

**23400 Series**  
**Two Way Test Set + ORL**

**27400 Series**  
**Two Way Loss Test Set**

*OPERATION & MAINTENANCE GUIDE*





# DECLARATION OF CONFORMITY

IN ACCORDANCE WITH ISO/IEC 17050:2004



**Manufacturer's Name:** Kingfisher International Pty. Ltd.  
**Manufacturer's Address:** 720 Springvale Road, Mulgrave, Victoria 3170, Australia  
**hereby declares, that the products listed below**  
**Product Name:** Optical Power Meter, Optical Light Source, Optical Loss Test Set  
**Model Number:** 2000 Series  
**Product Options:** *This declaration covers all options of the above product(s)*

**complies with the essential requirements of the applicable European Directives:**

- Low Voltage Directive 2014/35/UE and the EMC Directive 2014/30/UE, and carries the CE marking accordingly
- Directive 2011/65/EU on restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)
- Directive 2012/19/EU on waste electrical and electronic equipment (WEEE). The instrument can be disposed of local retail shop with WEEE collection point.

**and conform to the following standards and specifications:**

MIL-PRF-28800F:1996 Performance specification -Test equipment for use with electrical and electronic equipment, general specification  
IEC 60529 Ed. 2.2 / EN 60529:1991 Degrees of protection provided by enclosures

**Power Meter conforms to:**

IEC 61315 Ed. 2.0 Calibration of fibre-optic power meters

**EMC**

IEC 61326-1 Ed. 2.0 / EN 61326-1:2013  
IEC CISPR 11 Ed. 6.1 / EN 55011:2016  
IEC CISPR 16-1:2004~2019  
IEC CISPR 16-2:2003~2016  
IEC 61000-3-2 Ed. 5.0 (2018) / EN 61000-3-2:2014  
IEC 61000-3-3 Ed. 3.1(2017) / EN 61000-3-3:2013  
IEC 61000-4-2 Ed. 2.0 (2008) / EN 61000-4-2:2009  
IEC 61000-4-3 Ed. 3.2 / EN 61000-4-3:2006  
IEC 61000-4-4 Ed. 3.0 / EN 61000-4-4:2012  
IEC 61000-4-5Ed. 3.1 / EN 61000-4-5:2014  
IEC 61000-4-6 Ed. 4.0 / EN 61000-4-6:2014  
IEC 61000-4-11 Ed. 2.1 / EN 61000-4-11:2004  
ICES-001: 2006 (Canada)  
CFR 47 FCC Part 15, Subpart B (Exempted devices) (USA)

**Limit**

Limits applicable to Group 1 Class B equipment  
Limits applicable to Class B equipment  
Limits applicable to Class B equipment

4kV CD, 8kV AD  
3V/m, 80-1000MHz  
1kV signal lines, 2kV power lines  
1kV line-line, 2kV line-ground  
3V, 0.15-80 MHz  
0.5 cycle/100%/each polarity

**Safety**

**Light Source conforms to:**

IEC 60825-1:2014 Safety of laser products - Equipment classification, requirements and user's guide  
IEC 60825-2:2021 Safety of laser products - Safety of optical fibre communication systems (OFCS)  
CFR 21 part 1040.10 (FDA) Performance standards for light- emitting products-Laser products

**Supplemental Information:**

*The product was tested in a typical configuration with Kingfisher International test systems.*

28 Apr 2021

Date

Bruce Robertson

Name

Technical Director

Title

# OPERATION MANUAL

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## 234xx Premium Two-Way Optical Loss Test Set with Length & Optical Return Loss (ORL)

## 274xx Two-Way Optical Loss Test Set with Length

*Tempo series/model numbers with prefix “T”*

*Kingfisher series/model numbers with prefix “KI”*

Congratulations on your purchase of this equipment, engineered to provide excellent performance, convenience, and reliability. To get the best use from your instrument and to ensure its safe operation, please spend a few minutes to read this manual.



Made in Australia. International  
© Copyright Kingfisher International Pty Ltd  
Edition 15, Oct 2023 (Instrument FW version 1.03 & above)

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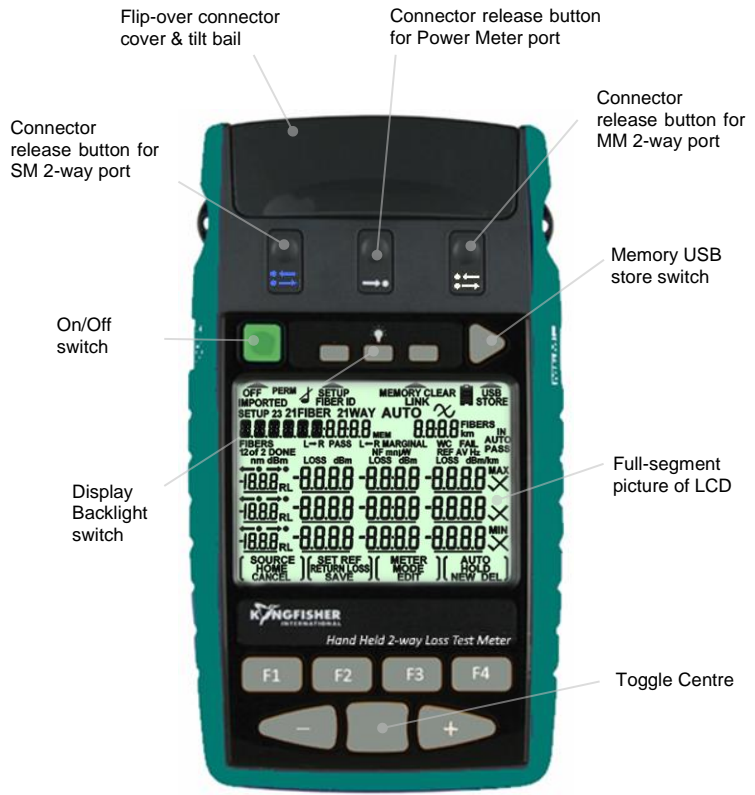
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# Pictures of Instrument



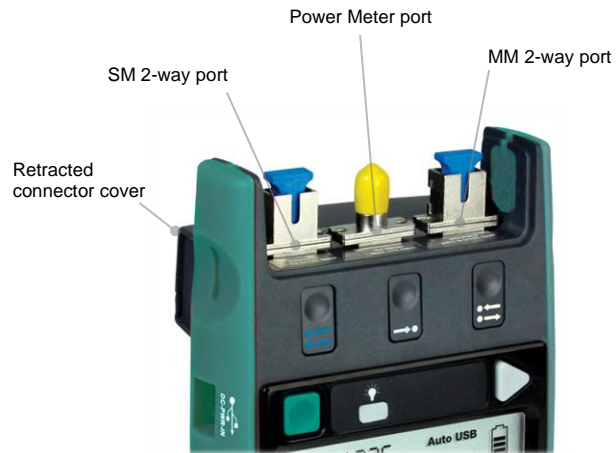
23400 / 27400 HANDHELD 2-WAY LOSS TEST METER

Micro USB port for data and power



Slim, easy to hold rubber casing

USB port for memory stick



## 23400 / 27400 HANDHELD 2-WAY LOSS TEST METER



## SERVICE AND SUPPORT

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### Applications Support

Please visit [www.kingfisherfiber.com](http://www.kingfisherfiber.com) to see our comprehensive **Application Notes** written to support instrument users, an updated version of this manual or instrument firmware updates. FAQs can be found in the “Support” section of our website.

This equipment can perform testing in accordance with TIA and IEC fiber optic test standards. Please refer to [www.kingfisherfiber.com](http://www.kingfisherfiber.com) for details.

Look at [www.kingfisherfiber.com](http://www.kingfisherfiber.com) to find distributor and service centre details from the **Contact Us** section.

Our local agents can offer excellent applications advice in your language and time zone.

If you are having difficulties, please feel free to contact [sales@kingfisher.com.au](mailto:sales@kingfisher.com.au) for applications support.

### Instrument Service

Qualified personnel must perform adjustment, maintenance, or repair of this product. Refer to General Safety Summary section of this manual. To obtain service, please contact your local Kingfisher International distributor or our office in Australia:

Tel: (+61) 3-8544-1700

Fax: (+61) 3-8544-1793

Email: [sales@kingfisher.com.au](mailto:sales@kingfisher.com.au)

If returning equipment to us for service or calibration, please download and complete the **Return Material Authorization Form** located on the **Support** page on our web site.

To avoid delays and minimise disruption for our customers, we offer a fixed price repair service.

For the staff at our fully equipped service and calibration centre, it is their pleasure to keep your equipment performing at its very best.

## INTRODUCTION AND APPLICATIONS

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### Introduction and Applications

The 2000 family of Two-Way Optical Loss Test Sets are used to test single mode and multimode fiber optic cable & systems, including for high throughput Tier 1 certification, with exceptional convenience, productivity, and accuracy. These instruments are compact, robust, and reliable, and are ideal for use by installers, technicians or engineers in field and laboratory situations.

The instruments are simple to operate, with convenient menus to guide the user through operational sequences. The large, sunlight readable custom LCD is an exceptional feature, with a wide viewing angle and backlight. With simple operation and visual appearance, these meters offer a surprising level of integrated functionality.

Excellent test accuracy is achieved, while the zero warm up source options provide exceptional source stability for demanding test situations.

The innovative VFL VisiTester option is particularly helpful in high fiber count environments, particularly to locate the exact fiber to be tested.

The interchangeable optical connectors are easily dis-assembled for cleaning. They are protected by a dust cover, which also flips over to serve as a handy instrument tilt bail. Many connector styles are available.

The tough housing has shock-absorbing rubber corners for drop protection. The latest materials and methods are used to produce an elegant, yet rugged instrument.

Battery life is 80 – 1000 hours from 2 x AA alkaline or NiMH cells. Instruments can be externally powered or charged via micro USB.

#### Typical Test Applications (all options):

- Instrument Pair and Two-Way Autotest: Two-way loss, ORL & length with pass/fail, ideal for Tier 1 Certification.
- Stand-alone instrument and One-Way Autotest: One-way loss, basic light source, power meter and ORL tester.
- Max / Min power stability testing
- Test reporting & data logging with data security in MS Excel with KITS™ software
- Optical power meter with interchangeable connectors
- Continuity & polarity check using test tones & VFL-VisiTester
- Tone source for fiber identifiers
- Single mode, multimode, mixed, and custom fiber options

#### Key Benefits

- ✓ Complete network certification & reporting
- ✓ Optimise productivity and minimise training

## INTRODUCTION AND APPLICATIONS

---

- ✓ Excellent test accuracy and flexibility
- ✓ Minimise false rework with simple one hook-up test method

With just one button push and high accuracy, a single fiber connected between two instruments can test & pass / fail at several wavelengths based on: Bi-directional loss, ORL each end, and cable length.

Autotest communicates test data between instruments to automate loss testing and share results. Test parameters are pre-configurable, to minimise test time and skill.

Pass/fail test & reporting parameters are flexible and can match latest standards.

These instruments supersede the functions and specifications of our popular 7000 series Two-Way testers.

### Memory and External Software Features

There are 3 ways of saving test data and reporting:

1. Test & Report in real time, with one click on a connected computer. Each cable test result is shown immediately on the KITS™ Excel pass/fail report. In this mode, instrument operation is remotely controlled from the attached computer.
2. Results can be stored in the instrument's large non-volatile memory along with text-input cable name and timestamp, then downloaded later onto a computer with the secure KITS™ reporting software.

3. Results can be stored in the instrument's large non-volatile memory along with text-input cable name and timestamp, and then a csv file is exported onto a USB memory stick (or a phone micro SD card using a suitable adaptor), via the Type A USB port, for later analysis on KITS™ or other software. This is a simple and easy way to store and transmit test data from a site, independent of any operating system or software.

KITS™ Excel reporting software allows interactive instrument control and data download. Real time display, data logging and unformatted data dumps are also included. In addition to two-way testing, KITS™ enables merging of test results from multiple one-way instruments and so supports bi-directional testing for one-way equipment using successive measurements.

Test data security is applied to all input and output data files, and KITS™ is designed to prevent data tampering when in Secure Data mode. This balances the conflicting requirements of data security, and user flexibility. Retained original data files can be accessed later as an audit function.

The KITS™ software data logging feature updates the data file continuously, so that in the event of a power cut or other computer malfunction, the acquired test data is secured. This is essential for long term integrity or environmental testing, for example.

## INTRODUCTION AND APPLICATIONS

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### Autotest Two-Way Loss, ORL & Length

This mode is the easiest, fastest and most complete test method for most applications. It requires a pair of instruments to operate.

Test time for Bidirectional Autotest Two-Way Loss, ORL and Length is typically a few seconds per fiber, with major savings in skill, time, cleaning materials and test confidence.

Accurate and stable, the real time display in this mode offers genuine time saving for users, since a poor or unstable fiber hook-up can be immediately recognized and corrected before saving a measurement.

Both local and remote loss referencing is supported.

A handy Autotest communications feature helps both users step quickly through a large fiber array. This feature also links through to real-time acquisition with KITS™ software.

### ORL Meter Features

ORL test is an option, depending on instrument p/n.

Full-function ORL testing can be performed as an integrated part of Two-Way Autotest, or as a stand-alone manual test.

User selectable offset and residual compensation functions greatly improve accuracy and range and are typically used in component or bench test applications.

### Power Meter Features

The full-function power meter can be used in One-Way Autotest or manual modes.

Power meter options cover the range +33dBm to -70dBm.

Various detector options include Indium Gallium Arsenide (InGaAs), Germanium (Ge), Silicon (Si) and high-power versions.

Power meters with standard detectors work with fiber core diameter up to 200 microns, with both PC and APC polish connectors such as universal 2.5, 1.25 mm, SC, LC, FC, ST, SMA, MU, LSA, E2000

Please enquire for alternative power meters with Large Area Detectors. Common applications include ribbon fiber MPO/MTP (all types up to 32 or 72 fibers), CS, MDC, SN and POF / HCS connectors.

Accurate & fully traceable calibration options cover all popular application  $\lambda$  from 635 to 1650 nm and may include CWDM calibrations from 1270 nm to 1610 nm in 20 nm increments.

Calibration  $\lambda$  are all genuine, with no interpolated or inferred calibration values.

Superior operational accuracy is clearly defined with a unique Total Uncertainty Specification, which covers the full temperature, dynamic and connector range.

There is no warmup period, range-changing delay, or user dark current zeroing.

## INTRODUCTION AND APPLICATIONS

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Power stability testing over a period can be performed using the max/min recording function.

The display shows dBm, dB mW,  $\mu$ W, nW, to 0.01 dB resolution, and can be put on hold for convenient manual data recording.

A separate reference for each  $\lambda$  is stored and displayed.

When performing loss testing using an Autotest light source, up to three  $\lambda$  are displayed simultaneously.

### Light Source Features

The full-function light source is used as part of Autotest, or as a simple test source, or for generating test tones. Multiple  $\lambda$  sources are selected through the same port, which makes operation faster.

Laser sources at 1310 / 1490 / 1550 / 1625 nm are used for testing single mode fiber systems, and LED sources at 850 / 1300 nm are used for testing multimode fiber systems. Laser power level can be user adjusted by 6 dB.

23400 series include zero warm up, ultra-stable lasers. These sources use an unusual architecture to achieve a stability of  $\pm 0.03$  dB over a wider temperature range with no warmup period and, are also relatively insensitive to back reflections.

LED sources are mode controlled and compliant with Encircled Flux & CPR test standards. The 1300 nm LED can also perform short distance single mode testing.

Laser / LED light sources have re-connection repeatability of 0.1dB / 0.05 dB. Combined with the instrument excellent stability, this provides more accurate measurement results.

### Multi-Fiber ID, Continuity & Locator Features

The instrument has a variety of helpful features to keep jobs moving.

The optional and innovative VFL VisiTester option is helpful for general loss testing, continuity testing and fault finding. VisiTester intermittently illuminates the connected test fiber with a red laser, very helpful to find a misplaced fiber end in a large array. It can also be used as a standard VFL (Visual Fault Locator) with continuous or flasher modes.

Multi-fiber ID allows for easy multi-fiber identification of up to 12 fibers at a time. Typically, when using this feature, multiple light sources are set up on multiple fibers, with each source set to a different Fiber ID. When detected by the power meter, a buzzer sounds and displays the corresponding fiber ID number.

A simple tone source / power meter detection feature turns the power meter into a quick and simple continuity tester, with continuity indicated by a buzzer.

The source can operate as a tone generator for other clip-on fiber identifiers.

## TEST STANDARDS COMPLIANCE

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### Test Standards Compliance

This equipment has features that help users comply with many international cabling test standards. Proper compliance is also a function of how equipment is used, who uses it, and other record keeping issues.

Compliance features of note include:

- ✓ Meets compliance for “Tier 1” testing attenuation with an OLTS, and checking length & polarity
- ✓ Eye safety complies with International & USA standards
- ✓ Encircled Flux compliant multimode LED sources
- ✓ Measures cable length
- ✓ Various features support quick polarity checking
- ✓ Optional Autotest-integrated VFL for polarity checking
- ✓ Optional Autotest-integrated ORL tester
- ✓ Wide variety of fiber connector styles
- ✓ Easy to perform multi-  $\lambda$  testing
- ✓ Supports single directional and bi-directional testing
- ✓ Results are time-stamped
- ✓ Calibration is fully traceable to primary or national standards via ILAC / ISO17025
- ✓ Results reporting & data files are security locked
- ✓ Easy pass/fail testing either on-instrument or on-Report

- ✓ Reporting software can be easily updated with new or in-house test standards
- ✓ Kingfisher can also supply suitable quality microscopes and cleaning materials

## GENERAL SAFETY SUMMARY

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### General Safety Summary

The following information, safety signs and symbols specify general safety precautions, which must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture and intended use of the instrument. Kingfisher International assumes no liability for the customer's failure to comply with these requirements.

Before operation, review the instrument and user manual for safety instructions. You must follow these to ensure safe operation and to maintain the instrument in safe condition.

#### **Warning! & Caution! conventions in this manual**

The **WARNING!** sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in injury. Do not proceed beyond a **WARNING!** sign until the indicated safety conditions are fully understood and met.

The **CAUTION!** sign denotes a hazard. It calls attention to an operating procedure, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part, or all, of the product. Do not proceed beyond a **CAUTION!** sign until the indicated conditions are fully understood and met.

The apparatus will be marked with this symbol when it is necessary for the user to refer to the instruction manual to protect the apparatus against damage.

#### **Initial Inspection**

Inspect the shipping container for damage. If there is damage to the container or cushioning, keep them until you have checked the contents of the shipment for completeness and verified the instrument both mechanically and electrically. If the contents are incomplete, mechanical damage or defect is apparent, or if an instrument does not pass the operator's checks, notify the nearest Sales/Service Office.

To check instrument performance, please refer to **Performance Verification Tests** section of this manual.

**WARNING!** Unauthorized adjustment of circuits, settings or software could create a hazardous optical condition. So, for service, these devices must be returned to an authorised service centre, and unauthorised modification or adjustment must not be performed.

**Proper Usage** This instrument is intended for measurements on optical fiber communications devices and systems. Please make sure the instrument is operated within the permitted ambient conditions. Always make sure that the instrument is in proper working order before switching it on.

## GENERAL SAFETY SUMMARY

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### Operating Environment

The range of Kingfisher equipment covered by this manual can be operated at temperatures between -15 °C and +55 °C and at relative humidity of <95 %.

If the instrument has been subject to condensing humidity, ensure it is thoroughly dried out, inside and out, before use.

### Storage & Shipment Environment

The range of Kingfisher equipment covered by this manual can be stored or shipped at temperatures between -25 °C and +70 °C and at relative humidity of less than 95 %. Protect the units from temperature extremes that may cause condensation within it.

### Mains Voltage Safety

Kingfisher International does not supply any mains voltage equipment with this low voltage product. If any other mains voltage equipment (such as a USB power supply) is obtained elsewhere, observe required safety & operating precautions for these devices.

### Laser Eye Safety Information

According to accepted international & USA safety standards, all laser devices in this instrument are Class 1, so no special eye safety precautions or signage for normal operation is required.

CLASS 1 LASER PRODUCT

However, if other safety standards are enforced, different specific rules and procedures may apply.

**WARNING!** Unauthorized modification of the circuits and settings could create a hazardous optical condition. For service, these devices must be returned to an authorised service centre, and unauthorised modification or adjustment must not be performed.

**WARNING!** Optical power levels in some fiber optic systems can be above Class 1 and, could cause permanent eye injury and damage to eyesight.

It is therefore sensible, by default, to always observe conservative optical safety precautions until the maximum hazard Class of a system and working environment is clearly established.

Organisations and users operating optical equipment above Class 1 MUST determine and observe relevant safety precautions, which are beyond the scope of this manual.

Laser Eye Safety Compliance signage, procedures and training are the legal responsibility of the organization using the equipment.

Eye safety risk is greatly increased by availability of simple magnifiers without optical safety filters. It is better practice to use either a microscope with suitable optical safety filters, or an electronic microscope.



## GENERAL SAFETY SUMMARY

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### Kingfisher Two-Way Tester Laser Eye Safety Information

This information on laser eye safety compliance covers all standard product variants.

#### Centre $\lambda$

Visual laser	650 $\pm$ 5 nm
Surface emitting LED <sup>3</sup>	850 / 1300 $\pm$ 50 nm
Infra-red laser	1310 / 1490 / 1550 / 1625 $\pm$ 20 nm

#### Specified CW Output Power<sup>1</sup>

650 nm visual laser	1.6 mW
850/1300 nm LED <sup>3</sup>	0.01 mW
1310 / 1490 / 1550 / 1625 nm laser	0.5 mW
1310 / 1550 nm Laser	1 mW

#### International Standard IEC 60825-2 2021 & IEC 60825-1 2014

$\lambda$	Instrument Hazard Level
650 / 850 / 1300 / 1310 / 1490 / 1550 / 1625 nm	Class 1

#### USA Standards ANSI Z136.2 / 21 CFR 1040.10 (1995)

Labelling for this product defers to IEC 60825 as per CDRH Laser Notices No. 56 (2019). Annual FDA reports are lodged by Kingfisher.

#### Maximum permissible CW output power<sup>2</sup>

IEC 60825-2 (2021) – Class 1	
633 nm, MM or SM fiber	2 mW

850 nm, MM or SM fiber <sup>3</sup>	3.9 mW
1310 nm, MM fiber	481 mW
1310 nm, SM fiber	166 mW
1550 nm, SM fiber	10.2 mW

**Note 1:** Specified CW output power is the optical power that the Source can produce at its output connector. Refer to specification sheet for actual operating power.

**Note 2:** Maximum permissible CW output power is the highest optical power that is permitted within the appropriate laser/LED Class for this safety standard. Refer to specification sheet for actual operating power

## BATTERY AND EXTERNAL POWER

### Battery & External Power

The instrument can be powered by battery or external input, and if rechargeable batteries are fitted, onboard charging can be enabled.

2 x AA size batteries can be 1.5V alkaline or lithium cells; or rechargeable NiMH cells.

For operation of the instrument from external power, plug in a computer / external power pack via the micro USB connector, marked "DC-PWR-IN". The large USB-A connector is not a power input.

To save energy when on battery power, the instrument automatically turns off after 10 minutes without operation

Instrument Function	Typical battery run time in hours:
Optical Power Meter only	1000
Optical Light Source Autotest	80

When using battery power, the battery symbol shows like this

The battery condition indicator shows 4 levels of battery state. When the battery indication goes low, there is approximately enough energy for another 10 hours of use (Power Meter).



When the instrument is being externally powered, and is not charging the battery, no battery symbol shows.

When the instrument is being externally powered, and is also charging the battery, an animated battery symbol shows like this.



To change the batteries, open the cover of the battery compartment at the base of the instrument, remove the batteries, insert new ones (polarity indication is shown on plastic case) and close the cover again. This will not lose test data stored in the non-volatile memory.

If the batteries are exchanged or get run down, date and time may need re-entering.

#### Disabling Battery Charging

If you will never charge batteries, it is a good idea to remove the programming shunt from the battery compartment, see next page.

Refer following page for visual instruction on how to turn off battery charging.

#### Enabling Battery Charging

As delivered, use of external power just disconnects the batteries (as a safety precaution), and does not charge them, since accidental charging of alkaline cells can be hazardous.

**CAUTION!** Users who are **only** going to use re-chargeable batteries can enable the battery charging feature by inserting a programming

## BATTERY AND EXTERNAL POWER

jumper onto charging pins in the battery compartment, Figure 1. We suggest that in this case, the battery compartment should be sealed (e.g. with an anti-tamper label), since attempting to recharge non-rechargeable batteries may lead to acid leakage and instrument damage.

Battery charge current is up to 0.2 A, giving a charge time of 6.5 hours for a 1.3 A-hr battery with the instrument off. For optimum charge time select a USB charging port with at least 0.2 Amp capability.

This modest charge current limits any adverse effect if non-rechargeable batteries are accidentally charged. For example, the risk of fire and explosion is avoided, however battery leakage could still occur.

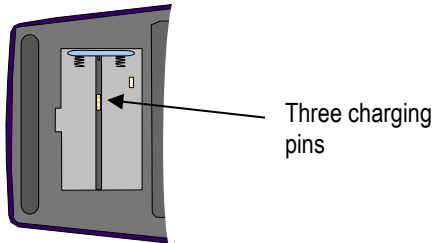


Figure 1. View inside battery compartment

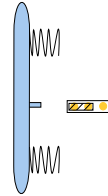


Figure 1A. To enable charging, programming jumper links two left pins

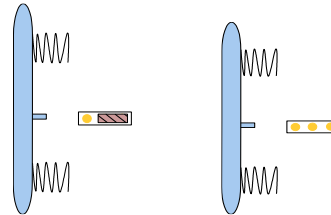


Figure 1B. To disable charging, programming jumper can be stored across two right pins, or just removed to prevent anyone from enabling charging.

**WARNING!** Do not short circuit batteries; there is a risk of fire or explosion.

**CAUTION!** Do not set up the instrument to charge non-rechargeable batteries. Risk of noxious fumes, acid leakage or instrument damage.

**CAUTION!** Remove batteries if they are exhausted, or if the unit is not to be used for some extended period, to avoid battery leakage and corrosion to instrument.

## BATTERY AND EXTERNAL POWER

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**CAUTION!** Do not use rechargeable lithium-ion batteries or any battery with a voltage over 1.8 V. This will damage the instrument.

**CAUTION!** Do not mix battery types.

**CAUTION!** Change all batteries as a group.

Please help protect our environment, by re-cycling your old batteries.

## PUSH ON OPTICAL CONNECTOR

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### Push-On Optical Connector

This section applies to instruments with push-on pull-off interchangeable optical adaptors.

To access the optical connector, grasp the grey cover on the top of the instrument and tilt the cover back. Slide the cover back and down to form a convenient tilt bail for the instrument.

The user can easily fit different styles of connector adaptors, replace worn or broken adaptors, or temporarily remove an adaptor to clean the adaptor and fiber tip.

A fitted connector adaptor may be easier to remove with a patch lead attached, since then it is easier to grasp. (typically, FC!)

To remove the fitted connector, simply pull of the connector while gently depressing the adjacent connector release button. Excessive force is not required.

To install a connector adaptor, position it in such a way that you are facing a locating slot on the side of the adaptor (SC end). This will allow you to align the locating slot with that on the instrument SC connector, and then press it in.

The supplied standard connector adaptor has a ceramic sleeve to avoid connector metal dust contamination of the target system.

Cover unused test ports with an opaque dust cap. Never touch connector tips with your fingers since body oils and dirt can impair performance.

Refer to ordering information section in this manual to see our wide range of available adaptor styles.

**CAUTION!** Do not use damaged or incompatible connector adaptors.

**CAUTION!** FC style through connectors can fail easily. The problem is that the connector can be assembled with the anti-rotation spigot misaligned, and the screwed housing can still be tightened. This is a connector design fault; users need to be aware of the problem. Usually, the result is that ceramic sleeve inside the instrument adaptor gets broken.

### Power Meter

This port can be used with both PC and APC connector styles.

Bare fiber adaptors must achieve fiber XY axis eccentricity of  $\pm 100$  microns, and Z axis tolerance of  $\pm 300$  microns relative to the ferrule end. Preferred bare fiber adaptors consist of a connector with fiber retention device or other end stop.

For regular work with bare fibers, to avoid instrument damage, it is preferable to use an alternative arrangement such as a multimode pigtail along with a v-groove or mechanical splice.

## PUSH ON OPTICAL CONNECTOR

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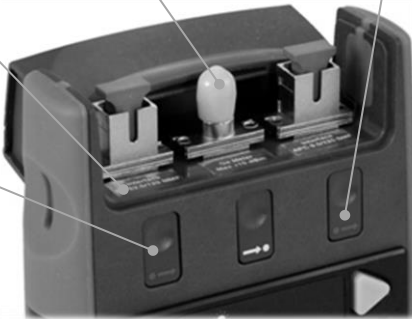
Cover unused test ports with an opaque dust cap. Never touch connector tips with your fingers since body oils and dirt can impair performance.

The power meter is in the middle

Symbol colour shows port type

Port Details Label

Connector Release Button



**CAUTION!** Do not scratch the detector lens with glass fiber end when using bare fiber adaptors, or the instrument will be permanently damaged.

### Light Source

A Light Source connector is either PC or APC polish. This is determined when ordering the instrument and can only be changed at the factory.

Cover unused test ports with an opaque dust cap. Never touch connector tips with your fingers since body oils and dirt can impair performance.

**CAUTION!** The use of bare fiber adaptors with any source port is not recommended as permanent instrument damage is likely, and very unstable measurements are likely.

### How To Clean Optical Connectors

Always clean the mating connector tip and ferrule before mating, using approved materials.

**CAUTION!** Never attempt to clean connector interfaces with abrasive cleaners, or sharp or hard objects. Permanent instrument damage may occur.

### Power meter

The recessed glass power meter interface does not make contact with inserted connectors; there is a slight air gap. Therefore, it will not wear and only needs occasional cleaning.

To clean the interface without removing the adaptor, use a 1.25 mm (LC) “stick” style connector cleaner (a 2.5 mm stick is too large and will not clean the glass). This cleans both the adaptor and end face in one operation.

## PUSH ON OPTICAL CONNECTOR

---

Alternatively, first remove the interchangeable connector adaptor, then use a soft brush, alcohol, air can, or 'Blu Tac' to clean the recessed glass interface.

### Light Source

To clean the interface without removing the adaptor, use a "stick" style connector cleaner (1.25 or 2.5 mm to match the connector interface). This cleans both the adaptor and end face in one operation.

Alternatively, first remove the interchangeable adaptor to access the optical interface. Then blow away any dust or dirt with compressed air. If this is not enough, then clean the interface by rubbing a lint-free lens cloth over the surface using small circular movements.

Connector Wear: Fiber Optic Connectors usually have a design life of around 1,000 insertions before they are worn out.

So, if your instrument has had considerable use, the removable connector adaptor may be worn out, and need replacing.

If your source has become very unstable, the through connector ceramic sleeve may be cracked, and the push-on through connector needs replacing.

It is good practice to use test leads that can be easily replaced as needed.

When performing precision measurements, it is usually helpful to have an APC connector plugged into a power meter, to reduce line reflections.

**CAUTION!** Disable the source when cleaning optical interfaces. Cleaning materials and chemicals can react with the intense emitted light and damage the connector.

### When To Clean The Optical Connectors

Every time they are mated. You will need a ready supply of suitable connector cleaning and inspection equipment. This will not only help get accurate readings but is also essential to protect your test equipment.

## SCREW ON OPTICAL CONNECTOR

---

### Screw-On Optical Connector

This section applies to power meter ports with large area detectors and screw-on interchangeable optical adaptors.

This port can be used with both PC and APC connector styles



To access the optical connector, grasp the grey cover on the top of the instrument and tilt it back. The cover can then be pushed back to form a convenient tilt bail for the instrument.

To remove the fitted adaptor, simply unscrew it. The user can easily fit different styles of standard and optional connector adaptors.

To fit a new adaptor, just screw it onto the detector head. Do not use excessive force.

Ge7 detectors only: When fitting an MPO connector adaptor, continue turning the adaptor clockwise until a “click” is felt. At this point, the adaptor is rotationally aligned with the rectangular optical detector.

Always clean the mating connector tip and ferrule before mating, using approved materials.

These meters can be used with low-precision bare fiber adaptors.

Cover unused test ports with an opaque dust cap. Never touch connector tips with your fingers since body oils and dirt can impair performance.

**CAUTION!** Be careful of the optical detector when the connector adaptor is removed. It can be damaged by static electricity, or damage to the exposed detector cover glass.

**CAUTION!** Ensure that inserted connectors or bare fibers do not project through the adaptor and scratch or push on the glass detector cover or instrument damage will occur.

### To Clean the Optical Connectors

The power meter interface does not contact the inserted connector; there is a slight air gap. Therefore, it will not wear and only needs occasional cleaning. To clean:

- Unscrew the connector adaptor, then use a soft brush, alcohol, air can, or ‘Blu Tac’ to clean the glass interface and inspect for cleanliness.



## SCREW ON OPTICAL CONNECTOR

---

- Using compressed air, blow out the pinhole in the connector adaptor, and carefully inspect for cleanliness. Dirt can get stuck in the pinhole.

When performing precision measurements, it is usually helpful to have an APC connector plugged into a power meter, to reduce line reflections.

**CAUTION!** Never attempt to clean connector interfaces with abrasive cleaners, or sharp or hard objects. Permanent instrument damage may occur

## GETTING STARTED AND TURNING ON

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### Getting Started & Turning On

This section is helpful when getting started and gives basic instrument operation.

For your later reference, please note the convenient Quick Reference Guide at the back of this manual. Please also note sections “Care of Your Instrument” and “General Safety Summary”.

To add a carry strap, slip the end of a strap through the eyes on the sides of the instrument, and secure the buckle.

Install the batteries or plug in a computer / external power pack via the micro-USB connector, marked “DC-PWR-IN”. The large USB-A connector is not a power input.

The instrument’s optical connector is protected by a dust cover, which also serves as a tilt bail. To access the optical connectors, grasp the grey cover on the top of the instrument, pull it up, then and tilt it back and down to form a tilt bail.

#### Turn On The Instrument

To turn on the instrument, press [On/Off] (square green button above the LCD). To preserve the batteries, the instrument will turn off after 10 minutes of inactivity.

If the instrument does not respond, change the batteries or apply external power to the micro USB connector, or refer to the end of this section to perform a hard re-start.

The battery condition is indicated with the battery symbol on the display.



The initial instrument display shows the date and time. Refer to the end of this section for instructions on how to set date and time, or continue:

Also, during use of the **On/Off** button:

- To disable auto-off, hold down **On/Off** for 3 sec, “Perm” displays.
- To set time & date, hold down **Toggle Centre**.
- To view firmware version (bottom right), hold down **F4**.
- To enter Slow Mode, hold down **F3**. “tone” displays
- To disable or activate beeping, hold **F2**. “beep” displays
- To show all display segments, hold down **F1**.

To turn off the instrument, press **On/Off** again.

At start up, if the instrument needs time and date to be entered, the “setting time and date” screen will appear, refer to manual section for details.

Or typically at start up, the instrument shows current date and time:

## GETTING STARTED AND TURNING ON

At start up, the following information is displayed

- “Perm” if the instrument will stay on
- Date & time
- Battery / external power / charging status
- ‘Memory’
- Last used meter  $\lambda$ , & current reading in dBm
- Function Keys, e.g. [SOURCE] [RETURN LOSS] [METER] [AUTO]

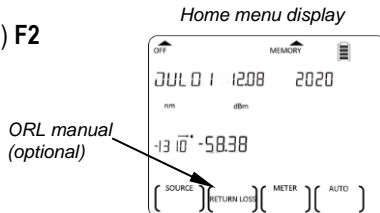
### Backlight

To toggle the display backlight, press [Backlight], (above LCD). The backlight is only needed in low ambient light conditions.

### Operation

These instruments can be used in one of the following modes, corresponding to the LCD legends and adjacent buttons **F1 – F4**:

- Light Source **F1**
- ORL Meter (optional) **F2**
- Power Meter **F3**
- Autotest **F4**



Operation mode is selected by pressing the corresponding button at the bottom of the LCD.

To return to the Home menu, press button below [HOME] or **F1**

The following instructions show basic power meter and light source operation only, to help you get started. Refer to other manual sections for further operation.

### Fiber Optic Connector Arrangement

The power meter connector is in the middle of the instrument. The Two-Way ports are on either the left or right side of the instrument. Source, ORL or VFL options are integrated with the Two-Way ports. Look at the connector button colour codes to see their function, eg

- White arrow = Power meter (not XL detector)
- Blue arrow = Single Mode, PC Connector
- Green arrow = Single Mode, APC Connector
- Beige arrow = Multimode Connector.

When not in use, keep test ports and connectors covered. Never touch connector tips with your fingers since body oils and dirt can impair performance.

**CAUTION!** Refer to connector section to avoid instrument damage. Always clean connector tips before mating.

## GETTING STARTED AND TURNING ON

---

### Basic Power Meter

- Press **F3** button below [METER].

You are now using the instrument as a power meter displaying operating  $\lambda$ , nm and nominal output power, dBm.

- Press - or + to select another calibration  $\lambda$ . Commonly used  $\lambda$  are bunched together for general convenience

The display shows: nm, dBm, dB, reference power

- Press button below [METER MODE] to toggle log (dB) / linear display modes.

The display shows: log or linear power in e.g. nW,  $\mu$ W, mW.

- To set reference, toggle to dB mode, then hold down button below [SET REF] for 3 seconds until the instrument beeps finish.

The loss display will go to approximately 0 dB, and the stored reference value will be displayed on the right side of the display.

### Basic Light Source

To return to the Home menu, press button below [HOME] (**F1**).

- Press button below [SOURCE] (**F1**).

This turns on the source light source displaying operating  $\lambda$ , nm and nominal output power, dBm.

- Press - or + to select another operating  $\lambda$  or, turn off the source.
- Press button below [SOURCE HOME] to go back to the Home menu, and leave the source running as required.

Once you have set up the source, you can leave the source on, and go back to the power meter.

If the source and meter are operated together, both source and meter are set to the same  $\lambda$ . If the source is off, all calibrated power meter  $\lambda$  are available.

Once you have established that the equipment is working, and used some simple functions you may want to:

- Explore Two-Way Autotest for Tier 1 Testing
- Set the date and time
- Explore memory functions
- Install KITS™ software on a computer

### Application Software

Please go to our website [www.kingfisherfiber.com](http://www.kingfisherfiber.com) to download and install the latest KITS™ software. User Manual and computer prerequisites (largely: MSOffice, USB port) are on the web site.

### Firmware upgrade

We suggest this is only performed if suggested by support staff to overcome a problem, it is not usually required. Firmware updates are available on our web site.

## GETTING STARTED AND TURNING ON

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### **Instrument Hard Re-start**

Should the instrument fail to respond, the microprocessor may need re-booting. To do this, remove the batteries and any other external power for at least 10 seconds. Alternatively, try some new batteries.

## SETTING DATE AND TIME

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### Setting Time & Date

Test date and time are stored with test results. So, if the instrument memory is used to record results, the user probably wants to set the correct date and time.

If the instrument loses power or battery condition for more than a minute, current date and time will be lost and will need to be re-entered. In this case, the time & date entry screen will show at power on.

At start up, if the instrument needs this setting to be entered, the “setting time and date” screen will appear so they can be re-entered.

Or typically at start up, the instrument shows current date and time.

To avoid international confusion, the date / time format is:

“Jan 02 -24 hr time- 2020”

#### Setting time and date:

- Turn on instrument while holding down **Toggle centre**.  
(Bottom row, large square button in the middle).
- To modify the selected (flashing) item, press - or +.
- To change selected item, press **Toggle centre**.
- To save new time and date settings, press button below [Save] (F2).

- To exit without saving new settings, press button below [Cancel] (F1).

## MENU NAVIGATION TIPS

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### Menu Navigation Tips

For your later reference, please note the convenient Quick Reference Guide at the back of this manual. Refer also to the display picture at the start of this manual

Menu navigation is consistent, and a few conventions cover most operations:

- The Main function keys are **F1 – F4**
- To go back a level, push “home” **F1**
- To toggle the backlight, use the dedicated button above the display.
- To update the power meter reference, hold down the “set ref” key (**F2**) for 3 seconds until beeping stops.
- To modify any parameter such as  $\lambda$ , memory location etc, use the - / + keys.
- To Toggle any binary parameter (like source on/off) use the **Toggle Centre** key.
- General memory operations such as store to memory or dump to USB, are performed by the grey triangular button above the display. If no USB key is inserted, operating this button stores into memory. If a USB key is inserted and

recognised (shown on the LCD), this button dumps the entire memory into a new file on the USB key.

### LCD General Information

- The power meter / loss display can show up to 3 active test  $\lambda$  at once. The number of active  $\lambda$  shown will depend on the options and tests chosen.
- Because the displayed information is comprehensive, overall operation is simpler.
- The custom display has excellent viewing angle, contrast, sunlight readability and temperature range.
- The backlight is only needed in very poor lighting conditions. It uses reliable white LEDs.

# AUTOTEST GENERAL OPERATION

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## Autotest Overview

Autotest is a mature Kingfisher fiber optic test data transfer protocol in use since 1994. It has been extended various times within its original framework. Length testing is the latest extension on these instruments, so may not be compatible with older Autotest instruments. There are two basic modes of operation:

### Two-Way Autotest

This is a common use for a pair of Two-Way testers, and for Tier 1 testing. On one fiber, it performs a bidirectional loss test in both directions, with as many  $\lambda$  as the sources fitted to your instrument, using either local or remote referencing. The instrument can display the loss up to 3  $\lambda$ . A single button push stores all results for a fiber into memory. Or a single click of a connected computer with KITS™ software.

Instruments with the ORL feature will seamlessly add the ORL test results from each end, at each  $\lambda$ . This extra test requires no user action, only a little extra test time.

Instruments with the cable length measuring feature seamlessly add the cable length test result, with no user action.

A handy Autotest communications feature helps both users step quickly through a large fiber array. This feature also links through to real-time acquisition with KITS™ software.

The instrument displays pass / fail / marginal.

Cover unused test ports with an opaque dust cap. Never touch connector tips with your fingers since body oils and dirt can impair performance.

### One-Way Autotest

This mode is used with light sources and meters and, is less likely to be used with a Two-Way tester unless just one instrument is in use. This mode is near-equivalent to a basic light source and meter, but with the  $\lambda$  synchronised. It can test one-way loss with as many  $\lambda$  as the sources fitted to your instrument, using either local or remote referencing.

The instrument can display the loss up to 3  $\lambda$ . A single button push stores all results for a fiber into memory. Or use a single click of a connected computer with KITS™ software. This software can also merge two sets of one-way Autotest results into a single two-way Autotest result.

### Limiting Active Autotest Options

In some instances, better testing is achieved by restricting active  $\lambda$  to only those required for the job at hand. This saves test time and restricts pass/fail criteria.



## AUTOTEST GENERAL OPERATION

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For example, a 3  $\lambda$  SM tester rotates by default around 1310, 1550, 1625 nm. If you just want to test at 1310 nm you can activate just 1310 nm only, which will then test 3x as fast.

### Autotest Data saved

(depending on options and test type) for each test:

- Absolute optical power, all active  $\lambda$
- Reference optical power, all active  $\lambda$
- ORL each end, all active  $\lambda$
- Cable Length
- Timestamp
- Auto-numbering Text ID Tag sequence
- Both instrument serial numbers
- Pass/fail status & parameters

### Autotest General Operation

Two-way Autotest operation can be initiated from either instrument. One-way Autotest is always initiated from the light source end.

Autotest provides a real time measurement display. This is very convenient to check that a connection looks good and stable before deciding to store a test result, resulting in a significant improvement in test quality, ease of operation and throughput compared to many other instruments.

Autotest transfers various data between test instruments. In Two-Way Autotest, data transfer is bi-directional, so both instruments appear to operate in the same way, with the same displayed results, and the complete test can be stored at either end. In One-Way Autotest with a source and meter, the data transfer is one way, e.g., to the meter.

Autotest detection remains activated for about 8 seconds after each fiber disconnect, so the user can change optical connections without re-starting Autotest each time, thus achieving productivity gains.

Autotest supports both local and remote referencing. The nominal source power is also transmitted. Although this is helpful, it is very inferior to taking a proper reference.

Two-way Autotest has an interlock / communication protocol also linked through to KITS™ software, to assist users to work quickly through a group of fibers and reliably fill in a test report in real time.

Autotest works in situations where high loss or  $\lambda$  selective elements stop some  $\lambda$  from transmitting. The meter will detect and show whatever  $\lambda$  are successfully transmitted.

The excellent test stability of Kingfisher test equipment is highly relevant to Autotest operation since the requirement to re-reference the source & meter is greatly reduced compared to most other equipment.

Autotest reduces source warm up drift and battery consumption compared to manual operation.

## AUTOTEST GENERAL OPERATION

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To realise the full benefit of Autotest, please consider using KITS™ software to achieve real-time data acquisition, and to facilitate acceptance testing and reporting in the field.

Cover unused test ports with an opaque dust cap. Never touch connector tips with your fingers since body oils and dirt can impair performance.

### Autotest Operation

Once in Autotest:

- To set reference, press and hold button below [Set Ref] (F2) for 3 seconds until beeps stop. The reference updates over the next few seconds.
- [Two-Way Autotest only]: To change from Average losses display to view reference and measured absolute values, press button below [MODE] (F3), then both lines of the display show information from the same  $\lambda$ , each line shows a different direction. To move on to view ORL (optional) values, press F3 again and, press - / + to scroll to another  $\lambda$ . To escape this and go back to the defaulted average losses mode, press button below [MODE](F3).
- Press button below [HOLD] (F4) to stop/allow display update.

- When Autotest reference & absolute and loss values are displayed, press **Toggle Centre** to show sources' nominal power levels on the left.
- [One-Way Autotest only]: To exit Autotest, press button below [HOME] (F1) on light source or disconnect patch lead for more than 8 seconds.
- [Two-Way Autotest only]: To exit Autotest, press button below [HOME] (F1) or disconnect patch lead for more than 8 seconds, on any of the 2 connected instruments.

### Kingfisher Autotest Compatibility

Some Autotest functionality may be used with other Kingfisher Autotest instruments that share similar  $\lambda$ . Achieved functionality should be verified prior to use.

Any Kingfisher Autotest source (except POF source of 470, 520 nm) / power meter / loss test set / two-way tester can be used as a source & meter, for one direction loss testing. This may include the following instrument series, for example:

- 2000 series sources, meters, and loss test sets
- 2000 series two-way testers
- 3000 series sources and meters
- 9000 series sources
- 7000 series sources, meters, and loss test sets
- 7000 series two-way testers (partial compatibility in two-way mode)

## AUTOTEST GENERAL OPERATION

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- Agilent N3970A Optical Power Meter
- Agilent N3974A Dual Laser Source

## AUTOTEST TWO-WAY OPERATION

---

### Autotest Two-Way Operation

This is the typical method of operation with a matched pair of Two-Way instruments, and for Tier 1 testing. It is possibly the easiest possible way to operate any loss test set, and quickly produces a comprehensive set of accurate test results.

Two-Way Autotest performs a bidirectional test of one connected fiber at a time, in a single hook-up. This is much easier and more accurate than many other instruments that require two fibers to be connected in a sequence of operations. The test can include loss, ORL and length depending on instrument options.

This method works when connected between the Two-Way Ports on a pair of instruments. The Two-Way test port is bidirectional, and can include a light source, power meter, length test and ORL meter.

To get started: Use one or more appropriate test reference leads to connect a Two-Way test port on **both** instruments, turn on both instruments, then on one of them, press [Auto] to initiate Autotest. **Do not connect to a power meter port for Two-Way Autotest!**

Cover unused test ports and connectors with opaque dust caps to block stray light or contaminants from entering.

A few seconds after initiating Autotest, both instruments will continuously cycle through available  $\lambda$  and both will show the same test results: loss, Length (optional), ORL (optional) for up to three  $\lambda$

displayed at the same time. To indicate Autotest is on; 'Auto' will be flashing.

Light sources with up to 3 active  $\lambda$  (excluding VisiTester) per source port will by default cycle through all available  $\lambda$ , unless a reduced/restricted  $\lambda$ -set has been selected, which can help speed up & simplify higher volume testing.

The instrument's large LCD is particularly good in this mode, since it shows a wide range of test information with no user intervention.

Depending on the instrument model number, various  $\lambda$ , ORL and length measurement may be included in the displayed test results. The LCD display can be toggled to show losses, cable lengths and ORL tests as the examples shown in Figure 1 at the end of this section.

To exit Autotest, press [Home] (F1) or disconnect a patch lead for more than 8 seconds, on any of the connected instruments.

### Two-Way Referencing

Referencing can be done in two different ways. The best method will depend on the practical situation and accuracy requirement.

1. Most accurate method: If it is practical to connect and reference a pair of instruments: connect a test reference lead between the Two-way ports of the two instruments, enter Autotest mode, and set the reference.
2. Less accurate method, suitable for remote operation: Remotely reference each meter by looping the Two-Way port round to the

## AUTOTEST TWO-WAY OPERATION

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on-board power meter. In this case: on each instrument, connect a patch lead from the two-way port to the power meter port, enter Autotest mode, and set the reference.

To set the reference, enter relative mode, then hold down [Set Ref] (F2) for 3 seconds until the instrument beeps finish. The main display will go to approximately 0 dB, and the reference value is displayed on the left side of the display. The length test will also be set to 0.

If measuring ORL, there are additional ways of optimising ORL test accuracy, which are covered in the ORL section of the manual.

To exit Two-Way Autotest, on any of the two connected instruments, select [Home] (F1) or disconnect patch lead for more than 8 seconds, and wait a few seconds for the other unit to drop out.

### Length Measurement

Length measurement is a part of the two-way Autotest function, on a pair of instruments that have the length measuring option.

Length is measured by time-of-flight on one fiber, which is affected by the fiber refractive index. The RI values used in the instrument are:

SM: 1550 nm 1.4668            1310 nm 1.4567

MM: 1300 nm 1.4835            850 nm 1.4734

These RI values are close enough for almost all applications.

Instruments fitted with either a 1550 nm laser or 1300 nm LED will use only these two wavelengths for length measuring.

If a fiber with a very different RI is used, the length can be recalculated e.g.  $\text{Actual} = \text{Measured} \times (\text{instrument RI} / \text{actual RI})$

Length measurement is zeroed when a reference is taken, so the test cord length is excluded from the measurement. Note that if reference has not been taken correctly prior to an actual measurement, "Err" may be displayed as the measured length value.

This function is reliable and unaffected by optical line reflections, PC / APC connector type etc.

Measuring range is determined by optical loss, e.g. the receiver sensitivity.

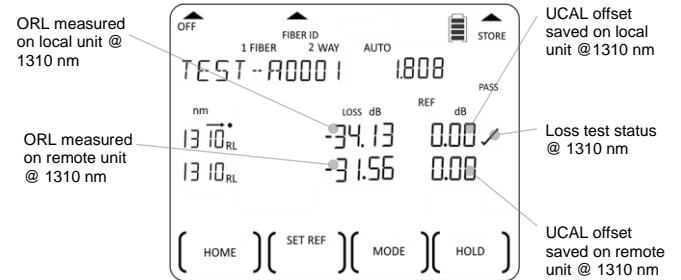
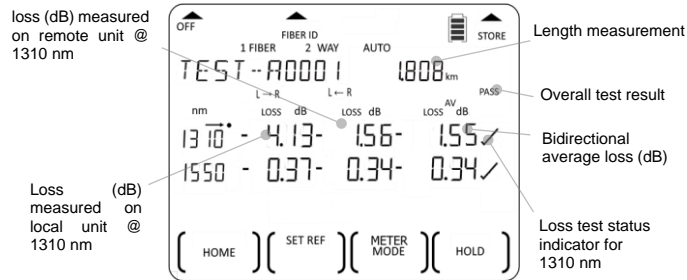
The theoretical absolute accuracy of this measurement is of the order of 0.01%  $\pm$ 1 meter,  $\pm$ any IOR inaccuracy. Towards the attenuation limit of the length test, absolute length accuracy will reduce slightly.

However, practical cable length measuring accuracy is usually limited by many other practical factors such as:

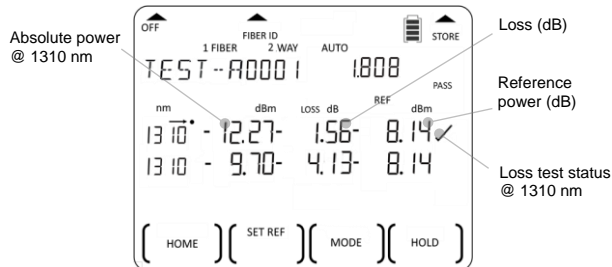
- Cable length marking accuracy (typically about 1 %)
- Fiber length is greater than cable length (often about 2 %)
- As-built dimensions are different to planned dimensions
- Various lengths of fiber get left looped in place, etc.
- Calibrated reference cable lengths of < 0.5 % accuracy do not exist in practice.

### Test Summary Display:

# AUTOTEST TWO-WAY OPERATION



## Test Detail Display:



## ORL Display:

Figure 1. LCD displays of Two-Way Autotest data/result

## AUTOTEST ONE-WAY OPERATION

### Autotest One-Way Operation

With the Two-Way tester instruments, you are recommended to use Two-Way Autotest when possible, however this method is included as a legacy or backwards compatibility option, or if just one instrument is to be used.

This One-Way Autotest method works when connecting between the Two-Way Port and Power Meter, or when performing testing with another non-Two-Way instrument.

In this test, the Two-Way port operates as an Autotest light source.

Cover unused test ports with an opaque dust cap. Never touch connector tips with your fingers since body oils and dirt can impair performance.

Connect a light source to a power meter with an appropriate test lead, turn on the instruments, then on the **light source** end press [Auto] (**F4**) to initiate Autotest.

Upon initiating Autotest, the light source will continuously cycle through available  $\lambda$  and the meter will automatically switch to Autotest mode. The meter detects the correct  $\lambda$ , and displays the source power in dBm, with the  $\lambda$  shown at the left-hand side of the display. Up to three  $\lambda$  can be displayed at the same time. To indicate Autotest is on; 'Auto' will be flashing. See Figure 2 at the end of this section for a sample LCD display.

Light sources with up to 3 active  $\lambda$  (excluding VisiTester) per source port will by default cycle through all available  $\lambda$ , unless a reduced/restricted  $\lambda$ -set has been selected, which can help speed up & simplify higher volume testing.

To exit Autotest, on the light source end, press [MENU] or disconnect a patch lead for more than 8 seconds.

### One-Way Referencing

Connect a test reference lead between the Two-way ports on one instrument to the power meter port on the other instrument, enter Autotest mode, and set the reference.

To set the reference, enter relative mode, then hold down [Set Ref] for 3 seconds until the instrument beeps finish. The main display will go to approximately 0 dB, and the reference value is displayed on the left side of the display.

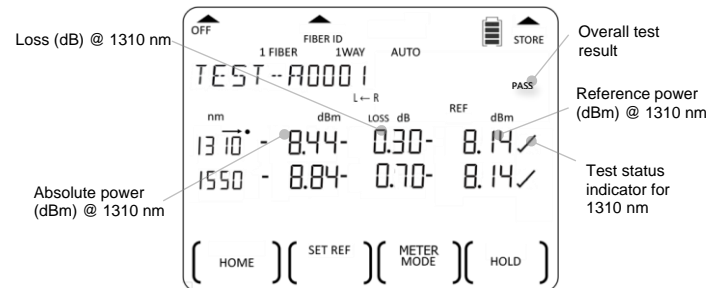


Figure 2. LCD display of One-Way Autotest data/result

## AUTOTEST USER TO USER COMMUNICATION

### Autotest User-To-User Communication

This is a Two-Way Autotest feature.

This feature helps two users to co-ordinate their actions as they step their testing through an array of fibers.

Communication is on the fiber being tested, so no additional order wire link or talk set is required to work through a fiber array.

If intending to use this feature, it would be a good idea for the users to practice together for a few minutes, to gain familiarity.

This communication function also links through to KITS™ software, so that the far end user knows when a reading has been saved in KITS™, and the near end user knows when the far end user has moved to the next fiber, and so is ready for the next reading. Refer to KITS™ user manual for detailed operating instructions.

Display update for both instruments can be started and stopped from either instrument by pressing [HOLD] button, which also activates the buzzer at each end. Once on, 'HOLD' symbol will flash on LCD. It allows handy communication method between two users, so they can synchronise while working through successive fibers, see related event sequence, ❶ ~ ❹ below,

If the VisiTester option is available, this is a useful feature to help get testing started: If one instrument at one end is hooked up and Autotest activated, the active fiber at the far end will flash, so the user at this end knows that the test is ready to start, and which fiber to start on.

@ "near-end" of DUT	@ "far-end" of DUT	Practical uses in the field
❶ Press button below [HOLD] (F4) on unit	❷ Unit beeps, "HOLD" symbol blinks.	After recording or saving test data for existing fiber, "near-end" user do this to signal "far-end" user to move on to next fiber.
❹ Unit beeps, "HOLD" symbol stops blinking.	❸ Press button below [HOLD] (F4) on unit.	After reconnecting meter with the next fiber, "far-end" user do this to signal "near-end" user to record or save test data

Note: Data acquisition must be controlled from one end only.



## AUTOTEST $\lambda$ RESTRICTION

---

### Autotest $\lambda$ Restriction

Once you are familiar with these instruments, particularly if the instrument has more than two  $\lambda$ , you might want to restrict the number of active  $\lambda$  in a test, for a few reasons:

- With restricted  $\lambda$ , pass / fail can be more meaningful.
- Pre-set instruments off-site, for lower skill operation on-site.
- Faster test time. For example, if testing SM fiber on a SM/MM capable instrument, there is no point in the instrument cycling through the MM  $\lambda$ . (use Method 1)
- For example, an instrument that can test 1310 / 1550 / 1625 nm, but you only want to test at 1310 / 1550 nm (use Method 2)
- You want to test at just one  $\lambda$ , e.g. 850 nm (use Method 2)

There are two different ways  $\lambda$  restriction can be achieved. Method 1 is easier and usually suited to choosing between multimode / single mode. Method 2 selects  $\lambda$  in more detail.

#### Method 1 (easy, for SM + MM instrument)

- This selects from an upper bank (e.g. single mode) or lower bank (e.g. multimode) groups on a SM & MM capable unit.

For example, on a Quad  $\lambda$  instrument, select between a 1310 / 1550 nm SM group, or 850 / 1300 nm MM group.

- To test with the lower bank / MM group only: Press + and [Auto] (F4) together.
- To test with the upper bank / SM group only: Press - and [Auto] (F4) together.

#### Method 2 (more control)

- This selects any individual test  $\lambda$ .

Put the instrument into [Source] mode, then:

- To check if a  $\lambda$  is selected for limited  $\lambda$  Autotest, press & hold F4 while source is on. Either “in” (on) or “out” (off) is displayed.
- To toggle selection of  $\lambda$  for limited  $\lambda$  Autotest, while continuing to hold down F4, press **Toggle Centre** to change between “in” or “out”.

For example, on a Quad  $\lambda$  instrument, select to test at just 850 nm:

- So, in the example Quad instrument, 850 nm would be “in” and 1300, 1310, 1550 nm would be selected as “out”.
- To start limited  $\lambda$  Autotest, press and hold **Toggle Centre**, while pressing button below [AUTO] (F4).

## TEST-LEAD VERIFICATION TEST

### A Test Lead Verification Test Procedure

Test lead loss repeatability is often a limiting factor in loss test accuracy and repeatability. As a result, test standards may mandate that test lead performance is verified before, during and after testing. Typically, the test limits are set to verify that test lead loss is “superior” to typical values.

It is in any case good practice to regularly verify test leads, so we have included this procedure also as a means of learning how to use this instrument for a simple but accurate loss test procedure.

This method meets TIA-568.3-D Annex E.5.1.2 (informative).

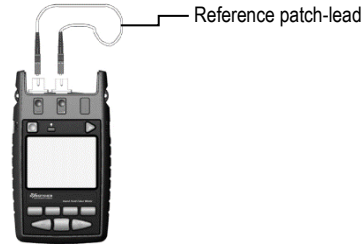
In this example, we use One-Way Autotest to perform a simple ILM (Insertion Loss Measurement) on a patch-lead connector.

Clean & inspect connectors prior to each mating, as per IEC 61300-3-35.

For SM fiber, a loop, and for MM fiber a Mandrel Wrap may be employed. The MM source on these instruments is EF compliant, but the additional use of a mandrel wrap may give better repeatability.

Connect a reference patch-lead (test grade) between the light source and power meter ports of the instrument as shown below. Use the

source port type which matches the fiber to be tested, eg single mode or multimode.



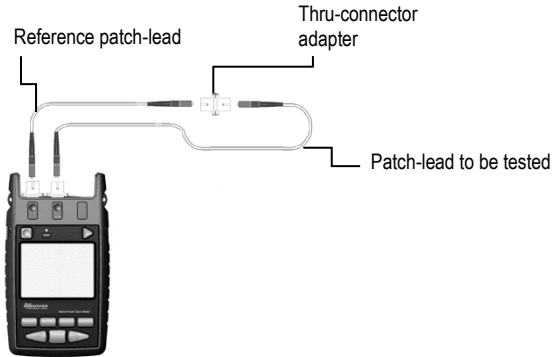
- Switch on the instrument, wait for the source to stabilise, and press [AUTO].
- Set measurement reference: press and hold [Set Ref] for 3 seconds until beeps stop.
- If the connector coupled to the light sources is moved, the reference must be taken again. Do not move this connector.
- Remove reference patch-lead connection at power meter port, connect reference patch-lead to the patch-lead to be tested via a thru-connector adapter, connect the free end of patch-lead to be tested to power meter port.

Please note that for test leads, both the patch leads used in this test should have “reference grade” loss performance.

## TEST-LEAD VERIFICATION TEST

---

If a variety of test leads pass this test, you can proceed to testing a system. If they all seem to fail, you should also consider that your first reference lead could be causing the problem.



- Read IL (in dB R mode) of the respective  $\lambda$  displayed on instrument.
- Turn the second patch lead around and repeat the test for the other connector.

You have now measured the insertion loss of each end of your second patch lead, against the first patch lead.

- For reference grade connectors, A test-quality lead should typically have a loss of <0.3 dB per end for MM fiber, and 0.5 dB for SM fiber, also including MPO types etc.

## PASS / FAIL OPERATION

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### Pass / Fail Testing

Pass/Fail testing and display is useful to ensure that cable tests pass before results are stored in memory.

For Tier 1 testing, for example, and other situations that can use two-way or one-way Autotest, the instrument can be set up to show pass / fail / marginal based on:

- Loss, two-way average, or worst case
- Length
- ORL

When pass/fail check function is enabled, test status will be shown automatically on the right of the LCD (see example in Figure 3 at the end of this section). Marginal values are accepted.

There are two ways of generally setting up the limits:

1. Limits can be set up directly on the instrument.
2. Limits can be downloaded from KITS reporting software, so they match a pass/fail report. This allows more complex data entry. Under this arrangement, the instrument setup screen shows “imported setup” if no setup change is made from the instrument. The software has several test standards already set up for use, or the user can easily add other standards for re-use as well. In this software, pass/fail can be set up for one-way testing, and two

sets of one-way results can be merged to create a bidirectional test.

3. If any limit value is set to 0, it is disabled.

In compliance with TIA standards, the default two-way loss pass/fail is based on the worst case of the bidirectional loss test. Alternatively, this can be set to fail on a two-way average.

### Pass/Fail Set Up

For KITS software operation, please refer to the KITS manual, which is downloaded with the software.

To set up pass/fail limits directly on the instrument:

- To enter setup, turn on the instrument with the – key (for SM), or + (for MM) key depressed.
- “Imported Setup” will show if a setup has been imported from KITS and will vanish if any changes are made locally.
- Press button below [MODE] to toggle between loss / ORL setup screens. For instrument without Length and/or ORL options, set the corresponding threshold values to “0”.
- Press **Toggle Centre** repeatedly to select a value to adjust threshold for PASS and/or MARGINAL.
- Use – or + to adjust value. Set values (magnitude) of MARGINAL must always be greater than PASS.

## PASS / FAIL OPERATION

- Use **F4** to toggle 'WC' (worst case) / 'AV' (average) pass/fail method.
- Press button below [SAVE] (**F2**) or [CANCEL] (**F1**)

For example, if you select a loss pass value of 2 dB, and a loss Marginal value of 3 dB, then any loss less than 2.0 will be a pass (indicate by '✓' on LCD), and values from 2.0 ~ 3.0 will be marginal (indicate by alternating '✓' & 'X' on LCD). Values more than 3 dB will be a fail (indicate by 'X' on LCD).

Setting Pass, Marginal, Length values to 0 disables the pass/fail check function.

### Pass/Fail Operation

During either One-Way or Two-Way Autotest,

- Loss test status for each wavelength will be shown with a '✓' (pass) or 'X'(fail) or blinking 'X' (marginal) on the right of LCD. If length (2-way Autotest only) test fails, the displayed value will flash. ORL (2-way Autotest only) test status for each wavelength is shown with a '✓' (pass) or 'X'(fail).
- An overall test result, "PASS" will be shown at the top right corner of LCD if:
  - pass/fail check function is disabled.

- loss test statuses of all wavelengths are passes or marginal and, the both the optional length and ORL tests pass.
- An overall test result, "FAIL" will be shown at the top right corner of LCD if, loss test of any wavelength fail or, any of the optional Length and ORL tests fails.

- Pass/fail method selection:

*For 2-way Autotest:*

- If 'WC' (worst case) is selected, the worst-case loss value will be used to determine the test status.
- If 'AV' (average) is selected, the average loss value will be used to determine the test status.

*For 1-way Autotest:*

Worst case loss value will always be used to determine the test status regardless of the selected pass/fail method.

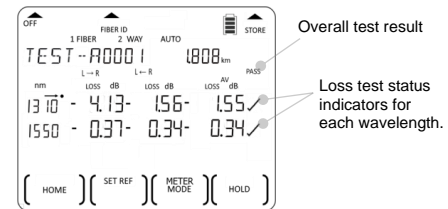


Figure 3. Example of auto pass/fail display in 2-way Autotest

## CONTINUITY & POLARITY TESTING

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### Continuity & Polarity Test Overview

This instrument has a variety of convenient ways to assist the user with polarity or continuity checking, and fault finding.

#### VFL-VisiTester Option

The instrument optionally features a fully functional VFL, which has a blink feature. The VFL uses the Two-Way port, it does not have a separate output connector.

Integration of the VFL with the Two-way port means that it can be seen during Autotest loss testing, with no further effort. This means that on shorter distance tests, polarity can be observed and checked during loss testing, without requiring an extra hook-up.

This feature can save a lot of time during loss testing, and improve test confidence, since on shorter distance tests, the fiber to be tested (e.g. connected to an instrument at one end) shows a flashing red light at the other end. This can be used to help initiate the testing process or quickly identify one fiber out of an array if the labelling is wrong or absent.

#### Standard Test Tone Source & Detection

The light source and power meter share tone detection features.

Standard test tones at 270 Hz, 1000 Hz and 2000 Hz are available on the source. If one of these tones is detected by the meter, a buzzer sounds to show continuity. This function is very similar in operation to a continuity tone indicator on a voltmeter, for example.

The source can also be used to determine continuity as a tone generator for most clip-on fiber identifiers (not supplied).

The tone detector measures and displays the actual tone frequency in Hz.

#### Advanced Test Tone Source & Detection

This is an advanced polarity detection method.

Using the Multifiber ID extended test tone function, up to 12 fibers can be uniquely identified in one pass.

To do this, 12 sources can be connected to a group of fibers, with each source set to a different Multifiber ID number. The sequence is noted for use at the far end.

Then at the far end, the meter will display ID 1 – 12, depending on the detected signal, which identifies the polarity of all 12 fibers in one pass.

Note that any Kingfisher Autotest source with Multifiber ID can be used, such as inexpensive 9800 series instruments.

For detailed operating instructions on any of these features, please turn to the relevant section of this manual.

## MANUAL OPERATION-POWER METER

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### Power Meter Manual Operation

To operate the Optical Power Meter, press [Meter]. The meter will default to the last used settings.

- 'HI' or 'LO' indicate that the input power level is out of range.
- Absolute power level can be measured in dBm, or linear mode. Optical loss or attenuation is measured in dB.
- To toggle logarithmic / linear / relative display mode, press button below [METER MODE]. Measured optical power will be displayed in dBm / dB or nW,  $\mu$ W, mW.
- To scroll calibration  $\lambda$ , press - or +. The display shows the active calibration  $\lambda$  in nm. Commonly used  $\lambda$  are grouped together.
- To set reference: In relative mode, hold down button below [SET REF] for 3 seconds until the instrument beeps finish. Then the main display will go to approximately 0 dB, and the reference value will be displayed on the left-hand side of the display.
- To stop / start display update, press button below [HOLD]. The symbol will flash when the display is on hold.
- To store to memory, press triangular button above "STORE" Please refer to "Recording, Storing, Recalling Readings and Clearing Memory" section for detailed memory operation.

- To display, hide or reset minimum and maximum recorded power for selected  $\lambda$ , press – and + simultaneously. This is a handy simple data logging function for field use.
- Press button below [HOME] to return to Home menu  
On rare occasions where the meter is unable to display a power level and displays a tone instead, refer to "Slow Mode" section in this manual, to set the meter to averaging mode.

Cover unused test ports with an opaque dust cap. Never touch connector tips with your fingers since body oils and dirt can impair performance.

## MANUAL OPERATION-LIGHT SOURCE

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### Light Source Manual Operation

On the 274x Series instruments, the light source requires a warmup period at the set  $\lambda$  for 15 min to achieve specified stability. On the 234x Series instruments, the specified stability is achieved with no warmup period.

- Press button below [SOURCE] to turn on the source at the last selected  $\lambda$ .
- Press - or + to select another operating  $\lambda$ .
- To turn source on and off, press **Toggle Centre**.
- [Laser source only]: To change power level, press and hold **F2** then use - or + (laser light source only, not available for LED sources). To toggle between max and min power level, hold **F2** then press **Toggle Centre**.
- To select modulation while source is on, press and release button below [MODE]. Repeatedly press [MODE] to scroll & select a tone frequency or ID-tone. Alternatively, press and hold [MODE] then use - or + to cycle through all options.
- Test tones available are CW, blink (or VFL), 270 Hz, 1 KHz, 2 KHz, and twelve tones for ID1 through to ID12.
- To end modulation, press and hold button below [MODE] then press **Toggle Centre**. Alternatively, press and hold button below [MODE] for 3 sec.

If the VisiTester VFL option is fitted, the VFL appears as a 650 nm source in the light source menu.

Cover unused test ports with an opaque dust cap. Never touch connector tips with your fingers since body oils and dirt can impair performance.



# MANUAL OPERATION-OPTICAL RETURN LOSS METER

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## ORL Meter Manual Operation

ORL is an instrument part number option.

23400 Series instruments measure Optical Return Loss (ORL) using the Optical Continuous Wave Reflectometer (OCWR) method. The meter measures the accumulated reverse power at the point of measurement.

This method is accurate and suitable for acceptance testing. However, it cannot locate a reflection source, and has limited optical range.

The instrument ORL test  $\lambda$  are the emitter  $\lambda$ .

Please refer to our application notes for optical return loss causes, effects and remedies.

It is common for in ORL test situations to use a relatively complex test lead assembly, which can cause test errors due to both connector loss and stray return losses. These can both be compensated if they are stable.

Cover unused test ports with an opaque dust cap. Never touch connector tips with your fingers since body oils and dirt can impair performance.

### Low Reflection Terminations

The instrument is delivered with a low loss termination, helpful for performing ORL testing. The termination can be placed at the far end of a test specimen, to help absorb far-end reflections.

For additional applications support to understand ORL in fiber systems, please refer to the application notes on our web site.

### ORL Meter Operation

No warmup is needed. Ensure all optical connectors are clean.

- Connect the device under test to the Two-Way port.
- Install an appropriate terminator (provided) on the other Two-Way port if available. The terminator blocks out stray light entering the instrument that may affect ORL measurement accuracy.
- Press button below [RETURN LOSS] (**F2**) to display ORL measurement, ORL for all available  $\lambda$  will now be displayed in dB RL.
- Toggle **-/+** to change the test  $\lambda$ .

To improve accuracy, the ORL Zero Function feature or User Calibration (UCAL) feature may be used.

These offsets can be also set in Autotest mode.

# MANUAL OPERATION-OPTICAL RETURN LOSS METER

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## ORL Zero Function

This compensates for stray (residual) reflections to allow testing of weak reflection levels. Using this feature, the instrument can read accurately up to 10 dB below the stray reflection level,

However, this feature causes increased noise, so when using this feature, ORL test resolution is decreased as follows:

If the zeroed value (Noise Floor) is  $x$  dB then,

- From  $x$  to  $(x+10)$  dB, resolution is limited to 0.1 dB.
- From  $x$  to  $(x-10)$  dB, resolution is limited to 1 dB, which is also the display range limit.

Perform the Zero Function whenever the stray ORL condition may have changed.

To set up this feature (first select the ORL function):

- Set up the stray optical condition.
- Press **F2** then press **F3** twice to enter Noise Floor (NF) setting mode.
- Press **F2** and NF offsets for all active wavelengths will be set and saved automatically. The new NF values will be displayed next to the selected wavelength.

## User Calibration (UCAL)

To compensate for optical loss in a test jig, or different singlemode/multimode fiber core geometries etc.

A multimode ORL meter can be used to measure either 50u or 62.5u fiber using this method.

Set up reference optical condition:

- Press **F2** at Home menu to enter ORL mode and select wavelength using **-/+**.
- Press **F3** to enter UCAL offset setting mode.
- Press **-/+** to enter the required offset (difference between measured ORL of test jig (or 50u or 62.5u MMF reference test lead) and  $-14.3$  dB\*. Press **F2** to save or **F1** to cancel the new settings.

\*The ORL value for an unmated PC polish connector in good condition is approximately  $-14.3$  dB.

## Reset User Calibration (UCAL) offset & Zero Function (Noise Floor) to factory defaults

To re-set Noise Floor and UCAL offset values to factory defaults,

- Press **F2** at Home menu to enter ORL mode.
- Press **F3** twice to enter Noise Floor setting mode.
- [For instrument with only 1x Two-way port]: hold down **F2** then **Toggle Centre** until it stops beeping.
- [For instrument with 2x Two-way port]:
  - For **SM port**: hold down **F2** then “**-**” until it stops beeping.
  - For **MM port**: hold down **F2** then “**+**” until it stops beeping.

## VFL-VISITESTER OPERATION

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### VFL-VisiTester Operation

VFL-VisiTester is an instrument part number option.

The VFL laser shares the Two-Way port, so it can be used in a few ways, for example:

1. If the instrument (source) is in Autotest mode, the red VFL laser is intermittently mixed in with the test signal. So, at the far end, on shorter distance tests, the fiber to be tested will flash red occasionally. This can save a lot of time finding a misplaced fiber to be tested and is very helpful to get the testing under way in the first place.
2. The VFL laser can be used as a typical full-feature VFL, e.g., for typical fault location or continuity testing.
3. The VFL is high powered for the longest possible range and is the maximum power level for an eye-safe Class 1 device.

The visible laser works equally well in single mode and multimode systems. Although red light is usually visible at the fiber end for up to about 10 Km, best performance is achieved over distances of less than 1km.

#### Operation:

If used with Autotest, no specific action is needed other than to start Autotest. In Autotest mode, the red laser is not included in the displayed test result. The red laser will only be visible on the master instrument on which Autotest is initiated.

If used in stand-alone VFL mode: To switch on the visible laser, press [On] then [SOURCE], then select the 650 nm VFL  $\lambda$ .

To improve visibility, the laser is modulated at 2Hz. To change modulation frequency or turn off modulation, press and release [Mode] repeatedly while source is on.

The visibility of the red light can be greatly improved by darkening the area to be observed. For example, a heavy blanket over both the observer and the fiber, can be happily used to block out sunlight.

#### Long Distance Fault Finding

For long distance fault finding, the non-VFL light source tone function can be used with a clip-on fiber identifier or power meter to give up to 200Km of fault-finding range.

**WARNING!** Although the visible laser is classified as Class 1, and so is eye safe, please observe any other required optical safety measures for the system under test.

## STONE DETECTION AND SLOW MODE

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### Tone Detection & Slow Mode

#### Tone detection

This is a useful feature of both source and meter for quick continuity / polarity checking. It provides several practical options.

- To enter the source tone mode, while [SOURCE HOME] displays on the left of the screen, select [MODE], and keep pushing [MODE] to scroll modulation options.
- If the power meter detects a standard optical test tone (e.g. 270 Hz, 1 KHz, 2 KHz), a buzzer sounds and the display changes to show the actual measured modulation frequency in Hz. This is useful for fiber identification and signalling.
- If the power meter detects a non-standard optical test tone, the display changes to show the actual measured modulation frequency in Hz. This is useful for fiber identification and signalling.
- The meter can be used to check the actual modulation frequency of test sources (between 150 and 9999 Hz).
- If a MultiFiber ID tone is detected, a buzzer will sound and the corresponding fiber ID xx number (1 – 12) will be displayed. To use this feature, one or more sources with MultiFiber ID are required. This is a very useful feature for quick ribbon fiber polarity checking. It can also be used to send one of 12 pre-coded signals between test staff.

#### Slow Mode

Slow Mode is occasionally useful to measure power on unstable signals that accidentally trigger tone detection, or to improve test resolution at very low power levels. In this mode, Autotest and tone detection are disabled, and measurement integration time is extended.

- To enter Slow Mode during turn on, hold down **F3** (button located in the middle row right from the centre). 'tonE' will be displayed briefly. After releasing [F3], the symbol of “∞” will be displayed to indicate Slow Mode has been activated.
- Alternatively, to turn Slow Mode on/off while in Meter Menu, press and hold button below [METER MODE] then press **F4**.
- To turn on Slow Mode while in Tone detection mode, press **F4**. This will disable tone detection.  
To turn Slow Mode off (i.e. to resume Tone detection), press **F3** to go to Meter Menu, hold **F3** and then press **F4**.
- In Slow Mode the display will show average optical power of the modulated signal, using a long average.

## TEST REPORTING OVERVIEW

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### Test Recording & Reporting Overview

These instruments can be used various ways to record results and get test reports. Typically:

- If the instrument is connected to a computer during testing, the instrument is controlled from the computer via KITS™ software, and test results are loaded directly into a KITS™ pass/fail report during testing. This is a very convenient option. No need to use the instrument memory, or even the instrument buttons in most cases. Or just save the Excel file and print the test report.
  - If working into instrument memory, then later, you can dump the test data onto a USB (formatted as FAT32 or exFAT) key, and then load this data file later (often, off-site) into KITS™ software. This can be handy to get data offsite, allow test data analysis as the job is completed, create duplicate test file back-ups, or allow for effectively endless test memory.
  - If working into memory, you can download the results later into KITS™ reporting software. This is the only method allowed by most competitor equipment.
- Note that all data files are secured with a checksum, and KITS™ software can run in “secure mode”, which prevents tampering with test results.
  - More detailed operation and instructions are elsewhere in this manual, or the KITS™ software manual.
  - KITS™ software can perform an unformatted data download for any other analysis by the user.
  - Data in KITS™ can be exported to a secure CSV file for audit purposes.
  - KITS™ software can be readily updated with your in-house or other latest test standards.

# INSTRUMENT MEMORY OVERVIEW

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## Instrument Memory Overview

Two-Way testers have various features for storing and recording test data or user settings in non-volatile memory

### Save & Store Test Results

The non-volatile user memory stores test data, which can then be displayed or downloaded to a spreadsheet in the KITS™ software or saved to a USB stick (formatted as FAT32 or exFAT). Addition of a USB stick give effectively infinite memory in practical field situations.

Data stored in Power Meter and Autotest mode, for example:

- Measured optical power in dBm, W, dB R
- Reference value, dBm
- Detected  $\lambda$ , nm
- Test time and date
- Autotest nominal source power
- Autotest relative mode references
- Text ID Tag
- Remote instrument serial number
- Pass / fail status

### Text ID Tag

Up to 20 pre-set text identifiers can be stored for later use, to help manage & identify stored test data per project etc. See Text ID Tag section for more details.

### Meter Display Hold

To hold the display at its current value, press [Hold], then store the measurement. To continue display update, press [Hold] again.

### Automatic MAX / MIN Recording

In manual power meter mode, the maximum and minimum power meter values are continuously recorded in real time. To display or hide minimum and maximum recorded values, press - and + simultaneously.

### User Setting Retention

Some convenient user settings are stored at instrument turn-off and restored when the instrument is turned back on.

### Time and Date

Test time and date is recorded in memory; However, the current instrument time and date is volatile if batteries are removed for some time, or they go flat. See section SETTING DATE AND TIME

### Instrument Sanitizing

All user data and retained settings can be removed, and the instrument fully restored to an (anonymous) original state.

## INSTRUMENT MEMORY OPERATION

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### Instrument Memory Operation

#### Recording Data to Memory

Make sure that the required Text ID (project name) tag is showing. If not, refer to “Text ID Tag” section.

- To record data to internal memory in Meter or Autotest modes, press triangular button above “STORE”. Data will be stored in the next location and the Text ID Tag display will auto-increment.
- To change the next location pointer for storage, return to Meter or Autotest mode and, press button above “MEMORY”. The last memory location stored with data will be displayed along with its Text ID Tag alternately. Select the desired location using the + or -, hold button above “MEMORY” then press **F2** for three seconds, or until it stops beeping.

Note: Existing memory following the selected location will be progressively overwritten.

#### Recalling Stored Data from Memory

- To enter Memory mode, press button above “MEMORY” at Home menu.
- press + or - to select a memory location to display data.

- [For data saved in 2-way Autotest mode only]: As default, a test summary for losses at each direction and their averages is displayed (see Figure 4 at the end of this section for an LCD display sample). To change to display test detail for absolute power, loss, reference power of each direction, (see Figure 5 for an LCD display sample) press **F3**. Press **F3** again to display optional ORL values (see Figure 6 for an LCD display sample). Press **F3** again now will return to default display.

To show nominal source power, hold down **left** rectangular button above LCD (only when displaying absolute power, loss, reference power).

To view absolute power, loss, reference power for other wavelengths, press **F4**.

To view saved time and date, press and hold **Toggle Centre**.

To exit memory mode, press **F1** to return to Home menu.

- [For data saved in 1-way Autotest mode only]: As default, absolute power will be displayed in dBm along with loss (dB) and reference power (dBm), see Figure 7 at the end of this section for an LCD display sample. To change to display absolute power in watt also, press **F3**. Press **F3** again will return to default display.  
To show nominal source power, hold down **left** rectangular button above LCD.

## INSTRUMENT MEMORY OPERATION

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To view saved time and date, press and hold **Toggle Centre**.

To exit memory mode, press button below [HOME].

- [For data saved in Meter mode only]: As default, absolute power will be displayed in dBm along with loss (dB) and reference power (dBm), see Figure 8 at the end of this section for an LCD display sample. To change to display absolute power in watt also, press **F3**. Press **F3** again will return to default display.

To view saved time and date, press and hold **Toggle Centre**.

To exit memory mode, press F1 to return to Home menu.

- To distinguish between stored manual and Autotest results, Autotest results are shown with “Auto” at the top of the display.

### Re-Test or Over-Write Results

- Note your currently displayed memory location: Press **F1** to return to Home menu, then press button above “MEMORY”. Note current memory location, which will be e.g. “MEM 123”.
- Go to the location to re-test: Select the desired location using + or -, then hold button above “MEMORY” and press **F2** for three seconds or until it stops beeping.
- To retest: Press **F1** to exit Memory mode. Enter Meter or Autotest mode, press triangular button above “STORE” now

will save new results in the memory location(s) selected above.

- When you have finished re-testing, go to the next empty location after your results: Enter Memory mode, select the desired (e.g., “MEM 124”) location using + or -, then hold button above “MEMORY” and then press **F2** for three seconds or until it stops beeping.
- Continue testing.

### Clearing Memory

A full memory is indicated by ‘Full’ label and beep.

- Prior to erasing the memory, you may want to copy the stored test data onto a USB key (formatted as FAT32 or exFAT), please refer to **USB Key Download** in this manual.
- To clear **all stored data**, while in the Memory menu, hold down [Memory], then press and hold [F2] followed by [F4] until beeping stops. “clr” will be displayed and all stored data will be cleared after it stops beeping. Note that this does not clear stored Text ID Tags.

### Memory Capacity

Memory capacity is:

8,000 fibers for one-way loss tests

4,000 fibers for two-way loss tests

Stored results can be easily recalled onto the instrument display.



# INSTRUMENT MEMORY OPERATION

## Instrument USB Ports

The 2000 Series instruments feature a micro-USB interface which gives remote access and control from an external PC.

Windows device drivers for the micro-USB interface are included in KITS software or can be downloaded separately.

Kingfisher does not provide API or other support for users to write their own programs to interface to this instrument.

Note that the larger USB port marked "MEM" is only used to dump data onto a USB memory key (formatted as FAT32 or exFAT) and has no other function.

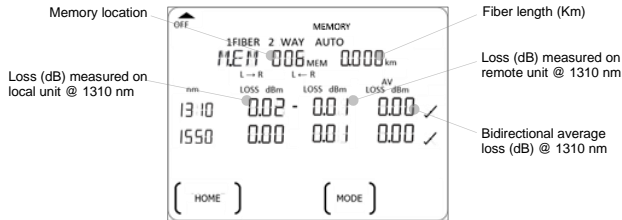


Figure 4. Memory display of Two-Way Autotest (Test summary)

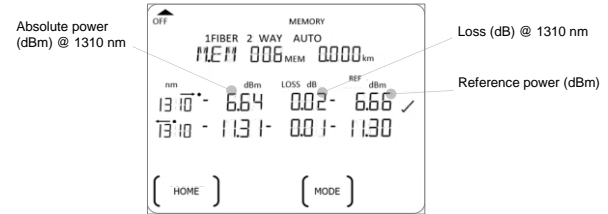


Figure 5. Memory display of Two-Way Autotest (Test detail)

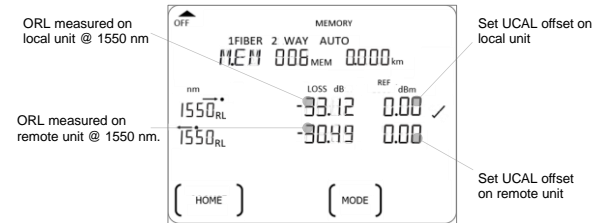


Figure 7. Memory display of Two-Way Autotest (ORL test)

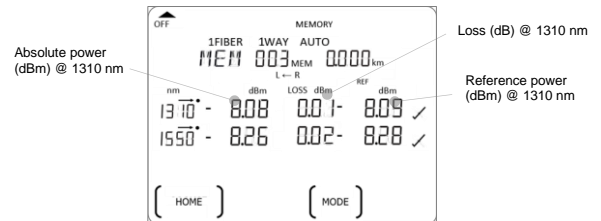


Figure 7. Memory display of One-Way Autotest

# INSTRUMENT MEMORY OPERATION

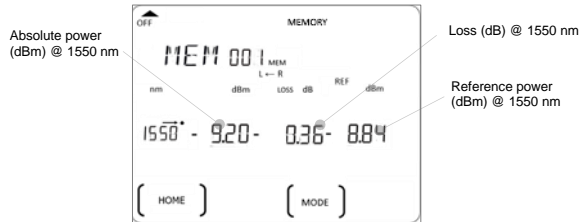


Figure 8. Memory display in Meter mode

## TEXT ID TAG

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### Text ID Tag Operation

Text ID tag is a useful auto-naming feature to systematically pre-configure (project) text names for test results stored in memory.

Note that this instruction does not refer to storing of test results; it refers to setting up a collection of user defined names that can be conveniently recalled as needed.

A Text ID tag is formed by 6 letters and a 4-digit fiber index, e.g. ABCDEF0001. The last 4 numbers auto-increment as results are stored. The incremented number is also recalled if this tag is called again.

Up to 20 user-created Text ID Tags can be stored. A new Text ID Tag can be created or modified while in Meter menu or in Autotest.

Text ID tag detail is independent of the actual memory location within the instrument. A Text ID tag number can be re-used, and it will store in the next available empty memory location.

#### Use a Stored Text ID Tag

- Enter Meter or AUTO menu.
- Press button above “Fiber ID”, ID Tag will flash.
- Press - or + to find required Tag,
- Press **F2** to save or **F1** to cancel.

#### Modify a Text ID Tag

- Enter Meter or AUTO menu.
- Press button above “FIBER ID”, then - or + to select a stored ID Tag.
- Press **F3** to enter edit mode.
- Press - or + to select new alphanumeric character, then press **Toggle Centre** to move to the next character.
- Press **F3** to reset the digit fiber index to ‘001’
- Press **F2** to save or **F1** to cancel new settings.

#### Delete a Text ID Tag

- Enter Meter or AUTO menu.
- Press button above “FIBER ID”, then - or + to select the stored ID Tag to be deleted.
- Press **F3** then **F4** to delete the selected ID.
- Press **F2** to confirm deletion or **F1** to cancel.

Text ID tags can only be deleted one at a time.

#### Create a New Text ID Tag

- Enter Meter or AUTO menu.
- Press button above “FIBER ID”, then **F4**. You will see a new ID Tag, AAAAAA0001, with the 1<sup>st</sup> character flashing.
- Press - or + to select new alphanumeric character, then press **Toggle Centre** to move to the next character.
- Press **F2** to save or **F1** to cancel.

## TEXT ID TAG

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### Application of TEXT ID Tag

Kingfisher 2000 Series instruments allow a test technician to quickly label and store test results in the instrument memory.

This feature can be used in conjunction with various labelling standards such as:

TIA-606-A, TIA-606-A Addendum 1, TIA-606-B, ISO/IEC TR 14763-2-1

This feature is at its best when used in conjunction with Autotest, so that multi- $\lambda$  loss tests can be labelled and stored with only one button push.

- i. The text format can be pre-set by the user with up to 20 pre-set text schemes ("Text ID Tags"), which can be set up for jobs, and assist in ensuring that the correct data is recorded and then identified during reporting.
- ii. The first 6 text digits are straight alpha-numeric e.g. A-Z, 1 – 9, dash, decimal point, blank.
- iii. The last 4 text digits are auto-incrementing numeric characters, so 9999 multi- $\lambda$  tests can be performed without manually entering any text. A great convenience.
- iv. The text includes enough port identifier digits to assist test personnel to adequately identify results for subsequent reporting purposes.

Some typical examples of 2000 text labelling schemes (auto-incrementing digits are in bold):

ABCDEF**1234**, ABC**1234**, ABCDE-**012**, AB-**1234**, A-**12345**, A-1 **345**,  
A-BC**0123**, -40.**1234**, A02-**1234**, A02 **1234**, 1-2**3012**, A-2 **012**, A.**012**,  
A **012**

## USB KEY Memory Dump

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### USB Key Memory Dump

The large USB (Type A) port on the right side of the instrument with “MEM” (Memory) is used only for dumping a data file onto a USB memory key (formatted as FAT32/exFAT), it has no other function. General USB connectivity and external charging are achieved with the other micro-USB port.

The instrument only detects the presence of a memory key when in memory mode, at which point “USB” shows on the LCD if a stick has been detected.

- To save memory to USB stick, insert USB stick (formatted as FAT32/exFAT) and enter Memory mode, then, and observe that “USB” shows on the display to indicate that the USB stick has been detected.
- Press the triangular button above the LCD. Do not remove the USB stick until the download has completed and the instrument stopped beeping.

The file name on the USB key will auto-increment with each memory dump. So successive memory dumps can be made without overwriting the previous files.

This gives the instrument effectively infinite autonomous test capacity, e.g., the instrument memory can be repeatedly dumped and cleared.

The saved file incorporates a checksum which is used by KITS™ to check the file integrity, and to detect tampering with the file.

### Instrument Data Sanitization

To entirely erase all traces of user activity on this instrument:

To erase all parts of the non-volatile user memory, including user data, and restore default instrument settings:

- Turn on the instrument
- Select [MEMORY] (a button above the LCD)
- Select and hold the following keys for 3 seconds until beeping stops: [MEMORY], **F2**, **F4**, **Toggle Centre**. “dFLt” will display during operation.

## EXTERNAL SOFTWARE

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### External KITS™ Software

Free KITS™ software is available on [www.kingfisherfiber.com](http://www.kingfisherfiber.com) and enables instrument control and transfer of live or stored data to an Excel spreadsheet, making it ideal for data logging and reporting in the field. KITS™ can be easily customised to change language, terminology or to add new reporting features.

The user manual for this software is downloaded and installed with the software. Alternatively, it is on our web site.

Functions currently supported by KITS™ are:

- Live Power Meter display
- One-Way Autotest loss reporting, also followed by merging one direction data into a bidirectional test.
- Two Way Autotest Loss, ORL and Length
- Spreadsheet to record loss measurements with direct click-and point data insertion or memory download
- Unformatted data dump
- Data logging with graph and statistical information
- When connected to an instrument, the software remotely controls the instrument. The test is typically then controlled from the computer, which makes for easier overall operation.
- Data security is achieved via a combination of checksums on data files, and Secure Mode within the spreadsheet.

- Pass/Fail according to many common test standards can be selected, or you can enter details of new or in-house test standards. Pass/Fail parameters created in KITS can be uploaded to a Two-Way tester, to ensure that it has the same pass/fail criteria.

### Instrument Firmware Updates

We suggest instrument firmware update is only performed if advised by our customer support staff. Please refer to our web site product page for downloads, procedures, and pre-requisites.

When updating firmware, it would be usually advisable to get the latest user manual from our web site.

To view the current instrument firmware version, hold [F4] during instrument turn-on.

## TIER 1 TEST EXAMPLE

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### Tier 1 Test Example

We give here an example of a typical Tier 1 Test / Acceptance / Certification test. Prior to this, the organization needs to determine the required test standard, test method, and ensure trained & accredited staff are available.

We assume a two-way Autotest (bi-directional) test method. This is faster and easier than a one-way Autotest test method, adds length (and ORL if available) testing, and is the “highest” loss test method available, accepted by all standards. Just hook-up one fiber up at a time, once only.

It is noticeable that a good part of this testing is up to personnel and associated procedures. The equipment plays a role in supporting “Tier 1 Testing” but is not in itself adequate to ensure compliance.

Don’t do this test until you are confident that the relevant physical cabling/ labelling and related site aspects are “stable”.

Post-test physical site access needs consideration. The system may get “accepted” but then later, someone unplugs and re-plugs a connection, then it may fail due to dirt etc. This is when the blame game starts 😊

Prepare equipment:

- ✓ Ensure your tester has required  $\lambda$ , fiber & test types
- ✓ Check equipment calibration status

- ✓ Check that instrument has correct connector types
- ✓ Check inspection & cleaning materials & qty available
- ✓ Check you have materials needed to secure or identify post-test access to site, closets, racks, ducts, connections etc.
- ✓ Check spare batteries & micro USB power lead.
- ✓ Determine project labelling sequence to be used
- ✓ Determine number of fibers to be tested
- ✓ Verify exact test method(s)
- ✓ Check and verify operation with the required referencing method(s) (1, 2, 3 fiber etc)
- ✓ If helpful, restrict the instrument test  $\lambda$ .
- ✓ Check, label & document test leads, test through adaptors & verify their performance. Maybe have separate low-grade leads to be used for continuity & polarity checking.
- ✓ Ensure equipment familiarity, including communications methods
- ✓ Set up test pass/fail parameters in the instrument

If intending to work (live or later) into KITS™ software:

- ✓ If intending to use KITS™ software, ensure it’s installed, connects, and verify that it’s doing what you want
- ✓ Select test standard & enter relevant details, or enter new test standard if needed
- ✓ In KITS™, set up and save the project details for later use

## TIER 1 TEST EXAMPLE

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- ✓ In KITS™, observe the “Secure Mode” symbol which is must be active for Tier 1 testing data security
- ✓ Check computer date & time

If intending to work into instrument memory:

- ✓ Set up a suitable Tag ID
- ✓ Set up the overall job size etc
- ✓ Empty the instrument memory
- ✓ Check instrument date & time

If intending to use USB download, check that the instrument can recognise your USB key(s) (formatted as FAT32 or exFAT) and that they have enough free space.

You are now ready to start testing the project on-site.

- ✓ First, you may want to continuity test the cabling prior to loss testing, since you want to minimise any (e.g., rectification) disturbances to the cabling once it is properly tested. Use the instrument tone function, or VFL if fitted, or go a bit further and use Autotest to also check performance and length.
- ✓ You will want to check polarity, e.g., ensure fiber pairs are not reversed. This may or may not be part of continuity testing, depending on the site conditions etc. Also check the cabling labelling one by one. Use the instrument tone

function, or VFL if fitted, or go a bit further and use Autotest to also check performance and length.

Once you have verified that the site & cabling continuity is looking promising, polarity is good, and labelling is good, (all key parts of Tier 1 testing) it's time to perform and record the formal loss (maybe ORL) and length test, with the expectation that there will be little re-work or cabling disturbance during or after this phase.

The following should have been covered prior:

Personnel training & accreditation, equipment suitability & calibration, test method, test  $\lambda$ , fiber & connector type, test lead selection & verification, site labelling, instrument & reporting software general operation, cleaning & inspection equipment & processes, referencing, pass/fail parameters.

Two-Way Loss, Length & ORL Testing Procedure

- If not done already, verify the patch leads.
- Reference both instruments using 1, 2, 3 cord methods as relevant.

To work live into KITS™ software:

- Connect the computer, start-up KITS™ with instrument on & connected to USB (so the program sets up to match the instrument). This can be at either instrument.
- Once connection is established, go to the Live Data Tab
- Fill in job details as needed (green cells)



## TIER 1 TEST EXAMPLE

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- KITS ribbon / Pass Fail Setup, select test standard or other
- Enter / adjust any relevant data
- Go to Test Setup, enter / adjust any relevant data, and set "Number of Tests" to set the spreadsheet size
- Go to Terminal ID to name each location
- KITS ribbon / ensure "Unset Secure" is locked

### Start Testing

- Connect one fiber to test to the Two-Way port each end
- Set instrument to Autotest if needed (just once)
- Observe reading, if good, click yellow cell on fiber to save on report
- Observe pass / fail on report (click again to retest)
- Next fiber, if good, click yellow cell on fiber to save on report
- Use the communications feature if helpful
- ...etc till job done
- When done, save the report and secure access to the tested equipment.
- Check Final Report Tab to see Final Report

If intending to work into instrument memory, and if not done already:

- Select suitable Tag ID
- Set up the overall job size etc
- Empty the instrument memory
- Check instrument date & time

## CARE OF YOUR INSTRUMENT

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### Care of Your Instrument

**CAUTION!** Follow the directions in this manual on optical connector care, to avoid permanently damaging the connectors.

**CAUTION!** During prolonged storage, remove batteries to eliminate the possibility of acid leakage. Use only high quality sealed alkaline, lithium or NiMH batteries.

**CAUTION!** During storage and transport keep the instrument in its carry case to protect against crushing, vibration, dust, and moisture.

**CAUTION!** The instrument is resistant to normal dust and moisture; however it is not waterproof. If moisture gets into the instrument, dry it out carefully before using it again. Where possible, keep instrument away from strong sunlight.

**CAUTION!** Clean the instrument case using soft damp cloth. Do not use strong solvents to avoid risk of damage to surfaces.

**CAUTION!** Input optical power must not exceed the damage level specified for each detector type.

## ACCURACY CONSIDERATIONS

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### Accuracy Considerations

Keep optical connectors clean and in good condition. Always clean and inspect connector tips before mating.

Use test-quality leads with a similar fiber type to the system under test. This is particularly important for multimode systems. If all else is well, test lead repeatability is often the limiting factor in test accuracy.

When testing to an acceptance standard, it is important to adhere carefully to requirements, test methods, patch lead verification and referencing methods (1, 2, 3 lead etc) specified in the standard.

To reduce the effect of polarisation changes, the fiber system should be neat, coiled and physically stable.

In multimode systems, modal noise and general uncertainty are often worse than in single mode systems. Optimum measurement repeatability is obtained by using of a mandrel wrap close to a source.

Please visit [www.kingfisherfiber.com](http://www.kingfisherfiber.com) to see our comprehensive **Application Notes** written to support instrument users.

#### Power Meter

Using an APC connector at the power meter interface reduces line reflections and so improves measurement stability, particularly in laser-based systems. This is important when measuring small connector losses.

Responsivity of InGaAs detectors may be very  $\lambda$  sensitive at 850 nm, resulting in poor absolute accuracy and excessive sensitivity to source  $\lambda$  drift during warm up. At this  $\lambda$ , Si or Ge detectors are preferable. Refer to responsivity graph.

Responsivity of Ge detectors may be very  $\lambda$  sensitive at 1550 nm and above, resulting in poor absolute accuracy and excessive sensitivity to source  $\lambda$  drift during warm up. At these  $\lambda$ , InGaAs detectors are preferable. Refer to responsivity graph.

For best absolute power testing accuracy, the meter calibration  $\lambda$  should be set close to the measured  $\lambda$ . Note that  $\lambda$  uncertainty of test sources may be 30 nm, in which case it is not possible to set the meter  $\lambda$  with great accuracy.

For high precision use, power meters provide better accuracy when measuring a non-coherent source such as an LED. So, for best accuracy when testing small losses on single mode patch leads etc, an LED source may be preferred.

High power (attenuated) meters tend to suffer overall reduced accuracy. Kingfisher high power meters use a multi-technology attenuating element to reduce the adverse effects of reflections and  $\lambda$  sensitivity.

At levels below about -45 dBm, spurious readings can be caused by stray light leaking into fiber and patch cables. This can be a problem with extended range linearity measurements.

Ge power meters have limited linearity, sensitivity and accuracy compared to all other types.

## ACCURACY CONSIDERATIONS

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### Light Source

Light source power may drift. When you have finished a test, go back to the start position to check if the light source power is still within acceptable limits. Note that light source specifications are usually for typical drift after a warm-up period and assume a stable ambient temperature and low back reflection. Actual drift will vary between instruments and test situations.

### Optical Return Loss

Optical return loss testing can be limited by the ORL performance of the instrument output connector or test leads, particularly for PC style connectors. Connector cleanliness and condition is critically important.

Far-end reflections at the end of a sample must also be controlled, or they will swamp the intended measurement

The two offset capabilities of the instrument can improve accuracy, however, note that the Zero function will need to be re-set if the residual ORL level changes, so care need to be exercised with this offset.

### DWDM Loss & Power Measurements

The DWDM bands are typically within 1525 ~ 1610 nm. For this application, an InGaAs detector calibrated at 1550 nm gives good absolute accuracy at all DWDM  $\lambda$ . Testing optical loss at 1610 or 1625 nm is common, since this represents the worst-case attenuation in most systems.

High power InGaAs detectors may be required to measure the system power level.

Ge detectors should not be used for accurate testing on WDM systems beyond 1550 nm, since inaccuracies become large and unpredictable.

### CWDM Loss & Power Measurements

The CWDM band is from 1270 ~ 1610 nm at 20 nm spacing, however, 1490 ~ 1610 nm is more common since it avoids the water absorption peak at 1383 nm.

The most common operating  $\lambda$  for FTTH PON systems are currently 1310 / 1490 / 1550 nm.

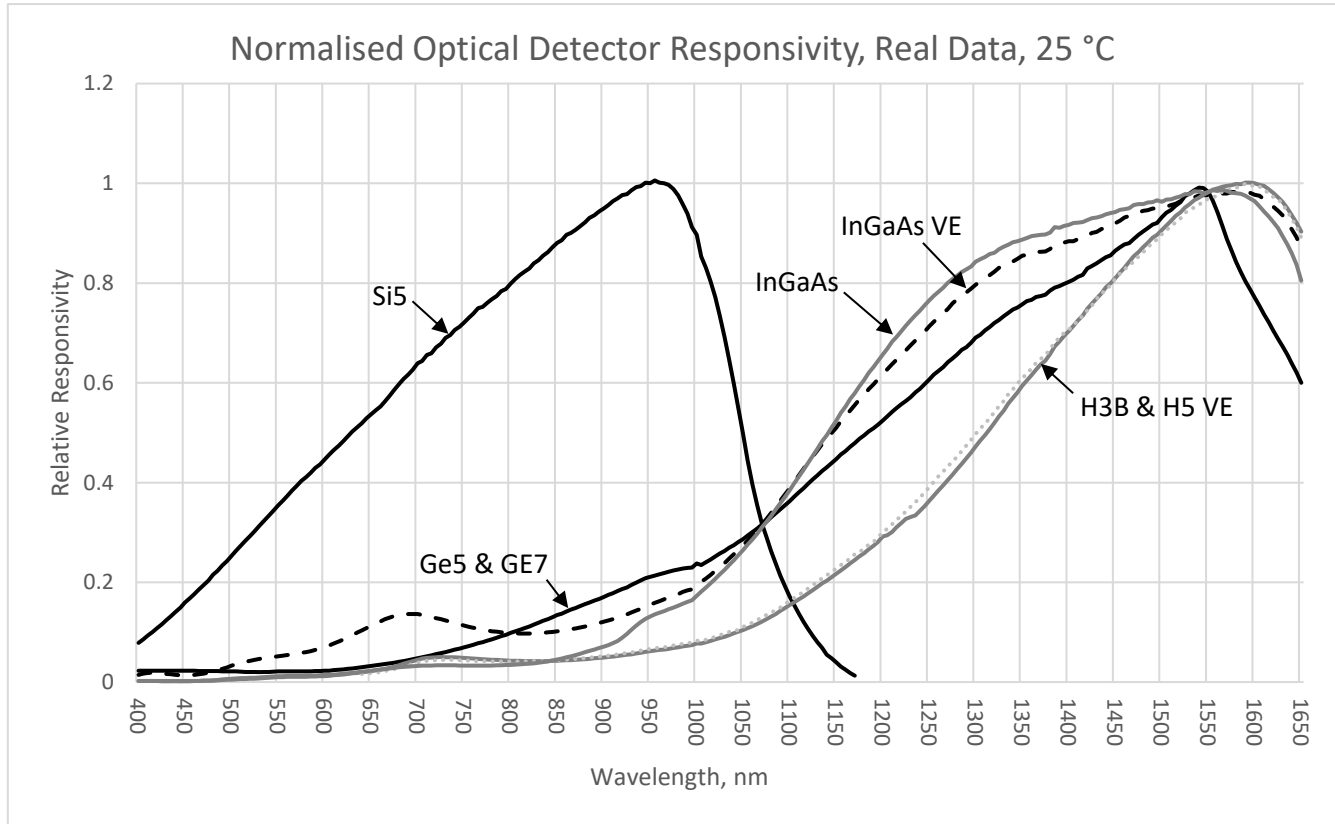
As in DWDM application, an InGaAs detector gives good absolute accuracy.

Because of the broad operating  $\lambda$  encountered, the power meter calibration  $\lambda$  needs to be matched to the measured  $\lambda$ , or absolute errors may be excessive.

Many systems are measured at 1390 nm to test for the water peak, and at 1625 nm to measure the high-end attenuation limit.

At 1625 nm, the fiber attenuation is actually very sensitive to  $\lambda$ , since the silica infra-red absorption zone is reached. So, the  $\lambda$  tolerance of this laser is a major issue, especially since many older source instruments have a tolerance of 30 nm.

# ACCURACY CONSIDERATIONS



## DEFINITION OF TERMS

### Definition Of Terms

#### Power Meter

**Power Range:** The range of input powers for which the instrument can be used.

**Maximum Input Power:** The input power not to be exceeded to avoid destroying the instrument.

**Uncertainty at Reference Conditions:** The uncertainty for the specified set of reference conditions, including all uncertainties in the calibration chain from the national laboratory to the test meter (connectors and test leads must be absolutely clean and undamaged). Reference conditions are the conditions during the responsivity calibration.

**Total Uncertainty:** The uncertainty for a specified set of operating conditions, including noise and drift (connectors and test leads must be absolutely clean and undamaged).

**Autotest Sensitivity:** The power level below which Autotest does not work.

#### Light Source

**Output Power:** The CW output power at the specified  $\lambda$ , at the end of a reference cable.

**Power Uncertainty / Repeatability:** Uncertainty in power level at the end of a reference cable.

**Short / Long Term (Power) Stability:** In CW mode, the uncertainty of the power level observed over a given time, compared to the mean power during this time. Measured with an averaging optical power meter, a 9/125 $\mu\text{m}$  fiber, at constant temperature, within a specified temperature window, and at line voltage.

**Centre wavelength:** The  $\lambda$  representing the centre of mass of the selected peaks:

$$\lambda_{\text{CW}} = (1/P_0) \sum (P_i \lambda_i),$$

where  $P_i$  and  $\lambda_i$  are the power and  $\lambda$  of each spectral component and  $P_0$  is the total power.

**Spectral Bandwidth:** FWHM (full width at half the maximum) describes the spectral width of the half-power points of the laser, assuming a Gaussian envelope of the spectral power distribution. The half-power points are those where the power-spectral density is one half of the peak amplitude of the Gaussian curve:

$$\Delta \lambda_{\text{RMS}} = \left( \frac{\sum P_i \lambda_i^2}{P_{\text{total}}} - \lambda_{\text{center}}^2 \right)^{1/2}$$

and

$$\Delta \lambda_{\text{FWHM}} = M \Delta \lambda_{\text{RMS}}$$

where:  $\lambda$  = centre  $\lambda$  of laser diode (in vacuum)  
 $P$  =  $\sum P_i$  = total power, in watts  
 $P$  = power of  $i^{\text{th}}$  longitudinal mode  
 $\lambda$  =  $\lambda$  of  $i^{\text{th}}$  longitudinal mode (in vacuum)  
 $M$  = multiplication factor; for a source with a Gaussian envelope  $M = 2.35$ ; for other types of spectra, use  $M = 2.35$  as well

## SPECIFICATIONS

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### Specifications

<b>Size:</b>	190 x 105 x 35 mm (7.5 x 4.1 x 1.4")
<b>Weight:</b>	420 gm (0.9 lb). Shipping 1.5 Kg (3.3 lb).
<b>Operating/ Storage:</b>	-15 to 55 °C / -25 to 70 °C.
<b>Power:</b>	2 alkaline or lithium AA cells /2x NiMH AA cells External input via micro USB Selectable auto-off, low battery indicator and back lit display.
<b>Battery life:</b>	Laser/LED source: 50 hours in Autotest, typical Power meter: 100 hours, typical

<b>Case:</b>	Rubber/Polycarbonate, 1 metre drop tested.
<b>Display:</b>	High contrast custom LCD, 74 x 55 mm / 2.9 x 2.2"
<b>Resolution:</b>	0.01 dB
<b>Modulated output:</b>	270 Hz, 1 kHz, 2 kHz $\pm$ 2 %, 12 Multi-Fiber ID tones
<b>Tone detection:</b>	150 ~ 9999 Hz $\pm$ 1%.
<b>Memory:</b>	Test results & timestamp for 8,000 fibers, unlimited on USB memory key
<b>Software</b>	KITS (free download)
<b>USB interfaces</b>	USB-micro for power & software / USB-A for memory key

## SPECIFICATIONS

### Two-way Autotest specifications:

Fiber Type	Wavelengths	Loss		Length		
		Range	Repeatability / Linearity	Range	Accuracy <sup>1</sup>	Resolution
MM	850, 1300 nm (62.5 μm)	27 dB	0.06 dB	6.0 dB / 20 Km	0.01 % ± 4 m	1 m (0.000–9.999 Km) 10 m (10.00–99.99 Km) 100 m (100.0–127.9 Km)
	850, 1300 nm (50 μm)	24.5 dB		4.0 dB / 20 Km		
MM	850, 1300 nm VisiTester (62.5 μm)	24 dB	0.06 dB	4.5 dB / 20 Km		
	850, 1300 nm VisiTester (50 μm)	21.5 dB		4.5 dB / 20 Km		
SM	1310, 1550 (VFL) nm	47 dB	0.04 dB	30 dB / 128 Km		
SM	1310, 1490, 1550, (VFL) nm 1310, 1550, 1625 (VFL) nm	44 dB	0.04 dB	27 dB / 128 Km		
SM	1310, 1550 nm, VisiTester	44 dB	0.04 dB	27 dB / 128 Km		
SM	1310, 1490, 1550, nm, VisiTester 1310, 1550, 1625 nm, VisiTester	41 dB	0.04 dB	24 dB / 128 Km		
SM	1310, 1490, 1550, 1625 (VFL) nm	41 dB	0.04 dB	24 dB / 128 Km		

Note 1: Up to 3 dB above optical measuring loss limit. Cable ORL variation and fiber/cable length mismatch are typically dominant

### One-way Autotest specifications:

Fiber Type	Wavelengths	Loss Range	Loss Repeatability / Linearity
MM	850, 1300 nm (62.5 μm)	27 dB	0.06 dB
	850, 1300 nm (50 μm)	24.5 dB	
MM	850, 1300 nm, VisiTester (62.5 μm)	24 dB	0.06 dB
	850, 1300 nm, VisiTester (50 μm)	21.5 dB	
SM	1310, 1550 nm	47 dB	0.04 dB
SM	1310, 1490, 1550, nm 1310, 1550, 1625 nm	44 dB	0.04 dB
SM	1310, 1550 nm, VisiTester	44 dB	0.04 dB
SM	1310, 1490, 1550, nm, VisiTester 1310, 1550, 1625 nm, VisiTester	41 dB	0.04 dB
SM	1310, 1490, 1550, 1625 (VFL) nm	41 dB	0.04 dB



# SPECIFICATIONS

## Optical Power Meter:

Response $\lambda$ Nm	Damage level dBm	Calibration $\lambda$ nm	Power range dBm	Tone & Autotest Min dBm	Midrange linearity <sup>2</sup> dB	Calibration Accuracy <sup>3</sup> %	Polarization Sensitivity <sup>5</sup> dB	$\lambda$ Sensitivity $\pm 30 \text{ nm}^4 \text{ dB}$
InGaAs detector								
600 ~ 1700	+15	780, 820, 850, 980 1270, 1290, <b>1300, 1310, 1330,</b> <b>1350, 1370, 1390, 1410, 1430,</b> <b>1450, 1470, 1490, 1510, 1530,</b> <b>1550, 1570, 1590,</b> 1610, 1625, 1650	+10 ~ -60 +10 ~ -70	-45 -50	0.04	1 % (0.06 dB)	< 0.05	0.2
Typical							Typical	typical

Note 2: Mid-range linearity excludes top 5 dB and bottom 10 dB of range.

Note 3: Calibration condition: non coherent light, -35±5 dBm, 23±1°C, ±0.5 nm, 20±3 nm FWHM, PC ceramic connector, 50 μm fiber.

Note 4: At calibration wavelengths in bold type.

Note 5: For APC connector only.

## SPECIFICATIONS

### Optical Light Source:

	1310 / 1550 nm F-P Laser	1490 / 1625 nm CWDM <sup>6</sup> Laser	650 nm VisiTester	850 / 1300 nm LED	Comments
Power accuracy	± 1 dB (for Laser & VisiTester @ SMF, LED @ 62.5 μm)				Refer to ORDERING INFORMATION for specific model's nominal power level.
Short term stability (dB) 27400 <sup>7</sup> / 23400 <sup>8</sup>	0.04 / 0.03	0.06 / 0.04	NA	0.01	
Stability over temp (dB) 27400 / 23400	0.6 / 0.2	0.6 / 0.2	NA	0.35	Typical / Max
λ initial tolerance (nm)	20	6.5	5	NA	At 25 °C
λ width, nm	3	< 1	3	NA	FWHM, typical
λ nm/°C	0.4	0.1	0.1	0.4	Typical
Mode Controlled Source	NA	NA	NA	Mode controlled	50/125 compliant: IEC 61280-4-1 {Ed.1.0}, TIA/EIA 526-14A & TIA TSB-178.
Reconnection repeatability (dB)	0.1	0.1	0.1	0.05	95 % confidence
Laser output power	Adjustable over 7 dB in 0.01 dB steps			NA	
Modulation	270 Hz, 1 kHz, 2 kHz ± 2 %, 12 Multi-Fiber ID tones, 2 Hz blink for VisiTester				

Note 6: CWDM laser wavelengths: 1270, 1290, (1310), 1330, 1350, 1370, 1390, 1410, 1430, 1450, 1470, 1490, 1510, 1530, (1550), 1570, 1590, 1610 nm

Note 6: For 15 min, typ. ± Δ 2°C, after warmup, ORL < -25 dB

Note 8: For 15 min, max, ± Δ 3°C

## SPECIFICATIONS

### VisiTester:

Parameters	Values
Wavelength (nm)	650 ± 5
Power (dBm)	0 ± 1 @ SM / MM fiber
Laser Safety	Class 1, IEC60825-2 Ed 4, 2021
Blink rate (manual)	CW or 2 Hz

### ORL:

Parameters	Laser		LED
	1 or 2 λ	3 or 4 λ	
Range <sup>9</sup>	0 ~ >60 dB	0 ~ >57 dB	0 ~ >30 dB (62.5 μm) 0 ~ >27.5 dB (50 μm)
Port isolation / residual <sup>9</sup>		>50 dB	> 20 dB
ORL linearity <sup>9</sup>	0.1 dB 55 ~ 60 dB: 1 dB after zero offset	0.1 dB 52 ~ 57 dB: 1 dB after zero offset	0.1 dB 22.5 ~ 30 dB: 1 dB after zero offset
ORL calibration accuracy <sup>10</sup>	0.2 dB	0.2 dB	0.2 dB
Resolution	0 ~ 50 dB: 0.01 dB 50 ~ 65 dB: 0.1 dB	0 ~ 45 dB: 0.01 dB 45 ~ 60 dB: 0.1 dB	0 ~ 30 dB: 0.01 dB 30 ~ 45 dB: 0.1 dB
λ available	See source options in LIGHT SOURCE SPECIFICATIONS		

Note 9: Instruments with PC connectors will have reduced ORL range due to ORL limitations of the PC connector, typically around 40 dB. We suggest an APC instrument connector is always preferable unless low-range ORL measurements are acceptable.

Note 10: Under calibration conditions: ORL of approximately 14.5 dB, 25 °C.

# ORDERING INFORMATION

## Ordering Information

Description	Source Power (dBm) @ Fiber Type (μm)					Ports	P/N (Tempo P/N with prefix "T", Kingfisher P/N with prefix "KI")
	Laser	LED			VisiTester / VFL		
		SMF	SMF	50			
Refer to LIGHT SOURCE SPECIFICATIONS for Power Accuracy specifications							
<b>27400 series: Loss Testing</b>							
Instrument, LTS-2W 1310-1550-1625 nm Laser APC, InGaAs	-7	-	-	-	-	2	27410-InGaAs-APC
Instrument, LTS-2W 850-1300 nm LED, 1310-1550 nm Laser, InGaAs	-3	-35	-25.5	-23	-	3	27424-InGaAs
Instrument, LTS-2W 850-1300 nm LED, 1310-1550 nm Laser APC, InGaAs	-3	-35	-25.5	-23	-	3	27424-InGaAs-APC
<b>27400 series: Loss Testing, Length, VisiTester (depends on model)</b>							
Instrument, LTS-2W Length VisiTester, 850-1300 nm LED, InGaAs	-	-39	-29.5	-27	0	2	27403LV-InGaAs
Instrument, LTS-2W Length VisiTester, 1310-1550 nm Laser, InGaAs	-7	-	-	-	0	2	27422LV-InGaAs
Instrument, LTS-2W Length VisiTester, 1310-1550 nm Laser APC, InGaAs,	-7	-	-	-	0	2	27422LV-InGaAs-APC
Instrument, LTS-2W Length VisiTester, 1310-1550-1625 nm Laser APC, InGaAs	-10	-	-	-	0	2	27410LV-InGaAs-APC
Instrument, LTS-2W Length VisiTester, 1310-1490-1550-1625 nm Laser APC, InGaAs	-7	-	-	-	0	2	27416LV-InGaAs-APC
Instrument, LTS-2W Length VisiTester, 850-1300 nm LED, 1310-1550 nm Laser, InGaAs	-7	-39	-29.5	-27	0	3	27424LV-InGaAs
Instrument, LTS-2W Length VisiTester, 850-1300 nm LED, 1310-1550 nm Laser APC, InGaAs	-7	-39	-29.5	-27	0	3	27424LV-InGaAs-APC
Instrument, LTS-2W Length VisiTester, 850-1300 nm LED, 1310-1490-1550-1625 nm Laser APC, InGaAs	-7	-35	-25.5	-23	-	3	27425LV-InGaAs-APC
<b>23400 series: Loss, Length, ORL, VisiTester or VFL (depends on model), Ultra Stable (U/S, depends on model)</b>							
Instrument, LTS-2W ORL Length VisiTester, 850-1300 nm LED APC, InGaAs	-	-39	-29.5	-27	0	2	23403OLV-InGaAs-APC
Instrument, LTS-2W ORL Length VisiTester, 850-1300 nm LED APC, 50 μm, Ge	-	-39	-29.5	-27	0	2	23403OLV-InGaAs-APC-50U
Instrument, LTS-2W ORL Length VisiTester, 1310-1550 nm U/S Laser, InGaAs	-7	-	-	-	0	2	23422OLV-InGaAs
Instrument, LTS-2W ORL Length VFL, 1310-1550 nm U/S Laser APC, InGaAs	-3	-	-	-	0	3	23422OLF-InGaAs-APC
Instrument, LTS-2W ORL Length VFL, 1310-1490-1550 nm U/S Laser APC, InGaAs	-7	-	-	-	0	3	23427OLF-InGaAs-APC
Instrument, LTS-2W ORL Length VFL, 1310-1550-1625 nm U/S Laser APC, InGaAs	-7	-	-	-	0	3	23410OLF-InGaAs-APC
Instrument, LTS-2W ORL Length VFL, 1310-1490-1550-1625 nm U/S Laser APC, InGaAs	-7	-	-	-	0	3	23416OLF-InGaAs-APC
Instrument, LTS-2W ORL Length, 850-1300 nm LED APC, 1310-1550 nm U/S Laser APC, InGaAs	-3	-38	-25.5	-23	-	3	23424OL-InGaAs-APC

## ORDERING INFORMATION

### Standard Accessories:

SC, LC, ST(for models with LED light source only) metal-free optical connector adaptors, KITS™ PC software (downloadable free from Kingfisher's website), USB cable, user manual, ILAC/ NATA traceable calibration certificates, carry pouch, carry strap, mandrel wrap set (for models with MM light source only), optical terminators (for models with ORL capability only), PC-to-APC test lead (for models with ORL capability only).

### Optical Connectors:

These instruments have interchangeable optical connectors. The power meter works with both PC and APC connectors. The light source ferrule type is fixed, and customer specified as either PC or APC. Green is associated with APC connectors.

### Optional Interchangeable Connector Adaptors:

Description	P/N	Description	P/N
E2000/LSH, blue	<b>OPT060</b>	D4	<b>OPT055</b>
E2000/LSH, green	<b>OPT060G</b>	Universal 2.5mm	<b>OPT081</b>
LSA/DIN 47256	<b>OPT071</b>	SMA 905/906	<b>OPT082</b>
LC / SC, metal body	<b>OPT076</b>	FC	<b>OPT051</b>
MU	<b>OPT080</b>	ST	<b>OPT040</b>
Universal 1.25 mm	<b>OPT084</b>	F3000 or LC Simplex	<b>OPT072</b>

### Optional Accessories:

Description	P/N
Option, Carry Case for 2 Instruments	<b>OPT153</b>
Option, Carry Case includes Cletop-style cleaner & Cleaning Sticks	<b>OPT154B</b>

Refer to product brochures on our website, [www.kingfisherfiber.com](http://www.kingfisherfiber.com) for Standard Accessories of specific instrument model, and the available optional accessories & optional interchangeable connector adaptors.

# CALIBRATION AND MAINTENANCE

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## Calibration & Maintenance

There are no internal user adjustments. Calibration is performed without opening the instrument. The optical sensor / connector assembly is not user serviceable.

Before commencing calibration:

- Ensure that all devices have been at a stable room temperature for over an hour, and that the light source is fully warmed up at the  $\lambda$  to be calibrated.
- Ensure that the equipment used for calibration has current calibration certificates etc to match your needs.
- Ensure that all patch leads are in good condition, Clean all optical connectors very carefully.
- Note that if using laser or LED sources, the calibration accuracy will be inferior to the method used by Kingfisher. Please use an APC connector into the power meter, to avoid line reflections.

Note: instrument is powered externally during calibration.

Perform calibration as per instructions below. When calibration is completed, place an anti-tamper label over the calibration contact's hole. Do not forget to update your calibration records and to schedule the next calibration service.

### Power Meter Calibration

Calibration is a transfer process. It is performed by setting up a light source at a stable, but non-critical power level between 0 and -30 dBm and adjusting the meter reading to the same value as that shown by a reference meter.

Required are laser and LED light sources with accurate, calibrated  $\lambda$  and good power stability, a power meter with appropriate calibrated  $\lambda$ , single mode and multimode test leads. Check the calibration certificates on your reference equipment to ensure current validity.

Known calibration constants can be re-entered directly without using other equipment. This is useful in case old calibration constants are to be put back.

Record the existing calibration offsets, re-enter, or adjust known offsets at this point or calibrate the meter at the selected  $\lambda$  as follows:

- Remove batteries, connect to external USB power
- Using tweezers, place a link across gold plated calibration contacts inside battery compartment, Figure 2. Turn on external power via micro USB.

## CALIBRATION AND MAINTENANCE

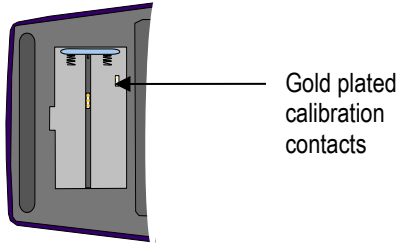


Figure 2. Link has to be placed across gold plated calibration contacts

- Press - or + to set the  $\lambda$  to be calibrated.
- Record the light source power measured by reference power meter.
- Transfer this power level to the meter to be calibrated.
- To modify calibration, press **F3** or **F4**.
- To save new calibration setting, press [Set Ref].
- To cancel unsaved changes, press [Home].

### Light Source Calibration

The emitter power level is adjusted to match the output level displayed on the LCD, and the device current can be checked.

Required are reference power meter with appropriate calibrated  $\lambda$ , single mode and multimode test leads. Check the calibration certificates on your reference equipment to ensure current validity.

Calibrate the source at the selected  $\lambda$  as follows:

- Remove batteries, connect to external USB power.
- Using tweezers, place a link across gold plated calibration contacts inside battery compartment, Figure 2. Turn on external power via micro USB.
- Press **F1** to select source calibration.  
Press + or - to set the  $\lambda$  to be calibrated. Measure light source power using the reference meter.
- Set the emitter power to the required level by pressing **F3** or **F4**.
  - Press **F2** to save new value.
  - To return to main calibration menu, press [Home]
  - To cancel unsaved changes, press [Toggle centre] or [Home].
  - Repeat the above process for any additional  $\lambda$  if required.

**CAUTION!** Do not open instrument unless warranty has expired and you are authorised to do so. Opening the unit will invalidate any warranty claim.

**CAUTION!** This unit contains static sensitive devices. Anti-static handling procedures should always be observed when handling internal circuits.

**WARNING!** Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

## PERFORMANCE VERIFICATION TESTS

---

### Performance Verification Tests

All tests can be performed without access to the interior of the instrument.

The test procedures described in this section are for performance verification of a 23400 & 27400 series 2-way Loss Test Set (LTS) with ORL, length measurement capabilities on specific models.

Due to the large number of possible instrument configurations, it is not possible to give detailed test procedures for all options in this manual, so some parameters may need adjusting to the appropriate specifications.

**Required Equipment** This is the required equipment for the performance test listed. Any equipment that satisfies the critical specifications of the equipment given in the table may be substituted for the recommended models.

**Test Record** Results of the performance test may be tabulated on a photocopy of the Test Record provided at the end of this test procedure. It is recommended that you fill out the Test Record and refer to it while doing the test. Alternatively, a soft copy of this manual may be obtained from our web site.

**Test Failure** If the equipment under test fails any performance test, return the instrument to the nearest Sales/Service Office for repair.

**Instrument Specification** Specifications are the performance characteristics of the instrument that are certified and are the limits against which the equipment under test can be tested.

Any changes in the specifications due to manufacturing changes, design will be covered in a manual change supplement or revised manual. Such specifications supersede any that were previously published.

#### General Instructions

Perform each step in the order given, using the corresponding test equipment. Use Tables 1 ~ 3 to record general test details.

The SMF / MMF test lead fiber type and PC / APC connector polish must be matched to the instrument type.

Make sure that all optical connections are dry and clean. **DO NOT USE INDEX MATCHING OIL.** For cleaning, use the cleaning instructions given in the section 'Optical Connector'.

Make sure that all patch cords are fixed to the table so that they will not move during measurements.

Ensure that the ambient conditions are in the following ranges:

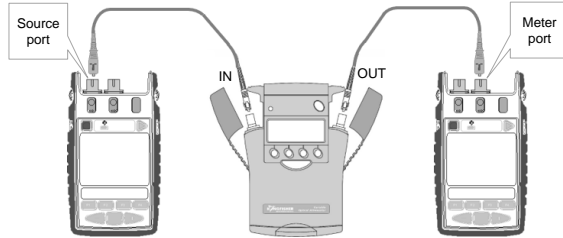
Temperature:  $23 \pm 3$  °C  
Relative humidity: 45 to 75 %



## PERFORMANCE VERIFICATION TESTS

### Power Meter Accuracy Test

1. Connect the equipment as shown in Figure 8:



Source Attenuator Power Meter/DUT

Figure 8. Test set-up for the Power Meter section Accuracy Test

2. Switch on all instruments.
3. Set all instruments to 1310 nm.
4. Change the attenuation of the attenuator until the reference power meter displays -10.00 dBm. Note the attenuator setting in row, *Setting 1* of Table 4. If the light source is not powerful enough to give -4.00 dBm, set the attenuator to 2.5 dB and correct the appropriate values in the test report.

Repeat the above for reference power meter readings of -20dBm, -30 dBm, -40 dBm and -50 dBm (last reading is not relevant to H series power meters).

5. Measure the DUT:

Re-connect the attenuator output cable to the DUT power meter port and, select the 1310nm on DUT.

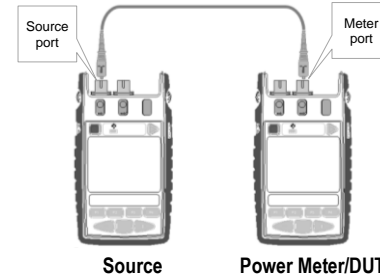
Set the attenuator to its value recorded in row, *Setting 1* of Table 4. Note the displayed power level of the DUT in the test record.

Repeat the above for attenuator settings in rows, 2~5 of Table 4.

4. Repeat the Power Meter Accuracy Test at 1550 nm.

### Light Source Output Power (CW) Test

1. Connect the equipment as shown in Figure 9.



Source Power Meter/DUT

Figure 9. Test set-up for Output Power & Short-term Stability Tests

2. Switch on the instruments.
3. Set instruments to 1310 nm.
4. Note the measured power level value in the test report in Table 5.
5. Repeat the above on 1550 nm.

## PERFORMANCE VERIFICATION TESTS

---

### Short Term Stability Test (optional)

1. Connect the equipment as in Figure 9 (previous page).
2. Set instruments to 1310 nm.
3. Let the light source to warm-up for 15 minutes, then note the power.
4. Record the optical power every 30 seconds for 3 minutes.
5. Calculate max – min value (< 0.1 dB).
6. Note this figure in Table 5.

Alternatively, the instrument max/min recording function can be used to record the data.

Note: The same instructions apply to Short Term Stability Test on 850/1300 nm Light Sources. For improved stability, mandrel wraps should be used in the case of 850/1300nm.

### Centre $\lambda$ and Spectral Bandwidth (FWHM) Test (optional).

1. Connect the equipment as shown in Figure 10 (next page).
2. Switch on the instruments and allow to fully warm up.
3. On Light Source, enable the source and set the  $\lambda$  to 1310 nm.
4. On the OSA, press the [Instr Preset] key.

Time	Measured power, dBm	Drift, dB	Tick max / min values
00 sec		0.00	
30 sec			
60 sec			
90 sec			
120 sec			
150 sec			
180 sec			

## PERFORMANCE VERIFICATION TESTS

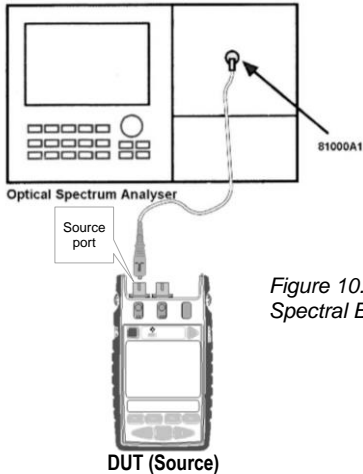


Figure 10. Centre  $\lambda$  and Spectral Bandwidth tests

5. Press [Auto/Meas] and wait until 'End of Automeasure' is displayed.
6. Choose [User] and select the type of source to be measured (FP for Fabry Perot laser).
7. To show the display in linear mode:
  - a. Press [Menu].
  - b. Press [Amptd] on the left side of the display.
  - c. Press [Linear] on the right side of the display.
8. To ensure interference-free reading of the display it is advisable to stop the repeating calculations.
  - Press [User].

- Press [Single Sweep].

If the trace on the display is not clear, you can change resolution by using the span key.

9. From the displayed measurements check and note the values for "Centre  $\lambda$ " and "FWHM" (Spectral Bandwidth) in Table 6.
10. Repeat the test with the DUT  $\lambda$  set to 1550 nm

### Two Way Autotest

Tests described below allow checking calibration accuracy, range and linearity for the pair of instruments.

### Two Way Calibration Accuracy Test

1. Connect the instruments as shown in Figure 11, using one test lead per instrument:

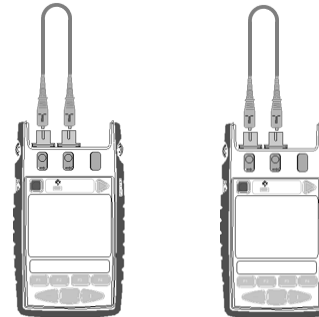


Figure 11. Reference set up for Two Way Calibration Accuracy Test

## PERFORMANCE VERIFICATION TESTS

2. Switch on each instrument and press [Autotest], [Abs / Rel], then [Set Ref] for 3 seconds. The displays should read approximately 0.00 dB
3. To check accuracy, remove the test lead on one instrument and re-connect the other test lead as in Figure 12.
4. The displays should now read between -0.50 and 0.50 dB for all source  $\lambda$ . Note the maximum displayed value for each  $\lambda$  in Table 7.

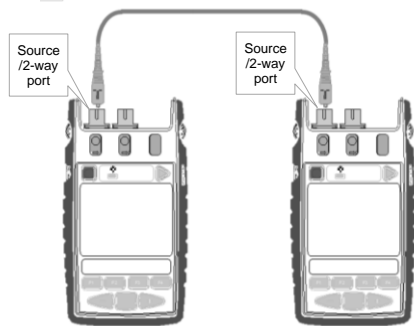


Figure 12. Test set up for Two Way Calibration Accuracy Test

**Note:** ensure your patch leads are clean and in good working order.

## Two Way Range and Linearity Test

1. Connect the equipment as shown in Figure 13.

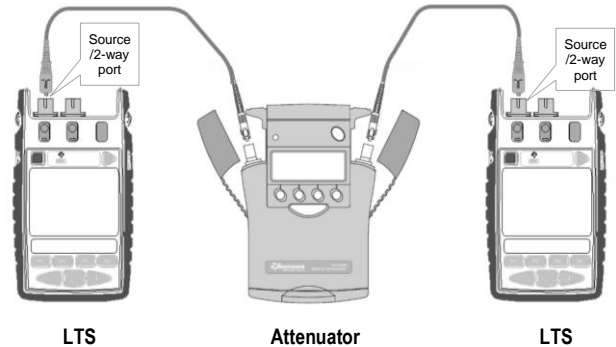


Figure 13. Test set up for Two Way Range and Linearity Test

2. Switch on all instruments.
3. Set the Light Source on one of the instruments to 1310nm and allow to warm up. Press [Autotest].
4. On the attenuator, set the  $\lambda$  to 1310nm and attenuation to 5 dB.
5. Make sure that Autotest is updating. Note the measured optical power at 1310 nm. Note meter reading in Table 7.
6. For single mode instruments, repeat the power readings for attenuator settings of 15 dB, 25 dB and 35 dB. For instruments

## PERFORMANCE VERIFICATION TESTS

with H series meter, repeat the readings for an attenuator setting of 15 dB only.

7. For multimode instruments, repeat the power readings for attenuator settings of 15 dB, 20 dB.
8. Repeat the above for 1550nm as required, however, this test typically only needs performing at one  $\lambda$ .

### One Way Autotest

#### One Way Range and Linearity Test

Test described below allows checking One Way Autotest range and linearity for one loss test set and verifies tone detector operation. To test power meter absolute accuracy and linearity, refer to Accuracy Test, Power Meter Section.

1. Connect the equipment as shown in Figure 14. A single LTS can also be used, with connections to both ports.

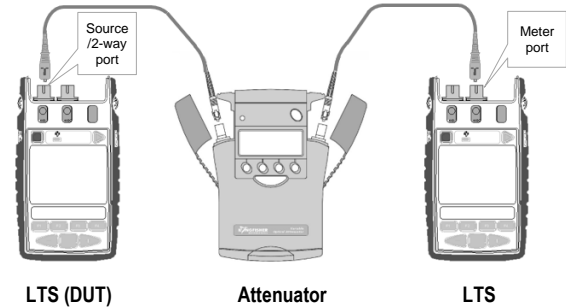


Figure 14. Test set up for One Way Range and Linearity Test

2. Switch on all instruments.
3. Set the Light Source to 1310nm and allow to warm up. Press [Autotest].
4. On the attenuator, set the  $\lambda$  to 1310nm and attenuation to 5 dB.
5. Make sure that Autotest is updating. Note the measured optical power at 1310 nm in Table 7.
6. For singlemode instruments, repeat the power readings for attenuator settings of 15 dB, 25 dB and 35 dB. For instruments with H series meter, repeat the readings for an attenuator setting of 15 dB only.
7. For multimode instruments, repeat the power readings for attenuator settings of 15 dB, 20 dB.
8. Repeat the above for 1550nm as required, however, this test typically only needs performing at one  $\lambda$ .

## PERFORMANCE VERIFICATION TESTS

### Length measurement

1. Connect the instruments as shown in Figure 15A.

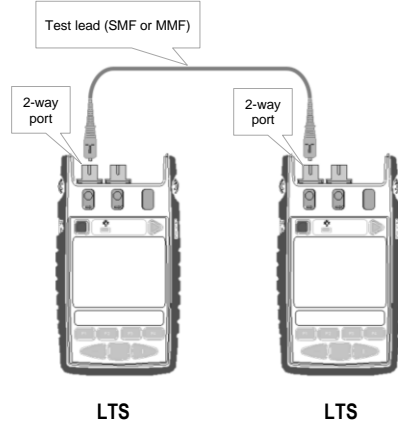


Figure 15A. Test set up for length measurement referencing

2. Switch on each instrument and press [Autotest], [Abs / Rel], then [Set Ref] for 3 seconds. The displayed length measurement should read 0 meter.

3. Disconnect one end of the test lead, reconnect it to a fiber spool (SMF or MMF as appropriate with expected length) via a thru adaptor and, connect the other end of fiber-spool to the other LTS, see Figure 15B.

4. Note the displayed length readings on both LTS, they should be within  $1\% \pm 9$  m of the fiber-spool's expected length.

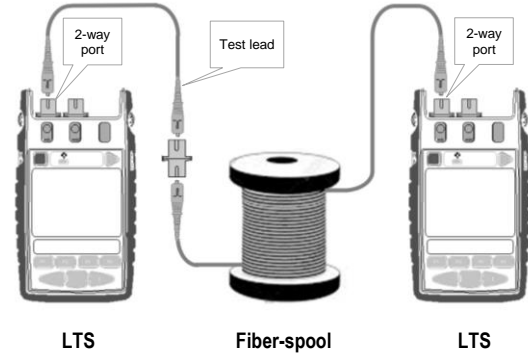


Figure 15B. Test set up for length measurement accuracy verification

### Optical Return Loss

#### ORL Verification Test for K23400 series instrument with PC connector, ORL port

For this test you will need standard accessories supplied with the unit:

- PC/APC test lead, single mode

## PERFORMANCE VERIFICATION TESTS

- PC Low Reflection Terminator
- APC Low Reflection Terminator

1. Very carefully, clean all the optical connectors to be used, including ORL port of the instrument.
2. Re-set the meter to factory ORL defaults, refer to *Reset User Calibration (UCAL) offset & Zero Function (Noise Floor) to factory defaults* section in Quick Reference Guide. To display ORL, press [Return Loss] (F2) at Home menu and [-/+ ] to select the active  $\lambda$ , e.g. 1310nm.
4. With nothing connected to the ORL port, note the reading:  
reading between -13.76 dB RL and -14.76 dB RL is within calibration specification. This is ORL measured on instrument connector.

Repeat this step for 1550nm

5. Plug the PC Low Reflection Terminator into the ORL port and note down the reading.  
For single mode instruments, reading between -35 and 'Lo' dB RL indicates terminator and instrument are working correctly.
6. To verify the supplied PC-APC test lead and APC Low Reflection Terminator, plug the PC end of the test lead into the ORL port and the APC terminator into the far end of the test lead.

The reading should meet limits for single mode instruments specified in step 5 above.

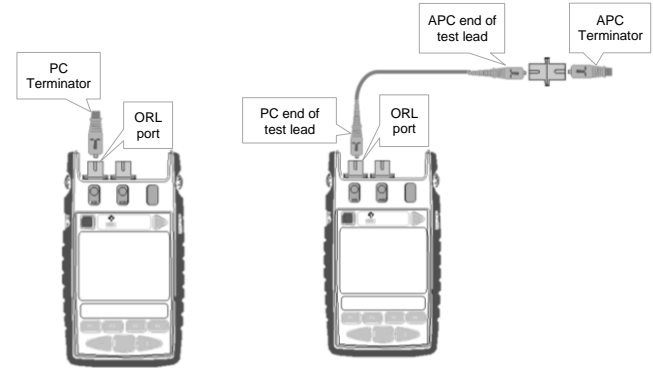


Figure 16A. Test set up for ORL verification test

### ORL Verification Test for 23400 instrument with APC connector, ORL port

For this test you will need standard accessories supplied with the unit:

- PC/APC test lead, multimode or single mode
- PC Low Reflection Terminator
- APC Low Reflection Terminator

1. Very carefully, clean all the optical connectors to be used, including ORL port of the instrument.

## PERFORMANCE VERIFICATION TESTS

2. Re-set the meter to factory ORL defaults: refer to *Reset User Calibration (UCAL) offset & Zero Function (Noise Floor) to factory defaults* section in Quick Reference Guide.
3. Plug the APC end of the patch lead into the ORL port. To display ORL, press [Return Loss] (F2) at Home menu and [-/+ ] to select the active  $\lambda$ , e.g. 1310nm.
4. With test lead's APC end connected to ORL port, note the reading:  
A reading between -13.26 dB RL and -15.26 dB RL for SMF and -13.15 dB RL and -15.15 dB RL for MMF is within calibration specification. This is ORL measured on PC end of the test lead.  
Repeat this step for 1550 nm.
5. Plug the APC Low Reflection Terminator into the ORL port and, note the reading.  
For single mode instruments, reading between -50 and 'Lo' dB RL indicates terminator and instrument are working correctly.  
For multimode instruments, reading between -35 and 'Lo' dB RL indicates terminator and instrument are working correctly.
6. To verify the supplied PC-APC test lead and PC Low Reflection Terminator, plug the APC end of the test lead into the ORL port and the PC terminator into the far end of the test lead.  
For single mode instruments, reading between -35 and 'Lo' dB RL indicates the terminator, patch lead and instrument are working correctly.

For multimode instruments, reading between -20 dB and 'Lo' RL indicates the terminator, patch lead and instrument, are working correctly.

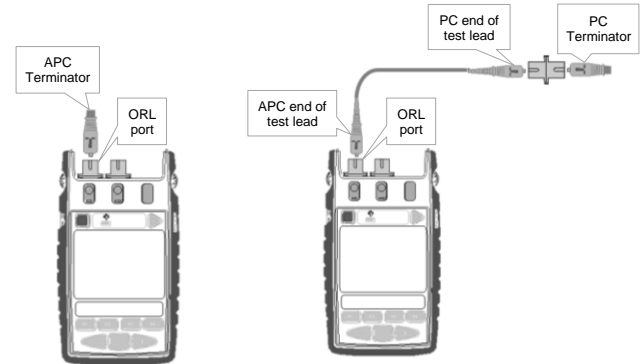


Figure 16B. Test set up for ORL verification test



## PERFORMANCE VERIFICATION TESTS

### Required Equipment

Instrument / Accessories	Recommended Model	Required Characteristics	Alternative Model
Optical Light Source	2822		
Optical Power Meter	2600-InGaAs		
2-way Loss Test Set	27422-InGaAs		
2-way Loss Test Set (with length only)	27422LV-InGaAs		
2-way Loss Test Set (with Length + ORL)	23422OLV-InGaAs		
Optical Attenuator	7010B		
Connector adaptors	OPT046		
SMF patch leads			
<b>For optional test only</b>			
Optical Spectrum Analyser	Agilent 86140B		Any equivalent model
Connector Adaptors			
SMF patch leads			

**Table 1: Required Equipment Record**

# PERFORMANCE VERIFICATION TESTS

## General Test Records

Model:		Date:
Serial No.:		Ambient Temperature: °C
Options:		Relative Humidity: %
Firmware Revision:		Line Frequency: Hz
Test Facility:		Customer:
Performed by:		Report No.:
Special Notes:		

**Table 2: General Record**

## PERFORMANCE VERIFICATION TESTS

Description		Model No.	Trace No.	Calibration due date
1.	Optical Light Source			
2.	Optical Power Meter			
3.	Optical Attenuator			
4.	Loss Test Set			
5.				
6.				
7.				
8.				
9.				
10.				

Accessories: SMF patch leads, Connector adaptors

**Table 3: Equipment Record for Performance Verification Tests**

# PERFORMANCE VERIFICATION TESTS

Model:

Report No.:

Date:

Total Uncertainty / Accuracy Test							
	Test Wavelength =                      nm						
Setting Number	Power Meter reference value	Attenuator Setting		Minimum specification (-0.3 dB of Ref.)	DUT measurement results		Maximum specification (+0.3 dB of Ref.)
1.	(~-10.00 dBm)		dB	(~-10.30 dBm)		dBm	(~-9.70 dBm)
2.	(~-20.00 dBm)		dB	(~-20.30 dBm)		dBm	(~-19.70 dBm)
3.	(~-30.00 dBm)		dB	(~-30.30 dBm)		dBm	(~-29.70 dBm)
4.	(~-40.00 dBm)		dB	(~-40.30 dBm)		dBm	(~-39.70 dBm)
5.	(~-50.00 dBm)		dB	(~-50.30 dBm)		dBm	(~-49.70 dBm)
Measurement Uncertainty						dB	

**Note 1:** This is for the 2600-InGaAs. For the H series instruments, increase by  $\pm 0.2$  dB.

**Table 4: Accuracy Test Record for 273400/27400 Series, Power Meter section**

## PERFORMANCE VERIFICATION TESTS

<b>Model:</b>	<b>Report No.</b>		<b>Date:</b>	
---------------	-------------------	--	--------------	--

### Output Power (CW) Test

Wavelength	Minimum Specification	DUT Measurement Results	Maximum Specification
1310 nm	-1.00 dBm	_____ dBm	
1550 nm	-1.00 dBm	_____ dBm	
Measurement Uncertainty		_____ dB	

### Short-Term Stability Test (optional)

1310 nm	_____ dBpp	(0.10 dBpp) 0.04 dBpp typical
1550 nm	_____ dBpp	(0.10 dBpp) 0.04 dBpp typical
Measurement Uncertainty	_____ dB	

**Table 5. Output Power Test and Short-term Stability Test Record for Source of 23400/27400 Series**

## PERFORMANCE VERIFICATION TESTS

<b>Model:</b>		<b>Report No:</b>		<b>Date:</b>	
<b>Central Wavelength &amp; Spectral Bandwidth (FWHM) Test (optional)</b>					
Wavelength		Minimum Spec.	DUT Measurement Results		Maximum Spec.
<b>Centre wavelength</b>					
1310 nm		1290 nm	_____ nm		1330 nm
1550 nm		1530 nm	_____ nm		1570 nm
<b>Spectral Bandwidth (FWHM)</b>					
1310 nm			_____ nm		(6nm) 3 nm typical
1550 nm			_____ nm		(6nm) 3 nm typical
Measurement Uncertainty			_____ dB		

**Table 6. Central wavelength Test Record for Source of 23400/27400 Series**

# PERFORMANCE VERIFICATION TESTS

<b>Model:</b>		<b>Instrument Connector:</b> APC [ ] PC [ ]		<b>Report No.:</b>	<b>Date:</b>
<b>Calibration Test</b>					
Wavelength		Acceptable Range		Measurement Results	
1310 nm		-0.5 to +0.5 dB		_____ dB R	
1550 nm		-0.5 to +0.5 dB		_____ dB R	
				_____ dB R	
				_____ dB R	
				_____ dB R	

Fiber Type: Singlemode [ ]

Multimode [ ]

<b>Linearity and Range Test</b>				
No	Attenuator setting	Meter Reading	Linearity Calculation	Acceptable Linearity Range <sup>1</sup>
1	5.00 dB		-	9.50 ~ 10.50 4.50 ~ 5.50 / 9.50 ~ 10.50 9.50 ~ 10.50
2	15.00 dB		No 2 – No 1 =	
3	20.00 / 25.00 dB		No 3 – No 2 =	
4	35.00 dB		No 4 – No 3 =	

Note1: The linearity range here is typically limited by attenuator linearity, rather than instrument performance

**Table 7: Test Record for Two Way /One Way Autotest Performance Verification Tests, 23400/27400 Series**

# PERFORMANCE VERIFICATION TESTS

Model:		Instrument Connector		Report No.:	Date:
		APC [ ]	PC [ ]		
<b>ORL Calibration Test</b>					
Wavelength	Acceptable Range	Measurement Results			
1310 nm	<b>PC:</b> -13.76 ~ -14.76				dB R
1550 nm	<b>APC:</b> -13.26 ~ -15.26				dB R
					dB R
					dB R
					dB R
<b>Residual Light Test</b>					
APC Connector, SMF	-50 ~ 'Lo'				dB R
PC Connector, SMF	-35 ~ 'Lo'				dB R
					dB R
					dB R

**Table 8. Test Record for ORL Verification Test, 23400 Series**



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### Quick Reference Guide

#### General Operation:

- To remove interchangeable connector adaptor, press button on front of case and pull off adaptor. This may be easier with a test lead attached.
- To turn instrument on / off, press **On/Off**.
- Low battery is indicated with a battery symbol.
- To turn back light on / off, press Backlight button.
- To disable auto-off *at turn-on*, hold **On/Off** for 3 seconds until 'Perm' is displayed.
- To disable or activate beeping *at turn-on*, hold **F2** then press **On/Off**, "beep" displays.
- To enter Slow Mode *at turn-on*, hold down **F3** then press **On/Off**, "tone" displays.
- To view firmware version and instrument serial number *at turn-on*, hold **F4** then press **On/Off**.
- To view all display segments *at turn-on*, press and hold **On/Off**, **F1** at the same time until it stops beeping.
- To set time & date, when instrument is off, hold down **Toggle Centre** then press **On/Off**. Press - or + to modify the selected (flashing) item. Press **Toggle Centre** to change selected item. Press **F2** to save new time and date settings. Press **F1** to exit without saving new settings.

- To enter Meter menu, press **F3**.
- To enter Memory menu, press button above [MEMORY].
- To return to Home menu, press **F1**.

#### Meter Menu:

- To enter Meter menu at Home menu, press **F3**.
- To select operational  $\lambda$  in Meter mode, press - or +.
- To toggle log / linear display mode, press **F3**.
- To display max and min values for absolute power and loss, press - and + simultaneously. To return to standard display, press - and + simultaneously again.
- To set reference, toggle to dB mode, then hold down **F2** for 3 seconds until the instrument beeps finish
- To stop / start display update, press **F4**.
- If a test tone is detected, meter will display 'Hz'.
- To store to memory press triangular button above [STORE].
- To return to Home menu, press **F1**.

#### Source Menu:

- To enter Source menu at Home menu, press **F1**.
- To select operating  $\lambda$ , press - or +.
- To turn source on and off, press **Toggle Centre**.
- [Laser source only] To change power level, press and hold **F2** then use - or + (not applicable to LED sources). To toggle

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between max and min power levels, hold **F2** then press **Toggle Centre**.

- To select modulation while source is on, press and release **F3**. Repeatedly press this button to scroll & select a tone frequency or ID-tone. Alternatively, press and hold **F3** then use - or + to cycle through all options.
- To end modulation, press and hold **F3** then press **Toggle Centre**. Alternatively, press and hold **F3** for 3 sec.
- To return to Home menu, press **F1**.

### Return Loss Menu:

- At Home menu, press **F2** to enter ORL menu.
- To select operating  $\lambda$ , press - or +.
- To enter UCAL offset setting mode, press **F3** [see quick reference guide section for User Calibration (UCAL)].
- To enter Zero Function setting mode, press **F3** again [see quick reference guide section for Zero Function].
- To exit ORL menu, press **F1** to return to Home menu.

### Autotest Operation:

- [1-way Autotest only] To start Autotest, press **F4** of the instrument connected at the source end of a fiber.
- [2-way Autotest] To start Autotest, press **F4** on either one of the connected instruments.

- [1-way Autotest only]: To toggle display to show *absolute-power(dBm)/loss(dB)/reference-power(dBm)* or *absolute-power in both dBm & watt*, press **F3** repeatedly.

To show sources' nominal power levels, hold down **Toggle Centre**.

- [2-way Autotest only]: When Autotest starts, a *Test Summary* showing losses (dB) of each direction, their averages and, optional cable length measured is displayed.

To change to display *Detail Test* showing absolute-power (dBm), loss (dB), reference-power (dBm) of each direction, press **F3**. Press - or + to show data for other active wavelengths. At this display, hold down **Toggle Centre** to show sources' nominal power levels.

To change from showing *Test Detail* to optional *ORL test*, press **F3**. Press - or + to show ORL data for other active wavelengths.

Press **F3** again now will return display to show *Test Summary*.

- To set reference (for loss and optional length tests only), press and hold **F2** for 3 seconds until beeps stop. The reference will then update over the next few seconds.
- To stop / restart display update, press **F4**.
- [1-way Autotest only]: To end Autotest, press **F1** of the instrument connected at source end or, disconnect patch lead for more than 8 seconds.

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- [2-way Autotest only]: To end Autotest, press **F1** on either one of the connected instruments or, disconnect patch lead for more than 8 seconds.
- To record data to internal memory in Meter or Autotest mode, press triangular button above [STORE]. Data will be stored in the next empty location.

### Autotest User-to-User Communication (2-way mode only):

- Connect an instrument at each end of a fiber link.
- Start 2-way Autotest on any of the connected instruments.
- For near-end unit to 'flag' far-end unit: Press **F4** on near-end unit. Far-end instrument will beep once and, "HOLD" will flash (display update stops) on both units.
- For far-end unit to respond to near-end unit: Press **F4** on far-end unit. Near-end instrument will beep once and, "HOLD" will stop flashing (display update resumes) on both units.

### Autotest Wavelength Restriction:

- To start Autotest with restricted wavelengths,  
**Method 1** (for instrument with 2 light source ports only),
  - To start Autotest for single mode  $\lambda$  (left source port), hold down - and press **F4**.
  - To start Autotest for multimode mode  $\lambda$  (right source port), hold down + and press **F4**.

#### **Method 2,**

- To activate (include) / deactivate (exclude) wavelength/s for Autotest, press **F1** in Home menu, then press - or + to select the wavelength/s. Hold **F4** then press **Toggle Centre** to change between 'in' (activated) or 'out' (deactivated).
- To start Autotest for the activated wavelength/s only, hold **Toggle Centre** then press **F4**.

### Memory Operation:

#### Recording Data to Memory

- In METER or AUTO mode, press triangular button above "STORE".
- To change the next location pointer for storage, press button above "MEMORY" at Home menu, select desired location using the + or -, hold button above "MEMORY" then press **F2** for three seconds, or until it stops beeping.

#### Recalling Stored Data from Memory

- To enter Memory mode, press button above "MEMORY" at Home menu.
- To select a memory location to display data, press + or -.
- [For data saved in 2-way Autotest mode only]: To toggle display to show summary or detail data of test results, press **F3** repeatedly.  
To show nominal source power, hold down **left** rectangular button above LCD (only when display shows detail data).

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To view detail data for other wavelengths, press **F4**.

To view saved time and date, press and hold **Toggle Centre**.

To exit memory mode, press **F1**.

- [For data saved in 1-way Autotest mode only]: To toggle display to show absolute power in dBm or in both dBm and watt, press **F3** repeatedly.

To show nominal source power, hold down **left** rectangular button above LCD.

To view saved time and date, press and hold **Toggle Centre**.

To exit memory mode, press button below [HOME].

- [For data saved in Meter mode only]: To toggle display to show absolute power in dBm or in both dBm & watt, press **F3** repeatedly.

To view saved time and date, press and hold **Toggle Centre**.

To exit memory mode, press **F1**.

### To retest or overwrite results

- Note currently displayed memory location: At Home menu, press button above “MEMORY”. Note current memory location e.g. “MEM 123”.
- Go to the memory location for retest/overwrite, select desired location using + or -, then hold down button above

“MEMORY” and press **F2** for three seconds or until it stops beeping.

- Press **F1** to exit Memory mode.
- To retest: Press **F3** (Meter mode) or **F4** (Autotest mode) to return to data acquiring mode. Press button above [STORE] now will save new results in the memory location selected above.
- Return memory location pointer for next storage to where it was before the retest: Press button below [HOME] then that above “MEMORY”, select the desired location (“MEM 124” in this example) using + or -, then hold down button above “MEMORY” and press **F2** for three seconds or until it stops beeping.
- Continue testing.

### Clearing Memory

- To clear *all stored data*, in Memory mode, hold down button above “MEMORY”, then press and hold **F2** followed by **F4** until it stops beeping.

### Transfer Instrument Memory Data to USB Stick:

- At Home menu, Insert USB stick (formatted as FAT32 or exFAT) into USB port (“MEM”) on the right side of instrument. Press button above “MEMORY” to power up USB stick.

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- Press triangular button above “USB”. Wait till instrument stop beeping.
- Press **F1** to power down USB stick before removing from instrument.

### Pass/Fail Operation:

- Loss test status for each wavelength will be shown with a ‘✓’ (pass) or ‘X’(fail) or blinking ‘X’ (marginal) on LCD. ORL (2-way Autotest only) test status for each wavelength will be shown with a ‘✓’ (pass) or ‘X’(fail). A failed length test value (2-way Autotest only) will flash.
- Overall test result, “PASS” will be shown at the top right corner of the if LCD:
  - pass/fail check function is disabled.
  - loss test statuses of all wavelengths are pass or marginal and, both the optional length and ORL tests pass.
  - An overall test result, “FAIL” will be shown at the top right corner of LCD if, loss test status of any wavelength is a fail or, any of the optional Length or optional ORL test fails.
- Pass/fail method selection:  
*For 2-way Autotest:* If ‘WC’ is selected, the worst-case loss value will be used to determine the test status. If ‘AV’ is

selected, the average loss value will be used to determine the test status.

*For 1-way Autotest:* Worst case loss value will always be used to determine the test status regardless of the selected pass/fail method.

### Pass/Fail Threshold Set Up:

#### To downloaded from KITS reporting software

- Refer to instruction in the software manual.

#### To set up directly on the instrument

- Turn on instrument with “-” button (for SM), or “+” (for MM) key depressed.
- “Imported Setup” will show if a setup has been imported from KITS and will vanish if any changes are made locally.
- Press **F3** to toggle between loss / ORL setup screens. For instruments without Length and/or ORL options, set the corresponding threshold values to “0”.
- Press **Toggle Centre** repeatedly to select a value to adjust threshold for PASS and/or MARGINAL.
- Use - or + to adjust value. Set values (magnitude) of MARGINAL must always be greater that PASS.
- Use **F4** to toggle WC (worst case) / AV (average) pass/fail method.
- Press **F2** to save or **F1** to cancel new settings.

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### Tone Detection Operation:

- Connect 2 instruments with a fiber i.e. at the source-port on one unit and the meter-port on the other.
- On source unit, enter Source menu, press **F3** to scroll modulation options.
- On meter unit, it detects the standard optical test tone (e.g. 270 Hz, 1 KHz, 2 KHz), a buzzer sounds and the display changes to show the actual measured modulation frequency in Hz.
- To end the operation (on source unit), press and hold **F3**, then press **Toggle Centre**. Alternatively, press and hold **F3** for 3 sec.

### Slow Mode Operation:

- To enter Slow Mode during turn on, hold down **F3** & press **On/Off**. The flashing symbol '∞' indicates that slow mode has been activated.
- Alternatively, to turn slow mode on/off while in Meter mode, press and hold key **F3** then press **F4**.
- To turn Slow Mode on while in Tone detection mode, press **F4**. This will disable tone detection.  
To turn Slow Mode off (i.e. to resume Tone detection), press **F3** to go to Meter menu, hold **F3** then press **F4**.

### Text ID Tag Operation:

#### To create a new Text ID Tag

- Enter Meter or AUTO menu.
- Press button above "FIBER ID", then press **F4**.
- Press - or + to select new alphanumeric character, then press **Toggle Centre** to move to the next character.
- Press **F2** to save or **F1** to cancel.

#### To use a stored Text ID Tag

- Enter Meter or AUTO menu.
- Press button above "FIBER ID".
- Press - or + to find required Tag,
- Press **F2** to confirm or **F1** to cancel selection.

#### To modify a stored Text ID Tag

- Enter Meter or AUTO menu.
- Press button above "FIBER ID", then - or + to select a stored ID Tag.
- Press **F3** to enter edit mode.
- Press - or + to select new alphanumeric character, then press **Toggle Centre** to move to the next character.
- Press **F2** to confirm or **F1** to cancel modification.

#### To delete a Text ID Tag

- Enter Meter or AUTO menu.
- Press button above "FIBER ID", then - or + to select a stored ID Tag.

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- Press **F3** to enter edit mode, then press **F4** to delete.
- Press **F2** to confirm or **F1** to cancel deletion.

### ORL Zero Function:

- Set up the stray optical condition.
- At Home menu, press **F2** then press **F3** twice to enter Noise Floor (NF) setting mode.
- Press **F2** and, NF offsets for all active wavelengths will be set and saved automatically. The new NF values will be displayed next to the selected wavelength.

### User Calibration (UCAL):

- At Home menu, press **F2** to enter ORL mode.
- Press - or + to select wavelength.
- Press **F3** to enter UCAL offset setting mode.
- Press - or + to enter the required value.
- Press **F2** to save or **F1** to cancel the new settings.

### Reset User Calibration (UCAL) offset & Zero Function (Noise Floor) to factory defaults:

- At Home menu, press **F2** to enter ORL mode.
- Press **F3** twice to enter Noise Floor setting mode.
- [For instrument with only 1x Two-way port]: hold down **F2** then **Toggle Centre** until it stops beeping.
- [For instrument with 2x Two-way ports]:

- For *SM port*: hold down **F2** then “-” until it stops beeping.
- For *MM port*: hold down **F2** then “+” until it stops beeping.

### Visible Laser Operation:

- At Home menu, press **F1** to enter Source menu.
- Press - or + to select 650 nm to turn on visible red light.
- Press Toggle Centre to turn off visible red light.
- Press **F1** to return to Home menu.

### Instrument Data Sanitization:

To erase all parts of the non-volatile user memory, including user data, and restore default instrument settings:

- Turn on instrument.
- Enter Memory mode by pressing button above “MEMORY”.
- Press and hold these buttons: “MEMORY”, **F2**, **F4**, **Toggle Centre** simultaneously for 3 seconds until beeping stops. “dFLt” will display during operation.

## DISCLAIMER AND WARRANTY

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### Disclaimer & Warranty

Information in this manual is given in good faith for the benefit of the user. It cannot be used as the basis for claims against Kingfisher International or its representatives, if accidental damage or inconvenience results from use or attempted repair of the equipment.



Kingfisher International products are guaranteed against defective components and workmanship for a period of 3 years from the date of delivery, unless specifically stated in the original purchase contract or agreement. This warranty excludes optical connectors or incorrect use. Opening the instrument will invalidate the warranty. Liability is limited solely to repair of the equipment.

### KINGFISHER INTERNATIONAL PTY. LTD.

720 Springvale Road, Mulgrave, VIC 3170 Australia

**Phone:** (61) 3-8544-1700

**Fax:** (61) 3-8544-1793

**E-mail:** [sales@kingfisher.com.au](mailto:sales@kingfisher.com.au)

**Website:** [www.kingfisherfiber.com](http://www.kingfisherfiber.com)

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# NOTES

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## Notes

Please use these pages to write notes

## NOTES

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## NOTES

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