

# FBP PROBE MICROSCOPE & HP3-60-P4 SYSTEM

Probe and system with integrated power meter and patch cord microscope

## USER MANUAL



ZP-PKG-0502  
REV 1



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**Patents** RibbonDrive Tips: US Patent No. 6,751,017 / 6,879,439  
CleanBlast: US Patent No. 7,232,262

**Tested Equipment** All pre-qualification tests were performed internally at JDSU, while all final tests were performed externally at an independent, accredited laboratory. This external testing guarantees the unerring objectivity and authoritative compliance of all test results. JDSU's Commerce and Government Entities (CAGE) code under the North Atlantic Treaty Organization (NATO) is 0L8C3.

**FCC Information** Electronic test equipment is exempt from Part 15 compliance (FCC) in the United States.

**European Union** Electronic test equipment is subject to the EMC Directive in the European Union. The EN61326 standard prescribes both emission and immunity requirements for laboratory, measurement, and control equipment. This unit has been tested and found to comply with the limits for a Class A digital device.

**Independent Laboratory Testing** This unit has undergone extensive testing according to the European Union Directive and Standards.

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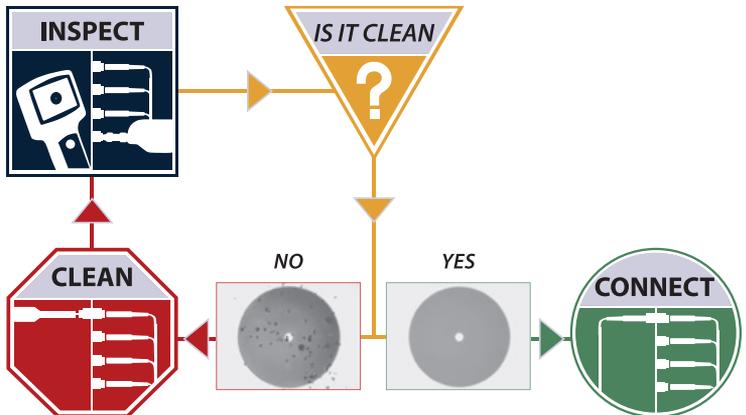
# JDSU FIBER INSPECTION SOLUTIONS

# 1

## INSPECT *BEFORE* YOU CONNECT<sup>SM</sup>

**CONTAMINATION IS THE #1 SOURCE OF TROUBLESHOOTING in optical networks.** A single particle mated into the core of a fiber can cause significant back reflection, insertion loss, and equipment damage. Visual inspection is the only way to determine if fiber connectors are truly clean before mating them.

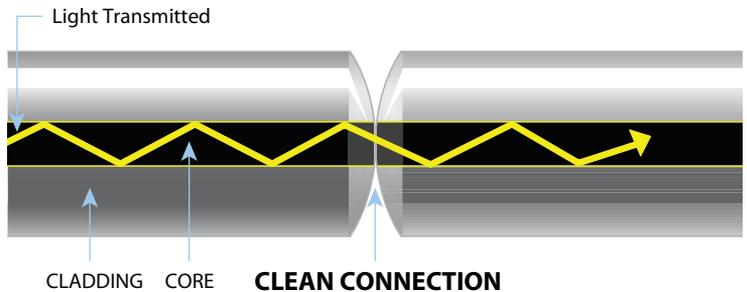
**Simple Solution** By implementing a **SIMPLE yet IMPORTANT** process of proactive visual inspection and cleaning, you can prevent poor signal performance and equipment damage.



**Good Fiber Connection**

There are **3 basic principles** that are critical to achieving an efficient fiber optic connection:

- 1. Perfect Core Alignment**
- 2. Physical Contact**
- 3. Pristine Connector Interface**



Today's connector design and production techniques have eliminated most of the challenges to achieving **core alignment** and **physical contact**. What remains challenging is maintaining a **pristine end face**.

**JDSU Fiber Inspection and Cleaning Solutions**

The JDSU video fiber inspection probe and handheld display system is used to quickly and easily inspect connector end faces, which ultimately minimizes loss and optimizes test conditions. Westover FBP-series video probes, available in digital or analog and single or dual-magnification (200/400X) models are high-performance, handheld microscopes designed for inspecting both *female* (bulkhead) and *male* (patch cord) connectors, as well as other optical devices. The probe microscope can also be combined with a USB converter module to inspect connectors via compatible test platforms and PC/laptop. Our versatile systems offer a wide range of configurable solutions that can meet the demands of any application.

**Benefits of Proactive Inspection**

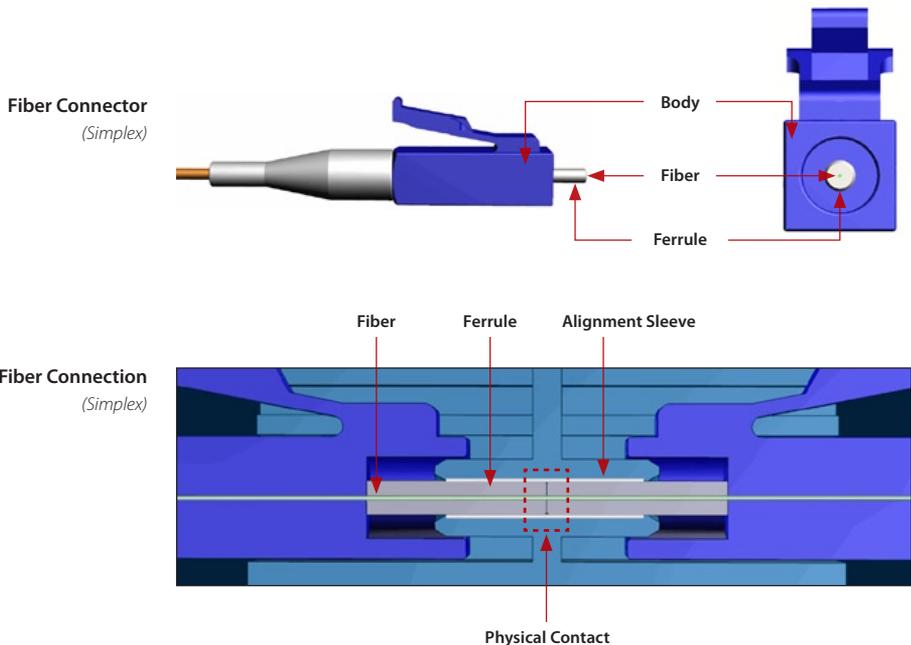
- **Reduce Network Downtime**
- **Reduce Troubleshooting**
- **Optimize Signal Performance**
- **Prevent Network Damage**

# FIBER OPTIC CONNECTORS

## 2

### Key Terms and Concepts

Fiber connectors enable fiber-to-fiber mating by aligning the two optical fibers. Fiber connectors come in various types and have different characteristics for use in different applications. The main components of a fiber connector are detailed below:



**Body** Houses the ferrule that secures the fiber in place; utilizes a latch and key mechanism that aligns the fiber and prevents the rotation of ferrules of two mated connectors.

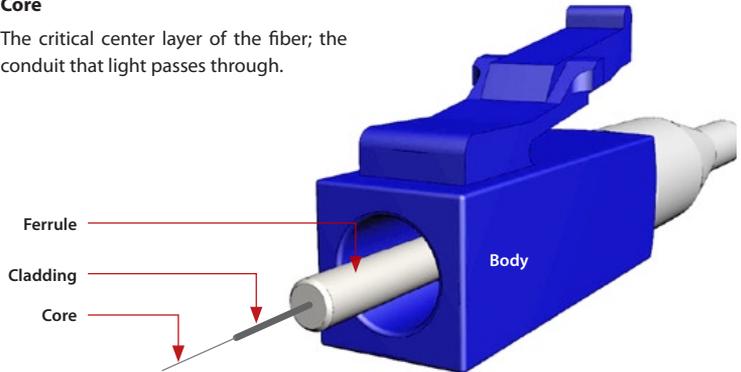
**Ferrule** Thin cylinder where the fiber is mounted and acts as the fiber alignment mechanism; the end of the fiber is located at the end of the ferrule.

**Fiber Cladding**

Glass layer surrounding the core, which prevents the signal in the core from escaping.

**Core**

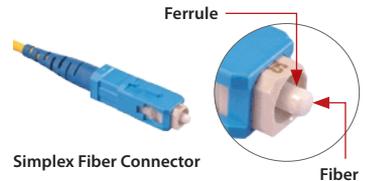
The critical center layer of the fiber; the conduit that light passes through.



**Simplex and Multi-fiber Connectors**

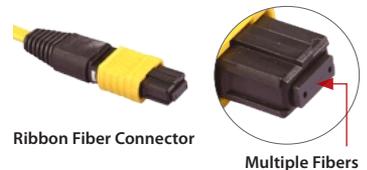
**Simplex Fiber Connector**

A simplex fiber connector contains a single fiber located in the center of the ferrule. Common types include SC, LC, FC and ST.



**Multi-fiber Connector**

A multi-fiber/ribbon fiber connector contains multiple linear fibers (4, 8, 12, 24, 48 or 72) in a single connector to provide high-density connectivity. The most common configuration is MPO (also called the MTP®).

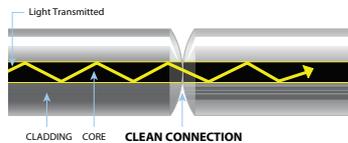


**Contamination** **Dirt is everywhere**, and a typical dust particle (2–15  $\mu\text{m}$  in diameter) can significantly affect signal performance and cause permanent damage to the fiber end face. Most field test failures can be attributed to dirty connectors, and most of them are not inspected until the problem is detected, AFTER permanent damage has already occurred.

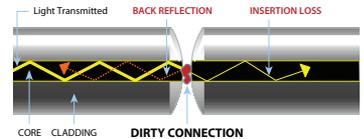
When dirt particles get on the core surface the light becomes blocked, creating unacceptable insertion loss and back-reflection. Furthermore, those particles can permanently damage the glass interface, digging into the glass and leaving pits that create further back-reflection if mated. Also, large particles of dirt on the cladding layer and/or the ferrule can introduce a barrier that prevents physical contact and creates an air gap between the fibers. To further complicate matters, loose particles have a tendency to migrate.

Scratches are typically created during polishing, cleaning or mishandling fiber connectors. Scratches that touch the core are problematic because they create back reflection.

#### CLEAN CONNECTION



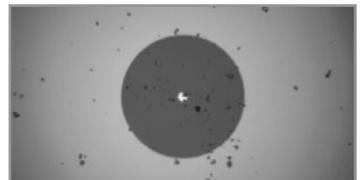
#### DIRTY CONNECTION



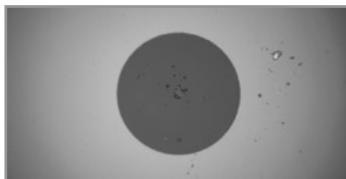
#### CLEAN FIBER



#### DIRT / CONTAMINATION



#### PITS / CHIPS



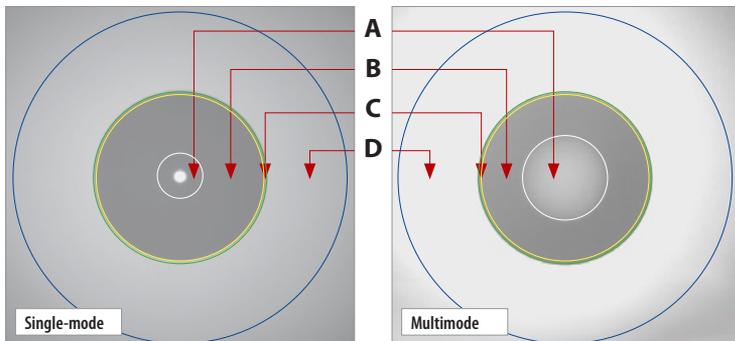
#### SCRATCH



**Zones** are a series of concentric circles that identify areas of interest on the connector end face. The inner-most zones are more sensitive to contamination than the outer zones.

### Zone Overlays

- A. Core
- B. Cladding
- C. Adhesive/Epoxy
- D. Contact/Ferrule



**Acceptance Criteria** **ACCEPTANCE CRITERIA** are a series of failure thresholds that define contamination limits for each zone.

The tables below list the **ACCEPTANCE CRITERIA** standardized by the **International Electrotechnical Commission (IEC)** for single-mode and multimode connectors as documented in *IEC 61300-3-35 Ed. 1.0*.

### Single-Mode

ZONE NAME (Diameter)	SCRATCHES	DEFECTS
<b>A. CORE Zone</b> (0–25 $\mu\text{m}$ )	none	none
<b>B. CLADDING Zone</b> (25–120 $\mu\text{m}$ )	no limit $\leq 3 \mu\text{m}$ none $> 3 \mu\text{m}$	no limit $< 2 \mu\text{m}$ 5 from 2–5 $\mu\text{m}$ none $> 5 \mu\text{m}$
<b>C. ADHESIVE Zone</b> (120–130 $\mu\text{m}$ )	no limit	no limit
<b>D. CONTACT Zone</b> (130–250 $\mu\text{m}$ )	no limit	none $\geq 10 \mu\text{m}$

### Multimode

ZONE NAME (Diameter)	SCRATCHES	DEFECTS
<b>A. CORE Zone</b> (0–65 $\mu\text{m}$ )	no limit $\leq 5 \mu\text{m}$ 0 $> 5 \mu\text{m}$	4 $\leq 5 \mu\text{m}$ none $> 5 \mu\text{m}$
<b>B. CLADDING Zone</b> (65–120 $\mu\text{m}$ )	no limit $\leq 5 \mu\text{m}$ 0 $> 5 \mu\text{m}$	no limit $< 2 \mu\text{m}$ 5 from 2–5 $\mu\text{m}$ none $> 5 \mu\text{m}$
<b>C. ADHESIVE Zone</b> (120–130 $\mu\text{m}$ )	no limit	no limit
<b>D. CONTACT Zone</b> (130–250 $\mu\text{m}$ )	no limit	none $\geq 10 \mu\text{m}$

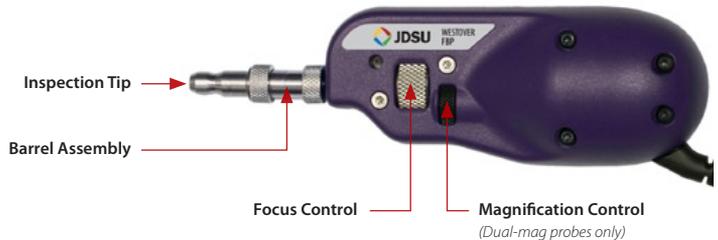
# FBP PROBE MICROSCOPE

## 3

**Introduction** JDSU's **Westover FBP Series Probe Microscopes** are portable video microscopes used to inspect fiber optic connectivity. While most fiber microscopes are limited to inspecting “male” connectors, JDSU's FBP Probe is designed to inspect both simplex and multi-fiber (ribbon) types of both *male* and *female* connectors as well as optical devices, such as transceivers. The probe is specially designed to fit and operate comfortably and easily in-hand, allowing the user to inspect hard-to-reach connectors that are installed on the backside of patch panels or inside hardware devices. This eliminates the need to disassemble hardware devices prior to inspection.



**Controls** The basic design of the **Westover FBP** probe microscope incorporates an imaging system, integrated light source, video camera, focus mechanism and magnification control. The probe is fully assembled and is powered by the display device. The only assembly required by the user is the connection to the display device and installation of the appropriate barrel assembly and/or the inspection tip. The FBP analog probe is equipped with a 4-pin circular Hirose™ connector with notch-keys, which allows for a secure and firm latch-lock connection to the display device.



**Focus Control** The *focus control* on the probe allows the user to adjust focus manually of the live fiber end face image on the display.

**Magnification Control** The *magnification control* (available only on dual-magnification probes) allows the user to switch between LOW and HIGH magnifications of the fiber end face image.

### Specifications

Dimensions	140 x 46 x 43 mm (5.5 x 1.8 x 1.7 in)
Weight	180 g (6.3 oz)
Optical magnification	200X, 400X, 200/400X
Focus control	Adjustable, in-probe
Cord length	240 cm (94-in)
Connector	4-pin Hirose™ male
Camera type	1/3-in CMOS Sensor
Video output	NTSC or PAL
Light source	Blue LED, 100,000+ hour life
Lighting technique	Coaxial
Power source	From the display device or USB module

# FBPT INSPECTION TIPS & ADAPTERS

## 4

**Introduction** JDSU's comprehensive selection of over 250 precision, stainless-steel fiber inspection tips and adapters will inspect every connector and application. Our unique optics architecture and design provide true versatility and adaptability, and are designed and engineered for consistent and accurate inspection. These connector-specific and universal inspection tips are interchangeable, which allow the probe to interface with different types of fiber connectors.



**Barrel Assembly** The **barrel assembly** houses the objective lens and works in conjunction with a number of tips.

**Note:** Certain tips are equipped with integrated optics and do not require a barrel assembly (e.g., Long Reach Tips [FBPT-LC-L], Angled Tips [FBPT-SC-A6]).



FBPP-BAP1



FBPP-BAP2



FBPP-BAP3



FBPT-SC (Bulkhead)

**Standard Tips** (Bulkhead and Patch Cord)

Standard bulkhead tips allow the user to inspect the fiber end face on the *female* side of the bulkhead (e.g., inside hardware devices or on the back side of patch panels).



FBPT-U25M (Patch Cord)

Standard patch cord tips allow inspection of *male* ends of a fiber connection (e.g., patch cords, pigtailed). Universal tips include the **FBPT-U25M**, compatible with 2.5 mm ferrules (e.g., FC, SC, ST) and the **FBPT-U12M**, used to inspect 1.25 mm ferrules (e.g., LC, MU).



FBPT-LC-L

**Long Reach Tips**

Long reach tips have a 1/2-in longer reach than standard tips, and allow the user to inspect the fiber end faces in tight, hard-to-reach spaces.



FBPT-SC-APC

**APC Tips**

APC tips are designed with an angle that complements the end face of an APC polish fiber connector. This allows the entire fiber image to stay in focus during inspection.



FBPT-SC-A6

**Angled Tips**

Angled tips, identified by “A6,” are angled 60 degrees to allow easy maneuvering and inspection of hard-to-reach locations such as transceivers on a printed circuit board (PCB) or bulkheads located in tight spaces.



FBPT-MTPA

**RibbonDrive™ Tips**

JDSU's patented RibbonDrive tips are specialty tips that allow inspection of high-density, multifiber array connectors that are mounted within a bulkhead adapter. Each tip mates securely with connectors using a precision-keyed mating adapter interface. The patented *panning knob* allows the user to view each fiber individually in the linear array.



FBPT-A801-2-001-R

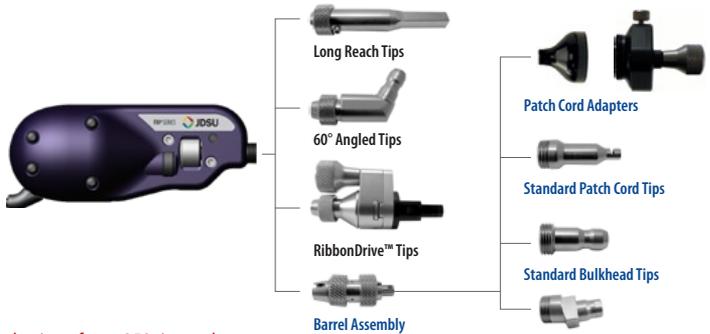
**Alignment Guides**

Alignment guides enable the inspection of various military and aerospace connectors that use a plug and receptacle design. In addition to providing an alignment channel for sockets, these alignment guides work in conjunction with a barrel assembly to prevent the pins from breaking.

**FMA Adapters**

FMA Adapters provide optimized inspection for *male* connector ends and are ideal for inspecting patch cords with multi-fiber ribbon and APC polish connectors. FMA adapters can be utilized by a probe microscope with a universal flare adapter (**FBPT-UFMA**).

**FBPT Tip  
Installation Guide**



*JDSU offers a comprehensive selection of over 250 tips and adapters that will inspect every connector and application. Visit our web site for a complete list of inspection tips and adapters.*

FBPT STANDARD INSPECTION TIPS <i>(common tips shown)</i>			
CONNECTOR TYPE	INSPECTION TIP	APPLICATION	DESCRIPTION
 SC/UPC	FBPT-SC 		Inspect SC/UPC connectors through a bulkhead.
	FBPT-U25M 		Inspect 2.5 mm UPC patch cord connectors.
 SC/APC	FBPT-SC-APC 		Inspect SC/APC connectors through a bulkhead.
	FBPT-U25MA 		Inspect 2.5 mm APC patch cord connectors.
 LC/UPC	FBPT-LC 		Inspect LC/UPC connectors through a bulkhead.
	FBPT-U12M 		Inspect 1.25 mm UPC patch cord connectors.
	FBPT-LC-L 		Inspect LC/UPC connectors through a bulkhead with 1/2-in longer reach.
 LC/APC	FBPT-LC-APC 		Inspect LC/APC connectors through a bulkhead.
	FBPT-U12MA-SF 		Inspect 1.25 mm APC patch cord connectors.

FBPT STANDARD INSPECTION TIPS				
CONNECTOR TYPE	INSPECTION TIP	APPLICATION	DESCRIPTION	
ST/ UPC	FBPT-ST			Inspect ST/UPC connectors through a bulkhead.
	FBPT-ST-A6			Inspect ST/UPC connectors through a bulkhead at a 60-degree angle.
FC/ UPC	FBPT-FC			Inspect FC/UPC connectors through a bulkhead.
FC/ APC	FBPT-FC-APC			Inspect FC/APC connectors through a bulkhead.
E2000/ APC	FBPT-E2000			Inspect E2000/APC connectors through a bulkhead.

FBPT MULTI-FIBER RIBBONDRIIVE INSPECTION TIPS				
CONNECTOR TYPE	INSPECTION TIP	APPLICATION	DESCRIPTION	
MTP®/UPC	FBPT-MTP			Inspect MTP®/UPC connectors through a bulkhead.
MTP®/APC	FBPT-MTPA-L			Inspect MTP®/APC connectors through a bulkhead (long reach).
MTP® Patch Cords	FMA-MTPA & FBPT-UFMA			Inspect MTP®/UPC or APC patch cords (MTP®/APC inspection shown).
	FCLT-MTP-MA			Inspect MTP®/UPC or APC patch cords (MTP®/APC inspection shown).

# HP3-60-P4 FIBER INSPECT & TEST SYSTEM

## 5

**Introduction** JDSU's HP3-60 series system combines the ability to inspect fiber and measure optical power into a single seamless handheld device. Derived from the popular HD3 series, the HP3-60 provides high-quality image resolution in a compact, portable design, and the integrated power meter offers quick, easy, and convenient field measure of optical power and attenuation. Easy push-button operation makes the device simple and straightforward, while the inspect-test process procedure establishes proper, optimal workflow practices.



### HP3-60-P4 Features

- **Fiber end face inspection and optical power testing with the same device**
- Integrated functions and features eliminate switching between multiple devices
- Instantly inspect fiber when power level is low
- Significantly reduces time for fiber inspection and testing
- 1.8-inch TFT LCD to view clear, crisp, detailed images of fiber end faces with optimum resolution
- Integrated patch cord microscope (PCM) for dedicated patch cord inspection
- PCM eliminates need for changing inspection tips, prevents misrouting, and protects patch cords
- Ergonomic, small form factor design for ultimate portability
- Easy-to-use, simple operation

### Components and Functions



**Improved Workflow with PCM**

With the integrated PCM, inspecting the bulkhead with the probe and the patch cord with the display can be achieved with a push of a button.

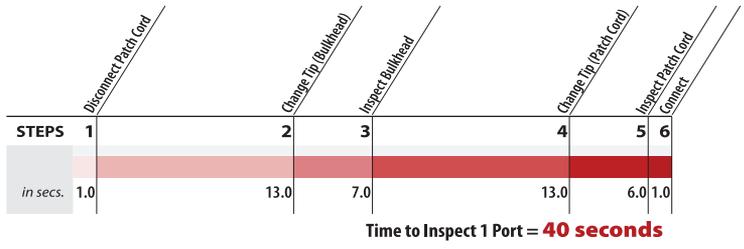


**Benefits of 2-Microscope System**

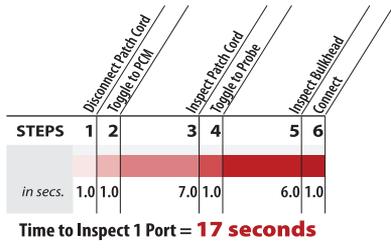
- Reduce inspection time by more than 50 percent
- Inspect the bulkhead with the probe and the patch cord with the display
- No more changing, mishandling and misplacing inspection tips for the probe
- Inspect 1 port/channel at a time and prevent mis-routing
- Ensure patch cords stay clean by *parking* it in the patch cord microscope before connecting

**Inspection Time Trial (Average)**

**Traditional Display**



**Display with PCM**



### Integrated Power Meter Features

- Easy-to-use, straightforward operation
- Reliable basic functionality for optical testing
- Suitable for all single-mode and multimode applications, such as LAN, TELECOM, CATV, and DWDM testing
- Universal Push-Pull (UPP) interface for 2.5 mm and 1.25 mm connectors
- Use with JDSU light source to detect modulation frequency and identify individual fibers
- TWINtest and Auto- $\lambda$  (with JDSU light source)

### Power Meter Controls

Universal Push-Pull (UPP) Power Meter input

Protective Rubber Cap



4-pin Probe Input

Display for Wavelengths and Types of Modulation

Power Meter Operation Controls

**dBm/dB**

- **SHORT KEY PRESS:** Switches between absolute and relative power level display
- **LONG KEY PRESS:** Stores a reference power level

$\lambda$

- Sets the calibrated wavelength; five possible wavelengths.



- **SHORT KEY PRESS:** Brief operating mode
- **LONG KEY PRESS:** Permanent operating mode

**Power Meter Display Indicators**



- REF** Reference level transfer
- BAT** Batteries discharged
- AU** Modulation frequency detected
- 29.70** Current power level
- LO** Too low for power level range
- HI** Too high for power level range
- 1300nm** Calibrated wavelength
- dBm** Absolute power level unit
- dB** Relative power level unit
- PERM** Permanent operating mode

**Measuring Modulated Light**



The power meter detects light signals modulated at standard frequencies of 270Hz, 330Hz, 1kHz, and 2kHz. If one of these frequencies is detected, it appears in the display. At very low input levels, the modulation signal cannot be identified, in which case 2 hyphens "--" will appear.

Using different modulation frequencies, you can detect a particular fiber in a fiber bundle.

**Service Information**



When first powered on, the power meter runs a self-test that checks the program and calibration data memory. If an error is detected, an error message is displayed at the end of the self-test.

CODE	DESCRIPTION
<b>E2</b>	An error occurred in the program memory. This can cause malfunctions in keypad operation or cause the device to lock up.
<b>E3</b>	A checksum error occurred in the calibration data memory. The device calibration data are invalid.

**HP3-60-P4 Display Specifications**

<b>Dimensions</b>	148 x 81 x 42 mm ( 5.8 x 3.2 x 1.7 in)
<b>Weight</b>	352 g (12.4 oz) with 6 x AA alkaline batteries
<b>Video display</b>	1.8-in (45.7 mm) TFT LCD
<b>Power modes</b>	<b>ON</b> (continuous ON) <b>OFF</b>
<b>Connectors</b>	4-pin Hirose™ for FBP probes
<b>Power source</b>	6 x AA batteries or AC power adapter (100–240 VAC/9V DC/500mA)
<b>Run time</b>	~3 hours continuous ON
<b>Horizontal FOV (200X Probe)</b>	550 μm
<b>Horizontal FOV (400X Probe)</b>	350 μm
<b>Warranty</b>	1 year

**Power Meter Specifications**

<b>Display range</b>	–65 to +10 dBm
<b>Max. permitted input level</b>	+10 dBm
<b>Intrinsic uncertainty<sup>(1)</sup></b>	± 0.20 dB (± 5%)
<b>Linearity<sup>1</sup> (-50 to +50 dBm)</b>	±0.06 dB
<b>Wavelength range</b>	780 to 1650 nm
<b>Standard wavelength settings</b>	850, 1300, 1310, 1490, 1550 nm
<b>Wavelength and modulation</b>	270Hz, 330Hz, 1kHz, 2kHz
<b>1300, 1310, 1490, 1550nm</b>	–50 to +10 dBm
<b>850nm</b>	–45 to +10 dBm
<b>Connectable fiber types</b>	9/125 to 100/140 μm
<b>Optical interfaces</b>	Universal PUSH-PULL (UPP) 2.5mm (DIN, ST, FC, SC, E2000) Universal UPP 1.25mm adapter (LC, MU)
<b>Display</b>	LCD, 4-digit
<b>Result display in</b>	dBm, dB
<b>Resolution</b>	0.01 dB

<sup>1</sup> Under the following reference conditions: –20 dBm (CW), 1300nm ± 1nm, 23°C ± 3K, 45 to 75% rel. humidity, 9 to 50μm fiber

# FIBER INSPECTION & TESTING

## 6

**Introduction** **Dirt is everywhere**, and a typical dust particle (2–15  $\mu\text{m}$  in diameter) can significantly affect signal performance and cause permanent damage to the fiber end face. Most field test failures can be attributed to **dirty connectors**, and most of them are not inspected until the problem is detected, **after** permanent damage has already occurred.

When dirt particles get on the core surface, light becomes blocked, creating unacceptable **insertion loss** and **back-reflection**. Furthermore, these contamination particles can permanently damage the glass interface by digging into the glass and leaving pits when mated, causing further signal loss. Damage also occurs when large particles of dirt on the cladding layer and/or the ferrule cause barriers that prevent physical contact, creating air gaps in the connection. These large particles are also known to break apart and migrate across the fiber surface when mated.

### OTDR Trace of Contamination and its Effect on Signal Performance



**Absolute Power** The **absolute power level** (*system power measurement*) is the amount of optical power present in the system, measured in **dBm**. The source of this power is the transmitter or transceiver sending information through the system. This test determines whether the signal has enough power to operate the receiver or transceiver at the end of the link.

### System Power Measurement



1. Select the connector you are testing and disconnect from the system.
2. **INSPECT**, and if necessary, **CLEAN** both the patch cord and bulkhead ends of the fiber interconnect.
3. **INSPECT**, and if necessary, **CLEAN** both ends of the **test lead** fiber.
4. Connect the **test lead** connector to the power meter and to the system.
5. Press  to turn the power meter **ON**.
6. Press  to select wavelength.
7. Press  to select **dBm**.
8. The optical power measurement is displayed on the power meter display.

**Relative Power** Acquiring **attenuation measurements** (*optical link loss*) on optical components or fiber optic links (*e.g., fiber connectors, cable assemblies, installed fiber optic links*) is done by measuring the **relative power level (dB)** at the far end of the link or device under test.

**Relative power level** (*attenuation measurement*) is the amount of power lost (*attenuated*) by the optical link being tested, measured in **dB**. The source of this power is typically a handheld optical light source. This test determines whether the optical link is constructed properly, either as a qualification test or when troubleshooting the network.

To measure attenuation, you must:

1. Get a **reference measurement**
2. Get an **attenuation measurement**

### Reference Measurement

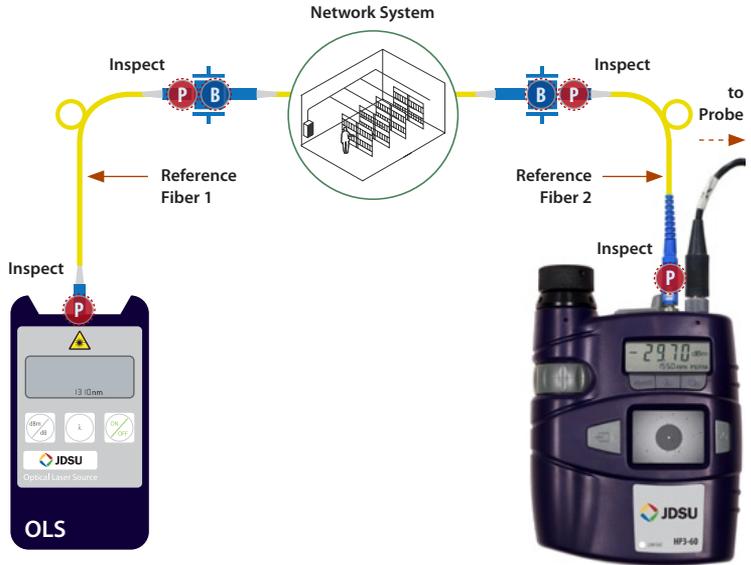


1. **INSPECT**, and if necessary, **CLEAN** both the ends of the **reference fiber**.
2. Connect the optical light source (OLS) to the power meter using the **reference fiber**.
3. Press  to turn both the power meter and light source (OLS) **ON**.
4. Press  to select wavelength.
5. Press and hold  until a reference level of **"0.00 dB"** is displayed on the power meter display.

**Note:** "REF" will flash briefly on the power meter to indicate that the reference level is saved.

**Note:** **DO NOT** disconnect the **reference fiber** from the light source (OLS).

### Attenuation Measurement



1. Disconnect the power meter from **reference fiber 1**.  
**Note: DO NOT** disconnect **reference fiber 1** from the light source (OLS).
2. **INSPECT**, and if necessary, **CLEAN** all ends of the system port.
3. Connect **reference fiber 1** to the system port.
4. **INSPECT**, and if necessary, **CLEAN** both ends of **reference fiber 2**.
5. **INSPECT**, and if necessary, **CLEAN** the fiber at the far end of the optical link.
6. Connect **reference fiber 2** to the system port.
7. Press  to turn both the power meter and light source (OLS) **ON**.
8. Press  to select wavelength.
9. The **attenuation measurement** (*insertion loss*) of the optical link is displayed on the power meter.

# JDSU Video Probe Inspection Systems

**Digital Video Probe** JDSU's **P5000** digital probe microscope connects directly to PC/laptops via a USB 2.0 connection, and operates with **FiberChek2™**, an advanced software that determines the acceptability of optical fiber end faces through advanced automated inspection and analysis.



USB 2.0 connection to PC/laptop

**Analog Video Probe** JDSU's **Westover FBP** analog probe microscopes connect directly to **Westover HD DISPLAYS** (*HD1, HD2, HD3, HP3-60*) or to a PC/laptop or JDSU test platform (*T-BERD/MTS, FST*) via a **USB analog-to-digital converter**.



with HD-series displays

USB analog-to-digital converter

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