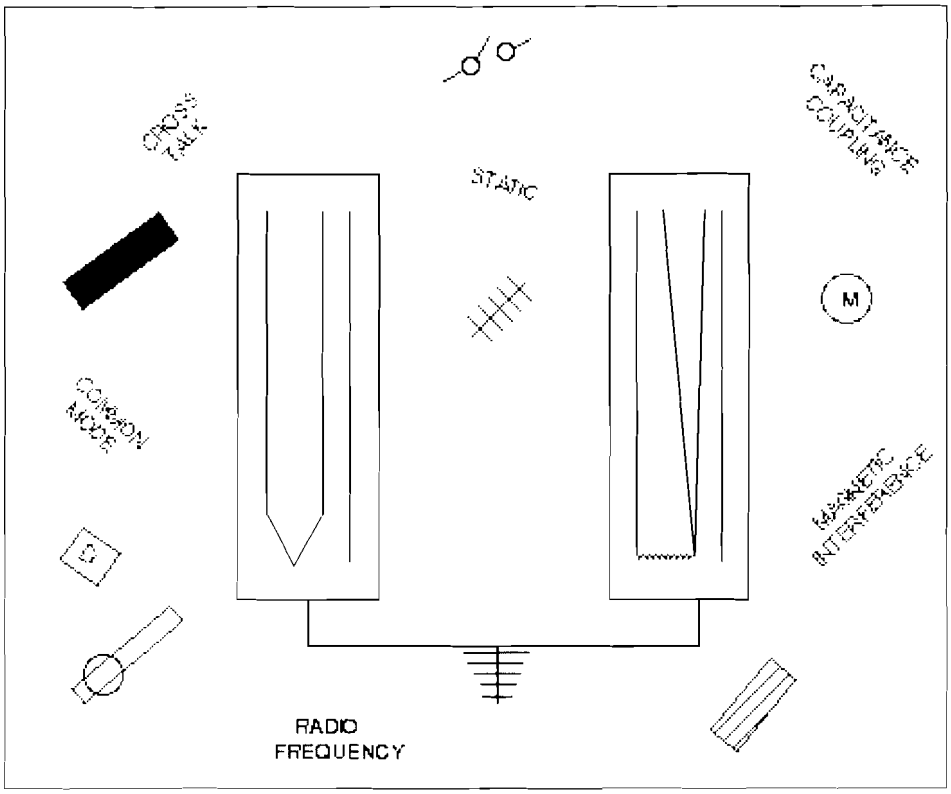
How Do It Know?

A major breakthrough in technology has been the development of the "Smart Transmitter".

However, these devices like your computer, output garbage if garbage is put in.

The JMS TempIRSense lets no garbage in!



TempIRsense

(Temperature / Insulation Resistance / Sensing)

The Smart Smart Sensor System

TempIRsense continuously monitors the insulation resistance of Thermocouples and RTD's as well as cabling between sensors and transmitters. Poor insulation resistance is the main cause of sensor error in industrial applications.

Protect Yourself with TempIRsense!

How it Works

TempIRsense-The System

This "Smart Transmitter" continuously monitors the insulation resistance of thermocouples and 3-wire RTD's as well as the cabling between sensor and transmitter. For this, an extra lead is required inside the thermocouple or RTD. When the insulation resistance is too low, the TempIR transmitter will signal this with a twinkling LED in the front and the output signal will go to a preprogrammed value.

How It Works?

A too low insulation resistance in temperature sensors will give erroneous measurements independent of brand and type. TempIRsense gives you the ability to detect a bad signal before you make a bad product for your customers. TempIRsense not only monitors the sensor but also the conductors from the sensors terminal to the transmitter terminals. This gives full control on the condition of the measuring chain from measuring point to transmitter.

TempIRsense - The Sensor

The ungrounded thermocouples and RTD's are made especially to match up with the TempIR transmitters. A separate wire, built into the sensor itself, allows the excitation current of the checking circuit to do its job at the business end of the sensor without interfering at all with the normal process signal.

Why you need it now...

Saves $

- You comply with ISO guidelines without sending a technician to calibrate on a frequent basis
- You know your sensor is going bad before you make a bad product
- You know your sensor is going bad before it fails
- Lower up front costs than other "so called" Smart Transmitters

Saves Time

- You spend less time on sensor calibrations
- You spend less time replacing sensors
- Your quality auditor does not have to review as many documents because you won't be generating any for these sensors
- Less time spent training on failure analysis

Compliance costs without wasting any time of the useful life of the sensor or the useful time of the technician. TempIRsense and TempIRsense +(Hart Protocol) are the names of these brand new products from JMS Southeast.

Here's how to order...

1) Select the thermocouple from page 1-1 in the JMS Southeast catalog as usual. However, when you get to selection #3 (Limits of Error) add an "S" to the category.

2) Select the RTD from page 3-1 in the JMS Southeast catalog as usual. However, when you get to selection #3 (Element Construction) add an "S" to the category.

See page 18 for transmitter ordering or just call 800. 873 .1835 and ask for TempIRsense

The following are Technical Notes and descriptions of the numerous benefits of these brand new products.

Technical Note

The influence of insulation resistance on temperature measurements

How to get an early warning of low insulation resistance

This Technical Note describes how the insulation resistance influences the measurements on RTD's and thermocouples and how to get an early warning regarding errors due to low insulation.

The structure of an RTD and a thermocouple have properties which can lead to erroneous measurements. This is independent of brand and type. One of the most common sources of error is the insulation in the thermometer, which, if too low, can give a serious degradation of the measurement. Insulation can be lowered by moisture, heat, vibration. Physical or chemical influence or radioactive influence. This Technical Note will give an explanation to the necessity of keeping an eye on the insulation resistance.

RTD's

The RTD element is a low-resistance sensor and a too low insulation resistance will influence the measurement. Figure 1 shows the electrical schematic for an RTD and the insulation resistance connected to a temperature transmitter.

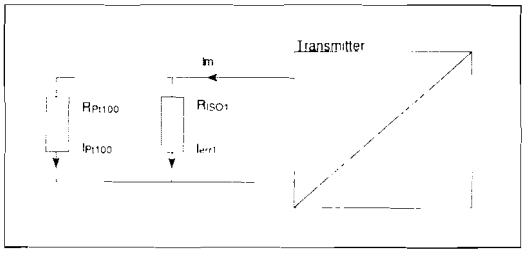


Fig. 1

The measuring current goes through the RTD element, but a negligible fraction is normally passing through the high insulation resistance Riso 1. When the insulation is lowered, a greater fraction of the current will pass through the insulation. As a result of this, the measured voltage over the combined resistance of RTD and insulation resistance will be lower than if the insulation resistance was sufficiently high. This will give a too low measured temperature value and this is not dependent on whether the transmitter is isolated or not. If the transmitter is without galvanic isolation between input and output, a low insulation resistance between sensor and earth can carry a part of the measuring current. This will also give a too low indicated temperature. With an isolated transmitter this will not happen. Please see Figure 2.

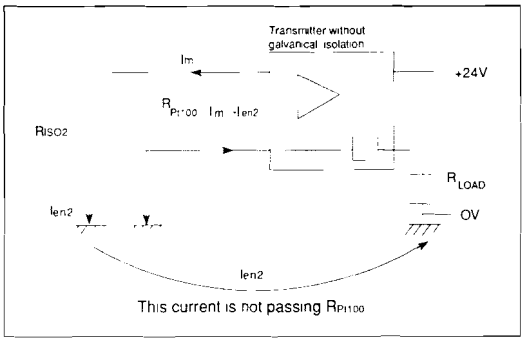


Fig. 2

Thermocouples

Low insulation in thermocouple sensors will give other errors. EMF from the thermocouple is not particularly sensitive for low insulation. The problem is rather that a low insulation will give a new measuring point on the location of the low insulation. If this location is near the intended measuring point, the error will be negligible. If the low insulation is in a location where the temperature differs from the measuring point, there is a possibility of a significant error. Low insulation in thermocouples can also give problems with the indication of sensor breakage. Please see Figure 3.

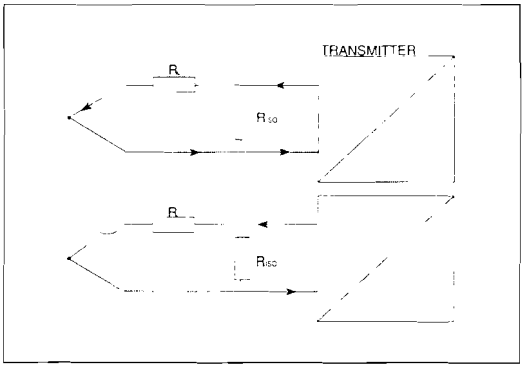


Fig. 3

Monitoring the insulation resistance

The TempIR transmitter is microcontroller based and does a couple of measurements and controls beyond the standard measurements. One of these controls is to monitor the insulation resistance of the sensor. To accomplish this the sensor must be furnished with an extra conductor. Under certain circumstances there is a possibility of using the cable shield. See below. When the insulation resistance is too low, the TemplRsense will signal this with a twinkling LED in the front and the output signal will go to a preprogrammed value.

RTD's

For RTD's the limit of insulation is 500 Kohm. By 400 C the added error is 0.4 C. If the insulation is lowered to 100 Kohm there will be an added error of 1.6 C. See Figure 4.

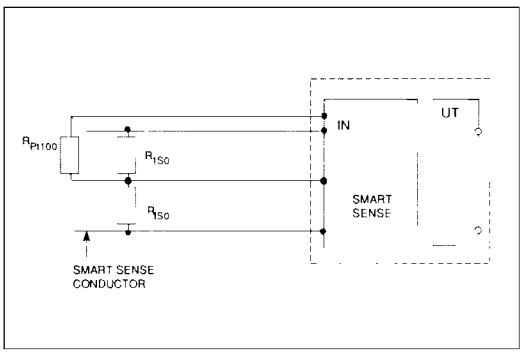


Fig. 4

Thermocouples

For thermocouples the limit of low insulation is 50 Kohm. The added error depends on the relation between the lead resistance R and the insulation resistance Risq. The error is also dependent on the temperature difference between the measuring point and the location of the low insulation. Under the following circumstances, measuring temperature 1000 C, ambient temperature 25 C and R equals 50 Ohm there will be an error of 1% if the insulation resistance is 5 Kohm. This equals 10 C. It is assumed that the low insulation is in the area with 25 C.

Sensor Solution

TemplRsense is applicable for 3-wire RTD's and thermocouples. For correct usage the sensor must have an extra conductor. This conductor will have a separate terminal and go through the sensor all the way to the sensor element. See Figure 5.

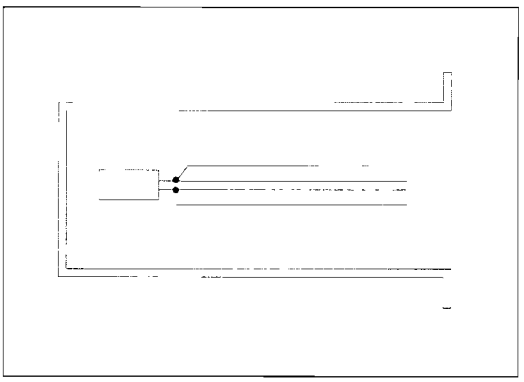


Fig. 5

Mineral insulated RTD's and thermocouples use an unconnected conductor. Due to the low insulation resistance in mineral insulated thermocouples at high temperatures, it is not useful to monitor the high temperature end, above 5–600 C depending on application. Instead, it is important to monitor connections and cables from the sensor to the transmitter. It is not recommended to use the housing of the sensor as the monitoring

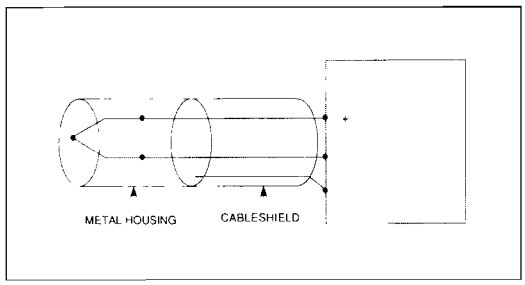


Fig. 6

conductor. One task of the housing is to keep interference outside the measurements. Connecting the housing to the TemplRsense terminal can lead to erroneous measurements. This is also applicable to cable sensors. See Figure 6.

Conclusion

Full control over sensor and connection

Too low insulation resistance in temperature sensors can give erroneous measurements independent of brand and type. TemplRsense gives the possibility of substituting sensors with low insulation resistance in 3-wire RTD's and thermocouples in time. TemplRsense does not only monitor the sensor but also the conductors from the sensors terminal to the transmitter terminals. This gives a full control on the condition of the measuring chain from measuring point to transmitter.

Causes of low insulation

- Moisture
- Contamination
- Physical influence (wear, jamming)
- Chemical influence (corrosion)
- Vibration
- Radioactive radiation

Examples of errors

RTD @ 400 C
Insulation Riso Error

500K	0.4 C
100K	1.6 C
50K	3.1C
10K	15 C

Thermocouple type K @ 1000 C
Insulation Riso Error

50K	1 C
20K	3 C
5K	10C

Ref: See Sensors Magazine, April 1995 Issue.
See Measurements & Control, September 1997 Issue, p. 276.

Precision In-head Temperature Transmitter

- **Standard Inputs for: RTD's, IEC – JIS 100 ohm – 1000 ohm 11 Thermocouples mV and resistance**
- **True on-line Configuration**
- **Customized 40 point linearization**
- **TempIRsense, unique monitoring of insulation resistance**
- **Input-output isolation 1500 VAC**
- **Simplified mounting with large center holes**
- **Integrated tagging and customized texts**
- **Easy to configure**

General Description

TempIR is a 2-wire loop-powered intelligent transmitter. Small size and extreme versatility makes the TempIR an ideal choice for all industrial instrumentation.

The transmitter is manufactured for inputs from a wide range of RTD's, thermocouples, plain mV, and resistance. A customized linearization can easily be generated.

Wide power supply range allows for high load in the output loop, e.g. long output leads and multiple instruments.

TempIR is configured with TemPRO, the general software to configure the entire temp-family. The program is Windows driven and easy to use.

The configuration can be performed on-line, with in- and outputs connected. While receiving new parameters, the transmitter will freeze the output signal and return to normal operation after completed transmission of the new parameters.

TempIRsense continuously monitors the isolation resistance of thermocouples and 3-wire RTD's as well as the cabling between sensor and transmitters.

Transmitter Features

Temperature Measurements with RTD's and other Resistances

- All resistance sensors are connected with 3 or 4 sensor leads.
- Monitors sensor break and forces output to user defined level when disconnected.
- Monitoring can be switched off.

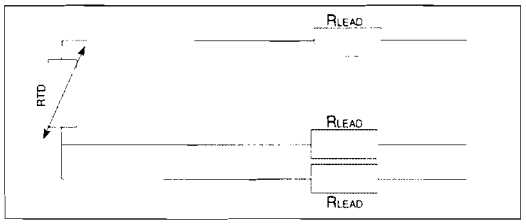


Fig. 1

Temperature Measurements with Thermocouples and plain voltage

- Accepts inputs from 11 types of Thermocouples.
- Leads or extension wire leads must be connected directly to the terminal of the TempIR to obtain correct junction compensation.
- A user definable linearization is accessible.
- Monitors sensor break and forces the output to a user defined level when disconnected
- Monitoring can be switched off.

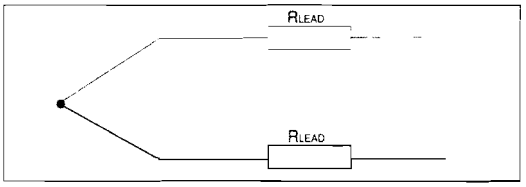


Fig. 2

Customized Linearization

- Input is configurable to an arbitrary nonlinear relation.
- Fig. 3a and 3b show how a nonlinear relation between the in and output of a pressure sensor is linearized.
- Concept of engineering units simplifies description of linearizing function.

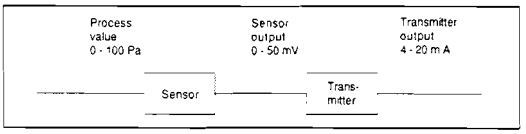


Fig. 3

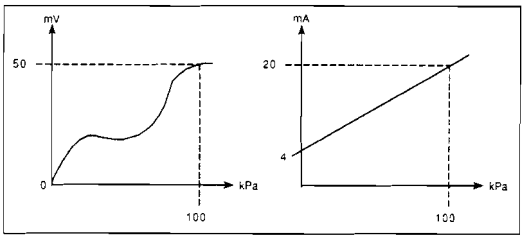


Fig. 3b

0-100 kPa/4-20 mA is reconfigured by changing the engineering units to the new value. The corresponding mV-signal is tied to the engineering unit and will follow accordingly.

Controlled Output for Installation Startup

- Set to automatically provide fixed or recurring output values regardless of input signal.
- Time periods in recurring modes are selectable.
- See Fig. 4

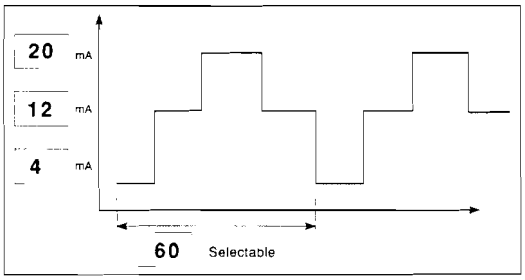


Fig. 4

Limited Output

- Limited to high and low selectable values.
- Overridden by sensor break and TempIRsense.

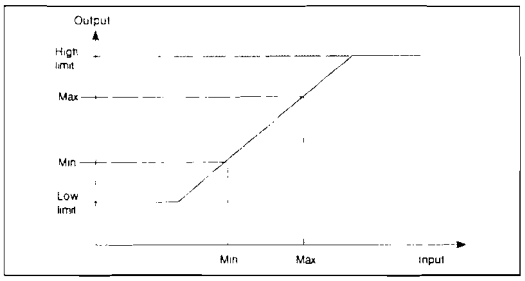


Fig. 5

Timing and Scanning

- A sampling method is used to process the input signal.
- Input changes will influence the output during the following cycle.
- See Fig. 6

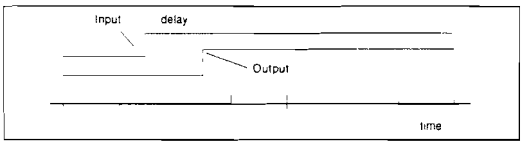


Fig. 6

Isolation

- Transformer designed
- Will resist 1500 VAC rms for 1 minute

Supply Voltage

- Loop-powered
- Will work on voltages down to 6.5 volts.
- Reversed supply voltage will not damage the transmitter.

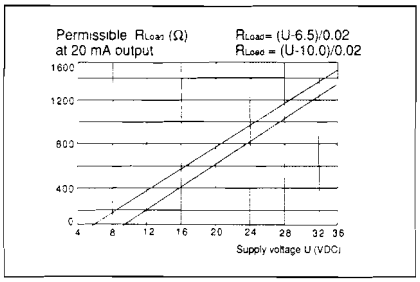


Fig. 7

Linearity Error

- Defined as the maximum deviation from a straight line through the lower and upper range values of the measuring range.
- See Fig. 8

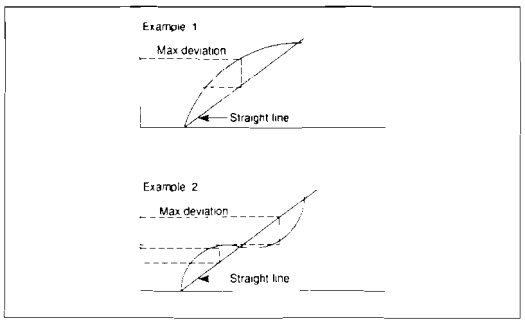


Fig 8

Calibration Inaccuracy

- Defined as the maximum deviation in the lower and upper range values of the measuring range.
- Offset and noise set the limits when measuring small ranges.
- Inaccuracy is expressed in either an absolute value (C, F, V, Ohms) or as a percentage of the maximum input signal.
- See Fig. 9

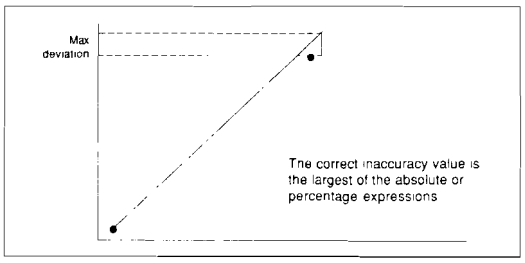


Fig 9

Mounting

- Designed to fit inside connection heads type DIN or larger.

The large center hole facilitates the pulling through of the sensor leads, simplifying the mounting procedure. Fig. 10

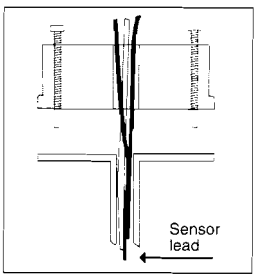


Fig 10

Sensor Break and Sensor Isolation

- Monitoring is furnished with a pulsed excitation voltage.
- Eliminates the voltage drop in leadwires normally caused by a dc excitation voltage.

Lead Resistance Effects

The effect of lead resistance is always negligible in 4-wire connections. The same goes for 3-wire connections when all 3 leads have equal resistance. See Table 1 for the error introduced by unequal lead resistance. For a difference of Rdiff the table shows the error in the measured temperature.

Table 1 shows an example of the error caused in a 3-wire connection for Pt100 and Pt1000 assuming all three wires first having equal resistance. A change in the wire resistance of the magnitude Rdiff will cause an error expressed in C or F.

Table 1.

Rdiff change in wire resistance.	0.01Ω	1Ω
Error		
Pt100	0.025 °C, 0.045°F	2.5 °C, 4.5°F
Pt1000	0.002 °C, 0.004°F	0.25 °C, 0.45°F

Error caused by unbalanced wires in 3-wire connection.

Low-Pass Filtering

- A configurable low-pass filter will filter out noise and other disturbances.
- Damping can be set to values between 0 and 60 seconds in internal of 1 second. Filtering time is measured as the time required for the output to go from 0 to 90% of its final value after a step input has been applied to the inputs.

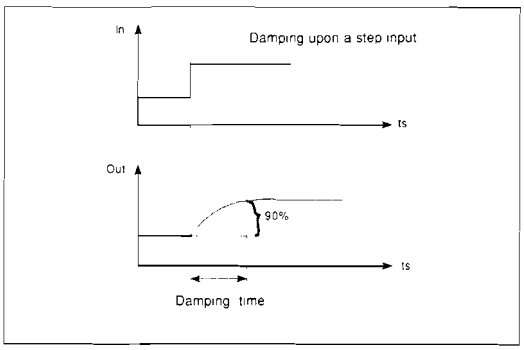


Fig 12

Software

TemPRO – the user friendly software for TempIR

TemPRO 4.03 is the software with which all user-configurable parameters in TempIR can be reached. TemPRO 4.03 is compatible with Windows 3.1 and Windows 95. The program is menu-driven and easy to learn. On-line help at your fingertips is an effective tool for all users. In addition, TemPRO 4.03 configures all products of the Temp family. See Fig. 13

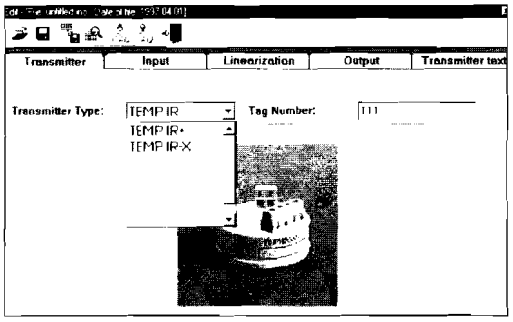


Fig 13

Software Features

Engineered Units

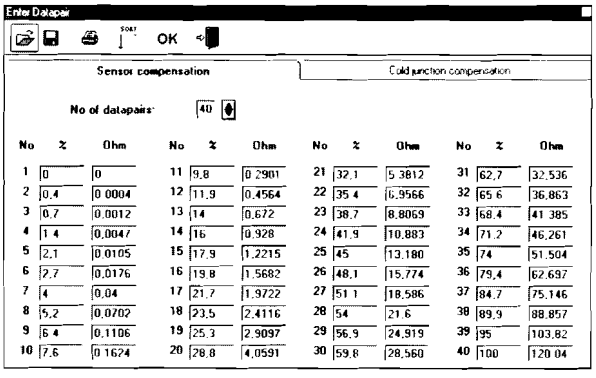
- Ability to use engineering units for directly specifying custom ranges.
- Can be changed instantly by re-ranging the engineering unit.

Customized Linearization

- Utilized in two ways: either by entering datapairs or entering coefficients of a polynomial.

Datapairs

- Up to 40 datapairs can be entered to describe the input signal.
- Up to 7 datapairs can be entered to describe the cold junction compensation of a thermocouple.
- See Fig. 14



No	%	Ohm	No	%	Ohm	No	%	Ohm	No	%	Ohm
1	0	0	11	9.8	0.2901	21	32.1	5.3812	31	62.7	32.536
2	0.4	0.0004	12	11.9	0.4564	22	35.4	6.9566	32	65.6	36.863
3	0.7	0.0012	13	14	0.672	23	38.7	8.8069	33	68.4	41.385
4	1.4	0.0047	14	16	0.928	24	41.9	10.883	34	71.2	46.261
5	2.1	0.0105	15	17.9	1.2215	25	45	13.180	35	74	51.504
6	2.7	0.0176	16	19.8	1.5682	26	48.1	15.774	36	79.4	62.697
7	4	0.04	17	21.7	1.9722	27	51.1	18.586	37	84.7	75.146
8	5.2	0.0702	18	23.5	2.4116	28	54	21.6	38	89.9	88.857
9	6.4	0.1106	19	25.3	2.9097	29	56.9	24.919	39	95	103.82
10	7.6	0.1624	20	28.8	4.0591	30	59.8	28.560	40	100	120.04

Fig 14

Polynomial

- For polynomial coefficients a sensor can be described by third order polynomials.
- The signal to be linearized can be divided into a maximum of 8 parts where each part is individually described by a separate polynomial for the highest possible accuracy.
- Interesting parts of the signal can be linearized with a higher degree of accuracy.
- The cold junction compensation of a thermocouple can be divided into a maximum of 4 polynomial parts.
- See Fig. 15

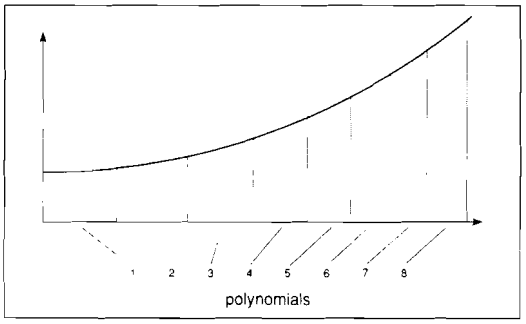


Fig 15

File Handling

- Configuration files can be stored for future use.
- TemPRO 4.03 has the ability to save configuration data in ASCII text format.
- See Fig. 16

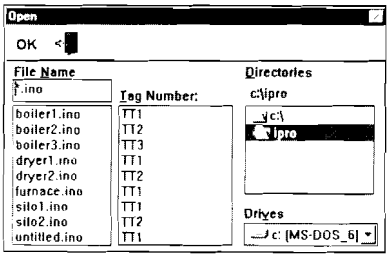


Fig. 16

Features

Documentation

- Configuration protocols can be printed for future use.
- Protocols are timestamped for traceability and furnished with user space for calibration notes.
- Up to 128 characters, for documentation purposes, can be stored in the configuration file.

On Screen Indication

- TemPRO 4.03 will show the measuring values on screen in real time.
- Updating time is user selected.
- Values are displayed in numericals, meters, or bargraphs.
- A lineprinter simulation is a useful feature for startup procedure, etc.
- See Fig. 17

Also available on screen are output signal, terminal temperature, and sensor status.

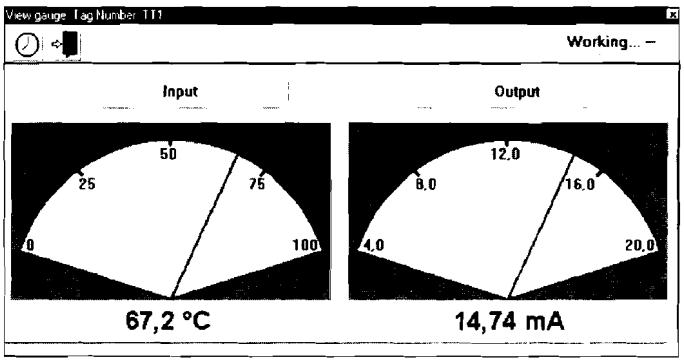


Fig 17

Utilities

- Field Calibration permits adjustment of the transmitter in one or two points.
- For this function the sensor/transmitter is subjected to a calibration source (e.g., oven).
- C, F are selectable at any time.

Software Requirements

- TempPro 4.03 is a Windows program.
- Runs on a PC with Win 3.1 or higher or Windows 95.
- Minimum processor requirements are 486, 3 MB free hard disk space and VGA display (640x480).
- More information can be obtained in the user instructions.

Warranty

- TempIR is covered by a 5 year limited warranty.

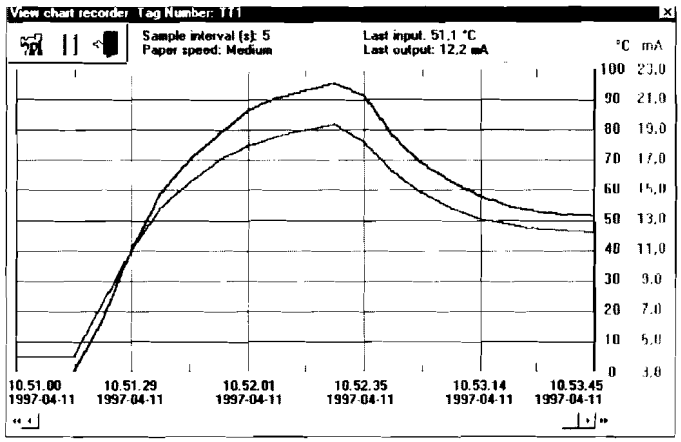
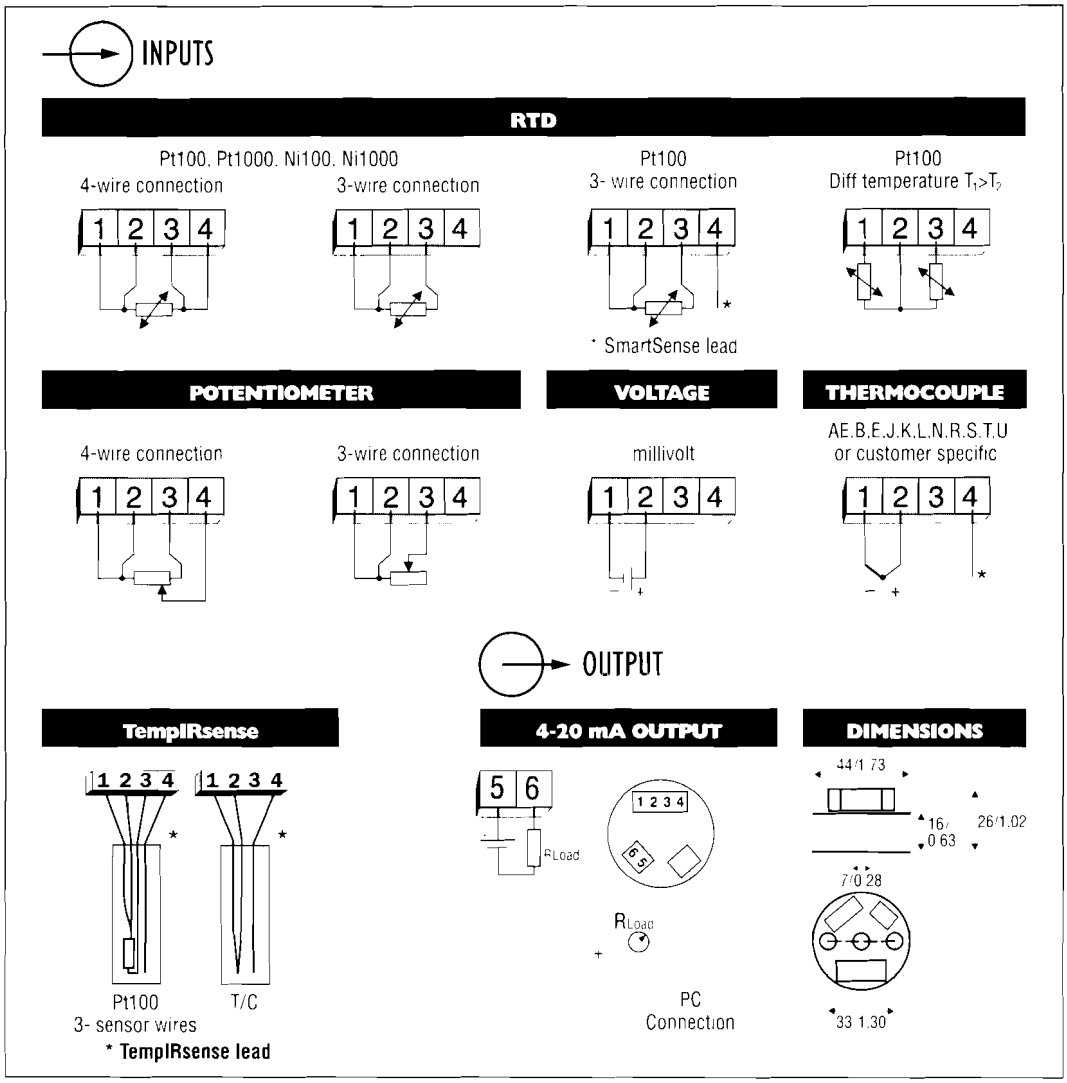


Fig 17B

Here's how to order...

1) Select the transmitter from page 8-2 in the JMS Southeast catalog as usual. However, when you get to selection #2 (Type of Transmitter), choose either T for Standard TempIR, I for TempIR with Hart Protocol, or R for Intrinsically Safe TempIR.

2) Select the TempPro software program from page 8-2 in the JMS catalog. When you get to selection #6 (Software), choose "A".



Special Introductory Offer

Mention this promotion on your first order of TempIRsense and you'll receive a $1200.00 training program on Temperature Measurement.

This offer is only good on your first order of the TempIRsense System.
(including sensor, transmitter, and software)

Call Today
800-873-1835

Specifications

RTD's and Resistance

Pt100	3, 4, wire	-200 to +1000 °C -328 to +1832 °F
Pt1000	3, 4, wire	-200 to +200 °C -328 to +392 °F
Ni100	3, 4, wire	-60 to +250 °C -76 to +482 °F
Ni1000	3, 4, wire	-60 to +150 °C -76 to +302 °F
Potentiometer	3, 4 wire	0 - 2000 ohm
Sensor Current		appro. 0.4 mA
Max. Permissible Lead Resistance		25 ohms/lead

Thermocouples and Voltages

T/C	AE, B E, J, K, L, N, R, S, T, U
Voltage Input	-10 -500 mV
Input Resistance	> 10 Mohm
Total permissible lead resistance for both input leads	500 ohms

Input Monitoring

	User definable settings
Sensor break detection	3.5 - 22.8 mA
Smart Sense, sensor isolation monitoring	3.5 - 22.8 mA

Adjustments

Zero adjstments		no limitation
Minimum ranges	Pt100, Pt1000	
	Ni100, Ni1000	10 °C, 18 °F
	Potentiometer	10 ohm
	T/C, mV	2 mV

Output

Straight, reversed or any intermediate value	4 - 20 mA
Resolution	5 µA
Min output signal	appr. 3.5 mA
Max output signal	appr. 23 mA

Common Data

Selectable filter time for low pass filter	0-60 s
Scan time	appr. 0.5 s
Rise Time 10 - 90%	appr. 0.3 s
Transformer Isolation In-Out	1500 VAC 1 min

Supply

Power supply polarity protected	6.5-36 VDC 10-36 VDC

Errors

Linearity	RTD, mV T/C	0.05%[1] 0.1%[1]
Calibration	Pt100, Pt1000 Ni100, Ni1000 Potentiometer mV, T/C	The larger of 0.1 °C, 0.2 °F or 0.05%[1] The larger of 0.1 ohm or 0.05%[1] The larger of 20 µV or 0.05%[1]
Cold Junction Compensation	T/C	0.5 °C, 0.9 °F
Temperature drift		The larger of 0.005 °C/°C, 0.005 °F/°F or 0.005 %/°C, 0.003%/°F
Cold Junction Compensation	T/C	0.02 °C/°C, 0.02 °F/°F
Lead wire Resistance influence:		
RTD 3-wire		see Table 1
RTD 4-wire		negligible
Thermocouple		negligible
Load influence		negligible
Power supply influence		negligible
Long term drift, 25 °C, 77 °F		typ 0.1%[1] /year

Temperature

Ambient Temperature	-40 to +85 °C -40 to +185 °C

EMC

Emission, EN50081-2 Industrial Environment,	30-230 MHz, 30 dB (µV/m) 230-1000 MHz, 37 dB (µV/m)
Immunity, EN50082-2 Industrial Environment,	RF, air, 80-1000 MHz, AM RF, air, 900 MHz, pulse modulated (GSM cellular telephone) RF, cables, 0.15-80 MHz, ESD 4kV contact, 8kV contact, 8kV air discharge Fast transcients, cables, 2kV
HF immunity tested for 10v/m	up to 1000 MHz

Housing

Material	PC + ABS, UL V0
Mounting	DIN B-head or larger
Weight	appr. 50g

[1] of selected maximum signal