MicroprocessorControlled Universal Simulator for Most Common Process Quantities in Automotive and Machine Manufacturing Applications

Test Standard

1 Impressum

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2 General Warning and Safety Instructions

All safety instructions must be followed to ensure personal safety and avoid damage to the module or devices connected to it.

Care has to be taken that venting slots of the modules are not blocked for sufficient cooling of the inside components.

Static discharges or external voltage to the connectors of the modules must be avoided not to impact the sensitive electronics inside negatively.

Repair and servicing of our appliances must only be carried out by IMTRON GmbH or suitably trained personnel. We accept no responsibility for any injuries or damage caused as a result of improper use.

There are spots with dangerous voltage inside the modules. To prevent injuries it must only be opened when disconnected from the power supply. Devices supplied with 230 V AC power supply must be operated with protective ground wire. The power cable has to be in perfect shape. To prevent fire and other hazards, the use of recommended fuses is mandatory. All modules are not explosion-proof.

Our devices are state-of-the-art and fail-proof. However there are residual hazards when operated by untrained personnel in an improper way.

Before either installation, commissioning, operation or maintenance it is therefore essential that every person involved reads the corresponding chapter of this manual and observes its instructions.

3 Applications

The Test Standard is designed for quick testing and verification of measurement modules in a measurement chain like strain gauge amplifiers, FV converters, temperature amplifiers, etc.

A rechargeable battery allows flexible mobile use in addition to stationary mains operation.

Inputs are done via a numerical key pad and displayed by a 2*16 characters display.

Direct entering of physical parameters like e.g. pressure, force, or torque offers an easy way to review if the value set by the user is correctly processed by the measurement device. The steady conversion of e.g. the sensitivity of a strain gauge into the resulting force is automatically done by the test standard and relieves the user of doing so manually.

4 General Features

4.1 Selection of Sensors

The listed sequence is in the same order as with the arrow tabs in mode "Type".

Sensor	Unit	Possible Entries
Pressure	bar	Calibrated value for 1 ‰ and nominal value
Force	N	Calibrated value for 1 ‰ and nominal value
Torque	Nm	Calibrated value for 1 ‰ and nominal value
Potentiometer	%	
Thermocouple L	°C	
Thermocouple K	°C	
Pt 100	°C	
Strain gauge FB	mV/V	
Strain gauge HB	mV/V	
Voltage	V	Value via key pad
Current	mA	Value via key pad
Revolutions	1/min	No. of teeth and maximum revolutions
Frequency	Hz/kHz	
Optional: Voltage measurement	V	(Option „DVM, Volt", please specify with order)

4.2 Keyboard

7	8	9	±	Type
4	5	6	.	Nom
1	2	3	←	Cal
Del	0	OK	→	Out

The meaning of the buttons is described in the following:

Type: Type of sensor (e.g. strain gauge) or unit of physical parameter (e.g. pressure). By pressing this button all outputs of the test standard are disabled.

Two blinking arrows show up in the display requesting the user to select the corresponding sensor. Scroll through the list with the forward/backward arrow buttons and confirm your selection by pressing *OK*.

Out: The output of the displayed value will be enabled by pressing this button. When switched off, the zero setting of the sensor is delivered. The status is shown in the display with ON/OFF. This button is only active with an already selected sensor via the *Type* button.

Cal: Calibration value.
A value can be entered by the user. The last entered value is suggested and can be acknowledged with *OK*. For strain gauges (pressure, force, torque) the calibration value is based on a sensitivity of 1 ‰ equal 0.5 mV/V. For RPM the number of teeth of the speed sensor can be entered. Table 4.1 shows slectable sensors with corresponding calibration values.
A new entered value is stored in the non-volatile memory. The *Cal* button is only active with an already selected sensor via the *Type* button.

Nom: Nominal value
A value can be entered by the user. The last entered value is suggested and can be acknowledged with *OK*. For strain gauges (pressure, force, torque) the nominal value is the full scale = maximum value of the sensor. For RPM it is the maximum value of the speed sensor.
A new entered value is stored in the non-volatile memory. If the nominal values of the sensor range are exceeded, it will be signalled by blinking OVL in the display. The *Nom* button is only active with an already selected sensor via the *Type* button.

± : Polarity of the output values

Del: Deletion of a wrongly entered value

OK: Acknowledgement of entered value
This button has to be pushed always after e.g. entering calibration or voltage values. It serves also to acknowledge sensor types selected by the arrow buttons.

$\rightarrow$: Next value (upwards or forward)
With this button either the next type of sensor (when an arrow in the first line of the display is shown) or the next output value (when an arrow in the second line of the display is shown) can be selected.
The output value is delayed for about 0.5 seconds after pressing the button. This avoids putting not desired values to the output when scrolling fast through the selectable sensor types.

$\leftarrow$: Next value (downwards or backward)
Same as above but in reverse direction

0 – 9 : Via the numerical key pad the corresponding calibration and nominal values can be entered.
For voltage and current arbitrary values can be chosen.

4.3 LCD Display

The display shows 2 * 16 characters. Normally the first line shows the type of sensor, and the second line the output value. Additional information is displayed (usually blinking) to the right of the lines.

The meanings of the abbreviations are:

OVL: (Blinking) Nominal value is exceeded or the selected value cannot be put out (e.g. with a selected voltage of 15 V).

OFF: The selected sensor is connected to the output, but is in zero balance (e.g. 0 V for voltages).

ON: The selected sensor is connected to the output, and the value in the second line is applied.
The *ON / OFF* state is changed by pressing the *OUT* button.

LO : (Blinking) Battery of the test standard is running out and needs to be recharged. Accuracy of the device might not be in specification any longer.

← →: Indicate the next choice. In first line it is the type of sensor, in second line it is the output value. Blinking means that no sensor or output value has been selected.

Further information is shown like:

AUTO ADJUST	With the sensors voltage, current, and thermocouples or when simply measuring voltage, an internal zero setting will be applied to the DA / AD converter before the value is displayed.
BATTERY EMPTY	If the battery is completely run out, this text is displayed and all outputs are disabled. Working with the device is not possible any longer.
CHARGING (READY!)	If the device is switched off and connected to the power supply, you will see this information. In charging mode a symbol will blink in the second line. *Ready!* will be displayed, when charging is complete.
SAVE PARAMETER S	When the device is switched off, the last configuration is saved. With power supply connected, battery will then be loaded. Switching on will display the last configuration.
CALIBRATION VALUE	Request to enter a calibration value via the key pad after having pressed *CAL* button. Close with *OK*.
NOMINAL VALUE	Request to enter a nominal value via the key pad after having pressed *NOM* button. Close with *OK*.

4.4 Battery and Mains Operation

The test standard is suited for stationary and mobile use. The rechargeable battery normally runs for about 8 hours, but less when constant current output is used. If the mains adapter is plugged in, the battery will be automatically charged. This is indicated by the *CHARGE* LED on the front panel. If the test standard is switched off, charging mode will be also indicated by the LCD panel.

In battery mode blinking characters *LO* indicate, that the battery is running out and needs to be recharged. To maintain a best possible lifetime, a complete discharge of the battery should be avoided. As it uses NiMH technology, the memory effect is not very distinct.

4.5 General Instructions

If you want to toggle between different types of sensors, the following procedure is recommended:

1. Press the *Type* button. This disables all the outputs.
2. Remove connecting cable, if applicable.
3. Select new sensor with the arrow buttons (do not press *OK* yet).
4. Plug in connecting cable.
5. Press the *OK* button. Now the outputs will be enabled.

Should there be a malfunction, a reset can be activated with the *RESET* switch at the back of the device. For that a sharp tool like a small screwdriver or pin is needed.

4.6 Control Elements on the Back Side

4. CANNON socket   3. Souriau socket   2. LEMO socket   1. BNC socket

5. Power ON /OFF switch

6. Charge adapter jack

7. Hole for *RESET* switch
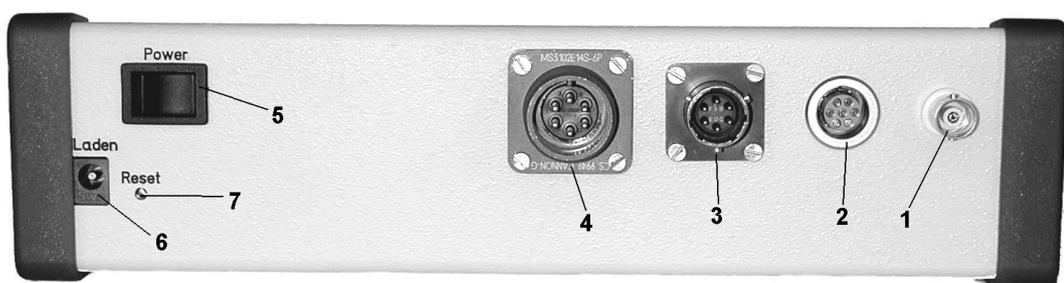
5 The Sensors

5.1 Strain Gauge Bridge Simulation

The resistance of the bridge is 350 Ω and has the following pin assignment:
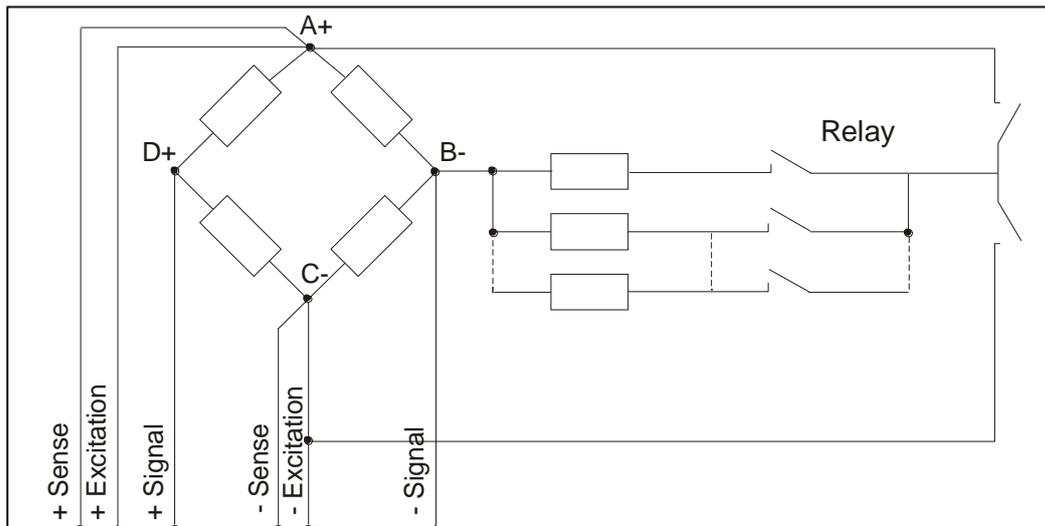
The following functions are implemented with a strain gauge bridge:

Simulation of:	Physical Parameters	Calibration and nominal value input	Remarks
Strain gauge full bridge	mV/V	No	
Strain gauge half bridge	mV/V	No	
Pressure	Bar	Yes	Only full bridge
Force	N	Yes	Only full bridge
Torque	N/m	Yes	Only full bridge

The calibration value input relates to 0.5 mV/V (1 ‰) sensitivity of the bridge. Pressing the arrow buttons will execute the next fixed value (see technical data). Simultaneously the entered value for pressure, force, and torque only will be calculated with respect to the selected sensitivity of the bridge. If e.g. a calibration value of 10 bar has been entered for pressure, a value of 20 bar will be displayed when advancing to 2 ‰ nominal value.

5.2 Torque Simulation (Strain Gauge Bridge)

Generation of torque with entering of calibration and nominal value:

1. Press *Type*
2. Toggle with ←→ arrows to type *Torque*
3. Acknowledge with *OK*
4. Press *Nom*
5. Enter new nominal value or acknowledge displayed one with *OK*
6. Press *Cal*
7. Enter new calibration value or acknowledge displayed one with *OK*
8. Select desired torque value with ←→ arrows
9. Press *Out*

5.3 Pt 100 Simulation

A Pt 100 sensor is simulated by switching of precision resistors with 6 benchmark values

between A+, D+, C-, and B-.
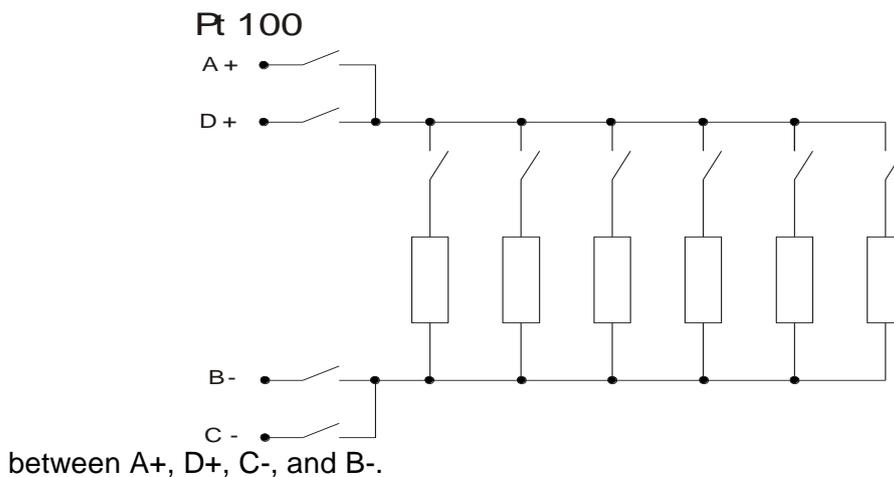
The following temperature values are provided:

-50	0	50	100	150	200	°C

5.4 Potentiometer Simulation

A potentiometer is simulated by switching of precision resistors with 6 benchmark values. The layout is as follows:

Poti
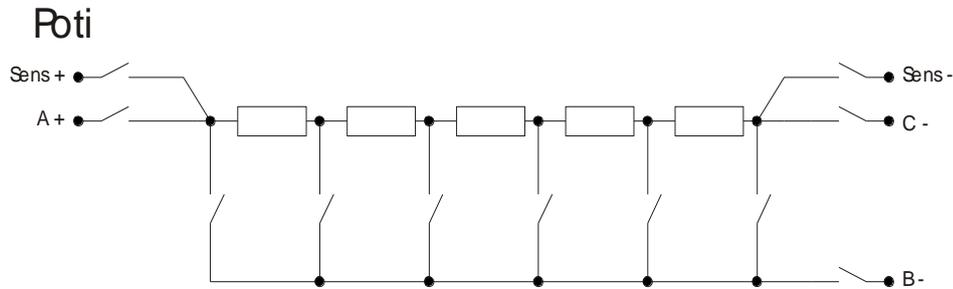
5.5 Generating Speed / Frequency Values

Simulation of rpm and frequency value is physically the same, but differs in the presentation on the LCD display.

For revolutions the speed is calculated based on the entered calibration value = number of gear teeth as follows:

$$\mathrm{Re}\,v/\min \;=\; \frac{60 \times frequency}{number\ of\ teeth}$$

This calculation is automatically done by the test standard. Should the entered nominal value be exceeded, it will be displayed nevertheless, but the user will be warned by blinking *OVL* characters in the display. For frequencies, the displayed value is the output frequency and there is no conversion.
Selectable frequencies are shown in the section Technical Data.

5.5.1 Example for Simulating Speed

Output of speed by definition of calibration and nominal value with

Calibration value = 10 teeth, nominal value = 8000 /min

1. Press *Type*
2. Toggle with ←→ arrows to type *Speed*
3. Acknowledge with *OK*
4. Press *Nom*
5. Enter new nominal value (8000 /min)
6. Press *Cal*
7. Enter new calibration value (10 teeth
8. Select desired speed value with ←→ arrows
9. Press *Out*

The selecred speed will be available at the output.

5.6 Output of Voltage

Voltages are generated by a 16 bit D/A converter. The programmed benchmark values can be selected via the arrow buttons or individually put in via the key pad in a range of ± 10 V. Voltage is available at outputs D+ and B-. To enter a value directly (after selecting *Voltage*), the first digit will lead to a numerical input field. Acknowledgement is done as usual by pressing *OK*.

The test standard is performing an auto adjust of the D/A converter for all related functions (voltage, thermocouples, current) after selection of the sensor type. This will automatically match changed environmental conditions, especially in sight of changed temperature.

5.6.1 Example for Voltage Output

Output of an arbitrary voltage in the ± 10 V range:
1. Press *Type*
2. Toggle with ←→ arrows to type *Voltage*
3. Acknowledge with *OK*
4. Enter arbitrary value via the key pad and acknowledge with *OK*
5. Press *Out*

The desired voltage will be available at the BNC socket or at outputs D+ B-.

5.7 Thermocouple Simulation

Thermocouples type L and K are simulated with 6 benchmark values. Selecting the benchmarks is done via the arrow buttons after choosing the type of thermocouple. Please note that the to be tested TC amplifier should not use the cold junction compensation with ambient temperature as the test standard provides only thermo voltages referring to 0 °C base.

5.8 Constant Current Simulation

Current benchmark values can be selected via the arrow buttons. Arbitrary values up to 50 mA can be put in via the key pad (for details see chapter 5.6.1).

Please note that with battery operation the discharging of the battery is much quicker when simulating currents. Therefore mains operation is more recommended for longer use of current simulation.

6 Voltage Measurement

(Optional, to be ordered as option "DVM")

As it is often useful for quick checks to measure voltages also, this feature can be integrated into the test standard. The range is ± 10 V, and the to be measured voltage is connected to pins D+ and C-.

After selection of this function, an auto adjust is being performed with the D/A converter (like 5.6). This will automatically match changed environmental conditions, especially in sight of changed temperature. Measurement of voltage is done at a rate of 2 Hz and shown in the LCD display.

Please note: If a low resistive voltage source is measured (e.g. a power supply) you must disconnect this source from the test standard before another sensor is selected. Otherwise some components in the test standard might be overloaded!

7 Technical Information

7.1 Technical Data

Strain Gauge (Force, Torque, Pressure)	Sensitivity [mV/V]	0.0 / ± 0.25 / ± 0.5 / ± 1.0 / ± 2.0 / ± 4.0 / ± 20.0 / ± 40.0
	Bridge resistance	350 Ω
	Accuracy	0.1 % (of output value) based on sensitivity ≥ 1 mV/V
	Output	6-wire technique (only for Lemosa connector) - Supply @ A+ and C- - Signal @ D+ and B- - Sense @ Sens+ and Sens- All other connectors do not support sense lines
Potentiometer	Sensitivity (% supply voltage)	0 % / 20 % / 40 % / 60 % / 80 % / 100 %
	Total resistance	5 kΩ
	Accuracy	0.1 % (of output value)
	Output	5-wire technique (only for Lemosa connector) - Supply @ A+ and C- - Signal @ B- - Sense @ Sens+ and Sens- All other connectors do not support sense lines
Pt 100	Selectable temperature [°C] corresponding [Ω]	-50 / 0 / 50 / 100 / 150 / 200 (80.31 / 100 / 119.4 / 138.5 / 157.3 / 175.8)
	Accuracy	0.2 % (of output value)
	Output	4-wire technique Current feed @ A+ and C-, Signal @ D+ and B-
Frequency (Speed)	Selectable frequency	0.5 Hz / 2 Hz / 10 Hz / 50 Hz / 200 Hz / 1 kHz / 5 kHz / 10 kHz / 15 kHz* / 20 kHz / 62 kHz* / 100 kHz /138 kHz*
	Type	TTL signal with duty cycle 1/1
	Accuracy	0.02 % (of output value); exception for * = 0.1 %
	Output	Signal @ D+ and B-
Voltage	Selectable voltage (via arrow buttons)	100 mV / 200 mV / 500 mV / 1 V / 2 V / 5 V / 10 V
	Selectable voltage (via key pad)	Arbitray in ± 10 V range (Full scale)
	Accuracy	0.05 % of FS (after auto adjust)
	Temperature drift	0.2 mV/°C (after auto adjust)
	Output	Signal @ D+ und B-
Thermocouple (L and K)	Selectable temperature [°C]	-50 / 0 / 50 / 100 / 150 / 200 (please see 5.7 for CJC)
	Accuracy	0.2 % (of output value)
	Output	Signal @ D+ und C-
Current	Selectable current (via arrow buttons)	0 mA / 4 mA / 10 mA / 20 mA / 40 mA
	Selectable current (via key pad)	Arbitrary in 0 to 50 mA range (Full scale) (maximum voltage appr. 10 V)
	Accuracy	0.03 % of FS (after auto adjust)
	Output	Current @ D+ and B-
Voltage	Range	+/- 10 V (FS) (Option „DVM, Volt")
	Accuracy	0.02 % of FS +/- 1 digit (after auto adjust)

Measurement	Input	Signal @ D+ and B-

7.2 Pin Assignments

As seen from soldering side
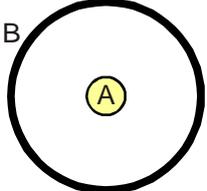
BNC	Pin
	A = Signal+ (D +) B = Signal- (B -)
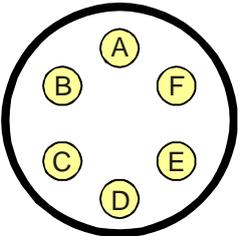
SOURIAU	Pin
	A = Supply+ (A+) B = Signal+ (D+) C = Signal– (B-) D = Supply- (C-) E = NC F = Shield
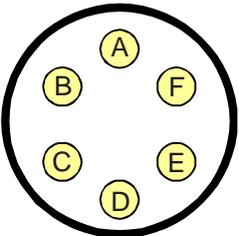
CANNON	Pin
	A = Supply+ (A+) B = Signal+ (D+) C = Signal– (B-) D = Supply- (C-) E = NC F = Shield
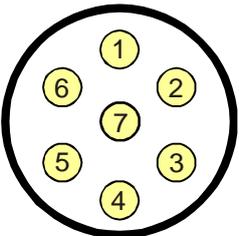
LEMOSA	Pin
	1 = Supply+ A+) 2 = Signal– (B-) 3 = Supply- (C-) 4 = Signal+ (D+) 5 = Sense- 6 = Shield

	7 = Sense+

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7.3 Block Diagram
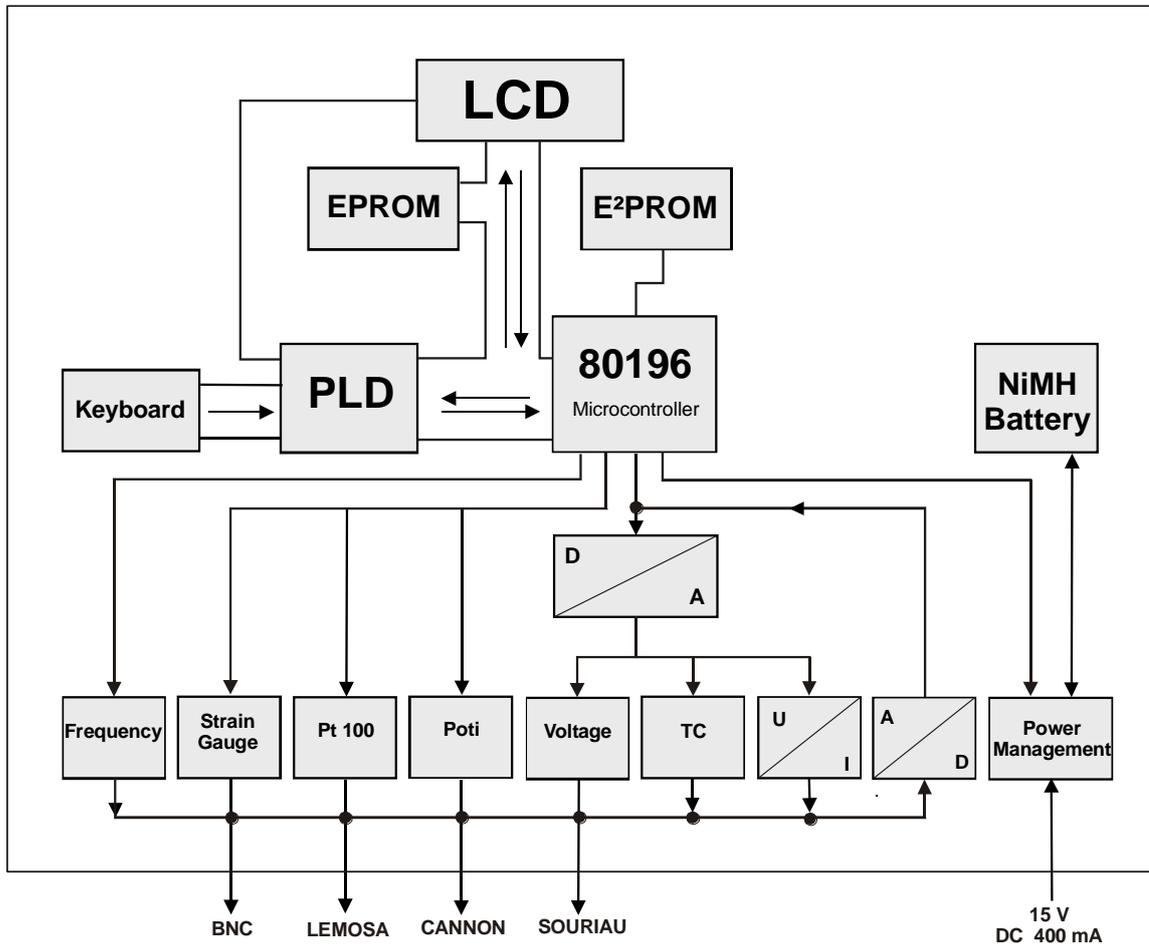
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