

400 Series

- -1000 to +3500 and
-10000 to +35000 Count
Resolution
- Thermocouple, RTD, and
Thermistor
- Temperature Measurement
in °C or °F without
Recalibration
- VDC and mADC Process
Measurement
- Large, Easy-to-Read LED
Display
- High Noise Rejection
- Rugged Construction
- Plug-in Range Modules and Options
- Made in USA



Temperature Measurement

Doric's Models 400A and 410A measure industrial temperatures with precision industrial accuracy. For reliable panel and rack digital indicators, DORIC Series 400A is a unique design that combines superior quality, reliability, accuracy, and versatility for economic measurement.

Easy-to-read display, tough metal case. Large 0.8" (20mm) LED display characters can easily be seen from across the room, and at all viewing angles. The case is solid die-cast aluminum - rugged enough to withstand the most hostile environments.

To cut measurement costs, enhanced models offer push-button selection of

up to five inputs or six different sensors. Temperature resolutions of 1°, 0.1°, 0.01°, DC from 0.1 to 0.001mV, and from 0.01 to 0.001V handle most precision industrial applications.

Flexibility now and for the future. The Series 400A Indicators never become obsolete. Plug-in options make field enhancements and application changes easy. Installations can be made in minutes without special instructions or soldering equipment.

The Series 400A is built around plug-in IC chips with range modules that provide superior linearization. Should your application change, simply change the range module.

Signals from thermocouples, RTD, and thermistors can be displayed with 1°, 0.1°, or 0.01° resolution. High instrument accuracy is achieved with a superior combination of low noise analog-to-digital conversion, multi-segment linearization conformity, and isolated electronics stability.

The standard resolution version, the Model 400A, has a 1° resolution (0.1° with some RTDs and thermistors). See the input range table for details.

Resolution is over the full temperature range. For example, when using iron-constantan (type J) thermocouples, the Model 400A displays its full temperature range, -328° to +1712°F with 1°F resolution; whereas, the Model 410A displays the same full range with 0.1°F resolution.

There is no need to change internal jumpers or recalibrate when changing between Celsius and Fahrenheit. A miniature DIP switch, easily accessible behind the front panel, makes °C to °F conversion a snap.

Each base instrument Model 400A or 410A can also have one of the Series 400A -0X option cards built into its chassis.

Order Model 400A for standard resolution; 410A for high resolution (specify an input type from the range table).

Thermocouple multi-input indicators. Two models, the 402A and the 412A provide the ability to switch between five inputs of a common type (e.g., type K thermocouples) cutting the costs of measuring and displaying multiple sensors. A row of five pushbutton switches, accessible on the front panel, permits easy switching between sensor readings. A screw terminal is located at the rear of the instrument to which up to five sensors can be attached.

The 402A is a standard resolution model and provides the same 1° resolution at the 400A. The 412A is a high resolution model with the same 0.1° resolution as the model 410A.

Order Model 402A for standard resolution; 412A for high resolution (specify input type from the range table).

Thermocouple multi-function indicators. Specifically designed to provide

an easy switching between different sensors, the Models 403A and 415A provide for selection between six thermocouple input types from a convenient row of easy-to-operate, front-panel push buttons. These six-function modules allow selection without recalibration between thermocouple types J, K, T, R, S, and B. Only one sensor can be attached at a time.

These multi-input switching models can be enhanced with the Series 400A -0X options.

Order Model 403A-1- 00 for 1° resolution; 415A-1- 00 for 0.1° resolution.

Thermocouple Range Table							
			Accuracy(±)			Resolution	
Sensor Type	Order Code	Range/Display	400A/402A/403A	410A/412A/415A	400A 402A 403A	410A 412A 415A	
Iron-Constantan	J 3-12	-328° to +1721°F -200° to +933°C	1.0° 1.0°	0.6° 0.6°	1° 1°	0.1° 0.1°	
Chromel®-Alumel®	K 3-01	-208° to +2552°F -133° to +1400°C	1.5°<0°<1° 1.0°	1.2°<0°<0.8° <0.8°<0°<0.5°	1° 1°	0.1° 0.1°	
Copper-Constantan	T 3-13	-328° to +752°F -200° to +400°C	2.0°<0°<1° 1.0°	1.5°<0°<0.6° 1.20°<0°<0.4°	1° 1°	0.1° 0.1°	
Chromel®-Constantan	E 3-04	-328° to +1952°F -200° to +1066°C	1.0° 1.0°	0.7° 0.4°	1° 1°	0.1° 0.1°	
Platinum-Platinum 13% Rhodium	R 1-05	+32° to +3252°F 0° to +1788°C	3°<350°<2° 2.0° 2°<315°<1°	3°<350°<1.5° 0.6° from 800° to 1300°	1° 1°	0.1° 0.1°	
Platinum-Platinum, 10% Rhodium	S 1-06	+32° to +3252°F 0° to +1788°C	3°<600°<2° 2.0° 2°<315°<1°	3°<600°<1.5° 0.5° from 800° to 1300°	1° 1°	0.1° 0.1°	
Platinum 30%, Rhodium/Platinum 6%, Rhodium	B 1-07	-912° to +3392°F -489° to +1866°C	4.0° 2.5°	2.5° 1.0°	1° 1°	0.1° 0.1°	

*CHROMEL® and ALUMEL® are registered trademarks of the Hoskins Manufacturing Company.

RTD Range Table						
			Accuracy (±)		Resolution	
Sensor Type	Order Code	Range/Display	400A	410A	400A	410A
Platinum 100Ω Cx.00385 3-wire	3-21	-388° to +1632°F -233° to +888°C	1.0° 1.0°	0.7° <328° <0.4° 0.3° <200° <0.2°	1° 1°	0.1° 0.1°
Platinum 100Ω Cx.00385 4-wire	3-22	-388° to +1632°F -233° to +888°C	1.0° 1.0°	0.7° <328° <0.4° 0.3° <200° <0.2°	1° 1°	0.1° 0.1°
Platinum 100Ω Cx.00392 3-wire	3-23	-388° to +1632°F -233° to +888°C	1.0° 1.0°	0.7° <328° <0.4° 0.3° <200° <0.2°	1° 1°	0.1° 0.1°
Platinum 100Ω Cx.00392 4-wire	3-24	-388° to +1632°F -200° to +933°C	1.0° 1.0°	0.7° <328° <0.4° 0.3° <200° <0.2°	1° 1°	0.1° 0.1°
Platinum 100Ω Cx.00392 4-wire	3-25	-30° to +143°C	0.14°	0.073°	0.1°	0.01°

Thermistor Range Table						
			Accuracy (±)		Resolution	
Sensor Type	Order Code	Range/Display	400A	410A	400A	410A

Thermistor YSI 700	3-41	+32° to +212°F	0.4°	0.4°	0.1°	0.1°
Thermistor YSI 700	3-42	+0° to +100°F	0.2°	0.2°	0.1°	0.1°

DC and Scaled DC Measurement and Display

DC voltage single range indicators. Models 400A and 410A provide exceptional accuracy and resolution for direct measurement of DC voltages. Ranges from 25mV to 25V can be selected and measured with precision industrial accuracy and repeatability.

Model 400A displays the voltage within -1000 to +2500 counts with 1 count accuracy. The higher resolution Model 410A provides an additional decade of resolution from -10000 to +25000 and improved accuracy to 0.01% of reading. Both of the instruments offer exceptional 1 count repeatability.

Each base instrument, 400A or 410A, can be enhanced by having one of the -0X option cards installed.

Order Model 400A for standard resolution, 410A for high resolution (specify input types from the DC Voltage Range Table).

DC voltage multi-input indicators. Models 402A and 412A provide low cost measurement for applications in which more than one voltage input is needed. Five front panel push buttons provide convenient selection between inputs. All channels measure the same input range (i.e., -10 to +25V).

The 402A provides the same resolution as the 400A, whereas Model 412A provides the same as the 410A.

Order Model 402A for standard resolution; 412A for high resolution (specify input types from the DC Voltage Range Table).

Scaled DC voltage and current loop single indicators. Doric's Models 400A and 410A display process parameters with precision industrial accuracy. Signals from current transmitters, signal conditioners, or other DC voltage sources can be scaled to display directly in engineering units with one of these wide ranging basic units.

Three types of input/display ranges are available. The 3-61 range accepts 4-20mA as its input and automatically scales and displays indicated results as 0.0 to 100% on the 400A (0.00 to 100.00% on the 410A). Decimal point position can be changed via a DIP switch behind the front panel, and various engineering unit labels are included that change the way the display is read (e.g., 0 to 1000 or 0.00 to 10.00).

For user-scalable, wide-ranging displays from 4-20mA inputs, select the 3-63 range; or for 0-5V inputs, select the 3-55 range. Both provide the ability to scale and offset the instrument's display proportional to process

engineering units.

Models 400A and 410A accept one of the 400A Series -0X option cards built into its chassis.

Order Model 400A for displays within -1000 to +2500 counts, 410A for displays within -10000 to +25000 (various pre-printed engineering unit labels are included with indicators).

Scaled DC voltage, multi-input indicators. Models 402A and 412A can be specified with the 3-55 range to provide the ability to switch among five inputs of a commonly scaled voltage (e.g., all inputs accepting 1-5VDC input are scaled to display as 0 to 2500). A row of five push button switches permits easy switching among input readings. There are five sets of screw terminals on the back where inputs are attached.

The 402A is a standard resolution model and provides the same scale resolution as the 400A. The 412A provides the same resolution as the 410A.

Order Model 402A for standard resolution, 412A for high resolution.

Series 400A -0X Options

Card options. All option cards can be specified at the time of initial instrument order or field installed later.

Switch error indication. The -01 Switch Error Indication Option prevents erroneous readings if two or more buttons from different rows on the multi-point model options 405A or 409A are accidentally pushed at the same time. If this does occur, the option causes the indicator display to blank out so an erroneous reading cannot be taken. *Order Option -01*

Digital high or low setpoint limits. The -03 option card offers a single switch-selectable alarm limit comparator. Two of this card should be specified for dual limit applications.

Option -03 includes a completely isolated 0.5A, 115VAC Form C contact closure. When a thumbwheel-set limit (between -3999 to +3999) is reached, the relay changes state and an LED lamp is illuminated. Resetting of the alarm can be either manual or automatic. *Order Option -03 for digital alarm setpoint.*

Analog output. For output to recorders or other analog input instruments, the -05 option card provides a linearized analog output voltage of 1mV per display count of the standard resolution indicators 400A, 402A, or 403A

(e.g., 1mV per 1°F with temperature). If specified with a high resolution model (410A, 412A, or 415A), the output is 1mV per 10 counts of display (e.g., 1mV per 1.0°F temperature). The output is completely isolated at the rear screw terminals with automatic polarity sensing. Accuracy is $\pm 0.25\%$ or reading; impedance is $5K\Omega$. *Order Option -05*

DC Voltage Range Table						
			Accuracy(\pm)		Resolution	
Sensor Type	Order Code	Range/Display	400A/402A	410A/412A*	400A/402A	410A/412A*
DC mV	3-51	-10 to +25mV	10 μ V	0.01	0.01	0.001
DC mV	3-52	-100 to +250mV	100 μ V	0.01	0.1	0.01
DC Volts	3-53	-1 to +2.5V	1mV	0.01	0.001	0.0001
DC Volts	3-54	-10 to +25V	10mV	0.01	0.01	0.001
*Accuracy percentage of reading, ± 1digit (3-51= ± 2digits)						
Scaled DC Range Table						
			Accuracy(\pm rdg)		Resolution	
Sensor Type	Order Code	Range/Display	400A	410A	400A/402A	410A/412A
4 to 20mA	3-61	0 to 100%	1 count	0.01%	0.01%	0.01%
4 to 20mA	3-63	Adjustable scaling to engineering units representation	5 counts	50 counts	-100 to +2500 (100 count minimum)	-1000 to +2500 (1000 count minimum)
0 to 5VDC	3-55	Adjustable scaling to engineering units representation	5 counts	50 counts	-100 to +2500 (100 count minimum)	-1000 to +2500 (1000 count minimum)

Series 400A - Other Options

Ten-input switching unit. Models 405A and 409A are options that add ten-point push-button selection to the base instruments 400A and 410A. Each unit has two rows of five mechanically interlocked switches. Multiple units can be daisy-chained together to provide more input switching and a lower cost-per-channel measurement.

The 405A is designed for thermocouple and voltage switching. Ten sets of easy-to-wire screw terminals are provided for attaching the 2-wire type inputs.

The 409A is specifically designed for the added wiring needs of thermistor and RTD sensors. Ten sets of 3- or 4-wire type sensors can be attached.

Installation of the -01 Switch Error Indication Option card is recommended in the base 400A and 410A units when 405A or 409A units are used. Option -01 prevents erroneous readings if push buttons from different rows are depressed at the same time.

Three different versions of front panel numbers can be ordered for the 405A by appending a dash number to the model number.

The first version, -10, has switches numbered from one to ten. The second version, -20, numbers the switches from eleven to twenty. The third version, -30, numbers the switches from twenty-one to thirty.

These models are housed in a separate stand-alone enclosure that is the same size as the 400A or 410A models.

Order Option 405A-10 or 405A-20 for thermocouples and voltage sensors, 409A-10 for thermistor and RTD.

Series 400A accessories. The Rack Adapter Plate permits the mounting of the Series 400A indicators in a standard 19" instrument rack. Three versions are available for mounting 1, 2, or 3 indicators and/or 405A, or 409A option chassis. *Order Accessory -RKM1 for 1 cutout, -RKM2 for 2 cutouts, -RKM3 for 3 cutouts.*

Series 400A Ordering Guide				
Base Model	Power Code	Input Type Code	Range	Options Code
400A 401A	-1=100-125VAC -2=190-250VAC	See individual range tables for input type codes	-01(°F) -02(°C) -03(-linear)	-01,-02,-03 -04,-05,-06, -07
402A 412A				-06,-07
403A 415A		3	-01(°F) -02(°C)	
Examples: 400A-1-3-63-03, 410A-1-3-12-02-05, 402A-1-3-12-02-05, 415A-1-3-12-02-05				

Series 400A General Specifications	
Repeatability	
R,S,B ranges:	(±0.2°C or °F)
T range:	below 200°F (±0.2°F)
All other ranges:	±1 digit

Stability with Temperature

Model 400A Zero: $1\mu\text{V}/^\circ\text{C}$
 Span: $0.001\%\text{rdg}/^\circ\text{C}$
Model 410A Zero: $0.5\mu\text{V}/^\circ\text{C}$
 Span: $0.005\%\text{rdg}/^\circ\text{C}$
Reference Junction, Internal built-in
 $0.025\%^\circ\text{C}/^\circ\text{C}$ for 10-40C base metal types
 $0.05\text{C}/\text{C}$ for $10^\circ\text{-}40^\circ\text{C}$ noble metal types

Open T/C or Break Detection

30mA, negative DC allows parallel connection of most controllers with negligible interaction

Stability with Time

No measurable drift

Noise Rejection

NMRR: $>60\text{dB}$ at 58-62Hz
 $>56\text{db}$ at 50Hz 3 pole, low pass filter with 6Hz poles

CMRR: $>120\text{dB}$ at 58-62Hz
 $>110\text{dB}$ at 50Hz with 250Ω imbalance

Overload Protection

230VDC or VAC w/out damage for at least 5 minutes
115VDC or VAC continuous

Input Impedance

-61 range: 12.5Ω (4-20mA)
-63 range: 6Ω (4-20mA)
-51, -52, -53 ranges: $1000\text{M}\Omega$ (Voltage)
-54 and -55 ranges: $10\text{M}\Omega$ (Voltage)

Source Resistance Effect

Thermocouples: $1.5\mu\text{V}$ offset for each 50Ω source resistance, removable by screwdriver adjustment

RTD

PT 4-wire range: $0.03^\circ\text{C}/\Omega$ offset in +1 and =V leads

PT 3-wire range: add an additional $2.5\text{C}/\Omega$ unbalance between +1 and -V leads, unbalance can be calibrated out

CU 3-wire range: add an additional $25.9^\circ\text{C}/\Omega$ unbalance between +1, +V, and -V leads, unbalance can be calibrated out

Thermistor: up to 10Ω of lead resistance in each of the three leads can be calibrated out

Point Update Rate

From 3 readings per second at low magnitudes, up to 1.5 seconds

per reading at upper limit magnitudes

Linearization

100% digital using 42-46 segments, depending on range selected

Display

0.8" (2.03cm) H LED uniplanar numerals
Standard models come in red display
Green display available upon request

Input Connections

Screw terminals

Environmental Ranges

Operating: 0° to 50°C
Temperature rise inside case: 5°C typical
Storage: -40° to +60°C
Humidity: ≤70% RH

Reliability

30,000 hours MTBF

Case Construction

Die-cast aluminum with textured vinyl paint

Installation

Panel mounting from the front of the panel and secured at the rear by U-channel supplied with each indicator

Size (H x W x D)

For all 400A Series indicators and 405A, and 409A options

Case: 2.63" x 5.34" x 6.38"
(6.7cm x 13.6cm x 16.2cm)
Bezel: 2.84" x 5.67" (7.2cm x 14.4cm)
Panel cutout: 2.68" x 5.44" (6.8cm x 13.8cm)

Weight

Net: 2 lb, 15 oz (1.3kg)
Shipping: 4 lb, 8 oz (2.04kg)

Power

100-125VAC or 190-250VAC (jumper selectable)
48-400Hz, 1.5W typical, 4W with all segments lit, slightly more when charging battery unit
6-foot (1.8m) detachable power cord supplied

Warranty

1 year