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International Telecommunication Union
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Recommendation

ITU-T L.210 (11/2022)

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Optical infrastructures – Infrastructure including node elements (except cables)

Requirements for passive optical nodes – Optical wall outlets and extender boxes

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Recommendation ITU-T L.210

Requirements for passive optical nodes – Optical wall outlets and extender boxes

Summary

Recommendation ITU-T L.210 refers to passive optical nodes (optical wall outlets and extender boxes) deployed in customer indoor premises. It deals with the node housing and fibre management system, and specifies the mechanical and environmental characteristics as well.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T L.210	2022-11-13	15	11.1002/1000/15123

Keywords

Customer indoor premises, FTTH, FTTR, interconnection, passive optical nodes.

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FOREWORD

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Introduction

Passive optical nodes for customer indoor premises are used in the final section of access networks of fibre to the home (FTTH) and similar fibre to the x (FTTx) systems to protect interconnection points (splices or connectors) between customer drop cables and patch cords/pigtails for optical network units (ONUs) or other terminal devices, or in premises cabling systems of fibre to the room (FTTR). The nodes are usually small in dimensions and simple in structures. A node comprises a housing for mechanical protection and environmental sealing, together with internal structures (integrated or separate with the housing) to fasten, guide and store cable ends, interconnection points and cable/fibre overlength (excess cable/fibre length). Passive optical nodes for customer indoor premises include:

– optical wall outlets (surface mounted, flush mounted);

– extender boxes;

– other types of passive optical nodes.

This Recommendation provides the requirements of the passive optical nodes and the means for characterization and evaluation of the performance of the nodes according to the principles of [ITU-T L.200]. This includes mechanical performance, sealing performance and optical stability of the product which simulate the effect of environmental factors or interventions related to network maintenance and reconfiguration. It contains a basic test programme for the box which is globally applicable. Additional requirements may be agreed between customer and supplier to reflect local or special conditions. All functions and features that a product may contain should be reflected in the mix of test samples that are subjected to the test programme.

Recommendation ITU-T L.210

Requirements for passive optical nodes – Optical wall outlets and extender boxes

1 Scope

This Recommendation refers to passive optical nodes (optical wall outlets and extender boxes) for customer indoor premises. The nodes contain interconnection points (maximum of 4) between customer drop cables and patch cords/pigtails for optical network units (ONUs) and terminal devices. The passive optical nodes may also be used as an interconnect between indoor cables and may also be used to store cable/fibre overlength.

This Recommendation:

– refers to passive optical nodes for customer indoor premises, including optical wall outlets (surface mounted, flush mounted) and extender boxes;

– specifies the characteristics and requirements of the housing as well as the fibre management system;

– specifies mechanical and environmental characteristics of the nodes;

– defines a test plan for the performance evaluation of different types of the nodes used in indoor non-temperature controlled (IN) or indoor temperature controlled (IC);

– provides simulation of the effect of interventions related to network maintenance and reconfigurations;

– includes a checklist for a systematic product characterization according to [ITU-T L.200].

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T G.652] Recommendation ITU-T G.652 (2016), *Characteristics of a single-mode optical fibre and cable*.

[ITU-T G.657] Recommendation ITU-T G.657 (2016), *Characteristics of a bending-loss insensitive single-mode optical fibre and cable*.

[ITU-T K.11] Recommendation ITU-T K.11 (2009), *Principles of protection against over voltages and over currents*.

[ITU-T K.47] Recommendation ITU-T K.47 (2012), *Protection of telecommunication lines against direct lightning flashes*.

[ITU-T L.200] Recommendation ITU-T L.200/L.51 (2003), *Passive node elements for fibre optic networks – General principles and definitions for characterization and performance evaluation*.

[IEC 60529] IEC 60529:2013, *Degrees of protection provided by enclosures (IP Code)*.

[IEC 60825-1] IEC 60825-1:2014, *Safety of laser products – Part 1: Equipment classification and requirements*.

[IEC 60825-2] IEC 60825-2:2021, *Safety of laser products – Part 2: Safety of optical fibre communication systems (OFCSs)*.

[IEC 61300-2-1] IEC 61300-2-1:2009, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-1: Tests – Vibration (sinusoidal)*.

[IEC 61300-2-4] IEC 61300-2-4:2019, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-4: Tests – Fibre or cable retention*.

[IEC 61300-2-5] IEC 61300-2-5:2022, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-5: Tests – Torsion*.

[IEC 61300-2-9] IEC 61300-2-9:2017, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-9: Tests – Shock*.

[IEC 61300-2-10] IEC 61300-2-10:2021, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-10: Tests – Crush and load resistance.*

[IEC 61300-2-12] IEC 61300-2-12:2009, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-12: Tests – Impact*.

[IEC 61300-2-22] IEC 61300-2-22:2007, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-22: Tests – Change of temperature*.

[IEC 61300-2-33] IEC 61300-2-33:2012, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-33: Tests – Assembly and disassembly of fibre optic mechanical splices, fibre management systems and closures.*

[IEC 61300-2-37] IEC 61300-2-37:2016, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-37: Tests – Cable bending for fibre optic closures*.

[IEC 61300-2-48] IEC 61300-2-48:2009, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-48: Tests – Temperature-humidity cycling*.

[IEC 61300-3-1] IEC 61300-3-1:2005, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-1: Examinations and measurements – Visual examination*.

[IEC 61300-3-3] IEC 61300-3-3:2009, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-3: Examinations and measurements – Active monitoring of changes in attenuation and return loss*.

[IEC 61300-3-28] IEC 61300-3-28:2012, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-28: Examinations and measurements – Transient loss*.

[IEC 61756-1] IEC 61756-1:2019, *Fibre optic interconnecting devices and passive components – Interface standard for fibre management systems – Part 1: General and guidance.*

[IEC 62368-1] IEC 62368-1:2018, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*.

3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 optical wall outlet: A passive optical node in customer indoor premises used to terminate the customer drop cable and provide a number of ports for connections to optical network units or other terminal devices.

3.2.2 extender box: A passive optical node in customer indoor premises used to seal and protect the splicing or connection points for extending customer drop cables, or indoor cables to optical wall outlets, optical network units or other terminal devices.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

FMS Fibre Management System

FTTH Fibre to the Home

FTTR Fibre to the Room

FTTx Fibre to the x

HTB Home Termination Box

IC Indoor temperature Controlled

IN Indoor Non-temperature controlled

IP Ingress Protection

OLT Optical Line Terminal

ONU Optical Network Unit

SC Single Circuit

SF Single Fibre

SPB Subscriber Premises Box

SR Single Ribbon

5 Conventions

None.

6 Characteristics of nodes for customer indoor premises

6.1 General requirements

Each node for customer indoor premises should comply with the general requirements as listed in clause 8 of [ITU-T L.200].

Examples of typical optical wall outlet applications are shown in Figure 1. Examples of optical wall outlet applications with splitters are in Appendix IV.

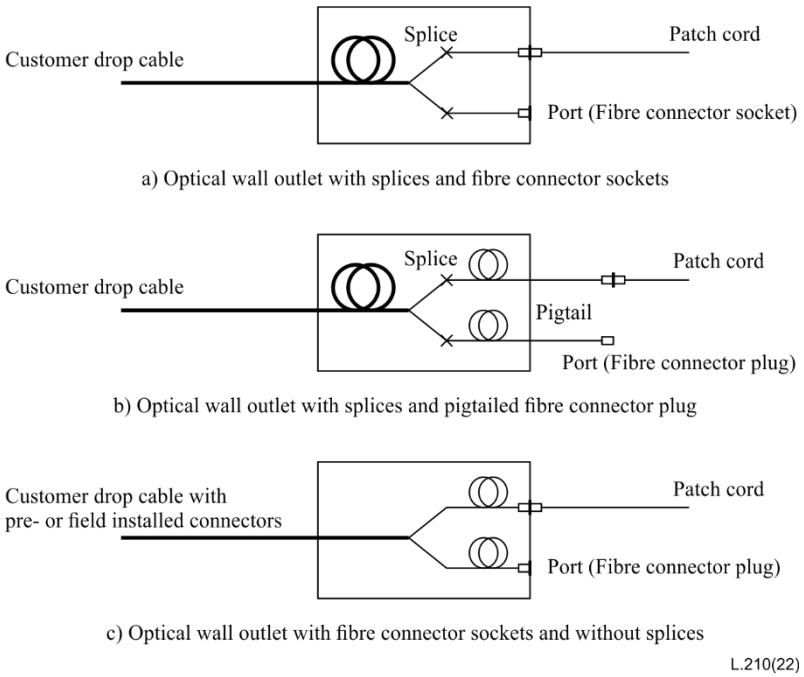


Figure 1 – Examples of typical optical wall outlet applications

Examples of extender box applications are shown in Figure 2.

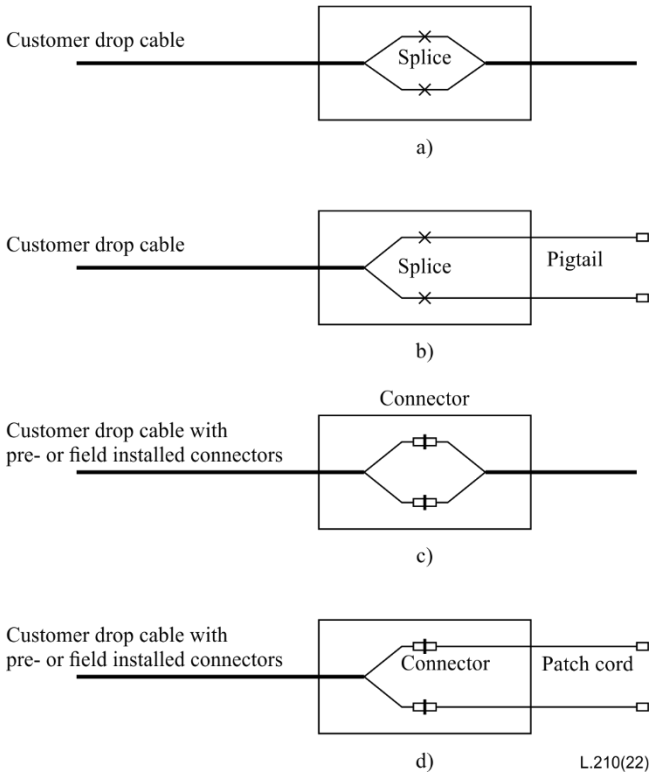
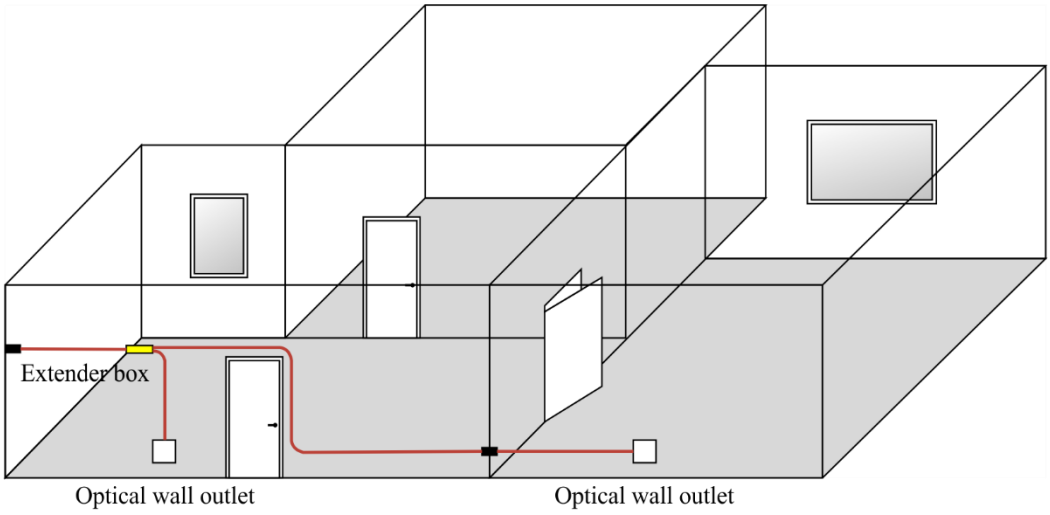
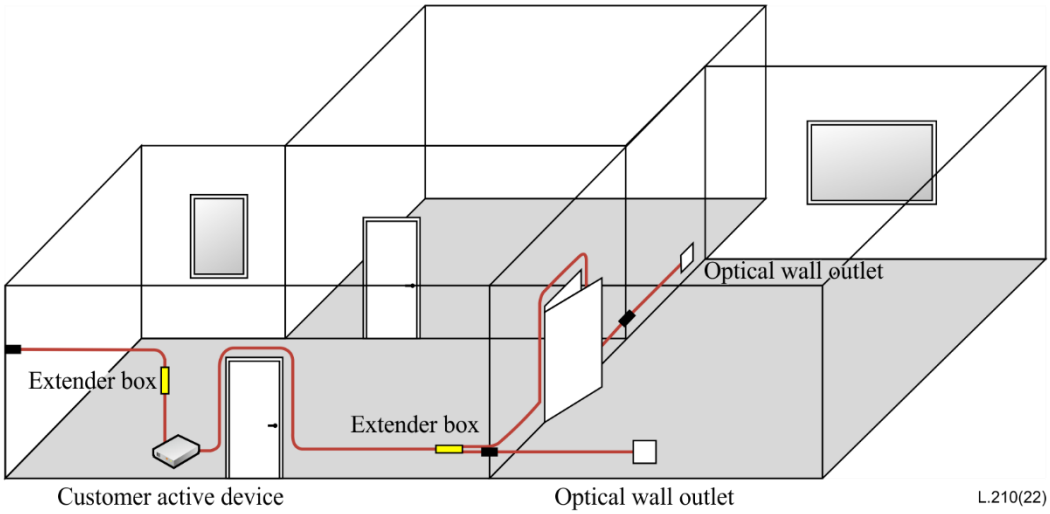


Figure 2 – Examples of typical extender box applications –
a) and b) Extender boxes with splices; c) and d) Extender boxes with connectors

Examples of locations of nodes for customer indoor premises are shown in Figure 3.



a) Nodes for customer indoor premises in typical FTTH system



b) Nodes for customer indoor premises in typical FTTH and FTTR system

Figure 3 – Examples of locations of nodes for customer indoor premises

6.2 Housing

The following should be considered:

– the housing of a node for customer indoor premises is of small size and light weight. In order to facilitate universal installations in customer indoor premises or replacement of existing outlets, the optical wall outlet housing typically has the same outer dimensions as the housing of a power or a copper wall outlet. The extender box housing usually has small dimensions and light weight, so that when it is directly mounted to an optical cable, without any other fixtures or bearers, the cable performance is not affected;

– the housing should be re-openable and can be reused for installation, maintenance or reconfiguration. Interruptions to existing circuits during the interventions are not desirable, but they are not restricted;

– after being installed (with possible secondary protections), the housing protection level should comply with the requirements of IP30 or higher [IEC 60529] for indoor temperature controlled (IC) and indoor non-temperature controlled (IN) applications;

– the housing should allow for multiple entries of customer drop cables, pigtails/patch cords, or allow for installations of connector adapters, depending on various applications. Cable entry points and optical ports visible to the customer should allow for sealing. The cable entry points of optical wall outlets could be large holes when they are hidden inside the wall, a desk or other furniture. Strain relief and bend radius should be guaranteed for incoming and outgoing fibres;
– the housing should allow for attachment of cable ends. The cable's metallic elements should be insulated with respect to other metallic parts of the node. If required, the housing should allow for bonding and grounding for all metallic elements of the cable. Further information is given in [ITU-T K.11], [ITU-T K.47] and [IEC 62368-1];
– the housing structure should support one or more mounting methods. The optical wall outlet housing could be surface mounted or flush mounted on the wall, desk or other furniture. The extender box housing could be directly attached to the cable link, while it may further be mounted to surface of wall, desk or other furniture. Accessories may be required for the mountings;
– if the housing supports more than one outgoing cable or optical ports, it should provide means for correct identification from the outside;
– the housing should be made from engineering plastic, metal or other suitable materials. The materials used should ensure fire safety of the node. The housing may include flame retardant material to help limit toxic gases and smoke when burning. Fire performance requirements may differ from country to country. The node should meet fire safety regulations in each country and be in accordance with each telecommunication carrier. The materials used should also comply with other local safety, health or environment friendly regulations.

6.3 Fibre management system

The fibre management system (FMS) is an integral part of the node for guiding, protecting and storing fibres, connectors and passive components inside the node, as described in [IEC 61756-1]. It may consist of some internal structures of the housing and/or some independent components. Compatibility and features of FMS can be listed by using the checklist in Appendix I. The desired optical stability type can be selected according to [ITU-T L.200].

The following should be considered:

– the FMS should provide means for routing, storing and protecting fibres, and / or fibre joints (splices or connectors) or other passive optical components (e.g., splitters) in a predetermined order;
– the FMS should provide means for installation and reconfiguration of fibre circuits;
– the FMS might provide means for storing excess cable/fibre overlength required for jointing and possible re-jointing in the future;
– the FMS should ensure the recommended minimum bend radius of the stored fibres for the application as specified by [IEC 61756-1] or [b-ITU-T G Suppl.59]. General applications with ITU-T G.652 fibres use a typical minimum bend radius of 20 mm. In the case of ITU-T G.657 A1, A2 and B2 fibres, a typical minimum bend radius not less than 15 mm is recommended;
– if required, the FMS should provide an identification method for the stored fibre and fibre joints for correct access during maintenance and reconfiguration;
– the materials used for making the FMS should be compatible with other materials in the node and the degreasing agents as recommended in the installation instructions.

6.4 Eye safety

Laser hazard level is defined in [IEC 60825-2] for the area where the customer might be exposed to the laser beam from the optical fibre. If the hazard level is higher than 1, a warning sign is

recommended to be shown. Hazard level 1 corresponds to an optical power of 10 mW or less at 1 550 nm. It is considered that a recent optical communication system uses a signal exceeding 100 mW. The optical power transmitted at a network node may exceed the hazard level 1, and the beam may cause eye damage when the customers look into the optical connector end face. In order to prevent eye hazard, the nodes are recommended to have safety measures such as a light shielding shutter so that the laser beam does not leak in the absence of an optical connector. More detailed information can be found in [IEC 60825-1] and [IEC 60825-2].

7 Performance evaluation test programme

The complete test programme for a node for customer indoor premises consists of:

– a basic test programme for the applicable environment (see Annexes A and B);

– a number of additional requirements according to local standards when necessary (see [ITU-T L.200] and the checklist in Appendix I).

For specific products, alternative test conditions to those given in Annex B may be agreed between customer and supplier.

Tests should be executed according to IEC 61300-2 test methods where available.

The performance test programme of a node for customer indoor premises should:

– evaluate the product for two groups of criteria: mechanical and sealing evaluation and optical stability (see Annex A);

– simulate the effects of exposure to:
  - the environment in which it will be installed;
  - an intervention at the node;

– simulate installation or maintenance conditions;

– evaluate all available features of the product.

When a node is suitable for both IC and IN environments, it should pass the most severe conditions of either environment. As an alternative, the tests that are different for each of these environments may be duplicated at both settings.

Two types of optical stability can be selected (see clause 6.2.1 of [ITU-T L.200]).

8 Sample preparation

A representative number of test samples should be prepared considering all product features and compatibility (see checklist in Appendix I) and applicable sizes of cables.

For sealing and optical performance, the test samples should be installed at room temperature for IC and IN applications.

For mechanical evaluation, a fresh sample should be prepared for each different test. If a failure occurs when consecutive testing is applied on the same sample, the failed test may be repeated on a fresh sample.

Appendix I of [ITU-T L.200] illustrates how optical test samples can be prepared. Due to their complexity, consecutive testing on the same sample is most practical.

Annex A

Performance evaluation criteria

(This annex forms an integral part of this Recommendation.)

A.1 Mechanical and sealing evaluation

The performance evaluation criteria should be assured during or after tests in Annex B.

A.1.1 Sealing performance

International standard:	[IEC 60529]
Conditions:	Conditions according to protection degree of the node: IP30 or higher.
Requirement:	Meet the requirements of the protection degree of the node: IP30 or higher.

A.1.2 Visual examination

International standard:	[IEC 61300-3-1]
Conditions:	Examination of product with the unaided naked eye.
Requirement:	No defects and physical damages which would affect product performance.

A.2 Optical evaluation

All optical losses indicated are referenced to the initial optical signal at the start of the test. An "incoming fibre" is defined as a part of an optical circuit containing the fibre entering the product, spliced to a fibre leaving the product. One optical circuit can contain many "incoming fibres". Light will sequentially flow through all the "incoming fibres".

A.2.1 Fibre type used for optical evaluation

Fibre type used for single mode fibre node optical evaluation: [ITU-T G.652] D fibre for nodes with minimum bend radius no less than 20 mm; [ITU-T G.657] A1 fibre for nodes with minimum bend radius smaller than 20 mm and no less than 15 mm. The applications with other fibre types will be qualified by similarity.

A.2.2 Change in attenuation (insertion loss) (static optical stability)

International standard:	[IEC 61300-3-3] Method 1
Conditions:	Source wavelength: 1 310, 1 550 and 1 625 nm
Requirements:	**If only splices are part of the optical path**: $\Delta IL \leq 0.2$ dB (1 310/1 550 nm) per incoming fibre during the test (excursion loss); $\Delta IL \leq 0.5$ dB (1 625 nm) per incoming fibre during the test (excursion loss); $\Delta IL \leq 0.1$ dB (1 310/1 550/1 625 nm) per incoming fibre after the test (residual loss).

If optical connectors are part of the optical path:

$\Delta IL \leq 0.2$ dB (1 310/1 550 nm) per incoming fibre during the test (excursion loss);

$\Delta IL \leq 0.5$ dB (1 625 nm) per incoming fibre during the test (excursion loss);

$\Delta IL \leq 0.2$ dB (1 310/1 550/1 625 nm) per incoming fibre after the test (residual loss).

If other passive optical components are part of the optical path, the above-mentioned change in attenuation values should be increased with the maximum allowed change in attenuation value specified for this passive optical component. For wavelength selective components the test wavelength might have to be changed to the operating wavelength(s) of the component(s).

A.2.3 Transient loss (dynamic optical stability)

International standard:	[IEC 61300-3-28]
Conditions:	Source wavelength: 1 310, 1 550 and 1 625 nm. Measurements at 1 550 nm and 1 625 nm are particularly important for dynamic transient loss. 1 310 nm is optional, subject to agreement between customer and supplier, unpolarised.
Requirements:	**If only splices are part of the optical path**: $\Delta IL \leq 0.5$ dB (1 310/1 550 nm) during the test measured in the live circuit (transient loss); $\Delta IL \leq 1.0$ dB (1 625 nm) during the test measured in the live circuit (transient loss); $\Delta IL \leq 0.1$ dB (1 310/1 550/1 625 nm) after the test in the live circuit (residual loss). **If optical connectors are part of the optical path**: $\Delta IL \leq 0.5$ dB (1 310/1 550 nm) during the test measured in the live circuit (transient loss); $\Delta IL \leq 1.0$ dB (1 625 nm) during the test measured in the live circuit (transient loss); $\Delta IL \leq 0.2$ dB (1 310/1 550/1 625 nm) after the test in the live circuit (residual loss). If other passive optical components are part of the optical path, the above-mentioned change in attenuation values should be increased with the maximum allowed change in attenuation value specified for this passive optical component. For wavelength selective components the test wavelength might have to be changed to the operating wavelength(s) of the component(s).

Annex B

Performance test programme for indoor temperature controlled (IC) and indoor non-temperature controlled (IN) nodes

(This annex forms an integral part of this Recommendation.)

For tests in this annex, the test settings are applicable for environments IC and IN unless specifically indicated. All testing is at room temperature unless otherwise stated. When sealing performance evaluation for dust and water ingress is required, it can be performed after all related tests have been finished, instead of after each of the tests. The performance criteria of visual examination, sealing performance, and static and dynamic optical evaluation are in accordance with Annex A, if not otherwise specified in this annex. For the optical evaluations in clause B.2, the requirements for static or dynamic optical stability are to be agreed between customer and supplier, and the appropriate optical performance criteria are to be selected accordingly.

B.1 Mechanical and sealing evaluation

B.1.1 Cable retention force (IC and IN)

International standard:	[IEC 61300-2-4]
Conditions:	Install cables of appropriate type on the node; Load: 25 N on cables or cords; Test time: 1 min per cable/cord.
Performance criteria:	Sealing performance; Visual appearance.

B.1.2 Cable bending (IC and IN)

International standard:	[IEC 61300-2-37]
Conditions:	Install cables of appropriate type on the node; Bending angle −90° and +90°; Point of application: 400 mm from end of seal; Duration at extreme position: 5 minutes; Number of cycles: 5 per cable/cord.
Performance criteria:	Sealing performance; Visual appearance.

B.1.3 Cable torsion (IC and IN)

International standard:	[IEC 61300-2-5]
Conditions:	Install cables of appropriate type on the node; Torsion angle: −180° and +180°; Torque application: 400 mm from end of seal; Duration at extreme position: 5 minutes; Number of cycles: 5 per cable/cord.
Performance criteria:	Sealing performance; Visual appearance.

B.1.4 Impact (IC and IN)

International standard:	[IEC 61300-2-12] Method B.
Conditions:	Impact tool: Steel ball; Weight: 1 kg; Drop height: 0.2 m; Location: centre of largest surface for optical wall outlets, typically the front cover; centre at 0°, 90°, 180° and 270° around longitudinal axis for extender boxes. 0° should be at one of the largest longitudinal surfaces (if there are any); Number of impacts: 1 per location.
Performance criteria:	Sealing performance; Visual examination: No evidence of cracks and deformations, surface protective layer (if there is one) does not fall off, scratches on surface can be ignored.

B.1.5 Crush (IC and IN, only for extender box)

International standard:	[IEC 61300-2-10]
Conditions:	Load: 100 N; Location: 0°, 90° around longitudinal axis for drop cable closures. 0° should be at one of the largest longitudinal surfaces (if there are any).
Performance criteria:	Sealing performance; Visual examination: No evidence of cracks and deformations, surface protective layer (if there is one) does not fall off, scratches in surface can be ignored.

B.1.6 Drop (IC and IN, only for extender box)

International standard:	None.
Conditions:	Height: 1.5 m; Application: drop freely to concrete ground; Number of tests: 5.
Performance criteria:	Sealing performance; Visual examination: No evidence of cracks and deformations, surface protective layer (if there is one) does not fall off, scratches in surface can be ignored.

B.1.7 Change of temperature (IC and IN)

International standard:	[IEC 61300-2-22]
Conditions (see Note):	Lowest/highest temperature: (+5 ± 2) °C / (+40 ± 2) °C for IC; (−10 ± 2) °C /+60 ± 2) °C for IN; Humidity: uncontrolled; Dwell time: 4 hours; Transition: 1 °C/minute; Number of cycles: 5 cycles.
Performance criteria:	Sealing performance; Visual appearance.

NOTE – Temperature ranges for the change of temperature tests are recommended for global usage. Adaptations to specific local conditions can be agreed between customer and supplier. Humidity could also be considered. If considered, a temperature-humidity cycle test could be performed according to [IEC 61300-2-48].

B.1.8 Re-entries (IC and IN)

International standard:	[IEC 61300-2-33]
Conditions:	Open the seal and gain access to fibres and joint points at each re-entry; Aging between each re-entry: at least one thermal cycle (See clause B.1.7); Number of re-entries: 5
Performance criteria:	Sealing performance; Visual appearance.

B.2 Optical evaluation

Construction of optical samples is according to Appendix I of [ITU-T L.200].

B.2.1 Cable retention force (IC and IN)

International standard:	[IEC 61300-2-4]
Conditions:	Install cables of appropriate type on the node; Load: 25 N on cables or cords. Test time: 1 min per cable/cord.
Performance criteria:	Static: Change in attenuation (residual loss).

B.2.2 Cable bending (IC and IN)

International standard:	[IEC 61300-2-37]
Conditions:	Install cables of appropriate type on the node; Bending angles –90° and +90°; Point of application: 400 mm from end of seal; Duration at extreme position: 5 minutes; Number of cycles: 5 per cable/cord.
Performance criteria:	Static: Change in attenuation (residual loss).

B.2.3 Cable torsion (IC and IN)

International standard:	[IEC 61300-2-5]
Conditions:	Install cables of appropriate type on the node; Torsion angles: –180° and +180°; Torque application: 400 mm from end of seal; Duration at extreme position: 5 minutes; Number of cycles: 5 per cable/cord.
Performance criteria:	Static: Change in attenuation (residual loss).

B.2.4 Intervention at a node (IC and IN)

International standard:	[IEC 61300-2-33]
Conditions:	Execute all manipulations that will normally occur for this product during an intervention after initial installation. A List of typical manipulations can be found in Appendix II of [ITU-T L.200].
Performance criteria:	Visual appearance; Static: Change in attenuation (residual loss).

B.2.5 Vibration (IC and IN)

International standard:	[IEC 61300-2-1]
Conditions:	Sweep range: 5 Hz – 500 Hz sinusoidal at 1 octave/minute; Crossover frequency: 9 Hz; – amplitude below 9 Hz: 1.5 mm; – acceleration above 9 Hz: 5 m/s^2 (~0.5 g); Axes: 3 mutually perpendicular axes; Duration: 10 cycles (5-500-5 Hz)/axis.
Performance criteria:	Visual appearance; Static: Change in attenuation (residual loss); Dynamic: Transient loss.

B.2.6 Shock (IC and IN)

International standard:	[IEC 61300-2-9]
Conditions:	Wave form: Half sine; Duration: 11 ms; Acceleration: 150 m/s^2 (~15g); Axes: 3 mutually perpendicular axes; Number of shocks: 3 up and 3 down per axis.
Performance criteria:	Visual appearance; Static: Change in attenuation (residual loss); Dynamic: Transient loss.

B.2.7 Change of temperature (IC and IN)

International standard:	[IEC 61300-2-22]
Conditions (See Note):	Lowest/highest temperature: (+5 ± 2) °C / (+40 ± 2) °C for IC; (–10 ± 2) °C /+60 ± 2) °C for IN; Humidity: uncontrolled; Dwell time: 4 hours; Transition: 1 °C/minute; Number of cycles: 5 cycles.
Performance criteria:	Visual appearance; Static: Change in attenuation (excursion and residual loss).

NOTE – Temperature ranges for the change of temperature tests are recommended for global usage. Adaptations to specific local conditions can be agreed between customer and supplier. Humidity could also be considered. If considered, a temperature-humidity cycle test could be performed according to [IEC 61300-2-48].

Appendix I

Product characterization checklist

(This appendix does not form an integral part of this Recommendation.)

This checklist facilitates the systematic characterization of the features and capabilities of a node for customer indoor premises. It reflects the parameters that are described in [ITU-T L.200]. It may be useful for preparation of the products' test programme as well as product description for tenders and purchasing specifications, comparison of different or competitive products and creation of commercial information and ordering guides.

Product name: .....

Material of node housing

☐ Engineering plastic
☐ Metal
☐ Other: …….....

Application Environment(s) (see clause 7.1 of [ITU-T L.200])

☐ IC Indoor temperature controlled level
☐ IN Indoor non-temperature controlled level
☐ E Extreme (describe differences versus a basic environmental class)

IP protection class

☐ IP30
☐ Other: …….....

Optical functionality & compatibility (see clause 6 of [ITU-T L.200])

– ***optical stability level****:*

☐ Static
☐ Dynamic (transient free)

– ***wavelength*** (see clause 6.3 of [ITU-T L.200])

☐ 1310 nm
☐ 1550 nm
☐ 1625 nm
☐ Other: …….....

– ***cable construction*** (see clause 6.1.1 of [ITU-T L.200])

☐ Loose buffer tube
☐ Micro-sheath
☐ Central core
☐ Slotted core
☐ Blown fibre
☐ Break out cable
☐ Interfacility cable
☐ Other: .....

– ***fibre type, fibre grouping, fibre coating*** (see clause 6.1.2 of [ITU-T L.200])

☐ Single mode
☐ Bending loss insensitive single mode fibre

☐ Ribbon 4
☐ other: ….....

☐ Primary coated (µm): ….....
☐ Secondary coated (µm): ….....

– ***passive devices*** (see clause 6.1.3 of [ITU-T L.200]):

☐ Splice type: ☐ Fusion
☐ Mechanical (brand/type): .....

☐ Splice protector type:
☐ Heatshrink (min/max dimensions): .....
☐ Mechanical (brand/type): .....

☐ Connectors: specify brand/type: .....

☐ Branching devices: (describe type, split ratio etc.): .....
Delivered as preassembled/pre-fibred modules ☐ yes ☐ no

☐ Other passive devices: (describe) .....
Delivered as preassembled/pre-fibred modules ☐ yes ☐ no

– ***fibre storage and separation level*** (see clause 6.2.2 of [ITU-T L.200])

	Circuit separation level			
	None	**SR**	**SC**	**SF**
☐ Uncut fibre (looped fibre)	☐	☐	☐	☐
☐ Splices	☐	☐	☐	☐
☐ Passive optical components	☐	☐	☐	☐
☐ Other:	☐	☐	☐	☐

Additional or special requirements and features

– ***storage/transport conditions*** (see clause 7.2 of [ITU-T L.200])

☐ Normal: public transport – indoor storage
☐ Special handling/transport: .....
☐ Special storage: .....

– ***additional (conditional) requirements*** (see Appendix III of [ITU-T L.200]):

☐ Earthquake resistance according to: .....
☐ Freeze-thaw resistance according to: .....
☐ Fire-related performance according to: .....
☐ Fire Retardancy according to: .....
☐ Halogen free according to: .....
☐ Low smoke emission according to: .....
☐ Electrical grounding and shield continuity according to: .....
☐ Current surge according to: .....
☐ Insulation resistance according to: .....

☐ Rodent resistance	according to: .....
☐ Termite resistance	according to: .....
☐ Steam resistance	according to: .....
☐ Cable blocking	according to: .....
☐ Other:	according to: .....

Appendix II

Japanese experience – optical wall outlets (flush mounted and surface mounted) in Japan

(This appendix does not form an integral part of this Recommendation.)

II.1 Introduction

This appendix provides examples of nodes for customer indoor premises. In Japan, nodes for customer indoor premises are classified in optical wall outlets (flush mounted and surface mounted). They are interfaces for connecting an optical drop cable that is pulled from the outside and optical cords that connect with ONUs in a premises. The end of the optical drop cable is terminated by an optical connector (SC type optical connector in general) and the adapter of this connector is mounted in the optical nodes. Using the optical nodes, it is possible to connect the optical drop cable and ONUs in the customer's premises with the optical cords with a single gesture. Since the eye may be damaged by the laser beam when the customers look into the optical connector end face, the nodes have safety measures such as a light shielding shutter so that the laser beam does not leak in the absence of an optical connector.

II.1.1 Optical wall outlet (flush mounted)

The optical wall outlet (flush mounted) is installed in the wall of the customer premises as done with electrical outlets. An example of a flush mounted optical wall outlet is shown in Figures II.1 and II.2.

Figure II.1 – Picture of optical wall outlets (flush mounted)

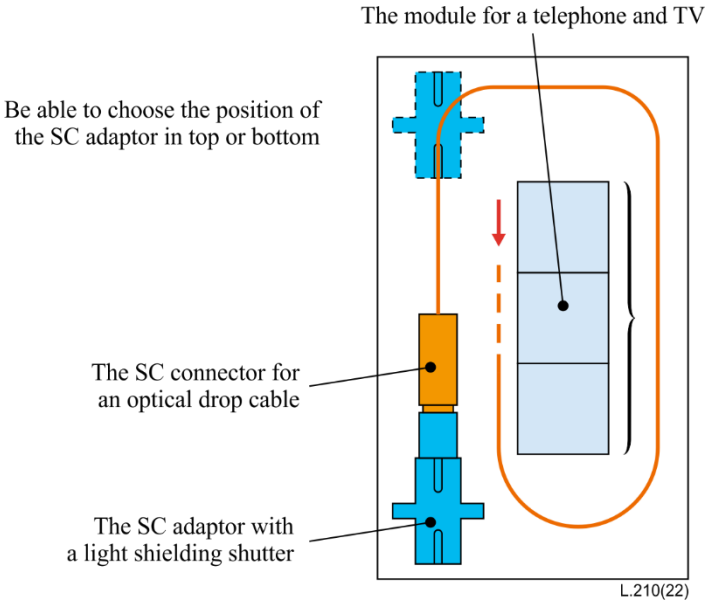


Figure II.2 – Schematic structure of an optical wall outlet (flush mounted)

II.1.2 Optical wall outlet (surface mounted)

The optical wall outlet (surface mounted) is an optical wall outlet that is exposed, and which has been installed in the customer's premises with minimal damage to the wallpaper. It is mainly used when the ONU has been installed in the premises without an outlet for the drop cable, or when the flush mounted type is not allowed because of rental restrictions or other reasons. Examples of surface mounted optical wall outlets are shown in Figures II.3 and II.4.

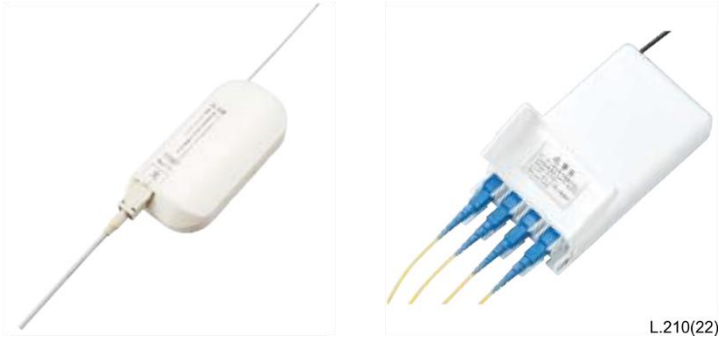


Figure II.3 – Picture of optical wall outlets (surface mounted)

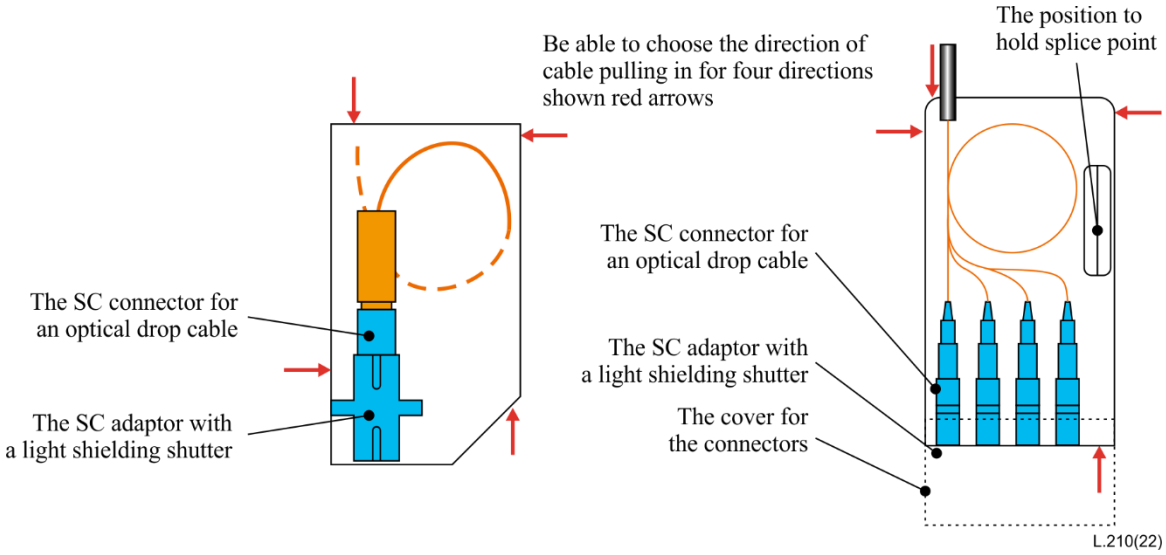


Figure II.4 – Schematic structure of optical wall outlets (surface mounted)

II.2 Light shielding shutter

Light shielding shutters can be classified into automatic type or manual type. An automatic shutter opens and closes automatically when the customer plugs or unplugs the connector into or from the adaptor. In the case of a manual shutter, the customer opens the shutter manually before the connector is pushed into the adaptor, and closes the shutter manually after the connector is pulled out of the adaptor. Figure II.5 gives examples of automatic and manual shutters.

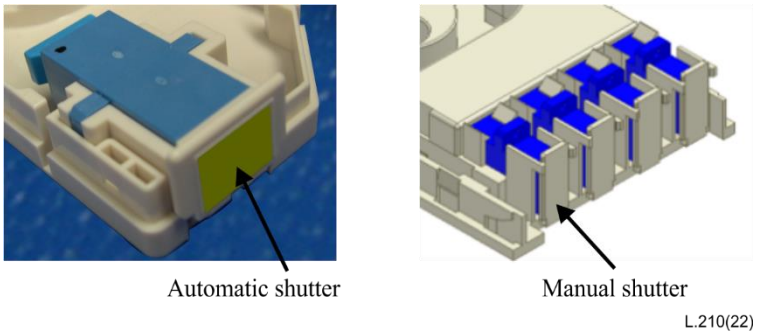


Figure II.5 – Example of shutters

II.3 Solution components 1 – Optical wall outlet (flush mounted)

An optical wall outlet (flush mounted) includes one port of the single circuit (SC) type connector adaptor, a telephone and TV module, and some electrical outlets. The adaptor comprises an automatic shutter to ensure eye safety. For the metallic parts of the shutter, the resistance to corrosion is confirmed according to [b-IEC 61300-2-26]. Additionally, the grade of sealing performance is IP5X, and that of flammability is equal to or higher than the one given in [b-UL94V-0].

The key characteristics are shown in Table II.1.

Table II.1 – Optical wall outlet (flush mounted) key characteristics

Characteristics	Description		
Type of connector	SC Type		
Shielding shutter	Automatic shutter		
Number of connectors	1		
Direction of cable pulling in	Back		
Number of electrical outlets	2	4	6
Dimension (W×H×D mm)	W78×H120×D14	W126×H120×D14	W172×H120×D14
Sealing performance	IP5X		
Flammability	Equal to or higher than the one given in [b-UL94V-0]		
Resistance to corrosion	There is no visual change in the conditions below. Exposure to a salt mist of 5% NaCl in water; pH between 6.5 and 7.2; Temperature: (+35 ± 2) °C; Duration: 48 hours.		

II.4 Solution components 2 – Optical wall outlet (surface mounted)

An optical wall outlet (surface mounted) has several ports with SC type connector adaptors. The adaptors are installed with light shielding shutters for eye safety. There are two kinds of adaptors. One has an automatic shutter, and the other has manual shutters. In the case of the optical wall outlet (surface mounted) with automatic shutter, the resistance to corrosion of the metallic parts of the shutter is confirmed according to [b-IEC 61300-2-26]. As there is no metallic material in optical wall outlets (surface mounted) with manual shutter, the test for resistance to corrosion is not needed. Additionally, the grades of sealing performance for the optical wall outlets (surface mounted) with automatic shutter and manual shutter are IP5X and IP4X, respectively, and the grades of flammability are equal to or higher than the one given in [b-UL94V-0] for both types of surface mounted optical wall outlets.

The key characteristics are shown in Table II.2.

Table II.2 – Optical wall outlet (surface mounted) key characteristics

Characteristics	Description	
Type of connector	SC type	SC type
Shielding shutter	Automatic shutter	Manual shutter
Number of connectors	1	2 or 4
Direction of cable pulling in	4 directions (top, bottom, right and left side)	4 directions (top, bottom, right and left side)
Dimensions (W×H×D mm)	W48×H99×D17.5	W76×H165×D26
Sealing performance	IP5X	IP4X
Flammability	Equal to or higher than the one given in [b-UL94V-0]	Equal to or higher than the one given in [b-UL94V-0]
Resistance to corrosion	There is no visual change after performing the following test: Exposure to a salt mist of 5% NaCl in water; pH between 6.5 and 7.2; Temperature: (+35 ± 2) °C; Duration: 48 hours.	–

Appendix III

Chinese experience – Extender boxes and optical wall outlets

(This appendix does not form an integral part of this Recommendation.)

III.1 Introduction

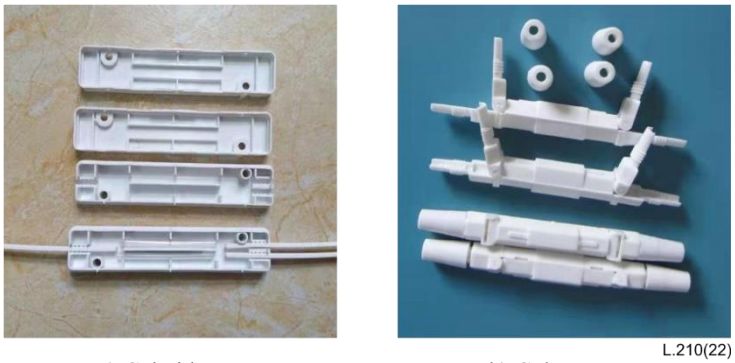
This appendix provides examples of nodes for customer indoor premises in China.

According to China local restrictions, every customer unit in a new building should have at least one fibre to the home (FTTH) fibre. Normally, a drop cable with 1 or 2 fibres is pre-installed and ends at an in-wall space called "information box". For existing buildings, drop cables are pulled to and coiled in small storage boxes near customer units, then pulled into the living units through wall entry holes when the customer subscribes the service. In both cases, an extender box can be used to extend the drop cable to one or two pigtails for ONUs. The extender boxes can also be used to repair indoor cabling systems.

In some customer units, especially those for businesses, offices or public services, wall outlets are installed for movable connections between the drop cables and cords for ONUs or other user terminals in FTTH, fibre to the room (FTTR) and fibre to the x (FTTx) systems.

III.2 Extender box

There are many designs for the extender boxes. The most used designs are presented in Figure III.1. Normally, the housing is non-metallic, but some designs use metal housings. Non-metallic housings should be flame-retardant. The typical length of the box is 10 cm to 12 cm. Extender boxes can be 1-in-1-out or 1-in-2-out. Most boxes have inner structures to fasten fibre splice(s), and some have inner structures to fasten connectors, as shown in Figure III.2.



a) Cuboid type b) Column type

Figure III.1 – Example of extender boxes

Figure III.2 – Extender boxes for connectors

III.3 Optical wall outlet

Optical wall outlets can be flush mounted or surface mounted. Flush-mounted wall outlets usually have square front panels with a side length of 86 mm, so they are also called "86 boxes". The dimensions of the front panel and the in-wall structure are the same as regular power wall outlets and copper cable wall outlets, allowing construction workers to build all in-wall holes the same way. An example of the inner structure of a flush mounted optical wall outlet is shown in Figure III.3. The in-wall part and the front panel can be non-metallic or metallic. The non-metallic housing should be flame-retardant. The optical socket (adapter) can be located at the bottom or in the front panel of the box. SC and dual LC connectors are mostly used. There are also designs of hybrid outlets for fibres and balanced cables or fibres and CATV coaxial cables.

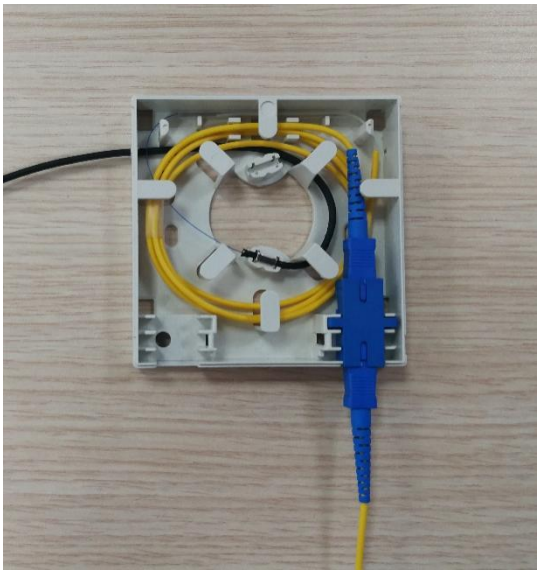


Figure III.3 – Example of inner structure of flush-mounted optical wall outlet

Appendix IV

Chinese experience – Optical wall outlets with splitters in an FTTR solution

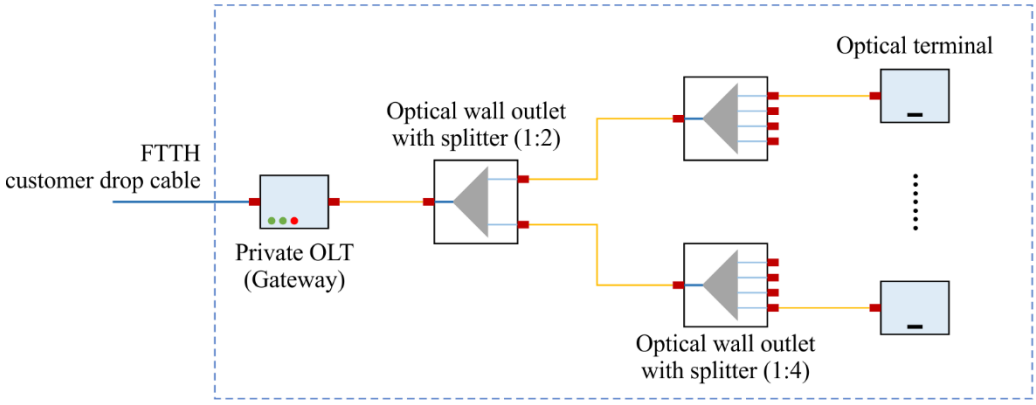
(This appendix does not form an integral part of this Recommendation.)

IV.1 Introduction

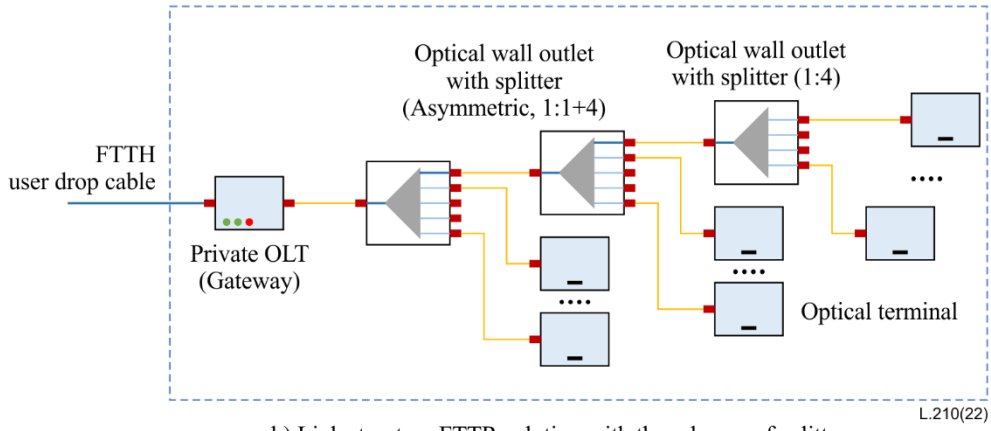
The requirements of broadband services have been growing rapidly in recent years. In houses or mansions with multiple rooms, a small number of wireless local area network equipment does not provide good coverage. In this case, FTTR solutions could provide complete coverage with a private optical line terminal (OLT) (gateway) cooperating with multiple optical termination equipment and an in-premises optical cabling system. Optical wall outlets with splitters can be used in the solution for a) branching optical power; b) increasing link loss to accommodate the power limit of optical transceivers.

IV.2 Optical wall outlets with splitters in FTTR solution

Examples of FTTR solutions with splitters are shown in Figure IV.1. Figure IV.1 a) shows an example of a tree structure FTTR. In this structure, one or more layers of equal ratio splitters are used and normally installed in optical wall outlets. Figure IV.1 b) shows an example of link structure FTTR. In this structure, one or more pass-through splitters with asymmetric splitting ratio (1 pass-through port with 70% or 80% of total optical power, and 2 to 4 branching ports sharing the remaining optical power) together with one terminal splitter with equal splitting ratio are used and also installed in optical wall outlets. These two structures can also be mixed. An example of optical wall outlet with an asymmetric ratio splitter is shown in Figure IV.2.



a) Tree structure FTTR solution
(Two-layer equal ratio optical splitting, first layer: 1:2, second layer: 1:4)



b) Link structure FTTR solution with three layers of splitters
(First and second layer: Asymmetric splitting ratio, 1:1+4; Third layer: Equal splitting ratio, 1:4)

Figure IV.1 – Examples of FTTR solutions with splitter

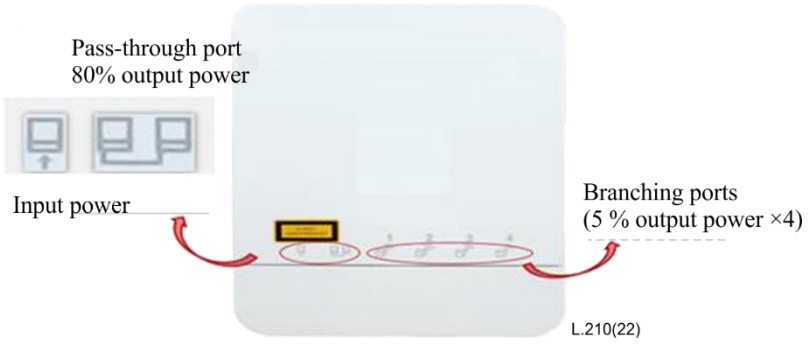


Figure IV.2 – Example of optical wall outlet with asymmetric ratio splitter

Appendix V

Indian experience – Subscriber premises box (SPB) for home termination

(This appendix does not form an integral part of this Recommendation.)

V.1 Introduction

This appendix gives examples of typical subscriber premises box (SPB) for home termination to provide management of optical fibres, cables, and connector/adapter assemblies for customer indoor premises. The SPB provides facilities for reconfiguration of fibres, network expansion, testing and storing extra length of fibres and pigtails, and has provision for cable termination and sealing requirements.

V.2 Subscriber premises box (SPB) (Type-I in [b-TEC 87030])

This type of wall mountable box is typically installed in the subscriber's premises as defined in [b-TEC 87030]. Termination up to four fibres is possible. Termination can be done by fusion splicing, by pre-polished connectors or by pre-connectorized cable. Provision for holding splice and connector adapter is available in the box. Figures V.1 and V.2 show typical examples of distribution of SPB on a building floor and on a single residential unit cluster, respectively.

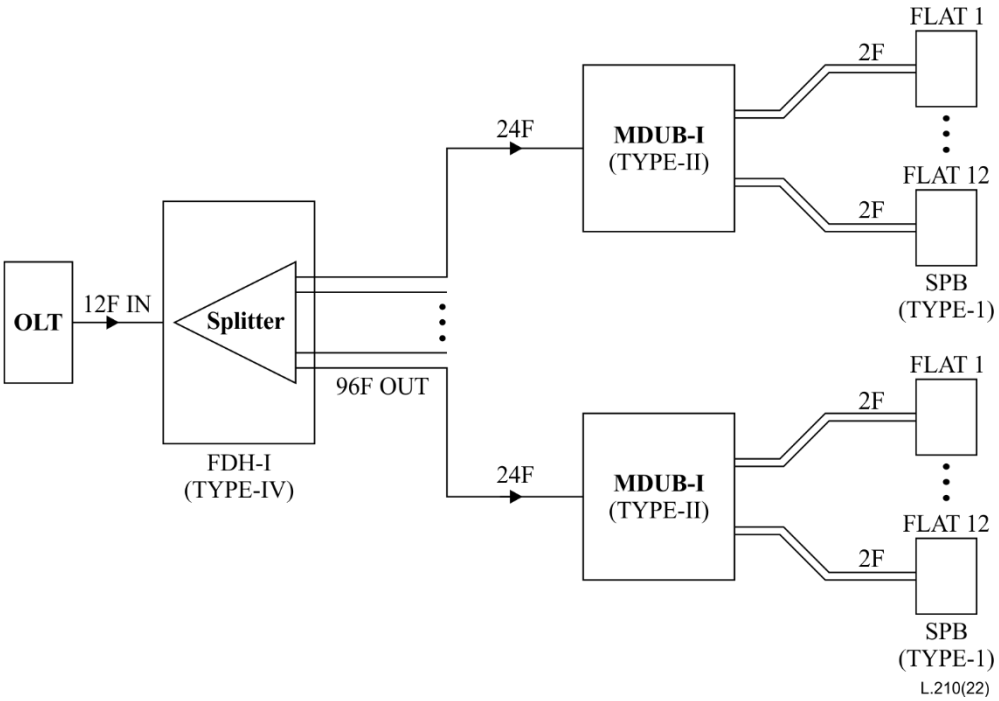


Figure V.1 – Typical example of distribution on a building floor

NOTE

1) In Figure V.1, Multi dwelling unit box – Indoor (MDUB-I) shows 12 outgoing cables of 2F. It can be any combination of cables depending on the actual site requirements provided the total number of outgoing fibres does not exceed 24.

2) The Fibre distribution hub – Indoor (FDH-I) will house splitter modules. It will have 12 incoming fibres and up to 96 outgoing fibres.

3) MDUB-I (Type-II) and FDH-I (Type-IV) are described in [b-ITU-T L.208].

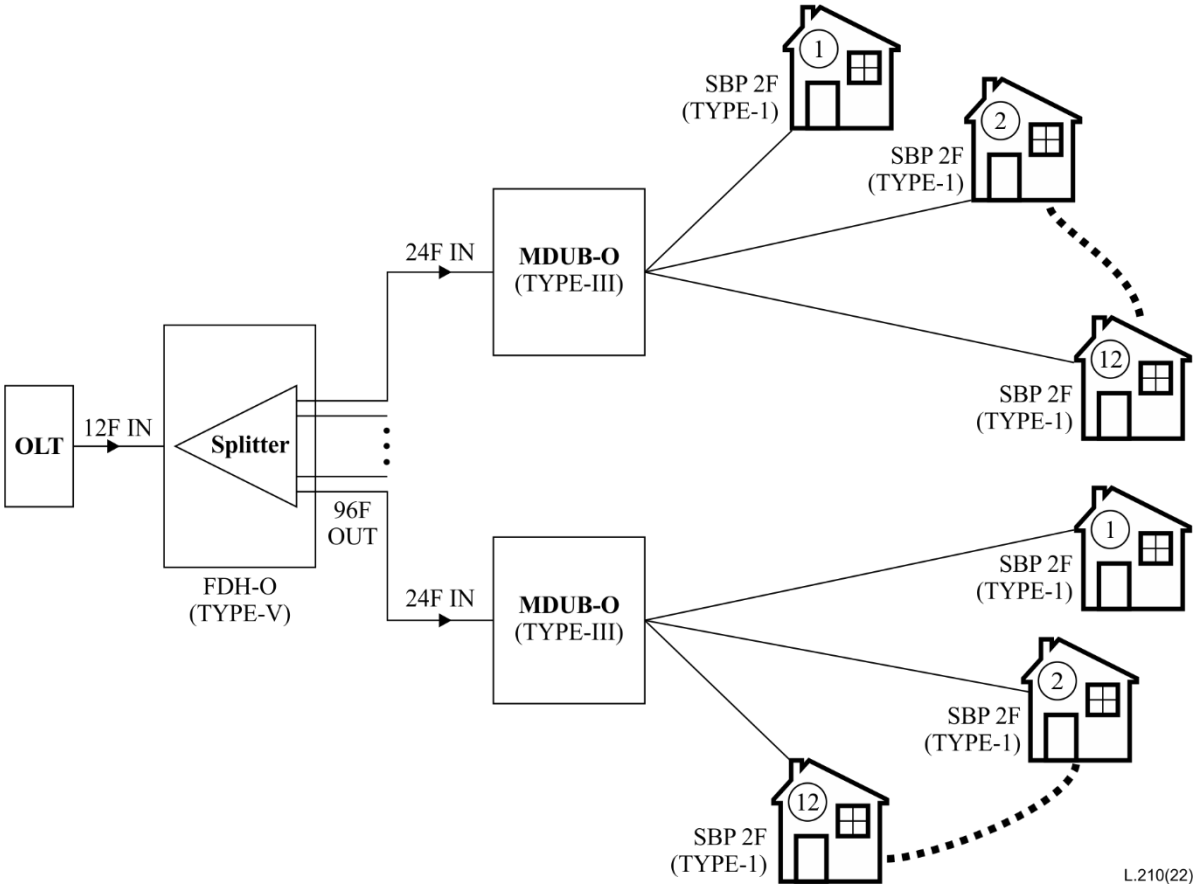


Figure V.2 – Typical example of distribution on a single residential unit cluster

NOTE

1) In Figure V.2, Multi dwelling unit box – Outdoor (MDUB – O) shows 12 outgoing cables of 2F. It can be any combination of cables depending on the actual site requirements provided the total number of outgoing fibres does not exceed 24.

2) The Fibre distribution hub – Outdoor (FDH-O) will house splitter modules. It will have 12 incoming fibres and up to 96 outgoing fibres.

3) MDUB-O (Type–III) and FDH-O (Type-V) are described in [b-ITU-T L.208].

V.3 Attributes of SPB

Various attributes of SPB are listed in Table V.1 to specify different types of SPB.

Table V.1 – Attributes of SPB

SN	Attributes	Type
1	Material of construction (PC, ABS, PC+ABS) PC = Polycarbonate PP = Poly Propylene ABS = Acrylonitrile Butadiene Styrene	User to specify
2	IP rating (As per [IEC 60529])	IP 30 or better
3	Installation location	Indoor
4	Fixture type	User to specify
5	Length (mm) without entry / exit ports	User to specify
6	Width (mm)	User to specify
7	Depth (mm)	User to specify

Table V.1 – Attributes of SPB

SN	Attributes	Type
8	Minimum thickness of the box body (mm)	User to specify
9	Colour of the box	User to specify
10	Number of incoming cable	User to specify
11	Diameter of incoming cable (mm)	User to specify
12	Fibre count of incoming cable	User to specify
13	Maximum splice capacity	User to specify
14	Box security provision	User to specify
15	Fire proof (Yes/No)	User to specify
16	Operating temperature	–5 to +55 °C
17	Number of cable entry port	User to specify
18	Number of output adapter and type	User to specify
19	Provision for cable/patch cord storage	User to specify

V.4 Examples of SPB

Based on the location of installation, number of fibres to be spliced and /or connected and other attributes, there are different types of SPB for home termination as mentioned in the examples of clauses V.4.1 to V.4.4.

V.4.1 Example 1

The type of SPB shown in Figure V.3 is also known as home termination box (HTB), which is a compact fibre wall outlet used in FTTx networks for the termination of optical fibre in the customer premises such as residence, offices, etc. Its design is ideal for in-premises fibre termination points. It has a provision to secure fibre splicing, storing of extra fibre and housing of single or dual adaptors. The HTB provides mechanical protection and managed fibre control in a format suitable for use inside customer premises.

It has storage space for drop cables of at least 500 mm with cable entry from the top or from the side of the box. It has provision for splicing of drop cable (4F or 2F) to factory terminated pigtails and provision to hold splice protection sleeves. It also has provision for direct termination with field installable connectors. It can accommodate two adaptors for the termination of either simplex SC, SC/PC, SC/APC or duplex LC.

The box allows easy fibre access during installation and maintenance. The box maintains the bend radius of the fibre suitable for ITU-T G.657 cables. It is a wall mount box made up of aging-resistant thermoplastics (PC/ABS) material complying to [b-UL94V-0] flame retardant rating.

It has a snap fit arrangement for the adaptors for ease of installation. It has two mounting slots for the adaptor such that the adaptors flushes with the surface for IP40 protection. It consists of a base and a cover with press fitment. The rear portion of the base is laminated in order to make the product dust and insect proof.

In Figure V.3, a) to d) show different fibre termination techniques:

a) This type of HTB can accommodate two simplex SC/PC or SC/APC adaptors.

b) This type of HTB can accommodate two adaptors for termination with 4F splicing capacity allowing drop cable spliced to pigtails.

c) This type of HTB can accommodate two adaptors for termination compatible with field installable connectors.

d) This type of HTB can accommodate two simplex SC adaptors/2 duplex LC adapter for termination.

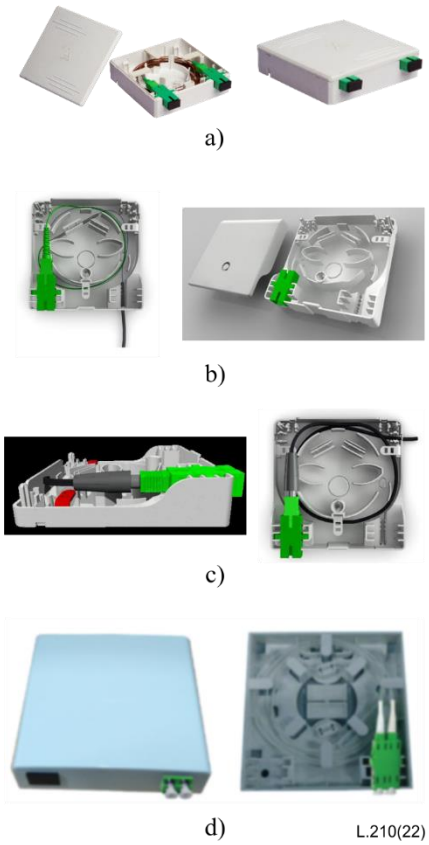


Figure V.3 – Example 1 of HTB

V.4.2 Example 2

The type of home termination box (HTB) shown in Figure V.4 is a compact termination box used at the customers' premises such as residence, offices, etc. in the FTTx or optical CATV or local area networks. The box has spring shutter cover for laser protection and dust-proof protection, self-clip design for easy operation, SC or LC shutter adaptor, optional RJ45 connection, provision to store slack, rear and bottom cable entry, integrated heat shrink splice and mechanical splice holder.

Figure V.4 – Example 2 of HTB

V.4.3 Example 3

The type of HTB shown in Figure V.5 is suitable for wall mount/pole mount/panel mount installations. The main attributes are ABS housing with mechanical seal, high impact resistance splicing tray, cable spool for fibre, pigtail routing, provision of storing up to 3 metres of 900 μm tight buffered fibre cable, patch cord or fusion splice, field termination provision, and replaceable panel for SC/LC/FC type couplers.

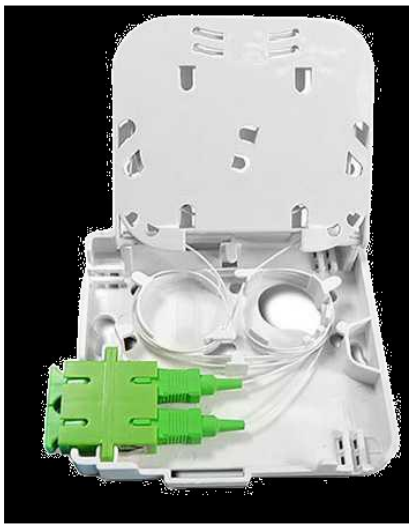


Figure V.5 – Example 3 of HTB

V.4.4 Example 4

The type of HTB shown in Figure V.6 is a termination box used at the customers' premises such as residence, offices, etc. in the FTTx or optical CATV or local area networks or point-to-point networks. The IP55 rated box can accommodate 50 metres of drop cable and has provision to accommodate 2 LC adapters and pigtails.

Figure V.6 – Example 4 of HTB

Bibliography

[b-ITU-T G Suppl.59] Supplement 59 to ITU-T G-series Recommendations (2018), *Guidance on optical fibre and cable reliability.*

[b-ITU-T L.208] Recommendation ITU-T L.208 (2019), *Requirements for passive optical nodes – Fibre distribution box.*

[b-IEC 61300-2-26] IEC 61300-2-26:2006, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-26: Tests – Salt mist.*

[b-TEC 87030] Telecommunication Engineering Centre (TEC), India (2010), Standard, *Optical Fibre Termination & Distribution Box (for FTTH applications).*

[b-UL94V-0] Flammability Test Procedure: UL 94 V-O (1996), *20 mm Vertical Burn Test.*

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