# Progres Programmer PP-96

## Manual

*(Final Release)*

# Contents :

# 1.) General information

### 1.1.) Introduction

Please read this manual carefully. You can save a lot of time and avoid unpleasant situations if you read this manual before working with the Progres-programmer.

**Attention : Transmitters built from '97 onwards are equipped with the PROGRES-95 integrated circuit, which can only be programmed when the IC temperature is in the range of 0°C to 40°C. Otherwise, the PROGRES-95 IC and therefore also the transmitter might be destroyed !**

In order to gain a better understanding of the Progres-Programmer PP-96, please read the following description of the PROGRES-95 Integrated Circuit.

### 1.2.) The PROGRES IC

The Progres-Programmer PP-96 is used to program the Keller PRO version pressure transmitters e.g. Series 21 PRO, or other electronics which are equipped with the PROGRES IC.
The PROGRES IC micro chip is the central element of all KELLER PRO electronics, it offers an extraordinary flexibility and is already proven in hundreds of thousands of electronic circuits.
A common description for this component would be a programmable, analogue amplifier. The PROGRES-95 IC gives us the ability to change the zero-point and amplification of this IC in very small steps and at any time from outside the system. It also has the ability to compensate thermal signal errors, which makes it an almost ideal element for sensor technology, and a very interesting instrument in many applications. The integrated constant current source and other features allow us to build, with this IC and a few passive components, transmitters with standardised output signals.

The PROGRES IC today is already in it's second generation. The first version was designed in 1989 and we therefore call it PROGRES-89. In the same way we call the new generation PROGRES-95.

Both generations can be programmed by digital lines. With the old PROGRES-89 IC only the writing of data to the IC was possible, but the new PROGRES-95 IC allows even the programmed data to be read back. In addition, the digital interface of the new generation has improved immunity to electro-magnetic disturbances. Both of these improvements require an additional programming line. Therefore the PROGRES-95 IC has five digital programming lines.

### 1.3.) The main functions of the programmer

The Progres-Programmer PP-96 is a microprocessor controlled handheld unit. It is able to automatically detect and to program both the old PROGRES-89 and the new PROGRES-95 generation. Programming lines can be up to 100 meters long.

The PP-96 provides the power supply to a connected PROGRES transmitter. The transmitter output signal can be measured using a separate multimeter. In addition, it is possible to loop the device into an operating process and then to program the transmitter to the requirements of the operating process.

For portable operation, a 9 Volt battery is used for the supply of the device and of the transmitter.

The PP-96 is equipped with a RS 232 type serial interface. Therefore it can be connected directly to a PC. The programming of a transmitter and the management of its data can also be carried out via the host PC.

### 1.4.) Extensions

The PP-96 can be optionally equipped with an RS 485 type serial interface (Has to be explicitly ordered). The RS485 interface allows the interconnection of several programmers on the same line connected to a single PC. The programmers then are networking, each PP-96 is served by the host PC simultaneously. Using this configuration, a multi station calibration system for the simultaneous calibration of several PROGRES transmitters can be built up easy, and step by step.

# 2.) Installation

### 2.1.) Inspection / Delivery contents

Before starting to work with the PP-96 please check the delivery. Optional components are only included if they have been ordered explicitly.

Standard delivery contents are :

- ❑ Progres-Programmer PP-96.
- ❑ Mains Power supply adapter for 220 VAC.
- ❑ RS 232 serial connection cable for 8-pin Series 21 PRO transmitter.
- ❑ Cable with three banana plugs for the connection of an external multimeter.
- ❑ 9 Volt battery.
- ❑ Manual.

Options, the following components may also be included if ordered.

- ❑ Short adapter cable, 8-pin connector to PCB edge connector (Progres PCB )
- ❑ Y-type cable for direct connection into operational process loop.
- ❑ RS 232 interface cable.
- ❑ RS 485 interface cable.
- ❑ RS 232 to RS 485 interface converter.

**2.2.) Setting Up**

Picture shows PP-96 with all cables connected :


Setting up the PP-96 is relatively simple. But please read the following instructions to avoid operational problems.

The PP-96 including the connected transmitter, can be powered either from the internal 9V battery or the mains power supply adapter.

## *Whenever possible, work with the mains power supply adapter !*

Battery power has certain disadvantages, as the internal 9V battery has insufficient voltage to drive transmitters with 0...10V signal output. These transmitters usually need a supply voltage above 13V. When using the PP-96 powered from the internal 9V battery the maximum output signal of transmitters will only be around 7 Volts.
If the mains power supply adapter is used, this won't be a problem.

Battery operation with 4...20mA and 0...20mA transmitters is only possible for a limited time period. Current loop transmitters can discharge the battery quickly. In worst case (continuous current consumption of 20mA) a standard 9 Volt battery runs out of charge after about 15 hours of operation. When operating a PP-96 with a partially discharged battery, the transmitter signal might level off before reaching 20mA. ( A common mistake is to assume that the test transmitter is faulty ). Always know roughly the charge level of the battery or fit a new battery before use.

Therefore, take great care regarding the output signal of transmitters if working from a battery powered PP-96. Battery power is only suited for portable, short term operation..

**Whenever possible, work with the mains power supply adapter.**

#### 2.2.1.) Connection of the power supply adapter :

Check, that your mains power supply corresponds with the voltage of the adapter 220..240V ac.
Plug the round connector of the adapter cable into socket A.

#### 2.2.2.) Connection of the transmitter cable :

Connect the transmitter cable (side entry on the double D connector) to socket B. The PP-96 will function without the test transmitter connected.
The free side of the double D connector is the connection for the serial interface RS 232.

#### 2.2.3.) Connection of the Y-type cable (Option) :

This cable is also equipped with a double D connector and is connected to socket B in the same way as the transmitter cable. The two cables coming from the double D connector are connected as follows :

Cable with plug : To the supply of the transmitter. ( max. 30V dc. )
Cable with socket : To the transmitter itself.

The programmer can be operated without battery power in this configuration. It takes its supply from the power supply of the transmitter.
Looping into a running process is not possible with 2-wire (4...20mA) transmitters, because in 2 wire configuration, the current consumption of the programmer would be added to the transmitter signal. The signal will therefore be incorrect. With 3-wire transmitters, this is not a problem.

**2.2.4.) Connection of an external multimeter :**

The cable fitted with 3 banana plugs / 1 jack plug is used to measure the signal of the connected transmitter with a multimeter. Connect the banana plugs to the multimeter as follows :

| Plug colour | 2 wire | 3 wire Voltage | 3 wire Current |
|---|---|---|---|
| Red | | Voltage | |
| White | Current | | Current |
| Black | GND | GND | GND |

(The red plug leads the voltage signal and the white plug leads all current output signals)

When measuring current signals ensure, that the voltage drop across the multimeter (current input with respect to GND) is less than 400mV. Otherwise, the multimeter will indicate in-accurate, low current signals.

Also respect, that any external current measurement only can be done as long as the instrument also is measuring the signal. This means, you have to press the corresponding function key in order to enable current measurement both for internal and external signals.

**Always make all connections to the multimeter before connecting the test transmitter. Never plug in the external multimeter connections when a transmitter is already connected to the progres-programmer. The PP-96 could reset and any previously evaluated data may be lost.**

**Do not make changes to adapter cables and connectors. Malfunction of the PP-96 will result. Especially on current signal measurements any manipulation can affect proper operation of the system.** Contact KELLER sales, if you intend to make changes on the cables and adapters !

The signals measured at the banana plugs are the **real** transmitter signals. Therefore, there is no need to measure the signals somewhere else than at these plugs.

The system is now ready for operation.

# 3.) Operation

### 3.1.) The main functions

The PP-96 has the following main functions :

| | |
|---|---|
| Programming transmitters | Manual programming.<br>Enables manual setting of the individual transmitter calibration parameters, ZERO, GAIN, TC-ZERO and TC-GAIN. |
| Measuring transmitter signals | The PP-96 is able to measure the output signal of the connected transmitter. The transmitter output signal type must be selected previously (the instrument cannot automatically detect the type). |

### 3.2) Operational modes

The PP-96 progres programmer has two different operational modes.
They are the **number edit mode** and **function mode**.
The keys are marked with two different functions. There are black function key and red number key markings.

The operational mode of the PP-96 is determined as follows :

**Function mode :**

This is the standard operation mode. The instrument always starts up in function mode.
The function mode is always active when no cursor is flashing on the display. Here, the following rules are valid :

- ❑ You can increase or decrease the programming values with the cursor keys (🡻🡹).
- ❑ Directly select a function by pressing the corresponding key.
- ❑ All error messages or warnings must always be acknowledged by pressing the "Enter" key.
  (Hint : All messages showing an exclamation mark must be acknowledged by "Enter".

**Number edit mode :**

PP-96 is in **Number Edit Mode** when the cursor on the display is flashing. Numbers can entered and confirmed by pressing the "Enter" key. After pressing "Enter", the PP-96 returns to function mode.

**Change between the Number Edit Mode and the Function Mode by pressing the "NUM" key.**

### 3.3.) Example

Familiarisation with the operation of the PP-96 is best learnt by working with it. The following **example** will demonstrate the features of the PP-96. The example includes the chapters 3.3 through 3.6.

Make sure, that there is no transmitter connected and then turn the instrument on.

The programmer boots and shows the following, during the first three seconds of operation :

PROGRES-
PROGRAMMER
PP-96 9912

The number at the bottom right shows the year and week of the software release.

After this "Intro" the PP-96 reacts differently depending on whether a transmitter is connected or not. To follow this example please make sure the transmitter is disconnected to begin.

Immediately after switch on, the PP-96 is in **Function Mode** and shows "NO DEVICE !". This means, that there is no transmitter connected.

### 3.4.) Programming

The programming of transmitters is the central element of the progres-programmer, version PP-96.

The display shows : "NO DEVICE !". there is no transmitter connected, please connect it now.

or PROGRES 89 / PROGRES 95 when transmitter is connected.

Because there is a transmitter connected now, the display shows the enabled sub function “ZERO“ instead of the message "NO DEVICE !". There are four sub functions available :

ZERO (the one you see now)
GAIN
TC-ZERO
TC-GAIN

These functions can directly be selected by pressing the corresponding function key.
Now, let’s select GAIN to programme the sensitivity of the transmitter.

After the selection of GAIN, the display shows :

| with new Progres 95 transmitter connected : | | with old Progres 89 transmitter : | |
|---|---|---|---|
| PROGRES | 95 | PROGRES | 89 |
| GAIN | 234 | GAIN | 512 |

The PP-96 displays the type of the PROGRES generation connected, and the actual setting of the GAIN parameter. The parameter value corresponds to the internal amplification of the Progres IC. The next item of this chapter explains the interpretations of the different numerical values for each parameter (ZERO ; GAIN ; TC-ZERO ; TC-GAIN).

**IMPORTANT** PLEASE READ THIS BEFORE MAKING CHANGES TO VALUES

When using old transmitters, equipped with the PROGRES-89 IC, the actual stored data setting cannot be read out (because the PROGRES 89 chip does not have this function).
Therefore, the PP-96 automatically assumes a mean value for each of the parameters.
For the GAIN parameter, this mean value is 512, for all the other parameters, the value 0 will be displayed. ( This is irrespective of the actual values set and stored previously ).

Assuming a mean value has the following disadvantages :

1.) The effectively stored data of a transmitter can only be evaluated using the analogue signal performance of the transmitter (unless records have been keep of previously programmed values).

2.) Immediately any parameter value is changed the first time after connecting an old PROGRES 89 transmitter, the output signal of the transmitter may jump to a completely new value. This is because the new programmed value may be completely different to the original one.
Users of old PROGRES 89 transmitters need to be aware of this.
To avoid this problem in subsequent operations, manually record all the data values of any transmitter, that has been reprogrammed.

With the new PROGRES-95 IC this problem does not arise because all data values can be read out.

However the new generation PROGRES-95 IC does have another attribute which must be respected:
**The new PROGRES-95 IC may only be programmed within the temperature range, 0°C..+40°C.**

Therefore, before using the PP-96, always make sure, that the temperature of the transmitter connected is within the temperature range of 0°C...+40°C. The transmitter should never be programmed outside of this range because it may be destroyed.

**Setting the GAIN cont.'**

To change the selected GAIN setting press : "Cursor Up" ↑ key to increase.
"Cursor Down" ↓ key to decrease.

If the keys are pressed longer than one second, the numbers change progressively faster.

The selected GAIN parameter can now be changed.
Programming of the transmitter is done immediately after the key is released. The analogue signal therefore will not change as long as the key is pressed.

**Alternative Method**

Selected parameters can also be changed using Number Edit Mode, reached by pressing "NUM" key once. Number Edit Mode is indicated by flashing cursor.

To change the selected GAIN setting, enter the new value using the number keys, then "Enter".
The new value will be programmed after the "Enter" key is pressed and released.
The programmer returns to the function mode and the "NUM" key must be pressed again in order to reach number edit mode.

HINT : If accidentally typing a wrong new value without pressing "Enter" afterwards, it is possible to return to the original value by pressing "NUM" once. The original value will be displayed again and the programmer is back in the function mode.

**Setting the ZERO**

The ZERO parameter is set using the same method as described above for the GAIN.

The parameters of TC-ZERO and TC-GAIN can be selected, but they cannot be changed because they are locked (The programmer always shows this on the bottom line by displaying "LOCKED").
Thermal parameters are locked because accidental programming will probably produce worsened thermal characteristics of the connected transmitter. Factory set KELLER transmitters are calibrated for ideal thermal characteristics, the change of any thermal parameters is not usually necessary. In addition, the accurate recalibration of an accidentally mis-programmed transmitter is a very extensive and difficult task. In most cases, it is unlikely that the customer will have the necessary equipment or expertise to recalibrate thermal parameters effectively. However, both parameters can be monitored in any case. For OEM customers with specific test requirements the PP-96 can be supplied with the thermal parameters active, but this is subject to our discretion.

**Note : If PP-96 continuously defaults to ZERO** ( this indicates LOW BATTERY, fit new one )

If the battery voltage falls below the pre-set limit during operation of the PP-96 the instrument will default to the ZERO function. No other functions can be selected until the battery is replaced.
After replacing the battery, re-programme the transmitter which was connected to the PP-96 when the battery failed, otherwise data retention of the transmitter cannot be guaranteed over the specified period of time (> 10 years) .

**3.5.) Ranges and influence of the different parameters**

The PROGRES IC allows to change to parameters ZERO, GAIN, TC-ZERO and TC-GAIN. The following part describes the meaning, ranges and influences of them.

**3.5.1.) ZERO :**

The ZERO parameter is used to set the zero point of a transmitter equipped with a PROGRES IC. Each PROGRES IC has 512 steps for zero adjustment, 256 in the positive direction and 256 in the negative direction. As shown below.

| Range of value | Influence |
|---|---|
| 0 to 255 | Neutral to most positive influence |
| 256 to 511 | Neutral to most negative influence |

This unusual order of the numbers may cause the user some confusion during programming. To raise the Zero point the user presses the “Cursor Up” ↑ key, this is correct, however the numbers on the display of the PP-96 will be reducing (e. g. form 305 down to 304). Don’t be confused by the value display, the PP-96 programmes with respect to the transmitter output signal. Therefore to shift the output signal in the positive direction press the “Cursor Up” ↑ key, and “Cursor Down” ↓ key for shift in the negative direction. The displayed numerical value is only relevant for data management.

Production transmitters do not have identical zero settings, there is no right or wrong numerical value for the zero point, it can be set anywhere within the 512 steps. The influence of 1 step change will be different for each individual transmitter. This is due to the influence of various production tolerances, it is the ability to overcome these inherent differences between transmitters, that makes the PROGRES system such a useful tool for transmitter calibration.

**3.5.2.) GAIN :**

The GAIN parameter is used to set the full-scale point of a transmitter equipped with a PROGRES IC. Each PROGRES IC has 1023 steps for gain adjustment, the value 0 equals an amplification at the PROGRES IC of a factor of one, and the value 1023 equals a PROGRES IC amplification of 14. However because the gain factors apply to the PROGRES IC these figures do not relate to the total gain of the transmitter. Most PROGRES transmitters have further amplifications stages after the PROGRES IC which will produce a greater overall gain for the transmitter. The displayed numerical value is only relevant for data management.

In order to calibrate the amplification and set the full-scale signal output of a transmitter, more than one cycle is necessary. Calibrate as follows step by step: Apply a stable full-scale pressure to the transmitter. Monitor and set the analogue output signal of the transmitter to its target value by using the GAIN programming function, “Cursor Up” ↑ and “Cursor Down” ↓ keys. Now release the pressure and check the zero point. Usually it its necessary to recalibrate the ZERO value following GAIN value changes. This is because the GAIN setting also affects the zero point. Normally, after two iterations (GAIN → ZERO → GAIN → ZERO), the amplification and full-scale signal of the transmitter can be set correctly.

**3.5.3.) TC-ZERO :**

The TC-ZERO parameter is used to set the thermal zero characteristics of a transmitter equipped with a PROGRES IC. Each PROGRES IC has 32 steps for TC-Zero adjustment, 16 in the positive direction and 16 in the negative direction. As shown below.

Range of value

0 to 15 and

16 to 31

The explanation of these values is extremely complicated and would fill a couple of pages. Therefore it is not described in detail. TC-ZERO function is normally supplied “LOCKED” on PP-96

**3.5.4.) TC-GAIN :**

The TC-GAIN parameter is used to set the thermal sensitivity characteristics of a transmitter equipped with a PROGRES IC. Each PROGRES IC has 8 steps for TC-GAIN adjustment.

The explanation of these values is extremely complicated and would fill a couple of pages. Therefore it is not described in detail. TC-GAIN function is normally supplied “LOCKED” on PP-96

If you need more information concerning TC-ZERO or TC-GAIN, please contact us.

**3.6) Measuring signals**

As mentioned above, the instrument is able to measure the output signal of the connected transmitter. Due to the fact, that the PP-96 is not able to automatically detect the output signal type (2-wire, 3-wire, current or voltage output), this information explicitly has to be entered. Therefore, the instrument also starts up without measuring the signal.

You can activate the measuring by pressing the appropriate function key, that corresponds with the transmitter type connected.

Please make sure, that you select the correct type. Choosing the wrong type will result into wrong measurements and in worst case, the PP-96 will display the message “WRONG SIGNAL TYPE“. This usually happens, when a 2-wire transmitter is connected, but a 3-wire current type was selected (mA). In this case, press “Enter“ to confirm the message (remember the exclamation mark rule) and choose the correct type.

As soon as the signal type is selected, the instrument shows the signal at the bottom line also indicating the chosen signal type and unit. After about two seconds, the signal will be stable.

Also respect, that the measurement usually updates about twice a second. But after programming of the transmitter or after signal changes, the display just will show a stable value **after about two seconds**.

In case you like to stop the measurements, just press the “MEASURE OFF“ key.

# 4.) Documentation

**4.1.) Eliminating errors**

Even in Switzerland, Murphy's Law is well known and respected. As Murphy's Law states, "errors can always happen, and will usually occur just at the time when we are in a hurry, or in moments when errors are never expected". We have done our best, but Murphy's Law is hard to avoid completely.

In order to help you in unexpected situations, the following table shows the possible cause of errors and their solution :

| **Error :** | **Possible Cause** | **Possible Solution** |
|---|---|---|
| Programmer does not start. | A) Battery is discharged. | Replace it. |
| | B) Supply adapter is not connected. | Check the plugs. |
| | C) Supply adapter is defective. | Try battery operation. |
| | D) Defective transmitter connected or transmitter causing a short circuit. | Check the transmitter and the connections to it. |
| | E) Programmer is not turned on ? | Check switches |
| | F) The cable for external signal measurement is not connected correctly. | Check signal meter wiring. |
| No transmitter detected. | A) Programming lines are not connected. | Check the wiring of programming lines. |
| | B) Connected transmitter is not a PROGRES transmitter ? | The PP96 can only detect PROGRES transmitters. |
| | C) The transmitter is defective. | Try another one to verify. |
| | D) Programmer is defective. | Contact Keller sales office. |
| Programmer detects the wrong PROGRES-type. | A) Some lines to the transmitter are not connected. | Check all the lines to the transmitter. |
| The message ERROR ! DATA MISMATCH appears during the programming. | A) The programming lines are cut. | Check the lines. |
| | B ) Programmer is defective. | Contact Keller sales office. |
| PP96 restarts each time during programming | A) The battery charge is too low. | Replace the battery. |
| | B) A wrong supply adapter is used. | Use correct adapter. |

### 4.2.) Error messages / Warnings

The PP-96 programmer displays warnings or error messages. The warnings are for user information only, they are intended to help guide the operator. Warning messages do not mean there is a malfunction of the programmer.

The PP-96 programmer can indicate the following warnings :

| **Warning :** | **Meaning :** |
|---|---|
| NO DEVICE ! | There is no transmitter connected, or the programming lines are cut. Check the connections to the transmitter if this warning appears, even if a transmitter is connected. |
| WRONG SIGNAL TYPE ! | The output signal type of the connected transmitter is different than the selected measurement type. Press “Enter“ and select the correct signal type. |

Take care if error messages appear on the display. The message usually refers to a critical condition and means that further investigation is required or something must be verified. Existing versions of the PP-96 have only two functional error messages, as follows :

| | |
|---|---|
| ERROR ! DATA MISMATCH | This error message indicates, that the PP-96 was trying to program a transmitter, but that the programming was not successful. The PP-96 realised, that the actual data stored in the transmitter after the programming sequence, is not the same as the data that should have been written to the transmitter. This message only appears for transmitters fitted with the new PROGRES-95 IC because only this device has read out capability. The most common cause for this error is disconnected programming lines. In event of this message, always check the programming lines carefully.<br>Another possible cause of this message is a defective PP-96 progres programmer. Contact Keller, if bad connections have been excluded. |
| ERROR ! MISSING EEPROM | The PP-96 programmer has a small memory chip fitted, a so called EEPROM. It stores the user defined configurations. The configurations option is not yet available on existing versions of PP-96. If this message appears it can be disregarded, it does not actually mean that there is a problem. The PP-96 is functioning normally. |

### 4.3.) Changing the battery

Change the battery as follows :

The battery case is located on the rear of the PP-96. Carefully prise it open using a flat screw driver inserted into the slot. Do not press hard, the battery case can be opened very easy without violence. Now change the battery and close the case again.

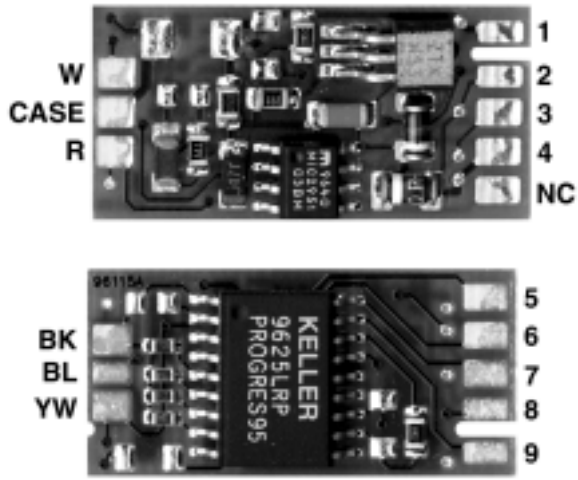
**4.4.) Pin assignments**

The following descriptions are included for users of specific connectors, or for users working with KELLER Printed Circuit Boards PCB's.

Pin assignments of the standard PROGRES transmitter PCB's. The assignment is valid for all standard boards :

(88288, 89113, 89114, 89115, 96288, 96113, 96114, 96115 )

Example Board No. 96115




**Analogue connector pin assignment :**

| Pin No. | 4 - wire :<br>96288 / 89288 | 3 - wire :<br>96113 / 89113<br>96114 / 89114 | 2 - wire :<br>96115 / 89115 |
|---|---|---|---|
| 1 | GND | GND | GND / OUT |
| 2 | + OUT | + OUT | |
| 3 | -OUT | | |
| 4 | Supply | Supply | Supply |

**Digital connector pin assignment :**

| Pin No. | Signal |
|---|---|
| 5 | SIO (old PROGRES : NC) |
| 6 | VPROG |
| 7 | WRITE |
| 8 | DATA |
| 9 | CLOCK |

Pin assignment of the standard PROGRES transmitters (Series 21 PRO) :

View on transmitter connector


**Analogue pin assignment :**

| Pin No. | 3 - wire :<br>96113 / 89113<br>96114 / 89114 | 2 - wire :<br>96115 / 89115 |
|---|---|---|
| 4 | Supply | Supply |
| 6 | + OUT | |
| 8 | GND | GND / OUT |

**Digital pin assignment :**

| Pin No. | Signal |
|---|---|
| 1 | SIO (old PROGRES : NC) |
| 2 | VPROG |
| 3 | DATA |
| 5 | WRITE |
| 7 | CLOCK |

**4.5.) Signal ranges of standard PROGRES electronics**

It is useful to know, when a transmitter can be calibrated for a chosen range. The following information allows you to calculate, if a transmitter can be calibrated to a desired range. Please note, that standard Series 21 PRO transmitters can be calibrated within the ranges listed on the data sheet. There is no necessity to calculate anything, just check the ranges on the data sheet.
With other types of programmable transmitters fitted with standard PROGRES electronics, the ranges can be evaluated as follows :

All the standard PROGRES boards require about 500mV at the output stage of the PROGRES IC in order to produce a full-scale signal. This means, a 4..20mA Transmitter will have 20mA output signal, if the voltage at the PROGRES output is 500mV. The same relationship is valid for the other standard boards (0..10V, 0..20mA). The 4-wire programmable mV signal transmitters have the PROGRES IC output signal as the output signal of the board itself.

The amplification of the PROGRES IC is programmable within the factors 1 to 14 (corresponds to the values 0..1023 indicated on the programmer).

Therefore the full-scale signal of a sensor, that is required for full-scale output at the transmitter, is calculated as follows :

| **Maximum :** | **Minimum :** |
|---|---|
| 500mV / 1 = 500mV | 500mV / 14 = 35.7mV |

Because KELLER sensor calibration cards normally indicate the output signal of a pressure sensor at a constant supply current of 4mA, there is an additional calculation to be done. The PROGRES boards supply the sensors with a constant current of only 0.8mA. Therefore, the output signal of a sensor connected to a PROGRES board is five times smaller than indicated on the KELLER sensor data sheets or calibration cards.

With respect to a constant current supply of 4mA, the sensor full-scale signal range required for full-scale output from the PROGRES board is as follows :

| **Maximum :** | **Minimum :** |
|---|---|
| 5 * 500mV / 1 = **2500mV** | 5 * 500mV / 14 = **178.5mV** |

With the formula above, you can calculate, if your sensor will reach full-scale in the desired pressure range when using a standard PROGRES board.

**Attention at ZERO :**

The zero point of a transmitter cannot be set in infinitely small steps, there are some limitations, especially at higher amplification factors. Care must be taken with the setting accuracy of the zero. The accuracy is calculated and checked as follows :

The absolute calibration accuracy of the PROGRES IC is 0.08mV related to its input and therefore also directly related to the sensor signal (when supplied by 0.8mA constant current).
The calibration accuracy of zero is calculated in relation to full-scale sensor signal, in order to get a useful value. The accuracy is expressed as a percentage of full-scale.

This leads to the following calculation :

Calibration accuracy = 0.08mV / ( Full-scale {@ 0.8mA / 100 )

for example : Desired accuracy of zero point : 0.5 % F.S.
Sensor full-scale signal at 0.8mA constant current : 120 mV

Calibration accuracy = 0.08mV / (120mV / 100) = 0.066 % F.S.

0.066 is smaller than 0.5. The signal is therefore easy to calibrate within 0.5 % F.S.

**4.6.) Technical data**

| | | |
|---|---|---|
| Dimensions of the PP-96 programmer | : | 145 x 75 x 30 mm |
| Weight | : | 200 gm. |
| Display | : | 3-lines dot-matrix LCD |
| Keyboard | : | 16 Keys |
| External supply | : | Mains adapter for 220V ac |
| Measurement accuracy | : | 0.2 % F.S. (10V ; 20 mA)<br>at 25°C |
| Connectors supplied for | | Progres Transmitters.<br>External analogue signal meter.<br>RS 232 interface. |
| Cleaning | : | Disconnect from the mains power supply before cleaning. Clean the instrument with a damp cloth.<br>Do not use detergents or solvents. |

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