AMETEK
POWER INSTRUMENTS

Digital & Analog Transducers

Power Measurement Catalog

POWER
INSTRUMENTS

Power Measurement You Can Rely On.

AMETEK Power Instruments is pleased to offer you the very finest brand of power measurement instrumentation - Scientific Columbus.

SCIENTIFIC COLUMBUS

The Scientific Columbus name is renown for quality and dependability in energy meters, electrical transducers and calibration standards. Power measurement data that's not accurate is worthless. Consequently, data from instruments who's accuracy fluctuates under differing conditions become just as meaningless - especially if you are making decisions based on these measurements. Our commitment to high-accuracy, high stability transducers, meters and calibration is unwavering. Digilogic ™ and Exceltronic transducer's ® .01% and 0.2% of reading (not full-scale) accuracy specifications remains the benchmark of the industry. And now our Digital Transducers set a new standard, allowing one transducer to be configured for many different applications. Further, one transducer can take up to 37 distinct measurements. AMETEK insures that all of the Scientific Columbus line of transducers meet exacting quality standards that insure their accuracy remains constant over extended periods of times – sometimes even 20 years.

For transducers you can count on… count on Scientific Columbus brand transducers from AMETEK!

AMETEK®
POWER INSTRUMENTS

Our Products

Digital Power Measurement
Fully programmable digital and analog transducers with built-in communications.

Electronic Energy Meters
A complete line of electrical metering products that measure power consumption for utilities and industry.

Electrical Transducers
Power-measurement transducers are ideal for power panels, switchgear, and plant process control.

Calibration Standards
Laboratory and portable field standards provide high-accuracy calibration for meters and transducers.

Power Instrumentation
Measurement devices developed for specific applications to provide electrical isolation, conversion, and alarms.

Technical Training
Training courses conducted by qualified instructors are available to assist you in getting the highest performance from your products.

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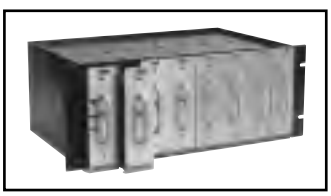
Meeting Your Accuracy, Output, and Bud

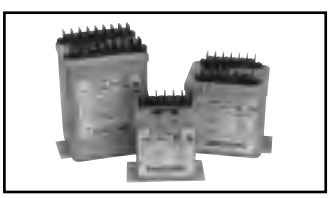
Scientific Columbus offers four dedicated lines of transducers that give you flexibility for meeting your power-measurement needs.

1. Digilogic™ Line - These are the most accurate commercially available transducers and are ideal for your most precise measurement applications (accuracy to 0.1% of reading). See pages 10-29.

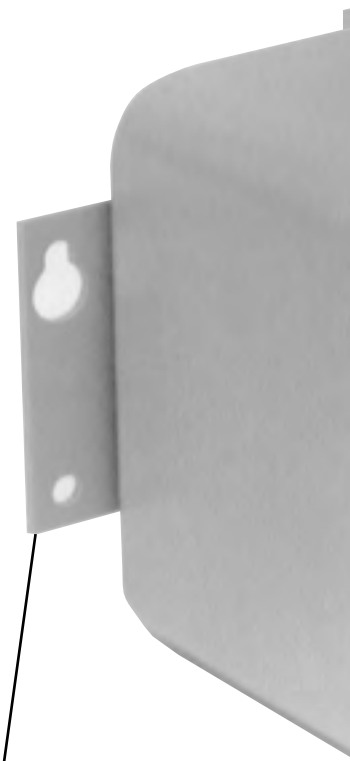
2. Exceltronic® Line - These are the most popular utility-grade transducers used in substations, generating plants, and a variety of applications requiring high-accuracy analog outputs (accuracy to 0.2% of reading). See pages 31-79.



3. Exceltronic® XLP Modular Plug-In Line - This innovative rack-mount housing allows you to place large numbers of transducers in a limited-space environment (accuracy to 0.2% of reading). See pages 81-98.

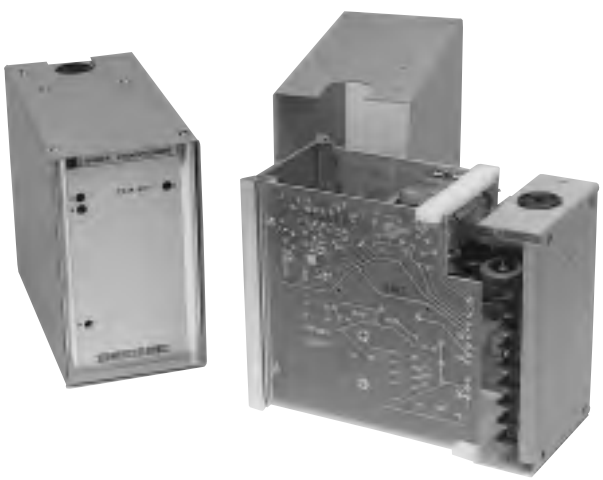


4. Exceltronic® II XLG Line - Smaller can size, 4-20 mAdc output, and UL recognition in both U.S. and Canada make this line ideal for utility and process-control applications (accuracy to 0.2% of reading). See pages 99-108.



Transducer Functions Available:

Watt	Current
Var	Voltage
Watt/Var	Phase Angle (Power Factor)
Watt/Watthour	
Var/Varhour	Phase Angle
Volt-Amp	Voltage Angle
Volt-Amp/Volt-Amphour	Frequency
	Temperature



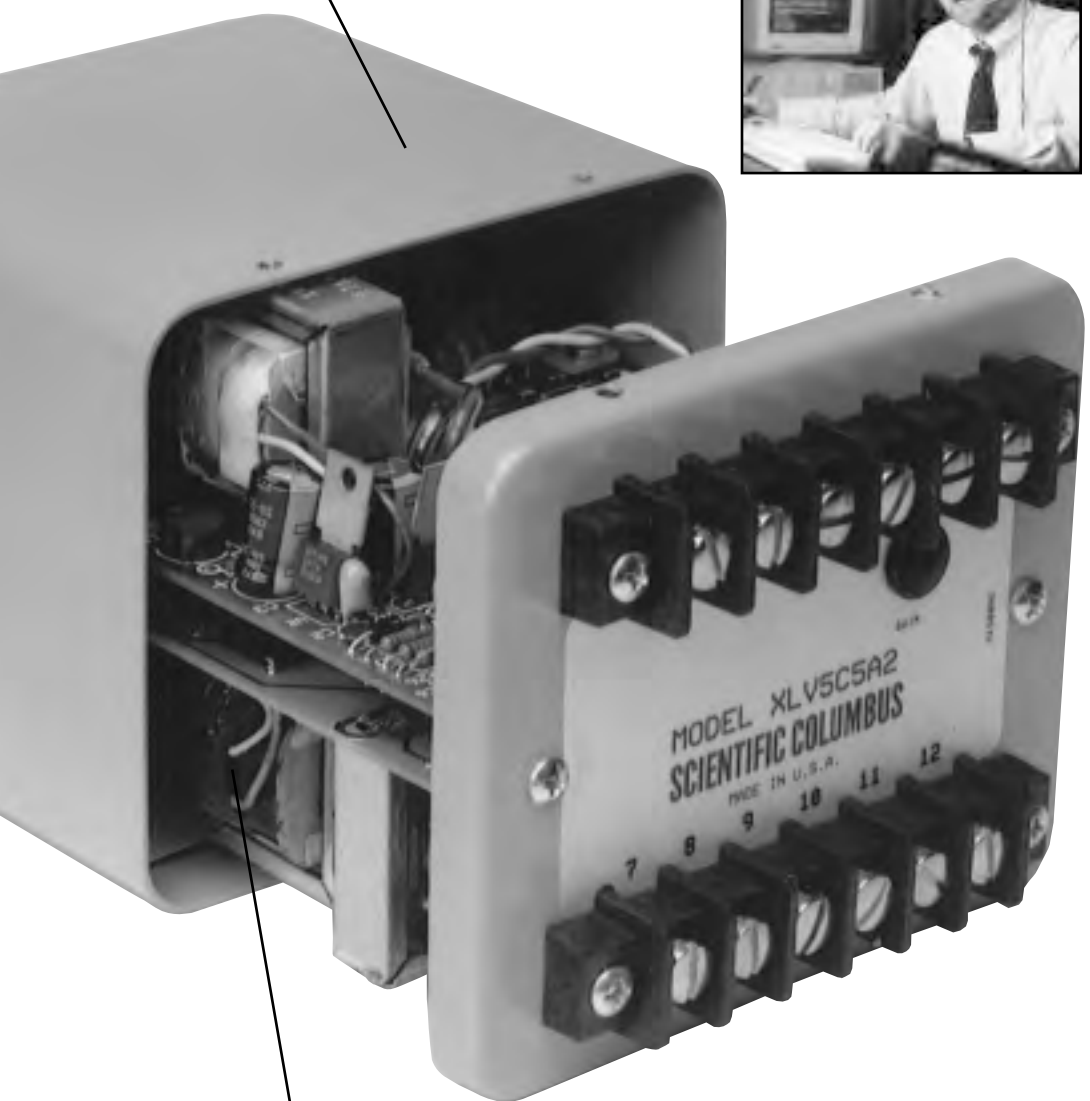
Easy Installation:

Keyhole slots make the unit easy to install and remove in the back of panels or tight corners.

Call 1-800-274-5368 for product information on our complete line of modular signal conditioners and alarms.

get Requirements–Without Compromise.

Metal Cans: **Seamless, cold-rolled steel cans, primed and painted inside and out, assure the product's integrity and long life.**



Sturdy Construction: **Supported circuit boards with wide electrical traces make the unit durable and electrically strong for harsh environments.**

Technical Support and Applications Assistance 1-800-274-5368

Speak directly to a Scientific Columbus technical specialist who will help you with questions pertaining to installation, mounting, accuracy, or measurement applications.

Fast Price Quotations

Consult the factory for pricing and delivery estimates.

Our Local Sales Representative Will Come to You

In addition to our factory field-service support, Scientific Columbus sales representatives will come to you to demonstrate products, discuss your application, or provide "hands-on" application assistance.

Fast Delivery on Orders from Stock

Scientific Columbus maintains inventory on many popular models for one-day turnaround. Contact your representative or the factory for a list of stocked items.

Maintenance, Rentals, and Calibration Services Available

Scientific Columbus maintains a complete maintenance facility and state-of-the-art calibration laboratory traceable to the National Institute of Standards and Technology. For information and a list of services and rental equipment, consult the factory.

The Element

When selecting a transducer, first determine the number of operating elements required. An element is an electronic-multiplier circuit that accepts voltage and current signals and generates an output signal proportional to the vector product of the two inputs. When one input is proportional to line voltage and the other to line current, the output signal becomes an analog of real power (watts = EI cos(ø)).

The number of elements required is one less than the number of wires delivering power from the source to the load.

Standard watt transducers are available with 1, 1 1/2, 2, 2 1/2, and 3 elements. Var transducers are identical to watt transducers with one exception: the incoming voltage signal is internally phase-shifted by 90 degrees. Var (volt-amperes reactive) transducer output is an analog signal proportional to vars (vars = EI sin(ø)).

Circuit Configuration	Elements Required
3 phase, 4 wire	3
3 phase, 4 wire (balanced voltage*)	2 1/2
3 phase, 3 wire	2
3 phase, 3 wire (balanced voltage & load**)	1 1/2
1 phase, 2 wire	1

* The individual phase-to-phase voltages have the same magnitude and equal phase displacement.

** The individual phase currents have the same magnitude and equal phase displacement.

Transducer Terminology

The label on a toaster, power drill, or radio might read, "for use on 120 Vac," and the actual measured voltage at the wall socket is 114.2 Vac. The device works because the 120 Vac statement is a nominal, or general-case value.

Nominal inputs for a watt or var transducer might be 120 Vac, 5 A. For linear operation, however, the input voltage may vary from 0 to 150 Vac and the current from 0 to 10 A. There is a maximum value for the product of the two inputs in addition to a maximum-current and a maximum-voltage value. This limit is twice the calibrating watts (or vars). For example, if the voltage varies up to 150 Vac, then the maximum-allowable current with linearity is 6.66 A (1000 W (or vars)/150 Vac). If the maximum current is 10 A, the maximum-allowable voltage is 100 Vac (1000 W (or vars)/10 A).

The 1000 W (or vars) value in the previous calculations refers to the effective range of the transducer and is usually twice the calibrating watts (or vars) value. The 150 Vac, 10 A, and 1000 W (or vars) values are maximum values. When calibrating watts (or vars) are applied, the resulting output is the rated output (RO). The watt or var transducer acts as a current generator. The rated output flows provided the load impedance is less than or equal to 10,000 Ω. In other words, the voltage across the output terminals rises to a value necessary to force the proper current flow through the load resistance. The available voltage is guaranteed to be greater than or equal to 10 Vdc, the compliance voltage of the transducer.

Transducer Output: Scale Factor

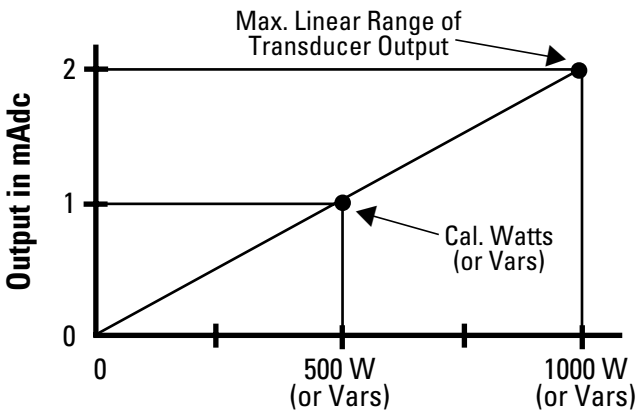
A transducer changes energy from one form to another. A watt or var transducer accepts a pair of ac input signals proportional to volts and amps and provides a dc output proportional to ac power (watts or vars). To be usable, the scale factor of this analog output must be specified in one of the following forms:

- **Secondary Calibration**
  Transducer output is related to the voltage and current inputs applied directly to the transducer input terminals.
- **Primary Calibration**
  Transducer output is related directly to the line voltage and currents "out at the load". This method includes the effects of potential and current transformers between the load and the input to the transducer.

Calibrating Watts (or Vars)

The term "calibrating watts (or vars)" is the point used to define the slope of the transducer-output curve. When applied to the transducer, calibrating watts (or vars) cause the rated dc output current to flow.

Input Watts (or Vars) vs. Transducer Output
Scale Factor: 500 W (or Vars)/mAdc



Input Watts (or Vars)—1 Element

The preceding graph indicates that the transducer has a linear output range of 2 mAdc which equals 1000 W (or vars). The calibrating watts (or vars) are stamped on the unit's name plate. The standard calibrating watts (or vars) depend on the nominal-input voltage rating, the nominal-input current, and the number of elements.

The following tables show calibration ranges for standard or P-Option watt, var, or combined watt/var transducers:

CALIBRATION RANGE FOR STANDARD WATT, VAR, AND COMBINED WATT/VAR (90% to 180% of Nominal)

Nominal Input		1 Element		1½ or 2 Element		2½ or 3 Element	
Voltage	Current	From	To	From	To	From	To
69 V	0–1 A	45	90	90	180	135	270
69 V	0–2.5 A	112.5	225	225	450	337.5	675
69 V	0–5 A	225	450	450	900	675	1350
69 V	0–7.5 A	337.5	675	675	1350	1012.5	2025
69 V	0–10 A	450	900	900	1800	1350	2700
69 V	0–15 A	675	1350	1350	2700	2025	4050
69 V	0–25 A	1125	2250	2250	4500	3375	6750
120 V	0–1 A	90	180	180	360	270	540
120 V	0–2.5 A	225	450	450	900	675	1350
120 V	**0–5 A**	**450**	**900**	**900**	**1800**	**1350**	**2700**
120 V	0–7.5 A	675	1350	1350	2700	2025	4050
120 V	0–10 A	900	1800	1800	3600	2700	5400
120 V	0–15 A	1350	2700	2700	5400	4050	8100
120 V	0–25 A	2250	4500	4500	9000	6750	13500
240 V	0–1 A	180	360	360	720	540	1080
240 V	0–2.5 A	450	900	900	1800	1350	2700
240 V	0–5 A	900	1800	1800	3600	2700	5400
240 V	0–7.5 A	1350	2700	2700	5400	4050	8100
240 V	0–10 A	1800	3600	3600	7200	5400	10800
240 V	0–15 A	2700	5400	5400	10800	8100	16200
240 V	0–25 A	4500	9000	9000	18000	13500	27000
480 V	0–1 A	360	720	720	1440	1080	2160
480 V	0–2.5 A	900	1800	1800	3600	2700	5400
480 V	0–5 A	1800	3600	3600	7200	5400	10800
480 V	0–7.5 A	2700	5400	5400	10800	8100	16200
480 V	0–10 A	3600	7200	7200	14400	10800	21600
480 V	0–15 A	5400	10800	10800	21600	16200	32400
480 V	0–25 A	9000	18000	18000	36000	27000	54000

CALIBRATION RANGE FOR P-OPTION WATT, VAR, AND COMBINED WATT/VAR (60% to 180% of Nominal)

Nominal Input		1 Element		1½ or 2 Element		2½ or 3 Element	
Voltage	Current	From	To	From	To	From	To
69 V	0–1 A	30	90	60	180	90	270
69 V	0–2.5 A	75	225	150	450	225	675
69 V	0–5 A	150	450	300	900	450	1350
69 V	0–7.5 A	225	675	450	1350	675	2025
69 V	0–10 A	300	900	600	1800	900	2700
69 V	0–15 A	450	1350	900	2700	1350	4050
69 V	0–25 A	750	2250	1500	4500	2250	6750
120 V	0–1 A	60	180	120	360	180	540
120 V	0–2.5 A	150	450	300	900	450	1350
120 V	**0–5 A**	**300**	**900**	**600**	**1800**	**900**	**2700**
120 V	0–7.5 A	450	1350	900	2700	1350	4050
120 V	0–10 A	600	1800	1200	3600	1800	5400
120 V	0–15 A	900	2700	1800	5400	2700	8100
120 V	0–25 A	1500	4500	3000	9000	4500	13500
240 V	0–1 A	120	360	240	720	360	1080
240 V	0–2.5 A	300	900	600	1800	900	2700
240 V	0–5 A	600	1800	1200	3600	1800	5400
240 V	0–7.5 A	900	2700	1800	5400	2700	8100
240 V	0–10 A	1200	3600	2400	7200	3600	10800
240 V	0–15 A	1800	5400	3600	10800	5400	16200
240 V	0–25 A	3000	9000	6000	18000	9000	27000
480 V	0–1 A	240	720	480	1440	720	2160
480 V	0–2.5 A	600	1800	1200	3600	1800	5400
480 V	0–5 A	1200	3600	2400	7200	3600	10800
480 V	0–7.5 A	1800	5400	3600	10800	5400	16200
480 V	0–10 A	2400	7200	4800	14400	7200	21600
480 V	0–15 A	3600	10800	7200	21600	10800	32400
480 V	0–25 A	6000	18000	12000	36000	18000	54000

One Enclosure!
37 Measurements!

Configure the DPMS to the
exact measurment that you need.

Fully Programmable
Digital & Analog
Transducer with
Built-in Communications

SCIENTIFIC
COLUMBUS

DPMS
Digital Power Measurement System

DPMS

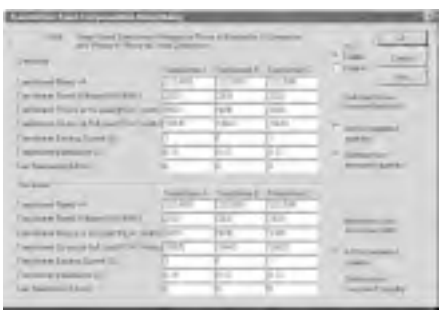
Digital Power Measurement System

With traditional transducers, one transducer is required for each measurement that you need. With the DPMS, one transducer can make multiple measurements. In fact, you can take up to 37 measurements simultaneously with just one DPMS unit! This means you can often specify one DPMS instead of multiple transducers. With direct communications capability, think of the savings that can be achieved in every aspect of a new project. Not only is it easier for Engineering, the DPMS will also save on wiring and valuable panel space.

Fully Programmable Digital & Analog Transducer with Built-in Communications

The DPMS can be configured to the exact measurement you need. Configuration is done easily with the included PC configuration software, or you can request that your DPMS come pre-configured from the factory. With optional voltage ranges, there is virtually no transducer application that a DPMS can't fill.

The DPMS makes an excellent back up strategy. Rather than stocking numerous types and quantities of back-up transducers, you can now stock far fewer DPMS units, which can be quickly and easily configured to your replacement needs.



The DPMS ships with configuration software to get you up and running quickly.

One of the most exciting innovations of the DPMS is its communication capabilities. With MODBUS and DNP as standard protocols, connections have never been simpler. The RS-485 port allows the transducer to communicate directly to your equipment through a multi-drop configuration, saving you valuable input ports and the need for multiplexors. All this and also a separate port to use with the DPMS-D external display. It gets even better! The DPMS also supports TLC. In those applications where accuracy is important, but it may not be practical to install equipment at the point you wish to actually measure, use TLC to correct for inaccuracies brought on by transformer and line losses.

Easily change transducer settings and outputs with DPMSTalk configuration software.

CHECK THE SPECS! You will find the DPMS to be highly accurate, durable, flexible, and economical. The future of transducers has arrived, and it's the DPMS – Digital Programmable Measurement System from Rochester Instrument Systems, the world leader in transducer technology!

Communicate with 15 DPMS Units!

DPMS-D
Optional Digital Display

Display
4 line x 20 character vacuum fluorescent display allows Unit ID and 3 simultaneous measurements to be viewed
Character height 0.19 inch
Color-blue
3 key switches allow selection of data to be viewed
12 standard display screens and
4 custom display screens
Displays in primary units
(CT&PT ratios configured in DPMS)

Quantities available for display
Watts – per phase and total
Vars – per phase and total
Watthours – delivered and received
Varhours – delivered and received
Voltage – phase to neutral and phase to phase
Current – phase and neutral (calculated)
Volt Amps – per phase and total
Power Factor – per phase and system frequency
Distortion – total harmonic distortion of each voltage and current
Watthours – bidirectional
Varhours – bidirectional

Communications
Multi Addressing allows communication to up to 15 DPMS units per DPMS-D display module
Half duplex RS-485
Recommended maximum distance between DPMS and DPMS-D is 4000 feet

Power Requirements
95 to 256 VAC @ 50/60 Hz or DC

Mechanical
Panel cutout 4.38 x 3.75 inches
Weight 1.4 lbs. (0.64 kg.)

Environmental
Operating Temperature range: -20° to +70°C
Storage Temperature: -40° to +85°C
Humidity: 20 to 90% RH non condensing
RFI: no effect when subjected to 10 V/M @ 1 meter
ESD: IEC 801-2 level 3 (8 kV) with no damage
Surge Withstand: ANSI/IEEE C37.90, IEC 801-4 Class 4
Isolation: 2500 VAC RMS from power to Case or Communications port1

Fully Programmable Digital & Analog Transducer with Built-in Communications

- Multi-Function Transducer is perfect solution for many varied applications
- Configured by User (or factory as needed)
- Programmable as 2, 2.5 or 3 elements
- Configurable Analog Outputs and Digital Contact & Alarm Outputs
- Excellent for replacement strategy: One unit replaces many makes and models
- Highly Accurate
- Excellent for back-up strategy: One unit on shelf backs up many varied units in the field.
- Programmable Communications of MODBUS and DNP 3.0
- Economical
- Remote Display Option available
- Space Saving Size 3.75" x 5.375" x 6.5"
- Transformer Loss Compensation (TLC)

DPMS Order Configuration Sheet

A base DPMS is standard equipped with: a nominal potential of 120V, nominal current of 5 Amps, no analog outputs, no digital outputs, and communications kit for programming the DPMS. The communications kit is standard and includes DPMSTalk programming software and a RS-232/485 adapter with cable.

Additional Options:	
Nominal voltage input:	P2 = 277V P3 = 480V P4 = 69V.
Analog output option:	A1 = 0-1mA A2 = 4-20mA.
Digital output option:	D1 = Contact outputs.
Programming Kit:	R0 = Without Programming kit consisting of DPMSTalk Configuration Software and RS-232/485 adapter cable

Fill in the order codes as shown below to create model number:

Example: DPMS-P3-A1-D1 is a DPMS at 480V with 1mA analog outputs, digital contact outputs, and with RS-232/485 adapter cable and DPMSTalk configuration software.

DIGITAL POWER MEASUREMENT SYSTEM

Programmable Configuration
2 element for 3 phase 3 wire delta
2 1/2 element for 3 phase 4 wire wye
3 element for 3 phase 4 wire wye

Measured and/or calculated quantities
Watts – per phase and total
Vars – per phase and total
Voltage – phase to neutral and phase to phase
Current – phase and neutral (calculated)
Volt Amps – per phase and total
Frequency
Distortion – Total Harmonic Distortion of each voltage & current
Watthours – delivered and received
Varhours – delivered and received
Power Factor – per phase and system

Inputs
Current Nominal – 5 amps
Operating Range – 0 to 10 amps
Burden per Element = 0.25 VA
Voltage Nominal – 120 volts
Operating Range – 85 to 150 volts
Optional: 69 VAC Nominal, Range 50-85 277 VAC Nominal, Range 180-320 VAC 480 VAC Nominal, Range 310-550 VAC
Burden per Element: 0.05 VA
Frequency 45 to 65 Hertz
Sample Rate 128 Samples/Cycle
Power Supply 95 to 265 VAC @ 50/60 Hz or DC
6 VA Maximum @ 120 V

Outputs
3 Channel Analog:
All (3) channels are independently configured and scaled with DPMSTalk software
Option A1: 0 to ± 1 ma, maximum 10 volt compliance
Option A2: 4 to 20 ma, maximum 12 volt compliance
Response Time </= 200 mS
6 Channel Digital – Option D1:
All (6) channels are independently configured and scaled with DPMSTalk software as KYZ contacts for energy measurements or as high/low threshold alarms.
Solid state rated 50 ma @135 VAC/VDC with less than 5 volt drop
54,000 CPH maximum

Measurement/Calculation Accuracy
Volts, Amps, Watts, Vars: 0.2%
Watthours, Varhours: 0.2%
Neutral current: 0.75%
Volt Amps: 0.5%
Power Factor: ±0.008* (rated VA/input VA)
Analog output: ±0.1%

Environment
Operating Temperature range: -20° to +70°C
Storage Temperature: -40° to +85°C
Humidity: 20 to 90% RH non condensing
RFI: <1% when subjected to 10 V/M @ 1 meter
ESD: IEC 801-2 level 3 (8 kV) with no damage
Surge Withstand: ANSI/IEEE C37.90, IEC 801-4 Class 4
Isolation: 2500 VAC RMS from Input/Output/Power/Case
500 VAC RMS between digital outputs
Communication/Configuration ports share common with the analog outputs

Influences Affecting Accuracy
Temperature: Conversion only: 75 ppm/°C
Including analog outputs: 125 ppm/°C
Long Term Stability: 0.1% of rated output/year, noncumulative
Humidity: less than 0.05% of rated output over the operating range

Mechanical
Size: 3.75" x 5.375" x 6.5"
Weight: 2.6 lbs. (1.2 kg.)

Communications
Hardware Protocol: RS-232 (full duplex) or RS-485 (half duplex)
Programmable Software Protocol
Modbus: RTU or ASCII Mode
DNP 3.0

A portion of this product was funded by the New York State Energy Research and Development Authority (NYSERDA)

Digilogic AC Watt or Var Transducers

Digilogic watt and var transducers provide utility, laboratory, and industrial users with the highest degree of accuracy for applications requiring precision measurement of real and reactive electrical power. A precision electronic multiplier allows measurement of true power to within 0.1% of reading throughout a wide range of input voltage, current, power factor, and environmental conditions.

Features

- Accuracy to 0.1% of reading
- Exceptional reliability
- Excellent long-term stability
- No zero adjustment required

Applications

- Utility billing
- Test laboratories
- State estimation

Outputs

- 0 to ±1 mAdc
- 1–5 or 1–3–5 mAdc
- 4–20 or 4–12–20 mAdc
- 10–50 or 10–30–50 mAdc

Measure Power Plant Losses with Digilogic Watt or Var Transducers

The exceptional accuracy of the Digilogic Transducer line allows for uncommon measurements that have real payback.

As in any system, generation losses represent unrecovered expense. Within the generating station, losses between the generator terminals and the high-voltage side of the generator step-up (GSU) transformer can be significant. These losses, which result from the high currents and large voltage change through the GSU, can affect the precision of the control room real and reactive power and energy measurements.

The Digilogic Transducer's measurement accuracy allows precise measurement of the difference between terminal power and GSU high-side power. This difference, characterized as a station loss, is measurable because the random errors associated with this type of measurement are negligible when using high-accuracy Digilogic Transducers.

Knowing generation losses assists in the optimal scheduling of generation resources. Using Digilogic Transducers assures accurate and reliable loss measurement.

Specifications

DIGILOGIC AC WATT OR VAR TRANSDUCERS

Specifications		0 to ±1 mAdc Watts (Watt Transducer)	P-Option* Watts (Watt Transducer)	0 to ±1 mAdc Vars (Var Transducer)	P-Option* Vars (Var Transducer)
Current Input	Nominal Range** Overload Continuous Overload 1 Second/Hour Burden/Element	5 A 0–10 A 20 A 250 A 0.2 VA (maximum) at 5 A			
Voltage Input	Nominal Range** Overload Continuous Burden/Element	120 V 0–150 V 200 V 0.02 VA (maximum) at 120 V			
External Auxiliary Power	Input Range Frequency Range Burden	85–135 Vac 50–500 Hz 3 VA Nominal	100–130 Vac 50–500 Hz 6 VA Nominal	85–135 Vac 50–500 Hz 3 VA Nominal	100–130 Vac 50–500 Hz 6 VA Nominal
Rated Output (RO) = 500 Watts or Vars/Element		±1 mAdc for Standard Calibration	5, 20, or 50 mAdc for Std. Calibration, depending on selected output range*	±1 mAdc for Standard Calibration	5, 20, or 50 mAdc for Std. Calibration, depending on selected output range*
Accuracy		±(0.09% Reading + 0.005% RO) at 0–200% RO	±(0.1% Reading + 0.05% RO) at 0–120% RO	±(0.15% Reading + 0.01% RO) at 0–200% RO	±(0.15% Reading + 0.05% RO) at 0–120% RO
Temperature Effect on Accuracy		±0.005% / ° C	±0.0065% / ° C	±0.009% / ° C	±0.01% / ° C
Operating Temperature Range		-20° C to +70° C	-20° C to +50° C	-20° C to +60° C	-20° C to +50° C
Compliance Voltage		10 Vdc	See Table 2 on page 8.	10 Vdc	See Table 2 on page 8.
Load		0–10,000 Ω		0–10,000 Ω	
Output Ripple Peak		< 0.5% RO	< 0.25% RO	< 0.5% RO	< 0.25% RO
Response Time		< 400 ms to 99%	< 1 Second to 99%	< 400 ms to 99%	< 1 Second to 99%
Power Factor		Any			
PF Effect on Accuracy		±0.04% VA (maximum) (Included in Accuracy specification above.)			
Standard Calibration Adjustments	Gain Zero	±1% of Reading (minimum) None Required	±10% of Span (minimum) ±5% of Zero Point (minimum)	±1% of Reading (minimum) None Required	±10% of Span (minimum) ±5% of Zero Point (minimum)
Frequency Range		58–62 Hz		60 Hz	
Stability (per year)		±0.05% RO, Noncumulative	±0.1% of Span, Noncumulative	±0.1% RO, Noncumulative	±0.2% of Span, Noncumulative
Operating Humidity		0–95% Noncondensing			
Isolation		Complete (Input/Output/Power/Case)			
Dielectric Withstand		1500 VRMS at 60 Hz			
Surge Withstand		ANSI/IEEE C37.90.1			
Maximum Net Weight		4 lbs., 6 oz. (2 kg)	4 lbs., 12 oz. (2.2 kg)	4 lbs., 8 oz. (2 kg)	4 lbs., 14 oz. (2.2 kg)
Approximate Dimensions (excluding mounting plate)		7.0" W x 3.7" D x 5.6" H (178 mm x 94 mm x 142 mm) Style I Case, see page 122	7.2" W x 5.3" D x 5.8" H (183 mm x 135 mm x 147 mm) Style V Case, see page 123	7.0" W x 3.7" D x 5.6" H (178 mm x 94 mm x 142 mm) Style I Case, see page 122	7.2" W x 5.3" D x 5.8" H (183 mm x 135 mm x 147 mm) Style V Case, see page 123
Overrange with Linearity		500–1000 Watts/Element	500–600 Watts/Element	500–1000 Vars/Element	500–600 Vars/Element
		No additional error within voltage compliance. Reduce load resistance as required.			

* P-Option includes 1–5/1–3–5, 4–20/4–12–20, and 10–50/10–30–50 mAdc outputs.

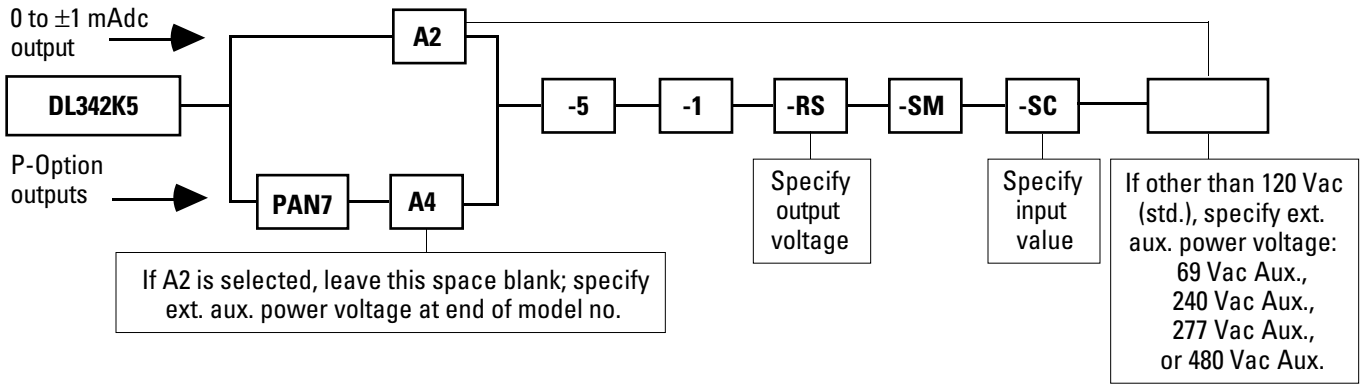
**Total input not to exceed 200% of standard-calibration watts or vars on units with 0 to ±1 mAdc output.
Total input not to exceed 120% of standard-calibration watts or vars on units with P-Option outputs.

Specifications subject to change without notice.

ORDERING PROCEDURE

Specify by base model number and appropriate selection or option suffixes in the order shown in the following example.

Base Model No.	Output	Auxiliary Power	Current Input	Voltage Input	-RS/Freq. Option #1	Option #2	Option #3	External Aux. Power
Table 1	Table 2	Table 3	Table 4	Table 4	Table 5	Table 6	Table 6	Table 3



EXAMPLES: DL342K5A2-5-1-RS-SM-SC

3-element, 0 to ±1 mAdc Watt Transducer; 120 Vac external auxiliary power; 10 A input; 240 V input; resistor scaling (converts current output to voltage output); seismic brace; special calibration (example: 7200 W).

DL342K5PAN7A4-5-1-RS-SM-SC

3-element, 4-20 mAdc Watt Transducer; internal auxiliary power; 10 A input; 240 V input; resistor scaling (converts current output to voltage output); seismic brace; special calibration (example: 7200 W).

Table 1 Base Model Number Selection

Element	Watt Model No.	Var Model No.	Connection	Calibration at Rated Output (5 A, 120 V Nominal Input)
1	DL5C5	DLV5C5	Single Phase	500 W or Vars
1 1/2*	DL5C51 1/2	DLV5C51 1/2	3 Phase, 3 Wire	1000 W or Vars
2	DL31K5	DLV31K5	3 Phase, 3 Wire	1000 W or Vars
2 1/2*	DL31K52 1/2	DLV31K52 1/2	3 Phase, 4 Wire	1500 W or Vars
3	DL342K5	DLV342K5	3 Phase, 4 Wire	1500 W or Vars

*** 1 1/2- and 2 1/2-element units require a balanced voltage.**

Table 2 Output Selection

0 to ±1 mAdc output is standard, and is specified by the Base Model Numbers. For outputs other than 0 to ±1 mAdc, indicate the appropriate P-Option in the "Output" position of the complete model number.

P-Option	Output Range	Compliance Voltage/ Maximum Load	Maximum Open Circuit Voltage
PAN6	1-5 mAdc	15 Vdc/3000 Ω	30 Vdc
PAN7	**4-20 mAdc**	**15 Vdc/750 Ω**	**30 Vdc**
PAN8	10-50 mAdc	15 Vdc/300 Ω	30 Vdc
PAN6-B	1-3-5 mAdc	15 Vdc/3000 Ω	30 Vdc
PAN7-B	4-12-20 mAdc	15 Vdc/750 Ω	30 Vdc
PAN8-B	10-30-50 mAdc	15 Vdc/300 Ω	30 Vdc

Table 3 Auxiliary Power Supply Selection

Option	Description	Input Range	Frequency Range	Burden
(0 to ±1 mAdc Units)				
A2**	**External Auxiliary Power (120 Vac std.)**	**85-135 Vac**	**50-500 Hz**	**3 VA**
A4	Internal Auxiliary Power (self-powered)	70-112% of Nominal Aux. Power Voltage	Equals Input Frequency	3 VA
(P-Option Units)				
A2** **(leave blank)**	**External Auxiliary Power (120 Vac std.)**	**100-130 Vac**	**50-500 Hz**	**6 VA**
A4	Internal Auxiliary Power (self-powered)	84-108% of Nominal Aux. Power Voltage	Equals Input Frequency	6 VA

**** For external auxiliary power voltages other than 120 Vac, specify the voltage in the last position of the complete model number. (Example: 240 Vac Aux.)**

DC external auxiliary power available; see Special Options on page 128.

Table 4 Input Selection

Current

Option	Nominal	Current Range w/ Accuracy	Calibration at Rated Output (5 A Nominal Input)
-3	1 A	0-2 A	100 W or Vars/Element
-4	2.5 A	0-5 A	250 W or Vars/Element
Std.***	**5 A**	**0-10 A**	**500 W or Vars/Element**
-11	7.5 A	0-15 A	750 W or Vars/Element
-5	10 A	0-20 A	1000 W or Vars/Element
15 A	0-20 A	1500 W or Vars/Element	
-8******	25 A	0-30 A	2500 W or Vars/Element

Voltage

Option	Nominal	Voltage Range w/ Accuracy	Calibration at Rated Output (120 V Nominal Input)
-0	69 V	0-75 V	250 W or Vars/Element
Std.***	**120 V**	**0-150 V**	**500 W or Vars/Element**
-1	240 V	0-300 V	1000 W or Vars/Element
-9	277 V	0-340 V	1200 W or Vars/Element
-2	480 V	0-600 V	2000 W or Vars/Element -7

**** Leave "Input" positions blank in the model number.**

******Option -8 requires a Style V case. (See page 123 for case dimensions. Maximum height of terminal strip(s) is 1.07" for units with -8 option.)**

Table 5 Scaling Resistor (-RS)/Frequency Options

Option	Description
-RS†	Scaling Resistor
-6	400 Hz
-12	50 Hz
-6-RS†	400 Hz and Scaling Resistor
-12-RS†	50 Hz and Scaling Resistor

† You must specify the desired output voltage:
For 0 to ±1 mAdc units, specify range from 0 to ±10 Vdc. Load impedance is 1 MΩ/Vdc (minimum).
For P-Option units, specify range from 0-15 Vdc. Load impedance is 200, 50, or 20 (kΩ/Vdc) (minimum) for units with outputs of 5, 20, or 50 mAdc, respectively.

This information is not part of the model number, but must be provided to the factory when you place your order.

Table 6 Other Options

Option	Description
-SC††	Special Calibration
-SM	Seismic Brace (available with 0 to ±1 mAdc units) (consult factory if you desire this option with a P-Option unit)
-Z	Zero-Based Output Calibration (ex.: PAN7-Z = 0-20 mAdc) (available only with P-Option unidirectional units)

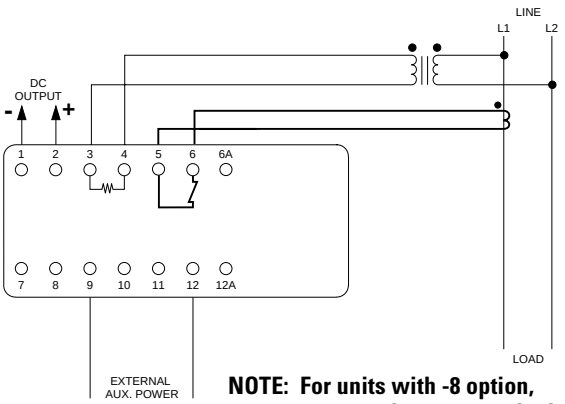
†† You must specify the desired input value:
0 to ±1 mAdc units can be calibrated within 90-180% of their standard-calibration input watts or vars. (Example: A 2-element watt transducer is calibrated to 1000 W standard. The -SC option can be added for input levels from 900 W (90%) to 1800 W (180%).) P-Option units can be calibrated within 60-180% of their standard-calibration input watts or vars.

This information is not part of the model number, but must be provided to the factory when you place your order.

If you require additional options not shown here, see Special Options on page 128. When ordering any special options, or more than three options, you must first consult the factory for pricing and delivery estimates.

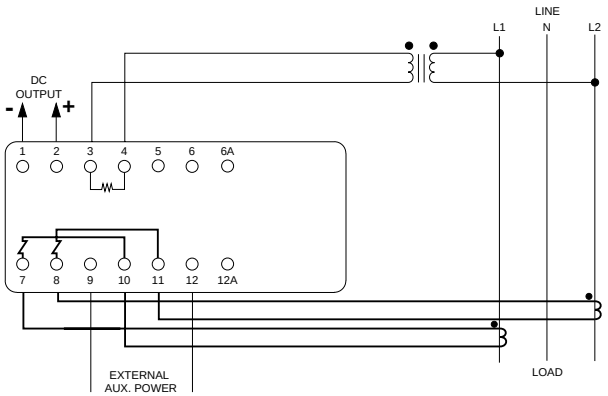
WIRING DIAGRAMS FOR 0 to ±1 mAdc UNITS (Style I Case)

1 Element, Single Phase, 2 Wire

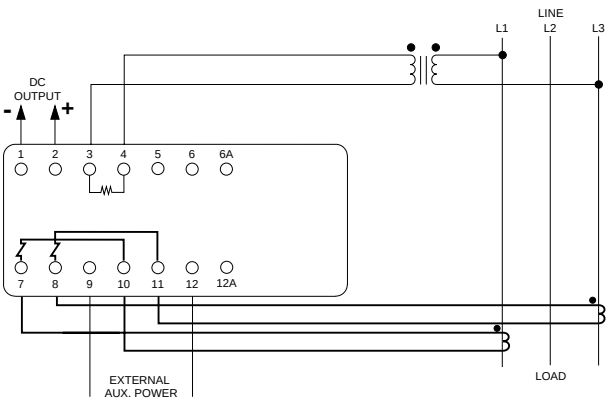


NOTE: For units with -8 option, connect current input to terminals 7 (•) & 10.

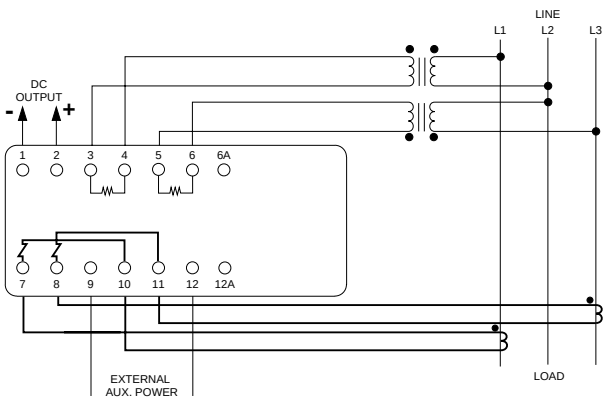
1 1/2 Element, Single Phase, 3 Wire



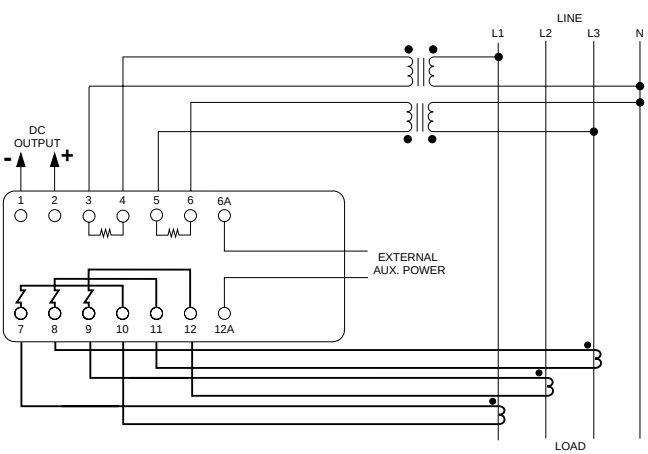
1 1/2 Element, 3 Phase, 3 Wire, Delta



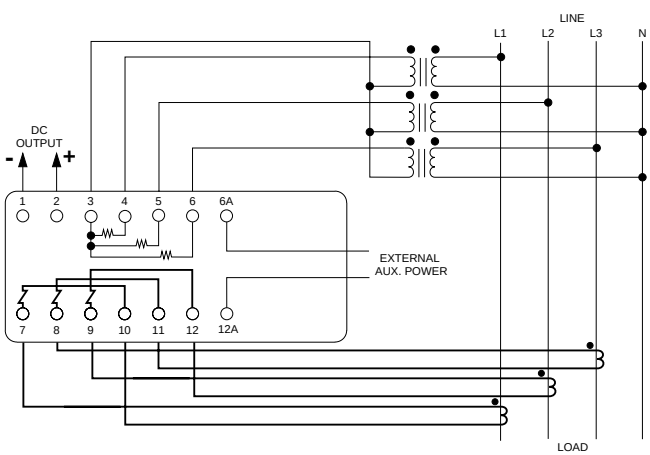
2 Element, 3 Phase, 3 Wire, Delta



2 1/2 Element, 3 Phase, 4 Wire, Wye



3 Element, 3 Phase, 4 Wire, Wye

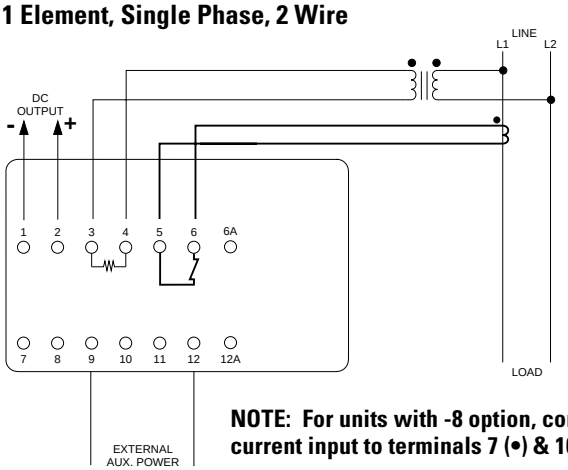


Adjust

A2 Models: Shown. A4 Models: External aux. power not required.

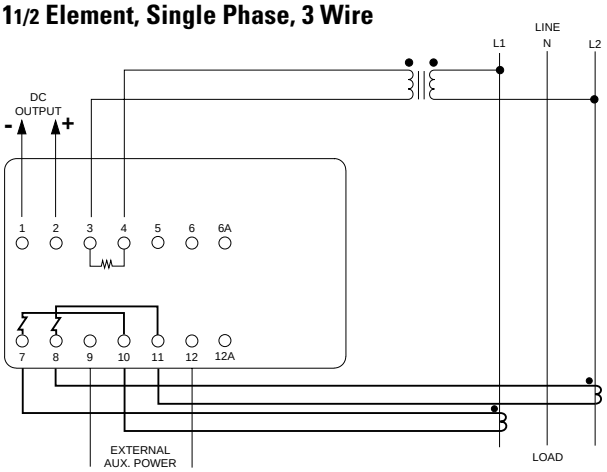
WIRING DIAGRAMS FOR P-OPTION UNITS (Style V Case)

1 Element, Single Phase, 2 Wire

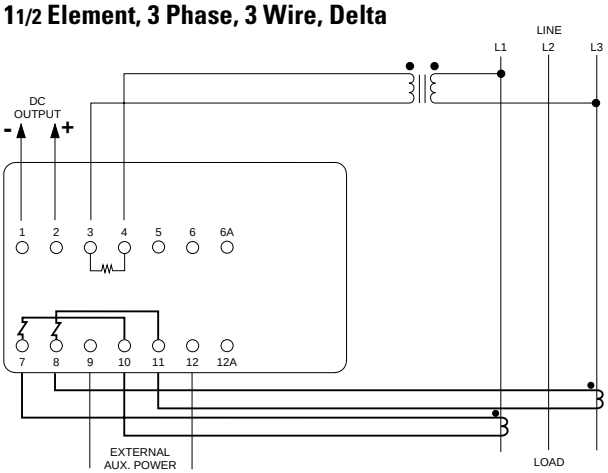


NOTE: For units with -8 option, connect current input to terminals 7 (•) & 10.

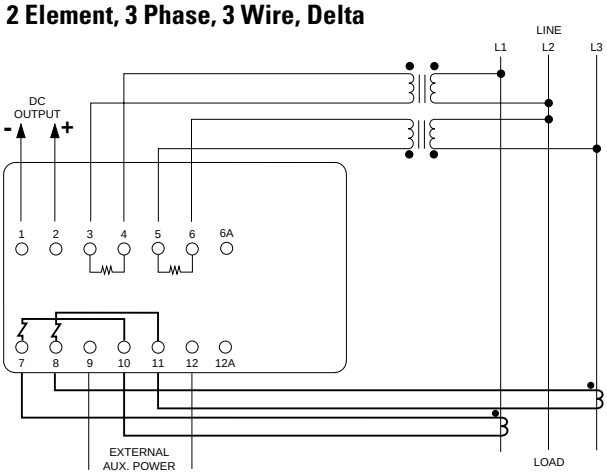
1 1/2 Element, Single Phase, 3 Wire



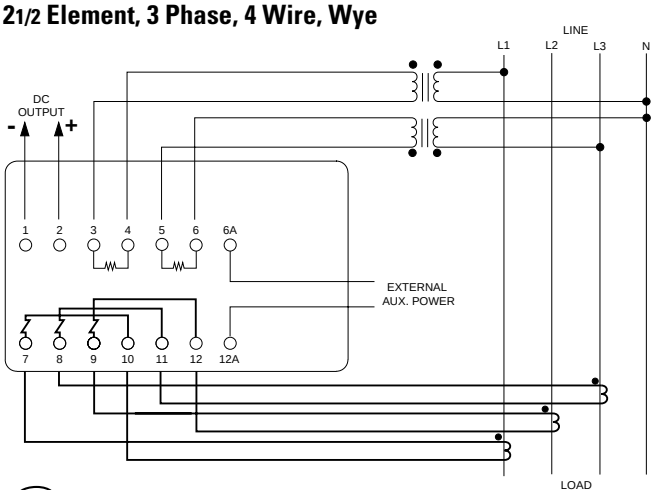
1 1/2 Element, 3 Phase, 3 Wire, Delta



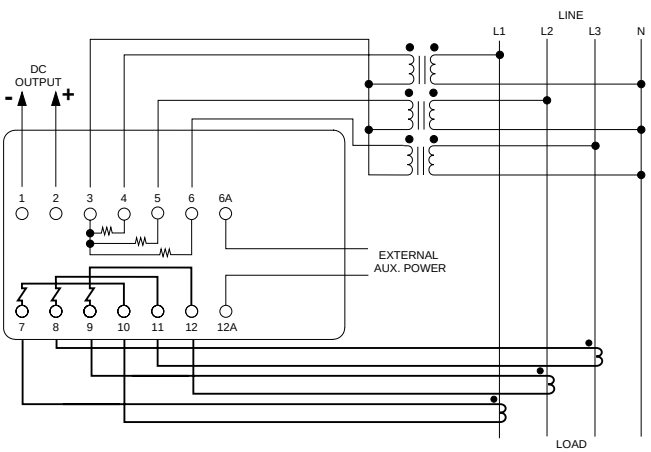
2 Element, 3 Phase, 3 Wire, Delta



2 1/2 Element, 3 Phase, 4 Wire, Wye



3 Element, 3 Phase, 4 Wire, Wye



Adjust

A2 Models: Shown. A4 Models: External aux. power not required.

Digilogic AC Watt/Watthour or Var/Varhour Transducers

Digilogic combined watt/watt-hour and var/varhour transducers provide high accuracy with two simultaneous outputs: an analog output directly proportional to instantaneous watts or vars, and a digital (pulse) output (Form-C mercury-wetted relay or solid-state) directly proportional to watthours or varhours. All models are available in either unidirectional or bidirectional configurations.

Features

- Accuracy to 0.1% of reading
- Analog & digital outputs
- Exceptional reliability
- Excellent long-term stability
- Wide selection of current & voltage input ranges

Applications

- Utility billing
- Test laboratories
- Process control

Outputs

- 0 to ±1 mAdc
- 1–5 or 1–3–5 mAdc
- 4–20 or 4–12–20 mAdc
- 10–50 or 10–30–50 mAdc
- Relay and solid-state outputs for watthour and varhour functions

Digilogic Transducers Used to Calibrate Accuracy Standards

The Digilogic Transducer is recognized as the premier power-system parameter-measurement device. A new twist in DL application results from the exceptional long-term stability of the patented Digilogic design.

Many Scientific Columbus customers have found that the accuracy and stability of our Digilogic Transducers rival or exceed the precision of their best laboratory standards. As one Scientific Columbus customer stated, "If my standard indicates that one of my Digilogic Transducers is no longer accurate, I send the standard in for repair!"

Specifications

DIGILOGIC AC WATT/WATTHOUR OR VAR/VARHOUR TRANSDUCERS

Specifications		0 to ±1 mAdc Watts (Watt/Watthour Transducer)	P-Option* Watts (Watt/Watthour Transducer)	0 to ±1 mAdc Vars (Var/Varhour Transducer)	P-Option* Vars (Var/Varhour Transducer)
Current Input	Nominal Range** Overload Continuous Overload 1 Second/Hour Burden/Element	5 A 0–10 A 20 A 250 A 0.2 VA (maximum) at 5 A			
Voltage Input	Nominal Range** Overload Continuous Burden/Element	120 V 0–150 V 200 V 0.02 VA (maximum) at 120 V			
External Auxiliary Power	Input Range Frequency Range Burden	85–135 Vac 50–500 Hz 3 VA Nominal	100–130 Vac 50–500 Hz 6 VA Nominal	85–135 Vac 50–500 Hz 3 VA Nominal	100–130 Vac 50–500 Hz 6 VA Nominal
Rated Output (RO) = 500 Watts or Vars/Element		±1 mAdc for Standard Calibration	5, 20, or 50 mAdc for Std. Calibration, depending on selected output range*	±1 mAdc for Standard Calibration	5, 20, or 50 mAdc for Std. Calibration, depending on selected output range*
Accuracy		±(0.09% Reading + 0.005% RO) at 0–200% RO	±(0.1% Reading + 0.05% RO) at 0–120% RO	±(0.15% Reading + 0.01% RO) at 0–200% RO	±(0.15% Reading + 0.05% RO) at 0–120% RO
Temperature Effect on Accuracy		±0.005% / ° C	±0.0065% / ° C	±0.009% / ° C	±0.01% / ° C
Operating Temperature Range		-20° C to +70° C	-20° C to +50° C	-20° C to +60° C	-20° C to +50° C
Compliance Voltage		10 Vdc	See Table 2 on page 14.	10 Vdc	See Table 2 on page 14.
Load		0–10,000 Ω		0–10,000 Ω	
Output Ripple Peak		< 0.5% RO	< 0.25% RO	< 0.5% RO	< 0.25% RO
Relay Contact Rating (-60XX option)		15 VA at 1 A (maximum) or 150 Vac/15 Vdc (maximum) with resistive load. Contact protection required for inductive loads.			
Relay Contact Life (-60XX option)		One billion operations when operated within specifications.			
Solid-State Output Contact Rating (-62XX option)		28 Vdc (maximum) V_{CESAT}: 1 Vdc (maximum) at 7 mAdc			
Response Time		< 400 ms to 99%	< 1 Second to 99%	< 400 ms to 99%	< 1 Second to 99%
Power Factor		Any			
PF Effect on Accuracy		±0.04% VA (maximum) (Included in Accuracy specification above.)			
Standard Calibration Adjustments	Gain Zero	±1% of Reading (minimum) None Required	±10% of Span (minimum) ±5% of Zero Point (minimum)	±1% of Reading (minimum) None Required	±10% of Span (minimum) ±5% of Zero Point (minimum)
Frequency Range		58–62 Hz		60 Hz	
Stability (per year)		±0.05% RO, Noncumulative	±0.1% of Span, Noncumulative	±0.1% RO, Noncumulative	±0.2% of Span, Noncumulative
Operating Humidity		0–95% Noncondensing			
Isolation		Complete (Input/Output/Power/Case) All KYZ outputs are isolated.			
Dielectric Withstand		1500 VRMS at 60 Hz			
Surge Withstand		ANSI/IEEE C37.90.1			
Maximum Net Weight		4 lbs., 12 oz. (2.2 kg)	5 lbs., 2 oz. (2.3 kg)	4 lbs., 14 oz. (2.2 kg)	5 lbs., 4 oz. (2.4 kg)
Approximate Dimensions (excluding mounting plate)		7.0" W x 3.7" D x 5.6" H (178 mm x 94 mm x 142 mm) Style I Case, see page 122	7.2" W x 5.3" D x 5.8" H (183 mm x 135 mm x 147 mm) Style V Case, see page 123	7.0" W x 3.7" D x 5.6" H (178 mm x 94 mm x 142 mm) Style I Case, see page 122	7.2" W x 5.3" D x 5.8" H (183 mm x 135 mm x 147 mm) Style V Case, see page 123
Overrange with Linearity		500–1000 Watts/Element	500–600 Watts/Element	500–1000 Vars/Element	500–600 Vars/Element
		No additional error within voltage compliance. Reduce load resistance as required.			

* P-Option includes 1–5/1–3–5, 4–20/4–12–20, and 10–50/10–30–50 mAdc outputs.

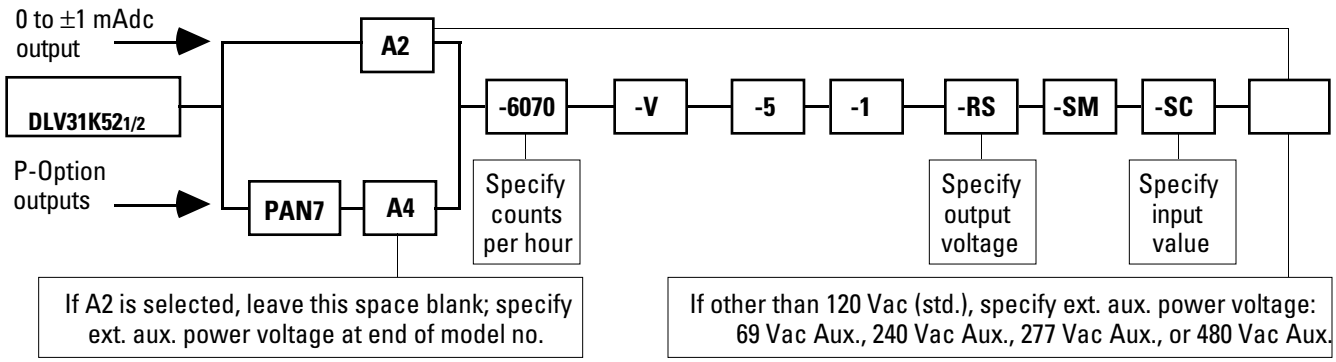
**Total input not to exceed 200% of standard-calibration watts or vars on units with 0 to ±1 mAdc output.
Total input not to exceed 120% of standard-calibration watts or vars on units with P-Option outputs.

Specifications subject to change without notice.

ORDERING PROCEDURE

Specify by base model number and appropriate selection or option suffixes in the order shown in the following example.

Base Model No.	Output	Auxiliary Power	Pulse Output	Mounting Orientation	Current Input	Voltage Input	-RS/Freq. Option #1	Option #2	Option #3	Ext. Aux. Power
Table 1	Table 2	Table 3	Table 4	Table 4	Table 5	Table 5	Table 6	Table 7	Table 7	Table 3



EXAMPLES: DLV31K52 1/2A2-6070-V-5-1-RS-SM-SC

2 1/2-element, 0 to ±1 mAdc Var/Varhour Transducer; 120 Vac external auxiliary power; mercury-wetted relay (unidirectional); vertical mounting; 10 A input; 240 V input; resistor scaling (converts current output to voltage output); seismic brace; special calibration (example: 7200 W).

DLV31K52 1/2PAN7A4-6070-V-5-1-RS-SM-SC

2 1/2-element, 4-20 mAdc Var/Varhour Transducer; internal auxiliary power; mercury-wetted relay (unidirectional); vertical mounting; 10 A input; 240 V input; resistor scaling (converts current output to voltage output); seismic brace; special calibration (example: 7200 W).

Table 1 Base Model Number Selection

Element	Watt Model No.	Var Model No.	Connection	Calibration at Rated Output (5 A, 120 V Nominal Input)
1	DL5C5	DLV5C5	Single Phase	500 W or Vars
2	DL31K5	DLV31K5	3 Phase, 3 Wire	1000 W or Vars
2 1/2*	DL31K52 1/2	DLV31K52 1/2	3 Phase, 4 Wire	1500 W or Vars
3	DL342K5	DLV342K5	3 Phase, 4 Wire	1500 W or Vars

*** 2 1/2-element units require a balanced voltage.**

Table 2 Output Selection

0 to ±1 mAdc output is standard, and is specified by the Base Model Numbers. For outputs other than 0 to ±1 mAdc, indicate the appropriate P-Option in the "Output" position of the complete model number.

P-Option**	Output Range	Compliance Voltage/ Maximum Load	Maximum Open Circuit Voltage
PAN6	1-5 mAdc	15 Vdc/3000 Ω	30 Vdc
PAN7	**4-20 mAdc**	**15 Vdc/750 Ω**	**30 Vdc**
PAN8	10-50 mAdc	15 Vdc/300 Ω	30 Vdc
PAN6-B	1-3-5 mAdc	15 Vdc/3000 Ω	30 Vdc
PAN7-B	4-12-20 mAdc	15 Vdc/750 Ω	30 Vdc
PAN8-B	10-30-50 mAdc	15 Vdc/300 Ω	30 Vdc

**** PAN models take -6070 or -6270 unidirectional pulse outputs; PAN-B models take -6096 or -6296 bidirectional pulse outputs.**

Table 3 Auxiliary Power Supply Selection

Option	Description	Input Range	Frequency Range	Burden
(0 to ±1 mAdc Units)				
A2* **	**External Auxiliary Power (120 Vac std.)**	**85-135 Vac**	**50-500 Hz**	**3 VA**
A4	Internal Auxiliary Power (self-powered)	70-112% of Nominal Aux. Power Voltage	Equals Input Frequency	3 VA
(P-Option Units)				
A2* (leave blank)**	**External Auxiliary Power (120 Vac std.)**	**100-130 Vac**	**50-500 Hz**	**6 VA**
A4	Internal Auxiliary Power (self-powered)	84-108% of Nominal Aux. Power Voltage	Equals Input Frequency	6 VA

*** For external auxiliary power voltages other than 120 Vac, specify the voltage in the last position of the complete model number. (Example: 240 Vac Aux.)

DC external auxiliary power available; see Special Options on page 128.

Table 4 Pulse Output Selection

Option	Description	CPH Range****	Mounting Orientation*****
-6070	Form-C Mercury-Wetted Relay, Unidirectional	2-14,000	-V (Vertical) or -H (Horizontal)
-6270	Form-C Solid-State, Unidirectional	2-900,000	Not Applicable
-6096	Form-C Mercury-Wetted Relay, Bidirectional	2-14,000	-V (Vertical) or -H (Horizontal)
-6296	Form-C Solid-State, Bidirectional	2-900,000	Not Applicable

**** Standard cph is one count/watthour or varhour unless otherwise specified.

***** You must specify the desired mounting orientation for units with mercury-wetted relays.

Table 5 Input Selection

Current

Option	Nominal	Current Range w/ Accuracy	Calibration at Rated Output (5 A Nominal Input)
-3	1 A	0-2 A	100 W or Vars/Element
-4	2.5 A	0-5 A	250 W or Vars/Element
Std.†	**5 A**	**0-10 A**	**500 W or Vars/Element**
-11	7.5 A	0-15 A	750 W or Vars/Element
-5	10 A	0-20 A	1000 W or Vars/Element
-7	15 A	0-20 A	1500 W or Vars/Element
-8††	25 A	0-30 A	2500 W or Vars/Element

Voltage

Option	Nominal	Voltage Range w/ Accuracy	Calibration at Rated Output (120 V Nominal Input)
-0	69 V	0-75 V	250 W or Vars/Element
Std.†	**120 V**	**0-150 V**	**500 W or Vars/Element**
-1	240 V	0-300 V	1000 W or Vars/Element
-9	277 V	0-340 V	1200 W or Vars/Element
-2	480 V	0-600 V	2000 W or Vars/Element

† Leave "Input" positions blank in the model number.

†† Option -8 requires a Style V case. (See page 123 for case dimensions. Maximum height of terminal strip(s) is 1.07" for units with -8 option.)

Table 6 Scaling Resistor (-RS)/Frequency Options

Option	Description
-RS†††	Scaling Resistor
-6	400 Hz
-12	50 Hz
-6-RS†††	400 Hz and Scaling Resistor
-12-RS†††	50 Hz and Scaling Resistor

††† You must specify the desired output voltage:
For 0 to ±1 mAdc units, specify range from 0 to ±10 Vdc. Load impedance is 1 MΩ/Vdc (minimum). For P-Option units, specify range from 0-15 Vdc. Load impedance is 200, 50, or 20 (kΩ/Vdc) (minimum) for units with outputs of 5, 20, or 50 mAdc, respectively.

This information is not part of the model number, but must be provided to the factory when you place your order.

Table 7 Other Options

Option	Description
-SC††††	Special Calibration
-SM	Seismic Brace (available with 0 to ±1 mAdc units) (consult factory if you desire this option with a P-Option unit)
-Z	Zero-Based Output Calibration (ex.: PAN7-Z = 0-20 mAdc) (available only with P-Option unidirectional units)

†††† You must specify the desired input value:
0 to ±1 mAdc units can be calibrated within 90-180% of their standard-calibration input watts or vars. (Example: A 2-element watt/watthour transducer is calibrated to 1000 W standard. The -SC option can be added for input levels from 900 W (90%) to 1800 W (180%).) P-Option units can be calibrated within 60-180% of their standard-calibration input watts or vars.

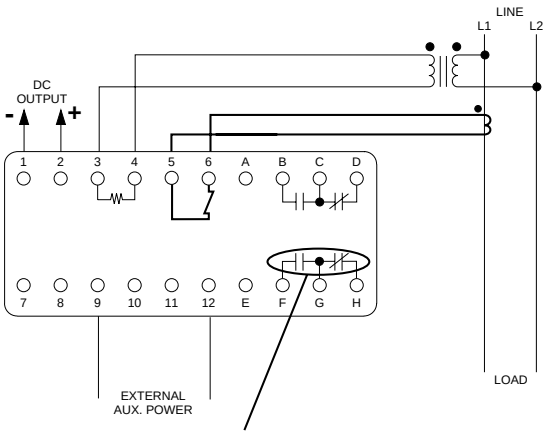
This information is not part of the model number, but must be provided to the factory when you place your order.

If you require additional options not shown here, see Special Options on page 128. When ordering any special options, or more than three options, you must first consult the factory for pricing and delivery estimates.

WIRING DIAGRAMS FOR 0 to ±1 mAdc UNITS (Style I Case)

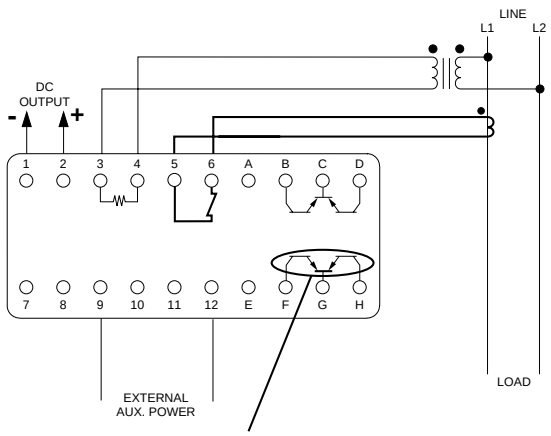
1 Element, Single Phase, 2 Wire

-6070/-6096 Models



Omitted on -6070 Models

-6270/-6296 Models

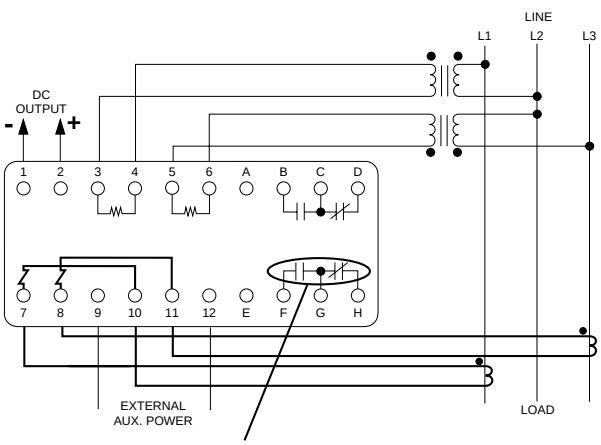


Omitted on -6270 Models

NOTE: For 1-element units with -8 option, connect current input to terminals 7 (•) & 10.

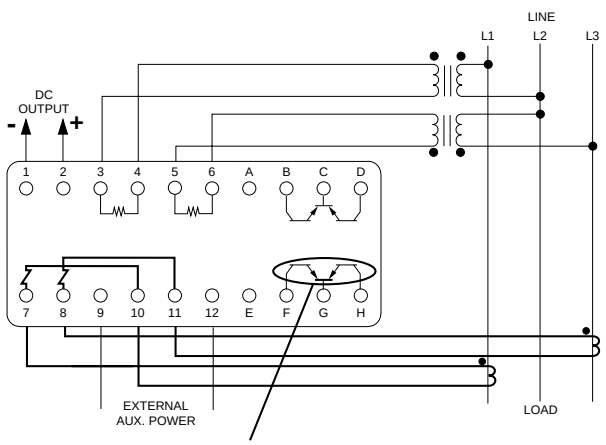
2 Element, 3 Phase, 3 Wire, Delta

-6070/-6096 Models



Omitted on -6070 Models

-6270/-6296 Models



Omitted on -6270 Models

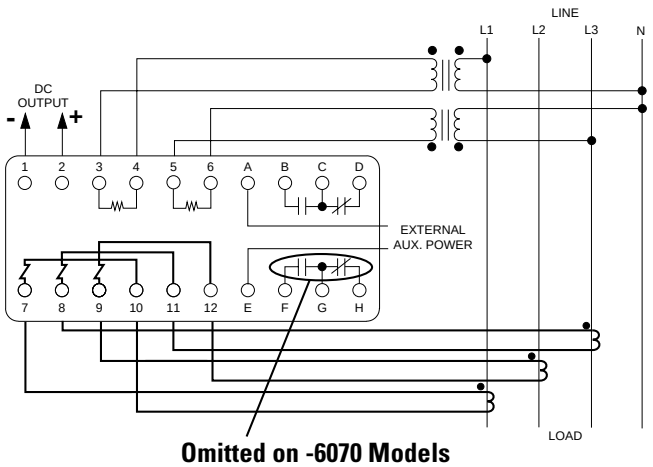
Adjust

A2 Models: Shown. A4 Models: External aux. power not required.

WIRING DIAGRAMS FOR 0 to ±1 mAdc UNITS (Style I Case)

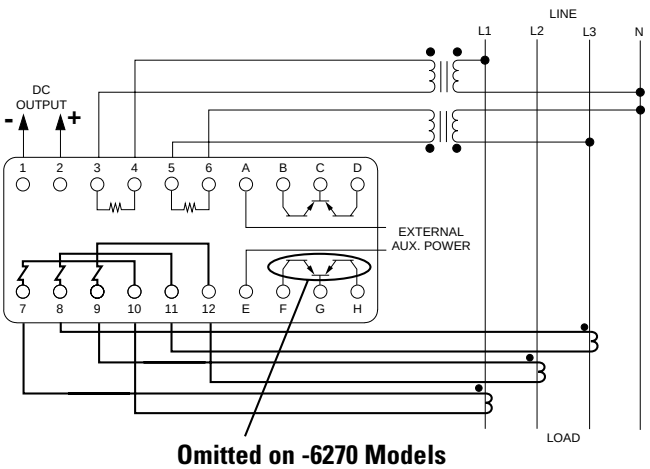
2 1/2 Element, 3 Phase, 4 Wire, Wye

-6070/-6096 Models



Omitted on -6070 Models

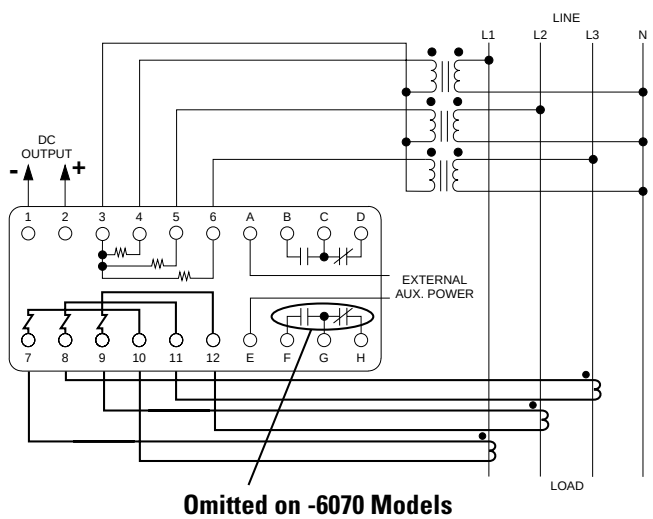
-6270/-6296 Models



Omitted on -6270 Models

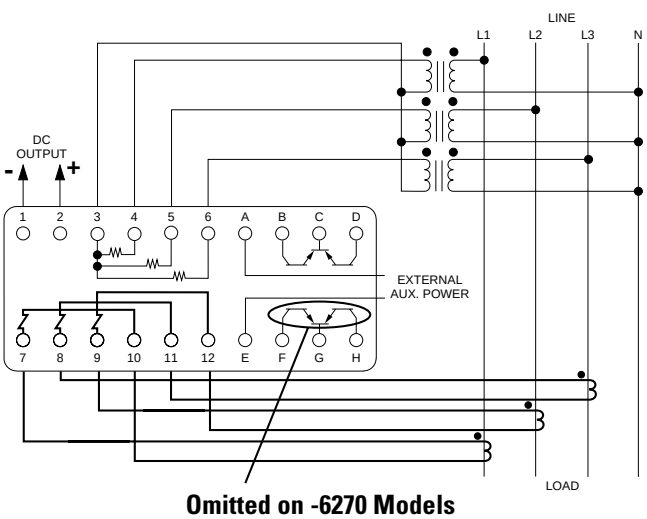
3 Element, 3 Phase, 4 Wire, Wye

-6070/-6096 Models



Omitted on -6070 Models

-6270/-6296 Models



Omitted on -6270 Models

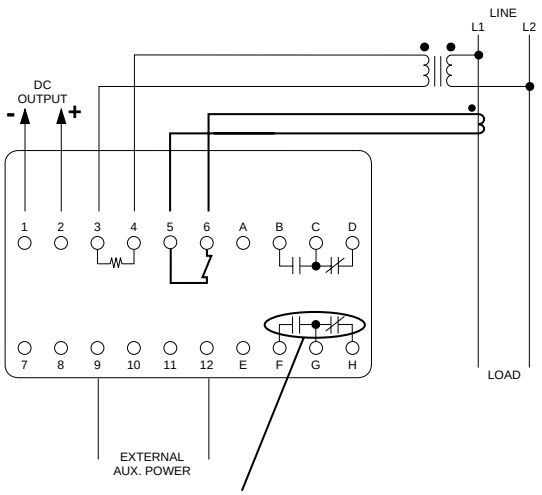
Adjust

A2 Models: Shown. A4 Models: External aux. power not required.

WIRING DIAGRAMS FOR P-OPTION UNITS (Style V Case)

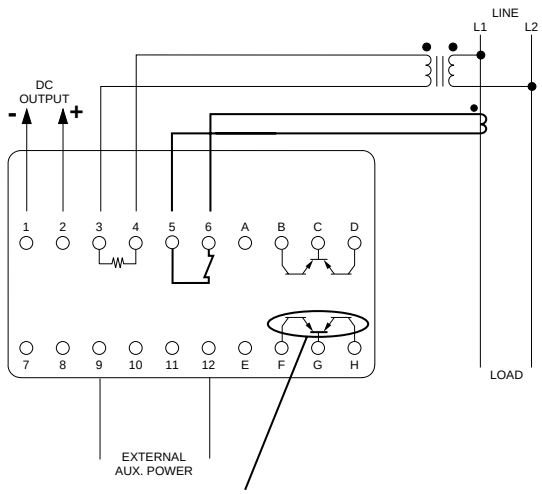
1 Element, Single Phase, 2 Wire

-6070/-6096 Models



Omitted on -6070 Models

-6270/-6296 Models

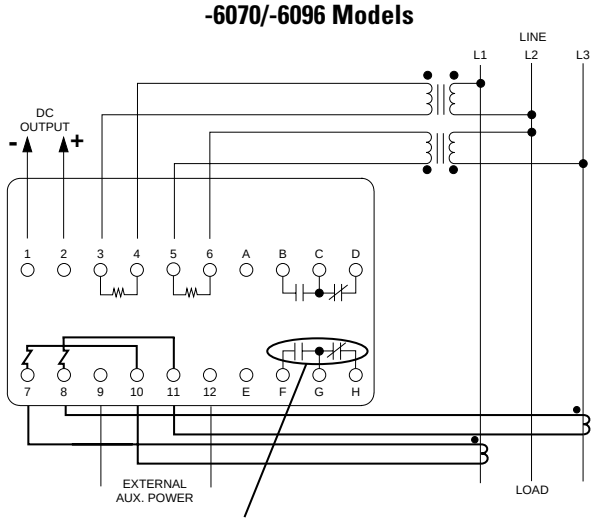


Omitted on -6270 Models

NOTE: For 1-element units with -8 option, connect current input to terminals 7 (•) & 10.

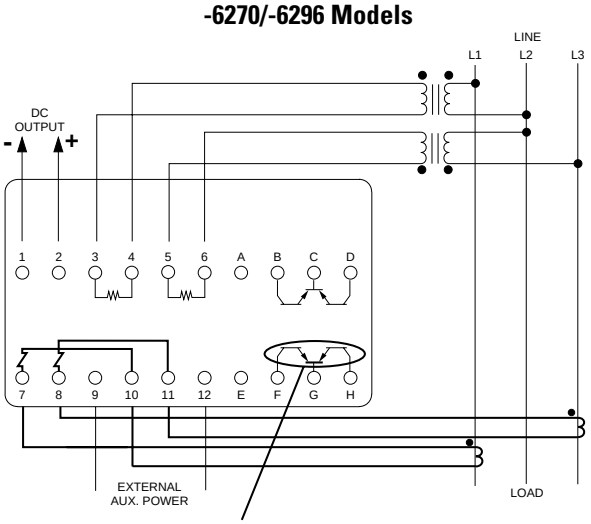
2 Element, 3 Phase, 3 Wire, Delta

-6070/-6096 Models



Omitted on -6070 Models

-6270/-6296 Models



Omitted on -6270 Models

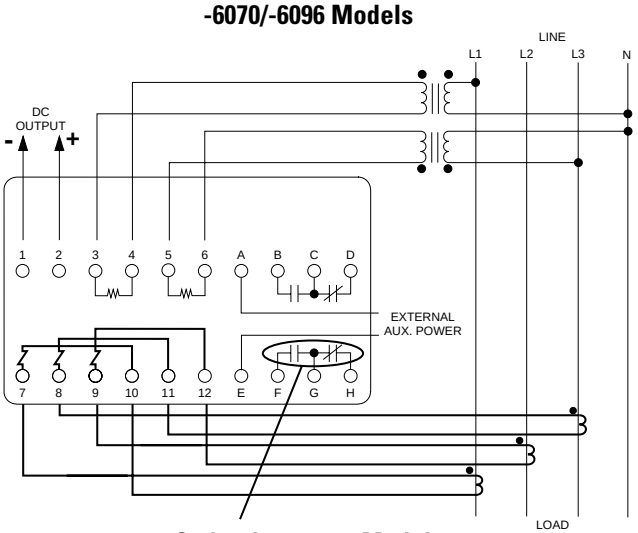
Adjust

A2 Models: Shown. A4 Models: External aux. power not required.

WIRING DIAGRAMS FOR P-OPTION UNITS (Style V Case)

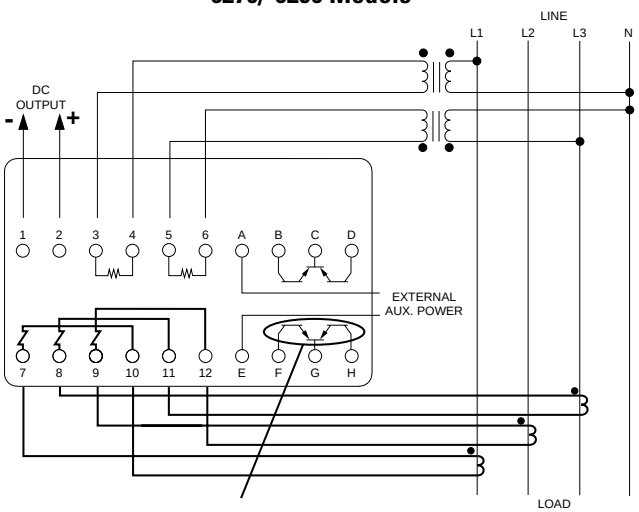
2 1/2 Element, 3 Phase, 4 Wire, Wye

-6070/-6096 Models



Omitted on -6070 Models

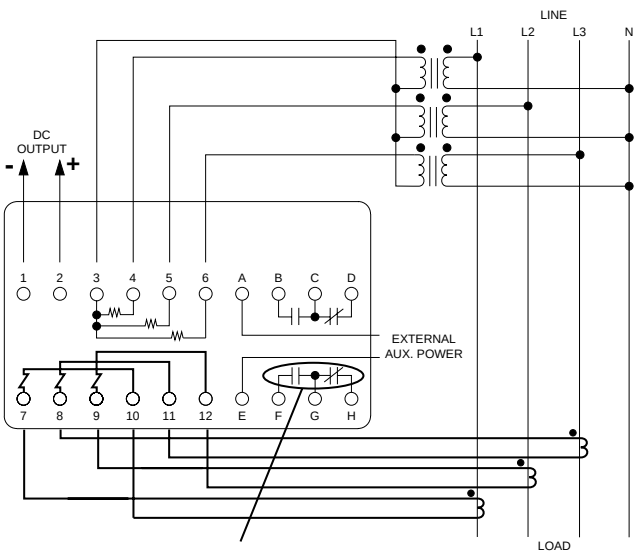
-6270/-6296 Models



Omitted on -6270 Models

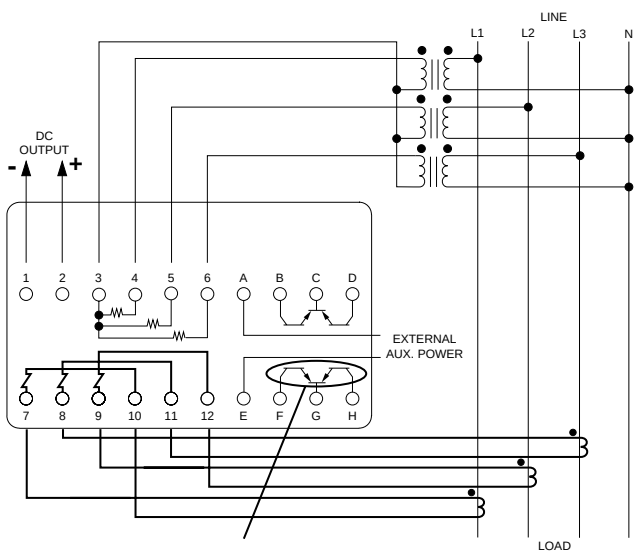
3 Element, 3 Phase, 4 Wire, Wye

-6070/-6096 Models



Omitted on -6070 Models

-6270/-6296 Models



Omitted on -6270 Models

Adjust

A2 Models: Shown. A4 Models: External aux. power not required.

Digilogic AC Volt-Amp or Combined Volt-Amp/Volt-Amphour Transducers

Digilogic volt-amp transducers provide a dc output signal proportional to input volt-amps, using an arithmetic RMS volt-amp measurement technique. These transducers are accurate over any range of power factor, are immune to the effects of distorted wave forms, and are stable over time and in wide extremes of environmental conditions.

Digilogic combined volt-amp/volt-amphour transducers provide two simultaneous outputs: an analog output directly proportional to volt-amps and a digital (pulse) output (Form-C mercury-wetted relay or solid-state) directly proportional to volt-amphours.

Features

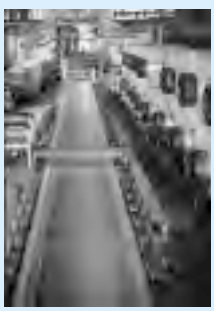
- Accuracy to 0.2% of reading
- Analog & digital outputs
- Exceptional reliability
- Excellent long-term stability
- Wide selection of current & voltage input ranges

Applications

- Utility billing
- Test laboratories
- Process control

Outputs

- 0–1 mAdc
- 1–5 mAdc
- 4–20 mAdc
- 10–50 mAdc
- Relay and solid-state outputs for volt-amphour function



Determining Volt-Amphour Levels in Submetering Applications

Digilogic Transducers can be employed in submetering applications to measure the level of volt-amps or volt-amphours. For example, install a Scientific Columbus Volt-Amp/Volt-Amphour Transducer and a counter to monitor the total system burden consumed by a specific process within your facility.

Specifications

DIGILOGIC AC VOLT-AMP OR COMBINED VOLT-AMP/VOLT-AMPHOUR TRANSDUCERS

Specifications		0–1 mAdc Volt-Amps (Volt-Amp or Combined Volt-Amp/Volt-Amphour Transducer)	P-Option* Volt-Amps (Volt-Amp or Combined Volt-Amp/Volt-Amphour Transducer)
Current Input	Nominal Range** Overload Continuous Overload 1 Second/Hour Burden/Element	5 A 0–10 A 20 A 250 A 0.2 VA (maximum) at 5 A	
Voltage Input	Nominal Range** Overload Continuous Burden/Element	120 V 0–150 V 200 V 0.02 VA (maximum) at 120 V	
External Auxiliary Power	Input Range Frequency Range Burden	85–135 Vac 50–500 Hz 3 VA Nominal	100–130 Vac 50–500 Hz 6 VA Nominal
Rated Output (RO) = 500 Volt-Amps/Element		1 mAdc for Standard Calibration	5, 20, or 50 mAdc for Standard Calibration, depending on selected output range*
Accuracy		±(0.2% Reading + 0.1% RO) at 0–200% RO	±(0.2% Reading + 0.15% RO) at 0–120% RO
Temperature Effect on Accuracy		±0.01% / ° C	±0.015% / ° C
Operating Temperature Range		-20° C to +70° C	-20° C to +50° C
Compliance Voltage		10 Vdc	See Table 2 on page 22.
Load		0–10,000 Ω	
Output Ripple Peak		< 2% RO	
Relay Contact Rating (-6070 option)		15 VA at 1 A (maximum) or 150 Vac/15 Vdc (maximum) with resistive load. Contact protection required for inductive loads.	
Relay Contact Life (-6070 option)		One billion operations when operated within specifications.	
Solid-State Output Contact Rating (-6270 option)		28 Vdc (maximum) V_{CESAT}: 1 Vdc (maximum) at 7 mAdc	
Response Time		< 400 ms to 99%	< 1 Second to 99%
Power Factor		Any	
PF Effect on Accuracy		(Included in Accuracy specification above.)	
Standard Calibration Adjustments	Gain Zero	±5% of Reading (minimum) None Required	±20% of Span (minimum) ±5% of Zero Point (minimum)
Frequency Range		58–62 Hz	
Stability (per year)		±0.2% RO, Noncumulative	
Operating Humidity		0–95% Noncondensing	
Isolation		Complete (Input/Output/Power/Case) All KYZ outputs are isolated.	
Dielectric Withstand		1500 VRMS at 60 Hz	
Surge Withstand		ANSI/IEEE C37.90.1	
Maximum Net Weight	Volt-Amp Volt-Amp/Volt-Amphour	4 lbs., 8 oz. (2 kg) 4 lbs., 14 oz. (2.2 kg)	5 lbs., 8 oz. (2.5 kg) 6 lbs. (2.7 kg)
Approximate Dimensions (excluding mounting plate)		7.2" W x 5.3" D x 5.8" H (183 mm x 135 mm x 147 mm) Style V Case, see page 123	8.0" W x 7.0" D x 6.0" H (203 mm x 178 mm x 152 mm) Special Case, contact factory for drawing
Overrange with Linearity		500–1000 Volt-Amps/Element	500–600 Volt-Amps/Element
		No additional error within voltage compliance. Reduce load resistance as required.	

* P-Option includes 1–5, 4–20, and 10–50 mAdc outputs.

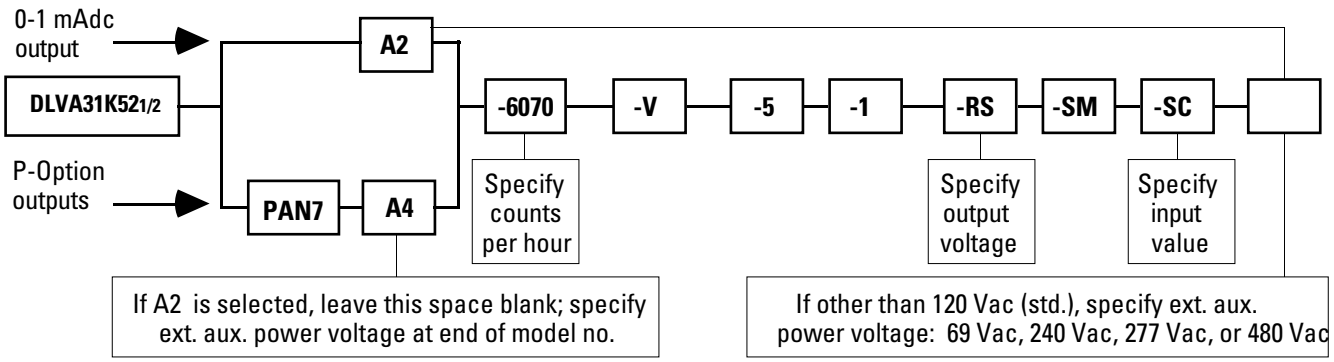
**Total input not to exceed 200% of standard-calibration volt-amps on units with 0–1 mAdc output.
Total input not to exceed 120% of standard-calibration volt-amps on units with P-Option outputs.

Specifications subject to change without notice.

ORDERING PROCEDURE

Specify by base model number and appropriate selection or option suffixes in the order shown in the following example.

Base Model No.	Output	Auxiliary Power	Pulse Output	Mounting Orientation	Current Input	Voltage Input	-RS/Freq. Option	Option #2	Option #3	Ext. Aux. Power
Table 1	Table 2	Table 3	Table 4	Table 4	Table 5	Table 5	Table 6	Table 7	Table 7	Table 3



EXAMPLES: DLVA31K52 1/2A2-6070-V-5-1-RS-SM-SC

2 1/2-element, 0-1 mAdc Volt-Amp/Volt-Amphour Transducer; 120 Vac external auxiliary power; mercury-wetted relay (unidirectional); vertical mounting;10 A input; 240 V input; resistor scaling (example: 0-5 Vdc); seismic brace; special calibration (example: 7200 VA).

DLVA31K52 1/2PAN7A4-6070-V-5-1-RS-SM-SC

2 1/2-element, 4-20 mAdc Volt-Amp/Volt-Amphour Transducer; internal auxiliary power; mercury-wetted relay (unidirectional); vertical mounting;10 A input; 240 V input; resistor scaling (example: 1-5 Vdc); seismic brace; special calibration (example: 7200 VA).

Table 1 Base Model Number Selection

Element	Volt-Amp Model No.	Connection	Calibration at Rated Output (5 A, 120 V Nominal Input)
1	DLVA5C5	Single Phase	500 VA
2	DLVA31K5	3 Phase, 3 Wire	1000 VA
2 1/2*	DLVA31K52 1/2	3 Phase, 4 Wire	1500 VA
3	DLVA342K5	3 Phase, 4 Wire	1500 VA

*** 2 1/2-element units require a balanced voltage.**

Table 2 Output Selection

0-1 mAdc output is standard, and is specified by the Base Model Numbers. For outputs other than 0-1 mAdc, indicate the appropriate P-Option in the "Output" position of the complete model number.

P-Option	Output Range	Compliance Voltage/ Maximum Load	Maximum Open Circuit Voltage
PAN6	1-5 mAdc	15 Vdc/3000 Ω	30 Vdc
PAN7	**4-20 mAdc**	**15 Vdc/750 Ω**	**30 Vdc**
PAN8	10-50 mAdc	15 Vdc/300 Ω	30 Vdc

Table 3 Auxiliary Power Supply Selection

Option	Description	Input Range	Frequency Range	Burden
(0-1 mAdc Units)				
A2**	**External Auxiliary Power (120 Vac std.)**	**85-135 Vac**	**50-500 Hz**	**3 VA**
A4	Internal Auxiliary Power (self-powered)	70-112% of Nominal Aux. Power Voltage	Equals Input Frequency	3 VA
(P-Option Units)				
A2** (leave blank)	**External Auxiliary Power (120 Vac std.)**	**100-130 Vac**	**50-500 Hz**	**6 VA**
A4	Internal Auxiliary Power (self-powered)	84-108% of Nominal Aux. Power Voltage	Equals Input Frequency	6 VA

** For external auxiliary power voltages other than 120 Vac, you must specify the voltage in the last position of the complete model number. (Example: 240 Vac)

DC external auxiliary power available; see Special Options on page 128.

Table 4 Pulse Output Selection

Option	Description	CPH Range***		Mounting Orientation****
-6070	Form-C Mercury-Wetted Relay, Unidirectional	2-14,000	Standard cph is one count/volt-amphour.	-V (Vertical) or -H (Horizontal)
-6270	Form-C Solid-State, Unidirectional	2-900,000		Not Applicable

*** You must specify the desired counts per hour. This information is not part of the model number, but must be provided to the factory when you place your order.

**** You must specify the desired mounting orientation for units with mercury-wetted relays.

Table 5 Input Selection

Current				Voltage			
Option	Nominal	Current Range w/ Accuracy	Calibration at Rated Output (5 A Nominal Input)	Option	Nominal	Voltage Range w/ Accuracy	Calibration at Rated Output (120 V Nominal Input)
-3	1 A	0-2 A	100 VA/Element	-0	69 V	0-75 V	250 VA/Element
-4	2.5 A	0-5 A	250 VA/Element	**Std.†**	**120 V**	**0-150 V**	**500 VA/Element**
Std.†	**5 A**	**0-10 A**	**500 VA/Element**	-1	240 V	0-300 V	1000 VA/Element
-11	7.5 A	0-15 A	750 VA/Element	-9	277 V	0-340 V	1200 VA/Element
-5	10 A	0-20 A	1000 VA/Element	-2	480 V	0-600 V	2000 VA/Element
-7	15 A	0-20 A	1500 VA/Element				

† Leave "Input" positions blank in the model number.

Table 6 Scaling Resistor(-RS)/Frequency Options

Option	Description
-RS††	Scaling Resistor
-6	400 Hz
-12	50 Hz
-6-RS††	400 Hz and Scaling Resistor
-12-RS††	50 Hz and Scaling Resistor

†† You must specify the desired output voltage:
For 0-1 mAdc units, specify range from 0-10 Vdc. Load impedance is 1 MΩ/Vdc (minimum).
For P-Option units, specify range from 0-15 Vdc. Load impedance is 200, 50, or 20 kΩ/Vdc (minimum) for units with outputs of 5, 20, or 50 mAdc, respectively.

This information is not part of the model number, but must be provided to the factory when you place your order.

Table 7 Other Options

Option	Description
-SC†††	Special Calibration
-SM	Seismic Brace (available with 0-1 mAdc units) (consult factory if you desire this option with a P-Option unit)
-Z	Zero-Based Output Calibration (ex.: PAN7-Z = 0-20 mAdc) (available only with P-Option units)

††† You must specify the desired input value:
0-1 mAdc units can be calibrated within 90-180% of their standard calibration input volt-amps. (Example: A 2-element volt-amp/volt-amphour transducer is calibrated to 1000 VA standard. The -SC option can be added for input levels from 900 VA (90%) to 1800 VA (180%.)) P-Option units can be calibrated within 60-180% of their standard calibration input volt-amps.

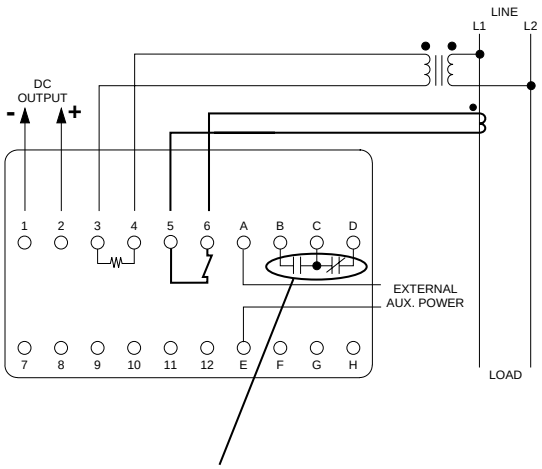
This information is not part of the model number, but must be provided to the factory when you place your order.

If you require additional options not shown here, see Special Options on page 128. When ordering any Special Options, or more than three options, you must first consult the factory for pricing and delivery estimates.

WIRING DIAGRAMS FOR 0-1 mAdc UNITS (Style V Case) AND P-OPTION UNITS (Special Case)

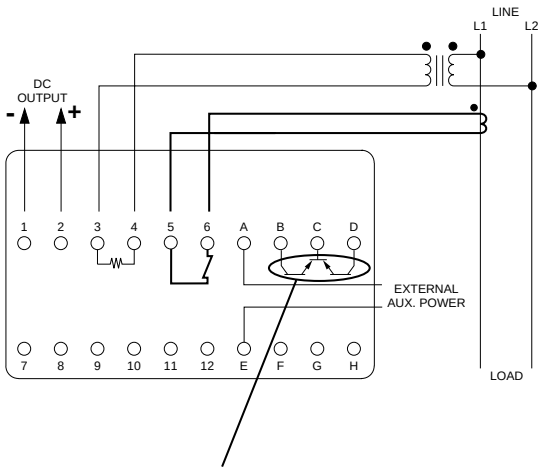
1 Element, Single Phase, 2 Wire

-6070 Models



Omitted on VA Models

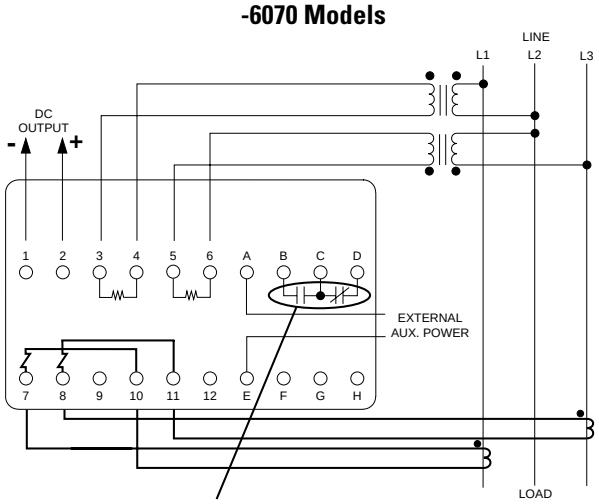
-6270 Models



Omitted on VA Models

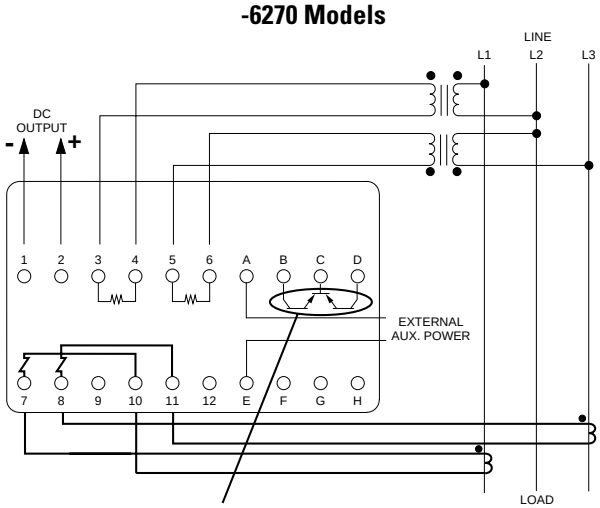
2 Element, 3 Phase, 3 Wire, Delta

-6070 Models



Omitted on VA Models

-6270 Models



Omitted on VA Models

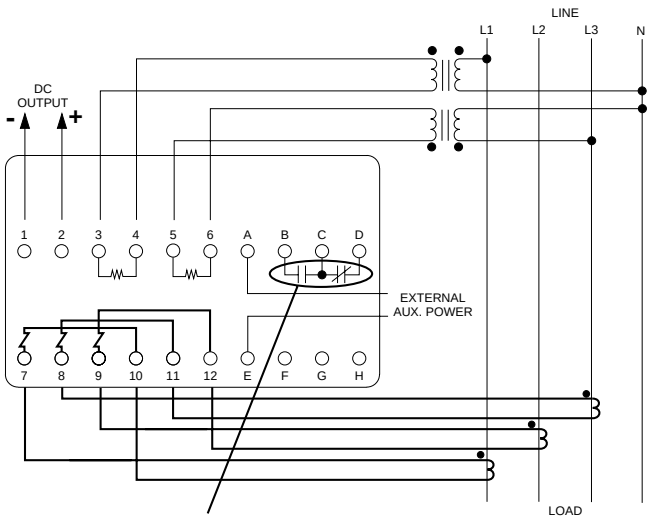
Adjust

A2 Models: Shown. A4 Models: External aux. power not required.

WIRING DIAGRAMS FOR 0-1 mAdc UNITS (Style V Case) AND P-OPTION UNITS (Special Case)

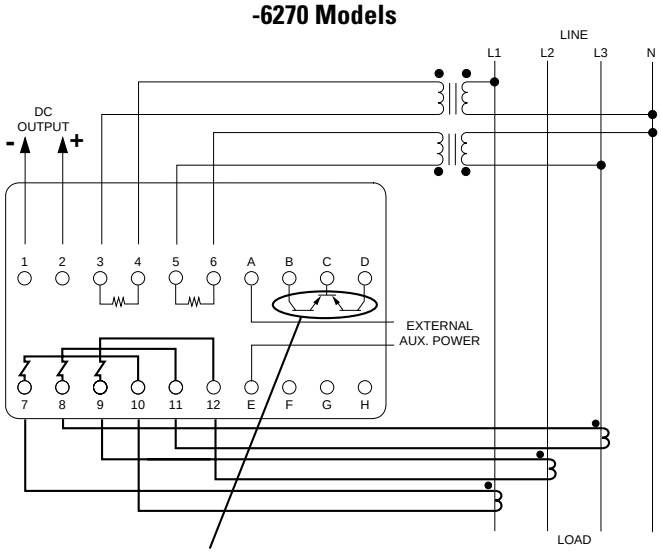
2 1/2 Element, 3 Phase, 4 Wire, Wye

-6070 Models



Omitted on VA Models

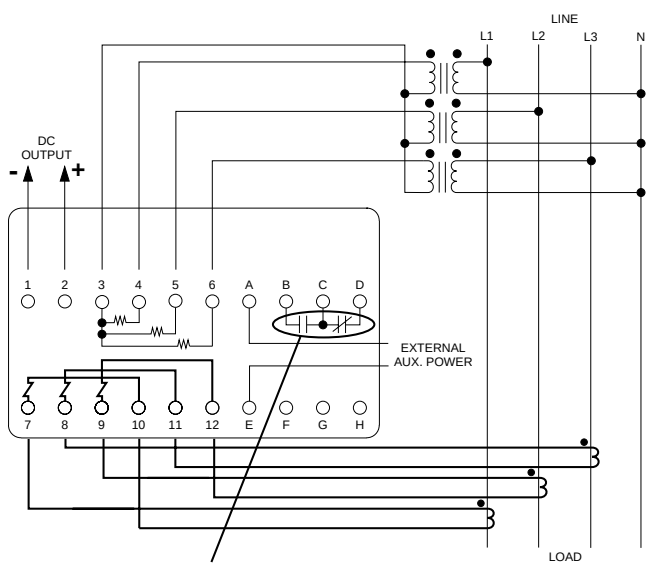
-6270 Models



Omitted on VA Models

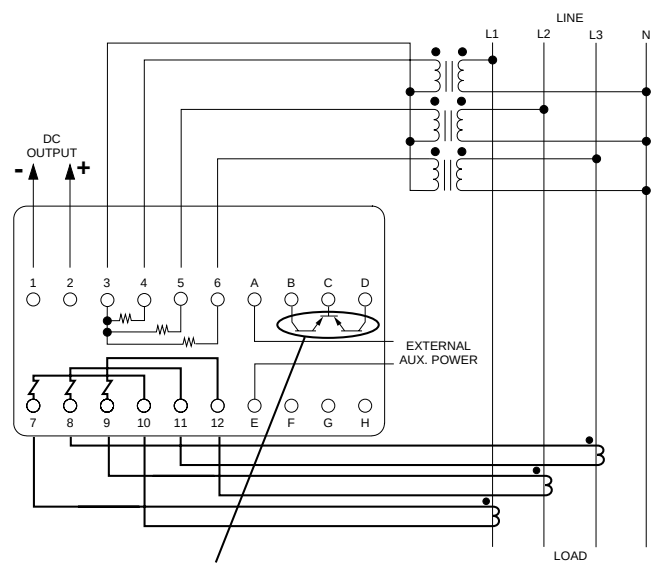
3 Element, 3 Phase, 4 Wire, Wye

-6070 Models



Omitted on VA Models

-6270 Models



Omitted on VA Models

Adjust

A2 Models: Shown. A4 Models: External aux. power not required.

DM-10 DEMAND MANAGER

Maximum value in power consuption means staying within your contractual demand limits. Once you exceed that limit, the costs start adding up. The Scientific Columbus DM-10 Demand Manager accumulates pulses which allows it to predict the demand level obtainable by the end of a demand interval. It also calculates and displays the level of demand to be shed to stay below a contractual level.

The DM-10 measures and stores customer demand by using the watthour KYZ pulses from an existing utility billing meter. The Demand Manager provides flexibility by featuring two user-defined alarm set points. The low set point (threshold) allows for internal control and monitoring of a desired demand level. The high threshold is set at the utility's contractual peak point.

The DM-10 Demand Manager features a serial RS-232 communication port for data retrieval. Connecting a portable printer to this port allows the user to obtain demand interval information. In addition, the port can be connected to a PC-compatible computer to download demand history in comma-delimited format for easy spreadsheet analysis.

EFFECTIVELY ELIMINATE EXCESS DEMAND CHARGES!

Imput Signals
All signals are optically isolated, 120 Vac norminal (90-140 V).

Output Signal
All pulse outputs are by (Form-A) relay contacts rated at 2A ac or dc, 200W. Relay operation is synchronized to the ac line zero crossing to maximize contact life.

Demand
Maximum capacity of 1999 counts. The current demand interval is user-selectable at 15, 30 or 60 minutes. Storage is provided for 3500 sequential demand intervals providing 36 days of storage at 15 minute intervals. Each interval is time-stamped.

Demand Count Inputs
One set of KYZ inputs (Form-C). Each toggle of the input will increment the demand register.

Cumulative Consuption
The cumulative total of all input counts is maintained. Register counts to 99,999,999 and then rolls over to zero.

Display and Keypad
The display and keypad are used to view all stored and operational values, set all controllable parameters, and indicate any detected error conditions.

Keypad
Four sealed-membrane keys provide all data entry and control by intuitive selection and scaling techniques.

Serial Output
Provides comma-delimited CSV data for downloading to a spreadsheet. The serial port is the master and utilizes X-on/X-off data-stream control. Baud rate is selectable from 300-4800 bps. Normal operation provides all current parameters and all demand intervals since the last downloa

Auxiliary Power
90-140 Vac, 50 or 60 Hz, less than 1 A.

Internal Battery
User-replaceable battery provides memory backup and clock operation for up to eight accumulated months of power outage. Minimum life is 10 years without power outage. Battery condition is monitored and displayed.

Time-of-Use
The DM-10 features one time-of-use setting for operation during peak hours.

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POWER INSTRUMENTS

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255 North Union Street
Rochester, NY 14605
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E-Mail: info@rochester.com

Exceltronic AC Current or Voltage Transducers

Exceltronic current and voltage transducers are available as either average-sensing devices calibrated to indicate RMS, or as true-RMS devices. The average-sensing transducers are offered as single units or triple units which combine three individual measurements in one compact enclosure. Average-sensing voltage transducers also are available as expanded-scale voltage transducers.

The Exceltronic current and voltage transducers provide a dc output signal proportional to input amps or volts. The dc output is a filtered, true current of 0–1, 1–5, 4–20, or 10–50 mAdc.

Features

- Accuracy to 0.15% of reading
- Exceptional reliability
- Excellent long-term stability
- Average-sensing or true-RMS measurement available
- Expanded-scale voltage models available
- Most popular models are UL Recognized

Applications

- Substation monitoring
- SCADA
- Distribution circuit monitoring
- Process control

Outputs

- 0–1 mAdc
- 1–5 mAdc
- 4–20 mAdc
- 10–50 mAdc

Also available in XLP modular, plug-in format for limited-space applications requiring large numbers of transducers.

- Up to six transducers in one module
- Two, four, or eight modules in one enclosure
- Easy to install, expand, or repair
- Convenient front-panel access for calibration and output-current jacks available

See pages 77–94 for more information.

Specifications		0–1 mAdc Amps (Current Transducer)	P-Option* Amps (Current Transducer)	0–1 mAdc Volts (Voltage Transducer)	P-Option* Volts (Voltage Transducer)
Current Input	Nominal Calibrating Range Range with Linearity Overload Continuous Overload 1 Second/Hour Burden/Element	5 A 0–5 A 0–10 A 20 A 250 A 0.25 VA (maximum) at 5 A	5 A 0–5 A 0–6 A 20 A 250 A 0.25 VA (maximum) at 5 A	N/A	N/A
Voltage Input	Nominal Calibrating Range Range with Linearity Overload Continuous Burden/Element	N/A	N/A	120 V 0–150 V 0–150 V 180 V 2.2 VA (maximum) at 120 V	120 V 0–150 V 0–165 V 180 V 2.2 VA (maximum) at 120 V
External Auxiliary Power	Input Range Frequency Range Burden/Element	None Required	100–130 Vac 50–500 Hz 3 VA Nominal	None Required	100–130 Vac 50–500 Hz 3 VA Nominal
Rated Output (RO) = 5 A or 150 V/Element		1 mAdc for Standard Calibration	5, 20, or 50 mAdc for Std. Calibration, depending on selected output range*	1 mAdc for Standard Calibration	5, 20, or 50 mAdc for Std. Calibration, depending on selected output range*
Accuracy	Standard A4 Models	±(0.15% Reading + 0.1% RO) ±(0.1% Reading + 0.05% RO)	± 0.5% of Span	±(0.15% Reading + 0.1% RO) ±(0.1% Reading + 0.05% RO)	± 0.5% of Span
Temperature Effect on Accuracy		±0.01% / ° C	±0.025% / ° C	±0.01% / ° C	±0.025% / ° C
Operating Temperature Range		-20° C to +60° C	-20° C to +50° C	-20° C to +60° C	-20° C to +50° C
Compliance Voltage		10 Vdc	See Table 2 on page 30.	10 Vdc	See Table 2 on page 30.
Load		0–10,000 Ω		0–10,000 Ω	
Output Ripple Peak		< 0.25% RO	< 0.1% of Span	< 0.25% RO	< 0.1% of Span
Response Time		< 400 ms to 99%	< 1 Second to 99%	< 400 ms to 99%	< 1 Second to 99%
Standard Calibration Adjustments	Gain Zero	±10% of Reading (minimum) None Required	±20% of Span (minimum) ±5% of Zero Point (minimum)	±10% of Reading (minimum) None Required	±20% of Span (minimum) ±5% of Zero Point (minimum)
Frequency Range		50–500 Hz (specify nominal)			
Stability (per year)		±0.1% RO, Noncumulative	±0.15% of Span, Noncumulative	±0.25% RO, Noncumulative	±0.3% of Span, Noncumulative
Operating Humidity		0–95% Noncondensing			
Isolation		Complete (Input/Output/Case)	Complete (Input/Output/Power/Case)	Complete (Input/Output/Case)	Complete (Input/Output/Power/Case)
Dielectric Withstand		2500 VRMS** at 60 Hz			
Surge Withstand		ANSI/IEEE C37.90.1			
Maximum Net Weight	Single Triple	13 oz. (0.4 kg) 1 lb., 13 oz. (0.8 kg)	2 lbs., 11 oz. (1.2 kg) 3 lbs., 14 oz. (1.8 kg)	13 oz. (0.4 kg) 1 lb., 13 oz. (0.8 kg)	2 lbs., 11 oz. (1.2 kg) 3 lbs., 14 oz. (1.8 kg)
Approximate Dimensions (excluding mounting plate)	Single Triple	3.3" W x 2.1" D x 4.1" H (84 mm x 53 mm x 104 mm) Style III Case, see page 122 4.4" W x 3.9" D x 4.7" H (112 mm x 99 mm x 119 mm) Style II Case, see page 122	7.0" W x 3.7" D x 5.6" H (178 mm x 94 mm x 142 mm) Style I Case, see page 122 7.2" W x 5.3" D x 5.8" H (183 mm x 135 mm x 147 mm) Style V Case, see page 123	3.3" W x 2.1" D x 4.1" H (84 mm x 53 mm x 104 mm) Style III Case, see page 122 4.4" W x 3.9" D x 4.7" H (112 mm x 99 mm x 119 mm) Style II Case, see page 122	7.0" W x 3.7" D x 5.6" H (178 mm x 94 mm x 142 mm) Style I Case, see page 122 7.2" W x 5.3" D x 5.8" H (183 mm x 135 mm x 147 mm) Style V Case, see page 123

* P-Option includes 1–5, 4–20, and 10–50 mAdc outputs.

**Dielectric levels as indicated for UL Recognized models; levels may vary on non-UL Recognized models.

Specifications subject to change without notice.

Specifications
Exceltronic AC True-RMS Current or Voltage Transducers

Specifications		0–1 mAdc Amps (Current Transducer)	P-Option* Amps (Current Transducer)	0–1 mAdc Volts (Voltage Transducer)	P-Option* Volts (Voltage Transducer)
Current Input	Nominal Calibrating Range Range with Linearity Overload Continuous Overload 1 Second/Hour Burden/Element	5 A 0–5 A 0.25–6 A** 15 A 250 A 0.2 VA (maximum) at 5 A		N/A	
Voltage Input	Nominal Calibrating Range Range with Linearity Overload Continuous Burden/Element	N/A		120 V 0–150 V 7.5–150 V*** 180 V 0.035 VA (maximum) at 120 V	
External Auxiliary Power	Input Range Frequency Range Burden/Element	85–135 Vac 50–500 Hz 2 VA Nominal	100–135 Vac 50–500 Hz 5 VA Nominal	85–135 Vac 50–500 Hz 2 VA Nominal	100–130 Vac 50–500 Hz 5 VA Nominal
Rated Output (RO) = 5 A or 150 V/Element		1 mAdc for Standard Calibration	5, 20, or 50 mAdc for Std. Calibration, depending on selected output range*	1 mAdc for Standard Calibration	5, 20, or 50 mAdc for Std. Calibration, depending on selected output range*
Accuracy		±(0.15% Reading + 0.1% RO)	±0.5% of Span	±(0.15% Reading + 0.1% RO)	±0.5% of Span
Temperature Effect on Accuracy		±0.01% / ° C	±0.025% / ° C	±0.01% / ° C	±0.025% / ° C
Operating Temperature Range		-20° C to +60° C	0° C to +50° C	-20° C to +60° C	0° C to +50° C
Compliance Voltage		10 Vdc	See Table 2 on page 30.	10 Vdc	See Table 2 on page 30.
Load		0–10,000 Ω		0–10,000 Ω	
Output Ripple Peak		< 1% RO	≤ 1% of Span	< 1% RO	≤ 1% of Span
Response Time		< 600 ms to 99%	< 2 Seconds to 99%	< 600 ms to 99%	< 2 Seconds to 99%
Standard Calibration Adjustments	Gain Zero	±5% of Reading (minimum) ±0.1% of RO	±20% of Span (minimum) ±5% of Zero Point (minimum)	±5% of Reading (minimum) ±0.1% of RO	±20% of Span (minimum) ±5% of Zero Point (minimum)
Frequency Range		55–65 Hz (fundamental and through ninth harmonic) (specify nominal)			
Crest Factor		2:1 (maximum)			
Stability (per year)		±0.1% RO, Noncumulative	±0.15% of Span, Noncumulative	±0.1% RO, Noncumulative	±0.15% of Span, Noncumulative
Operating Humidity		0–95% Noncondensing			
Isolation		Complete (Input/Output/Power/Case)			
Dielectric Withstand		1500 VRMS at 60 Hz			
Surge Withstand		ANSI/IEEE C37.90.1			
Maximum Net Weight		2 lbs., 1 oz. (0.9 kg)	3 lbs., 8 oz. (1.6 kg)	2 lbs., 1 oz. (0.9 kg)	3 lbs., 8 oz. (1.6 kg)
Approximate Dimensions (excluding mounting plate)		4.4" W x 3.9" D x 4.7" H (112 mm x 99 mm x 119 mm) Style II Case, see page 122	7.0" W x 3.7" D x 5.6" H (178 mm x 94 mm x 142 mm) Style I Case, see page 122	4.4" W x 3.9" D x 4.7" H (112 mm x 99 mm x 119 mm) Style II Case, see page 122	7.0" W x 3.7" D x 5.6" H (178 mm x 94 mm x 142 mm) Style I Case, see page 122

* P-Option includes 1–5, 4–20, and 10–50 mAdc outputs.

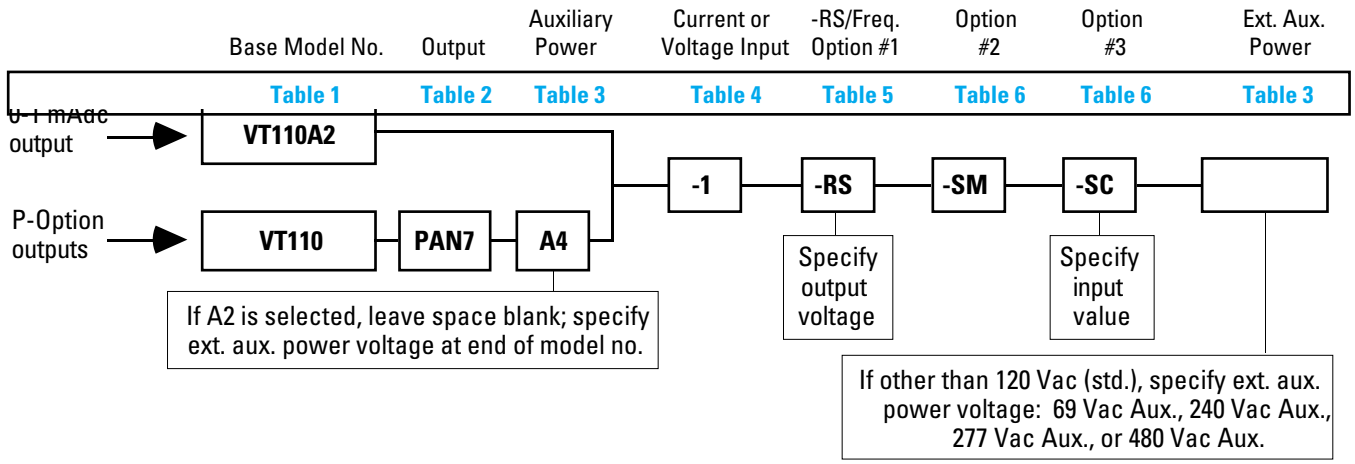
** Operates at reduced accuracy from 0–0.25 Aac.

***Operates at reduced accuracy from 0–7.5 Vac.

Specifications subject to change without notice.

ORDERING PROCEDURE

Specify by base model number and appropriate selection or option suffixes in the order shown in the following example.



EXAMPLES: VT110A2-1-RS-SM-SC

0-1 mAdc Average-Sensing Voltage Transducer with 0.25% accuracy, 240 V input, resistor scaling (converts current output to voltage output), seismic brace, special calibration (example: 360 V).

VT110PAN7A4-1-RS-SM-SC

4-20 mAdc Average-Sensing Voltage Transducer, internal auxiliary power, 240 V input, resistor scaling (converts current output to voltage output), seismic brace, special calibration (example: 360 V).

Table 1 Base Model Number Selection

Current Model No.	Voltage Model No.	Description	Calibration at Rated Output (5 A or 120 V Nominal Input) Current	Voltage
(0-1 mAdc Units)				
CT510A2*	VT110A2*	Average Sensing, Single Unit	5 A	150 V
CT510A4*	VT110A4*	Average Sensing, Single Unit	5 A	150 V
4044	3588	Average Sensing, Triple Unit	5 A	150 V
4044A4*	3588A4*	Average Sensing, Triple Unit	5 A	150 V
4074A	3567A	True RMS, Single Unit	5 A	150 V
(P-Option Units)				
CT510	VT110	Average Sensing, Single Unit	5 A	150 V
4044	3588	Average Sensing, Triple Unit	5 A	150 V
4074	3567	True RMS, Single Unit	5 A	150 V

*** On 0-1 mAdc Average-Sensing Current and Voltage units, A2 and A4 refer to accuracy. A2 denotes 0.25% accuracy, which is the standard/default; A4 denotes 0.15% optional accuracy. On P-Option Current and Voltage units, A2 and A4 refer to auxiliary power (see Table 3). Standard accuracy on P-Option Current and Voltage units is 0.50%.**

See Specifications on previous pages for more detail.

Table 2 Output Selection

0-1 mAdc output is standard, and is specified by the Base Model Numbers. For outputs other than 0-1 mAdc, indicate the appropriate P-Option in the "Output" position of the complete model number.

P-Option	Output Range	Compliance Voltage/ Maximum Load	Maximum Open Circuit Voltage
PAN6	1-5 mAdc	15 Vdc/3000 Ω	30 Vdc
PAN7	**4-20 mAdc**	**15 Vdc/750 Ω**	**30 Vdc**
PAN8	10-50 mAdc	15 Vdc/300 Ω	30 Vdc
PA6	1-5 mAdc	40 Vdc/8000 Ω	70 Vdc
PA7	4-20 mAdc	40 Vdc/2000 Ω	70 Vdc
PA8	10-50 mAdc	30 Vdc/600 Ω	70 Vdc

Table 3 Auxiliary Power Supply Selection

Option	Description	Input Range	Frequency Range	Burden
(0-1 mAdc Units)				
None required for average-sensing units.				
A2 (leave blank)**	**External Auxiliary Power (120 Vac std.)** (true-RMS units only)	**85-135 Vac**	**50-500 Hz**	**2 VA**
(P-Option Units)				
A2 (leave blank)**	**External Auxiliary Power (120 Vac std.)**	**100-130 Vac**	**50-500 Hz**	**3 VA**
A4	Internal Auxiliary Power (self-powered) (voltage units only)	84-108% of Nominal Aux. Power Voltage	Equals Input Frequency	3 VA

**** For external auxiliary power voltages other than 120 Vac, specify the voltage in the last position of the complete model number. (Example: 240 Vac Aux.)**

DC external auxiliary power available; see Special Options on page 128.

Table 4 Input Selection

Current Units Only

Output Option	Nominal	Current Range	Calibration at Rated Output (5 A Nominal Input)
-3	1 A	0-2 A	1 A/Element
Std.***	**5 A**	**0-10 A**	**5 A/Element**
-5	10 A	0-20 A	10 A/Element
-8****	25 A	0-30 A	25 A/Element

Voltage Units Only

Option	Nominal	Voltage Range	Calibration at Rated (120 V Nominal Input)
Std.***	**120 V**	**0-150 V**	**150 V/Element**
-1	240 V	0-300 V	300 V/Element
-2	480 V	0-600 V	600 V/Element

***** Leave "Input" positions blank in the model number.**

****** Option -8 requires a larger case: Style II case for Models CT510A2 and CT510A4; Style I case for Models 4044 and 4074. (See page 132 for case dimensions. Maximum height of terminal strip(s) is 1.07" on units with -8 option.)**

Table 5 Scaling Resistor (-RS)/Frequency Options

Option	Description
-RS†	Scaling Resistor
-6	400 Hz
-12	50 Hz (not UL Recognized)
-6-RS†	400 Hz and Scaling Resistor
-12-RS†	50 Hz and Scaling Resistor

† You must specify the desired output voltage:
For 0-1 mAdc units, specify range from 0-10 Vdc. Load impedance is 1 MΩ/Vdc (minimum).
For P-Option units, specify range from 0-15 Vdc (PAN models) or 0-40 Vdc (PA models). Load impedance is 200, 50, or 20 (kΩ/Vdc) (minimum) for units with outputs of 5, 20, or 50 mAdc, respectively.

This information is not part of the model number, but must be provided to the factory when you place your order.

Table 6 Other Options

Option	Description
-24	24 Vdc Loop-Powered (PA7 models only) (consult factory for specifications—requires a Style III case; see page 122 for case dimensions)
-SC††	Special Calibration (voltage units only) (consult factory for special calibration on current units)
-SM	Seismic Brace
-Z	Zero-Based Output Calibration (ex.: PA7-Z = 0-20 mAdc) (available only with P-Option units)

†† You must specify the desired input value:
Voltage transducers can be calibrated within 70-120% of the calibration input voltage (150 V), or 105-180 V. Please consult the factory for input ranges other than 105-180 V.

This information is not part of the model number, but must be provided to the factory when you place your order.

If you require additional options not shown here, see Special Options on page 128. When ordering any special options, or more than three options, you must first consult the factory for pricing and delivery estimates.

TRANSDUCERS IN THE PRESENCE OF HARMONICS

Harmonics are becoming a major issue in the quality of utility power signals, and our customers are concerned about their effect on measurement accuracy. Transducers can be affected by harmonics and have been the focal point of many questions and concerns. Two primary questions seem to surface when discussing transducers and harmonics: (1) Whether or not an average-sensing device or a true-RMS transducer should be used when harmonics are present, and (2) What is the performance of a watt or var transducer when harmonics are present?

To determine whether to use an average-sensing device or a true-RMS device, it is important to understand the difference between the two. An average-sensing device simply keeps a running average of the continuously varying signal at its input. A true-RMS device actually calculates, in analog circuitry, the root-mean-squared value by: (1) **S**quaring each instantaneous input value, (2) taking the average (or **M**ean), and then (3) taking the square **R**oot of the result. In a case where the sine wave is not distorted, both the average-sensing and the RMS output values would be the same. However, when a wave form is distorted, the RMS value reflects a truer measure of the wave form. For example, the self-heating in a transmission line is directly proportional to the square of the RMS value of the current wave form, not the square of the average value of the current wave form. In the presence of a distorted wave form, the average-sensing device provides an averaged answer and disregards some of the effects of distortion. Therefore, an RMS device is advantageous when a large harmonic content is present and precise measurement is required (i.e., capacitor banking switching).

The harmonic performance for Scientific Columbus watt or var transducers is excellent. The design of the watt transducer makes it an inherently true-RMS device, as the multiplication of current and voltage results in the "square" term necessary for the computation. In addition, the analog nature of Scientific Columbus devices gives them an inherently better performance than many digital-sampling devices. Our data shows accurate readings by Scientific Columbus watt transducers up to the 15th-order harmonic.

The same holds true for Scientific Columbus var transducers. A var transducer also calculates a true-RMS value, multiplying the current by the voltage, shifted 90 degrees in phase. As long as the frequency of the voltage signal remains at 60 Hz and the voltage signal remains clean (i.e., no harmonics), a true-RMS signal results. Since most harmonic content appears on the current axis, this method produces accurate signals for most users.

For more information on transducers and their performance in the presence of harmonics, or for assistance in selecting the proper transducer for your application, please consult the factory at 1-800-274-5368 (U.S. and Canada).

Specifications		0–1 mAdc Volts (Expanded-Scale Voltage Transducer)	P-Option* Volts (Expanded-Scale Voltage Transducer)
Voltage Input	Span/Range Overload Continuous Burden/Element	Any 20–60 V span between 90–150 V (customer specified)** 150 V 2 VA (maximum) at 120 V	
External Auxiliary Power	Input Range Frequency Range Burden	None Required	100–130 Vac 50–500 Hz 3 VA Nominal
Rated Output (RO)		0 mAdc at low end of range (customer specified) 1 mAdc at high end of range (customer specified)	1, 4, or 10 mAdc at low end of range (customer specified) 5, 20, or 50 mAdc at high end of range (customer specified)
Accuracy		±0.25% of Input Voltage for 60 Hz	±0.5% of Input Voltage for 60 Hz
Temperature Effect on Accuracy		±0.007% / ° C	±0.015% / ° C
Operating Temperature Range		-20° C to +60° C	-20° C to +50° C
Compliance Voltage		10 Vdc	See Table 2 on page 34.
Load		0–10,000 Ω	
Output Ripple Peak		< 2.5% RO	< 2.5% of Span
Response Time		< 400 ms to 99%	< 1 Second to 99%
Standard Calibration Adjustments	Gain Zero	±5% of Span ±5% of Span	±20% of Span ±5% of Span
Frequency Range		55–65 Hz	
Stability (per year)		±0.25% of Input Voltage, Noncumulative	
Operating Humidity		0–95% Noncondensing	
Isolation		Complete (Input/Output/Case)	Complete (Input/Output/Power/Case)
Dielectric Withstand		1500 VRMS at 60 Hz	
Surge Withstand		ANSI/IEEE C37.90.1	
Maximum Net Weight		1 lb., 3 oz. (0.5 kg)	3 lbs., 3 oz. (1.4 kg)
Approximate Dimensions (excluding mounting plate)		3.3" W x 2.1" D x 4.1" H (84 mm x 53 mm x 104 mm) Style III Case, see page 122	7.0" W x 3.7" D x 5.6" H (178 mm x 94 mm x 142 mm) Style I Case, see page 122

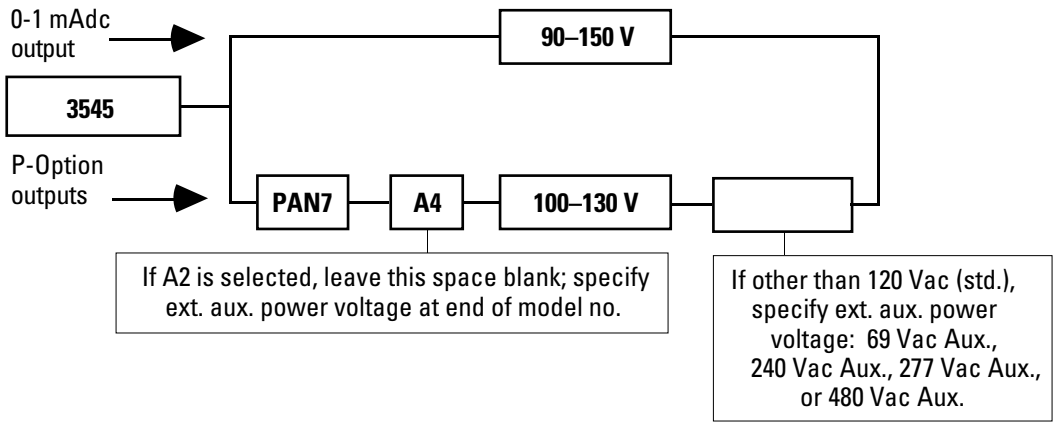
* P-Option includes 1–5, 4–20, and 10–50 mAdc outputs.
**Minimum span must be at least 18% of low-end voltage.

Specifications subject to change without notice.

ORDERING PROCEDURE

Specify by base model number and appropriate selection or option suffixes in the order shown in the following example.

Base Model No.	Output	Auxiliary Power	Input Range	External Aux. Power
Table 1	Table 2	Table 3	Table 4	



EXAMPLES: 3545 90-150 V
0-1 mAdc Expanded-Scale Voltage Transducer, 90-150 V input range.

3545PAN7A4 100-130 V
4-20 mAdc Expanded-Scale Voltage Transducer, internal auxiliary power, 100-130 V input range.

Table 1 Base Model Number Selection

Model No.	Description
3545	Expanded-Scale Voltage, Average Sensing, Single Unit

Table 2 Output Selection

0-1 mAdc output is standard, and is specified by the Base Model Numbers. For outputs other than 0-1 mAdc, indicate the appropriate P-Option in the "Output" position of the complete model number.

P-Option	Output Range	Compliance Voltage/ Maximum Load	Maximum Open Circuit Voltage
PAN6	1-5 mAdc	15 Vdc/3000 Ω	30 Vdc
PAN7	**4-20 mAdc**	**15 Vdc/750 Ω**	**30 Vdc**
PAN8	10-50 mAdc	15 Vdc/300 Ω	30 Vdc
PA6	1-5 mAdc	40 Vdc/8000 Ω	70 Vdc
PA7	4-20 mAdc	40 Vdc/2000 Ω	70 Vdc
PA8	10-50 mAdc	30 Vdc/600 Ω	70 Vdc

Table 3 Auxiliary Power Supply Selection

Option	Description	Input Range	Frequency Range	Burden
(0-1 mAdc Units)				
None Required				
(P-Option Units)				
A2* (leave blank)	**External Auxiliary Power (120 Vac std.)**	**100-130 Vac**	**50-500 Hz**	**3 VA**
A4**	Internal Auxiliary Power (self-powered)	84-108% of Nominal Aux. Power Voltage	Equals Input Frequency	3 VA

*** For external auxiliary power voltages other than 120 Vac, specify the voltage in the last position of the complete model number. (Example: 240 Vac Aux.)**

**** If the A4 option is selected, the voltage measurement range must stay within the Auxiliary Power Input Range of 84-108% of the Nominal Aux. Power Voltage. For example, if the Nominal Aux. Power Voltage is 120 Vac, the Auxiliary Power Input Range must be 100-130 Vac in order to be within 84-108% of 120 Vac.**

DC external auxiliary power available; see Special Options on page 128.

Table 4 Input Selection

Measurement Range***	Customer-Specified Span****
90-150 V	**20-60 V**
180-300 V	40-120 V
360-600 V	80-240 V

***** The standard measurement range is 90-150 V. This information goes in the "Input Range" position in the complete model number.**

****** The span should equal the maximum Measurement Range value minus the minimum Measurement Range value. Minimum span must be at least 18% of low-end voltage.**

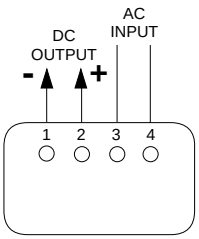
This information is not part of the model number, but must be provided to the factory when you place your order.

Please consult the factory if you require any options with Expanded-Scale Voltage Transducers.

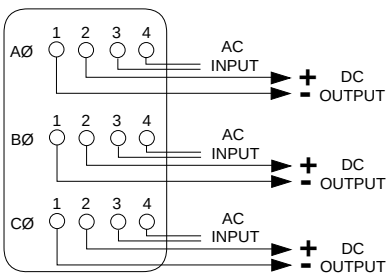
WIRING DIAGRAMS FOR 0-1 mAdc UNITS (Styles III & II Cases) AND P-OPTION UNITS (Styles I & V Cases)

0-1 mAdc Units

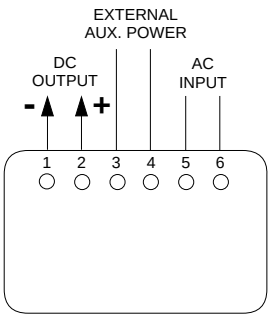
Single Current or Voltage, Expanded-Scale Voltage (Style III Case)



Triple Current or Voltage (Style II Case)

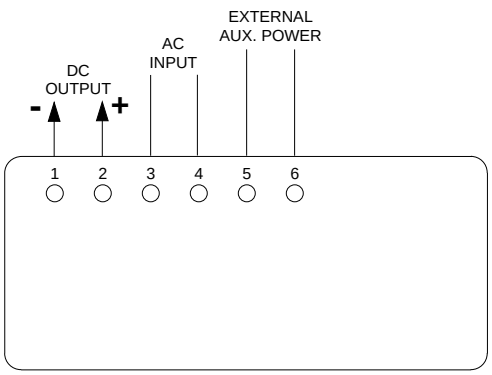


True-RMS Current or Voltage (Style II Case)

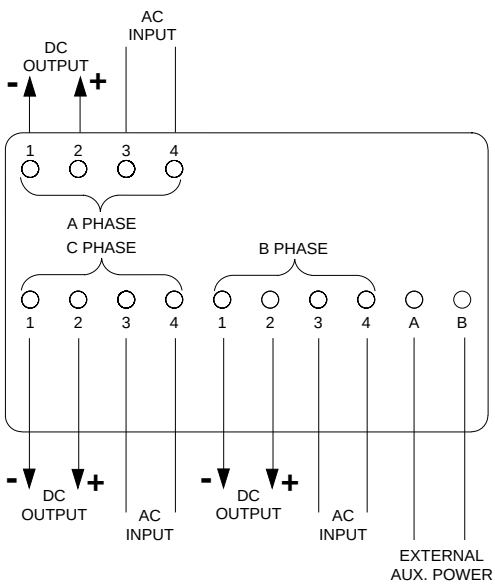


P-Option Units

Single Current or Voltage, Expanded-Scale Voltage, True-RMS Current or Voltage (Style I Case)



Triple Current or Voltage (Style V Case)



UNDERSTANDING TRANSDUCER ACCURACY

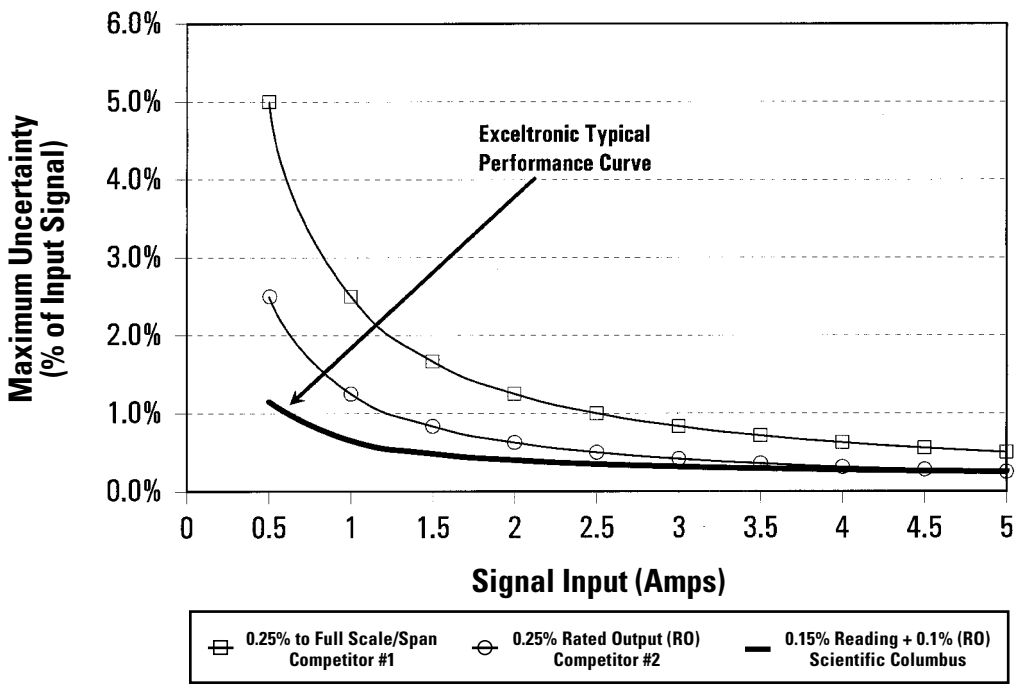
Accuracy, as defined in this catalog, is "the degree of uncertainty with which a measured value agrees with the ideal value." So, to understand accuracy, we must first define uncertainty.

There are basically two ways to quantify uncertainty in a measured value: as a percentage of the measured value (reading) that varies with the input, or as a percentage of a fixed value. This fixed value can be either rated output (RO) or full scale, which results in a constant uncertainty over the range of inputs. The less the absolute value of the uncertainty, the more accurate the device.

It would be ideal if a measurement device could be specified as a percent-of-reading device; then the uncertainty of any reading would always be known and constant. However, in practical use, a transducer cannot be specified strictly as a percent-of-reading device. All electronic circuits have an inherent offset error, which is accounted for by adding a constant error term (such as % RO) to the accuracy specification. At Scientific Columbus, we express the total accuracy of our transducers as the percent of reading plus the offset error. For example, the accuracy of our typical current transducer (CT510A2) is 0.15% Reading + 0.1% RO.

The chart below depicts the maximum uncertainty for a CT510A2 transducer compared with two competitive units. The operation of the devices is graphed from several input values. Each plot represents a different method of specifying transducer accuracy. Scientific Columbus' CT510A2 accuracy is shown in bold.

Example: CT510A2 - Nominal: 5 Amps, Full Scale: 10 Amps



Exceltronic AC Watt or Var Transducers

Exceltronic watt and var transducers provide utility and industrial users with a high degree of accuracy for applications requiring precise measurements. These transducers provide a dc-output signal proportional to input watts or vars. All models are available with a wide range of input and output options.

Features

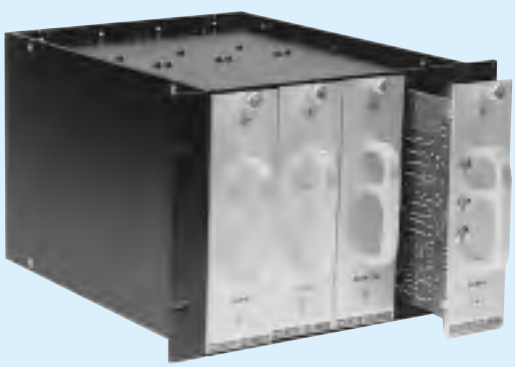
- Accuracy to 0.2% of reading
- Exceptional reliability
- Excellent long-term stability
- Self- or externally powered
- No zero adjustment required
- Most popular models are UL Recognized

Applications

- Substation monitoring
- SCADA
- Energy-management systems
- Distribution monitoring
- Process control

Outputs

- 0 to ±1 mAdc
- 1–5 or 1–3–5 mAdc
- 4–20 or 4–12–20 mAdc
- 10–50 or 10–30–50 mAdc



Also available in XLP modular, plug-in format for limited-space applications requiring large numbers of transducers.

- Two, four, or eight modules in one enclosure
- Easy to install, expand, or repair
- Convenient front-panel access for calibration and output-current jacks available

See pages 77–94 for more information.

Specifications

EXCELTRONIC AC WATT OR VAR TRANSDUCERS

Specifications		0 to ±1 mAdc Watts (Watt Transducer)	P-Option* Watts (Watt Transducer)	0 to ±1 mAdc Vars (Var Transducer)	P-Option* Vars (Var Transducer)
Current Input	Nominal Range** Overload Continuous Overload 1 Second/Hour Burden/Element	5 A 0–10 A 20 A 250 A 0.2 VA (maximum) at 5 A			
Voltage Input	Nominal Range** Overload Continuous Burden/Element	120 V 0–150 V 200 V 0.035 VA (maximum) at 120 V			
External Auxiliary Power	Input Range Frequency Range Burden	85–135 Vac 50–500 Hz 3 VA Nominal	100–130 Vac 50–500 Hz 6 VA Nominal	85–135 Vac 50–500 Hz 3 VA Nominal	100–130 Vac 50–500 Hz 6 VA Nominal
Rated Output (RO) = 500 Watts or Vars/Element		±1 mAdc for Standard Calibration	5, 20, or 50 mAdc for Std. Calibration, depending on selected output range*	±1 mAdc for Standard Calibration	5, 20, or 50 mAdc for Std. Calibration, depending on selected output range*
Accuracy		±(0.2% Reading + 0.01% RO) at 0–200% RO	±(0.2% Reading + 0.05% RO) at 0–120% RO	±(0.2% Reading + 0.02% RO) at 0–200% RO	±(0.3% Reading + 0.05% RO) at 0–120% RO
Temperature Effect on Accuracy		±0.005% / ° C	±0.0075% / ° C	±0.009% / ° C	±0.012% / ° C
Operating Temperature Range		-20° C to +70° C	-20° C to +50° C	-20° C to +60° C	-20° C to +50° C
Compliance Voltage		10 Vdc	See Table 2 on page 40.	10 Vdc	See Table 2 on page 40.
Load		0–10,000 Ω		0–10,000 Ω	
Output Ripple Peak		< 0.5% RO	< 0.25% RO	< 0.5% RO	< 0.25% RO
Response Time		< 400 ms to 99%	< 1 Second to 99%	< 400 ms to 99%	< 1 Second to 99%
Power Factor		Any			
PF Effect on Accuracy		±0.1% VA (maximum)		±0.15% VA (maximum)	
Standard Calibration Adjustments	Gain Zero	±2% of Reading (minimum) None Required	±20% of Span (minimum) ±5% of Zero Point (minimum)	±2% of Reading (minimum) None Required	±20% of Span (minimum) ±5% of Zero Point (minimum)
Frequency Range		58–62 Hz		60 Hz	
Stability (per year)		±0.1% RO, Noncumulative	±0.15% of Span, Noncumulative	±0.2% RO, Noncumulative	±0.25% of Span, Noncumulative
Operating Humidity		0–95% Noncondensing			
Isolation		Complete (Input/Output/Power/Case)			
Dielectric Withstand		2500 VRMS*** at 60 Hz			
Surge Withstand		ANSI/IEEE C37.90.1			
Maximum Net Weight		3 lbs., 5 oz. (1.5 kg)	4 lbs., 8 oz. (2 kg)	3 lbs., 5 oz. (1.5 kg)	4 lbs., 8 oz. (2 kg)
Approximate Dimensions (excluding mounting plate)		4.4" W x 3.9" D x 4.7" H (112 mm x 99 mm x 119 mm) Style II Case, see page 122	7.0" W x 3.7" D x 5.6" H (178 mm x 94 mm x 142 mm) Style I Case, see page 122	4.4" W x 3.9" D x 4.7" H (112 mm x 99 mm x 119 mm) Style II Case, see page 122	7.0" W x 3.7" D x 5.6" H (178 mm x 94 mm x 142 mm) Style I Case, see page 122
Overrange with Linearity		500–1000 Watts/Element	500–600 Watts/Element	500–1000 Vars/Element	500–600 Vars/Element
		No additional error within voltage compliance. Reduce load resistance as required.			

* P-Option includes 1–5/1–3–5, 4–20/4–12–20, and 10–50/10–30–50 mAdc outputs.

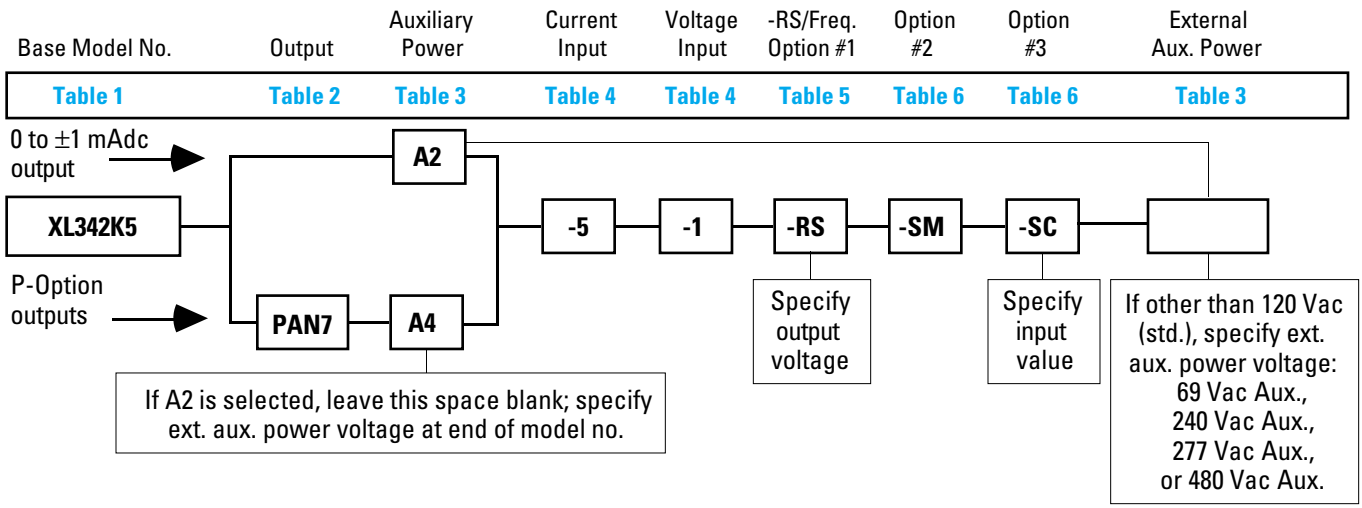
** Total input not to exceed 200% of standard-calibration watts or vars on units with 0 to ±1 mAdc output.
Total input not to exceed 120% of standard-calibration watts or vars on units with P-Option outputs.

***Dielectric levels as indicated for UL Recognized models; levels may vary on non-UL Recognized models.

Specifications subject to change without notice.

ORDERING PROCEDURE

Specify by base model number and appropriate selection or option suffixes in the order shown in the following example.



EXAMPLES: XL342K5A2-5-1-RS-SM-SC

3-element, 0 to ±1 mAdc Watt Transducer; 120 Vac external auxiliary power; 10 A input; 240 V input; resistor scaling (converts current output to voltage output); seismic brace; special calibration (example: 7200 W).

XL342K5PAN7A4-5-1-RS-SM-SC

3-element, 4-20 mAdc Watt Transducer; internal auxiliary power; 10 A input; 240 V input; resistor scaling (converts current output to voltage output); seismic brace; special calibration (example: 7200 W).

Table 1 Base Model Number Selection

Element	Watt Model No.	Var Model No.	Connection	Calibration at Rated Output (5 A, 120 V Nominal Input)
1	XL5C5	XLV5C5	Single Phase	500 W or Vars
1 1/2*	XL5C51 1/2	XLV5C51 1/2	3 Phase, 3 Wire	1000 W or Vars
2	XL31K5	XLV31K5	3 Phase, 3 Wire	1000 W or Vars
2 1/2*	XL31K52 1/2	XLV31K52 1/2	3 Phase, 4 Wire	1500 W or Vars
3	XL342K5	XLV342K5	3 Phase, 4 Wire	1500 W or Vars

*** 1 1/2- and 2 1/2-element units require a balanced voltage.**

Table 2 Output Selection

0 to ±1 mAdc output is standard, and is specified by the Base Model Numbers. For outputs other than 0 to ±1 mAdc, indicate the appropriate P-Option in the "Output" position of the complete model number.

P-Option	Output Range	Compliance Voltage/ Maximum Load	Maximum Open Circuit Voltage
PAN6	1-5 mAdc	15 Vdc/3000 Ω	30 Vdc
PAN7	**4-20 mAdc**	**15 Vdc/750 Ω**	**30 Vdc**
PAN8	10-50 mAdc	15 Vdc/300 Ω	30 Vdc
PAN6-B	1-3-5 mAdc	15 Vdc/3000 Ω	30 Vdc
PAN7-B	4-12-20 mAdc	15 Vdc/750 Ω	30 Vdc
PAN8-B	10-30-50 mAdc	15 Vdc/300 Ω	30 Vdc
PA6	1-5 mAdc	40 Vdc/8000 Ω	70 Vdc
PA7	4-20 mAdc	40 Vdc/2000 Ω	70 Vdc
PA8	10-50 mAdc	30 Vdc/600 Ω	70 Vdc
PA6-B	1-3-5 mAdc	40 Vdc/8000 Ω	70 Vdc
PA7-B	4-12-20 mAdc	40 Vdc/2000 Ω	70 Vdc
PA8-B	10-30-50 mAdc	30 Vdc/600 Ω	70 Vdc

Table 3 Auxiliary Power Supply Selection

Option	Description	Input Range	Frequency Range	Burden
(0 to ±1 mAdc Units)				
A2**	**External Auxiliary Power (120 Vac std.)**	**85-135 Vac**	**50-500 Hz**	**3 VA**
A4	Internal Auxiliary Power (self-powered)	70-112% of Nominal Aux. Power Voltage	Equals Input Frequency	3 VA
(P-Option Units)				
A2** (leave blank)	**External Auxiliary Power (120 Vac std.)**	**100-130 Vac**	**50-500 Hz**	**6 VA**
A4	Internal Auxiliary Power (self-powered)	84-108% of Nominal Aux. Power Voltage	Equals Input Frequency	6 VA

** For external auxiliary power voltages other than 120 Vac, specify the voltage in the last position of the complete model number. (Example: 240 Vac Aux.)

DC external auxiliary power available; see Special Options on page 128.

Table 4 Input Selection

Current

Option	Nominal	Current Range w/ Accuracy	Calibration at Rated Output (5 A Nominal Input)
-3	1 A	0-2 A	100 W or Vars/Element
-4	2.5 A	0-5 A	250 W or Vars/Element
Std.***	**5 A**	**0-10 A**	**500 W or Vars/Element**
-11	7.5 A	0-15 A	750 W or Vars/Element
-5	10 A	0-20 A	1000 W or Vars/Element
15 A	0-20 A	1500 W or Vars/Element	
-8******	25 A	0-30 A	2500 W or Vars/Element

Voltage

Option	Nominal	Voltage Range w/ Accuracy	Calibration at Rated Output (120 V Nominal Input)
-0	69 V	0-75 V	250 W or Vars/Element
Std.***	**120 V**	**0-150 V**	**500 W or Vars/Element**
-1	240 V	0-300 V	1000 W or Vars/Element
-9	277 V	0-340 V	1200 W or Vars/Element
-2	480 V	0-600 V	2000 W or Vars/Element
-7			

*** Leave "Input" positions blank in the model number.

**** Option -8 requires a Style I case. (See page 122 for case dimensions. Maximum height of terminal strip(s) is 1.07" for units with -8 option.)

Table 5 Scaling Resistor (-RS)/Frequency Options

Option	Description
-RS†	Scaling Resistor
-6	400 Hz
-12	50 Hz (not UL Recognized)
-6-RS†	400 Hz and Scaling Resistor
-12-RS†	50 Hz and Scaling Resistor

† You must specify the desired output voltage:
For 0 to ±1 mAdc units, specify range from 0 to ±10 Vdc. Load impedance is 1 MΩ/Vdc (minimum).
For P-Option units, specify range from 0-15 Vdc (PAN models) or 0-40 Vdc (PA models). Load impedance is 200, 50, or 20 (kΩ/Vdc) (minimum) for units with outputs of 5, 20, or 50 mAdc, respectively.

This information is not part of the model number, but must be provided to the factory when you place your order.

Table 6 Other Options

Option	Description
-20	50-200% Calibration Adjustment (current outputs)
-21	50-200% Calibration Adjustment (voltage outputs) (available only with 0 to ±1 mAdc units)
-24	24 Vdc Loop-Powered (PA7 and PA7-B models only) (consult factory for specifications)
-CE	Analog Output Shorting Relay (available only with 0 to ±1 mAdc units)
-SC††	Special Calibration
-SM	Seismic Brace (available with 0 to ±1 mAdc units) (consult factory if you desire this option with a P-Option unit)
-Z	Zero-Based Output Calibration (ex.: PA7-Z = 0-20 mAdc) (available only with P-Option units, except PAN-B models)

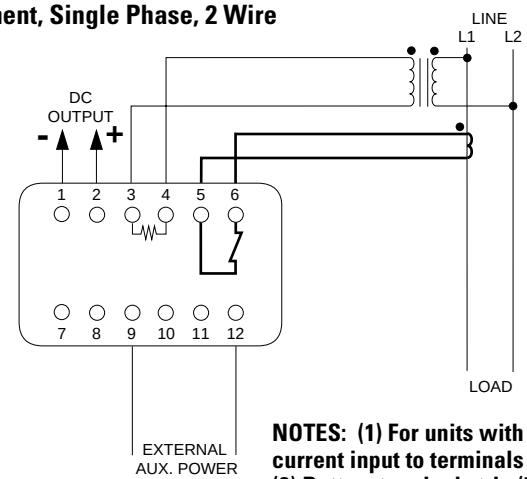
†† You must specify the desired input value:
0 to ±1 mAdc units can be calibrated within 90-180% of their standard-calibration input watts or vars. (Example: A 2-element watt transducer is calibrated to 1000 W standard. The -SC option can be added for input levels from 900 W (90%) to 1800 W (180%).) P-Option units can be calibrated within 60-180% of their standard-calibration input watts or vars.

This information is not part of the model number, but must be provided to the factory when you place your order.

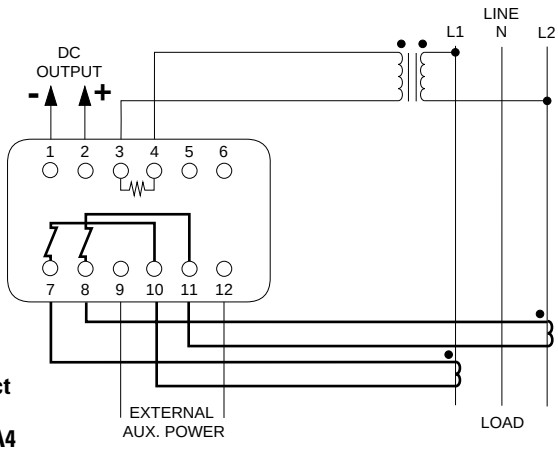
If you require additional options not shown here, see Special Options on page 128. When ordering any special options, or more than three options, you must first consult the factory for pricing and delivery estimates.

WIRING DIAGRAMS FOR 0 to ±1 mAdc UNITS (Style II Case)

1 Element, Single Phase, 2 Wire

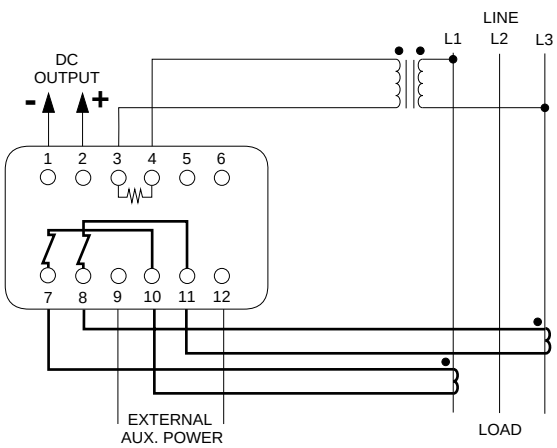


1 1/2 Element, Single Phase, 3 Wire

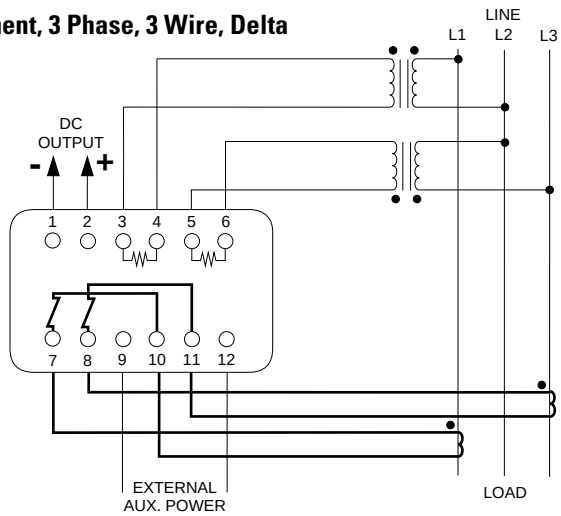


NOTES: (1) For units with -8 option, connect current input to terminals 7 (•) and 10 .
(2) Bottom terminal strip (7-12) omitted on A4 models, except with -8 option.

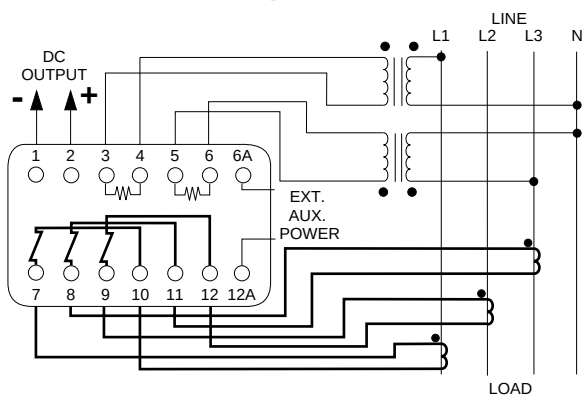
1 1/2 Element, 3 Phase, 3 Wire, Delta



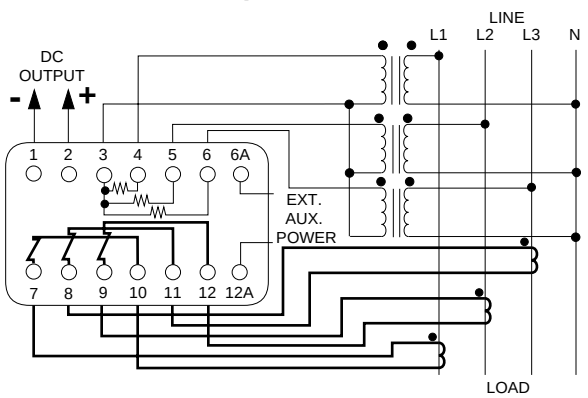
2 Element, 3 Phase, 3 Wire, Delta



2 1/2 Element, 3 Phase, 4 Wire, Wye



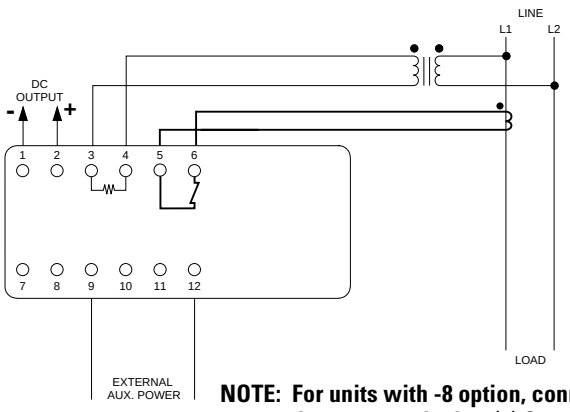
3 Element, 3 Phase, 4 Wire, Wye



A2 Models: Shown. A4 Models: External aux. power not required.

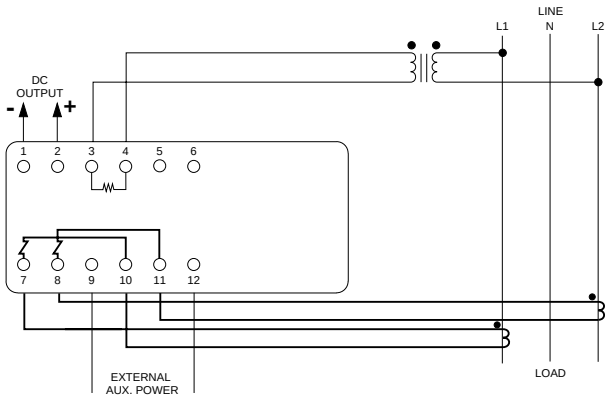
WIRING DIAGRAMS FOR P-OPTION UNITS (Style I Case)

1 Element, Single Phase, 2 Wire

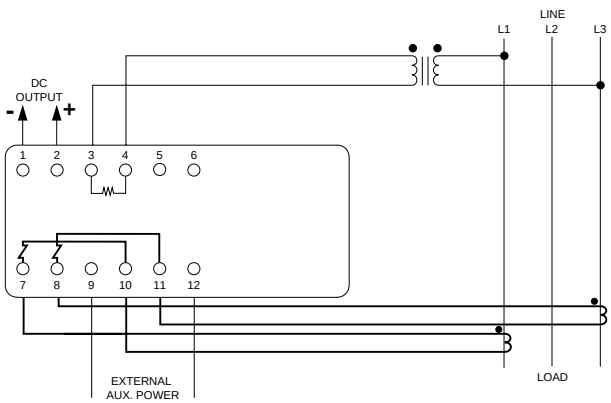


NOTE: For units with -8 option, connect current input to terminals 7 (•) & 10.

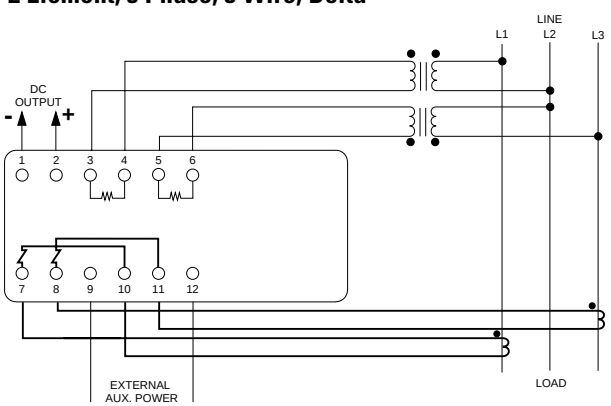
1 1/2 Element, Single Phase, 3 Wire



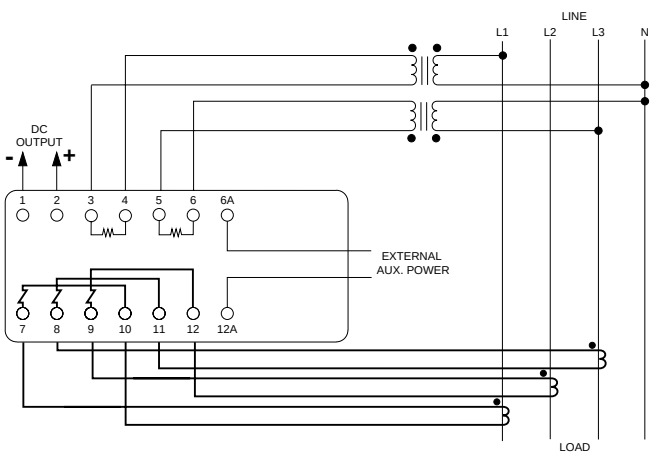
1 1/2 Element, 3 Phase, 3 Wire, Delta



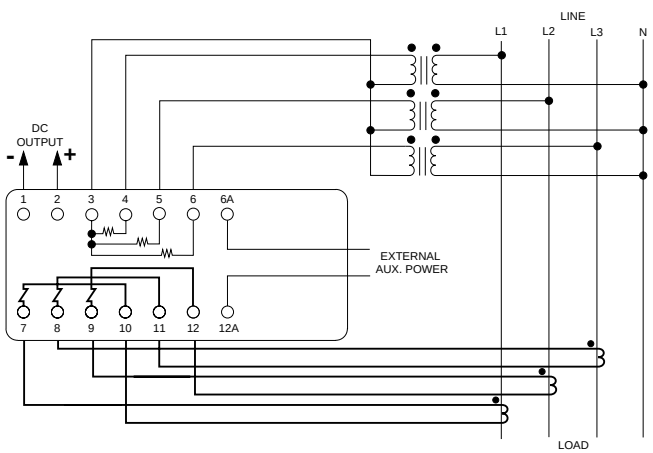
2 Element, 3 Phase, 3 Wire, Delta



2 1/2 Element, 3 Phase, 4 Wire, Wye



3 Element, 3 Phase, 4 Wire, Wye



Adjust

A2 Models: Shown. A4 Models: External aux. power not required.

Exceltronic Combined AC Watt/Var Transducers

Exceltronic combined watt/var transducers provide all the functions of the individual watt and var transducers, but require only half the panel space and half the wiring. These transducers use a common power supply and share the input voltage and current transformers. Because of this unique feature, the burden on the user's transformers is the same as when only one watt or var transducer is used.

Features

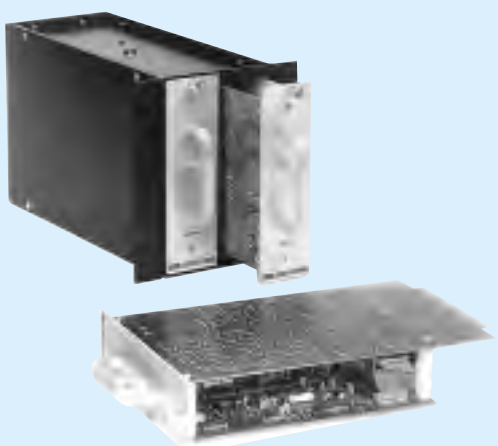
- Accuracy to 0.2% of reading
- Two transducers in one enclosure
- Excellent long-term stability
- Most popular models are UL Recognized

Applications

- Substation line monitoring
- Energy-management systems
- Process control

Outputs

- 0 to ±1 mAdc
- 1–5 or 1–3–5 mAdc
- 4–20 or 4–12–20 mAdc



Also available in XLP modular, plug-in format for limited-space applications requiring large numbers of transducers.

- Up to three single-phase watt/var transducers in one module
- Two, four, or eight modules in one enclosure
- Easy to install, expand, or repair
- Convenient front-panel access for calibration and output-current jacks available

See pages 77–94 for more information.

Specifications

EXCELTRONIC COMBINED AC WATT/VAR TRANSDUCERS

Specifications		0 to ±1 mAdc Watts (Combined Watt/Var Transducer)	P-Option* Watts (Combined Watt/Var Transducer)	0 to ±1 mAdc Vars (Combined Watt/Var Transducer)	P-Option* Vars (Combined Watt/Var Transducer)
Current Input	Nominal Range** Overload Continuous Overload 1 Second/Hour Burden/Element	5 A 0–10 A 20 A 250 A 0.2 VA (maximum) at 5 A			
Voltage Input	Nominal Range** Overload Continuous Burden/Element	120 V 0–150 V 200 V 0.035 VA (maximum) at 120 V			
External Auxiliary Power	Input Range Frequency Range Burden	85–135 Vac 50–500 Hz 3 VA Nominal	100–130 Vac 50–500 Hz 5 VA Nominal	85–135 Vac 50–500 Hz 3 VA Nominal	100–130 Vac 50–500 Hz 5 VA Nominal
Rated Output (RO) = 500 Watts or Vars/Element		±1 mAdc for Standard Calibration	5 or 20 mAdc for Std. Calibration, depending on selected output range*	±1 mAdc for Standard Calibration	5 or 20 mAdc for Std. Calibration, depending on selected output range*
Accuracy		±(0.2% Reading + 0.01% RO) at 0–200% RO	±(0.2% Reading + 0.05% RO) at 0–120% RO	±(0.2% Reading + 0.02% RO) at 0–200% RO	±(0.3% Reading + 0.05% RO) at 0–120% RO
Temperature Effect on Accuracy		±0.005% / ° C	±0.0075% / ° C	±0.009% / ° C	±0.012% / ° C
Operating Temperature Range		-20° C to +60° C	-20° C to +50° C	-20° C to +60° C	-20° C to +50° C
Compliance Voltage		10 Vdc	20 Vdc	10 Vdc	20 Vdc
Load		0–10,000 Ω	See Table 2 on page 46.	0–10,000 Ω	See Table 2 on page 46.
Output Ripple Peak		< 0.5% RO	< 0.25% RO	< 0.5% RO	< 0.25% RO
Response Time		< 400 ms to 99%	< 1 Second to 99%	< 400 ms to 99%	< 1 Second to 99%
Power Factor		Any			
PF Effect on Accuracy		±0.1% VA (maximum)		±0.15% VA (maximum)	
Standard Calibration Adjustments	Gain Zero	±2% of Reading (minimum) None Required	±20% of Span (minimum) ±5% of Zero Point (minimum)	±2% of Reading (minimum) None Required	±20% of Span (minimum) ±5% of Zero Point (minimum)
Frequency		60 Hz			
Stability (per year)		±0.1% RO, Noncumulative	±0.15% of Span, Noncumulative	±0.2% RO, Noncumulative	±0.25% of Span, Noncumulative
Operating Humidity		0–95% Noncondensing			
Isolation		Complete (Input/Output/Power/Case)			
Dielectric Withstand		2500 VRMS*** at 60 Hz			
Surge Withstand		ANSI/IEEE C37.90.1			
Maximum Net Weight		3 lbs., 10 oz. (1.6 kg)	3 lbs., 14 oz. (1.8 kg)	3 lbs., 10 oz. (1.6 kg)	3 lbs., 14 oz. (1.8 kg)
Approximate Dimensions (excluding mounting plate)		4.4" W x 3.9" D x 6.3" H (112 mm x 99 mm x 160 mm) Style IV Case, see page 123			
Overrange with Linearity		500–1000 Watts/Element	500–600 Watts/Element	500–1000 Vars/Element	500–600 Vars/Element
		No additional error within voltage compliance. Reduce load resistance as required.			

* P-Option includes 1–5/1–3–5 and 4–20/4–12–20 mAdc outputs.

** Total input not to exceed 200% of standard-calibration watts and vars on units with 0 to ±1 mAdc output.
Total input not to exceed 120% of standard-calibration watts and vars on units with P-Option outputs.

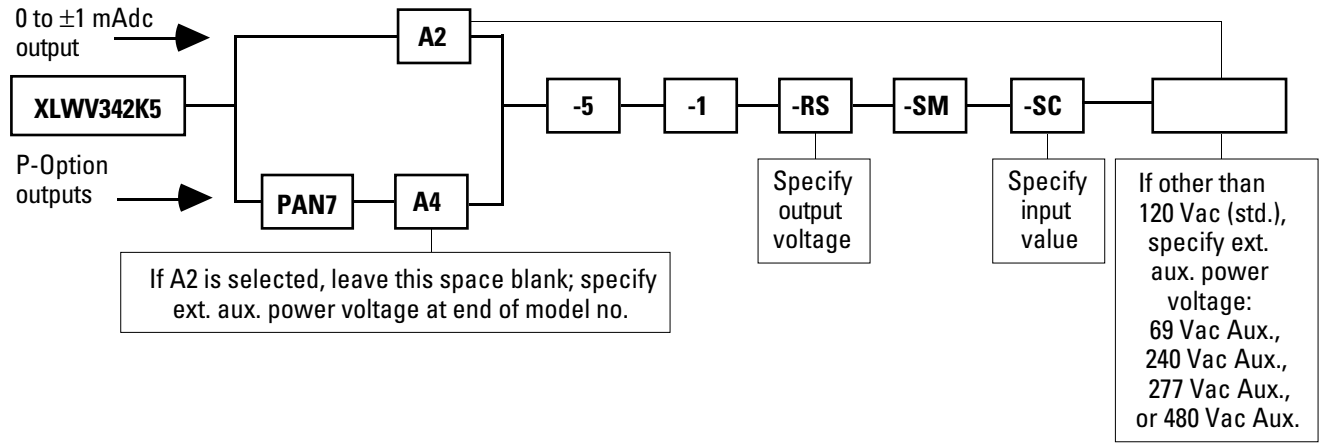
***Dielectric levels as indicated for UL Recognized models; levels may vary on non-UL Recognized models.

Specifications subject to change without notice.

ORDERING PROCEDURE

Specify by base model number and appropriate selection or option suffixes in the order shown in the following example.

Base Model No.	Output	Auxiliary Power	Current Input	Voltage Input	-RS/Freq. Option #1	Option #2	Option #3	Ext. Aux. Power
Table 1	Table 2	Table 3	Table 4	Table 4	Table 5	Table 6	Table 6	Table 3



EXAMPLES: XLWV342K5A2-5-1-RS-SM-SC

3-element, 0 to ±1 mAdc Watt/Var Transducer; 120 Vac external auxiliary power; 10 A input; 240 V input; resistor scaling (converts current output to voltage output); seismic brace; special calibration (example: 7200 W).

XLWV342K5PAN7A4-5-1-RS-SM-SC

3-element, 4-20 mAdc Watt/Var Transducer; internal auxiliary power; 10 A input; 240 V input; resistor scaling (converts current output to voltage output); seismic brace; special calibration (example: 7200 W).

Table 1 Base Model Number Selection

Element	Watt/Var Model No.	Connection	Calibration at Rated Output (5 A, 120 V Nominal Input)
1	XLWV5C5	Single Phase	500 W or Vars
1 1/2*	XLWVW5C51 1/2	3 Phase, 3 Wire	1000 W or Vars
2	XLWV31K5	3 Phase, 3 Wire	1000 W or Vars
2 1/2*	XLWV31K52 1/2	3 Phase, 4 Wire	1500 W or Vars
3	XLWV342K5	3 Phase, 4 Wire	1500 W or Vars

*** 1 1/2- and 2 1/2-element units require a balanced voltage.**

Table 2 Output Selection

0 to ±1 mAdc output is standard, and is specified by the Base Model Numbers. For outputs other than 0 to ±1 mAdc, indicate the appropriate P-Option in the "Output" position of the complete model number.

P-Option	Output Range	Compliance Voltage/ Maximum Load	Maximum Open Circuit Voltage
PAN6	1-5 mAdc	20 Vdc/4000 Ω	30 Vdc
PAN7	**4-20 mAdc**	**20 Vdc/1000 Ω**	**30 Vdc**
PAN6-B	1-3-5 mAdc	20 Vdc/4000 Ω	30 Vdc
PAN7-B	4-12-20 mAdc	20 Vdc/1000 Ω	30 Vdc

Table 3 Auxiliary Power Supply Selection

Option	Description	Input Range	Frequency Range	Burden
(0 to ±1 mAdc Units)				
A2**	**External Auxiliary Power (120 Vac std.)**	**85-135 Vac**	**50-500 Hz**	**3 VA**
A4	Internal Auxiliary Power (self-powered)	70-112% of Nominal Aux. Power Voltage	Equals Input Frequency	3 VA
(P-Option Units)				
A2** (leave blank)	**External Auxiliary Power (120 Vac std.)**	**100-130 Vac**	**50-500 Hz**	**6 VA**
A4	Internal Auxiliary Power (self-powered)	84-108% of Nominal Aux. Power Voltage	Equals Input Frequency	6 VA

** For external auxiliary power voltages other than 120 Vac, specify the voltage in the last position of the complete model number. (Example: 240 Vac Aux.)

DC external auxiliary power available; see Special Options on page 128.

Table 4 Input Selection

Current				Voltage			
Output Option	Nominal	Current Range w/ Accuracy	Calibration at Rated Output (5 A Nominal Input)	Option	Nominal	Voltage Range w/ Accuracy	Calibration at Rated (120 V Nominal Input)
-3	1 A	0-2 A	100 W or Vars/Element	-0	69 V	0-75 V	250 W or Vars/Element
-4	2.5 A	0-5 A	250 W or Vars/Element	**Std.*****	**120 V**	**0-150 V**	**500 W or Vars/Element**
Std.***	**5 A**	**0-10 A**	**500 W or Vars/Element**	-1	240 V	0-300 V	1000 W or Vars/Element
-11	7.5 A	0-15 A	750 W or Vars/Element	-9	277 V	0-340 V	1200 W or Vars/Element
-5	10 A	0-20 A	1000 W or Vars/Element	-2	480 V	0-600 V	2000 W or Vars/Element
-7	15 A	0-20 A	1500 W or Vars/Element				

*** Leave "Input" positions blank in the model number.

Table 5 Scaling Resistor (-RS)/Frequency Options

Option	Description
-RS†	Scaling Resistor
-6	400 Hz
-12	50 Hz (not UL Recognized)
-6-RS†	400 Hz and Scaling Resistor
-12-RS†	50 Hz and Scaling Resistor

† You must specify the desired output voltage:
For 0 to ±1 mAdc units, specify range from 0 to ±10 Vdc. Load impedance is 1 MΩ/Vdc (minimum).
For P-Option units, specify range from 0-15 Vdc. Load impedance is 200, 50, or 20 (kΩ/Vdc) (minimum) for units with outputs of 5, 20, or 50 mAdc, respectively.

This information is not part of the model number, but must be provided to the factory when you place your order.

Table 6 Other Options

Option	Description
-20	50-200% Calibration Adjustment (current outputs)
-C2	Complete Isolation Between Watt & Var Analog Outputs (for units with external auxiliary power—requires a Style I case; see page 122 for case dimensions)
-C4	Complete Isolation Between Watt & Var Analog Outputs (for units with internal auxiliary power—requires a Style I case; see page 122 for case dimensions)
-CE	Analog Output Shorting Relay (available only with 0 to ±1 mAdc units)
-SC††	Special Calibration
-SM	Seismic Brace (available with 0 to ±1 mAdc units) (consult factory if you desire this option with a P-Option unit)
-UB	Combination Unidirectional (watt)/Bidirectional (var) (available only with P-Option units)
-Z	Zero-Based Output Calibration (ex.: PAN7-Z = 0-20 mAdc) (available only with P-Option unidirectional units)

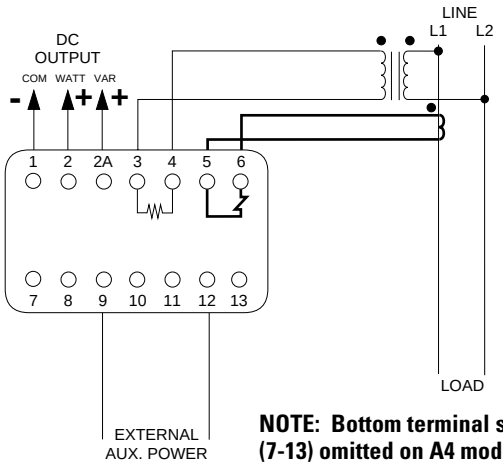
†† You must specify the desired input value:
0 to ±1 mAdc units can be calibrated within 90-180% of their standard-calibration input watts or vars. (Example: A 2-element watt/var transducer is calibrated to 1000 W or vars standard. The -SC option can be added for input levels from 900 W or vars (90%) to 1800 W or vars (180%).) P-Option units can be calibrated within 60-180% of their standard-calibration input watts or vars.

This information is not part of the model number, but must be provided to the factory when you place your order.

If you require additional options not shown here, see Special Options on page 128. When ordering any special options, or more than three options, you must first consult the factory for pricing and delivery estimates.

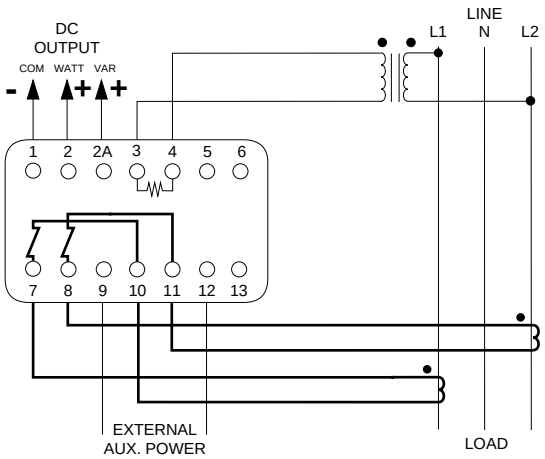
WIRING DIAGRAMS FOR 0 to ±1 mAdc AND P-OPTION UNITS (Style IV Case)

1 Element, Single Phase, 2 Wire

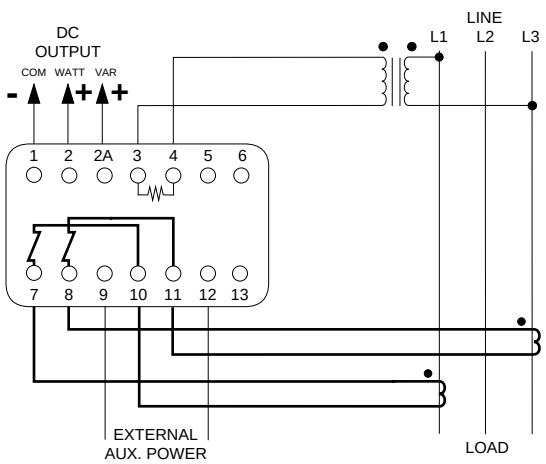


NOTE: Bottom terminal strip (7-13) omitted on A4 models.

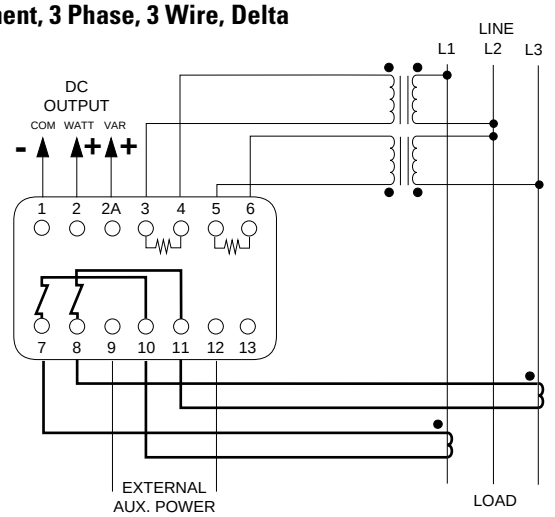
1 1/2 Element, Single Phase, 3 Wire



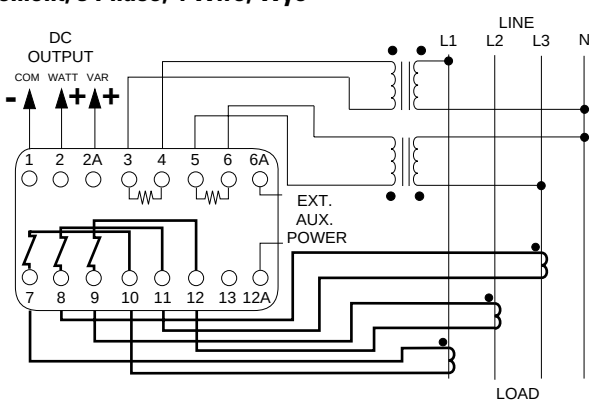
1 1/2 Element, 3 Phase, 3 Wire, Delta



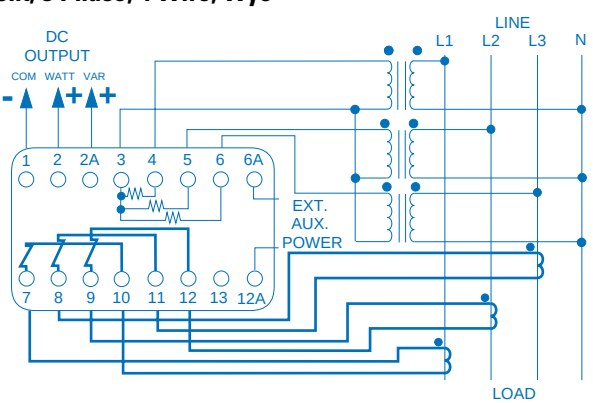
2 Element, 3 Phase, 3 Wire, Delta



2 1/2 Element, 3 Phase, 4 Wire, Wye



3 Element, 3 Phase, 4 Wire, Wye



Adjust

A2 Models: Shown. A4 Models: External aux. power not required.

9100 SERIES ANALOG TOTALIZERS

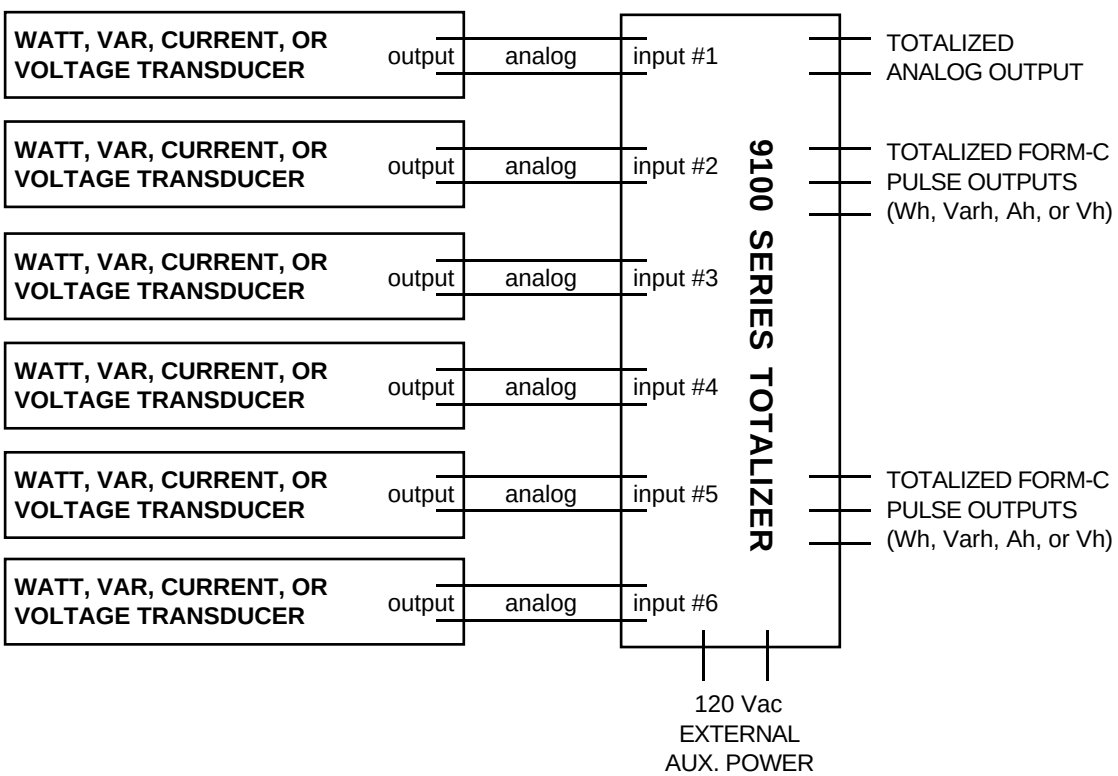
In many applications, the need to sum the output of a series of transducers is necessary to help determine the operation of a total system. Scientific Columbus' 9100 Series Analog Totalizers meet this requirement. For example, the total watts supplied by six separate watt transducers can be summed (or totalized) to give a total watts value for all six devices. Other quantities that can be measured and summed include vars, current, and voltage.

Each totalizer is custom designed to meet customer requirements. Options include:

- Up to six inputs
- Up to three outputs (one analog and two Form-C pulse outputs)
- Analog outputs can be a dc voltage (specify ranges from 0–10 Vdc) or a dc current (0–1, 1–5, 4–20, or 10–50 mAdc)
- Inputs normally are 0–1 mAdc. Consult factory for other inputs.

For more information on Scientific Columbus' 9100 Series Analog Totalizers, please consult the factory at 1-800-274-5368 (U.S. and Canada).

Typical Totalizer Showing All Options



Exceltronic AC Watt/Watthour or Var/Varhour Transducers

Exceltronic combined watt/watthour and var/varhour transducers provide two simultaneous outputs: an analog output directly proportional to instantaneous watts or vars, and a digital (pulse) output (Form-C mercury-wetted relay or solid-state) directly proportional to watthours or varhours. All models are available in either unidirectional or bidirectional configurations.

Features

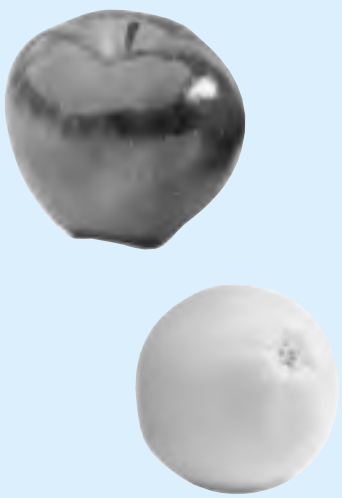
- Accuracy to 0.2% of reading
- Analog & digital outputs
- Excellent long-term stability
- Exceptional reliability
- Wide selection of current & voltage input ranges

Applications

- Energy-management systems
- Distribution monitoring
- Process control

Outputs

- 0 to ±1 mAdc
- 1–5 or 1–3–5 mAdc
- 4–20 or 4–12–20 mAdc
- 10–50 or 10–30–50 mAdc
- Relay and solid-state outputs for watthour and varhour functions



Transducer Accuracy Specsmanship

Metrology is the science of measurement for determination of conformance to technical requirements. Scientific Columbus is dedicated to this science. Scientific Columbus transducers provide precise measurements which are rated as "Percent-of-Reading-plus-Percent-of-RO" devices.

What does this mean? Aren't all accuracy specifications the same?

No.

Like any specification, what is defined may not be as important as how it is defined. When a Percent-of-Reading-plus-Percent-of-RO device is used in a measurement, the maximum measurement tolerance is known. However, many devices are specified as "Percent of Full Scale." Full-scale specifications can result in a measurement tolerance of 3% or greater, when the tolerance is 0.3% from a Scientific Columbus, Percent-of-Reading-plus-Percent-of-RO Transducer.

Specifications

EXCELTRONIC AC WATT/WATTHOUR OR VAR/VARHOUR TRANSDUCERS

Specifications		0 to ±1 mAdc Watts (Watt/Watthour Transducer)	P-Option* Watts (Watt/Watthour Transducer)	0 to ±1 mAdc Vars (Var/Varhour Transducer)	P-Option* Vars (Var/Varhour Transducer)
Current Input	Nominal Range** Overload Continuous Overload 1 Second/Hour Burden/Element	5 A 0–10 A 20 A 250 A 0.2 VA (maximum) at 5 A			
Voltage Input	Nominal Range** Overload Continuous Burden/Element	120 V 0–150 V 200 V 0.03 VA (maximum) at 120 V			
External Auxiliary Power	Input Range Frequency Range Burden	85–135 Vac 50–500 Hz 3 VA Nominal	100–130 Vac 50–500 Hz 6 VA Nominal	85–135 Vac 50–500 Hz 3 VA Nominal	100–130 Vac 50–500 Hz 6 VA Nominal
Rated Output (RO) = 500 Watts or Vars/Element		±1 mAdc for Standard Calibration	5, 20, or 50 mAdc for Std. Calibration, depending on selected output range*	±1 mAdc for Standard Calibration	5, 20, or 50 mAdc for Std. Calibration, depending on selected output range*
Accuracy		±(0.2% Reading + 0.01% RO) at 0–200% RO	±(0.2% Reading + 0.05% RO) at 0–120% RO	±(0.2% Reading + 0.02% RO) at 0–200% RO	±(0.3% Reading + 0.05% RO) at 0–120% RO
Temperature Effect on Accuracy		±0.005% / ° C	±0.0075% / ° C	±0.009% / ° C	±0.012% / ° C
Operating Temperature Range		-20° C to +70° C	-20° C to +50° C	-20° C to +60° C	-20° C to +50° C
Compliance Voltage		10 Vdc	See Table 2 on page 52.	10 Vdc	See Table 2 on page 52.
Load		0–10,000 Ω		0–10,000 Ω	
Output Ripple Peak		< 0.5% RO	< 0.25% RO	< 0.5% RO	< 0.25% RO
Relay Contact Rating (-60XX option)		15 VA at 1 A (maximum) or 150 Vac/15 Vdc (maximum) with resistive load. Contact protection required for inductive loads.			
Relay Contact Life (-60XX option)		One billion operations when operated within specifications.			
Solid-State Output Contact Rating (-62XX option)		28 Vdc (maximum) V_{CESAT}: 1 Vdc (maximum) at 7 mAdc			
Response Time		< 400 ms to 99%	< 1 Second to 99%	< 400 ms to 99%	< 1 Second to 99%
Power Factor		Any			
PF Effect on Accuracy		±0.1% VA (maximum)		±0.15% VA (maximum)	
Standard Calibration Adjustments	Gain Zero	±1% of Reading (minimum) None Required	±20% of Span (minimum) ±5% of Zero Point (minimum)	±1% of Reading (minimum) None Required	±20% of Span (minimum) ±5% of Zero Point (minimum)
Frequency Range		58–62 Hz		60 Hz	
Stability (per year)		±0.1% RO, Noncumulative	±0.15% of Span, Noncumulative	±0.2% RO, Noncumulative	±0.25% of Span, Noncumulative
Operating Humidity		0–95% Noncondensing			
Isolation		Complete (Input/Output/Power/Case) All KYZ outputs are isolated.			
Dielectric Withstand		1500 VRMS at 60 Hz			
Surge Withstand		ANSI/IEEE C37.90.1			
Maximum Net Weight		4 lbs., 12 oz. (2.2 kg)	5 lbs., 2 oz. (2.3 kg)	4 lbs., 14 oz. (2.2 kg)	5 lbs., 4 oz. (2.4 kg)
Approximate Dimensions (excluding mounting plate)		7.0" W x 3.7" D x 5.6" H (178 mm x 94 mm x 142 mm) Style I Case, see page 122	7.2" W x 5.3" D x 5.8" H (183 mm x 135 mm x 147 mm) Style V Case, see page 123	7.0" W x 3.7" D x 5.6" H (178 mm x 94 mm x 142 mm) Style I Case, see page 122	7.2" W x 5.3" D x 5.8" H (183 mm x 135 mm x 147 mm) Style V Case, see page 123
Overrange with Linearity		500–1000 Watts/Element	500–600 Watts/Element	500–1000 Vars/Element	500–600 Vars/Element
		No additional error within voltage compliance. Reduce load resistance as required.			

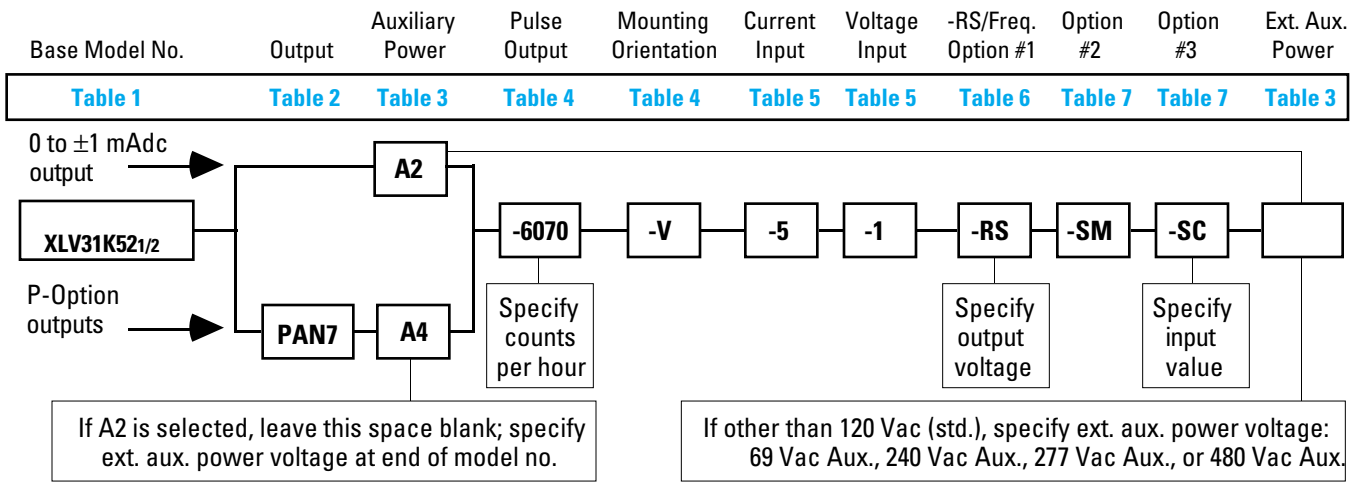
* P-Option includes 1–5/1–3–5, 4–20/4–12–20, and 10–50/10–30–50 mAdc outputs.

**Total input not to exceed 200% of standard-calibration watts or vars on units with 0 to ±1 mAdc output.
Total input not to exceed 120% of standard-calibration watts or vars on units with P-Option outputs.

Specifications subject to change without notice.

ORDERING PROCEDURE

Specify by base model number and appropriate selection or option suffixes in the order shown in the following example.



EXAMPLES: XLV31K52 1/2A2-6070-V-5-1-RS-SM-SC

2 1/2-element, 0 to ±1 mAdc Var/Varhour Transducer; 120 Vac external auxiliary power; mercury-wetted relay (unidirectional); vertical mounting; 10 A input; 240 V input; resistor scaling (converts current output to voltage output); seismic brace; special calibration (example: 7200 W).

XLV31K52 1/2PAN7A4-6070-V-5-1-RS-SM-SC

2 1/2-element, 4-20 mAdc Var/Varhour Transducer; internal auxiliary power; mercury-wetted relay (unidirectional); vertical mounting; 10 A input; 240 V input; resistor scaling (converts current output to voltage output); seismic brace; special calibration (example: 7200 W).

Table 1 Base Model Number Selection

Element	Watt Model No.	Var Model No.	Connection	Calibration at Rated Output (5 A, 120 V Nominal Input)
1	XL5C5	XLV5C5	Single Phase	500 W or Vars
2	XL31K5	XLV31K5	3 Phase, 3 Wire	1000 W or Vars
2 1/2*	XL31K52 1/2	XLV31K52 1/2	3 Phase, 4 Wire	1500 W or Vars
3	XL342K5	XLV342K5	3 Phase, 4 Wire	1500 W or Vars

*** 2 1/2-element units require a balanced voltage.**

Table 2 Output Selection

0 to ±1 mAdc output is standard, and is specified by the Base Model Numbers. For outputs other than 0 to ±1 mAdc, indicate the appropriate P-Option in the "Output" position of the complete model number.

**** PAN and PA models take -6070 or -6270 unidirectional pulse outputs; PAN-B and PA-B models take -6096 or -6296 bidirectional pulse outputs.**

P-Option**	Output Range	Compliance Voltage/ Maximum Load	Maximum Open Circuit Voltage
PAN6	1-5 mAdc	15 Vdc/3000 Ω	30 Vdc
PAN7	**4-20 mAdc**	**15 Vdc/750 Ω**	**30 Vdc**
PAN8	10-50 mAdc	15 Vdc/300 Ω	30 Vdc
PAN6-B	1-3-5 mAdc	15 Vdc/3000 Ω	30 Vdc
PAN7-B	4-12-20 mAdc	15 Vdc/750 Ω	30 Vdc
PAN8-B	10-30-50 mAdc	15 Vdc/300 Ω	30 Vdc
PA6	1-5 mAdc	40 Vdc/8000 Ω	70 Vdc
PA7	4-20 mAdc	40 Vdc/2000 Ω	70 Vdc
PA8	10-50 mAdc	30 Vdc/600 Ω	70 Vdc
PA6-B	1-3-5 mAdc	40 Vdc/8000 Ω	70 Vdc
PA7-B	4-12-20 mAdc	40 Vdc/2000 Ω	70 Vdc
PA8-B	10-30-50 mAdc	30 Vdc/600 Ω	70 Vdc

Table 3 Auxiliary Power Supply Selection

Option	Description	Input Range	Frequency Range	Burden
(0 to ±1 mAdc Units)				
A2* **	**External Auxiliary Power (120 Vac std.)**	**85-135 Vac**	**50-500 Hz**	**3 VA**
A4	Internal Auxiliary Power (self-powered)	70-112% of Nominal Aux. Power Voltage	Equals Input Frequency	3 VA
(P-Option Units)				
A2* (leave blank)**	**External Auxiliary Power (120 Vac std.)**	**100-130 Vac**	**50-500 Hz**	**6 VA**
A4	Internal Auxiliary Power (self-powered)	84-108% of Nominal Aux. Power Voltage	Equals Input Frequency	6 VA

*** For external auxiliary power voltages other than 120 Vac, specify the voltage in the last position of the complete model number. (Example: 240 Vac Aux.)

DC external auxiliary power available; see Special Options on page 128.

Table 4 Pulse Output Selection

Option	Description	CPH Range****	Mounting Orientation*****
-6070	Form-C Mercury-Wetted Relay, Unidirectional	2-14,000	-V (Vertical) or -H (Horizontal)
-6270	Form-C Solid-State, Unidirectional	2-900,000	Not Applicable
-6096	Form-C Mercury-Wetted Relay, Bidirectional	2-14,000	-V (Vertical) or -H (Horizontal)
-6296	Form-C Solid-State, Bidirectional	2-900,000	Not Applicable

*** Standard cph is one count/watthour or varhour unless otherwise specified.

***** You must specify the desired mounting orientation for units with mercury-wetted relays.

Table 5 Input Selection

Current

Option	Nominal	Current Range w/ Accuracy	Calibration at Rated Output (5 A Nominal Input)
-3	1 A	0-2 A	100 W or Vars/Element
-4	2.5 A	0-5 A	250 W or Vars/Element
Std.†	**5 A**	**0-10 A**	**500 W or Vars/Element**
-11	7.5 A	0-15 A	750 W or Vars/Element
-5	10 A	0-20 A	1000 W or Vars/Element
-7	15 A	0-20 A	1500 W or Vars/Element
-8††	25 A	0-30 A	2500 W or Vars/Element

Voltage

Option	Nominal	Voltage Range w/ Accuracy	Calibration at Rated Output (120 V Nominal Input)
-0	69 V	0-75 V	250 W or Vars/Element
Std.†	**120 V**	**0-150 V**	**500 W or Vars/Element**
-1	240 V	0-300 V	1000 W or Vars/Element
-9	277 V	0-340 V	1200 W or Vars/Element
-2	480 V	0-600 V	2000 W or Vars/Element

† Leave "Input" positions blank in the model number.

†† Option -8 requires a Style V case. (See page 123 for case dimensions. Maximum height of terminal strip(s) is 1.07" for units with -8 option.)

Table 6 Scaling Resistor (-RS)/Frequency Options

Option	Description
-RS†††	Scaling Resistor
-6	400 Hz
-12	50 Hz
-6-RS†††	400 Hz and Scaling Resistor
-12-RS†††	50 Hz and Scaling Resistor

††† You must specify the desired output voltage:
For 0 to ±1 mAdc units, specify range from 0 to ±10 Vdc. Load impedance is 1 MΩ/Vdc (minimum).
For P-Option units, specify range from 0-15 Vdc (PAN models) or 0-40 Vdc (PA models). Load impedance is 200, 50, or 20 (kΩ/Vdc) (minimum) for units with outputs of 5, 20, or 50 mAdc, respectively.

This information is not part of the model number, but must be provided to the factory when you place your order.

Table 7 Other Options

Option	Description
-20	50-200% Calibration Adjustment (current outputs)
-21	50-200% Calibration Adjustment (voltage outputs) (available only with 0 to ±1 mAdc units)
-24	24 Vdc Loop-Powered (PA7 and PA7-B models only) (consult factory for specifications)
-CE	Analog Output Shorting Relay (available only with 0 to ±1 mAdc units)
-SC††††	Special Calibration
-SM	Seismic Brace (available with 0 to ±1 mAdc units) (consult factory if you desire this option with a P-Option unit)
-Z	Zero-Based Output Calibration (ex.: PA7-Z = 0-20 mAdc) (available only with P-Option units, except PAN-B models)

†††† You must specify the desired input value:
0 to ±1 mAdc units can be calibrated within 90-180% of their standard-calibration input watts or vars. (Example: A 2-element watt/watthour transducer is calibrated to 1000 W standard. The -SC option can be added for input levels from 900 W (90%) to 1800 W (180%).) P-Option units can be calibrated within 60-180% of their standard-calibration input watts or vars.

This information is not part of the model number, but must be provided to the factory when you place your order.

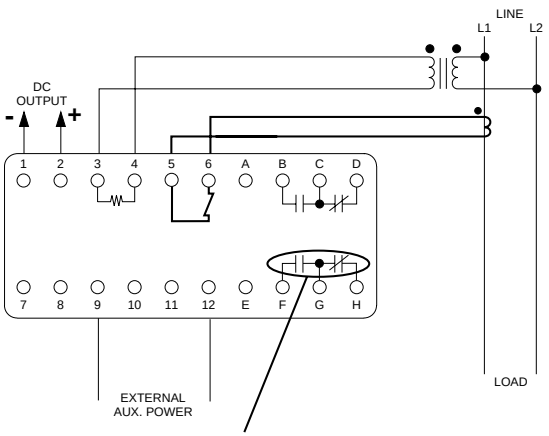
If you require additional options not shown here, see Special Options on page 128. When ordering any special options, or more than three options, you must first consult the factory for pricing and delivery estimates.

Exceltronic

WIRING DIAGRAMS FOR 0 to ±1 mAdc UNITS (Style I Case)

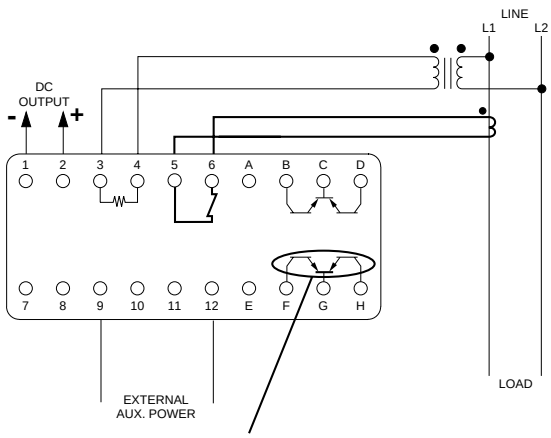
1 Element, Single Phase, 2 Wire

-6070/-6096 Models



Omitted on -6070 Models

-6270/-6296 Models

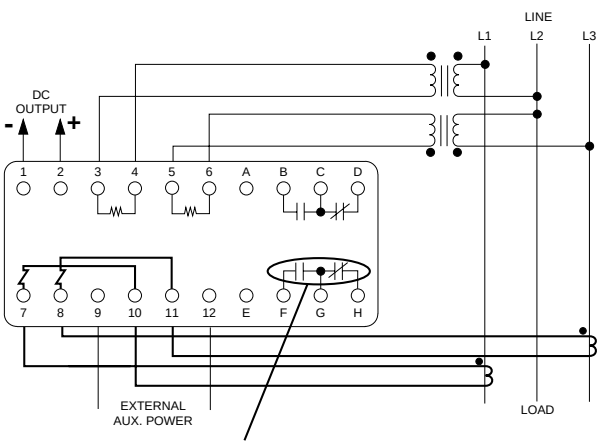


Omitted on -6270 Models

NOTE: For 1-element units with -8 option, connect current input to terminals 7 (•) & 10.

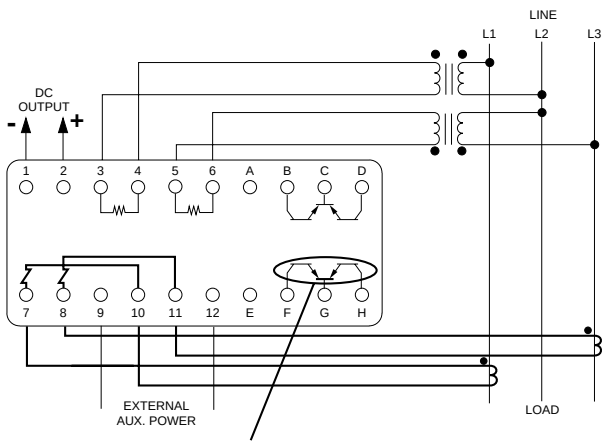
2 Element, 3 Phase, 3 Wire, Delta

-6070/-6096 Models



Omitted on -6070 Models

-6270/-6296 Models



Omitted on -6270 Models

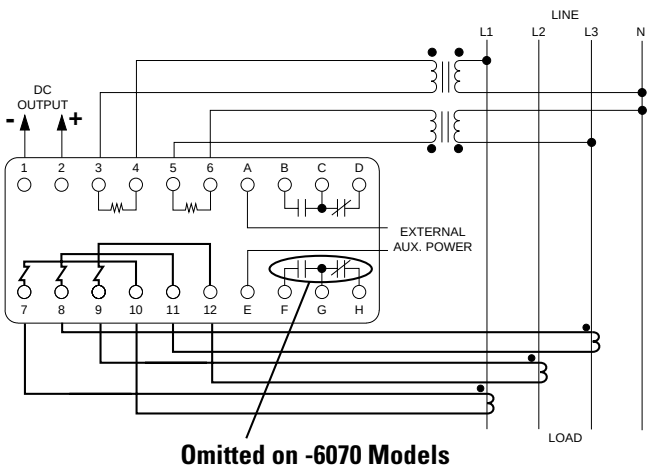
Adjust

A2 Models: Shown. A4 Models: External aux. power not required.

WIRING DIAGRAMS FOR 0 to ±1 mAdc UNITS (Style I Case)

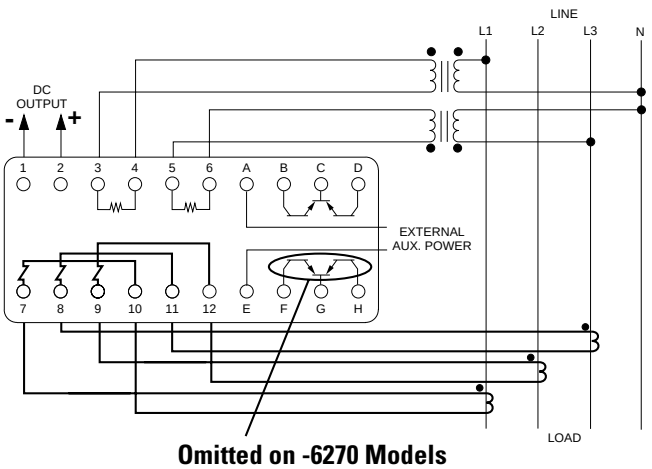
2½ Element, 3 Phase, 4 Wire, Wye

-6070/-6096 Models



Omitted on -6070 Models

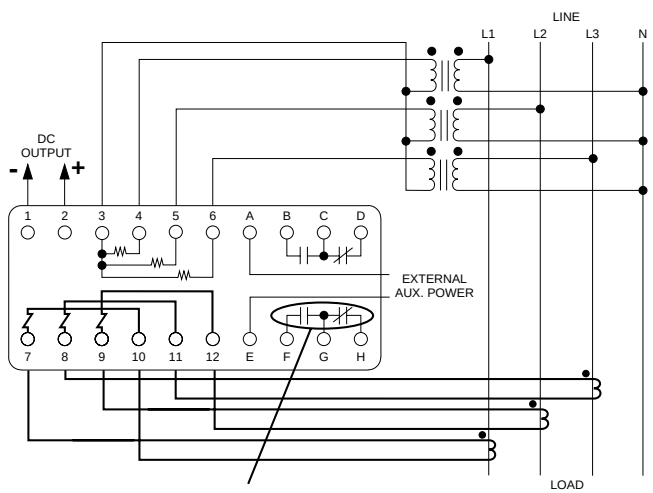
-6270/-6296 Models



Omitted on -6270 Models

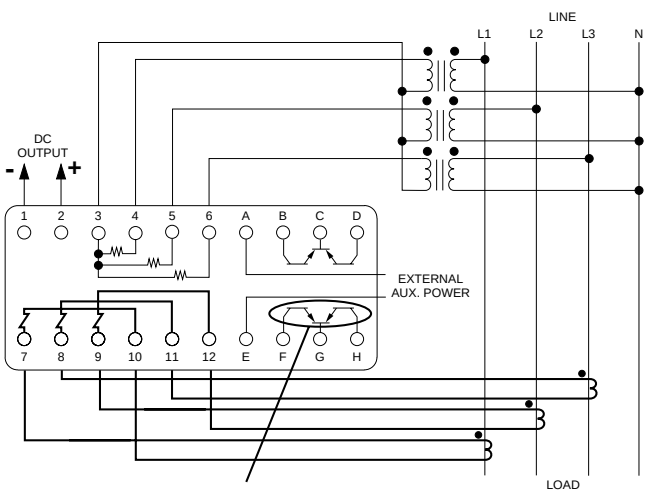
3 Element, 3 Phase, 4 Wire, Wye

-6070/-6096 Models



Omitted on -6070 Models

-6270/-6296 Models



Omitted on -6270 Models

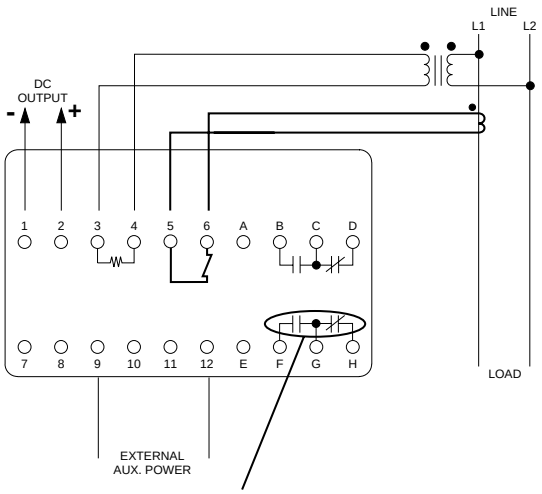
Adjust

A2 Models: Shown. A4 Models: External aux. power not required.

WIRING DIAGRAMS FOR P-OPTION UNITS (Style V Case)

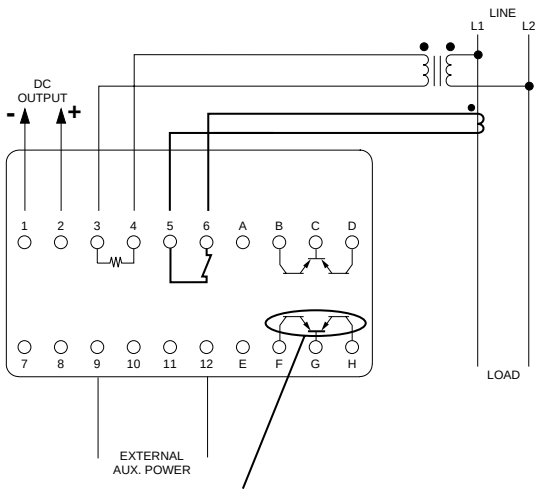
1 Element, Single Phase, 2 Wire

-6070/-6096 Models



Omitted on -6070 Models

-6270/-6296 Models

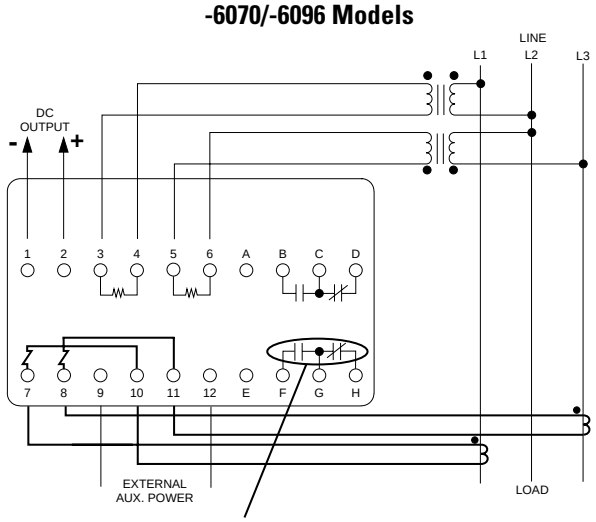


Omitted on -6270 Models

NOTE: For 1-element units with -8 option, connect current input to terminals 7 (•) & 10.

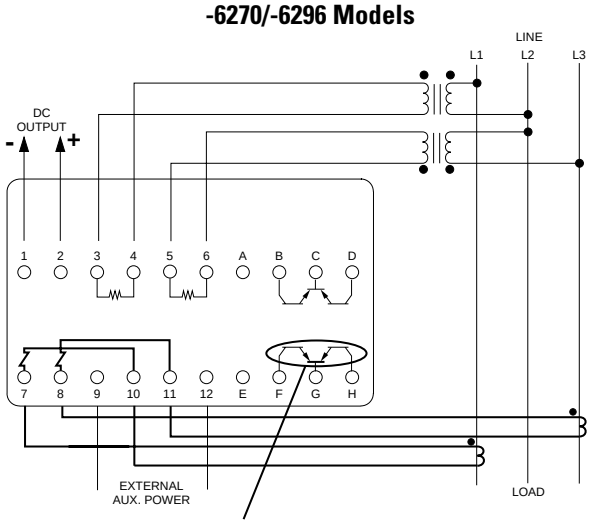
2 Element, 3 Phase, 3 Wire, Delta

-6070/-6096 Models



Omitted on -6070 Models

-6270/-6296 Models



Omitted on -6270 Models

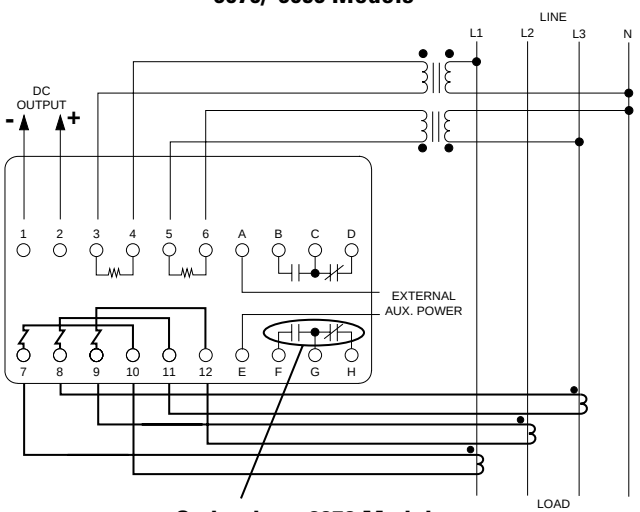
Adjust

A2 Models: Shown. A4 Models: External aux. power not required.

WIRING DIAGRAMS FOR P-OPTION UNITS (Style V Case)

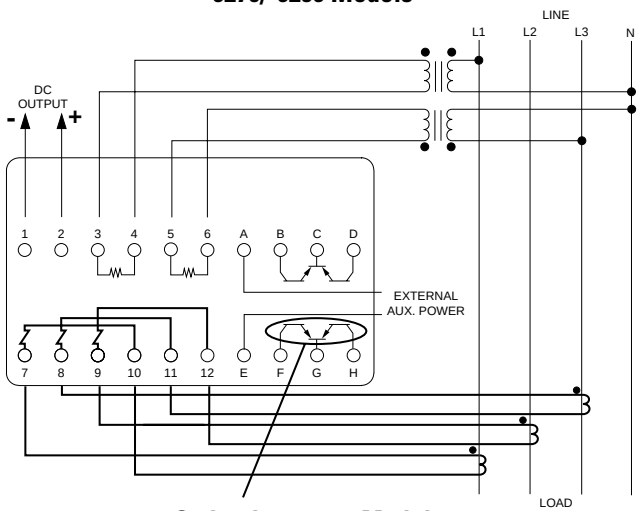
2 1/2 Element, 3 Phase, 4 Wire, Wye

-6070/-6096 Models



Omitted on -6070 Models

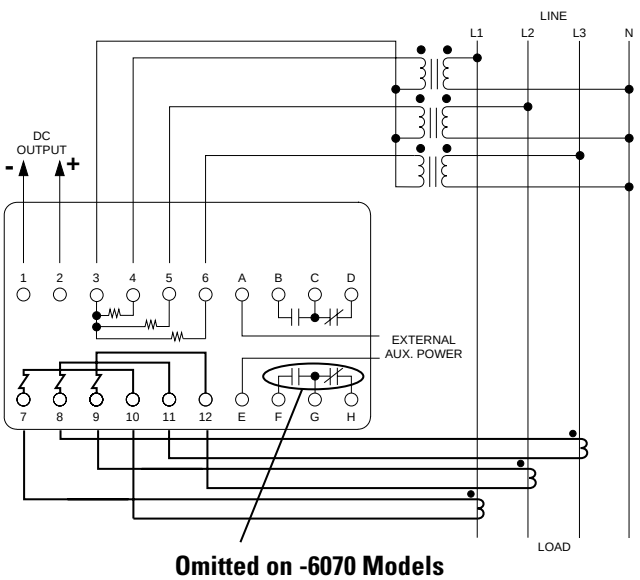
-6270/-6296 Models



Omitted on -6270 Models

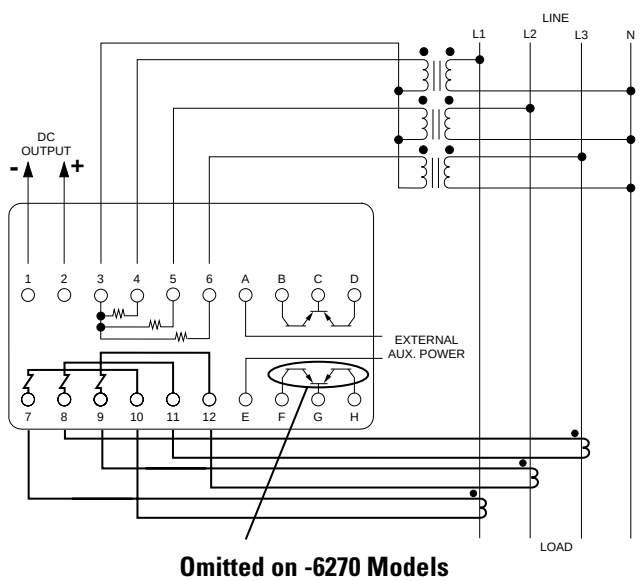
3 Element, 3 Phase, 4 Wire, Wye

-6070/-6096 Models



Omitted on -6070 Models

-6270/-6296 Models



Omitted on -6270 Models

Adjust

A2 Models: Shown. A4 Models: External aux. power not required.

Exceltronic AC Phase Angle (Power Factor) Transducers

Scientific Columbus offers a wide selection of phase angle trans-ducers that can be used to determine power factor. The transducers produce a dc output which is linearly proportional to the phase angle difference between the voltage and current in an ac power system. The power factor is equal to the cosine of the phase angle. Therefore, a conversion is required if the linear phase angle output is to be converted to power factor. (See Conversion Table on page 62.)

All models have bipolar output; therefore indicating not only the phase angle but also whether it is lead or lag. The transducers provide a meaningful indication of phase angle on a three-phase system, only when balanced load conditions prevail. While all models may be used on three-phase, four-wire systems, only the PF-34 models can be used on three-phase, three-wire systems. The PF-34 models are recommended if varying line frequency is present.

Features

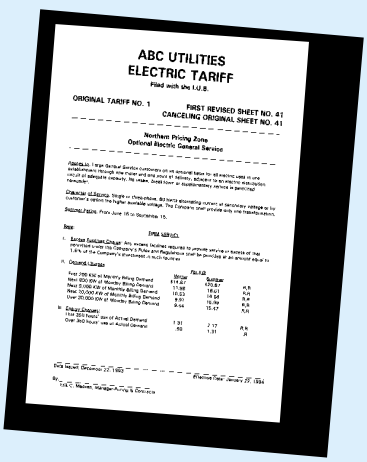
- Bipolar output
- Exceptional reliability
- High accuracy

Applications

- Generating stations
- Process control
- Energy-management systems

Outputs

- 0 to ±50 mVdc
- 0 to ±0.5 mAdc
- 1–3–5 mAdc
- 4–12–20 mAdc
- 10–30–50 mAdc



Utility Rate Tariffs and Power Factor

When utility rate tariffs are predicated on power factor, a Scientific Columbus Exceltronic Phase Angle (Power Factor) Transducer can be employed to help establish set points or targets. By installing a Scientific Columbus Exceltronic Phase Angle (Power Factor) Trans-ducer and a Scientific Columbus Signal Conditioner together, a target can be set to give indication or alarm when a specific value is achieved.

Specifications

EXCELTRONIC PHASE ANGLE (POWER FACTOR) TRANSDUCERS

Specifications		0 to ±50 mVdc or 0 to ±0.5 mAdc (Phase Angle (Power Factor) Transducer)	P-Option* (Phase Angle (Power Factor) Transducer)
Current Input	Nominal Range Overload Continuous Overload 1 Second/Hour Burden/Element	5 A 0.25–5 A 10 A 250 A 1 VA (maximum) at 5 A	
Voltage Input	Nominal Range Overload Continuous Burden/Element	**PF-1, -2, -3 Models** 120 V 95–135 V 150 V 5.5 VA (maximum) at 120 V	**PF-34 Models** 120 V/220 V 95–135 V/190–250 V 150 V/275 V 5.5 VA (maximum) at 120 V
External Auxiliary Power	Input Range Frequency Range Burden	None Required	100–130 Vac 50–500 Hz 3 VA Nominal
Rated Output (RO)	Type A & A1 Units Type A4 Units	±50 mVdc for Standard Calibration ±0.5 mAdc for Standard Calibration	5, 20, or 50 mAdc for Standard Calibration, depending on selected output range*
Accuracy		See table below.	
Temperature Effect on Accuracy		See table below.	
Operating Temperature Range		-20° C to +60° C	-20° C to +50° C
Compliance Voltage		5 Vdc for Type A4 Units	See Table 2 on page 61.
Load		See Table 1 on page 60.	
Output Ripple Peak	Type A Units Type A1 & A4 Units	200 mV Peak to Peak < 1% RMS	< 0.25% of Span
Response Time	Type A Units Type A1 & A4 Units	< 10 ms to 99% < 400 ms to 99%	< 1 Second to 99%
Power Factor		See Table 1 on page 60.	
Standard Calibration Adjustments	Gain Zero	±10% of Reading (minimum) ±2% of RO (minimum)	±20% of Span (minimum) ±5% of Zero Point (minimum)
Frequency Range	PF-1, -2, -3 Models PF-34 Models	Nominal ±0.25% Nominal ±5%	
Stability (per year)		±1% of Span, Noncumulative	
Operating Humidity		0–95% Noncondensing	
Isolation		Complete (Input/Output/Case)	Complete (Input/Output/Power/Case)
Dielectric Withstand		1500 VRMS at 60 Hz	
Surge Withstand		ANSI/IEEE C37.90.1	
Maximum Net Weight		2 lbs., 12 oz. (1.2 kg)	4 lbs., 2 oz. (1.9 kg)
Approximate Dimensions (excluding mounting plate)		4.4" W x 3.9" D x 4.7" H (112 mm x 99 mm x 119 mm) Style II Case, see page 122	7.0" W x 3.7" D x 5.6" H (178 mm x 94 mm x 142 mm) Style I Case, see page 122

*P-Option includes 1–3–5, 4–12–20, and 10–30–50 mAdc outputs.

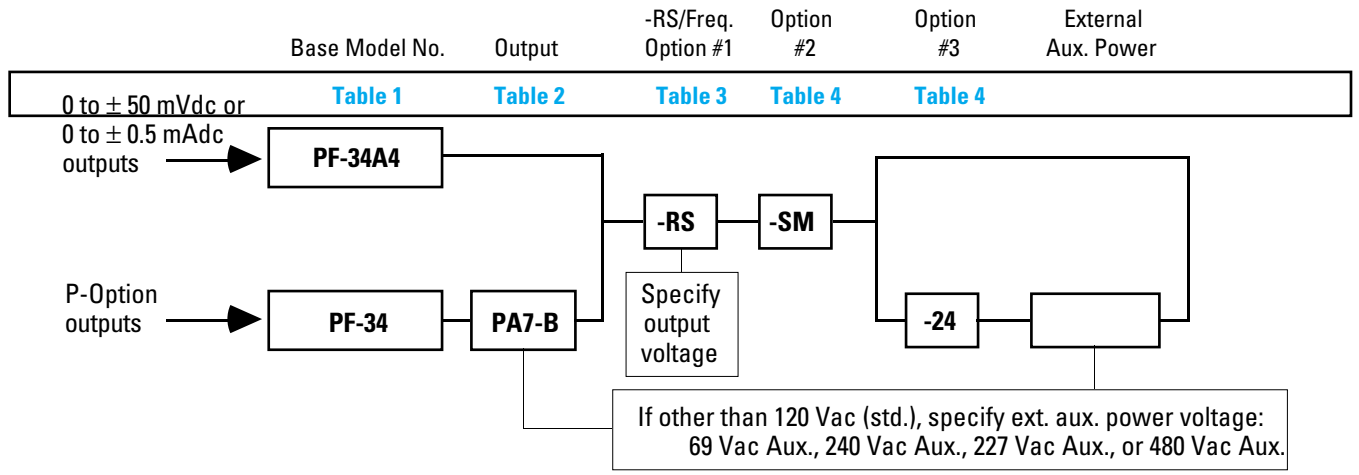
Specifications subject to change without notice.

Model No./Accuracy

25° C		-20° C to +60° C (-25° C to +50° C for P-Option Units)	
PF-1A, PF-1A1, PF-1A4		**PF-1**	
±0.01 PF from 0.8 Lead to 0.8 Lag	±0.03 PF from 0.3 Lead to 0.3 Lag	±0.02 PF from 0.8 Lead to 0.8 Lag	±0.05 PF from 0.3 Lead to 0.3 Lag
PF-2A, PF-2A1, PF-2A4		**PF-2**	
±0.01 PF from 0.8 Lead to 0.8 Lag	±0.025 PF from 0.5 Lead to 0.5 Lag	±0.02 PF from 0.8 Lead to 0.8 Lag	±0.04 PF from 0.5 Lead to 0.5 Lag
PF-3A, PF-3A1, PF-3A4		**PF-3**	
±0.01 PF from 0.9 Lead to 0.9 Lag	±0.02 PF from 0.7 Lead to 0.7 Lag	±0.015 PF from 0.9 Lead to 0.9 Lag	±0.03 PF from 0.7 Lead to 0.7 Lag
PF-34A, PF-34A1, PF-34A4		**PF-34**	
±0.01 PF from 0.8 Lead to 0.8 Lag	±0.025 PF from 0.5 Lead to 0.5 Lag	±0.02 PF from 0.8 Lead to 0.8 Lag	±0.04 PF from 0.5 Lead to 0.5 Lag

ORDERING PROCEDURE

Specify by base model number and appropriate selection or option suffixes in the order shown in the following example.



EXAMPLES: PF-34A4-RS-SM

3-phase, 0 to ±0.5 mAdc Phase Angle (PF) Transducer; resistor scaling (converts current output to voltage output); seismic brace.

PF-34PA7-B-RS-SM-24

3-phase, 4-12-20 mAdc Phase Angle (PF) Transducer; resistor scaling (converts current output to voltage output); seismic brace; 24 Vdc loop-powered.

Table 1 Base Model Number Selection

Model No.	Output (Linear to Phase Angle)	Output Load Required	Phase Angle Range	Power Factor Range
(0 to ±50 mVdc or 0 to ±0.5 mAdc Units)				
Single Phase or 3 Phase, 4 Wire				
PF-1A	0 to ±50 mVdc	100 Ω	0 to ±72.5°	Lead 0.3 to Unity to Lag 0.3
PF-1A1	0 to ±50 mVdc	≥50,000 Ω	0 to ±72.5°	Lead 0.3 to Unity to Lag 0.3
PF-1A4	0 to ±0.5 mAdc	0-10,000 Ω	0 to ±72.5°	Lead 0.3 to Unity to Lag 0.3
PF-2A	0 to ±50 mVdc	100 Ω	0 to ±60°	Lead 0.5 to Unity to Lag 0.5
PF-2A1	0 to ±50 mVdc	≥50,000 Ω	0 to ±60°	Lead 0.5 to Unity to Lag 0.5
PF-2A4	0 to ±0.5 mAdc	0-10,000 Ω	0 to ±60°	Lead 0.5 to Unity to Lag 0.5
PF-3A	0 to ±50 mVdc	100 Ω	0 to ±45.5°	Lead 0.7 to Unity to Lag 0.7
PF-3A1	0 to ±50 mVdc	≥50,000 Ω	0 to ±45.5°	Lead 0.7 to Unity to Lag 0.7
PF-3A4	0 to ±0.5 mAdc	0-10,000 Ω	0 to ±45.5°	Lead 0.7 to Unity to Lag 0.7
3 Phase, 3 Wire or 4 Wire				
PF-34A	0 to ±50 mVdc	100 Ω	0 to ±60°	Lead 0.5 to Unity to Lag 0.5
PF-34A1	0 to ±50 mVdc	≥50,000 Ω	0 to ±60°	Lead 0.5 to Unity to Lag 0.5
PF-34A4	0 to ±0.5 mAdc	0-10,000 Ω	0 to ±60°	Lead 0.5 to Unity to Lag 0.5
(P-Option Units)				
Single Phase or 3 Phase, 4 Wire				
PF-1	See Table 2	See Table 2	0 to ±72.5°	Lead 0.3 to Unity to Lag 0.3
PF-2	See Table 2	See Table 2	0 to ±60°	Lead 0.5 to Unity to Lag 0.5
PF-3	See Table 2	See Table 2	0 to ±45.5°	Lead 0.7 to Unity to Lag 0.7
3 Phase, 3 Wire or 4 Wire				
PF-34	See Table 2	See Table 2	0 to ±60°	Lead 0.5 to Unity to Lag 0.5

Table 2 Output Selection

If one of the bidirectional outputs at right is required, indicate the appropriate P-Option in the "Output" position of the complete model number.

P-Option	Output Range	Compliance Voltage/ Maximum Load	Maximum Open Circuit Voltage
PAN6-B	1-3-5 mAdc	15 Vdc/3000 Ω	30 Vdc
PAN7-B	**4-12-20 mAdc**	**15 Vdc/750 Ω**	**30 Vdc**
PAN8-B	10-30-50 mAdc	15 Vdc/300 Ω	30 Vdc
PA6-B	1-3-5 mAdc	40 Vdc/8000 Ω	70 Vdc
PA7-B	4-12-20 mAdc	40 Vdc/2000 Ω	70 Vdc
PA8-B	10-30-50 mAdc	30 Vdc/600 Ω	70 Vdc

Table 3 Scaling Resistor (-RS)/Frequency Options

Option	Description
-RS*	Scaling Resistor
-6	400 Hz
-12	50 Hz
-6-RS*	400 Hz and Scaling Resistor
-12-RS*	50 Hz and Scaling Resistor

*** You must specify the desired output voltage:**
For 0 to ±50 mVdc or 0 to ±0.5 mAdc units, specify range from 0 to ±5 Vdc. Load impedance is 2 MΩ/Vdc (minimum).
For P-Option units, specify range from 0-15 Vdc (PAN models) or 0-40 Vdc (PA models). Load impedance is 200, 50, or 20 (kΩ/Vdc) (minimum) for units with outputs of 5, 20, or 50 mAdc, respectively.

This information is not part of the model number, but must be provided to the factory when you place your order.

Table 4 Other Options

Option	Description
-24	24 Vdc Loop-Powered (PA7-B models only) (consult factory for specifications)
-SM	Seismic Brace (available with 0-1 mAdc units) (consult factory if you desire this option with a P-Option unit)

If you require additional options not shown here, see Special Options on page 128. When ordering any special options, or more than three options, you must first consult the factory for pricing and delivery estimates.

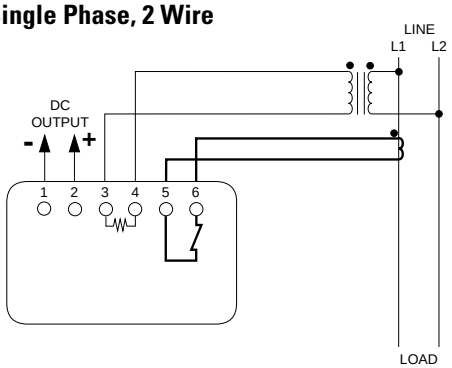
CONVERSION TABLE (% Full Scale to Power Factor)

Power Factor	Angle	Angle in Decimals	Percent Full Scale (45.57°) FS = 0.7 PF	(60°) FS = 0.5 PF	(72.54°) FS = 0.3 PF
1.000	0°0'	0.00°	0.00	0.00	0.00
.995	5°44'	5.73°	12.58	9.56	7.90
.990	8°6.6'	8.11°	17.80	13.52	11.18
.985	9°56'	9.94°	21.80	16.56	13.70
.980	11°29'	11.48°	25.19	19.13	15.82
.975	12°50'	12.84°	28.17	21.40	17.70
.970	14°4.2'	14.07°	30.87	23.45	19.40
.965	15°12'	15.20°	33.36	25.34	20.96
.960	16°16'	16.26°	35.70	27.10	22.41
.955	17°15'	17.25°	37.86	28.76	23.78
.950	18°12'	18.19°	39.92	30.32	25.08
.940	19°57'	19.95°	43.77	33.25	27.50
.930	21°34'	21.57°	47.32	35.94	29.73
.920	23°4.4'	23.07°	50.63	38.46	31.81
.910	24°30'	24.49°	53.75	40.82	33.77
.900	25°50.5'	25.84°	56.70	43.07	35.62
.890	27°8'	27.13°	59.52	45.21	37.39
.880	28°21.5'	28.36°	62.22	47.26	39.09
.870	29°32.5'	29.54°	64.82	49.24	40.72
.860	30°41'	30.68°	67.32	51.14	42.30
.850	31°47'	31.79°	69.75	52.98	43.82
.840	32°52'	32.86°	72.10	54.77	45.30
.830	33°54'	33.90°	74.39	56.50	46.73
.820	34°55'	34.92°	76.61	58.19	48.13
.810	35°54'	35.90°	78.78	59.84	49.49
.800	36°52'	36.87°	80.90	61.45	50.83
.790	37°49'	37.81°	82.98	63.02	52.13
.780	38°44'	38.74°	85.01	64.57	53.40
.770	39°39'	39.65°	86.99	66.08	54.05
.760	40°32'	40.54°	88.95	67.56	55.88
.750	41°25'	41.41°	90.86	69.02	57.08
.740	42°16'	42.27°	92.75	70.45	58.27
.730	43°7'	43.11°	94.60	71.86	59.43
.720	43°57'	43.95°	96.43	73.24	60.58
.710	44°46'	44.77°	98.23	74.61	61.71
.700	45°34'	45.57°	100.00	75.95	62.82
.680	47°9'	47.16°		78.59	65.01
.660	48°42'	48.70°		81.17	67.13
.640	50°12.5'	50.21°		83.68	69.21
.620	51°41'	51.68°		86.14	71.25
.600	53°8'	53.13°		88.55	73.24
.580	54°33'	54.55°		90.92	75.20
.560	55°57'	55.94°		93.24	77.12
.540	57°19'	57.32°		95.53	79.01
.520	58°40'	58.67°		97.78	80.87
.500	60°0'	60.00°		100.00	82.71
.480	61°19'	61.31°			84.52
.460	62°37'	62.61°			86.31
.440	63°54'	63.90°			88.08
.420	65°10'	65.17°			89.83
.400	66°25'	66.42°			91.56
.380	67°40'	67.67°			93.28
.360	68°54'	68.90°			94.98
.340	70°7.4'	70.12°			96.67
.320	71°20.2'	71.34°			98.34
.300	72°32.5'	72.54°			100.00

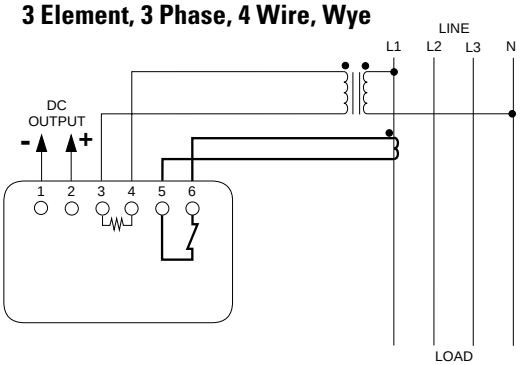
WIRING DIAGRAMS FOR 0 to ±50 mVdc AND 0 to ±0.5 mAdc UNITS (Style II Case) AND P-OPTION UNITS (Style I Case)

0 to ±50 mVdc and 0 to ±0.5 mAdc Units—PF-1, PF-2, PF-3 Models

1 Element, Single Phase, 2 Wire

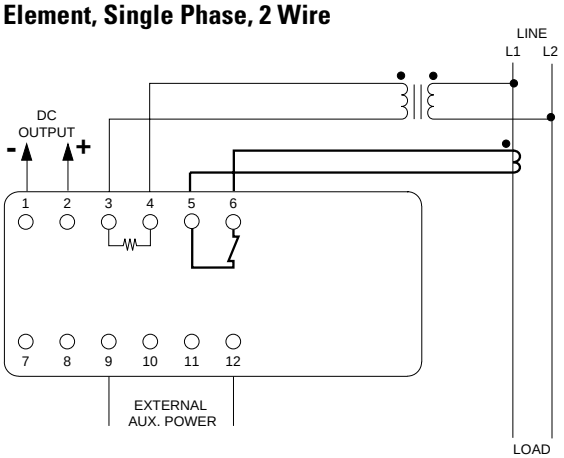


3 Element, 3 Phase, 4 Wire, Wye

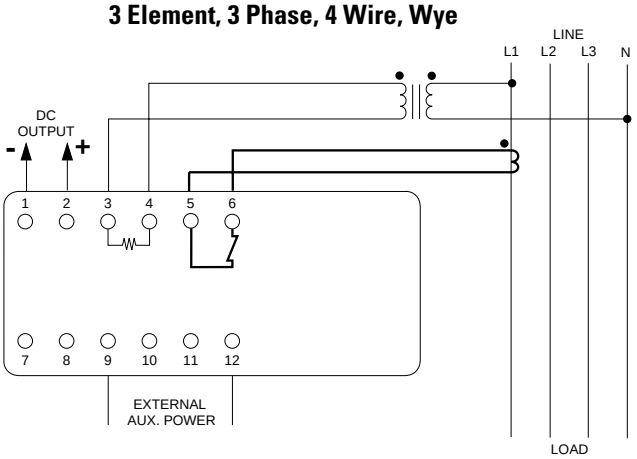


P-Option Units—PF-1, PF-2, PF-3 Models

1 Element, Single Phase, 2 Wire

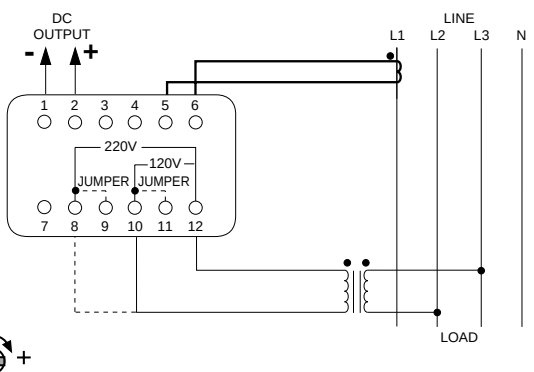


3 Element, 3 Phase, 4 Wire, Wye



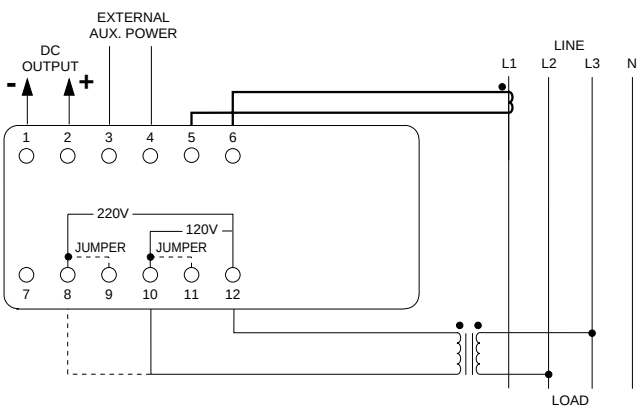
0 to ±50 mVdc and 0 to ±0.5 mAdc Units—PF-34 Models

3 Element, 3 Phase, 4 Wire, Wye



P-Option Units—PF-34 Models

3 Element, 3 Phase, 4 Wire, Wye



Adjust

NOTE: Connections for 3 Phase, 3 Wire PF-34 Models are the same, except there is no "N" line.

Exceltronic AC Phase Angle or Voltage Angle Transducers

Model 6330 Phase Angle Transducers measure the phase angle between one voltage and one current input. These units are more stable and accurate than the PF Series Phase Angle Transducers used for determining power factor; they also provide a wider range of measurement.

The Model 6314 Voltage Angle Transducers measure the angle between two voltage inputs.

All 6330 and 6314 models have a ±180° phase detector which prevents ambiguous readings when the input goes beyond full scale. The unique circuits use both zero-crossing times to measure the angle. They use phase-locked loops to reduce the effects of noise interference and harmonics on the inputs.

Features

- Angle ranges from ±45° to ±180°
- Circuits reduce noise & harmonic interference

Applications

- SCADA
- Substation monitoring
- Generating stations

Outputs

- 0 to ±1 mAdc
- 1–3–5 mAdc
- 4–12–20 mAdc
- 10–30–50 mAdc

Also available in XLP modular, plug-in format for limited-space applications requiring large numbers of transducers.

- One or two phase angle or voltage angle transducers in one module
- Two, four, or eight modules in one enclosure
- Easy to install, expand, or repair
- Convenient front-panel access for calibration and output-current jacks available

See pages 77–94 for more information.

Specifications

EXCELTRONIC AC PHASE ANGLE OR VOLTAGE ANGLE TRANSDUCERS

Specifications		0 to ±1 mAdc (Phase Angle Transducer)	P-Option* (Phase Angle Transducer)	0 to ±1 mAdc (Voltage Angle Transducer)	P-Option* (Voltage Angle Transducer)
Current Input	Nominal Range Overload Continuous Overload 1 Second/Hour Burden/Element	5 A 0.5–5 A 10 A 250 A 0.2 VA (maximum) at 5 A		N/A	
Voltage Input	Nominal Range Overload Continuous Burden/Element	120 V 95–135 V 150 V 4 VA (maximum) at 120 V			
Second Voltage Input	Nominal Range Overload Continuous Burden/Element	N/A		120 V 50–135 V 150 V 2.2 VA (maximum) at 120 V	
External Auxiliary Power	Input Range Frequency Range Burden	None Required	100–130 Vac 50–500 Hz 3 VA Nominal	None Required	100–130 Vac 50–500 Hz 3 VA Nominal
Rated Output (RO)**		±1 mAdc for Standard Calibration	5, 20, or 50 mAdc for Std. Calibration, depending on selected output range*	±1 mAdc for Standard Calibration	5, 20, or 50 mAdc for Std. Calibration, depending on selected output range*
Accuracy		±1° at 25° C			
Phase Angle Range (without ambiguous readings)		0 to ±45°, 0 to ±60°, 0 to ±75°, and 0 to ±180°			
Temperature Effect on Accuracy		±0.5° over Temperature Range	±0.6° over Temperature Range	±0.5° over Temperature Range	±0.6° over Temperature Range
Operating Temperature Range		-20° C to +60° C	-20° C to +50° C	-20° C to +60° C	-20° C to +50° C
Compliance Voltage		10 Vdc	See Table 2 on page 66.	10 Vdc	See Table 2 on page 66.
Load		0–10,000 Ω		0–10,000 Ω	
Output Ripple Peak		< 1% RO	< 0.5% RO	< 1% RO	< 0.5% RO
Response Time		< 400 ms to 99%	< 1 Second to 99%	< 400 ms to 99%	< 1 Second to 99%
Standard Calibration Adjustments	Gain Zero	±3% of Reading (minimum) ±2% RO (minimum)	±20% of Span (minimum) ±5% of Zero Point (minimum)	±3% of Reading (minimum) ±2% RO (minimum)	±20% of Span (minimum) ±5% of Zero Point (minimum)
Frequency		Nominal ±3%			
Stability (per year)		±1% RO, Noncumulative	±1% of Span, Noncumulative	±1% RO, Noncumulative	±1% of Span, Noncumulative
Operating Humidity		0–95% Noncondensing			
Isolation		Complete (Input/Output/Case)	Complete (Input/Output/Power/Case)	Complete (Input/Output/Case)	Complete (Input/Output/Power/Case)
Dielectric Withstand		1500 VRMS at 60 Hz			
Surge Withstand		ANSI/IEEE C37.90.1			
Maximum Net Weight		2 lbs., 2 oz. (1 kg)	3 lbs., 8 oz. (1.6 kg)	2 lbs., 2 oz. (1 kg)	3 lbs., 8 oz. (1.6 kg)
Approximate Dimensions (excluding mounting plate)		4.4" W x 3.9" D x 4.7" H (112 mm x 99 mm x 119 mm) Style II Case, see page 122	7.0" W x 3.7" D x 5.6" H (178 mm x 94 mm x 142 mm) Style I Case, see page 122	4.4" W x 3.9" D x 4.7" H (112 mm x 99 mm x 119 mm) Style II Case, see page 122	7.0" W x 3.7" D x 5.6" H (178 mm x 94 mm x 142 mm) Style I Case, see page 122

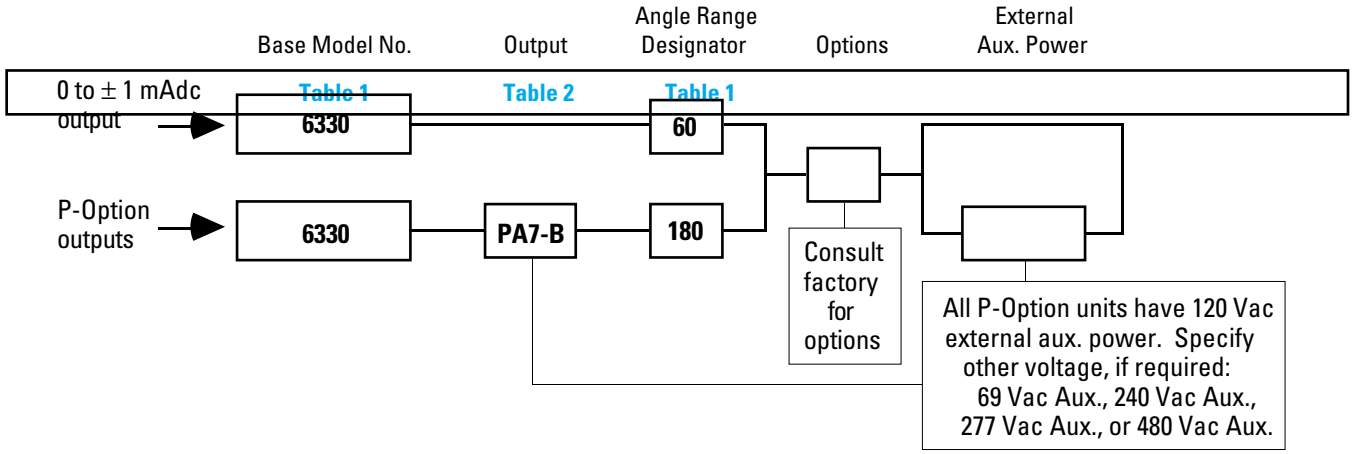
* P-Option includes 1–3–5, 4–12–20, and 10–30–50 mAdc outputs.

**For Phase Angle units, output is positive when current lags voltage.
For Voltage Angle units, output is positive when "B" lags "A".

Specifications subject to change without notice.

ORDERING PROCEDURE

Specify by base model number and appropriate selection or option suffixes in the order shown in the following example.



EXAMPLES: 6330-60
0 to ±1 mAdc Phase Angle Transducer, 0 to ±60° input range.

6330PA7-B-180
4-12-20 mAdc Phase Angle Transducer, 0 to ±180° input range.

Table 1 Base Model Number Selection

Phase Angle Model No.	VoltageAngle Model No.	Angle Range Designator	Power Factor	Standard Calibration Input	Standard Calibration Output
6330	6314	45	1 to ±0.7071	0 to ±45°	0 to ±1mAdc
		60	1 to ±0.5	0 to ±60°	0 to ±1mAdc
		75	1 to ±0.2588	0 to ±75°	0 to ±1mAdc
		180	1 to -1 and -1 to 1	0 to ±180°	0 to ±1mAdc

Table 2 Output Selection

If one of the bidirectional outputs at right is required, indicate the appropriate P-Option in the "Output" position of the complete model number.

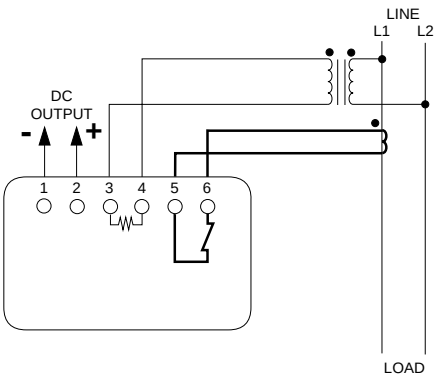
P-Option	Output Range	Compliance Voltage/ Maximum Load	Maximum Open Circuit Voltage
PAN6-B	1-3-5 mAdc	15 Vdc/3000 Ω	30 Vdc
PAN7-B	**4-12-20 mAdc**	**15 Vdc/750 Ω**	**30 Vdc**
PAN8-B	10-30-50 mAdc	15 Vdc/300 Ω	30 Vdc
PA6-B	1-3-5 mAdc	40 Vdc/8000 Ω	70 Vdc
PA7-B	4-12-20 mAdc	40 Vdc/2000 Ω	70 Vdc
PA8-B	10-30-50 mAdc	30 Vdc/600 Ω	70 Vdc

Please consult the factory if you require any options with Phase Angle or Voltage Angle Transducers.

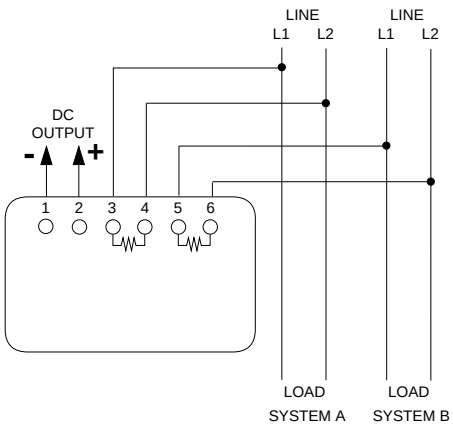
WIRING DIAGRAMS FOR 0 to ±1 mAdc UNITS (Style II Case) AND P-OPTION UNITS (Style I Case)

0 to ±1 mAdc Units

Model 6330 Phase Angle

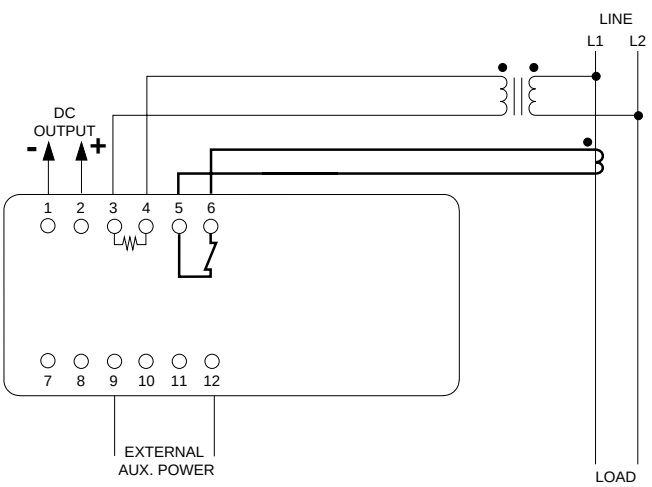


Model 6314 Voltage Angle

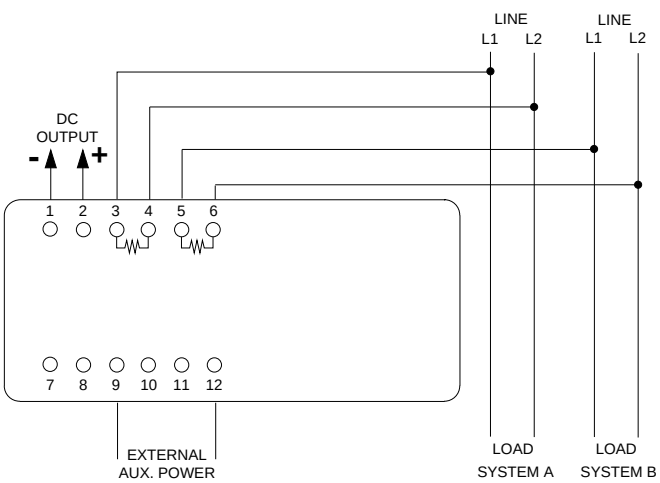


P-Option Units

Model 6330 Phase Angle



Model 6314 Voltage Angle



Adjust

Exceltronic AC Frequency Transducers

Frequency transducers have an expanded-scale output. A variety of calibrations may be ordered, or the user may calibrate the transducer at the installation site to meet specific requirements.

Customers can add series components and devices to the output signal circuit without having to recalibrate these transducers. Series components and devices include: indicators, recorders, resistors for alarms, and analog-to-digital pick-off points.

Features

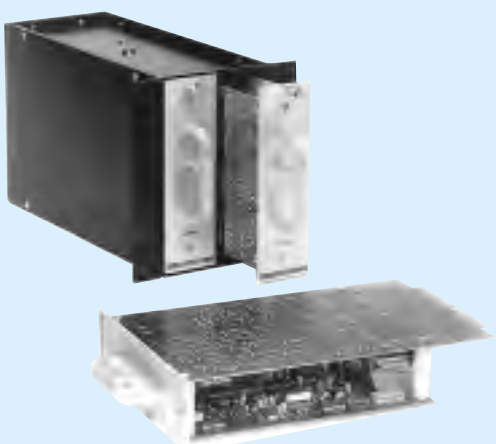
- Filtering for fast-response devices
- Series components & devices added without recalibration
- Variety of calibration available

Applications

- Process control
- Generating stations
- Substation monitoring

Outputs

- 0–1 mAdc
- 1–5 mAdc
- 4–20 mAdc
- 10–50 mAdc



Also available in XLP modular, plug-in format for limited-space applications requiring large numbers of transducers.

- One or two frequency transducers in one module
- Two, four, or eight modules in one enclosure
- Easy to install, expand, or repair
- Convenient front-panel access for calibration and output-current jacks available

See pages 77–94 for more information.

Specifications

EXCELTRONIC AC FREQUENCY TRANSDUCERS

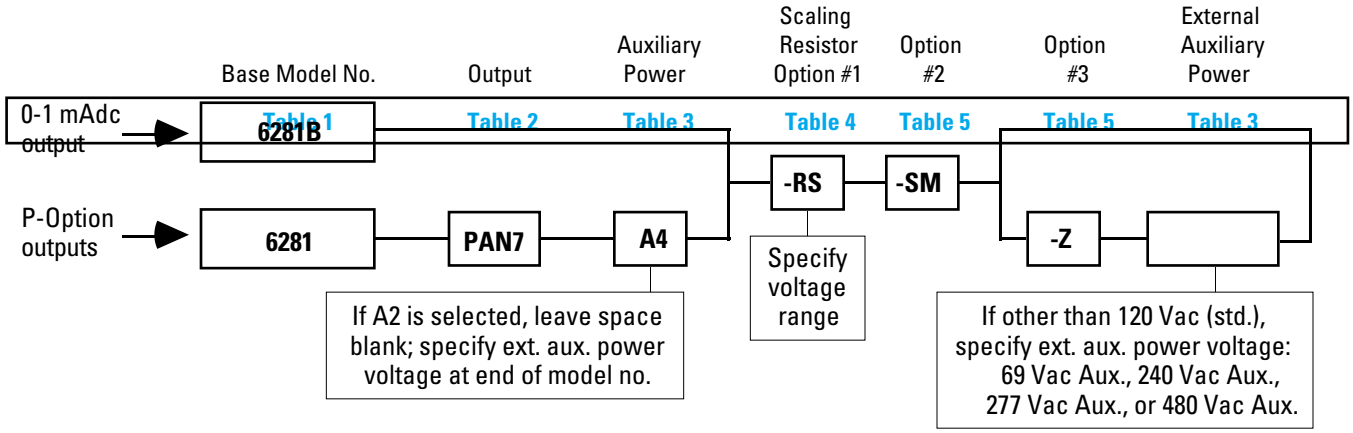
Specifications		0–1 mAdc (Frequency Transducer)	P-Option* (Frequency Transducer)
Voltage Input	Nominal Range Overload Continuous Burden/Element	120 V 90–150 V 150 V 2 VA (maximum) at 120 V	
External Auxiliary Power	Input Range Frequency Range Burden	None Required	100–130 Vac 50–500 Hz 3 VA Nominal
Rated Output (RO)		1 mAdc at Maximum Rated Frequency	5, 20, or 50 mAdc for Standard Calibration, depending on selected output range*
Accuracy		±0.02% of Center Frequency at 25° C	±0.05% of Center Frequency at 25° C
Temperature Effect on Accuracy		±0.0025% / ° C	±0.01% / ° C
Operating Temperature Range		-20° C to +60° C	-20° C to +50° C
Compliance Voltage		10 Vdc	See Table 2 on page 70.
Load		0–10,000 Ω	
Output Ripple Peak		< 1% RO	< 0.25% of Span
Response Time		< 400 ms to 99%	< 1 Second to 99%
Standard Calibration Adjustments	Gain Zero	±5% of Span (minimum) ±10% of Span (minimum)	±20% of Span (minimum) ±5% of Zero Point (minimum)
Stability (per year)		±0.02% of Center Frequency	±0.04% of Center Frequency
Operating Humidity		0–95% Noncondensing	
Isolation		Complete (Input/Output/Case)	Complete (Input/Output/Power/Case)
Dielectric Withstand		1500 VRMS at 60 Hz	
Surge Withstand		ANSI/IEEE C37.90.1	
Maximum Net Weight		1 lb., 14 oz. (0.9 kg)	3 lbs., 1 oz. (1.4 kg)
Approximate Dimensions (excluding mounting plate)		4.4" W x 3.9" D x 4.7" H (112 mm x 99 mm x 119 mm) Style II Case, see page 122	7.0" W x 3.7" D x 5.6" H (178 mm x 94 mm x 142 mm) Style I Case, see page 122

*P-Option includes 1-5, 4-20, and 10-50 mAdc outputs.

Specifications subject to change without notice.

ORDERING PROCEDURE

Specify by base model number and appropriate selection or option suffixes in the order shown in the following example.



EXAMPLES: 6281B-RS-SM

45-55 Hz, 0-1 mAdc Frequency Transducer; resistor scaling (converts current output to voltage output); seismic brace.

6281PAN7A4-RS-SM-Z

45-55 Hz, 4-20 mAdc Frequency Transducer; internal auxiliary power; resistor scaling; seismic brace; zero-based output calibration (-Z option converts 4-20 mAdc output to 0-20 mAdc output and -RS option converts current output to voltage output).

Table 1 Base Model Number Selection

Model No.	Input Range
(0-1 mAdc Units)*	
6281B	45-55 Hz
6283B	375-425 Hz
6284B	55-65 Hz
(P-Option Units)	
6281	45-55 Hz
6283	375-425 Hz
6284	55-65 Hz

*** All 0-1 mAdc output units are calibrated for 0.5 mAdc output at center frequency.**

Table 2 Output Selection

0-1 mAdc output is standard, and is specified by the Base Model Numbers. For outputs other than 0-1 mAdc, indicate the appropriate P-Option in the "Output" position of the complete model number.

P-Option	Output Range	Compliance Voltage/ Maximum Load	Maximum Open Circuit Voltage
PAN6	1-5 mAdc	15 Vdc/3000 Ω	30 Vdc
PAN7	**4-20 mAdc**	**15 Vdc/750 Ω**	**30 Vdc**
PAN8	10-50 mAdc	15 Vdc/300 Ω	30 Vdc
PA6	1-5 mAdc	40 Vdc/8000 Ω	70 Vdc
PA7	4-20 mAdc	40 Vdc/2000 Ω	70 Vdc
PA8	10-50 mAdc	30 Vdc/600 Ω	70 Vdc

Table 3 Auxiliary Power Supply Selection

Option	Description	Input Range	Frequency Range	Burden
(0-1 mAdc Units)				
None Required				
(P-Option Units)				
A2 (leave blank)**	**External Auxiliary Power (120 Vac std.)**	**100-130 Vac**	**50-500 Hz**	**3 VA**
A4	Internal Auxiliary Power (self-powered)	84-108% of Nominal Aux. Power Voltage	Equals Input Frequency	3 VA

**** For external auxiliary power voltages other than 120 Vac, specify the voltage in the last position of the complete model number. (Example: 240 Vac Aux.)**

DC external auxiliary power available; see Special Options on page 128.

Table 4 Scaling Resistor (-RS) Option

Option	Description
-RS***	Scaling Resistor

***** You must specify the desired output voltage:**
For 0-1 mAdc units, specify range from 0-10 Vdc. Load impedance is 1 MΩ/Vdc (minimum).
For P-Option units, specify range from 0-15 Vdc (PAN models) or 0-40 Vdc (PA models). Load impedance is 200, 50, or 20 (kΩ/Vdc) (minimum) for units with outputs of 5, 20, or 50 mAdc, respectively.

This information is not part of the model number, but must be provided to the factory when you place your order.

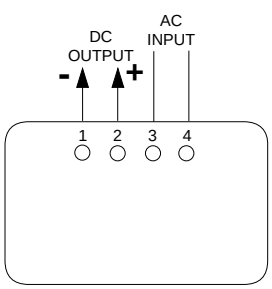
Table 5 Other Options

Option	Description
-24	24 Vdc Loop-Powered (PA7 models only) (consult factory for specifications)
-SM	Seismic Brace (available with 0-1 mAdc units) (consult factory if you desire this option with a P-Option unit)
-Z	Zero-Based Output Calibration (ex.: PA7-Z = 0-20 mAdc) (available only with P-Option units)

If you require additional options not shown here, see Special Options on page 128. When ordering any special options, or more than three options, you must first consult the factory for pricing and delivery estimates.

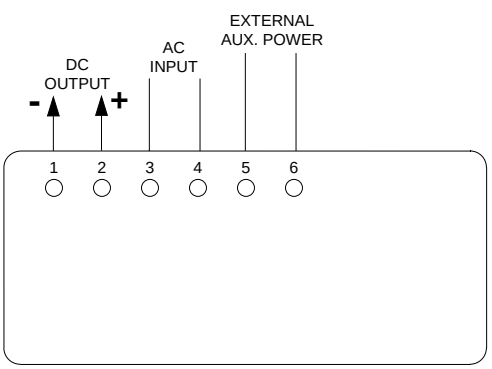
WIRING DIAGRAMS FOR 0-1 mAdc UNITS (Style II Case) AND P-OPTION UNITS (Style I Case)

Frequency
0-1 mAdc Units



Adjust

Frequency
P-Option Units



Exceltronic

Exceltronic Temperature Transducers

Scientific Columbus temperature transducers offer an accurate, inexpensive method of measuring temperature through interface with a variety of RTD sensor types. These transducers have true current outputs that will simplify your own calibrating or scaling networks, as well as allow telemetering over long distances without line-drop error. To achieve higher accuracy, the true current output is compensated to be proportional to true temperature changes, rather than merely the resistance change of the RTD.

Features

- Compatible with nickel-iron, platinum, & copper RTDs
- Exceptional reliability
- Wide range of operating temperatures
- Excellent long-term stability

Applications

- Process control
- Substation monitoring
- Generating stations

Outputs

- 0–1 mAdc
- 1–5 mAdc
- 4–20 mAdc
- 10–50 mAdc

Also available in XLP modular, plug-in format for limited-space applications requiring large numbers of transducers.

- One or two temperature transducers in one module
- Two, four, or eight modules in one enclosure
- Easy to install, expand, or repair
- Convenient front-panel access for calibration and output-current jacks available

See pages 77–94 for more information.

Specifications

EXCELTRONIC TEMPERATURE TRANSDUCERS

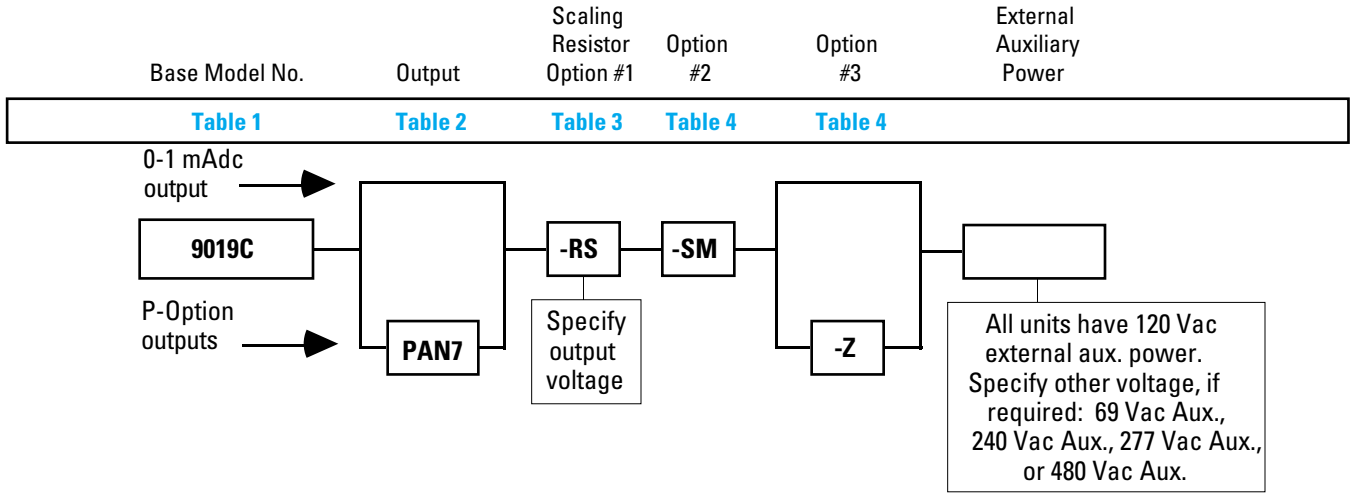
Specifications		0–1 mAdc (Temperature Transducer)	P-Option* (Temperature Transducer)
External Auxiliary Power	Input Range Frequency Range Burden	90–130 Vac 50–500 Hz 3.5 VA Nominal	100–130 Vac 50–500 Hz 6 VA Nominal
Rated Output (RO)		1 mAdc at Maximum Calibrated Temperature	5, 20, or 50 mAdc for Standard Calibration, depending on selected output range*
Accuracy		See Table 1 on page 74.	
Temperature Effect on Accuracy		±0.015% / ° F	±0.02% / ° F
Operating Temperature Range		-20° C to +60° C (-4° F to +140° F)	-20° C to +50° C (-4° F to +122° F)
Compliance Voltage		10 Vdc	See Table 2 on page 74.
Open Circuit Voltage		16 Vdc	
Load		0–10,000 Ω	
Output Ripple Peak		< 1% RO	< 0.25% of Span
Response Time		< 50 ms to 99%	< 1 Second to 99%
Standard Calibration Adjustments	Gain Zero	±10% of Span (minimum) ±3% of Span (minimum)	±20% of Span (minimum) ±5% of Zero Point (minimum)
Stability (per year)		±0.4% RO, Noncumulative	±0.5% of Span, Noncumulative
Operating Humidity		0–95% Noncondensing	
Isolation		Input/Power/Case and Output/Power/Case	
Dielectric Withstand		1500 VRMS at 60 Hz	
Surge Withstand		ANSI/IEEE C37.90.1	
Maximum Net Weight		2 lbs., 1 oz. (0.9 kg)	3 lbs., 8 oz. (1.6 kg)
Approximate Dimensions (excluding mounting plate)	Model 9015N Models 9016P & 9019C	3.3" W x 2.1" D x 4.1" H (84 mm x 53 mm x 104 mm) Style III Case, see page 122 4.4" W x 3.9" D x 4.7" H (112 mm x 99 mm x 119 mm) Style II Case, see page 122	7.0" W x 3.7" D x 5.6" H (178 mm x 94 mm x 142 mm) Style I Case, see page 122

*P-Option includes 1–5, 4–20, and 10–50 mAdc outputs.

Specifications subject to change without notice.

ORDERING PROCEDURE

Specify by base model number and appropriate selection or option suffixes in the order shown in the following example.



EXAMPLES: 9019C-RS-SM

0-1 mAdc Temperature Transducer for use with copper RTD, resistor scaling (converts current output to voltage output), seismic brace.

9019CPAN7-RS-SM-Z

4-20 mAdc Temperature Transducer for use with copper RTD, resistor scaling, seismic brace, zero-based output calibration (-Z option converts 4-20 mAdc output to 0-20 mAdc output and -RS option converts current output to voltage output).

Table 1 Base Model Number Selection

Model No.	For Use w/ RTD Type	RTD Resistance	Temperature Range*	Temperature Span*	Measurement Accuracy	Maximum RTD Current
9015N	Nickel-Iron	676 Ω at 77° F	-200° F to +500° F	50° F thru 150° F	±0.4° F or ±1° F	<3 mAdc
9016P**	Platinum	100 Ω at 32° F	-320° F to +1000° F	150° F thru 300° F	±0.8° F or ±1.5° F	<5 mAdc
9019C	Copper	10 Ω at 77° F	-100° F to +300° F	150° F thru 300° F	±1° F or ±2° F	<50 mAdc

*** You must specify minimum and maximum input temperature values from within the Temperature Range shown for each RTD type. The resulting temperature span (maximum temperature value minus minimum temperature value) must fall within the Temperature Span shown for each RTD type. (Example: Model 9015N temperature range = -195° F to -110° F and temperature span = 85° F.)**

This information is not part of the model number, but must be provided to the factory when you place your order.

**** You must specify the Temperature Coefficient of Resistance (TCR) of your 100 Ω platinum RTD probe—whether it is designed to the American Standard (TCR = .00392 Ω/Ω/°C), U.S. Industrial Standard (TCR = .00391 Ω/Ω/°C), or European Standard (TCR = .00385 Ω/Ω/°C).**

This information is not part of the model number, but must be provided to the factory when you place your order.

Table 2 Output Selection

0-1 mAdc output is standard, and is specified by the Base Model Numbers. For outputs other than 0-1 mAdc, indicate the appropriate P-Option in the "Output" position of the complete model number.

P-Option	Output Range	Compliance Voltage/ Maximum Load	Maximum Open Circuit Voltage
PAN6	1-5 mAdc	15 Vdc/3000 Ω	30 Vdc
PAN7	**4-20 mAdc**	**15 Vdc/750 Ω**	**30 Vdc**
PAN8	10-50 mAdc	15 Vdc/300 Ω	30 Vdc
PA6	1-5 mAdc	40 Vdc/8000 Ω	70 Vdc
PA7	4-20 mAdc	40 Vdc/2000 Ω	70 Vdc
PA8	10-50 mAdc	30 Vdc/600 Ω	70 Vdc

Table 3 Scaling Resistor (-RS) Option

Option	Description
-RS	Scaling Resistor***

*** **You must specify the desired output voltage:**
For 0-1 mAdc units, specify range from 0-10 Vdc. Load impedance is 1 MΩ/Vdc (minimum).
For P-Option units, specify range from 0-15 Vdc (PAN models) or 0-40 Vdc (PA models). Load impedance is 200, 50, or 20 (kΩ/Vdc) (minimum) for units with outputs of 5, 20, or 50 mAdc, respectively.
This information is not part of the model number, but must be provided to the factory when you place your order.

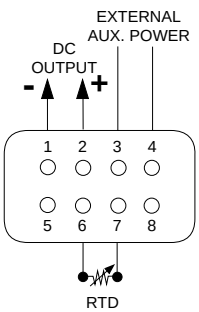
Table 4 Other Options

Option	Description
-24	24 Vdc Loop-Powered (PA7 models only) (consult factory for specifications)
-SM	Seismic Brace (available with 0-1 mAdc units) (consult factory if you desire this option with a P-Option unit)
-Z	Zero-Based Output Calibration (ex.: PA7-Z = 0-20 mAdc) (available only with P-Option units)

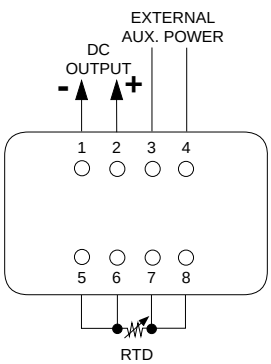
If you require additional options not shown here, see Special Options on page 128. When ordering any special options, or more than three options, you must first consult the factory for pricing and delivery estimates.

WIRING DIAGRAMS FOR 0-1 mAdc UNITS (Styles III & II Cases) AND P-OPTION UNITS (Style I Case)

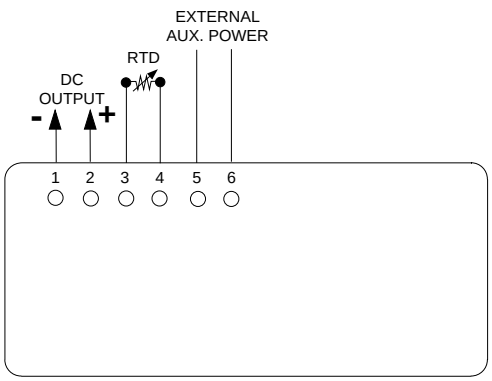
9015N Temperature 0-1 mAdc Units (Style III Case)



9016P & 9019C Temperature 0-1 mAdc Units (Style II Case)

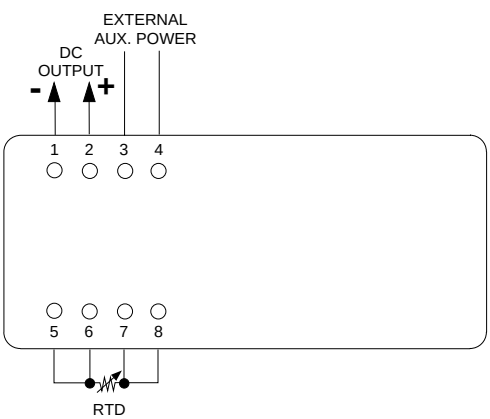


9015N Temperature P-Option Units (Style I Case)



Adjust

9016P & 9019C Temperature P-Option Units (Style I Case)



MAV 2
Meter Accuracy Verifier

MAV2 offers
Simplicity, Safety, and Accuracy — All In One Compact Portable Meter-testing Instrument.

The MAV2 Meter Accuracy Verifier is a straightforward, safe, and cost-effective instrument for on-site verification and calibration of self-contained meter accuracy. Every aspect of the MAV2's design and construction, from its menu-driven operation to the lightweight and compact package, is focused on the needs of the customer service representative or field technician—including accuracy assurance traceable to NIST.

The small size and light weight of the MAV2 Verifier make it possible for the customer service representative or technician to carry it in their vehicle, and bring it to distant locations such as apartment building meter rooms, without any special effort. Full-load testing capability to 50 amps eliminates the need for larger test instruments, and the affordability of the MAV2 makes it practical to have many units in the field.

The MAV2 Verifier can be used by relatively "less technically trained" customer service personnel as well as trained meter technicians. Designed for safety, the MAV2 incorporates an electrically interlocked deadfront design in the meter socket adapter, insuring that there are no live circuits in the adapter socket until the meter is installed. Anyone qualified to replace a meter in the field is capable of using the MAV2.

MAV2 SPECIFICATIONS

Watthour Accuracy
±0.1 % of Reading (0.05% typical)
Operating Temperature Range
-20° C to +60° C (Temperature Effect on Accuracy is 30 ppm/°C)
Storage Temperature Range
-30° C to +80° C
Operating Voltage (Autoranging)
108–264 V (120 Volt L-G Nominal)
Test Currents

Full Load	15, 30, or 50 A
Light Load	1.5, 3, or 5 A

Meter Power Interlocks
Redundant interlocks, activated by meter insertion, provide dead-front access to MAV2 meter adapter socket.
Display
Two lines of 16 characters each, 0.3-inch character height, Internally backlit
Keyboard
Three sealed keys (UP, DOWN, and ENTER) control all operations including Start and Stop of test.
Interconnecting Cable
Control unit is connected to the meter adapter socket by a spiral cable Length range is two to seven feet.
Disk Rotation Sensor
Optional photo optical disk rotation sensor uses reflective measuremer Connecting the sensor automatically sets up the meter for rotation sensor operation.
Pendant Snap Switch
Optional snap switch is provided on a 30-inch cord. Plugging in the sna switch automatically configures the unit for snap-switch operation.
Calibration and Certification
Traceable to NIST. User calibration can be performed using the infrare optical pulse port. Calibration is digital, via the front-panel display and keyboard, and requires the installation of an internal hardware key as well as a special keyboard sequence.
Size

Meter Adapter Socket	7" diameter x 8" deep
Hand-held Control Unit	9.6" H x 7" W x 3.7" D
Carrying Case	15" H x 13.5" W x 9" D

Weight

Meter Adapter Socket	6.7 lbs.
Hand-held Control Unit	6.4 lbs.
Custom Case	3.5 lbs.

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Exceltronic XLP Modular Plug-In Transducers

The XLP Series of transducers is a family of power instrumentation transducers in a compact, modular plug-in form. XLP transducers are ideal where large quantities of transducers are required, but space is limited.

XLP transducers feature three enclosure widths to accomodate two, four, or eight modules. Each module consists of two parts: a plug-in assembly and a back-panel assembly.

For current inputs, the current transformers are located on the back-panel assembly so the current inputs are not opened when the plug-in assembly is removed. New or additional plug-ins or back panels can be added in the field.

Modules Available

- Current
- Voltage
- Combined Current/Voltage
- Expanded-Scale Voltage
- Watt
- Var
- Combined Watt/Var
- Phase Angle
- Voltage Angle
- Frequency
- Temperature (RTD)

Features

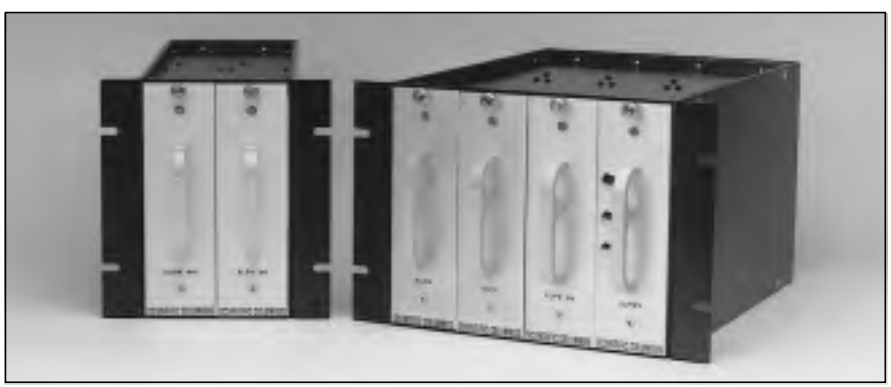
- Modular concept & compact design save transducer panel space
- Up to six transducers in one module
- Two, four, or eight modules in one enclosure
- Lower installation costs
- Easy to install
- Convenient front-panel access

Applications

- Substations
- Generating stations
- SCADA

Outputs

- 0 to ±1 mAdc
- 1–5 or 1–3–5 mAdc
- 4–20 or 4–12–20 mAdc



Specifications
Exceltronic XLP AC Average-Sensing Current or Voltage Transducers

Specifications		0–1 mAdc Amps (Current Transducer)	P-Option* Amps (Current Transducer)	0–1 mAdc Volts (Voltage Transducer)	P-Option* Volts (Voltage Transducer)
Current Input	Nominal Calibrating Range Range with Linearity Overload Continuous Overload 1 Second/Hour Burden/Element	5 A 0–5 A 0–10 A 20 A 250 A 0.25 VA (maximum) at 5 A	5 A 0–5 A 0–6 A 20 A 250 A 0.25 VA (maximum) at 5 A	N/A	N/A
Voltage Input	Nominal Calibrating Range Range with Linearity Overload Continuous Burden/Element	N/A	N/A	120 V 0–150 V 0–150 V 180 V 2.2 VA (maximum) at 120 V	120 V 0–150 V 0–165 V 180 V 2.2 VA (maximum) at 120 V
External Auxiliary Power	Input Range Frequency Range Burden/Element	None Required	100–130 Vac 50–500 Hz 3 VA Nominal	None Required	100–130 Vac 50–500 Hz 3 VA Nominal
Rated Output (RO) = 5 A or 150 V/Element		1 mAdc for Standard Calibration	5 or 20 mAdc for Std. Calibration, depending on selected output range*	1 mAdc for Standard Calibration	5 or 20 mAdc for Std. Calibration, depending on selected output range*
Accuracy	Standard A4 Models	±0.25% RO ±0.1% RO	±0.25% of Span	±0.25% RO ±0.1% RO	±0.25% of Span
Temperature Effect on Accuracy		±0.01% / ° C	±0.015% / ° C	±0.01% / ° C	±0.015% / ° C
Operating Temperature Range		-20° C to +60° C	-20° C to +50° C	-20° C to +60° C	-20° C to +50° C
Compliance Voltage		10 Vdc	25 Vdc	10 Vdc	25 Vdc
Load		0–10,000 Ω	0–5,000 W for 1–5 mAdc units 0–1,250 W for 4–20 mAdc units	0–10,000 Ω	0–5,000 W for 1–5 mAdc units 0–1,250 W for 4–20 mAdc units
Output Ripple Peak		< 0.25% RO	< 0.25% of Span	< 0.25% RO	< 0.25% of Span
Response Time		< 400 ms to 99%			
Standard Calibration Adjustments	Gain Zero	±10% of Reading (minimum) None Required	±20% of Span (minimum) ±5% of Zero Point (minimum)	±10% of Reading (minimum) None Required	±20% of Span (minimum) ±5% of Zero Point (minimum)
Frequency Range		50–500 Hz (specify nominal)			
Stability (per year)		±0.1% RO, Noncumulative	±0.15% of Span, Noncumulative	±0.25% RO, Noncumulative	±0.3% of Span, Noncumulative
Operating Humidity		0–95% Noncondensing			
Isolation		Complete (Input/Output/Case)	Complete (Input/Output/Power/Case)	Complete (Input/Output/Case)	Complete (Input/Output/Power/Case)
Dielectric Withstand		1500 VRMS at 60 Hz			
Surge Withstand		ANSI/IEEE C37.90.1			
Maximum Net Weight		Weights vary by model; consult factory.			
Approximate Dimensions		See enclosure diagrams on page 85.			

*P-Option includes 1–5 and 4–20 mAdc outputs. Not available on all models.

Specifications subject to change without notice.

Specifications		0–1 mAdc Volts (Expanded-Scale Voltage Transducer)	P-Option* Volts (Expanded-Scale Voltage Transducer)
Voltage Input	Span/Range Overload Continuous Burden/Element	Any 20–60 V span between 90–150 V (customer specified)** 150 V 2 VA (maximum) at 120 V	
External Auxiliary Power	Input Range Frequency Range Burden	None Required	100–130 Vac 50–500 Hz 3 VA Nominal
Rated Output (RO)		0 mAdc at low end of range (customer specified) 1 mAdc at high end of range (customer specified)	1 or 4 mAdc at low end of range (customer specified) 5 or 20 mAdc at high end of range (customer specified)
Accuracy		±0.25% of Input Voltage for 60 Hz	
Temperature Effect on Accuracy		±0.007% / ° C	±0.01% / ° C
Operating Temperature Range		-20° C to +60° C	-20° C to +50° C
Compliance Voltage		10 Vdc	25 Vdc
Load		0–10,000 Ω	0–5,000 Ω for 1–5 mAdc units 0–1,250 Ω for 4–20 mAdc units
Output Ripple Peak		< 2.5% RO	< 2.5% of Span
Response Time		< 400 ms to 99%	
Standard Calibration Adjustments	Gain Zero	±5% of Span ±5% of Span	±20% of Span ±5% of Span
Frequency Range		55–65 Hz	
Stability (per year)		±0.25% of Input Voltage, Noncumulative	
Operating Humidity		0–95% Noncondensing	
Isolation		Complete (Input/Output/Case)	Complete (Input/Output/Power/Case)
Dielectric Withstand		1500 VRMS at 60 Hz	
Surge Withstand		ANSI/IEEE C37.90.1	
Maximum Net Weight		Weights vary by model; consult factory.	
Approximate Dimensions		See enclosure diagrams on page 85.	

* P-Option includes 1–5 and 4–20 mAdc outputs.
**Minimum span must be at least 18% of low-end voltage.

Specifications subject to change without notice.

Specifications
Exceltronic XLP AC Watt or Var Transducers

Specifications		0 to ±1 mAdc Watts (Watt Transducer)	P-Option* Watts (Watt Transducer)	0 to ±1 mAdc Vars (Var Transducer)	P-Option* Vars (Var Transducer)
Current Input	Nominal Range** Overload Continuous Overload 1 Second/Hour Burden/Element	5 A 0–10 A 20 A 250 A 0.2 VA (maximum) at 5 A			
Voltage Input	Nominal Range** Overload Continuous Burden/Element	120 V 0–150 V 200 V 0.02 VA (maximum) at 120 V			
External Auxiliary Power	Input Range Frequency Range Burden	85–135 Vac 50–500 Hz 3 VA Nominal	100–130 Vac 50–500 Hz 5 VA Nominal	85–135 Vac 50–500 Hz 3 VA Nominal	100–130 Vac 50–500 Hz 5 VA Nominal
Rated Output (RO) = 500 Watts or Vars/Element		±1 mAdc for Standard Calibration	5 or 20 mAdc for Std. Calibration, depending on selected output range*	±1 mAdc for Standard Calibration	5 or 20 mAdc for Std. Calibration, depending on selected output range*
Accuracy		±(0.2% Reading + 0.01% RO) at 0–200% RO	±(0.2% Reading + 0.05% RO) at 0–120% RO	±(0.2% Reading + 0.02% RO) at 0–200% RO	±(0.3% Reading + 0.05% RO) at 0–120% RO
Temperature Effect on Accuracy		±0.005% / ° C	±0.0075% / ° C	±0.009% / ° C	±0.012% / ° C
Operating Temperature Range		-20° C to +70° C	-20° C to +50° C	-20° C to +60° C	-20° C to +50° C
Compliance Voltage		10 Vdc	25 Vdc	10 Vdc	25 Vdc
Load		0–10,000 Ω	0–5,000 Ω for 1–5/1–3–5 mAdc units 0–1,250 Ω for 4–20/4–12–20 mAdc units	0–10,000 Ω	0–5,000 Ω for 1–5/1–3–5 mAdc units 0–1,250 Ω for 4–20/4–12–20 mAdc units
Output Ripple Peak		< 0.5% RO			
Response Time		< 400 ms to 99%			
Power Factor		Any			
PF Effect on Accuracy		±0.1% VA (maximum)		±0.15% VA (maximum)	
Standard Calibration Adjustments	Gain Zero	±2% of Reading (minimum) None Required	±20% of Span (minimum) ±5% of Zero Point (minimum)	±2% of Reading (minimum) None Required	±20% of Span (minimum) ±5% of Zero Point (minimum)
Frequency Range		58–62 Hz		60 Hz	
Stability (per year)		±0.1% RO, Noncumulative	±0.15% of Span, Noncumulative	±0.2% RO, Noncumulative	±0.25% of Span, Noncumulative
Operating Humidity		0–95% Noncondensing			
Isolation		Complete (Input/Output/Power/Case)			
Dielectric Withstand		1500 VRMS at 60 Hz			
Surge Withstand		ANSI/IEEE C37.90.1			
Maximum Net Weight		Weights vary by model; consult factory.			
Approximate Dimensions		See enclosure diagrams on page 85.			
Overrange with Linearity		500–1000 Watts/Element	500–600 Watts/Element	500–1000 Vars/Element	500–600 Vars/Element
		No additional error within voltage compliance. Reduce load resistance as required.			

* P-Option includes 1–5/1–3–5 and 4–20/4–12–20 mAdc outputs.

**Total input not to exceed 200% of standard-calibration watts or vars on units with 0 to ±1 mAdc output.
Total input not to exceed 120% of standard-calibration watts or vars on units with P-Option outputs.

Specifications subject to change without notice.

Specifications
Exceltronic XLP Combined AC Watt/Var Transducers

Specifications		0 to ±1 mAdc Watts (Combined Watt/Var Transducer)	P-Option* Watts (Combined Watt/Var Transducer)	0 to ±1 mAdc Vars (Combined Watt/Var Transducer)	P-Option* Vars (Combined Watt/Var Transducer)
Current Input	Nominal Range** Overload Continuous Overload 1 Second/Hour Burden/Element	5 A 0–10 A 20 A 250 A 0.2 VA (maximum) at 5 A			
Voltage Input	Nominal Range** Overload Continuous Burden/Element	120 V 0–150 V 200 V 0.02 VA (maximum) at 120 V			
External Auxiliary Power	Input Range Frequency Range Burden	85–135 Vac 50–500 Hz 3 VA Nominal	100–130 Vac 50–500 Hz 7 VA Nominal	85–135 Vac 50–500 Hz 3 VA Nominal	100–130 Vac 50–500 Hz 7 VA Nominal
Rated Output (RO) = 500 Watts or Vars/Element		±1 mAdc for Standard Calibration	5 or 20 mAdc for Std. Calibration, depending on selected output range*	±1 mAdc for Standard Calibration	5 or 20 mAdc for Std. Calibration, depending on selected output range*
Accuracy		±(0.2% Reading + 0.01% RO) at 0–200% RO	±(0.2% Reading + 0.05% RO) at 0–120% RO	±(0.2% Reading + 0.02% RO) at 0–200% RO	±(0.3% Reading + 0.05% RO) at 0–120% RO
Temperature Effect on Accuracy		±0.005% / ° C	±0.0075% / ° C	±0.009% / ° C	±0.012% / ° C
Operating Temperature Range		-20° C to +60° C	-20° C to +50° C	-20° C to +60° C	-20° C to +50° C
Compliance Voltage		10 Vdc	25 Vdc	10 Vdc	25 Vdc
Load		0–10,000 Ω	0–5,000 Ω for 1–5/1–3–5 mAdc units 0–1,250 Ω for 4–20/4–12–20 mAdc units	0–10,000 Ω	0–5,000 Ω for 1–5/1–3–5 mAdc units 0–1,250 Ω for 4–20/4–12–20 mAdc units
Output Ripple Peak		< 0.5% RO			
Response Time		< 400 ms to 99%			
Power Factor		Any			
PF Effect on Accuracy		±0.1% VA (maximum)		±0.15% VA (maximum)	
Standard Calibration Adjustments	Gain Zero	±2% of Reading (minimum) None Required	±20% of Span (minimum) ±5% of Zero Point (minimum)	±2% of Reading (minimum) None Required	±20% of Span (minimum) ±5% of Zero Point (minimum)
Frequency		60 Hz			
Stability (per year)		±0.1% RO, Noncumulative	±0.15% of Span, Noncumulative	±0.2% RO, Noncumulative	±0.25% of Span, Noncumulative
Operating Humidity		0–95% Noncondensing			
Isolation		Complete (Input/Output/Power/Case)			
Dielectric Withstand		1500 VRMS at 60 Hz			
Surge Withstand		ANSI/IEEE C37.90.1			
Maximum Net Weight		Weights vary by model; consult factory.			
Approximate Dimensions		See enclosure diagrams on page 85.			
Overrange with Linearity		500–1000 Watts/Element	500–600 Watts/Element	500–1000 Vars/Element	500–600 Vars/Element
		No additional error within voltage compliance. Reduce load resistance as required.			

* P-Option includes 1–5/1–3–5 and 4–20/4–12–20 mAdc outputs. Not available on XLPWV10-30 model.

**Total input not to exceed 200% of standard-calibration watts and vars on units with 0 to ±1 mAdc output.
Total input not to exceed 120% of standard-calibration watts and vars on units with P-Option outputs.

Specifications subject to change without notice.

XLP Plug-In

Specifications
Exceltronic XLP AC Phase Angle or Voltage Angle Transducers

Specifications		0 to ±1 mAdc (Phase Angle Transducer)	P-Option* (Phase Angle Transducer)	0 to ±1 mAdc (Voltage Angle Transducer)	P-Option* (Voltage Angle Transducer)
Current Input	Nominal Range** Overload Continuous Overload 1 Second/Hour Burden/Element	5 A 0.5–5 A 10 A 250 A 0.2 VA (maximum) at 5 A		N/A	
Voltage Input	Nominal Range** Overload Continuous Burden/Element	120 V 95–135 V 150 V 4 VA (maximum) at 120 V			
Second Voltage Input	Nominal Range** Overload Continuous Burden/Element	N/A		120 V 50–135 V 150 V 2.2 VA (maximum) at 120 V	
External Auxiliary Power	Input Range Frequency Range Burden	None Required	100–130 Vac 50–500 Hz 2 VA Nominal	None Required	100–130 Vac 50–500 Hz 2 VA Nominal
Rated Output (RO)		±1 mAdc for Standard Calibration	5 or 20 mAdc for Std. Calibration, depending on selected output range*	±1 mAdc for Standard Calibration	5 or 20 mAdc for Std. Calibration, depending on selected output range*
Accuracy		±1° at 25° C			
Phase Angle Range (without ambiguous readings)		0 to ±45°, 0 to ±60°, 0 to ±75°, and 0 to ±180°			
Temperature Effect on Accuracy		±0.5°	±0.6°	±0.5°	±0.6°
Operating Temperature Range		-20° C to +60° C	-20° C to +50° C	-20° C to +60° C	-20° C to +50° C
Compliance Voltage		10 Vdc	25 Vdc	10 Vdc	25 Vdc
Load		0–10,000 Ω	0–5,000 Ω for 1–3–5 mAdc units 0–1,250 Ω for 4–12–20 mAdc units	0–10,000 Ω	0–5,000 Ω for 1–3–5 mAdc units 0–1,250 Ω for 4–12–20 mAdc units
Output Ripple Peak		< 1% RO			
Response Time		< 400 ms to 99%			
Standard Calibration Adjustments	Gain Zero	±3% of Reading (minimum) ±2% RO (minimum)	±20% of Span (minimum) ±5% of Zero Point (minimum)	±3% of Reading (minimum) ±2% RO (minimum)	±20% of Span (minimum) ±5% of Zero Point (minimum)
Frequency		Nominal ±3%			
Stability (per year)		±1% RO, Noncumulative	±1% of Span, Noncumulative	±1% RO, Noncumulative	±1% of Span, Noncumulative
Operating Humidity		0–95% Noncondensing			
Isolation		Complete (Input/Output/Case)	Complete (Input/Output/Power/Case)	Complete (Input/Output/Case)	Complete (Input/Output/Power/Case)
Dielectric Withstand		1500 VRMS at 60 Hz			
Surge Withstand		ANSI/IEEE C37.90.1			
Maximum Net Weight		Weights vary by model; consult factory.			
Approximate Dimensions		See enclosure diagrams on page 85.			

*P-Option includes 1–3–5 and 4–12–20 mAdc outputs.

Specifications subject to change without notice.

Specifications		0–1 mAdc (Frequency Transducer)	P-Option* (Frequency Transducer)
Voltage Input	Nominal Range Overload Continuous Burden/Element	120 V 90–150 V 150 V 2 VA (maximum) at 120 V	
External Auxiliary Power	Input Range Frequency Range Burden	None Required	100–130 Vac 50–500 Hz 2 VA Nominal
Rated Output (RO)		1 mAdc at Maximum Rated Frequency	5 or 20 mAdc for Standard Calibration, depending on selected output range*
Accuracy		±0.02% of Center Frequency at 25° C	±0.005% of Center Frequency at 25° C
Temperature Effect on Accuracy		±0.0025% / ° C	±0.005% / ° C
Operating Temperature Range		-20° C to +60° C	-20° C to +50° C
Compliance Voltage		10 Vdc	25 Vdc
Load		0–10,000 Ω	0–5,000 Ω for 1–5 mAdc units 0–1,250 Ω for 4–20 mAdc units
Output Ripple Peak		< 1% RO	< 1% of Span
Response Time		< 400 ms to 99%	
Standard Calibration Adjustments	Gain Zero	±5% of Span (minimum) ±10% of Span (minimum)	±20% of Span (minimum) ±5% of Zero Point (minimum)
Stability (per year)		±0.02% of Center Frequency	±0.04% of Center Frequency
Operating Humidity		0–95% Noncondensing	
Isolation		Complete (Input/Output/Case)	Complete (Input/Output/Power/Case)
Dielectric Withstand		1500 VRMS at 60 Hz	
Surge Withstand		ANSI/IEEE C37.90.1	
Maximum Net Weight		Weights vary by model; consult factory.	
Approximate Dimensions		See enclosure diagrams on page 85.	

*P-Option includes 1–5 and 4–20 mAdc outputs.

Specifications subject to change without notice.

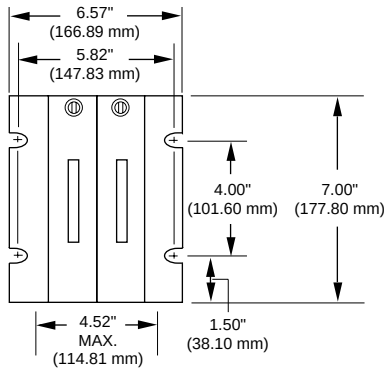
Specifications		0–1 mAdc (Temperature Transducer)	P-Option* (Temperature Transducer)
External Auxiliary Power	Input Range Frequency Range Burden	90–130 Vac 50–500 Hz 3.5 VA Nominal	100–130 Vac 50–500 Hz 5.5 VA Nominal
Rated Output (RO)		1 mAdc at Maximum Calibrated Temperature	5 or 20 mAdc for Standard Calibration, depending on selected output range*
Accuracy	Nickel-Iron Platinum Copper	0.8% of Span 0.5% of Span 0.8% of Span	
Temperature Effect on Accuracy		±0.015% / ° F	±0.017% / ° F
Operating Temperature Range		-20° C to +60° C (-4° F to +140° F)	-20° C to +50° C (-4° F to +122° F)
Compliance Voltage		10 Vdc	25 Vdc
Open Circuit Voltage		16 Vdc	30 Vdc
Load		0–10,000 Ω	0–5,000 Ω for 1–5 mAdc units 0–1,250 Ω for 4–20 mAdc units
Output Ripple Peak		< 1% RO	< 1% of Span
Response Time		< 50 ms to 99%	
Standard Calibration Adjustments	Gain Zero	±5% of Span (minimum) ±3% of Span (minimum)	±20% of Span (minimum) ±5% of Zero Point (minimum)
Stability (per year)		±0.4% RO, Noncumulative	±0.5% of Span, Noncumulative
Operating Humidity		0–95% Noncondensing	
Isolation		Input/Power/Case and Output/Power/Case	
Dielectric Withstand		1500 VRMS at 60 Hz	
Surge Withstand		ANSI/IEEE C37.90.1	
Maximum Net Weight		Weights vary by model; consult factory.	
Approximate Dimensions		See enclosure diagrams on page 85.	

*P-Option includes 1–5 and 4–20 mAdc outputs.

Specifications subject to change without notice.

ENCLOSURE DRAWINGS

2-Module Enclosure



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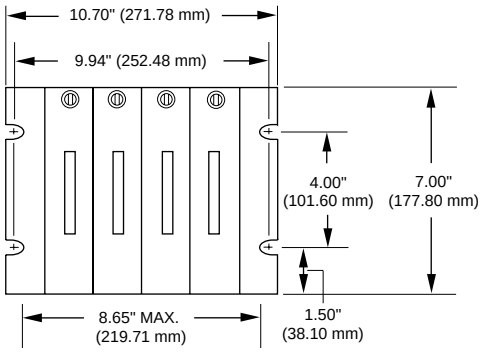
4-Module Enclosure



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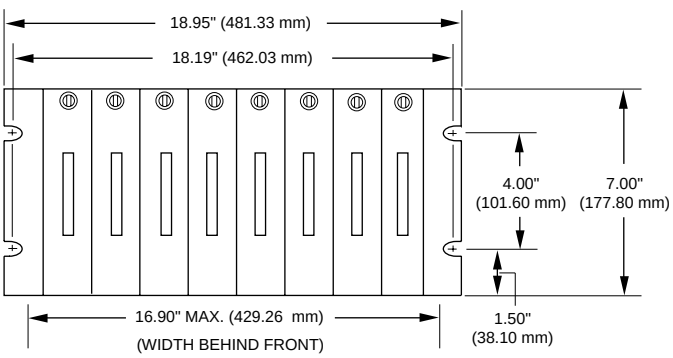
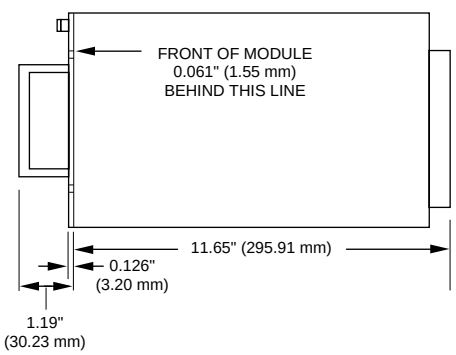
8-Module Enclosure (front view)



Enclosure Module (side view)

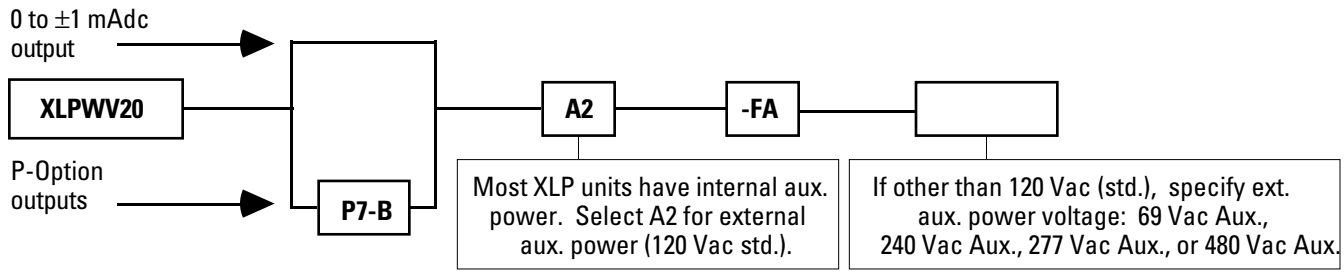


Instrumentation

ORDERING PROCEDURE

Specify by base model number and appropriate selection or option suffixes in the order shown in the following example.

Base Model No.	Output	Option #1	Option #2	External Aux. Power
Tables 1 thru 5	Table 6	Table 7	Table 7	



EXAMPLES: XLPWV20A2-FA
2-element, 0 to ±1 mAdc Watt/Var Plug-In Transducer; 120 Vac external auxiliary power; front access.

XLPWV20P7-BA2-FA
2-element, 4-12-20 mAdc Watt/Var Plug-In Transducer; 120 Vac external auxiliary power; front access.

You must specify a model number for each module position in the bin (l-r). Specify unused positions as either "blank" or "empty".

Position 1	
Position 2	
Position 3	
Position 4	
Position 5	
Position 6	
Position 7	
Position 8	

You must specify the size of enclosure and quantity of blank modules (if required). This information is not part of the model number, but must be provided to the factory when you place your order. Delete the "K" from the part numbers below if you do not want the factory to assemble your enclosure.

8-Position Bin		10093-001K
4-Position Bin		10387-001K
2-Position Bin		10386-001K
Quantity of Blanks		10184-001

Table 1 Current or Voltage Base Model Numbers

CURRENT OR VOLTAGE TRANSDUCERS IN ONE PLUG-IN MODULE

Current Model No.	Description
XLPC	One Current Unit
XLPC2	Two Current Units
XLPC3	Three Current Units

Voltage Model No.	Description
XLPE	One Voltage Unit
XLPE2	Two Voltage Units
XLPE3	Three Voltage Units
XLPE4*	Four Voltage Units

Expanded-Scale Voltage Model No.	Description
XLPEX	One Voltage Unit (with 90-150 V expanded-scale option)
XLPEX2	Two Voltage Units (with 90-150 V expanded-scale option)
XLPEX3	Three Voltage Units (with 90-150 V expanded-scale option)

COMBINED CURRENT/VOLTAGE TRANSDUCERS IN ONE PLUG-IN MODULE

Combined Current/ Voltage Model No.	Description
XLPCE	One Current Unit/One Voltage Unit
XLPC2E	Two Current Units/One Voltage Unit
XLPC3E*	Three Current Units/One Voltage Unit
XLPCE2	One Current Unit/Two Voltage Units
XLPCE3*	One Current Unit/Three Voltage Units
XLPCE4*	One Current Unit/Four Voltage Units
XLPC2E2*	Two Current Units/Two Voltage Units
XLPC2E3*	Two Current Units/Three Voltage Units
XLPC2E4*	Two Current Units/Four Voltage Units
XLPC3E2*	Three Current Units/Two Voltage Units
XLPC3E3*	Three Current Units/Three Voltage Units

*** Not available with 1-5 or 4-20 mAdc outputs.**

Ordering Procedure
Exceltronic XLP Modular Plug-In Transducers

Table 2 Watt or Var Base Model Numbers

WATT OR VAR TRANSDUCERS IN ONE PLUG-IN MODULE

Watt Model No.	Description	Var Model No.	Description
XLPW10	1-Element Watt	XLPV10	1-Element Var
XLPW15	1 1/2-Element Watt	XLPV15	1 1/2-Element Var
XLPW20	2-Element Watt	XLPV20	2-Element Var
XLPW25	2 1/2-Element Watt	XLPV25	2 1/2-Element Var
XLPW30	3-Element Watt	XLPV30	3-Element Var

COMBINED WATT/VAR TRANSDUCERS IN ONE PLUG-IN MODULE

Combined Watt/Var Model No.	Description
XLPWV10	1-Element Watt/Var
XLPWV15	1 1/2-Element Watt/Var
XLPWV20	2-Element Watt/Var
XLPWV25	2 1/2-Element Watt/Var
XLPWV30	3-Element Watt/Var
XLPWV10-30*	Three 1-Element Watt/Vars

*** Not available with 1-5 or 4-20 mAdc outputs.**

Table 3 Phase Angle or Voltage Angle Base Model Numbers

ONE OR TWO PHASE ANGLE TRANSDUCERS IN ONE PLUG-IN MODULE

Phase Angle Model No.	Description
XLPF1-45	One 45° Phase Angle Unit
XLPF1-60	One 60° Phase Angle Unit
XLPF1-75	One 75° Phase Angle Unit
XLPF1-180	One 180° Phase Angle Unit
XLPF2-45	Two 45° Phase Angle Units
XLPF2-60	Two 60° Phase Angle Units
XLPF2-75	Two 75° Phase Angle Units
XLPF2-180	Two 180° Phase Angle Units

ONE OR TWO VOLTAGE ANGLE TRANSDUCERS IN ONE PLUG-IN MODULE

Voltage Angle Model No.	Description
XLPA1-45	One 45° Voltage Angle Unit
XLPA1-60	One 60° Voltage Angle Unit
XLPA1-75	One 75° Voltage Angle Unit
XLPA1-180	One 180° Voltage Angle Unit
XLPA2-45	Two 45° Voltage Angle Units
XLPA2-60	Two 60° Voltage Angle Units
XLPA2-75	Two 75° Voltage Angle Units
XLPA2-180	Two 180° Voltage Angle Units

Table 4 Frequency Base Model Numbers

ONE OR TWO FREQUENCY TRANSDUCERS IN ONE PLUG-IN MODULE

Frequency Model No.	Description
XLPZ150	One 50 Hz Frequency Unit
XLPZ160	**One 60 Hz Frequency Unit**
XLPZ1400	One 400 Hz Frequency Unit
XLPZ250	Two 50 Hz Frequency Units
XLPZ260	**Two 60 Hz Frequency Units**
XLPZ2400	Two 400 Hz Frequency Units

Table 5 Temperature Base Model Numbers

ONE OR TWO TEMPERATURE TRANSDUCERS IN ONE PLUG-IN MODULE

Temperature Model No.	Description
XLP15	One Nickel-Iron Temperature Unit
XLP16	One Platinum Temperature Unit
XLP19	One Copper Temperature Unit
XLP25	Two Nickel-Iron Temperature Units
XLP26	Two Platinum Temperature Units
XLP29	Two Copper Temperature Units

See Table 1 on page 74 for additional ordering information.

Table 6 Output Selection

0 to ±1 mAdc output is standard, and is specified by the Base Model Numbers. For outputs other than 0 to ±1 mAdc, indicate the appropriate P-Option in the "Output" position of the complete model number.

P-Option	Output Range	Compliance Voltage	Maximum Load	Max. Open Circuit Voltage
P6**	1-5 mAdc	25 Vdc	5000 Ω	30 Vdc
P7**	4-20 mAdc	25 Vdc	1250 Ω	30 Vdc
P6-B***	1-3-5 mAdc	25 Vdc	5000 Ω	30 Vdc
P7-B***	4-12-20 mAdc	25 Vdc	1250 Ω	30 Vdc

**** P6 and P7 options are available for all XLP types except Phase Angle and Voltage Angle.**

***** P6-B and P7-B options are available for all XLP types except Current, Voltage, Frequency, and Temperature.**

Table 7 Options

Option	Description
-1	240 V Input
-5	10 A Input
A2****	External Auxiliary Power (120 Vac std.)
-FA	Front Access

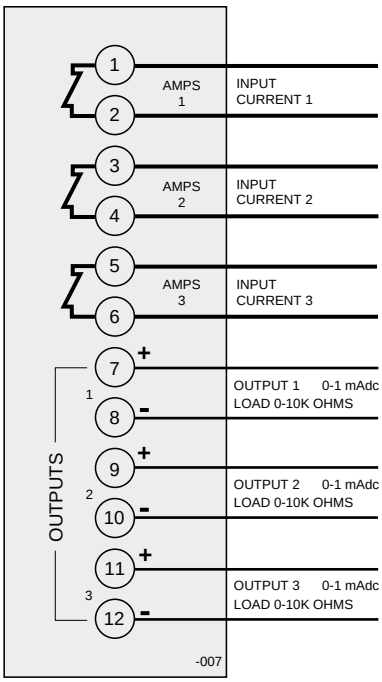
****** Most XLP transducers come standard with internal auxiliary power (A4 option). If you require external auxiliary power, the A2 option designator should come before any other options in the complete model number.**

If you require additional options not shown here, please consult the factory.

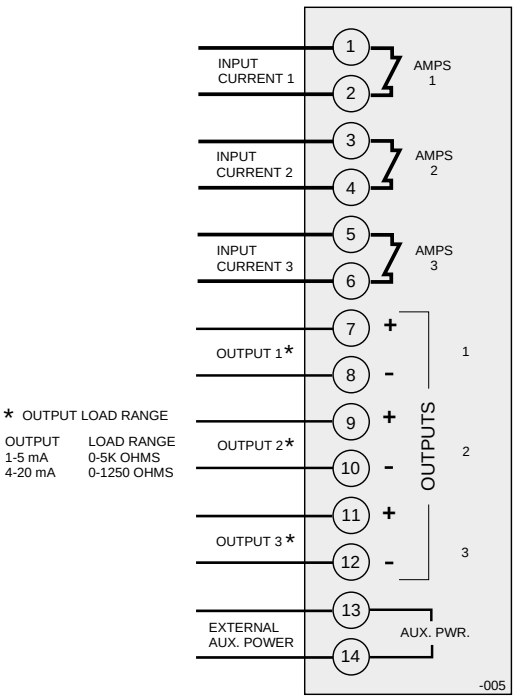
Combined Watt/Watthour or Var/Varhour and Combined Phase/Voltage Angle transducers are available in XLP format on special order. Please consult the factory for more information.

WIRING DIAGRAMS

Models C, C2, C3 Current



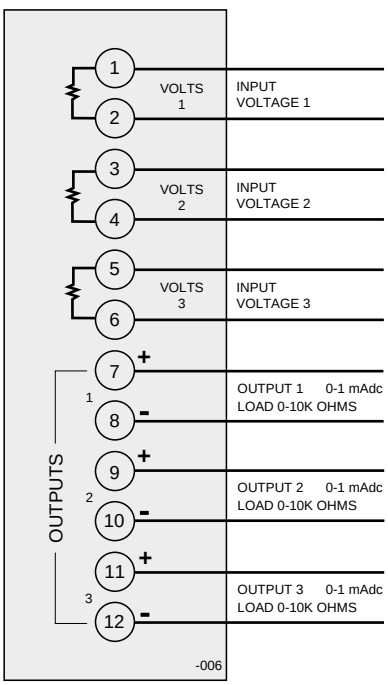
Models CP7A2, C2P7A2, C3P7A2 Current with External Aux. Power



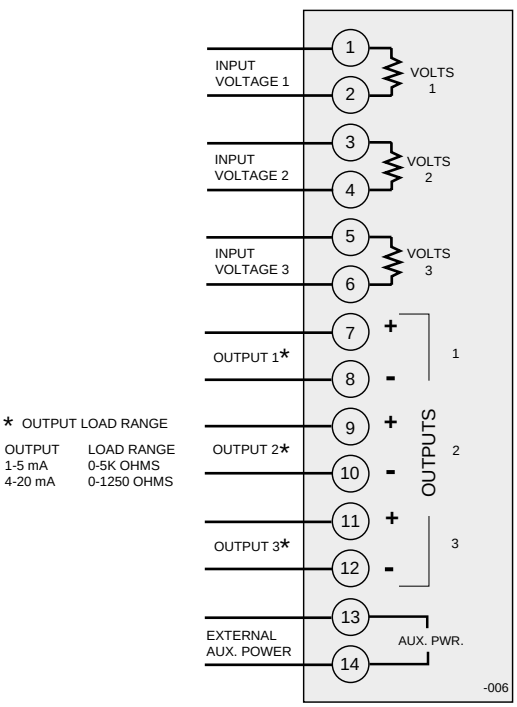
* OUTPUT LOAD RANGE

OUTPUT	LOAD RANGE
1-5 mA	0-5K OHMS
4-20 mA	0-1250 OHMS

Models E, E2, E3 Voltage
Models EX, EX2, EX3 Expanded-Scale Voltage
Models Z1, Z2 Frequency



Models EP7A2, E2P7A2, E3P7A2 Voltage with External Aux. Power
Models Z1P7A2, Z2P7A2 Frequency with External Aux. Power
(Consult factory for drawing of Expanded-Scale Voltage with External Aux. Power)

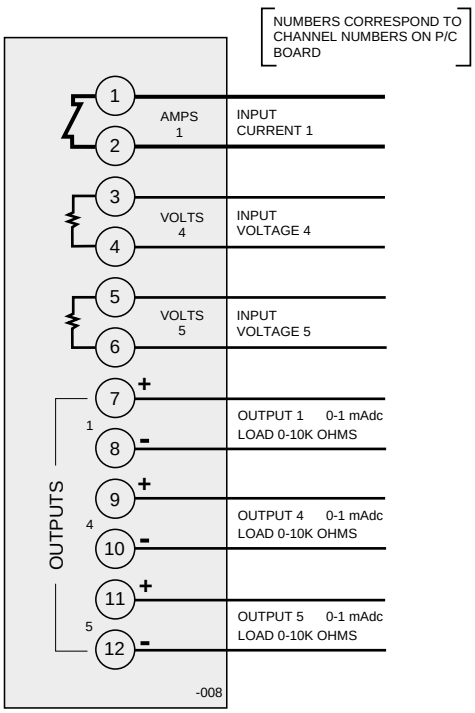


* OUTPUT LOAD RANGE

OUTPUT	LOAD RANGE
1-5 mA	0-5K OHMS
4-20 mA	0-1250 OHMS

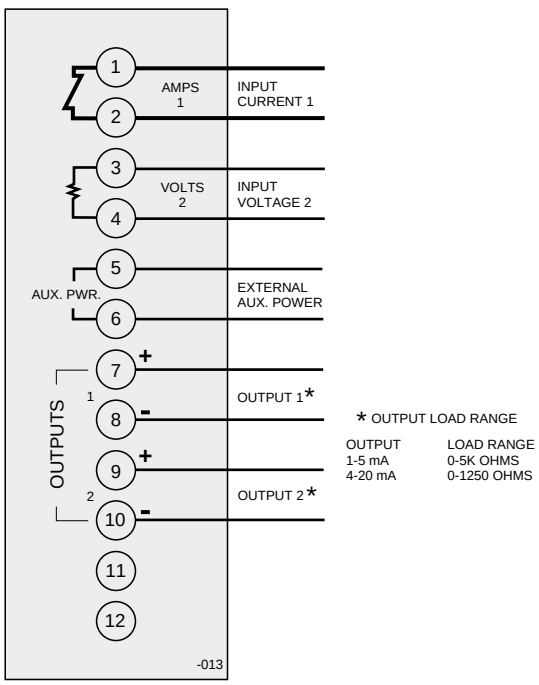
WIRING DIAGRAMS

Models CE, CE2, Current/Voltage

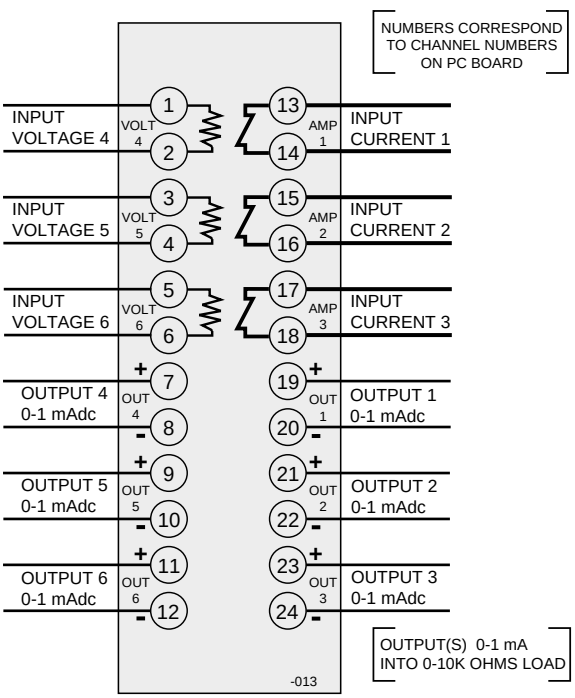


Model CEP7A2 Current/Voltage with External Aux. Power

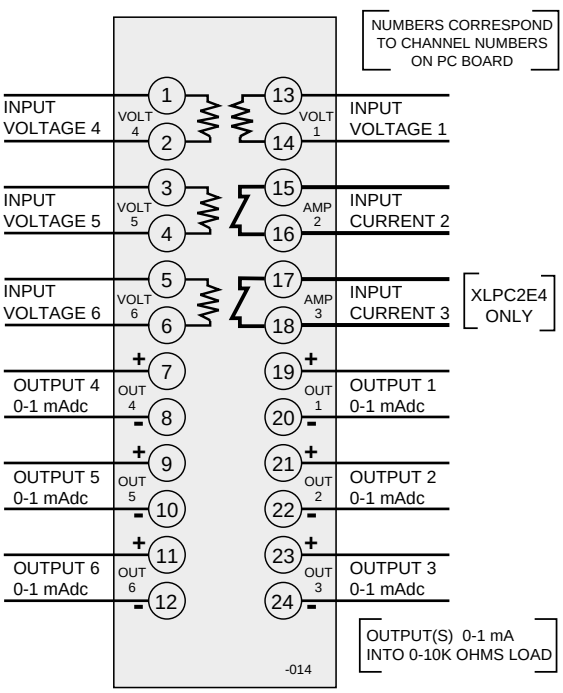
(Consult factory for drawing of CE2P7A2)



Models CE3, C2E, C2E2, C2E3, C3E, C3E2, C3E3 Current/Voltage



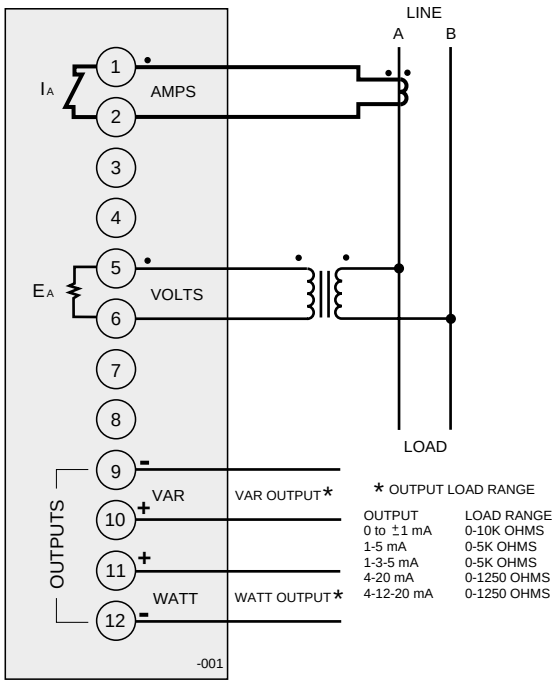
Models CE4, C2E4, Current/Voltage
Model E4 Voltage



XLP Plug-In

WIRING DIAGRAMS

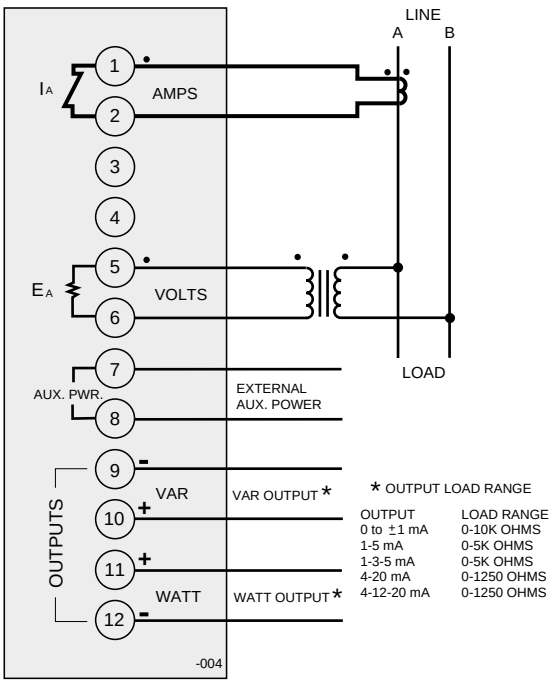
1-Element Watt, Var, Watt/Var



* OUTPUT LOAD RANGE

OUTPUT	LOAD RANGE
0 to ±1 mA	0-10K OHMS
1-5 mA	0-5K OHMS
1-3-5 mA	0-5K OHMS
4-20 mA	0-1250 OHMS
4-12-20 mA	0-1250 OHMS

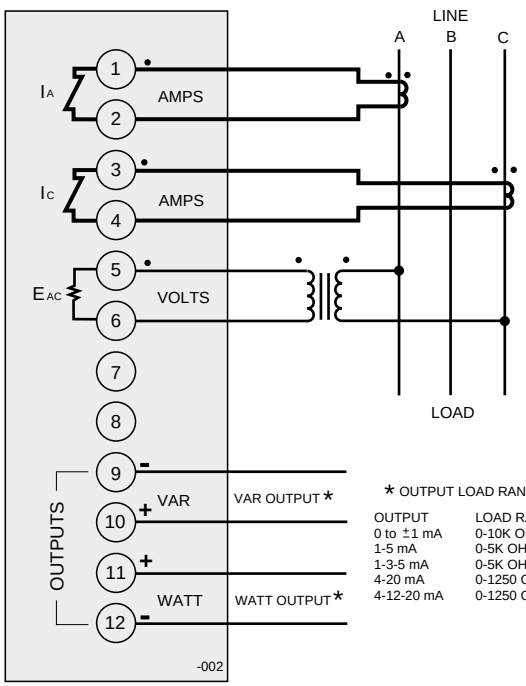
1-Element Watt, Var, Watt/Var with External Aux. Power



* OUTPUT LOAD RANGE

OUTPUT	LOAD RANGE
0 to ±1 mA	0-10K OHMS
1-5 mA	0-5K OHMS
1-3-5 mA	0-5K OHMS
4-20 mA	0-1250 OHMS
4-12-20 mA	0-1250 OHMS

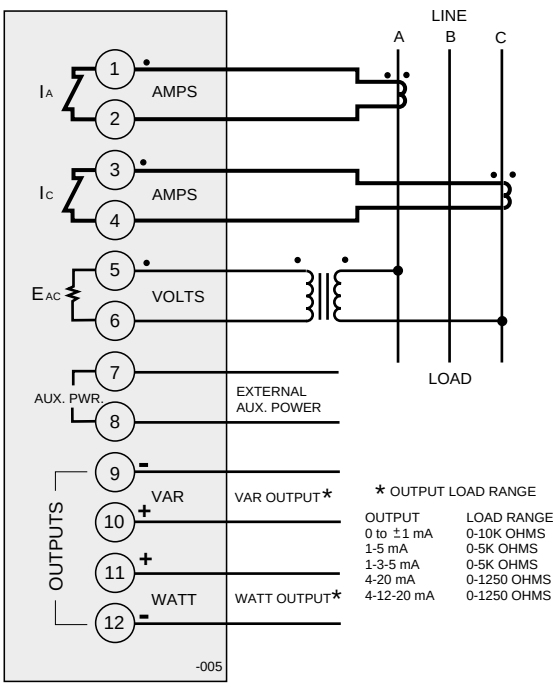
1 1/2-Element Watt, Var, Watt/Var



* OUTPUT LOAD RANGE

OUTPUT	LOAD RANGE
0 to ±1 mA	0-10K OHMS
1-5 mA	0-5K OHMS
1-3-5 mA	0-5K OHMS
4-20 mA	0-1250 OHMS
4-12-20 mA	0-1250 OHMS

1 1/2-Element Watt, Var, Watt/Var with External Aux. Power

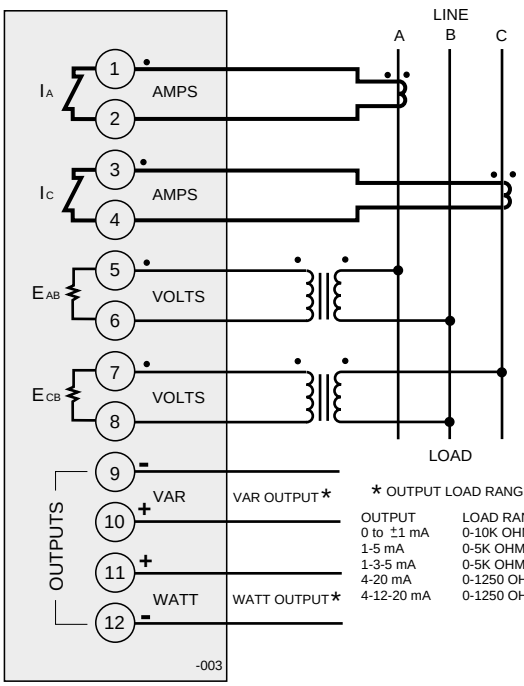


* OUTPUT LOAD RANGE

OUTPUT	LOAD RANGE
0 to ±1 mA	0-10K OHMS
1-5 mA	0-5K OHMS
1-3-5 mA	0-5K OHMS
4-20 mA	0-1250 OHMS
4-12-20 mA	0-1250 OHMS

WIRING DIAGRAMS

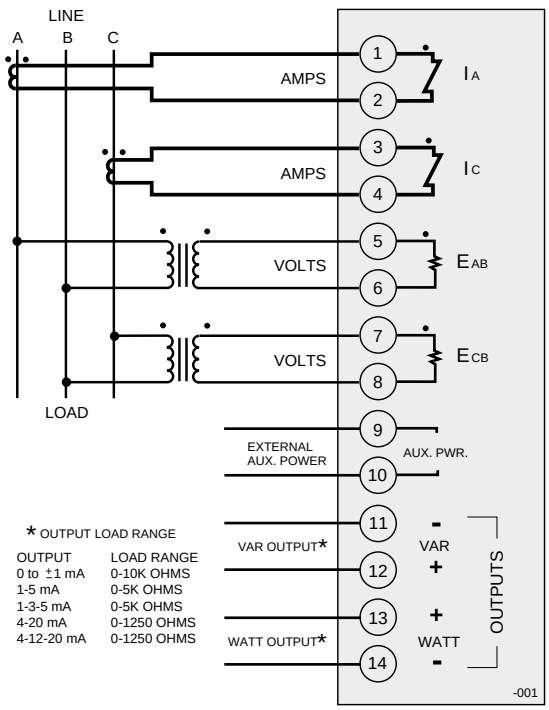
2-Element Watt, Var, Watt/Var



* OUTPUT LOAD RANGE

OUTPUT	LOAD RANGE
0 to ±1 mA	0-10K OHMS
1-5 mA	0-5K OHMS
1-3-5 mA	0-5K OHMS
4-20 mA	0-1250 OHMS
4-12-20 mA	0-1250 OHMS

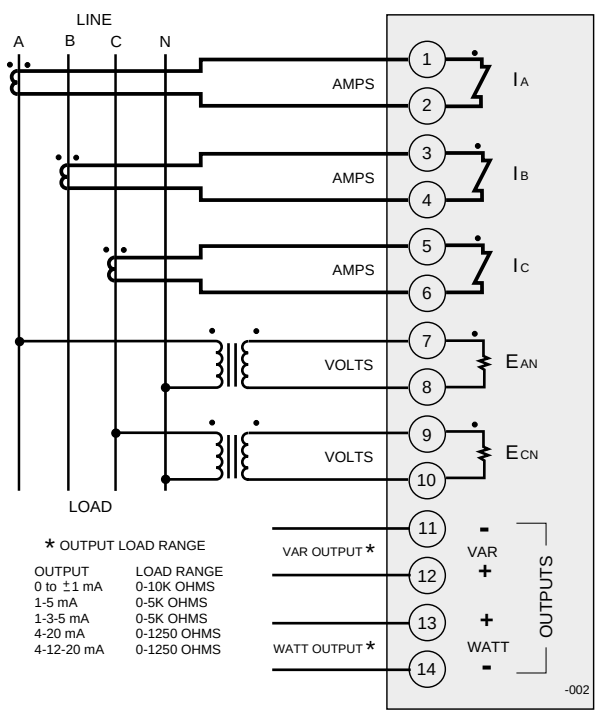
2-Element Watt, Var, Watt/Var with External Aux. Power



* OUTPUT LOAD RANGE

OUTPUT	LOAD RANGE
0 to ±1 mA	0-10K OHMS
1-5 mA	0-5K OHMS
1-3-5 mA	0-5K OHMS
4-20 mA	0-1250 OHMS
4-12-20 mA	0-1250 OHMS

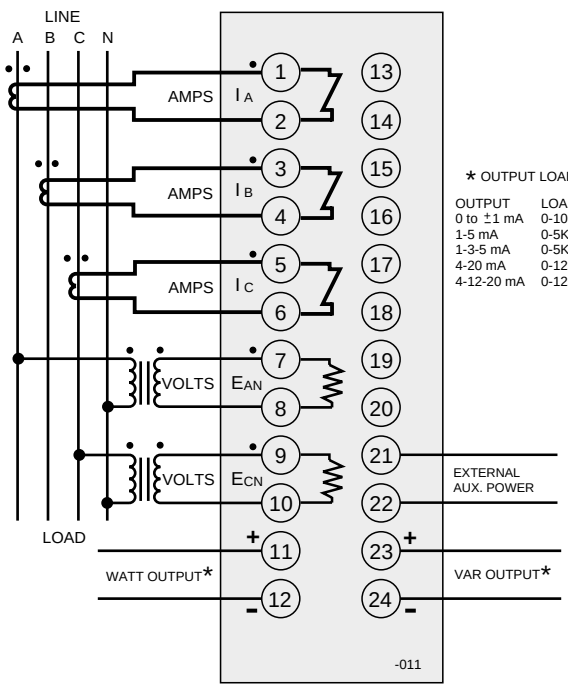
2½-Element Watt, Var, Watt/Var



* OUTPUT LOAD RANGE

OUTPUT	LOAD RANGE
0 to ±1 mA	0-10K OHMS
1-5 mA	0-5K OHMS
1-3-5 mA	0-5K OHMS
4-20 mA	0-1250 OHMS
4-12-20 mA	0-1250 OHMS

2½-Element Watt, Var, Watt/Var with External Aux. Power



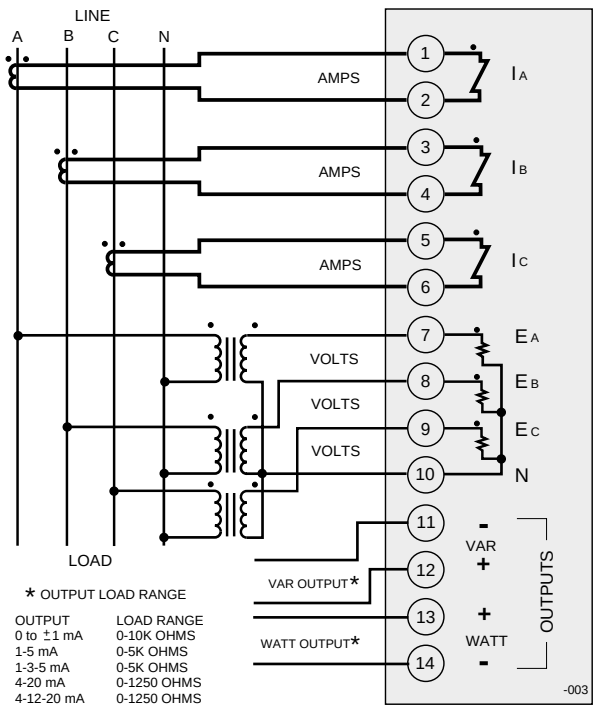
* OUTPUT LOAD RANGE

OUTPUT	LOAD RANGE
0 to ±1 mA	0-10K OHMS
1-5 mA	0-5K OHMS
1-3-5 mA	0-5K OHMS
4-20 mA	0-1250 OHMS
4-12-20 mA	0-1250 OHMS

XLP Plug-In

WIRING DIAGRAMS

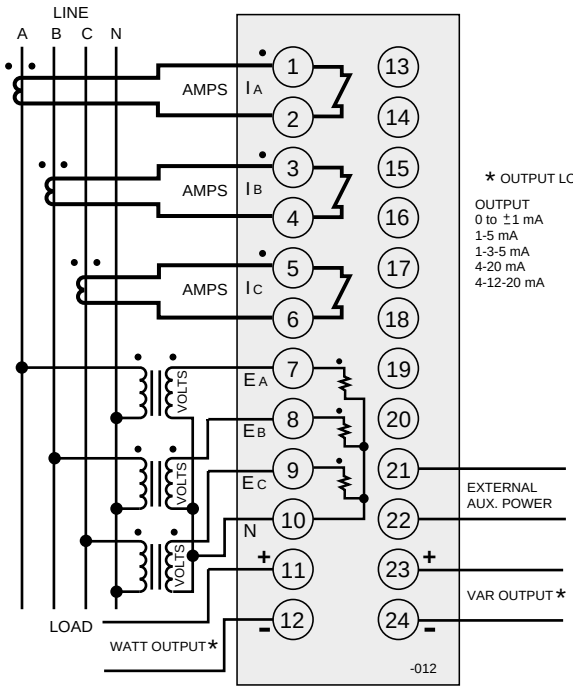
3-Element Watt, Var, Watt/Var



* OUTPUT LOAD RANGE

OUTPUT	LOAD RANGE
0 to ±1 mA	0-10K OHMS
1-5 mA	0-5K OHMS
1-3-5 mA	0-5K OHMS
4-20 mA	0-1250 OHMS
4-12-20 mA	0-1250 OHMS

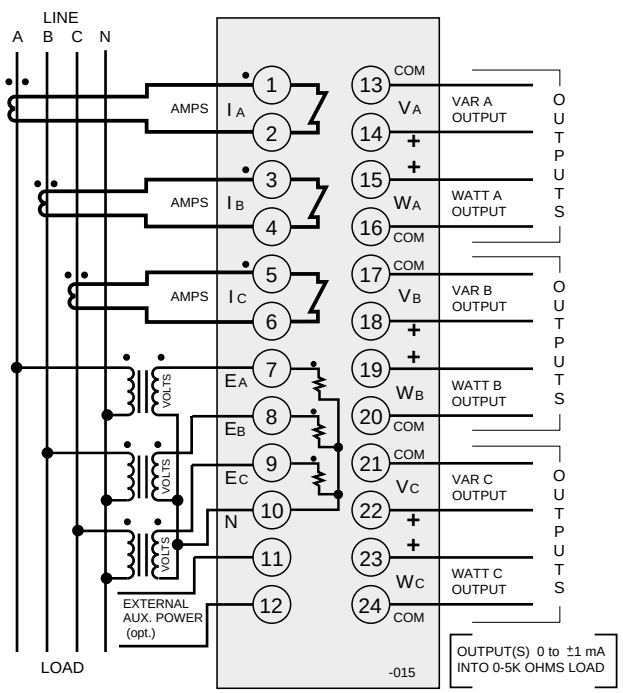
3-Element Watt, Var, Watt/Var with External Aux. Power



* OUTPUT LOAD RANGE

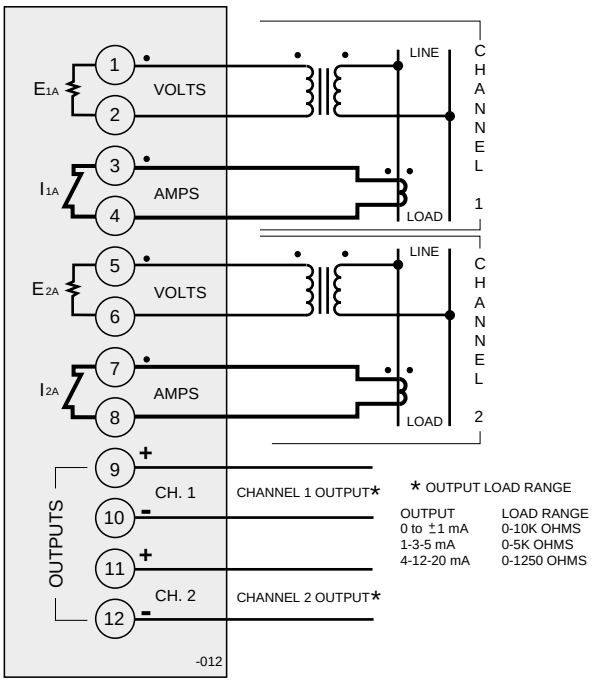
OUTPUT	LOAD RANGE
0 to ±1 mA	0-10K OHMS
1-5 mA	0-5K OHMS
1-3-5 mA	0-5K OHMS
4-20 mA	0-1250 OHMS
4-12-20 mA	0-1250 OHMS

Three 1-Element Watt/Vars in One Module with or without External Aux. Power



WIRING DIAGRAMS

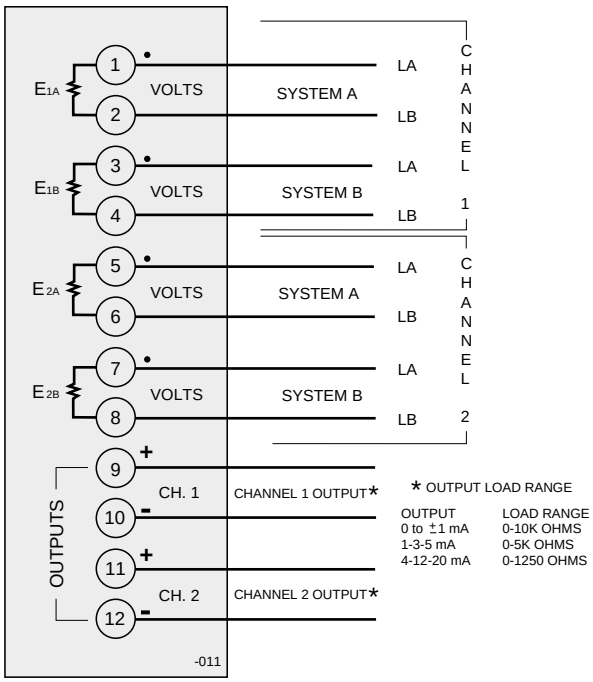
Models F1, F2 Phase Angle



* OUTPUT LOAD RANGE

OUTPUT	LOAD RANGE
0 to ±1 mA	0-10K OHMS
1-3-5 mA	0-5K OHMS
4-12-20 mA	0-1250 OHMS

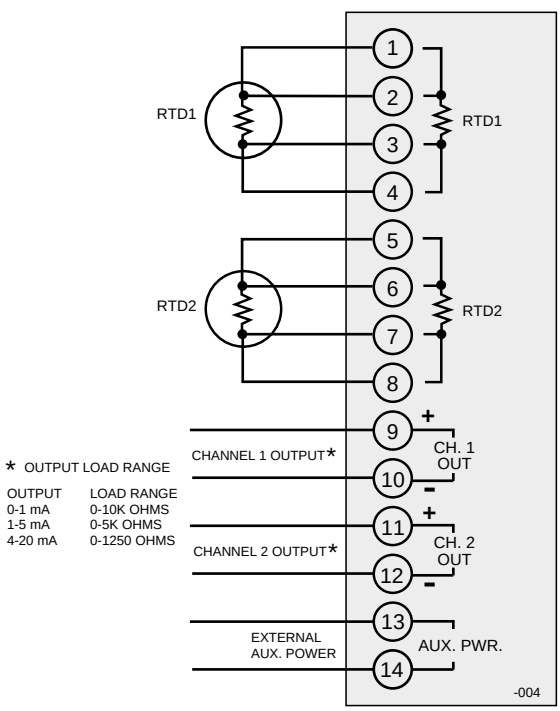
Models A1, A2 Voltage Angle



* OUTPUT LOAD RANGE

OUTPUT	LOAD RANGE
0 to ±1 mA	0-10K OHMS
1-3-5 mA	0-5K OHMS
4-12-20 mA	0-1250 OHMS

Models T1, T2 Temperature



* OUTPUT LOAD RANGE

OUTPUT	LOAD RANGE
0-1 mA	0-10K OHMS
1-5 mA	0-5K OHMS
4-20 mA	0-1250 OHMS

XLP Plug-In

AVAILABLE TEST EQUIPMENT

Scientific Columbus offers three testing devices for use with XLP transducers:

Test Fixture (Model XLP 6329B)

This device is used for bench calibrating and troubleshooting XLP transducer modules. The test fixture contains all of the various types of current transformers necessary to cover all of the different transducer configurations. Special switching selects the transducer configuration for the unit under test. All calibration is performed using the single-phase method.

This fixture is intended as a method of making electrical connections to the modules; it does not contain the necessary power source and reference standards. The Model 6444 Calibrator (see pages 120–121) is available for that purpose.

Output Loop Tester (Model XLP 6304)

This test module uses internal batteries to generate a very accurate 0.1 or 1 mAdc signal for testing equipment connected to the output loops of any of the XLP modules. A self-contained voltmeter measures the voltage across the loop under test to check for loop resistance or intermittent open circuits.

Input Signal Tester (Model XLP 6303)

This plug-in test module measures all 5 A or 150 V inputs to the XLP back-panel assemblies. It does not measure RTD inputs to temperature transducers. Its self-contained meter (0-5 A and 0-150 V ranges) allows 2% full-scale accuracy measurements. A front-panel jack allows up to 0.25% accuracy with an external 0-1 mAdc meter, such as a battery-powered DVM (digital voltmeter). An overload indicator is mounted on the front panel of the tester to indicate false readings due to an input overload.

Consult the factory for complete information on these test devices.

JEM® MULTIFUNCTION TRANSDUCER

As an alternative to the XLP plug-in transducers, Scientific Columbus offers a multifunction transducer packaged in a JEM®1-style case (dimensions are approximately 6.3" W x 7.6" D x 8.9" H or 161 mm x 192 mm x 227 mm). Functions available are watt, var, volt-amp, amp, amp^2, volt, volt^2, expanded-scale volt, plus integrated quantities for each of the above functions (watthours, etc.). Up to three functions can be packaged in one case (the third function is limited to one of the volt functions).

Consult the factory for specifications and ordering information.

Exceltronic II XLG AC Transducers

The Exceltronic II XLG is a lower-priced line of transducers that meets all common energy-measurement needs. Its 0.2% accuracy level permits measurement or monitoring of any circuit at minimal cost. Smaller can size with 4–20 mAdc output makes these transducers ideal for industrial applications and generating stations.

The XLG is available in current, voltage, watt, var, and combined watt/var units with 5 A or 120 V input levels on all units. The current and voltage units also have options for 10 A and 240 V inputs. Frequency levels of 50 or 60 Hz are available on all units. The 60 Hz XLG line is UL Recognized, and both 50 and 60 Hz models meet the ANSI/IEEE C37.90.1-1989 surge-withstand test.

Features

- Accuracy to 0.2% of reading
- UL Recognized
- Excellent long-term stability
- Isolated outputs on combined watt/var units
- 2500 VRMS isolation

Applications

- Process control
- Generating stations
- SCADA
- Substation monitoring

Outputs

- 0 to ±1 mAdc
- 4–20 mAdc
- 4–12–20 mAdc
- Unidirectional & bidirectional outputs on combination watt/var units

XLG

Exceltronic II XLG Transducers Provide Unique Process-Control Measurements

The Exceltronic II XLG Transducer line provides utilities with accuracy and measurement flexibility, and brings precision, utility-grade power measurement and control to the process-control industry.

Through the development of patented measurement technology, outputs of 4–20 mAdc and zero-center 4–12–20 mAdc are combined with Exceltronic design in smaller, versatile enclosures.

Scientific Columbus XLG Transducers provide precise measurement of voltage, current, watts (real power), and vars (reactive power), and can be utilized in many ways as inputs to your process-control system. Applications include early detection of machinery failure and electrical balance of the power system.

Specifications		0–1 mAdc Amps (Current Transducer)	4–20 mAdc Amps (Current Transducer)	0–1 mAdc Volts (Voltage Transducer)	4–20 mAdc Volts (Voltage Transducer)
Current Input	Nominal Calibrating Range Range with Linearity Overload Continuous Overload 1 Second/Hour Burden/Element	**Option A** 5 A 0–5 A 0–7.5 A 15 A 250 A 0.25 VA (maximum) at 5 A	Option D 10 A 0–10 A 0–15 A 20 A 250 A 0.35 VA (maximum) at 10 A	N/A	
Voltage Input	Nominal Calibrating Range Range with Linearity Overload Continuous Burden/Element	N/A		**Option 1** 120 V 0–150 V 0–150 V 180 V 2.2 VA (maximum) at 120 V	**Option 3** 240 V 0–300 V 0–300 V 300 V 2.2 VA (maximum) at 120 V
External Auxiliary Power	Input Range Frequency Range Burden/Element	None Required	85–150 Vac 50–500 Hz 2.5 VA (maximum) at 120 V	None Required	85–150 Vac 50–500 Hz 2.5 VA (maximum) at 120 V
Rated Output (RO) = 5 A or 150 V/Element		1 mAdc for Standard Calibration	20 mAdc for Standard Calibration	1 mAdc for Standard Calibration	20 mAdc for Standard Calibration
Accuracy		±0.2% RO			
Temperature Effect on Accuracy		±0.0075% / ° C (typical)		-0.015% / ° C (typical)	
Operating Temperature Range		-20° C to +60° C	-20° C to +50° C	-20° C to +60° C	-20° C to +50° C
Compliance Voltage		10 Vdc	15 Vdc	10 Vdc	15 Vdc
Load		Any load from 0–10,000 Ω at 1 mAdc	Any load from 0–750 Ω at 20 mAdc	Any load from 0–10,000 Ω at 1 mAdc	Any load from 0–750 Ω at 20 mAdc
Output Ripple Peak		< 0.5% RO			
Response Time		< 400 ms to 99%	< 500 ms to 99%	< 400 ms to 99%	< 500 ms to 99%
Standard Calibration Adjustments	Gain Zero	±10% of Reading (minimum) None Required	±20% of Reading (minimum) ±5% of Zero Point (minimum)	±10% of Reading (minimum) None Required	±20% of Reading (minimum) ±5% of Zero Point (minimum)
Frequency Range		48–62 Hz			
Stability (per year)		±0.25% RO, Noncumulative			
Operating Humidity		0–95% Noncondensing			
Isolation		Complete (Input/Output/Case)	Complete (Input/Output/Power/Case)	Complete (Input/Output/Case)	Complete (Input/Output/Power/Case)
Dielectric Withstand		2500 VRMS at 60 Hz			
Surge Withstand		ANSI/IEEE C37.90.1-1989			
Maximum Net Weight	Single Triple	1 lb., 1 oz. (0.5 kg) 2 lbs., 9 oz. (1.2 kg)			
Approximate Dimensions (excluding mounting plate)	Single Triple	3.3" W x 2.1" D x 4.3" H (84 mm x 53 mm x 109 mm) Style III Case, see page 122 4.4" W x 3.9" D x 4.9" H (112 mm x 99 mm x 124 mm) Style II Case, see page 122			

Specifications subject to change without notice.

ORDERING PROCEDURE

XLG Model Number: XLG V 10 S 1 - 1

Transducer Type
V = Voltage
I = Current

Elements
10 = 1 Element (single)
30 = 3 Element (triple)

Auxiliary Power
S = Self-Powered (internal auxiliary power)—0-1 mAdc units only
E = External Auxiliary Power (120 Vac std.)—4-20 mAdc units only

Output
1 = 0-1 mAdc
4 = 4-20 mAdc (unidirectional)

Input

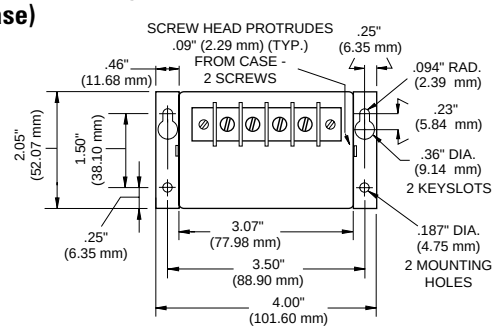
Current Units	Voltage Units
A = 5 A	1 = 120 V
D = 10 A	3 = 240 V

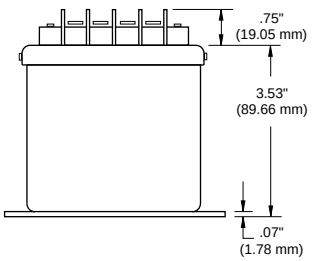
EXAMPLE: XLGV10S1-1
Voltage Transducer, 1 element, self-powered (internal auxiliary power), 0-1 mAdc output, 120 V input.

50-60 Hz is standard on all XLG Current and Voltage Transducers.

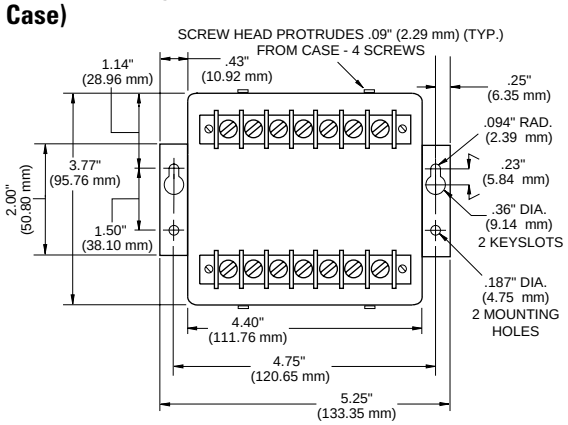
CASE DIMENSIONS (Styles III & II Cases)

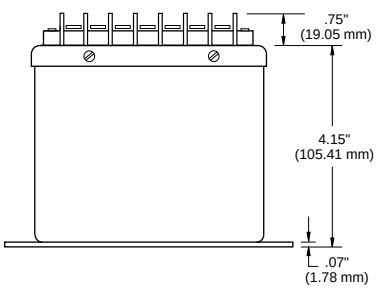
Single Current or Voltage (Style III Case)





Triple Current or Voltage (Style II Case)





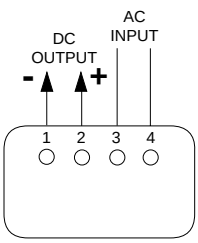
Terminal strips shown for illustration purposes only. For exact terminal-strip configuration on specific units, see connection diagrams on page 98. Drawings not to scale.

XLG

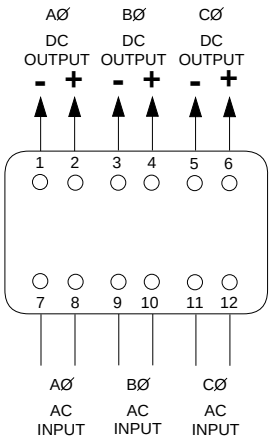
WIRING DIAGRAMS FOR 0-1 mAdc AND 4-20 mAdc UNITS (Styles III & II Cases)

0-1 mAdc Units

Single Current or Voltage (Style III Case)

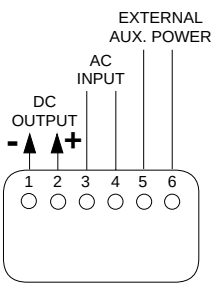


Triple Current or Voltage (Style II Case)

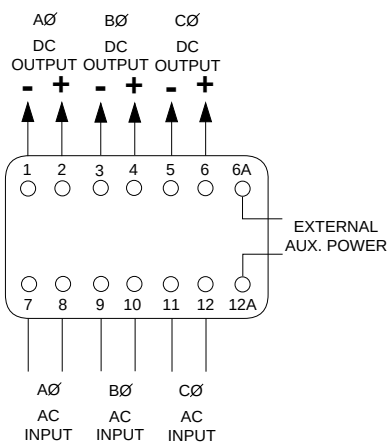


4-20 mAdc Units

Single Current or Voltage (Style III Case)



Triple Current or Voltage (Style II Case)



Adjust

Specifications
Exceltronic II XLG
AC Watt or Var Transducers

Specifications		0 to ±1 mAdc Watts (Watt Transducer)	4–20 mAdc Watts (Watt Transducer)	0 to ±1 mAdc Vars (Var Transducer)	4–20 mAdc Vars (Var Transducer)
Current Input	Nominal Range* Overload Continuous Overload 1 Second/Hour Burden/Element	5 A 0–10 A 15 A 250 A 0.3 VA (maximum) at 5 A			
Voltage Input	Nominal Range* Overload Continuous Burden/Element	120 V 0–150 V 180 V 0.035 VA (maximum) at 120 V			
External Auxiliary Power	Input Range Frequency Range Burden	85–150 Vac 50–500 Hz 4 VA (maximum) at 120 V		85–150 Vac 50–500 Hz 4.5 VA (maximum) at 120 V	
Rated Output (RO) = 500 Watts or Vars/Element		±1 mAdc for Standard Calibration	20 mAdc for Standard Calibration	±1 mAdc for Standard Calibration	20 mAdc for Standard Calibration
Accuracy		±(0.1% Reading + 0.05% RO) at 0–200% RO	±0.2% of Output Range	±(0.1% Reading + 0.1% RO) at 0–200% RO	±0.2% of Output Range
Temperature Effect on Accuracy		±0.005% / ° C (typical)	±0.0075% / ° C (typical)	±0.0075% / ° C (typical)	±0.008% / ° C (typical)
Operating Temperature Range		-20° C to +70° C	-20° C to +50° C	-20° C to +60° C	-20° C to +50° C
Compliance Voltage		10 Vdc	15 Vdc	10 Vdc	15 Vdc
Load		Any load from 0–10,000 Ω at 1 mAdc	Any load from 0–750 Ω at 20 mAdc	Any load from 0–10,000 Ω at 1 mAdc	Any load from 0–750 Ω at 20 mAdc
Output Ripple Peak		< 0.5% RO			
Response Time		< 400 ms to 99%	< 500 ms to 99%	< 400 ms to 99%	< 500 ms to 99%
Power Factor		Any			
PF Effect on Accuracy		±0.2% RO (maximum)			
Standard Calibration Adjustments	Gain Zero	±2% of Reading (minimum) None Required	±20% of Reading (minimum) ±5% of Zero Point (minimum)	±2% of Reading (minimum) None Required	±20% of Reading (minimum) ±5% of Zero Point (minimum)
Frequency Range		58–62 Hz		60 Hz	
Stability (per year)		±0.25% RO, Noncumulative			
Operating Humidity		0–95% Noncondensing			
Isolation		Complete (Input/Output/Power/Case)			
Dielectric Withstand		2500 VRMS at 60 Hz			
Surge Withstand		ANSI/IEEE C37.90.1-1989			
Maximum Net Weight		2 lbs., 11 oz. (1.2 kg)			
Approximate Dimensions (excluding mounting plate)		4.4" W x 3.9" D x 4.9" H (112 mm x 99 mm x 124 mm) Style II Case, see page 122			
Overrange with Linearity		500–1000 Watts/Element	500–600 Watts/Element	500–1000 Vars/Element	500–600 Vars/Element
		No additional error within voltage compliance. Reduce load resistance as required.			

*Total input not to exceed 200% of standard-calibration watts or vars on units with 0 to ±1 mAdc output.
Total input not to exceed 120% of standard-calibration watts or vars on units with 4–20 mAdc output.

Specifications subject to change without notice.

XLG

ORDERING PROCEDURE

XLG Model Number: XLG **W** **20** **E** **4** - **A1** -

Transducer Type
W = Watt
R = Reactive (var)

Elements
10 = 1 Element
20 = 2 Element
25 = 2 1/2 Element
30 = 3 Element

Auxiliary Power
S = Self-Powered (internal auxiliary power)
E = External Auxiliary Power (120 Vac std.)

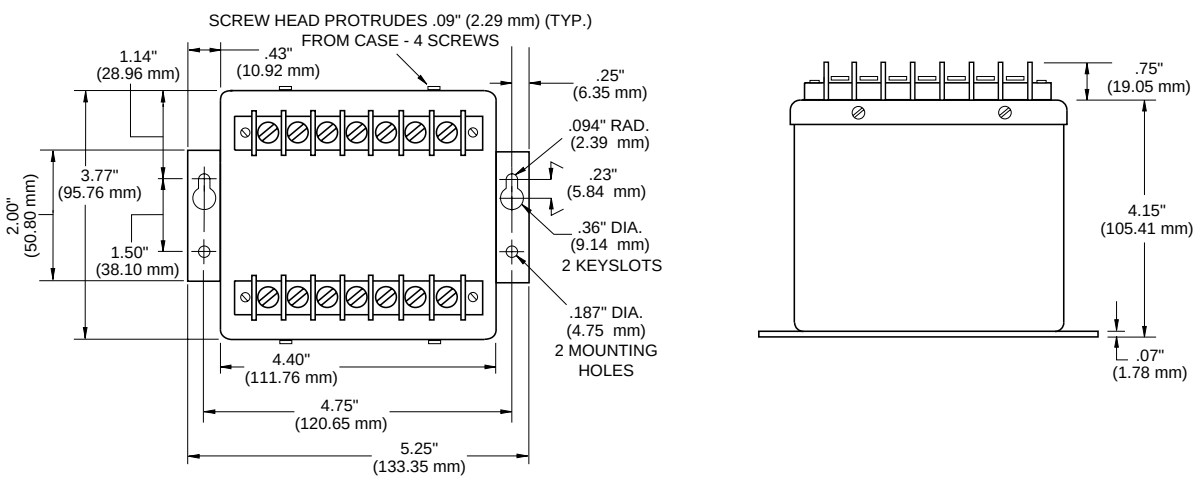
Output
1 = 0-1 mAdc
4 = 4-20 mAdc (unidirectional)
12 = 4-12-20 mAdc (bidirectional)

Input
A = 5 A
1 = 120 V

Option
5 = 50 Hz (not UL Recognized)

EXAMPLE: XLGW20E4-A1
Watt Transducer, 2 element, 120 Vac external auxiliary power, 4-20 mAdc output, 5 A/120 V input.

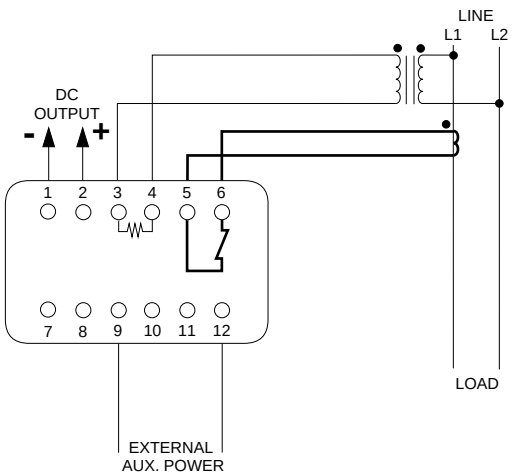
CASE DIMENSIONS (Style II Case)



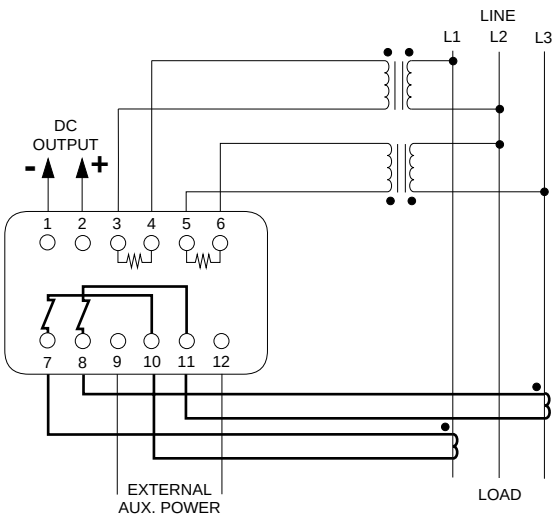
Terminal strips shown for illustration purposes only. For exact terminal-strip configuration on specific units, see connection diagrams on page 101. Drawings not to scale.

WIRING DIAGRAMS FOR 0-1 mAdc AND 4-20 mAdc UNITS (Style II Case)

1 Element, Single Phase, 2 Wire

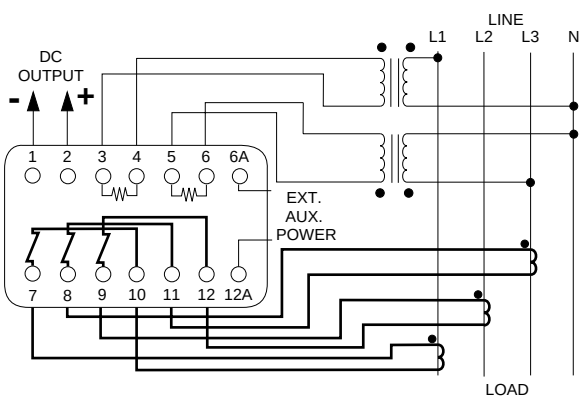


2 Element, 3 Phase, 3 Wire, Delta

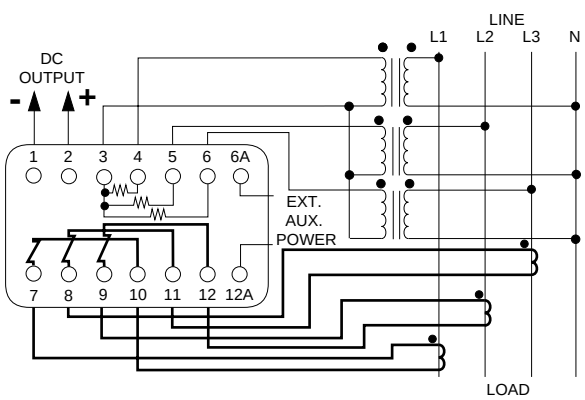


NOTE: Bottom terminal strip (7-12) omitted on S models.

2 1/2 Element, 3 Phase, 4 Wire, Wye



3 Element, 3 Phase, 4 Wire, Wye



Adjust

E Models: Shown. S Models: External aux. power not required.

Specifications
Exceltronic II XLG Combined AC Watt/Var Transducers

Specifications		0 to ±1 mAdc Watts (Combined Watt/Var Transducer)	4–20 mAdc Watts (Combined Watt/Var Transducer)	0 to ±1 mAdc Vars (Combined Watt/Var Transducer)	4–20 mAdc Vars (Combined Watt/Var Transducer)
Current Input	Nominal Range* Overload Continuous Overload 1 Second/Hour Burden/Element	5 A 0–10 A 15 A 250 A 0.3 VA (maximum) at 5 A			
Voltage Input	Nominal Range* Overload Continuous Burden/Element	120 V 0–150 V 180 V 0.035 VA (maximum) at 120 V			
External Auxiliary Power	Input Range Frequency Range Burden	85–150 Vac 50–500 Hz 8 VA (maximum) at 120 V			
Rated Output (RO) = 500 Watts or Vars/Element		±1 mAdc for Standard Calibration	20 mAdc for Standard Calibration	±1 mAdc for Standard Calibration	20 mAdc for Standard Calibration
Accuracy		±(0.1% Reading + 0.05% RO) at 0–200% RO	±0.2% of Output Range	±(0.1% Reading + 0.1% RO) at 0–200% RO	±0.2% of Output Range
Temperature Effect on Accuracy		±0.005% / ° C (typical)	±0.0075% / ° C (typical)	±0.0075% / ° C (typical)	±0.008% / ° C (typical)
Operating Temperature Range		-20° C to +60° C	-20° C to +50° C	-20° C to +60° C	-20° C to +50° C
Compliance Voltage		10 Vdc	15 Vdc	10 Vdc	15 Vdc
Load		Any load from 0–10,000 Ω at 1 mAdc	Any load from 0–750 Ω at 20 mAdc	Any load from 0–10,000 Ω at 1 mAdc	Any load from 0–750Ω at 20 mAdc
Output Ripple Peak		< 0.5% RO			
Response Time		< 400 ms to 99%	< 500 ms to 99%	< 400 ms to 99%	< 500 ms to 99%
Power Factor		Any			
PF Effect on Accuracy		±0.2% RO (maximum)			
Standard Calibration Adjustments	Gain Zero	±2% of Reading (minimum) None Required	±20% of Reading (minimum) ±5% of Zero Point (minimum)	±2% of Reading (minimum) None Required	±20% of Reading (minimum) ±5% of Zero Point (minimum)
Frequency		60 Hz			
Stability (per year)		±0.25% RO, Noncumulative			
Operating Humidity		0–95% Noncondensing			
Isolation		Complete (Input/Output/Power/Case)			
Dielectric Withstand		2500 VRMS at 60 Hz			
Surge Withstand		ANSI/IEEE C37.90.1-1989			
Maximum Net Weight		3 lbs., 5 oz. (1.5 kg)			
Approximate Dimensions (excluding mounting plate)		4.4" W x 3.9" D x 6.5" H (112 mm x 99 mm x 165 mm) Style IV Case, see page 123			
Overrange with Linearity		500–1000 Watts/Element	500–600 Watts/Element	500–1000 Vars/Element	500–600 Vars/Element
		No additional error within voltage compliance. Reduce load resistance as required.			

*Total input not to exceed 200% of standard-calibration watts and vars on units with 0 to ±1 mAdc output.
Total input not to exceed 120% of standard-calibration watts and vars on units with 4–20 mAdc output.

Specifications subject to change without notice.

ORDERING PROCEDURE

XLG Model Number: XLG C 30 E 1 - A1 - N

Transducer Type
C = Combined Watt/Var

Elements
10 = 1 Element
20 = 2 Element
25 = 2 1/2 Element
30 = 3 Element

Auxiliary Power
S = Self-Powered (internal auxiliary power)
E = External Auxiliary Power (120 Vac std.)

Output
1 = 0-1 mAdc
4 = 4-20 mAdc (unidirectional)
12 = 4-12-20 mAdc (bidirectional)
15 = 4-20 mAdc Unidirectional (watts)/4-12-20 mAdc Bidirectional (vars)

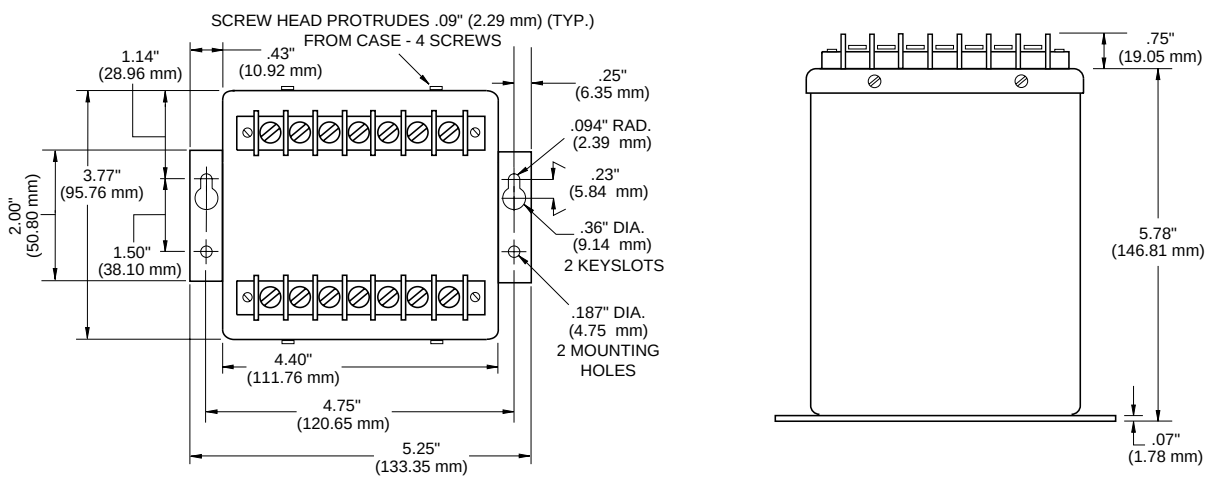
Input
A = 5 A
1 = 120 V

Options
N = Nonisolated Outputs
5 = 50 Hz (not UL Recognized)

EXAMPLE: XLGC30E1-A1-N
Combined Watt/Var Transducer, 3 element, 120 Vac external auxiliary power, 0-1 mAdc output, 5 A/120 V input, nonisolated.

XLG

CASE DIMENSIONS (Style IV Case)

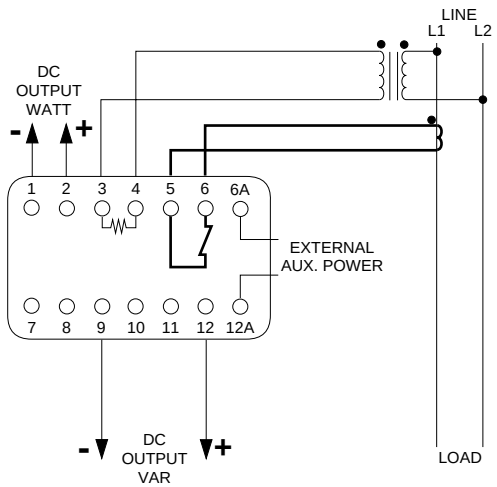


Terminal strips shown for illustration purposes only. For exact terminal-strip configuration on specific units, see connection diagrams on page 104. Drawings not to scale.

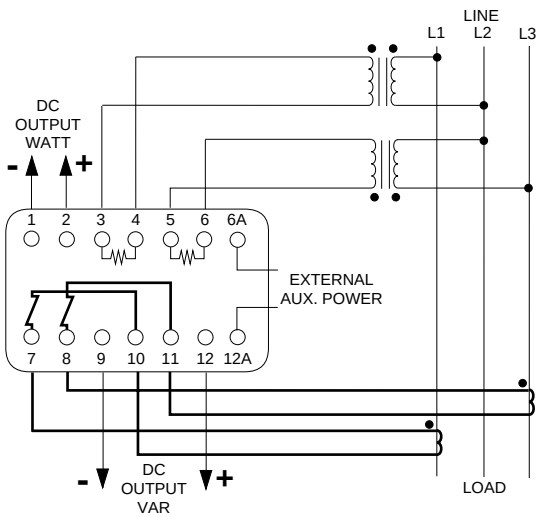
WIRING DIAGRAMS FOR 0-1 mAdc AND 4-20 mAdc ISOLATED UNITS (Style IV Case)

Nonisolated units have the same connections as the Exceltronic Combined Watt/Var Transducers on page 48.

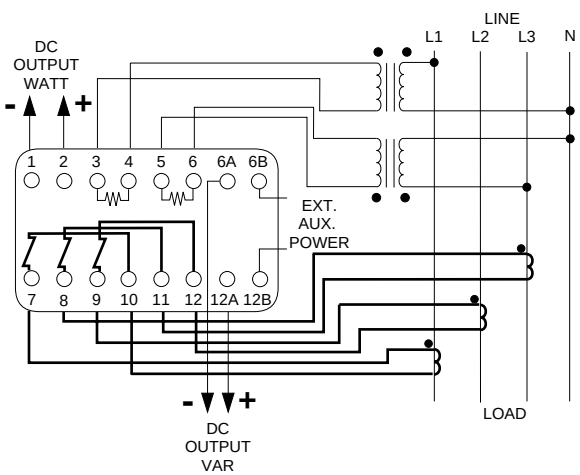
1 Element, Single Phase, 2 Wire



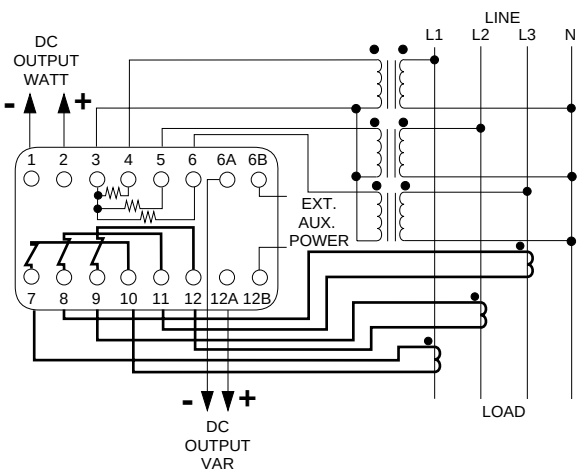
2 Element, 3 Phase, 3 Wire, Delta



2 1/2 Element, 3 Phase, 4 Wire, Wye



3 Element, 3 Phase, 4 Wire, Wye



E Models: Shown. S Models: External aux. power not required.

NOTE: Dynamic separation between the two analog outputs is limited to ±10 Vdc (±15 Vdc separation on E1 & S1 units).

How Accurate is your Cash Register?

In this industry an error rate as low as a fraction of a percent can mean the loss of hundreds of thousands of dollars. If you think of your meter as the "cash register" of your utility, you can envision the money you are losing through inaccurate measurements. Deregulation makes accurate metering your responsibility and even more important than ever before.

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JemStar is the metering solution for the new era of deregulation. At a time when old metering standards just won't do, JemStar provides accuracy you can take to the bank. Put profit and loss control at your fingertips. A powerful meter, that exceeds industry standards, JEMSTAR is the new "cash register" for the industry. Accurate monitoring provides more data, and it allows you to provide customers with additional services and information. JEMSTAR can help turn your profits around.

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Watthour Accuracy: 0.07% Reading exceeds IEC 687 Class 0.2 The JEMSTAR accuracy is unparalleled in the industry.

Graphical Display

Bi-Directional and 4 Quadrant Metering

Per Phase and System Measurements
Watts, Vars, VA, Q, Voltage, Current, PF, THD, Watthours, Varhours, VAhours, Qhours, Amphours

Registers:
Instantaneous, Consumption, Demand (Sliding & Fixed), Time of Peak, Average Power Factor, Coincident Demand, Coincident Power Factor, Cumulative Demand, Continuous Cumulative Demand,

Thermal Demand Emulation, Demand Prediction

Transformer Loss Compensation—TLC

Simultaneous Communications
I/R Port, RS-232, RS-485, Modem

Inputs and Outputs:
Analog Outputs are fully Programmable for any instantaneous measurement. (3) channels of either 0-1 or 4-20 mA.
Contact Outputs
(4) Channels Programmable as Threshold Alarms, Site Monitoring Alarms, Energy Pulses, EOD Output or Demand Prediction Alarm

Contact Inputs
(2) Channels Programmable for Pulse counter, Demand Synchronization, Status Input or TOU Rate Override.

S-Base, A-base, Switchboard

Auto-ranging Voltage: 55-530 VAC

Site Diagnostics include installation verification and on-going monitoring.

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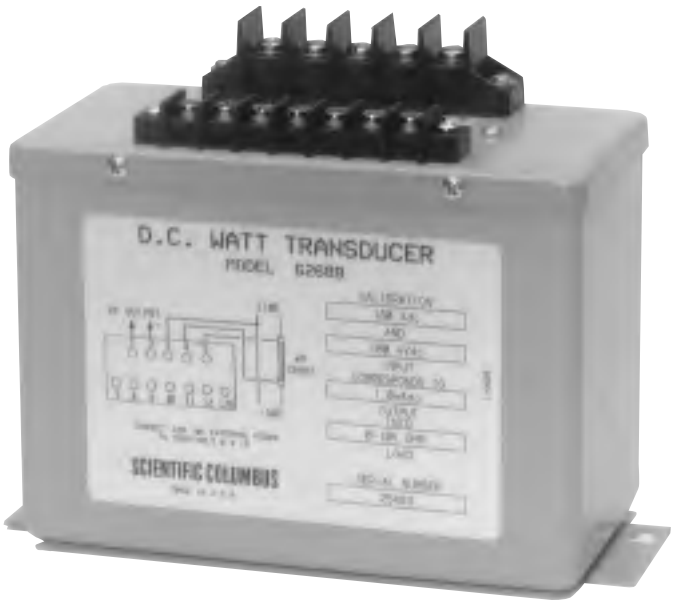
SCIENTIFIC COLUMBUS

DC Watt Transducers

The Model 6268 DC Watt Transducer is designed to monitor power in a dc power line and provide an analog output proportional to watts. Each unit is calibrated per customer requirement; dc current and voltage inputs must be specified prior to calibration. The current input can be direct from a customer-supplied 50 mVdc or 100 mVdc external shunt. The line-to-line voltage input connection can be made directly for voltages from 100–600 Vdc. An external multiplier resistance box is supplied for line-to-line voltages from 600–1000 Vdc.

Scientific Columbus DC Watt Transducers have the same three-year warranty as the Exceltronic line.



Features

- High reliability
- Wide operating temperature range
- Long-term stability

Applications

- DC rail systems
- DC transmission lines
- DC control & monitoring
- Mining

Outputs

- 0 to ±1 mAdc

DC Rail Systems

Scientific Columbus DC Watt Transducers perform well for monitoring dc power on electric rail systems. In a dc rail system, the catenary is energized to a specified dc level for operating the train. A Scientific Columbus DC Watt Transducer can derive an analog output signal proportional to watts to reflect the dc power delivered to the train.

Specifications, Ordering Procedure, & Wiring Diagram

DC WATT TRANSDUCERS

Specifications		DC Watt Transducer
Current Input	Nominal Range Overload Continuous Burden	50 mVdc or 100 mVdc from External Shunt (customer supplied) 0–150% of Rated Input ±5 Vdc 10 mAdc (maximum—excluding shunts)
Voltage Input	Nominal Range Overload Continuous Burden	100–1000 Vdc (For input above 600 Vdc, an external multiplier resistance box is supplied.) Rated Voltage ±20% Rated Voltage +30% 200 Ohms/Volt Nominal
External Auxiliary Power	Input Range Frequency Range Burden	105–130 Vac 60–500 Hz 6 VA Nominal
Rated Output (RO)		±1 mAdc at Nominal Inputs
Output Range		0 to ±1 mAdc
Accuracy	50 mVdc Shunt 100 mVdc Shunt	±0.75% RO ±0.5% RO
Temperature Effect on Accuracy		±0.015% / ° C (excluding shunts)
Operating Temperature Range		-20° C to +60° C
Compliance Voltage		10 Vdc
Load		0–10,000 Ω
Output Ripple Peak		< 0.5% RO
Response Time		< 400 ms to 99%
Standard Calibration Adjustments	Gain Zero	±2% of Reading (minimum) None Required
Stability (per year)		±0.2% RO, Noncumulative
Operating Humidity		0–95% Noncondensing
Isolation		Complete (Input/Output/Power/Case)
Dielectric Withstand		2500 Vdc for 1 Second
Surge Withstand		ANSI/IEEE C37.90.1
Maximum Net Weight		3 lbs., 14 oz. (1.8 kg)
Approximate Dimensions (excluding mounting plate)		7.0" W x 3.7" D x 6.1" H (178 mm x 94 mm x 155 mm) Style I Case, see page 122

Specifications subject to change without notice.

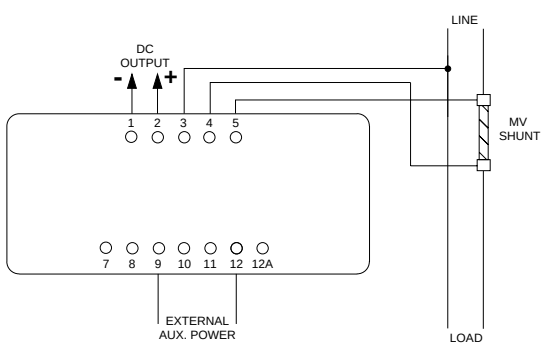
ORDERING PROCEDURE

Model No.
6268

Please consult the factory if you require any options with the 6268 DC Watt Transducer.

WIRING DIAGRAM (Style I Case)

Model 6268 DC Watt Transducer



Instrumentation

SCIENTIFIC COLUMBUS

DC Voltage Isolation Amplifiers

The Model 6271A DC Voltage Isolation Amplifier is a linear amplifier designed to amplify dc shunted millivolt signals or dc voltages ranging from 0–50 mV through 0–1000 V, and provide complete isolation of the input signal.

The output circuit is a hybrid amplifier operating in the transconductance mode to provide true current output. Load resistance variations from 0–10,000 Ω have less than 0.1% effect on the output current.

Scientific Columbus DC Voltage Isolation Amplifiers have the same three-year warranty as the Exceltronic line.

Features

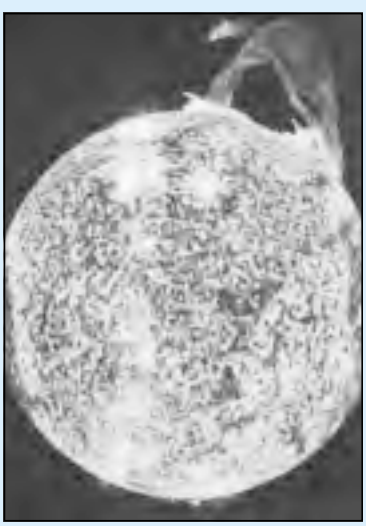
- Complete isolation
- DC shunt inputs or dc voltage from 0–50 mV thru 0–1000 V
- 4000 Vdc input isolation
- Filtered output

Applications

- Telemetering
- Recording devices
- A/D converters

Outputs

- 0 to ±1 mAdc
- 1–5 or 1–3–5 mAdc
- 4–20 or 4–12–20 mAdc
- 10–50 or 10–30–50 mAdc



Neutral-Current Sensor Warns of Magnetic Storms

Off-the-shelf electronic components are used by a large investor-owned utility to measure quasi-direct currents flowing in the neutrals of key transformers during solar-magnetic storms. The primary aim is to collect field data confirming the accuracy of recently developed models of dc current during geomagnetic activity. The geomagnetic current sensors interface with the utility's SCADA system, so dispatchers can act accordingly when magnetic activity occurs.

The neutral-current sensor consists of the Scientific Columbus Model 6271A DC Voltage Isolation Amplifier and a removable-yoke dc current sensor. The isolation amplifier filters out ac current and provides a precision 0 to ±1 mAdc bidirectional output to interface with the SCADA system.

Specifications

DC VOLTAGE ISOLATION AMPLIFIERS

Specifications		0 to ±1 mAdc (DC Voltage Isolation Amplifier)		P-Option* (DC Voltage Isolation Amplifier)	
Current Input Units Only	Nominal Range Overload Continuous Impedance	— 0 to ±1 mAdc**† ±3 mAdc < 100 Ω			
Voltage Input Units Only	Nominal Ranges Available Impedance 0–20 Vdc 21–1000 Vdc	0 to ±100 mVdc† 0 to ±50 mVdc thru 0 to ±1000 Vdc (customer specified)† 5000 Ohms/Volt 1400 Ohms/Volt			
External Auxiliary Power	Input Range Frequency Range Burden	108–132 Vac 58–62 Hz 2 VA Nominal		108–132 Vac 58–62 Hz 5 VA Nominal	
Rated Output (RO)		0 to ±1 mAdc for Standard Calibration		5, 20, or 50 mAdc for Standard Calibration, depending on selected output range*	
Accuracy		±0.5% RO at 25° C		±0.7% of Span	
Temperature Effect on Accuracy		±0.04% / ° C		±0.05% / ° C	
Operating Temperature Range		-10° C to +70° C		-10° C to +50° C	
Compliance Voltage		10 Vdc		See Table 2 on page 110.	
Load		0–10,000 Ω			
Output Ripple Peak		6271A unit contributes < 0.25% RO at steady-state dc input		6271 unit contributes < 0.25% of Span at steady-state dc input	
Response Time		< 400 ms to 99%		< 1 Second to 99%	
Standard Calibration Adjustments	Gain Zero	±15% RO (minimum) ±1% RO (minimum)		±20% of Span (minimum) ±5% of Zero Point (minimum)	
Stability (per year)		±0.25% RO, Noncumulative		±0.4% of Span, Noncumulative	
Operating Humidity		0–95% Noncondensing			
Isolation		Input to (Output/Power/Case)	Output/Power/Case	Input to (Output/Power/Case)	Output/Power/Case
Dielectric Withstand		4000 Vdc	1500 VRMS at 60 Hz	4000 Vdc	1500 VRMS at 60 Hz
Maximum Net Weight		2 lbs., 2 oz. (1 kg)		3 lbs., 8 oz. (1.6 kg)	
Approximate Dimensions (excluding mounting plate)		4.4" W x 3.9" D x 4.7" H (112 mm x 99 mm x 119 mm) Style II Case, see page 122		7.0" W x 3.7" D x 5.6" H (178 mm x 94 mm x 142 mm) Style I Case, see page 122	

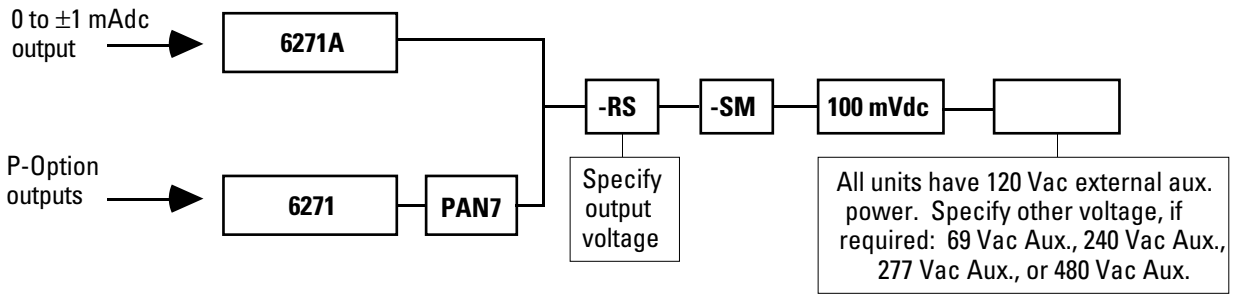
* P-Option includes 1–5/1–3–5, 4–20/4–12–20, and 10–50/10–30–50 mAdc outputs.
**Other input ranges available; consult factory.
† All inputs are zero-based spans.

Specifications subject to change without notice.

ORDERING PROCEDURE

Specify by base model number and appropriate selection or option suffixes in the order shown in the following example.

Base Model No.	Output	Scaling Resistor Option #1	Option #2	Input	External Auxiliary Power
Table 1	Table 2	Table 3	Table 4	Table 5	



EXAMPLES: 6271A-RS-SM-100 mVdc

0 to ±1 mAdc output DC Voltage Isolation Amplifier, resistor scaling (converts current output to voltage output), seismic brace, 0 to ±100 mVdc (std.) input calibration.

6271PAN7-RS-SM-100 mVdc

4-20 mAdc output DC Voltage Isolation Amplifier, resistor scaling (converts current output to voltage output), seismic brace, 0-100 mVdc (std.) input calibration.

Table 1 Base Model Number Selection

Model No.

(0 to ±1 mAdc Units)

6271A

(P-Option Units)

6271

Table 2 Output Selection

0 to ±1 mAdc output is standard, and is specified by the Base Model Numbers. For outputs other than 0 to ±1 mAdc, indicate the appropriate P-Option in the "Output" position of the complete model number.

P-Option	Output Range	Compliance Voltage/ Maximum Load	Maximum Open Circuit Voltage
PAN6	1-5 mAdc	15 Vdc/3000 Ω	30 Vdc
PAN7	**4-20 mAdc**	**15 Vdc/750 Ω**	**30 Vdc**
PAN8	10-50 mAdc	15 Vdc/300 Ω	30 Vdc
PAN6-B	1-3-5 mAdc	15 Vdc/3000 Ω	30 Vdc
PAN7-B	4-12-20 mAdc	15 Vdc/750 Ω	30 Vdc
PAN8-B	10-30-50 mAdc	15 Vdc/300 Ω	30 Vdc
PA6	1-5 mAdc	40 Vdc/8000 Ω	70 Vdc
PA7	4-20 mAdc	40 Vdc/2000 Ω	70 Vdc
PA8	10-50 mAdc	30 Vdc/600 Ω	70 Vdc
PA6-B	1-3-5 mAdc	40 Vdc/8000 Ω	70 Vdc
PA7-B	4-12-20 mAdc	40 Vdc/2000 Ω	70 Vdc
PA8-B	10-30-50 mAdc	30 Vdc/600 Ω	70 Vdc

Table 3 Scaling Resistor (-RS) Option

Option	Description
-RS*	Scaling Resistor

***You must specify the desired output voltage:**
For 0 to ±1 mAdc units, specify range from 0 to ±10 Vdc. Load impedance is 1 MΩ/Vdc (minimum).
For P-Option units, specify range from 0-15 Vdc (PAN models) or 0-40 Vdc (PA models). Load impedance is 200, 50, or 20 (kΩ/Vdc) (minimum) for units with outputs of 5, 20, or 50 mAdc, respectively.

This information is not part of the model number, but must be provided to the factory when you place your order.

Table 4 Other Options

Option	Description
-24	24 Vdc Loop-Powered (PA7 and PA7-B models only) (consult factory for specifications)
-SM	Seismic Brace (available with 0 to ±1 mAdc units) (consult factory if you desire this option with a P-Option unit)
-Z	Zero-Based Output Calibration (ex.: PA7-Z = 0-20 mAdc) (available only with P-Option units, except PAN-B models)

If you require additional options not shown here, see Special Options on page 128. When ordering any special options, or more than three options, you must first consult the factory for pricing and delivery estimates.

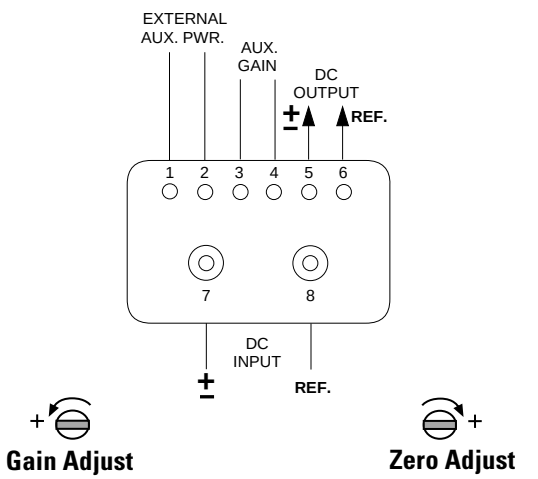
Table 5 Input Selection

Type of Input	Input Span
Current	0 to ±1 mAdc
Voltage	0 to ±50 mVdc thru 0 to ±1000 Vdc

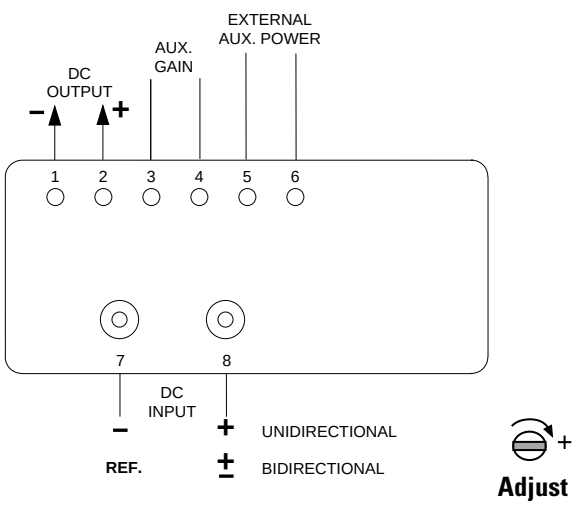
All inputs for these units are zero-based spans. The standard input span is 0 to ±100 mVdc. All 0 to ±1 mAdc output units are inherently bidirectional; P-Option units are unidirectional or bidirectional as indicated in Table 2.

WIRING DIAGRAMS FOR 0 to ±1 mAdc UNITS (Style II Case) AND P-OPTION UNITS (Style I Case)

6271A DC Voltage Isolation Amplifier 0 to ±1 mAdc Units



6271 DC Voltage Isolation Amplifier P-Option Units



Caution: **For 0 to ±1 mAdc units, external auxiliary power connects to terminals 1 & 2; for P-Option units, external auxiliary power connects to terminals 5 & 6.**

DC Instrument Amplifiers

The Model 6181A DC Instrument Amplifier is a non-isolated unit with unmatched stability which provides a direct interface to low-level signals.

Operating modes include: current-amplifier mode, voltage-amplifier mode, transresistance mode, and transconductance mode.

Scientific Columbus DC Instrument Amplifiers have the same three-year warranty as the Exceltronic line.

SPECIFICATIONS

Specifications		DC Instrument Amplifier
External Auxiliary Power	Input Range Frequency Range Burden	100–130 Vac 50–500 Hz 5 VA (maximum)
DC Input Limits (zero-based span)	Current Voltage	0–10 µA thru 0–5 mA 0–10 mV thru 0–8 V
DC Output Limits (zero-based span)	Current Voltage	0–10 mA (maximum) 0–8 V (maximum)
Effective Input Impedance	Current Voltage	<10 Ω >10 MΩ
DC Linearity		±0.5% of Maximum Output*
Gain Stability		±0.5% of Maximum Output*
Zero Stability		20 µV / ° C (maximum), 5 µV / ° C (typical) Referenced to Input
Accuracy/Temperature Effect/ Long-Term Stability		Dependent on externally selected components
Operating Temperature Range		-10° C to +50° C
Response Time		< 100 ms to 99%
Maximum Net Weight		1 lb., 14 oz. (0.9 kg)
Approximate Dimensions (excluding mounting plate)		4.4" W x 3.9" D x 4.7" H (112 mm x 99 mm x 119 mm) Style II Case, see page 122

* Must fall within input, output, and feedback resistance limits listed.

Specifications subject to change without notice.

Ordering Procedure & Wiring Diagrams

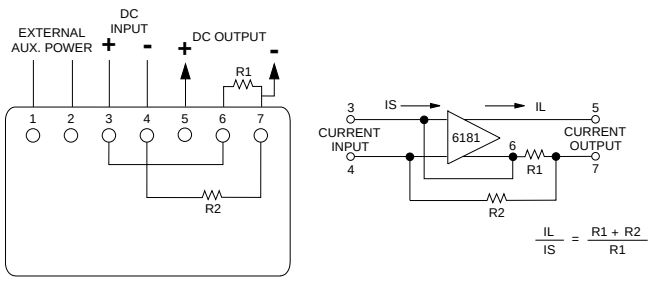
ORDERING PROCEDURE FOR DC INSTRUMENT AMPLIFIERS

Model No.
6181A

Please consult the factory if you require any options with the 6181A DC Instrument Amplifier.

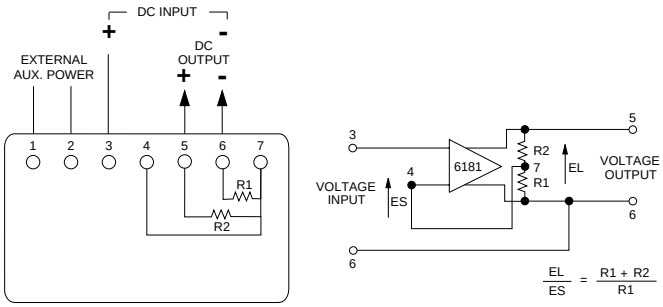
WIRING DIAGRAMS FOR DC INSTRUMENT AMPLIFIERS (Style II Case)

Current-Amplifier Mode



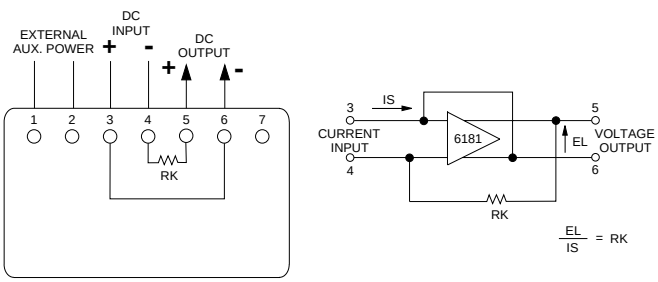
LOW INPUT IMPEDANCE (CURRENT INPUT)
HIGH OUTPUT IMPEDANCE (CURRENT OUTPUT)

Voltage-Amplifier Mode



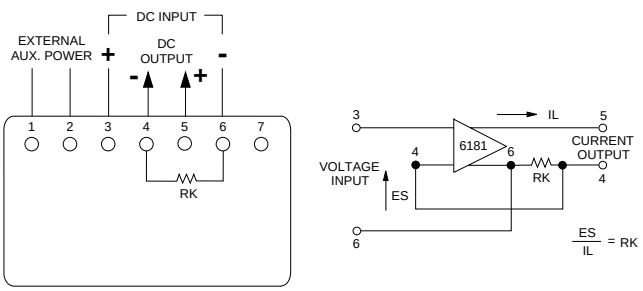
HIGH INPUT IMPEDANCE (VOLTAGE INPUT)
LOW OUTPUT IMPEDANCE (VOLTAGE OUTPUT)

Transresistance Mode



LOW INPUT IMPEDANCE (CURRENT INPUT)
LOW OUTPUT IMPEDANCE (VOLTAGE OUTPUT)

Transconductance Mode



HIGH INPUT IMPEDANCE (VOLTAGE INPUT)
HIGH OUTPUT IMPEDANCE (CURRENT OUTPUT)

Zero Adjust

SCIENTIFIC COLUMBUS

Analog-to-Pulse Converters

Scientific Columbus analog-to-pulse converters are patented, high-accuracy, crystal-referenced devices for converting an analog signal into an integrated pulse output. Inputs may be from a watt, var, current, voltage, temperature, or other type of transducer for which integrated output information is required. Unidirectional and bidirectional models are available as well as multiple-channel (1, 2, or 3) models. The outputs can be either mercury-wetted relay or solid-state and can be fed into Scientific Columbus registers (see pages 118–119), pulse recorders, or other Form-A (2-wire) or Form-C (3-wire) receiving devices. A second, isolated Form-C relay may be added on some models. Isolated inputs are also available as an option on some models.

Scientific Columbus analog-to-pulse converters have the same three-year warranty as the Exceltronic line.

Features

- Accuracy to ±0.1% of reading
- Unidirectional or bidirectional
- Form-C mercury-wetted relay or solid-state output
- Multichannel units available

Applications

- Converting any analog signal into a pulse signal
- Substations
- Generating stations

Outputs

- 2–14,000 cph (relay)
- 2–900,000 cph (solid-state)

Specifications

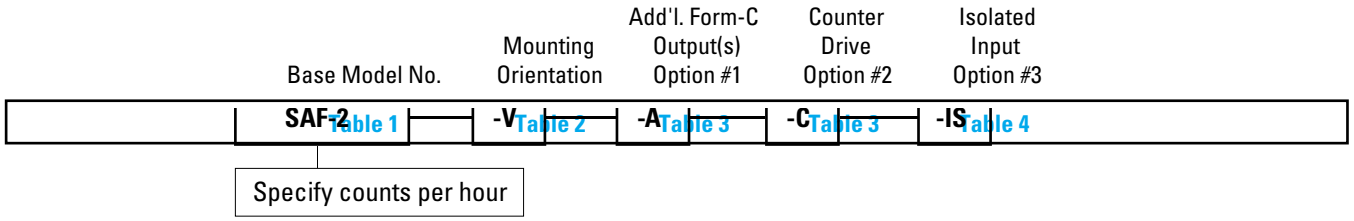
ANALOG-TO-PULSE CONVERTERS

Specifications		Analog-to-Pulse Converters	
Current Input	Models 6070, 6270, 6096, 6296, & SAF Range Overload Continuous	1 mAdc or ±1 mAdc Full Scale 0–200% of Full Scale Rating ±10 mAdc	
Voltage Input	Models 6370, 6396 6570, & 6596 Range Overload Continuous	1 Vdc or ±1 Vdc Full Scale 0–200% of Full Scale Rating ±10 Vdc	
External Auxiliary Power	Input Range Frequency Range Burden	85–135 Vac 50–500 Hz 2 VA Nominal	
Rated Output (RO)	Models 6070, 6370 6096, & 6396 Models 6270, 6296 6570, 6596, & SAF	2–14,000 cph 2–900,000 cph	
Accuracy	Models 6070, 6270, 6096, 6296, & SAF Models 6370, 6396, 6570, & 6596	±(0.05% Reading + 0.005% RO) ±(0.09% Reading + 0.01% RO)	
Temperature Effect on Accuracy	Models 6070, 6270, 6096, 6296, & SAF Models 6370, 6396, 6570, & 6596	±0.003% / ° C (maximum) ±0.005% / ° C (maximum)	
Operating Temperature Range		-20° C to +70° C	
Output	Models 6070, 6370, 6096, & 6396 Models 6270, 6296, 6570, 6596, & SAF	Form-C, SPDT, 3-Wire, Mercury-Wetted Relays Form-C, SPDT, 3-Wire, Solid-State	
Relay Contact Rating		15 VA at 1 A (maximum) or 150 Vac/15 Vdc (maximum) with resistive load. Contact protection required for inductive loads. Relay maintains its position under power-failure conditions.	
Relay Contact Life		One billion operations when operated within specifications.	
Solid-State Output Contact Rating		28 Vdc (maximum). V_{CESAT}: 1 Vdc (maximum) at 7 mAdc	
Standard Calibration Adjustment		±1% (minimum)	
Stability (per year)		±0.1% RO, Noncumulative	
Operating Humidity		0-95% Noncondensing	
Isolation		Input/Power/Case and Output/Power Case	Input/Output (except counter-drive output)
Dielectric Withstand		1500 VRMS	1000 VRMS on KYZ Output
Surge Withstand		ANSI/IEEE C37.90.1	
Orientation	Models 6070, 6370, 6096, & 6396 Models 6270, 6296, 6570, 6596, & SAF	Within 30° of Vertical/Horizontal Unlimited	
Maximum Net Weight		3 lbs., 2 oz. (1.4 kg)	
Approximate Dimensions (excluding mounting plate)		7.0" W x 3.7" D x 5.8" H (178 mm x 94 mm x 147 mm) Style I Case, see page 122	

Specifications subject to change without notice.

ORDERING PROCEDURE

Specify by base model number and appropriate selection or option suffixes in the order shown in the following example.



EXAMPLES: SAF-2-V-A-C-IS

0 to -1 mAdc, 2-channel Analog-to-Pulse Converter with two standard Form-C solid-state outputs; vertical mounting; two additional Form-C mercury-wetted relays; two counter-drive outputs; isolated inputs.

Table 1 Base Model Number Selection

Model No.	Input	Configuration	Input Impedance	Output	CPH Range*
6070	0-1 mAdc	Unidirectional	1 Ω (maximum)	1 Form-C Mercury-Wetted Relay	2-14,000
6270	0-1 mAdc	Unidirectional	1 Ω (maximum)	1 Form-C Solid-State Output	2-900,000
6370	0-1 Vdc	Unidirectional	10 MΩ (minimum)	1 Form-C Mercury-Wetted Relay	2-14,000
6570	0-1 Vdc	Unidirectional	10 MΩ (minimum)	1 Form-C Solid-State Output	2-900,000
6096	0 to ±1 mAdc	Bidirectional	1 Ω (maximum)	2 Form-C Mercury-Wetted Relays	2-14,000
6296	0 to ±1 mAdc	Bidirectional	1 Ω (maximum)	2 Form-C Solid-State Outputs	2-900,000
6396	0 to ±1 Vdc	Bidirectional	10 MΩ (minimum)	2 Form-C Mercury-Wetted Relays	2-14,000
6596	0 to ±1 Vdc	Bidirectional	10 MΩ (minimum)	2 Form-C Solid-State Outputs	2-900,000
SAF-1	0 to -1 mAdc	1 Channel, Unidirectional	1 Ω (maximum)	1 Form-C Solid-State Output	2-900,000
SAF-2**	0 to -1 mAdc	2 Channels, Unidirectional	1 Ω (maximum)	2 Form-C Solid-State Outputs	2-900,000
SAF-3**	0 to -1 mAdc	3 Channels, Unidirectional	1 Ω (maximum)	3 Form-C Solid-State Outputs	2-900,000

*** You must specify the desired counts per hour. This information is not part of the model number, but must be provided to the factory when you place your order.**

**** Standard SAF-2 and SAF-3 units have common positive input terminals.**

Table 2 Mounting Orientation Selection

Option	Description
-H	Horizontal Mounting (std.) (table, bench, or shelf)
-V	Vertical Mounting (wall mounting with vertical terminal blocks)

These options apply only to units with mercury-wetted relays: Models 6070, 6370, 6096, 6396, or any SAF model with option -A.

Table 3 Output Options

Option	Description
-A	Add'l. Form-C Mercury-Wetted Relay(s)
-B	Add'l. Form-C Solid-State Output(s)
-C	Counter-Drive Output(s)

These options apply only to SAF models. The number of relays, solid-state outputs, or counter drives corresponds to the number of channels in the unit. (Example: An SAF-3-A unit has three additional Form-C mercury-wetted relays in addition to the three standard solid-state outputs.)

Table 4 Isolated Input Option

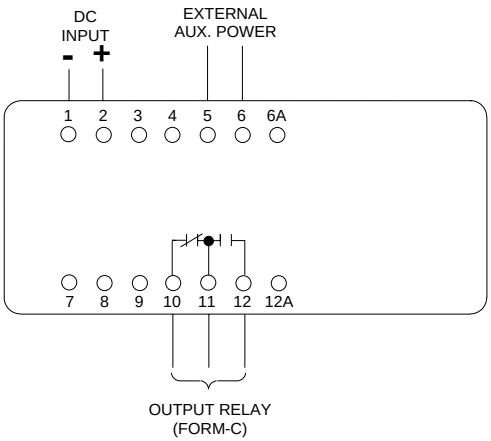
Option	Description
-IS	Isolated Inputs

This option applies only to SAF-model units and requires a Style V case. (See page 123 for case dimensions.)

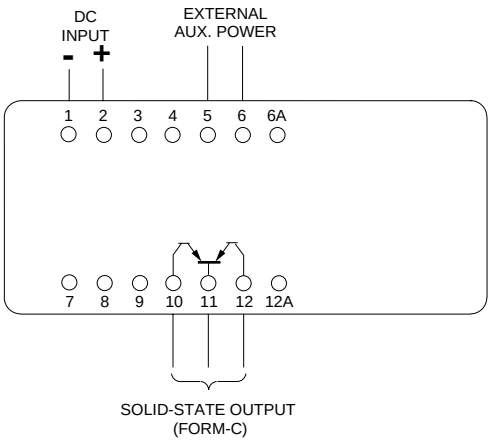
Please consult the factory if you require any additional options with Analog-to-Pulse Converters.

WIRING DIAGRAMS (Style I Case)

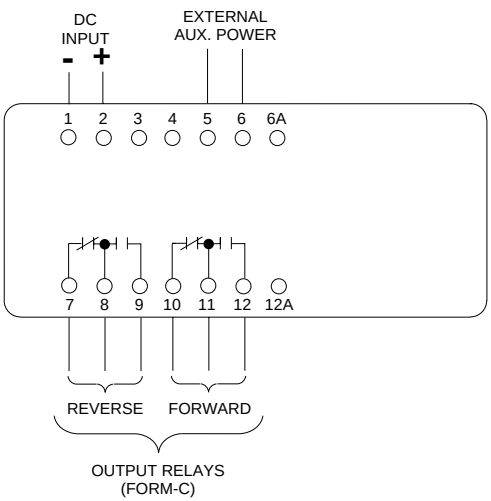
Models 6070 & 6370



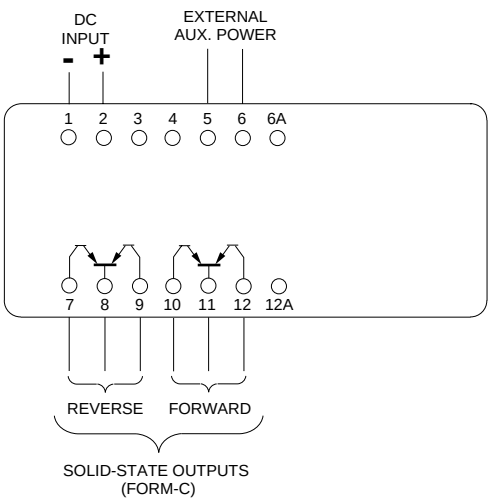
Model 6270 & 6570



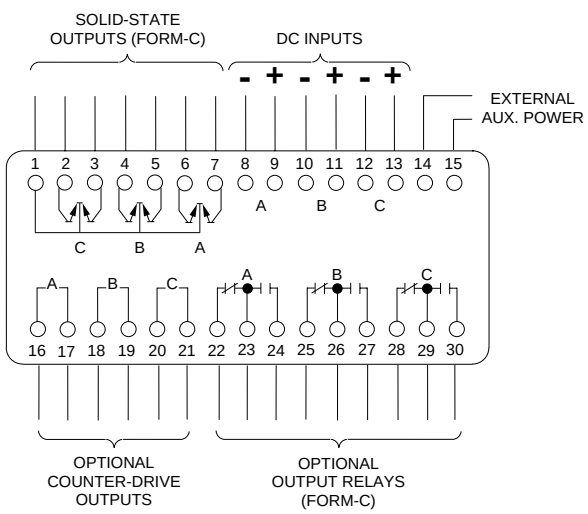
Models 6096 & 6396



Model 6296 & 6596



Models SAF-1, -2, -3



Model SAF-3 is shown with options -A (additional mercury-wetted relays) and -C (counter drives). SAF-1 models have only the Channel "A" connections; SAF-2 models have only the Channel "A" and "B" connections.

Terminals 9, 11, & 13 (positive current input) are commoned internally. Requires negative current input for proper operation.

Gain Adjust

Instrumentation

Registers

The Models 6152 and 6153 Registers are used to display pulse outputs. They are designed for use with all Scientific Columbus pulse-output transducers and analog-to-pulse converters. They can also be used as remote registers for our JEM meters. Models 6172 and 6173 Registers are available for remote mounting of the can away from the counter. Consult the factory for more information on these products.

Scientific Columbus registers have the same three-year warranty as the Exceltronic line.

FEATURES

- Unidirectional or bidirectional
- 6-digit resettable or 7-digit nonresettable display
- Optional auxiliary relays and panel mounting

SPECIFICATIONS

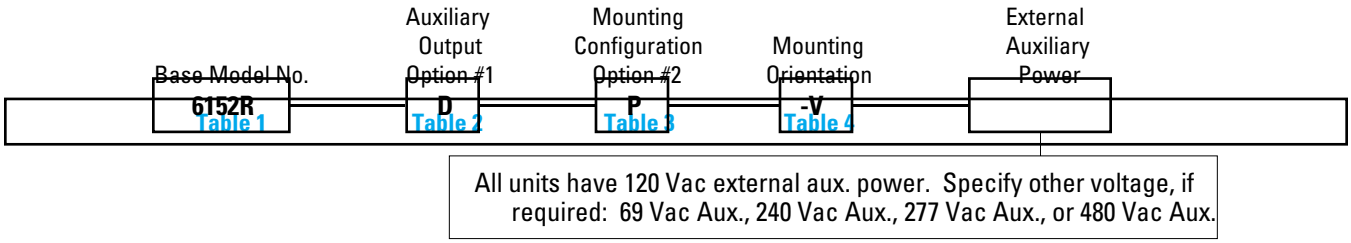
Specifications		Registers
Input	Single or Dual Form-C Relays Maximum Input Rate Open Contact Voltage Closed Contact Current Closed Contact Voltage	3-Wire, SPDT, Dry Contact 15,000 cph V_{OC} Maximum ≤ 15 Vdc I_{SC} ≤ 10 mAdc Maximum V_{SC} Closed ≤ 2.5 Vdc
External Auxiliary Power	Input Range Frequency Range Burden	108–132 Vac 50–500 Hz 1.5 VA Nominal at 120 V
Accuracy		Exact (1 output for 1 input)
Operating Temperature Range		-20° C to +60° C
Visual Output		Single or Dual Registers, Figure Size 3/16" High, 6-Digit Resettable or 7-Digit Nonresettable Display
Electrical Output (optional)		Single or Dual Isolated Relay Output: Form-C, 3-Wire, SPDT
Relay Contact Rating		15 VA at 1 A (maximum) or 150 Vac/15 Vdc (maximum) with resistive load. Contact protection required for inductive loads.
Relay Contact Life		One billion operations when operated within specifications.
Register Characteristics		One count is registered for each transfer of the Form-C, 3-wire input. The register holds counts indefinitely under power-failure conditions and does not give false counts when the power is restored.
Output Relay Characteristics		The normally open and normally closed contacts transfer their previous position for each transfer of the corresponding input relay.
Response Time		< 250 ms
Operating Humidity		0–95% Noncondensing
Isolation/ Dielectric Withstand	Visual Output Units Electrical Output Units	Input/Power/Case 1500 VRMS at 60 Hz Input/Output 1000 VRMS at 60 Hz
Mounting Configuration	Standard Optional	Wall and Shelf Mounting Panel Mounting
Maximum Net Weight		3 lbs., 6 oz. (1.5 kg)
Approximate Dimensions (excluding mounting plate)		3.7" W x 5.6" D x 7.0" H (94 mm x 142 mm x 178 mm) Style I Case, see page 122

Specifications subject to change without notice.

Ordering Procedure & Wiring Diagrams

ORDERING PROCEDURE FOR REGISTERS

Specify by base model number and appropriate option or selection suffixes in the order shown in the following example.



EXAMPLE: 6152RDP-V
Single 6-digit Resettable Register, single auxiliary relay output, panel mounting, vertical mounting.

Table 1 Base Model Number Selection

Model No.	Description	Configuration
6152	Single 7-digit Register	Nonresettable
6152R	Single 6-digit Register	Resettable
6153	Dual 7-digit Register	Nonresettable
6153R	Dual 6-digit Register	Resettable

Table 2 Auxiliary Output Options

Option	Description
D	Single Auxiliary Relay Output (one relay per register)
DD	Dual Auxiliary Relay Output (two relays per register)

Table 3 Mounting Configuration Options

Option	Description
Std. (leave blank)	**Wall or Shelf Mounting**
P	Panel Mounting

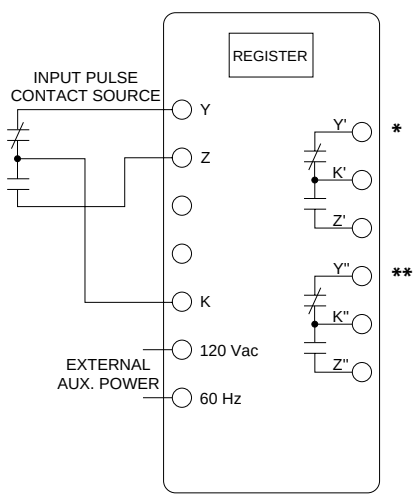
Table 4 Mounting Orientation Selection

Option	Description
-H	Horizontal Mounting
-V	Vertical Mounting

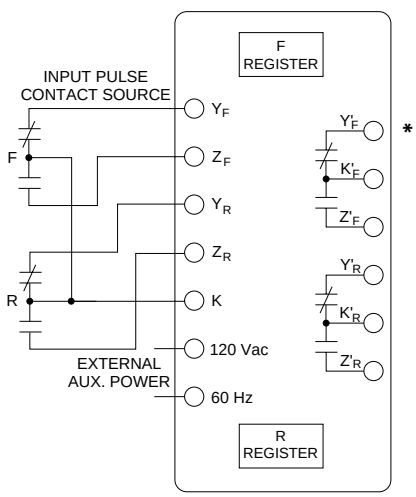
You must specify mounting orientation (vertical or horizontal) on units with D or DD options.

WIRING DIAGRAMS FOR REGISTERS (Style I Case)

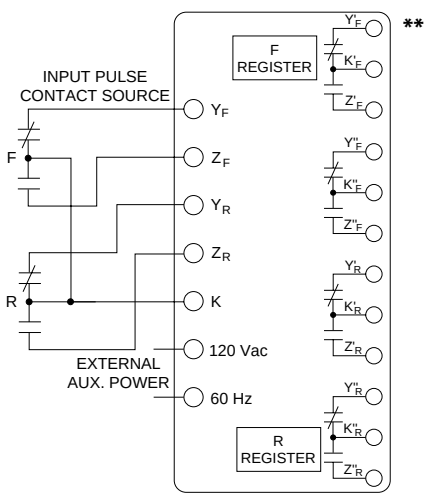
Models 6152, 6152R, 6152D, 6152RD, 6152DD, & 6152RDD



Models 6153, 6153R, 6153D, & 6153RD



Models 6153DD & 6153RDD



*** Relay outputs are present only on models with D or DD options.**

**** Dual relay outputs are present only on models with DD option.**

SCIENTIFIC COLUMBUS Calibrator

Scientific Columbus' Model 6444 Portable Transducer Calibrator is designed for easy field verification and precision calibration of watt, var, voltage, and current transducers. With its solid-state measurement technology and programmability, it is ideal for field testing and calibration of power-monitoring transducers and supervisory control systems, and as a calibrator/tester for receiving inspection.

This compact, rugged unit is completely self-contained and mounted in a portable carrying case. It is designed for easy, one-person operation. The operator is provided push-button selection of:

- Test Mode
- Current Range
- Voltage Range
- Test Variable
- Number of Elements
- Power Factor
- Polarity

Individual LCD indicating displays provide readouts of watts, vars, volts, and amps. The "% Error" meter displays percent-of-reading error. Test voltage from 0–150 Vac and current from 0–5 A or 0–10 A may be adjusted independently. During watt or var testing, volts and amps are displayed continuously.

No external loads or accessory equipment are required. The null method of calibration and testing is used. An internal precision-reference standard and the transducer under test are subjected to identical input variables. The standard and test transducer output signals are compared algebraically. The difference between the two is displayed directly on a differential null meter, which reads deviations of up to ±19.99%. The Model 6444 Calibrator and this differential measurement technique offer distinct advantages:

- The industry's highest resolution and accuracy.
- Consistent readings. Variations in test conditions do not influence the results.
- Eliminates test instrument cumulative errors and data transcription errors, since there's no need to read and record many separate device data points.
- Calibration time is reduced through the one-person operation, with integrated hardware.
- Allows testing over an infinite range of operating variables. Not confined to reading only specific cardinal points.
- Digital design provides easier operation, eliminates ambiguity of reading and meter reading parallax errors.

Scientific Columbus' Model 6444 Calibrator has the same three-year warranty as the Exceltronic line.

Features

- Multifunction calibrator/tester
- Digitally programmable
- Self-contained
- Portable
- One-person operation
- No external loads required

Applications

- Transducer calibration
- Receiving inspection
- Field testing

Outputs

- 0–150 V
- 0–5 or 0–10 A
- 0–750 or 0–1500 W
- 0–750 or 0–1500 Vars

Specifications & Ordering Procedure

CALIBRATOR

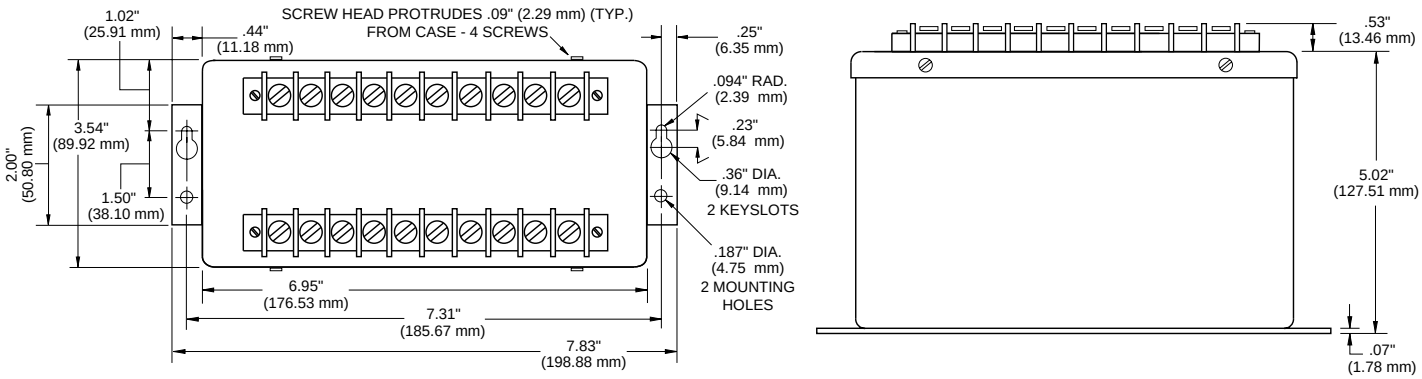
Specifications		Calibrator
Function		Tester and calibrator for ac watt, var, voltage, and current transducers
Output Ranges		0–150 V 0–5 or 0–10 A 0–750 or 0–1500 W 0–750 or 0–1500 Vars
Voltage Output Burden		15 VA Nominal
Current Output Burden	High Range Low Range	24 VA Nominal at 1 PF and 22 VA Nominal at 0.5 PF 6 VA Nominal at 1 PF and 3 VA Nominal at 0.5 PF
Standard Output Signal		0–10 Vdc for zero to full scale of test quantity (V, A, W, Var)
External Auxiliary Power	Input Range Frequency Burden	108–132 Vac 60 Hz (50 Hz optional) 40–130 VA (dependent upon loading on voltage- and current-output circuits)
Accuracy of Internal Reference		±0.1% RO
Accuracy of Digital Indicating Displays		Volt, Amp, & Watt/Var Indicators ±0.15% of Reading (±1 digit)
Accuracy of Standard Output		±0.1% RO
Operating Temperature Range		15° C to 35° C
Transducer Signal Load		1–99,999 Ω and Infinity, selected by thumbwheel digital-readout switches
Load Power Factor		Unity and 0.5 Lag (approximately)
Operating Humidity		0–95% Noncondensing
Displays		Liquid Crystal, $3\frac{1}{2}$ Digit, High Contrast
Display Scaling	Volts Amps Watts/Vars Error	0–150 0–5 or 0–10 0–750 or 0–1500 0 to ±19.99%
Terminations		Five-way binding posts are mounted on the front panel of the instrument. Power receptable is on the rear of the case.
Accessories		No accessories are required for complete functional testing of transducers with 0–1 mAdc output. An optional offset adapter (Model 6242B) is available for use with transducers with outputs of 1–5/1–3–5, 4–20/4–12–20, or 10–50/10–30–50 mAdc.
Packaging		Wood-formica portable instrument case with carrying handle
Maximum Net Weight		45 lbs., 8 oz. (20.7 kg)
Average Shipping Weight		50 lbs. (22.7 kg)
Approximate Dimensions		22" W x 9" D x 13" H (56 cm x 23 cm x 33 cm)

Specifications subject to change without notice.

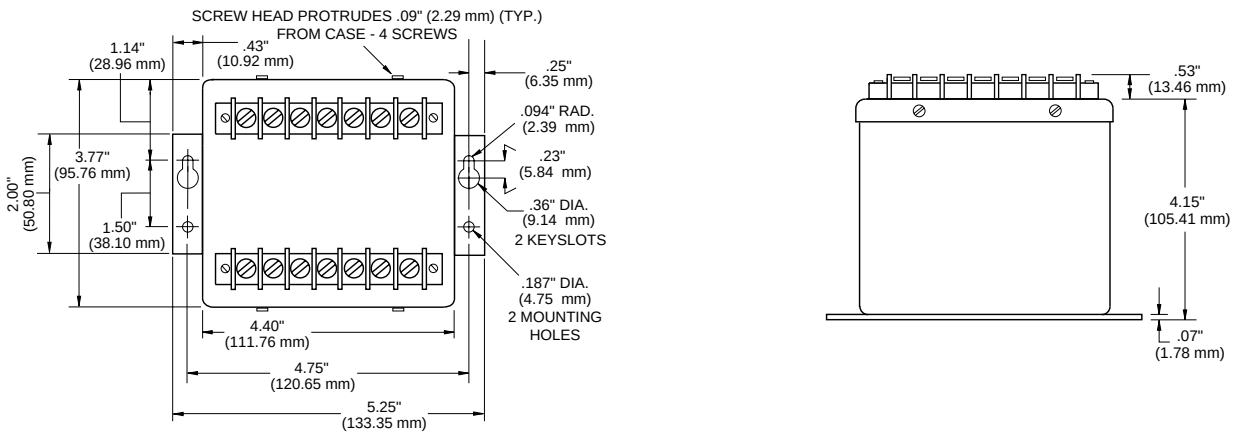
ORDERING PROCEDURE

Model No.	Description
6444	6444 Calibrator, 60 Hz
6444-50	6444 Calibrator, 50 Hz
6444-240V Aux.	6444 Calibrator, 60 Hz, 240 Vac External Auxiliary Power
6444-50 240V Aux.	6444 Calibrator, 50 Hz, 240 Vac External Auxiliary Power
6444-EX	6444 Calibrator, 60 Hz, Expanded Scale
6444-P	Calibrator with Internal Offset Adapter for Calibrating Transducers with 1–5/1–3–5 mAdc, 4–20/4–12–20 mAdc, or 10–50/10–30–50 mAdc Outputs
6242B	Offset Adaptor (to be used with 6444 Calibrator) for Calibrating Transducers with 1–5/1–3–5 mAdc, 4–20/4–12–20 mAdc, or 10–50/10–30–50 mAdc Outputs

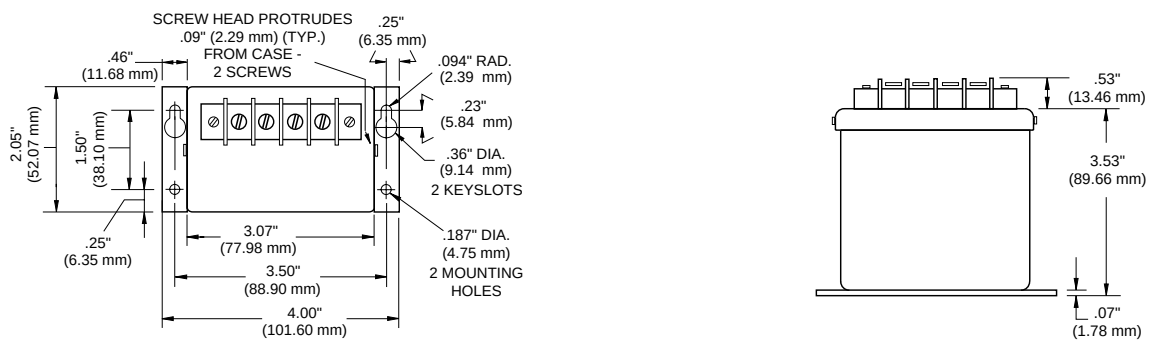
Case Dimensions for Styles I, II, & III Cases



Style I



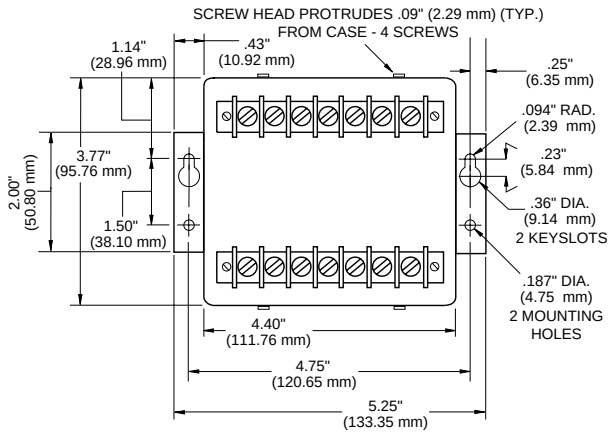
Style II

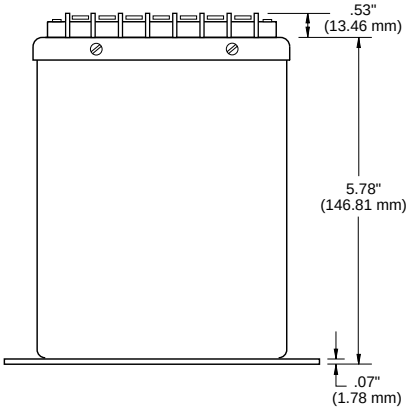


Style III

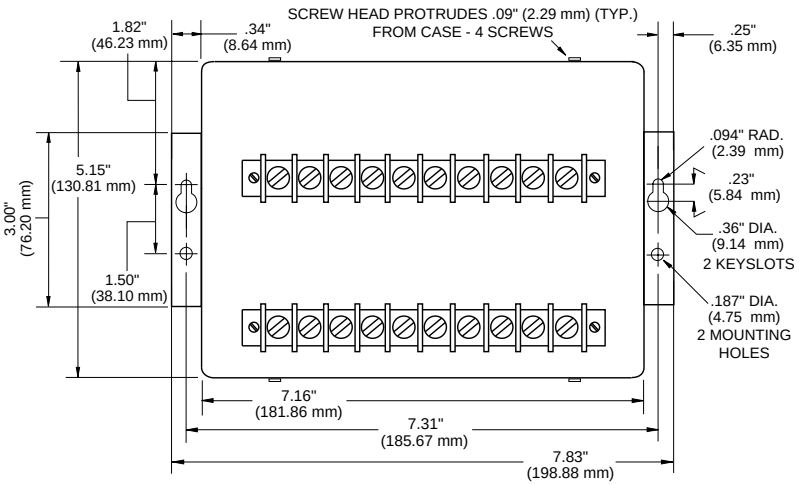
Terminal strips shown for illustration purposes only. For exact terminal-strip configuration on specific units, see connection diagrams. Drawings not to scale.

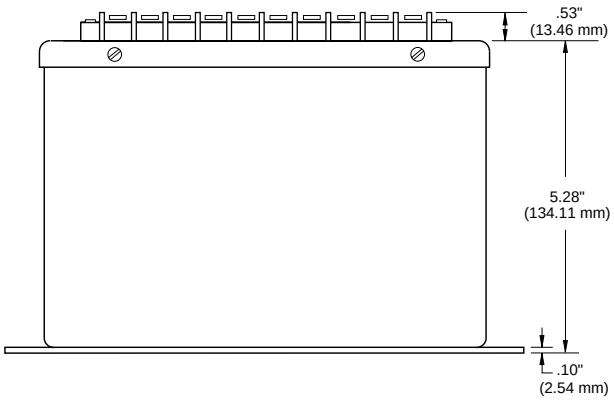
Case Dimensions for Styles IV & V Cases





Style IV





Style V

Instrumentation

Terminal strips shown for illustration purposes only. For exact terminal-strip configuration on specific units, see connection diagrams. Drawings not to scale.

Accuracy
The degree of uncertainty with which a measured value agrees with the ideal value.

Analog Output Shorting Relay (-CE)
The shorting relay monitors the external auxiliary power signal on a watt, var, or watt/var unit. If the external auxiliary power deviates from a prespecified range (i.e., below 85 V), a relay contact closes, shorting the analog output. This helps prevent erroneous signals from the analog output due to low external auxiliary power.

Apparent Power (volt-amps)
The product of the applied voltage and current in an ac circuit. Apparent power, or volt-amps, is not the true power of the circuit because the power factor is not considered in the calculation.

Auxiliary Power
See External Auxiliary Power and Internal Auxiliary Power.

Balanced Load
Refers to an equal loading of the phases in a polyphase system (current and phase angle).

Bidirectional (-B)
A bidirectional unit allows measurements of inputs which flow in two directions, forward and reverse. A typical 4–12–20 mAdc device would have a zero setting at 12 and minimum and maximum settings at 4 and 20, respectively. The -B option applies only to P-Option units. Add -B to the PAN or PA designator to specify a bidirectional unit (for example, 4–12–20 mAdc versus 4–20 mAdc).

Burden
Load imposed by a transducer on the measured input circuit, expressed in volt-amps.

Calibration
Adjustment of a transducer so the output is within a specified range for particular values of the input.

50–200% Calibration Adjustment (current outputs) (-20)
The common gain adjustment is ± 2%. When the wide-range adjustment is specified, the current output can be adjusted from 50–200% of its normal value. For example, the normal output for a 500 W input is 1 mAdc when using a 1-element watt transducer. This unit could be adjusted to equate any output from 0.5 mAdc to 2 mAdc, for a 500 W input. The drawback to using the wide adjustment is that it makes precision calibration of the unit more difficult (a small turn of the potentiometer results in a large change in the output).

50–200% Calibration Adjustment (voltage outputs) (-21)
The common gain adjustment is ± 2%. When the wide-range adjustment is specified, the voltage output can be adjusted from 50–200% of its normal value. For example, if the normal conversion is 500 W in to 5 Vdc out, the unit could be adjusted to equate any output from 2.5 Vdc to 10 Vdc, for a 500 W input. The drawback to using the wide adjustment is that it makes precision calibration of the unit more difficult (a small turn of the potentiometer results in a large change in the output). These units have true voltage outputs, versus a milliamp output applied across a scaling resistor.

Combination Unidirectional/Bidirectional Unit (-UB)
The -UB option applies only to P-Option combined watt/var transducers. This option specifies a unidirectional output for watts (example: 4–20 mAdc) and a bidirectional output for vars (example: 4–12–20 mAdc).

Compliance Voltage
The specified maximum voltage that a transducer current output must be able to supply while maintaining the specified accuracy.

Current Transformer (CT)
Transformer used to accurately scale ac currents up or down, or to provide isolation. Generally used to scale large primary or bus currents to usable values for measuring purposes.

Current Transformer Ratio (CTR)
The ratio of primary amps divided by secondary amps.

Dielectric
The medium used to provide electrical isolation or separation.

Dielectric Withstand
The ability of a medium that is providing electrical isolation in a transducer to withstand an applied voltage for a specified time without flashover or puncture.

Dielectric Withstand Voltage Test
Test used to determine the ability of insulating materials and spacings to withstand specified overvoltages for a specified time (one minute unless otherwise stated) without flashover or puncture.

Effective Power (watts)
In ac measurements, effective power (measured in watts) equals the product of voltage, current, and power factor (the cosine of the phase angle between the current and the voltage). (Watts = EI cos(ø))

External Auxiliary Power (A2)
The power required for correct operation of a transducer is supplied via an external auxiliary power source, rather than the line being measured. Unless otherwise specified, external auxiliary power is 120 Vac, 50–500 Hz.

> ***Exception:*** *For average-sensing current and voltage transducers with 0–1 mAdc output, the A2 option specifies standard accuracy of 0.25% (default accuracy).*

Front Access (-FA)
The -FA option allows for external calibration or access to test jack points on XLP transducers.

Frequency
A measure of the number of complete cycles of a waveform per unit of time, specified in Hertz (Hz), or cycles per second. The following options refer to signal input frequency only:

50 Hz Operation (-12)

400 Hz Operation (-6)

Full Scale (F.S.)
The specified maximum magnitude of the input quantity being measured that can be applied to a transducer without causing a change in performance beyond specified tolerance.

Full Scale Output
The specified maximum output value for which the stated accuracy condition applies.

Impedance
The total opposing force to the flow of current in an ac circuit.

Input
The standard transducer input is 5 A and 120 V; however, many other inputs are available:

69 V Input (-0)
The unit operates from 0–75 V. The standard calibration is 250 W or vars per element input for 1 mAdc output.

240 V Input (-1)
The unit operates from 0–300 V. The standard calibration is 1000 W or vars per element input for 1 mAdc output.

277 V Input (-9)
The unit operates from 0–340 V. The standard calibration is 1200 W or vars per element input for 1 mAdc output.

480 V Input (-2)
The unit operates from 0–600 V. The standard calibration is 2000 W or vars per element input for 1 mAdc output.

1 A Input (-3)
The unit operates from 0–2 A. The standard calibration is 100 W or vars per element input for 1 mAdc output.

2.5 A Input (-4)
The unit operates from 0–5 A. The standard calibration is 250 W or vars per element input for 1 mAdc output.

7.5 A Input (-11)
The unit operates from 0–15 A. The standard calibration is 750 W or vars per element input for 1 mAdc output.

10 A Input (-5)
The unit operates from 0–20 A. The standard calibration is 1000 W or vars per element input for 1 mAdc output.

15 A Input (-7)
The unit operates from 0–20 A. The standard calibration is 1500 W or vars per element input for 1 mAdc output.

25 A Input (-8)
The unit operates from 0–30 A. The standard calibration is 2500 W or vars per element input for 1 mAdc output. The 25 A option requires a larger case and is not available on all transducers.

Internal Auxiliary Power (self-powered) (A4)
The power required for correct operation of a transducer is supplied via the line being measured, and adds additional burden to the input.

Exception: *For average-sensing current and voltage transducers with 0–1 mAdc output, the A4 option specifies optional accuracy of 0.1%.*

Isolated Inputs (-IS)
The -IS option applies only to Models SAF-2 and SAF-3 analog-to-pulse converters. This option specifies that the positive current inputs are electrically isolated from each other.

Isolated Outputs (for units with external auxiliary power) (-C2)
Complete isolation between the watt and var outputs of combined watt/var transducers. The -C2 replaces A2 in the model number. Units with the -C2 option require a Style I case. This does not apply to XLG transducers.

Isolated Outputs (for units with internal auxiliary power) (-C4)
Complete isolation between the watt and var outputs of combined watt/var transducers. The -C4 replaces A4 in the model number. Units with the -C4 option require a Style I case. This does not apply to XLG transducers.

Isolation
To be electrically separate. A measure of the strength of the dielectric providing the electrical division or separation.

KYZ
A designator for the Form-C pulse initiator output from a transducer.

Lag
The condition where the current is delayed in time with respect to the voltage in an ac circuit (for example, an inductive load).

Lead
The condition where the current precedes in time with respect to the voltage in an ac circuit (for example, a capacitive load).

Load
The total impedance of all the items in the output circuit.

24 Vdc Loop-Powered (-24)
This is a variation to the normal 4–20 mAdc output unit (PA7) or 4–12–20 mAdc output unit (PA7-B) that requires a 24 Vdc power supply to power the analog output. The transducer does not supply any current; it only controls the current flow in the output circuit. All -24 option units are self-powered, unless otherwise specified.

Nominal
The normal operating value.

Overload
The specified maximum magnitude of the input quantity being measured that can be applied to a transducer for a specified period of time without causing damage.

Overrange
The specified maximum operating point for which the stated accuracy condition applies.

Peak to Peak
The amplitude of the ac waveform from its positive peak to its negative peak.

Phase Angle
The angular displacement between a current and voltage waveform, measured in degrees or radians.

P-Option
P-Option refers to model number designators that specify certain outputs required for process control applications:

1–5 mAdc Output
(-PAN6) *Where a compliance rating of 3000 Ω or 15 Vdc is required.*

(-PA6) *Where a compliance rating of 8000 Ω or 40 Vdc is required.*

(-P6 for XLP models) *Where a compliance rating of 5000 Ω or 25 Vdc is required.*

4–20 mAdc Output
(-PAN7) *Where a compliance rating of 750 Ω or 15 Vdc is required.*

(-PA7) *Where a compliance rating of 2000 Ω or 40 Vdc is required.*

(-P7 for XLP models) *Where a compliance rating of 1250 Ω or 25 Vdc is required.*

10–50 mAdc Output
(-PAN8) *Where a compliance rating of 300 Ω or 15 Vdc is required.*

(-PA8) *Where a compliance rating of 600 Ω or 30 Vdc is required.*

Power Factor (PF)
The ratio of the effective power (watts) to the apparent power (volt-amps). Equal to the cosine of the phase angle for single-phase or 3-phase, 3-wire or 4-wire systems.

Range
Nominal operating limits, specified by the lowest calibration point to the highest calibration point.

Rated Output (RO)
The output at standard calibration.

Reactive Power (var)
A component of apparent power (volt-amps) which does not produce any real power (watt) transfer (the sine of the phase angle between the current and the voltage). (Var = $\sqrt{VA^2 - W^2}$ *or Var = EI sin (ø))*

Reading
The expected output at a given input value.

Real Power (in an ac circuit)
The average value of the instantaneous product of volts and amps over a fixed period of time.

Response Time
The time for a transducer output signal to reach 99% of its final value after a step change in the applied input. Typically the response is an exponential curve.

Ripple
The magnitude of ac fluctuations in a dc signal, after filtering. Usually expressed as a percentage of rated output.

Root-Mean-Square (RMS)
The effective value of alternating current or voltage. The RMS value equates an ac signal to a dc signal that provides the same power transfer.

Scaling Resistor (-RS)
The -RS option provides a scaled voltage output by the attachment of an external resistor to the transducer. The output is not a "true" voltage output and may be susceptible to loading errors. The resistor can be attached internally if specified by the user when ordering.

Seismic Brace (-SM)
The seismic brace is added to the transducer to keep its printed circuit boards stable. These are not seismically rated units.

Self-Powered
See Internal Auxiliary Power.

Span
The algebraic difference between the upper and lower values of a range.

Special Calibration (-SC)
All units can be calibrated to within a specified range. This information can be found in the "Other Options" table under the Ordering Procedure for most types of transducers. For some types of transducers, the information is in the Special Options section on page 128.

Stability
The ability of a transducer to maintain its performance characteristics over a specified period of time.

Standard Calibration
The nominal point at which a transducer is adjusted.

Surge Withstand
A measure of a transducer's ability to withstand high-voltage, high-frequency transients of short duration without damage.

Surge Withstand Capability (SWC) Test (Ref. ANSI/IEEE C37.90.1)
The SWC test wave is an oscillatory wave, frequency range of 1-1.5 MHz, voltage range of 2.5-3 kV crest value of first peak, envelope decaying to 50% of the crest value of the first peak in not less than 6 μs from the start of the wave. The source impedance is from 150-200 Ω. The test wave is to be applied to a test specimen at a repetition rate of not less than 50 tests per second for a period of not less than two seconds. (All voltage and time values refer to the open circuit condition of the generator.)

Transducer
A device for converting an electrical signal into a usable direct current or voltage for measurement purposes.

Transformer Factor
The product of the current transformer ratio (CTR) and the voltage transformer ratio (VTR). Also called the power ratio.

True RMS Amps
The effective value of an ac signal. For an amp signal, true RMS is a precise method of stating the amp value regardless of waveform distortion. An ac measurement which is equal in power transfer capability to a corresponding dc current.

True RMS Volts
The effective value of an ac signal. For a voltage signal, true RMS is a precise method of stating the voltage value regardless of the waveform distortion. An ac measurement which is equal in power transfer capability to a corresponding dc voltage.

Unbalanced Loads
Refers to an unequal loading of the phases in a polyphase system (current and/or phase angle).

Unidirectional Unit
A unidirectional unit allows inputs to be measured in one direction only. The stated output range (for example, 4–20 mAdc) indicates the minimum and maximum input levels.

Voltage Transformer (VT)
Transformer used to accurately scale ac voltages up or down, or to provide isolation. Generally used to scale large primary or bus voltages to usable values for measuring purposes.

Voltage Transformer Ratio (VTR)
The ratio of primary volts divided by secondary volts.

Zero-Based Output Calibration (-Z)
The -Z option applies only to P-Option units. The normal zero point—1, 4, or 10 mAdc—is replaced with a 0 mAdc zero point. For example, when a PAN7-Z unit is specified, the output range of the unit will be 0–20 mAdc instead of 4–20 mAdc. The -Z option is not available with PAN-B models.

When ordering any Special Options, or more than three options, you must first consult the factory for pricing and delivery estimates.

DC External Auxiliary Power
If dc external auxiliary power is required, the following levels are available:

24 Vdc external auxiliary power (-JB)
48 Vdc external auxiliary power (-JC)
125 Vdc external auxiliary power (-JD)

Extended Range (-ER)
Special calibration levels that fall outside the normal calibration range.

Fast Response (-FR)
With fast response, the analog output responds faster to the change in input. The normal response time is 400 ms to 99%, but with the fast response option this changes to 50 ms or 100 ms to 99%. The change in response time results in an inversely proportional increase in output ripple. Consult factory for other response time requirements.

Sepia Drawings (-DG)
Drawings that can be used to reproduce blueprints.

Frequency– 25 Hz Operation (-25)
A measure of the number of complete cycles of a waveform per unit of time, specified in Hertz (Hz), or cycles per second. This option refers to signal input frequency only.

Isolated VT Inputs (-AY)
The -AY option specifies that the voltage inputs are isolated from each other on 3-element watt or var transducers.

Special Calibration (Frequency Transducers)
Frequency transducers can be calibrated within a specific range. Please consult the factory for special calibration requirements.

Test Jack (-TJ)
The test jack is connected in series with the analog output to allow testing without disconnecting the unit. The transducer is connected to the standard via the test jack to verify the circuit is working and to test the accuracy of the unit. The total resistance on the test jack plus the analog output cannot exceed the maximum load resistance of the transducer per its specification. The test jack is shorted when it is not in use.

STANDARD ABBREVIATIONS

Symbol or Abbreviation	Unit or Term	Symbol or Abbreviation	Unit or Term	Symbol or Abbreviation	Unit or Term
A	ampere (amp)*	Hz	hertz	RFI	radio-frequency interference
AC/ac	alternating current	K_e	secondary constant of energy (watthours**/ pulse)	RMS	root-mean-square
add'l.	additional			RO	rated output
adj.	adjustable/adjustment	kHz	kilohertz	RPM	revolutions per minute
Ah	amperehour (amphour)	kΩ	kilohm	RTD	resistance temperature detector
aux.	auxiliary	kV	kilovolt		
AWG	American wire gauge	kVA	kilovolt-ampere	SPDT	single-pole, double-throw
°C	degree Celsius	kvar	kilovar	std.	standard
cal.	calibration	kW	kilowatt	µA	microampere
cph	counts per hour	kWh	kilowatthour	µs	microsecond
CT	current transformer	mA	milliampere	µV	microvolt
CTR	current transformer ratio	ms	millisecond	V	volt*
DC/dc	direct current	MΩ	megohm	VA	volt-ampere (volt-amp)
DPDT	double-pole, double-throw	mV	millivolt	VAh	volt-amperehour (volt-amphour)
ext.	external	MW	megawatt	var	volt-ampere reactive
°F	degree Fahrenheit	mW	milliwatt	varh	varhour
F.S.	full scale	Ω	ohm	VT	voltage transformer
h	hour	PF	power factor	VTR	voltage transformer ratio
hp	horsepower	PK_e	primary constant of energy (watthours**/pulse)	W	watt
HV	high voltage			Wh	watthour

*Assumed here to be ac unless otherwise specified.

**Watthours, varhours, or volt-amphours

AC FORMULAS

To Find	Alternating Current Formulas			Direct Current Formulas
	Single-Phase	Two-Phase* Four-Wire	Three-Phase	
Kilowatts	$\frac{I \times E \times PF}{1000}$	$\frac{I \times E \times 2 \times PF}{1000}$	$\frac{I \times E \times 1.73 \times PF}{1000}$	$\frac{I \times E}{1000}$
Kilovolt-Amps	$\frac{I \times E}{1000}$	$\frac{I \times E \times 2}{1000}$	$\frac{I \times E \times 1.73}{1000}$	
Horsepower (output)	$\frac{I \times E \times \% \text{ Eff.} \times PF}{746}$	$\frac{I \times E \times 2 \times \% \text{ Eff.} \times PF}{746}$	$\frac{I \times E \times 1.73 \times \% \text{ Eff.} \times PF}{746}$	$\frac{I \times E \times \% \text{ Eff.}}{746}$
Amps when Kilowatts are known	$\frac{kW \times 1000}{E \times PF}$	$\frac{kW \times 1000}{2 \times E \times PF}$	$\frac{kW \times 1000}{1.73 \times E \times PF}$	$\frac{kW \times 1000}{E}$
Amps when Kilovolt-Amps are known	$\frac{kVA \times 1000}{E}$	$\frac{kVA \times 1000}{2 \times E}$	$\frac{kVA \times 1000}{1.73 \times E}$	
Amps when Horsepower is known	$\frac{hp \times 746}{E \times \% \text{ Eff.} \times PF}$	$\frac{hp \times 746}{2 \times E \times \% \text{ Eff.} \times PF}$	$\frac{hp \times 746}{1.73 \times E \times \% \text{ Eff.} \times PF}$	$\frac{hp \times 746}{E \times \% \text{ Eff.}}$

I = Line Current (Amps) % Eff. = Percent Efficiency kW = Kilowatts hp = Horsepower
E = Volts Line to Line PF = Power Factor kVA = Kilovolt-Amps x = Multiply
*For three-wire, two-phase circuits the current in the common conductor is 1.41 times that in either of the other two conductors.

CALIBRATION FORMULAS

Definitions and Formulas for Calibration of Watt/Watthour, Var/Varhour, and Volt-Amp/Volt-Amphour Transducers

- *Primary Calibration = CTR x VTR x Calibrating Watts (Vars or Volt-Amps)*
- *cph = counts per hour; where a count is a contact transfer of a 3-wire (KYZ) output device (mercury-wetted relay or solid-state). cph = Calibrating Watts (Vars or Volt-Amps) ÷ K_e*
  cph = (Calibrating Watts (Vars or Volt-Amps) x CTR x VTR) ÷ PK_e
- *K_e = secondary constant in Wh/count (or other appropriate units) of a pulse-initiator output. Usually Wh/count of a 3-wire output where a count is any transition of the output-contact device. K_e = Watts ÷ cph*
- *PK_e = primary constant of a pulse-initiator output. PK_e = CTR x VTR x K_e*

- ***Ordering Information & Technical Assistance***
  If you need help with your order, or have technical questions, a transducer specialist is available to answer your questions.

  Call us: 8 AM to 5 PM EST, Monday through Friday, ***1-800-274-5368 (U.S. and Canada)***
  Fax us: 24 hours a day, seven days a week, ***585-454-7805***

- ***Quotes***
  Contact your local representative for pricing and delivery estimates.

- ***Payment Terms***
  Standard terms of payment are net thirty (30) days from date of invoice.

- ***Warranty***
  Seller warrants its Equipment to meet applicable specifications, if any, and to be free from defects in material and workmanship for a period of one (1) year from date of shipment to the original Purchaser, provided that such warranty shall be for a period of (a) two (2) years from the date of shipment for the Exceltronic® II XLG product and (b) three (3) years from the date of shipment for the Exceltronic® XL and Digilogic™ DL products. Upon receipt of prompt notice from Purchaser, referencing the order number and detailing the claimed nonconformity or defect, Seller shall, at its option, repair or replace the Equipment. Equipment returned to Seller will only be accepted with a Returned Materials Authorization number ("RMA") issued by Seller or one of its authorized representatives. Inbound shipping charges to Seller's factory in Rochester, New York, or other designated facility, are the responsibility of Purchaser. Normal shipping charges for the return to Purchaser of repaired or replacement Equipment shall be the responsibility of the Seller (North American points only).

  Repair or replacement of the Equipment in the manner described above is the exclusive warranty remedy and shall constitute complete fulfillment of all Seller's liabilities for breach of this Warranty. Seller assumes no responsibility hereunder for any Equipment damage or failure caused by (a) improper installation, operation, and maintenance of the Equipment, or (b) normal wear and tear on disposable and/or consumable parts. This Warranty shall be void in the event of unauthorized modification or servicing of the Equipment.

  THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ANY OTHER WARRANTIES OF QUALITY, WHETHER EXPRESSED OR IMPLIED (INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE). *In no event shall Seller be liable hereunder for any special, indirect, incidental, or consequential damages including but not limited to loss of revenue or production.*

- ***Delivery***
  Standard delivery is via UPS, F.O.B. shipping point (Rochester, New York). Express delivery can be made via either UPS or Federal Express. Shipments over 150 pounds are made via Yellow Freight or Overnight Transportation. All delivery charges are automatically added to your invoice.

- ***Returns***
  If it is necessary to return Scientific Columbus products for repair or calibration, contact either your local representative or the factory at ***1-800-274-5368 (U.S. and Canada).***

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