



**P6701B & P6703B**  
**Optical-to-Electrical Converters**  
**Instructions**



071-3537-00





**P6701B & P6703B  
Optical-to-Electrical Converters  
Instructions**

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- In North America, call 1-800-833-9200.
- Worldwide, visit [www.tek.com](http://www.tek.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.

## 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.

### To avoid fire or personal injury

**Observe all terminal ratings.** To avoid fire or shock hazard, observe all rating and markings on the product. Consult the product manual for further ratings information before making connections to the product.

**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.

**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.

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.

## Terms in the manual

These terms may appear in this manual:



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

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

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## 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.

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# Compliance Information

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

## Environmental compliance

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 2012/19/EU and 2006/66/EC on waste electrical and electronic equipment (WEEE) and batteries. For information about recycling options, check the Tektronix Web site ([www.tek.com/productrecycling](http://www.tek.com/productrecycling)).



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# Preface

This manual contains instructions and specifications for using the P6701B, and P6703B Optical-to-Electrical Converter Probes.

## Related manuals

For performance verification procedures, adjustment procedures, list of replaceable parts, and other service information, refer to the P6701B, P6703B, & P6723 Service Manual (070-9892-xx).



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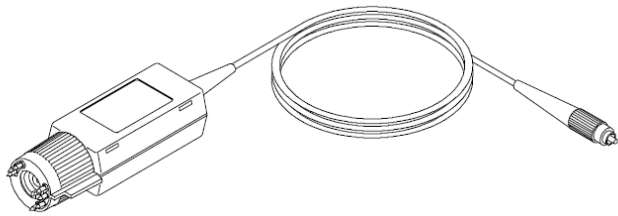
# Getting started

This section contains a description of the P6701B, & P6703B O/E Converters and information about features, options, accessories, and proper installation.

## Product description

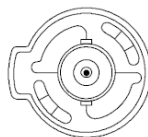
The P6701B and P6703B products are optical-to electrical (O/E) converters that convert optical communication and optical video signals into electrical signals for display on an oscilloscope.

- The P6701B analog converter accepts short wavelength signals (500 to 950 nm) present in multi-mode fibers. Conversion gain of 1 V/mW is calibrated at 780 nm.
- The P6703B analog converter accepts longer wavelength signals (1100 to 1600 nm) present in single-mode or multi-mode fibers. Conversion gain of 1V/mW is calibrated at 1310 nm.



**Figure 1: P6701B and P6703B O/E converters**

The P6701B and P6703B O/E Converters have the TekProbe II interface which is standard on many Tektronix oscilloscopes. The interface supplies power to the converter, selects the correct vertical scale (watts/division), and automatically sets the 50  $\Omega$  termination on the oscilloscope input. The following figure shows the input connector of the TekProbe II interface.



**Figure 2: TekProbe II interface (input)**

To adapt the P6701B, and P6703B O/E Converters to measurement instruments that do not have the TekProbe II interface, order the Tektronix 1103 TekProbe Power Supply.

## Options

The following options are available. These options must be ordered when you purchase the O/E converter.

- **Frequency response data (Option FR).** Option FR documents the frequency response of the O/E converter.

## Standard accessories

The following standard accessories are available.

- **Calibration certificate.** A certificate of traceable calibration is provided with every instrument shipped.
- **User instructions (This document).** This document provides instructions for operating the P6701B and P6703B O/E converters.
- **Service information.** This document includes performance verification procedures and a list of replaceable parts, Tektronix part number: 070-9892-xx.

## Optional accessories

The following optional accessories are available.

- **1103 Power Supply.** Order the 1103 power supply for instruments that do not have the TekProbe Interface.

## Installation

Before you connect the output of the P6701B and P6703B O/E Converters, determine whether or not your instrument has the TekProbe II interface.



## Instruments with the TekProbe II Interface

For instruments that have the TekProbe II interface, simply connect the converter to the oscilloscope input. The interface provides connections for power, signal, and scale factor coding.

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**NOTE.** *Some old TDS 400 and TDS 400A series oscilloscopes always interpret the P6701B and P6703B attenuation setting as  $\div 10$  and display units as V instead of mW. When you use the O/E converters, divide the measurement (or scale factor) by 10 and interpret measurements as milliwatts instead of volts.*

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## Instruments without the TekProbe II Interface

For instruments that do not have the TekProbe interface, order the optional 1103 TekProbe Power Supply. Accessories are also available to terminate the output into the required 50  $\Omega$ . For instruments with Tek VPI interface, you will need a TPA-BNC adapter.



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# Operating basics

This section presents the basic information necessary you need to know to operate the P6701B and P6703B O/E Converters.

## Operating safety



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**WARNING.** *To avoid eye injury, wear eye protection if risk of exposure to high-intensity rays or laser radiation exists.*

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Refer to the *Important safety information* at the beginning of this document for more information on safety issues.

## Cleaning

Small dust particles and oils can easily contaminate fiber-optic connectors and reduce or block the signal. Take care to preserve the integrity of your connectors by keeping them free of contamination.



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**CAUTION.**

*To prevent loss of optical power or damage to the fiber-optic connectors, keep the connectors clean at all times.*

*When cleaning the connectors with a swab, use gentle circular motions. Use only high quality cleaning supplies that are non-abrasive and leave no residue.*

*To reduce the need for cleaning, immediately replace protective caps on the fiber-optic connectors when not in use.*

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To remove contamination, clean the fiber-optic connectors using the following procedure:

Equipment required

- Clean compressed air
- Fiber-optic cleaning swabs
- Isopropyl alcohol

### Procedure

1. Hold the can of compressed air upright and spray the can into the air to purge any propellant.
2. Spray the clean compressed air on the connectors to remove any loose particles or moisture.
3. Moisten a clean fiber-optic swab with isopropyl alcohol then lightly swab the surfaces of the connectors.
4. Spray the clean compressed air on the connectors again to remove any loose particles or isopropyl alcohol.

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**NOTE.** *Cleaning kits for fiber-optic connectors are available from a number of suppliers.*

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## Handling

Even though the fiber-optic cable of the P6701B or P6703B O/E Converter is protected by a jacket and strain relief, the fiber-optic cable should be handled carefully at all times.



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**CAUTION.** *To avoid damaging the P6701B or P6703B O/E Converters, take the following precautions:*

- *Do not crush, crimp, or sharply bend the fiber optic cable.*
  - *Do not pull or yank the fiber-optic cable.*
  - *Do not drop the converter assembly since damage and misalignment of the photo diode optical assembly can result. Store the converter in a secure location when not in use.*
  - *Replace the protective cap on the connector when the converter is not in use.*
-

## Optical input

The P6701B and P6703B O/E Converters can be connected to optical fibers with a core diameter of up to 62.5  $\mu\text{m}$  through one of the FC, ST, SC, or DIN adapters. Adapter cables that aid in connecting many other popular optical connectors are also available.



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**CAUTION.** *To maintain the high performance (low return loss) of the O/E converter, connect an adapter and cable between the input of the O/E converter and the device under test. When you make connections to other devices, leave the adapter and cable in place to protect the optical connector of the O/E converter from wear.*

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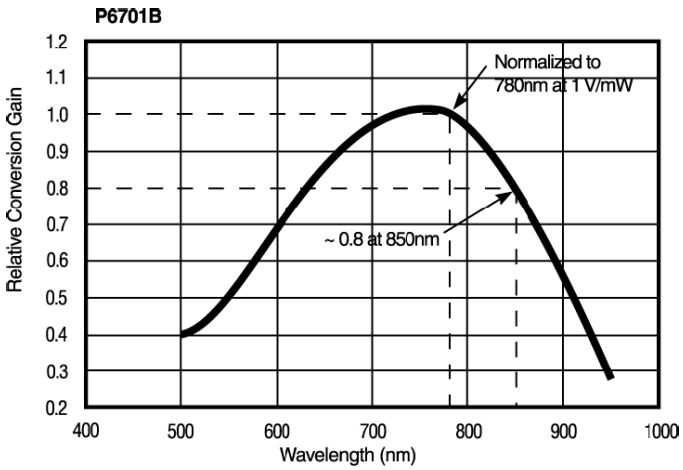
If you connect fiber cores larger than 62.5  $\mu\text{m}$ , the O/E converters may still couple light, but the mismatch in core diameter will cause lower conversion gain and high insertion loss.

## Electrical output

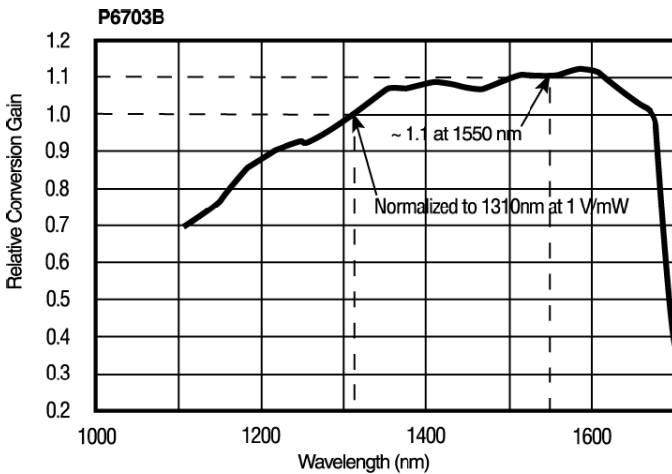
The P6701B and P6703B O/E converters output approximately 1 V/mW across 50  $\Omega$  at the nominal calibrated wavelength (780 nm for the P6701B converter and 1310 nm for the P6703B converter).

## Correcting for conversion gain

You can compensate your measurement for wavelengths that have a conversion gain other than one. For example, if you are using a P6703B to measure a signal with a wavelength of 1550 nm, the conversion gain at that wavelength is typically 1.1 V/mW versus 1.0 V/mW at 1310 nm. To correct the measurement to 1 V/mW, multiply the measurement by 0.909 (the reciprocal of 1.1). See the following figures for more information.



**Figure 3: P6701B typical wavelength dependent gain (25 °C)**

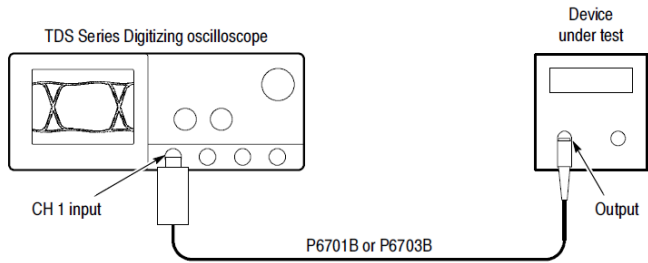


**Figure 4: P6703B typical wavelength dependent gain (25 °C)**

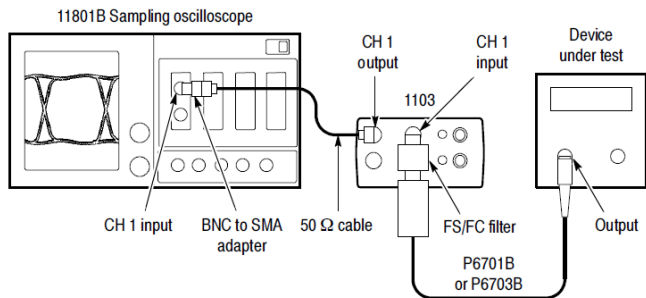
If your measurement instrument is so equipped, you can automatically multiply displayed waveforms or measurements by the appropriate correction factor. Refer to your instrument manual for details.

## Setup

The following figures show some typical equipment setups using the P6701B and P6703B O/E Converters on instruments with and without the TekProbe interface.



**Figure 5: Setups with the TekProbe II interface**



**Figure 6: Setups without the TekProbe II interface**





# Specifications

The following specifications apply to a P6701B or P6703B O/E converter. The converter must have a warm-up period of at least 20 minutes and be in an environment that does not exceed the limits described below.

## Warranted characteristics

Warranted characteristics describe guaranteed performance within tolerance limits or certain type-tested requirements. Warranted characteristics that have checks in the Performance Verification section of the service manual (070-9892-xx) are marked with the ✓ symbol.

<b>Absolute maximum non-destructive optical input</b>	10 mW average power; 20 mW peak power
<b>DC optical input dynamic range</b>	DC electrical out will meet conversion gain specifications up to 1 mW (0 dBm) peak optical power input
<b>✓ DC conversion gain</b>	
<b>P6701B</b>	1 V/mW $\pm$ 8% at DC, 780 nm
<b>P6703B</b>	1 V/mW $\pm$ 8% at DC, 1310 nm
<b>✓ AC conversion gain</b>	
<b>P6701B</b>	1 V/mW $\pm$ 8%, with $\leq 100 \mu\text{W}_{\text{p-p}}$ optical modulation, 780 nm
<b>P6703B</b>	1 V/mW $\pm$ 8%, with $\leq 100 \mu\text{W}_{\text{p-p}}$ optical modulation, 1310 nm
<b>✓ Output zero</b>	$\leq \pm 1$ mV into 50 $\Omega$ , 20 to 25 °C
<b>✓ Noise equivalent power</b>	(with 1 GHz low-pass filter)
<b>P6701B</b>	$\leq 0.87 \mu\text{W}_{\text{rms}}$ ( $\leq 28 \text{ pW} \div \sqrt{\text{Hz}}$ )
<b>P6703B</b>	$\leq 0.59 \mu\text{W}_{\text{rms}}$ ( $\leq 19 \text{ pW} \div \sqrt{\text{Hz}}$ )
<b>Output impedance</b>	50 $\Omega \pm 10\%$

**Temperature**

<b>Operating</b>	0 to +50 °C
<b>Nonoperating</b>	-40 to +71 °C

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**Humidity**

<b>Operating</b>	0 to 90% RH, tested at +30 to +50 °C
<b>Nonoperating</b>	0 to 90% RH, tested at +30 to +60 °C

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**Altitude**

<b>Operating</b>	4,572 m (15,000 ft)
<b>Nonoperating</b>	15,240 m (50,000 ft)

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**Typical characteristics**

The following characteristics describe typical but not guaranteed performance.

**Electrical wavelength range**

<b>P6701B</b>	500 to 950 nm
<b>P6702B</b>	1100 to 1650 nm

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**Wavelength dependent gain** Refer to the figures under [Correcting for conversion gain](#) on page 7

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**Optical bandwidth**

<b>P6701B</b>	≥1.0 GHz
<b>P6703B</b>	≥1.2 GHz

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**Rise time** Peak optical signal input < 100  $\mu\text{W}_{\text{p-p}}$

<b>P6701B</b>	≤475 ps
<b>P6703B</b>	≤390 ps

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**Aberrations** ≤ ±15% peak optical signal input < 200  $\mu\text{W}_{\text{p-p}}$

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## Nominal characteristics

The following nominal characteristics describe guaranteed traits, but the traits do not have tolerance limits.

<b>Optical input coupling</b>	Accepts up to 62.5 $\mu\text{m}$ core diameter; numerical aperture $\leq 0.29$ .
<b>Optical input coupling</b>	$> 1$ in. bend radius, not to exceed a bend radius of $< 1$ in. to maintain performance
<b>Absolute non-destructive fiber bend</b>	0.5 in. bend radius
<b>DC conversion gain linearity</b>	$< 3\%$ deviation in DC conversion gain from 50 $\mu\text{W}$ to 1000 $\mu\text{W}$ average optical input relative to conversion gain with 500 $\mu\text{W}$ average optical power input
<b>Output zero drift</b>	$\leq \pm 1.5$ mV with output load requirement met for ideally stable optical input, 0 to $-25$ $^{\circ}\text{C}$
<b>Output load requirement</b>	50 $\Omega \pm 1\%$



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