Multifunction Intelligent 4-wire Isolated Signal Conditioner

IPAQ-4L is a *fully universal* and intelligent 4-wire (mains powered) transmitter for temperature measurement and signal conditioning applications. IPAQ-4L is designed for wall and DIN rail mounting.

The high isolation of 4000 VAC between input, output and power supply provides safe and problem-free measurements.

The Windows based and user friendly software, IPRO 4, is used for transmitter configuration, documentation, monitoring and calibration purposes.

Performance and design:

Input-output-supply isolation 4000 VAC
- *High level isolation between measurement loops.*
- *Excellent filtering of noise and voltage spikes.*
- *Elimination of ground loops.*

Excellent stability
- *Long-term stability 0.1 %/year.*

Enhanced total system accuracy
- *Sensor error correction (for known sensor errors).*
- *System error correction (against known temperatures).*

Designed for harsh conditions
- *Excellent EMC performance.*
- *Durable due to protected PCBs.*

Flexible and compact mounting
- *Only 22.5 mm / 0.89 inch wide.*
- *Quick mounting on DIN rail.*
- *Extractable brackets for wall mounting.*

5 years limited warranty

Functions:

Current and voltage output
- *Programmable: 0/4-20 mA, 0/1-5 V and 0/2-10 V with direct or reversed action.*

Input for RTD, T/C, mV, V, mA and resistance
- *Reduced inventory costs.*
- *Simplified plant engineering.*

True on-line communication
- *Full access to all features while in operation.*

Sensor diagnostics
- *SmartSense detects low sensor isolation (essential for correct measurements).*
- *Selectable sensor break action.*

Simplified loop check-up
- *The transmitter works as an accurate current generator.*

On-screen indications and line recording
- *Valuable tools for temporary measurements.*

Main features of IPAQ-4L

Accuracy and stability

IPAQ-4L is designed for applications with standard industrial demands on accuracy. To reach these demands, the following factors are essential:

Linearity and calibration errors -The use of quality components and precision calibration equipment reduce these errors, e.g. ±0.1 % of span for RTD inputs.

High long-term stability -Internal "self calibration", by means of continuos adjustment of important parameters after comparison with accurate built-in references, contributes to a stability of ±0.1 %/year.

Measurements with RTDs and other resistances

IPAQ-4L accepts inputs from standardized Platinum and Nickel RTDs like Pt10…Pt1000 acc. to IEC 751 (α=0.00385), Pt100 acc. to JIS 1604 (α=0.003916) and Ni100/Ni1000 acc. to DIN 43760, as well as inputs from plain resistance sensors such as potentiometers. 3- or 4-wire connection can be chosen.
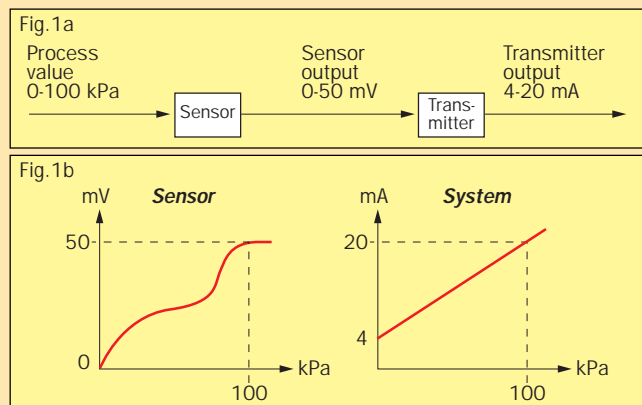
Measurements with thermocouples voltage and current

IPAQ-4L accepts inputs from 11 types of standardized thermocouples as well as plain mV, V and mA input.

For T/C input, the CJC (cold junction compensation) is fully automatic, by means of an accurate measurement of the terminal temperature. Alternatively, the CJC can be disabled.

Customized linearization and Engineering units

The *Customized linearization* can be used to create a linearization curve for RTD, T/C, resistance, voltage and current inputs. By combining *Customized linearization* with the use of *Engineering units*, the transmitters can be programmed to give a linear output corresponding to a specific measuring range expressed in the primary process value. The sensor characteristics are described by a maximum of 9 data pairs. *Fig. 1a and 1b*.
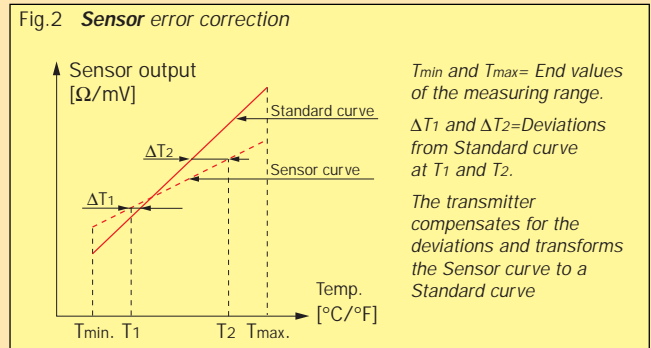

Fig.1a

Process value 0-100 kPa → Sensor → Sensor output 0-50 mV → Transmitter → Transmitter output 4-20 mA

Fig.1b

*Exemple of a system (sensor + transmitter) with an output **linear** to the process value, in spite of a **non-linear** sensor.*
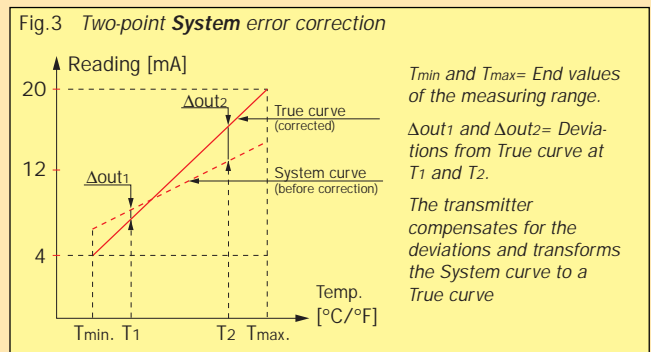
Sensor or System error correction

IPAQ-4L offers two ways of improving the measurement with temperature sensors:

Sensor error correction - Known sensor errors compared to the standard curve, e.g. for a calibrated sensor, are entered, and the transmitter automatically corrects for the sensor errors. *Fig. 2.*

Fig.2 *Sensor* error correction

T_{min} and T_{max}= End values of the measuring range.

ΔT_1 and ΔT_2=Deviations from Standard curve at T_1 and T_2.

The transmitter compensates for the deviations and transforms the Sensor curve to a Standard curve

System error correction -This method is used to correct the system error (sensor + transmitter error) by exposing the sensor to one (one-point correction) or two (two-point correction) accurately measured temperatures (true temperatures).The true temperature(s) are entered, and the transmitter automatically corrects for the system errors. *Fig. 3.*

Fig.3 *Two-point **System** error correction*

T_{min} and T_{max}= End values of the measuring range.

Δout_1 and Δout_2= Deviations from True curve at T_1 and T_2.

The transmitter compensates for the deviations and transforms the System curve to a True curve

SmartSense - Sensor isolation monitoring

SmartSense continuously monitors the isolation resistance of thermocouples and 3-wire connected RTDs as well as the cabling between sensor and transmitter. The transmitter will react by forcing the output to a user defined level if the isolation is too low. SmartSense requires an extra lead inside the thermocouple or RTD. *Fig. 4.*

For detailed information, see section Theory and Facts.

Sensor break monitoring

IPAQ-4L monitors sensor break and forces the output signal to a user defined level, when *any* sensor lead is broken or disconnected. The sensor break monitoring can be switched off. The monitoring is furnished with a *pulsed excitation current*. This eliminates the voltage drop in the lead wires (giving a measuring error), caused by a standard DC excitation current.

Controlled output for instrument calibration

IPAQ-4L can be set to automatically provide a recurring output signal of 0%, 50% and 100% of the selected output signal regardless of the input value. The total time for the controlled output is adjustable up to 30 minutes.

Dampening

The dampening function can be used to dampen undesired instabilities on the input signal. The dampening time is approximately 2 seconds. The dampening time is the time required, in addition to the update time, for the output to reach 90% of its final value after a step change has been applied to the input.

Power supply

IPAQ-4L is mains powered, i. e. a 4-wire transmitter. Two versions of IPAQ -4L are available:
– Supply voltage 90-250 VAC / 110-220 VDC.
– Supply voltage 20-30 VDC.
DC supply accepts reversed polarity without damage.

Mounting

IPAQ-4L is designed to fit on a standard 35 mm rail according to DIN EN 50022. The transmitter is also equipped with extractable brackets for wall mounting.

Warranty

IPAQ-4L is covered by a 5 year limited warranty.

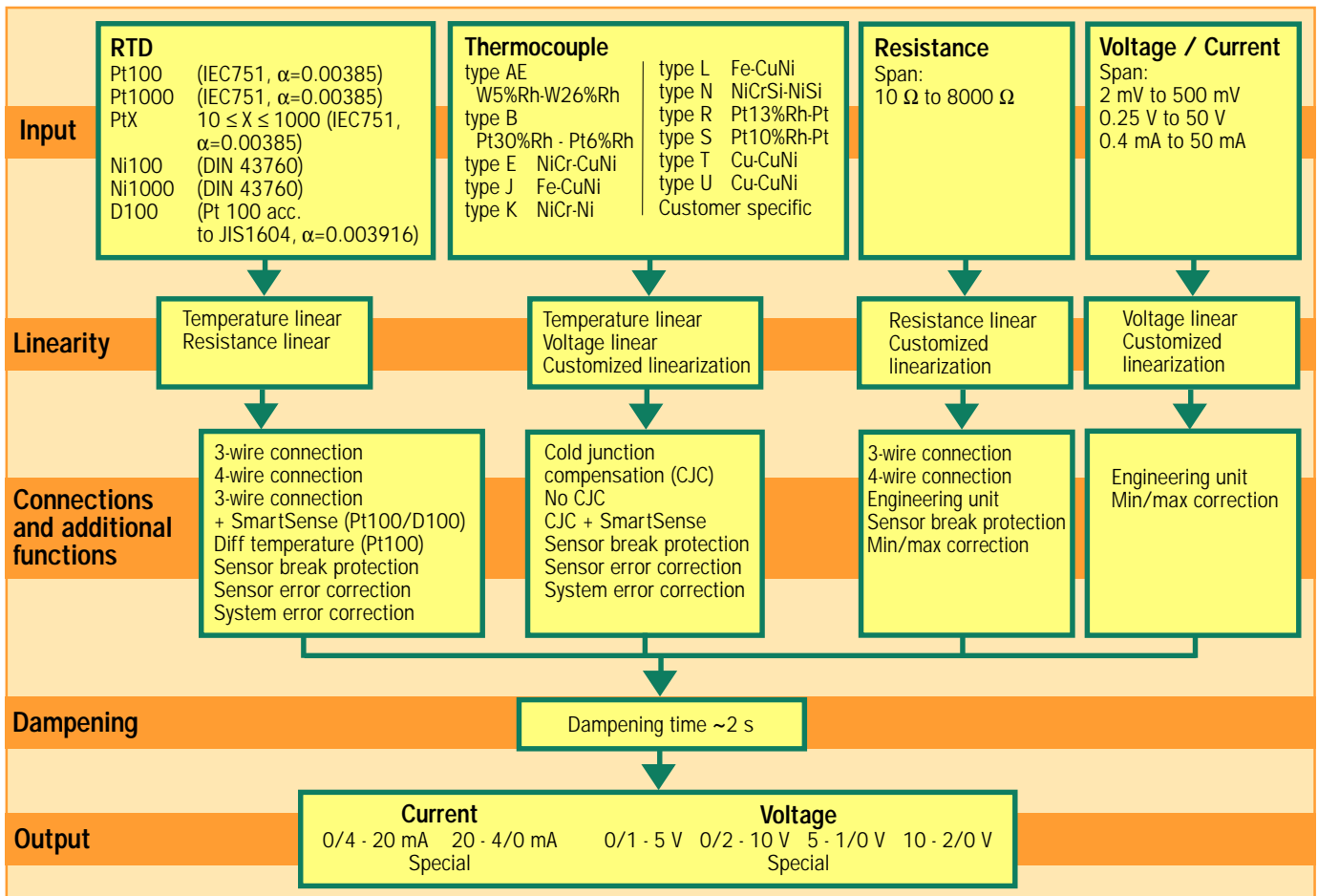## IPRO 4 - The user friendly software for all transmitters of the IPAQ family

IPRO 4, which is used with all IPAQ-transmitters, is the tool to utilize all the versatile functions of the IPAQ-4L such as:

- Measurement configuration: Sensor type, range, sensor or system error correction, linearization, engineering units, output settings, filter activation, etc.
- Monitoring of sensor status: Sensor break and sensor isolation (SmartSense).
- On-screen real time presentation of measured values and output signal in the form of numericals, meters, bar graphs and line recorder.
- Transmitter calibration: Field calibration in one or two points and basic calibration.
- Documentation: Configuration files can be saved for future use and configuration protocols can easily be printed.

The communication with the transmitter can be performed on line, i.e. with transmitter in operation. An isolated and Ex-approved communication cable is included in the software kit, IPRO-X.

IPRO 4 is compatible with Windows 3.1, Windows 3.11, Windows 95 and Windows NT Workstation 4.0. The program is menu-driven and easy to learn. On-line help is an effective tool for the user.

IPAQ-4L Configuration scheme

Input	RTD Pt100 (IEC751, α=0.00385) Pt1000 (IEC751, α=0.00385) PtX 10 ≤ X ≤ 1000 (IEC751, α=0.00385) Ni100 (DIN 43760) Ni1000 (DIN 43760) D100 (Pt 100 acc. to JIS1604, α=0.003916)	Thermocouple type AE W5%Rh-W26%Rh type B Pt30%Rh - Pt6%Rh type E NiCr-CuNi type J Fe-CuNi type K NiCr-Ni type L Fe-CuNi type N NiCrSi-NiSi type R Pt13%Rh-Pt type S Pt10%Rh-Pt type T Cu-CuNi type U Cu-CuNi Customer specific	Resistance Span: 10 Ω to 8000 Ω	Voltage / Current Span: 2 mV to 500 mV 0.25 V to 50 V 0.4 mA to 50 mA
Linearity	Temperature linear Resistance linear	Temperature linear Voltage linear Customized linearization	Resistance linear Customized linearization	Voltage linear Customized linearization
Connections and additional functions	3-wire connection 4-wire connection 3-wire connection + SmartSense (Pt100/D100) Diff temperature (Pt100) Sensor break protection Sensor error correction System error correction	Cold junction compensation (CJC) No CJC CJC + SmartSense Sensor break protection Sensor error correction System error correction	3-wire connection 4-wire connection Engineering unit Sensor break protection Min/max correction	Engineering unit Min/max correction

Dampening	Dampening time ~2 s

Output	Current		Voltage	
	0/4 - 20 mA 20 - 4/0 mA		0/1 - 5 V 0/2 - 10 V 5 - 1/0 V 10 - 2/0 V	
	Special		Special	

Specifications

Input

RTD's and Resistance

Pt100 (IEC751, α = 0.00385)	3-, 4-wire connection	-200 to +1000 °C / -328 to +1832 °F
Pt1000 (IEC751, α = 0.00385)	3-, 4-wire connection	-200 to +200 °C/ -328 to +392 °F
PtX 10 ≤ X ≤ 1000 (IEC751, α = 0.00385)	3-, 4-wire connection	Upper range depending on X-value
Ni100 (DIN 43760)	3-, 4-wire connection	-60 to +250 °C / -76 to +482 °F
Ni1000 (DIN 43760)	3-, 4-wire connection	-60 to +150 °C / -76 to +302 °F
D100 (Pt 100 acc.to JIS1604, α = 0.003916)	3-, 4-wire connection	-200 to +1000 °C / -328 to +1832 °F
Potentiometer/resistance	3-, 4-wire connection	0 to 8000 Ω
Sensor current	R ≤ 2000 Ω	~ 0.4 mA
	R > 2000 Ω	~ 0.1 mA
Maximum sensor wire resistance		25 Ω/wire

Thermocouples, Voltage and Current

T/C	Type: AE, B, E, J, K, L, N, R, S, T, U	Ranges according to users manual
Voltage	Millivolt	-10 to + 500 mV
	Volt	-10 to + 50 V
Current		-1 to + 50 mA
Input impedance	T/C, Voltage	>1 MΩ
	Current	<25 Ω
Maximum sensor wire resistance	T/C, Voltage	500 Ω (total loop)

Monitoring

Sensor break monitoring	User definable output	0 to 23 mA or 0 to 11 V
SmartSense, sensor isolation monitoring	User definable output	0 to 23 mA or 0 to 11 V

Adjustments

Zero adjustment	All inputs	Any value within range limits
Minimum spans	Pt100, Pt1000, Ni100, Ni1000	10 °C / 18 °F
	Potentiometer	10 Ω for R ≤2000 Ω, 100 Ω for R >2000 Ω
	T/C, Millivolt	2 mV
	Volt	0,25 V
	Current	0.4 mA

Output

Straight,reversed or any intermediate value	Current	0/4-20 or 20-4/0 mA
	Voltage	0/2-10 or 10-2/0 V
Resolution	Current	6 µA
	Voltage	3 mV
Limitation	Current	~24 mA
	Voltage	~12 V
Permissible load	Current	≤750 Ω
	Voltage	≥10 kΩ

Temperature

Ambient, storage		-20 to +70 °C / -4 to +158 °F
Ambient, operation		-20 to +70 °C / -4 to +158 °F

General data

Selectable damping time		~ 2 s
Update time		~ 0.8 s
Isolation In - Out - Power supply		4000 VAC, 1 min
Humidity (non-condensing)		0 to 95% RH

Power supply

Supply voltage	Part No. 70IP4L0001	90 to 250 VAC / 110 to 220 VDC
	Part No. 70IP4L0002	20 to 30 VDC
Permissible ripple		4 V p-p @ 50/60 Hz (DC version)
Power consumption		<1.5 W

Accuracy

Linearity	RTD, Potentiometer, mV, V, mA	±0.1 % [1]
	T/C	±0.2 % [1]
Calibration	RTD	Max. of ±0.2 °C / ±0.4 °F or ±0.1 % [1]
	Potentiometer R ≤2000 Ω	Max. of ±0.1 Ω or 0.1 % [1]
	R >2000 Ω	Max. of ±1.0 Ω or ±0.5 % [1]
	mV, T/C	Max. of ±20 µV or ±0.1 % [1]
	V	Max. of ±2 mV or ±0.1 % [1]
	mA	Max. of ±4 µA or ±0.1 % [1]
Cold Junction Compensation (CJC)	T/C	±0.5 °C / ±0.9 °F
Temperature influence [4]	All inputs	Max. of ±0.25 °C/25 °C or ±0.25%/25 °C [1] [3]
		Max. of ±0.5 °F/50 °F or ±0.28%/50 °F [1] [3]
Temperature influence CJC [4]	T/C	±0.5 °C/25 °C / ±1.0 °F/50 °F
Instrument calibration output	mA / V	±8 µA / ±5 mV
Sensor wire resistance influence	RTD, Potentiometer, 3-wire	Negligible [2]
	RTD, Potentiometer, 4-wire	Negligible
	mV, V, T/C, mA	Negligible
Load influence		Negligible
Power supply influence		Negligible
RFI influence, 0.15-1000 MHz, 10 V or V/m		±0.2% [1] (typical)
Long-term stability		±0.1 % [1] /year

Housing

Material / Flammability (UL)		PC + ABS/VO
Mounting		Rail acc. to DIN EN 50022, 35 mm, and wall (brackets)
Connection	Single/stranded wires	≤2.5 mm², AWG 14
Weight		125 g
Protection, housing / terminals		IP 40 / IP 00

[1] Of input span

[2] With equal wire resistance

[3] If zero-deflection > 100% of input span:
add 0.125% of input span/25 °C or 0.14%
of input span/50 °F per 100% zero-deflection

[4] Reference temperature 23 °C/73 °F

The User Instructions must be read prior to adjustment and/or installation.

INPUTS

RTD

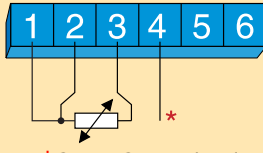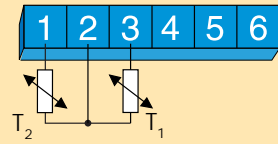| Pt100, Pt1000, Ni100, Ni1000, PtX, D100 4-wire connection	3-wire connection	Pt100, D100 3-wire connection	Pt100 Diff temperature $T_1 > T_2$
1 2 3 4 5 6	1 2 3 4 5 6	1 2 3 4 5 6 *SmartSense lead	1 2 3 4 5 6 T_2 T_1
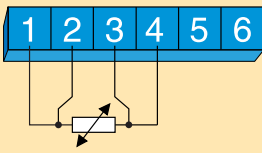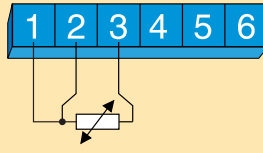
Potentiometer

4-wire connection	3-wire connection
1 2 3 4 5 6	1 2 3 4 5 6
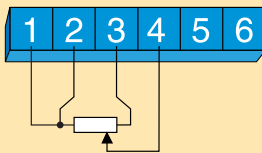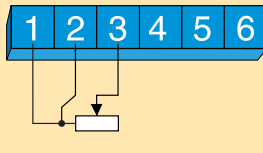
Voltage

Millivolt	Volt
1 2 3 4 5 6 - +	1 2 3 4 5 6 - +

Current

mA

1 2 3 4 5 6
- +
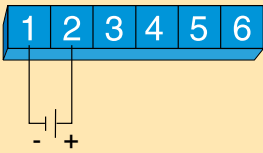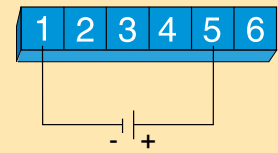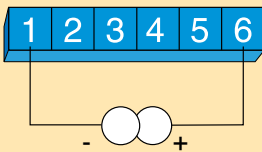
Thermocouple

AE,B,E,J,K,L,N,R,S,T,U or customer specific

1 2 3 4 5 6
- + *
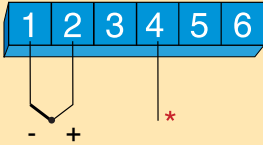
*SmartSense lead

Dimensions

Extractable wall mounting bracket

35/1.38
82/3.23
99/3.90
mm/inches

10 12
7 8
INOR
IPAQ-4L
1 2 3
4 5 6
80/3.15
90/3.54
22.5/0.89
PC connection

OUTPUT

Voltage

Volt

7 8
+ -

Current

mA

7 8
+ -

Power supply

10 12
$\approx$ 0
(+) (-)

SmartSense

Fig.4

1 2 3 4   1 2 3 4
*   *

Pt100   T/C
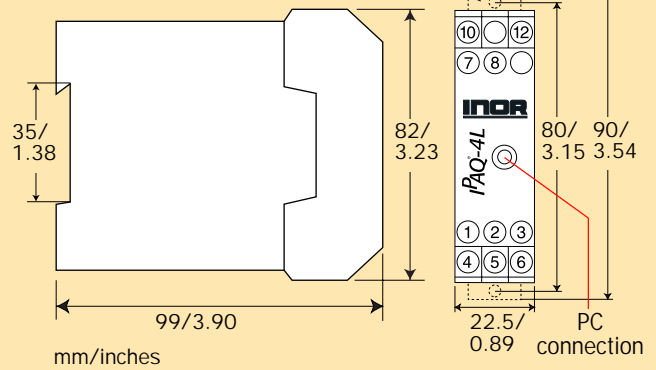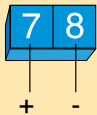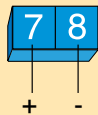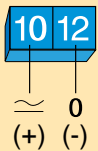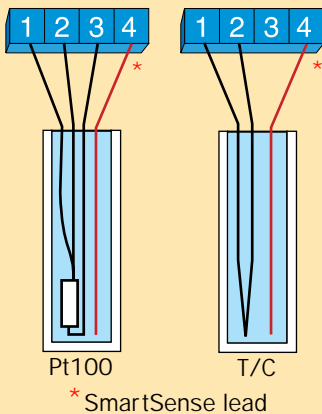
*SmartSense lead

Ordering table

Item	Part No.
Transmitter	
IPAQ-4L, Power Supply 90-250 VAC / 110-220 VDC	70IP4L0001
IPAQ-4L, Power Supply 20-30 VDC	70IP4L0002
Options	
Configuration	70CAL00001
Configuration with 5-point calibration certificate	70CAL00051
Software and cable	
IPRO-X (IPRO with cable)	70IPRX0001
Software IPRO upgrade	70IPRS0001

IPAQ-4L

INOR