 V	0.3 % + 100 mV	0.5 % + 100 mV

Measurement minimum scanning time: 2 seconds.

Measurement range: from 4 % to 110 % of range, from 40 Hz to 400 Hz.

Crest Factor influence (CF): 1 % for CF = 3.

Repeatability between two different channels: \leq C.

Input resistance: > 100 M Ω over ranges \leq 6 V, 10 M Ω over 60 V range.

Input current: $< 300 \text{ pA}$ over ranges $\leq 6 \text{ V}$.

Max. permissible common mode voltage: 60 VDC or AC peak.

Max. permissible voltage between different channels: 60 VDC or AC peak.

Temperature coefficient: $(0.05 \% + 0.5 \text{ RU})/^{\circ}\text{C}$.

2.1.4 DC current

2.1.4.1 *General specifications*

The current ranges are determined by the external range used.

Each channel must be programmed for the shunt's rated voltage and for the corresponding scaling factor (conversion algorithm).

Example: For a 20 A, 100 mV shunt, use the range 600 mV and program the conversion algorithm $\text{CONV}=\text{X}/5$ to display the current in A.

Accuracy and other specifications: Those of the programmed voltage range in terms of the displayed value. Additionally, take account of the accuracy of the shunt used.

Max. permissible common mode voltage: 60 VDC or AC peak.

2.1.4.2 *PROCESS ranges 0-20 mA, 4-20 mA*

Refer to paragraph 2.1.6.1.

2.1.5 Thermocouple

Temperature measurement can be programmed:

- without temperature compensation of the system terminals (reference junction at 0°C).
- with temperature compensation of the system terminals (one per board).
- **Board accuracy**

S e n s.	Measurement range	Resolution unit				Accuracy			
		7 meas/s	20 meas/s	50 meas/s	200 meas/s	7 meas/s		20 meas/s	
						90 days	1 year	90 days	1 year
K	- 250°C - 200°C	0.5°C	0.5°C	1°C	1°C	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 1.5°C)	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 1.5°C)
	- 200°C - 100°C	0.2°C	0.2°C	1°C	1°C	+ (0.03 % rdg + 0.5°C)	+ (0.06 % rdg + 0.7°C)	+ (0.03 % rdg + 0.5°C)	+ (0.06 % rdg + 0.7°C)
	- 100°C + 1 370°C	0.1°C	0.1°C	1°C	1°C	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.3°C)	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.3°C)
T	- 250°C - 200°C	0.5°C	0.5°C	1°C	1°C	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 2°C)	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 2°C)
	- 200°C - 100°C	0.2°C	0.2°C	1°C	1°C	+ (0.03 % rdg + 0.5°C)	+ (0.06 % rdg + 0.6°C)	+ (0.03 % rdg + 0.5°C)	+ (0.06 % rdg + 0.6°C)
	- 100°C + 400°C	0.1°C	0.1°C	1°C	1°C	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.3°C)	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.3°C)
J	- 210°C - 120°C	0.2°C	0.2°C	1°C	1°C	+ (0.03 % rdg + 0.4°C)	+ (0.06 % rdg + 0.5°C)	+ (0.03 % rdg + 0.4°C)	+ (0.06 % rdg + 0.5°C)
	- 120°C + 1 100°C	0.1°C	0.1°C	1°C	1°C	+ (0.03 % rdg + 0.2°C)	+ (0.06 % rdg + 0.3°C)	+ (0.03 % rdg + 0.2°C)	+ (0.06 % rdg + 0.3°C)
S	- 50°C + 550°C	1°C	1°C	1°C	1°C	+ (0.03 % rdg + 1.5°C)	+ (0.06 % rdg + 2°C)	+ (0.03 % rdg + 1.5°C)	+ (0.06 % rdg + 2°C)
	+ 550°C + 1 768°C	0.5°C	0.5°C	1°C	1°C	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 1°C)	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 1°C)
B	+ 400°C + 900°C	1°C	1°C	1°C	1°C	+ (0.03 % rdg + 1.5°C)	+ (0.06 % rdg + 2°C)	+ (0.03 % rdg + 1.5°C)	+ (0.06 % rdg + 2°C)
	+ 900°C + 1 820°C	0.5°C	0.5°C	1°C	1°C	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 1°C)	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 1°C)
N	- 250°C - 200°C	1°C	1°C	1°C	1°C	+ (0.03 % rdg + 1.5°C)	+ (0.06 % rdg + 2.5°C)	+ (0.03 % rdg + 1.5°C)	+ (0.06 % rdg + 2.5°C)
	- 200°C - 120°C	0.5°C	0.5°C	1°C	1°C	+ (0.03 % rdg + 0.7°C)	+ (0.06 % rdg + 1°C)	+ (0.03 % rdg + 0.7°C)	+ (0.06 % rdg + 1°C)
	- 100°C + 0°C	0.2°C	0.2°C	1°C	1°C	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.4°C)	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.4°C)
	- 0°C + 1 300°C	0.1°C	0.1°C	1°C	1°C	+ (0.03 % rdg + 0.2°C)	+ (0.06 % rdg + 0.3°C)	+ (0.03 % rdg + 0.2°C)	+ (0.06 % rdg + 0.3°C)
E	- 250°C + 1 000°	0.1°C	0.1°C	1°C	1°C	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 1.5°C)	+ (0.03 % rdg + 1°C)	+ (0.06 % rdg + 1.5°C)
C	- 20°C + 2 320°C	0.2°C	0.2°C	1°C	1°C	+ (0.03 % rdg + 0.4°C)	+ (0.06 % rdg + 0.6°C)	+ (0.03 % rdg + 0.4°C)	+ (0.06 % rdg + 0.6°C)
Mo	+ 0°C + 1 375°C	0.1°C	0.1°C	1°C	1°C	+ (0.03 % rdg + 0.2°C)	+ (0.06 % rdg + 0.2°C)	+ (0.03 % rdg + 0.2°C)	+ (0.06 % rdg + 0.2°C)
R	- 50°C + 550°C	1°C	1°C	1°C	1°C	+ (0.03 % rdg + 1.5°C)	+ (0.06 % rdg + 2°C)	+ (0.03 % rdg + 1.5°C)	+ (0.06 % rdg + 2°C)
	+ 550°C + 1 768°C	0.5°C	0.5°C	1°C	1°C	+ (0.03 % rdg + 0.6°C)	+ (0.06 % rdg + 0.8°C)	+ (0.03 % rdg + 0.6°C)	+ (0.06 % rdg + 0.8°C)
L	- 200°C + 900°C	0.1°C	0.1°C	1°C	1°C	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.4°C)	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.4°C)
U	- 200°C - 100°C	0.2°C	0.2°C	1°C	1°C	+ (0.03 % rdg + 0.4°C)	+ (0.06 % rdg + 0.5°C)	+ (0.03 % rdg + 0.4°C)	+ (0.06 % rdg + 0.5°C)
	- 100°C + 600°C	0.1°C	0.1°C	1°C	1°C	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.3°C)	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.3°C)
PI	- 100°C + 1 400°C	0.1°C	0.1°C	1°C	1°C	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.4°C)	+ (0.03 % rdg + 0.3°C)	+ (0.06 % rdg + 0.4°C)

The accuracy above is warranted for a reference junction at 0°C.

Additionally, take account of any temperature sensor and cabling error.

If using an internal reference junction compensation, add $\pm 0.3^\circ\text{C}$ to the values.



Software version A.00 of the analog board does not hold cut-off tests over channels 201 to 340.

Repeatability between two different channels:

Example for a RJ at 0°C and a thermocouple at room temperature.

	Over the same board
RJ	Thermocouple K
at 0°C	0.1°C

Input resistance: > 100 MΩ.

Input current: < 300 pA.

Permissible line resistance: ≤ 1 kΩ per wire.

Broken line test and sensor test: programmable, with display of an error message.

Temperature display in °F by programming the appropriate conversion algorithm: $T(^{\circ}\text{F}) = 1.8 T(^{\circ}\text{C}) + 32$.

Max. permissible normal mode voltage: 20 mV peak to peak.

Normal mode rejection (1 μV/mV, 50 or 60 Hz, 7 meas/s):

- thermocouple K: 0.025°C/mV,
- thermocouple S: 0.2°C/mV.

Max. permissible common mode voltage: 75 VDC or AC peak.

Common mode rejection (1 μV/V, 50 or 60 Hz, 7 meas/s):

- thermocouple K: < 0.025°C/V,
- thermocouple S: < 0.2°C/V.

Temperature coefficient

	from 0 to 35°C		from 35 to 50°C	
RJ	Thermocouple K	Thermocouple S	Thermocouple K	Thermocouple S
at 0°C	(0.001 % + 0.015°C)/°C	(0.001 % + 0.1°C)/°C	(0.001 % + 0.025°C)/°C	(0.001 % + 0.2°C)/°C
internal	(0.001 % + 0.025°C)/°C	(0.001 % + 0.1°C)/°C	(0.001 % + 0.04°C)/°C	(0.001 % + 0.2°C)/°C

2.1.6 Process

This heading includes the CURRENT 0-20 mA, 4-20 mA ranges from telemetering loop or 4-wire transmitters or equivalent and VOLTAGE 1-5 V, 0-10 V ranges.

Each range can be associated to a pair of high and low values (corresponding to signal variation limits) programmable by the operator with the unit of measurement (4 characters as a maximum).

100 different PROCESS can be specified.

2.1.6.1 0-20 mA and 4-20 mA current signals

Use a 50 Ω , 0.1 % shunt per channel, optionally supplied as an accessory, part number ER 44007-024 (rated voltage drop 1 VDC, max. permissible current 100 mA, temperature coefficient 0.0025 %/°C).

Max. measurement capacity: 24 mA.

Max. display capacity: 8 digits including the sign and decimal point.

Max. display resolution (theoretical):

The display resolution can be programmed by the ACCU instruction (see chapter 2 from the Reference Manual).

Range	7 meas/s	20 meas/s	50 meas/s	200 meas/s
0-20 mA	0.0002 % Δ	0.001 % Δ	0.02 % Δ	0.3 % Δ
4-20 mA	0.00025 % Δ	0.0012 % Δ	0.025 % Δ	0.4 % Δ

Δ = High value – Low value.

Accuracy and other specifications: those concerning DC current.

2.1.6.2 1-5 V and 0-10 V voltage signals

Max. measurement capacity: 6 V (1-5 V range) or 12 V (0-10 V range).

Max. display capacity: 8 digits including the sign and decimal point.

Min. display resolution:

Range	7 meas/s	20 meas/s	50 meas/s	200 meas/s
1-5 V	0.0005 % Δ	0.0025 % Δ	0.05 % Δ	0.5 % Δ
0-10 V	0.0002 % Δ	0.001 % Δ	0.02 % Δ	0.2 % Δ

Δ = High value – Low value.

Other specifications: same as the 60 VDC range.

NOTE: Sending messages below and/or above the measured signal permissible range of variation is handled by the Error function.

2.1.7 Contact (Go/No go)

Connecting a zero voltage contact to an analog input enables the operator to check its open (level 0) or closed (level 1) state as soon as the corresponding channel relay is closed.

Measurement current: 1 mA.

Max. voltage in open circuit: 10 V.

Level 0: line resistance $R_0 \geq 100 \text{ k}\Omega$.

Level 1: line resistance $R_1 \leq 1 \text{ k}\Omega$.

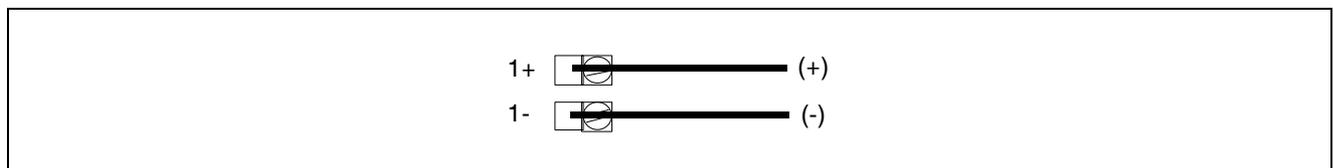
The contact function can be confirmed by an opto-electronic isolator output if the specifications R_0 and R_1 are respected.

2.2 Connection

The I/O 48-pin screw terminal connector blocks are identified by marks directly on the connector as shown below.

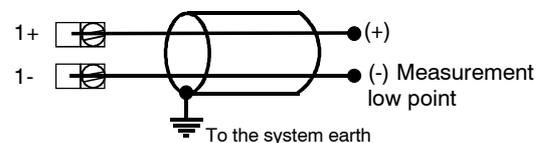
Channels Numbers X = unused											
X	X	210+	X	X	220+	X	X	290+	X	X	340+
X	X	210-	X	X	220-	X	X	290-	X	X	340-
209+	208+	207+	219+	218+	217+	289+	288+	287+	339+	338+	337+
209-	208-	207-	219-	218-	217-	289-	288-	287-	339-	338-	337-
206+	205+	204+	216+	215+	214+	286+	285+	284+	336+	335+	334+
206-	205-	204-	216-	215-	214-	286-	285-	284-	336-	335-	334-
203+	202+	201+	213+	212+	211+	283+	282+	281+	333+	332+	331+
203-	202-	201-	213-	212-	211-	283-	282-	281-	333-	332-	331-
etc			etc			etc			etc		
X	X	10+	X	X	20+	X	X	90+	X	X	140+
X	X	10-	X	X	20-	X	X	90-	X	X	140-
9+	8+	7+	19+	18+	17+	89+	88+	87+	139+	138+	137+
9-	8-	7-	19-	18-	17-	89-	88-	87-	139-	138-	137-
6+	5+	4+	16+	15+	14+	86+	85+	84+	136+	135+	134+
6-	5-	4-	16-	15-	14-	86-	85-	84-	136-	135-	134-
3+	2+	1+	13+	12+	11+	83+	82+	81+	133+	132+	131+
3-	2-	1-	13-	12-	11-	83-	82-	81-	133-	132-	131-
ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ
Channels - Board 1			Channels - Board 2			Channels - Board 9			Channels - Board 14		

2.2.1 DC voltage, AC voltage

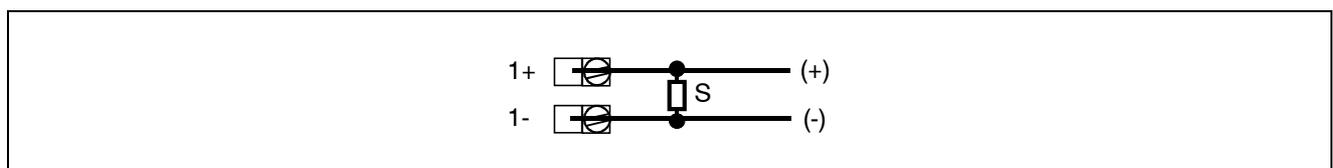


NOTE:

When measuring voltage, it is advisable to use, for each measurement channel, an insulated and shielded two-wire lead and to connect it to the system earth.



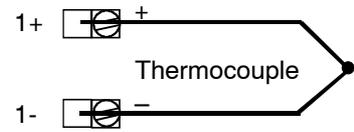
2.2.2 DC current



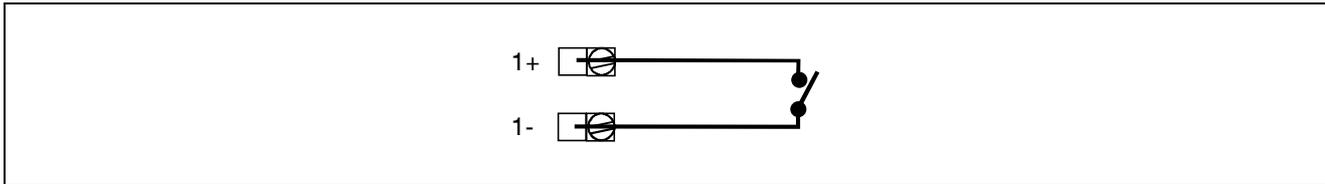
S = External Shunt for current measurement (50 Ω, 0.1 % for 0-20 mA or 4-20 mA current, part number ER 44006-024).

2.2.3 Thermocouple

For an internal reference junction compensation (one per analog inputs board), the system must be connected by thermocouple wires or by equivalent compensation wires on the e (-) and e (+) inputs as described opposite.



2.2.4 Contact (Go/No go)



2.3 Exploitation

2.3.1 Operating principle – Operating modes

The different channels to be measured are successively applied to the inputs of the Analog-to-Digital converter. Controlling the optomos and driving the converter are managed by microprocessors from the CPU board.

2.3.2 Programming by keywords

- Use the range programming instruction to declare the type of measurement to be performed over each channel of the board.

CH <number list> **RA** <range keyword>

Example: CH11-20 RA THK

- Use the task channel programming instruction to assign the channels to the task in charge of their scanning.

T <task number> **CH** <channel list>

Keywords	Corresponding ranges
CONTACT (Go/No go)	Contact closing test. Value 1 if contact closed, value 0 if contact opened.
60MV	60 mVDC.
600MV	600 mVDC.
6V	6 VDC.
60V	60 VDC.
100V	100 VDC.
60MVAC	60 mVAC.
600MVAC	600 mVAC.
6VAC	6 VAC.
60VAC	60 VAC.
100VAC	100 VAC.
THK	Thermocouple K.
THT	Thermocouple T.
THJ	Thermocouple J.
THS	Thermocouple S.
THB	Thermocouple B.
THN	Thermocouple N.
THC	Thermocouple C.
THR	Thermocouple R.
THE	Thermocouple E.
THMO	Thermocouple Mo.

Keywords	Corresponding ranges
THL	Thermocouple L
THU	Thermocouple U.
THPL	Thermocouple PL.
THSPE	Special thermocouple to be loaded using LOGIDAT software For full details, refer to the Instruction Manual, chapter 6.

Keywords	Corresponding ranges
PROCESS <i>number</i>	<p>The PROCESS ranges are as follows:</p> <ul style="list-style-type: none"> • 4-20 mA, • 0-20 mA, • 1-5 V and • 0-10 V. <p>They are programmed in two stages. The PROCESS <i>number</i> defines the measurement range selected from the four ranges available with both low and high values.</p>

2.3.3 Programming by means of the LOGIDAT software

2.3.3.1 Declaring the type of board

When creating a new program document, it is advisable to select the option "Re-read the boards set of a connected DATALOG", thus enabling LOGIDAT to identify itself the type of the boards inside the system. However, if the system is not connected to a PC the operator can manually define the type of each board:

- Select the board number in the screen left window (tree).
- Click the mouse right button to open the context menu.
- Select **Properties...**
- A window opens. Select the desired board type, i.e.:

E20	20 analog inputs board
-----	------------------------

- Press **OK**.

2.3.3.2 Configuring the channel

- Select a channel from the board in the screen left window (tree).
- Click the mouse right button to open the context menu.
- Select **Configure...**
- A window opens: **Programming channel Nr x**

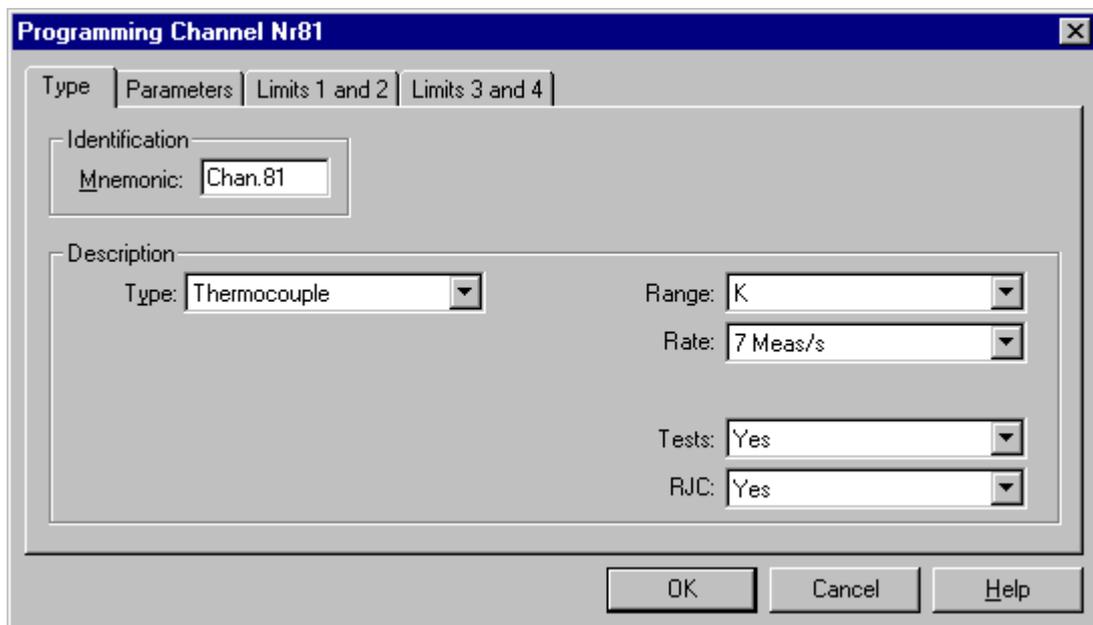
- Using the **Type** tab, select:
 - The channel mnemonic if desired.
 - The programming type (voltage, thermocouple, process, Go/No go (contact)).
 - The range associated to the measurement type previously selected.

Some ranges need additional parameters, such as:

- Rate: Measurement scanning speed over the channel.
- Tests: Checking for periodical sensor wire cut-off.
- RJC: Measuring a thermocouple with reference junction correction.

- Press **OK**.

Channel programming example



To define the parameters of the other tabs, refer to the Instruction Manual, chapter 6.

2.3.4 Operation

The channels to be measured must be declared in the channel list of at least one task.

Programming the task enables the operator to define its execution and results recording conditions.

For the tasks to be executed, the system must be set to RUN position.

2.4 Calibrating the voltmeter

To maintain the specified accuracy, the voltmeter should be periodically calibrated. This operation is rendered easier because it does not need any internal manipulation due to the permanent storage of automatically computed correction ratios which compensate for the difference between the measured value and the standard value applied to the system terminals during the calibration procedure.

Calibration should be done every year.

Calibrating the voltmeter needs highly accurate instruments: voltage standards with a minimal accuracy of 10^{-5} .

If such standards are not available, it is advisable to return the system to AOIP for professional calibration.

The system is calibrated in air-conditioned rooms at $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$.

2.4.1 Material required

- A voltage divider with a ratio of 1/10 or 1/100, with an internal resistance of at least $1\ 000\ \Omega$ and an accuracy better than 0.001 %.
- A DC voltage standard for values included between:
 - 1 V and 6 V with an accuracy better than 0.001 %.
 - 10 V and 60 V with an accuracy better than 0.001 %.

NOTE: For every voltage value lower than 1 V, a voltage divider 1/10 or 1/100 will be used.

2.4.2 Adjustable ranges

DC voltage ranges: 60 mV, 600 mV, 6 V, 60 V; AC voltage ranges: 60 mV, 600 mV, 6 V, 60 V.

Each of these ranges can be adjusted separately from each other.

2.4.3 Adjustment procedure

Before adjusting a range, place the system for 12 h minimum in an air-conditioned room at $23^{\circ}\text{C} \pm 1^{\circ}\text{C}$. The system should be programmed to the range 60 mV, 7 meas/s, in order to ensure a good thermal stability for all system components.

- Set the system to **STOP**.
- Program the range to be adjusted on one of the system channels.
As the system adjusts simultaneously at all four rates, the programmed rate does not matter.
- Apply to this channel a reference corresponding to 1 % of the full scale approximately (E.g.: 60 mV for the range 6 V) and enter the following command:
ADJ1 (*applied value*) **CH** *adjustment channel number*
in expressing the *applied value* in the range unit.

Example:

If applying 60 mV on the channel 1 to adjust the range 6 V, type: ADJ1 (0.06) CH1.

The system gives the measurement of the applied reference on the four rates 7, 20, 50 and 200 meas/s, then displays the message: **OK TO CONTINUE**.

- Apply a reference corresponding approximately to the full scale of the range and enter the following command:
ADJ2(*applied value*) **CH** *adjustment channel number*
in expressing the *applied value* in the range unit.

Example: ADJ2 (6) CH1

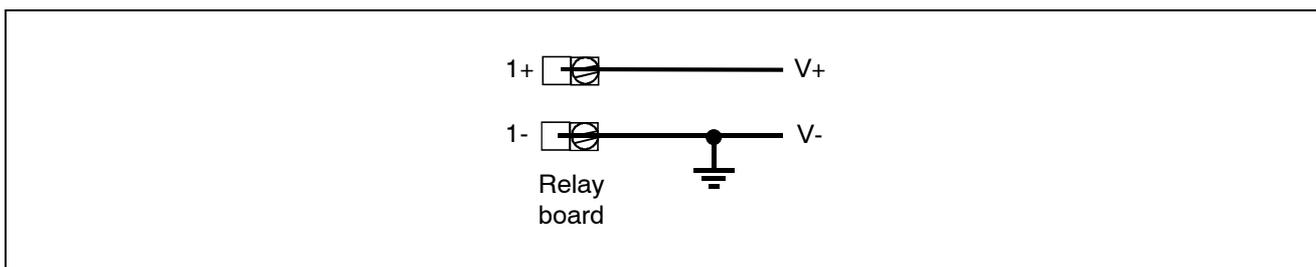
The system measures, computes and stores the correction coefficients, then display the message ending the calibration: **OK**

- Program the next range to be adjusted.

2.4.4 Table of recommended adjustment values for the different ranges

Adjusted range	Programmed range	Advised adjustment values and corresponding values to be declared			
		Phase 1		Phase 2	
DC voltage					
60 mVDC	60MV	0.6 mV	ADJ1(0.6)	60 mV	ADJ2(60)
600 mVDC	600MV	6 mV	ADJ1(6)	600mV	ADJ2(600)
6 VDC	6V	60 mV	ADJ1(0.06)	6 V	ADJ2(6)
60 VDC	60V	600 mV	ADJ1(0.6)	60 V	ADJ2(60)
AC voltage					
60 mVAC	60MVAC	0.6 mV	ADJ1(0.6)	60 mV	ADJ2(60)
600 mVAC	600MVAC	6 mV	ADJ1(6)	600mV	ADJ2(600)
6 VAC	6VAC	60 mV	ADJ1(0.06)	6 V	ADJ2(6)
60 VAC	60VAC	600 mV	ADJ1(0.6)	60 V	ADJ2(60)

2.4.5 Calibration connection



Connections are made to the relay board connector corresponding to the selected channel (example: CH1).

3. RELAY OUTPUTS BOARD

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Notes

3.1 Specifications

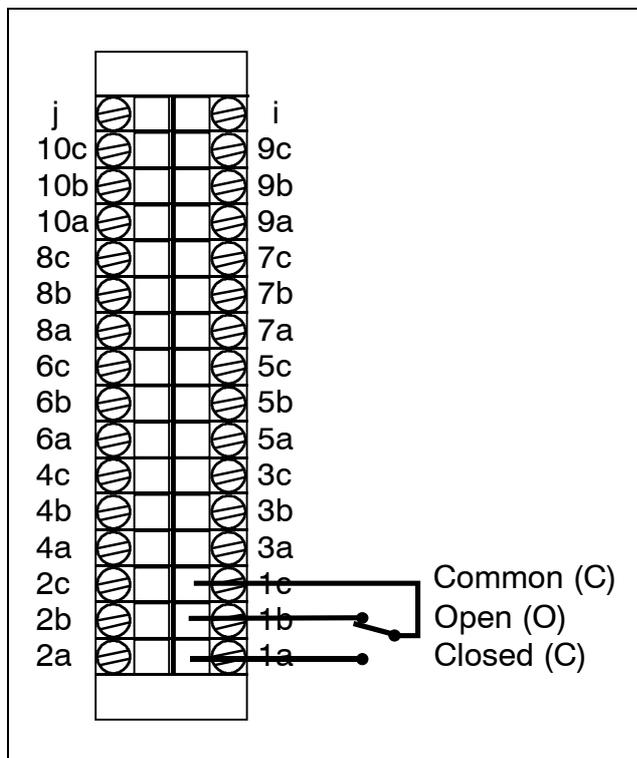
This board is composed of 10 trigger relays equipped with inverting dry contacts on the 32-terminal removable connector.

Switching capacity of relay contacts on ohmic load: 48 VDC, or 1 ADC or 30 W.

Switching life:

- Mechanical: 10^8 operations.
- Electrical: $5 \cdot 10^5$ operations under the above conditions.

3.2 Connection



NOTES:

1. The relays are bistable and keep their position even after a power supply cut. When power returns, relay position is not modified. The system continues scanning and relay position is set by program.
2. By convention, the CLOSED position corresponds to the alarm presence or to the memorized alarm.

3.3 Exploitation

3.3.1 Operating principle – Operating modes

Many applications are possible:

- Can be used as alarm relay associated to the limit programmed over a channel (physical or memory): the relay is set to CLOSED position when the limit is exceeded and to OPEN position when the alarm disappears.
- Switching a contact CLOSED during channel measurement by the Analog-to-Digital converter (a time delay should be programmed over this channel).
- Controlling the relay by means of conversion algorithms or processing procedure instructions. E.g.: using a single relay for signalling several alarms over different channels.

3.3.2 Programming by keywords

- Use the range programming instruction to declare the type of measurement to be performed over each channel of the board.

CH <number list> **RA** <range keyword>

Example: CH11-20 RA RELO

- Use the task channel programming instruction to assign the channels to the task in charge of their scanning.

T <task number> **CH** <channel list>

Keyword	Corresponding range
RELO	Relay outputs.

3.3.3 Programming by means of the LOGIDAT software

3.3.3.1 Declaring the type of board

When creating a new program document, it is advisable to select the option "Re-read the boards set of a connected DATALOG", thus enabling LOGIDAT to identify itself the type of the boards inside the system. However, if the system is not connected to a PC the operator can manually define the type of each board:

- Select the board number in the screen left window (tree).
- Click the mouse right button to open the context menu.
- Select **Properties...**
- A window opens. Select the desired board type, i.e.:

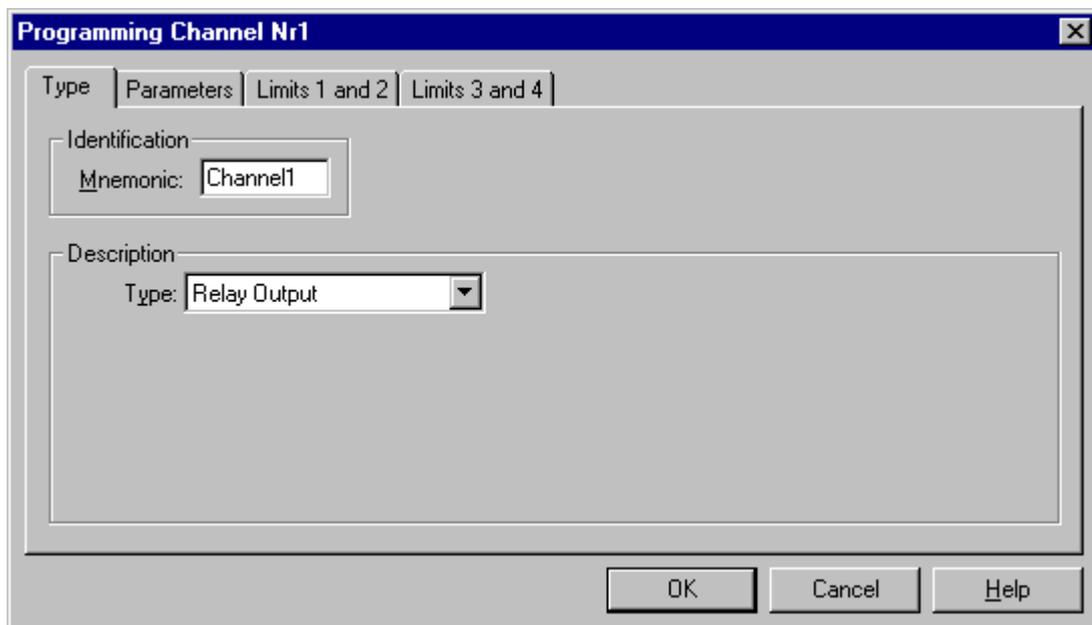
SR	10 relay outputs board
----	------------------------

- Press **OK**.

3.3.3.2 Configuring the channel

- Select a channel from the board in the screen left window (tree).
- Click the mouse right button to open the context menu.
- Select **Configure...**
- A window opens: **Programming channel Nr x**
- Using the **Type** tab, select:
 - The channel mnemonic if desired.
 - The programming type: Relay Output.
- Press **OK**.

Channel programming example



To define the parameters of the other tabs, refer to the Instruction Manual, chapter 6.

3.3.4 Operation

3.3.4.1 Using alarm relays

An output relay can be assigned when programming an alarm limit on a channel.

This relay is then set to OPEN when an alarm condition is not present and to CLOSED position when an alarm condition is present.

The relay is set during the channel processing procedure where a limit is programmed.

Example: Programming by keywords

```
CH1-10 RA THK LIM1 100 HI  
CH1 LIM1 REL11  
CH2 LIM1 REL12
```

....

```
CH10 LIM1 REL20
```

The output relays 11 to 20 follow the status of alarms 1 over the channels 1 to 10.

With this mode, it is better to assign a different relay number for each alarm limit. This is because, if the following instruction is programmed:

```
CH1-10 LIM1 100 HI REL11
```

the system sets the relay 11 to CLOSED position when processing a channel on which the relay is in alarm condition, and sets to OPEN position when processing a channel on which the relay is not in alarm condition. This can cause undesirable relay beating when scanning channels.

3.3.4.2 Specifying relay output channels in a task

Relay outputs can be specified in the channel list scanned by the tasks.

In this case, program the RANGE of these channels (**RELO** when keyword programming).

Programming a conversion algorithm on such a channel sets the relay.

When the channel is processed by the task, the X channel value is read in the Last Values Table for each channel. Then, any conversion algorithm is applied and the value is again stored in the Last Values Table for each channel.

The relay is set according to this value, either to CLOSED position if it is more than 0.5; or to OPEN position if not.

Example

In this example, the channel 11 relay output signals an alarm limit overrun on one of the channels from 1 to 10.

```
CH1-10 RA THK LIM1 100 HI
CH11 RA RELO CONV1
CONV1 AP1(1-10)
T1 CH1-11
```

The AP1(1-10) function returns the value 1 if an alarm 1 is present on one of the channels from 1 to 10, and returns 0 if none of the channels is in alarm 1.

The relay 11 is then set to CLOSED position as soon as an alarm is present. Unlike the previous example, it is set to OPEN position only when no channel is in alarm condition.

3.3.4.3 Setting a relay output by an assignment instruction

The relay outputs can also be set by assignment instructions **CH** (*extended list*) = *expression* which can occur in a processing procedure, or **CH** *channel list* = *value* entered in a command line.

The channel range must be programmed in order to set the relay; this takes place when the assignment instruction is executed.

Example

The relay 11 is used to memorize the appearance of an alarm condition on one of the channels from 1 to 10.

```
CH11 RA RELO
CH1-10 RA THK LIM1 100 HI PR1
PR1 IF AA1 THEN CH11=1
T1 CH1-10
```

Once set, the relay can be reset to OPEN position by the command: CH11=0.



3.3.5 Additional information on the board operation

3.3.5.1 *Initial setting of relay outputs*

The instruction for overall system initialization **INIT YES** sets the relay to OPEN position, as does the **RUN** command.

On power fail, relays keep their setting; they are not reset on power restore.

4. ANALOG OUTPUTS BOARD

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Notes

4.1 Specifications

Number of channels:

5-12 bits channels individually programmable as voltage output (- 10 V to + 10 V) or as current output (0-20 mA or 4-20 mA).

Range	Resolution	Accuracy
± 10 V	5 mV	± 10 mV
0-20 mA	0.01 mA	± 0.02 mA
4-20 mA	0.01 mA	± 0.02 mA

Voltage output:

Min. permissible load resistance: 5 k Ω .

Current output:

- Internal supply.
Max. permissible load resistance: 500 Ω .
Open circuit voltage present: 12 V.
- External supply.
Supply voltage: $15 \text{ V} \leq V_{\text{supply}} \leq 50 \text{ V}$.
Max. permissible load resistance: $R_{\text{max.}} = (V_{\text{supply}} - 2) / 0.02$.

Galvanic insulation:

The 5 channels on a same board are connected between them and insulated from the other system I/O boards.

Max. permissible common mode voltage between the analog channels and the other system I/O boards: 150 VDC or AC peak.

Signal risetime to resistance load: 20 $\mu\text{s/V}$.

Maximum load capacity: 10 μF .

Temperature coefficient: 0.01 % per $^{\circ}\text{C}$.

4.2 Connection

The odd channels are assigned to voltage outputs $\pm 10\text{ V}$; the even channels are assigned to current outputs 0-20 mA or 4-20 mA.

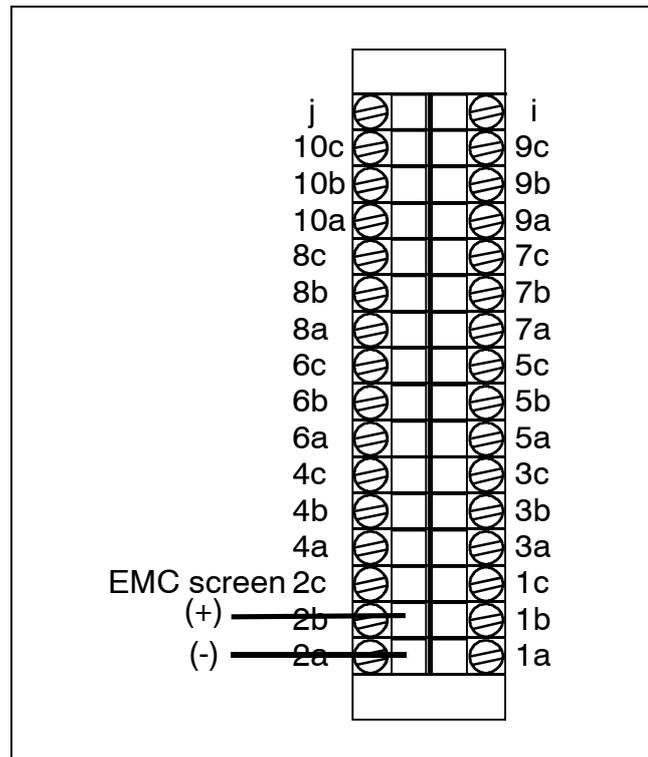
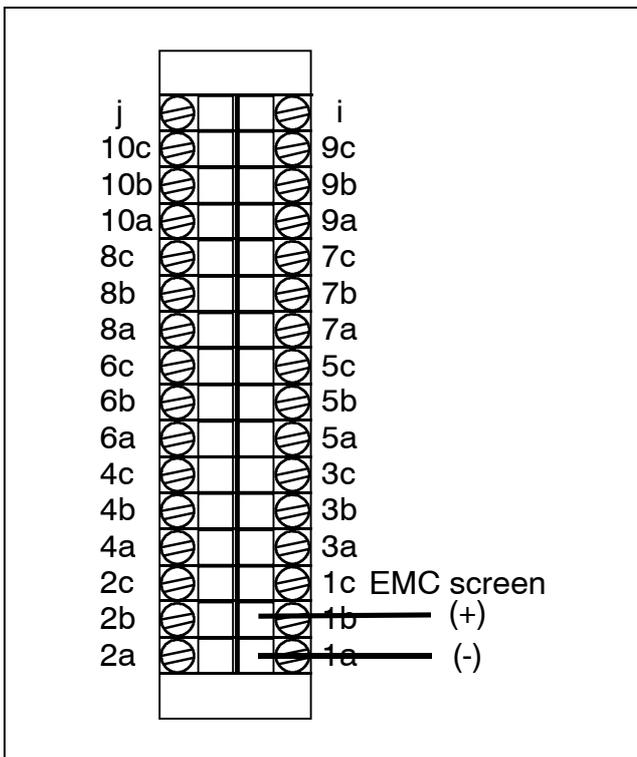
A current channel cannot be used if the voltage channel immediately preceding it is already assigned and vice versa.

4.2.1 Voltage outputs $\pm 10\text{ V}$

They are available on odd channels: 1, 3, 5, 7 and 9.

4.2.2 Current outputs 0-20 mA or 4-20 mA

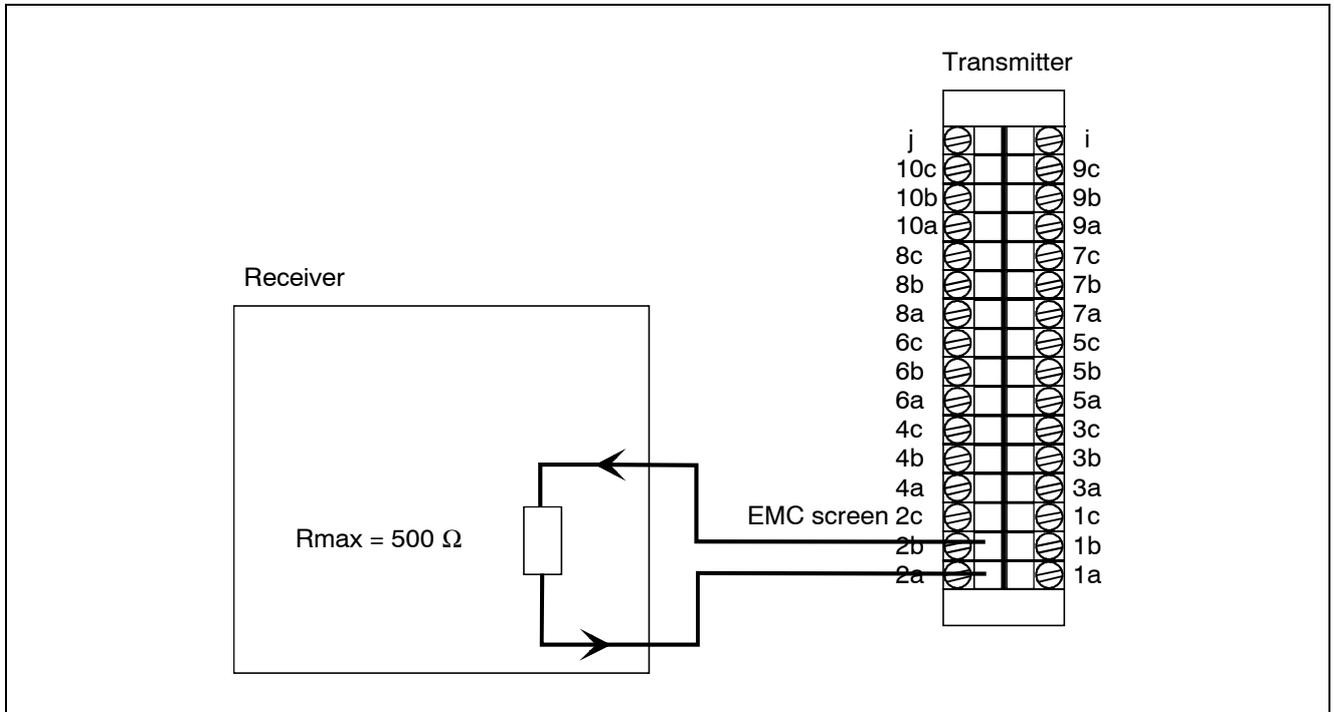
They are available on even channels: 2, 4, 6, 8 and 10.



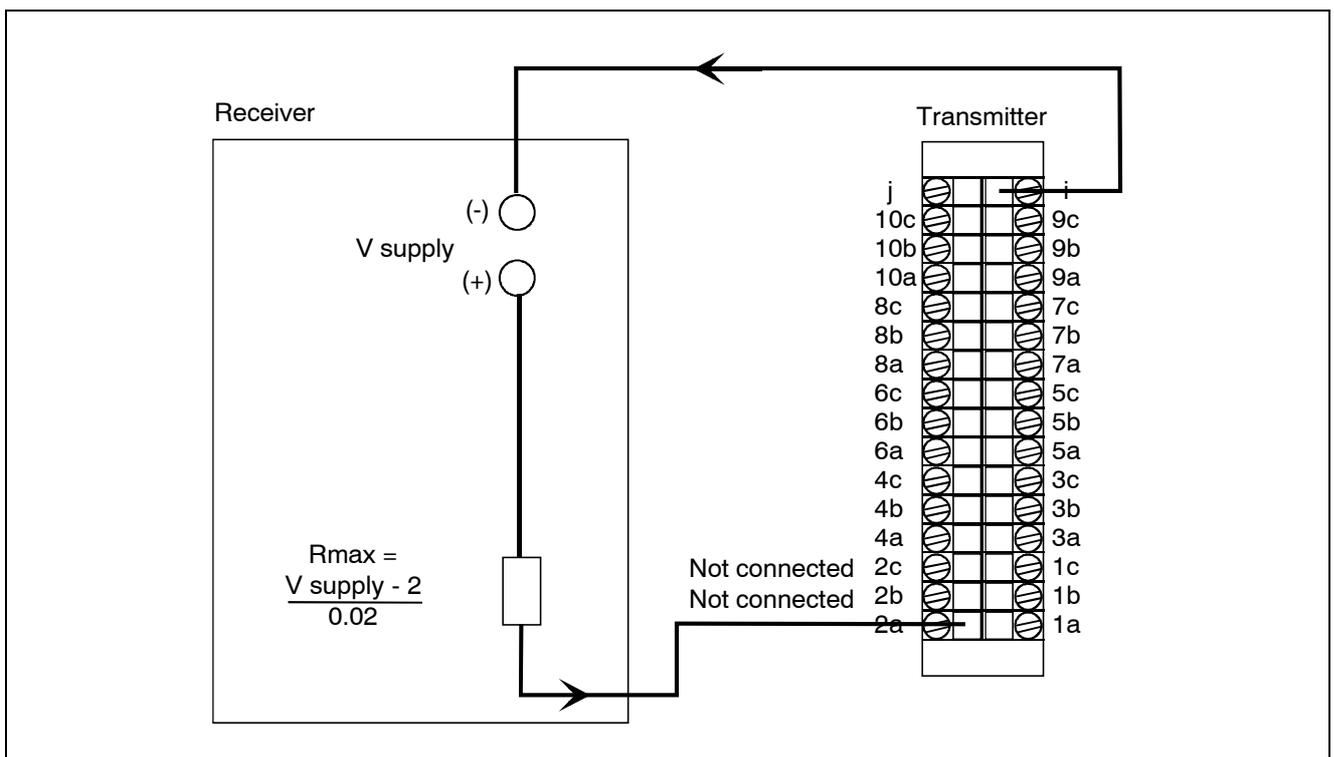
4.2.3 Current outputs power supply

Three wiring methods are possible.

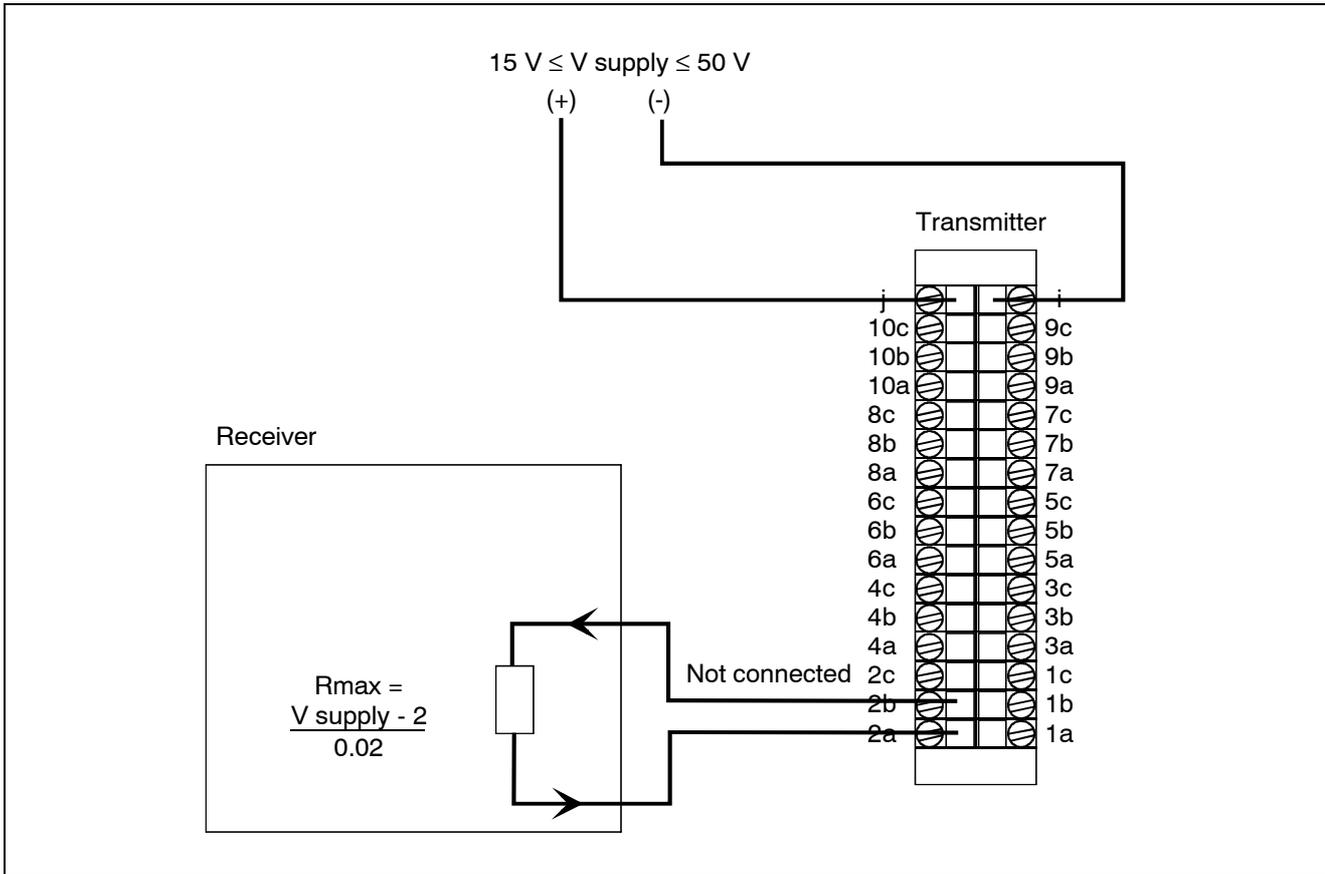
4.2.3.1 Powering a channel from the analog outputs board



4.2.3.2 Powering a channel from the receiver



4.2.3.3 Powering all channels from an external source



4.3 Exploitation

4.3.1 Operating principle – Operating modes

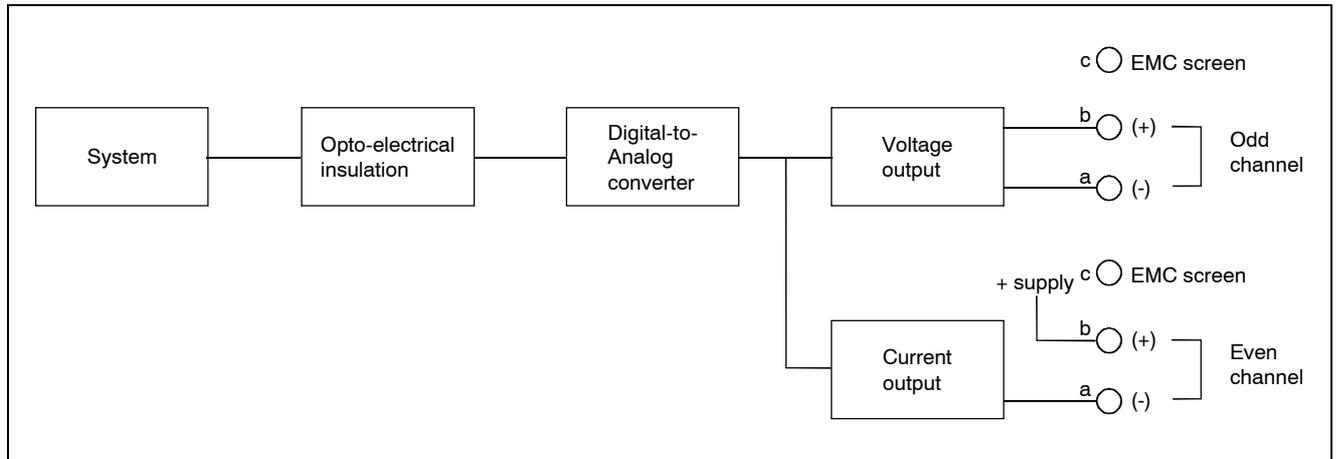
The board is composed of 5-12 bit Digital-to-Analog converters, each supplying two output quantities: one voltage – 10 V to + 10 V and one current 0-20 mA or 4-20 mA.

The voltage quantity and current quantity are associated to a same converter and using them simultaneously is not possible.

The operator must select and program the desired output: the odd channels are used for the voltage outputs and the even channels for the current outputs.

These outputs can be set, either by program, or by assignment instructions.

Channel block diagram



4.3.2 Programming by keywords

4.3.2.1 Programming the ranges

- Use the range programming instruction to declare the type of measurement to be performed over each channel of the board.

CH <number list> **RA** <range keyword>

Example: CH12 RA 0-20AO

- Use the task channel programming instruction to assign the channels to the task in charge of their scanning.

T <task number> **CH** <channel list>

Keywords	Description
10VAO	For ± 10 V voltage output (odd channels).
0-20AO	For 0-20 mA current output (even channels).
4-20AO	For 4-20 mA current output (even channels).

NOTES:

- It is not possible to program a voltage channel (odd channel) if the previous current channel is already programmed.
- Similarly, programming a current channel (even channel) is not possible if the following voltage channel is already programmed. If it is, unassign the channel, using the instruction **-RA** then program it again.

Example

CH1 -RA

CH2 RA (0-20AO)

4.3.2.2 Programming the other channel parameters

All the other programming instructions are applicable to the analog outputs; particularly **CONV** and **PR** instructions which set the analog output values.

4.3.3 Programming by means of the LOGIDAT software

4.3.3.1 Declaring the type of board

When creating a new program document, it is advisable to select the option "Re-read the boards set of a connected DATALOG", thus enabling LOGIDAT to identify itself the type of the boards inside the system. However, if the system is not connected to a PC the operator can manually define the type of each board:

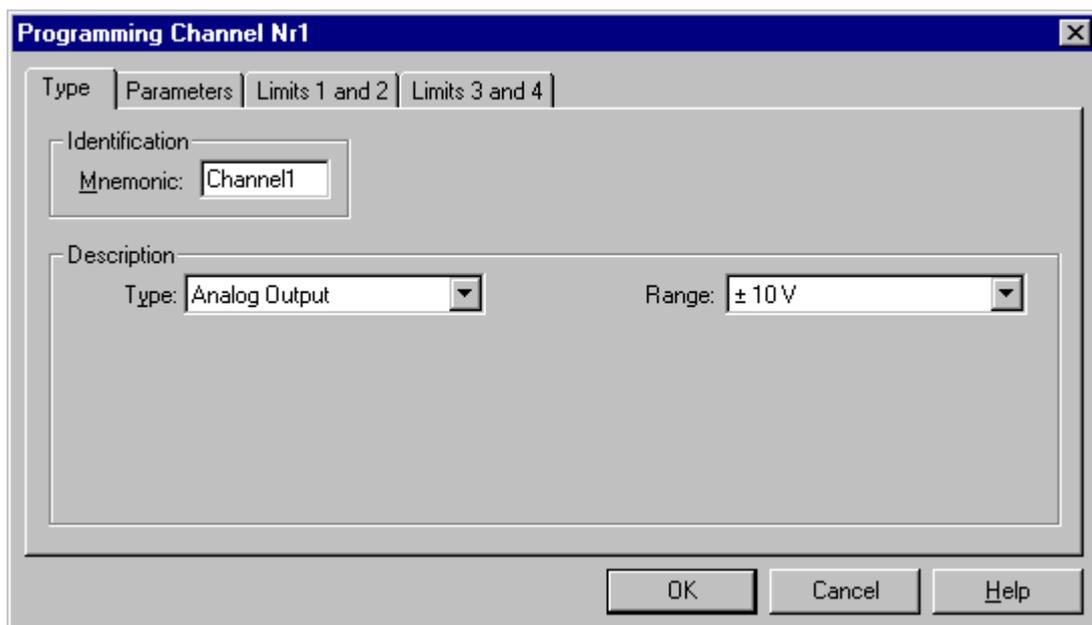
- Select the board number in the screen left window (tree).
- Click the mouse right button to open the context menu.
- Select **Properties...**
- A window opens. Select the desired board type, i.e.:

SA	5 analog outputs board
----	------------------------

4.3.3.2 Configuring the channel

- Select a channel from the board in the screen left window (tree).
- Click the mouse right button to open the context menu.
- Select **Configure...**
- A window opens: **Programming channel Nr x**
- Using the **Type** tab, select:
 - The channel mnemonic if desired.
 - The programming type: Analog Output.
- Press **OK**.

Channel programming example



To define the parameters of the other tabs, refer to the Instruction Manual, chapter 6.

4.3.4 Operation

Assigning a value to an analog output can be done, either by program (by using a conversion algorithm or an assignment instruction in a processing procedure), or directly by an immediate assignment command.

The value sent to a voltage output must be expressed in V and the value sent to a current output must be expressed in mA.

The value sent to an analog output depends on the resolution and on the Digital-to-Analog converter limits.

Ranges	10VAO	0-20AO	4-20AO
Upper limit	+ 10 V	20 mA	20 mA
Lower limit	- 10 V	0 mA	4 mA

Consequently, the value sent on a channel by the converter may be different from the conversion algorithm or processing procedure result, but remains stored as the channel value.

4.3.4.1 Setting by program

The value assigned to the channel can be defined by a conversion algorithm, which is evaluated when scanning the channel by a task. See chapter 3 from the Reference Manual.

Example

Recopy of channel 1 value on channel 11. The 10/6 coefficient in the conversion algorithm extends expression of the channel 1 measurement on all the analog output span.

```

CONV1 (CH(1) * 10/6)
CH11 RA(10VAO) CONV1
CH1 RA(6V)
T1 CH1,11

```

4.3.4.2 Setting by assignment instructions

- **Assignment by the PR instruction**

This command line in a **PR** instruction assigns a value to the outputs.

CH *channel list* = *expression* or **CH** *channel list* = *value*

The channel range must be programmed in order to set the output. The output is then set immediately after execution of the processing procedure. See chapter 4 from the Reference Manual.

Example 1

Creating a periodic signal of 100 seconds under ramp form of 0-10 V by successive 100 mV step incrementation.

```
CH1 RA(10VAO) PR1
PR1 IF X>10 THEN X=0 ELSE X=X+0.1
T1 CH1 E -CONT I 00:00:01
```

Example 2

Recopy of channel 1 value on channel 11. The 10/6 coefficient extends expression of the measurement on all the analog output span.

```
CH1 RA(6V) PR1
CH11 RA(10VAO)
PR1 (CH(11) = X * 10/6)
T1 CH1
```

- **Immediate assignment by means of the CH= command**

This command assigns a value to any channel. This instruction is executed from a peripheral, see chapter 2 from the Reference Manual.

In that case, only the following type assignment is possible: **CH** *channel list* = *value*
The channel takes the value immediately.

Example

```
CH1 = 5
```

NOTES:

1. The channel range must be programmed.
2. The value must be expressed in the range unit.

4.3.5 Additional information on the board operation

Initial setting of outputs

Initializing the system by **INIT YES**, resets all outputs to zero.

On a **RUN** command, the outputs whose ranges are programmed, take the values following:

0 V	for a ± 10 V voltage output,
0 mA	for a 0-20 mA current output,
4 mA	for a 4-20 mA current output.

On power fail, the output values are not maintained but on power restore they are reset to the state prior to the power fail.

4.4 Calibration

4.4.1 Material required

- A board extension, part number AN 3705.
- A standard digital voltmeter, accuracy 0.01 %.
The system voltmeter can be used with the uncertainty due to the 6 V range.
- A standard resistor from 50 Ω to 150 Ω , accuracy 0.01 %.

Calibrating the analog outputs is done in two steps:

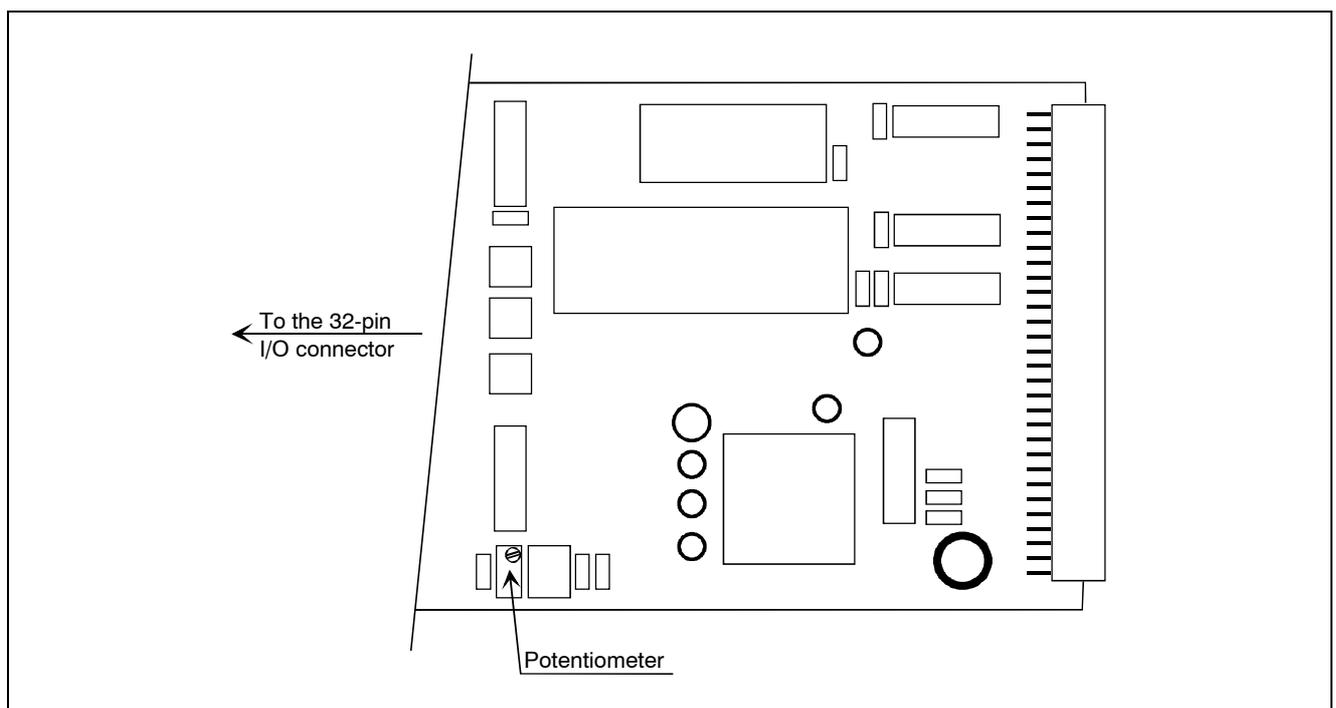
- Calibrating the low point.
- Calibrating the high point.

4.4.2 Calibrating the low point

A potentiometer, located on the board, adjusts simultaneously all outputs to low point.

Proceed as follows:

- Power the system down.
- Remove the analog outputs board and plug it in the board extension.
- Connect the digital voltmeter to terminals a and b of an odd channel.
- Power the system up.
- Program the 10VAO range on the channel where the voltmeter is connected.
- Set the output to - 10 V by assigning **CH** channel number = -10.
- Operate the potentiometer to read - 10 V on the voltmeter.



4.4.3 Calibrating the high point

4.4.3.1 Calibrating a voltage output (odd channel)

- Connect the output to be adjusted to an input analog channel on the system.
- Execute the following command: **ADJAO** *output number* **CH** *input channel*

Where:

output number = channel number to be adjusted.

input channel = channel number on which measurement is performed.

4.4.3.2 Calibrating a current output (even channel)

- Connect the standard resistor of known value (current terminals) to the channel to be adjusted between terminals a and b.
- Also connect the resistor (voltage terminals) to an input analog channel.
- Execute the following command: **ADJAO** *channel number ao* **CH** *input channel* **R** *value*.

Where:

channel number ao = channel number of the analog output to be adjusted.

input channel = channel number on which measurement is performed.

value = resistor value.

4.4.4 Examples

We have an analog outputs board, board 1, channels from 1 to 10 and an analog inputs board, board 2, channels from 11 to 20.

a) Calibrating the low point

CH1 RA(10VAO)

CH1 = -10

Potentiometer adjustment.

b) Calibrating channel 1 (voltage output)

Connect CH1 to CH11.

Execute ADJAO1 CH11.

c) Calibrating channel 2 (current output)

Connect the standard resistor (current terminal) to the CH2 output.

Connect the standard resistor (voltage terminal) to CH11 input.

Execute ADJAO2 CH11 R50.01 (50.01 is the value of the resistor used).

d) Repeat b and c to calibrate other channels.

5. DIGITAL INPUTS BOARD

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Notes

5.1 Specifications

This board counts pulses or measures frequencies of ten periodic signals. Each channel is coil-insulated from the other channels of the system.

Input level for any channel:

Logic level 1: $V_1 > + 2.9 \text{ V}$.

Logic level 0: $V_0 < + 1 \text{ V}$.

Max. applicable voltage: $\pm 50 \text{ VDC}$ or AC peak.

Input current for level 1: 1.6 mA typical; 2 mA max.

Input insulation: 100 VDC or AC rms max. between each channel.

5.1.1 Counter inputs

Count positive changes on the inputs.

Operator selectable bounce filtering time: 500 μs and 1 ms (typical) by a switch located on the board. The filter on channels 1 and 2 can be eliminated to permit high-speed counting.

A jumper on the board allows the use of channel input 10 as a trigger to validate or inhibit other counter inputs on the same board.

Channel number	1-2	1 to 10	
Filter is use	None	500 μs	1 ms
Maximum counter frequency	100 kHz	180 Hz	50 Hz
Minimal pulse duration	5 μs	2 ms	2 ms
Minimal duration between pulses	5 μs	2 ms	2 ms

5.1.2 Frequency inputs

Range	Resolution	Measurement range		
		Min. F Integration time		Max. F
		1 second	0.2 second	
100 Hz	0.001 Hz	1 Hz	5 Hz	99.999 Hz
1 000 Hz	0.01 Hz	1 Hz	5 Hz	999.99 Hz
10 kHz	0.1 Hz	0.01 kHz	0.05 kHz	9.9999 kHz
100 kHz	1 Hz	0.1 kHz	0.5 kHz	99.999 kHz

Accuracy: 0.02 % + 2 RU.

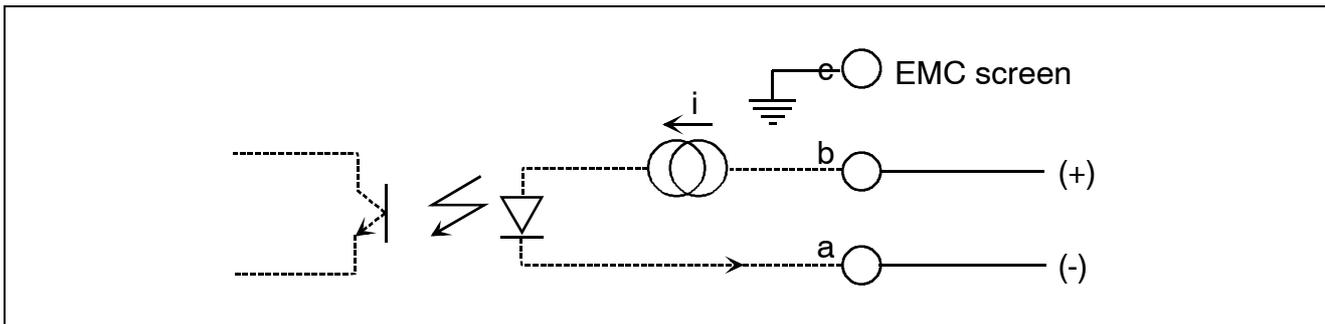
Temperature coefficient: 0.0004 %/°C.

NOTES

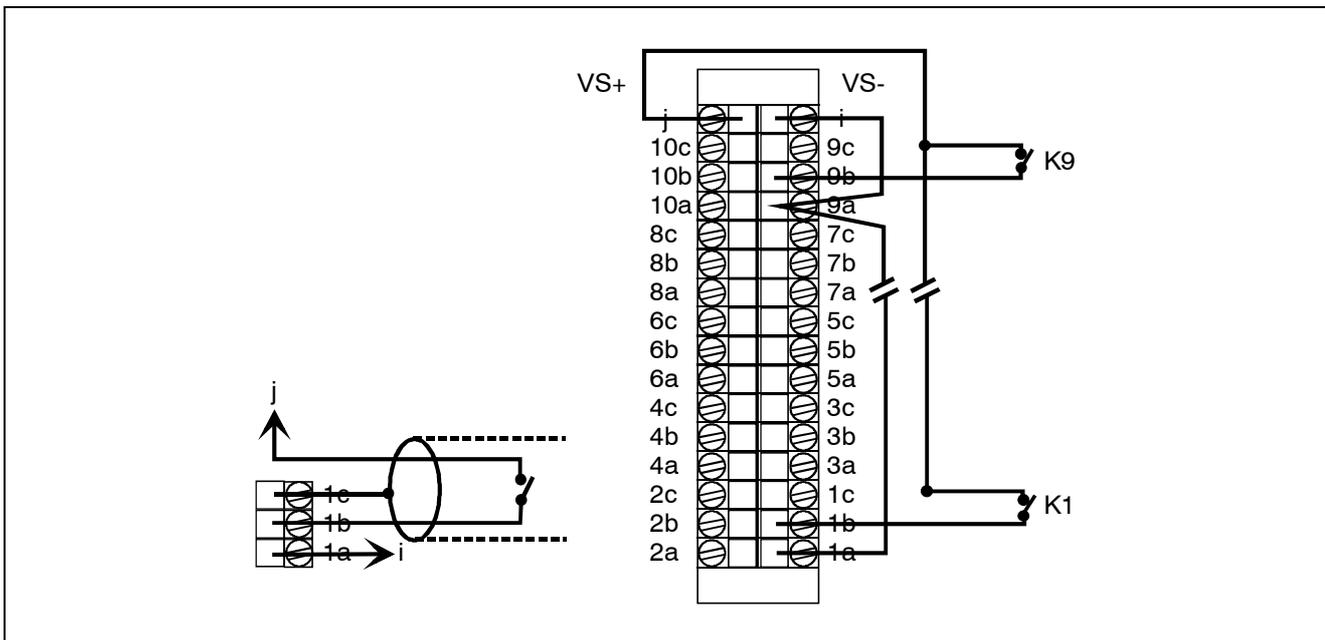
1. No filter is provided on frequency inputs.
2. A cyclic ratio of approx. 50 % (square signal) is advisable to obtain stable measurements; the pulse duration should be always at least 5 μs .

5.2 Connection

5.2.1 Channel block diagram



5.2.2 Using the VS contact power supply



The power supply accepts 10 contacts as a maximum.

VS is a DC floating power supply with the following specifications:
 5 V \pm 20 %; I_{max}: 20 mA.

1c, 2c, ... 9c: EMC screen internally connected to the ground.

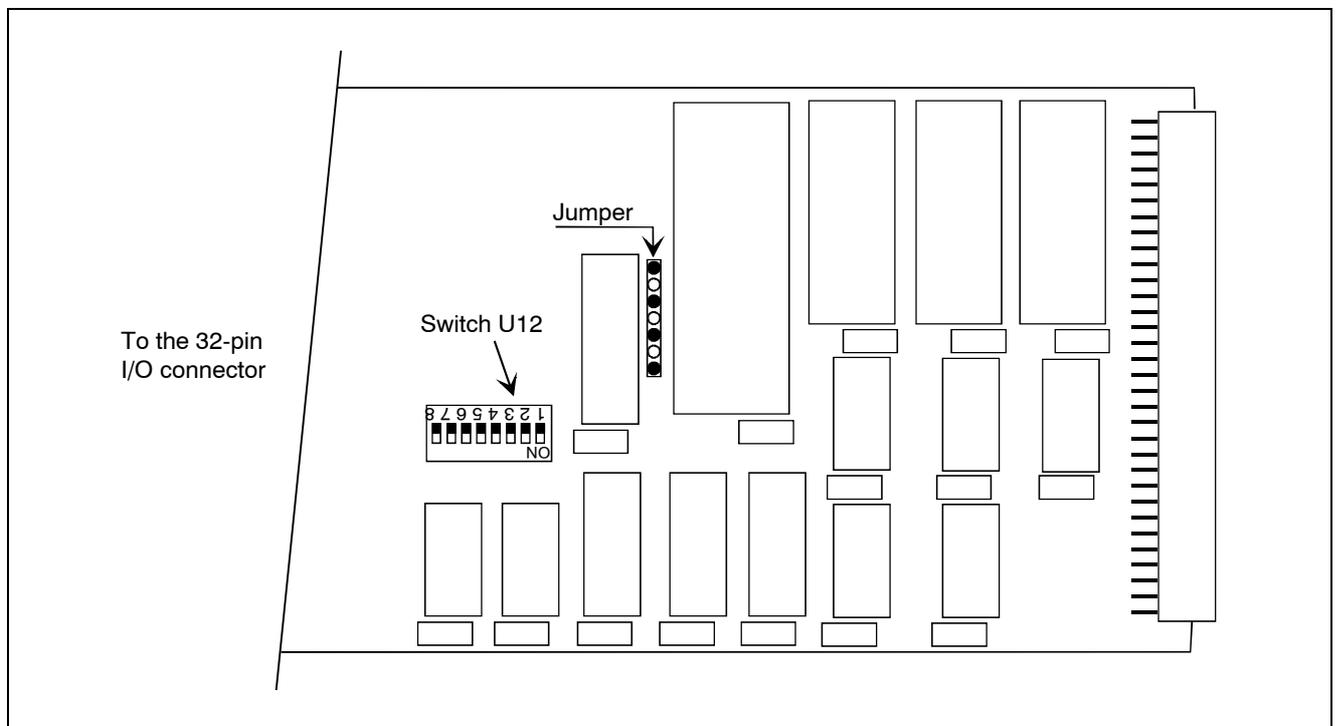
5.2.3 Selecting the filtering time (in pulse counter mode)

With the "pulse counter" mode, the board inputs can be digitally filtered to be free from any contact bounces.

There are two possible levels of rebound filtering time selectable by the switch U12 located on the board.

To access this board:

- Power down the system by pressing the  key for keypad-equipped models or by using the **OFF** key on slave models. The corresponding indicator is turned off.
- Disconnect the wires from the rear part of the digital inputs board and slide it back out. From the component side, the board looks as follows:



The filtering depends on the channel numbers and on the ON or OFF position from the microswitches 1 to 8 on switch U12 as shown in table below.

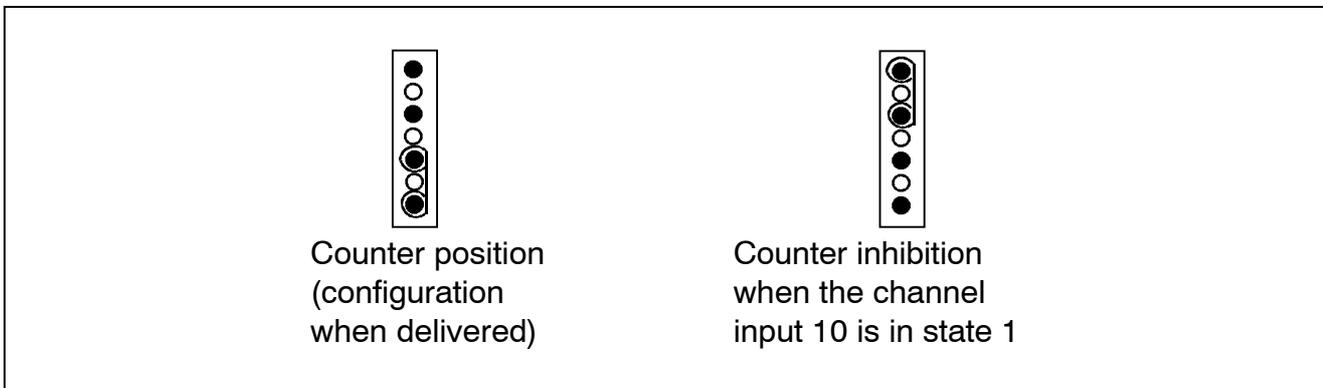
Channel numbers	Filtering time	U12 switch numbers			
		5	6	7	8
4, 5, 6, 7, 8, 9	500 μ s 1 ms	OFF ON	OFF ON	- -	- -
1() , 2() , 3, 10	500 μ s 1 ms	- -	- -	OFF ON	OFF ON

() For channels 1 and 2, specified as the quickest ones, the filtering ON/OFF position is described in table hereafter.

Channel numbers	Filtering	U12 switch numbers			
		1	2	3	4
Channel 1	YES	ON	OFF	-	-
	NO	OFF	ON	-	-
Channel 2	YES	-	-	ON	OFF
	NO	-	-	OFF	ON

5.2.4 "Trigger" input

Depending on the position of the jumper indicated in paragraph 5.2.3, channel input 10 of the corresponding board can be assigned to a counter function or to a "trigger" function (this implies counter inhibition of the other channels on the same board).



NOTE:

Channel 10 is not filtered when used as "trigger" input.

5.3 Exploitation

5.3.1 Operating principle – Operating modes

The digital inputs board can contain 10 logic input channels.

Each input is insulated from the other channels and the system by an opto-electronic isolator.

Each channel can be used as a pulse counter or frequency input.

Totalizing pulses and measuring frequencies are performed on the digital inputs board which is equipped with its own microcontroller. The values of the channels are transmitted to the system CPU for processing when these channels are scanned by a task.

5.3.2 Programming by keywords

- Use the range programming instruction to declare the type of measurement to be performed over each channel of the board.

CH <number list> **RA** <range keyword>

- Use the task channel programming instruction to assign the channels to the task in charge of their scanning.

T <task number> **CH** <channel list>

Example: CH11-20 C CTR

Keywords	Corresponding ranges	
CTR	Counting pulses.	
F100 0.2S	Frequency from 5 Hz to 100 Hz.	For the four frequency ranges, indication 0.2S or 1S is the input counting time. 0.2S is the default value.
F1000 0.2S	Frequency from 5 Hz to 1 000 Hz.	
F10K 0.2S	Frequency from 0.05 kHz to 10 kHz.	
F100K 0.2S	Frequency from 0.5 kHz to 100 kHz.	
F100 1S	Frequency from 1 Hz to 100 Hz.	
F1000 1S	Frequency from 1 Hz to 1 kHz.	
F10K 1S	Frequency from 0.01 kHz to 10 kHz.	
F100K 1S	Frequency from 0.1 kHz to 100 kHz.	

5.3.3 Programming by means of the LOGIDAT software

5.3.3.1 Declaring the type of board

When creating a new program document, it is advisable to select the option "Re-read the boards set of a connected DATALOG", thus enabling LOGIDAT to identify itself the type of the boards inside the system. However, if the system is not connected to a PC the operator can manually define the type of each board:

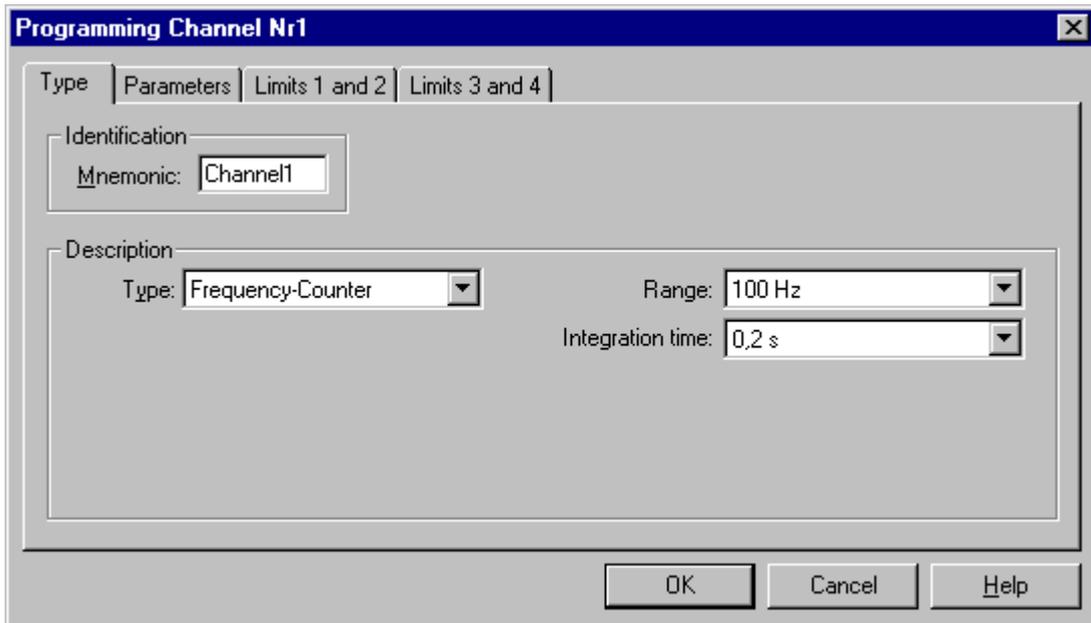
- Select the board number in the screen left window (tree).
- Click the mouse right button to open the context menu.
- Select **Properties...**
- A window opens. Select the desired board type, i.e.:

EN	10 count and frequency measurement inputs
----	---

5.3.3.2 Configuring the channel

- Select a channel from the board in the screen left window (tree).
- Click the mouse right button to open the context menu.
- Select **Configure...**
- A window opens: **Programming channel Nr x**
- Using the **Type** tab, select:
 - The channel mnemonic if desired.
 - The programming type: Frequency-Counter.
 - The range associated to the type of measurement previously selected.
 - The integration time.
- Press **OK**.

Channel programming example



To define the parameters of the other tabs, refer to the Instruction Manual, chapter 6.

5.3.3.3 Task assignment

The channels to be measured must be assigned to a task in order to define the scanning and result recording conditions. If required, refer to the system Instruction Manual.

5.3.4 Operation

5.3.4.1 Pulse counter

The channels concerned should be programmed with the Counter range and assigned to at least one task (it is not necessary to create specific tasks for scanning these channels, they can be assigned to tasks scanning analog inputs).

The positive transitions of the input signal are counted and totalized on the digital inputs board. The count value is transferred to the system when the channel is scanned by a task. The value indicates the total number of counts occurring since its last resetting to zero (up to 2^{32} pulses, i.e.: $4 \cdot 10^9$ pulses approx.).

The channel is reset to zero:

- At system power up.
- By a RUN command.
- By one of the following "processing" instructions:

CLCTR *expression*

The *expression* is evaluated as a channel number. For further information, refer to chapter 4 from the Reference Manual.

Function: Clears the counter from the digital inputs board and also keeps the total of counted pulses since the last channel acquisition by a task.

Example: If the last channel acquisition gives a result of 1 580 pulses and that 3 pulses have been counted since this acquisition, the **CLCTR** instruction will set the counter to 3.

CH (*extended channel list*) = 0

See also chapter 4 from the Reference Manual.

Function: When processing starts, clears the counter on the digital inputs board.

Example

To totalize the number of pulses during 1 hour:

```
CH11 RA(CTR) PR(CLCTR 11)
T1 E(-CONT I 1)
```

5.3.4.2 Frequency measurement

The channels concerned should be programmed with the Frequency range and assigned to at least one task (it is not necessary to create specific tasks for scanning these channels, they can be assigned to tasks scanning analog inputs).

The ranges vary from 100 Hz to 100 kHz with an integration time programmable as 0.2 s or 1 s.

After a RUN command, the digital inputs board scans and memorizes, channel by channel, all inputs programmed for frequency measurements.

If 5 channels are programmed for frequency measurements with an integration time of 0.2 s, these channels are refreshed every $5 \times 0.2 = 1$ s or every 5 s with an integration time of 1 s.

The values are stored on the board and are transferred when the channel is scanned by a system task.

5.3.5 Additional information on the board operation

5.3.5.1 Using the STOP, RUN and CONT commands over pulse counter channels

If the system scanning is stopped by the STOP command, the digital inputs board continues to totalize the transitions on the counter inputs

If the CONT command restarts scanning, counter inputs are not cleared. But, if the RUN command is used, the counters are reset to zero.

5.3.5.2 Resetting to zero at power up of the pulse counter channels

Note that the values of the channels programmed as counter are cleared after any system power fail. If this is not the desired behaviour, the operator can use memory channels and CLCTR instruction.

Example:

```
CH11 RA(CTR) PR1
CH211 RA(MEM) CONV1
PR1 CLCTR11
CONV1 X+CH11
T1 CH11,211 E (-CONT I 0:01:00)
```

The counter channel 11 is cleared after each scanning by the task 1.

The memory channel 211 performs the totalization. Its value is kept in case of power fail.



Notes

6. GAUGES POWER SUPPLY BOARD

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Notes

6.1 Specifications

Measurement by strain gauges or other resistive transducers.

Configuration: full bridge, half-bridge or quarter-bridge.

Transducer power: a specific power board common to all "gauge" channels occupies one standard slot in the system.

Available voltage: 2 V or 10 V switched to each bridge measured.

Measurement current: 1 mA or 8 mA switched to each half-bridge or quarter-bridge measured.

Voltage and current are selected by switches on the gauge power board.

Three compensation gauges can be connected to three quarter-bridge configurations.

Measured signals: applied to the standard inputs of the analog inputs board as follows:

- One channel per quarter-bridge.
- Two consecutive channels per half-bridge or full bridge.

Free channels can still be used for other purposes.

Usable sensors: minimum 120 Ω gauges or transducers; maximum permissible voltage drop in one gauge: 3.2 V.

Permissible unbalanced voltages compatible with the 60 mV and 600 mV ranges of the system voltmeter.

Measurement rate: 7 meas/s, 20 meas/s or 50 meas/s.

For 350 Ω gauges and a Gauge Factor NGF = 2.

6.1.1 Measurement range and resolution

Configuration	Range	Bridge supply	Max. sensor sensitivity (mV/V)	Measurement range (m ϵ)	Resolution $\mu\epsilon$		
					7 meas/s	20 meas/s	50 meas/s
Full bridge	60 mV	10 V	6	$\pm 12\ 000$	0.2	0.2	2
	60 mV	2 V	30	$\pm 60\ 000$	1	1	10
	600 mV	10 V	60	$\pm 120\ 000$	0.2	2	20
	600 mV	2 V	300	$\pm 600\ 000$	1	10	100
Half- and Quarter-bridge	60 mV	8 mA	-	$\pm 12\ 000$	0.2	0,2	2
	60 mV	1 mA	-	$\pm 80\ 000$	1	2	20
	600 mV	8 mA	-	$\pm 120\ 000$	0.2	2	20
	600 mV	1 mA	-	$\pm 800\ 000$	2	20	200

6.1.2 Accuracy

The accuracy quoted applies to a system operating in the reference conditions specified elsewhere and is expressed in $\pm (n \% \text{ rdg} + C)$ where rdg = reading and C = Constant expressed in $\mu\epsilon$.

Rate: 7 meas/s

Configuration	Range	Supply or V supply	Accuracy	
			90 days	1 year
Full bridge	60 mV	10 V	0.05 % + 2	0.08 % + 3
	60 mV	2 V	0.05 % + 10	0.08 % + 12
	600 mV	10 V	0.04 % + 3	0.06 % + 5
	600 mV	2 V	0.04 % + 15	0.06 % + 25
Half-bridge	60 mV	8 mA	0.05 % + 12	0.08 % + 18
	60 mV	1 mA	0.05 % + 20	0.08 % + 27
	600 mV	8 mA	0.04 % + 13	0.06 % + 20
	600 mV	1 mA	0.04 % + 25	0.06 % + 40
Quarter-bridge	60 mV	8 mA	0.05 % + 13	0.08 % + 20
	60 mV	1 mA	0.05 % + 27	0.08 % + 37
	600 mV	8 mA	0.04 % + 14	0.06 % + 22
	600 mV	1 mA	0.04 % + 32	0.06 % + 50

Rate: 20 meas/s

Configuration	Range	Supply or V supply	Accuracy	
			90 days	1 year
Full bridge	60 mV	10 V	0.05 % + 3	0.08 % + 4
	60 mV	2 V	0.05 % + 15	0.08 % + 20
	600 mV	10 V	0.05 % + 24	0.07 % + 30
	600 mV	2 V	0.05 % + 120	0.07 % + 150
Half-bridge	60 mV	8 mA	0.05 % + 13	0.08 % + 20
	60 mV	1 mA	0.05 % + 25	0.08 % + 35
	600 mV	8 mA	0.05 % + 34	0.07 % + 45
	600 mV	1 mA	0.05 % + 130	0.07 % + 165
Quarter-bridge	60 mV	8 mA	0.05 % + 14	0.08 % + 22
	60 mV	1 mA	0.05 % + 32	0.08 % + 45
	600 mV	8 mA	0.05 % + 35	0.07 % + 47
	600 mV	1 mA	0.05 % + 137	0.07 % + 175

Temperature coefficient

Configuration	Range	Supply or V supply	Temperature coefficient	
			0 to 35°C	35°C to 50°C
Full bridge	60 mV	10 V	0.005 % + 0.1 $\mu\epsilon$	0.005 % + 0.2 $\mu\epsilon$
	60 mV	2 V	0.005 % + 0.5 $\mu\epsilon$	0.005 % + 1 $\mu\epsilon$
	600 mV	10 V	0.005 % + 0.1 $\mu\epsilon$	0.005 % + 0.2 $\mu\epsilon$
	600 mV	2 V	0.005 % + 0.5 $\mu\epsilon$	0.005 % + 1 $\mu\epsilon$
Half- and Quarter-bridge	60 mV	8 mA	0.005 % + 2 $\mu\epsilon$	0.005 % + 2.5 $\mu\epsilon$
	60 mV	1 mA	0.005 % + 2.5 $\mu\epsilon$	0.005 % + 3 $\mu\epsilon$
	600 mV	8 mA	0.005 % + 2 $\mu\epsilon$	0.005 % + 2.5 $\mu\epsilon$
	600 mV	1 mA	0.005 % + 3 $\mu\epsilon$	0.005 % + 4 $\mu\epsilon$

Other specifications: those of the 60 mV and 600 mV ranges of the system.

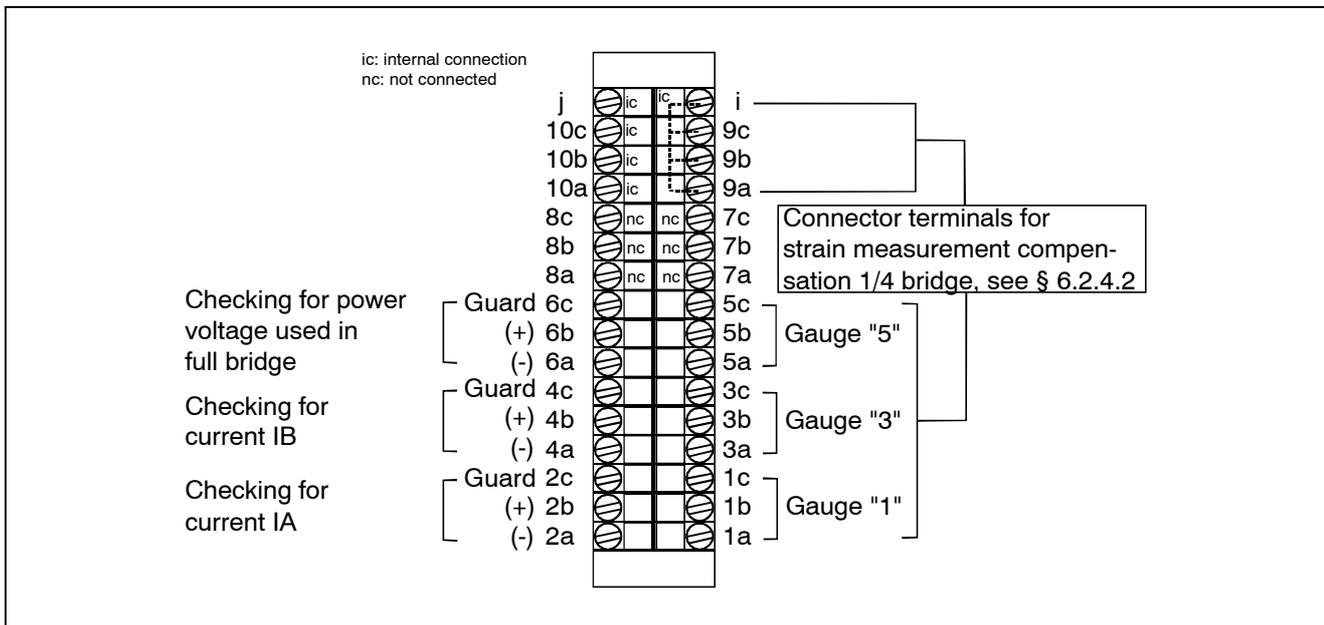
Repeatability between channels: < 3 RU + 5 μV .

6.2 Connection

The signals from transducers are measured by the standard input channels on the analog inputs board; the voltage and current generators are located on the corresponding power supply board.

6.2.1 Screw terminal connection block for strain gauges

Using the same physical layout as the I/O board screw terminal block, the strain gauge power board terminal block has the following terminal assignment.

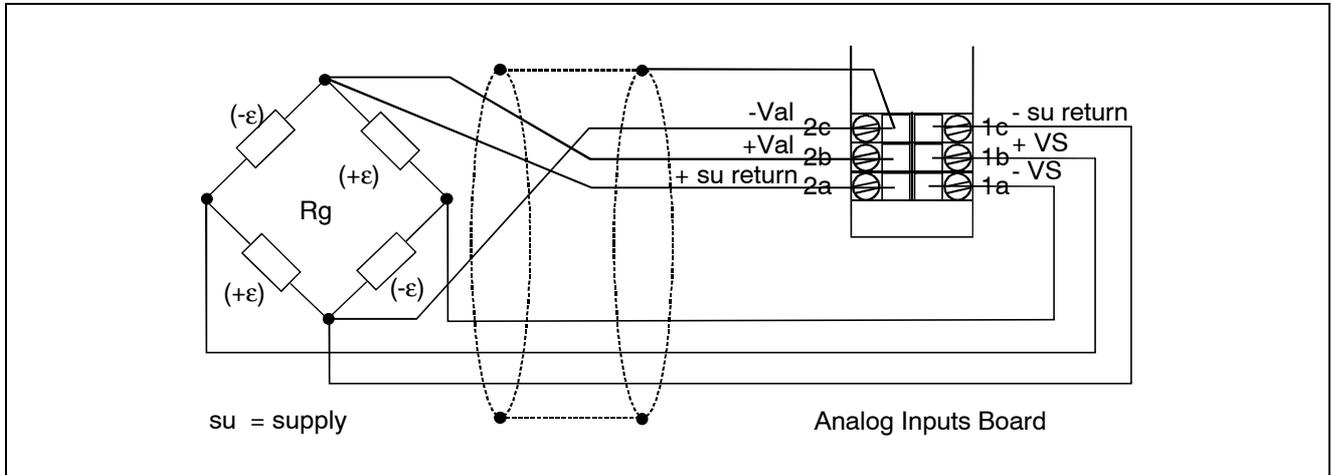


NOTES:

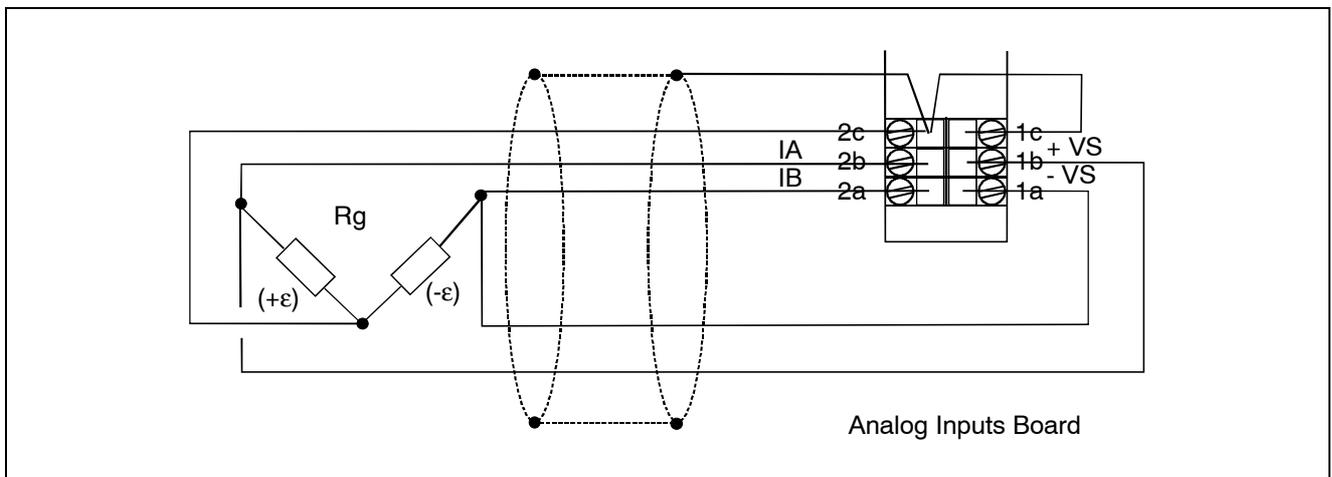
1. Pins 2a, 2b, 2c, 4a, 4b, 4c, 6a, 6b and 6c are test points for checking current values IA and IB and supply voltage of the board.
2. When the system is not measuring strain, the supply voltage used for full bridge measurements can be measured between pins 6b (+) and 6a (-): 2 V or $10\text{ V} \pm 0.5\%$.
3. Similarly, the current value IA can be checked by measuring the voltage between 2b (+) and 2a (-) and the current IB between 4b (+) et 4a (-): As the internal shunt resistance values are $50\ \Omega$, the measured voltages should be $50\text{ mV} \pm 1\%$ for $I = 1\text{ mA}$ and $400\text{ mV} \pm 1\%$ for $I = 8\text{ mA}$.

6.2.2 Wiring full bridge configurations

A full bridge must be connected to an odd channel of the system and the immediate even channel number following.

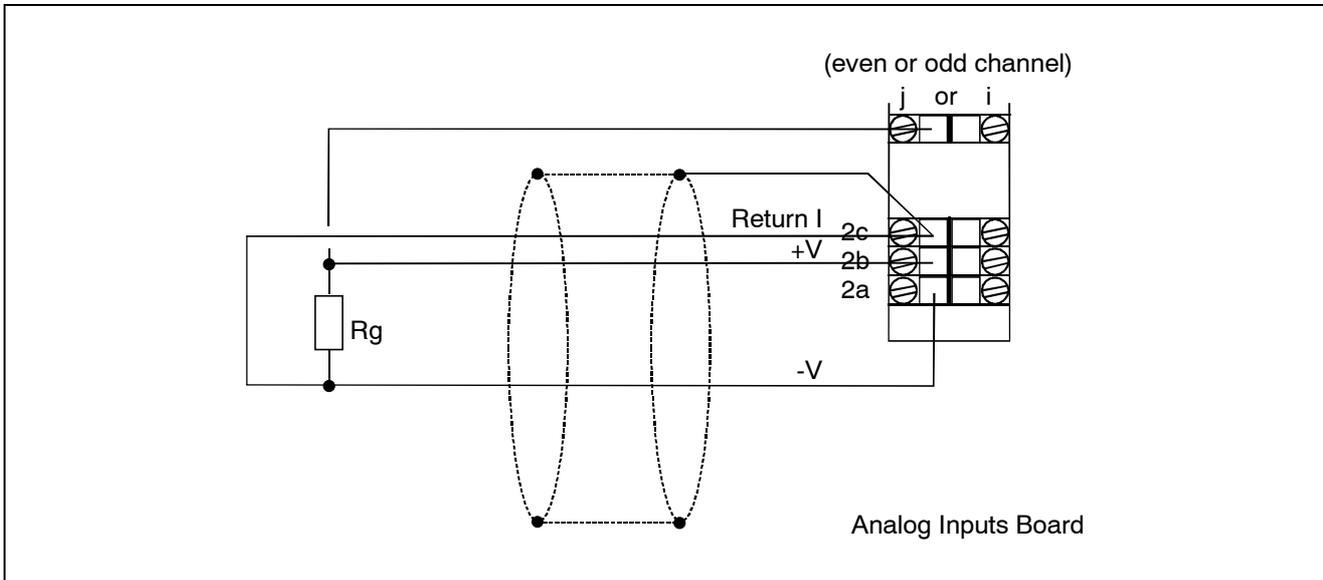


6.2.3 Wiring half-bridge configurations



6.2.4 Wiring quarter-bridge configurations

6.2.4.1 Wiring active gauges



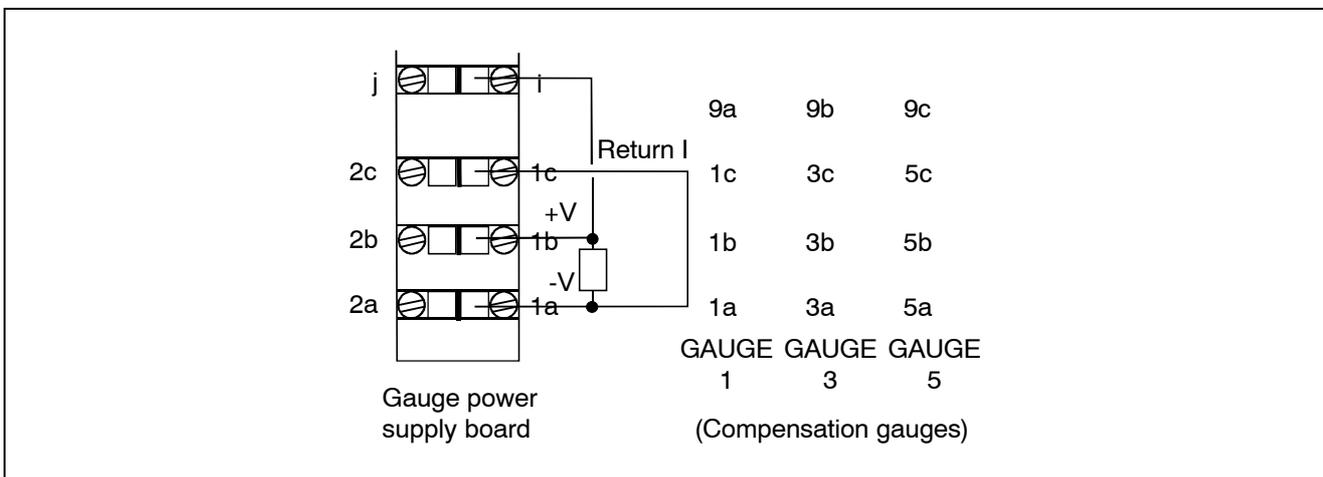
6.2.4.2 Wiring compensation gauges

The system measures the gauges declared in quarter-bridge by realizing a connection equivalent to a half-bridge with a gauge called "compensation" to be connected to the gauge power board.

This compensation gauge can either be a fixed and stable resistor of value close to that of the active gauges measured, or an unstrain gauge. This last solution gives temperature compensation.

Three compensation gauges can then be wired to the terminal block of the gauge power supply board.

The correct compensation gauge to be used for each measured channel in quarter-bridge can be specified by program.



6.3 Exploitation

6.3.1 Introduction

The DATALOG systems enable measurements by strain gauges or other resistive transducers in full bridge, half-bridge and quarter-bridge.

The system software allows a direct reading in microstrains (measurements by strain gauges), or in the unit of the physical quantity converted by the transducer (measurements by resistive transducers).

These channels are wired on the standard inputs of the analog inputs board, thus enabling a same board to measure temperatures by thermocouples on some channels and strains on other channels.

However, measurements in full, half- and quarter-bridge need usage of high stable voltage or current generators.

The power board for strain gauges supplies these generators.

Using one board of this type is necessary for measurements in full bridges powered by the system, as well as for measurements in half-bridge and quarter-bridge. In the second case, this board enables connection of three compensation gauges.

The system also enables measurements in full bridges externally powered. For this type of measurement, the power board is useless.

Only one power board for strain gauges is necessary whatever the number of inputs to be measured. It lies in the I/O slot. So a DATALOG 140 equipped with this board can only receive 13 I/O boards, a DATALOG 90, 8 I/O boards and a DATALOG 20, a single one.

Measurements in full bridge or half-bridge need two consecutive channels while one channel is used for measurements in quarter-bridge. So, each analog inputs board allows wiring of 5 inputs maximum in full bridge or half-bridge or 10 inputs in quarter-bridge.

6.3.2 Measurement principle

6.3.2.1 Strain expression

The term strain designates the distortion per unit of length of a structure under force effect and generally bears letter ε .

$$\varepsilon = dL/L$$

The strain gauges convert the length variation into resistance variation and are specified by their Gauge Factor GF.

$$dR/R = GF\varepsilon$$

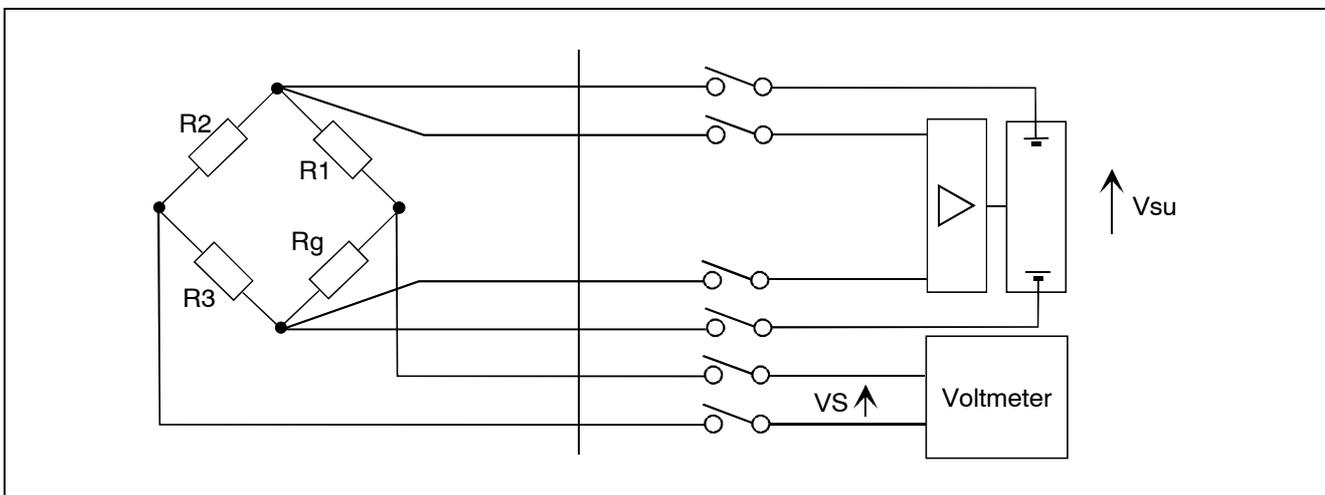
The gauge factor for conventional gauges is ranging about 2.

These variations being very low (typically less than 1 %), they are generally expressed in microstrains $\mu\varepsilon$.

6.3.2.2 Measurements in full bridge

The bridge can include 1, 2 or 4 active gauges (R_g).

- **Single active gauge (R_g)**



The quotient of the bridge unbalance VS voltage regarding the supply voltage V_{su} is expressed as follows:

$$VS / V_{su} = (R_g / (R_1 + R_g)) - (R_3 / (R_2 + R_3)) \quad \text{①}$$

Calling Q this Quotient variation between unstrain and strain state:

$$Q = (VS / V_{su})_{\text{strain}} - (VS / V_{su})_{\text{unstrain}}, \quad \textcircled{2}$$

the resistance variation is expressed as follows:

$$dR_g / R_g = 4Q / (1 - 2Q)$$

and the strain:

$$\varepsilon = 4Q / (GF (1 - 2Q)) \quad \textcircled{3}$$

- **n active gauges**

Usually, the strain is given by the following formula:

$$\varepsilon = 4Q / nGF \quad \textcircled{4}$$

where:

n = Number of active gauges.

GF = Gauge Factor of one gauge.

Q as stated in $\textcircled{2}$ formula.

For a single gauge, this formula introduces an error for important strain values.

The table below gives the error percentage by using the $\textcircled{4}$ formula for a single gauge and different strain values (GF = 2):

Strain	100 $\mu\varepsilon$	1 000 $\mu\varepsilon$	10 000 $\mu\varepsilon$
Error	0.01 %	0.1 %	1 %

- **Application of theory by the system**

In order to measure supply voltage at each bridge level and to limit consumption, the bridge supply located in the board is internally switched to the channel V_{su} terminals.

Connecting full bridges is then performed on the analog inputs boards by using 6 wires (see paragraph 6.2):

- 2 wires for V_{su} supply.
- 2 wires for V_{su} measurement.
- 2 wires for VS measurement.

The V_{su} bridge supply voltage can be set to 2 V or 10 V for the whole set of channels by means of the switches located on the gauge power board.

Depending on the operator's program and sensor sensitivity, measuring the VS bridge unbalance can be performed over the 60 mV or 600 mV ranges.

Each $(VS)_u$ unstrain bridge unbalance is first measured when the operator triggers an adjustment procedure.

Then, the system measures, on each channel, the strain unbalance $(VS)_s$ and displays the result either in microstrains if the Gauge Factor has been programmed or in unit of physical quantity if it is the bridge Conversion Factor specified.

Display in microstrains (Gauge Factor specified)

The value ε expressed in microstrains is computed as follows:

$$(4 / NGF) ((VS)_s / V_{su} - (VS)_u / V_{su}) 10^6$$

where:

NGF = product of gauge factor by number of active gauges on the bridge. E.g.: for a bridge including 4 active gauges having GF = 2 each, the operator will specify NGF = 8.

$(VS)_s$ = strain bridge unbalance.

$(VS)_u$ = unstrain bridge unbalance.

V_{su} = bridge supply voltage.

Display in physical quantity (Conversion Factor specified)

The operator can specify the bridge Conversion Factor instead of the Gauge Factor.

That conversion factor which depends on the sensor Measurement range M and Sensitivity S expressed in millivolts per volt of the bridge supply voltage writes:

$$CF = M / S.$$

E.g.: For a pressure transducer with a sensitivity of 2 mV/V per 10 bars, its conversion factor is: $FC = (10 / 2) = 5$.

In that case, the systems computes as follows:

$$CF ((VS)s / Vsu - (VS)u / Vsu) 10^3$$

where:

CF = bridge Conversion Factor as explained above.

(VS)s = strain bridge unbalance.

(VS)u = unstrain bridge unbalance.

Vsu = bridge supply voltage.

NOTES

1. Bridge supply voltage Vsu

The bridge supply voltage Vsu is not measurement by the system at each acquisition. It can be optionally measured during adjustment procedure (see paragraph 6.3.4.9).

2. Bridge with a single active gauge

The error introduced by the simplified formula (see paragraph 6.3.2.2) can be corrected by applying, on the concerned channels, the conversion algorithm as follows:

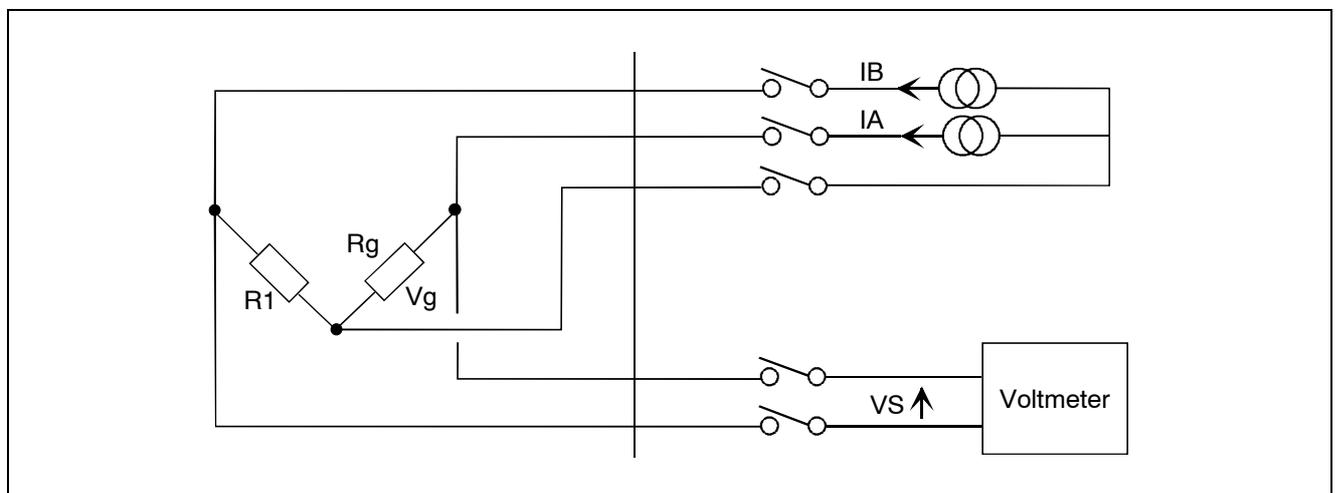
$$x / (1 - x GF \cdot 0.5 \cdot 10^{-6})$$

x is the value computed by the system from the simplified formula.

6.3.2.3 Half-bridge measurements

- **Connection and equations**

The 2 half-bridge branches are powered by 2 equal currents. The voltage unbalance in both branches is measured by the voltmeter.



The initial voltage V_g at terminals of the active gauge R_g is first measured by the voltmeter by applying current I_A only.

Let:

$$Q = (V_S \text{ strain} - V_S \text{ unstrain}) / V_g,$$

The strain is as follows:

$$\varepsilon = Q / GF \text{ (for a single active gauge)}$$

or

$$\varepsilon = Q / (2 GF) \text{ (for 2 active gauges).}$$

- **Application of theory by the system**

Connecting half-bridges is performed by using 5 wires (see paragraph 6.2):

- 2 wires for I_A and I_B currents,
- 1 wire for current return,
- 2 wires for measuring V_S by the system.

The half-bridge I_A and I_B excitation currents can be set to 1 mA or 8 mA for the whole set of channels by means of the switches located on the gauge power board.

We generally use current 8 mA for 120 Ω or 350 Ω gauges, and current 1 mA for gauges above 350 Ω .

The I_A and I_B currents of the power board are applied to the 2 half-bridge branches to be measured. Using constant current generators eliminates any resistance variation in the junction wires.

The voltage unbalance between the 2 half-bridge branches is measured by the system voltmeter.

Depending on the operator's program, measuring the V_S unbalance can be performed over the 60 mV or 600 mV ranges.

When the operator triggers the adjustment procedure, the system measures, first, the voltage drop in one V_g gauge by emitting only the I_A excitation current, then the unbalance voltage $(V_S)_u$ by sending both I_A and I_B currents.

Then, the system measures the strain unbalance $(V_S)_s$ by sending both I_A and I_B currents and directly displays the result in microstrains or in unit of the physical quantity which depends on the gauge factor or the conversion factor programmed.

Display in microstrains (Gauge Factor specified)

In that case, the value ε expressed in microstrains is computed as follows:

$$(1 / \text{NGF}) ((\text{VS})_s - (\text{VS})_u / V_g) 10^6$$

where:

NGF = product of gauge factor by the number of active gauges.

(VS)_s = strain half-bridge unbalance.

(VS)_u = unstrain half-bridge unbalance.

V_g = initial drop in the active gauge.

Display in physical quantity (Conversion Factor specified)

The operator can specify the bridge Conversion Factor instead of the Gauge Factor.

The conversion factor which depends on the sensor Measurement range M and Sensitivity S expressed in millivolts per volt of the bridge supply voltage writes:

$$\text{CF} = M / S.$$

E.g.: For a pressure transducer with a sensitivity of 2 mV/V per 10 bars, its conversion factor is: $\text{CF} = (10 / 2) = 5$.

In that case, the system computes as follows:

$$(\text{CF} / 4) ((\text{VS})_s - (\text{VS})_u / V_g) 10^3$$

where:

CF = bridge Conversion Factor as explained above.

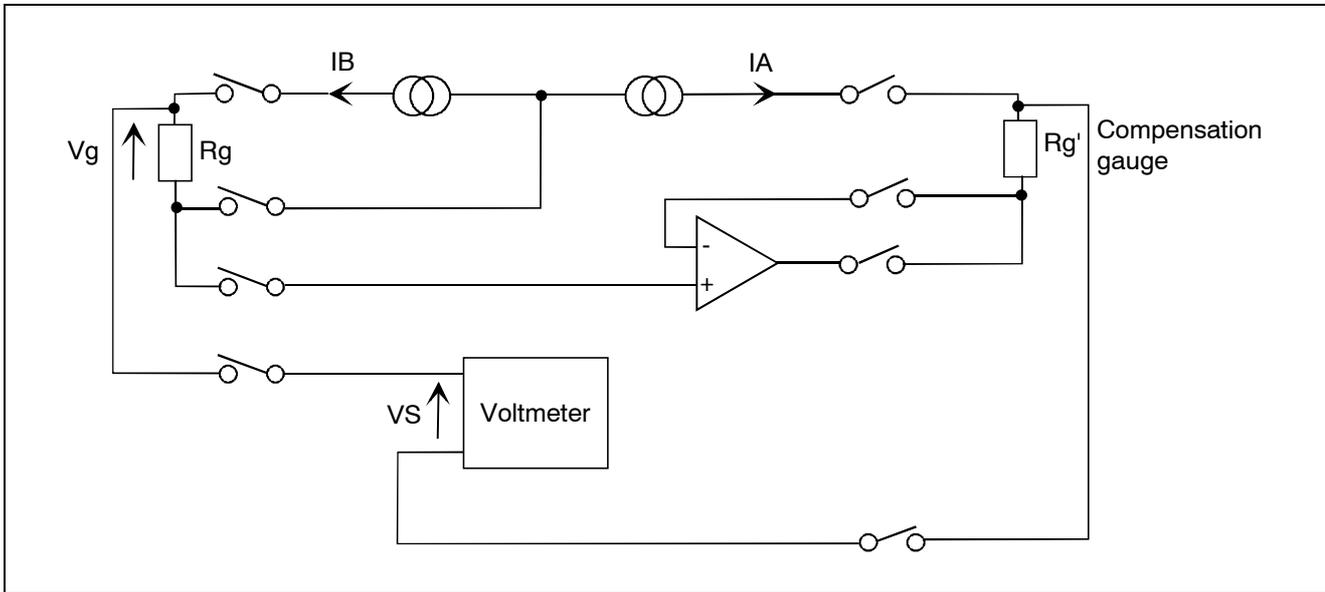
(VS)_s = strain half-bridge unbalance.

(VS)_u = unstrain half-bridge unbalance.

V_g = initial voltage drop in the active gauge.

6.3.2.4 Quarter-bridge measurements

With that connection type, the voltage drop induced by the IB current in the active gauge is compensated by the voltage drop induced by the IA current in a compensation gauge connected to the gauge power board terminal block.



The gauge power board allows connection of 3 different compensation gauges and the operator must specify, at level of each quarter-bridge channel, the compensation gauge to be used.

The measurement principle is same as the 2-wire measurement and the equations used by the system are identical but it does not authorize specification of a Conversion Factor.

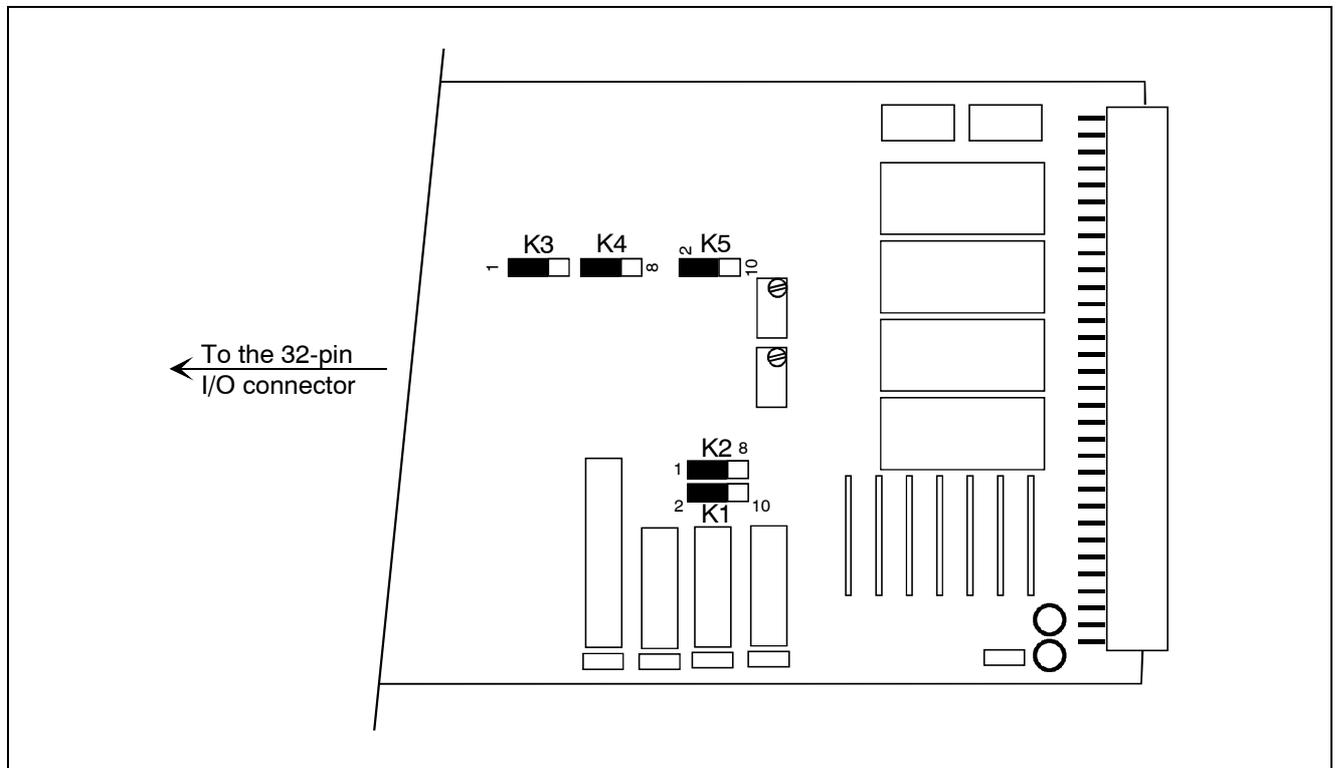
6.3.3 Preparing for operation

Connect as described in paragraph 6.2.

6.3.3.1 Configuring the gauge power board

If the gauge power board is already set in the system, ask for its configuration with instruction **GBST** (see hereafter). If the configuration does not suit, switch the system off and disconnect the gauge power board in order to reconfigure it.

The configuration is made by means of the K1 to K5 switches located on the diagram below:



- **Selecting the supply voltage of full bridges**

Select the desired voltage (2 V or 10 V) by setting the switches K1 and K5 as follows:

- 2 V: K1 and K5 set on side "2".
- 10 V: K1 and K5 set on side "10".

- **Selecting the measurement current value of half- and quarter-bridges**

Select the desired current (1 mA or 8 mA) by setting the switches K2, K3 and K4 as follows:

- 1 mA: K2, K3, K4 set on side "1".
- 8 mA: K2, K3, K4 set on side "8".

We generally use current 8 mA for 120 Ω or 350 Ω gauges, and current 1 mA for gauges above 350 Ω .

NOTE:

The voltage drop at gauge terminals should not exceed 3.2 V.

It is then impossible to select current 8 mA for gauges whose resistance exceeds 400 Ω .

- **Setting the gauge power board and checking configuration**

Switch the system off, plug the gauge power board in any I/O board slot, for example near to the voltmeter board.

Switch the system on and check configuration.

For that, enter command: **GBST** from the front keypad.

The system displays: **I: x mA V: y V**, where x = 1 or 8 and y = 2 or 10.

Both x and y values must correspond to the configuration performed.

6.3.3.2 Connecting inputs

The bridges are connected to the analog inputs boards and to the gauge power board according to the desired configuration:

- Full bridge: see paragraph 6.2.2.
- Half-bridge: see paragraph 6.2.3.
- Quarter-bridge: see paragraph 6.2.4.

6.3.4 Programming by keywords

6.3.4.1 How to declare range

Use the instruction **RA** to specify the channel range:

CH channel list **RA** range rate

The range mnemonic gives information on the connection, voltmeter range used for the measurement and, for quarter-bridge configuration, the compensation gauge location.

Full and half-bridge configurations using an odd channel and the even channel following should be declared on the odd channel. That is why, the even channel following must not be used as measurement input but only as memory channel with **MEM** range programmed.

3 programmable acquisition rates: **7/S**, **20/S** or **50/S**.

By default, the system selects 20/S.

Keywords	Corresponding ranges
BG	full Bridge Gauge, measurement over 60 mV range.
EBG	Extended full Bridge Gauge, measurement over 600 mV range.
HBG	Half-Bridge Gauge, measurement over 60 mV range.
EHBG	Extended Half-Bridge Gauge, measurement over 600 mV range.
QBG1	Quarter-Bridge Gauge, measurement over 60 mV range. Using the compensation gauge No 1.
EQBG1	Extended Quarter-Bridge Gauge, measurement over 600 mV range. Using the compensation gauge No 1.
QBG3	Quarter-Bridge Gauge, measurement over 60 mV range. Using the compensation gauge No 3.
EQBG3	Extended Quarter-Bridge Gauge, measurement over 600 mV range. Using the compensation gauge No 3.
QBG5	Quarter-Bridge Gauge, measurement over 60 mV range. Using the compensation gauge No 5.
EQBG5	Extended Quarter-Bridge Gauge, measurement over 600 mV range. Using the compensation gauge No 5.

Examples

CH1 RA (EBG 7/S)
CH3-10 RA (QBG1) (20 meas/s by default).

NOTES:

1. Selecting 60 mV or 600 mV ranges: for a given sensor whose sensitivity or gauge factor is known, the available signal is determined by the usable measurement range and the voltage or current value applied to the sensor. Select the upper range value to that determined.
2. Reminder: In case the even channel following (full or half-bridge configuration) is programmed with a range other than **MEM**, do clear it with **-RA** instruction before programming the odd channel.

Examples

CH2 -RA

CH1 C (EBG 7/S)

6.3.4.2 How to declare the Gauge Factor (NGF) or the Conversion Factor (CF)

The gauge factor is declared with the **NGF** keyword followed by the gauge factor numerical value:

CH *channel list* **NGF** *value*

Examples

CH1 NGF 8

CH3-10 NGF 2

The specified **NGF** value must be the Gauge Factor GF multiplied by the Number of active gauges N.

E.g.: Write NGF8 for a bridge with 4 active gauges, each having 2 as gauge factor.

Programming the gauge factor displays the results in microstrains. The display resolution depends on the voltmeter range (60 mV or 600 mV) and rate. The default unit is **uc** because $\mu\epsilon$ characters are not available.

A conversion factor can be specified for the full or half-bridge configurations (see paragraph 6.3.2.3).

The conversion factor is declared with the **CF** keyword followed by the value in units / (mV / V supply).

CH channel list **CF** value

Example: CH1 CF 5

Programming a conversion factor displays the results with the best possible resolution. There is no default unit on the corresponding channels.

The display resolution can be changed by means of the **ACCU** instruction. A unit can also be programmed using **U** instruction (see chapter 2 from the reference manual).

6.3.4.3 How to declare the optional Gauge Resistance for the half- or quarter-bridge configuration – GR instruction

For these configurations, the system needs the estimated value of the gauge resistance to compute the result. That resistance is automatically measured by the system when starting the adjustment procedure.

So, if that procedure is not performed and the gauge resistance unspecified, the system displays the error message **Err 101** over these channels.

To display the results before adjustment (for example, to check connections or during system thermal settling) use the instruction **GR** to specify a temporary gauge resistance.

Syntax

CH channel list **GR** value

Example: CH3-10 GR 350

Note that the specified value will be replaced by the measured value when starting the adjustment.

6.3.4.4 How to declare the channel type instructions

All the channel type instructions can be specified over the bridge channels, such as conversion algorithm, values of alarm limits, processing procedure, and so on...

6.3.4.5 Programming tasks

To be processed, these channels should be specified in one or more tasks.

For that, select **Cycle** from the system programming menu or use the keyword programming instructions.

The hyphen, specifying a channel group, should be used with great care because full or half-bridge channels take 2 consecutive physical inputs but only one logical input.

So, if the channels 1, 3, 5, 7 and 9 are bridge-configured and the task specifies channels 1-9, the error message **Err 41** (Range not programmed) will occur on channels 2, 4, 6 and 8.

6.3.4.6 Scanning

After a RUN command, the channels are scanned as specified in the tasks.

As long as the adjustment procedure is not performed, the system computes and supposes the bridges well balanced ($(VS)_u = 0$).

6.3.4.7 Adjustment procedure

The adjustment procedure consists in making the unstrain unbalance measurement $(VS)_u$ and optionally the gauge resistance (full and half-bridge configurations) on the specified channel list by the system.

Before running this procedure, switch the system on for 30 minutes.

- Set the system to STOP position to stop scanning.
- To adjust a channel or a channel group, enter command: **GZ** *channel list*

Example: GZ 1,3-10

The system measures the unbalances and stores them.

Command GZ can be entered as much as necessary to adjust the whole set of channels.

6.3.4.8 Configuring full bridge powered by an external supply

Full bridge measurements can be performed with no need of the gauge power board.

In that case, the operator must power the bridges by means of a stable external supply between 1 V and 10 V.

6.3.4.8.1 Connection

The bridges are parallel-powered by the external supply.

The bridge diagonals are connected to the voltmeter measurement inputs just as normal "voltage" inputs.

Each input occupies only one measurement channel.

The bridge supply voltage can optionally be connected to one measurement input of the system.

6.3.4.8.2 Programming

- **Programming channel range**

2 ranges are available on the analog inputs board for this type of measurement:

Keyword	Meaning
BGES	full Bridge Gauge, External Supply, measurement over 60 mV range.
EBGES	Extended full Bridge Gauge, External Supply, measurement over 600 mV range.

Example: CH1-10 RA (BGES 7/S)

- **Optional specification of the bridge gauge supply voltage**

Either with the instruction **GS** followed with the value as below:

CH *channel list* **GS** *value*

Example: CH1-10 GS 5

or

by requesting measurement during procedure adjustment (see paragraph 6.3.4.9 below). In that case, **GS** instruction is useless.

- **How to declare the gauge factor or conversion factor and programming the other CHANNEL and TASK type instructions**

Same as the other gauge ranges. See paragraph 6.3.4.

6.3.4.9 Adjustment procedure

Same as the other gauge ranges. See paragraph 6.3.4.7.

An option to the command **GZ** consists in making the bridge supply voltage measurement by the system.

For that, this voltage must be connected to a measurement channel of the system which is then specified by the **CHS** keyword in the **GZ** instruction:

GZ *channel list* **CHS** *channel supply number*

Example: Supply of the bridges measured on channel 1 to 10 is connected to channel 11.
Enter then command: GZ 1-10 CHS 11

6.3.4.10 Using GS (channel number) variables for measuring the bridge supply voltage periodically

To each channel *channel number* of the system corresponds a **GS** (*channel number*) variable whose value corresponds to the channel bridge supply voltage.

The **PR** processing instructions of the system allow to assign a value to this variable in the same manner a value can be assigned to a channel or to a limit. See chapter 3 from the reference manual (**CONV** instruction variables) and chapter 4 from the reference manual (**PR** instruction variables).

In practice, this allows to measure periodically, on a measurement channel, the bridge supply voltage and to assign it to the corresponding **GS** variable to avoid any supply shift.

Example:

The channels 1 to 10 of the system are programmed in full bridge, external supply and the bridge supply voltage (approx. 10 V) is connected to channel 11.

The programming below allows to measure, at each cycle of task 1, the bridge supply voltage and to use it in the strain computations in order to minimize the possible supply shift:

```
CH1-10 RA (BGES) NGF8  
CH11 RA (60V) PR1  
PR1 GS (1-10)=X  
T1 CH11,1-10
```

6.3.5 Programming by means of the LOGIDAT software

6.3.5.1 Configuring the gauge board

If set in the DATALOG.

- Select the board number in the screen left window (tree).
- Click the mouse right button to open the context menu.
- Select **Properties...**
- A window opens. Select the desired board type, i.e.:

JG	Gauges power supply board
----	---------------------------

- Press **OK**.

6.3.5.2 Configuring the analog inputs board associated to gauge measurements

- Select the board number in the screen left window (tree).
- Click the mouse right button to open the context menu.
- Select **Properties...**
- A window opens. Select the desired board type, i.e.:

EA	10 analog inputs board	AN 5885
----	------------------------	---------

- Press **OK**.

6.3.5.3 Configuring the gauge measurement channel

- Select a channel from the analog inputs board in the screen left window (tree).
- Click the mouse right button to open the context menu.
- Select **Configure...**
- A window opens: **Programming channel Nr x**
- Using the **Type** tab, select:
 - The channel mnemonic if desired.
 - The programming type: Gauges Bridges.
 - The connection (only the first choice is available if there is no gauge power supply board).
 - ✓ Bridge, External supply: Bridges are externally powered.
 - ✓ Bridge, DATALOG supply: The bridges are powered by the system.
 - ✓ 1/2 Bridge: The half-bridges are powered by the system.
 - ✓ 1/4 Bridge C1 C3 or C5: The quarter-bridges are powered by the system with compensation on the gauge power board.

Some ranges request additional parameters, such as:

- Rate: Measurement scanning rate over the channel.
- Measurement range: Differential measurement range.
- Gauge factor: Number of active gauges.
- Conv. factor: Connection sensitivity.
- Bridge supply (V): For bridges with external supply in Volt.
- Gauge Resist.: For half- and quarter- bridges in ohms.

- Press OK.

Channel programming example

The screenshot shows a software dialog box titled "Programming Channel Nr1". It has four tabs: "Type", "Parameters", "Limits 1 and 2", and "Limits 3 and 4". The "Parameters" tab is selected. Under "Identification", the "Mnemonic" field contains "Channel1". Under "Description", there are several fields: "Type" is a dropdown menu set to "Gauges Bridge"; "Connection" is a dropdown menu set to "1/2 Bridge"; "Rate" is a dropdown menu set to "7 Meas/s"; "Measurement range" is a dropdown menu set to "60 mV"; "Gauge factor" is a dropdown menu set to "1"; and "Gauge resist." is a text input field containing "120". At the bottom of the dialog are three buttons: "OK", "Cancel", and "Help".

To define the parameters of the other tabs, refer to the Instruction Manual, chapter 6.

6.4 Calibration

6.4.1 Material required

- A board extension, part number AN 3705.
- A standard digital voltmeter, accuracy 0.01 %.
The system voltmeter can be used with the uncertainty due to the 6 V and 60 V ranges.

6.4.2 Procedure

Two adjustments by potentiometers are needed to calibrate the power board for strain gauges.

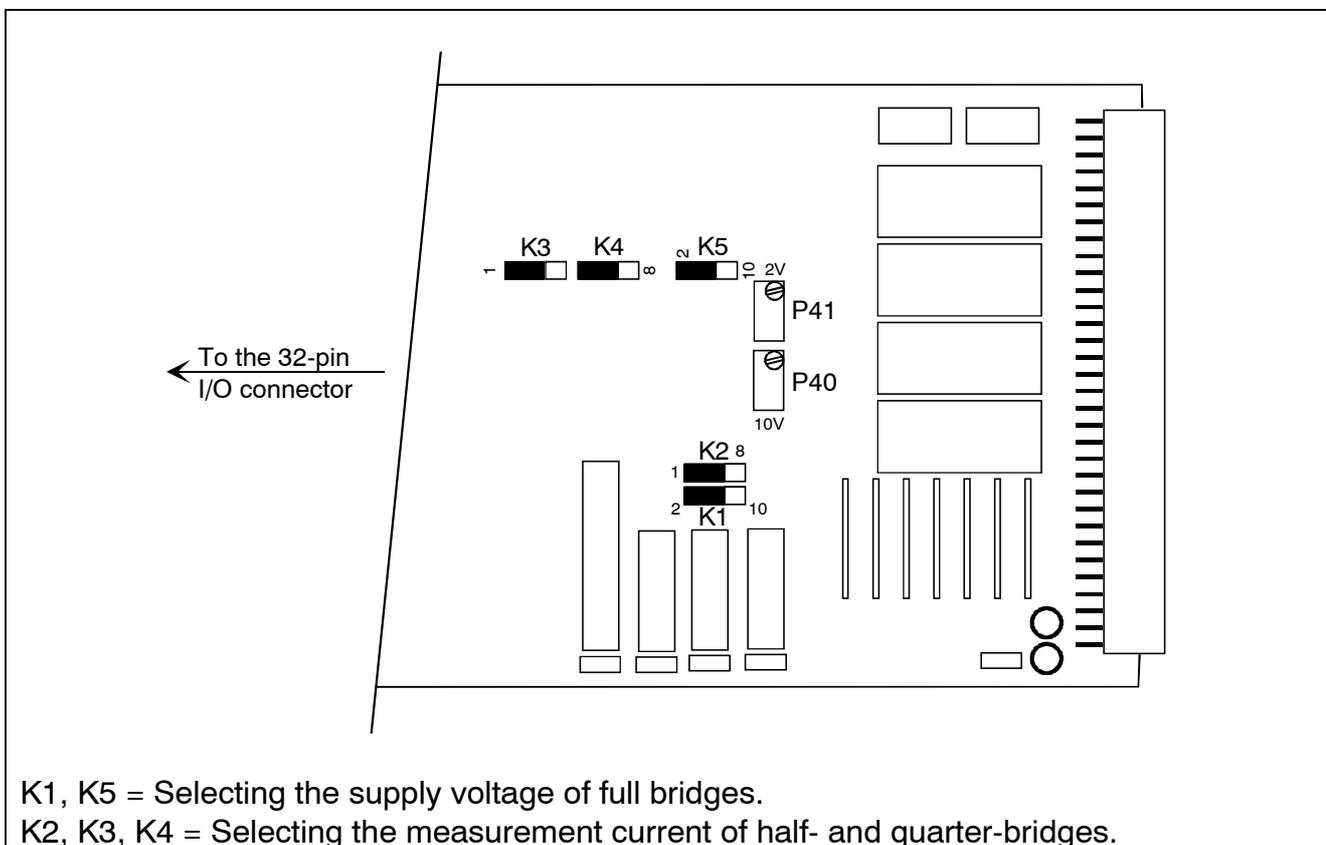
They correspond to adjustments:

- of the 10 V voltage generator,
- of the 2 V voltage generator.

Adjusting the 10 V generator must be executed before that of the 2 V.

Both voltage generators are selectable by the switches K1 and K5 located on the board.
See paragraph 6.3.3.1.

Only the voltage generators are to be adjusted.



Proceed as follows:

- Power the system down.
- Remove the power board and plug it on the board extension.
- Connect the digital voltmeter to the power board terminals as follows:
terminal 6a to - voltmeter,
terminal 6b to + voltmeter,
terminal 6c to voltmeter screening.

Adjusting the 10 V generator

- Select the 10 V generator by means of the K1 and K5 switches.
- Power the system up.
- Wait for 15 minutes and operate the P40 potentiometer to read 10.000 V on the voltmeter.

Adjusting the 2 V generator

- Select the 2 V generator by means of the K1 and K5 switches.
- Operate the P41 potentiometer to read 2.000 V on the voltmeter.

NOTE: During these adjustments, strain measurements should not be performed.

6.4.3 Example by using the system voltmeter

We have an analog inputs board, board 1, channels 1 to 10 and a power board for strain gauges, board 2.

6.4.3.1 Calibrating the 10 V voltage generator

Program:

CH1 RA (60V 7/S)
T1 CH1

- Connect CH1 to the power board for strain gauges as indicated above for the standard digital voltmeter.
- Set the switches K1 and K5 to 10 V position.
- Press the system RUN key.
- Wait for 15 minutes and adjust the P40 potentiometer.
- Press the system STOP key.

6.4.3.2 Calibrating the 2 V voltage generator

Program:

CH1 RA (6V 7/S)

T1 CH1

- Set the switches K1 and K5 to 2 V position.
- Press the system RUN key.
- Adjust the P41 potentiometer.

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Notes

7.1 Specifications

This board measures voltages and currents on a single-phase or three-phase network with or without neutral and deduces the essential parameters: RMS voltages and currents, powers, energies and frequencies.

The voltage and current inputs are sampled on a whole number of network periods by means of fast analog-to-digital converters. The sampling frequency is determined in order to get approximately 100 samples in **trigger** mode or 200 in **continuous** mode for each voltage or current input. The different parameters requested are then determined by computation on these samples.

Two versions of this board are available:

- Number 1: to connect voltage and current transformers.
- Number 2: to connect Hall effect sensors, module **LEM** types.

The specifications are available for both numbers unless otherwise stated.

7.1.1 Measurement inputs

7.1.1.1 Board number 1

- Three **voltage** inputs for connection to the voltage transformer secondary windings.

Rated voltage	100 V
Measurement range	10 to 125 V (input 1) 0 to 125 V (inputs 2 and 3)
Input impedance	250 k Ω
Permanent overload	200 V
Crest factor at rated voltage	1.8
Range selection	Programming the primary voltage for 100 V secondary

- Three **current** inputs for connection to shunt terminals placed on the secondary windings of current transformers.

Rated voltage at shunt terminals	100 mV
Measurement range	0 to 125 mV
Input impedance	2.5 k Ω
Permanent overload	15 V
Crest factor at rated current	2.5
Range selection	Programming the primary current for 100 mV at shunt terminals

The voltage and current inputs are not isolated between themselves.
Secondary windings of voltage and current transformers must be connected to the earth.

7.1.1.2 Board number 2

- Three **voltage** inputs and three **current** inputs for connection to shunt terminals placed on the secondary windings of voltage and current sensors, **module LEM** types.

Rated voltage	4 V
Measurement range	0.4 to 4 V (input 1) 0 to 4 V (inputs 2 and 3)
Input impedance	100 k Ω
Permanent overload	100 V
Crest factor at rated voltage	1.5
Range selection	Programming the primary voltage and current for 4 V at shunt terminals

The voltage and current inputs are not isolated between themselves.
The 0 V of the sensor supply must be connected to the earth.

7.1.1.3 Frequency operating range

AC signals from 10 to 440 Hz. Harmonic lower than 3.2 kHz.
Minimum signal amplitude applied to voltage input 1: 10 % of the rated voltage.
This signal should give only one changing for zero in the period.

7.1.2 Acquisition trigger input in triggered mode

DC voltage level from 10 to 28 V. The voltage source can be supplied by the system power supply board.
Isolating voltage: 100 V.

7.1.3 Programmable measurements

RMS voltages phases/neutral V	V1, V2, V3
RMS voltages between phases U	U12, U13, U23
RMS currents	I1, I2, I3
Active powers	P1, P2, P3, P = P1 + P2 + P3
Reactive powers	Q1, Q2, Q3, Q = Q1 + Q2 + Q3
Apparent powers	S1, S2, S3, S = S1 + S2 + S3
Power factors	PF1, PF2, PF3, PF
Active energies	EP1, EP2, EP3, EP
Reactive energies	EQ1, EQ2, EQ3, EQ
Apparent energies	ES1, ES2, ES3, ES
Frequency	F

7.1.4 Connections

Single-phase	1, 2 or 3 couples V, I
Three-phase without neutral	1U, 1I, 2U, 2I
Three-phase with neutral	1V, 1I, 2U, 3I, 3V, 3I

7.1.5 Operating modes

The board may operate in **continuous** or **triggered** mode.

With the **continuous** mode, the board continually measures the inputs and performs the computations according to channel programming. All the results corresponding to the last measurements performed are kept at the system CPU board's disposal. The CPU board asks for these results at the task programming rate.

If the CPU board does not ask for a result before the availability of a new one, it is lost and replaced by the new one.

With the **triggered** mode, the acquisition is triggered by the command **EBRUN** typed from the system keypad or by one voltage level on the board trigger input. The results are stored in a buffer on the board. The acquisition ends when the buffer is full or on a system keypad command **EBSTOP**, or on the disappearance of the voltage level on the board trigger input. The buffer contents can then be transferred to the system storage memory at the end of the acquisition or by a keypad command **EBMEM**.

With this mode, it is possible to declare a storage threshold, expressed in % of the full scale on current I1. In that case, the acquisition is triggered by the **EBRUN** or **TRIG** command, but storage only begins when the current I1 exceeds the declared threshold.

Storage buffer size: 60 000 bytes. The corresponding number of measurement cycles depends on the stored parameters and may vary from 15 000 for only one parameter to 588 when all the parameters are stored.

7.1.6 Input sampling time

From 1 to 7 network periods measured according to operating mode, frequency and number of voltage and current inputs.

7.1.7 Computation times and average acquisition rate

They depend on the parameters requested, operating mode and frequency.

Single-phase configuration, only 1 couple (V, I):

- Computation of 10 parameters V1, I1, P1, Q1, S1, PF1, EP1, EQ1, ES1 and F.

Mode	Computation time	Average acquisition rate (meas/s, computations included)		
		at 10 Hz	at 50 Hz	at 400 Hz
Continuous	35 ms	5	25	29
Triggered	23 ms	5	25	43

Three-phase configuration with neutral, 3 voltage inputs and 3 current inputs:

- Computation of 10 parameters V1, I1, P1, V2, I2, P2, V3, I3, P3 and F.

Mode	Computation time	Average acquisition rate (meas/s, computations included)		
		at 10 Hz	at 50 Hz	at 400 Hz
Continuous	70 ms	5	14	14
Triggered	47 ms	5	20	20

- Computation of all parameters V, I, P, Q, S, PF, EP, EQ, ES per phase and total + F.

Mode	Computation time	Average acquisition rate (meas/s, computations included)		
		at 10 Hz	at 50 Hz	at 400 Hz
Continuous	115 ms	5	8	8
Triggered	70 ms	5	14	14

7.1.8 Accuracies

In the reference conditions defined elsewhere in this publication and for inputs between 5 % and 100 % of the measurement scale.

	Continuous mode	Triggered mode
Voltages and currents	0.1 % rdg + 0.2 % scale	0.2 % rdg + 0.2 % scale
Powers and energies		
0.8 < PF ≤ 1	0.2 % rdg + 0.3 % scale	0.4 % rdg + 0.3 % scale
0.5 < PF ≤ 0,8	0.4 % rdg + 0.3 % scale	0.6 % rdg + 0.3 % scale
0.2 < PF ≤ 0,5	1 % rdg + 0.3 % scale	1.2 % rdg + 0.3 % scale
Frequency	0.1 % rdg	0.1 % rdg

rdg = reading; PF: Power Factor.

Temperature coefficient: (0.01 % rdg + 0.01 % scale)/°C.

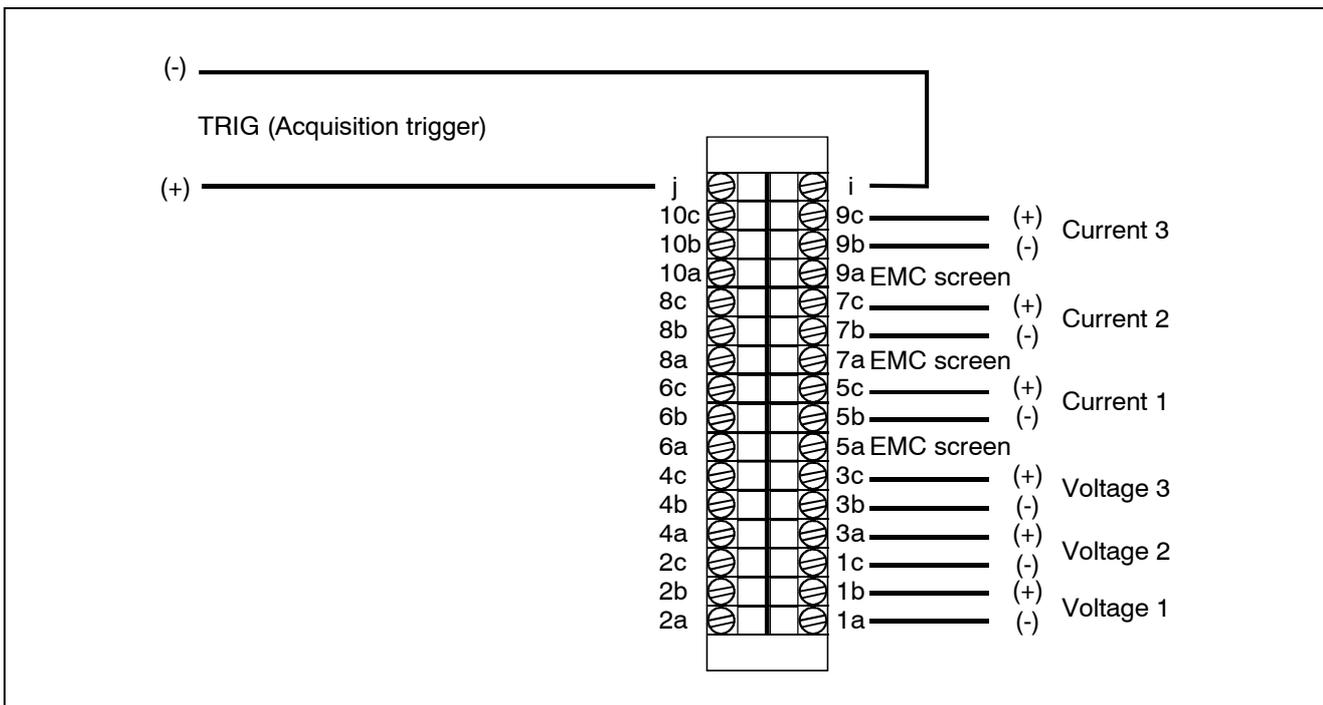
7.2 Connection

There are two versions of the electrotechnical inputs board:

- Number 1: for connection to voltage or current transformers.
- Number 2: for connection to Hall effect sensors, module LEM types.

7.2.1 Connector

Pin assignment is as follows for both numbers.



The pins i and j are used to connect a trigger signal in the trigger operating mode.

Apart from i and j, all the other face to face pins of the connector are internally connected (1a is connected to 2a, 1b to 2b, ...), so as the input can be connected indifferently to one or the other pin.

IMPORTANT NOTE

To ensure safety, the secondary windings of the voltage and current transformers as well as the 0 V of the Hall effect sensor supply must be connected to the earth.

Voltage and current inputs of the board are not isolated between them but are isolated from the data acquisition system.

7.2.2 Connecting the voltage (VT) and current (CT) transformers Electrotechnical inputs board, number 1

The voltage inputs are for 100 V RMS full scale signal coming from a VT secondary. Connect the VT secondary windings directly to the board voltage inputs.

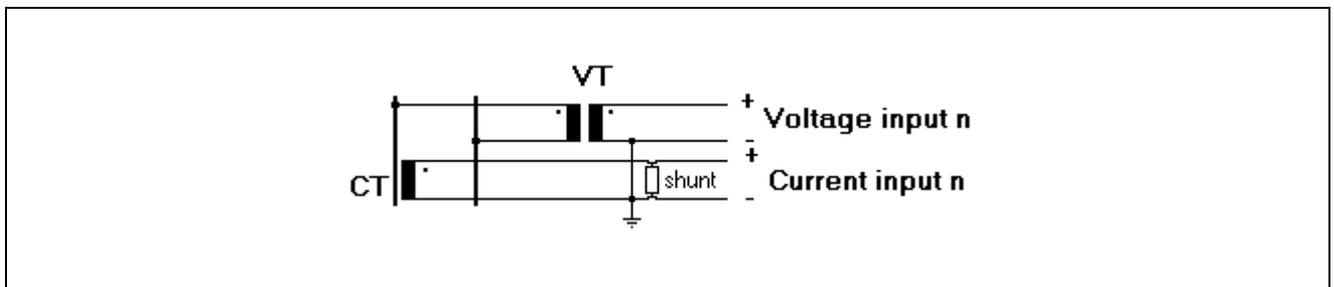
The current inputs are for 100 mV RMS full scale signal obtained at terminals of a shunt connected to a CT secondary.

Secondary windings of the current transformers must then be be connected to an external shunt whose value will be determined to get 100 mV RMS for the rated value of the primary current.

For a 1 A secondary current, use a 0.1 Ω shunt.

For a 5 A secondary current, use a 0.02 Ω shunt.

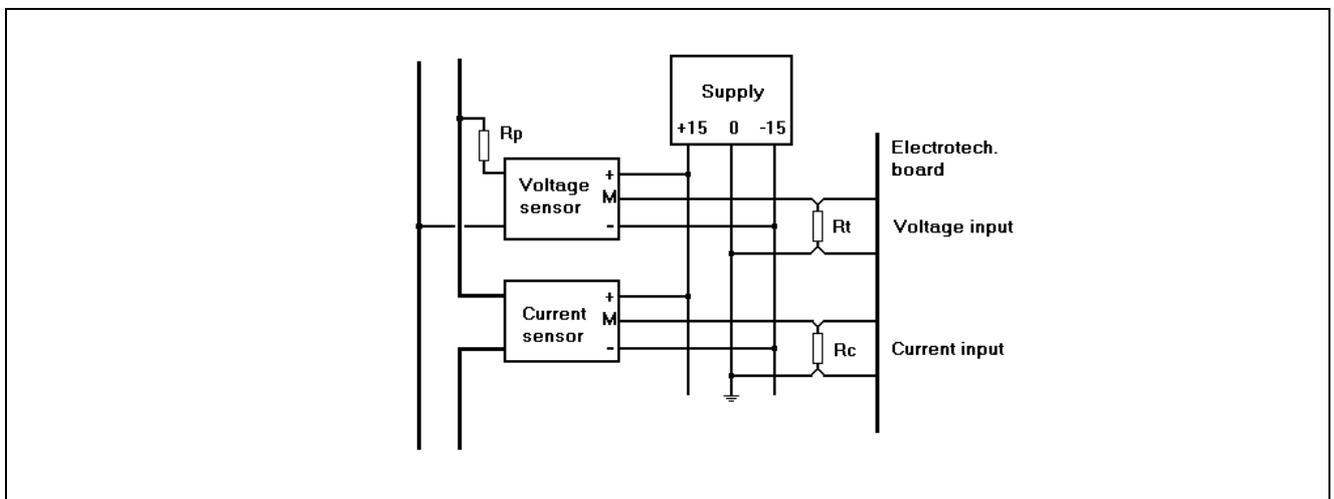
The shunts should be placed as near as possible to the connector.



7.2.3 Connecting the voltage and current Hall effect sensors Electrotechnical inputs board, number 2

The supply of these sensors must be supplied by a source external to the system. The sensor current output must be applied to a shunt external to the board. The value of this shunt must be determined to get 4 V RMS for the rated value of the primary voltage and current.

Some voltage sensors need a serial resistor R_p in their primary and others integrate this resistor.



Determining the resistors Rc, Rt and Rp.

Notations

Rc_th	Theoretical value of the current sensor shunt.
Rt_th	Theoretical value of the voltage sensor shunt.
Rp_th	Theoretical value of the resistor to be placed in series.
Rc_e	Selected RMS value of the current sensor shunt.
Rt_e	Selected RMS value of the voltage sensor shunt.
Rp_e	Selected RMS value of the resistor to be placed in series with the primary of the voltage sensor for sensors which do not integrate it.
Vp	Rated primary voltage to be measured.
Ip	Rated primary current to be measured.
Isc	Rated output current of the current sensor (for the rated primary current Ip). See sensor specifications.
Ist	Rated output current of the voltage sensor (for the rated primary voltage Vp on sensors which integrate a serial resistor in their primary or for the rated input current Inp on sensors which do not integrate it). See sensor specifications.
Inp	Rated input current of the voltage sensor for sensors which do not integrate the serial resistor. See sensor specifications.
Rip	Internal resistance of the voltage sensor primary. See sensor specifications.

The theoretical values Rc_th, Rt_th and Rp_th (if required) are given by the formula below:

$$\begin{aligned}
 \mathbf{Rc_th (W)} &= 4000/Isc \text{ (mA)} \\
 \mathbf{Rt_th (W)} &= 4000/Ist \text{ (mA)} \\
 \mathbf{Rp_th (kW)} &= Vp \text{ (V)}/Inp \text{ (mA)} - Rip \text{ (kW)}
 \end{aligned}$$

From these theoretical values computed, choose high stability resistors having actual values closest to the computed values. The primary voltages and currents corresponding to 4 V at the shunt terminals will be determined according to the real values of the resistors used and be specified in the system programming.

Primary current to be declared in the instruction **PC**: $PC = Ip * 4000 / (Rc_e * Isc)$.

Primary voltage to be declared in the instruction **PV**:

- Sensors with integrated primary resistor: $PV = Vp * 4000 / (Rt_e * Ist)$.
- Sensors without integrated primary resistor: $PV = (Rp_e + Rip) * Inp * 4000 / (Rt_e * Ist)$.

Example

Using LEM LA25NP modules as current sensors 25 A, and LEM LV25P modules as voltage sensors 250 V.

The LA25NP module technical leaflet gives: $I_p = 25$ A; $I_{sc} = 25$ mA.

The LV25P module technical leaflet gives: $I_{np} = 10$ mA; $I_{st} = 25$ mA ; $R_{ip} = 250 \Omega = 0.25$ k Ω .

One can deduce:

$$R_{c_th} = 4000 / 25 = 160 \Omega.$$

$$R_{t_th} = 4000 / 25 = 160 \Omega.$$

$$R_{p_th} = 250 / 10 - 0.25 = 24.75 \text{ k}\Omega.$$

The dissipated power in the resistor R_{p_th} is: $P = RI^2 = 24750 * (0.01)^2 = 2.5$ W.

A resistor dissipating 5 W minimum will be used.

Suppose we have resistors R_{c_e} and R_{t_e} of 162 Ω , and one power resistor R_{p_e} of 27.5 k Ω , we determine the PC and PV values to be programmed:

- $PC = 25 * 4000 / (162 * 25) = 24.69$ A.
- $PV = (27.5 + 0.25) * 10 * 4000 / (162 * 25) = 274.07$ V.

7.2.4 Connection to the network

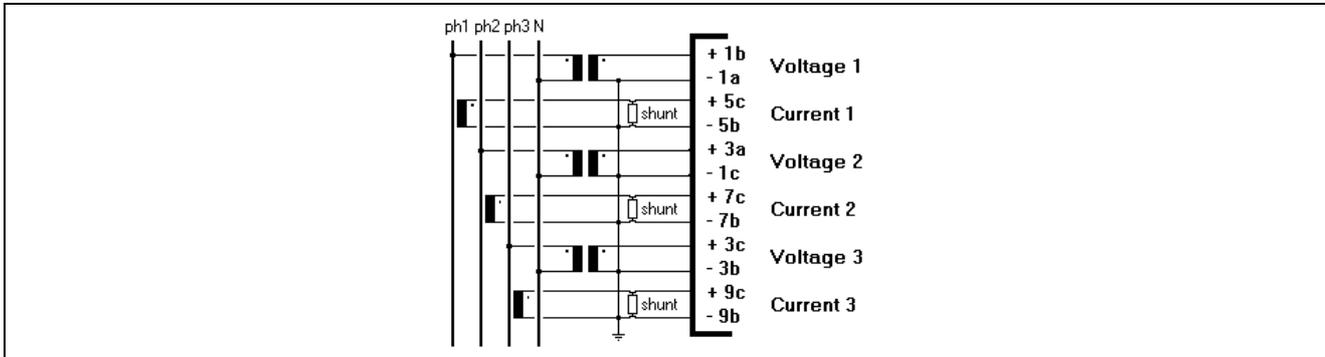
Diagrams hereafter indicate the input connection for the different measurement configurations.

They are given for board number 1 (connection to voltage and current transformers).

For board number 2 (Hall effect modules) replace the VT and CT by the corresponding sensors and follow the connection indicated in previous paragraph.

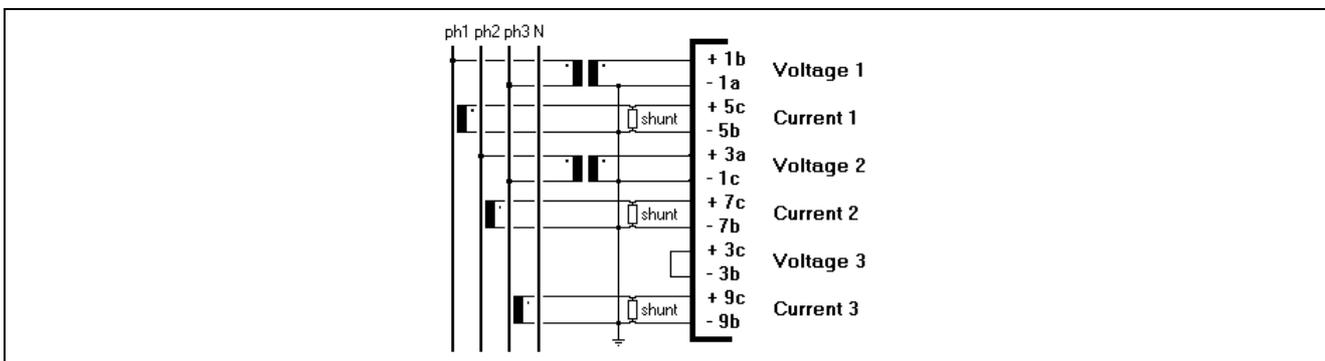
7.2.4.1 Connection to a three-phase network with neutral and measurement of three voltages and three currents

The board measures the three-phase/neutral voltages V1, V2, V3 and the three phase currents I1, I2 and I3.



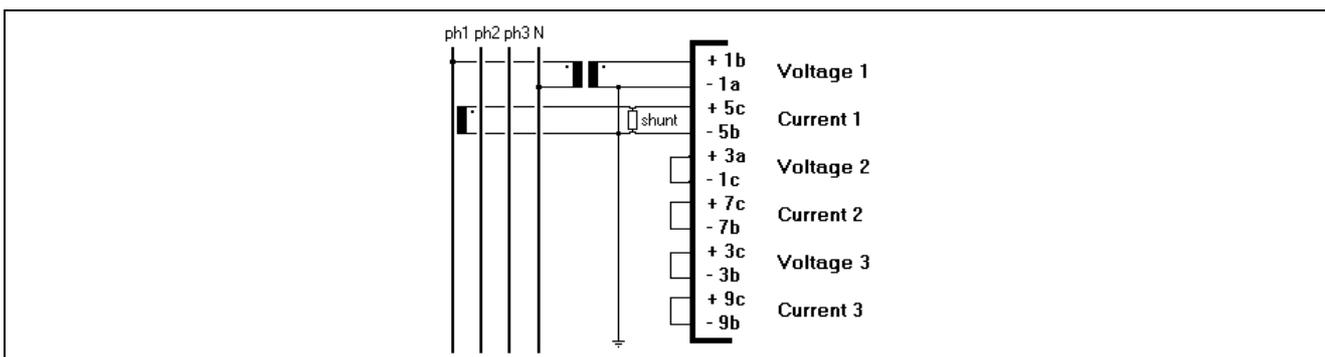
7.2.4.2 Connection to a three-phase network with neutral and measurement of three currents and two interphase voltages

The board measures the two interphase voltages U13, U23 and the three phase currents I1, I2 and I3.



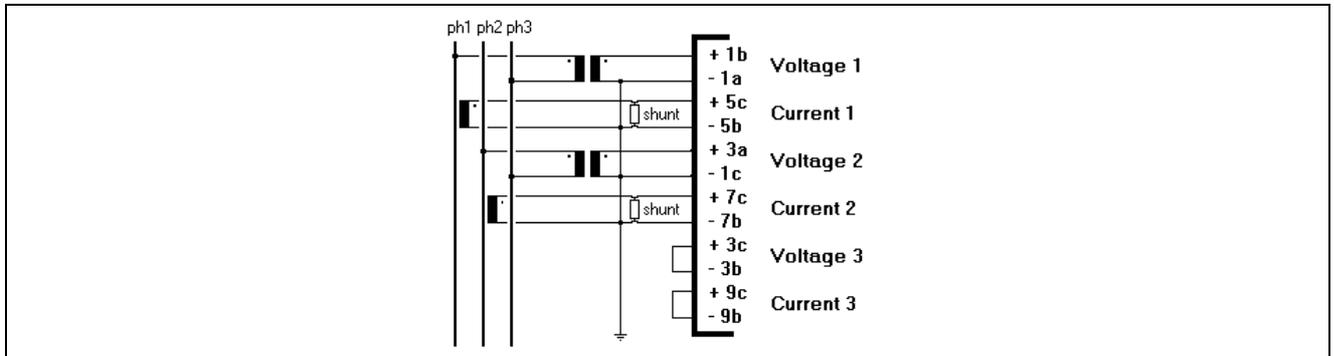
7.2.4.3 Connection to a three-phase network with neutral and measurement of one current and one voltage

The board measures the phase/neutral voltage V1 and the phase current I1. The network is supposed to be balanced.



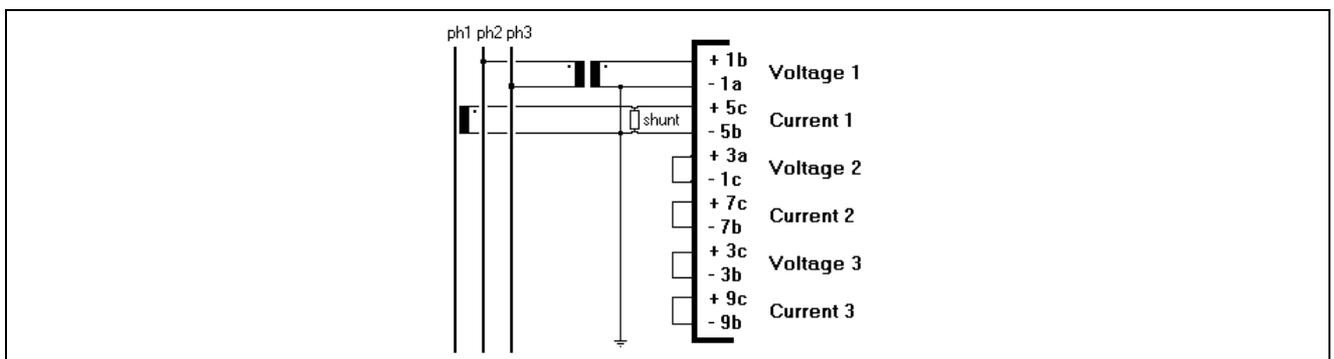
7.2.4.4 Connection to a three-phase network without neutral and measurement of two currents and two interphase voltages

The board measures the two interphase voltages U13, U23 and the two phase currents I1 and I2.



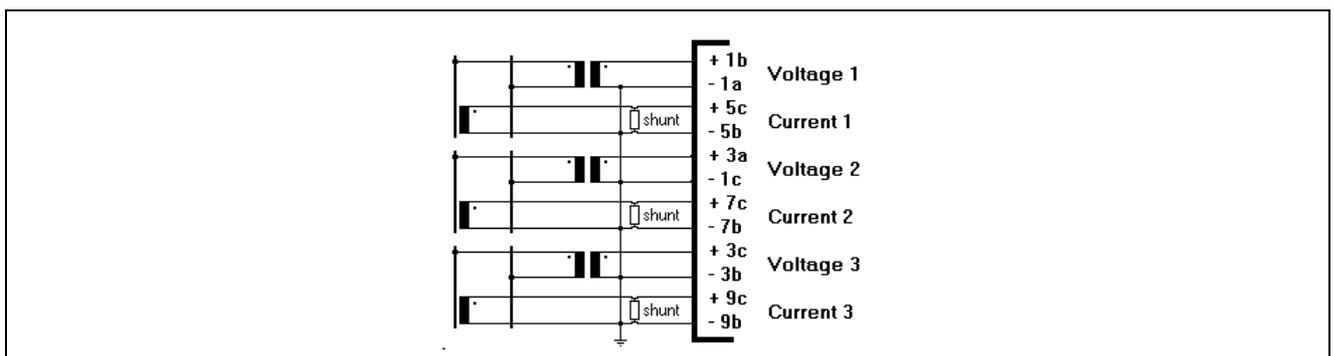
7.2.4.5 Connection to a three-phase network without neutral and measurement of only one current and only one voltage

The board measures the interphase voltage U23 and the phase current I1. The network is supposed to be balanced.



7.2.4.6 Connection to a single-phase network

Connecting one, two or three couples (V, I). With only one couple, connection is done on the voltage input 1 and current input 1. With two couples, connection is done on the voltage inputs 1 and 2 and current inputs 1 and 2.



7.2.5 Connecting the trigger input in triggered mode

DC voltage signal, level between 10 V and 28 V.

This signal must be applied between inputs j (+) and i (-) of the connector.

The unregulated voltage available on the DATALOG supply board connector can be used (see paragraph 2.5 from the Instruction Manual).

7.3 Exploitation

7.3.1 Operating principle – Operating modes

The board has 3 voltage inputs and 3 current inputs sampled using analog-to-digital converters. Sampling of these inputs is performed at high frequency facing the network frequency. From the samples obtained on a whole number of network periods (1 to 8 periods, depending on the network frequency and operating mode) the board computes the essential parameters: RMS voltages and currents, active and reactive powers, power factors, energies...

With the acquisition of samples being synchronized on the network period, the board can measure only when a signal is present on its voltage input 1. Amplitude of this signal must be minimized to 1/20e of the full scale, i.e. 5 V RMS for board number 1, and 0.2 V RMS for board number 2.

Two programmable operating modes as follows:

- **Continuous mode**

The board continually measures the inputs and performs the computations according to the channel programming. All the results corresponding to the last measurements performed are kept at the system CPU board's disposal. The CPU board asks for these results at the task programming rate. If the micro-board does not ask for a result before the availability of a new one, it is lost and replaced by the new one. With this mode, acquisition is done on the network period number allowing 200 samples. Optionally, it is possible to specify the number of periods acquired.

- **Triggered mode**

The acquisitions are triggered by the command **EBRUN** typed from the system keypad or by one voltage level on the board TRIGger input. The results are stored in a buffer on the board. Each acquisition is done on the network period number allowing 100 samples.

The acquisitions end when the buffer is full or on a system keypad command **EBSTOP**, or on the disappearance of the TRIG signal.

The buffer contents can then be transferred to the system storage memory at the end of the acquisition by a keypad command **EBMEM**.

With this mode, it is possible to declare a storage threshold, expressed in % of the current I1 full scale. In this case, the acquisitions are triggered by the **EBRUN** command or the TRIG signal, but storage only begins when the current I1 exceeds the declared threshold.

7.3.2 Programming by keywords

7.3.2.1 Declaring the electrotechnical board. Instruction EB

This instruction is used to declare:

- The network type and the number of voltage and current inputs wired.
- The primary voltages and currents.
- The operating mode: continuous or triggered.

The instruction general syntax is as follows:

EB <electrotechnical board programming instructions>

Several programming instructions may appear on the same line.

Example:

EB TRI4W3V3I PV 380 PC 50 M CONT

- Keyword **EB** indicates that the electrotechnical board is being programmed.
- Keyword **TRI4W3V3I** declare a three-phase network with neutral (-> 4 wires), with measurement of three phases/neutral voltages (3V) and three currents (3I).
- Keyword **PV** declares the primary voltages of the voltage transformers (here 380 V).
- Keyword **PC** declares the primary currents of the current transformers (here 50 A).
- Keywords **M** and **CONT** declare the CONTinuous operating Mode.

7.3.2.1.1 Declaring the network type

As follows:

Keyword	Network	Measured inputs
MONO1	Single-phase	1 couple (V, I)
MONO2	Single-phase	2 couples (V, I)
MONO3	Single-phase	3 couples (V, I)
TRI3W1U1I	Three-phase without neutral	Voltage U23 (between phases 2 and 3) and current I1
TRI3W2U2I	Three-phase without neutral	Voltages U13 and U23, currents I1 and I2
TRI4W1V1I	Three-phase with neutral	Phase/neutral voltage V1 and current I1
TRI4W2U3I	Three-phase with neutral	Voltages U13 and U23, currents I1, I2 and I3
TRI4W3V3I	Three-phase with neutral	Voltages V1, V2 and V3, currents I1, I2 and I3

7.3.2.1.2 Declaring primary voltages and primary currents. Keywords PV and PC

Syntax:

EB PV <value of the Primary Voltage>
EB PC <value of the Primary Current>

For the single-phase configurations:

EB P1V <value of primary voltage V1>
EB P2V <value of primary voltage V2>
EB P3V <value of primary voltage V3>
EB P1C <value of primary current I1>
EB P2C <value of primary current I2>
EB P3C <value of primary current I3>

The primary voltages are declared by the keyword **PV** followed with the voltage value corresponding to 100 V RMS at secondary (board number 1) or 4 V RMS at shunt terminals (board number 2).

For single-phase configurations, it is possible to declare different primary voltages for each of the voltage inputs. In this case, use the keywords **P1V**, **P2V**, **P3V**.

In the same way, the primary currents are declared with the keywords **PC**, **P1C**, **P2C**, **P3C**.

The value specified is that corresponding to 100 mV at shunt terminals (board number 1) or to 4 V RMS at shunt terminals (board number 2).

Examples:

EB TRI4W3V3I PV 274.1 PC 24.7
EB MONO3 PV 220 P1C 50 P2C 20

7.3.2.1.3 Declaring the shunt resistance values. Keywords VS and CS

It is possible to declare the values of the external shunts placed on the current transformers (board number 1) and on the voltage and current sensor (board number 2).

The system uses these values to correct the results taking account of the board input impedances.

This is useless for the board number 1 when the shunt value does not exceed 2.5 Ω , and for board number 2 if it does not exceed 100 Ω .

Above these values, declare them.

Syntax:

EB VS <shunt value on voltage channels in Ohms>
EB CS <shunt value on current channels in Ohms>

For single-phase configurations, it is possible to place shunts of different values for each input. In this case, use the keywords **V1S**, **V2S**, **V3S** for shunts of voltage channels, and **C1S**, **C2S**, **C3S** for shunts on current channels.

Example:

EB MONO1 PV 500 PC 25 CS 160 VS 80

(Hall sensors with board number 2: 160 Ω shunt on the current inputs and 80 Ω shunt on the voltage inputs).

7.3.2.1.4 Declaring the operating mode. Keyword M

Syntax:

EB M CONT <optional number of sampled periods>.
EB M TRIG <storage optional level trigger>.

The first form declares a continuous mode. With this mode, it is possible to declare a number of sampled periods (from 1 to 8). In this case, the board will sample the number of periods declared at each acquisition. This is generally useless.

The second form declares the triggered mode. With this mode, it is possible to declare the minimum value of current I1 which triggers storage of results. This value should be expressed in % of I1 full scale.

Examples:

EB TRI3W2U2I PV 380 PC 10 M CONT
EB MONO1 PV 220 PC 5 M TRIG 10

The first example declares the continuous mode.

The second example declares the triggered mode and specifies a level of 10 % from 5 A, i.e. 0.5 A: the acquisitions will be triggered by command **EBRUN** or by the TRIG signal and storage of results will begin only when current I1 will exceed 0.5 A.

7.3.2.2 Programming the channels

Programming the channels enables the operator to specify the parameters to be computed by the board from the measured samples.

The type of parameter to be computed is defined by the range programmed on the channel.

The keywords used to declare the different ranges indicate at the same time the type of computation to be performed and the electrotechnical board inputs intervening in this computation. (For example, the keyword **EBV1** specifies to compute the RMS voltage between phase 1 and neutral).

Just as any channel of the system can receive the MEMory range, any channel can receive an electrotechnical range (irrespective of their channel number and electrotechnical board location).

In practice, we will preferably use the channel numbers corresponding to a physical location on the board (for example channels 61 to 70 and 261 to 270 if the board lies in the 7th location of a DATALOG).

Syntax:

CH <channel number> RA <range of the desired parameter>

The electrotechnical ranges always begin with letters **EB** and are followed by the parameter keyword.

The table following gives the list of ranges. The columns Validity indicate, for each type of network, if the range is valid or not.

Keyword	Corresponding parameter	VALIDITY								
		MONO			TRI3W		TRI4W			
		1	2	3	1U1I	2U2I	1V1I	2U3I	3V3I	
EBV1	RMS voltage, phase 1	✓	✓	✓	✓	✓	✓	✓	✓	✓
EBV2	RMS voltage, phase 2		✓	✓		✓		✓	✓	
EBV3	RMS voltage, phase 3			✓		✓		✓	✓	
EBU23	RMS voltage, phase 2/phase 3				✓	✓	✓	✓	✓	
EBU13	RMS voltage, phase 1/phase 3					✓		✓	✓	
EBU12	RMS voltage, phase 1/phase 2					✓		✓	✓	
EBI1	RMS current, phase 1	✓	✓	✓	✓	✓	✓	✓	✓	✓
EBI2	RMS current, phase 2		✓	✓		✓		✓	✓	✓
EBI3	RMS current, phase 3			✓		✓		✓	✓	✓
EBP1	Active power, phase 1	✓	✓	✓	✓	✓	✓	✓	✓	✓
EBP2	Active power, phase 2		✓	✓		✓		✓	✓	✓
EBP3	Active power, phase 3				✓	✓		✓	✓	✓
EBP	Total active power				✓	✓	✓	✓	✓	✓
EBQ1	Reactive power, phase 1	✓	✓	✓	✓	✓	✓	✓	✓	✓
EBQ2	Reactive power, phase 2		✓	✓		✓		✓	✓	✓
EBQ3	Reactive power, phase 3			✓		✓		✓	✓	✓
EBQ	Total reactive power				✓	✓	✓	✓	✓	✓
EBS1	Apparent power, phase 1	✓	✓	✓	✓	✓	✓	✓	✓	✓
EBS2	Apparent power, phase 2		✓	✓		✓		✓	✓	✓
EBS3	Apparent power, phase 3			✓		✓		✓	✓	✓
EBS	Total apparent power				✓	✓	✓	✓	✓	✓
EBPF1	Power factor, phase 1	✓	✓	✓	✓	✓	✓	✓	✓	✓
EBPF2	Power factor, phase 2		✓	✓		✓		✓	✓	✓
EBPF3	Power factor, phase 3			✓		✓		✓	✓	✓
EBPF	Average power factor				✓	✓	✓	✓	✓	✓
EBEP1	Active energy, phase 1	✓	✓	✓	✓	✓	✓	✓	✓	✓
EBEP2	Active energy, phase 2		✓	✓		✓		✓	✓	✓
EBEP3	Active energy, phase 3			✓		✓		✓	✓	✓
EBEP	Total active energy				✓	✓	✓	✓	✓	✓
EBEQ1	Reactive energy, phase 1	✓	✓	✓	✓	✓	✓	✓	✓	✓
EBEQ2	Reactive energy, phase 2		✓	✓		✓		✓	✓	✓
EBEQ3	Reactive energy, phase 3			✓		✓		✓	✓	✓
EBEQ	Total reactive energy				✓	✓	✓	✓	✓	✓
EBES1	Apparent energy, phase 1	✓	✓	✓	✓	✓	✓	✓	✓	✓
EBES2	Apparent energy, phase 2		✓	✓		✓		✓	✓	✓
EBES3	Apparent energy, phase 3			✓		✓		✓	✓	✓
EBES	Total apparent energy				✓	✓	✓	✓	✓	✓
EBF	Network frequency (measured on voltage input 1)	✓	✓	✓	✓	✓	✓	✓	✓	✓

All the "channel" programming instructions are applicable to channels having an electrotechnical range.

Default units

The values computed are scaled by taking account of PV and PC values programmed, which are supposed to be expressed in Volts and Amperes.

Under these conditions:

- The voltages are expressed in V.
- The current in A.
- The active powers in kW, the reactive powers in kVar, and the apparent powers in kVA.
- The energies in kWh and kVAh.
- The frequency in Hz.

Display resolution

Results of computations are displayed with the highest possible resolution, which can lead to non-significant or unstable digit display regarding the accuracy of the computation performed.

It is advisable to set the number of digits after the decimal point using the programming instruction **ACCU** (refer to chapter 2 from the Reference Manual).

For example, for a full scale voltage of 380 V, we will display the voltages with only one figure after the decimal point by specifying the instruction **ACCU1** on the voltage channels.

Examples:

EB TRI3W3V3I PV 380 PC 30 M CONT		Declaring the board.
CH61 RA (EB I1)	ACCU2	Current in Amperes, 2 figures after the decimal point.
CH62 RA (EB I2)	ACCU2	
CH63 RA (EB I3)	ACCU2	
CH64 RA (EB P)	ACCU4	Total power in en kW, 4 figures after the decimal point.
CH65 RA (EB PF)	ACCU3	Average power factor.

NOTE ON THE ENERGY RANGES

Totalling energies is performed on the electrotechnical board; the results are transmitted to the CPU board when it asks for them, depending on the task programming.

As the contents of the electrotechnical board memories are not saved in case of power failure, all the energy totalizations are lost.

Processing energies by taking into account of the possible power failures is explained in paragraph 7.3.4.1.

7.3.2.3 Programming the tasks

Programming tasks defines the list of channels to be scanned and the scanning period.

With the continuous mode, the channels with electrotechnical range must be specified in the tasks in the same way as for the other channels.

But, they should not be declared in the tasks with the triggered mode (see paragraph 7.3.4.2).

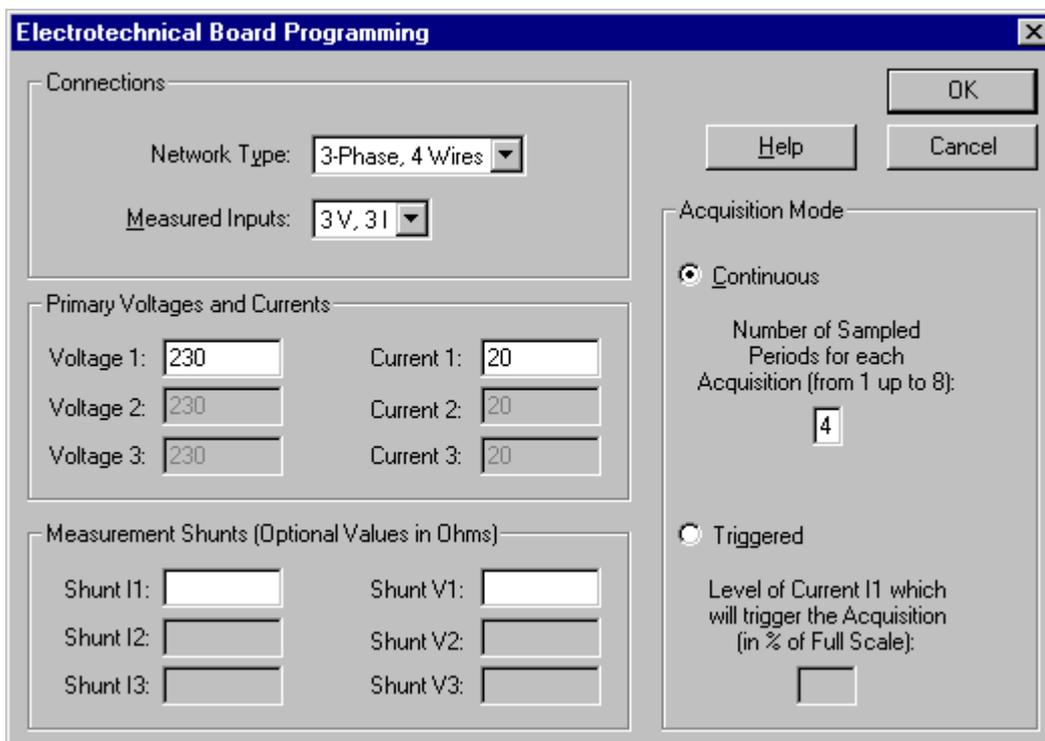
7.3.3 Programming by means of the LOGIDAT software

7.3.3.1 Configuring the board

- Select the board number in the screen left window (tree).
- Click the mouse right button to open the context menu.
- Select **Properties...**
- A window opens. Select the desired board type, i.e.:

EL	Electrotechnical board
----	------------------------

- Press **OK**.
- A new window opens Electrotechnical Board Programming:



Electrotechnical Board Programming

Connections

Network Type: 3-Phase, 4 Wires

Measured Inputs: 3V, 3I

Primary Voltages and Currents

Voltage 1: 230 Current 1: 20

Voltage 2: 230 Current 2: 20

Voltage 3: 230 Current 3: 20

Measurement Shunts (Optional Values in Ohms)

Shunt I1: Shunt V1: Shunt I2: Shunt V2: Shunt I3: Shunt V3:

Acquisition Mode

Continuous

Number of Sampled Periods for each Acquisition (from 1 up to 8):

4

Triggered

Level of Current I1 which will trigger the Acquisition (in % of Full Scale):

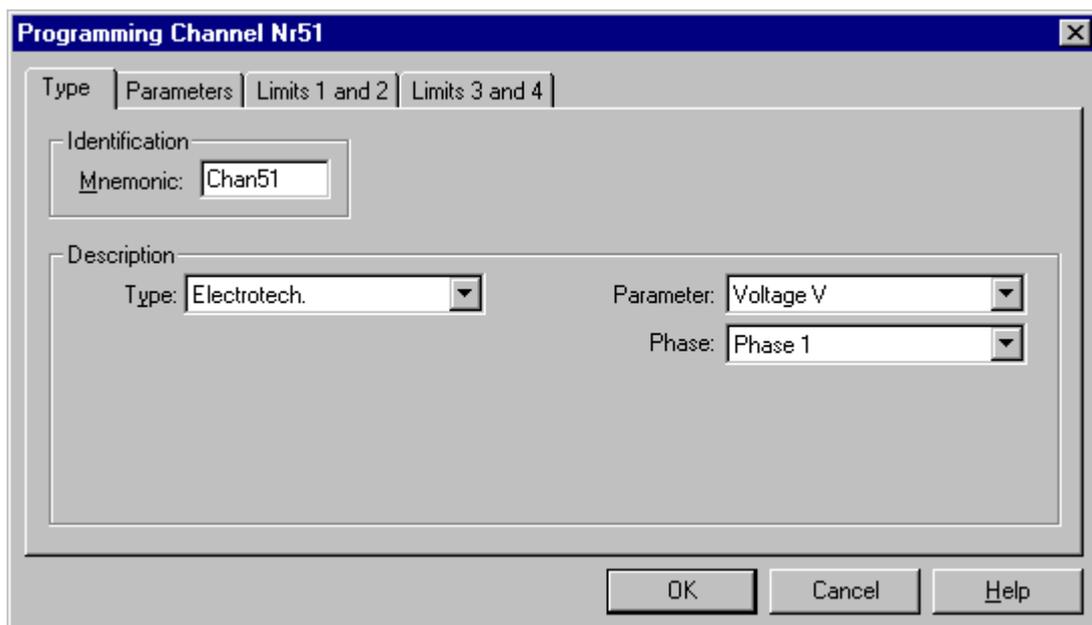
Help Cancel OK

- Network type: either Single-Phase, 3-Phase 3 wires or 3-Phase 4 wires.
 - Measured inputs: Specify the number of voltage and current inputs connected (refer to the table in paragraph 7.3.2.2).
 - Primary voltages and currents: Indicate the values (refer to paragraph 7.3.2.1.2).
 - Measurement shunts: Optional (refer to paragraph 7.3.2.1.3).
 - Acquisition mode: either continuous or triggered.
 - ✓ Continuous mode: Number of sampled periods. This edition is useless in most cases. It defines a number of sampled periods for each acquisition (from 1 to 8).
 - ✓ Triggered mode: Level of current I1. Indicate the current I1 percentage which will trigger the storage into the buffer (see paragraph 7.3.2.1.4).
- Press OK.

7.3.3.2 Configuring the channel

- Select a channel from the board in the screen left window (tree).
- Click the mouse right button to open the context menu.
- Select **Configure...**
- A window opens: **Programming channel Nr x**
- Using the **Type** tab, select:
 - The channel mnemonic if desired.
 - The programming type: Electrotech.
 - The parameter: see table in paragraph 7.3.2.2.
 - The phase: see table in paragraph 7.3.2.2.
- Press OK.

Channel programming example



To define the parameters of the other tabs, refer to the Instruction Manual, chapter 6.

7.3.3.3 Programming the tasks

With the triggered operating mode, the channels must not be specified in the tasks.

With the continuous operating mode, specify the electrotechnical channels to be scanned in the task channel list.

7.3.4 Operation

7.3.4.1 Continuous operating mode

After declaring the electrotechnical board and programming the channels and tasks, the system is ready to perform the measurements. Command **RUN** starts the acquisitions.

The board continuously measures its inputs and computes all the electrotechnical parameters programmed. The system CPU board interrogates the electrotechnical board to get the current results from the channels programmed in the tasks.

Note that the electrotechnical board computes all the parameters programmed on channels, even if these channels are not scanned by the tasks. To get the best acquisition rate, only program the channels actually declared in the tasks.

Channels declared in energy counting:

- The energy is expressed in kWh.
- The counters are reset to zero by the command **RUN**.
- The processing instruction CH (extended channel number) = N also resets to zero the specified counter channel, whatever is the N value, (for full details, refer to chapter 4 from the Reference Manual).

The counters are also reset to zero at system switching on or after a power failure. To avoid losing the energy counters in case of power failure, it is advisable to use a recopy memory channel.

For example, the programming below can be performed:

```
CH61 RA (EB EP) PR1
CH62 RA (MEM)
PR1 (CH(62)=CH(62)+X : CH(61)=0)
T1 CH(61,62) E(-CONT I 1:00:00)
```

In this example, the energy channel 61 is totalled every hour in memory channel 62, then reset to zero.

In case of power failures, energy not totalled corresponds to one hour of maximum operation.

Using units other than the default units.

It is possible to use units other than the default ones.

For this, program the desired units and assign them to the channels.

In the following example, the primary voltage is expressed in kV, and the units of voltages and powers are changed consequently.

```
EB TRI4W3V3I PV 12 PC 100 M CONT
CH61 RA(EBV1) U1           Assigns unit 1 (kV) to the channel.
CH62 RA(EBI1)
CH63 RA (EBP1) U2         Assigns unit 2 (MW) to the channel.
U1 (kV)                   Declares the unit 1.
U2 (MW)                   Declares the unit 2.
```

7.3.4.2 Triggered operating mode

After declaring the electrotechnical board and programming the channels, the board monitors the level of its TRIG input.

Commands **RUN** and **STOP** have no effect on its operation.

7.3.4.2.1 Triggering and stopping the acquisitions

The acquisition is triggered when its TRIG input goes to 1, or by the command **EBRUN** typed from the keypad.

The storage in the buffer of the programmed parameters starts immediately (if no level has been specified for the current I1), or as soon as the current I1 exceeds the specified level.

The acquisition continues as long as the TRIG signal is present, or the command **EBRUN** is not followed by an **EBSTOP** command, or the buffer is not full.

NOTE:

If the acquisitions have been triggered by the EBRUN command, it is absolutely necessary to type the EBSTOP command to complete them, even if the buffer has been filled. It is not possible to restart other acquisitions since this command is not typed.

Triggering or stopping by program

The keywords **EBRUN** and **EBSTOP** can be used in the channel processing instructions, thus allowing triggering and stopping the acquisitions by program.

The channel processing instructions are programmed by means of the keyword **PR**. Refer to chapter 4 from the Reference Manual.

Example:

In this example, channel 1 of the system monitors temperature and triggers acquisitions on the electrotechnical board when the temperature exceeds 80 degrees.

**CH1 RA(THK) LIM1(80 HI) PR1
PR1 (IF AA1 THEN EBRUN)**

7.3.4.2.2 Storage buffer capacity

The buffer has a capacity of 60 000 bytes. The number of corresponding measurements depends on the parameters programmed.

Storage of parameters voltages, currents, powers, power factor and frequency needs 2 bytes. That of energy requires 4 bytes. Moreover, the records are dated in tens of ms from the acquisition trigger command. Each dating takes 2 bytes.

Size for each record is expressed as follows:

Size = 2

+ 2 * number of parameters V, U, I, P, Q, S, PF, F

+ 4 * number of parameters EP, EQ, ES.

E.g.: For a 4W3V3I configuration with programming of 3 voltages, 3 currents and 3 powers, each record will take 20 bytes. The buffer can then store $60\,000/20 = 3000$ cycles.

The average acquisition rate and computation of these parameters being of 20 per second, the buffer will be filled in: $3\,000 : 20 = 150$ seconds, i.e. 2 mn 30 s.

7.3.4.2.3 Asking for the buffer state. Command EB ?

This command is used to get the number of cycles recorded and available in the buffer. The system response is as follows: **xxxx set yyyy free**

xxxx indicates the number of cycles stored and yyyy the number remaining free.

This information is only valid when the system is in triggered mode and when there is at least one cycle stored. If not, xxxx and yyyy are null.

7.3.4.2.4 Transferring the buffer contents in the system storage memory. Command EBMEM

To process the stored results, they must be transferred in the system memory storage No 1. As a matter of fact, this transfer can only be done in the system memory MEM1.

Moreover, as **the buffer content of the electrotechnical board is not saved in case of power failures**, the transfer should be done before switching the system off.

Before the transfer and unless it is absolutely not necessary, it's better to reset the system storage memory to zero by means of the MEMCL command. The graphic representation of results on the LOGIDAT software will be more operative.

Command syntax: **EBMEM <first cycle> - <last cycle>**

Where:

<first cycle>: number of the first cycle to be transferred,

<last cycle>: number of the last cycle to be transferred (the value specified may be higher than the number of available cycles).

Transferring the results does not clear them from the electrotechnical board. The transfer may start again without any problem.

Example: **EBMEM 1-15000**

As the maximum number of available cycle is 15 000 (4 bytes minimum per cycle: the date and one parameter), this command transfers all the cycles.



When the transfer is completed, the system displays the number of cycles actually transferred.

NOTE: Time needed to transfer is important and may reach 5 minutes when the buffer is full.

In case the system storage memory becomes full before all the cycles requested be transferred, the system displays **MEMORY FULL** message as well as the number of cycles transferred.

It is then necessary to empty the storage memory by the normal procedure with the LOGIDAT software and ask again for transfer of cycles not read.

Example:

By means of command EB?, the operator determines the number of cycles available.

The system displays:	8000 set	7000 free
Ask for the transfer:	EBMEM	1-8000
The system starts transfer and displays:	MEMORY FULL. 4000 cycles read.	
Use the LOGIDAT software to empty the storage memory by creating a .M90 file		
Ask for the transfer of the remaining records:	EBMEM	4001-8000
The system goes on with transfer and displays:	4000 cycles read.	

7.3.4.2.5 Processing the results

They can be transferred on the PC by means of the LOGIDAT software.

In the memory, the results are preceded by a Date message (letter P) indicating the time the transfer was performed.

The Date messages usually displayed at the beginning of the stored cycles are replaced by Time messages (letter T) indicating in ms the time which has elapsed since the trigger command.

7.3.4.3 Asking for the board software version. Command EB VER

In response to this command, the system displays the board program number followed by a letter indicating the version and two figures giving the alternative. E.g.:

For a board number 1: PP 45012 A.00.

For a board number 2: PP 45023 A.00.

7.3.4.4 *Electrotechnical board processing errors*

09 Measurement overflow

This error may correspond either to a too high input signal or to a computation overflow. If the error is due to a too high input signal, it is displayed on all the channels of the electrotechnical board. For example, error 09 displayed on a channel computing an RMS voltage indicates a measurement overflow on one of the board inputs which can either be a voltage or a current input.

Note that a measurement overflow may be a too high crest factor on input able to have a permissible RMS value.

103 Electrotechnical board not connected

The system CPU board cannot communicate with the electrotechnical board. Check that it is correctly plugged-in.

104 Incompatible with programmed configuration

The range programmed on the channel is not valid for the specified network type.

105 Primary voltage or current not specified

Scaling the result cannot be performed by the system when these values are not specified. Use the keywords **PV** and **CP** to specify them.

106 No result available

The signal on the board voltage input 1 has insufficient amplitude to trigger the measurements, or the input signal frequency is lower than 10 Hz or higher than 440 Hz.

107 Memory full

The contents of the board buffer cannot be transferred into the storage memory because it is full (see paragraph 7.3.4.2.4).

108 Elec. board is not in TRIG mode

The measurements are stored into the buffer only when the board is in triggered mode (see paragraph 7.3.4.2.4).

7.3.5 Additional specifications

7.3.5.1 Sampling frequency and number of sampled periods

The sampling frequency and the number of sampled periods are determined in order to get approximately 100 samples in triggered mode and 200 samples in continuous mode. The maximum sampling frequency depends on the number of channels to be acquired.

Number of channels	Maximum sampling frequency
1 voltage and 1 current	16.66 kHz (T = 60 μ s)
2 voltages and 2 currents	15.38 kHz (T = 65 μ s)
3 voltages and 3 currents	14.29 kHz (T = 70 μ s)

Depending on the input signal frequency, the board computes the minimum number of periods to be sampled to get the desired sample quantity (100 or 200 according to the mode) by using the maximum sampling frequency for the number of channels to be acquired.

It uses the number of periods obtained to determine the effective sampling frequency (allowing for 100 or 200 samples).

These computations are performed before each acquisition by using the frequency computed by means of the samples of the previous acquisition.

Tables below, give, for the different configurations, the number of sampled periods according to the network frequency:

MONO1, TRI3W1U1I, TRI4W1V1I configurations

Frequency (Hz)	83		167		250		333		416	
Continuous mode	1	2	3	4	5	6				
Triggered mode	1		2		3					

MONO2, TRI3W2U2I configurations

Frequency (Hz)	77		154		231		308		384	
Continuous mode	1	2	3	4	5	6				
Triggered mode	1		2		3					

MONO3, TRI4W2U3I, TRI4W3V3I configurations

Frequency (Hz)	71		143		214		286		357		429	
Continuous mode	1	2	3	4	5	6	7					
Triggered mode	1		2		3		4					

When a number of periods to be acquired is specified (in continuous mode), the sampling frequency is determined as indicated above irrespective of the programmed number; the number of periods really acquired is the maximum between the computed value and that programmed.

In this case, the number of samples acquired may be higher than 200.

Example: Let be a 50 Hz network frequency.

The board determines the sampling frequency of 10 kHz and only one acquisition period.

If the board programming specifies 4 sampled periods, the number of samples will be 800 (and of course, the parameter computation times will be higher).

7.3.5.2 Computation time and acquisition rate

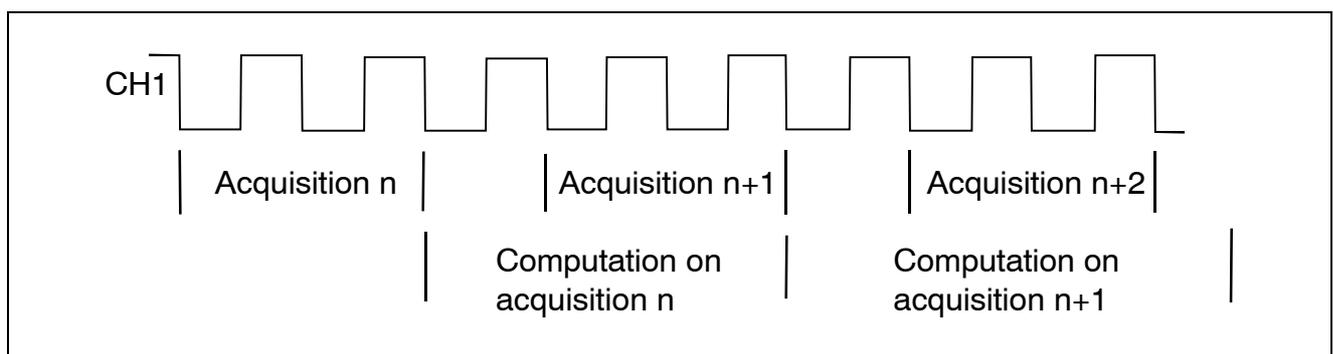
The parameter computation times depend on the number of samples to be processed and on the requested parameters.

The board performs computations on the samples of acquisition n during acquisition $n+1$.

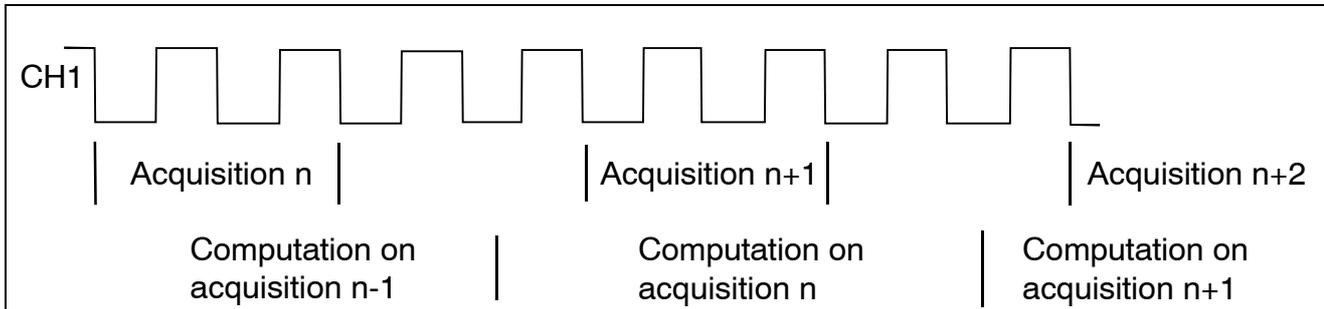
The acquisitions have a network period multiple duration and are synchronized on the changing for zero of the channel voltage 1 signal.

Two consecutive acquisitions are separated by one network period minimum, or more when the computation times are important.

Example with computation times which do not slow down the acquisition: (sampling on 2 network periods)



Example with computation times which slow down the acquisition: (sampling on 2 network periods)



The acquisition n+1 starts on the period following the end of computations on the samples of the acquisition n-1.

Computation times and average acquisition rate for different configurations.

MONO1 configuration

- Computing 10 parameters V1, I1, P1, Q1, S1, PF1, EP1, EQ1, ES1 and F.

Mode	Computation time	Average acquisition rate (meas/s)		
		at 10 Hz	at 50 Hz	at 400 Hz
Continuous	35 ms	5	25	29
Triggered	23 ms	5	25	43

TRI4W3V3I configuration

- Computing 10 parameters V1, I1, P1, V2, I2, P2, V3, I3, P3 and F.

Mode	Computation time	Average acquisition rate (meas/s)		
		at 10 Hz	at 50 Hz	at 400 Hz
Continuous	70 ms	5	14	14
Triggered	47 ms	5	20	20

- Computing all parameters V, I, P, Q, S, PF, EP, EQ, ES per phase and total + F.

Mode	Computation time	Average acquisition rate (meas/s)		
		at 10 Hz	at 50 Hz	at 400 Hz
Continuous	115 ms	5	8	8
Triggered	70 ms	5	14	14

7.3.5.3 Electrotechnical parameters computation modes for different measurement configurations

7.3.5.3.1 MONO1, MONO2, MONO3 and TRI4W1V1I configurations

The board samples v and i per phase on a whole number of periods.
(The sampling frequency and the number of sampled periods are determined in order to get approximately 100 samples in triggered mode, or 200 in continuous mode).

From n samples of each channel, the board computes:

$$\Sigma v^2, \Sigma i^2, \Sigma vi$$

Depending on programming, it computes:

$$V = \sqrt{(\Sigma v^2/n)}$$

$$I = \sqrt{(\Sigma i^2/n)}$$

$$P = \Sigma vi/n$$

$$S = VI$$

$$Q = \sqrt{(S^2 - P^2)}$$

P is signed.

Sign of Q is determined by testing if v is in advance or late regarding i ($Q > 0$ if v is in advance regarding i).

Depending on programming, it totals P , Q and S to determine energies EP , EQ , ES per phase.

With the three-phase configuration TRI4W1V1I:

- the voltage U is computed according to $U = \sqrt{3} V$,
- the total power is computed according to $P = 3 P_1$, as for Q and S .

7.3.5.3.2 TRI4W3V3I configuration

The board samples $v_1, i_1, v_2, i_2, v_3, i_3$ on a whole number of periods.

It computes systematically:

$$\Sigma v_1^2, \Sigma i_1^2, \Sigma v_1 i_1$$

$$\Sigma v_2^2, \Sigma i_2^2, \Sigma v_2 i_2$$

$$\Sigma v_3^2, \Sigma i_3^2, \Sigma v_3 i_3$$

Depending on the parameters requested, it computes:

$$V1=\sqrt{(\sum v1^2/n)}, I1=\sqrt{(\sum i1^2/n)}, P1=\sum v1i1/n, S1=V1I1, Q1=\sqrt{(S1^2-P1^2)}, PF1=P1/S1$$

$$V2=\sqrt{(\sum v2^2/n)}, I2=\sqrt{(\sum i2^2/n)}, P2=\sum v2i2/n, S2=V2I2, Q2=\sqrt{(S2^2-P2^2)}, PF2=P2/S2$$

$$V3=\sqrt{(\sum v3^2/n)}, I3=\sqrt{(\sum i3^2/n)}, P3=\sum v3i3/n, S3=V3I3, Q3=\sqrt{(S3^2-P3^2)}, PF3=P3/S3$$

$$P= P1+P2+P3, Q= Q1+Q2+Q3, S= S1+S2+S3, PF = P/S.$$

If U parameters are requested, it computes:

$$\sum v1v2, \sum v1v3, \sum v2v3.$$

and deduces:

$$U23=\sqrt{((\sum v2^2+\sum v3^2-2\sum v2v3)/n)}$$

$$U13=\sqrt{((\sum v1^2+\sum v3^2-2\sum v1v3)/n)}$$

$$U12=\sqrt{((\sum v1^2+\sum v2^2-2\sum v1v2)/n)}$$

P1, P2 and P3 are signed.

Signs of Q1, Q2 and Q3 are determined by testing if v is in advance or late regarding i.

Depending on programming, it totals P, Q and S to determine energies EP, EQ, ES per phase and total.

7.3.5.3.3 TRI4W2U3I configuration

The computations are performed by making the supposition $v1 + v2 + v3 = 0$, thus allowing to express the instantaneous voltages v regarding u:

$$v1 = (2u13 - u23)/3, \text{ i.e. } 9v1^2 = 4u13^2 + u23^2 - 4 u13u23$$

$$v2 = (2u23 - u13)/3, \text{ i.e. } 9v2^2 = 4u23^2 + u13^2 - 4 u13u23$$

$$v3 = -(u13 + u23)/3, \text{ i.e. } 9v3^2 = u13^2 + u23^2 + 2 u13u23$$

Computing the reactive powers is performed by supposing a network balanced in voltage.

The board samples u13, i1, u23, i2, and i3 on a whole number of periods.

It computes systematically:

$$\sum u13^2, \sum u13i1, \sum u13i2, \sum u13i3$$

$$\sum u23^2, \sum u23i1, \sum u23i2, \sum u23i3$$

$$\sum i1^2, \sum i2^2, \sum i3^2$$

$$\sum u13u23$$

Depending on the parameters requested, it computes:

$$V1 = \sqrt{((4\Sigma u_{13}^2 + \Sigma u_{23}^2 - 4\Sigma u_{13}u_{23})/n)}/3, I1 = \sqrt{(\Sigma i_{12}^2/n)}, P1 = (2\Sigma u_{13}i_{11} - \Sigma u_{23}i_{11})/3n$$

$$S1 = V1I1, Q1 = u_{23}i_{11}/n\sqrt{3}, PF1 = P1/S1, U23 = \sqrt{(\Sigma u_{23}^2/n)}$$

$$V2 = \sqrt{((4\Sigma u_{23}^2 + \Sigma u_{13}^2 - 4\Sigma u_{13}u_{23})/n)}/3, I2 = \sqrt{(\Sigma i_{22}^2/n)}, P2 = (2\Sigma u_{23}i_{22} - \Sigma u_{13}i_{22})/3n$$

$$S2 = V2I2, Q2 = \Sigma u_{13}i_{22}/n\sqrt{3}, PF2 = P2/S2, U13 = \sqrt{(\Sigma u_{13}^2/n)}$$

$$V3 = \sqrt{((\Sigma u_{13}^2 + \Sigma u_{23}^2 + 2\Sigma u_{13}u_{23})/n)}/3, I3 = \sqrt{(\Sigma i_{32}^2/n)}, P3 = (-\Sigma u_{13}i_{33} - \Sigma u_{23}i_{33})/3n$$

$$S3 = V3I3, Q3 = (\Sigma u_{13}i_{33} - \Sigma u_{23}i_{33})/n\sqrt{3}, PF3 = P3/S3, U12 = \sqrt{((\Sigma u_{13}^2 + \Sigma u_{23}^2 - 2\Sigma u_{13}u_{23})/n)}$$

$$P = P1 + P2 + P3, Q = Q1 + Q2 + Q3, S = S1 + S2 + S3, PF = P/S$$

Depending on programming, it totals P, Q and S to determine energies EP, EQ, ES per phase and total.

7.3.5.3.4 TRI3W2U2I configuration

The computations are performed by making the supposition $v1 + v2 + v3 = 0$, thus allowing to express the instantaneous voltages v taking u in the same way as for the TRI4W2U3I configuration.

Computing the reactive powers is performed by supposing a network balanced in voltage. The board samples $u_{13} i_{11} u_{23}$ and i_{22} on a whole number of periods.

It computes systematically:

$$\Sigma u_{13}^2, \Sigma u_{13}i_{11}, \Sigma u_{13}i_{22}$$

$$\Sigma u_{23}^2, \Sigma u_{23}i_{11}, \Sigma u_{23}i_{22}$$

$$\Sigma i_{11}^2, \Sigma i_{22}^2$$

$$\Sigma u_{13}u_{23}, \Sigma i_{11}i_{22}$$

Depending on the parameters requested, it computes:

$$V1 = \sqrt{((4\Sigma u_{13}^2 + \Sigma u_{23}^2 - 4\Sigma u_{13}u_{23})/n)}/3, I1 = \sqrt{(\Sigma i_{11}^2/n)}, P1 = (2\Sigma u_{13}i_{11} - \Sigma u_{23}i_{11})/3n$$

$$S1 = V1I1, Q1 = \Sigma u_{23}i_{11}/n\sqrt{3}, PF1 = P1/S1, U23 = \sqrt{(\Sigma u_{23}^2/n)}$$

$$V2 = \sqrt{((4\Sigma u_{23}^2 + \Sigma u_{13}^2 - 4\Sigma u_{13}u_{23})/n)}/3, I2 = \sqrt{(\Sigma i_{22}^2/n)}, P2 = (2\Sigma u_{23}i_{22} - \Sigma u_{13}i_{22})/3n$$

$$S2 = V2I2, Q2 = \Sigma u_{13}i_{22}/n\sqrt{3}, PF2 = P2/S2, U13 = \sqrt{(\Sigma u_{13}^2/n)}$$

$$V3 = \sqrt{((\Sigma u_{13}^2 + \Sigma u_{23}^2 + 2\Sigma u_{13}u_{23})/n)}/3, I3 = \sqrt{((\Sigma i_{11}^2 + \Sigma i_{22}^2 + 2\Sigma i_{11}i_{22})/n)}$$

$$P3 = (\Sigma u_{13}i_{11} + \Sigma u_{13}i_{22} + \Sigma u_{23}i_{11} + \Sigma u_{23}i_{22})/3n, Q3 = (\Sigma u_{23}i_{11} + \Sigma u_{23}i_{22} - \Sigma u_{13}i_{11} - \Sigma u_{13}i_{22})/n\sqrt{3}$$

$$S3 = V3I3, PF3 = P3/S3, U12 = \sqrt{((\Sigma u_{13}^2 + \Sigma u_{23}^2 - 2\Sigma u_{13}u_{23})/n)}$$

$$P = (\Sigma u_{13}i_{11} + \Sigma u_{23}i_{22})/n, Q = Q1 + Q2 + Q3, S = S1 + S2 + S3, PF = P/S$$

Depending on programming, it totals P, Q and S to determine energies EP, EQ, ES per phase and total.

7.3.5.3.5 TRI3W1U1I configuration

The network is supposed to be balanced in voltage and current.

The board samples u_{23} and i_1 on a whole number of periods.

It computes:

$$\Sigma u_{23}^2, \Sigma u_{23}i_1, \Sigma i_1^2.$$

Depending on programming, it deduces:

$$U_{23} = \sqrt{(\Sigma u_{23}^2/n)}, V_1 = U_{23}/\sqrt{3}, I_1 = \sqrt{(\Sigma i_1^2/n)}, Q_1 = \Sigma u_{23}i_1/n\sqrt{3}, S_1 = V_1 I_1$$

$$P_1 = \sqrt{(S_1^2 - Q_1^2)}, PF_1 = P_1/S_1$$

$$P = 3P_1, Q = 3Q_1, S = 3S_1, PF = PF_1$$

Depending on programming, it totals P , Q and S to determine energies EP , EQ , ES .

7.3.5.4 Note concerning computation of the apparent and reactive powers and power factor in non sinusoidal mode

When the current or the voltage are not sinusoidal, we can, as in sinusoidal rate, define the apparent power as the product of the voltage and current RMS values: $S = VI$.

The power factor is then defined as the quotient of the active power by the apparent power: $PF = P/S$.

Here, this power factor has no relation with the dephasing of the current fundamental term together with its harmonics regarding the corresponding voltages.

On the other hand, we cannot, as in sinusoidal rate, show up, from the expression of the instantaneous power, a reactive power and give a physical interpretation.

So, many methods have been suggested for determination, and consequently measurement, of the reactive power in deformed rate. One of them is to consider the total reactive power as the sum of the reactive powers due to fundamental and to each of its harmonics:

$$Q = \sum_n V_n I_n \sin \varphi_n$$

But with P and Q definitions, the relation $S^2 = P^2 + Q^2$ is no more true as in sinusoidal rate and we must write: $S^2 = P^2 + Q^2 + D^2$, by introducing the notion of power D called *deforming power*.

The previous paragraph 7.3.5.3 details the computation modes of the different electrotechnical parameters.

We can see that the apparent power S and the power factor PF are always computed as indicated above, whatever is the connection mode used.

On the other hand, how is computed the reactive power Q depends on the instantaneous parameters able to be measured by the board, hence on the connection mode performed:

- Through the modes of connection to a three-phase network with measurement of the interphase voltages (configurations TRI4W2U3I and TRI3W2U2I), the computation mode of Q gives a result corresponding to the formulation above, and the relation $S^2 = P^2 + Q^2$ is checked only in sinusoidal rate.
- For the other connection modes (configurations MONO, TRI4W1V1I and TRI4W3V3I), Q is computed using formula $Q^2 = S^2 - P^2$. *The value obtained is then valid only in sinusoidal rate.*

7.4 Calibration

Before calibration, switch the system to measurement for 1 hour minimum to ensure a good thermal settling of the components.

Calibration must be performed on the 3 voltage channels and the 3 current channels.

Two steps:

- Zero calibration.
- Gain calibration.

Calibrating the zero must be performed before calibrating the gain.

During adjustments, AC voltage should not be applied to voltage input 1 on the board.

7.4.1 Material required

For board number 1 (inputs for voltage and current transformers):

- Voltage input adjustment: a DC standard voltage of approximately 160 V and an accuracy greater than 0.01%.
- Current input adjustment: a DC standard voltage of approximately 220 mV and an accuracy greater than 0.01%.

For board number 2 (inputs for Hall effect sensors, module LEM type):

- A DC standard voltage of approximately 5.5 V and an accuracy greater than 0.01%.

7.4.2 Calibrating the zero

Short-circuit the inputs of the channel to be adjusted. If it is a current channel on board number 1, also connect them to the 0 V on the board (low point of a voltage input).

Enter the following command from the system keypad: **EB Z <input>**

Where **<input>** =

V1 for voltage channel 1.

V2 for voltage channel 2.

V3 for voltage channel 3.

C1 for current channel 1.

C2 for current channel 2.

C3 for current channel 3.

Example: **EB Z C2** adjusts zero of current channel 2.

The adjustment can be performed simultaneously on several inputs. The adjusted channel list should then be specified in the command.

Example: **EB Z V1 V2 V3 C1 C2 C3** to simultaneously adjust the zero of the 6 inputs.

7.4.3 Calibrating the gain

Connect the DC voltage standard output to the input to be adjusted and apply a known voltage of:

- approximately 160 V for adjusting a voltage input on board number 1.
- approximately 220 mV for adjusting a current input on board number 1.
- approximately 5.5 V for adjusting any input on board number 2.

To adjust the current channels on board number 1, the standard low point must also be connected to the 0 V on the board (low point of a voltage input).

The input impedances of current channels on board number 1 being low (2.5 k Ω), use a standard with very low output impedance or check the voltage applied by means of an accurate voltmeter.

Enter the following command from the system keypad: **EB ADJ <input> <value>**

Where:

<input> = adjusted input as indicated for the zero adjustment,

<value> = value of the applied voltage, expressed in mV for the current inputs on board number 1, and in V for the other inputs.

Examples:

EB ADJ V1 160 (if 160 V are applied to the voltage channel 1),

EB ADJ C1 218.5 (if 218.5 mV are applied to the current channel 1).

The adjustment can be performed simultaneously on several inputs. The adjusted channel list should then be specified in the command.

Example:

EB ADJ V1 V2 V3 160 (if 160 V are applied on the 3 voltage channels).



Notes

8. CENTRONIX PARALLEL PRINTER

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Notes

8.1 Connection

The parallel port connector is located at back of the DATALOG, on the Centronix board.

The movable connector is a 25-pin male SUB-D type, whose pin assignment is as follows:

DATALOG pin	Description	DATALOG input or output	Printer pin	Default voltage
1	STROBE	→	1	+ 5
2	D0	→	2	-
3	D1	→	3	-
4	D2	→	4	-
5	D3	→	5	-
6	D4	→	6	-
7	D5	→	7	-
8	D6	→	8	-
9	D7	→	9	-
10	ACK	←	10	NC
11	BUSY	←	11	0
12	PE	←	12	NC
13	SLCT	←	13	NC
14	AUTOFDXT	→	14	+ 5
15	ERROR	←	32	+ 5
16	INIT	→	31	+ 5
17 to 25	-	—	-	0

→ = Output (transmitted data); ← = Input (received data).

NOTE: A standard connection cable can also be used for the PC (or compatible) parallel port.

8.2 Setting-up

Connect the parallel printer interface cable to the system. For that:

- Make sure that the printer and system are switched off.
- Using the parallel printer instruction manual, check the connections between the cable and printer.

Automatic line feed

The printer should be configured with an automatic line feed when line feed is activated (refer to the printer instruction manual).

8.3 Exploitation

All details and instructions described in the Instruction and Reference manuals concerning the DATALOG internal printer also apply to the Centronix parallel printer.

9. APPENDIX

9.1 BOARD AN 5891 - BLACK BOX BOARD 2 PORTS RS 232/422/485 - IC113C	163
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Notes

9.1 Board AN 5891 - Black Box board 2 ports RS 232/422/485 - IC113C

The COM3 and COM4 ports must have the following parameters:

PORT	IRQ	Address
COM3	4	03E8
COM4	3	02E8

To avoid any IRQ problem with the PC extensions, the 2 ports on the IC113C board should be set to shared mode.

9.1.1 Board configuration

- 2 RS 232 ports:

- 1) Switch the PC off.
- 2) Dismantle the PC.
- 3) On the board, set the shunts on the supports E6 and E7.
- 4) Set the jumper on 4 of E2.
- 5) Set the jumper on 3 of E1.
- 6) Open the jumper on A and close the jumper on C of E3 and E4.
- 7) Set the jumper on M of E9 and E10.
- 8) On SW1: 1, 2, 3, 4, 5, 7 = Off – 6, 8 = On.
- 9) On SW2: 1, 3, 4, 5, 7 = Off – 2, 6, 8 = On.
- 10) Plug the board in an available ISA slot.
- 11) Remantle the PC.
- 12) Switch the PC on.

- 2 RS 422/485 ports:

- 1) Switch the PC off
- 2) Dismantle the PC.
- 3) On the board, set the shunts on the supports E5 and E8.
- 4) Set the jumper on 4 of E2.
- 5) Set the jumper on 3 of E1.
- 6) Open the jumper on A and close the jumper on C of E3 and E4.
- 7) Set the jumper on M of E9 and E10.
- 8) On SW1: 1, 2, 3, 4, 5, 7 = Off – 6, 8 = On.
- 9) On SW2: 1, 3, 4, 5, 7 = Off – 2, 6, 8 = On.
- 10) Plug the board in an available ISA slot.
- 11) Remantle the PC.
- 12) Switch the PC on.

9.1.2 Exploitation system configuration

- Windows® 3.x:
 - a) In **Main Group**, open **Control panel**.
 - b) Open **Ports**.
 - c) Open **COM1** by a double-click, then go to **Extension....**
 - d) Set **IRQ** to **Default** then **OK** (retart Windows® only after changing COM4).
 - e) Repeat "c" and "d" for COM2, COM3 and COM4.
 - f) Restart Windows® to take the new parameters into account.

- Windows® 9x:
 - a) Open **Work Station** then **Control panel**.
 - b) Open **Add device**.
 - c) **Next**, click **No** then **Next**.
 - d) From the list, click **Ports** then **Next**.
 - e) **Next**, Windows® starts searching for the COM3 port detection.
 - f) Repeat from "b" for COM4.
 - g) In the **Control panel**, go to **System**.
 - h) Click tab **Device Manager**, then click **Ports**.
 - i) Click **COM3** then **Properties**.
 - j) Click tab **Resources** then select the **Base Configuration 4** (IRQ 4, 03E8 – 03EF).
 - k) To the question **Do you want ...**, answer **Yes**.
 - l) Repeat from "g" for COM4.

NOTES:

1. It is possible to configure the board with 1 RS 232 port and 1 RS 422/485 port.
2. For Pentium PC type with Windows® 9x, configure in the Bios, the ports COM1 and COM2 with their respective addresses 03F8 and 02F8.