Precision RTD Temperature Interface - SDI12/RS-485 Network

Intelligent single channel 4 Wire RTD Temperature Sensor Interface Card
with SDI-12, RS-485 and Modbus over RS-485 Digital Communications.

OEM Customised Product

Introduction

Temperature measurement is vital in many processes and industries. For the majority of these applications, a temperature sensor in contact with a solid surface, or immersed in a fluid, can often be used. The most commonly used contact sensors are RTDs (resistance temperature detectors). These sensors readily available from many suppliers and offer high performance and accurate results combined to simplified installation.

The NP-RTD-4-RSD-1 card is the latest of the single channel cards available from Keynes Controls. This device, unlike any of the others in the range supports SDI-12, RS-485 and Modbus over RS-485 in a single device. The User has full control over the selection of the network type to be used. The NP-RTD-4-RSD-1 card can communicate with stand-alone devices, data loggers and network SCADA systems. The NP-RTD-4-RSD-1 is and ideal building block for many applications and is available for OEM applications.

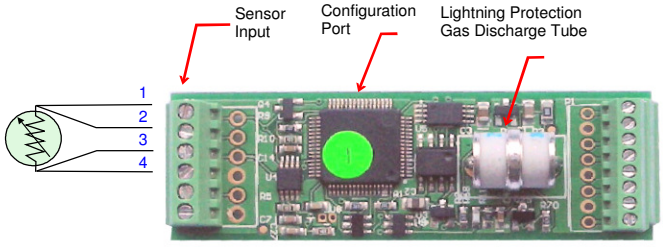
The image below shows the NP-RTD-4-RSD-1 RTD temperature interface card that supports RS-485, Modbus over 485 and SDI-12 communications. The card supports most manufacturers 4 wire RTD sensors and can be fully 'User' configured using simple industry standard SDI-12/RS485 measurement commands.

The 4 wire RTD sensor input on NP-RTD-4-RSD-1 RTD the supports most different manufactures sensors and gives very accurate results comparable to those obtained from far more expensive devices. The 4-wire RTD technique is the choice in research labs and other sensitive applications.

Average Temperature Sensor

4 Wire RTD - Laboratory Sensor

Precision Temperature Probe



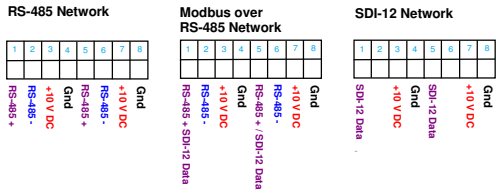
Part No: NP-RTD-4-RSD-1

Image is for marketing purposes only
The supplied card may differ slightly from the image below.

Communication Port Pin-out

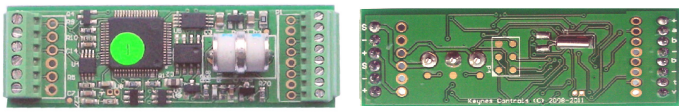
View looking into port

The images below show the pin-outs used by the different network configuration options on the NP-RTD-4-RSD-1.

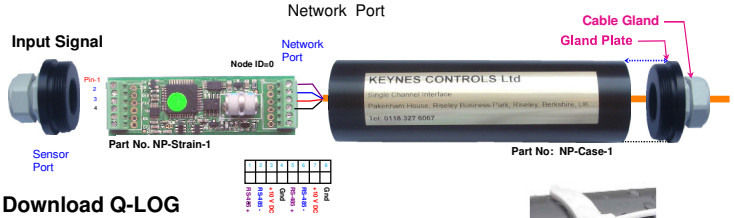


The **USB-SDI12-Pro** media converter connects to a Microsoft Windows laptop or PC, and powers SDI-12 based sensors and interfaces directly from the USB port.

Rear PCB View - Pin out Label



Network Port



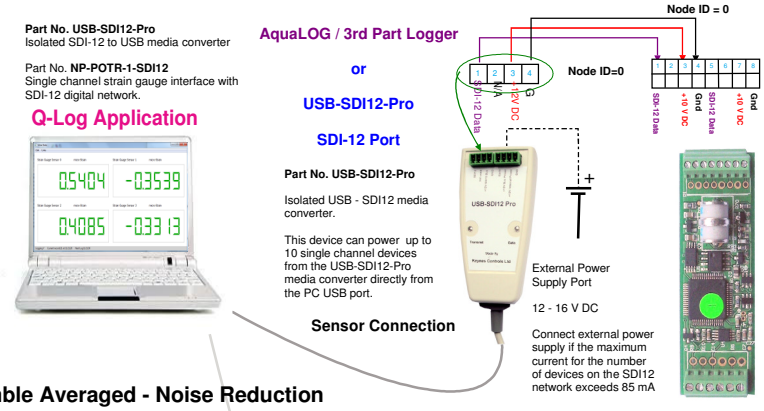
Measurement Operations SDI-12 & RS485

Any four-wire resistance thermometer can be connected to the sensor input of the **NP-RTD-4-RSD-1** card. The length of the signal cable is automatically compensated for within the measurement operations.

Using the setup software available for this product, or via the SDI2 port, set the sensor input to Pt 100 or PT1000.

Use the commands

aM! - start measurement aD0! Return Data (SDI-12)
%aM! - start measurement %aD0! Return Data (RS-485)



Download Q-LOG

Download a free copy of Q-LOG at

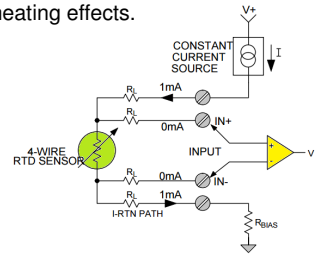
http://www.aquabat.net/QLOGFree/qlogv2.html

RTD temperature sensors can be difficult to measure because they have relatively low resistance (100 Ω) that changes only slightly with temperature (less than 0.4 Ω/°C). In order to accurately measure these small changes in resistance, the 4 wire RTD circuit is used. This form of the RTD measurement circuit minimise errors from lead wire resistance.

Temperature Calculations

The NP-RTD-4-RSD-1 card uses a form the Callendar - Van Dusen equations to determine temperature from the measured resistance of a platinum RTD sensor.

A low constant current sensor excitation current minimises the self heating effects.



4 Wire RTD Signal Conditioning Circuit used by the NP-RTD-4-RSD-1

Callendar - Van Dusen equations

$$R_t = R_0[1 + At + Bt^2 + C(t - 100)^3]$$

where A, B and C are the Callendar - Van Dusen calibration factors

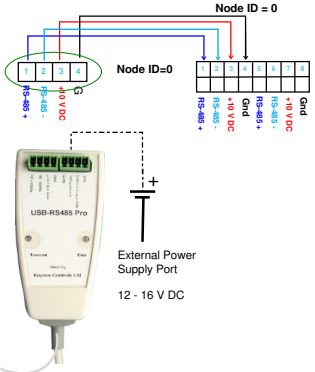
Typical Cal factors - Table-1

Standard	Temperature Coefficient (α)	A	B	C*
DIN 43760	0.003850	3.9080×10^{-3}	-5.8019×10^{-7}	-4.2735×10^{-12}
American	0.003911	3.9692×10^{-3}	-5.8495×10^{-7}	-4.2325×10^{-12}
ITS-90	0.003926	3.9848×10^{-3}	-5.870×10^{-7}	-4.0000×10^{-12}

Ensemble Averaged - Noise Reduction

The NP-RTD-4-RSD-1 card has a 'User Defined' measurement period.

The measurement period can be adjusted gives to minimise the effects 50/60 Hz power line noise.



Most platinum RTD curves follow one of three standardized curves

DIN 43760 standard (α = 0.00385)
U.S. Industrial or American standard (α = 0.003911)
International Temperature Scale (ITS-90) wire-wound RTDs (α = 0.003925)

The Callendar-Van Dusen coefficients for each of these three platinum RTD curves are listed in Table 1.

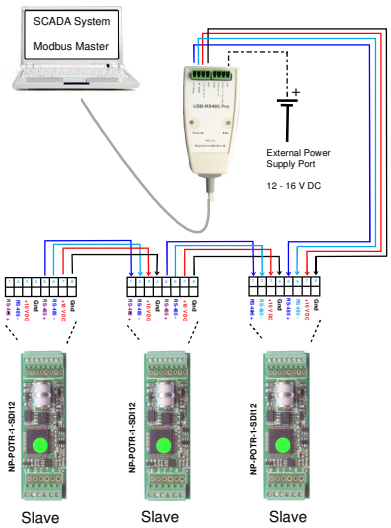
Technical Specifications

Specifications are accurate at the time of publishing but can be changed without notice.

The results are typical of what can be achieved under laboratory conditions.

Power Supply	10 -18 V
Current	2 mA at acquisition 10 uA standby
Input Range	+/- 0 - 2.5 V Other ranges on request
SDI-12 Port	1 x Port Version 1.03
Max update rate	1 sec
Cable Clamp Size	2 mm diameter
Sensor Excitation	0.25 mA Const Curr
Raw Value	Raw data mV/V
Engineering Value	Deg C / Deg F
Range	User defined, depends on sensor installed
RTD	Pt100, Pt1000
Operating Temp	-20 to 70 Deg C
Accuracy	0.05 Deg -8 to 25 Deg C
Range	-30 to + 60 Deg
Units	Deg C, Deg F, Deg K user select
RMS Noise (Typical values)	less than 1 uV/V less than 0.01 Deg C
PCB Dimension	
Length	60 mm
Width	19.7 mm
Max depth	11.2 mm
Cable Entry	1 m Screw terminal
Number Channels	1
Operating Humidity	5 - 90 % non condensing
ADC	16 Bit Sigma Delta
Statistics	
Input	Max, Min
Temp	Max, Min

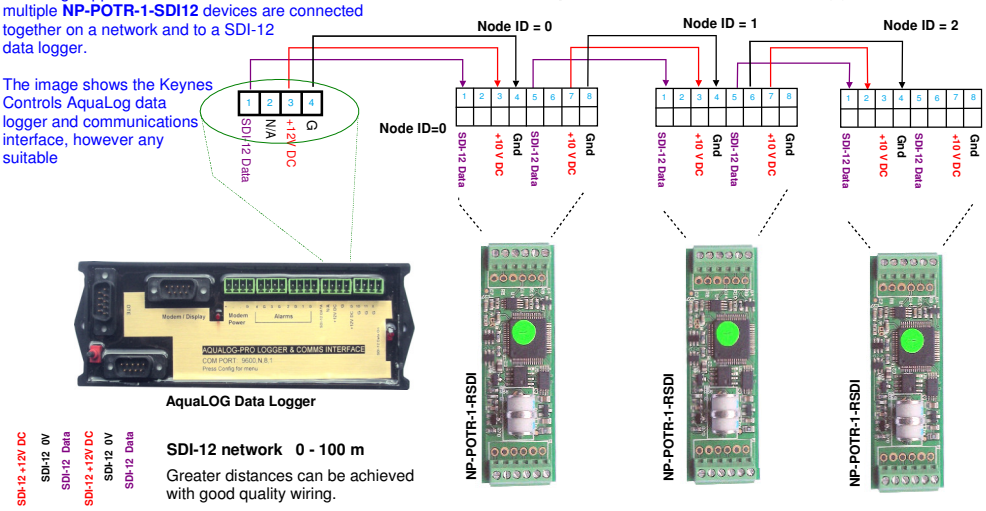
Modbus-485 Network Connection



The image opposite demonstrates how multiple **NP-POTR-1-SDI12** devices are connected together on a network and to a SDI-12 data logger.

The image shows the Keynes Controls AquaLog data logger and communications interface, however any suitable

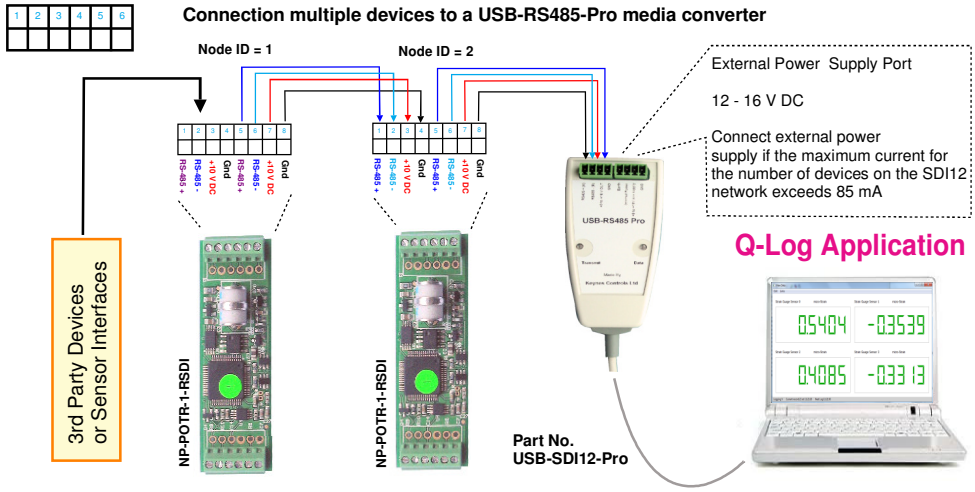
Connection multiple devices to a SDI-12 data logger



SDI-12 network 0 - 100 m

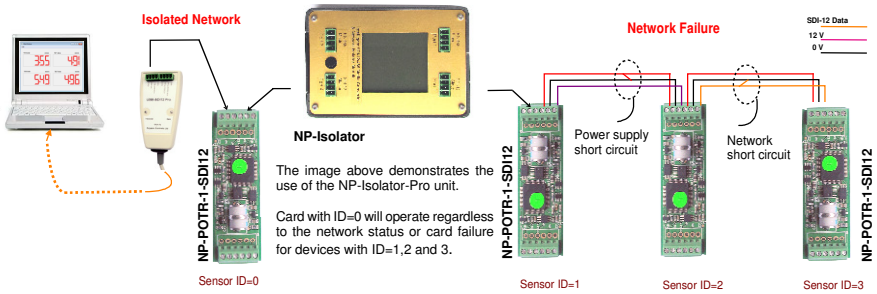
Greater distances can be achieved with good quality wiring.

Connection multiple devices to a USB-RS485-Pro media converter



Isolated Network Operations

In applications where the SDI-12 intelligent sensors and interfaces are being are to be used in harsh environments, or hard to access locations, and where long term stand-alone operations are desired, then the NP-Isolator module should be used to protect the NP-POTR-1-SDI12 cards and/or additional devices connected to the network.



The image above demonstrates the use of the NP-Isolator-Pro unit.

Card with ID=0 will operate regardless to the network status or card failure for devices with ID=1,2 and 3.

Supported SDI-12 Commands

Command	Response	Description
aM!	a0tt2	2 values in time tt given by stats
aD0!	a+0.123+25.5	Raw data/ Engineering value & temperature values
aD1!	a+0.1299+0.1201+25.9+25.0	Statistical values max S, min S, max T, Min T
aI!	a13KEYNESCOPRESR001	Identification string
aXUTu!	au	Temperature units u=0 → Celsius, u=1 → Fahrenheit with read back
aXCn,xxxx	an,xxxx	Calibration data (No temp compensation - default) E = [0] + [1]*s with read back. s is in mV E is in engineering units
aXFt,nn,xxxx!	at,nn,xxxx	Ensemble Averaging Command t → filter type (should be 0 - mean only) nn → number of filtered values 1 to 12 xxxx → interval between measurement * 200m
aXTHMT(0..1)	a+0/1	Thermistor type selection 0 → default = 3.3 K Material type F - Model EC95 1 → 10 K Ohm Model 10K3A1 Betatherm

Modbus Operations

In Modbus operations the **NP-POTR-1-RSDI** card runs continuously. The device makes new measurements and updates the data register automatically.

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