IEC TR 61282-15

Edition 1.0 2017-05

TECHNICAL REPORT

Fibre optic communication system design guides – Part 15: Cable plant and link – Testing multi-fibre optic cable plant terminated with MPO connectors

IEC TR 61282-15:2017-05(en)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue
The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org
The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

IEC TR 61282-15

Edition 1.0 2017-05

TECHNICAL REPORT

Fibre optic communication system design guides – Part 15: Cable plant and link – Testing multi-fibre optic cable plant terminated with MPO connectors

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 33.180.01

ISBN 978-2-8322-4238-4

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

FIBRE OPTIC COMMUNICATION SYSTEM DESIGN GUIDES –

Part 15: Cable plant and link – Testing multi-fibre optic cable plant terminated with MPO connectors

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a Technical Report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC TR 61282-15, which is a Technical Report, has been prepared by subcommittee 86C: Fibre optic systems and active devices, of IEC technical committee 86: Fibre optics.

The text of this Technical Report is based on the following documents:

Enquiry draft	Report on voting
86C/1427/DTR	86C/1443/RVDTR

Full information on the voting for the approval of this Technical Report can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 61282 series, published under the general title *Fibre optic communication system design guides*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

Cabling testing standards such as IEC 61280-4-1 for multimode attenuation measurements and IEC 61280-4-2 for single-mode attenuation and optical return loss measurement describe testing simplex or duplex fibre cabling terminated with single-fibre ferrule connectors (e.g. LC). This document has been written to describe measurement methods for attenuation and polarity and can be used in the absence of any multi-fibre testing standard.

This document addresses the testing of installed multimode and single-mode cabling terminated with multi-fibre connectors of IEC 61754-7 (all parts) related to multi-fibre push on (MPO) and describes the challenges when testing array connectivity, which parameters are important to measure, and why the test methods of IEC 61280-4-2 and IEC 61280-4-1 cannot be used.

Installed optical fibre cabling terminated with MPO interfaces can be tested in different ways, for example, with equipment having an MPO connector test port. Testing using other types of equipment is possible, for example using an optical time domain reflectometer (OTDR).

This document focuses on MPO connectors containing 12 fibres in a single row; however, many of the principles can also be applied to testing of cabling terminated with different types of MPO connectors with appropriate changes to test cords and/or test equipment interfaces.

FIBRE OPTIC COMMUNICATION SYSTEM DESIGN GUIDES –

Part 15: Cable plant and link – Testing multi-fibre optic cable plant terminated with MPO connectors

1 Scope

This part of IEC 61282 provides guidance for the testing of multi-fibre cable, multimode or single-mode, terminated with plugs described in IEC 61754-7 (all parts) (multiple-fibre push on – MPO). Guidance is provided on the measurement of attenuation, polarity, length and optical return loss. The cabling can be installed in a variety of environments, including residential, commercial, industrial, and data centre premises, and possibly in outside plant environments.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61280-4-1, *Fibre-optic communication subsystem test procedures – Part 4-1: Installed cable plant – Multimode attenuation measurement*

IEC 61280-4-2, *Fibre-optic communication subsystem test procedures – Part 4-2: Installed cable plant – Single-mode attenuation and optical return loss measurement*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
adapter
part of a connector in which one or two plugs are inserted and aligned

3.1.2
attenuation
reduction of optical power induced by transmission through a medium such as cabling, given as

$$L = 10 \log_{10}(P_{in}/P_{out})$$

where P_{in} and P_{out} are the power, typically measured in mW, into and out of the cabling

Note 1 to entry: Attenuation is expressed in dB.

3.1.3
configuration
form or arrangements of parts or elements such as terminations, connections and splices

3.1.4
connector
component consisting of two plugs mated together in an adapter, for the purpose of providing frequent optical interconnection/disconnection of optical fibres or cables, between two cables, or a cable to an apparatus

3.1.5
encircled flux
fraction of cumulative near-field power to total output power as a function of radial distance from the optical centre of the core

3.1.6
launch cord
test cord used to connect the light source to the cabling under test

3.1.7
light source power meter
test system consisting of a light source (LS), power meter (PM) and associated test cords used to measure the attenuation of installed cable plant

3.1.8
MPO connector
multi-fibre component consisting of pinned or unpinned plug and mating adapter, normally attached to an optical fibre cable, for the purpose of providing high density termination capability, and frequent interconnection or disconnection

3.1.9
plug
free part of a connector

3.1.10
test cord
terminated optical fibre cord used to connect the optical source or detector to the cabling, or to provide suitable interfaces to the cabling under test

Note 1 to entry There are two types of test cords:

– launch cord;
– receive cord.

3.2 Abbreviated terms

APC	angled physical contact (description of plug polish)
LED	light emitting diode
LSPM	light source power meter
MPO	multiple-fibre push on
OTDR	optical time domain reflectometer
PC	physical contact (description of plug polish)
VFL	visual fault locator
OPM	optical power meter
OLTS	optical loss test set

4 MPO connectors

4.1 General

A multi-fibre push on (MPO) connector is a multi-fibre device, used with ribbon cables, that is defined in IEC 61754-7 (all parts). Plugs for multimode have flat end faces, whereas single-mode plugs have angled end faces to minimize back reflection. These plugs are keyed and use a large rectangular plastic ferrule. The plugs can be either pinned or unpinned. The MPO plugs rely on the pins and corresponding holes to align the fibres. An adapter is used for further alignment and to hold two MPO plugs in a fixed position (see Figure 1).

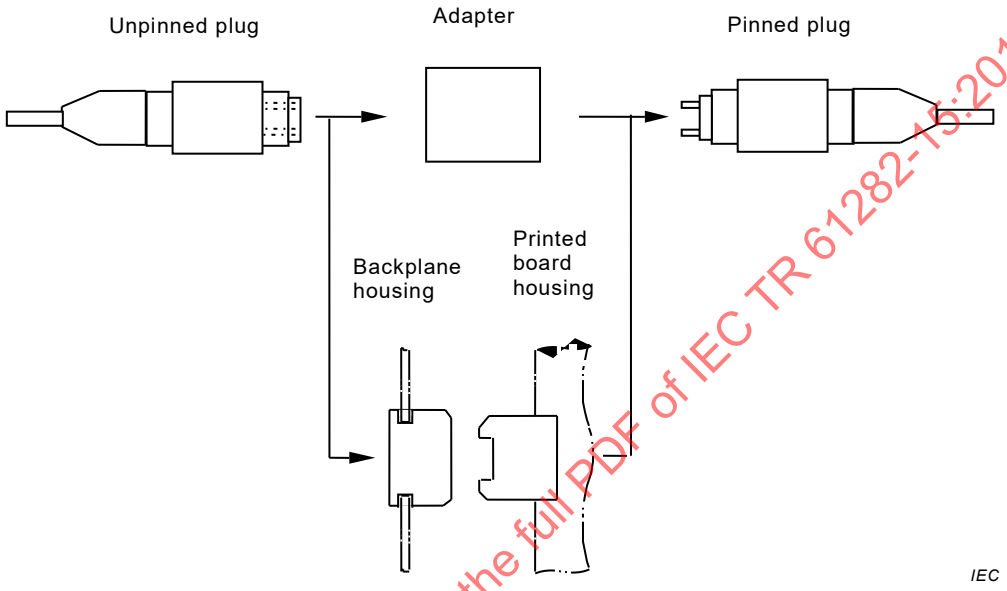

Figure 1 – MPO connector

4.2 Keying and fibre positions

Testing an installed optical fibre plant terminated with MPO plugs requires knowledge of the interface between the test equipment and the cabling under test. Intermateability between 12- and 16-fibre position MPO plugs can complicate testing as can the number of rows. There are two different fibre optic intermateability standards: one for a 12-fibre position MPO plug as defined in IEC 61754-7-1 and IEC 61754-7-2[1], and another for a 16-fibre position MPO plug defined in IEC 61754-7-3[2] and IEC 61754-7-4[3]. The 12- and 16-fibre position MPO plugs are not intermateable due to keying. Although a 12-way connector is mechanically intermateable with a 12-way connector, the number of fibre rows contained in each plug shall match. The same is true for the 16-way connector.

MPO plugs can be one of two types: pinned or unpinned. The plug interfaces are configured as a version without pins and another type with pins. The unpinned plug is intermateable with the pinned plug. Some plugs can be adjusted for either type.

1 Under preparation. Stage at the time of publication: IEC AFDIS 61754-7-2:2017.

2 Under preparation. Stage at the time of publication: IEC CDM 61754-7-3:2017.

3 Under preparation. Stage at the time of publication: IEC ACD 61754-7-4:2017.

The fibre positions in an array plug are referred to as position 1 through N, where N is the number of fibre positions in the plug. When viewing the plug end-on with the key-way on top, position 1 is the left-most fibre position, and N is the right-most fibre position. Multi-fibre cabling and connectors can vary in fibre positions. Any examples shown in this document are with 1 x 12-position test cords.

Keying and fibre position also have a specific configuration on angled physical contact (APC) MPO plugs used with single-mode multi-fibre cabling. For single-mode cabling terminated with APC plugs, it is essential to know if key-up/key-up or key-up/key-down adapters and test cords are used.

NOTE It is normal for the single-mode ferrules to be "up angled", i.e. the highest part of the ferrule is on the same side as the key; however, it is also possible for the ferrule to be "down angled", with the slope running the other way.

4.3 Polarity

IEC standards describing MPO connectors can use different polarity nomenclature than other standards bodies. Equivalent polarity nomenclatures are shown in parenthesis below:

- key-up to key-down (type A)
- key-up to key-up (type B)
- key-up to key-down, pair-wise flip (type C)

For the sake of simplicity, the type of polarity, A, B, or C, is used in the descriptions below.

The polarity of the connections between the meter and source can have several configurations and can be indicated on the power meter as "A", "B", and "C" or other common polarity types not standardized. In some cases, an alternate type is necessary.

For testers capable of identifying polarity, the polarity is shown on the meter when the source is selected to scan all fibre positions and all fibres are connected properly or improperly.

1) One of three polarity types: The connections use a standard method, key-up to key-down (type A), key-up to key-up (type B), or key-up to key-down pair-wise flip (type C). In this case, the tester should identify the polarity (see Figure 2).
2) Unknown polarity: The connections do not use a standard method, one or more fibres are not connected, or the source polarity scanner is off. In this case, something may be wrong with the cabling, so the tester cannot determine the polarity. However, all three cases do not necessarily indicate an error in the cabling.
3) Alternate polarity: The connections are made to a box wherein a breakout cable, also known as a fan-out cable, is used (see Figure 3).

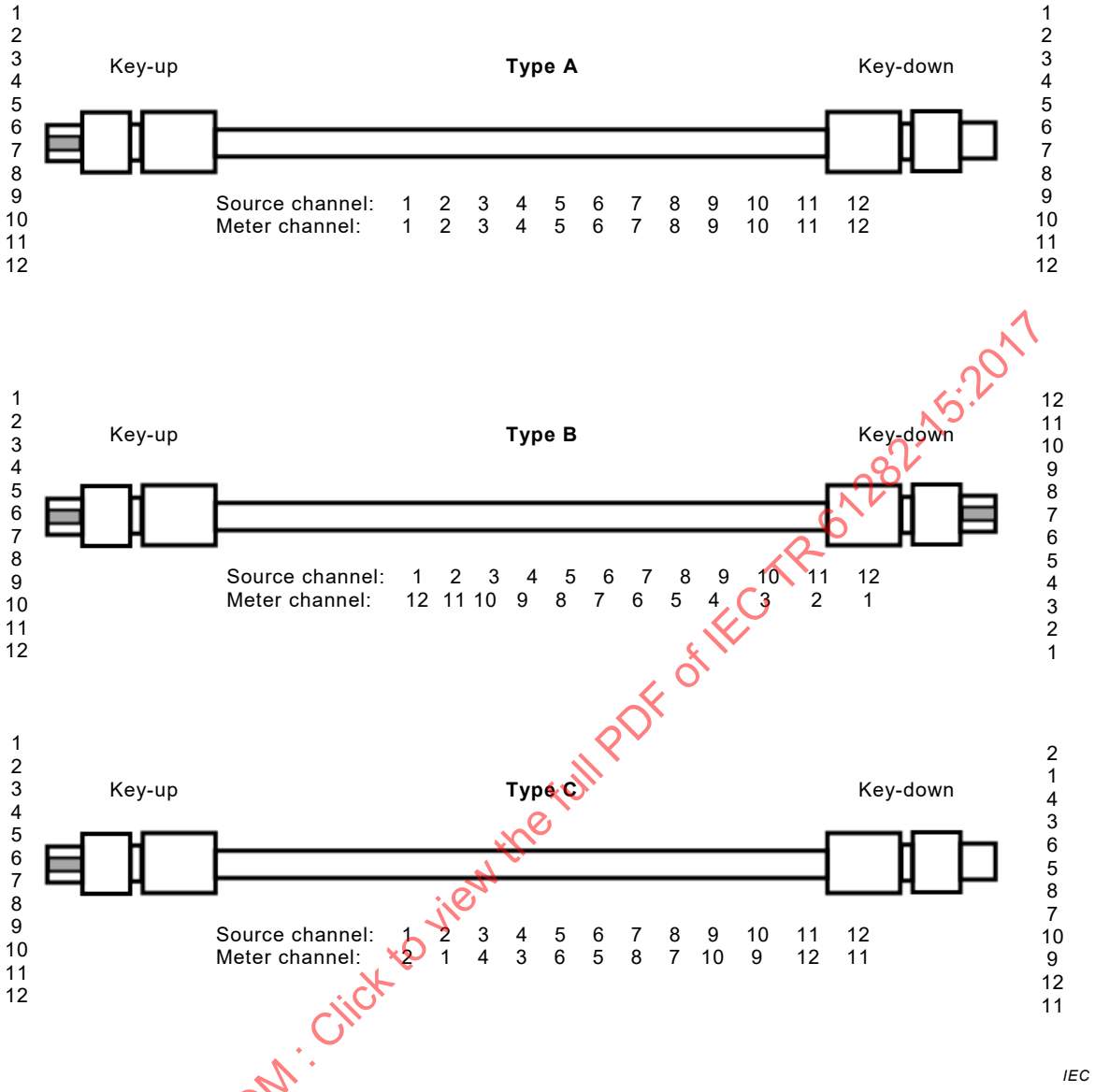

Figure 2 – Polarity for three standard configurations

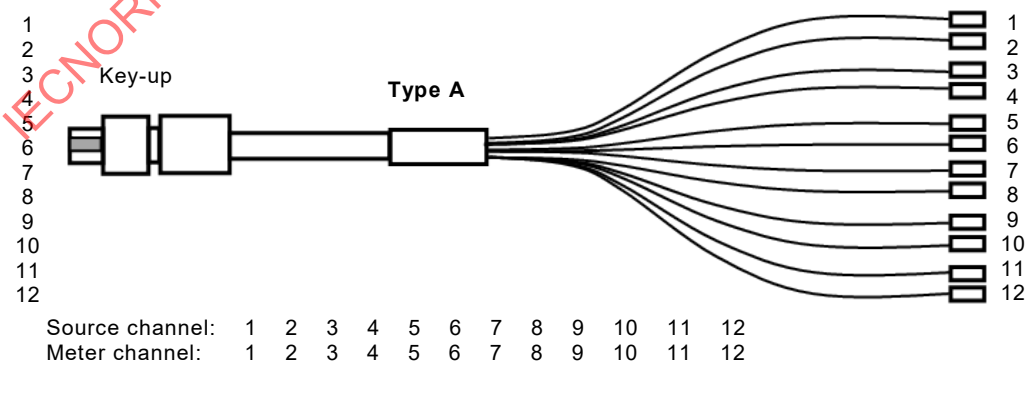

Figure 3 – Polarity for a breakout cord

5 Test methods and measurements

5.1 General

Installed optical fibre terminated with MPO connectors can be tested using three known methods:

- a specialized multi-fibre tester having an MPO interface (optical loss test set – OLTS or optical time domain reflectometer – OTDR);
- an OLTS (or light source power meter – LSPM) with non-MPO interface;
- an OTDR with non-MPO interface.

A red light source or other visual fault locator (VFL) can also be used for continuity and polarity testing but cannot be used for other measurements. A visible light source or VFL may be used to determine polarity. However, using a VFL for polarity identification may prove difficult, especially when laser safety is considered, because seeing which fibre is lit in an MPO plug involves looking directly into the plug.

Each of these methods can test fibre installations terminated with MPO plugs. The implementation of the first method can have different forms, while the second and third methods utilize equipment typically used to make measurements described in IEC 61280-4-2 and IEC 61280-4-1.

5.2 Attenuation

The attenuation measurement indicates how much optical power is lost in the fibre, connectors and other passive devices in a link (see 3.1.2).

5.3 Polarity

Optical fibre trunk cabling can be configured in different ways. Deployment mistakes are common because these different configurations require a combination of patch cords with different polarity types. A polarity test is performed to verify that connectivity will be established between the transmitters at one end of the cabling and the receivers at the other end and vice versa.

5.4 Length

Fibre length verification can be obtained from several methods, including cable sheath markings, installed cabling documentation, job bill of materials, propagation delay, or with an OTDR. Cabling and trunk lines terminated with MPO plugs are typically of a known length and are labelled accordingly. Due to the complexity of testing, some testers use simplex measurements, so length is determined from labelling or other documentation. For duplex installations where an OLTS can be used, propagation delay may sometimes be used for length measurements. However, this requires a round trip measurement where the far-end tester loops the propagation pulse back to the source.

Since multiple fibres terminated with MPO plugs are bundled together within cabling, and their lengths are equal or within 1 % of each other due to the helical nature of some cabling, it may be adequate to measure the length of just one fibre.

5.5 Optical return loss and reflectance

Optical components such as fibre, connectors, and splices exhibit various amounts of return loss and reflectance. Overall optical return loss includes the contributions from all of the optical components in a link. Some cabling standards and transmission system standards define a limit for the reflectance of individual components (e.g. connectors) and some standards (e.g. IEEE) also define a limit on the overall return loss.

Optical return loss may be important for installed single-mode cabling. This is because single-mode transmission systems may be more sensitive to back-reflections. However, all single-mode MPO plugs have APC end faces specified with a typically low return loss (e.g. > 50 dB). Multimode MPO plugs terminated with physical contact (PC) end faces typically have high return loss (e.g. 20 dB). However, multimode transmission systems are less sensitive to back reflections. If needed, an OTDR is capable of measuring overall cabling return loss and the discrete return loss of individual components also known as reflectance.

6 Variations of test methods

6.1 General

The equipment used to test installed fibre optical cabling can have either an MPO interface or a non-MPO interface. For these two types of testers, the apparatus can be a light source/power meter or an OTDR.

For either the MPO interface or non-MPO interface type, optical switching and fan-out assemblies (e.g. 1 MPO to 12 LC plug test cord) can be used to expand testing to a higher fibre count.

Testers with an MPO interface specifically designed for MPO testing can be designed in different ways and are described herein; there may be other implementations. Testers with a non-MPO interface can also be used for testing cabling with MPO terminations; they are also described herein.

6.2 Optical light source

6.2.1 General

The light source used during LSPM testing can be a simplex version (one fibre port) or an MPO version (multi-fibre port). In general, since source optical ports are coupled to a fibre, either multimode or single-mode, different light sources are used for testing multimode or single-mode cabling. Another consideration when testing with the MPO ported version is that multimode uses a flat MPO plug while the single-mode version uses an angled MPO plug.

Caution is advised not to mix flat and angled MPO plugs, unless the light source is designed to do so. Determine whether the light source MPO port is pinned or unpinned before connecting a launch cord.

The wavelengths used for the measurements can be the same as the wavelengths used in the installed cabling, such as 850 nm and 1 300 nm for multimode and 1 310 nm and 1 550 nm for single-mode.

The characteristics of the light sources, such as centre wavelength, spectral width, and stability, are found in IEC 61280-4-1, using an LED, and IEC 61280-4-2. The multimode source shall meet the encircled flux requirements of IEC 61280-4-1 at the output of the test cord that is coupled to the light source. This can be met with commercially available equipment for single fibre port sources.

6.2.2 Source with MPO interface

The light source contains one or more emitters attached, typically fibre coupled, to an MPO plug at the light source interface (bulkhead connector). The MPO plug at the bulkhead can be pinned or unpinned. For determining polarity, the light source emits power sequentially at each fibre position from position 1 to position 2 to position 3, etc.

6.2.3 Source with non-MPO interface and fan-out cable

The light source contains one or two emitters attached to a 1,25 mm or 2,5 mm circular ferruled plug placed at the light source bulkhead; there is no MPO interface. The non-MPO side of the breakout cable is connected to the bulkhead. The MPO end of the breakout cable is connected to the cabling under test. At the completion of each measurement, the non-MPO side of the breakout cable is moved to the next position, from position 1 to position 2, etc.

6.2.4 Source with non-MPO interface and optical switch

The light source contains one or two emitters attached to a 1,25 mm or 2,5 mm circular ferruled plug. The ferruled plug is placed at the light source bulkhead. An optical switch is connected to the light source via a non-MPO connectorized test cord. The other port on the optical switch has an MPO interface. An MPO to MPO test cord is attached between the optical switch and the cabling under test.

6.3 Optical power meter

6.3.1 General

An optical power meter (OPM) without an MPO compatible port shall meet the requirements for the power meter (LSPM methods only) defined in IEC 61280-4-1 and IEC 61280-4-2. This type of power meter uses a single detector.

An optical power meter with an MPO compatible port shall meet the requirements of the non-MPO compatible meter defined in IEC 61280-4-1 and IEC 61280-4-2. The MPO ported meter should interface with either a multimode MPO plug that has PC end faces or a single-mode MPO plug that has APC end faces. Although not as easy to use, it is acceptable to have separate meters for PC and APC. The MPO end face (i.e. the actual fibre) may not be in contact with the detector.

The MPO type power meter should be able to determine the position (polarity) of each fibre during testing, in addition to measuring attenuation.

Caution is advised: note if the power meter MPO port is pinned or unpinned.

6.3.2 Meter with MPO interface having multiple detectors

This meter should be able to determine installed cabling polarity regardless of the polarity of the test cord connected to the meter.

The power meter contains multiple detectors attached to an MPO plug, via optical fibres for example, at the power meter interface (bulkhead). The power meter measures the emitted power or attenuation in a sequence and also indicates the polarity of the cabling under test.

The MPO type power meter should be able to determine if there are absent fibres. In one example, a 12-fibre MPO plug may have the middle four fibres absent. In another example, a 12-position MPO plug may have positions 1 and 12 absent.

This type of tester uses the 1-cord or 2-cord reference method and can automatically measure attenuation and polarity by relying on the sequence of a specific light source. Testing is fast and setup is minimal. Length measurements can be supplemented with a single-ended measurement such as with an OTDR. An OTDR can also be used to measure reflectance of individual connectors and optical return loss of the entire cabling system.

6.3.3 Meter with MPO interface having large area detector

The power meter contains one large area detector, used in typical power meters, wide enough (greater than 5 mm) to capture received light at the MPO interface. Alternatively, an integrating sphere can be used in conjunction with a smaller detector.

The power meter measures attenuation (optical power) from any fibre position but cannot differentiate between adjacent fibre positions. The sequence of emitted light from the source cannot be determined.

This type of tester uses the 1-cord reference method and can measure only attenuation. Length, reflectance, and optical return loss can be measured with an OTDR as a secondary test. Since this is a simplex tester, propagation delay cannot be used to measure fibre length.

6.3.4 Meter with non-MPO interface and fan-out cable

The power meter contains one large area detector commonly used in typical power meters. A breakout cord with a non-MPO plug is attached to the power meter port. The other end of the breakout cord is terminated with an MPO plug that is attached to the cabling under test. The power meter can then measure the attenuation (optical power) of each channel as described in 7.3.

6.3.5 Meter with non-MPO interface and optical switch

The power meter is connected to an optical switch via a non-MPO connectorized test cord. The other port on the optical switch has an MPO interface. An MPO to MPO test cord is attached between the optical switch and the cabling under test.

This method may improve test time compared to using fan-outs. However, setting a reference with an optical switch on the source side and power meter side may be difficult or may have high uncertainty.

6.4 OTDR

6.4.1 General

The OTDR should meet the requirements defined in IEC 61280-4-1 for multimode and IEC 61280-4-2 for single-mode as described for a single connector port.

When using an OTDR, and to comply with some testing standards, it is required to add a launch and tail cord to the cabling under test. The OTDR can make total attenuation measurements, provided that a long enough launch cord and tail cord are used.

The OTDR test can measure polarity if, for example, a single fibre tail cord is used to identify fibre connectivity. Another possible way to identify polarity is to use a multi-fibre tail cord where each fibre is of a known different length, for example fibre 1 = 10 m, fibre 2 = 15 m, fibre 3 = 20 m.

6.4.2 OTDR with MPO interface

An OTDR utilizing an MPO interface would need to emit optical power sequentially at the MPO interface (bulkhead). In addition, a launch cord comprising multiple optical fibres would need to interface between the OTDR and the cabling under test. This implementation may be possible by using an optical switch inside the OTDR.

6.4.3 OTDR with non-MPO interface and fan-out cable

To make measurements with an OTDR, attach the MPO end of a fan-out to the cabling under test. The other end of the fan-out, typically a plug with a 1,25 mm or 2,5 mm ferrule, is attached to the OTDR. The OTDR executes a test with fibre position 1 of the fan-out. Next, fibre position 2 on the fan-out replaces fibre position 1 on the OTDR port. The sequence is repeated for the remaining fibre positions. Note that the fan out assembly in this scenario becomes the OTDR launch cord, and therefore every fibre in it shall meet the requirements of an OTDR launch cord, i.e. it shall be long enough to get past the dead zone of the OTDR and give a reliable straight line fit to the trace of the fibre in the launch cord.

6.4.4 OTDR with non-MPO interface and optical switch

An OTDR, without an MPO interface, using an optical switch may be an improvement over the use of a fan-out cable. One test cord is attached from the OTDR to the optical switch using a non-MPO test cord. The other port of the optical switch is the MPO interface that couples an MPO to MPO launch cord from the switch to the cabling under test.

6.5 Other adaptations and accessories

6.5.1 Adapters

Devices that couple two MPO plugs are required during testing. There are two types of array adapters: opposed key or key-up to key-down (type A) and aligned key or key-up to key-up (type B). In the key-up to key-up type, both ends of the adapter have the key on the same side. For the key-up to key-down adapter, the keys are on opposite sides.

IEC 61754-7 (all parts) provides information on adapters and keying differences.

6.5.2 Test cords

Testing an installed multi-fibre network using MPO connectors may require several types of test cords to accommodate various test configurations. The cabling under test could be pinned or unpinned and of various polarity types.

The MPO end of the test cord should have low attenuation (i.e. 0,35 dB) and for testing single-mode, it should have a high return loss (i.e. 60 dB) when mated to another MPO plug. The single-fibre ferrule end of fan-out plugs should be compatible with performance described in IEC 61280-4-1 and IEC 61280-4-2 for reference grade connectors.

The following test cords are typically used with compatible test equipment such as light sources, power meters, OTDRs, and optical switches. The LSPM with MPO interface are assumed to be unpinned for these examples.

- Fan-out (e.g. breakout) cord with an MPO plug on one end and 12 or more individual single fibre ferrule plugs (e.g. LC or SC plugs) on the other end – used when testing breakout cassettes (i.e. box with MPO and non-MPO) or when using a simplex or duplex LSPM.
- Test reference cord, with MPO unpinned on both ends, key-up to key-up – used as the launch cord conversion when using MPO interfaced testers on type A, B, or C cabling that are pinned on each end.
- Test reference cord, with MPO unpinned on one end and MPO pinned on the other end, key-up to key-up – used as the launch and receive cords when using MPO interfaced testers on type A, B, or C cabling that are pinned on one end and unpinned on the other.
- Test reference cord, with MPO pinned on both ends, key-up to key-up – used as the launch and receive cords when using MPO interfaced testers on unpinned type A, B, or C cabling.

The following applies to the preparation of the test cords.

- The cords should be terminated at one end with a plug suitable for attachment to the light source and meter – MPO plug for a tester with an MPO interface or single fibre ferruled plug for a tester with a non-MPO interface.
- The fibre used in the cord should be protected. This may be done by enclosing most of the length of the cord in a container or by using test cords that have a thick jacket.

The single-fibre ferruled end of the fan-out cords and MPO plugs may be inspected using IEC 61300-3-35.

6.5.3 Optical switch

An optical switch can be used with existing equipment that does not have an MPO port. The optical switch (MPO switch) may have a circular, single-fibre, ferrule input test port and an MPO output port. The tester is coupled to the input port of the switch using a test cord. The MPO output port is coupled to the cabling under test using an MPO to MPO test cord and an appropriate adapter. The tester can communicate with an external optical switch to select fibre positions automatically.

The advantage of the MPO switch is that fan-outs, which typically require re-mating and un-mating connectors, are not needed. The MPO switch is used to advance from one fibre position to the next position along the MPO cabling under test.

6.5.4 Polarity and pinned/unpinned changers

Some brands of MPO plugs are available with a mechanism to change the polarity from a “type A” to a “type B” or vice versa. The polarity can be changed by removing the outer housing from the plug, rotating the housing 180°, and re-installing the housing onto the plug.

Some brands of MPO plugs are also available with a mechanism to change from pinned to unpinned. The pins can be changed by removing the outer housing from the plug, using a special tool in the inner housing to slide the guide pins out/in, and re-installing the housing onto the plug. This changes the plug from pinned to unpinned or vice versa.

This type of plug simplifies testing and reduces the conversions and re-mating with test cords.

6.6 Visual inspection

Testing fibre optic cabling terminated with MPO plugs requires the same level of care as do other fibre optic plugs, specifically inspecting and cleaning. IEC 61300-3-35 describes methods for evaluating the end face of a polished fibre optic plug. The entire ferrule surface of the MPO plug should be inspected for contamination. If contamination is found, proper cleaning methods should be used to remove the contamination. Attention should be given to cleaning the male MPO plug since unclean pins may cause mechanical interference.

7 Test configurations

7.1 General

Clause 7 describes two common practices for measuring attenuation and polarity on installed cabling terminated with MPO plugs.

7.2 LSPM with MPO interface

When using test equipment having an MPO interface, for example, an LSPM, the light source or power meter can have a pinned or unpinned MPO bulkhead interface. In order for the test cords to function with the cabling under test, while still using a low-uncertainty reference method, the light source and power meter shall have compatible pinning. For example, if testing cabling is terminated with unpinned MPO plugs on each end, the launch and receive cords shall be pinned on the cabling interface side. Furthermore, for the 1-cord reference method, the meter shall be unpinned to accept the pinned launch cord (see Figure 4 and Figure 5). In the examples of Figure 4 and Figure 5, the light source and power meter bulkhead ports are unpinned. In this example, one test cord is used to set the reference (test cord 1). Then, test cord 1 is disconnected from the meter and a second test cord 2 is connected to the meter.

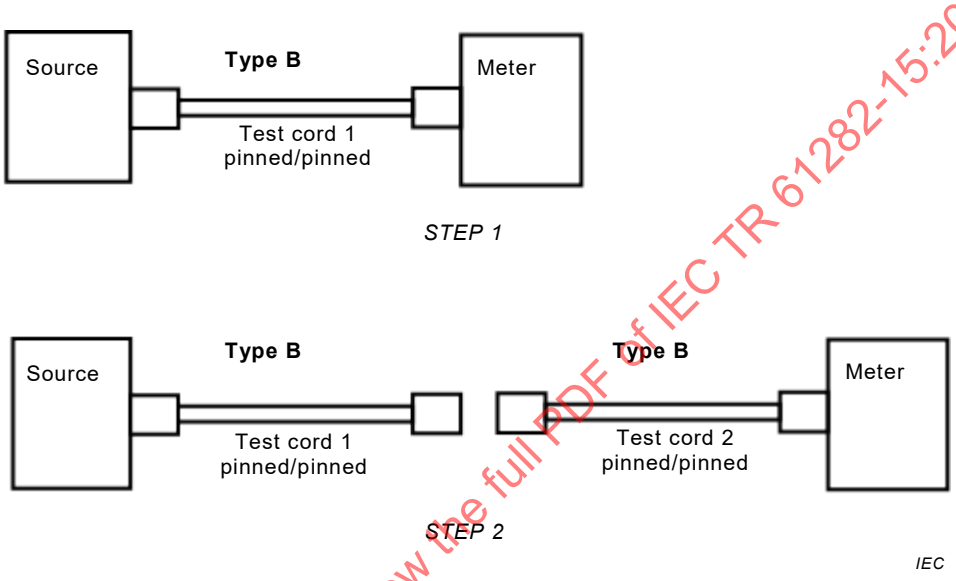

Figure 4 – Reference connections for cabling with unpinned MPO plugs

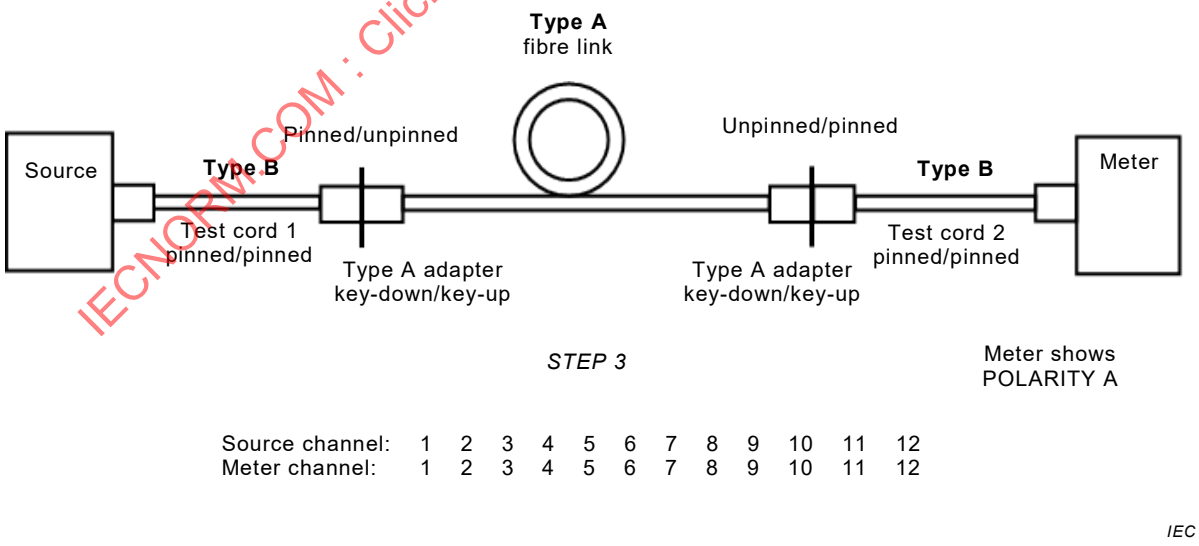

Figure 5 – Connections for measurements on type A cabling with unpinned MPO connectors

While there are various methods of testing cabling terminated with MPO plugs, the method that can automatically determine polarity may be easier to use than other methods. The multi-fibre optical power meter and source can be used to measure the polarity of MPO cords and