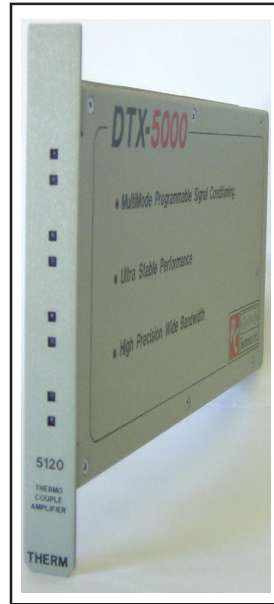


### Description

The Model 5120 Signal Conditioner is a four-channel module that provides voltage amplification, non-linearity correction, and cold-junction compensation for multiple thermocouple types. Incorporating a “lookup” table approach for real time signal correction, any transducer signal can be converted real time into equivalent engineering units. Correction tables for common thermocouple types and ranges are integrated into each 5120 module. Although designed for the linearization of thermocouple inputs with cold junction compensation, the flexible configuration of the 5120 amplifier provides the capability of dynamic sensor calibration, including temperature compensation, when utilizing the cold junction temperature sensor to monitor transducer temperature.

### Design Features

The 5120 uses an ultra stable low noise instrumentation amplifier and digital signal processing to convert the millivolt output of non-linear thermocouples to a linear output voltage. Included is a programmable input voltage offset feature allowing specific ranges of interest to be offset prior to amplification for more detailed measurements. Programmable Low-pass filtering between 0.01Hz and 10kHz can be used to reduce system noise, and a programmable calibration voltage source is available for establishing baseline temperature values before and after a test is run. Front-panel LEDs indicate signal presence and warn of over-temp conditions or module operational problems. All circuitry is housed in a shielded enclosure for improved reliability and noise reduction.



5120 Thermocouple

### Input Amplifiers

The primary thermocouple signal is first fed to a low-noise instrumentation pre-amp and then followed by a variable gain amplifier. A programmable offset voltage is injected after the pre-amp stage allowing for amplified measurement of offset temperatures without forcing a zero degree reference. For example, the 5120 output of 0 to 10 volts could be set to span 500 to 1000°C. The gain of this amplifier is automatically set by an on-board DSP depending on the thermocouple type and temperature measurement range selected.

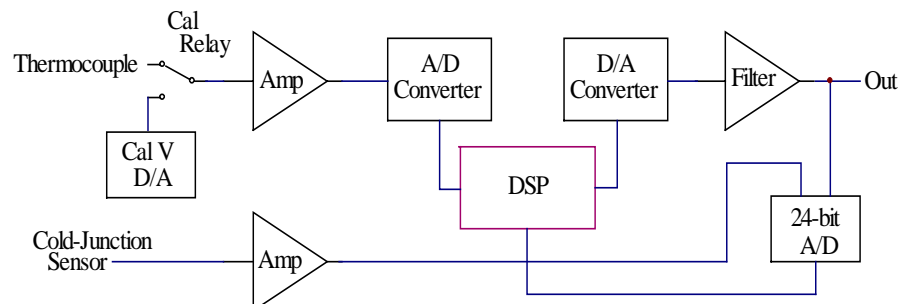
### Features

- **Extended Temperature Range**  
Range: -300 to 2000 °C
- **Wideband Frequency Response**  
DC to 100kHz
- **Ultra-stable Low Noise Amps**  
Output Noise: 1 mV rms  
Stability: 50 ppm/degC
- **Thermocouple Linearization**  
Type B,E,J,K,N,R,S,T
- **Cold Junction Compensation**
- **LED Status Indicators**

### DSP- Linearization

The Digital Signal Processor is the heart of the 5120 module. Following input signal amplification and offset adjustment, the analog signal is then digitized by a 16 bit high-speed Sigma-Delta converter. As the string of digitized values is fed to the DSP, an 8K lookup table is used to translate any arbitrary non-linear input data string into an error corrected digitized output. Processing includes real time error correction based upon internal amplifier calibration values, digital low pass filtering and addition of any “cold junction compensation” correction input from the secondary A/D converter. Lookup tables are included

*continued on next page*



5120 Technical Diagram

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 for common temperature and thermocouple ranges along with the ability to download a user calibration table. This “lookup table” approach avoids computation limitations normally associated with “Nth order polynomial” approximations.

### Output Circuit

The processed digital output is converted back to an analog voltage by a high-speed 16-bit Digital-to-Analog Converter. A four-pole low-pass filter/buffer-amp removes the digitizing steps in the reconstructed signal, along with any high-frequency noise. As with the input circuit, temperature-stable components are used to ensure that system calibration holds over a wide temperature range.

### Cold-Junction Compensation.

Thermocouples measure the temperature difference between the point where the two thermocouple wires connect to each other (the “hot” junction) and the point where they connect to the amplifier copper wiring (the “cold” junction). The thermocouple table of voltage values assume that the cold junction is at 0°C. If this is not the case (and it rarely is), the cold-junction temperature must be measured and added to the thermocouple reading. The 5120 uses a cold-junction temperature sensor, amplifier, and A/D converter to determine the cold junction temperature with the results sent to the Digital Signal Processor for inclusion in the final result.

### System Calibration

High accuracy is obtained during the conversion process by implementing a unique end-to-end calibration scheme within the 5120 Converter. A precision programmable voltage generator is connected to the input, and two calibration voltages (0v and 80% of full-scale) are fed in, amplified by the input stage, converted by the A/D, processed by the DSP, converted back to analog by the D/A, filtered by the output filter, and then measured by a high-accuracy 24-bit A/D converter. The input and output voltages are compared, and gain and offset correction values are computed and saved in the DSP memory. When data is being collected, these correction factors are applied to each thermocouple data point in real time, resulting in amplifier accuracy better than ±0.05% of full-scale.

## Specifications

### General

Thermocouple Types	B, E, J, K, N, R, S, T
Temperature measurement	-300 to 2000°C*
Frequency response	DC to 100kHz
Amplifier Accuracy	±0.05% of full-scale
Linearity	±0.025%
Stability	50 ppm/°C
Input Noise	10uV rms
Input Impedance	1 Meg, differential
Input Protection	250V max.
Output Noise	0.5mV rms
Output voltage	±10v@50mA
Output impedance	50 ohms

### Linearization

Type	On board DSP
Accuracy	0.025%

### Cold-Junction Compensation

Range	-50 to 150°C
Accuracy	±1%

### Low-Pass Filter

Type	Digital programmable
Range	0.01Hz to 100kHz
Roll-off	96 dB / octave

### Signal Overload

Indicator	Front-panel LED
Trip Level	0.1v to 10v, programmable

### Calibration Source

Type	Voltage substitution
Temperature range	-100 to 1500°C
Accuracy	0.01%
Stability	10 ppm /°C

### Environmental

Operating temperature	0 to 50 °C
Storage temp	-25 to 85 °C
Humidity	0 to 90% non condensing

### Physical Characteristics

Package	Shielded, 6 sides
Dimensions	0.8” x 4.2” x 9.5”
Weight	1.3 lbs

\* Dependent on thermocouple type and range selection