

Ballast-CT Measurement Accessory for Tektronix Power Analyzers Instruction Manual

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- In North America, call 1-800-833-9200.
- Worldwide, visit www.tektronix.com to find contacts in your area.

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Important safety information

This manual contains information and warnings that must be followed by the user for safe operation and to keep the product in a safe condition.

To safely perform service on this product, additional information is provided at the end of this section. (See page iv, *Service safety summary*.)

General safety summary

Use the product only as specified. Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. Carefully read all instructions. Retain these instructions for future reference.

Comply with local and national safety codes.

For correct and safe operation of the product, it is essential that you follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

The product is designed to be used by trained personnel only.

Only qualified personnel who are aware of the hazards involved should remove the cover for repair, maintenance, or adjustment.

Before use, always check the product with a known source to be sure it is operating correctly.

This product is not intended for detection of hazardous voltages.

Use personal protective equipment to prevent shock and arc blast injury where hazardous live conductors are exposed.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

When incorporating this equipment into a system, the safety of that system is the responsibility of the assembler of the system.

To avoid fire or personal injury

Connect and disconnect properly. Do not connect or disconnect probes or test leads while they are connected to a voltage source.

Use only insulated voltage probes, test leads, and adapters supplied with the product, or indicated by Tektronix to be suitable for the product.

Observe all terminal ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product. Do not exceed the Measurement Category (CAT) rating and voltage or current rating of the lowest rated individual component of a product, probe, or accessory. Use caution when using 1:1 test leads because the probe tip voltage is directly transmitted to the product.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Do not operate without covers. Do not operate this product with covers or panels removed, or with the case open. Hazardous voltage exposure is possible.

Avoid exposed circuitry. Do not touch exposed connections and components when power is present.

Do not operate with suspected failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Disable the product if it is damaged. Do not use the product if it is damaged or operates incorrectly. Clearly mark the product to prevent its further operation.

Before use, inspect voltage probes, test leads, and accessories for mechanical damage and replace when damaged. Do not use probes or test leads if they are damaged, if there is exposed metal, or if a wear indicator shows.

Examine the exterior of the product before you use it. Look for cracks or missing pieces.

Use only specified replacement parts.

Do not operate in wet/damp conditions. Be aware that condensation may occur if a unit is moved from a cold to a warm environment.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry. Remove the input signals before you clean the product.

Probes and test leads

Remove all probes, test leads and accessories that are not in use.

Use only correct Measurement Category (CAT), voltage, temperature, altitude, and amperage rated probes, test leads, and adapters for any measurement.

Service safety summary

The *Service safety summary* section contains additional information required to safely perform service on the product. Only qualified personnel should perform service procedures. Read this *Service safety summary* and the *General safety summary* before performing any service procedures.

To avoid electric shock. Do not touch exposed connections.

Do not service alone. Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

Use care when servicing with power on. Dangerous voltages or currents may exist in this product. Disconnect test leads before removing protective panels, soldering, or replacing components.

Terms in this manual

These terms may appear in this manual:



WARNING. Warning statements identify conditions or practices that could result in injury or loss of life.



CAUTION. Caution statements identify conditions or practices that could result in damage to this product or other property.

Symbols and terms on the product

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.



When this symbol is marked on the product, be sure to consult the manual to find out the nature of the potential hazards and any actions which have to be taken to avoid them. (This symbol may also be used to refer the user to ratings in the manual.)

The following symbol(s) may appear on the product:



Compliance information

This section lists the safety and environmental standards with which the instrument complies.

Safety compliance

This section lists the safety standards with which the product complies and other safety compliance information.

EU declaration of conformity – low voltage

Compliance was demonstrated to the following specification as listed in the Official Journal of the European Union:

Low Voltage Directive 2006/95/EC.

- EN 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.
- EN 61010-2-030. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2-030: Particular requirements for testing and measuring circuits.

U.S. nationally recognized testing laboratory listing

- UL 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.
- UL 61010-2-030. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2-030: Particular requirements for testing and measuring circuits.

Canadian certification

- CAN/CSA-C22.2 No. 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.
- CAN/CSA-C22.2 No. 61010-2-030. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2-030: Particular requirements for testing and measuring circuits.

Additional compliances

- IEC 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.
- IEC 61010-2-030. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2-030: Particular requirements for testing and measuring circuits.

Equipment type

Test and measuring equipment.

Safety class

Class 2 Double Insulated Product.

Pollution degree descriptions

A measure of the contaminants that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.

- Pollution degree 1. No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.
- Pollution degree 2. Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.
- Pollution degree 3. Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.
- Pollution degree 4. Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.

Pollution degree rating

Pollution degree 2 (as defined in IEC 61010-1). Rated for indoor, dry location use only.

Measurement and overvoltage category descriptions

Measurement terminals on this product may be rated for measuring mains voltages from one or more of the following categories (see specific ratings marked on the product and in the manual).

- Category II. Circuits directly connected to the building wiring at utilization points (socket outlets and similar points).
- Category III. In the building wiring and distribution system.
- Category IV. At the source of the electrical supply to the building.

NOTE. Only mains power supply circuits have an overvoltage category rating. Only measurement circuits have a measurement category rating. Other circuits within the product do not have either rating.

Environmental considerations

This section provides information about the environmental impact of the product.

Product end-of-life handling

Observe the following guidelines when recycling an instrument or component:

Equipment recycling. Production of this equipment required the extraction and use of natural resources. The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. To avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.



This symbol indicates that this product complies with the applicable European Union requirements according to Directives 2002/96/EC and 2006/66/EC on waste electrical and electronic equipment (WEEE) and batteries. For information about recycling options, check the Support/Service section of the Tektronix Web site (www.tektronix.com).

Restriction of hazardous substances

This product is classified as an industrial monitoring and control instrument accessory, and is not required to comply with the substance restrictions of the recast RoHS Directive 2011/65/EU until July 22, 2017.

Preface

This manual describes the Ballast-CT measurement accessory, and how to connect it to your circuit and to Tektronix Power Analyzers.

Ballast-CT

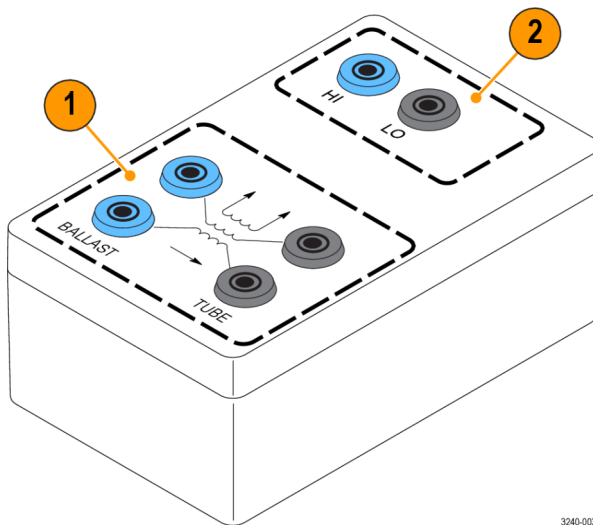
The Tektronix Ballast-CT simplifies the measurement of output power and tube current in high-frequency electronic lighting ballasts. This device is specifically designed for high-frequency lighting applications. When used in conjunction with a Tektronix PA1000 or PA4000 power analyzer, the free-standing Ballast-CT module provides a convenient and accurate solution to taking power measurements in lighting ballast circuits.

Features

- Convenience: No need to feed cables through a CT core
- High accuracy: Close-coupled, trifilar-wound toroidal design
- No cable positioning/contact error
- Wide bandwidth: High frequency design provides 5 kHz to 1 MHz bandwidth
- Wide current range: 5 mA to 1 A is compatible with many modern ballasts

Description

The Ballast-CT is an enclosed current-sensing transformer with 4 mm terminals that connect between your lighting circuit and Tektronix power analyzers. Circuit connections are made with the high-quality safety leads that are supplied with the analyzers. Additional lead sets are available; see your power analyzer manual for ordering information.



3240-003

Figure 1: Ballast-CT connections

1. Ballast and lamp terminals — these terminals are connected in series with your lighting circuit to establish a measurement sense point for the power analyzer.
2. Output to power analyzer — the AHI and ALO terminals typically connect to the AHI and ALO current inputs on the power analyzer. For measurement currents less than 1 A, the AHI output terminal is connected to the A1A input on the analyzer.

Connecting the Ballast-CT

Use the connection sequence shown below to make the typical connections in your Ballast-CT circuit. Connections for specific applications are shown for the PA1000 and PA4000 power analyzers on the following pages.



CAUTION. The Ballast-CT should only be used with Tektronix power analyzers.

1. Using the test leads provided with the Tektronix power analyzer, make the current connections between the Ballast-CT and the AHI and ALO input jacks on the power analyzer.



CAUTION. Do not operate the Ballast-CT without first making the connections between the Amps Hi and LO connections on the Ballast-CT and the corresponding connections on the Analyzer.

2. Make the connections from your circuit to the Ballast-CT.

NOTE. Due to the high frequency nature of ballasts, the inductance of the leads can have an effect on measurements. To reduce the effect of the lead inductance, lead length should be kept to a minimum, and the leads should be twisted together.

3. Power on the device under test and begin taking measurements.

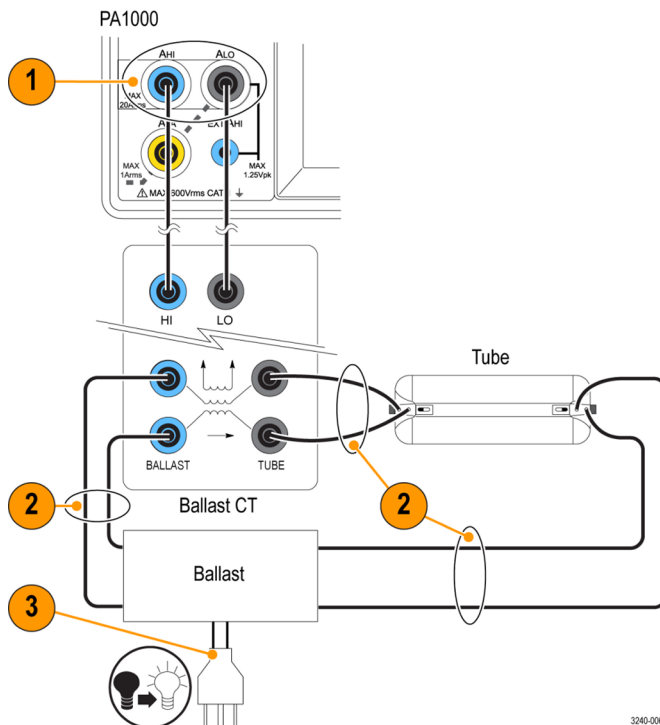


Figure 2: Connection sequence

Measuring low-current fluorescent tubes

Using either a PA1000 or PA4000 power analyzer and a single Ballast-CT, tube currents up to 500 mA may be measured as shown in the figure below.

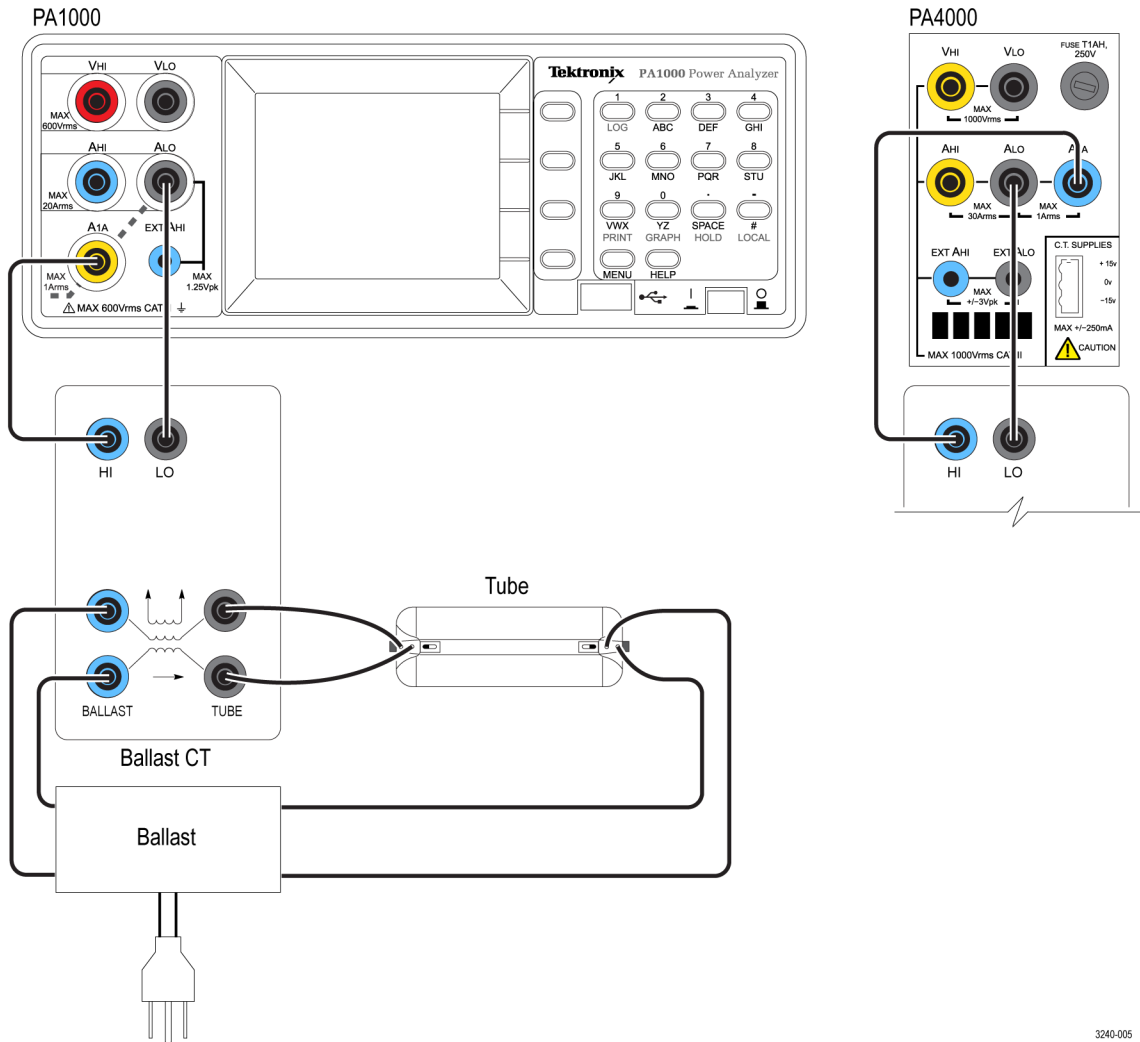


Figure 3: Low-current (<500 mA) connections

3240-005

Measuring high-current fluorescent tubes

Using either a PA1000 or PA4000 and a single Ballast-CT, tube currents of up to 1 A may be measured as shown in the figure below.

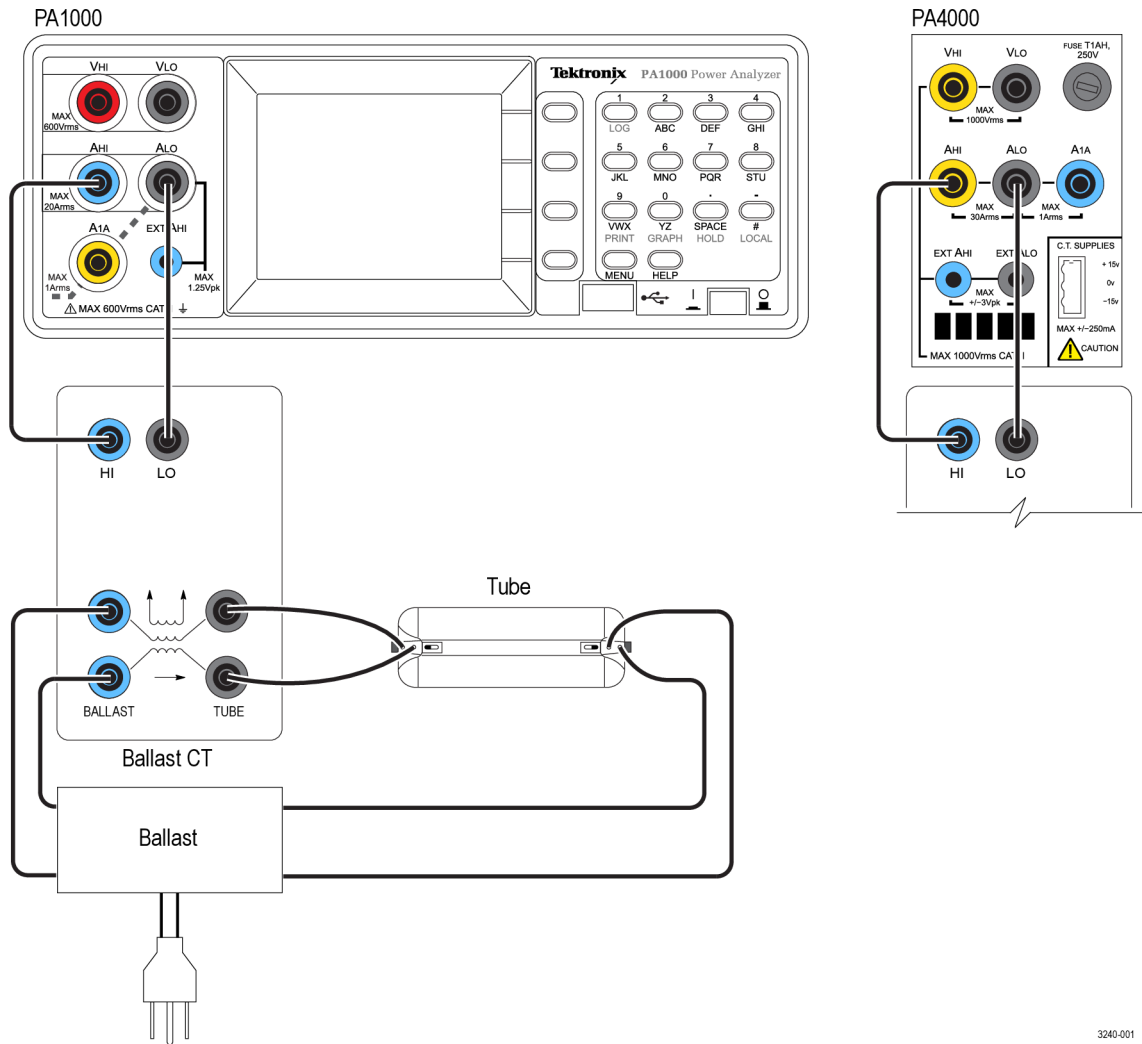


Figure 4: High-current connections (up to 1 A)

3240-001

Measuring a two-tube fluorescent lighting ballast circuit

With two Ballast-CT units and a 3-channel PA4000 power analyzer, it is simple to make efficiency measurements, even with a complex lighting configuration.

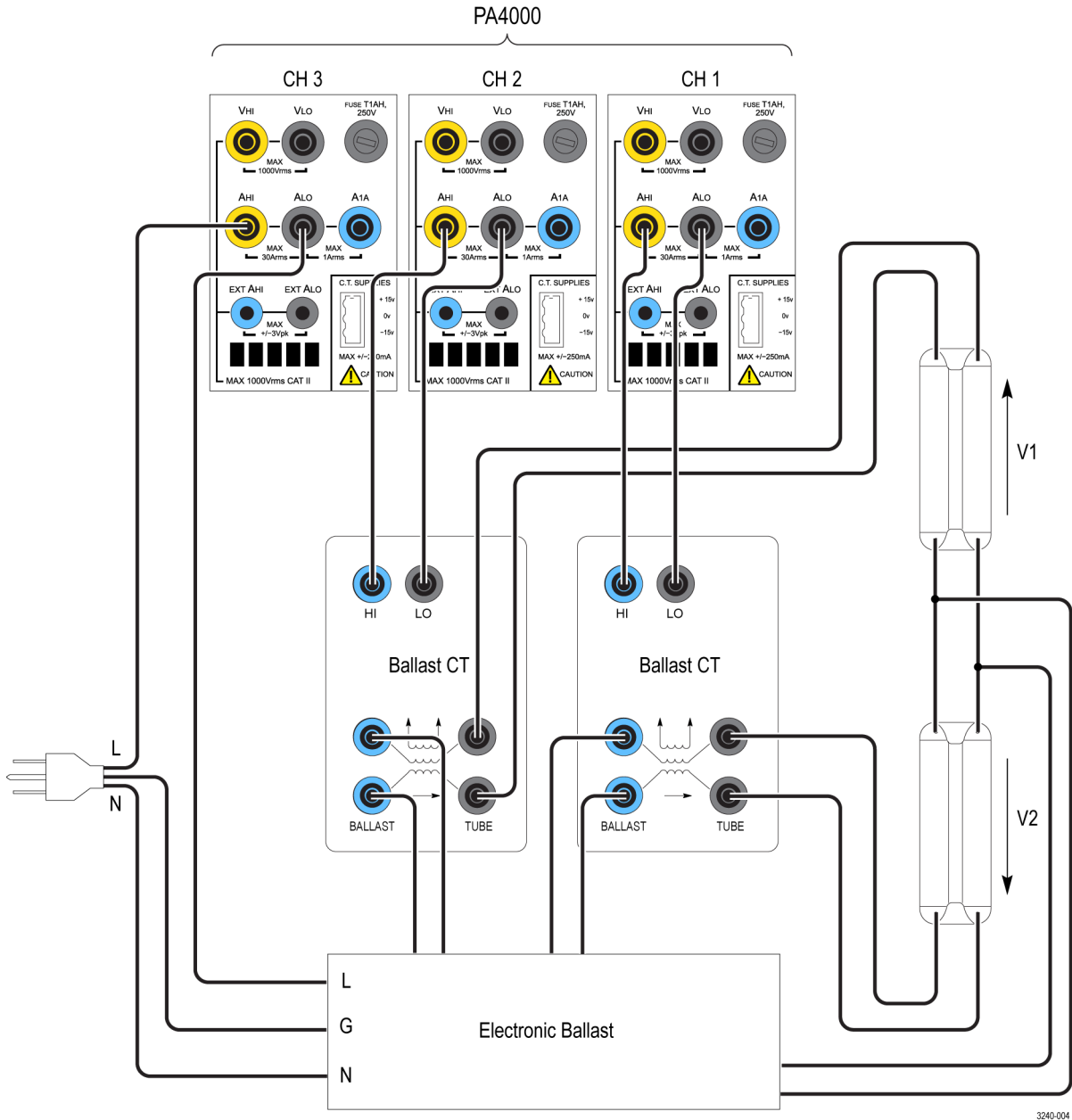


Figure 5: Two-tube fluorescent lighting connections

Measuring low-voltage lighting circuits

The benefits provided by the Ballast-CT of isolating the common mode switching voltages also apply to low-voltage lighting systems. A typical connection setup is shown below.

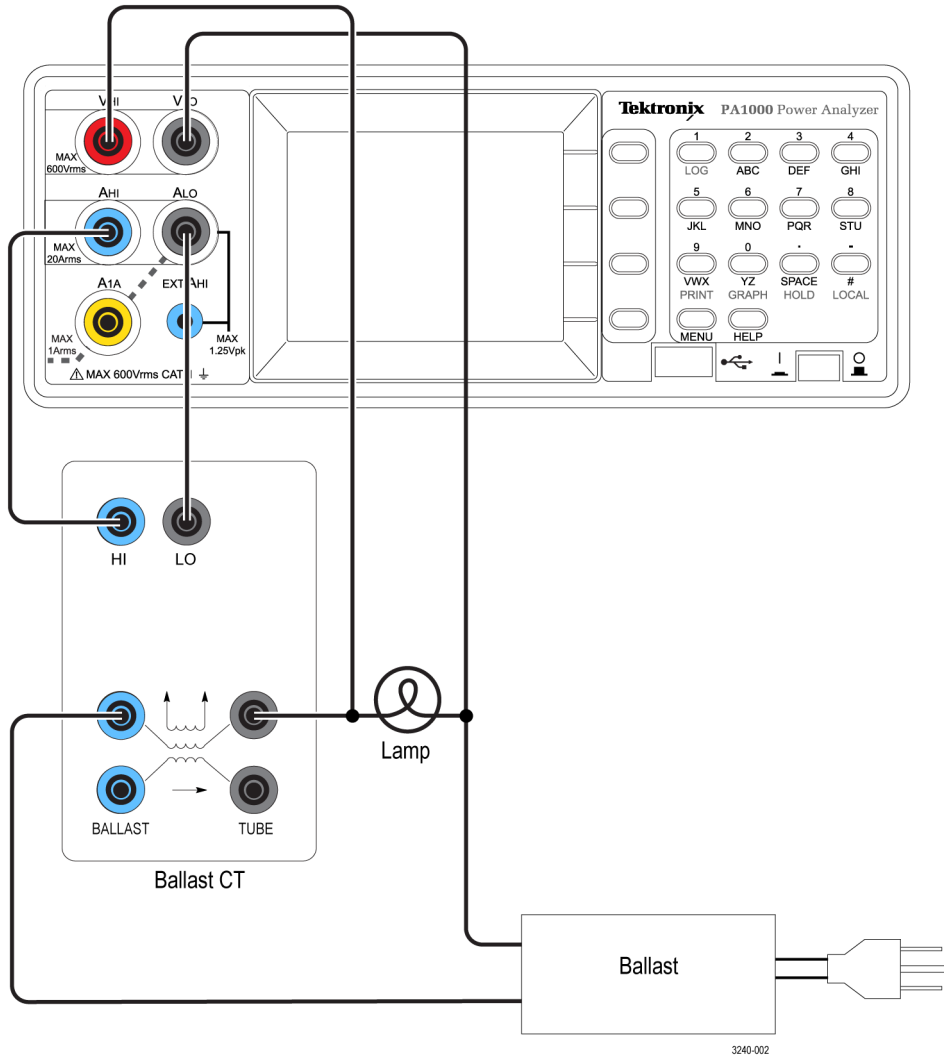


Figure 6: Low-voltage lighting connections

Specifications

Table 1: Electrical specifications (typical)

Characteristic	Description
Operating current range	5 mA to 1 A _{RMS}
Operating frequency	5 kHz to 1 MHz
Accuracy	
Amplitude	better than 1% (up to 500 kHz)
Phase	better than 1 degree (up to 500 kHz)
Maximum voltage, tube/ballast to output or Earth	600 V _{RMS} , CAT II
Isolation, tube/ballast to output	1 kVac

Table 2: Physical specifications

Characteristic	Description
Dimensions	
Height	41 mm (1.6 in)
Width	65 mm (2.6 in)
Depth	120 mm (4.7 in)
Weight	200 gms (7 oz)

Table 3: Environmental specifications

Characteristic	Description
Temperature	
Operating	0 °C to 40 °C (32 °F to 104 °F)
Nonoperating	-20 °C to +60 °C (-4 °F to 140 °F)
Humidity, operating	80% for temperatures up to 31 °C (88 °F), decreasing linearly to 50 % relative humidity at 40 °C (104 °F)
Altitude, operating	Up to 2000 m (6562 ft)