

Champion™ Series

Digital Process Monitor/Controller

AN2402

4½ Digit ± 19999 Count,
Thermocouple Input
Microprocessor Based
Panel Instrument

Introduction

The Champion™ Series of process monitor/control instruments represents a performance breakthrough in instrumentation for industrial sensor applications. Incorporating a new type of A/D from Analogic (patent-pending), Champion Series instruments measure faster and more accurately than others that cost substantially more.

The thermocouple model of the Champion Series is the AN2402. This 1/8 DIN unit provides front panel push-button setup and a high-visibility 4½-digit readout of temperatures from -233°C to 2200°C (-388°F to 3800°F). Measuring 20 times per second, this thermocouple monitor/controller achieves better than 0.3°C T/C conformity and 0.5°C accuracy.

The AN2402 retains its high accuracy in electrically noisy areas through an input common mode rejection of more than 150 dB. A digital "smart" filter further rejects noise, yet it immediately recognizes a significant input change and provides an accurate reading on the very next conversion cycle. The instrument's fast response to variations in process temperatures yields tighter control tolerances and improved process stability. Instrument stability is excellent, relying on advanced A/D design with continuous self calibration and a minimum of precision parts. An optional splash-proof case kit is available.

The AN2402 is entirely set up and operated using six front panel push buttons with the aid of displayed alphanumeric mnemonics. The unit may be set up for any of eight thermocouple types and in all standard temperature units. In operating mode, the unit displays the operator's choice of current temperature, peak, valley, or setpoints.

A choice of input/output options is available either factory installed or as a field installable card. Dual relays, analog output, and serial communications are offered. Each is separately isolated, as is the T/C input for protection against power line shorts, input and ground loop problems. The two internal relays respond according to the selected setpoints and deadbands. The analog output is scaleable for ranges up to 10V or 20 mA to drive a remote display or recorder, for example. RS232 serial communications provide calibrated 5½-digit data to a computer and allow remote setup and operation of the unit.

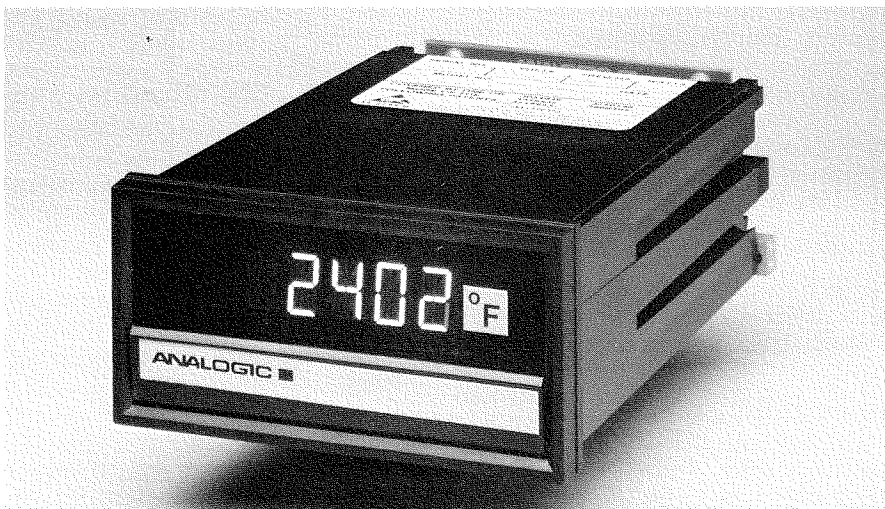
The unique design of the Champion Series model AN2402 makes it economically attractive for meeting custom OEM requirements, as well as for standard applications of thermocouple signal conditioning, temperature measurement, and control. A two-year warranty demonstrates our confidence in this highly responsive and cost effective process monitor and controller. Refer to Ordering Guide for available options and models in the Champion Series.

Features

- Linearized and calibrated for thermocouple types J, K, T, E, C, S, B, N per IEC 584, where applicable and DIN 43760
- 20 measurements per second
- 0.5°C accuracy
- 0.1° or 1° resolution, F or C
- Front panel push-button selection of T/C type and display units
- 4½ digit vacuum fluorescent display with output status indicators
- Digital "smart" filter for fast transient response
- Peak and Valley monitoring
- Scaleable analog output in volts or mA
- Dual setpoints with internal relays
- RS232 bidirectional serial communications
- Isolated input and outputs
- Adaptable for custom OEM software and hardware requirements
- Reliable design with low parts count and < 2 watt power consumption
- Two year warranty

Applications

- High Accuracy, Wide Range Temperature Measurement
- Computer Based Acquisition and Control Systems
- Turbine Exhaust Temperature Monitoring
- Heat Treat Oven Temperature Display/Control
- Fluid Temperature for Mass Flow Computation
- Ambient Temperature Monitoring
- Cryogenic Equipment Testing
- Process Monitoring and Control



Simple Setup and Operation

A six push-button keypad provides convenient setup and operation as illustrated below. The normal mode of the meter is to display the current temperature in the selected units. The "D" key can be pressed to scroll through different modes, displaying Peak, Valley, Setpoint 1, and Setpoint 2. A display mnemonic, such as S2 for Setpoint 2, appears while the D key is held down, and a value when it's released. The \blacktriangleright and \blacktriangle keys are used to change the value, and the E key is used to enter the changed value. Parameters are saved when power is off.

The 4½ digit vacuum fluorescent display is bright enough even for outdoor use. Red indicator bars appear to the left and right of the blue-green numeric display. With 9-segment digits, the VFD shows alpha as well as numeric characters, providing improved mnemonic readouts.

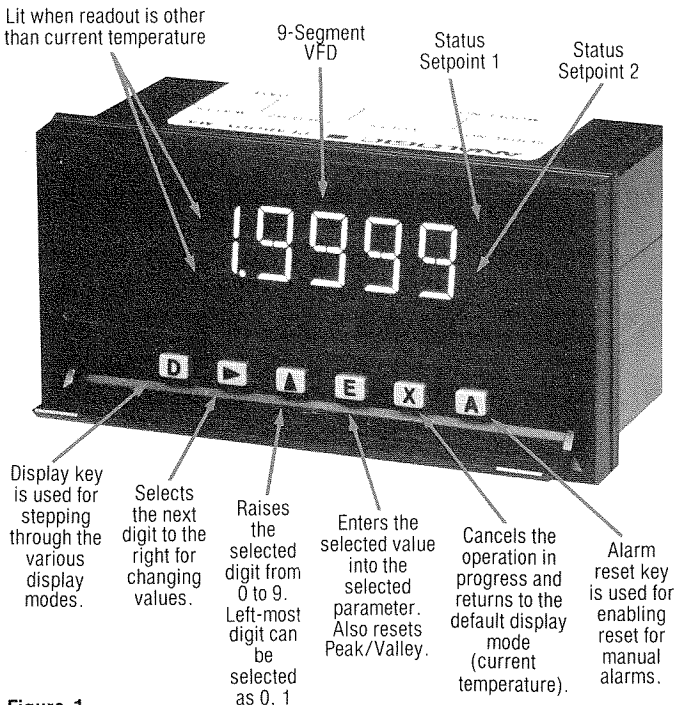


Figure 1.

Front Panel Selection of 8 Thermocouple Types

Calibrated temperature measurements can be obtained by simply connecting the thermocouple and power wires at the rear screw terminals, then selecting the T/C type and desired temperature units at the front panel. Linearized and calibrated temperature values are then displayed over the conformity range of the selected thermocouple, as illustrated for the 8 types in the chart, Figure 4. An unusually high thermocouple conformity is achieved with a proprietary software linearization algorithm.

Dependable Accuracy Under Industrial Conditions

For consistently accurate temperature measurements in process monitoring and control, the AN2402 starts with an exceptional 0.01% voltage accuracy at 20 conversions per second and makes it dependable with several features to enhance noise rejection and reliability.

To keep the AN2402 accurate over the long term, its design provides continuous auto calibration and a lower parts count than previous 4½-digit meters (see Figure 2). Low power consumption helps keep the instrument reliable at ambient temperatures up to 60°C.

The meter's fast, 50 ms conversion cycle means that measuring speed and setpoint response are limited only by the thermocouple in the majority of applications. A high internal resolution of 19 bits (2 ppm) gives OEM customers unique options for custom applications.

Independently Scaleable Analog Output

The optional voltage/current analog output, with its selectable +10V or 20 mA range, is easily scaled to any linear function using the $MX + B$ equation:

$$\text{ANALOG OUT} = (M \times \text{INPUT}) + B$$

The M (slope) and B (offset) scaling values might be selected, for instance, to "magnify" a range of cryogenic temperatures for full-scale records on a chart recorder. The output scaling is not affected by display scaling, which uses separate M and B values. These are selected automatically according to the temperature units chosen, or manually by the user for special display units such as 0.01°C, °K, °R (Rankin).

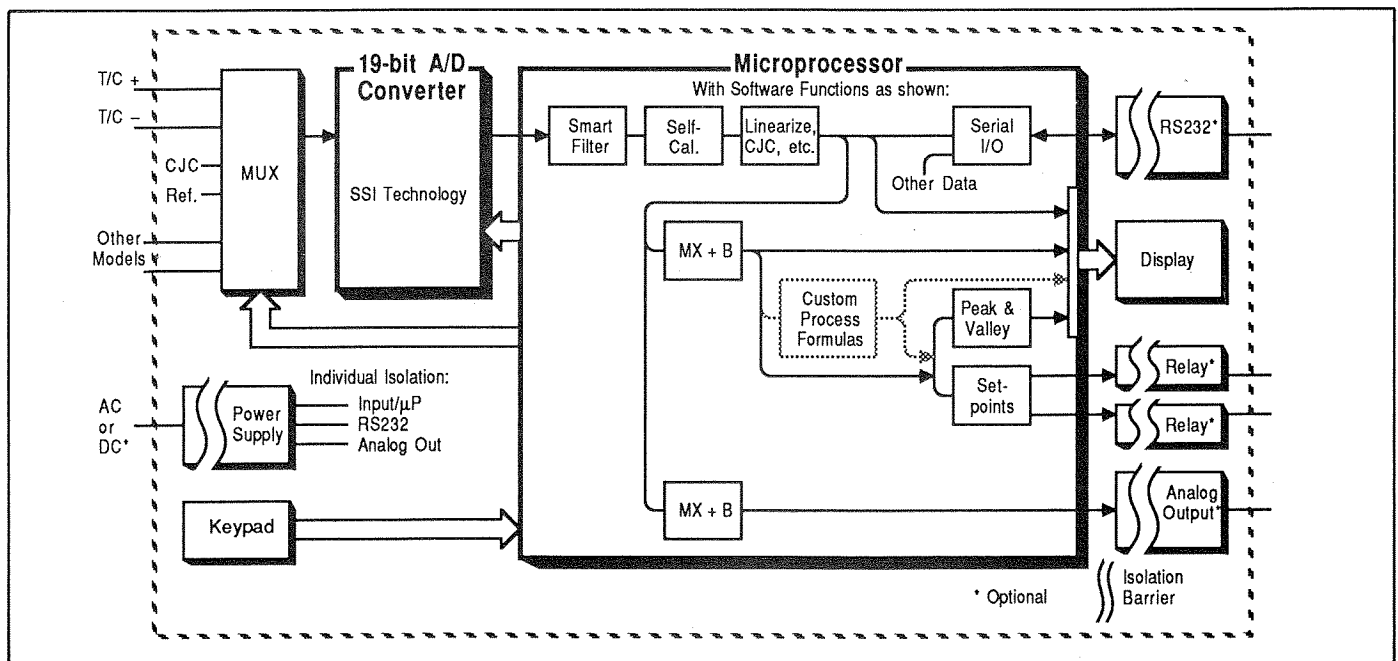


Figure 2. The AN2402 mates a 19-bit A-to-D conversion technology, called Successively Summed Integration, with a microprocessor to achieve an unprecedented combination of accuracy and speed in a panel instrument.

During auto calibration, ground and reference signals are measured instead of the T/C signal. The μP also performs the indicated software functions and direct hardware interfaces, reducing the parts count and cost.

Dual Relay Control Outputs

The relay contacts are form A and rated for 5 amps at 130 Vac or 30 Vdc. Each of the two isolated relay outputs (optional) has its own setpoint parameters, including rising/falling action and hysteresis (deadband) as well as the actual setpoint. When used for alarms, the relays can be reset either automatically or manually using the Alarm key.

Serial Communications

The AN2402 monitor/controller can communicate directly with host computers through its optional 3-wire RS232 interface. Through this isolated, bidirectional serial link, all front-panel key functions can be duplicated. Setup, data retrieval, download of

setpoints, and many other functions can be performed from a remote location.

Easy Installation

The standard 1/8 DIN case is of a high impact plastic, and is nonvented to resist airborne contamination. An optional Splash Proof Case Kit provides both a bezel gasket and a case/panel gasket. The rear of the case has integral posts and snaps to secure the supplied screw-terminal connector. All connections are made to it, as illustrated in Figure 3. After wiring, the electronics can be removed and exchanged without disturbing the field connections. The AN2402 has been designed to meet safety standards worldwide.

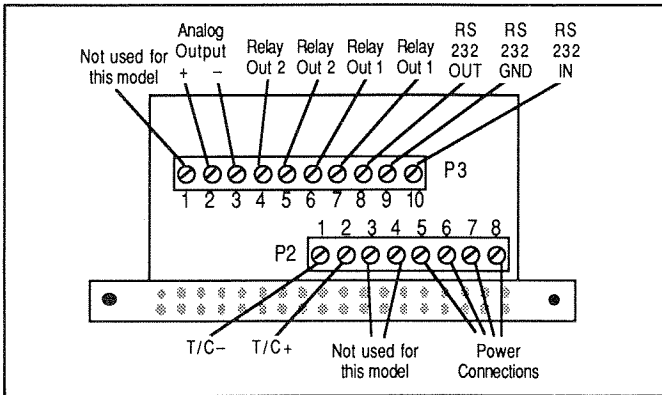


Figure 3. AN2402 pin-out for supplied screw terminal connector, ANTC2-TC.

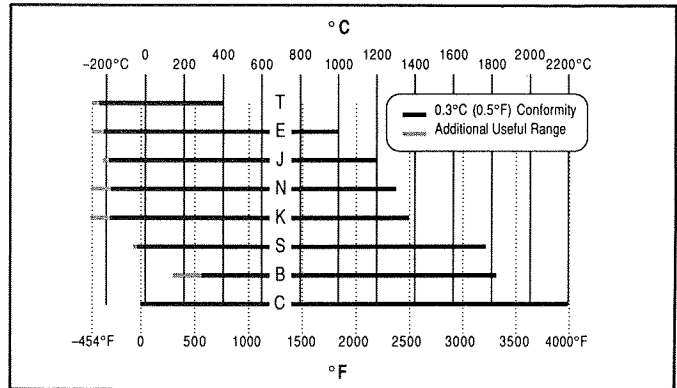


Figure 4. AN2402 Thermocouple types and their measurement ranges.

For Power Source	Connect P2 Terminals			
	5	6	7	8
115 Vac*	ac	•	•	ac
230 Vac	ac	•	•	ac
8 to 28 Vdc	dc+	dc-		

•—• Jumper

AN2402 Thermocouple Conformity Ranges in °C

T/C Type	Range for Error < 0.3°C	Additional Useful Rng., Min. °C	Min. Temp. for Err. < 0.2°C*	Max. Err. from Volt. Tolerance, °C
N	-178 to 1300	-270	-50	0.38
E	-214 to 1000	-270	-200	0.25
T	-233 to 400	-270	-128	0.50
K	-191 to 1372	-270	-140	0.30
J	-196 to 1200	-210	-187	0.22
S	-31.4 to 1768	-50	112	1.00
C	-18 to 2200	NA	NA	2.00
B	286 to 1820	140	783	2.00

* < 0.8°C for types S, B

Specifications

THERMOCOUPLE INPUT (AN2402)

Thermocouple Type

J, K, T, E, C, S, B, N, software selectable linearized and calibrated (excluding C) per IEC 584 and DIN 43760

Accuracy

0.5°C

Cold Junction Compensation (CJC)

Automatic; $\pm 0.03^\circ\text{C}/^\circ\text{C}$ from 0°C to 60°C
Max. Error due to Voltage Tolerance: 0.03°C
Error due to Thermistor Matching: 0.1°C

Input Impedance

> 1000 M Ω

External Lead Resistance Effect

400 Ω maximum for rated accuracy

Resolution

1° or 0.1°C or F, software selectable

Temperature Drift

20 ppm/°C

Step Response

> 50 ms typ., 100 ms max.

Warm Up Time

10 minutes, ± 1 display count

Maximum Common Mode Voltage

354V dc or peak ac

Common Mode Rejection Ratio

150 dB @ power line frequency with 1000 Ω source impedance

Normal Mode Rejection Ratio

60 dB @ power line frequency

Thermocouple Burnout

Same indication as Open Circuit

Thermocouple Short to AC Line

No effect, automatically protected

ANALOG TO DIGITAL CONVERSION

Technique

A proprietary method, called Successively Summed Integration, offering several improvements over the conventional dual slope process without losing the advantages of noise reduction through signal integration and inherently high linearity

Rate

20 input conversions per second
> 15/s with simultaneous serial output (includes reference and ground conversions used for self-calibration)

Input Integration Period

33.3 ms

INTERNAL SIGNAL PROCESSING

Digital Filtering

772 ms time constant (1.3 Hz)

Self Calibration

Offset and gain calibration once per second

Input Conditioning

Linearization & CJC

Display Scaling

$\text{MX} + \text{B}$: (M x input) + B, where M = 0.0001 to 99.99 and B = 0 to ± 19999 display counts

Peak and Valley

Displayed and reset by push button or serial port

DIGITAL OUTPUTS (OPTIONAL)

Output Type

2 Form A Relays

Output Rating

5A @ 130 Vac or 30 Vdc

Setpoints

Outputs are individually configurable for:
Setpoint: full scale range, ± 19999
Deadband: 0 to 400 display counts
Operating mode: inactive, trip on rise, trip on fall

Reset mode: manual or automatic

Isolation

354V dc or peak ac

Specifications (cont.)

ANALOG OUTPUT (OPTIONAL)

Range
0 to 20 mA or 0 to 10V with MX + B scaling independent of display; (M x input) + B, where M = 0.0001 to 99.99 and B = 0 to ±19999

Isolation
354V dc or peak ac

Resolution
12 bits (1/4096)

Accuracy
0.05% ±1 LSB

Linearity
±1 LSB

Step Response
0.05 second rise/fall time (10 to 90%)

SERIAL COMMUNICATIONS (OPTIONAL)

RS232
Bidirectional, 9600 baud

Isolation
354V dc or peak ac

OPERATOR INTERFACE

Display
4½ digit (±19999), 9-segment, 0.5" (12 mm) high, blue-green vacuum fluorescent display with red status indicators

Display Update
Selectable: 2 seconds, 1s, 3/s, 20/s

Keypad
6 key splash-proof elastomeric keypad

POWER

AC
90 to 130/180 to 260V, 47 to 63 Hz, 2W max. in standard configuration, 4W max. fully configured

DC (Optional)
8 to 28V, 2W max. in standard configuration, 4W max. fully configured

Isolation
1500V minimum between power and any other leads

Surge Withstand
Per IEEE-472B-1974

ENVIRONMENTAL & MECHANICAL

Operating Temperature
0 to 60°C

Storage Temperature
-40 to +85°C

Humidity
0 to 90% non-condensing

Electromagnetic Interference
Designed to meet noise spec. per FCC-Docket 20780 & VDE 0871 Curve B

Vibration (Random)
IEC 68-2-36, Test Fdb (1.6g)

Packaging
High impact plastic case

External Connections
Rear screw terminal assembly (18 contacts) for one AWG 12 or two AWG 14 wires
Wiring is fixed and rigid; electronics can be removed and exchanged without disturbing field connections

Cutout Dimensions
Standard 1/8 DIN dimensions:
1.772" x 3.622" (45 x 92 mm)

External Dimensions
1.890" H x 3.79" W x 6.00" D (48 x 96 x 152 mm)
Depth includes connector

Weight
1.1 lb (508 g)

RELIABILITY

MTBF
>40,000 hours, calculated

Calibration
NIST-traceable (formerly NBS) Certificate of Calibration with each instrument

Recalibration
Recommended 3-year intervals

Warranty
Two years

Specifications subject to change without notice.

Ordering Guide

AN2400 Champion™ Series Process Monitor/Controller

AN240□-□-□-□

Input		<input type="checkbox"/>
DC Voltage/Current ¹	0	
Thermocouple ²	2	
RTD/Thermistor ¹	6	
Power		<input type="checkbox"/>
110 Vac Power	1	
220 Vac Power	2	
8 to 28 Vdc Power ⁴	3	
Case		<input type="checkbox"/>
Standard Case	0	
Splash Proof Case	1	
Option		<input type="checkbox"/>
No Option	X	
Dual Relay, RS232	A	
Analog Output, Dual Relay, RS232 ³	B	
Analog Output, RS232 ³	C	
RS232	D	
Dual Relay	E	
Analog Output ³	G	
Analog Output, Dual Relay ³	H	
Excitation ³	X1	
Excitation, Dual Relay ³	XE	
Excitation, Analog Out ³	XG	
Excitation, Analog Out, Dual Relay ³	XH	

Option—Field Installed

- AN24A (Dual Relay, RS232)
- AN24B (Analog Output, Dual Relay, RS232)
- AN24C (Analog Output, RS232)
- AN24D (RS232)
- AN24E (Dual Relay)
- AN24F (Custom Voltage Range Card)
- AN24G (Analog Output)
- AN24H (Analog Output, Dual Relay)
- AN24X1 (Excitation)
- AN24XE (Excitation, Dual Relay)
- AN24XG (Excitation, Analog Out)
- AN24XH (Excitation, Analog Out, Dual Relay)

NOTES

1. ANSC3 I/O Connector included for all models except AN2402
2. Includes ANTC2-TC Connector
3. Available August, 1989
4. Available September, 1989

Accessories

- ANSC3 (Solder Type Connector)
- ANSPCK (Splash Proof Case Kit)
- ANTC2-TC (T/C Input/Output Term. Conn.)
- ANTC2 (Input/Output Term. Conn.)
- ANC101 (Program Disk for Serial Communications:³ Setup/Calibration/Data/Status)

Analogic is no longer in the panel meter business.

Contact MetersUSA for an alternate digital meter replacement of the same size, form and function

www.MetersUSA.com

Meters@MetersUSA.com

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