Z-4RTD2 — CONVERTER FOR THERMO-RESISTORS WITH 6-POINT INSULATION

General Description

The Z-4RTD2 instrument is a digital converter for platinum or nickel thermo-resistors, with four measuring channels, which are independent and insulated among each other from the power supply and from the serial communication line up to 1.5 kV. Furthermore, the module has:

- Facilitated wiring of power supply and serial bus by means of the bus housed in the DIN rail.
- Communication can be configured by DIP-switch or software.
- RS485 serial communication with MODBUS-RTU protocol, 32 nodes maximum.
- Inputs protected against ESD discharges up to 4 kV.
- High acquisition speed.
- In-field re-calibration possible.

Every input has the following characteristics:

- Measurement of thermo-resistors: PT100, PT500, PT1000, NI100, with 4, 3 or 2 wires wiring.
- Measurement of temperature or resistance.
- Filter programmable at eight levels to stabilise reading.
- Rejection programmable at 50 Hz or 60 Hz.
- Measurement available in the following formats: floating point representation, reverse floating-point, fixed dot at 16 bits, in tenths degrees with sign for temperature, tenths Ohms or hundredths Ohms for resistance.
- Three selectable acquisition speeds (two at 13 bit, one at 14 bit).
- Programmable value in case of fault or freezing of last reading.
- Compensation of three wire resistor on the average value of the connection resistor.

Technical Specifications

Power supply :	10..40 Vdc or 19..28 Vac (50..60 Hz)
Consumption :	max 0.7 W
Communication Ports :	-RS485, 1200..115200 Baud. -RS232, 2400 Baud, Address:01, Parity: NO, Stop bits:1, Delay on the answer: NO, Time-out: 3 s
Protocol :	MODBUS-RTU

PT100 Input - EN 60751/A2 (ITS-90)

Measuring range :	-200..650 °C
Resistance range :	18.5 Ω.. 330 Ω
Fault signalling :	Rx < 18 Ω, Rx > 341 Ω
Current on sensor :	875 µA Nominal
Resistance of cables :	20 Ω Maximum per wire

PT500 Input - EN 60751/A2 (ITS-90)

Measuring range :	-200..750 °C
Resistance range :	92.5 Ω ..1800 Ω
Fault signalling :	Rx < 90 Ω, Rx >1851 Ω
Current on sensor :	333 µA Nominal
Resistance of cables :	30 Ω Maximum per wire

PT1000 Input - EN 60751/A2 (ITS-90)

Measuring range :	-200..210 °C
Resistance range :	185 Ω...1800 Ω
Fault signalling :	Rx < 180 Ω, Rx > 1851 Ω
Current on sensor :	333 µA Nominal
Resistance of cables :	30 Ω Maximum per wire

NI100 Input

Measuring range :	-60..250 °C
Resistance range :	69 Ω...295 Ω
Fault signalling :	Rx < 60 Ω, Rx > 301 Ω
Current on sensor :	875 µA Nominal
Resistance of cables :	30 Ω Maximum per wire

Other features

ADC :	14 bits or 13 bits on input range.
Class\Base Precision :	0.05
Calibration Precision :	0.04 % (1)
Linearity :	0.025 % (1)
Thermal Drift :	< 50 ppm/K
Insulation Voltage :	1,5 kV between channels, power supply and communication.
Protection Index :	IP20
Environmental conditions :	Temperature -10..+65 °C, Saving of parameters in EEPROM guaranteed in range: 0..50 °C. Humidity 30..90 % non-condensing. Altitude: up to 2000 m a.s.l.
Storage temperature :	-20..+85 °C.
Signalling by LED :	Power Supply, Fail, RS485 Communication.
Connections :	-Removable 4-way screw terminals, max 1,5 mm², 3,5 mm pitch. -Rear IDC10 connector for DIN rail. -3.5 mm stereophonic front jack for RS232 (COM) connection.
Box :	PBT, black
Dimensions and weight :	100 x 112 x 17.5 mm, 120 g.
Standards :	EN61000-6-4/2002 (electromagnetic emission, industrial environment) EN61000-6-2/2005 (electromagnetic immunity, industrial environment) EN61010-1/2001 (safety). All circuits must be insulated from the other circuits under dangerous voltage with double insulation. The power supply transformer must comply with EN60742: "Insulated transformers and safety transformers". Notes: - Use with copper conductor.- Use in Pollution Degree 2 Environment - Power Supply must be Class 2. - When supplied by an Isolated Limited Voltage/Limited Current power supply a fuse rated max 2.5 A shall be installed in the field.

(1) On resistor, with Full Scale of 350 Ω (PT100, NI100) or 1850 Ω (PT500, PT1000).

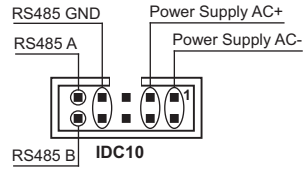
Installation rules

The module is designed to be installed in vertical position on a DIN 46277 rail. In order to ensure optimum performance and the longest working life, the module(s) must be supplied adequate ventilation and no raceways or other objects that obstruct the ventilation slots.
Never install modules above sources of heat; we recommend installation in the lower part of the control panel.

Electric connections

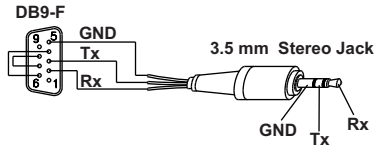
POWER SUPPLY AND RS485 COMMUNICATION PORT

The electric connections for power supply and RS485 bus can be made only by using the bus for the Seneca DIN rail.



RS232 SERIAL PORT

Connection cable DB9 with a 3.5 mm stereo Jack, can be assembled as indicated in the following figure, or can be bought as an accessory.



INPUTS

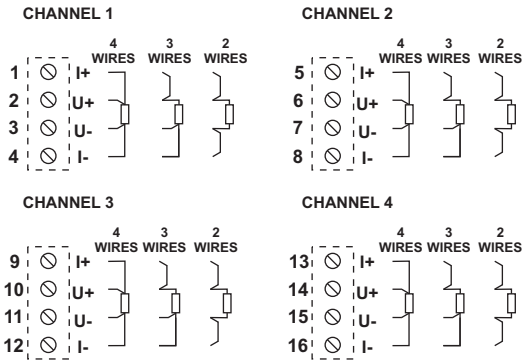
The module accepts, at input, temperature probes in platinum and nickel, with 2, 3 or 4 wire connection.

For the electrical connections, we advise you to use screened cables.

2 Wires Connection
This connection can be used for short distances (< 10 m) between module and probe. Remember that this connection introduces a measurement error equal to the resistance of the connection cables.

3 Wires Connection
A connection to be used for medium-long distances (> 10 m) between module and probe. The instrument compensates the resistance of the connection cables. To ensure correct compensation, the cables must have the same resistance. The compensation is on the average value of the connection resistance.

4 Wires Connection
A connection to be used for medium-long distances (> 10 m) between module and probe. It offers maximum precision, in view of the fact that the instrument reads the resistance of the sensor independently from the resistance of the cables.



Indications by LED on the frontal panel

PWR LED (GREEN)	Meaning
Steady	Power Supply is present.

ERR LED (YELLOW)	Meaning
Steady	Fault: insufficient power supply, faulty channel, faulty sensor, internal communication error (can be de-activated via software).

RX LED (RED)	Meaning
Steady	Data are being received through the RS485 communication port.

TX LED (RED)	Meaning
Steady	Data are being transmitted through the RS485 communication port.

Serial interface

For detailed information on RS485 serial interface, consult the documentation provided by the website www.seneca.it, in the section **Prodotti/Serie Z-PC/MODBUS TUTORIAL**.

DIP-SWITCH SETTING

The instrument leaves the factory with all DIP-switches configured in position 0. The settings of the DIP-switches defines the module's communication parameters: address and speed.

In all the following tables, the indication ● corresponds to a DIP-switch set in 1 (ON); no indication is provided when the DIP-switch is set in 0 (OFF).

SPEED (BAUDRATE)			
SW1	1	2	
			9600 Baud
	●		19200 Baud
		●	38400 Baud
	●	●	57600 Baud

ADDRESS								
SW1	3	4	5	6	7	8	
								Communication Parameters from EEPROM (2)
							●	Fixed Address: 01
						●		Fixed Address: 02
						●	●	Fixed Address: 03
				●				Fixed Address: 04
	X	X	X	X	X	X	X	Fixed Address, as from binary representation.
	●	●	●	●	●	●	●	Fixed Address: 63

(2) The default configuration is the following: Address 1, 38400, no parity, 1 stop bit.

NOT USED		
SW1	9	Not used
		Leave to OFF position.

RS485 TERMINATOR		
SW1	10	
		Terminator OFF
	●	Terminator ON

FILTER SETTING

The filtering methods can be set for every channel. The filter consists of two independent low-pass filters:
-Filter FIR, in running average, able to increase the rejection of disturbances to the mains power line frequency and to reduce measuring noise.
-Filter IIR exponential, with programmable time constant, able to dampen fluctuations.

If an input variation higher than the threshold **T** is detected, both filters are forced to adapt rapidly to the new value, stabilising it only later on. The filter is set with the three least significant bits of registers MODBUS 40037..40 (refer to section **MODBUS REGISTERS**). The following is a table containing all settable filter types. The propagation time (90%) is indicated for each filter, i.e. the maximum time between the step variation of the input and the variation of the number which represents it in the Modbus register, including the interrogation time of an individual register at 115 kbaud). The times indicated apply to the 50 Hz setting - for 60 Hz, divide by 1,2.

SET	SAMPLING		FILTER	PROP. TIME 90%	
	Bit ADC	Hz	TYPE	<T (3)	>T (3)
000	13	48	Not Present	45 ms	45 ms
001	13	20	Average	236 ms	103 ms
010 (4)	14	11	Average	405 ms	179 ms
011	14	11	Average + exp	1 s	179 ms
100	14	11	Average + exp	3 s	179 ms
101	14	11	Average + exp	8 s	179 ms
110	14	11	Average + exp	24 s	179 ms
111	14	11	Average + exp	72 s	179 ms

(3) The threshold value depends on the type of RTD:
T_{PT100} = 8 °C
T_{PT500} = 9 °C
T_{PT1000} = 5 °C
T_{NI100} = 5 °C

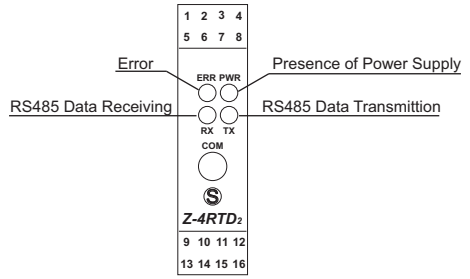
(4) Default Value.

Programming

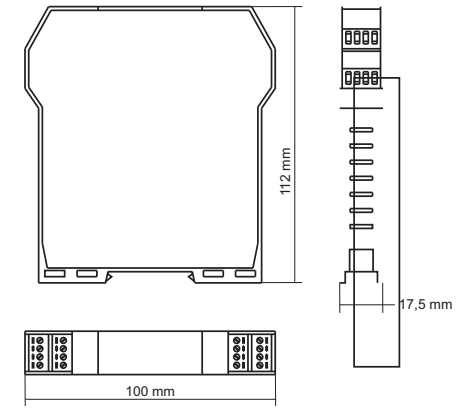
For the product's programming and/or configuration tools, consult the website www.seneca.it.
During initial programming, the EEPROM (SW3 ..8 in OFF position) default setting values originally programmed as follows can be used:
Address = 1, **SPEED = 38400 baud, PARITY = none**, **BIT NUMBER = 8**, **STOP BIT = 1**.

The module can also be programmed through the front connector (COM) while paying attention to set the following connection parameters:
Address = 1, Speed = 2400 Baud, **PARITY = none**, **STOP BIT = 1**.
The Com communication port behaves in the same way as the RS485 bus port except for the communication parameters described above. It also has priority over the RS485 serial port and closes after 3 seconds of inactivity.

Frontal panel and Led Position



Dimensions and Overall dimensions



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MODBUS REGISTERS

Z-4RTD2 has MODBUS 16 bits (words) registers, accessible by RS485 or RS232 serial communication. In the next paragraphs, we shall describe the supported MODBUS commands, and the functions of the registers.

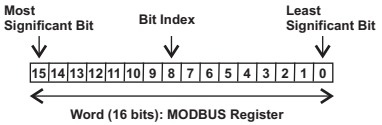
Supported MODBUS Commands

Code	Function	Description
03 (*)	Read Holding Registers	Reading of word registers up to 16 at a time.
04 (*)	Read Input Registers	Reading of word registers up to 16 at a time.
06	Write Single Register	Writing of a word register.
16	Write Multiple Registers	Writing of word registers up to 16 at a time.

(*) The two functions have the same effect.

Holding Registers

The 16-bit Holding Registers have the following structure:



Word (16 bits): MODBUS Register

In the table the notation Bit [x:y] indicates all bits from x to y. For example Bit [2:1] indicates bit 2 and bit 1, and serves to illustrate the meaning of the various united combinations of the values of the two bits. Remember that MODBUS functions 3, 4, 6 and 16, of single or multiple writing and reading, can be executed in the following registers.
Default values are indicated with the * symbol.

REGISTER	Description	ADD.	R/W
MACHINE ID	**Bit [15:8]: contain the module's ID: 22. Bit [7:0]: contain the firmware's revision.**	40001	R
STATUS_INP	**Status of input channels.**	40002	R
Bit 15	**1**: *Fault on channel 1.*		
Bit 14	**1**: *Fault on channel 2.*		
Bit 13	**1**: *Fault on channel 3.*		
Bit 12	**1**: *Fault on channel 4.*		
Bit 11	**1**: *Fault on sensor of channel 1.*		

Bit 10	**1**: *Fault on sensor of channel 2.*		
Bit 9	**1**: *Fault on sensor of channel 3.*		
Bit 8	**1**: *Fault on sensor of channel 4.*		
Bit 7	**1**: *Communication Error with channel 1.*		
Bit 6	**1**: *Communication Error with channel 2.*		
Bit 5	**1**: *Communication Error with channel 3.*		
Bit 4	**1**: *Communication Error with channel 4.*		
Bit 3	**1**: *Init Error on channel 1.*		
Bit 2	**1**: *Init Error on channel 2.*		
Bit 1	**1**: *Init Error on channel 3.*		
Bit 0	**1**: *Init Error on channel 4.*		
CHAN1_TENTHS	**Channel 1 measurement (tenths of °C or tenths/hundredths of Ohms)**(5)	40003	R
Bit [15:0]	Temperature of channel 1 in tenths of °C (or resistance in tenths/hundredths of Ohms).		
CHAN2_TENTHS	**Channel 2 measurement (tenths of °C or tenths/hundredths of Ohms)**(5)	40004	R
Bit [15:0]	Temperature of channel 2 in tenths of °C (or resistance in tenths/hundredths of Ohms).		
CHAN3_TENTHS	**Channel 3 measurement (tenths of °C or tenths/hundredths of Ohms)**(5)	40005	R
Bit [15:0]	Temperature of channel 3 in tenths of °C (or resistance in tenths/hundredths of Ohms).		
CHAN4_TENTHS	**Channel 4 measurement (tenths of °C or tenths/hundredths of Ohms)**(5)	40006	R
Bit [15:0]	Temperature of channel 4 in tenths of °C (or resistance in tenths/hundredths of Ohms).		
CHAN1_FLOAT_H	**Measurement of channel 1 in floating point (most significant word).**	40007	R
Bit [15:0]	Temperature in °C or resistance in Ohms of channel 1 (MSW).		

CHAN1_FLOAT_L	**Measurement of channel 1 in floating point (least significant word).**	40008	R
Bit [15:0]	Temperature in °C or resistance in Ohms of channel 1 (LSW).		
CHAN2_FLOAT_H	**Measurement of channel 2 in floating point (most significant word).**	40009	R
Bit [15:0]	Temperature in °C or resistance in Ohms of channel 2 (MSW).		
CHAN2_FLOAT_L	**Measurement of channel 2 in floating point (least significant word).**	40010	R
Bit [15:0]	Temperature in °C or resistance in Ohms of channel 2 (LSW).		
CHAN3_FLOAT_H	**Measurement of channel 3 in floating point (most significant word).**	40011	R
Bit [15:0]	Temperature in °C or resistance in Ohms of channel 3 (MSW).		
CHAN3_FLOAT_L	**Measurement of channel 3 in floating point (least significant word).**	40012	R
Bit [15:0]	Temperature in °C or resistance in Ohms of channel 3 (LSW).		
CHAN4_FLOAT_H	**Measurement of channel 4 in floating point (most significant word).**	40013	R
Bit [15:0]	Temperature in °C or resistance in Ohms of channel 4 (MSW).		
CHAN4_FLOAT_L	**Measurement of channel 4 in floating point (least significant word).**	40014	R
Bit [15:0]	Temperature in °C or resistance in Ohms of channel 4 (LSW).		
STATUS_INP	**Copy of register 4002 containing the status of the input channels.**	40015	R
CHAN1_WIRE	**Measurement of channel 1 connection wire.**	40016	R
Bit [15:0]	Value of connection wire in mΩ of channel 1.		
CHAN2_WIRE	**Measurement of channel 2 connection wire.**	40017	R
Bit [15:0]	Value of connection wire in mΩ of channel 2.		
CHAN3_WIRE	**Measurement of channel 3 connection wire.**	40018	R
Bit [15:0]	Value of connection wire in mΩ of channel 3.		

CHAN4_WIRE	**Measurement of channel 4 connection wire.**	40019	R
Bit [15:0]	Value of connection wire in mΩ of channel 4.		
ERR_CH1_CH2	**Details of Errors on Channel 1 (MSB), Channel 2 (LSB).**	40025	R
Bit 15	**1**: *Power supply voltage error (channel 1).*		
Bit 14	**1**: *Reception Error (channel 1).*		
Bit 13	**1**: *EEPROM saving Error (channel 1).*		
Bit 12	**1**: *EEPROM saving blocked (channel 1).*		
Bit 11	**1**: *Reading Error of Resistor (Rx) (channel 1).*		
Bit 10	**1**: *Reading Error of 3 wire resistor (channel 1).*		
Bit 9	**1**: *Acquisition Error (channel 1).*		
Bit 8	**1**: *Reading Error CRC EEPROM (channel 1).*		
Bit 7	**1**: *Power supply voltage error (channel 2).*		
Bit 6	**1**: *Reception Error (channel 2).*		
Bit 5	**1**: *EEPROM saving Error (channel 2).*		
Bit 4	**1**: *EEPROM saving blocked (channel 2).*		
Bit 3	**1**: *Reading Error of Resistor (Rx) (channel 2).*		
Bit 2	**1**: *Reading Error of 3 wire resistor (channel 2).*		
Bit 1	**1**: *Acquisition Error (channel 2).*		
Bit 0	**1**: *Reading Error CRC EEPROM (channel 2).*		
ERR_CH3_CH4	**Details of Errors on Channel 3 (MSB), Channel 4 (LSB).**	40026	R
Bit 15	**1**: *Power supply voltage error (channel 3).*		
Bit 14	**1**: *Reception Error (channel 3).*		
Bit 13	**1**: *EEPROM saving Error (channel 3).*		
Bit 12	***1**: EEPROM saving blocked (channel 3).*		
Bit 11	**1**: *Reading Error of Resistor (Rx) (channel 3).*		
Bit 10	**1**: *Reading Error of 3 wire resistor (channel 3).*		
Bit 9	**1**: *Acquisition Error (channel 3).*		
Bit 8	**1**: *Reading Error CRC EEPROM (channel 3).*		

Bit 7	**1**: *Power supply voltage error (channel 4).*		
Bit 6	**1**: *Reception Error (channel 4).*		
Bit 5	**1**: *EEPROM saving Error (channel 4).*		
Bit 4	**1**: *EEPROM saving blocked (channel 4).*		
Bit 3	**1**: *Reading Error of Resistor (Rx) (channel 4).*		
Bit 2	**1**: *Reading Error of 3 wire resistor (channel 4).*		
Bit 1	**1**: *Acquisition Error (channel 4).*		
Bit 0	**1**: *Reading Error CRC EEPROM (channel 4).*		
RESET	**Module Reset.**	40029	R/W
Bit [15:0]	Write value 0xCCCC to reset the module.		
ADDR	**Register for the setting of the module's address and parity control.**	40035	R/W
Bit [15:8]	Set the module's address. Permissible values from **0x00** to **OxFF** (decimal values in the interval of 0-255). Default address: **1**.		
Bit [7:0]	Set the type of parity control : 00000000 : No parity (NONE) (Default) 00000001 : Even parity (EVEN) 00000010 : Odd parity (ODD)		
BAUDR	**Register for the setting of the Baudrate and the response delay time in characters.**	40036	R/W
Bit [15:8]	Set the serial communication speed value (Baudrate) : 00000000 (0x00) : 4800 Baud 00000001 (0x01) : 9600 Baud 00000010 (0x02) : 19200 Baud 00000011 (0x03) : 38400 Baud (Default) 00000100 (0x04) : 57600 Baud 00000101 (0x05) : 115200 Baud 00000110 (0x06) : 1200 Baud 00000111 (0x07) : 2400 Baud		
Bit [7:0]	Set the response delay time in characters that represents the number of pauses of 6 characters each to be entered between the end of the Rx message and the start of the Tx message. Default value: 0.		

CONFIG_CH1	**Configuration Register for channel 1.**	40037	R/W
Bit [15:8]	*For internal use, do not modify.*		
Bit [7:6]	*Sensor Type :* **00**: PT100 * **10**: PT500 **01**: NI100 **11**: PT1000		
Bit 5	*Type of returned Data Item :* **0**: Measurement in °C*.* **1**: Measurement in Ω.		
Bit 4	*Third wire compensation :* **0**: NO * **1**: YES		
Bit 3	*Rejection to mains frequency :* **0**: 50 Hz * **1**: 60 Hz		
Bit [2:0]	*Filter* (for details, refer to the *FILTER SETTING* section): **000**: Not present **001**: Average filter Other settings in **FILTER SETTING**.		
CONFIG_CH2	**Configuration Register for channel 2.**	40038	R/W
Bit [15:8]	*For internal use, do not modify.*		
Bit [7:6]	*Sensor Type :* **00**: PT100 * **10**: PT500 **01**: NI100 **11**: PT1000		
Bit 5	*Type of returned Data Item :* **0**: Measurement in °C*.* **1**: Measurement in Ω.		
Bit 4	*Third wire compensation :* **0**: NO * **1**: YES		
Bit 3	*Rejection to mains frequency :* **0**: 50 Hz * **1**: 60 Hz		
Bit [2:0]	*Filter* (for details, refer to the *FILTER SETTING* section): **000**: Not present **001**: Average filter Other settings in **FILTER SETTING**.		
CONFIG_CH3	**Configuration Register for channel 3.**	40039	R/W
Bit [15:8]	*For internal use, do not modify.*		
Bit [7:6]	*Sensor Type :* **00**: PT100 * **10**: PT500 **01**: NI100 **11**: PT1000		

Bit 5	*Type of returned Data Item :* **0**: Measurement in °C*.* **1**: Measurement in Ω.		
Bit 4	*Third wire compensation :* **0**: NO * **1**: YES		
Bit 3	*Rejection to mains frequency :* **0**: 50 Hz * **1**: 60 Hz		
Bit [2:0]	*Filter* (for details, refer to the *FILTER SETTING* section): **000**: Not present **001**: Average filter Other settings in **FILTER SETTING**.		
CONFIG_CH4	**Configuration Register for channel 4.**	40040	R/W
Bit [15:8]	*For internal use, do not modify.*		
Bit [7:6]	*Sensor Type:* **00**: PT100 * **10**: PT500 **01**: NI100 **11**: PT1000		
Bit 5	*Type of returned Data Item :* **0**: Measurement in °C*.* **1**: Measurement in Ω.		
Bit 4	*Third wire compensation :* **0**: NO * **1**: YES		
Bit 3	*Rejection to mains frequency :* **0**: 50 Hz * **1**: 60 Hz		
Bit [2:0]	*Filter* (for details, refer to the *FILTER SETTING* section): **000**: Not present **001**: Average filter Other settings in **FILTER SETTING**.		
AUX_SETTINGS	**Additional Configuration Register.**	40041	R/W
Bit 15	*Floating point interpretation :* **0** *: The high word of floating point is transmitted first, then the low word. **1** : The low word of floating point is transmitted first, then the high word.		
Bit [14:8]	*Reserved and not modifiable.*		
Bit 7	*Fault on channel 1 signalled by LED :* **0** *: a fault on channel 1 is signalled by LED. **1** : a fault on channel 1 is not signalled by LED.		
Bit 6	*Fault on channel 2 signalled by LED* (as Bit 7)		

Bit 5	*Fault on channel 3 signalled by LED* (as Bit 7).		
Bit 4	*Fault on channel 4 signalled by LED* (as Bit 7).		
Bit 3	*Action in case of fault on channel 1 :* **0** *: The temperature/resistance value is forced to the programmed fault value. **1** : The temperature/resistance value is frozen at the last acquired value before fault is signalled.		
Bit 2	*Action in case of fault on channel 2* (As Bit 3)		
Bit 1	*Action in case of fault on channel 3* (As Bit 3)		
Bit 0	*Action in case of fault on channel 4* (As Bit 3)		
VAL_FAULT_1	**Value loaded in case of fault on channel 1 (expressed as 40003.** (5)(6) **8500 * (850 °C)**	40042	R/W
VAL_FAULT_2	**Value loaded in case of fault on channel 2 (expressed as 40004).** (5)(6) **8500 * (850 °C)**	40043	R/W
VAL_FAULT_3	**Value loaded in case of fault on channel 3 (expressed as 40005).** (5)(6) **8500 * (850 °C)**	40044	R/W
VAL_FAULT_4	**Value loaded in case of fault on channel 4 (expressed as 40006).** (5)(6) **8500 * (850 °C)**	40045	R/W

(5) Registers 40003..40006 should be interpreted as follows:
- In Degree tenths, with sign, when they return a temperature.
- In Ω tenths, without sign, when they return a resistance for PT1000 or PT500.
- In Ω hundredths without sign when they return a resistance for PT100 or NI100.

(6) The value in registers 40042..40045 is copied respectively in registers 40003..40006, when the corresponding bit in register 40041 is 0. The same value is converted in floating-point, with factor 10 or 100 according to the type of data item returned.