FIA

The Fibreoptic Industry Association

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TECHNICAL SUPPORT DOCUMENT

FIA-TSD-2000-3-3

OPTICAL FIBRE CABLING

-

OPERATION

-

POLARITY MAINTENANCE

Price: £50 (free to FIA members)

FIA

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The Fibreoptic Industry Association
-
An introduction for the new millennium

The past decade has been a time in which there has been a vast increase in the use of optical fibre - primarily driven by the need to provide a quality, high-speed transmission media for digital trunk telephony services. The specifications for these systems have typically been produced by large national telecommunications service providers. This has resulted in clear standards and specifications exist to which all suppliers to the WAN telecommunications industry must adhere.

In parallel there has been a significant growth in optical fibre systems being installed in private data, entertainment and telecommunications networks which are separate from the national telephony and data carrier systems. This part of the industry is characterised by having a large number of relatively small company participants albeit supplying large corporate customers with products and services. The use of optical fibres in private, local area data and sensor networks has increased rapidly throughout the 1990's. In order to support this rate of growth, an organizational focus is required for both suppliers and users in the industry in order to ensure the quality and reliability of network design, installation practice and methods of training.

The **Fibreoptic Industry Association** provides such a focus as a Trade Association to which companies, organizations and individuals involved with, or planning an involvement with, fibre optics can subscribe. In addition, by means of seminars, publications, newsletters, press promotion and similar activities, the **Fibreoptic Industry Association** is dedicated to raising the profile of the industry and highlighting its many benefits in order to increase its growth and thus provide direct benefits for members.

Our overall aims can be summarised as follows:

- to promote an awareness of the benefits and applications of fibre optic technology as an adjunct to - or as a replacement for - conventional copper communications technology;
- to promote an awareness of the existence of a professional fibre optics industry fully capable of meeting the needs of users or, so benefiting both suppliers and their customers;
- to promote and adopt standards to which professional participants within the fibre optic industry should be expected to adhere;
- to provide a central source for information on wide ranging aspects of the fibre optic industry;
- to provide a single voice to promote and represent the interests of the industry obtained by consensus and debate amongst FIA members;
- to develop and promote codes of practice within the industry - both operational and ethical - to which members will be expected to adhere and thus offer an assurance that the highest quality of service will be provided.

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FIA TECHNICAL SUPPORT DOCUMENTS

This document is one a series of FIA Technical Support Documents. During the year 2000 all the existing FIA documents were re-written or re-published in the format used throughout this document.

More importantly, the way in which these Technical Support Documents is published has also changed.

These documents are now **free** to **FIA members** via downloads from the FIA web-site (**www.fia-online.co.uk**). Non-members are also able to purchase these documents either by contacting the Secretariat (address shown below) or by on-line purchase.

Members and non-members unable to benefit from this service may receive the documents in hard-copy or diskette/CD ROM by contacting the FIA Secretariat (contact details are shown at the bottom of each text page in this document). However, the rapidly changing nature of our technology means that web-based documents can be amended and revised easily and it is the responsibility of the reader to ensure that the latest issue of a document is used.

The FIA web-site will indicate the issue status of each document and will have links to previous issues in order that changes made will be clear to readers.

The complete list of FIA Technical Support Documents is shown in the Table below.

TOPIC	FIA-TSD-	TITLE
DESIGN	2000-1-1	OPTICAL FIBRE CABLING: LAN APPLICATION SUPPORT GUIDE
COMPONENT SELECTION	2000-2-1	OPTICAL FIBRE CABLING: CABLE SELECTION GUIDE
	2000-2-2	OPTICAL FIBRE CABLING: CONNECTING HARDWARE SELECTION GUIDE
OPERATION	2000-3-2-1	OPTICAL FIBRE CABLING: ADMINISTRATION: User Guides
	2000-3-2-2	OPTICAL FIBRE CABLING: ADMINISTRATION: Cords
	2000-3-3	OPTICAL FIBRE CABLING: POLARITY MAINTENANCE
INSTALLATION	2000-4-1-1	OPTICAL FIBRE CABLING: INSTALLATION PRACTICE: SPLICING
	2000-4-2-1	OPTICAL FIBRE CABLING: TESTING Installed cabling using LSPM equipment
	2000-4-2-2	OPTICAL FIBRE CABLING: TESTING Installed cabling using OTDR equipment
	2000-4-2-3	OPTICAL FIBRE CABLING: TESTING: Test cords
SAFETY	2000-5-1	OPTICAL POWER: SAFETY LEVELS
	2000-5-2	OPTICAL FIBRE: HANDLING OF PROCESSING CHEMICALS
	2000-5-3	OPTICAL FIBRE: DISPOSAL OF WASTE

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FOREWORD AND EXECUTIVE SUMMARY

It has long been accepted that good channel management practices are the key to network reliability. Historically, as an industry, we have concentrated our attention on establishing clear administration procedures, simplifying cabinet design and promoting configuration control systems to achieve this end.

The maintenance of polarity (transmitter to receiver and vice versa) within optical fibre transmission systems that used simplex connections was not viewed as a major issue with respect to channel reliability. The polarity fix was achieved in the physical construction of the patch and equipment cords; and, as such, relatively fault-free. Even if the polarity was mismanaged, the necessary corrective actions were relatively simple to implement.

However, the continuing move towards duplexable, duplex and multi-fibre connectivity mechanisms has highlighted the critical importance of polarity maintenance in respect of the delivery and subsequent reliability of the transmission channel. Simple "trial and error" fixes are no longer an adequate solution of polarity maintenance; indeed in many cases they are impossible to undertake without the purchase of new patch and/or equipment cords.

Consideration of rules for polarity maintenance is a complex issue that can be likened to three-dimensional chess; with for example straight-through cords that appear crossed and cross-over cords that appear straight-through; as a result there exists a substantial amount of confusion for both installers and users alike.

This document seeks to give installers a clear understanding of what is a key element of the optical fibre channel operation. It will also enable them to establish and follow leading edge, best practice, procedures which should, in turn, be adopted by their clients by means of an cabling infrastructure User Guide.

When followed faithfully these practices, in conjunction with a unique and unambiguous labelling scheme and a clearly defined inspection/fault-finding system, will enhance the ongoing operational integrity of all optical fibre transmission channels.

By Paul Bateson, Chairman of the FIA

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INTRODUCTION

The majority of optical fibre transmission systems deliver a signal in one direction on one optical fibre and receiving a signal on another, separate optical fibre. Groups of applications covered by such signalling schemes include virtually all of the local and wide area network technologies.

In the past the management of polarity of such transmission channels was the responsibility of the user and was achieved by the correct connection of equipment cords at either end of the installed cabling (in many cases by simple trial and error).

The growth in popularity of duplex and array interfaces, which prevents simple re-configuration of the equipment cords, requires that recommendations be prepared to allow management of channel polarity in the most appropriate manner. In addition, future network solutions may utilise parallel optical fibre elements terminated with array interfaces.

Since Issue 2 of this Technical Support Document was produced three standards are either published or will soon be published to define polarity maintenance. These are BS EN 50174-1, ANSI/TIA-568-C.3 and ISO/IEC 14763-2 (in preparation). This document provides explains their requirements and recommendations which, providing that they are followed, allow users and installers to clearly specify the polarity maintenance approach in order to maximise channel reliability.

1 SCOPE

This Technical Support Document details recommended practices for the termination of optical fibre cabling in single and multi-element interfaces and the associated use of termination modules, patch cords and equipment cords to create channels of known and repeatable connection polarity.

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2 REFERENCES

ANSI/TIA-568-C.3 (2009)	Optical Fiber Cabling Components Standard
ANSI/TIA/EIA-598-B	Optical fibre cable colour coding
BS 6701 (2004)	Telecommunications equipment and telecommunications cabling - Specification for installation, operation and maintenance
BS EN 50173-1 (2007)	Information technology - Generic cabling systems - Part 1: General requirements
BS EN 50174-1:2009	Information technology - Cabling installation - Part 1: Installation specification and Quality Assurance
BS EN 60794-2	Optical fibre cables - Indoor cables - Sectional specification
ISO/IEC 14763-2 (in preparation)	Information technology -Implementation and operation of customer premises cabling - Part 2: Planning and installation

3 DEFINITIONS AND ABBREVIATIONS

3.1 Definitions

For the purpose of this Technical Support Document the following definitions apply:

Application	A system, with its associated transmission method, which is supported by telecommunications cabling (EN 50173-1).
Array interface	An interface designed to terminate more than two optical fibres within a single housing.
Channel	The end-to-end transmission path connecting any two pieces of application-specific equipment. Equipment … cords are included in the channel, but not the connecting hardware into the application specific equipment (EN 50173-1).
Connection	Mated device or combination of devices including terminations used to connect cables or cable elements to other cables, cable elements or application-specific equipment (EN 50173-1).
Cord	A demountable (i.e. non-permanent) cabling segment designed and installed to allow easy re-configuration of connections between fixed cabling segments and application-specific equipment.
Duplex interface	An interface designed to terminate two optical fibres within a single housing.
Equipment cord	A cord connecting a link to application-specific equipment.
Fixed cabling	Cabling installed designed and installed as part of the “permanent” premises cabling infrastructure.
Interface	A point at which cords are connected to either fixed cabling or application-specific equipment.
Patch cord	A cord connecting two fixed cabling segments.
Segment	Part of a cabling channel between any two adjacent interfaces.
Simplex interface	An interface designed to terminate a single optical fibres within a single housing
Termination module	Closure containing the termination system for a pre-terminated optical fibre cable with array interfaces

3.2 Abbreviations

For the purpose of this Technical Support Document the following definitions apply:

R	Receiver (detector)
T	Transmitter (source)

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4 THE CONSTRUCTION OF TRANSMISSION CHANNELS

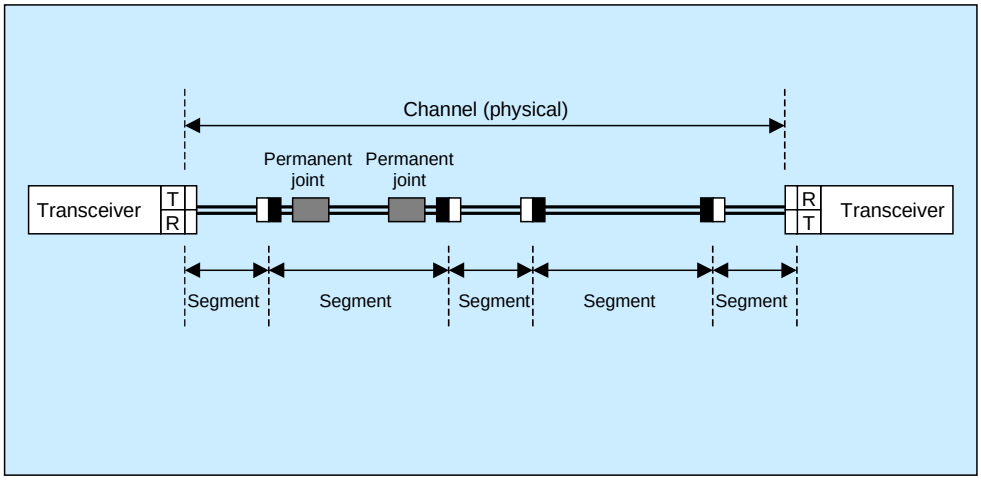

Figure 1 - A duplex transmission channel containing two optical fibres

A physical transmission channel containing the optical fibres can take a wide range of forms but will, as shown in Figure 1, always consist of one or more segments. Segments may take the form of fixed cabling, equipment cords or patch cords.

NOTE: A physical channel differs from the "performance channel" in that the channel performance specifications and measurements exclude the connections at the transmission equipment. More information on this topic is included in relevant FIA Technical Support documents.

The connections between the segments may be installed within or on closures (e.g. patch panels, equipment presentation panels, wall and floor boxes). Fixed cabling segments may contain additional "permanent" joints (e.g. fusion or mechanical splices). For the purposes of this document these joints do not provide further segmentation.

Maintenance of polarity requires, firstly, that each of the fixed cabling segments provide the correct polarity designation at its interfaces. The insertion of patch cords, where used, between cabling segments and the equipment cords at either end of the channel ultimately defines the nature of the polarity of the resulting channel.

5 OPTICAL FIBRE COLOUR CODING AND NUMBERING

For the purposes of this document it is assumed that optical fibre cables contain optical fibres with coloured buffer coatings.

Where cables do not contain coloured optical fibres then the reader will have to apply the recommendations of this document via the optical identification system present in the cable under consideration.

There is a generally accepted colour scheme for cables containing up to twelve optical fibres. The primary standards-based scheme is defined in BS EN 60794-2. Other schemes exist including those in ANSI/TIA/EIA-598-B, which are used in ANSI/TIA-568-C.3. These two schemes are shown in Table 1. There are many others that could be used. This document uses the colour sequence of BS EN 60794-2 shown in bold type. The principle reason for this is that the new standards that define polarity maintenance, BS EN 50174-1 and a future ISO/IEC 14763-2 use the BS EN 60794-2 schemes.

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	Numbering sequence used within this document as per **BS EN 60794-2**	Numbering sequence used within ANSI/TIA-568-C.3
Blue	**01**	01
Yellow	**02**	09
Red	**03**	07
White	**04**	06
Green	**05**	03
Violet	**06**	10
Orange	**07**	02
Slate/Grey	**08**	05
Turquoise	**09**	12
Black	**10**	08
Brown	**11**	04
Pink	**12**	11

Table 1: Optical fibre colour code scheme

6 CHANNELS CONTAINING FIXED CABLING SEGMENTS WITH SIMPLEX CONNECTIVITY

6.1 Fixed cabling segments

Where a cabling segment contains simplex interfaces at one or both ends then all the optical fibres shall be terminated in a sequential manner as shown in Figure 2: Optical fibre polarity within channels containing fixed cabling with simplex interfaces.

6.2 Cords

6.2.1 Patch cords

Patch cords shall be of simplex or duplex cable construction and shall be terminated with simplex connecting hardware compatible with the interfaces of the fixed cabling segments.

NOTE The physical intermateability between connecting hardware components from different suppliers is specified by reference to international or European standards. However, transmission performance interoperability is only specified for a small number of simplex interfaces e.g. SC (IEC 60874-14) and ST (IEC 60874-10).

Patch cords shall be designed, manufactured and used to provide “straight-through “ i.e. port 1 to port 1 interconnections (see clause 8.1.1).

6.2.2 Equipment cords

For channels to be created using fixed cabling segments with simplex interfaces, polarity management is attained and maintained by the appropriate orientation and configuration of the equipment cords.

Equipment cords shall be terminated at one end with simplex connecting hardware compatible with the interfaces of the fixed cabling segment and at the other end by simplex or duplex connecting hardware compatible with the interfaces to the application-specific equipment.

NOTE The physical intermateability between connecting hardware components from different suppliers is specified by reference to international or European standards. However, transmission performance interoperability is only specified for a small number of simplex interfaces e.g. SC (IEC 60874-14) and ST (IEC 60874-10).

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Where the equipment cords have simplex connecting hardware at both ends, the cords shall be marked/labelled to indicate how the cord is to be used as:

- a straight-through (port 1 to port 1) interconnection (see clause 8.1.1);
- a cross-over (port 1 to port 2/port 1a to port 1b) interconnection (see clause 8.1.2).

At one end of the channel the equipment cord shall be used as a “straight-through” interconnection and at the other end the equipment cord shall be used as a “cross-over” interconnection. The User Guide (see clause 10) shall define the location of each type of cord and how it shall be used.

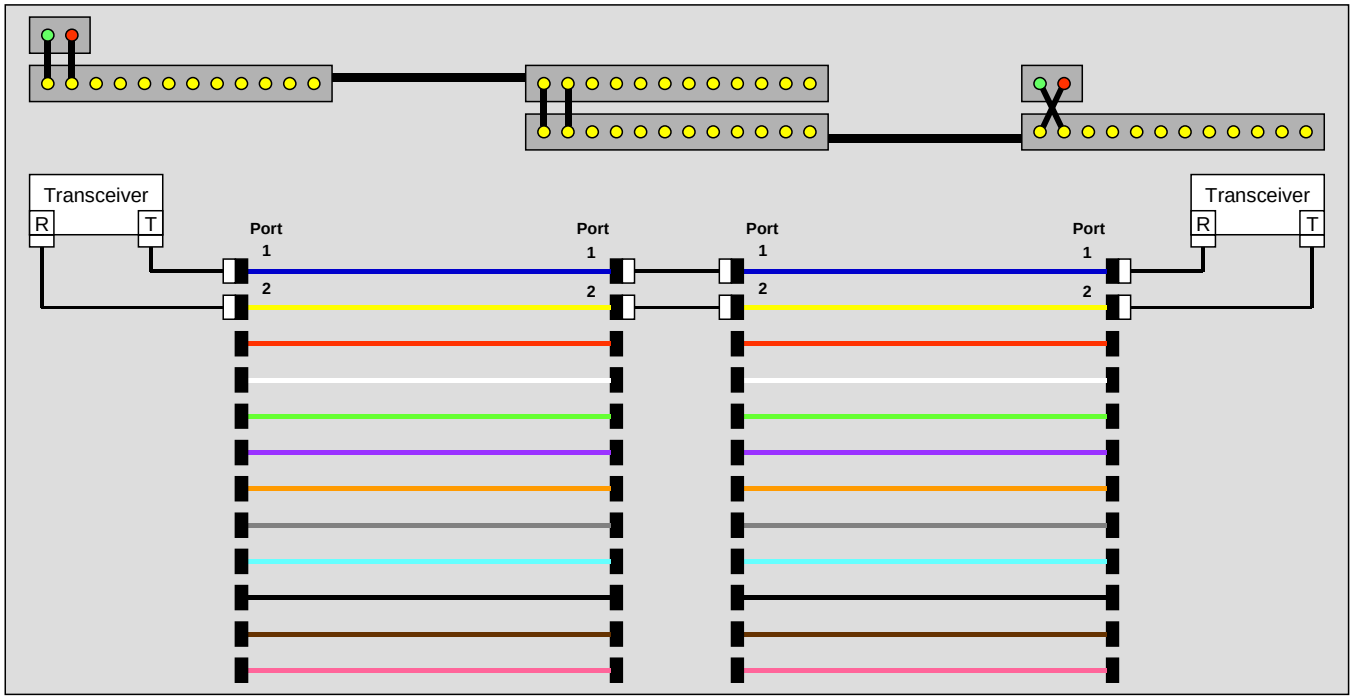

Figure 2: Optical fibre polarity within channels containing fixed cabling with simplex interfaces

7 CHANNELS CONTAINING FIXED CABLING SEGMENTS WITH DUPLEX CONNECTIVITY

7.1 Duplex and duplexable interfaces

There are two types of duplex interfaces - fixed duplex and duplexable.

Fixed duplex connecting hardware terminates two optical fibres in a fixed interface that cannot be taken disassembled. Examples of this type of interface are the MT-RJ, 3M Volition, OptiJack etc.

NOTE: Some versions of these interfaces do allow rotation of the ferrule within the interface to create alternate polarity.

Duplexable connecting hardware terminates each optical fibre in a simplex unit that can be assembled into, and disassembled from, a duplex configuration. This approach readily allows the creation of cabling segments with appropriate polarity.

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7.2 Fixed cabling segments

All the three standards defining polarity maintenance (BS EN 50174-1, ANSI/TIA-568-C.3 and ISO/IEC 14763-2) require that where a cabling segment contains duplex (fixed or duplexable) interfaces at both ends then each pair of optical fibres shall be terminated in a reverse manner at each end as shown in Figure 3. In addition all three standards allow the options for presenting the cabling in sequential order at both ends by inverting the connecting hardware at one end.

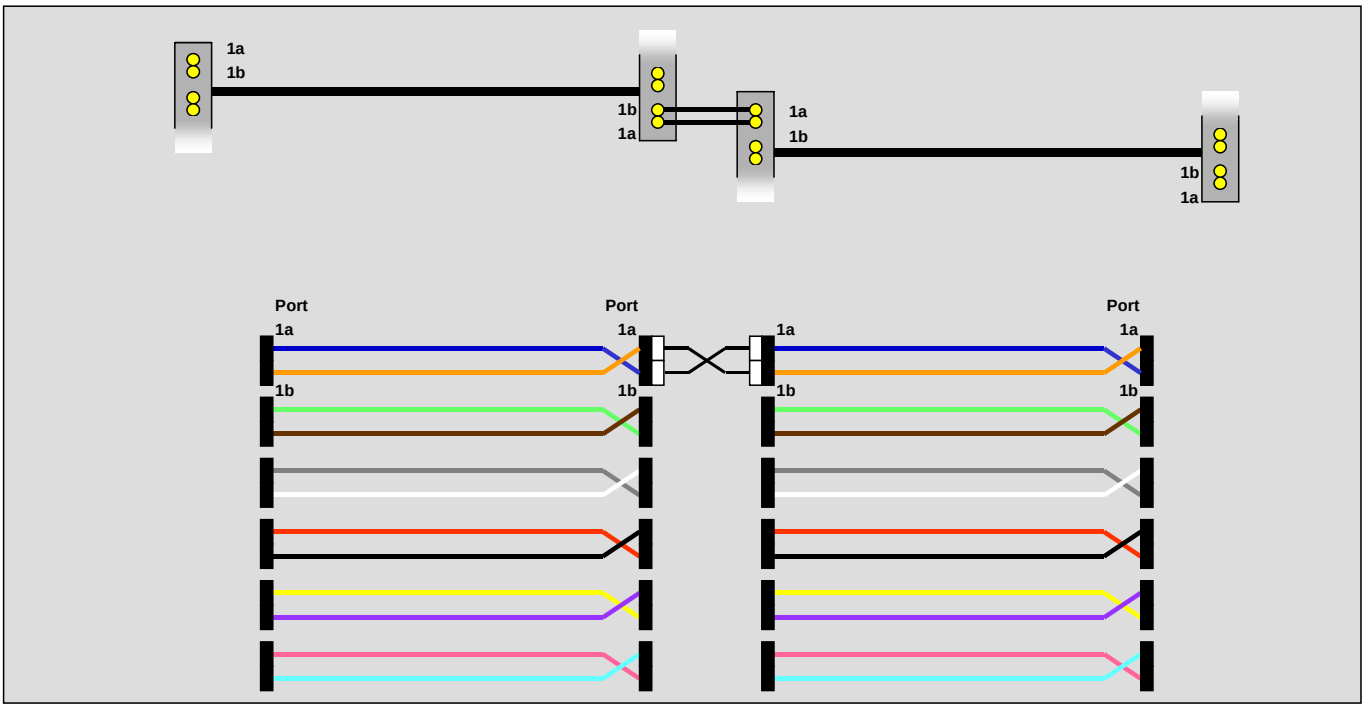

Figure 3: Optical fibre polarity within channels containing fixed cabling with duplex interfaces

7.3 Cords

7.3.1 General

The use of fixed duplex (i.e. fixed duplex, not duplexable) connecting hardware on cords can provide a simple method of polarity maintenance. However, if the user purchases the wrong type of cord and if there is no mechanism by which the polarity may be reversed then it may be impossible to create operational channels. It is therefore important to ensure that the correct rules are followed as detailed in the User Guide (see clause 10).

For this reason it is important to implement the correct approach from the outset.

7.3.2 Patch cords

Patch cords shall be of simplex or duplex cable construction and shall be terminated with duplex connecting hardware compatible with the interfaces of the fixed cabling segments.

NOTE The physical intermateability between connecting hardware components from different suppliers is specified by reference to international or European standards. However, transmission performance interoperability is only specified for a small number of duplex interfaces e.g. SC-D (IEC 60874-19-1).

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All the three standards defining polarity maintenance (BS EN 50174-1, ANSI/TIA-568-C.3 and ISO/IEC 14763-2) require that patch cords shall be designed, manufactured and used to provide “cross-over “, i.e. port 1a to port 1b, interconnections (see clause 8.1.2).

7.3.3 Equipment cords

7.3.3.1 General

Using the approach defined in clauses 7.2 and 7.3.2, an odd number (1, 3, 5, 7 etc.) of cabling segments, including patch cords, will always contain an odd number of polarity reversals. The consistent use of either “straight-though” or “cross-over” equipment cords at both ends will provide a functional channel. However, as many users confuse patch cords and equipment cords (particularly where the connecting hardware used is common), it is logical to mandate that polarity reversal (i.e. cross-over) be continued in equipment cords wherever possible - in accordance with all the three standards defining polarity maintenance (BS EN 50174-1, ANSI/TIA-568-C.3 and ISO/IEC 14763-2).

Using the approach defined in clauses 7.2 and 7.3.2, an even number (2, 4, 6 , 8 etc.) of cabling segments, including patch cords, will always contain an even number of, i.e. no, polarity reversals. The creation of a functional channel requires the addition of a single “cross-over” equipment cord. As a result there are situations where the use of a “straight-though” equipment cord would be required. These occasions are relatively uncommon, are not covered in the three standards defining polarity maintenance (BS EN 50174-1, ANSI/TIA-568-C.3 and ISO/IEC 14763-2), but do exist

7.3.3.2 Application-specific equipment with simplex interfaces

Equipment cords shall be terminated at one end with duplex connecting hardware compatible with the interfaces of the fixed cabling segment and at the other end by simplex connecting hardware compatible with the interfaces to the application-specific equipment.

NOTE The physical intermateability between connecting hardware components from different suppliers is specified by reference to international or European standards. However, transmission performance interoperability is only specified for a small number of duplex interfaces e.g. SC-D (IEC 60874-19-1).

The cords shall be marked/labelled to indicate how the cord is to be used as:

- a straight-through (port 1 to port 1) interconnection (see clause 8.1.1);
- a cross-over (port 1 to port 2/port 1a to port 1b) interconnection (see clause 8.1.2).

If the number of cabling segments in the proposed channel is even (4, 6, 8 etc.) then at one end of the channel the equipment cord shall be used as a “straight-through” interconnection and at the other end the equipment cord shall be used as a “cross-over” interconnection. The User Guide (see clause 10) shall define the location of each type of cord.

If the number of cabling segments in the proposed channel is odd (3, 5, 7 etc.) then at both ends of the channel the equipment cord shall be used as a “cross-over” interconnection.

7.3.3.3 Application-specific equipment with duplex interfaces

Equipment cords shall be terminated at one end with duplex connecting hardware compatible with the interfaces of the fixed cabling segment, and at the other end by duplex connecting hardware compatible with the interfaces to the application-specific equipment.

NOTE The physical intermateability between connecting hardware components from different suppliers is specified by reference to international or European standards. However, transmission performance interoperability is only specified for a small number of duplex interfaces e.g. SC-D (IEC 60874-19-1).

The cords shall be designed and manufactured to provide either:

- a straight-through (port 1a to port 1a) interconnection (see clause 8.1.1);
- a cross-over (port 1a to port 1b) interconnection (see clause 8.1.2).

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If the number of cabling segments in the proposed channel is even (4, 6, 8 etc.) then at one end of the channel the equipment cord shall be provide a “straight-through” interconnection and at the other end the equipment cord shall be provide a “cross-over” interconnection. The User Guide (see clause 10) shall define the location of each type of cord.

If the number of cabling segments in the proposed channel is odd (3, 5, 7 etc.) then the equipment cord shall provide a “cross-over” interconnection at both ends of the channel.

8 CORD DESIGN

8.1.1 “Straight-through” cords

The concept of a “straight-through” cord is obvious for simplex cable assemblies. However, it is more difficult to understand for duplex connecting hardware. Figure 4 is a useful explanation.

A “straight-through” duplex cord has to connect one port 1a to another port 1a on the panel as shown on the left in Figure 4. When viewed from above, the cord as connected has to introduce a reversal within the cabling and with the key-way uppermost the reversal is obvious for all to see. So, a duplex cord that contains a cabling reversal is actually a “straight-through” cord as far a duplex connection system is concerned.

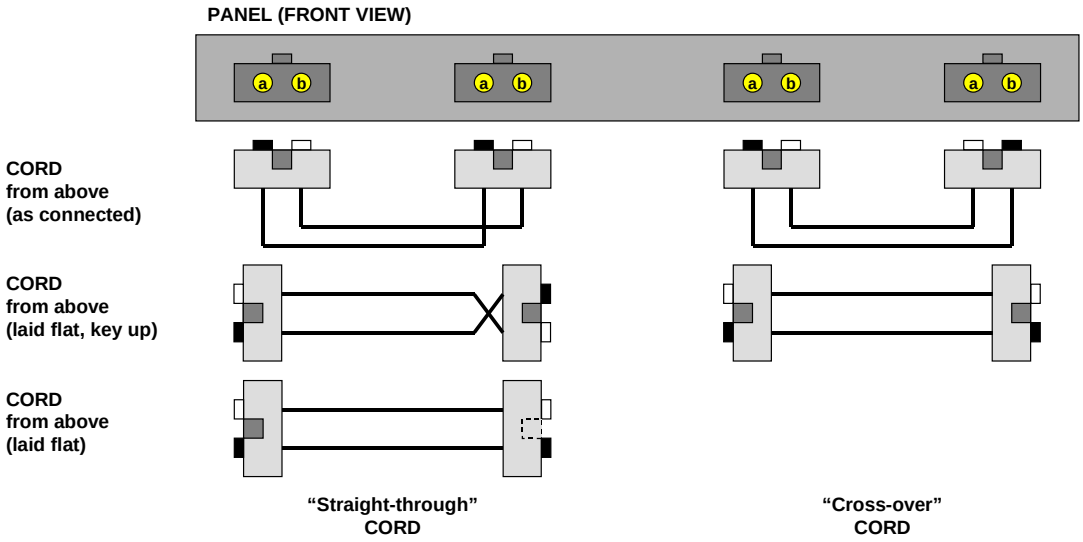

Figure 4: “Straight-through” and “cross-over cords”

8.1.2 “Cross-over” cords

A “cross-over” duplex cord has to connect one port 1a to a port 1b on the panel as shown on the right in Figure 4. When viewed from above, the cord as connected appears to NOT to introduce a reversal within the cabling and with the key-way uppermost the cabling appears “straight-through” i.e. as if two “straight-through” simplex cords were connected in parallel So, a duplex cord that does NOT contain a cabling reversal is actually a “cross-over” cord as far a duplex connection system is concerned.

As a result many users believe that they are buying “straight-though” cords, even though they are actually “cross-over” cords. Indeed many suppliers refer to them wrongly also. It is no wonder that problems occur.

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9 ARRAY INTERFACES

9.1 General

There are a growing number of situations in which array interfaces are used. The applications for such interfaces fall into three main groups:

- application-specific transmission products that use parallel optics (e.g. 4 or 12 devices on a 250 micron pitch) - this requires array interfaces to be used throughout the channel and the maintenance of polarity for such systems is addressed in this clause.
- high density patching - this requires array interfaces to be used either at one or both ends of fixed cabling segments in support of application-specific equipment that may feature simplex or duplex interfaces;
  - the maintenance of polarity where array interfaces are used at only one end of fixed cabling segments is for further study;
  - the maintenance of polarity where array interfaces are used at both ends of fixed cabling segments is is addressed in this clause;
- pre-terminated cabling systems that use cable segments with array interfaces to which termination modules are added to provide a range of fixed cabling interfaces (see clause 10).

There are many ways in which polarity can be maintained.

In Issue 2 of this Technical Support Document the FIA selected the most open system of polarity maintenance is that shown in Annex A. This was then known as Implementation A of ANSI/TIA/EIA-TSB136. However, this document was never published and the Implementation A of the proposed ANSI/TIA/EIA-TSB136 was removed from the subsequent publication of all three standards defining polarity maintenance (BS EN 50174-1, ANSI/TIA-568-C.3 and ISO/IEC 14763-2).

BS EN 50174-1 and ISO/IEC 14763-2 (in preparation) both recommend a common solution which is consistent with Type B of ANSI/TIA-568-C.3. Readers of this Technical Support Document are referred to these standards for the details of the recommended solution.

10 USER GUIDES

Many installers simply provide fixed cabling segments to their clients. Usually the fixed cabling segments will be well documented, indicating the routes taken by the cables with schematic diagrams of cabinets and associated test results. However, few installers provide detailed descriptions of the channel creation components, i.e. patch cords and equipment cords, necessary to deliver reliable service - that is to say - a User Guide for the cabling infrastructure.

Why should a User Guide be necessary?

The repeated use of the notes in the sub-clauses of this document concerning the lack of guaranteed interoperability, i.e. transmission performance, when creating connections with components from different suppliers should provide a wake-up call for installers and users alike. The performance of connections at patch panels etc. needs to be managed by the correct specification of the cord connector.

In these days of bandwidth-limited applications, such as 1000BASE-SX/LX or the various 10 Gigabit Ethernet solutions, the length of cords may even be an issue - particularly if there is a risk of high and low bandwidth performance cabling being mixed.

Obviously, the maintenance of polarity is also a critical matter and the selection and use of cords needs to be documented.

Finally, and perhaps most importantly, the latest revision of BS 6701 to be published in 2004, demands that "*all relevant documentation shall be provided to enable the user to implement operating procedures for the telecommunications system(s)*".

NOTE: BS 6701 is now a "one stop shop" standard (no longer a Code of Practice but now a true specification) covering cabling and telecommunications systems installation, operation and maintenance in the United Kingdom.

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The development of User Guides is not designed to be yet another hurdle for hard-pressed installers to cross. They can be very simple and in many cases are cut-and-paste tasks. The Fibreoptic Industry Association will be releasing technical Support Documents which include templates for this process in due course.

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Annex A
Array connectivity requirements of Issue 2, TSD-2000-3-3

A.1 General

Issue 2 of this Technical Support Document required the approach detailed in Annex, beginning with the basic structure in Figure A.1.

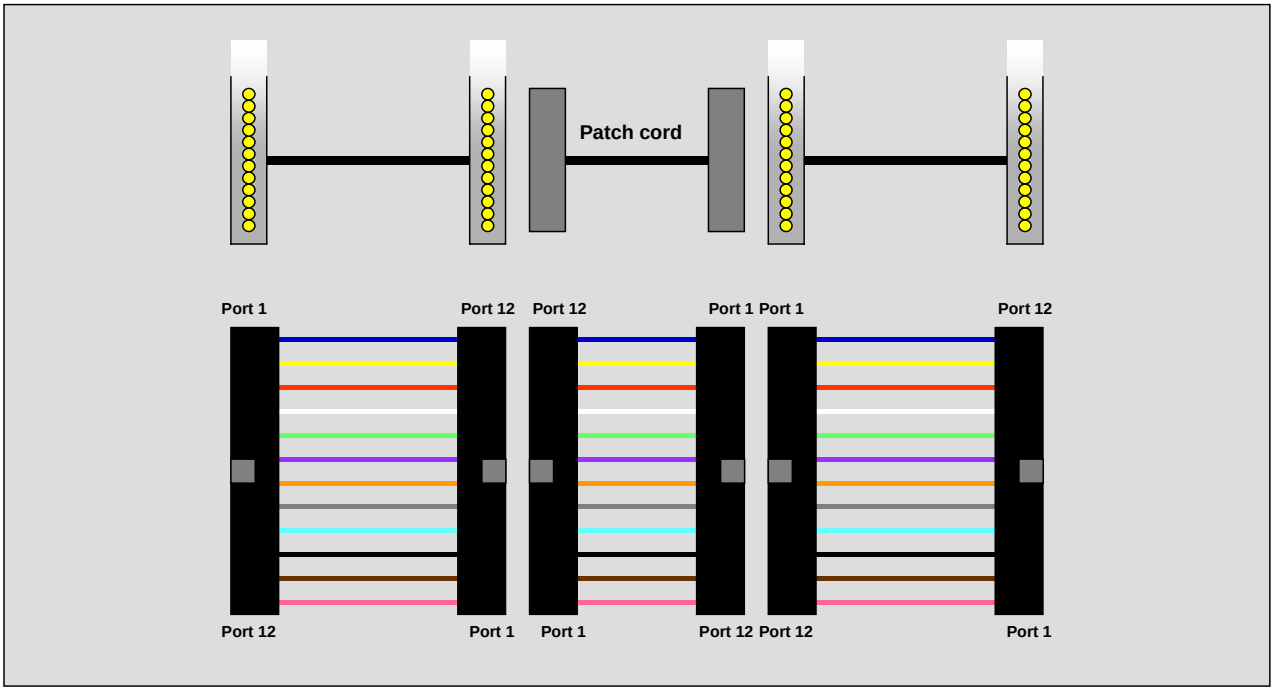

Figure A.1 - Optical fibre polarity within channels containing fixed cabling with array interfaces

In Figure A.1, two 12-element fixed cabling segments are shown connected by a patch cord. The requirements of this clause apply to any array interface containing a single row of 4, 8 or 12 optical fibre elements. They are also applicable to array interfaces containing multiple rows where each row is subject to the approach detailed below.

Array interfaces normally include a key-way to define the orientation of the connection made at the interface. It is possible to obtain interfaces in which the key-ways on either side of the array interface differ i.e. the key-way on the terminated fixed cable is “up” but the key-way offered to the connection to a cord is “down”. Such combinations are not supported by this Technical Support Document. In all cases, the key-way is shown to face upward.

A.2 Fixed cabling

By reference to Figure 4, it is clear that the fixed cabling segments of Figure A.1 each provide a complete element reversal i.e. port 1 to port 12, port 2 to port 11 etc.

Where an array interface is designed to support more optical fibre elements than contained in the fixed cabling segment i.e. a 12-element interface where only 4 elements are terminated then the termination rules of Table A.1 apply.

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	Optical fibre terminations		
12-element interface port number	12-element segment termination	8-element segment termination	4-element segment termination
1	1 or 12		
2	2 or 11		
3	3 or 10	1 or 8	
4	4 or 9	2 or 7	
5	5 or 8	3 or 6	1 or 4
6	6 or 7	4 or 5	2 or 3
7	7 or 6	5 or 4	3 or 2
8	8 or 5	6 or 3	4 or 1
9	9 or 4	7 or 2	
10	10 or 3	8 or 1	
11	11 or 2		
12	12 or 1		

Table A.1 - Allocation of array interface ports

A.3 Cords

A.3.1 Patch cords

By reference to Figure 4 it is clear that the patch cord shown in Figure A.1 provides a complete element reversal i.e. port 1 to port 12, port 2 to port 11 etc.

Patch cords shall be terminated with array connecting hardware compatible with the interfaces of the fixed cabling segments.

NOTE The physical intermateability between connecting hardware components from different suppliers is specified by reference to international or European standards. However, transmission performance interoperability is not specified for any array connecting hardware.

Patch cords shall be designed, manufactured and used to provide “cross-over “, i.e. port 1 to port 12 interconnections.

A.3.2 Equipment cords

Equipment cords shall be terminated at one end with array connecting hardware compatible with the interfaces of the fixed cabling segment, and at the other end by array connecting hardware compatible with the interfaces to the application-specific equipment.

NOTE The physical intermateability between connecting hardware components from different suppliers is specified by reference to international or European standards. However, transmission performance interoperability is not specified for any array connecting hardware.

The cords shall be designed and manufactured to provide either:

- a straight-through (e.g. port 1 to port 1) interconnection (see clause 8.1.1);
- a cross-over (e.g. port 1 to port 12) interconnection (see clause 8.1.2).

If the number of cabling segments in the proposed channel is even (4, 6, 8 etc.) then at one end of the channel the equipment cord shall be provide a “straight-through” interconnection and at the other end the equipment cord shall be provide a “cross-over” interconnection. The User Guide (see clause 10) shall define the location of each type of cord.

If the number of cabling segments in the proposed channel is odd (3, 5, 7 etc.) then the equipment cord shall provide a “cross-over” interconnection at both ends of the channel.

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A.4 Pre-terminated optical cables and termination modules

A.4.1 General

The use of fixed cabling segments that pre-terminated with array interfaces to which termination modules are attached to present a modified interface to the fixed cabling segment are becoming popular since they allow comparatively simple re-configuration of both the fixed cabling and its presentation.

There are many ways in which polarity can be maintained but the FIA has determined that the most open system of polarity maintenance requires the approach detailed below. This was consistent with ANSI/TIA/EIA-TSB136 (Implementation A).

A variety of array interfaces are available and clearly the interface on the termination module shall be compatible with that of the pre-terminated cable.

NOTE The physical intermateability between connecting hardware components from different suppliers is specified by reference to international or European standards. However, transmission performance interoperability is not specified for any array connecting hardware.

A.4.2 Fixed cabling

The fixed cabling, i.e. pre-terminated cable shall have the same polarity as shown for array interfaces in Figure A.1. This allows any termination module to be replaced directly with array-based equipment cords conforming to clause 9.

A.4.3 Termination modules

The termination modules at each end of the pre-terminated cable are used to present the array interface of the per-terminated cable in the required format.

Where the array interface has the capacity for the termination of 12-element, Figure A.2, Figure A.3 and Figure A.4 show the termination module polarity for 12-elements, 8-elements and 4-elements respectively.

Using termination modules allows them to be interchanged (as they are identical) and provides an appropriate reversal for duplex and quad-array interfaces on the termination module.

NOTE: The simplex presentation shown in Figure A.2, Figure A.3 and Figure A.4 provides a pair reversal (i.e. not in line with clause 6). This should be clearly indicated on the front panel of the termination modules.

A.4.4 Cords

See 6.2, 7.3 or A.3 as appropriate to the interfaces presented on the termination modules.

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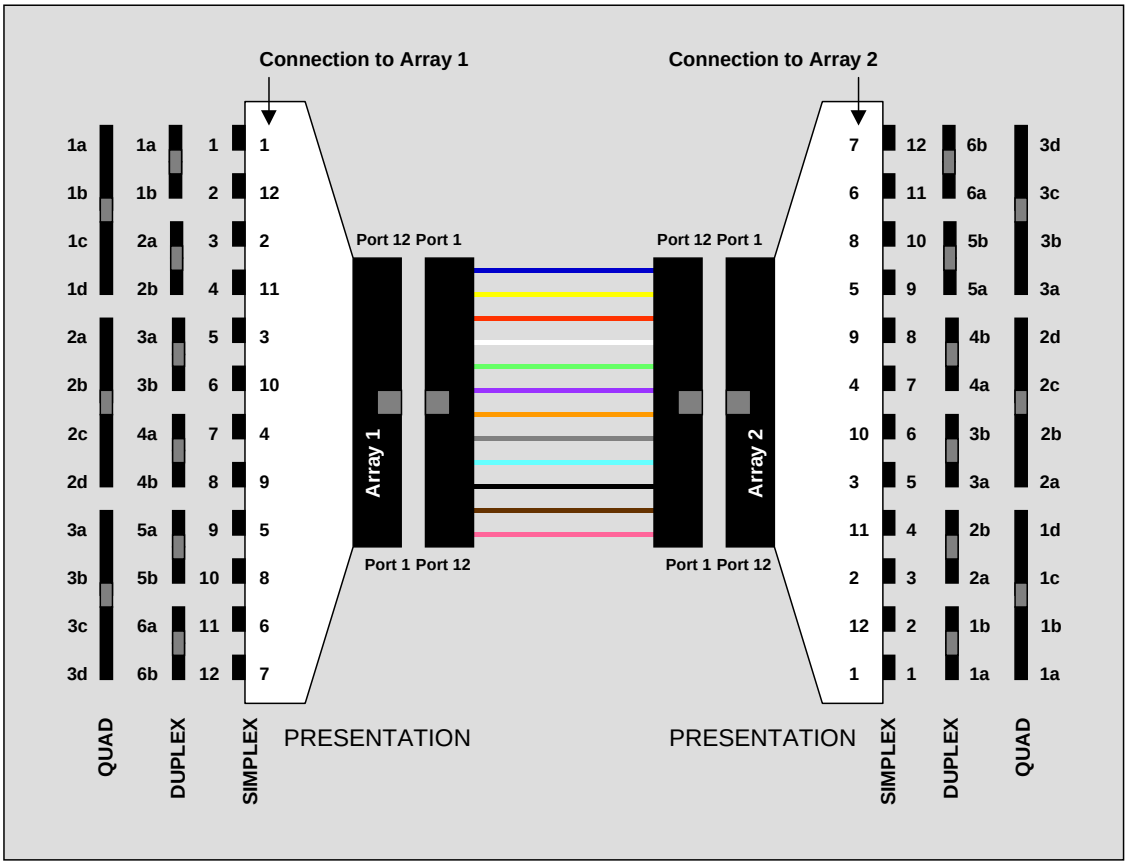

Figure A.2: 12-element presentations of a 12-element array pre-terminated interface

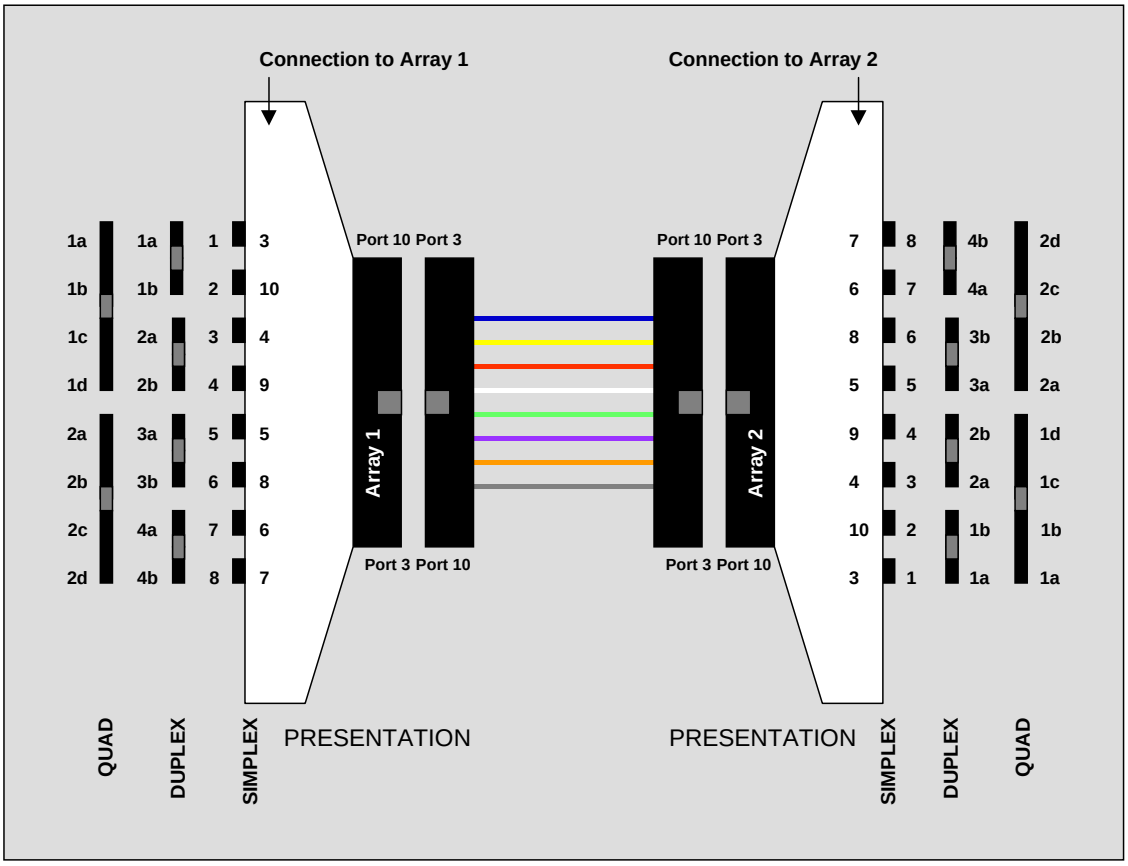

Figure A.3: 8-element presentations of a 12-element array pre-terminated interface

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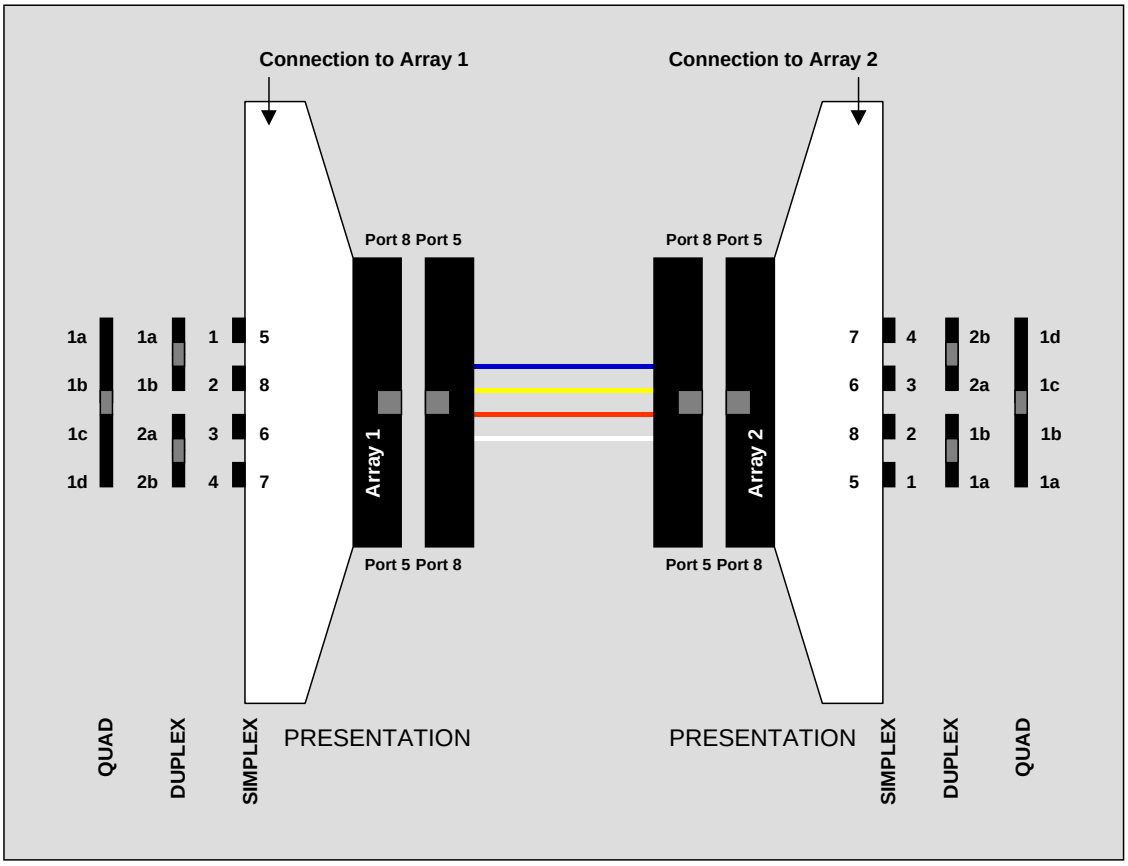

Figure A.4: 4-element presentations of a 12-element array pre-terminated interface