

**Lucent Technologies**  
Bell Labs Innovations



**WaveStar™ OLS 40G**  
**Enhanced Optical Networking (EON)**  
**Release 7.0**

Applications, Planning, and Ordering Guide

365-575-386  
Issue 2  
April 2001

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# About This Document

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## **Intended Audience**

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This book is written primarily for network planners and engineers, as well as for anyone who needs information about the features, applications, operation, engineering, and ordering of WaveStar OLS 40G.

## **Reason for Reissue**

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Release 7.0 updates WaveStar OLS 40G with the following:

- New optical amplifier, LEA107B
- ODU to OMU pass-through connections without OTUs
- The ENT-SYS TL1 command - new provisionable parameter, PASS\_THRU which allows the selection of the new pass-through ring mode feature.

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## How to Use This Document

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For general product and release information, refer to Chapters 1, 2, 4, and 5. For information about applications planning, refer to Chapters 2, 3, 4, and 6. Personnel responsible for engineering a system should refer to Chapters 4 and 6. Those responsible for ordering equipment should refer to Chapters 4, 6, and 7.

The guide is organized as follows:

- “About This Document” describes the purpose, intended audiences, reason for reissue, and the organization of this document. This section also references other related documentation and explains how to order copies of the documentation and how to comment on it
- Chapter 1, “Introduction,” presents a summary description of WaveStar OLS 40G and related products.
- Chapter 2, “Features,” describes the major features of WaveStar OLS 40G. The features are further described in Chapter 3, “Applications,” Chapter 4, “Product Description,” and Chapter 5, “Operations, Administration, Maintenance, and Provisioning”.
- Chapter 3, “Applications,” describes how WaveStar OLS 40G handles point-to-point, Dual End Terminal, and 4 fiber rings
- Chapter 4, “Product Description,” describes WaveStar OLS 40G architecture. After introducing the various WaveStar OLS 40G and OTU packages, Chapter 4 describes the system control, physical design, transmission, synchronization, protection, and powering down to the circuit pack level
- Chapter 5, “Operations, Administration, Maintenance, and Provisioning,” discusses the features available for monitoring and maintaining WaveStar OLS 40G.
- Chapter 6, “System Planning and Engineering,” summarizes descriptive information used with applications information to plan procurement and deployment of WaveStar OLS 40G.
- Chapter 7, “Ordering,” contains equipment ordering information for WaveStar OLS 40G.
- Chapter 8, “Product Support,” describes how Lucent Technologies supports WaveStar OLS 40G; with information on engineering and installation services, technical/documentation support, and training.
- Chapter 9, “Quality Statements and Technical Specifications,” contains the Lucent Technologies quality policy, describes the reliability program, and lists technical specifications for WaveStar OLS 40G.

- Appendix A, “Circuit Pack Sparing,” provides information on circuit pack sparing for WaveStar OLS 40G. Circuit pack comcodes and CLEI codes are also provided.
- The “Glossary” section defines and lists abbreviated terms and acronym associated with WaveStar OLS 40G.
- The Index provides page numbers for key words and subject names.

## **Related Documentation**

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The following documents provide information about WaveStar OLS 40G:

- Number: 365-575-387  
Comcode: 109074492  
  
Title: *WaveStar™ OLS 40G Release 7.0 User/Service Manual*  
  
Audience: End user maintenance personnel  
  
Content: Detailed system description, technical specifications, operation and maintenance, and user interface descriptive/tutorial information.
- Number: 365-575-398  
  
Title: *WaveStar™ OLS 40G Provisioning Job Aid*  
  
Audience: End user maintenance personnel  
  
Content: Laminated job aid cards used as quick reference, containing detailed provisioning information.
- Number: 365-575-399  
  
Title: *WaveStar™ OLS 40G Threshold-Crossing Alert (TCA) Parameters Provisioning Job Aid*  
  
Audience: End user maintenance personnel  
  
Content: Laminated job aid cards used as quick reference, containing detailed information on TCA parameter provisioning.
- Number: 365-575-389  
  
Title: *WaveStar™ OLS 40G Release 7.0 Installation Manual*  
  
Audience: Customers planning to install WaveStar OLS  
  
Content: Customer installation instructions
- Number: 365-575-388  
  
Title: *WaveStar™ OLS 40G Release 7.0 Operations Systems Engineering Guide*  
  
Audience: End user maintenance personnel  
  
Content: Operations Systems software commands, messages, and other information
- Number: 365-575-550  
Comcode: 109074484

Title: *WaveStar™ OLS 40G Release 7.0 Software Release Description (SRD)*

Audience: End-user maintenance personnel

Content: Status of problems fixed and known problems for Release 7.0 - WaveStar OLS 40G software

## **Drawings**

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The following drawings, which are shipped with the product, provide information about WaveStar OLS 40G. These drawings are needed for the installation process.

J68982C-1	WaveStar OLS 40G Cabinet (Equipment and Circuit Packs Ordered with Equipment)
J68982D-1	WaveStar OLS 40G Integrated Bay (Equipment and Circuit Packs Ordered with Equipment)
J68982CS-1	WaveStar OLS 40G Cabinet Software and Documentation
J69000C-1	Optical Translator Cabinet (Equipment and Circuit Packs Ordered with Equipment)
SD-5G276-01	WaveStar OLS 40G Application Schematic
SD-6G156-01	Optical Translator Cabinet Application Schematic
SD-5G157-01	WaveStar OLS 40G Integrated Bay Application Schematic
T-5G276-33	WaveStar OLS 40G Interconnection Circuit
T-6G156-33	Optical Translator Interconnection Circuit
T-5G157-33	WaveStar OLS 40G Integrated Bay Interconnection Circuit
T-5G276-30	WaveStar OLS 40G Circuit
T-6G156-30	Optical Translator Circuit
T-6G157-30	WaveStar OLS 40G Integrated Bay Circuit
ED-7G033-30	WaveStar OLS 40G Cabinet Framework
ED-7G044-30	Optical Translator Cabinet Framework

ED-7G048-30	WaveStar OLS 40G Integrated Bay Framework
ED-7G028-20	WaveStar OLS 40G Cable Assembly
ED-7G045-20	OTU Cable Assembly
ED-7G028-22	WaveStar OLS 40G Intercabinet Cable Assembly
ED-7G045-22	OTU Intercabinet Cable Assembly
ED-7G028-30	WaveStar OLS 40G Shelf Assembly
ED-7G045-30	Optical Translator Shelf Assembly
ED-7G027-30	WaveStar OLS 40G User/Fuse Power Indicating Panel Assembly
ED-7G047-30	OTU Fuse/Fuse Power Indicating Panel Assembly
FPD 804-604-161	WaveStar OLS 40G Cabinet Floor Plan Data Sheets
FPD 804-604-162	OTU Cabinet Floor Plan Data Sheets

The following drawings are available from the Customer Information Center (CIC) at 1-888-582-3688 for WaveStar OLS 40G. These drawings contain valuable product information, but are not needed for product installation. Therefore, they are not shipped with the product.

T-5G276-30	WaveStar OLS 40G Circuit
T-5G276-33	WaveStar OLS 40G Interconnection Circuit
T-6G156-30	Optical Translator Circuit
T-6G156-33	Optical Translator Interconnection Circuit
T-6G157-30	WaveStar OLS 40G Integrated Bay Circuit
T-6G157-33	WaveStar OLS 40G Integrated Bay Interconnection Circuit

For more information, see “How to Order Documents,” later in this chapter.

## **Electronic Documentation**

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Documentation on CD-ROM has many advantages over traditional paper documentation, including cost savings, search and retrieve capability, and access to current information.

The documentation for WaveStar OLS 40G is available on CD-ROM. To order an annual subscription, or to obtain pricing information and a list of all documents available on CD-ROM:

- Contact your Lucent Technologies account executive or
- See the table in “How to Order Documents” which lists contact phone numbers.

## How to Order Documents

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Customer	Mail/Internet Order	Telephone/Fax Order <i>(Monday through Friday)</i>
Commercial Customers *	<p>Lucent Technologies, Inc. Customer Information Center Attention: Order Entry Section 2855 N. Franklin Road P.O. Box 19901 Indianapolis, IN 46219 USA</p> <p>Internet Address: <a href="http://www.lucentdocs.com">www.lucentdocs.com</a></p>	<p>From USA: <b>+1-888 LUCENT-8</b> <b>(+1-888-582-3688)</b> Fax: <b>1-800-566-9568</b></p> <p>From North American Region (NAR): <b>+1-317-322-6619</b> Fax: <b>+1-317-322-6359</b></p> <p>From Europe, Middle East, and Africa (EMEA): <b>+1-317-322-6416</b> Fax: <b>+1-317-322-6699</b></p> <p>From Asia/Pacific Region and China; Caribbean/Latin American Region (CALA): <b>+ 1-317-322-6411</b> Fax: <b>+1-317-322-6699</b></p>
RBOC/BOC	Process through your Company Documentation Coordinator	

\* For commercial customers, a check, money order, purchase order number, or charge card number is required with all orders. Make checks payable to Lucent Technologies.

Lucent Technologies entities should use Form IND 1-80.80 FA, available through the Customer Information Center.

## **Training**

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No product offering is complete without a formal training package. Suitcasing of these courses is also available.

To register for a course or obtain schedule information in the continental United States, please call: 1-888-LUCENT8 (582-3688): Prompt 2. For course registration or schedule information outside the continental United States, please contact your in-country training representative or call: +1-407-767-2798.

### **Curriculum Path for the WaveStar OLS 40G Applications, Planning, and Ordering Guide**

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- Number: TSCBAS

Title: *Communications Basics (CD-ROM)*

Audience: Personnel working in telecommunications or preparing to work in telecommunications.

Content: This course provides an overview of communications and describes its media. The evolution of telecommunications and the topic of electrical signals as a communications technique in the telecommunications industry are presented.

Prerequisites: None. However, a familiarity with general telecommunications principles and the fundamentals of optical line transmission equipment is helpful.

- Number: TSANLG

Title: *Analog and Digital Concepts (CD-ROM)*

Audience: Personnel working in telecommunications or preparing to work in telecommunications.

Content: This course discusses analog and digital signals, modulation techniques, and types of multiplexing including an explanation of distributive processing.

Prerequisites: None. However, a familiarity with general telecommunications principles and the fundamentals of optical line transmission equipment is helpful.

- Number: TR9203

Title: *SONET: Understanding the Basics (CD-ROM)*

Audience: This course is primarily intended for network planners; product/project managers; operations, maintenance, installation, and equipment engineers; and account representatives/sales personnel. In general, the course will be helpful to anyone needing a general knowledge of the requirements of a Synchronous Optical Network (SONET) network.

Content: This course provides a basic description of the SONET standard and addresses key points which include SONET advantages and capabilities, topologies and rings, pointers, virtual tributaries, and synchronous transport signal (STS) multiplexing.

Prerequisites: A familiarity with general telecommunications principles and the fundamentals of optical line transmission equipment is helpful or:

- TSANLG - Analog and Digital Concepts, (CD-ROM)
- TSCBAS - Communication Basics, (CD-ROM)

■ Number: TR9208

Title: *Dense Wavelength Division Multiplexing (CD-ROM)*

Audience: This course is primarily intended for network, facility, and strategic planners, product managers, equipment engineers, technical consultants, and account representatives. In general, the course will be helpful to anyone responsible for network implementation and operations.

Content: This course investigates what Dense Wavelength Division Multiplexing (DWDM) technology is, why it was developed, how it works, and where it fits in communications networks.

Prerequisites: The student should have previous transmission experience or:

- TSANLG - Analog and Digital Concepts, (CD-ROM)
- TSCBAS - Communication Basics, (CD-ROM)
- TR9203 - SONET: Understanding the Basics (CD-ROM) or TR5951 - Synchronous Digital Hierarchy Introduction, or TR5951M - Synchronous Digital Hierarchy Introduction (CD-ROM)

■ Number: LW2252

Title: *WaveStar Optical Line System 40G Applications and Planning*

Audience: This course is primarily intended for network planners, product managers, project managers, equipment engineers, technical consultants, and account representative/sales personnel. In general, the course will be helpful to anyone needing a general knowledge of the optical line system (OLS) equipment.

Content: This course provides instruction on the product applications, features and architecture as well as the office and network planning needed for implementation. Included in the last session is instruction and practice on ordering the equipment. This course is based on the contents of the *WaveStar OLS 40G Applications, Planning, and Ordering Guide*.

Prerequisites: The student should have a basic understanding of SONET and transmission fiber-optic signals or:

- TSANLG - Analog and Digital Concepts, (CD-ROM)
- TSCBAS - Communication Basics, (CD-ROM)
- TR9203 - SONET: Understanding the Basics (CD-ROM)
- TR9208 - Dense Wavelength Division Multiplexing, (CD-ROM)

## Curriculum Path for the WaveStar OLS 40G User Service Manual

---

- Number: TSCBAS

Title: *Communications Basics (CD-ROM)*

Audience: Personnel working in telecommunications or preparing to work in telecommunications.

Content: This course provides an overview of communications and describes its media. The evolution of telecommunications and the topic of electrical signals as a communications technique in the telecommunications industry are presented.

Prerequisites: None. However, a familiarity with general telecommunications principles and the fundamentals of optical line transmission equipment is helpful.

- Number: TSANLG

Title: *Analog and Digital Concepts (CD-ROM)*

Audience: Personnel working in telecommunications or preparing to work in telecommunications.

Content: This course discusses analog and digital signals, modulation techniques, and types of multiplexing including an explanation of distributive processing.

Prerequisites: None. However, a familiarity with general telecommunications principles and the fundamentals of optical line transmission equipment is helpful.

- Number: TR9203

Title: *SONET: Understanding the Basics (CD-ROM)*

Audience: This course is primarily intended for network planners; product/project managers; operations, maintenance, installation, and equipment engineers; and account representatives/sales personnel. In general, the course will be helpful to anyone needing a general knowledge of the requirements of a Synchronous Optical Network (SONET) network.

Content: This course provides a basic description of the SONET standard and addresses key points which include SONET advantages and capabili-

ties, topologies and rings, pointers, virtual tributaries, and synchronous transport signal (STS) multiplexing.

Prerequisites: A familiarity with general telecommunications principles and the fundamentals of optical line transmission equipment is helpful or:

- TSANLG - Analog and Digital Concepts, (CD-ROM)
- TSCBAS - Communication Basics, (CD-ROM)

■ Number: TR9208

Title: *Dense Wavelength Division Multiplexing (CD-ROM)*

Audience: This course is primarily intended for network, facility, and strategic planners, product managers, equipment engineers, technical consultants, and account representatives. In general, the course will be helpful to anyone responsible for network implementation and operations.

Content: This course investigates what Dense Wavelength Division Multiplexing (DWDM) technology is, why it was developed, how it works, and where it fits in communications networks.

Prerequisites: The student should have previous transmission experience or:

- TSANLG - Analog and Digital Concepts, (CD-ROM)
- TSCBAS - Communication Basics, (CD-ROM)
- TR9203 - SONET: Understanding the Basics (CD-ROM) or TR5951 - Synchronous Digital Hierarchy Introduction, or TR5951M - Synchronous Digital Hierarchy Introduction (CD-ROM)

■ Number: LW2652

Title: *WaveStar Optical Line System 40G Operations and Maintenance (Hands On)*

Audience: This course is primarily intended for technicians responsible for the operation and maintenance of the equipment, but will be useful to technical support people and anyone needing a working knowledge of the equipment.

**Content:** This course prepares the student for operation and maintenance of WaveStar OLS 40G. The course provides in-depth description of the equipment and how it is used with other lightwave equipment. The course is based on the *WaveStar OLS 40G User Service Manual*.

**Prerequisites:** The student should have a basic understanding of SONET and transmission fiber-optic signals or:

- TSANLG - Analog and Digital Concepts, (CD-ROM)
- TSCBAS - Communication Basics, (CD-ROM)
- TR9203 - SONET: Understanding the Basics (CD-ROM)
- TR9208 - Dense Wavelength Division Multiplexing, (CD-ROM)

■ **Number:** TR3510

**Title:** *Integrated Transport Management-SubNetwork Controller User Training* (optional)

**Audience:** This course is primarily intended for operations, maintenance, and engineering personnel responsible for the operation and maintenance of the SONET network elements using the Integrated Transport Management-SubNetwork Controller (ITM-SNC).

**Content:** This course provides an introduction to the features, network applications, and configurations of the ITM-SNC. In addition, the course provides hands-on exercises with the ITM-SNC to cover provisioning of site-specific instructions, monitoring of events, and maintenance activities.

**Prerequisites:** The student should be familiar with SONET multiplexing structures and terminology, the principles of provisioning, and maintenance of central office equipment in addition to:

- TR9203 - SONET: Understanding the Basics (CD-ROM)
- TR5951 (SDH) - Synchronous Digital Hierarchy Introduction, or TR5951M - Synchronous Digital Hierarchy Introduction (CD-ROM)

To obtain more information or to register for these courses write to:

Lucent Technologies  
Customer Training and Information Products  
307 North Lake Blvd.  
Altamonte Springs, FL 32701  
USA

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# Introduction

# 1

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  - WaveStar OLS 40G Functions. . . . . 1-5
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# Introduction

# 1

---

This chapter presents a brief overview of the WaveStar OLS 40G EON (Enhanced Optical Networking) optical networking product.

## Introduction to WaveStar OLS 40G EON

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WaveStar OLS 40G EON is a flexible, high capacity lightwave system comprised of end terminals that

- multiplex digitally encoded information (contained in up to sixteen different wavelengths, up to 32, 256 voice channels each) on one end,
- transmit the resulting combined signal through the optical fibers, and
- then demultiplex the WaveStar OLS 40G R7.0 information at the other end.

Repeater terminals are used to re-amplify the optical signal on an optical line between adjacent end terminal and repeater sites or between adjacent repeater sites. Enhanced Optical Networking (EON) has been added to highlight the fact that the WaveStar OLS 40G is a family of optical network equipment, inclusive of hardware and software, used by service providers in broadband applications to increase and manage bandwidth.

Lucent Technologies offers the industry's widest range of transmission systems and related services in order to provide total network solutions. WaveStar OLS 40G, with Dense Wavelength Division Multiplexing (DWDM), is part of an optical networking family of products.

Designed to help telecommunications service providers enter a new century of advanced services, WaveStar OLS 40G provides higher capacity per fiber over longer distances than previously possible, promoting greater economy and efficiency. WaveStar OLS 40G supports a variety of network topologies, including high capacity loop, inter-office, outstate, Short Reach, and Long Span applications. These network topologies are described in Chapter 3, "Applications."

WaveStar OLS 40G provides the following functions:

- Multiplexes up to 16 wavelengths (of up to 2.5 Gb/s per wavelength) per fiber
- Multi-vendor compatibility
- Concatenation of multiple WaveStar OLS 40G terminals
- Signal regeneration
- Wavelength blocking prevention via wavelength interchange
- Wavelength Add/Drop (WAD) supported.

This combined functionality increases the flexibility and cost-effectiveness of WaveStar OLS 40G.

Several Lucent terminals have been designed to operate directly with WaveStar OLS 40G. These include the:

- FT-2000 OC-48 Lightwave System (Add Drop Ring Terminal),
- FT-2000 OC-48 Large Capacity Terminal (LCT),
- SLM-2000,
- WaveStar BandWidth Manager,
- WaveStar ADM 16/1, and
- WaveStar TDM 2.5G (OC-48)/10G (OC-192) (2-Fiber)



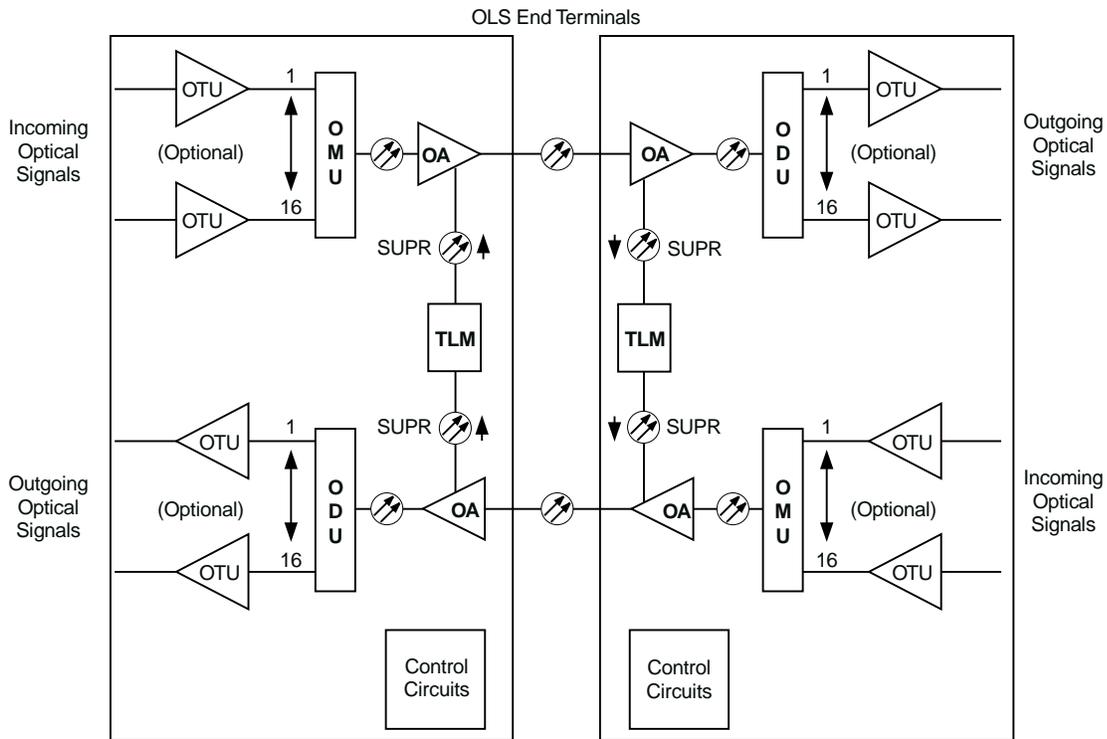
**NOTE:**

An OTU is required for WaveStar OLS 40G when non-Lucent network elements are used.

WaveStar OLS 40G also works with the SubNetwork Management System (SNMS). The SNMS is an element management system that supports synchronous optical network (SONET) network elements. SNMS provides fault, provisioning, configuration, and security management functions via a graphical user interface (GUI). Through these functions, SNMS is able to support communication multiplexing or concentration, guarantee network security, and record all database changes. The SNMS also provides a cut-through capability, allowing the SNMS user to access a network element through its native command set.

The SNMS operates as an enhanced graphical tool and as a general configuration management aid. It provides network element, port, cross-connection, and path provisioning, as well as flow-through from provisioning operations systems (OS) to network elements. The SNMS also provides fault management through subnetwork alarm and event pre-processing prior to sending fault information to a network surveillance system such as the Network Monitoring and Analysis-facility (NMA-F).

WaveStar OLS 40G supports applications that need to expand to accommodate increasing amounts of information. WaveStar OLS 40G supports wavelength growth and, when equipped with the OT, a highly flexible form of WAD is also possible. Wavelength growth increases capacity and decreases the need for fibers, especially useful in cases of fiber exhaust. Utilizing DWDM technology, WaveStar OLS 40G can handle transmission of up to sixteen wavelengths over a single fiber; each channel can be equipped in any order. Figure 1-1 shows a block diagram of a simplified WaveStar OLS 40G system.



NC-OLS80G002

**Figure 1-1. Simplified WaveStar OLS 40G System**

## **WaveStar OLS 40G Functions**

---

WaveStar OLS 40G has the following functions:

- Receives up to sixteen optical channels
- Performs Dense Wavelength Division Multiplexing (DWDM) and demultiplexing of up to sixteen optical lines on one optical fiber on standard single mode fiber (SSMF) or non-zero dispersion-shifted fiber (for example, TrueWave®).
- Supports OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, Gigabit Ethernet (GbE), and 100 - 750 Mb/s low speed broadband
- Multiplexes optical signals with a maintenance signal that is used by DWDM
- Amplifies signals using an erbium-doped fiber Optical Amplifier (OA)
- Provides a full suite of OAM&P capabilities, including optical monitoring of individual wavelength channels at the OA output
- If needed, uses Repeater terminals to optically amplify the signal
- Can be economically deployed for applications of a few kilometers to hundreds of kilometers and more. In Long Span configurations, supports a maximum distance of 600 km (five spans, up to four WaveStar OLS 40G Repeaters). In Long Reach configurations, supports a maximum optical line length of 640 km (eight spans) In Short Reach configurations, supports one span with optical line lengths up to 80 km
- Provides a TL1 interface for maximum operations flexibility available via X.25 interface
- Available to support 2-fiber and 4-fiber, point-to-point and ring configurations
- Provides Automatic Power Shut Down (ASPD) and restart for optical safety.

## **WaveStar OLS 40G Benefits**

---

WaveStar OLS 40G has the following benefits:

- Provides a cost-effective solution to fiber-exhaust situations (no need to add more fiber)
- Provides an open system interface with all types of transmission equipment and operations systems
- Extends optical channels to thousands of kilometers without the need for SONET/SDH repeaters; replaces multiple repeaters
- Reduces office congestion
- Facilitates implementation of Wavelength Add/Drop (WAD) topologies
- Prevents wavelength blocking via Wavelength Interchange
- Configurable for a variety of topologies, such as point-to-point and ring configurations
- Works with embedded base transmission systems, instantly increases fiber capacity 16-fold or more
- Bit-rate Independent
- Provides user-settable alarms and control of equipment collocated with WaveStar OLS 40G
- Provides performance monitoring, fault isolation, and preventive maintenance
- Handles up to 40 Gb/s of traffic on one optical line
- Single-OA and Two-OA operation supported
- Repeater sites between End Terminals to support each span

## WaveStar OLS 40G Feature Release Plan

---

WaveStar OLS 40G Release 1.0 included the following features:

- Up to eight wavelengths at [OC-48/STM-16](#) bit rate
- Long Span transmission up to 360 km
- Flexible span engineering (1 to 3 spans)
- Support for up to four bidirectional optical lines
- Redundantly-pumped OAs
- Automatic OA gain control
- Craft Interface Terminal (CIT)
- Transaction Language 1 (TL1) command operations system interface
- Orderwire
- Parallel telemetry
- Automatic fault detection and isolation
- [155 Mb/s](#) customer maintenance signal
- Gateway Network Element (GNE) operation
- Alarm Gateway Network Element (AGNE) support
- Optical signal performance monitoring
- Pump performance monitoring
- Threshold Crossing Alert (TCA) reporting
- Automatic and CIT provisioning
- User software download
- Multi-level security
- Login and password aging

WaveStar OLS 40G Release 2.0 offered the following additional features:

- The [OC-48/STM-16](#) Optical Translator Unit (OTU) for open optical interface to multi-vendor [OC-48/STM-16](#) products
- Fully flexible WAD capability
- Long Reach transmission up to 640 km
- Flexible span engineering (1 to 8 spans).

WaveStar OLS 40G Release 2.1 offered the following:

- Up to sixteen wavelengths with any mix of OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, or 400-700 Mb/s signal rates.
- Open optical interfaces to multi-vendor OC-3/STM-1, OC-12/STM-4, and 400-700 Mb/s products with the Quad Optical Translator Units (QOTUs)
- Single-OA capability for up to sixteen wavelengths
- OA for Short Reach applications
- Dual-facing Shelf
- CenterLink craft interface terminal
- Enhanced security.

WaveStar OLS 40G Release 3.0.2 offered the following:

- Full integration of WaveStar OLS 40G and OT systems
- Telemetry feed-through capability for 4-fiber SONET applications
- 16-wavelength transmission on Long Span routes of up to 120 km per span
- Low speed broadband Optical Translator Port Module (OTPM) supporting 100 - 750 Mb/s low speed signal rates
- Automatic power shut-down and restart.

WaveStar OLS 40G Release 3.3 supports the standard for GbE signals, GbE-1 and introduces the new LEA7B OA.

WaveStar OLS 40G Release 3.4 offered the X.25 traffic redirect feature.

WaveStar OLS 40G Release 7.0 offers the following features:

- A new Optical Amplifier (LEA107B) with:
  - support for a 1532 nm or 1510 nm supervisory channel
  - an optical monitoring test port at the output
- Metropolitan and Regional Ring Applications
  - OMU/ODU pass-through connections
  - Low loss OMU/ODU

For information on WaveStar OLS 40G product features, refer to “Features.”



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# Features

# 2

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# Features

# 2

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This chapter summarizes the main features of WaveStar OLS 40G.

## **Overview**

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The features of WaveStar OLS 40G are presented in six categories:

- Release 7.0 features
- Release 3.4 feature
- Release 3.3 feature
- System features
- Maintenance features
- Physical features

## **Release 7.0 Features**

---

The Release 7.0 features of the WaveStar OLS 40G are:

- New optical amplifier, LEA107B
- ODU to OMU pass through connections without OTUs
  - Cross-modulation tone countermeasures no longer use OTUs in all cases
  - New engineering rules for short span regional or metropolitan applications

- Support for up to a 4-node ring without through OTUs (based on engineering rules)
- Low loss OMU and ODU
  - New, enhanced OMU 506B with reduced insertion loss
    - New OMU faceplate allows the use of LC-type LBOs to balance power levels
    - New OMU prevents in-service wavelength from being impacted if an accidental connection of a second signal wavelength occurs on the same wavelength
    - New OMU uses filter device instead of coupler device
  - New, enhanced ODU 606C with reduced insertion loss
  - New, enhanced ODU 606D with reduced insertion loss
  - Existing OMU and ODU slots used for new OMU 506B and ODUs, 606C and 606D
- The ENT-SYS TL1 command has a new provisionable parameter PASS\_THRU which allows the selection of the new pass-through ring mode feature.

## **Optical Amplifier LEA107B**

---

WaveStar OLS 40G Release 7.0 introduces the LEA107B Optical Amplifier.

- The LEA107B Optical Amplifier (OA) is a hardware enhancement to the current LEA104 that adds the following features:
- A dual filter to support either 1532 nm or 1510 nm optical supervisory channel (OSC)
- An optical monitoring test port at the optical amplifier output

The increased output power of the LEA107B (compared to the Long Reach LEA7B) allows some applications to require less repeater sites, resulting in significant cost savings. Also, some customers may desire to use the optical monitoring port to monitor individual wavelengths with an optical spectrum analysis (OSA) instrument.

The LEA107B OA has the following engineering rules:

- The LEA107B is not backwards compatible.
- The LEA107B cannot be mixed with any other OA type within the same end terminal to end terminal configuration
- For the 1532 nm telemetry, the LEA107B can be used in all applications, except in a one-OA configuration.

- For the 1510 nm telemetry the configurations supported by the LEA107B are limited by the engineering rules for the LDA4 telemetry circuit pack. The maximum span losses for the one and two span applications cannot exceed 33 db.

The engineering rules are developed for up to five spans.

## **Release 3.4 Feature**

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The X.25 Redirect Traffic feature is introduced in WaveStar OLS 40G Release 3.4. This feature:

- Allows a WaveStar OLS 40G Network Element (End Terminal) to perform intelligent rerouting of TL1 traffic over the customer X.25 network in the case of line failure.
- Decreases the time needed to identify a failure in the network
- Establishes, for linear systems, communication with the other end of the system around a line failure
- Is provisioned using the new ENT-SYS TL1 command parameter, PVC2\_Redirect. This parameter must be enabled by setting the parameter value to YES on only one End Terminal in a string.

For more information on the X.25 Redirect Traffic feature see the *WaveStar™ OLS 40G Release 7.0 Operations Systems Engineering Guide*.

## **Release 3.3 Feature**

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WaveStar OLS 40G Release 3.3. introduces the new feature which allows Optical Translator Units to support 1.25 Gb/s Ethernet (GbE) traffic on WaveStar OLS 40G systems. For GbE this release provides:

- 17 new OTUs to support 1.25 Gb/s IEEE 802.3 Ethernet traffic,
- 16 add OTUs for the 16 different 1.5 μm wavelengths of the WaveStar OLS 40G, and
- One drop OTU with a 1.3 μm output supporting all 16 wavelengths.

Release 3.3 also introduces the LEA7B OA, a hardware enhancement to the current LEA7 OA. The LEA7B adds the following features:

- A dual filter to support either 1532- or 1510-nm optical supervisory channel (OSC)
- An optical monitoring test port at the optical amplifier output to enable the customer to monitor individual wavelengths.

The LEA7B OA has the following engineering rules:

**⇒ NOTE:**

When operating in 1510-nm mode, the LEA7B OA cannot detect the supervisory signal tone. The LDA4 has a supervisory input band-pass filter to extract 1510 nm signal from 1532 nm signal. However, even with the band-pass filter, the signal-to-noise ratio is so low that the LOS (Loss of Modulation for E1) detector on the E1 framer is unreliable; therefore, a supervisory LOF (Loss of Frame) is used instead. You will see an incoming signal failure alarm regardless of whether it is from LOS or LOF.

- The LEA7B is not backwards compatible.
- The LEA7B cannot be mixed with any other OA-type within the same end terminal to end terminal configuration.
- For the 1532-nm telemetry, the LEA7B can be used in all applications, except in a one-OA configuration.
- For the 1510-nm telemetry the configurations supported by the LEA7B are limited by the engineering rules for the LDA4 telemetry circuit pack. The maximum span losses for the one- and two-span applications exceed 33 db.
- The engineering rules are developed for up to eight spans.

## **System Features**

---

The System features of the WaveStar OLS 40G are:

- 16-wavelength point-to-point and ring applications
- Automatic power shut-down (APSD) and restart capability

### **16-Wavelength Point-to-Point and Ring Applications**

---

WaveStar OLS 40G can be deployed in 2-fiber and 4-fiber configurations for point-to-point applications. WaveStar OLS 40G may also be deployed in a dual-facing end terminal configuration. In this configuration, transmission is supported in both the East and West directions, similar to an add/drop multiplexer. When WaveStar OLS 40G is deployed in repeater and dual-facing end terminal configurations, linear add/drop and ring topologies may also be deployed.

To optimize WaveStar OLS 40G for a variety of applications, four optical amplifiers are available for  $16\lambda$  applications. These amplifier choices allow selection of the amplifier that best suits the span distance in a given application.

Optical Translator Units (OTUs) and Optical Translator Port Modules (OTPMs) may be used as an interface to SONET/SDH network elements (OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, GbE) or for signals with data rates from 100 - 750 Mb/s (e.g., PDH or data).

SONET/SDH products equipped with OLS-compatible optics may be connected directly to the OLS multiplexing/demultiplexing units without the need for an Optical Translator (OT), for example, FT-2000 Add Drop Ring (ADR), FT-2000 Large Capacity Terminal (LCT), SLM-2000. Refer to the appropriate product documentation for availability).

Refer to Chapter 6, “System Planning and Engineering” for information on engineering rules.

## **Automatic Power Shut-down (APSD) and Restart**

---

The APSD feature is provided as a safety mechanism for WaveStar OLS 40G equipment. It protects against optical surges and exposure to high-powered lasers by automatically reducing output power during an optical power loss (caused by equipment failure, a fiber cut, or a removed connector). Specifically, WaveStar OLS 40G qualifies as a Class 3B system; during a power loss, the OA is brought down to Class 1 levels. Once the system has been repaired or links have been re-established, APSD ensures that normal operation resumes within four to five seconds.

The APSD feature has the following benefits:

- Increases safety levels of equipment use
- Meets IEC requirements
- Facilitates operation at very high levels of optical power

For more information on this feature, refer to Chapter 5, “Operations, Administration, Maintenance, and Provisioning.”

## **Maintenance Features**

---

WaveStar OLS 40G provides multiple maintenance features that are similar to and compatible with those of other Lucent Technologies 2000 family products. Maintenance features provide a wide range of system information and control, from summary-level status information to detailed reporting. The following sections summarize the major features. Chapter 5, “Operations, Administration, Maintenance, and Provisioning,” describes these features in more detail.

### **CenterLink-CIT**

---

The CenterLink-CIT is a graphical craft interface terminal that provides extensive on-line help as well as security against unauthorized access. Running under the *Windows 95*®, *Windows 98*®, *Windows NT*®, or *Windows 2000*® operating system, CenterLink-CIT also provides detailed information and system control for specialized local and remote maintenance and administrative activities.

### **Operations Interface Flexibility**

---

WaveStar OLS 40G offers a variety of operations interfaces to meet the needs of an evolving operations system (OS) network. The operations interfaces include the following:

- **Office alarms interface:** provides a set of discrete relays that control office audible and visible alarms
- **Parallel telemetry interface:** provides a minimum set of alarm and status information to an operations center for local and remote alarm centers
- **Miscellaneous discrete interface:** provides a total of 144 miscellaneous discrete input points and 36 miscellaneous discrete output points. Miscellaneous discrete inputs can monitor conditions like open doors or high temperatures, and miscellaneous discrete outputs can control equipment like fans and generators
- **X.25 interface:** uses X.25 protocol to provide communications with a message-based operations system through Transaction Language 1 (TL1) operations messages. A message-based operations system can access local and remote WaveStar OLS 40G network elements in a maintenance WaveStar OLS 40G using the gateway network element (GNE) capability
- **User panel:** provides indicators showing critical (CR), major (MJ), and minor (MN) alarms, abnormal conditions (ABN), near-end activity (NE ACTY), and far-end activity (FE ACTY). The user panel also features CIT DCE connection, an electrostatic discharge (ESD) jack, power on (PWR

ON) light-emitting diode (LED), and an alarm cut-off button (ACO) that silences audible office alarms when pressed and lights up during suppression of the alarm.

## **Operations Domains**

---

WaveStar OLS 40G subnetwork continues to include all dual-facing end terminals and repeaters interconnected with each other. The subnetwork may originate/terminate at two single-facing end terminals, two single side equipped dual-facing end terminals, or in a ring made of dual-facing end terminals and repeaters. WaveStar OLS 40G, however, comprises two end terminals and the repeaters between them.

WaveStar OLS 40G network elements and the signal transmitter network elements (such as the FT-2000 OC-48 LCT and FT-2000 OC-48 Lightwave System ADR) operate as separate and independent systems. There is no DCC connectivity between the two types of network elements. The dual-facing shelf feature extends WaveStar OLS 40G operations domain in 2-fiber applications to adjoining WaveStar OLS 40G subnetworks, maintaining communication.

For more information about operations domains, see Chapter 5, “Operations, Administration, Maintenance, and Provisioning.”

## **Single-Ended Operations**

---

The single-ended operations capability provides operations support from a single location to remote WaveStar OLS 40G network elements in the same WaveStar OLS 40G subnetwork. With this capability, you can perform operations, administration, maintenance, and provisioning on a centralized basis, saving travel time and money. Both the CIT and the OS interfaces can access network elements that can be WaveStar OLS 40G End Terminals or Repeater.

Capabilities of single-ended operations (operations interworking) include:

- GNE (remote TL1 operations system access)
- Alarm groups
- Remote login (remote craft access)
- Inventorying capabilities
- Remote network element status (remote alarming, alarm groups, AGNE, remote alarm status, remote office alarms, and parallel telemetry)
- Local and remote software copy/upgrades
- Directory Service Network Element (DSNE).

### **Gateway Network Element (GNE)**

One or more WaveStar OLS 40G network elements can be used as a GNE. The GNE serves as a single interface to the X.25 message-based operations system for all network elements in the same WaveStar OLS 40G subnetwork.

The GNE receives operations information from these network elements through the DCC and reports that information and its own information to the operations system. The operations information is in the form of TL1 messages. Through the GNE, the operations system can send TL1 commands to any network elements in WaveStar OLS 40G subnetwork.

The number of GNEs you use depends on your application and operations needs. For example, to reduce the number of operations data communication links between WaveStar OLS 40G subnetwork and the operations system, you might choose to use one WaveStar OLS 40G network element as the GNE. If you need redundancy, you might choose to use two network elements as GNEs.

### **Alarm groups**

To communicate remote status information efficiently, you must provision each network element with an alarm group parameter. Members of the alarm group exchange remote network element status information through one or more AGNEs that are defined in the same alarm group.

## **Remote Login**

You can log in remotely from one WaveStar OLS 40G network element to another WaveStar OLS 40G network element when they are in the same WaveStar OLS 40G subnetwork.

## **Inventorying Capabilities**

WaveStar OLS 40G provides automatic version recognition of all hardware and software installed in the system. Circuit pack types, circuit pack CLEI™ codes, and serial numbers are accessible via CenterLink and SNMS. These capabilities greatly simplify troubleshooting, dispatch decisions, and inventory audits.

## **Remote Network Element Status (Through DCC)**

Through the supervisory channel DCC interface, a WaveStar OLS 40G network element can receive and transmit summary alarm and status information from and to remote network elements in the same WaveStar OLS 40G. A far-end activity LED on the local terminal indicates whether any condition is present in a WaveStar OLS 40G network element elsewhere in the subnetwork.

## **Local Software Copy/Upgrades**

WaveStar OLS 40G can upgrade system software while in service. To upgrade, no control circuit pack changes are required. System monitoring and control are fully functional during software download. The CIT can be used to load software locally, or a modem can be used to download it remotely.

## **Remote Software Copy/Upgrades**

System software contained in one WaveStar OLS 40G (source) can be copied /upgraded to another (destination) in the same maintenance subnetwork. System monitoring and control are fully functional during the copying process.

## **Directory Service Network Element (DS-NE)**

Any one node in a WaveStar OLS 40G system can be designated as the “DS-NE”. The DS-NE provides a centralized database that maps terminal names (TIDs) to addresses (Network Service Access Points (NSAPs)). The NSAPs are used internally for routing information within WaveStar OLS 40G. No provisioning is required for the DS-NE database; the mapping is configured automatically.

## **Continuous Performance Monitoring**

---

Continuous performance monitoring allows WaveStar OLS 40G to detect transmission problems before they affect service. WaveStar OLS 40G monitors analog performance on each wavelength of an optical line. WaveStar OLS 40G receives digital performance information on the supervisory channel. Depending on customer needs, thresholds for each parameter can be provisioned.

You can specify a single start time for measuring all twenty-four hour performance monitoring parameters. The start time can be the beginning of any hour (the default is midnight). The performance monitoring parameters for each day are collected separately, beginning at the specified time. WaveStar OLS 40G keeps information for the current day and the previous six days. WaveStar OLS 40G also records performance data at fifteen minute intervals, storing data from the previous eight hours.

## **Original Value Provisioning and User-Selectable Thresholds**

---

WaveStar OLS 40G provides extensive circuit provisioning capabilities such as performance monitoring thresholds. The alarm severity of incoming signal failures can be provisioned.

To minimize provisioning, each parameter is initially assigned an original value which can easily be changed. Either the CIT or X.25 interface can be used to modify the value of any parameter.

## **Security Features**

---

WaveStar OLS 40G provides the following three tiers of security to protect against unauthorized access to the CIT and OS functions:

- Port security
- Network element login security
- Enhanced user login security.

For detailed information, see Chapter 5, “Operations, Administration, Maintenance, and Provisioning.”

## **Physical Features**

---

WaveStar OLS 40G packaging is designed for ease of use and adaptability. The following information highlights some of these features. For more details, see Chapter 4 “Product Description.”

### **Front Access**

---

You can access all operation, maintenance, and installation activities from the front of WaveStar OLS 40G. Front access provides greater flexibility, permitting placement of the equipment in physically restricted locations.

### **Equipment Packages**

---

WaveStar OLS 40G is available in the following packages:

- Cabinets
- Bay frames
- Miscellaneously-mounted.

### **Easy Installation and Self-tests**

---

WaveStar OLS 40G minimizes installation time with “one box” product deliveries, connectorized cabling with commercially available connectors, and simplified procedures. The “one box” product delivery concept ensures that all product components arrive at the installation site at the same time in a small number of containers.

A set of automatic turn-up tests is provided to verify that installation cabling is present to and from various circuit packs for each optical line. A manual local test is also provided to verify components are working properly. Since test signal generators and detectors are integrated into the system, external test equipment is not needed.

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# Applications

# 3

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# Applications

# 3

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This chapter describes WaveStar OLS 40G configurations, applications, and the basics of its transmission technology.

For more information about the physical components of WaveStar OLS 40G, see Chapter 4, “Product Description.” For information about Lucent products that are compatible with WaveStar OLS 40G, see the documents referenced in the section “Documentation for Related Equipment and Software” in “About This Document.”

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## Basic WaveStar OLS 40G Configurations

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As a bit-rate independent optical system, WaveStar OLS 40G can be configured in a variety of ways, ranging from single span, two terminal systems to complex multi-span systems involving multiple repeaters and end terminals. The information in this section describes basic configurations in which WaveStar OLS 40G can be used.

### Applications Without Repeaters

---

Point-to-point applications may or may not need repeaters. Two types of applications can be applied to this situation. They are:

- Two-OA
- Single-OA (repeaterless applications only)

### Two-OA Applications

For Long Span and Long Reach applications, two-OAs are used to prevent signal degradation. In addition to two-fiber applications the WaveStar OLS 40G may also be equipped for four-fiber applications.

Figure 3-1 shows a single, bidirectional WaveStar OLS 40G span. In the transmit direction, a WaveStar OLS 40G End Terminal does the following:

- Combines up to sixteen optical wavelengths\* onto a common optical fiber (performed by the OMU)
- Amplifies the light (performed by the OA)
- Couples the supervisory signal into the optical line signal
- Monitors the power of each optical signal in the OA
- Launches the signal (optical line signal) onto the transmission fiber.

At the receive end, a WaveStar OLS 40G End Terminal does the following:

- Receives the low level optical line signal from the optical line and amplifies it (performed by the second OA)

---

\* These wavelengths originate from up to sixteen add/drop multiplexers [ADM]. The receive-end ODU demultiplexes the optical line signal back into sixteen optical wavelengths for transmission to the receive-end ADMs. Optical channels, one each wavelength, can carry any combination of OC-48/STM-16, OC-12/STM-4, OC3/STM-1, GbE, and 100-750 Mb/s signals.

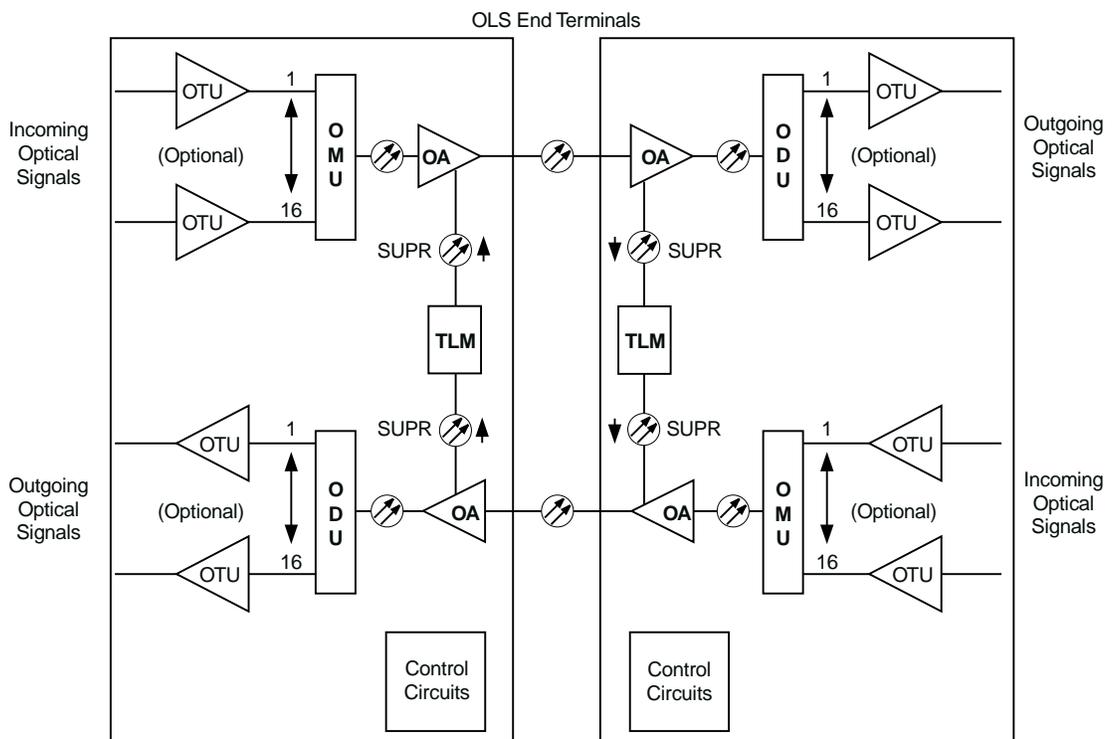
- Optically demultiplexes up to sixteen optical signals from the optical line (performed by the ODU)
- Demultiplexes the supervisory signal from the optical line signal and provides this to the TLM (telemetry) circuit pack
- Monitors the received power of each optical wavelength and the total received optical power.

Depending on the particular span distance, the OAs can be either LEA7, LEA7B, LEA104, LEA107B, or LEA105. See Chapter 6, “System Planning and Engineering” for specific engineering rules.



**NOTE:**

OTUs are optional. For more information see “Applications with Pass-through OMUs and ODUs” later in Chapter 3 and the design rules for drop OTU usage in Chapter 6.



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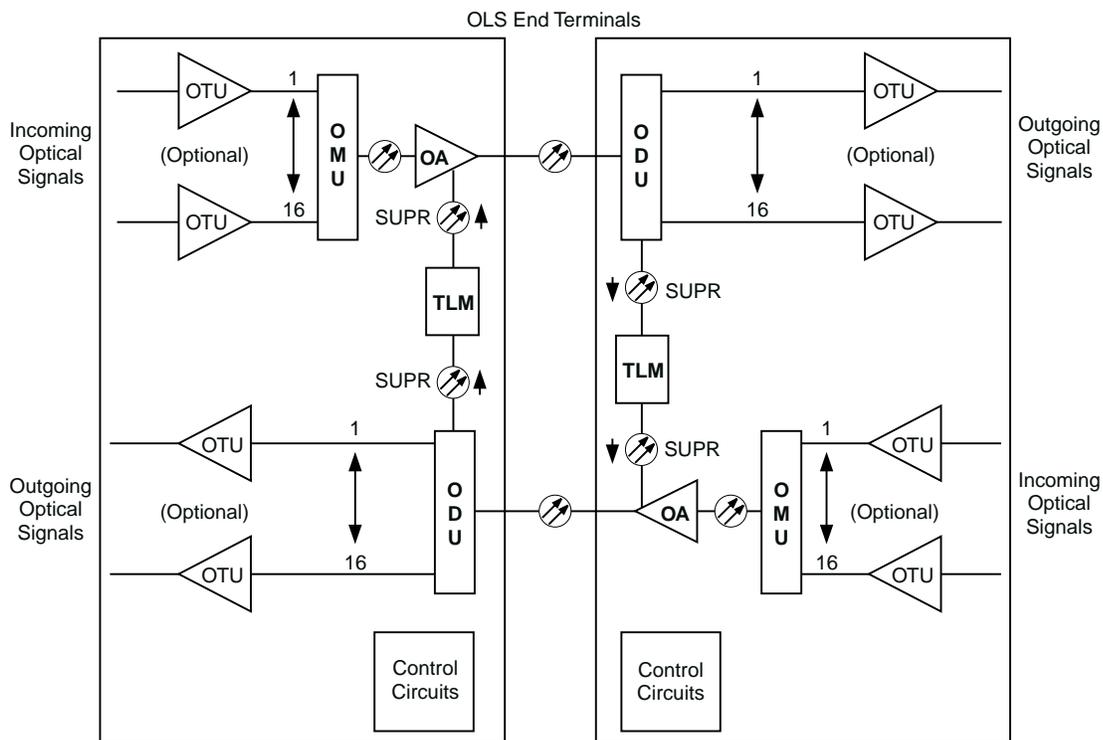
**Figure 3-1. WaveStar OLS 40G Single Span with Two-OA Operation\***

\* In the Figures 3-1 and 3-2, (Optional) denotes that OTUs are not required when the transmitter/receiver of the optical channel source are WaveStar OLS-compatible. The label OTU is used here to refer to OC-48/STM-16 OTUs or GbE OTUs or OC-12/STM-4 OTPMs or OC-3/STM-1 OTPMs, or 100 - 750 Mb/s OTPMs.

### Single-OA Applications

Over shorter span lengths, pre-amplification at the receive-end ODU is not necessary because signal degradation is less prevalent. Figure 3-2 shows a single, bi-directional WaveStar OLS 40G span in a Short Reach, 2-fiber application. One OA is used on the transmit side of the optical fiber without an OA on the receive end. Due to the short span length, the LEA105 or LEA7 OA and the 606B or 606D ODU are required in these Short Reach applications. Except for the absence of a receive pre-amplifier, the operation of this type of end terminal is the same as other end terminal shelves.

The WaveStar OLS 40G may also be deployed in a 4-fiber configuration.



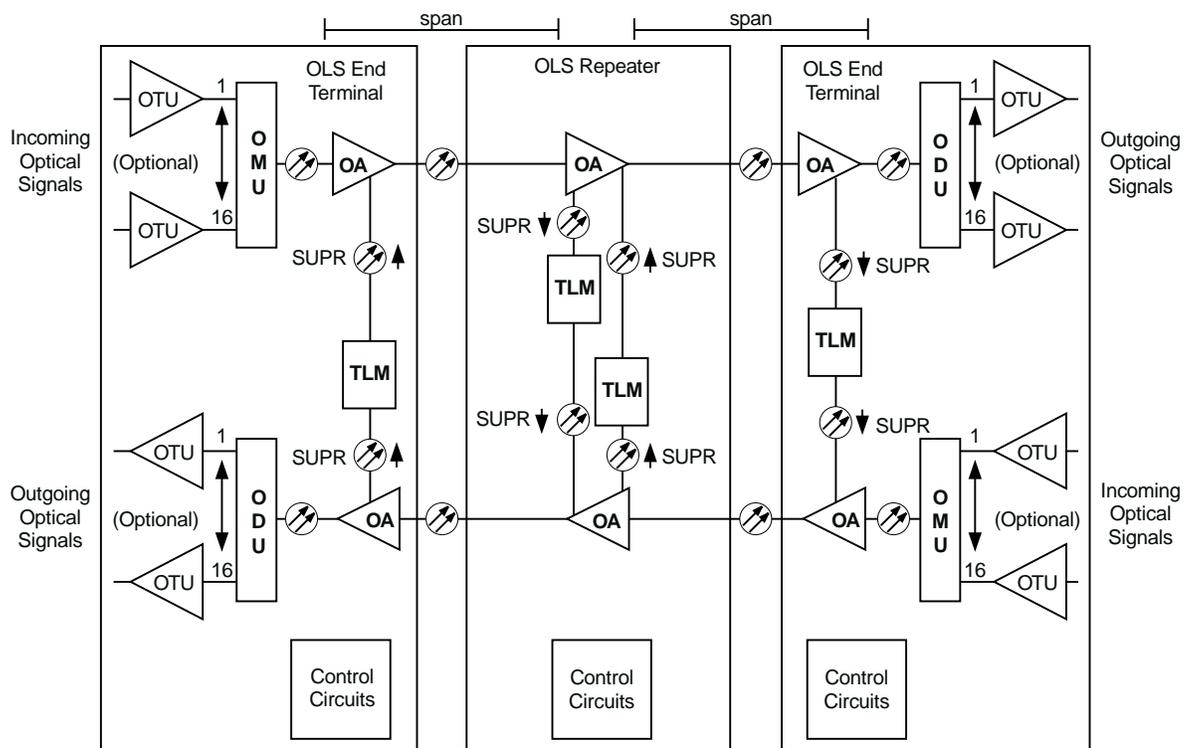
Note: OAs must be LEA105 or LEA7  
ODUs must be 606B or 606D

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**Figure 3-2. WaveStar OLS 40G Single Span with Single-OA Operation\***

## Applications With Repeaters

Figure 3-3 shows a multi-span WaveStar OLS 40G. For through-transmission of the optical line signal, WaveStar OLS 40G Repeaters are used in the intermediate spans. WaveStar OLS 40G Repeaters contain only OAs and control circuit packs. OMUs and ODUs are not required. Repeaters use LEA7, LEA7B, LEA104, or LEA107B OAs, depending on span distance and fiber type. Specific engineering rules appear in Chapter 6, “System Planning and Engineering.” Repeaters use the same OAs as the end terminals on either end of the system.



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**Figure 3-3. WaveStar OLS 40G Multiple Span System with Repeaters (two-span system shown)**

\* In the figure above, (Optional) denotes that OTUs are not required when the transmitter/receiver of the optical channel source are WaveStar OLS-compatible. The label OTU is used here to refer to OC-48/STM-16 OTUs or GbE OTUs or OC-12/STM-4 OTPMs or OC-3/STM-1 OTPMs, or 100 - 750 Mb/s OTPMs.

**Note:** Additional repeaters may be used to increase the number of spans between end terminals.

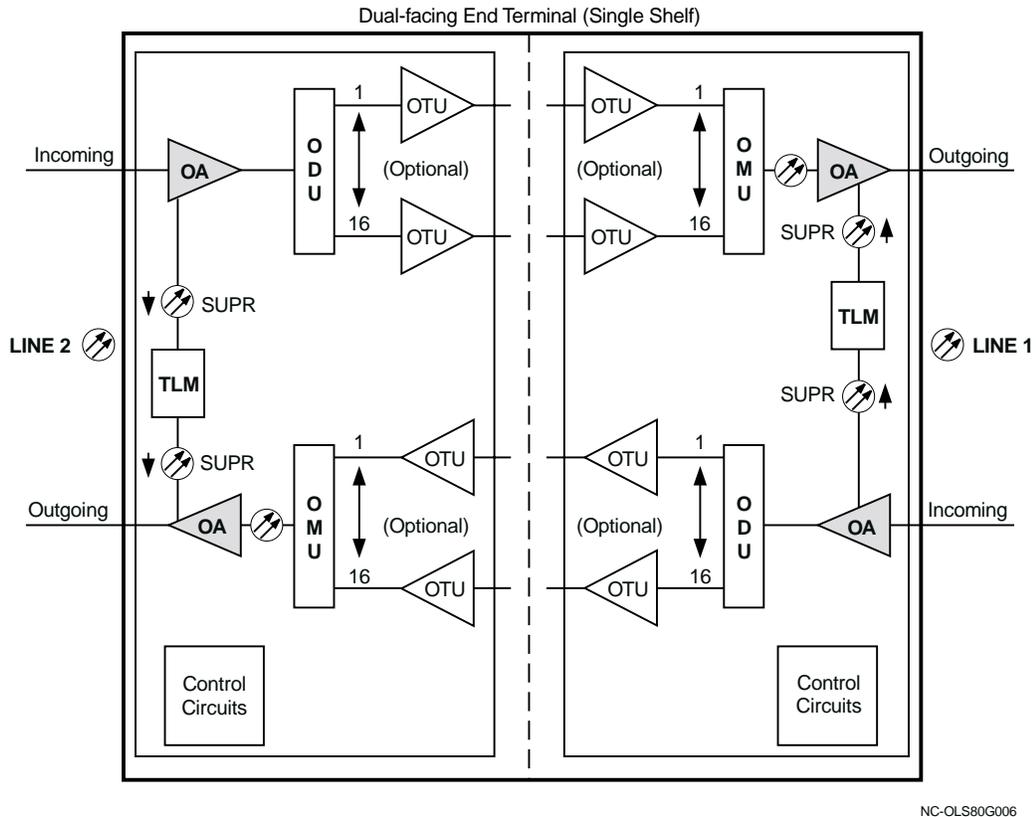
## **Dual-facing Shelf Applications**

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In two-fiber applications, collocated end terminals with dual-facing shelf capability can be combined both physically and operationally into a single network element. In each of the two-OA, single-OA, or repeater applications shown previously, a 2-fiber end terminal may be replaced with a dual-facing shelf. The dual-facing shelf can support a two-OA, a single-OA, or repeater application on one side and another two-OA, single-OA or repeater application on the other side, thus replacing two 2-fiber end-terminal shelves with one dual-facing shelf. The applications supported on each side are independent and may be different in a dual-facing shelf; the OAs in each direction may be different depending on the span length and number of spans required.

In applications where it is desirable to carry DCC information between WaveStar OLS 40G systems, an End Terminal Shelf can be provisioned as a dual-facing network element. Dual-facing shelves allow a compact terminal design to handle WAD applications for two-fiber applications. Additionally, dual-facing shelves allow extension of the operations domain across WAD sites. Telemetry channels may be connected through between two four-fiber end terminals in the same office to extend the management subnetwork size. This capability is useful for end terminal sites where Operations Systems access might otherwise be difficult to provide.

Figure 3-4 illustrates a dual-facing shelf configuration utilizing two OA circuit packs on both bidirectional lines.

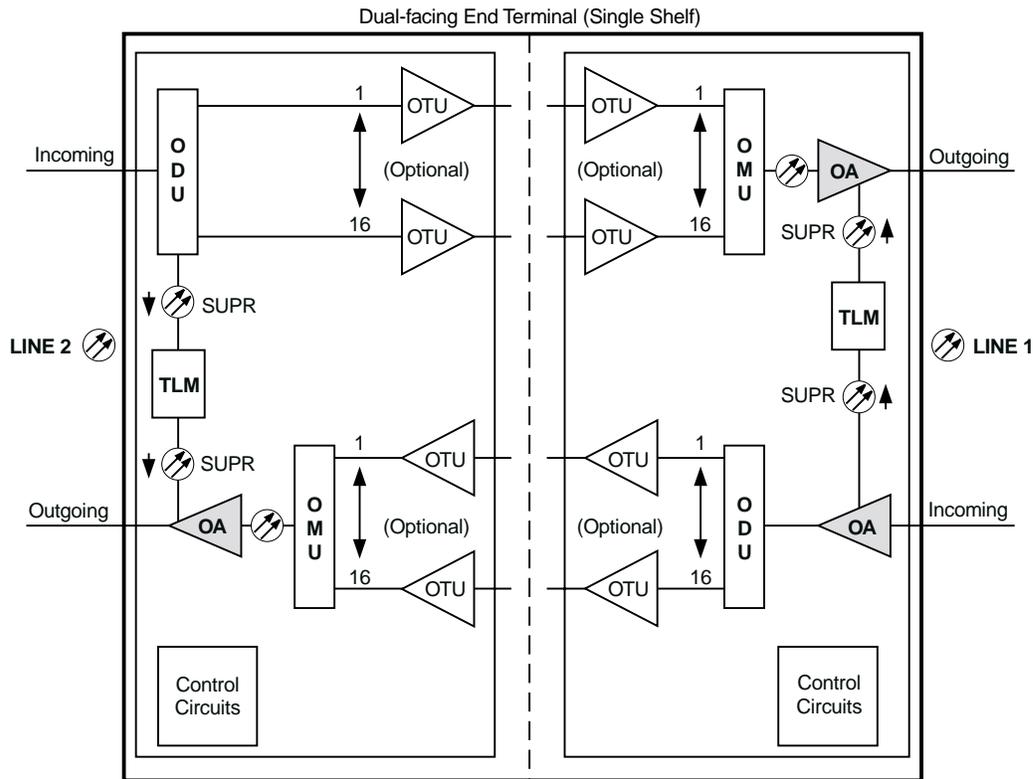


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Figure 3-4. Two-OA/Two-OA Dual-facing Shelf\*

\* In Figure 3-4 (Optional) denotes that OTUs are not required when the transmitter/receiver of the optical channel source are OLS-compatible. The label OTU is used here to refer to OC-48/STM-16 OTUs or GbE OTUs or OC-12/STM-4 OTPMs or OC-3/STM-1 OTPMs, or LSBB OTPMs.

Figure 3-5 illustrates a dual-facing shelf configuration utilizing one OA circuit pack on one bidirectional line (Line 2 in Figure 3-5) and two OA circuit packs on the other (line 1 in Figure 3-5).

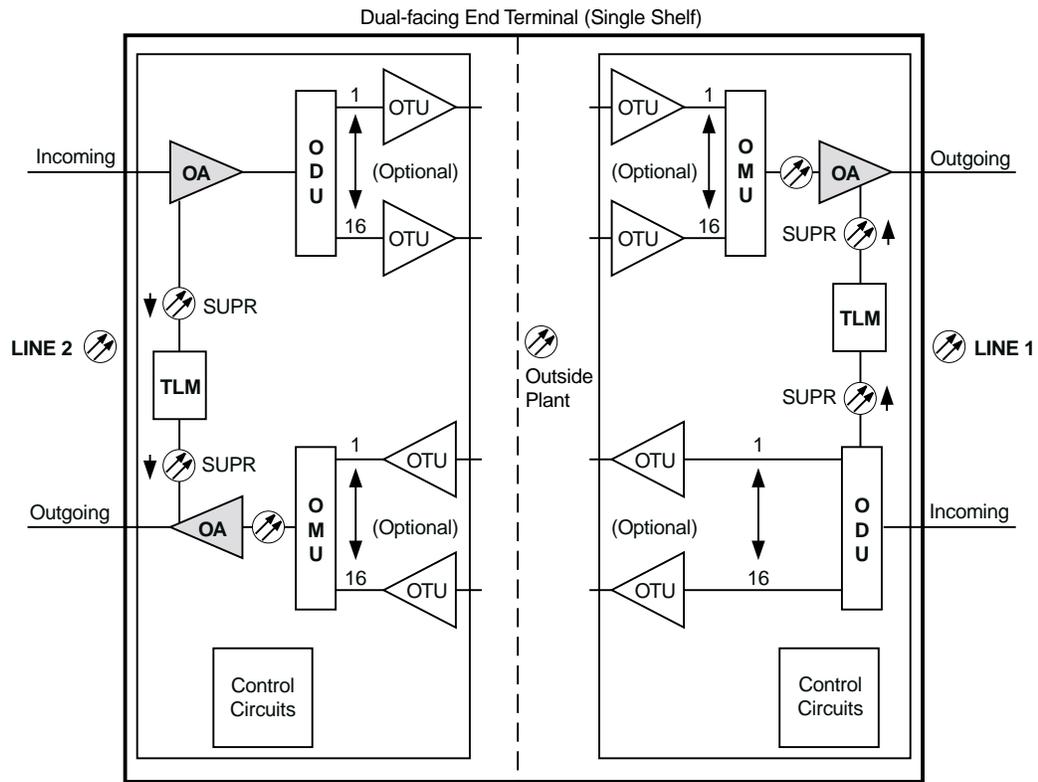


NC-OLS80G007

**Figure 3-5. Two-OA/Single-OA Dual-facing Shelf\***

\* In Figure 3-5 (Optional) denotes that OTUs are not required when the transmitter/receiver of the optical channel source are OLS-compatible. The label OTU is used here to refer to OC-48/STM-16 OTUs or GbE OTUs or OC-12/STM-4 OTPMs or OC-3/STM-1 OTPMs, or LSBB OTPMs.

Figure 3-6 illustrates a dual-facing shelf configuration utilizing two OA circuit packs on one bidirectional line and one OA circuit pack on the other. This configuration is similar to the one shown in Figure 3-5; the OA circuit pack arrangement has been switched between lines.

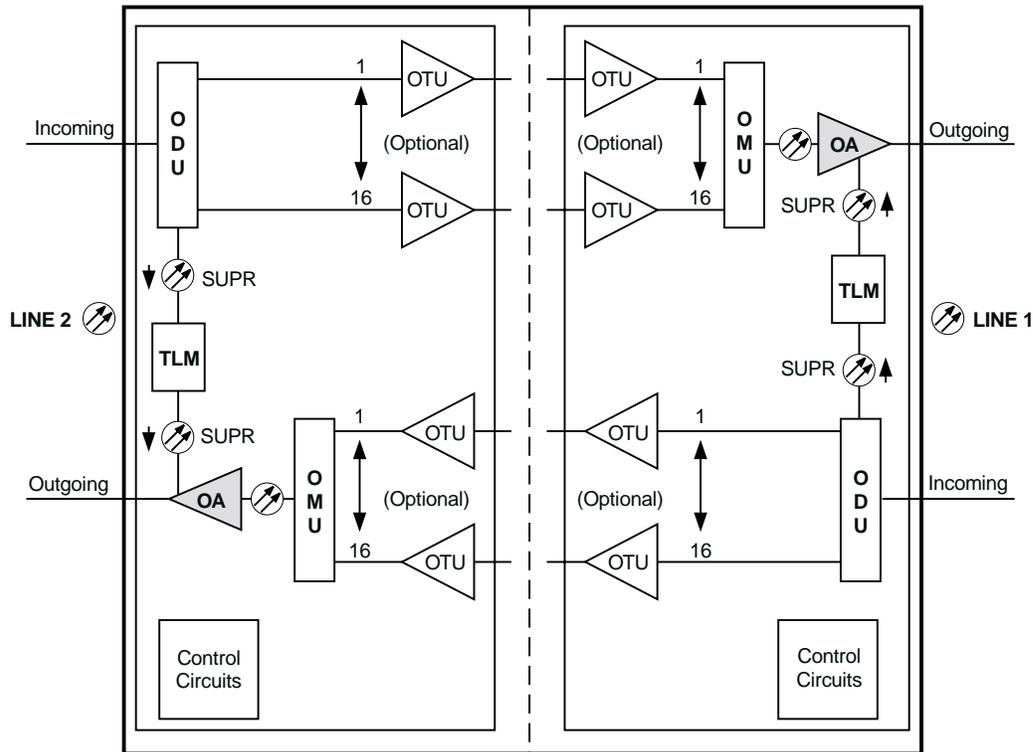


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**Figure 3-6. Single-OA/Two-OA Dual-facing Shelf\***

\* In Figure 3-6 (Optional) denotes that OTUs are not required when the transmitter/receiver of the optical channel source are OLS-compatible. The label OTU is used here to refer to OC-48/STM-16 OTUs or GbE OTUs or OC-12/STM-4 OTPMs or OC-3/STM-1 OTPMs, or LSBB OTPMs.

Figure 3-7 illustrates a dual-facing shelf configuration utilizing one OA circuit pack on both bidirectional lines.



NC-OLS80G005

**Figure 3-7. Single-OA/Single-OA Dual-facing Shelf\***

\* In Figure 3-7 (Optional) denotes that OTUs are not required when the transmitter/receiver of the optical channel source are OLS-compatible. The label OTU is used here to refer to OC-48/STM-16 OTUs or GbE OTUs or OC-12/STM-4 OTPMs or OC-3/STM-1 OTPMs, or LSBB OTPMs.

When dual-facing end-terminals are used in a point-to-point or ring configuration, the network end-to-end configuration can contain up to 32 OLS network elements, as shown in Figure 3-8. Larger applications may be supported using the technique described in the section, “Alternate Configurations for Regeneration and Wavelength Add/Drop”.

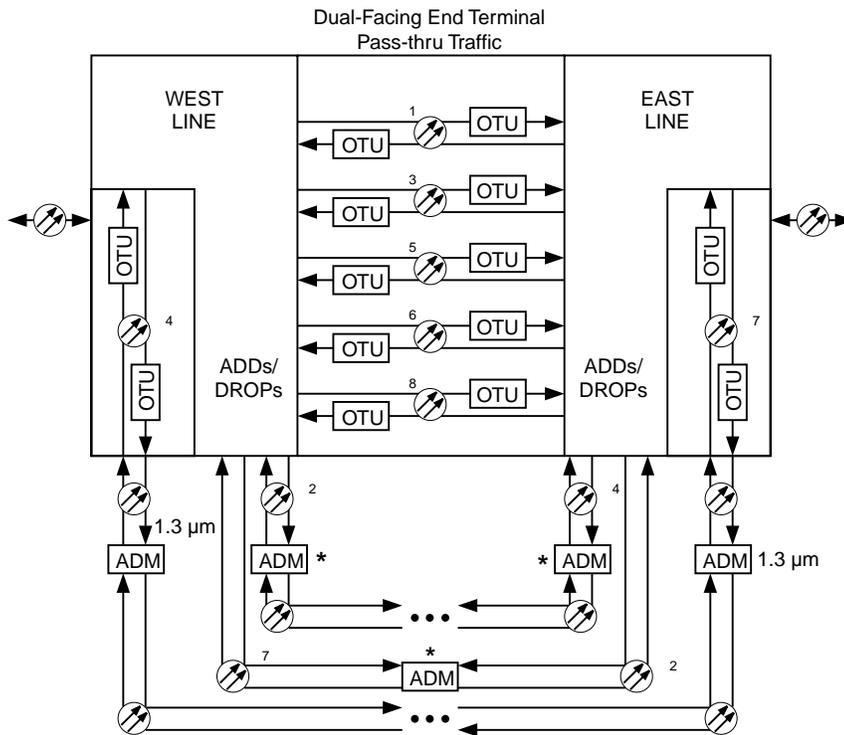


NC-OLS80G009

**Figure 3-8. Point-to-Point Linear Add/Drop Chain**

WaveStar OLS 40G can also utilize OTUs in order to support interfaces to network elements using standard interfaces.

Figure 3-9 illustrates a WaveStar OLS 40G application designed to carry 2-fiber bidirectional traffic. In the illustration, all OTUs are associated with the same WaveStar OLS 40G which is configured as a dual-facing shelf. The term, “ADM,” refers generically to SONET/SDH ADM equipment. In this figure, wavelength add/drop is also shown. To simplify the figure, OMUs, ODUs and OAs are not shown.



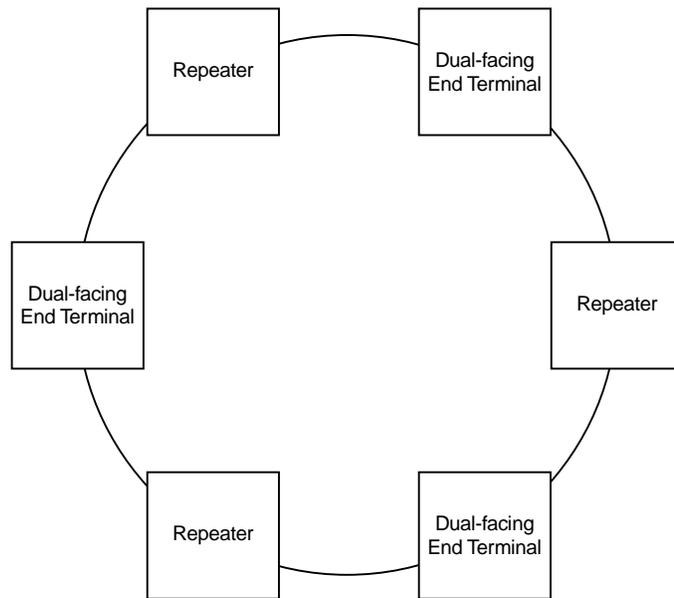
\* These Lucent NEs do not require OTUs because they have WaveStar OLS-compatible optics. The NEs include: WaveStar BWM, WaveStar TDM 2.5G (OC-48)/10G (OC-192) (2-Fiber), FT-2000 ADR, FT-2000 LCT, and ADM 16-1.

NC-OLS80G010

**Figure 3-9. WaveStar OLS 40G Application Using OTUs**

In Figure 3-9, wavelengths 1, 3, 5, 6, and 8 are carrying optical channels that are being expressed through this location. In the west direction, wavelengths 2 and 7 are provided from ADMs using WaveStar OLS-compatible optics. Wavelength 4 uses an OT to interface to an ADM with a standard interface. In the east direction, wavelengths 2 and 4 are provided from ADMs with WaveStar OLS-compatible optics and wavelength 7 from an ADM with a standard interface.

Ring applications may be created using dual-facing end terminals and repeaters. Figure 3-10 shows a simple example.

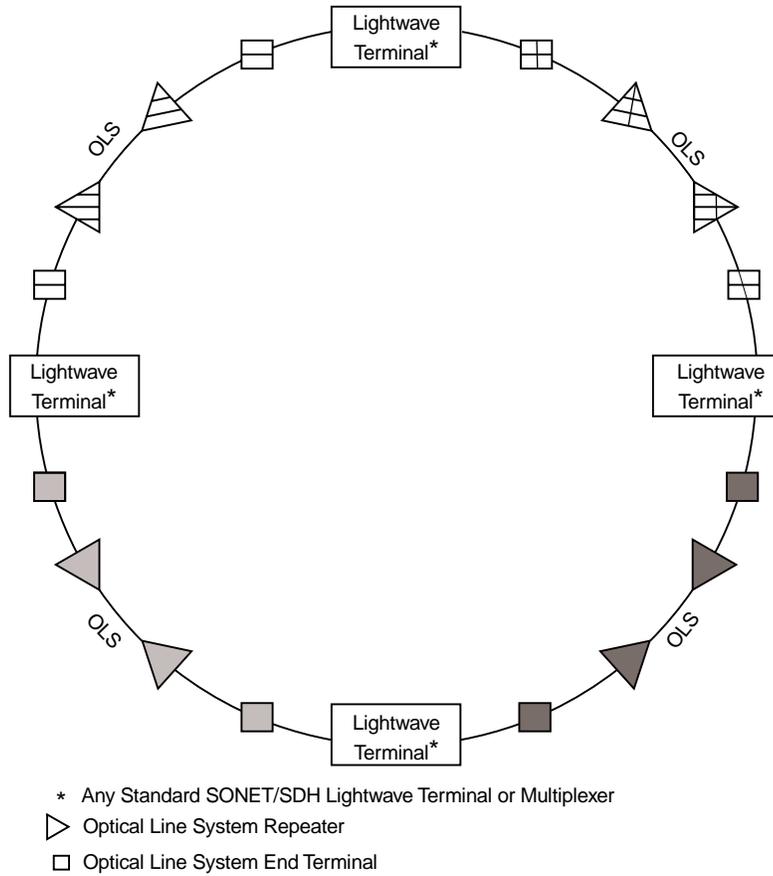


NC-OLS80G011

**Figure 3-10. Ring Example**

The WaveStar OLS 40G can be used in ring applications to increase the distance between SONET/SDH lightwave terminals and multiplexers, to increase span capacity, and to relieve fiber exhaust.

Figure 3-11 shows a ring application with four SONET/SDH lightwave terminals connected with four separate WaveStar OLS 40Gs.



NC-OLS80G098

**Figure 3-11. Ring Application with SONET/SDH Lightwave Terminals**

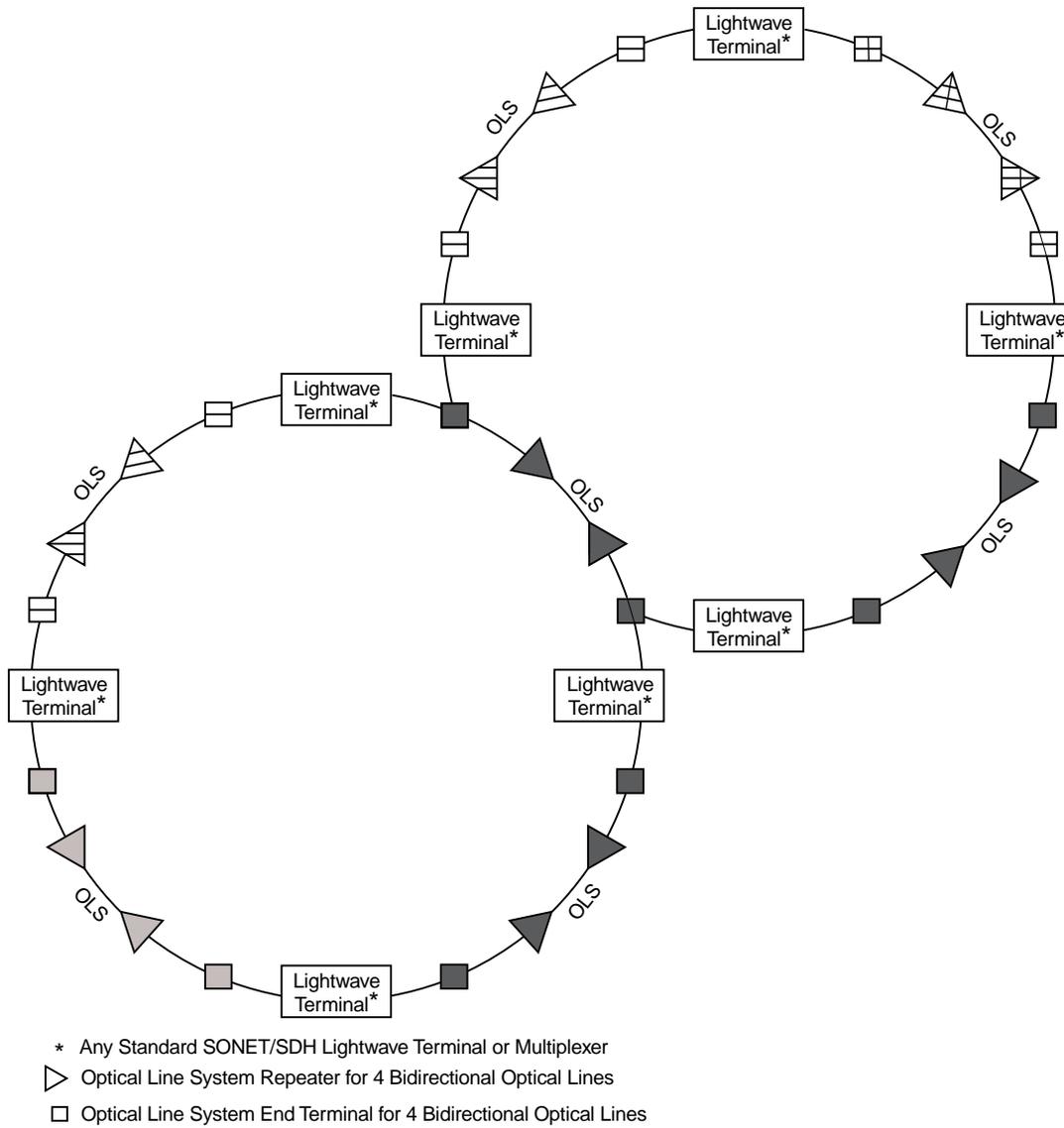
The WaveStar OLS 40G can interface with any standard OC-48/STM-16, GbE, OC-12/STM-4, OC-3/STM-1, and/or 100 - 750 MB/s lightwave terminals or multiplexers.

If required, OTU circuit packs and/or OTPMs may be used for wavelength conversion and/or electrical regeneration. The OTU circuit packs and/or OTPMs may also be used to provide wavelength add/drop. With the OTU circuit packs and/or the OTPMs, the WaveStar OLS 40G can be used to create very large ring networks where express wavelengths bypass intermediate offices without going through a lightwave terminal. In ring applications, a separate WaveStar OLS 40G is used between each pair of adjacent SONET/SDH nodes.

The WaveStar OLS 40G also allows the data communications channel DCC bytes to be passed from one WaveStar OLS 40G subnetwork to another in 2-fiber and 4-fiber rings. In 2-fiber ring applications, an OLS End Terminal equipped as dual facing and provisioned as DUAL can be used to replace back-to-back OLS End Terminals at intermediate offices. In 4-fiber ring applications, an OLS End Terminal equipped and provisioned as 1A-TX-THRU can exchange the data communication channel bytes with a co-located OLS End Terminal equipped and provisioned as 1A-RCV-THRU in another subnetwork.

For more information about equipping an OLS End Terminal, refer to Chapter 4, "Product Description." For more information about provisioning, refer to Chapter 5, "Operations, Administration, Maintenance, and Provisioning."

The WaveStar OLS 40G allows flexibility in ring applications. The WaveStar OLS 40G can accept optical signals from different lightwave terminals in different rings. For example, the following figure shows two rings equipped with lightwave terminals sharing the same WaveStar OLS 40G system. The lightwave terminals that share the same optical line transmit different wavelengths of optical signals.

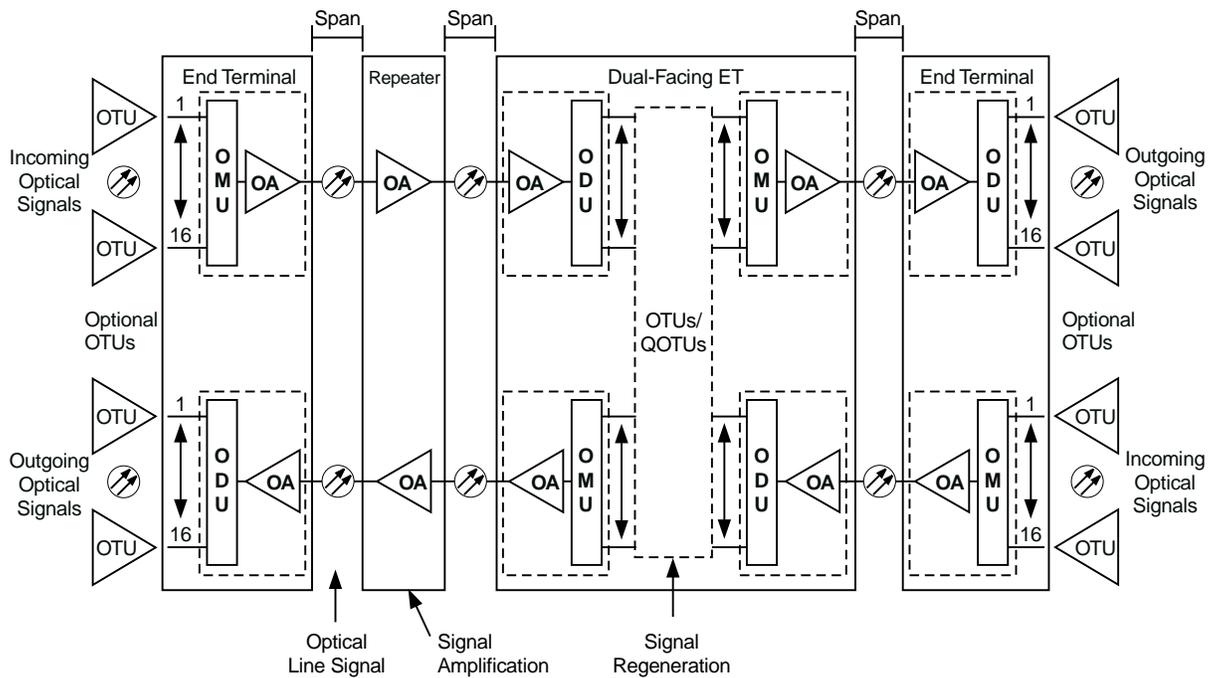


NC-OLS80G099

**Figure 3-12. Two Rings Sharing a WaveStar OLS 40G System**

### Applications With Multi-Regenerated Spans

Figure 3-13 shows how WaveStar OLS 40G systems can be concatenated for routes extending beyond the eight span capability of the traditional LEA7 OA. To go beyond five spans (LEA104 and LEA107B) or eight spans (LEA7 and LEA7B), the optical line signal must be regenerated. Regeneration is performed by OTUs/QOTUs in an OT Bay or Cabinet arrangement or in miscellaneous-mounted OT shelves. Engineering rules appear in Chapter 6, “System Planning and Engineering.”

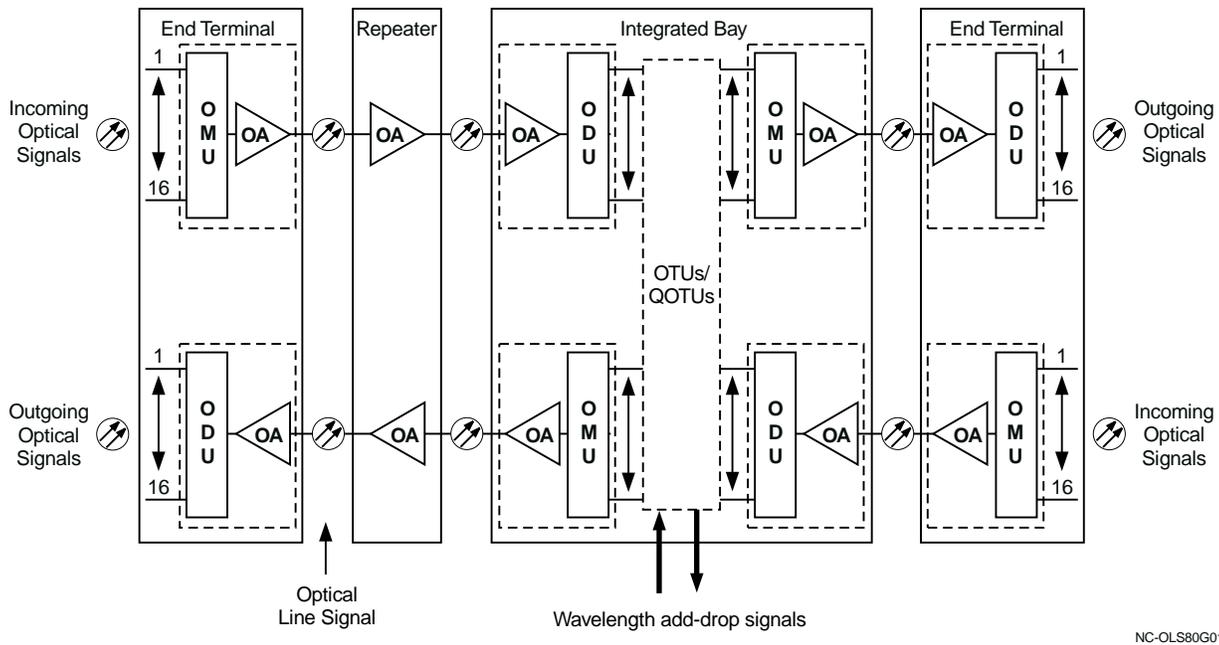


NC-OLS80G013

**Figure 3-13. Multiple WaveStar OLS 40G Systems and OTU/QOTUs as Regenerators (2-fiber Application)**

**Applications With Wavelength Add/Drop (WAD)**

Figure 3-14 shows a multi-span WaveStar OLS 40G with an intermediate WAD site. This site consists of a WaveStar OLS 40G Integrated Bay configured as dual-facing. It comprises an End Terminal shelf, an OT System Controller Shelf, and one OT Complementary Shelf. Figure 3-9 also illustrates wavelength add/drop.



NC-OLS80G014

**Figure 3-14. WaveStar OLS 40G with Wavelength Add/Drop (WAD)**

## **Applications with Pass-through OMUs and ODU**

---

Ring applications with pass-through OMUs and ODUs will eliminate OTUs on many pass-through channels. To enable ring applications with pass-through OMUs and ODUs, the TL1 ENT-SYS command has a new provisionable parameter, PASS\_THRU. This parameter can be set to either:

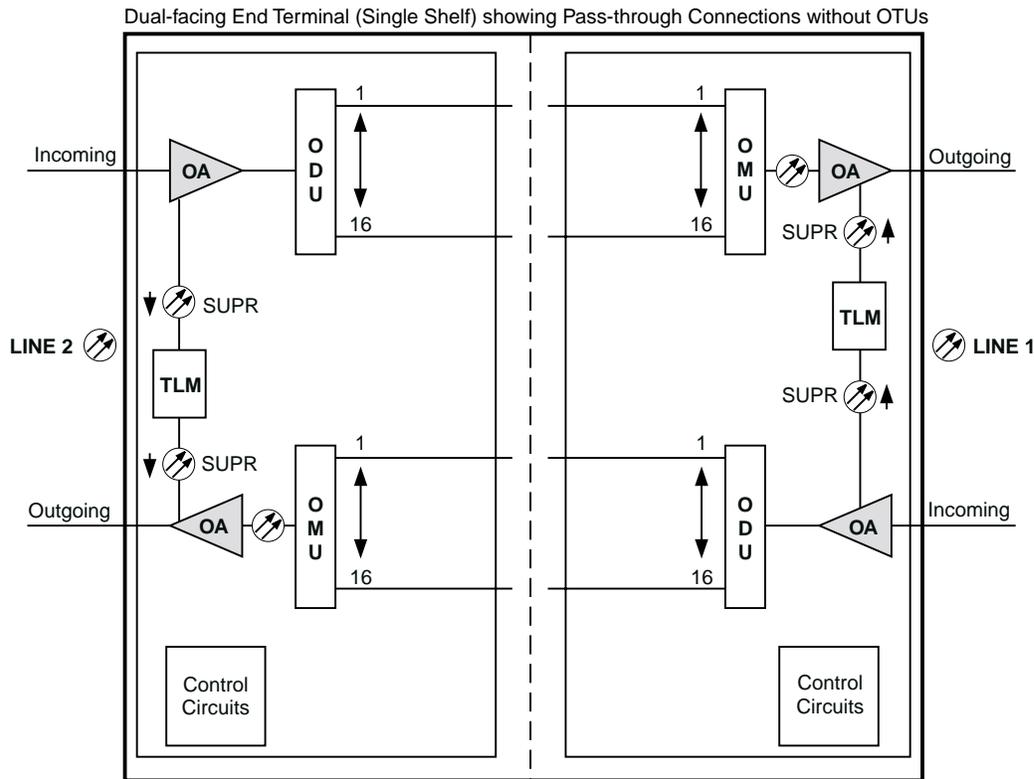
- YES - to allow the network to operate in the new ring mode for pass-through OMUs and ODUs
- NO - to allow the network to operate in the same manner as previous releases

When the PASS\_THRU parameter is provisioned:

- The OA has an improved channel detection window for pass-through metropolitan applications.
- Network topology is used to verify that pass-through design limits are not exceeded. The engineering rules for pass-through systems allow only zero or one repeaters.

If the PASS\_THRU parameter is set to YES, and there are two or more repeaters, then the network should raise an abnormal condition, “Invalid Pass Through Route Configuration”. Otherwise, Optical Channel LOS alarms may occur. This condition is caused by the power divergence across the spectrum after several OAs exceeding the OA tone detection range.

Figure 3-15 illustrates a dual-facing shelf configuration that shows pass-through OMU and ODU connections without OTUs. For more information see the “Engineering Rules for Pass-through Connections” in Chapter 6.

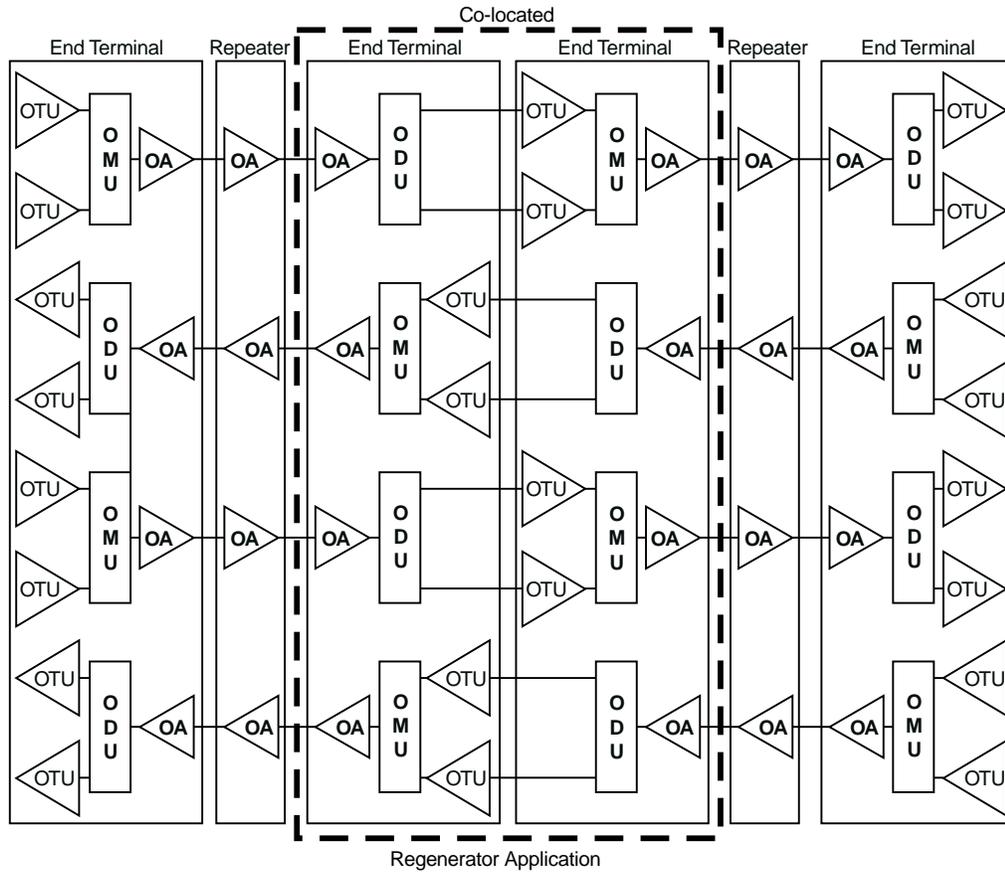


NC-OLS80G114

**Figure 3-15. Two-OA/Two-OA Dual Facing Shelf with Pass-Through Connections**

## Alternate Configurations for Regeneration and WAD

Figure 3-16 and Figure 3-17 show how signals can be regenerated or added/dropped in 4-fiber applications. These configurations may also be used in 2-fiber applications where dual-facing shelves are not supported or desired.



NC-OLS80G015

**Figure 3-16. 4-Fiber Regenerator**

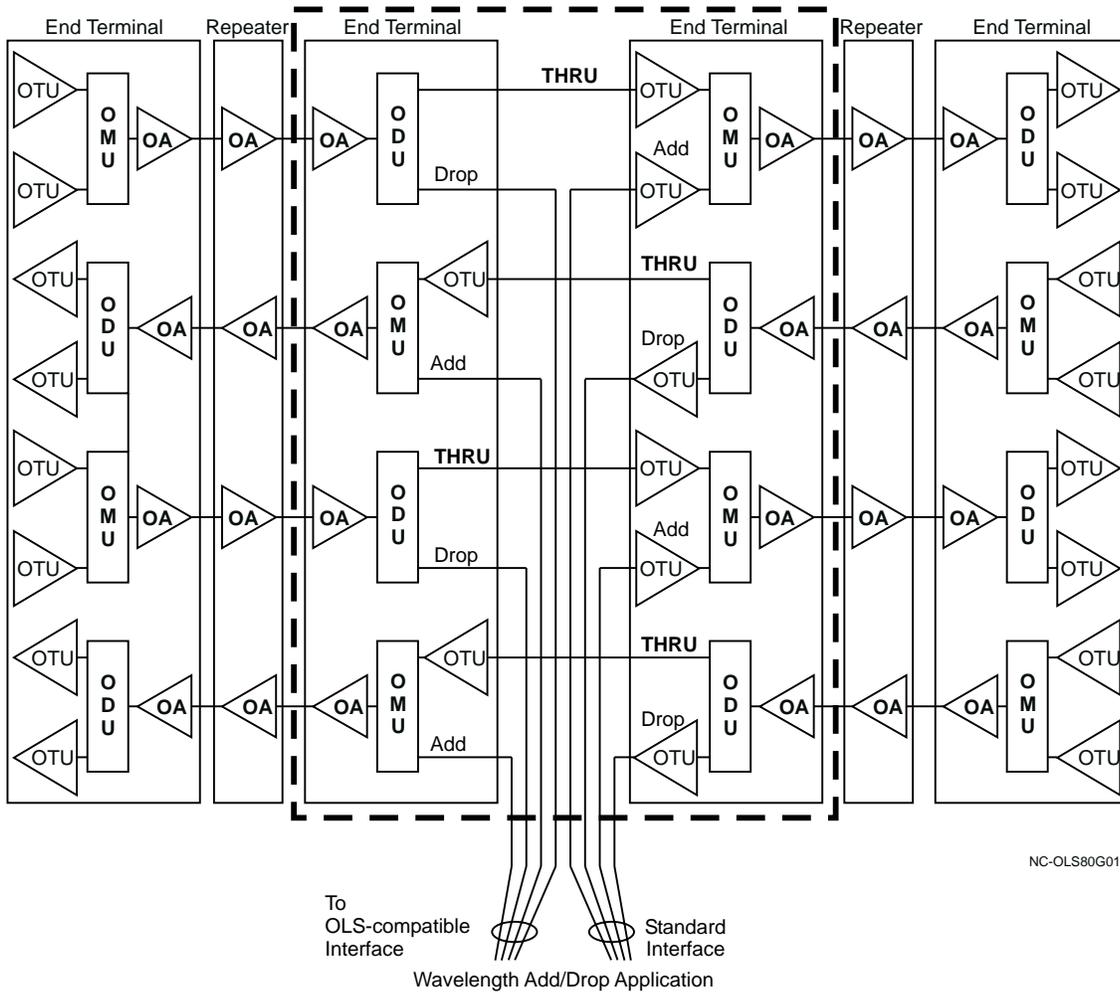
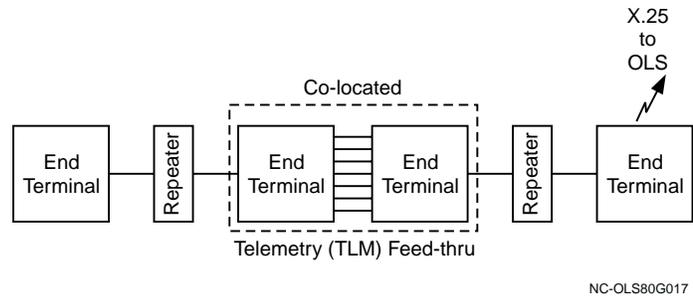


Figure 3-17. 4-Fiber WAD

When single-facing terminals are co-located, the DCN may be extended beyond end terminal boundaries by using the telemetry feed-thru feature to connect end terminals. Telemetry feed-thru requires Release 3.0 or later.

Telemetry feed-thru can be used to connect two end-terminals where it is not convenient to provide a physical X.25 connection to the location as in Figure 3-18.



**Figure 3-18. Telemetry Feed-thru**

There cannot be more than 32 WaveStar OLS 40G single-facing End Terminals, repeaters and dual-facing terminals in configurations connected via the telemetry feed-thru capability. Each single-facing end terminal at the telemetry feed-thru location counts as one network element for a total of two at that site. Dual-facing end terminals may not be equipped with the telemetry feed-thru feature. Single-facing end terminals may be equipped for telemetry feed-thru.



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# Product Description

# 4

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# Product Description

# 4

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This chapter describes shelf design, package descriptions, and configuration information for the WaveStar OLS 40G. It also includes package illustrations and information on equipment packages, system control, physical design, transmission, protection, and powering.

## **Introduction**

---

WaveStar OLS 40G is available in the following equipment packages:

- Dual End Terminal Cabinet or Bay
- Dual Repeater Cabinet or Bay
- End Terminal and Repeater Cabinet or Bay
- End Terminal Shelf (miscellaneously-mounted)
- Repeater Shelf (miscellaneously-mounted)
- Integrated Bay (Single)
- Integrated Cabinet or Bay (Double)
- Integrated Cabinet or Bay (Triple 1)
- Integrated Cabinet or Bay (Triple 2)

Additional Optical Translator (OT) equipment is available in the following equipment packages:

- OT Cabinet or Bay
- Miscellaneously-mounted OT
- Miscellaneously-mounted OT System Controller Shelf
- Miscellaneously-mounted OT Complementary Shelf 1
- Miscellaneously-mounted OT Complementary Shelf 2.

For descriptions and illustrations of these packages, refer to “WaveStar OLS 40G Packages” later in this chapter.

## WaveStar OLS 40G Bay/Cabinet Design

WaveStar OLS 40G Bay and Cabinet shelves are similar to each other but have key differences. Bay-mounted shelves have front covers while cabinet shelves have front doors. In addition, a bay frame arrangement or miscellaneous-mounted unit has heat baffles attached to the shelf, whereas heat baffles are supplied as a physical component of the cabinet (one heat baffle is located between the two shelves). In addition, miscellaneous-mounted shelves are not used in cabinet arrangements. Figure 4-1 shows the WaveStar OLS 40G Cabinet.

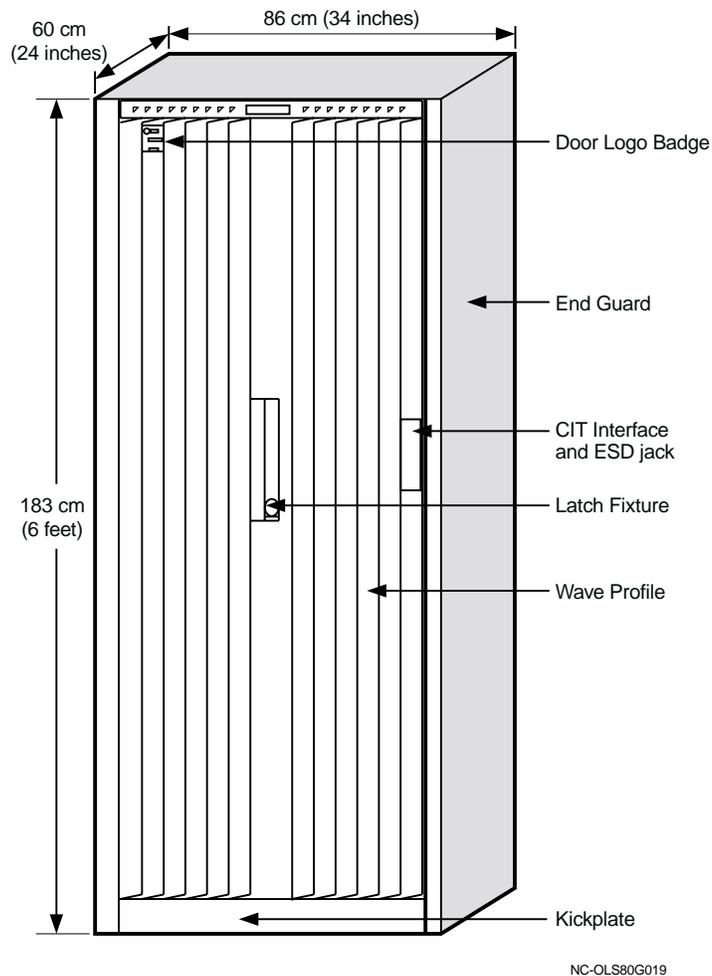
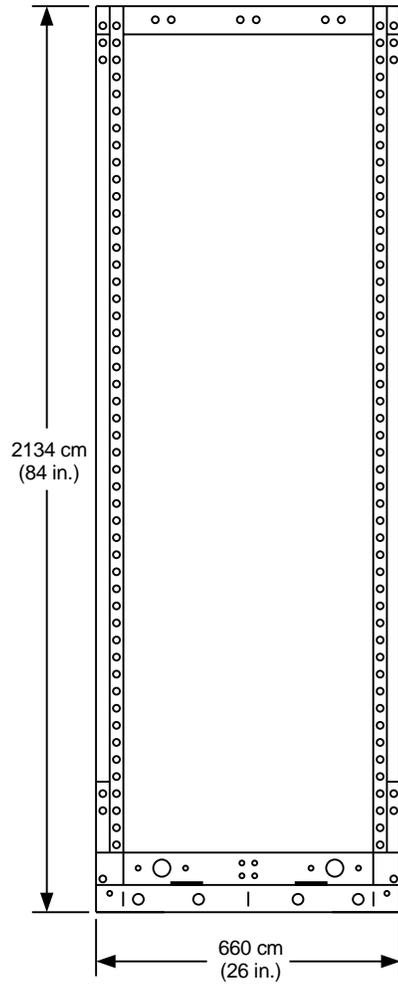


Figure 4-1. WaveStar OLS 40G Cabinet (Doors Closed)

Figure 4-2 shows a front view of the WaveStar OLS 40G Bay frame.



NC-OLS80G018

Figure 4-2. WaveStar OLS 40G Bay Frame

## **WaveStar OLS 40G Shelf Design**

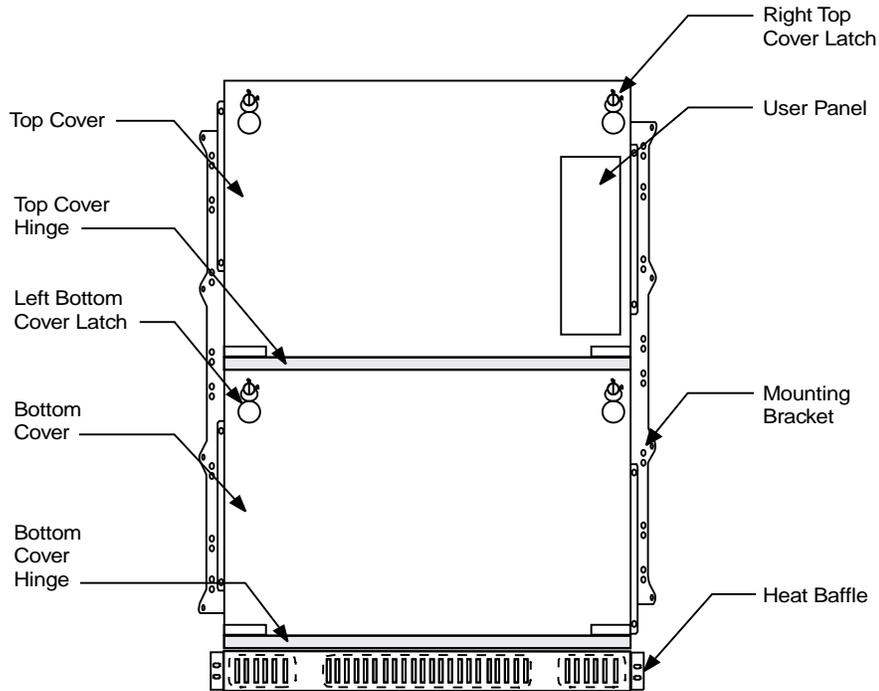
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WaveStar OLS 40G shelves can be used in a variety of ways. They can be housed in Lucent Technologies Newlook 2000 cabinets, mounted in European Telecommunications Standard Institute (ETSI) compatible racks, or mounted in a Network System Bay Framework (800 or 801 type). The shelves can be ordered from the factory with a cabinet or bay frame or as separate, miscellaneous-mounted units.

Miscellaneous-mounted and bay-mounted WaveStar OLS 40G shelves include:

- Two front shelf covers (flat or Newlook-2000)
- Attached heat baffle
- User panel
- Bay mounting brackets.

Figure 4-3 shows a miscellaneous-mounted WaveStar OLS 40G shelf with front covers (bay-mounted shelves are similar).



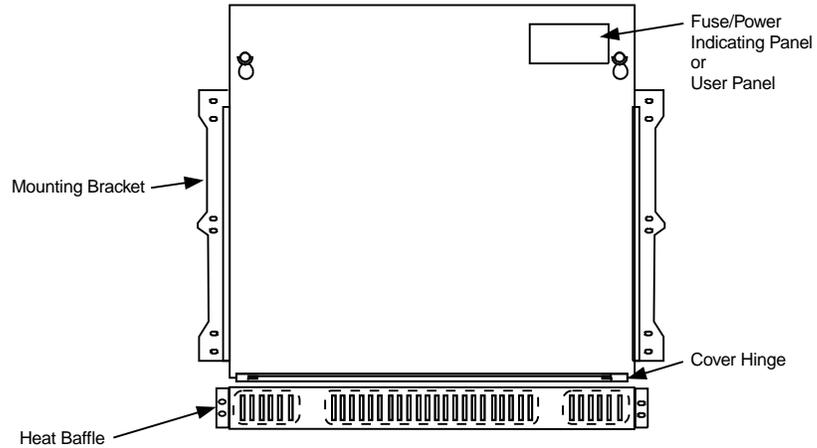
NC-OLS080G-022

**Figure 4-3. Miscellaneous-Mounted WaveStar OLS 40G Shelf with Front Covers (flat cover shown)**

Miscellaneous-mounted and bay-mounted OT shelves include:

- One front shelf cover (flat or Newlook-2000)
- Attached heat baffle
- Fuse/power indicating panel for Complementary Shelf 1 and 2
- User panel for the System Controller Shelf
- Bay mounting brackets.

Figure 4-4 shows a miscellaneous-mounted OT shelf with front cover (bay-mounted shelves are similar).



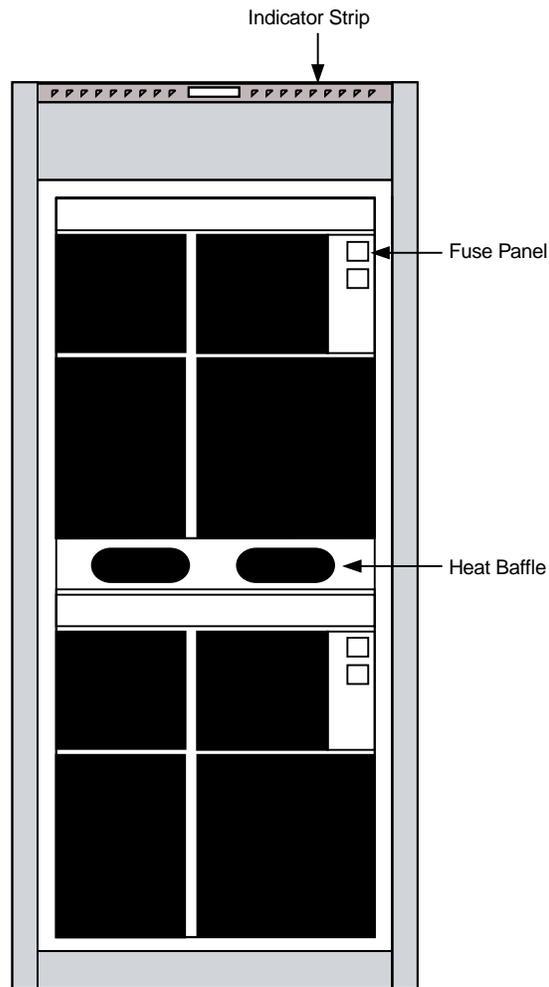
NC-OLS80G023

**Figure 4-4. Miscellaneous-mounted OT Shelf with Front Cover (flat cover shown)**

WaveStar OLS 40G cabinet shelves include:

- Fuse panel
- Alarm and status indicators (provided on an indicator strip at the top of the cabinet, rather than on shelf indicator panels).

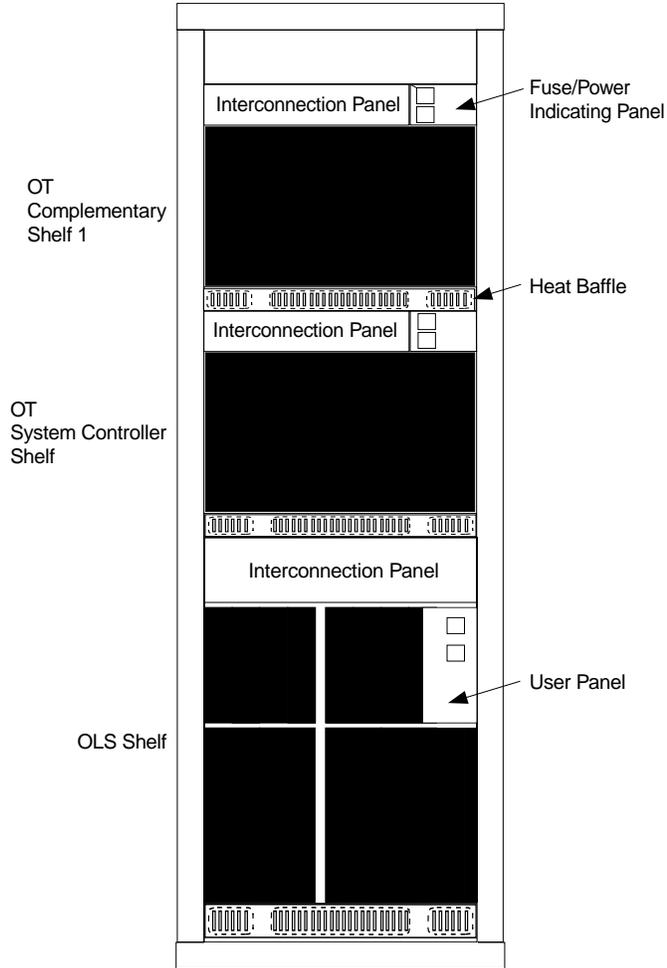
Figure 4-5 shows the WaveStar OLS 40G cabinet shelf (cabinet doors open). Externally, it is similar to the OT Cabinet.



NC-OLS80G020

**Figure 4-5. WaveStar OLS 40G Cabinet Shelf**

Figure 4-6 depicts an unequipped WaveStar OLS 40G Integrated Bay.



NC-OLS80G021

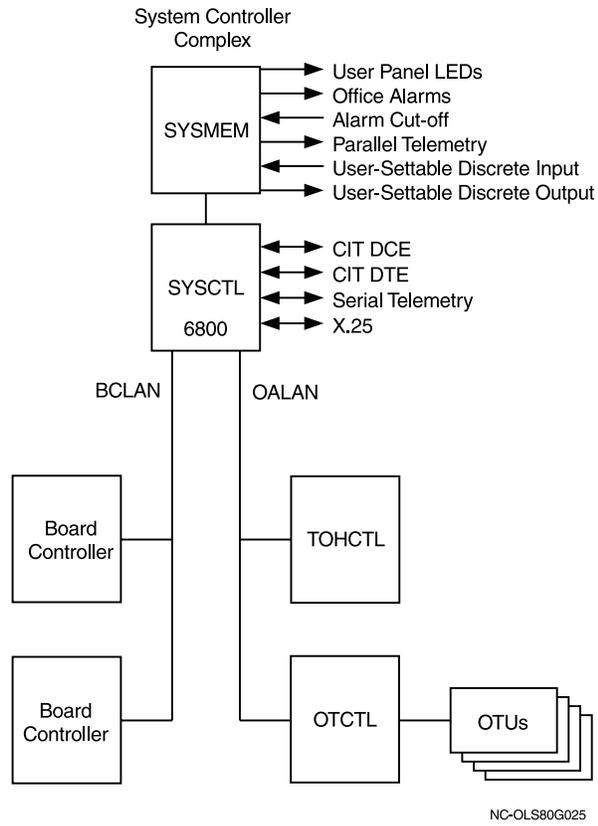
Figure 4-6. WaveStar OLS 40G Integrated Bay Shelves

## **WaveStar OLS 40G Architecture**

---

WaveStar OLS 40G uses a hierarchical control architecture. The control system hierarchy consists of two levels, the system controller complex and the board controller. The system controller complex functions as the higher level of control and the board controller, residing on the OA and telemetry (TLM) circuit packs, serve as the lower level of control. Figure 4-7 shows WaveStar OLS 40G system control architecture. See “Control Circuit Packs” in Chapter 4 for more information.

The system controller complex is responsible for system-wide computations and system user interface functions. The complex is physically partitioned into two separate circuit packs, referred to as the system controller (SYSCTL) and system memory (SYSMEM) circuit packs, respectively. The board controller local area network (BCLAN) connects these two control levels. The system controller complex also plays a major role in providing the operations, administration, maintenance, and provisioning functions. A single system controller complex controls up to four bidirectional optical lines.



**Figure 4-7. System Control Architecture for WaveStar OLS 40G**

The board controller contains a micro-controller with supporting circuitry. This controller monitors and controls the OA and TLM circuit packs, isolates faults at the circuit pack level, controls the FAULT LEDs, controls hardware provisioning data, maintains a sanity timer, and provides debugging functions. The tributary overhead controller (TOHCTL) performs data communications channel (DCC) processing functions.

The controllers communicate among the various levels of the system using internal local area networks (LANs). The board controllers communicate using the board controller local area network (BCLAN). The TOHCTL circuit pack and the system controller complex communicate using the overhead access local area network (OALAN).

WaveStar OLS 40G control features are available to the operator through several craft and operations system (OS) interfaces. In addition to accessing the local terminal, the craft and OS interfaces can reach a remote terminal using the DCC in the optical signal. These functions are provided by the SYSCTL, SYSMEM, and TOHCTL circuit packs.

## **WaveStar OLS 40G Shelf Descriptions**

---

This section describes the basic types of WaveStar OLS 40G shelves that are equipped with circuit packs. These shelves include the following:

- End Terminal Shelf
- Repeater Shelf
- Optical Translator System Controller Shelf
- Optical Translator Complementary Shelves 1 and 2.

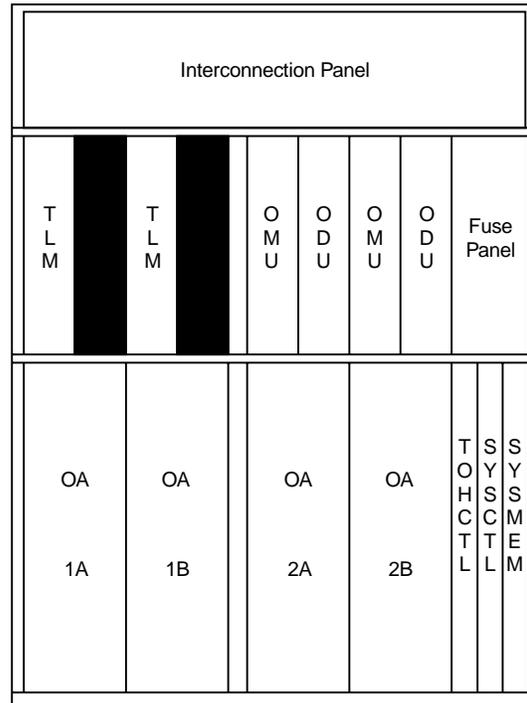
### **End Terminal Shelf**

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In WaveStar OLS 40G End Terminal shelves, the Optical Multiplexer Units (OMU) and Optical Demultiplexer Units (ODU) are placed in different order at each end of an WaveStar OLS 40G system to produce different shelf configurations, all of which are provisionable by network element software.

This type of shelf contains telemetry (TLM) circuit packs, OAs, OMUs, and ODUs that provide Dense Wavelength Division Multiplexing (DWDM) of up to sixteen wavelengths per fiber, and system control circuit packs (TOHCTL, SYSCTL, and SYSMEM) see Figure 4-8.

For information on circuit packs, refer to “WaveStar OLS 40G Integration Cable Engineering” and “Control Circuit Packs” later in this chapter. See Chapter 5, “Operations, Administration, Maintenance, and Provisioning,” for provisioning information and shelf illustrations.

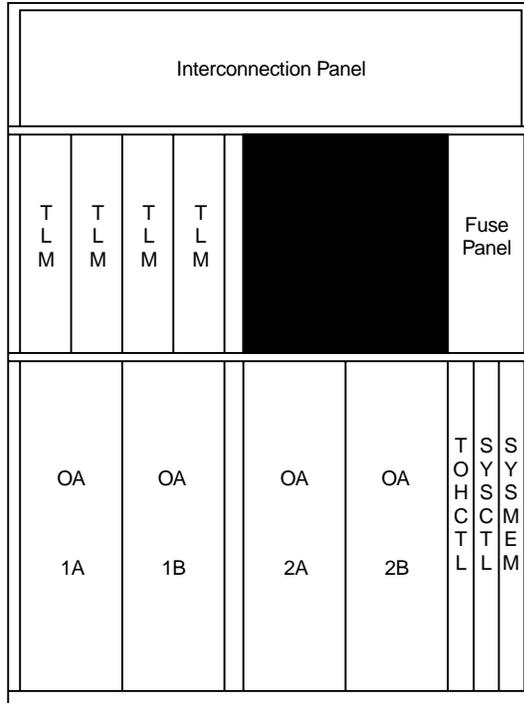


NC-OLS80G101

**Figure 4-8. WaveStar OLS 40G End Terminal Shelf (fully equipped)**

**WaveStar OLS 40G Repeater Shelf**

The WaveStar OLS 40G Repeater Shelf, shown in Figure 4-9, is similar to the End Terminal Shelf, except that it does not contain an OMU or ODU and it requires two TLM circuit packs per line. The Repeater shelf contains OA circuit packs, associated system control and telemetry circuit packs, a fuse panel, and an interconnection panel. For information on circuit packs, refer to “WaveStar OLS 40G Integration Cable Engineering” and “Control Circuit Packs” later in this chapter.



NC-OLS80G049

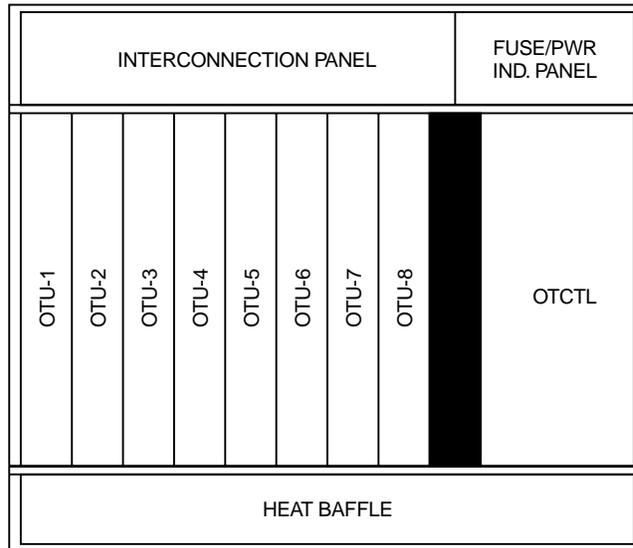
**Figure 4-9. WaveStar OLS 40G Repeater Shelf (fully equipped)**

### OT System Controller Shelf

To accommodate OT integration, the OT Controller (OTCTL) circuit pack is inserted into the shelf between the System Controller circuit pack (SYSCTL) and the OTUs. It is controlled by the existing SYSCTL and SYSMEM circuit packs in the WaveStar OLS 40G shelf. For information on circuit packs, refer to “WaveStar OLS 40G Integration Cable Engineering” and “Control Circuit Packs” later in this chapter.

In addition to the OTCTL, each miscellaneous-mounted OT System Controller Shelf consists of eight OTU (or four QOTU) circuit pack slots and one empty slot.

Figure 4-10 shows a miscellaneous-mounted OT System Controller Shelf without the front shelf cover.



NC-OLS80G050

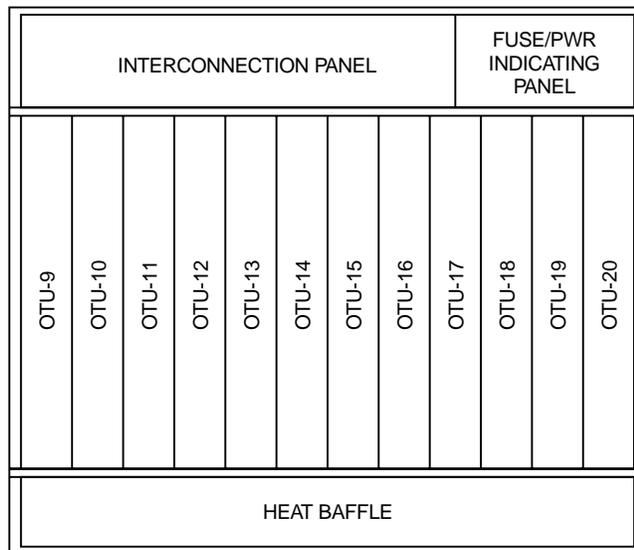
**Figure 4-10. Miscellaneously-mounted OT System Controller Shelf (8 OTUs; fully equipped)**

## OT Complementary Shelves 1 and 2

Each miscellaneous-mounted Complementary Shelf consists of 12 OTU or 6 QOTU circuit pack slots (one QOTU utilizes two slots), an interconnection panel, a fuse/power indicating panel, a designation label strip, an attached heat baffle, power filters, cables, a front and rear cover, and an indicator strip. For information on circuit packs, refer to “WaveStar OLS 40G Integration Cable Engineering” and “Control Circuit Packs” later in this chapter.

The Complementary Shelves each have a fuse/power indicating panel that displays a green-colored Power On (PWR ON) LED. This LED illuminates to indicate that the respective shelf is receiving -48 V power.

Figure 4-11 shows a miscellaneous-mounted Complementary Shelf 1 without the front shelf cover. Complementary Shelf 2 is identical to Complementary Shelf 1 except that the OTUs are numbered from 21 to 32 in Shelf 2.



NC-OLS80G051

**Figure 4-11. Miscellaneously-Mounted Complementary Shelf 1  
(12 OTUs; fully equipped)**

---

## **Transmission Circuit Packs**

---

The following are transmission circuit packs used in the WaveStar OLS 40G:

- Optical Amplifier (OA)
- Optical Multiplexer Unit (OMU)
- Optical Demultiplexer Unit (ODU)
- Optical Translator Unit (OTU)
- Quad Optical Translator Unit (QOTU)
- Optical Translator Port Module (OTPM)
- Telemetry (TLM)

All circuit pack, unit, and port module assemblies connect to the backplane. All optical connections in and out of the circuit packs run through faceplate-mounted optical connectors.

### **Optical Amplifier (OA)**

---

The OAs operate in the 1.5  $\mu\text{m}$  wavelength band. The main components of the OAs are as follows:

- **Pump lasers**– Two high powered optical pump lasers, operating at a wavelength of 980 nm, provide power which is combined with the 1.5  $\mu\text{m}$  signal
- **Filter**– In the middle of the OA, a filter separates the light at 1532 nm from the rest of the 1.5  $\mu\text{m}$  band. This filtering separates the supervisory channel from the optical (signal) wavelengths and reduces noise
- **Optical splitter**– An optical splitter in the OA splits off a small amount of light for monitoring purposes
- **Optical isolators**– Optical isolators prevent optical reflections from degrading system performance.

WaveStar OLS 40G demultiplexes the signals at the other end of the optical line and passes them on to compatible optical receivers. WaveStar OLS 40G also uses a highly flexible form of WAD.

For details on span length and network topologies and a description of the engineering rules used in building WaveStar OLS 40G networks and management subnetworks, see Chapter 6, “System Planning and Engineering”

The OA circuit pack does the following:

- Amplifies the optical line signal

- Provides power monitors on the optical monitor point provided by the amplifier module
- Controls the pump lasers which, in turn, automatically control OA output power
- Provides add/drop ports for the supervisory signal
- Provides temperature control for the ODU
- Receives data from the OMUs and ODUs for version and type information.



**NOTE:**

WaveStar OLS 40G utilizes the LEA104 or LEA107B OA for Long Span, 16-wavelength systems. Long Reach systems use the LEA7 or LEA7B OA while the LEA105 OA is used for Short Reach systems. Both LEA7 and LEA105 are required for single-OA operation.

### **Optical Multiplexer Unit (OMU)**

Used at the end terminal site, the OMU combines up to sixteen optical wavelengths into one signal called the optical line signal.

The OMUs used with WaveStar OLS 40G, are:

- 506A which combines up to 16 optical wavelengths into one signal. This signal, known as the optical line signal, has a through loss of  $\leq 15$  dB.
- 506B which combines up to 16 optical wavelengths into one signal. This signal, known as the optical line signal, has a through loss of  $\leq 8$  dB.
  - A new faceplate allows the use of LC-type LBOs to balance power.
  - A filter device is used with the 506B OMU instead of a coupler device

Both the OMU and ODU units are mechanically fastened to the shelf with screw fasteners and are field replaceable. The shelf card guides enable proper alignment with the backplane.

### **Optical Demultiplexer Unit (ODU)**

The ODU demultiplexes the input optical signal into a maximum of sixteen wavelengths. The four types of ODUs used with WaveStar OLS 40G are:

- 606A (sixteen wavelength; without Supervisory Channel Output, and a through loss of  $\leq 10$  dB)
- 606B (sixteen wavelength; with Supervisory Channel Output, and a through loss of  $\leq 10$  dB)

- 606C (sixteen wavelength; without 1532 nm Supervisory Channel Output, and a through loss of  $\leq 8$  dB)
- 606D (sixteen wavelength; with 1532 nm Supervisory Channel Output, and a through loss of  $\leq 8$  dB)



**NOTE:**

The 606B or 606D ODU is required for single-OA operation.

### **Optical Translator Unit (OTU)**

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The OTU circuit pack regenerates an OC-48/STM-16 optical signal by:

- Converting the signal from optical to electrical format
- Converting the signal back into an optical signal that is compatible with WaveStar OLS 40G or a receiver of the optical channel source
- Monitoring the signal for degradation.

The OTU control structure provides the following functionality:

- Equipment version information per OTU (OC-48/STM-16), QOTU, and OTPM (OC-3/STM-1, OC-12/STM-4, 100-750 Mb/s) and GbE.
- Software download from the SYSCTL/SYSMEM to the OTCTL and through the OTCTL to the OTUs and QOTUs
- Equipment failure indications for OTUs, QOTUs, and OTPMs
- Incoming signal failure indications (LOS, LOF, and AIS) for OTU and OTPM ports
- B1 performance monitoring in 15 minute/daily bins and TCAs for each OTU and OTPM port (this is not provided for the LSBB OTPM)
- Optical parameter performance monitoring (LBFC/OPT, RCV PWR/OPR, LBC) for the OC-48/STM-16 OTUs. For OC-3/STM-1 and OC-12/STM-4 OTPMs and 100-750 Mb/s LSBB OTPMs, analog performance parameters are not provided (available for factory testing and calibration) and all out-of-range indications are treated as OTPM failures.
- Autonomous TL1 alarm reporting for all OTU, QOTU, and OTPM equipment
- Autonomous TL1 alarm reporting for QOTU and OTPM incoming signal conditions, including the T-x condition types for TCAs
- Incoming signal port state provisioning for all OTU and OTPM ports
- In-service indications (green LED) for OTPM ports.

This information is reported through the WaveStar OLS 40G user interface.

### Quad Optical Translator Unit (QOTU)

Each QOTU circuit pack occupies two OTU slots in an OT shelf, and contains a maximum of four OC-3/STM-1, OC-12/STM-4, or 100-750 Mb/s OTPMs in any combination.

OTPMs are housed individually in QOTU ports 1, 2, 3, and 4. Figure 4-8 illustrates the port locations on the QOTU.

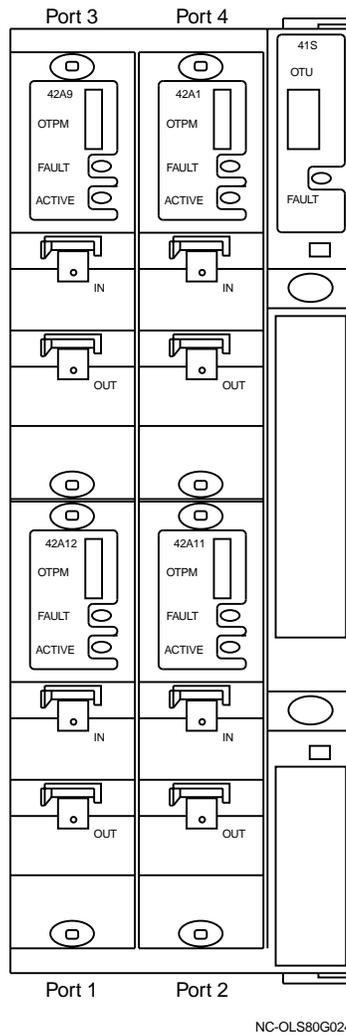


Figure 4-12. QOTU Design

### **Optical Translator Port Module (OTPM)**

The OTPMs perform the same functions as the OTUs for sixteen wavelength OC-3/STM-1, OC-12/STM-4, and 100-750 Mb/s rate signals.

### **Telemetry (TLM) Circuit Pack**

The TLM circuit pack provides a supervisory channel on the optical line. This channel is used for fault location and maintenance functions. A fully-equipped End Terminal Shelf requires one TLM circuit pack per line, while a fully-equipped Repeater Shelf requires two TLM circuit packs per line. When the end terminal uses the telemetry-thru feature, two TLM circuit packs per line are used. A network can contain LDA1 circuit packs (for 1532 nm).

The LDA1 TLM circuit pack hardware also supports an IS-3 interface that can be used to transmit an STS-3 maintenance signal. The customer can use the payload in the STS-3 signal for site-to-site customer-specific data.

In addition, three orderwire channels, E1, E2, and F1, are available with the LDA1.

## **Control Circuit Packs**

---

Control circuit packs used in WaveStar OLS 40G are as follows:

- System controller (SYSCTL)
- System memory (SYSTEMEM)
- Tributary overhead controller (TOHCTL)
- OT controller (OTCTL— used in the OT)

### **System Controller (SYSCTL)**

---

The SYSCTL circuit pack, together with the SYSTEMEM, provides the highest level of system control for WaveStar OLS 40G. The SYSCTL circuit pack provides system-level user and operations systems interfaces, performs system-wide maintenance computations and performance monitoring, and supports serial telemetry and X.25 interfaces.

The SYSCTL circuit pack can support two fully-integrated OT System Controller Shelves and up to four Complementary Shelves. An Integrated Bay or Cabinet (Double, Triple 1, or Triple 2) package can be used for full operation.

### **System Memory (SYSTEMEM)**

---

The SYSTEMEM circuit pack provides memory support for the system controller (SYSCTL) circuit pack. The SYSTEMEM circuit pack contains erasable/programmable read-only memory (EPROM) for nonvolatile storage of the system state and user-provisioned data. It also contains a flash EPROM for nonvolatile storage of the software for the entire system. The SYSTEMEM circuit pack also supports the user panel, parallel telemetry, miscellaneous discretes, and office alarms.

### **Tributary Overhead Controller (TOHCTL)**

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The TOHCTL circuit pack processes the overhead (D1 - D3) of the supervisory channel. The TOHCTL interfaces with the transmission overhead on the TLM circuit pack in order to deliver and receive DCC data. The TOHCTL interfaces with the system controller complex by means of the OALAN. Refer to Chapter 5, “Operations, Administration, Maintenance, and Provisioning,” for more information on this circuit pack.

## **OT Controller (OTCTL)**

---

To facilitate integration of the OT with WaveStar OLS 40G, the OTCTL is used to integrate the OTUs into the WaveStar OLS 40G control structure. It occupies three slots in the OT System Controller Shelf.

Operationally, the integration of these circuit packs makes the combination of WaveStar OLS 40G and OT appear as a single network element. The OTCTL controls all of the OTUs within the same cabinet or network bay frame via the BCLAN connections provided in the backplane and inter-shelf OT cabling.

## **Optical Transmission Elements**

---

WaveStar OLS 40G can be used in a variety of applications. The following sections describe basic WaveStar OLS 40G transmission elements and configurations that use these elements.

WaveStar OLS 40G uses Optical Amplifiers (OAs), Optical Multiplexer Units (OMUs), Optical Demultiplexer Units (ODUs), and Optical Translator Units (OTUs/OTPMs) as its basic components.

## **Optical Amplifier**

---

WaveStar OLS 40G Optical Amplifier (OA) is an erbium-doped fiber amplifier (EDFA). OAs generate high optical power which supports longer optical sections and lines between lightwave terminals than traditional lightwave applications. For any given application, one OA code can serve as a power amplifier, pre-amplifier, or repeater.

WaveStar OLS 40G uses one or two-OAs per line at each End Terminal site. Depending on the type of operation, one OA serves as a power amplifier at the transmit end and the other serves as an optional pre-amplifier at the receive end. At Repeater sites, an OA serves as an optical repeater. Each OA can amplify the multiplexed signals, handling up to sixteen wavelengths simultaneously.

Table 4-1 lists the five types of available OAs and their associated applications.

**Table 4-1. WaveStar OLS 40G Optical Amplifiers**

OA Code	Application	Two-OA Operation	Single-OA Operation
LEA7	Long Reach	✓	✓
LEA7B	Long Reach	✓	✓
LEA104	Long Span	✓	
LEA107B	Long Span	✓	
LEA105	Short Reach	✓	✓

## Optical Multiplexer Units/Optical Demultiplexer Units

WaveStar OLS 40G supports

- One type of 16λ OMU
- two types of 16λ ODUs [one 16λ with supervisory channel, one 16λ without supervisory channel]

Optical Multiplexer Units (OMUs) multiplex up to 16 signals together. Optical Demultiplexer Units (ODUs) optically demultiplex the signals, separating the optical input signal into sixteen separate wavelength signals. Table 4-2 lists the types of optical units supported by WaveStar OLS 40G.

**Table 4-2. WaveStar OLS 40G OMUs/ODUs**

Unit	Code	Wavelengths	Notes
OMU	506A 506B*	16	Provides supervisory channel output
ODU	606A 606C*	16	Does not provide supervisory channel output
ODU	606B 606D*	16	Provides supervisory channel output for single-OA applications

\* These units have reduced insertion loss to support the ODU-OMU pass through feature.

## Optical Translator Units

WaveStar OLS 40G utilizes Optical Translator Units (OTUs and OTPMs) supporting up to sixteen wavelengths and OC-48/STM-16, OC-12/STM-4, OC-3/STM-1, GbE, and 100-750 Mb/s bit rates.

The OC-48/STM-16 and GbE OTUs are standard WaveStar OLS 40G OTUs covering sixteen wavelengths. For OC-12/STM-4, OC-3/STM-1, and 100-750 Mb/s applications, a Quad Optical Translator Unit (QOTU) carrier pack holds up to four Optical Translator Port Modules (OTPMs) in any combination.

Table 4-3 lists the supported OTUs and OTPMs. For specific engineering rules, refer to Chapter 6, “System Planning and Engineering.”

**Table 4-3. WaveStar OLS 40G OTUs/OTPMs**

Code	Bit Rate	Wavelength Band	Notes
41A(1-16)C	OC-48/STM-16	1.5 μm	OTU. For applications with dispersion of up to 6800 ps/nm.
41BB	OC-48/STM-16	1.3 μm	OTU, used to transmit from the OLS ODU to a SONET/SDH Network Element receiver
41C(1-16)C	OC-48/STM-16	1.5 μm	OTU. For applications with dispersion of up to 10,900 ps/nm, concatenation of up to 20 OTUs, and used to transmit to the OLS OMU.
41F(1-16)	Ethernet 1.25 Gb/s	1.5 μm	OTU. For applications with dispersion of up to 6800 ps/nm
41G	Ethernet 1.25 Gb/s	1.3 μm	OTU
41S			QOTU carrier pack for up to 4 OTPMs of any mix
42A(1-16)B	OC-12/STM-4	1.5 μm	OTPM, used to transmit to the OLS OMU
42B	OC-12/STM-4	1.3 μm	OTPM, used to transmit from the OLS ODU to a SONET/SDH Network Element receiver

**Table 4-3. WaveStar OLS 40G OTUs/OTPMs (Contd)**

<b>Code</b>	<b>Bit Rate</b>	<b>Wavelength Band</b>	<b>Notes</b>
43A(1-16)B	OC-3/STM-1	1.5 μm	OTPM, used to transmit to the OLS OMU
43B	OC-3/STM-1	1.3 μm	OTPM, used to transmit from the OLS ODU to a SONET/SDH Network Element receiver
44A(1-16)B	100-750 Mb/s	1.5 μm	LSBB OTPM, used to transmit to the OLS OMU
44B	100-750 Mb/s	1.3 μm	LSBB OTPM, used to transmit from the OLS ODU to a Network Element receiver

**Other Elements**

In addition to the transmission elements described above, WaveStar OLS 40G contains telemetry and control circuits, as well as having a collocated external miscellaneous discrete unit (EMDU). These units are described in Chapter 4, “Product Description.”

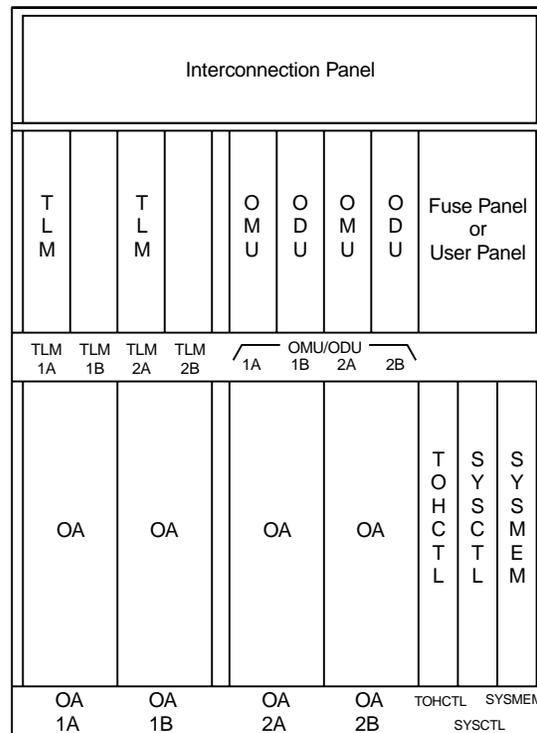
## **End Terminal Shelf Configurations**

This section provides information on the following end terminal shelf configurations:

- 1A-TX end Terminal
- 1A-TX-THRU End Terminal
- 1A-RCV End Terminal
- 1A-RCV-THRU End Terminal
- Dual Facing (DUAL) End Terminal
- Single Optical Amplifier 1A-TX End Terminal
- Single Optical Amplifier 1A-TX-THRU End Terminal
- Single Optical Amplifier 1A-RCV End Terminal
- Single Optical Amplifier 1A-RCV-THRU End Terminal
- Single Optical Amplifier DUAL Facing End Terminal

### 1A-TX End Terminal

The End Terminal may be configured with two OA circuit packs per bidirectional optical line and provisioned as 1A-TX. Figure 4-13 shows the End Terminal equipped for 2 bidirectional optical lines (2-fiber applications typically equip only one bidirectional optical line). In this configuration, the A slot of the OMU/ODU slot pair must be equipped with the OMU, and the B slot of the slot pair must be equipped with the ODU. The OA circuit packs in the OA 1A and OA 2A slots act as transmitters, and the OA circuit packs in the OA 1B and OA 2B slots act as receivers.

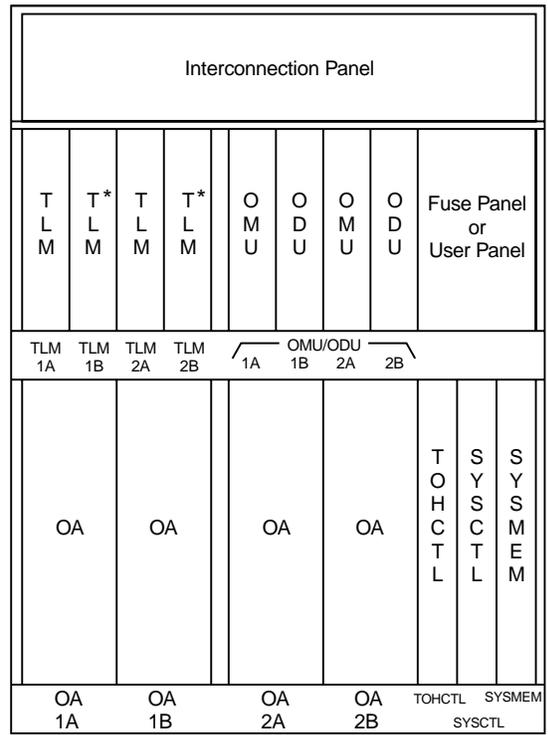


NC-OLS80G040

Figure 4-13. 1A-TX End Terminal Configuration

**1A-TX-THRU End Terminal**

The End Terminal may be configured with two OA circuit packs per bidirectional optical line and provisioned as 1A-TX-THRU. Figure 4-14 shows the End Terminal equipped for 2 bidirectional optical lines (2-fiber applications typically equip only one bidirectional optical line). In this configuration, the A slot of the OMU/ODU slot pair must be equipped with the OMU, and the B slot of the slot pair must be equipped with the ODU. The OA circuit packs in the OA 1A and OA 2A slots act as transmitters, and the OA circuit packs in the OA 1B and OA 2B slots act as receivers. The TLM circuit packs in the TLM 1B and TLM 2B slots are used to extend the data communication channel in 4-fiber ring applications (telemetry feed-through).



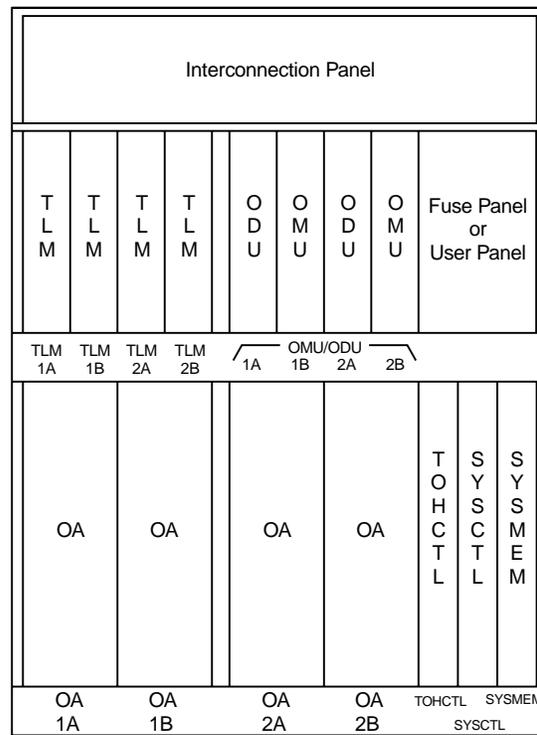
\* Required for DCC Protection

NC-OLS80G041

**Figure 4-14. 1A-TX-THRU End Terminal Configuration**

**1A-RCV End Terminal**

The End Terminal may be configured with two OA circuit packs per bidirectional optical line and provisioned as 1A-RCV. Figure 4-15 shows the End Terminal equipped for 2 bidirectional optical lines (2-fiber applications typically equip only one bidirectional optical line). In this configuration, the A slot of the OMU/ODU slot pair must be equipped with the ODU, and the B slot of the slot pair must be equipped with the OMU. The OA circuit packs in the OA 1A and OA 2A slots act as receivers, and the OA circuit packs in the OA 1B and OA 2B slots act as transmitters.

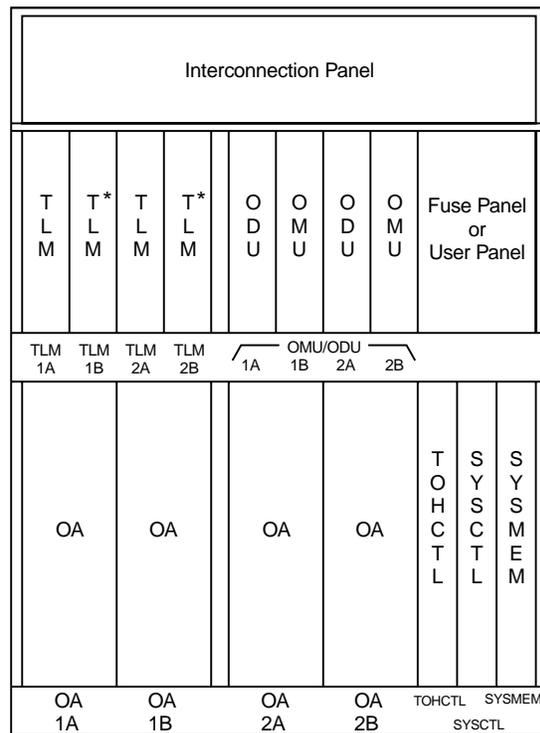


NC-OLS80G102

**Figure 4-15. 1A-RCV End Terminal Configuration**

**1A-RCV-THRU End Terminal**

The End Terminal may be configured with two OA circuit packs per bidirectional optical line and provisioned as 1A-RCV-THRU. Figure 4-16 shows the End Terminal equipped for 2 bidirectional optical lines (2-fiber applications typically equip only one bidirectional optical line). In this configuration, the A slot of the OMU/ODU slot pair must be equipped with the ODU, and the B slot of the slot pair must be equipped with the OMU. The OA circuit packs in the OA 1A and OA 2A slots act as receivers, and the OA circuit packs in the OA 1B and OA 2B slots act as transmitters. The TLM circuit packs in the TLM 1B and TLM 2B slots are used to extend the data communication channel in 4-fiber ring applications (telemetry feed through).



\* Required For DCC Protection

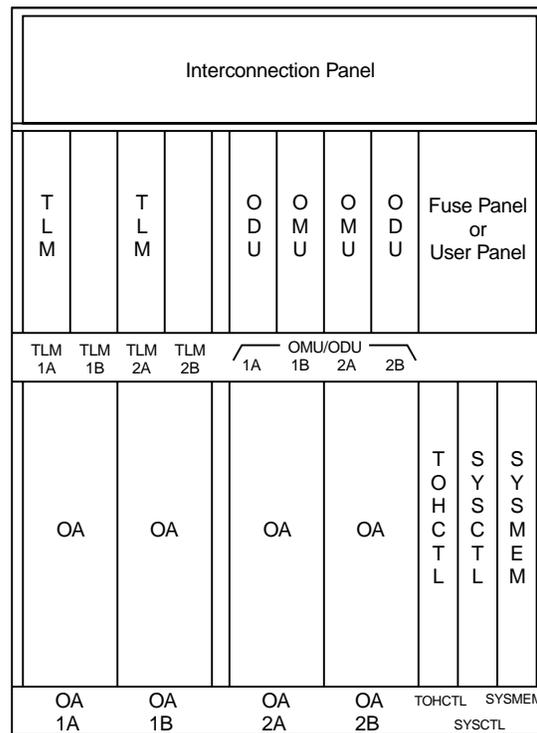
NC-OLS80G042

**Figure 4-16. 1A-RCV-THRU End Terminal Configuration**

**Dual Facing (DUAL) End Terminal**

The End Terminal may be configured with two OA circuit packs per bidirectional optical line and provisioned as DUAL. DUAL indicates that the end terminal has two sides (side 1 and side 2). Side 1 represents line 1, and side 2 represents line 2. Each side is provisioned separately.

Figure 4-17 shows the Dual End Terminal. The side 1 (line 1) OMU/ODU 1A/1B slot pair must be equipped as a 1A-RCV end terminal, and the side 2 (line 2) OMU/ODU 2A/2B slot pair must be equipped as a 1A-TX end terminal. The OA circuit packs in slots OA 1B and OA 2A act as transmitters, and the OA circuit packs in slots OA 1A and OA 2B act as receivers.

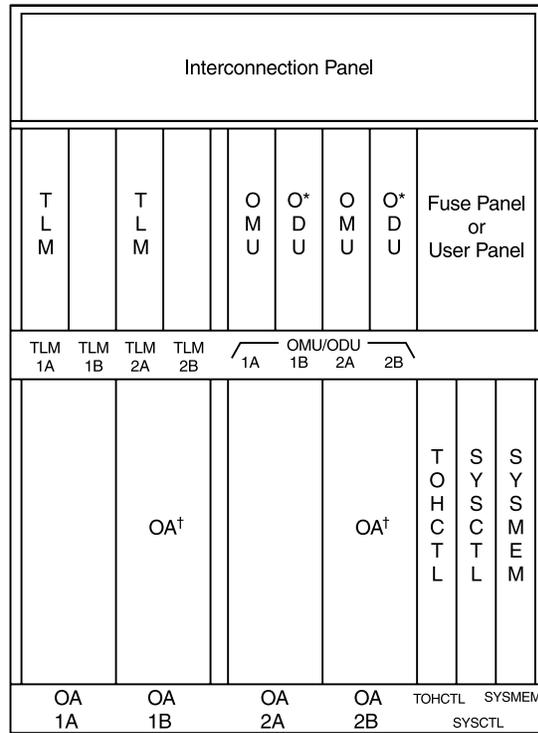


NC-OLS80G043

**Figure 4-17. Dual Facing End Terminal Configuration**

**Single Optical Amplifier 1A-TX End Terminal**

The End Terminal may be configured with one OA circuit pack per bidirectional optical line and provisioned as 1A-TX. Figure 4-18 shows the End Terminal equipped for 2 bidirectional optical lines (2-fiber applications typically equip only one bidirectional optical line). In this configuration, the A slot of the OMU/ODU slot pair must be equipped with the OMU, and the B slot of the slot pair must be equipped with the ODU. The OA circuit packs in the OA 1B and OA 2B slots act as transmitters. The OA circuit packs must be located in the OA slots that correspond to the OMU/ODU slots that are equipped with ODUs. The OA circuit packs provide temperature control for the corresponding ODUs.



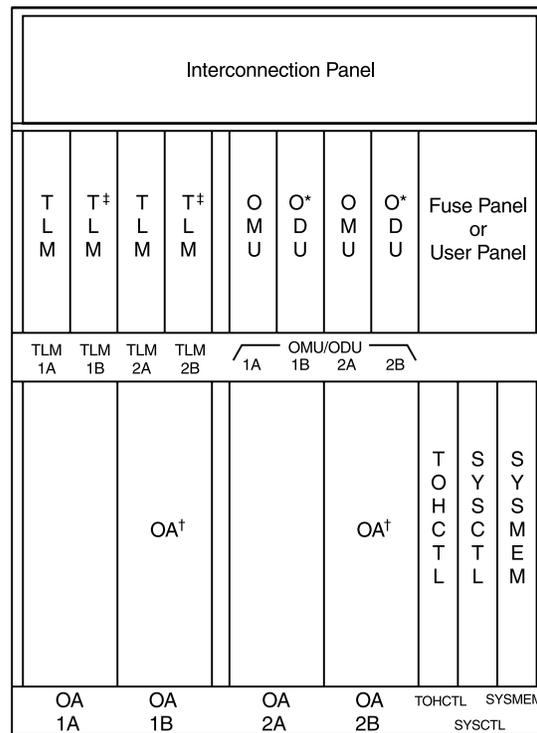
\* 606B or 606D Optical Demultiplexing Unit only.  
† LEA105 or LEA7 Optical Amplifier Circuit Pack only.

NC-OLS80G103

**Figure 4-18. Single Optical Amplifier 1A-TX End Terminal Configuration**

### Single Optical Amplifier 1A-TX-THRU End Terminal

The End Terminal may be configured with one OA circuit pack per bidirectional optical line and provisioned as 1A-TX-THRU. Figure 4-19 shows the End Terminal equipped for 2 bidirectional optical lines (2-fiber applications typically equip only one bidirectional optical line). In this configuration, the A slot of the OMU/ODU slot pair must be equipped with the OMU, and the B slot of the slot pair must be equipped with the ODU. The OA circuit packs in the OA 1B and OA 2B slots act as transmitters. The OA circuit packs must be located in the OA slots that correspond to the OMU/ODU slots that are equipped with ODUs. The OA circuit packs provide temperature control for the corresponding ODUs. The TLM circuit packs in the TLM 1B and TLM 2B slots are used to extend the data communication channel in 4-fiber ring applications (telemetry feed through).



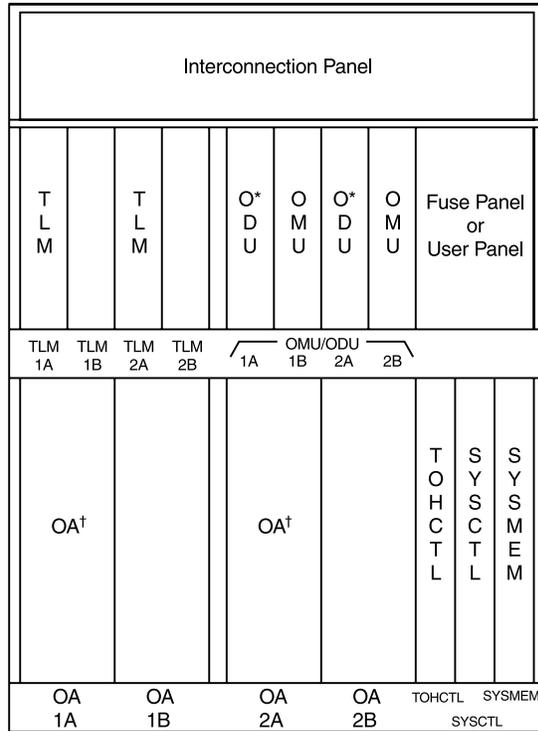
\* 606B or 606D Optical Demultiplexing Unit only.  
<sup>†</sup> LEA105 or LEA7 Optical Amplifier Circuit Pack only.  
<sup>‡</sup> Required for DCC Protection

NC-OLS80G104

**Figure 4-19. Single Optical Amplifier 1A-TX-THRU End Terminal Configuration**

**Single Optical Amplifier 1A-RCV End Terminal**

The End Terminal may be configured with one OA circuit pack per bidirectional optical line and provisioned as 1A-RCV. Figure 4-20 shows the End Terminal equipped for 2 bidirectional optical lines (2-fiber applications typically equip only one bidirectional optical line). In this configuration, the A slot of the OMU/ODU slot pair must be equipped with the ODU, and the B slot of the slot pair must be equipped with the OMU. The OA circuit packs in the OA 1A and OA 2A slots act as transmitters. The OA circuit packs must be located in the OA slots that correspond to the OMU/ODU slots that are equipped with ODUs. The OA circuit packs provide temperature control for the corresponding ODUs.

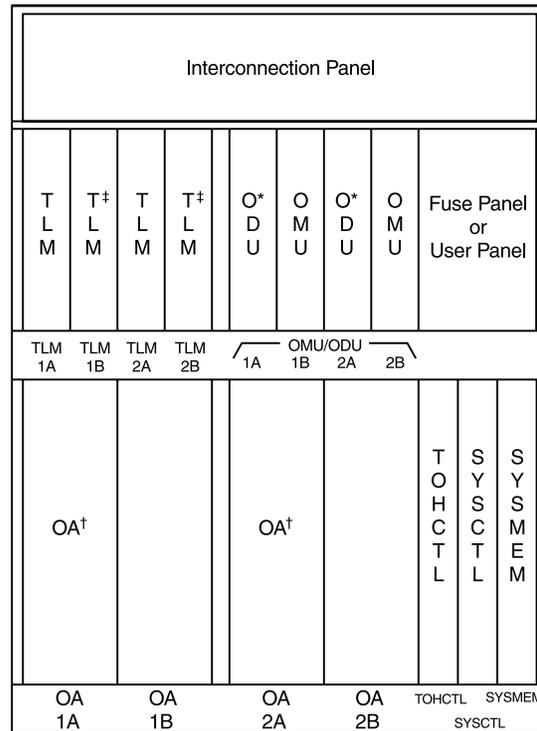


\* 606B or 606D Optical Demultiplexing Unit only.  
 † LEA105 or LEA7 Optical Amplifier Circuit Pack only.

**Figure 4-20. Single Optical Amplifier 1A-RCV End Terminal Configuration**

### Single Optical Amplifier 1A-RCV-THRU End Terminal

The End Terminal may be configured with one OA circuit pack per bidirectional optical line and provisioned as 1A-RCV-THRU. Figure 4-21 shows the End Terminal equipped for 2 bidirectional optical lines (2-fiber applications typically equip only one bidirectional optical line). In this configuration, the A slot of the OMU/ODU slot pair must be equipped with the ODU, and the B slot of the slot pair must be equipped with the OMU. The OA circuit packs in the OA 1A and OA 2A slots act as transmitters. The OA circuit packs must be located in the OA slots that correspond to the OMU/ODU slots that are equipped with ODUs. The OA circuit packs provide temperature control for the corresponding ODUs. The TLM circuit packs in the TLM 1B and TLM 2B slots are used to extend the data communication channel in 4-fiber ring applications (telemetry feed through).



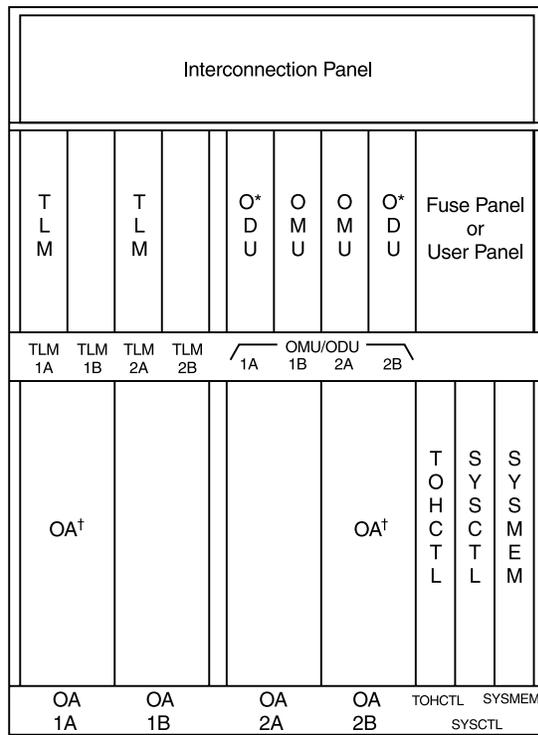
\* 606B or 606D Optical Demultiplexing Unit only.  
 † LEA105 or LEA7 Optical Amplifier Circuit Pack only.  
 ‡ Required for DCC Protection

NC-OLS80G106

Figure 4-21. Single Optical Amplifier 1A-RCV-THRU End Terminal Configuration

**Single Optical Amplifier Dual Facing End Terminal**

The End Terminal may be configured with one OA circuit pack per bidirectional optical line and provisioned as DUAL. DUAL indicates that the end terminal has two sides (side 1 and side 2). Side 1 represents Line 1, and Side 2 represents Line 2. Each side is provisioned separately. Dual shelves may be equipped with different OA configurations in each line. For example, Line 1 can be a single-OA configuration and Line 2 can be a two-OA configuration. Figure 4-22 shows the Dual End Terminal Shelf. The Side 1 (Line 1) OMU/ODU 1A/1B slot pair must be equipped as a 1A-RCV end terminal, and the Side 2 (Line 2) OMU/ODU 2A/2B slot pair must be equipped as a 1A-TX end terminal. The OA circuit packs in the OA 1A and OA 2B slots act as transmitters. The OA circuit packs must be located in the OA slots that correspond to the OMU/ODU slots that are equipped with ODUs. The OA circuit packs provide temperature control for the corresponding ODUs.



\* 606B or 606D Optical Demultiplexing Unit only.  
 † LEA105 or LEA7 Optical Amplifier Circuit Pack only.

NC-OLS80G107

**Figure 4-22. Single Optical Amplifier Dual Facing End Terminal Configuration**

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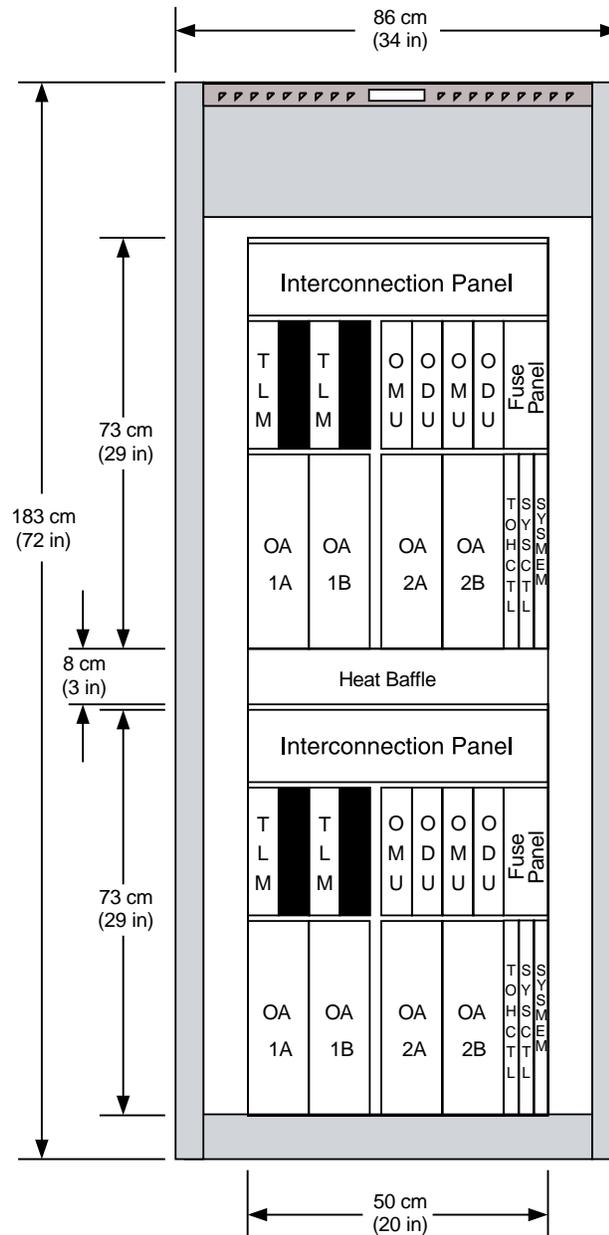
## WaveStar OLS 40G Packages

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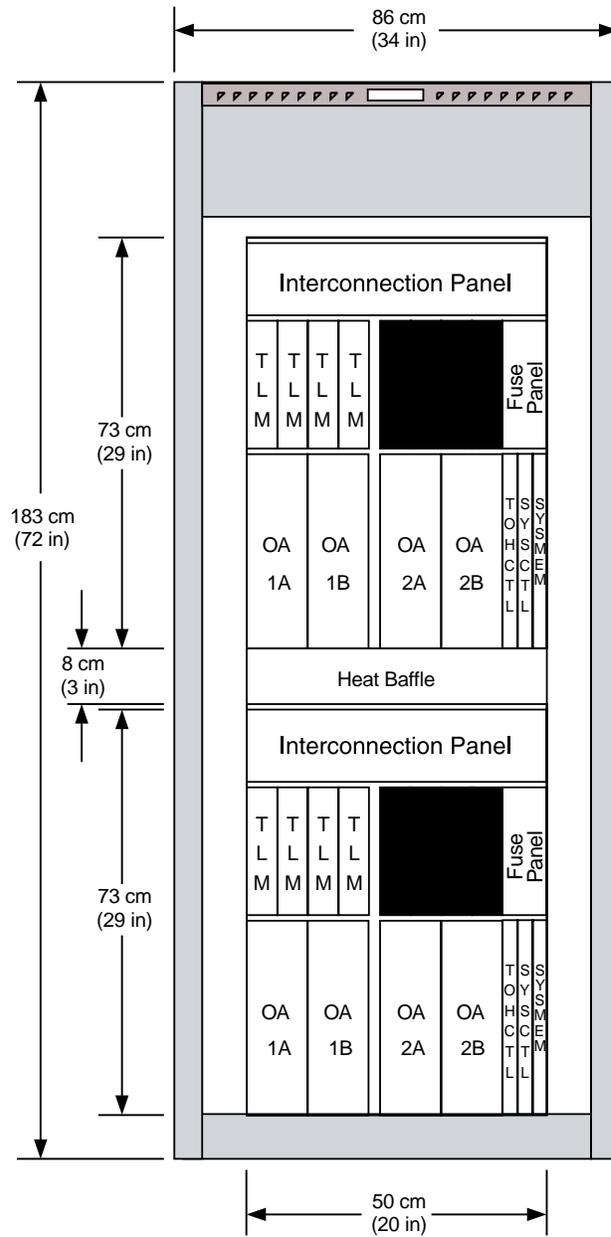
This section describes the different types of WaveStar OLS 40G packages that can be housed in cabinet or bay frame arrangements. All WaveStar OLS 40G network element configurations (except the Integrated Bay) are available in cabinet configurations. Packages include:

- **Dual End Terminal or Dual Repeater Bay or Cabinet**— houses two independent shelves, each shelf having a maximum of two bidirectional optical lines (See Figure 4-23 and Figure 4-24)
- **End Terminal and Repeater Bay or Cabinet**— houses two independent shelves, each shelf having a maximum of two bidirectional optical lines (See Figure 4-25 and Figure 4-26)
- **Miscellaneous-mounted Shelf**— independent **WaveStar OLS 40G** shelf similar to a bay-mounted shelf
- **OT Bay or Cabinet**— houses three shelves, containing a maximum of 32 OTUs or 64 OTPMs per cabinet, depending on bit rate (See Figure 4-27 and Figure 4-28)
- **Integrated Bay (Single)**— houses two OT shelves (20 OTUs or 40 OTPMs) and one End Terminal shelf in one bay, containing two bidirectional optical lines (See Figure 4-29)
- **Integrated Bay or Cabinet (Double)**— a two-bay/cabinet arrangement housing one End Terminal Shelf and one unequipped shelf (first bay) and three OT shelves (second bay) (See Figure 4-30)
- **Integrated Bay or Cabinet (Triple 1)**— a three-bay/cabinet arrangement housing two End Terminal Shelves (first bay), three OT shelves (second bay), and three additional OT shelves (third bay) (See Figure 4-31)
- **Integrated Bay or Cabinet (Triple 2)**— a three-bay/cabinet arrangement housing one End Terminal Shelf and one unequipped shelf (first bay), three OT shelves (second bay), and three additional OT shelves (third bay) (See Figure 4-32).

Illustrations of WaveStar OLS 40G packages are included in the following pages. The majority of these illustrations show cabinet arrangements.

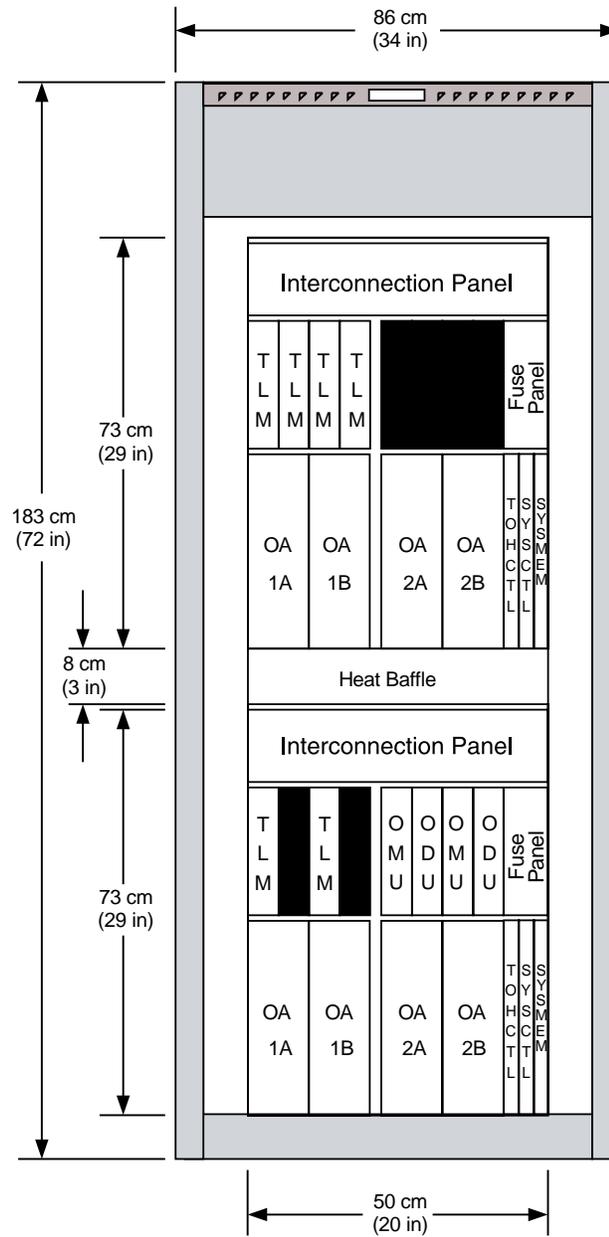


**Figure 4-23. Dual End Terminal Cabinet (fully equipped)**



NC-OLS80G054

Figure 4-24. Dual Repeater Cabinet (fully equipped)



NC-OLS80G055

Figure 4-25. End Terminal and Repeater Cabinet

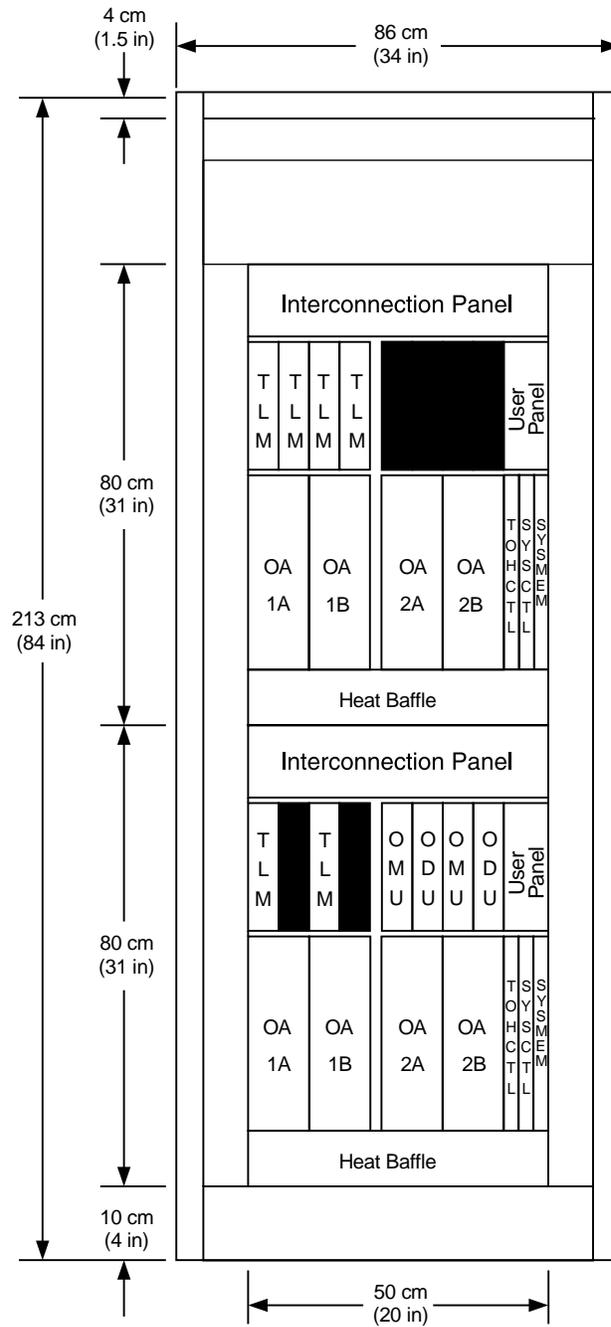


Figure 4-26. Bay-Mounted End Terminal and Repeater

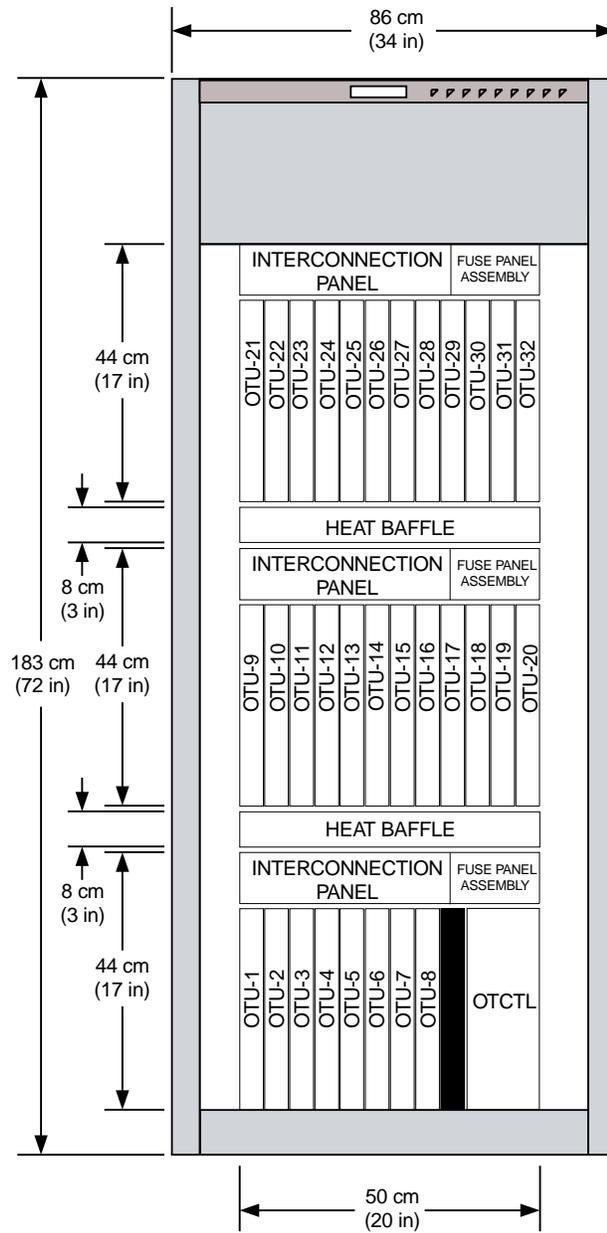
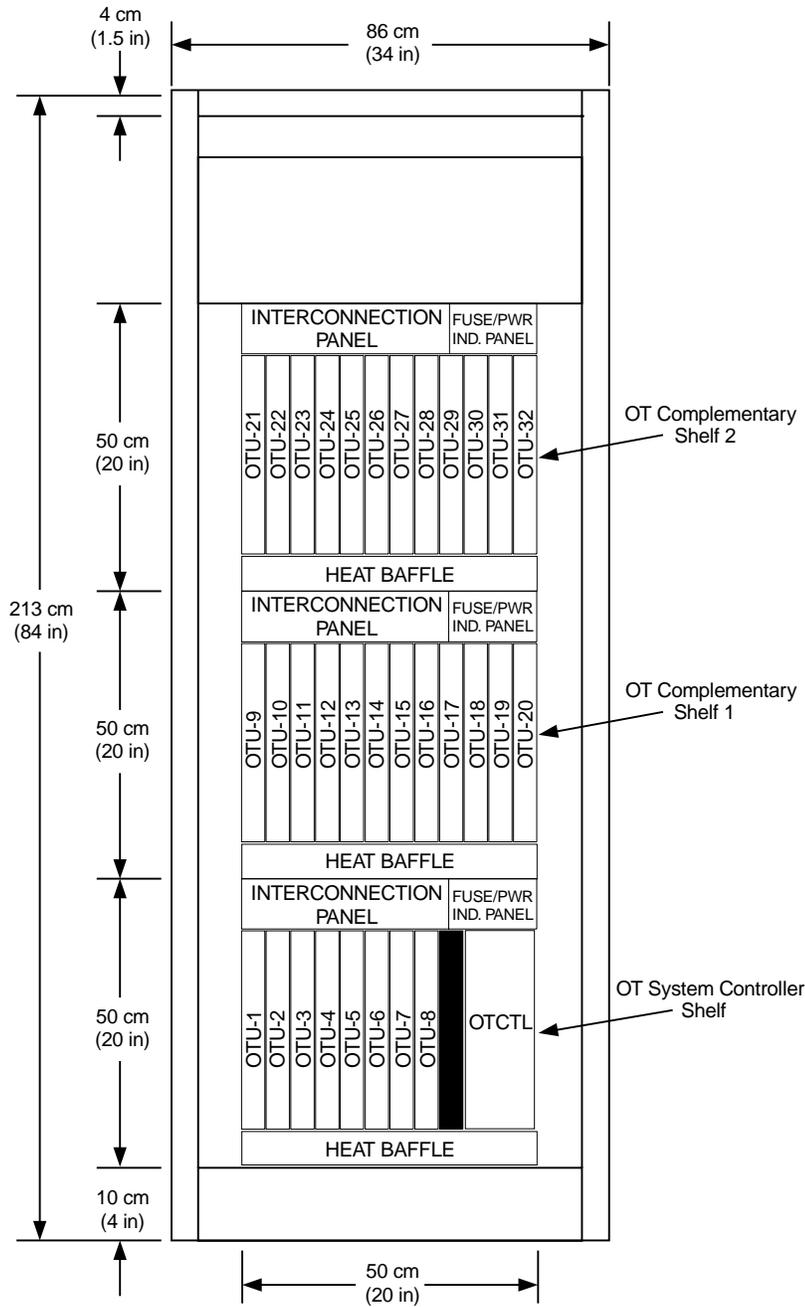
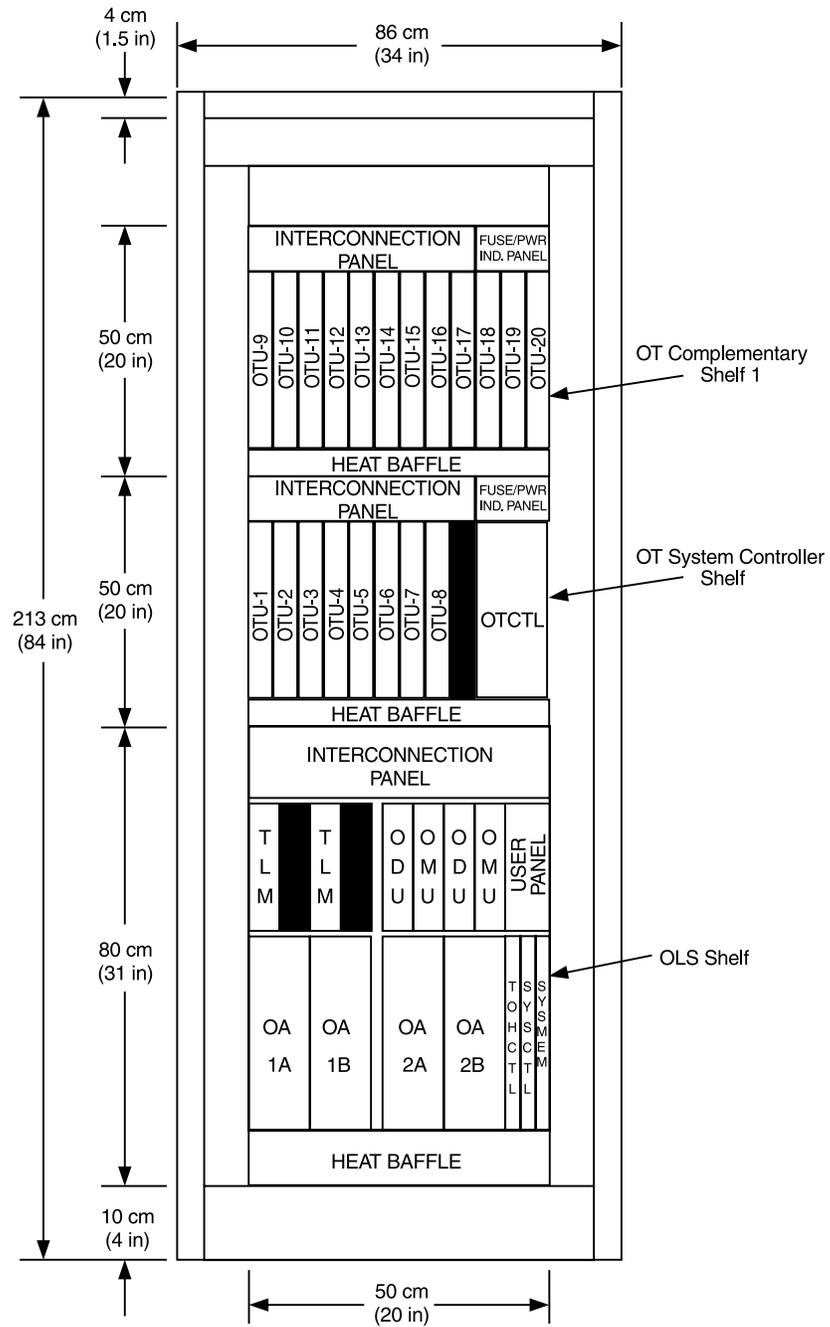


Figure 4-27. OT Cabinet



NC-OLS80G058

Figure 4-28. Bay-Mounted OT



NC-OLS80G059

Figure 4-29. Integrated Bay (Single)

Figure 4-30 shows an Integrated Bay (Double). This package consists of a single WaveStar OLS 40G bay (with one equipped shelf) and an OT bay (with three equipped shelves) and has the following specifications:

- Cabinet or bay-mounted (bay shown)
- One WaveStar OLS 40G Shelf with one or two optical lines controls up to 64 OC-48/STM-16 or GbE OTUs, or 128 OC-3/STM-1, OC-12/STM-4 OTPMs, or 100-750 Mb/s.
- Appears operationally as a single network element
- User interfaces are provided by the WaveStar OLS 40G interconnection panel
- Allows fault correlation between WaveStar OLS 40G and OT equipment
- Existing WaveStar OLS 40G and OT equipment can be combined with an in-service upgrade (OTCTL circuit packs and control cabling is added)
- Depending on the configuration, WaveStar OLS 40G and OT equipment can be located up to 200 feet apart.

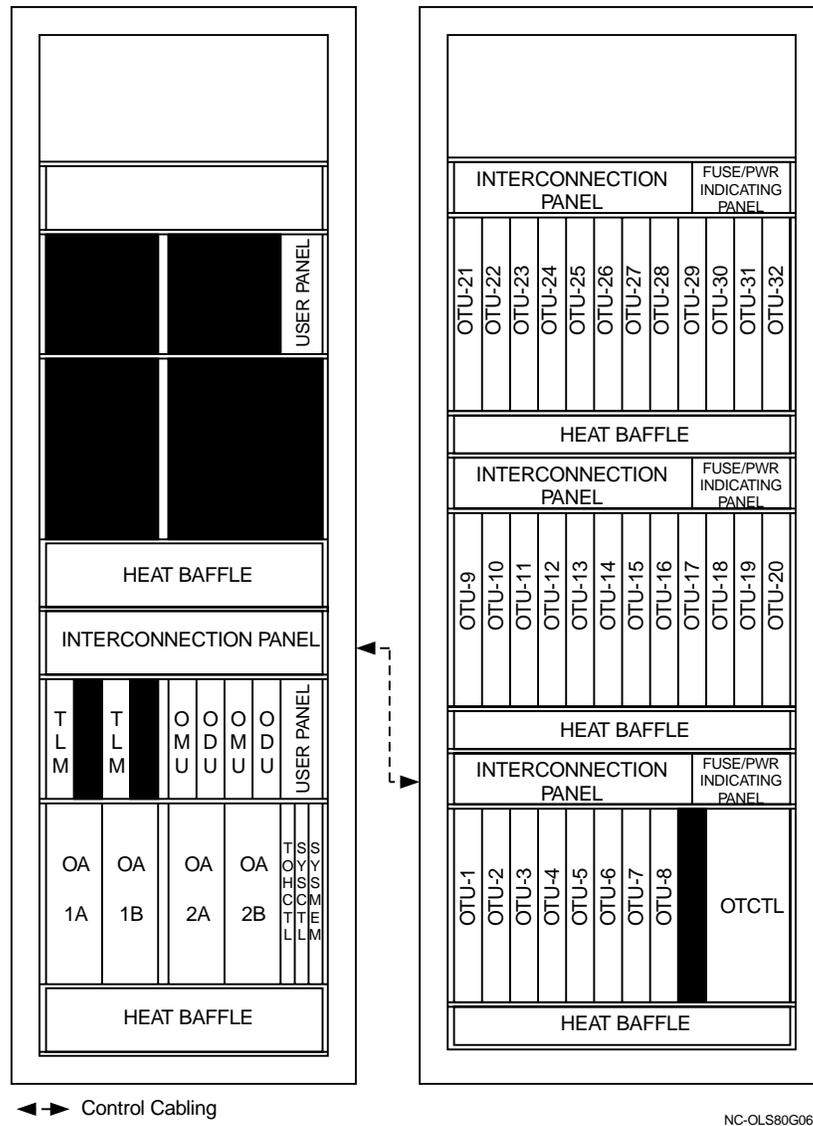


Figure 4-30. Integrated Bay (Double)

Figure 4-31 shows an Integrated Bay (Triple 1) package. This package consists of two separate, bay-mounted WaveStar OLS 40G Shelves and two OT bays (three shelves each) and has the following specifications:

- Cabinet or bay-mounted (bay shown)
- Each WaveStar OLS 40G Shelf has two optical lines and controls up to 32 OC-48/STM-16 or GbE, or 64 OC-3/STM-1, OC-12/STM-4/100-750 Mb/s OTPMs
- User interfaces are accessed from the WaveStar OLS 40G interconnection panel
- Depending on the configuration, WaveStar OLS 40G and OT equipment can be located up to 200 feet apart.

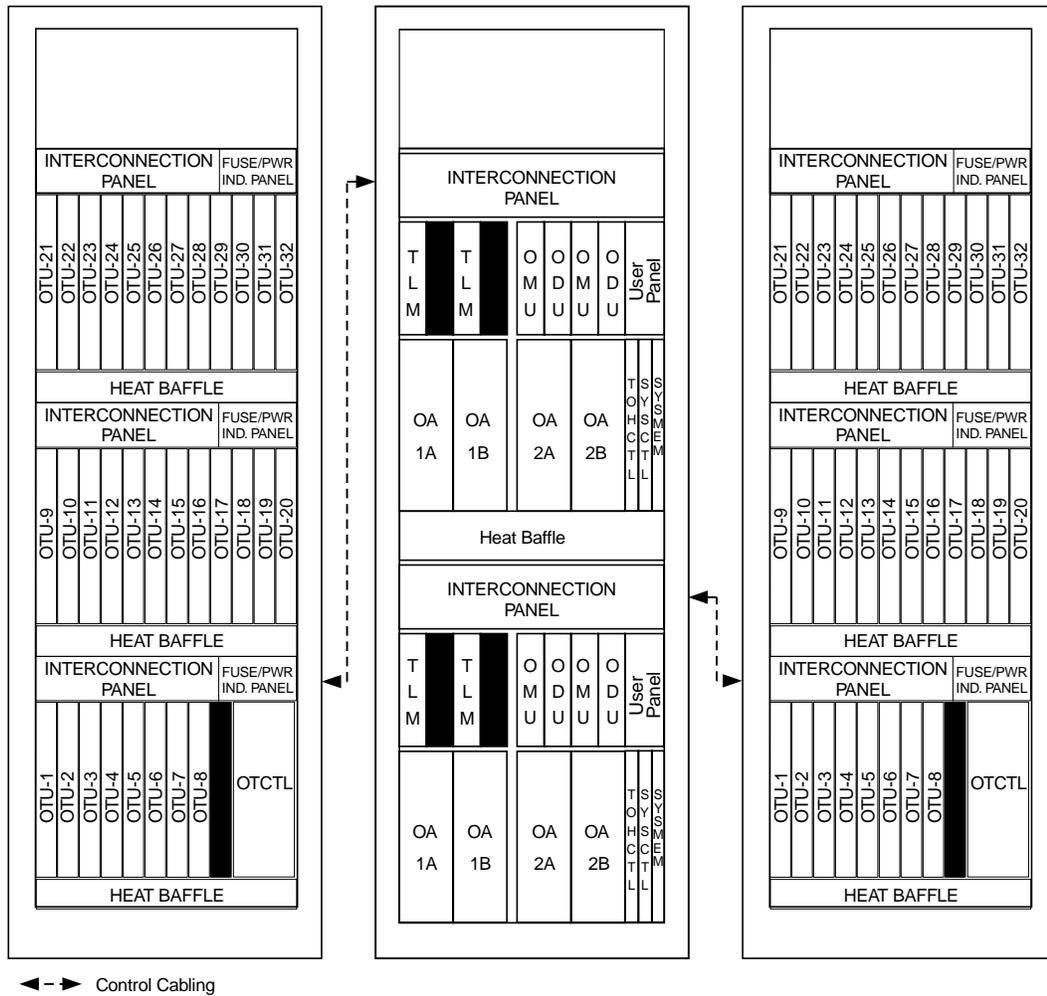


Figure 4-31. Integrated Bay (Triple 1)

Figure 4-32 shows an Integrated Bay (Triple 2) package. This package consists of a single, bay-mounted WaveStar OLS 40G Shelf integrated with two OT bays (three shelves each) and has the following specifications:

- Cabinet or bay-mounted (bay shown)
- One WaveStar OLS 40G Shelf with two optical lines controls up to 64 OC-48/STM-16 or GbE OTUs or 128 OC-3/STM-1, OC-12/STM-4/100-750 Mb/s OTPMs
- User interfaces are accessed from the WaveStar OLS 40G interconnection panel
- Depending on the configuration, WaveStar OLS 40G and OT equipment can be located up to 200 feet apart.

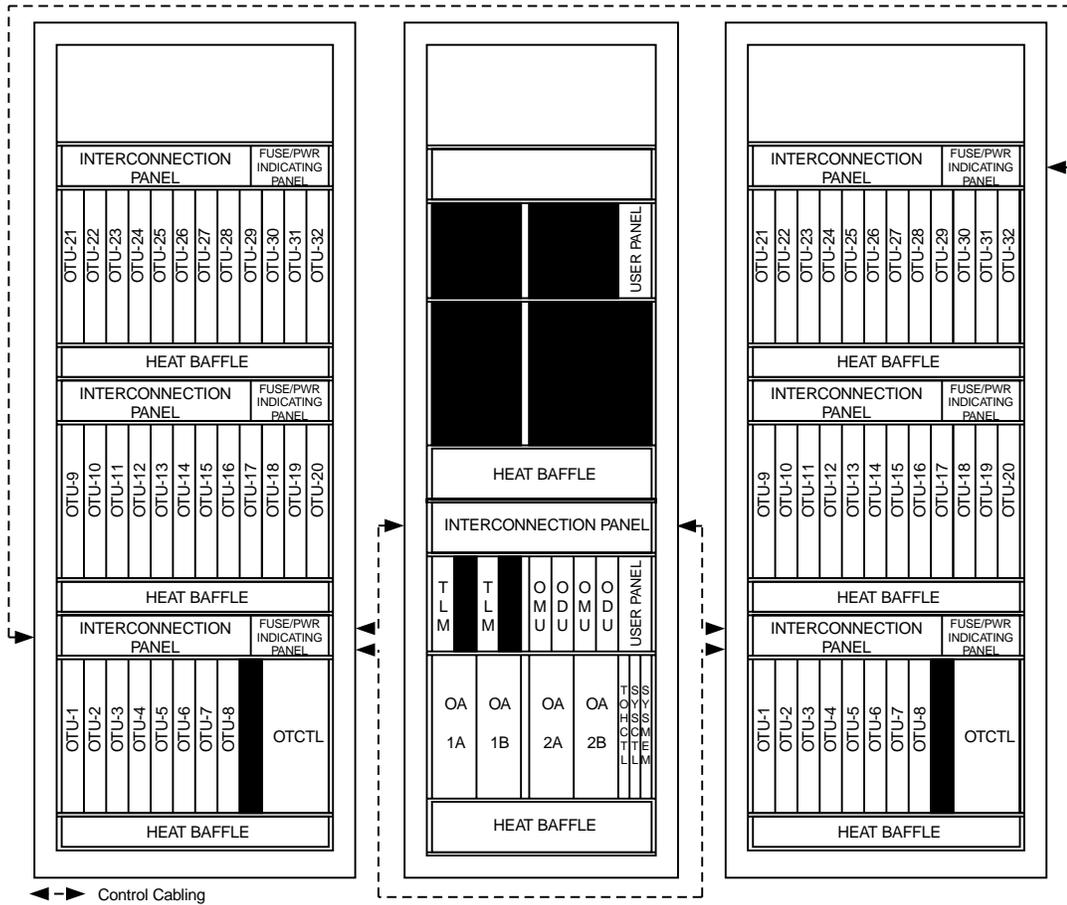


Figure 4-32. Integrated Bay (Triple 2)

## WaveStar OLS 40G Integration Cable Engineering

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This section describes the integration cables that are used to combine WaveStar OLS 40G equipment with the OT. Engineering rules for each configuration are also described. See Chapter 7, “Ordering” for information on ordering these cables.

### Integration Cable Descriptions

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The following three integration cables are used to connect WaveStar OLS 40G equipment to the OT Controller shelves:

- **LAN cable**– supports LAN signals from the WaveStar OLS 40G to either one or two OT bays/cabinets
- **Reset-and-equipage cable**– supports non-switching signals between WaveStar OLS 40G equipment and OT bays/cabinets
- **Dual Reset-and-equipage cable**– provides same functionality as the reset-and-equipage cable with an additional cable branch for OT connections
- **Miscellaneous cable**– provides LED power and other non-switching signals between WaveStar OLS 40G equipment and OT bays/cabinets.

These cables come in several lengths and configurations, depending upon the desired arrangement. These lengths are detailed in the following pages.

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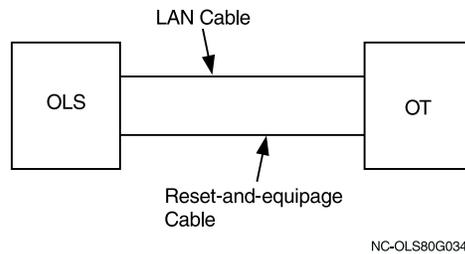
## Integration Cable Configurations

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The integration cabling is used to form the Integrated Bay/Cabinet Double, Triple 1, and Triple 2 packages described earlier. The physical connections are illustrated in the sections that follow.

### Integration Cabling for Integrated Bay/Cabinet Double and Triple 1

The physical cable connection for an Integrated Bay/Cabinet Double or Triple 1 equipment packages is shown in Figure 4-33.



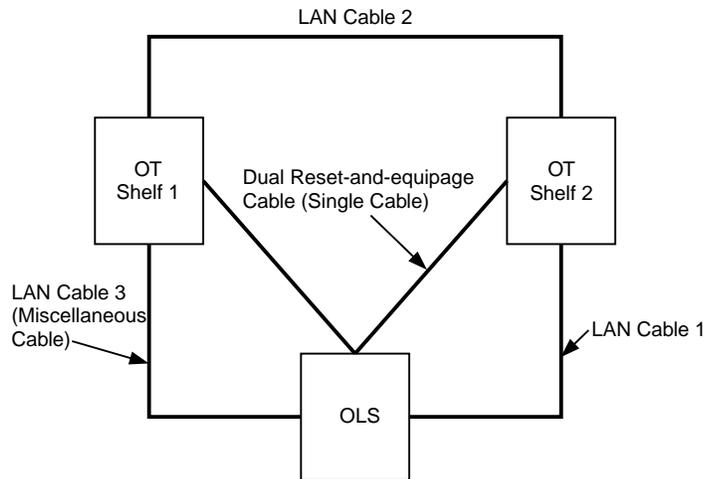
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**Figure 4-33. Integrated Bay/Cabinet Double and Triple 1 Cabling Diagram**

To maintain LAN signal integrity, the maximum distance that is allowed between WaveStar OLS 40G equipment and the OT is 200 feet; the maximum length of the LAN cable is also 200 ft. Contrarily, the reset-and-equipage cable does not limit distance between equipment since switched signals are not present on it. To facilitate engineering and installation, however, the reset-and-equipage cable is offered in the same lengths as the LAN cable.

## Integration Cabling for Integrated Bay/Cabinet Triple 2

The physical cable connection for an Integrated Bay/Cabinet Triple 2 equipment package is shown in Figure 4-34.



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**Figure 4-34. Integrated Bay/Cabinet Triple 2 Cabling Diagram**

The maximum LAN cable length that is allowed for the Triple 2 arrangement is also 200 ft. Here, as before, LAN cables govern the maximum distances between the WaveStar OLS 40G equipment and OT shelves since the dual reset-and-equipage and miscellaneous cables do not carry switched traffic.

**⇒ NOTE:**

The sum of the lengths of LAN cable 1 and LAN cable 2 must not exceed 200 feet.

As depicted in Figure 4-34, the dual reset-and-equipage cable connects to the WaveStar OLS 40G equipment via a single connector and extends to each OT shelf via two completely independent branches of equal length. For example, the 20 foot dual reset-and-equipage cable (G812) consists of a single connector (for the WaveStar OLS 40G) and two 20 foot branches, one connecting to OT Shelf 1 and the other to OT Shelf 2. Similarly, the 100 foot cable consists of two 100 foot branches, and the 200 foot cable consists of two 200 foot branches.

It is possible to engineer a configuration in which a single OT is equipped initially and a second OT is added later. To do this, the WaveStar OLS 40G equipment and the OT should be installed with dual reset-and-equipage cable and one of the LAN Cable 1 groups.

**⇒ NOTE:**

Careful preparation should be taken to insure a proper distance between the WaveStar OLS 40G equipment, OT Shelf 1, and the eventual OT Shelf 2. The appropriate dual reset-and-equipage cable should be chosen based on the maximum distance between the WaveStar OLS 40G equipment and either OT Shelf 1 or OT Shelf 2.

The total cable length of LAN Cable 1 and the eventual LAN Cable 2 should not exceed 200 ft. When installing the WaveStar OLS 40G equipment and OT Shelf 1, the LAN path must be terminated once OT Shelf 1 has been connected. This termination is done using a supplied termination plug located on the backplane of the OT shelf. This plug must remain in place when OT Shelf 1, alone, is being installed.

**⇒ NOTE:**

The LAN cable connecting OT Shelf 1 to OT Shelf 2 cannot be installed without being terminated.

The unused branch of the dual reset-and-equipage cable can be coiled and stored until needed. Similarly, the miscellaneous cable can have one end installed on the WaveStar OLS 40G and the other left coiled and stored until needed with no special termination required on the other end.

When OT Shelf 2 is installed, the LAN termination plug on OT Shelf 1 is first removed from the backplane. The appropriate LAN Cable 2 group is then installed and the previously unused branch of the dual reset-and-equipage cable is connected to OT Shelf 2. Finally, a miscellaneous cable of appropriate length is installed between the WaveStar OLS 40G equipment and OT Shelf 2.

## **Interconnection Panels**

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This section describes the interconnection panels, cabinet indicator strips, and both the fuse and user panels associated with WaveStar OLS 40G shelves (including OT).

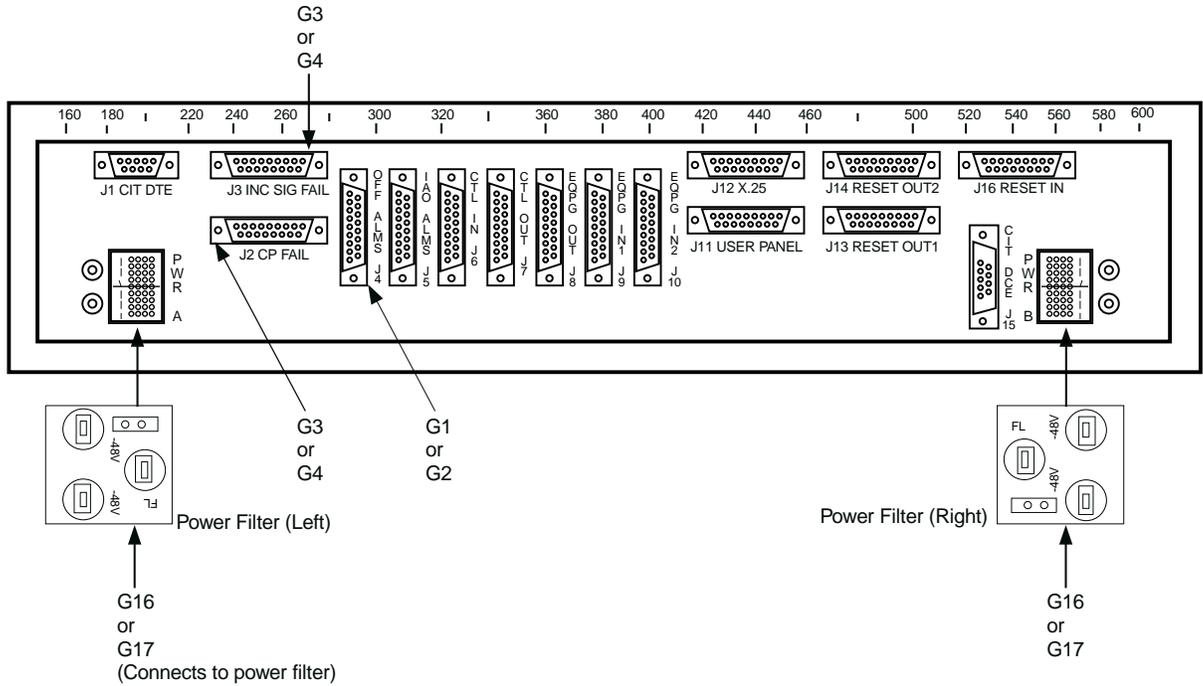
### **WaveStar OLS 40G Interconnection Panel**

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At the top of WaveStar OLS 40G shelf, there is a built-in interconnection panel that is used for OAM&P connections. Each shelf backplane provides intrashelf interconnection between all circuit packs used in the shelf. The backplane also provides interconnection from the OAM&P interconnectors at the top of the shelf to the various circuit pack connector pins. All access to connections is from the front of the shelf, and a CIT access port is available for the interconnection panel.

**OT Interconnection Panel (System Controller Shelf)**

Figure 4-35 depicts an interconnection panel of OT System Controller Shelf as seen from the front of the shelf. Associated cable groups and their connection points are indicated.

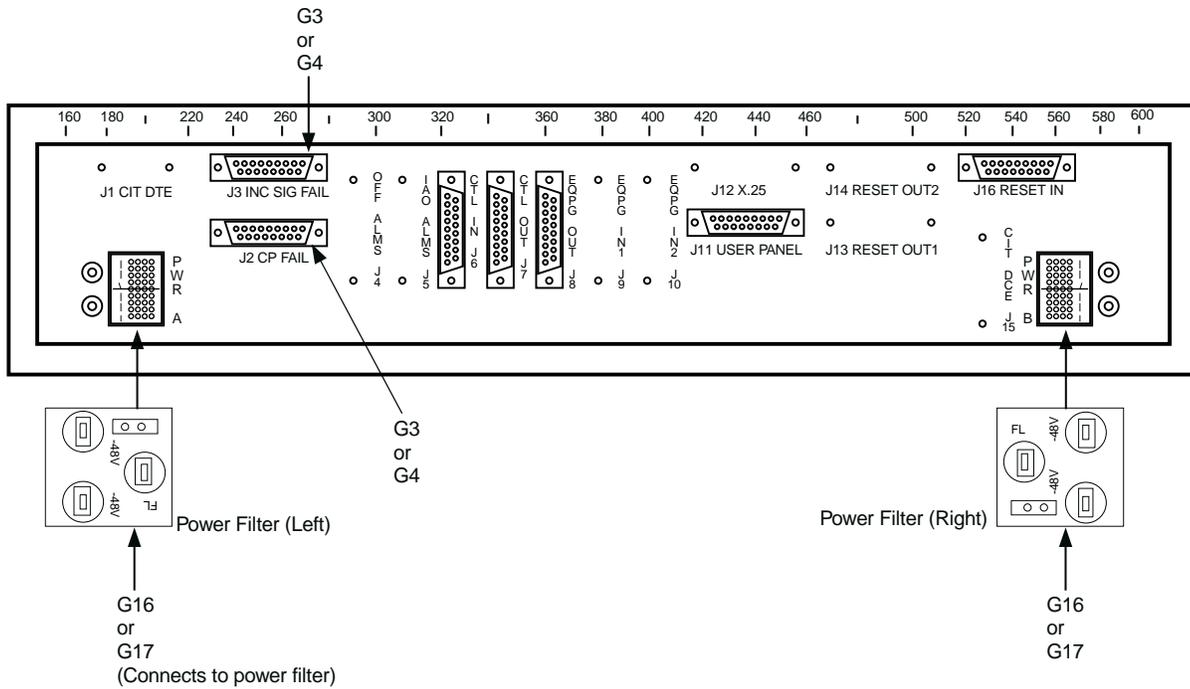


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**Figure 4-35. OT System Controller Shelf Interconnection Panel and Cabling**

**OT Interconnection Panel (Complementary Shelves)**

Figure 4-36 depicts an OT Complementary Shelf interconnection panel as seen from the front of the shelf. Associated cable groups and their connection points are indicated.



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**Figure 4-36. OT Complementary Shelf Interconnection Panel and Cabling**

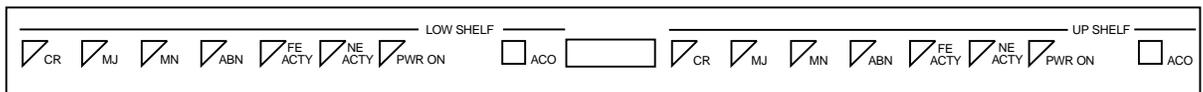
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### **WaveStar OLS 40G Cabinet Indicator Strips**

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Each WaveStar OLS 40G Cabinet has an indicator strip located in the front along the top front of the cabinet. Connectorized cabling connects the shelves to the indicator strip. Figure 4-37 shows the indicator strip for the Dual End Terminal and Dual Repeater cabinets.

Refer to Table 4-4 for a list and description of the SONET indicators and Table 4-5 for the SDH indicators.



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**Figure 4-37. Indicator Strip for Dual End Terminal and Dual Repeater Cabinets**

Table 4-4 provides the Synchronous Optical Network (SONET) equivalents of SDH-specific indicators found on the OT Cabinet indicator strip..

**Table 4-4. User Panel Indicators for WaveStar OLS 40G in SONET Applications**

Indicator Name	Abbrev.	Type	Color	Description
Critical	CR	LED	Red	Indicates critical active alarm level
Major	MJ	LED	Red	Indicates major active alarm level
Minor	MN	LED	Yellow	Indicates minor active alarm level
Alarm Cut-off	ACO	SW/LED	Green	When depressed, silences active audible alarms
Abnormal	ABN	LED	Yellow	Indicates an abnormal condition
Near End Activity	NE ACTY	LED	Yellow	Indicates alarm or status conditions at the local equipment
Far End Activity	FE ACTY	LED	Yellow	Indicates alarm or status conditions at the remote equipment
Power On (Lower Shelf)*	PWR ON LOW SHELF	LED	Green	Indicates the lower shelf is receiving -48V power
Power On (Upper Shelf)*	PWR ON UP SHELF	LED	Green	Indicates the upper shelf is receiving -48V power

\* Applies only to cabinet applications.

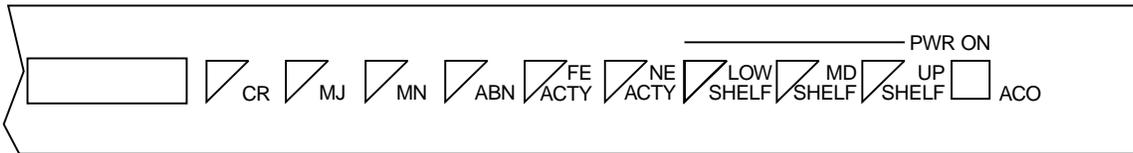
Table 4-5 provides the Synchronous Digital Hierarchy (SDH) equivalents of SONET-specific indicators found on the OT Cabinet indicator strip.

**Table 4-5. User Panel Indicators for WaveStar OLS 80G in SDH Applications**

Indicator Name	Abbrev.	Type	Color	Description
Critical	CR	LED	Red	Indicates critical active alarm level
Prompt	PROMPT	LED	Red	Indicates prompt active alarm level
Deferred	DEFR	LED	Yellow	Indicates deferred active alarm level
Suppress	SUPPRESS	SW/LED	Green	When depressed, silences active audible alarms
Abnormal	ABN	LED	Yellow	Indicates an abnormal condition
Info-N	INFO-N	LED	Yellow	Indicates alarm or status conditions at the local equipment
Info-F	INFO-F	LED	Yellow	Indicates alarm or status conditions at the remote equipment
Power On (Upper Shelf)*	PWR ON	LED	Green	Indicates the lower shelf is receiving -48V power
Power On (Lower Shelf)*	PWR ON	LED	Green	Indicates the upper shelf is receiving -48V power

\* Applies only to cabinet applications.

As shown in Figure 4-38, each OT Cabinet is equipped with an indicator strip located in the front along the top of the cabinet. Refer to Table 4-6 for a list and description of the indicators. Connectorized cabling connects the shelves to the indicator strip.



NC-OLS80G030

**Figure 4-38. OT Cabinet Indicator Strip**

Although Table 4-6 lists all the indicators that appear on the OT indicator strip, only the three Power On (PWR ON) LEDs are active.

**Table 4-6. Indicator Strip LEDs for OT (SONET)**

Indicator Name	Abbrev.	Color	Description
Power On *	PWR ON	Green	Indicates that the respective shelf is receiving -48 V power
Critical	CR	Red	Indicates critical active alarm level
Major	MJ	Red	Indicates major active alarm level
Minor	MN	Yellow	Indicates minor active alarm level
Near End Activity	NE ACTY	Yellow	Indicates alarm or status conditions at the local equipment
Far End Activity	FE ACTY	Yellow	Indicates alarm or status conditions at the remote equipment
Alarm Cut-off†	ACO	Green	When depressed, silences active audible alarms
Abnormal	ABN	Yellow	Indicates an abnormal condition

\* The indicator panel has three PWR LEDs representing the three shelves installed in the cabinet. The three LEDs are designated as Lower Shelf (LOW SHELF, System Controller Shelf), Middle Shelf (MID SHELF, Complementary Shelf 1), and Upper (UP SHELF, Complementary Shelf 2).

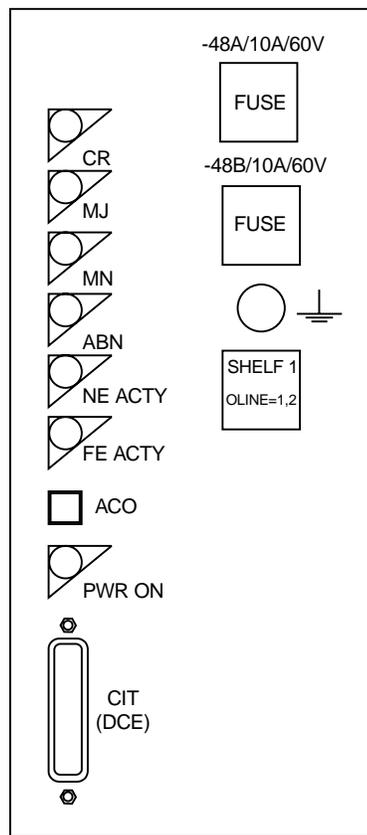
† The ACO switch is functional only after controller circuit packs are installed in future releases.

## Panels

This section provides information on user, fuse, and power indicating panels for WaveStar OLS 40G.

### WaveStar OLS 40G User Panel

Figure 4-39 shows a diagram of the WaveStar OLS 40G user panel for the miscellaneous-mounted shelf and bay configurations.

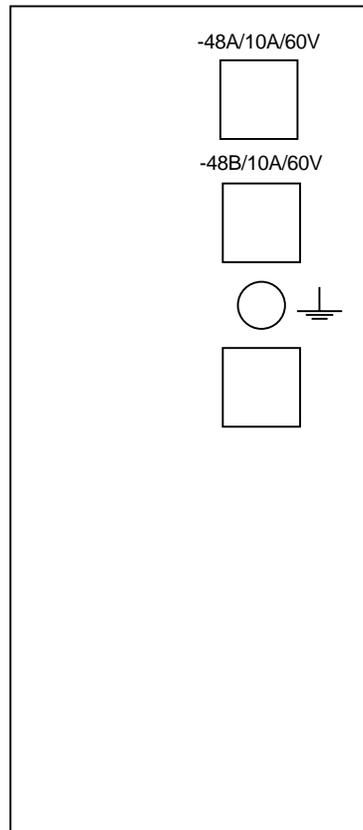


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**Figure 4-39. WaveStar OLS 40G Shelf User Panel**

### WaveStar OLS 40G Fuse Panel

WaveStar OLS 40G fuse panel, shown in Figure 4-40, displays the fuse indicators for overcurrent protection (A and B feeds) and provides an electrostatic discharge (ESD) jack that is connected to a frame ground. The fuse panel can be replaced in the field.



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**Figure 4-40. WaveStar OLS 40G Fuse Panel**

Table 4-7 lists all the SONET indicators that appear on the user panel. Note that only the green Power On (PWR ON) LED should be active. Table 4-8 lists all the SDH indicators.

**Table 4-7. SONET Indicators on WaveStar OLS 40G User Panel (L10 and L11)**

Indicator Name	Abbrev.	Color	Description
Power On	PWR	Green	Indicates the shelf is receiving -48 V power
Critical	CR	Red	Indicates critical active alarm level
Major	MJ	Red	Indicates major active alarm level
Minor	MN	Yellow	Indicates minor active alarm level
Near End Activity	NE ACTY	Yellow	Indicates alarm or status conditions at the local equipment
Far End Activity	FE ACTY	Yellow	Indicates alarm or status conditions at the remote equipment
Alarm Cut-off	ACO	Green	When depressed, silences active audible alarms
Abnormal	ABN	Yellow	Indicates an abnormal condition

**Table 4-8. SDH Indicators Present on WaveStar OLS 80G User Panel (L10 and L11)**

Indicator Name	Abbrev.	Color	Description
Power On	PWR	Green	Indicates the shelf is receiving -48 V power
Critical	CR	Red	Indicates critical active alarm level
Prompt	PROMPT	Red	Indicates prompt active alarm level
Deferred	DEFR	Yellow	Indicates deferred active alarm level
Info-N	INFO-N	Yellow	Indicates alarm or status conditions at the local equipment

**Table 4-8. SDH Indicators Present on WaveStar OLS 80G User Panel (L10 and L11) (Contd)**

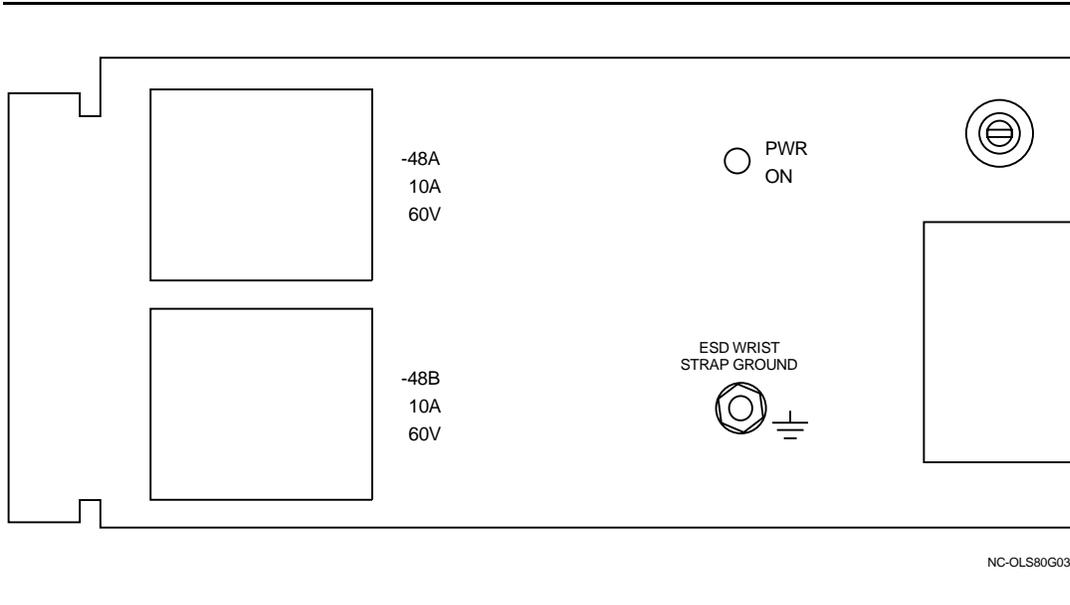
<b>Indicator Name</b>	<b>Abbrev.</b>	<b>Color</b>	<b>Description</b>
Info-F	INFO-F	Yellow	Indicates alarm or status conditions at the remote equipment
Suppress	SUPPRESS	Green	When depressed, silences active audible alarms
Abnormal	ABN	Yellow	Indicates an abnormal condition

**OT Complementary Shelf Fuse/Power Indicating Panel Assembly**

In OT miscellaneous-mounted and bay frame configurations, Complementary Shelves 1 and 2 are both equipped with a fuse/power indicating panel. Each panel provides the following:

- Fuse indicators for overcurrent protection (A and B feeds)
- One green Power On (PWR ON) LED that lights up to indicate the shelf is receiving -48 V power
- An electrostatic discharge (ESD) jack that is connected to a frame ground.

Figure 4-41 shows a diagram of the OT Complementary Shelf fuse/power indicating panel.



**Figure 4-41. Miscellaneously-Mounted OT Complementary Shelf Fuse/Power Indicating Panel**

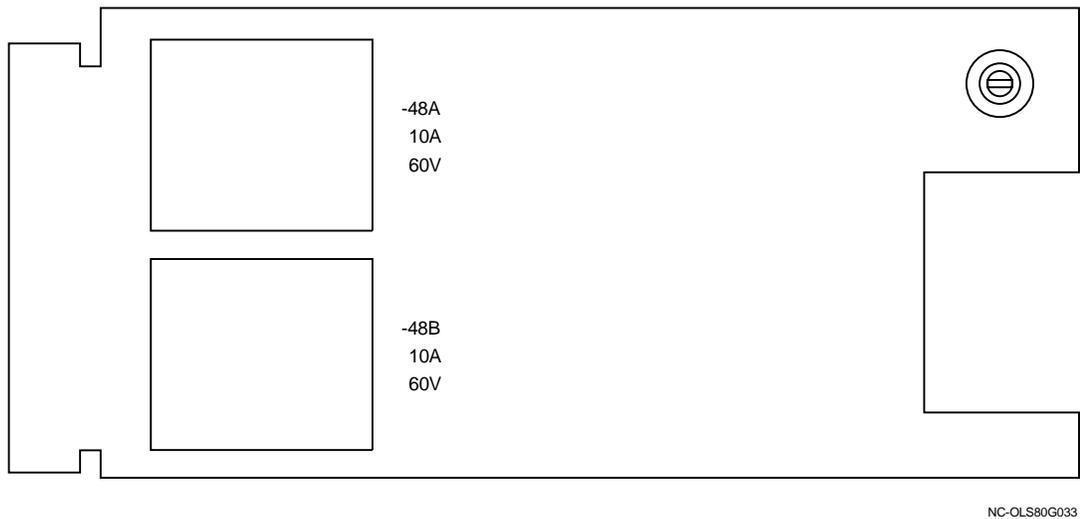
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### OT Shelf Fuse Panel Assembly in Cabinet Configurations

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The OT Shelf fuse panel is used for all OT shelves in cabinet configurations. The fuse panel provides fuse indicators for overcurrent protection (A and B feeds).

Figure 4-42 shows a diagram of the fuse panel.



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**Figure 4-42. OT Shelf Fuse Panel**

## Power

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This section provides information on WaveStar OLS 40G power distribution.

Power distribution is based on individual rather than bulk power supplies. Each circuit pack contains DC-to-DC converters that change the office battery voltages to the voltages required. This leads to improved system reliability with heat dissipated uniformly across the system, thereby avoiding “hot spots.”

WaveStar OLS 40G is powered by -48 V direct current (DC). Power filtering and fusing are performed on the shelf level. DC-to-DC on-board power converters convert power on individual circuit packs.

## Power Cables

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The power feed cable uses stranded, color coded, and keyed connectors. All panel-mounted power connector functions are labeled. Table 4-9 shows the color codes used for power cabling.

**Table 4-9. Power Cable Color Codes**

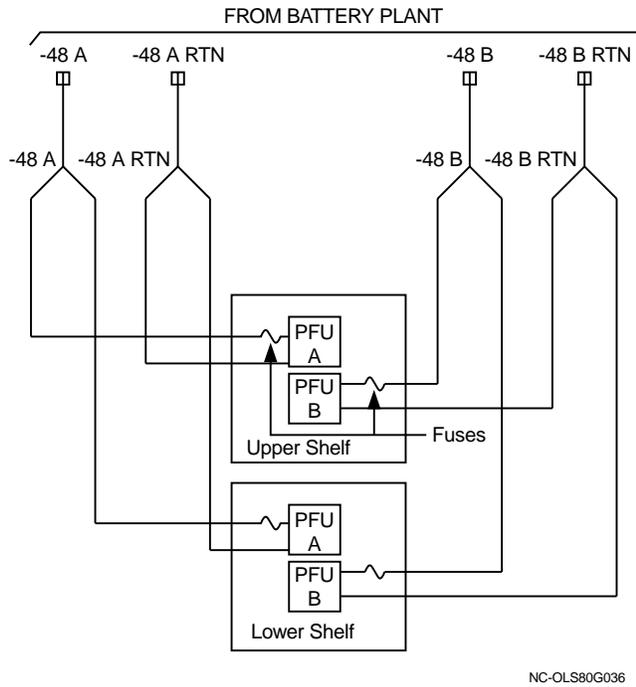
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Description	Color
-48V A	Red
-48V A RTN	Black
-48V B	Slate
-48V B RTN	Slate/Black

## Power Distribution for End Terminal and Repeater Bay/Cabinet

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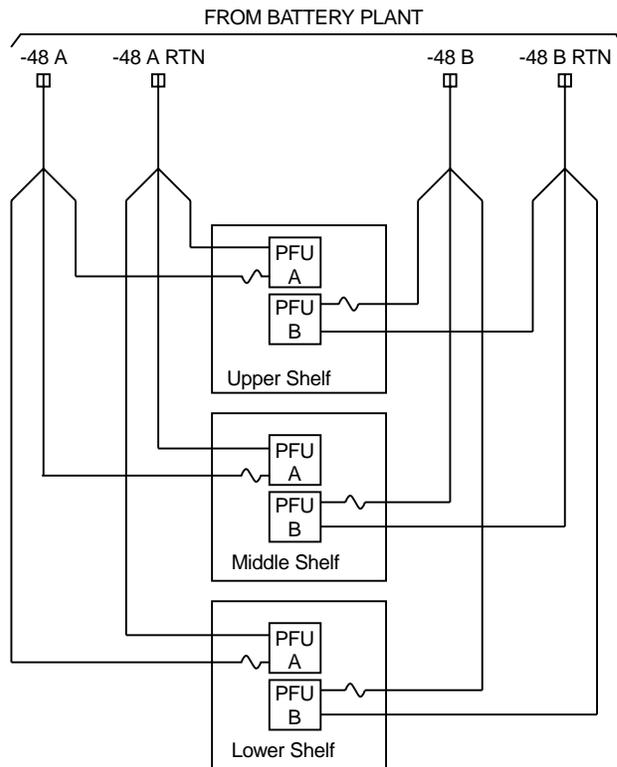
Figure 4-43 shows overall two-shelf installation power distribution. Dual -48 V feeders (A and B) provide redundant power. Each installation uses two 8-gauge power cables that branch into two 10-gauge cables (one for each shelf). These power cables terminate directly onto the shelves. Each branch connects to an overcurrent limiter located on the shelves.



**Figure 4-43. General Power Distribution in a Two-Shelf WaveStar OLS 40G Bay or Cabinet**

### WaveStar OLS 40G Integrated Bay (Single) and OT Bay/Cabinet Power Distribution

Dual -48 V feeders (A and B) provide redundant power. Each application uses two 8-gauge power cables. Each 8-gauge cable branches into three 10-gauge power cables (one for each shelf) that terminate directly on the shelves. Each branch connects to an overcurrent limiter located on the shelves. Figure 4-44 shows the overall power distribution for a three-shelf installation.

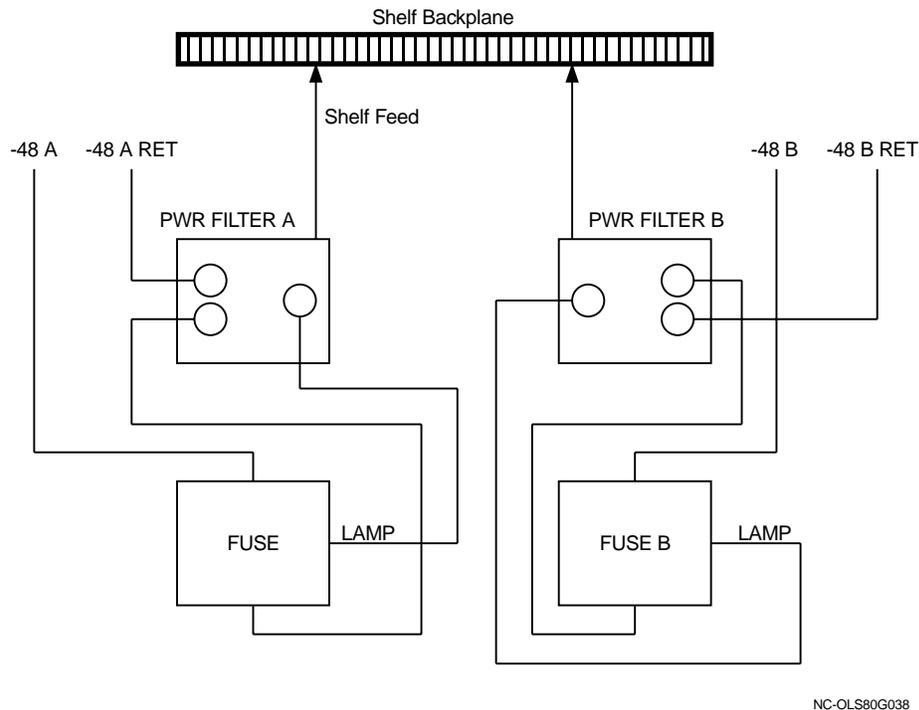


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**Figure 4-44. OT Power Distribution in a Three Shelf Bay or Cabinet**

## Shelf-Level Power Distribution

Figure 4-45 shows a block diagram of WaveStar OLS 40G power distribution at the shelf level.



**Figure 4-45. WaveStar OLS 40G Power Distribution at Shelf Level**

### Shelf-Level Filtering

The filters (one for each feeder) smooth the input current to the shelf. They plug directly into the backplane via a connector. The backplane distributes -48 V power to all the circuit packs by means of a printed power bus that spans the entire width of the panel.

The power filter units also provide a low voltage cutoff feature. This protects the equipment from abnormally low incoming voltage. If the incoming voltage drops below  $-38.5 \pm 1$  V, the power is cut off until the incoming voltage returns to  $-43 \pm 1$  V. WaveStar OLS 40G will experience no damage if the power fluctuates between  $-38.5 \pm 1$  V and  $-43 \pm 1$  V. If a fuse blows, the fuse cap illuminates to indicate which power feeder has opened.

### **Backplane and Circuit Pack Interface**

All WaveStar OLS 40G (including OTU) circuit packs have identical common battery power and return pins. This avoids catastrophic failure if a pack is plugged into the wrong connector. An active circuit on the circuit packs provides in-rush current protection whenever a circuit pack is inserted and also when circuit packs are equipped and bay power is applied.

### **Diode ORing, On-Board Fusing, Filtering, and Powering**

Each WaveStar OLS 40G circuit pack is equipped with diodes that provide ORing to the two redundant feeds and their return leads as well as a fuse that protects the feeders. Board-mounted fuses are provided on each circuit pack. If one of these board-mounted fuses fails, the circuit pack fails and must be replaced with a new pack. A filtering section follows the fused input, prior to the DC-to-DC conversion. On-board power converters are used for -48V power conversion.

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# Operations, Administration, Maintenance, and Provisioning

# 5

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# Operations, Administration, Maintenance, and Provisioning

# 5

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This chapter describes the various features regarding operations, maintenance, administration, and provisioning (OAM&P) of the WaveStar OLS 40G.

## **Operations**

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This section describes the hardware and software user interfaces that control the administration, maintenance, and provisioning of WaveStar OLS 40G. Maintenance procedures use Craft Interface Terminals (CIT) to retrieve detailed reports about performance monitoring, alarms and status, and system configuration for local and remote terminals. Office alarms, the indicator strip, and the circuit pack faceplate LEDs provide audible and visible alarm information.

## **Operations Interfaces**

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WaveStar OLS 40G supports the following operations interfaces:

- CIT
- Message-based operations system interface (X.25)
- Office alarms
- Parallel telemetry
- User-settable miscellaneous discrete input

## CenterLink-CIT

The CenterLink-CIT is a personal computer in which WaveStar OLS 40G CIT software has been installed. The CenterLink-CIT uses Microsoft® Internet Explorer to provide a user-friendly operations interface. The CenterLink-CIT provides detailed information and system control for specialized local and remote maintenance and administrative activities; it supports one NE at a time. You must use the CenterLink-CIT if you are installing or accepting a system.

The CenterLink-CIT supports local access, remote access using a modem, and remote access using the data communications channel (DCC). WaveStar OLS 40G also provides enhanced security features to protect against unauthorized access to CIT system functions (for example, provisioning). Security includes log-ins, passwords, CIT port disabling/enabling, and authorization levels for the system capabilities.

The CIT provides the following functions:

- Reporting
- Testing
- Initializing performance-monitoring storage registers
- Provisioning.

The following are the minimum requirements for the CenterLink-CIT:

- Pentium® desktop or laptop PC (66 MHz clock speed or greater)
- 16 Mb RAM
- 20 Mb of available hard disk space
- 800 x 600 or higher resolution VGA monitor
- Microsoft Mouse or compatible pointing device
- 2x CD-ROM Drive
- 16 bit sound (optional)
- *Windows 95*®, *Windows 98*®, *Windows NT*®, *Windows 2000*®, or higher operating system
- Microsoft® Internet Explorer, Version 4.0 or higher
- Serial port (EIA-232-D) — configured as COM1 or COM2
- Microsoft® Personal Web Server



**NOTE:**

A dumb terminal can be connected to the CIT ports on WaveStar OLS 40G for experienced TL1 users. However, CenterLink-CIT is highly recommended.

**CIT Access**

WaveStar OLS 40G provides two CIT ports compatible with the ASCII EIA-232-D standard. The first port is configured as data communications equipment (DCE) for direct CIT access. The second port, found on the interconnection panel, is configured as data-terminating equipment (DTE) to permit connection to a modem or an RS-232 switch. A pair of compatible modems are required for remote dial-up access to WaveStar OLS 40G from a CIT over the public switched telephone network.

A digital data network may be used in place of the modem pair to provide remote dial-up access to WaveStar OLS 40G from the CIT. A compatible modem or digital data network must support full duplex, asynchronous, and byte serial data transmission of 8-bit bytes with one start bit and one stop bit.

To use CenterLink-CIT, the modems must comply with the V.32 transmission standard, operating at a rate of 9600 baud. To use CIT-TL1, the modems must comply with one of the transmission standards shown in Table 5-1, depending on the desired baud rate. These standards apply to signaling used between modems.

**Table 5-1. CIT-TL1 Modem Transmission Standards**

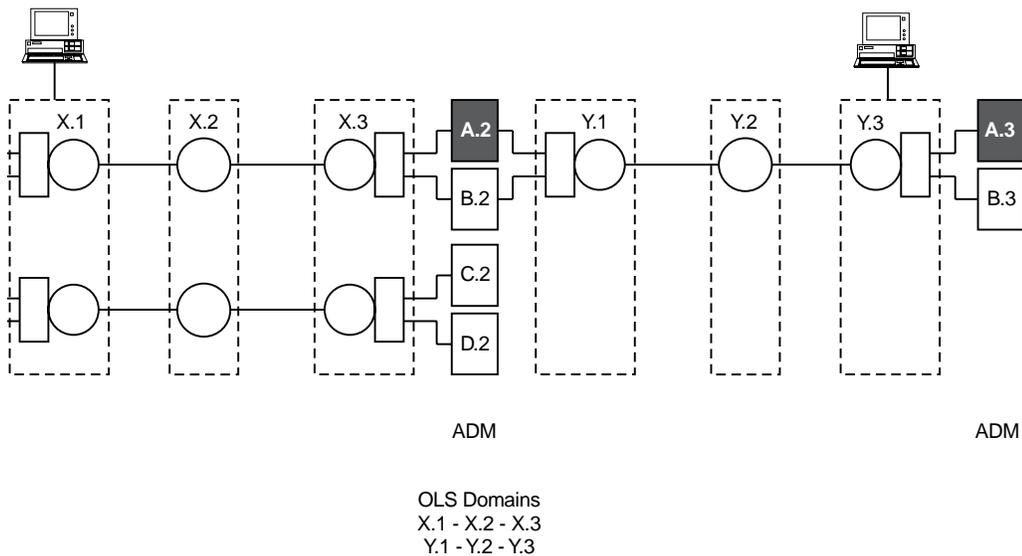
<b>Standard</b>	<b>Baud Rate</b>
Bell 212A	1200
V.22	1200
V.22 bis	2400
V.32	4800, 9600
V.32 bis	14,400
V.34	28,800

## Operations Domains

The operations domain for WaveStar OLS 40G allows remote access to any WaveStar OLS 40G network element in the same management subnetwork. The WaveStar OLS 40G management subnetwork includes all end terminals and repeaters interconnected with each other and managed via the DCC of the same EMS. The management subnetwork may originate/terminate at two single-facing end terminals, two single side equipped dual-facing end terminals, or in a ring made of dual-facing end terminals and repeaters.

### ➡ NOTE:

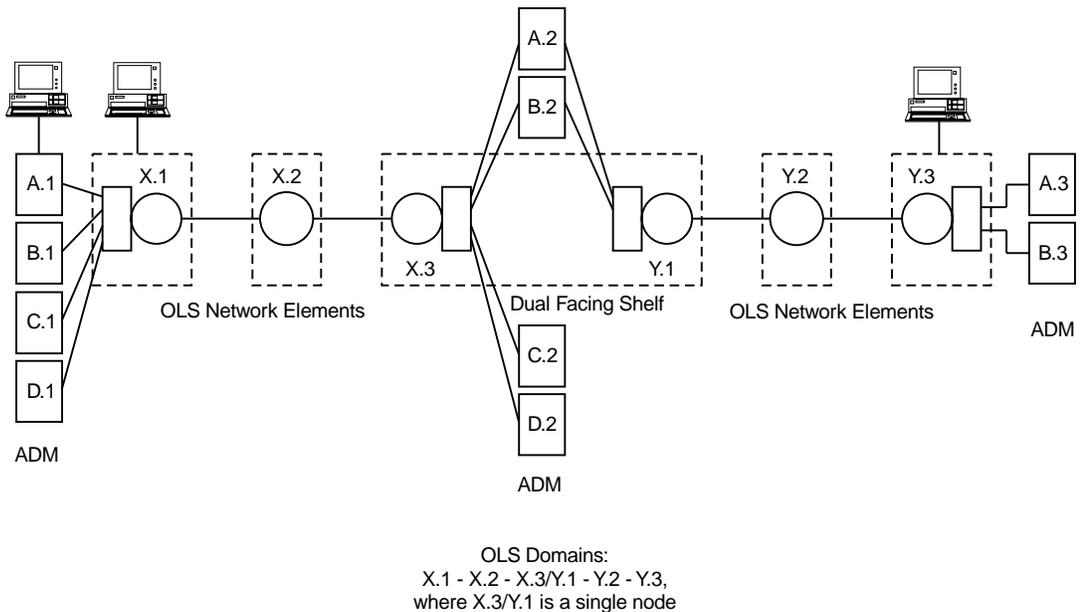
To illustrate remote access within an operations domain, Figure 5-1 shows CenterLink-CIT logins at various WaveStar OLS 40G sites. A CenterLink-CIT login at an end terminal allows remote access to the other end terminal and all repeaters between them. Here, a CenterLink-CIT login at WaveStar OLS 40G X.1 allows remote logins at sites X.2 and X.3.



NC-OLS80G063

Figure 5-1. CIT Operations Domain with Standard End Terminals

With a dual-facing shelf, the operations domain can be extended to additional WaveStar OLS 40G network elements. Figure 5-2 shows a dual-facing terminal at an intermediate add/drop site; a CenterLink-CIT login at WaveStar OLS 40G X.1 now allows remote logins to X.2, X.3, Y.1, Y.2, and Y.3.



NC-OLS80G064

**Figure 5-2. CIT Operations Domain with Dual-facing End Terminal**

### **Message-Based Interface (X.25/TL1)**

WaveStar OLS 40G continues to support a message-based operations systems interface. This interface uses the X.25 protocol to provide communications with a message-based operations system and supports Transaction Language 1 (TL1). A message-based operations system allows access to the local WaveStar OLS 40G terminal (local access capability) and any remote terminals in a maintenance management subnetwork using the DCC (GNE capability).

WaveStar OLS 40G provides predefined sets of OS types. An OS type is a filter that determines the types of TL1 autonomous messages that appear at a port in addition to TL1 commands and responses. The types include:

- **Maintenance**– sends reports on the maintenance status of the system (for example: alarm and event reports)
- **Memory administration**– sends reports on changes in the provisioning status of equipment (for example: database changes)
- **Command response only**– sends no autonomous messages (you can manually request information through TL1 commands)
- **Other**– sends all autonomous messages
- **Peer**– automatically sets peer as the OS type if the user provisions none of the other OS types (if the OS type is peer, messages are in the form of commands and responses)
- **Restoration**– sends the same system status reports as the maintenance OS type, except TCAs and user command information.

### Office Alarms Interface

The office alarms interface is a set of discrete relays that control office audible and visible alarms. Separate relays handle Critical, Major, and Minor alarms\*. The Critical and Major alarm outputs can be wire OR'd to the office major alarm, if desired.

### Parallel Telemetry Interface

Parallel telemetry brings a minimum set of alarm and status information to an operations center. Six alarm closures show Critical, Major, and Minor alarms for local and remote terminals.

### Miscellaneous Discrete Interface

The state of the miscellaneous discrete inputs can be reported on demand to a remote operations center via the CIT. Miscellaneous discrete state changes are autonomously reported by the TL1 interface. Sixteen inputs and four outputs are available. One hundred twenty-eight additional inputs and thirty additional outputs are supported using an optional external miscellaneous discrete unit (EMDU), available from Dantel, Inc. or Harris Corp. This optional EMDU can be connected to the serial telemetry interface of WaveStar OLS 40G to provide an additional set of miscellaneous discrete input and output points.

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\* “Critical”, “Major”, and “Minor” are SONET-based alarm classifications. “Critical”, “Prompt”, and “Deferred” are the equivalent SDH-based alarm classifications, respectively.

The EMDU allows an operations system to control and monitor equipment collocated with WaveStar OLS 40G through a set of input and output contact closures. One hundred twenty-eight additional user-settable inputs that can monitor external conditions like open doors or high temperature. The additional thirty-two user-settable outputs can control equipment such as external fans and generators.



**NOTE:**

An EMDU is listed as an ordering option in the package worksheets found in Chapter 7, “Ordering.”

### **Circuit Pack Faceplate LEDs**

Each circuit pack has a red FAULT LED on its faceplate. A continuously lighted FAULT LED means that WaveStar OLS 40G has isolated a failure in that circuit pack. A flashing FAULT LED has two meanings:

- On a transmission circuit pack, it indicates that an incoming signal to that circuit pack has failed
- On the system memory (SYSMEM) circuit pack, it indicates that the contents of the nonvolatile memory differs from the duplicate copy in the system controller (SYSCTL) circuit pack. It can also indicate corrupted data in the nonvolatile memory of the SYSMEM circuit pack.

In addition to a red FAULT LED, an OTPM circuit pack also has a green LED on its faceplate. This LED indicates that an OTPM port is in-service.

Remote parameter selection, switching, and switch state monitoring by SNMS is also supported by the integrated WaveStar OLS 40G software control.

## **Administration**

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This section provides information on WaveStar OLS 40G administration features.

### **Version Recognition**

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WaveStar OLS 40G provides automatic version recognition of all installed hardware and software, reporting the type, version, and serial number of the circuit pack installed in each slot. Each circuit pack CLEI™ code and serial number is stored on the circuit pack and is accessible by the system controller circuit pack (SYSCTL). The equipment catalog item (ECI) version identification and apparatus codes for each circuit pack are also provided.

The Optical Multiplexer Unit (OMU) and Optical Demultiplexer Unit (ODU) units have four discrete leads that are used by the Optical Amplifier (OA) to determine the circuit pack's version and type.

### **Security**

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WaveStar OLS 40G provides three tiers of security to protect against unauthorized access to the CIT and OS functions (for example, provisioning). The three tiers are:

- Port security
- Network element login security
- Enhanced user login security.

#### **Port Security**

In CenterLink-CIT mode, port security is provided through the CIT interface. Port security controls access to the system through a per-port enable/disable mechanism and inactivity time-outs.

#### **Network Element Login Security**

This feature controls access to the system through a lockout mechanism that disables all but administrative logins.

#### **Enhanced User Login Security**

The following features control access to the system on an individual user basis:

- **Function category**– commands are separated into the following four function categories:
  - Configuration Management (C)
  - Fault Management (F)
  - Performance Monitoring (PM)
  - Security Management (S)
- **User authorization levels**– five user authorization levels are provided within each function category to control which network element functions a particular user may perform (based on login ID). The five authorization levels are:
  - **Expert (Level 5):** provides access to all commands and options. Only expert users have access to the security and access functions. These functions include assigning and changing logins/passwords, setting login/password aging times, enabling/disabling ports, setting TID names, and rebooting the system
  - **Privileged (Level 4):** provides access to all commands and options except those that may affect all service at once (for example, TEST-AUTO-TURNUP)
  - **General (Level 3):** provides access to all commands except those relating to security and system access
  - **Basic (Level 2):** provides access to commands used to carry out minimum administration work for the system
  - **Reports-only (Level 1):** provides access to the reports only (OPR-ACO and TEST-LED). The reports only users are not allowed to change any of the system provisioning values.
- **Login ID and password assignment**– requires the user to enter a valid login ID and password to access the system. WaveStar OLS 40G allows up to one hundred login IDs and passwords. Two of these login IDs are privileged and the remainder are reports-only and general

Users may execute any command within the limits of their authorization level and function category, including all commands on levels below them. For example, a user with Authorization Level 4 in the Security Management function category (S4 status), can execute commands in levels 4, 3, 2 and 1 of Security Management.

- **Login aging**– enables a privileged user to set individual **non-expert** logins to be deleted if unused within a certain number of days or by a particular date (for example, for a visitor or for temporary access during installation)
- **Password aging**– enables a privileged user to require each user to change his or her password periodically
- **Autonomous indications and history log records**– provides autonomous indications and history log records for security auditing of successful/unsuccessful logins and intrusion attempts
- **Guest login**– enables a privileged user to set a temporary login that is automatically deleted after a specified amount of time.

## **Equipment Inventory**

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WaveStar OLS 40G maintains an automatic inventory equipment list of circuit packs in the cabinet. The list contains serial numbers and CLEI codes. The inventory is automatically updated when a new circuit pack is inserted.

## **System Start-up**

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System start-up is an initialization process that identifies all nodes in a WaveStar OLS 40G subsystem and establishes communications. Start-up is triggered by the following actions:

- A WaveStar OLS 40G subsystem is started for the first time
- A node is added or deleted
- The SYSCTL in a neighboring node is replaced
- A node is reset.

## **Maintenance**

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This section describes WaveStar OLS 40G maintenance. The objective of WaveStar OLS 40G maintenance is to detect failures, monitor facility performance degradation, isolate faults to specific circuit packs, and report to an OS and/or raise alarm indicators. Maintenance consists of reactive maintenance and performance monitoring. Reactive maintenance identifies a failure after it occurs. Performance monitoring identifies transmission degradation before it causes a service-affecting condition.

### **Reactive Maintenance**

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Reactive maintenance features identify failures after they occur. Reactive maintenance conditions detected by WaveStar OLS 40G are:

- Signal failures
- Equipment failures.

### **Proactive Maintenance**

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**Proactive maintenance** refers to the process of detecting degrading conditions not severe enough to initiate alarming, but indicative of degradations that may lead to hard failures. Proactive maintenance conditions detected by performance monitoring are:

- B2 parity errors
- Out of range (OOR) on Laser Bias Current (LBC) and Laser Backface Current (LBFC)
- Single fuse failure on -48 V feeders
- Threshold crossing alert (TCAs).

If a proactive maintenance condition is detected, maintenance activities should be scheduled to isolate and correct the condition and avoid service-affecting failures.

### **Remote Maintenance**

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Remote maintenance is provided through DCC links between WaveStar OLS 40G network elements. Remote access lets you perform maintenance at a remote site as if you were local to that site. This capability provides operations support from a single location to local and remote WaveStar OLS 40G network elements.

WaveStar OLS 40G uses an additional optical signal, the supervisory signal, for communication of maintenance information. This signal (STS-3 format) is generated by the TLM circuit pack and multiplexed onto the optical line at each OA. This signal is demultiplexed at each OA and returned to the TLM circuit pack, providing an add/drop function for it at every WaveStar OLS 40G site. WaveStar OLS 40G uses the DCC channel (D1-D3) within the STS-3 format for WaveStar OLS 40G communication. The customer is provided with the orderwire bytes (E1, E2, F1) and the payload contained in the STS-3 signal.

WaveStar OLS 40G uses the supervisory channel DCC to provide the following:

- **Craft interface terminal (CIT) remote access**– the local terminal provides a remote login capability from its CIT to a remote terminal
- **Indicator strip remote activity**– the indicator strip/user panel provides a far-end activity (FE ACTY) LED to show that one or more remote terminals have a lighted near-end activity (NE ACTY) LED
- **Operations system remote access**– a message-based operations system (X.25) can access local and remote WaveStar OLS 40G elements
- **Alarm report remote access**– the local terminal provides a summary alarm report that indicates the highest active alarm, if any, at all remote network elements in the same alarm group
- **Remote software copy**– this feature allows you to copy software from one WaveStar OLS 40G element to another anywhere in the management sub-network.

## Gateway Network Element

You can use one or more WaveStar OLS 40G network elements as a gateway network element (GNE). The GNE serves as a single interface to the local X.25 message-based operations system covering all WaveStar OLS 40G elements in the same management subnetwork.

The GNE receives operations information from these network elements through the DCC and reports that information and its own to the operations system.

One or more WaveStar OLS 40G terminals can be used as GNEs, but the number used depends on your application and operations needs. For example, to reduce the number of operations data communication links between the network and operations system, you might choose to use only one WaveStar OLS 40G terminal as the network GNE. If you need redundancy, then two WaveStar OLS 40G elements could be used as GNEs.

## Remote NE Status

Through the DCC, a WaveStar OLS 40G terminal can receive and transport summary alarm and status information from remote WaveStar OLS 40G terminals that are in the same management subnetwork.

The remote network element status feature conveys remote summary alarm and status information through the following:

- Logical ORing of local and remote office alarms
- A set (CR, MJ, MN) of far-end parallel telemetry relays
- A far-end activity LED
- A network alarm report that indicates the highest active alarm severity at other network elements in the management subnetwork.

Members of an alarm group exchange remote network element status information through one or more alarm group network elements (AGNEs) that are defined in the same alarm group. The AGNEs and remote network elements use the DCC to receive and report alarm status information from and to all network elements in the alarm group. When an AGNE receives alarm and status information, it rebroadcasts the information to other network elements in the group. The information allows each network element to provide, for example, far-end activity indications and a remote alarm report for all other network elements in the group.

The use of AGNEs makes it unnecessary for each network element in an alarm group to communicate directly with every other network element in the group. This allows DCC resources to be used efficiently.

## Local and Remote Software Copy/Upgrades

WaveStar OLS 40G lets you upgrade system software at a local site. System monitoring and control are fully functional during the upgrade. To upgrade software at the local network element, use the DCE port and installation software distributed with the generic. See the *Software Release Description* for performing an upgrade.

Using CenterLink, you may also copy/upgrade the system software contained in a WaveStar OLS 40G terminal to other local or remote terminals in the same management subnetwork. System monitoring and control are fully functional during the copying process.

## Optical Transmission Maintenance

WaveStar OLS 40G maintenance is based on the following three-tier approach to performance monitoring of optical parameters:

- **First tier**– functioning of the Threshold Crossing Alert (TCA) which uses a provisionable delta threshold
- **Second tier**– use of predetermined threshold values to indicate signal degradation
- **Third tier**– use of predetermined threshold values to indicate signal failure conditions.

WaveStar OLS 40G is an analog system. The following features are used to support maintenance of the analog transmission:

- **Tones**– are used to determine the power of the optical signal
- **Supervisory signal**– carries the DCC for internodal communication and out- of-band messages
- **Optical line ID**– is carried by the supervisory signal. It is an integer associated with a line. This ID is transmitted and received by each WaveStar OLS 40G network element to identify any misconnection of fibers between sites.

## Protection Switching for DCC Signal

WaveStar OLS 40G provides automatic protection for the DCC signal. In 2-line (4-fiber) systems, DCC protection is implemented on an optical span basis (between two adjacent WaveStar OLS 40G network elements). In 1-line (2-fiber) closed ring applications, WaveStar OLS 40G provides protection of the DCC channel via the OSI stack protocols. The DCC is the only protected part of the signal on the primary supervisory channel. The DCC protection switching is bidirectional, revertive, and 1x1.

The DCC offers the following types of protection switching:

- **Bidirectional switching**– protection switching is performed in both the transmit and receive directions
- **Revertive switching**– the traffic switches from the service line to the protection line when a fault occurs. When the fault clears, the traffic reverts to the service line
- **1x1 switching**– one service and one protection line exist.

## **Automatic Detection of Facility Failures**

WaveStar OLS 40G continuously monitors the performance of the optical signal and the health of the circuit packs. Any failures or degradations are automatically detected and reported.

### **Optical Facility Failure Conditions**

The optical facility failure conditions based on detected defects are as follows:

- **Optical Channel Loss of Signal (LOS)**– An optical channel LOS is declared when the signal power of the channel (SPR-C) falls below a specified level of the strongest SPR-C present. When there is only one channel, the optical channel LOS is declared when the SPR-C falls below a specified absolute level
- **Optical Line LOS**– If all the optical channels in an optical line and the supervisory channel have LOS, a correlation of defects results in an optical line loss.



#### **NOTE:**

The Alarm Severity for LOS is provisionable in SONET networks as Critical/SA, SA, Major/NSA, or Minor/NSA. For SDH networks the LOS is provisionable as Critical/SA, Prompt/NSA, or Deferred/NA. In addition, a remote defect indication (RDI) signal will be sent upstream to the transmitting terminal. The RDI signal is generated using the K1-byte of the supervisory channel.

### **Digital Facility Failure Conditions for Supervisory Signal**

The digital facility failure conditions for the supervisory signal are as follows:

- Supervisory signal (SUPR) loss of signal (LOS)
- SUPR loss of frame (LOF)
- SUPR signal failure (SF)
- SUPR signal degrade (SD).

## Digital Facility Failure Conditions for Customer Maintenance Signal

The digital facility failure conditions for customer maintenance signals are as follows:

- Customer Maintenance Signal (CMS) LOS
- CMS LOF
- CMS SF
- CMS SD.



### NOTE:

The LDA1 TLM circuit pack does not support a Customer Maintenance Signal.

## Fault Isolation

WaveStar OLS 40G continuously monitors circuit packs and incoming signals for defects. When a fault is detected, it employs automatic diagnostics to isolate the failed circuit pack or signal. Failures are reported to local craft and operations systems so that repair decisions can be made. If desired, operations system personnel and local craft can use the CIT to gain more detailed information on the fault condition.

All fault conditions detected and isolated by WaveStar OLS 40G are stored and made available for reporting, on demand. In addition, a history of the past 500 alarm and status conditions and command events is maintained and available for on-demand reporting. Each event is date and time stamped. WaveStar OLS 40G detects and reports alarm and status conditions autonomously through the office alarm relays, indicator strip, equipment LEDs, parallel telemetry, and message-based operations systems.

## Baselining

Signal quality degradation in WaveStar OLS 40G is detected by measuring the following parameters for deviations from baselines:

- Total optical power received (TOPR-OL)
- Signal power per channel (SPR-C).

Measured values of these parameters vary depending on the number of optical wavelengths present, OA performance, etc. Therefore, new baselines are required when wavelengths are added or removed. WaveStar OLS 40G automatically measures and provisions the baseline parameters when optical wavelengths transition

from the AUTO to IS state. The user is provided with CIT commands to baseline manually when wavelengths are removed. For future reference, the user can also record the reason for the manual baselining.

## Baselining

Signal quality degradation in the WaveStar OLS 40G is detected by measuring the following parameters for deviations from baselines:

- Total optical power received (TOPR-OL)
- Signal power per channel (SPR-C).

Measured values of these parameters vary depending on the number of optical wavelengths present, OA performance, etc. Therefore, new baselines are required when wavelengths are added or removed. The WaveStar OLS 40G automatically measures and provisions the baseline parameters when optical wavelengths transition from the AUTO to IS state. The user is provided with CIT commands to baseline manually when wavelengths are removed. For future reference, the user can also record the reason for the manual baselining.

## Automatic Power Shutdown and Restart (APSD)

WaveStar OLS 40G utilizes APSD as an equipment safety mechanism. The APSD feature protects against optical surges and possible human exposure to powerful WaveStar OLS 40G output by reducing power to Hazard Level 1 on the optical line between adjacent offices.

The following high power links exist in a WaveStar OLS 40G system along which APSD can occur:



### **DANGER:**

The link between an OA and the ODU at the receive-end OA should be protected as well. In this case, an LBO needs to be installed during system installation to ensure that power levels never exceed IEC Class 3A).

APSD timing requirements are as follows:

- **Shutdown** = < 3 seconds
- **Restart** = < 5 seconds.

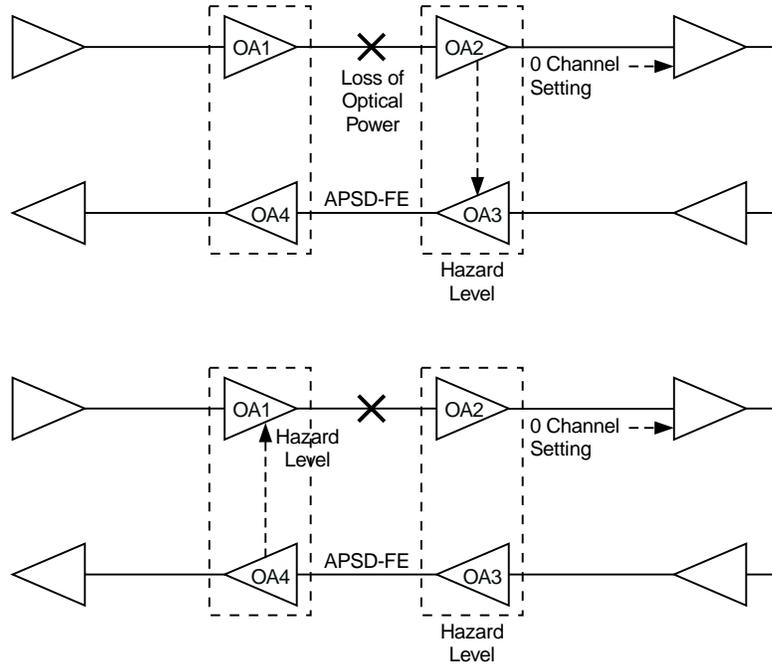
## APSD in Two-OA Operation

The following information describes various network reliability scenarios in which the APSD feature can be used for two-OA operation.

### **Scenario 1 (Shutdown): Protection on an optical line link between WaveStar OLS 40G terminals.**

In Figure 5-3, if a fiber cut occurs in a span between two WaveStar OLS 40G End Terminals or Repeaters, “OA2” in the downstream WaveStar OLS 40G detects a loss of optical power and starts operating in a 0 channel setting. The downstream WaveStar OLS 40G sends an APSD-FE message to the upstream terminal to inform it of the condition. Upon detecting the message, the upstream terminal powers down “OA1” below 10 dBm. Powering down of “OA1” and “OA3” to Class 1 levels is completed within 3 seconds of the fiber cut.

Loss of optical power is declared when the OA detects a loss of all channels (including the telemetry channel) and the telemetry circuit pack detects an incoming SUPR LOS. The OAs downstream from “OA2” also experience channel loss. These amplifiers operate in 0 channel power configuration within one second of a fiber cut occurring. The OAs downstream from “OA4” experience a decrease in incoming power and may or may not declare loss of channels. Simultaneously, the OAs upstream from “OA1” and “OA3” continue to operate in normal mode.

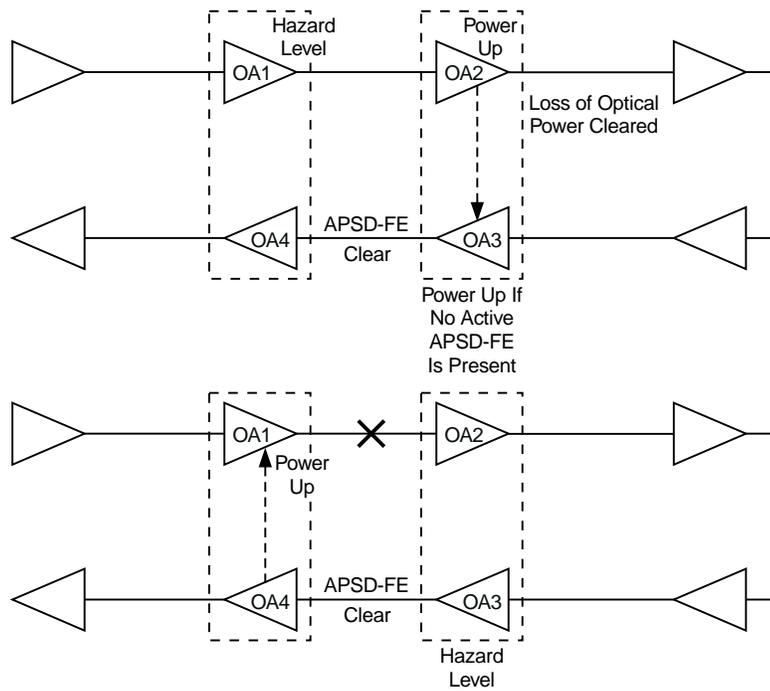


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**Figure 5-3. APSD for Optical Line Failure Between Terminals (Two-OA)**

**Scenario 2: Restarting on an optical line link between terminals.**

In Figure 5-4, when the link between “OA1” and “OA2” is restored, the downstream WaveStar OLS 40G clears the power loss condition and then notifies the upstream terminal of the correction. The upstream terminal then reverts “OA1” back to normal power. Provided there are no failures upstream, the downstream terminal also turns “OA3” back up. “OA1” and “OA3” adjust to normal power within one second of start-up.



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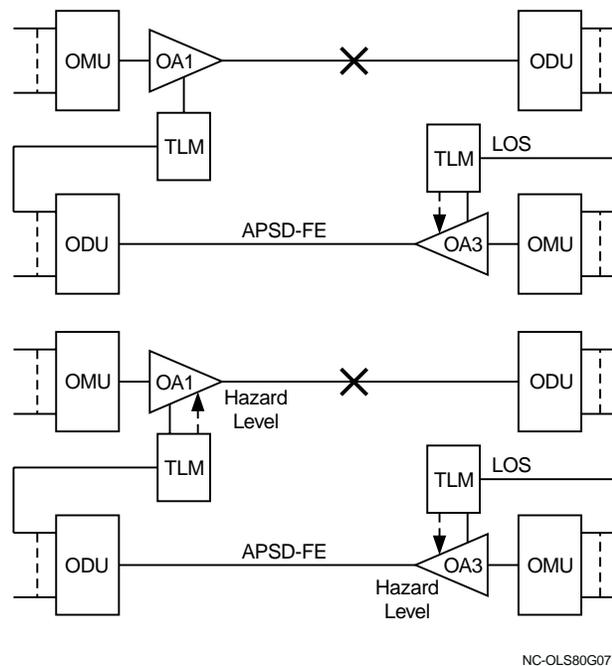
**Figure 5-4. Restart on an Optical Line Link Between Terminals (Two-OA)**

## APSD in Single-OA Operation

The following information describes various network reliability scenarios in which the APSD feature can be used for single-OA operation.

### Scenario 1: Protection on an optical line link between terminals

Figure 5-5 shows protection on an optical line link between terminals in a single-OA configuration. Here, optical line LOS stems from supervisory LOS detected by the TLM circuit pack. This could result in false APSD triggers due to failures in the upstream TLM. However, these false triggers do not adversely affect overall network reliability.

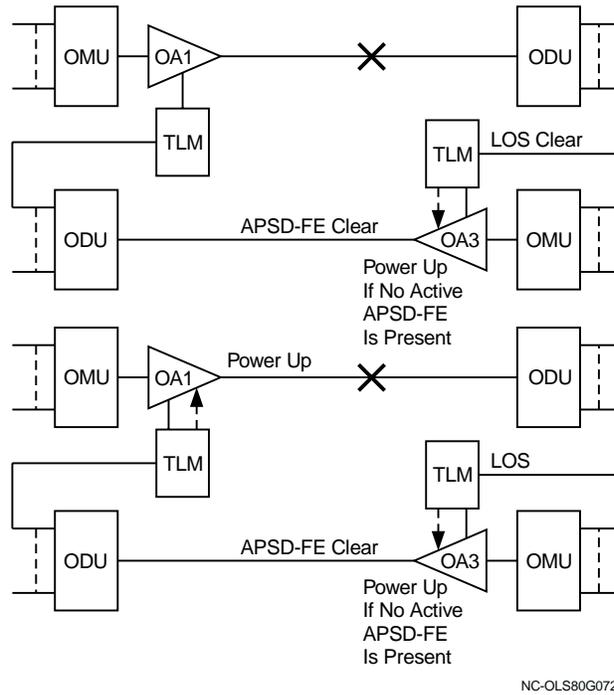


**Figure 5-5. APSD from Optical Line Failure (Single-OA)**

### Scenario 2: Restarting on an optical line link between terminals.

The restart procedure for single-OA configuration is almost identical to Scenario 3. When the link between “OA1” and the ODU is restored, the telemetry circuit pack clears the LOS condition. It also clears the APSD-FE message on the supervisory output. The upstream WaveStar OLS 40G detects the clearing of the mes-

sage and instructs “OA1” to power up. Provided there is no active APSD-FE message from upstream, the downstream terminal powers up “OA3.” Figure 5-6 illustrates restarting in a single-OA configuration.



**Figure 5-6. Restarting on an Optical Link Between Terminals (Single-OA)**

## APSD Double Failure Contingencies

The following double failure contingencies exist with the APSD feature:

- If an incoming supervisory channel failure exists at an upstream WaveStar OLS 40G, APSD cannot be activated
- If an incoming supervisory channel with an active RDI condition fails, APSD cannot resume normal operation when it is activated. However, manual resumption of normal operation is possible.

## Performance Monitoring

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WaveStar OLS 40G does performance monitoring as part of its proactive maintenance philosophy. Performance parameters include digital performance data (coding violation counts on the supervisory channel) and threshold crossing alerts of analog parameters. **Proactive maintenance** refers to the process of detecting conditions not severe enough to initiate alarming, but indicative of degradations that may lead to hard failures. Certain performance parameters are inhibited during periods of unavailability.

## Supervisory Channel (SUPR) Performance Monitoring Parameters

The supervisory channel carries B2 parity information. The telemetry (TLM) circuit pack can detect the following parameters:

- Line coding violation (CV) counts
- Line errored second counts
- Line severely errored second counts
- Line unavailable second counts.

This data is collected in 15 minute and 24 hour registers and is available for retrieval by operations interfaces. Thresholds are set on these parameters to show degraded performance. When a performance-monitoring threshold is crossed, it is reported to the operations system where all threshold crossings associated with a particular path can be correlated and the likely source of the degradation can be identified.

Optical parameters for the SUPR include the following:

- **Laser bias current (LBC-SU)**– a signal indicating whether or not the system is operating within normal margins
- **Supervisory Signal Power (SPR-SU)**– the signal power is determined by monitoring the tone power on the supervisory signal. TCAs are reported when the supervisory signal power falls below a fixed value

Digital parameters for the SUPR include the following:

- **Composite B2 coding violations (CV-L)**– the sum of B2 parity violations on the supervisory signal is an indicator of the line's performance. The system calculates, writes, and checks the composite B2 parity for errors. For each line bit-interleaved-parity (BIP) error it detects, it increments the B2 parity violation counter
- **Errored seconds (ES-L)**– an ES-L is a second in which the system detects one or more B2 parity violations or an alarm indication signal (AIS)
- **Severely errored seconds (SES-L)**– an SES-L is a second in which the system detects 32 or more B2 parity violations or a line AIS
- **Unavailable seconds (UAS-L)**– a UAS-L is a second in which the line is “unavailable.” A line is considered unavailable during loss of signal, loss of frame, and line AIS conditions.

### Optical Channel/Line Performance Monitoring Parameters

The following parameters are monitored for optical channels and optical lines:

- **Laser bias currents (LBC-P1, LBC-P2):** laser bias currents from both OA pumps are monitored and reported as “in-range” and “out-of-range.” An out-of-range condition causes pump shut-off
- **Laser backface currents (LBFC-P1, LBFC-P2):** laser backface currents from both OA pumps are also monitored and reported as “in range” and “out of range”
- **Signal power per channel (SPR-C):** signal power per channel is monitored by measurements of tone power on a channel. Normalized values can be retrieved in a scale of 0 to 100. TCAs are reported when thresholds are crossed
- **Total optical power received (TOPR-OL):** total optical power for all the channels is monitored and normalized values can be retrieved in a scale of 0 to 100. TCAs are reported when thresholds are crossed.

## Performance Parameter Thresholds

The threshold for each performance monitoring parameter, except LBFC-P1, P2, and LBC-P1, P2, are provisionable. Whenever the threshold for a given performance-monitoring parameter is reached or exceeded, WaveStar OLS 40G generates a TCA.

## Performance Monitoring Data Storage

WaveStar OLS 40G provides a current and 32 previous 15-minute registers and a current and 6 previous 24-hour registers for all accumulated performance parameters. WaveStar OLS 40G enables you to provision the hour that the system is to begin measuring all daily performance monitoring periods. The performance monitoring parameters begin daily at the provisioned time. WaveStar OLS 40G can retrieve and report the contents of any parameter storage register at any time. It can also initialize the current 15-minute and/or current 24-hour registers at any time.

## Performance Monitoring During Failed Conditions

When a trouble condition is detected, WaveStar OLS 40G stops accumulating affected digital performance parameters per Telcordia requirements. All unaffected performance parameters continue to be accumulated during the condition.

## Threshold-Crossing Alert Transmission to an Operations System

WaveStar OLS 40G supports the TL1 REPORT EVENT autonomous messages for TCA reporting. The TL1 messages provide information on the crossing of a CV, ES, SES, UAS, or Optical Power Received threshold for the current 24-hour and 15-minute registers.

## Testing

WaveStar OLS 40G provides turn-up tests to verify signal path continuity. These tests are a combination of automatic and manual tests designed to ensure that cables are correctly installed. WaveStar OLS 40G supports the following installation tests:

- **Local**— local self-tests check cabling within a network element. Fiber loopbacks are necessary for these tests
  - **Automatic turn-up test:** verifies installation cabling to and from TLM and OA circuit packs for each optical line

- **Automatic CMS cable test:** verifies the continuity of customer maintenance signal cables
- **Manual local test:** verifies the OMU and ODU are working properly. These tests require an optical power meter but do not require external line terminating equipment to drive the lines
- **CMS cable test**– automatic test to verify the continuity of customer maintenance signal cables.

WaveStar OLS 40G also provides self-tests for office alarms, parallel telemetry, and LEDs.

### **Consistency Audits**

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WaveStar OLS 40G network elements provide a function that monitors (audits) the consistency of the provisioning information. This function alerts you to situations that may result in lost traffic.

In particular, WaveStar OLS 40G audits the following information to ensure consistent operation of the ring subnetwork as a whole:

- **Target Identifier (TID)**– the TID must be unique within a given management subnetwork for proper operation of the OS interface. WaveStar OLS 40G uses a protocol called Directory Services to ensure the uniqueness of TIDs for all network elements in a management subnetwork. You can make changes to a TID at any time. However, if a change would result in a duplication, WaveStar OLS 40G sends an alarm and does not put the change into effect until another change is made to remove the duplication
- **End terminal provisioning (1A-TX, 1A-RCV, 1A-TX-THRU, 1A-RCV-THRU, and DUAL)**– see “WaveStar OLS 40G Terminal Provisioning” in this chapter for information on provisioning telemetry circuit pack orientation. At start-up and after each ENT-SYS command, WaveStar OLS 40G checks to ensure that all nodes are provisioned as transmit or receive with respect to each other.

## Reports

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WaveStar OLS 40G provides the following alarm, status, and monitoring reports.

### Active Alarms and Status

WaveStar OLS 40G provides a report showing all active alarm and status conditions. Immediately after logging in, WaveStar OLS 40G automatically displays the local alarm and status report on the local and remote CIT. This report shows the following alarm levels:

- Critical (CR)
- Major (MJ)
- Minor (MN)
- Abnormal (ABN)
- Near-end activity (NE ACTY)
- Far-end activity (FE ACTY).

The source address and description of the condition (for example, controller failure and incoming high speed signal failure) are included in the report along with the date and time it was detected. The report also indicates if the condition affects service. The option to display specified subsets of conditions by severity is also provided.

### Performance Monitoring

WaveStar OLS 40G provides reports that contain values for all requested performance monitoring (PM) registers. The start time of each register's recording period is included. The reports provide optical and digital PM data for optical lines, optical channels, and supervisory channels recorded in a series of 15-minute and 24-hour storage registers.

### History

The history report displays the past 500 events. An event is any change in WaveStar OLS 40G that may affect its performance (for example, a failure) or change its operational status (for example, loopback setup). This summary report includes time stamps showing when each condition was detected and when it was cleared. The user's initiated events contain a time stamp showing when the command was entered.

## Version/Equipment List

The version/equipment list report is an on-demand report listing all the circuit packs that are present. This report also lists the circuit pack version and software generic (if applicable).

## State

An on-demand report displays the state of each addressed slot and port in WaveStar OLS 40G. For each addressed entity, the report includes the following:

- Address
- Circuit pack type (for slots only)
- Port state
- Slot state.

The possible port states are:

- **Auto (AUTO)**– the port is available for automatic provisioning. An optical channel transitions from the AUTO state to the IS state if a good signal is detected
- **Not monitored (NMON)**– the port is not monitored and will not transition to the IS state even if a good signal is detected
- **In service (IS)**– the port is fully monitored and alarmed.

The possible slot states are:

- **Auto (AUTO)**– the original value of the circuit pack slot state parameter. AUTO means the slot is available for automatic provisioning
- **Equipped (EQ)**– the slot is fully monitored and alarmed.

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## Orderwire

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Orderwire provides voice communications through a DANTEL® unit for personnel performing facility maintenance. WaveStar OLS 40G provides an EIA-422, 64 kb/s orderwire interface per optical line for the following:

- Section orderwire
- Line orderwire
- Section user channel.

The overhead controller (OHCTL) circuit packs in the Enhanced High Speed (EHS) Shelf No. 1 allow access to the orderwire interfaces. The orderwire shelf must be installed within a few feet of the cabinet. Refer to the “Related Products” section in Chapter 7, “Ordering,” for orderwire shelf ordering information.

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## Alarm Correlation

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WaveStar OLS 40G integration capability, user provisioning is done manually to associate a particular OTU port with one or two optical channels. These channels are referred to as “upstream” and “downstream,” depending on their relative location in the system. With OTU integration, there is no longer a need to rely on the OS to correlate alarms reported by WaveStar OLS 40G for optical channels and OTU ports.

Any alarm condition reported for an optical channel is noted. The report resulting from this test indicates which optical channels are immediately downstream from each OTU or OTPM port in a system and is used to help establish correct optical channel/OTU port associations. Each OTU or OTPM port can be associated with the following:

- 1 downstream optical channel (ADD connections- optical channel is in the multiplex direction)
- 1 upstream and 1 downstream optical channel (THRU connection- one optical channel in the multiplex direction and 1 in the demultiplex direction)\*
- 1 upstream optical channel (DROP connection - one optical channel in the demultiplex direction)

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\* This is true only for terminals configured as DUAL. For other cases, only upstream or downstream associations can be provisioned.

If an alarm is reported for a particular OTU or OTPM port (for example: equipment failure or incoming signal failure), the port's output is turned off. Normally, this would result in an additional alarm (LOS) reported by the downstream optical channel. However, if the user has provisioned an associated downstream optical channel, reporting of the LOS alarm is suppressed on the downstream optical channel. WaveStar OLS 40G also sends an alarm indication message (AIM) to repeaters and end terminals further downstream in order to suppress any alarms they might generate due to the loss of the optical signal from the OTU port.

**⇒ NOTE:**

The AIM does not pass between End Terminals when they are configured as a Dual-facing Shelf. The next separate WaveStar OLS 40G section this signal passes through will report OTU port or optical channel alarms.

For THRU connections made in a Dual-facing Shelf, AIM is transmitted within WaveStar OLS 40G from one optical line to the other (provided that the user has provisioned THRU connections). Likewise, if an AIM or LOS is detected on a particular upstream optical channel, WaveStar OLS 40G would normally either do nothing (AIM) or report the LOS condition. An OTU or OTPM port connected to this optical channel would report an alarm condition in this situation as well (the exact alarm may depend on the type of WaveStar OLS 40G failure, with LOS being most probable). However, if the OTU or OTPM port has an associated upstream optical channel with an active AIM or LOS, the alarm for that port is not reported. The output of the OTU or OTPM port is suppressed (laser turned off) and the alarms of any associated downstream optical channel are also suppressed.

Present WaveStar OLS 40G installations are arranged so that the alarms from each OTU are reported through the downstream WaveStar OLS 40G in an attempt to make it easier for the OS to perform alarm correlation. The transmission paths of carried signals usually take one of the following three possible paths through the WaveStar OLS 40G:

- **THRU connection**– The signal is processed through the OTU and continues along the line
- **ADD connection**– The signal is taken from a terminal, processed by an OTU, and then added to the multiplexed line signal
- **DROP connection**– The signal is processed by an OTU and then drops off the line onto a WAD terminal

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## **Provisioning**

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**Provisioning** is the assigning of values to parameters in memory. These parameters, in turn, affect the operation of the network element. WaveStar OLS 40G provides two types of provisioning modes

- **Auto-provisioning:** network element parameters that are provisioned automatically, based on the presence or absence of circuit packs and/or good incoming signals
- **Technical provisioning:** manual provisioning of parameter values via Technical Interface commands or the OS interface (TL1 command).

### **Parameters and Original Value Provisioning**

---

Original values minimize installation provisioning. At the factory, each provisionable parameter is assigned an original value. The provisionable parameters and original values are copied (using CenterLink) from floppy disks to the system memory (SYSMEM) circuit pack.

Under normal conditions, three complete sets of data (parameters and their values) exist in the system. The first set, located in the nonvolatile memory of the SYSMEM circuit pack, contains the system parameters and their original values (values assigned to parameters at the factory). The second set, also located in the nonvolatile memory of the SYSMEM circuit pack, contains system parameters and their current values (values currently being used by the system). The third set, located in the volatile memory of the SYSCTL circuit pack, contains the system parameters and their current values.

**⇒ NOTE:**

The original values assigned at the factory cannot be changed. Current values can be overridden through local or remote provisioning.

### **Local or Remote Provisioning**

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WaveStar OLS 40G software control allows local and remote provisioning of all provisionable parameters using CenterLink or the TL1 interface. Most of these parameters are also provisionable through TL1 commands. The provisionable parameters and values (current and original) are maintained in the nonvolatile memory of the SYSMEM circuit pack. For more information about provisioning parameters and original values using CenterLink or TL1 commands, refer to the *WaveStar OLS 40G Release 7.0 User/Service Manual*.

## **Preprovisioning Slots**

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To simplify circuit pack installation, slot parameters can be provisioned before the corresponding circuit pack is installed. All system parameters and values (current and original) are preserved by WaveStar OLS 40G in the nonvolatile memory of the SYSMEM circuit pack. The parameters and values are protected by the nonvolatile memory if a power failure occurs and are retrievable on demand regardless of the means used for provisioning. The parameters are downloaded automatically when the affected circuit pack is installed.

## **Provisioning on Circuit Pack Replacement**

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Replacement of a failed circuit pack is simplified by WaveStar OLS 40G slot provisioning. The system controller (SYSCTL) and SYSMEM circuit packs maintain a provisioning map of the entire system. When a transmission or timing circuit pack is replaced, the SYSCTL and SYSMEM circuit packs automatically download provisioning parameters and values to the new circuit pack.

## **Provisionable Parameters Summary**

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The following list shows a high level summary of provisionable parameters:

- End terminal type (1A-TX, 1A-RCV, 1A-TX-THRU, 1A-RCV-THRU, and DUAL)
- Network element access security (TID, port states, etc.)
- Login ID security (login IDs, log-in aging, etc.)
- Miscellaneous discrete attributes (names, alarm levels, etc.)
- Supervisory channel (SD threshold, alarm level, etc.)
- Performance monitoring thresholds (optical, digital) and start times
- Optical pump power
- Loss of Signal (LOS) Severity
- Reduction of OTU turn-on time

## **Network Element Configuration**

WaveStar OLS 40G automatically provisions a network element as an end terminal or a repeater by detecting the presence or absence of the OMU and ODU circuit packs. If both are present, the network element is provisioned as an end terminal. If these circuit packs are absent and the slots are left empty, the network element is provisioned as a repeater.

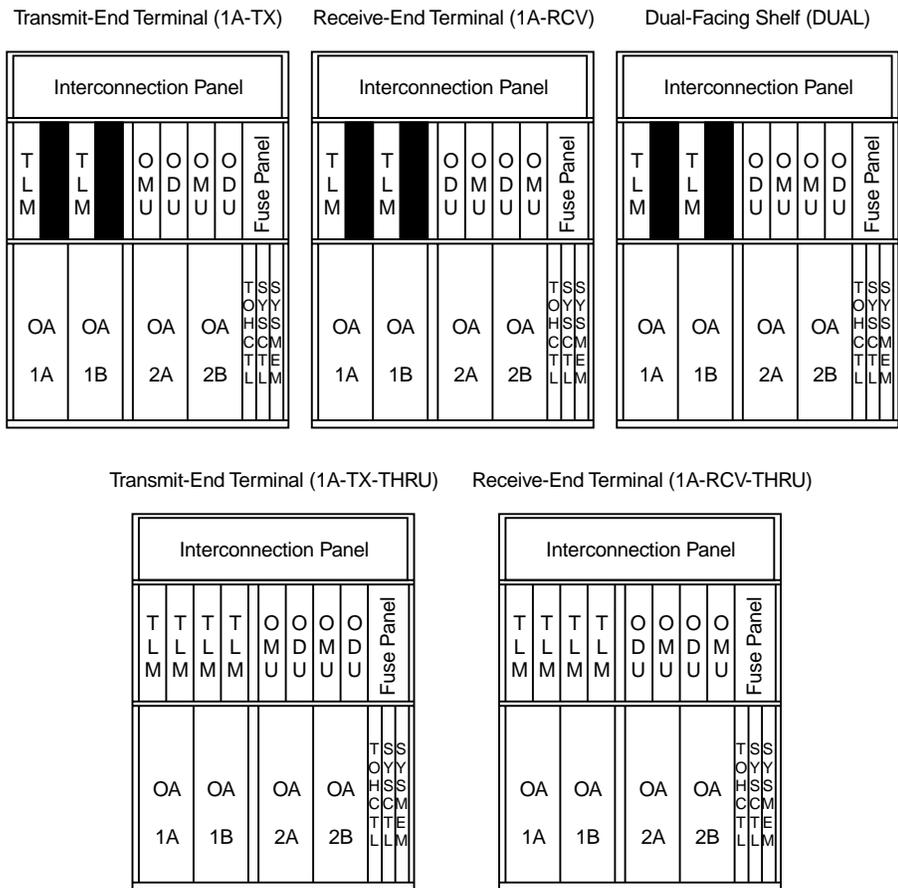
## **WaveStar OLS 40G Terminal Provisioning**

During configuration of a single bidirectional optical line (not using single-OA operation), End Terminals and Repeaters are connected to the OA circuit packs in the 1A slot to establish the transmit direction. To establish the receive direction, terminals are connected to OAs in the 1B slot. Terminals on opposite ends from each other have opposite OA connections. The order of OMUs and ODUs are also arranged differently.

The telemetry (TLM) circuit pack has the same orientation. The outputs of the TLM packs are connected to the 1A OA circuit pack to establish the transmit direction. The 1A TLM circuit pack in the opposite end terminal is connected to the 1B OA circuit pack to establish the receive direction.

Since it is necessary to provision this circuit pack scheme for fault isolation, the end terminal with the 1A TLM-1A OA connection combined with all repeaters on the line are provisioned as “1A-TX” (transmit). The other end terminal is provisioned as “1A-RCV” (receive). Dual-facing shelves handling 2-fiber applications are provisioned as “DUAL”. End terminals equipped with 4-Fiber Telemetry Feed-through have different designations than the existing types; to differentiate them, two new values, “1A-TX-THRU” and “1A-RCV-THRU” are added to the “dirn” parameter in the ENT-SYS-TL1 command.

Figure 5-7 shows WaveStar OLS 40G End Terminal shelves with different configurations.



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**Figure 5-7. WaveStar OLS 40G End Terminal Shelves (fully equipped)**

## Dual-Facing Shelf

In 2-fiber applications, the Dual-facing Shelf feature is designed to extend the WaveStar OLS 40G operations domain and reduce the number of links between the Operations Support System and WaveStar OLS 40G gateway network elements. Refer back to Figure 5-7 for an illustration of a Dual-facing Shelf (shown at right). The Dual-facing Shelf allows the functions of collocated single-facing shelves to be combined so that only one shelf, recognized as a single network element, is used. In addition to the equipment savings on shelves and SYSCTL/SYS-MEM/TOHCTL packs, coordination across the old limit of operations domains (using an Operations Support System [OSS] or orderwire) is no longer necessary. In this application, OA lines 1A and 1B are used as receivers and OA lines 2A and 2B are used as transmitters.

Refer back to Figure 5-1 and Figure 5-2 for a depiction of the differences between 2-fiber WaveStar OLS 40G operations with and without the Dual-facing Shelf feature.

## Telemetry Feed-Through

The same operations principle governing the Dual-facing Shelf applies to the Telemetry Feed-through feature. In WAD or regenerator sites with collocated WaveStar OLS 40G End Terminals linked via Telemetry Feed-through, the operations domain for network operators and/or the OSS is extended beyond a single WaveStar OLS 40G. This allows the DCC to go from one End Terminal (one WaveStar OLS 40G management subnetwork) through to the other collocated End Terminal (another WaveStar OLS 40G management subnetwork) and also creates savings in operations coordination between WaveStar OLS 40G systems with regard to configuration management and fault management.

From a hardware perspective, this feature requires an additional TLM circuit pack for each optical line (in the slot of TLM 1B or TLM 2B). From a software perspective, the DCC software on the TOHCTL circuit pack is enhanced to process not only the DCC information routed from the TLM 1A/2A circuit pack but further route the DCC information to the TLM 1B/2B circuit pack. The TLM 1B/2B circuit pack in one End Terminal is connected via a fiber jumper to the TLM 1B/2B in the other End Terminal for routing the DCC information through. When the DCC information comes out from the other TLM 1B/2B circuit pack to the TOHCTL in the other end terminal, it gets processed by the TOHCTL as needed.

In normal situations, the DCC on Optical Line 1 is used. If Optical Line 2 is available and Optical Line 1 fails, the DCC is protection-switched to Optical Line 2. For Optical Line 2, Telemetry Feed-through works the same way. In Figure 5-8, the shaded blocks represent the additional TLM slots filled with TLM 1B circuit packs, and the dashed lines indicate the passage of DCC information from one

WaveStar OLS 40G End Terminal in one WaveStar OLS 40G management sub-network to another co-located End Terminal in another management subnetwork via the fiber jumper connecting the two additional TLM packs. Similarly, the DCC information in the opposite direction takes a symmetric passage.

Figure 5-8 and Figure 5-9 illustrate the WaveStar OLS 40G architecture without and with the Telemetry Feed-through feature, respectively. These figures show only the case of Optical Line 1 in one direction. Only the DCC on one of the two optical lines is used at any one time. The DCC in the other direction works the same way.

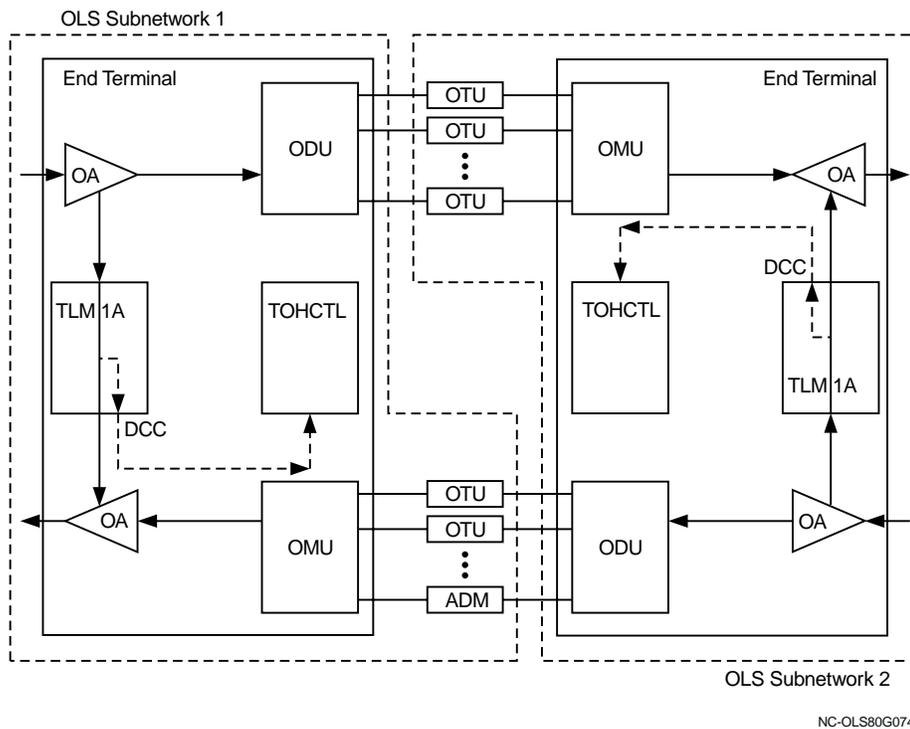
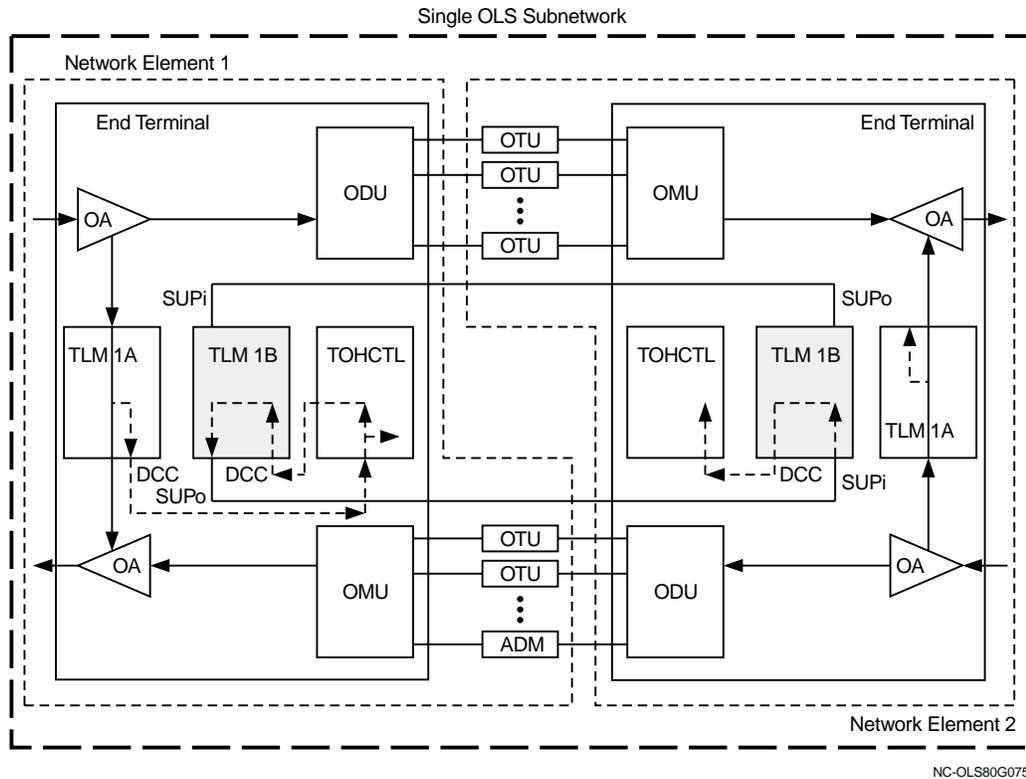


Figure 5-8. WaveStar OLS 40G Architecture without Telemetry Feed-Through



**Figure 5-9. WaveStar OLS 40G Architecture with Telemetry Feed-Through**

The Telemetry Feed-through feature extends the DCC across concatenated WaveStar OLS 40G management subnetworks so that the following operations interworking capabilities are available in a much larger scope:

- Remote TL1 access through GNE
- Remote network element status (remote alarming, alarm groups, AGNE)
- Remote software copy
- Directory service network element (DSNE)
- Network map retrieval (RTRV-MAP-NETWORK).

DCC protection switching still works on a per span basis. Here, the span can be situated on the left side or the right side, or it can be the fiber jumper itself. In the extended operations domain, only one DSNE exists and it can work without modification.

## **WaveStar OLS 40G/OTU Integration**

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The OTU Controller (OTCTL) integrates the WaveStar OLS equipment with the OTU. Occupying three slots in the OTU System Controller Shelf, the OTCTL is controlled by the existing SYSCTL and SYSMEM circuit packs in a WaveStar OLS 40G shelf and integrates the OTUs into the WaveStar OLS 40G control structure. From an operations perspective, the addition of the OTCTL makes the WaveStar OLS equipment and the OTU appear to the user as a single network element. The WaveStar OLS 40G operations interfaces now become the mechanism for obtaining information about the OTUs.

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# System Planning and Engineering

# 6

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# System Planning and Engineering

# 6

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This chapter summarizes information needed for applications planning before procurement and deployment of WaveStar OLS 40G.

There are several considerations to keep in mind when planning a network. Projected customer requirements determine the initial capacity needed as well as growth. Where you install the network and how you plan to use it determine the physical installation considerations.

Before ordering or installing the equipment, you need to develop an overall plan and designate a building that will serve as a terminal office or repeater site. This plan should take into consideration the eventual system size and include the following elements:

- Engineering rules
- Floor plan layout
- Equipment interconnection
- Cabling
- Environmental considerations
- Power planning.

Lucent Technologies offers engineering and installation services for planning and installing WaveStar OLS 40G. For more information, refer to Chapter 8, “Product Support.”

## Engineering Rules

This section describes the engineering rules for WaveStar OLS 40G Release 7.0.

### Lightguide Buildouts (LBO)

If outside plant loss is within the nominal range, no LBOs are required. If any span loss is below the specified minimum limit, an LBO is required. Detailed LBO selection guidelines are provided in the *WaveStar OLS 40G R7.0 Installation Manual*.

To adjust signal power distribution among the channels, LBOs should be used at End Terminals.

### WaveStar OLS 40G Network Topologies

Table 6-1 shows the five types of Optical Amplifiers (OA) used in Release 7.0. WaveStar OLS 40G supports any mix of OC-3/12/48, STM-1/4/16, Ethernet 1.25 Gb/s, or 100-750 Mb/s signal rates and supports both two-OA and single-OA operations. See the corresponding table in Chapter 5 for more information.

**Table 6-1. Optical Amplifiers used in WaveStar OLS 40G**

OA Code	Application	Two-OA	Single-OA
LEA7	Long Reach	✓	✓
LEA7B	Long Reach	✓	✓
LEA104	Long Span	✓	
LEA107B	Long Span	✓	
LEA105	Short Reach	✓	✓

### Engineering Rules for Two-OA Applications

Figure 6-1 shows the configuration of a two-OA WaveStar OLS 40G system where each span is supported by two OAs. WaveStar OLS 40G systems carry up to sixteen signals on an optical line of up to eight spans. The engineering rules for two-OA systems are shown in Table 6-2.

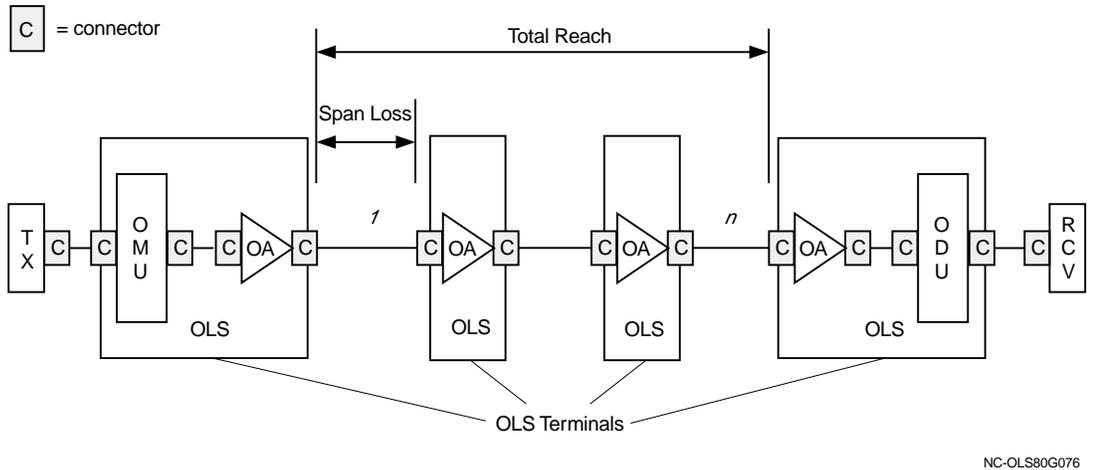


Figure 6-1. WaveStar OLS 40G Two-OA System

Table 6-2. Engineering Rules for Two-OA WaveStar OLS 40G Systems \*

Application	OA Code	Max No. Channels	No. Spans	Span Loss dB		Total Reach (dB) Max	Max Span Distance (km) <sup>†</sup>	Max Total Reach (km) <sup>†</sup>
				Min	Max			
Long Reach	LEA7 or LEA7B	16	1	22	33	33	132	132
			2	22	30	60	120	240
			3	22	28	84	112	336
			4	22	27	108	108	432
			5	21	26	130	104	520
			6	21	26	156	104	624
			7	17	22	154	88	616
			8	17	22	176	88	640 <sup>‡</sup>

**Table 6-2. Engineering Rules for Two-OA WaveStar OLS 40G Systems**

Application	OA Code	Max No. Channels	No. Spans	Span Loss dB		Total Reach (dB) Max	Max Span Distance (km) <sup>†</sup>	Max Total Reach (km) <sup>†</sup>
				Min	Max		Fiber Loss= 0.25dB/km	
Long Span <sup>**</sup>	LEA104 or LEA107B	16	1	22	35	35	140	140
			2	22	34	68	136	272
			3	22	33	99	132	396
			4	26	31	124	124	496
			5	23	27	135	108	540
Short Reach	LEA105	16	1	14	18	18	72	72

\* WaveStar OLS 40G supports any mix of OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, GbE, or 100-750 Mb/s signal rates.

† Some spans with distances greater than the maximum value may be accommodated by using fiber with lower loss values. Lucent Technologies provides network engineering support to optimize WaveStar OLS 40G for actual networks. Please contact your Lucent Technologies sales representative for more information.

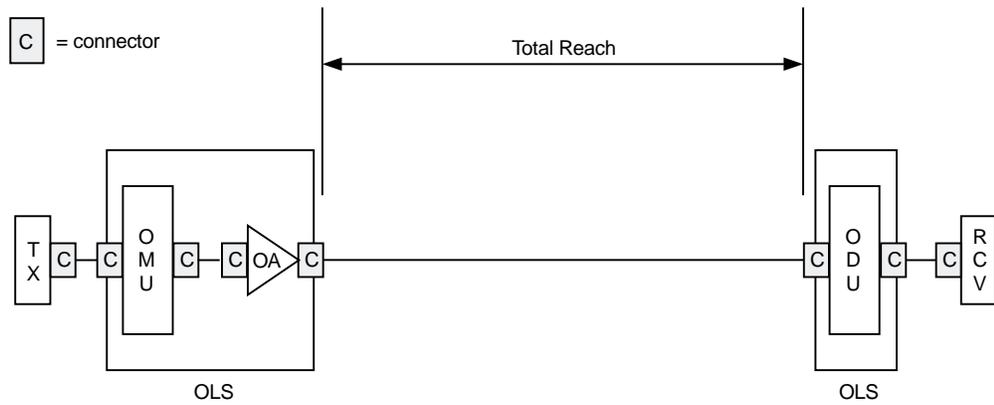
‡ This distance is limited by the dispersion characteristics of standard single-mode fiber (640 km x 17 ps/nm-km=10,900 ps/nm). Longer distances are available with non-zero dispersion-shifted fiber (for example: TrueWave®).

\*\* In systems where LEA104 is used, Release 2.0.2 or later software must be used.

### Engineering Rules for Single-OA Applications

For Short Reach applications, WaveStar OLS 40G supports single-OA (one-OA) operation. Over short distances, the receive end of a span can be configured to operate without an input OA, providing economy.

Figure 6-2 shows the single-OA operation with only one span between End Terminals. Single-OA systems use the LEA105, LEA7, or LEA7B OA and carry up to sixteen channels.



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**Figure 6-2. WaveStar OLS 40G Single-OA System**

Table 6-3 displays engineering rules for single-OA WaveStar OLS 40G systems.

**Table 6-3. Engineering Rules for Single-OA WaveStar OLS 40G Systems using LEA105/LEA7/LEA7B\*†**

OA Code	Max No. Channels	No. Spans	Span Loss dB		Total Reach (km)	Signals/Bit Rates
			min	max	Fiber Loss= 0.25 dB/km	
LEA105, LEA7, or LEA7B	16	1	0	12**	48	OC-48/STM-16, GbE, OC-12/STM-4, OC-3/STM-1, or 100-750 Mb/s
		1	0	12**	48	OC-48/STM-16, GbE, OC-12/STM-4, or 100-750 Mb/s
		1	0	13**	52	OC-48/STM-16, GbE, or OC-3/STM-1
		1	0	16**	64	OC-12/STM-4, OC-3/STM-1, or 100-750 Mb/s
		1	0	13**	52	OC-48/STM-16 or GbE
		1	0	16	64	OC-12/STM-4 alone or 100-750 Mb/s
		1	0	20	80	OC-3/STM-1 alone

\* For standard single-mode fiber (SSMF)

† WaveStar OLS 40G supports any mix of OC-3/STM-1, OC-12/STM-4, OC-48/STM-16, GbE, or 100-750 Mb/s signal rates.

\*\*The 12 dB or 13 dB maximum span loss for single-OA systems becomes 16dB when using the 506B OMU and 606D ODU.

## **Engineering Rules for Pass-through Connections**

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This section presents the engineering rules for determining whether a regeneration OTU is required for pass-through connections.

### **A. Optical Line Design Rules for OMU to ODU**

1. Determine the number of terminal locations and span losses between the OMU and ODU. The optical line to be designed exists from the OMU at one terminal to the ODU at the next terminal.
2. Use the Engineering Rules in Table 6-2 and Table 6-3 to determine the number and type of amplifiers and any repeater sites needed to support the optical line.
3. For point-to-point systems the optical line design is complete; for ring systems with pass-through wavelengths see the “Design Rules for Pass-through Wavelength” in this section.

### **B. Design Rules for Pass-through Wavelengths**

The engineering design rules for pass-through wavelengths consist of:

- General rules for Ring DWDM systems
- Rules specific to Release 7.0.0 systems
- General pass-through rules for single-OA systems
- General pass-through rules for two-OA systems
- General pass-through rules for combined single-OA and two-OA systems

#### **General Rules for Ring DWDM Systems**

- Each wavelength used is dual fed around both sides of the ring.
- An Optical Add Drop Multiplex (OADM) office is defined as a WaveStar OLS 40G dual terminal shelf or two co-located end terminal shelves with pass-through wavelengths. These wavelengths can be connected directly from ODU OUT to OMU IN. The ODU to OMU connection has 27dB of loss for Release 3 and 16dB of loss for Release 7.
- Pass-through wavelengths must meet the optical line engineering rules over their entire transmission path.

### Rules Specific to Release 7.0.0 Systems

- The Release 7.0.0 pass-through feature provides the capability of “passing through” a maximum of 4 optical amplifiers (6 optical amplifiers for two-OA repeatered systems). This feature allows 2 pass-through OADM offices for single-OA systems and 1 pass-through OADM office for two-OA systems.
- For Release 7.0.0 only 60% of the wavelengths in the system should be pass-through wavelengths from another system. This 60% limit will avoid overdriving any added wavelengths if all pass-through wavelengths simultaneously fail. Table 6-4 lists the allowed number of pass-through wavelengths for the number of wavelengths equipped.

**Table 6-4. Maximum Number of Pass-throughs for Total Channels Equipped**

Total Channels Equipped	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Maximum Number of Pass-throughs	1	1	1	2	3	3	4	4	5	6	6	7	7	8	9	9

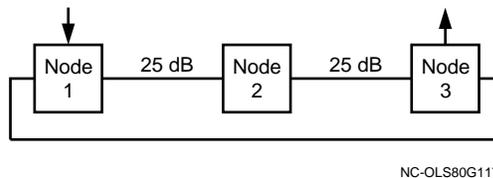
### General Pass-through Rules for Single-OA Systems

- For single-OA systems, when a wavelength is connected to an OADM office, the ODU-OMU connection adds to the span loss for that pass-through wavelength.
- For Release 7.0.0 a pass-through wavelength can travel:
  - 3 spans of 9dB outside plant loss (2 pass-through connections using a nominal level of -13 dBm into the OMU)
  - 2 spans of 12dB outside plant loss (1 pass-through connection using a nominal level of -15 dBm into the OMU)

### General Pass-through Rules for Two-OA Systems

- For two-OA systems, when a wavelength is connected to an OADM office the ODU-OMU connection counts as a span for that pass-through wavelength. As shown in Figure 6-3 a signal passes from Node1 to Node3 through Node2. The signal traverses 3 spans: 2 spans with 25dB of loss and a connection of 16dB. The wavelength meets the 3x28 engineering rule for the LEA7 amplifier.
- There can be no more than 1 repeater site between any 2 terminals.

- The maximum number of spans that a single wavelength can travel is 5. Using a pass-through connection, this single wavelength can go through either a:
  - one-1-span system connected to a 3-span system or
  - two 2-span systems connected together.
- LEA7 or LEA7B amplifiers must be set to pump setting C for pass-through applications.
- LEA104 or LEA107B amplifiers must be set to pump setting B for pass-through applications.



**Figure 6-3. Pass-through Route Example**

### **General Pass-through Rules for Combined Single-OA and Two-OA Systems**

- Combined systems are allowed a maximum of 3 systems:
  - 2 two-OA systems and 1 single-OA system or
  - 1 two-OA system and 2 single-OA systems.One of the two-OA systems is allowed a maximum of one repeater site.
- For combined single-OA and two-OA systems.
  1. Check that the single-OA spans meet their pass-through maximum span loss requirements of 3x9dB or 2x12dB.
  2. Count the number of optical amplifiers in the system. Subtract 1 from the number of amplifiers to determine the equivalent "span count".
  3. Verify that all two-OA system spans meet level requirements (see Table 6-2) for the "span count".

### C. Design Rule for Regeneration

Wavelengths must use OTUs for regeneration when the wavelengths exceed the cumulative number of spans based on the span loss rules (see Table 6-2) or pass-through rules.

### D. Design Rules for Drop OTU Usage

Wavelengths must use OTUs for regeneration when they exceed the cumulative number of spans based on the span loss rules or pass-through rules. For WaveStar OLS 40G systems with many repeater amplifiers drop OTUs or OLS-compatible receivers are always required to guarantee performance.

Drop OTUs may not be needed for shorter WaveStar OLS 40G systems performing fiber congestion relief or metro/regional distribution if the existing customer standard receivers perform sufficiently.

The following statements describe requirements for using or omitting the drop OTU:

- The receiver on the customer equipment must operate in the 1550 nm band and meet the input power range (SONET long range requirements) (see Table 9-x) and signal-to-noise requirements that the drop OTU would meet as specified in Chapter 9, Technical Specifications. Not all receivers from all manufacturers will meet these requirements. Customers must evaluate the various receivers they wish to directly connect to WaveStar OLS 40G.
- In the case of fiber congestion relief, if the WaveStar OLS 40G system is inserted into a direct fiber span that previously carried the customer signal between transmitter and receiver, then no drop OTU is needed. In other words, if the customer equipment operated over the existing span then it should also operate through the WaveStar OLS 40G system using the same span.
- For OLS 40G systems with more than one span, typically the drop OTU is required because the fiber dispersion or signal-to-noise performance exceeds the existing receiver capability. For example, non OLS-compatible OC-48 receivers may have a range of only 80 to 100 km. The range will vary depending on the manufacturer.
- The receiving equipment should be co-located with the WaveStar OLS 40G equipment. The fiber jumper connecting the ODU to the receiver must have less than 0.5 dB loss. If the receiving equipment is not co-located with the WaveStar OLS 40G then a drop OTU is needed or the span loss values must be reduced for single-OA spans. The engineering rules assume a direct connection between the OTUs and the OMUs and ODUs. If a cus-

tomers chooses to remotely locate OTUs from the OMU/ODUs for a total loss of 2dB, then up to 1.5 dB should be subtracted from the maximum loss budget for single-OA applications.

## Dispersion

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In WaveStar OLS 40G systems with dispersion of less than 6800 ps/nm, use of 41AxC OTUs, or Lucent Add/Drop Multiplexers (ADM) with an equivalent OLS-compatible transmitter is recommended for OC-48/STM-16 signals. The GbE OTU 41Fx also accommodates dispersion of less than 6800 ps/nm.

In WaveStar OLS 40G systems with dispersion up to 10,900 ps/nm, use of 41CxC OTUs, or Lucent ADMs with an equivalent OLS-compatible transmitter is required for OC-48/STM-16 signals.

The 42AxB, 43AxB, and 44AxB Optical Translator Port Modules (OTPM), associated with the Quad Optical Translator Units (QOTU) and used for OC-3/STM-1, OC-12/STM-4, and 100-750 Mb/s optical channels, respectively, can accommodate dispersions of up to 10,900 ps/nm.

## WaveStar OLS 40G/OTU Interworking

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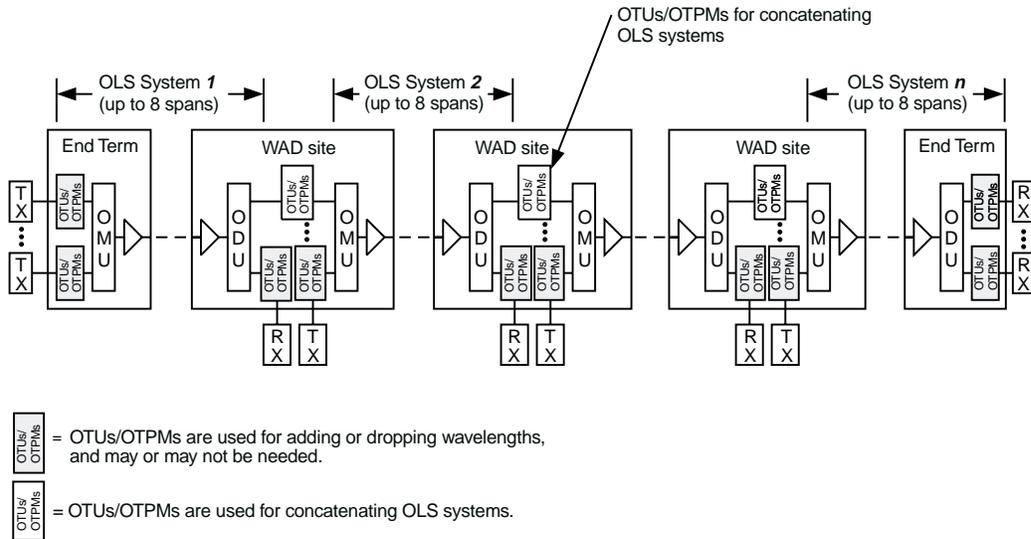
OTUs (OC-48/STM-16), GbE, and OTPMs that are installed in a QOTU (OC-3/STM-1, OC-12/STM-4) can be used to concatenate WaveStar OLS 40G systems to increase the distance between SONET/SDH line terminals. They can also be used for adding and dropping wavelengths.

### **NOTE:**

All OTPMs and OTUs can be used to concatenate WaveStar OLS 40G systems, except low speed broadband 100-750 Mb/s OTPMs.

An optical channel starts at a signal source, such as a SONET/SDH add/drop multiplexer and ends at another signal source. It may pass through multiple OLS systems before being terminated at another signal source. Each optical channel may pass through as many as 16 OTUs before optical channel termination is required independent of how and where the OTUs are used and independent of the number of spans traversed.

A maximum of sixteen OTUs/OTPMs can be used between SONET/SDH line terminals. Figure 6-4 shows WaveStar OLS 40G systems using OTUs/OTPMs for adding or dropping wavelengths. In this way, OTUs/OTPMs can also be used to concatenate multiple point-to-point WaveStar OLS 40G systems.



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Figure 6-4. WaveStar OLS 40G/OTU Interworking

Table 6-5 shows examples of maximum overall distance in cases where sixteen OTUs/OTPMs are used to concatenate seventeen point-to-point WaveStar OLS 40G systems and each system has the maximum number of spans. For example, when sixteen OTUs/OTPMs are used to concatenate seventeen WaveStar OLS 40G systems with LEA7 OAs (each WaveStar OLS 40G system has eight spans with 22 dB loss each), the maximum overall distance is 10,880 km.

**Table 6-5. Examples of OTUs Used to Concatenate 16-Channel WaveStar OLS 40G Systems**

Description	LEA7/ LEA7B Two-OA System	LEA105 Two-OA System	LEA105/ LEA7/ LEA7B Single-OA System	LEA104 Two-OA System
<b>Per WaveStar OLS 40G System*</b>				
Max. # Spans	8	1	1	5
Max. Span Loss (dB)	22	18	12	27
Total Reach (km) <sup>†</sup>	640	72	48	540
<b>Per Wavelength</b>				
Max. # OTUs/OTPMs	16	16	16	16
Max. # Systems	17	17	17	17
Max. # Spans	136	17	17	85
Max Overall Distance (km)	10,880 <sup>‡</sup>	1,224	816	9,180

\* Data is based on use of either standard single-mode fiber (SSMF) or non-zero dispersion-shifted fiber (for example: TrueWave®). Data assumes a dispersion rate of 17ps/nm-km for SSMF and 4ps/nm-km for non-zero dispersion-shifted fiber.

† Assumes a fiber loss rate of 0.25 dB/km.

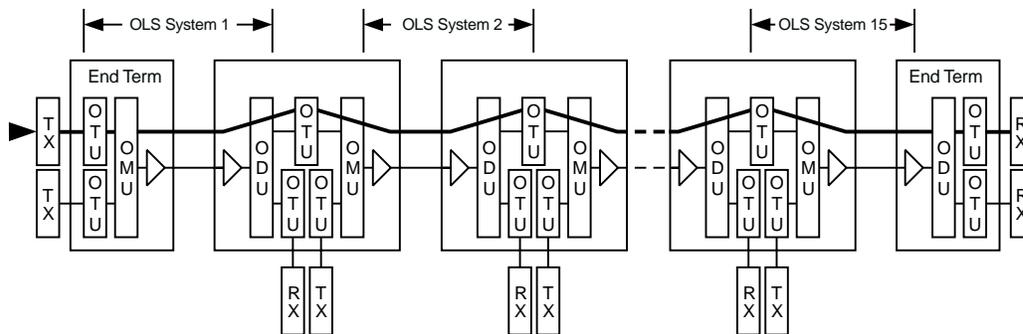
‡ Each 8-span system is dispersion-limited to 640 km. The total reach, 640 km multiplied by 17 (the maximum number of systems) equals 10,880 km, the maximum overall distance.

Refer to Table 6-6 for the maximum number of concatenated systems for each channel rate.

**Table 6-6. Maximum Number of Concatenated Systems**

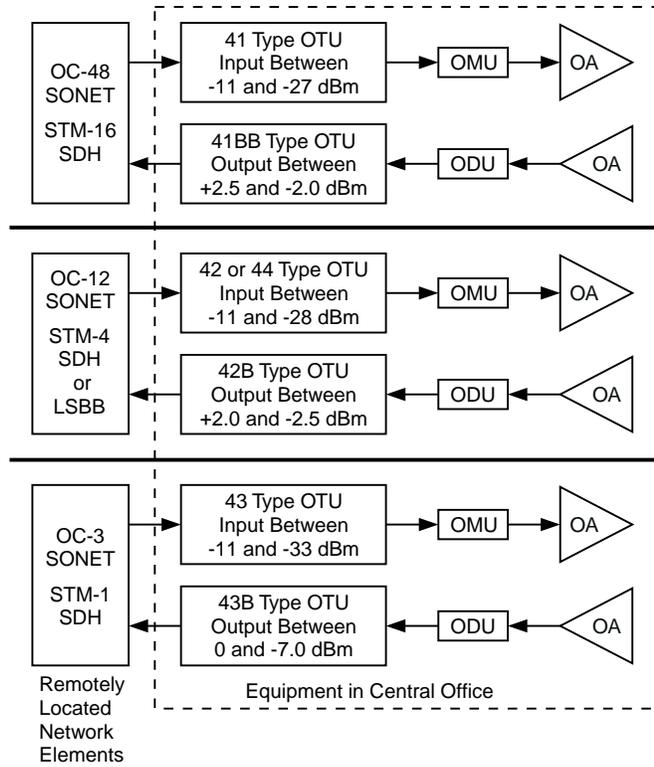
Channel Rate	OTU/OTPM Model	Maximum Number of OTUs/OTPMs
OC-48/STM-16	Any combination of 41AxC, 41BB, and 41Cx C	16 (20 with LCT, FT, ADM-16, SLM, BWM)
GbE	41Fx	16 (20 with LCT, FT, ADM-16, SLM, BWM)
OC-12/STM-4	43AxB, 43B	16
OC-3/STM-1	42AxB, 42B	16
100-750 Mb/s	44AxB, 44B	2 (concatenation is not supported)

Refer to Figure 6-5 for an example showing 15 OLS systems concatenated. The optical channel in this example, shown by the heavy line, begins at OLS system 1 and ends after OLS system 15.



**Figure 6-5. Concatenation with Standard Optics**

SONET/SDH network elements that are not co-located with the OLS can be connected using OTUs to regenerate the signals at the OLS location. Figure 6-6 shows the power levels going into and out of the OTUs. The customer must take into account the receiver sensitivity of both the remote SONET/SDH equipment and the OTU to determine the maximum appropriate losses between the equipment



NC-OLS80G096

**Figure 6-6. Connecting Remote Network Elements**

## **Upgrade Considerations**

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### **LBO Considerations**

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LBO kits 108138470 (ST), 108138504 (FC), 108436254 (SC) are recommended for use with the Optical Amplifiers, telemetry and OMU/ODU circuit packs. The following LBO kits are recommended for use with the various OTUs/OTPMs:

- 108371741 (ST) with OC48/STM16 or Ethernet 1.0 Gb/s OTUs
- 108371766 (ST) with OC3/STM1, OC12/STM4, and 100-750 Mb/s broadband OTPMs
- 108371717 (FC) with OC48/STM16 or Gigabit Ethernet OTUs
- 108371725 (FC) with OC3/STM1, OC12/STM4, and 100-750 Mb/s broadband OTPMs
- 108435926 (SC) with OC48/STM16 or Gigabit Ethernet OTUs
- 108435918 (SC) with OC3/STM1, OC12/STM4, and 100-750 Mb/s broadband OTPMs

### **Upgrading from Release 3 to Release 7**

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This upgrade can be performed in service via software download from the Center-Link Download Manager to at least one OLS node in each area and software copy from that node to other OLS nodes in the area.

**Network Element Software Upgrade Paths**

Nominal WaveStar OLS 40G upgrade paths are shown in Table 6-7.

**Table 6-7. Supported Software Upgrade Paths**

		Upgrade Release				
		3.0.1	3.0.2	3.3	3.4	7.0
Current Release	3.0.0	✓	✓			
	3.0.1		✓			
	3.0.2			✓	✓	✓
	3.3				✓	✓
	3.4					✓

## Floor Plan Layout

Figure 6-7 shows a typical floor plan layout for the WaveStar OLS 40G in a central office. WaveStar OLS 40G is a front access system with rear aisle space of 2 feet that is recommended for allowing the rear doors to be fully opened in cabinet mounted systems. If floor space is limited, the rear aisle can be reduced to no less than 4 inches. Refer to the floor plan data sheets (804-604-161 and 804-604-162) for explicit details.

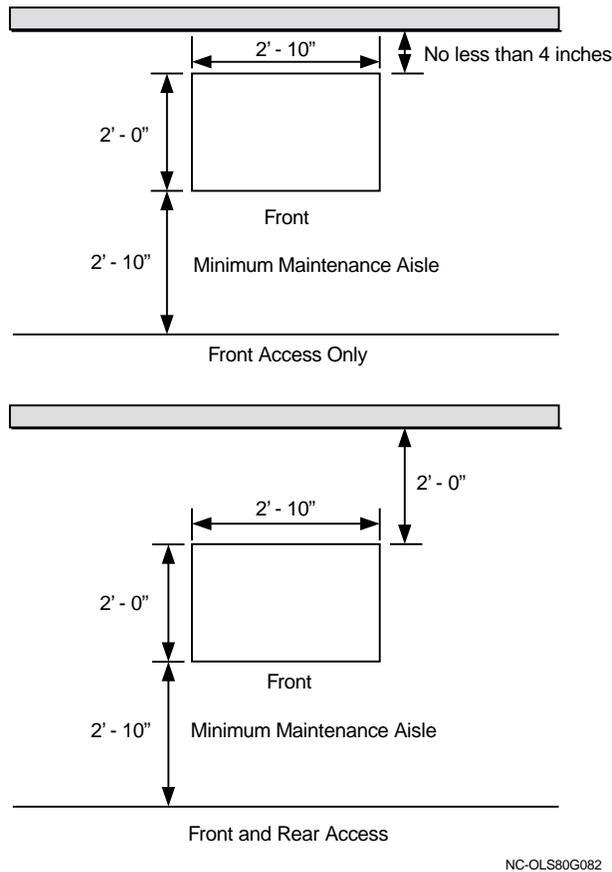


Figure 6-7. Floor Plan Layout

## Equipment Interconnection

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WaveStar OLS 40G is designed as a front access product; all cable and fiber connections can be made from the front of the system. This feature allows planners to design networks with WaveStar OLS 40G in controlled environment vaults, concrete huts, or other locations, where space is limited and equipment must be placed close to the wall.



**NOTE:**

All external interconnection cabling uses industry standard connectors.

## Cabling

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The following are major classes of signals cabled to WaveStar OLS 40G:

- Optical channels (drop side signals)
- OAM&P electrical signals
- Customer maintenance (CM) optical signals
- Optical line signals.

Optical interfaces (TLM, ODU, OMU, and OA) are designed to provide connections through a front-mounted connector system. The connector system supports the use of the following four types of connectors:

- ST<sup>®\*</sup>
- FC\*
- SC\*
- LC.

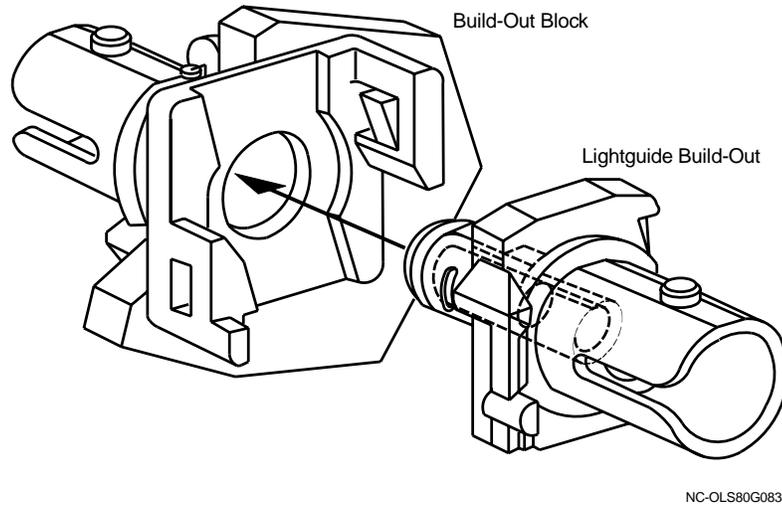
If required, the connector system also provides optical attenuation (optical LBO). All optical interfaces are factory-equipped with ST connectors having 0 dB attenuation. These connectors can be changed and other connector types used.

In addition, a kit with LBO values from 3 to 10 dB is shipped with the ODU. The correct LBO value must be chosen after the system is installed. The sixteen wavelength ODU and OMU require the smaller LC-type connectors due to the higher density of optical connections associated with the sixteen wavelength feature.

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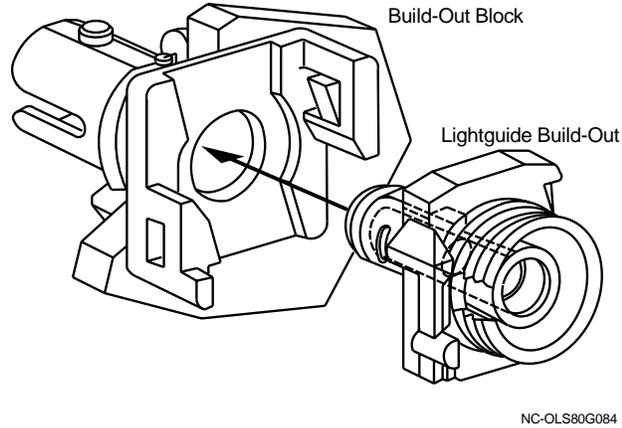
\* Function as both a connector and an LBO.

Figure 6-8 shows the build-out block and an ST-type LBO assembly.



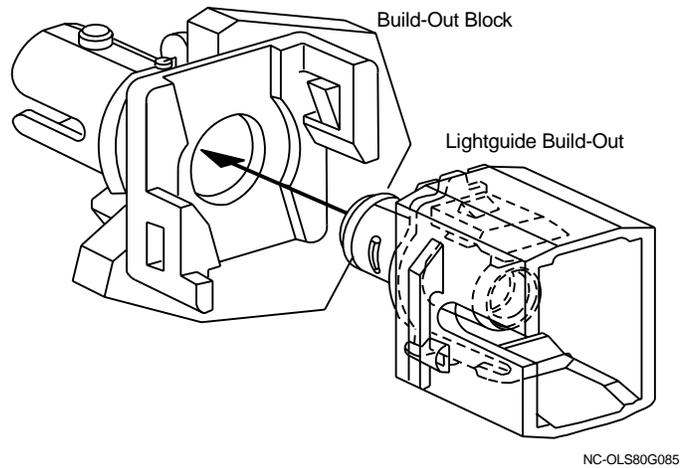
**Figure 6-8. ST-Type Build-Out Assembly (enlarged)**

Figure 6-9 shows the buildout block and an FC-type LBO assembly.



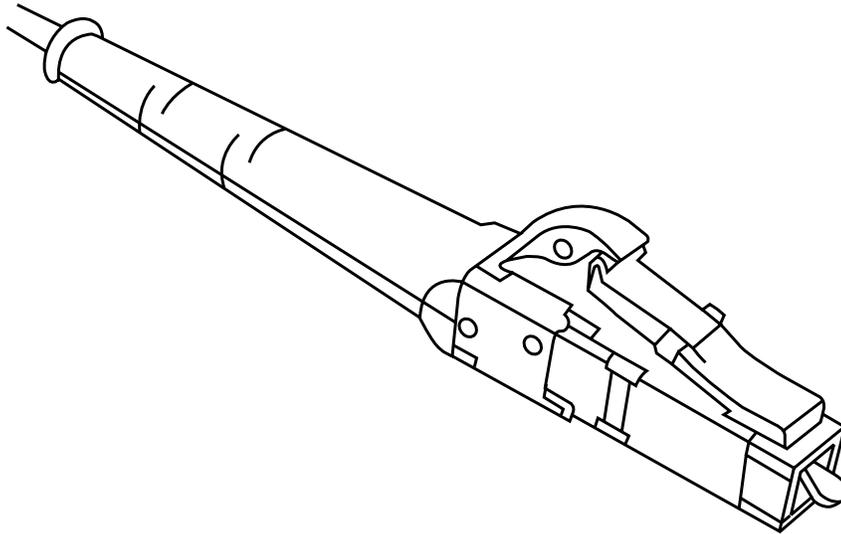
**Figure 6-9. FC-Type Build-Out Assembly (enlarged)**

Figure 6-10 shows the build-out block and SC-type LBO assembly.



**Figure 6-10. SC-Type Build-Out Assembly (enlarged)**

Figure 6-11 shows an LC-type connector.



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**Figure 6-11. LC-Type Connector (enlarged)**

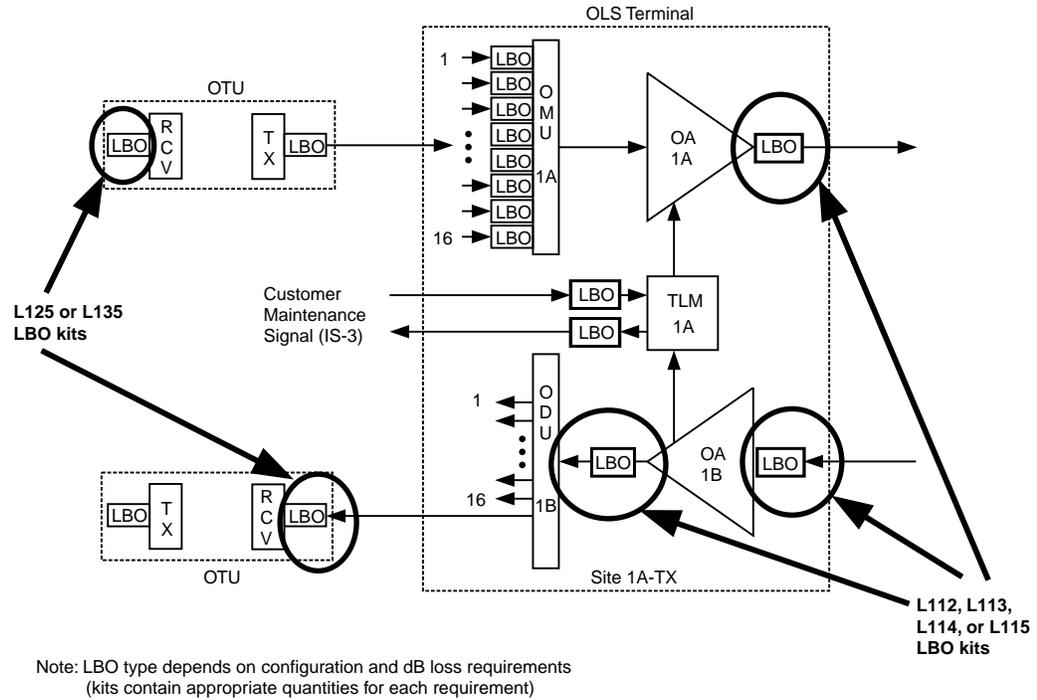
All fiber jumpers connected to the OMU and ODU units must use standard single-mode fiber (SSMF). The intrashelf fiber jumpers and the optical line I/O fiber must use SSMF. Single mode or multi-mode fiber (depending on the type of input source) can be used for the input customer maintenance signal. However, multi-mode fiber must be used for the output customer maintenance signal.

When ST, FC, SC or LC connectors are used together, hybrid jumpers must be used. A hybrid jumper has different types of connectors at either end. The connectors at both ends of the jumper must match the panel-mounted connectors. ST connectors are available for use with the LBO cross-connect panel and can be installed when WaveStar OLS 40G is installed.

**⇒ NOTE:**

All optical fiber connectors (ST, FC, SC, and LC types) must be cleaned before initial or subsequent connections are made. Refer to “Related Products” in Chapter 7, “Ordering,” for information on cleaning materials.

Figure 6-12 provides a depiction of LBO kit usage in an End Terminal. Refer to “LBO Considerations” earlier in this chapter for information on using LBO kits.



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**Figure 6-12. LBO Location in an End Terminal**

**LBO Color Types**

Table 6-8 lists specifications of various LBO color types used with WaveStar OLS 40G systems.

**Table 6-8. LBO\* Color Types**

LBO Color	Fiber Use†	Attenuation Values (dB)	Connectors Supported	Wavelength at Nominal Attenuation (nm)	LBO Body Marking	Attenuator Element (dB)	Optical Power Limits (dBm)‡
White	SM-SM	0	ST and FC	No restriction			Connector limited
	SM-MM						
	MM-MM						

**Table 6-8. LBO\* Color Types (Contd)**

LBO Color	Fiber Use†	Attenuation Values (dB)	Connectors Supported	Wavelength at Nominal Attenuation (nm)	LBO Body Marking	Attenuator Element (dB)	Optical Power Limits (dBm)‡
	MM-MM	5,10,15,17.5	ST	1310	Nominal value	Clear for 5	≤ 20
						Tinted for 10, 15, 17.5	≤ 5
Blue	SM-SM	0	SC	No restriction			Connector limited
	SM-MM						
	MM-MM						
	MM-MM	5,10,15,17.5	SC	1310	Nominal value	Clear for 5	≤ 20
						Tinted for 10, 15, 17.5	≤ 5
Yellow**	SM-SM	3, 5, 7, 10, 15, 20	ST, FC, and SC	1310 to 1550	Nominal value	Clear for ≤ 10	≤ 20
						Tinted for ≥ 15	≤ 5

**Table 6-8. LBO\* Color Types (Contd)**

LBO Color	Fiber Use†	Attenuation Values (dB)	Connectors Supported	Wavelength at Nominal Attenuation (nm)	LBO Body Marking	Attenuator Element (dB)	Optical Power Limits (dBm)‡
Green††	SM-SM	3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5, 7, 7.5, 8, 8.5, 9, 9.5, 10, 10.5, 11, 11.5, 12, 12.5, 13, 13.5, 14, 14.5, 15, 16, 18, 20	ST and FC	1550	Nominal value	Clear	≤ 20
		3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5, 7, 7.5, 8, 8.5, 9, 9.5, 10	SC	1550	Nominal value	Clear	≤ 20
Gray	SM-MM	5, 7, 10, 12, 15, 17, 20	ST and FC	1550	Nominal value	Tinted	≤ 5

\* Maximum reflectance = -30 dB

† SM= Single-mode, MM= Multi-mode

‡ These optical power values are conservative estimates.

\*\* The yellow LBOs have nominal values appropriate to both 1310 and 1550 nm. Worst case tolerance on attenuation is +/- 15% of nominal attenuation.

†† Green LBOs are highly recommended for 16 wavelength systems due to their finer granularity. These LBOs have nominal values appropriate to 1550 nm. Tolerance is +/- 0.3 dB of nominal attenuation for 3 to 15 dB values, +/-0.5 dB for the 16dB value, and +/-1 dB for 18 or 20 dB values.

**⇒ NOTE:**

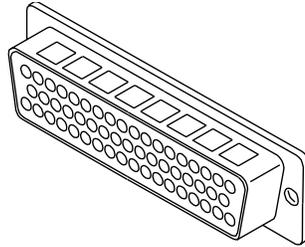
Except for 15 dB and 20 dB yellow LBO values, both green and yellow LBO types use elements of the same kind. Power tolerance is, therefore, the same.

Table 6-9 lists information on converting LBOs used in WaveStar OLS 40G Release 2.0 and earlier to those used in later releases. Specifically, the table provides specifications for use when converting from yellow LBOs to green LBOs.

**Table 6-9. Yellow LBO-to-Green LBO Conversion Specifications**

Yellow LBO Value	Comcode (ST Connector)	Actual Attenuation (dB)	Convert To:	Green LBO Value	Comcode (ST Connector)	Actual Attenuation
3.0	107380438	2.7 +/- 0.3		3.0	108053059	3.0 +/- 0.3
5.0	107406183	4.7 +/- 0.3		4.5	108053083	4.5 +/- 0.3
7.0	107107740	6.1 +/- 0.4		6.0	108053117	6.0 +/- 0.3
10.0	107408191	9.0 +/- 0.7		9.0	108053174	9.0 +/- 0.3
15.0	107406209	14.0 +/- 0.7		14.0	108053232	14.0 +/- 0.3
20.0	107406217	18.0 +/- 1.0		18.0	108053265	18.0 +/- 1.0

The OAM&P cables are terminated with D-subminiature connectors, shown in Figure 6-13, that have crimp removable contacts. The length of the power feeds are individually engineered and are sized to handle the maximum current drain the equipment can experience. For more information about cabling, refer to Chapter 7, "Ordering."



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**Figure 6-13. D-Subminiature Connector**

## **Environmental Considerations**

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WaveStar OLS 40G Shelves and Cabinets comply with the environmental compatibility requirements in *GR-63-CORE, Issue 1, October 1995* and *GR-1089-CORE, Issue 1, November 1994* documents.

Perforated metal meshes are used as part of the shelf construction to cover the top and bottom areas of the shelf in order to form an electromagnetic enclosure for all circuit packs in the shelf. WaveStar OLS 40G shelves, circuit packs, and cable treatments are designed to satisfy the requirements of *GR-1089-CORE, Issue 1, November 1994*.

WaveStar OLS 40G complies with the IEC 801-2 electrostatic discharge (ESD) recommendation for exchange carriers. The shelves are grounded to the cabinet by the shelf mounting hardware. An ESD jack is provided on the fuse panel for grounding straps.

## Power Planning

Two power feeders and returns (feeders A and B) should be used to power each WaveStar OLS 40G or OT Cabinet. Redundant power feeders are used to ensure maximum system reliability. All power feeders should be sized to carry the maximum shelf power consumption. Each feeder is equipped with a filter to reduce any switching noise that may be present on the input current.

WaveStar OLS 40G dissipates heat by natural convection cooling and does not require a cooling fan. Table 6-10 presents information on power dissipation and current drains for different system configurations.

**Table 6-10. WaveStar OLS 40G Power Planning**

	Maximum Power Dissipation		Current Drains per Feeder*	
	Watts	Watts per Square Foot	Nominal at -48V (List 1†)	Maximum (List 2‡)
<b>J68982C-1 Equipment Package</b>				
Dual End Terminal	276	22.1	2.9	6.5
Dual Repeater	344	27.6	3.6	8.0
End Terminal & Repeater	310	24.8	3.2	7.3
Miscellaneously-mounted Shelf:				
Dual End Terminal Shelf				
Dual Repeater Shelf	138	NA	1.4	3.2
Dual Facing Shelf	172	NA	1.8	4.0
	138	NA	1.4	3.2
<b>J69000C-1 Equipment Package</b>				
OT System Controller Shelf	182	14.6	1.7	3.7
OT Complementary Shelf	232	18.6	2.1	4.7
Fully-equipped OT Cabinet (3 Shelves)	646	51.7	5.9	13.2
	Maximum Power Dissipation		Current Drains per Feeder**	

**Table 6-10. WaveStar OLS 40G Power Planning (Contd)**

<b>J68982D-1 Equipment Package</b>				
Integrated Bay (Single)	552	78.4	5.8	12.9
End Terminal	138	11.1	1.5	3.3
OT System Controller Shelf	182	14.6	1.7	3.7
OT Complementary Shelf	232	18.6	2.1	4.7
<b>Integrated Bay/Cabinet (Double), (ED-8C903-40 Super Kit)</b>				
Bay/Cabinet	138	11.1	1.5	3.3
OT Bay/Cabinet	646	91.8	6.7	15.1
<b>Integrated Bay/Cabinet (Triple 1), (ED-8C903-40 Super Kit)</b>				
Bay/Cabinet	276	22.1	2.9	6.5
OT Bay/Cabinet 1	646	91.8	6.7	15.1
OT Bay/Cabinet 2	646	91.8	6.7	15.1
<b>Integrated Bay/Cabinet (Triple 2), (ED-8C903-40 Super Kit)</b>				
Bay/Cabinet	138	11.1	1.5	3.3
OT Bay/Cabinet 1	646	91.8	6.7	15.1
OT Bay/Cabinet 2	646	91.8	6.7	15.1

\* Nominally, both feeders share the current equally for the cabinet or shelf. If one feeder fails, the remaining feeder carries the total load for the cabinet (feeder A + feeder B current).

† In power engineering, List 1 refers to the current drains used to size batteries and rectifiers. To size batteries and rectifiers, use twice the Nominal (List 1) current drain per feeder. These current drains represent the average busy-hour current at normal operating voltages.

‡ In power engineering, List 2 refers to the current drains used to size feeder cables and fuses. To size feeder cables and fuses, use the Maximum (List 2) current drain per feeder. These current drains represent the peak current under worst case operating conditions.

\*\* Nominally, both feeders share the current equally for the cabinet or shelf. If one feeder fails, the remaining feeder carries the total load for the cabinet (feeder A + feeder B current).

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# Ordering

# 7

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This chapter provides information on the following:

- Ordering WaveStar OLS 40G equipment
- Ordering Optical Translator (OT) equipment
- Ordering related products that operate with the WaveStar OLS 40G and OT
- Lucent Technologies software release ratings
- Slot, circuit pack, and software compatibility.

## **Ordering WaveStar OLS 40G Equipment**

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The OLS order comprises equipment, cables, circuit packs, software, and customer documentation. The equipment necessary to form different application packages is grouped together into both J-drawing and “super-kit” ED list and group numbers. This section contains the ordering information you need to develop your WaveStar OLS 40G applications.



### **NOTE:**

For information on ordering spare circuit packs, refer to Appendix A, “Circuit Pack Sparing.”

## **Ordering Lightguide Office Cable**

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When ordering lightguide office cable, use the *Lucent Technologies Fiber Optic Products* catalog (select code: 2492C). To order copies of this catalog, use the following information:

**Non-Lucent personnel:** contact the National Telemarketing Center, 1-800-344-0223, ext. 3023

**Lucent personnel:** contact the Lucent Technologies Ordering Center (LTOC), 1-800-458-1761

The catalog is also available on-line at the following address:

<http://www.wr.lucent.com/ncs/fiberoptics/catalog/>

## **WaveStar OLS 40G Package Descriptions**

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### **J-Drawing J68982C-1 (WaveStar OLS 40G Cabinet and Bay Equipment)**

**Dual End Terminal or Dual Repeater Cabinet** provides a two-shelf cabinet equipped with a heat baffle, fuse panel, power filters, indicator strip, cables, rear cover, and door for use in Dual End Terminal, Dual Repeater, or End Terminal and Repeater combination applications. For a Dual End Terminal application, L103 is required in addition. For a Dual Repeater application, L104 is required in addition. For an End Terminal and Repeater combination application, L105 is required in addition. Refer to Chapter 4, "Product Description," for application illustrations.

**(L10) Miscellaneously-mounted Shelf with Newlook-2000 covers:** provides a miscellaneously-mounted WaveStar OLS 40G shelf, heat baffle, and Newlook-2000 covers. For an End Terminal shelf, L106 is required in addition. For a Repeater shelf, L107 is required in addition.

**(L11) Miscellaneously-mounted Shelf with flat covers:** provides a miscellaneously-mounted WaveStar OLS 40G, heat baffle, and flat covers. For an End Terminal shelf, L106 is required in addition. For a Repeater shelf, L107 is required in addition. Refer to Chapter 4, "Product Description," for application illustrations.

**Dual End Terminal or Dual Repeater Bay** provides a two-shelf bay equipped with heat baffles, fuse panel, power filters, user panels, and cables for use in Dual End Terminal, Dual Repeater, or End Terminal and Repeater combination applications. For a Dual End Terminal application, L103 is required in addition. For a Dual Repeater application, L104 is required in addition. For an End Terminal and Repeater combination application, L105 is required in addition. Refer to Chapter 4, “Product Description,” for application illustrations.

**Dual End Terminal Label** provides the necessary labels for a Dual End Terminal application. Used only with L2 and L14 applications that have two End Terminal shelves.

**(L104) Dual Repeater Label Kit:** provides the necessary labels for a Dual Repeater application. Used only with L2 and L14 applications that have two Repeater shelves.

**(L105) End Terminal and Repeater Combination Label Kit:** provides the necessary labels for an End Terminal and Repeater combination application. Used only with L2 and L14 applications that have combined End Terminal and Repeater shelves.

**(L106) Miscellaneously-mounted End Terminal Shelf Label Kit:** provides the necessary labels for a miscellaneously-mounted End Terminal shelf application. Used with L10 and L11.

**(L107) Miscellaneously-mounted Repeater Shelf Label Kit:** provides the necessary labels for a miscellaneously-mounted Repeater shelf application. Used with L10 and L11.

**(C108138470) ST LBO Kit:** (R2.1 and later, up to  $16\lambda$ ) provides a kit of light-guide build-outs with ST connectors for a single bidirectional line. Includes all necessary LBOs for OA and TLM inputs and outputs. Refer to Chapter 6, “System Planning and Engineering.”

**(C107515561) ST LBO Kit:** (R2.1 and later, up to  $16\lambda$ ) provides a kit of light-guide build-outs with ST connectors for a single bidirectional line. Includes all necessary LBOs for use on OA inputs and outputs only. Refer to Chapter 6, “System Planning and Engineering.”

**(C108138504) FC LBO Kit:** (R2.1 and later, up to 16 $\lambda$ ) provides a kit of lightguide build-outs with FC connectors for a single bidirectional line. Includes all necessary LBOs for OA and TLM inputs and outputs. Refer to Chapter 6, “System Planning and Engineering.”

**Lightguide Jumper Kit** provides 50-inch ST-to-ST lightguide jumpers and associated labels required for intrashelf connections on a single bidirectional line. Connection is made between OA and TLM (ST-to-ST) and between OA and OMU/ODU (ST-to-LC).

In repeater applications, L161 can be used for 16 $\lambda$  applications. Refer to Chapter 3, “Applications,” for illustrations of different OA configurations.

**Lightguide Jumper** provides 50-inch ST-to-ST and LC-to-ST, and 20-inch LC-to-ST lightguide jumpers and associated labels required for intrashelf connections on a single bidirectional line. Connection is made between OA and TLM (ST-ST) and OA and OMU/ODU (ST-LC).

L162 is used only with 16 $\lambda$  OMU (L61) and ODU (L51, L52), non-dual facing applications for two-OA operation. Refer to Chapter 3, “Applications,” for illustrations of different OA configurations.

**(L163) Lightguide Jumper Kit:** provides 50-inch ST-to-ST and LC-to-ST, and 20-inch LC-to-ST lightguide jumpers and associated labels required for intrashelf connections on a single bidirectional line. Connection is made between OA and TLM (ST-to-ST), between OA and OMU/ODU (ST-to-LC), and between TLM to ODU.

L163 is used only with 16 $\lambda$  OMU (L61) and ODU (L51, L52), non-dual facing applications for single-OA operation. Refer to Chapter 3, “Applications,” for illustrations of different OA configurations.

**(L164) Lightguide Jumper Kit:** provides 50-inch ST-to-ST and LC-to-ST lightguide jumpers and associated labels required for intrashelf connections on up to two bidirectional lines. Connection is made between OA and TLM (ST-to-ST) and between OA and OMU/ODU (ST-to-LC).

L164 is used only with 16 $\lambda$  OMU (L61) and ODU (L51, L52) applications for two-OA/two-OA dual-facing operation. Refer to Chapter 3, “Applications,” for illustrations of different OA configurations.

**(L165) Lightguide Jumper Kit:** provides 50-inch ST-to-ST and LC-to-ST, and 20-inch LC-to-ST lightguide jumpers and associated labels required for intrashelf connections on a single shelf. Connection is made between OA and TLM (ST-to-ST) and between OA and OMU/ODU (ST-to-LC).

L165 is used only with 16λ OMU (L61) and ODU (L51, L52) applications for two-OA/single-OA, single-OA/two-OA, and single OA/single-OA dual-facing operation. Refer to Chapter 3, “Applications,” for illustrations of different OA configurations.

**(L171) WaveStar OLS 40G Integrated Bay/Cabinet (Double) Integration Cabling:** provides integration cabling to connect a WaveStar OLS bay/cabinet (with 1 equipped shelf) to an OT bay/cabinet. These cables are used in a 2 bay/cabinet arrangement.

**(L172) WaveStar OLS 40G Integrated Bay/Cabinet (Triple 1) Integration Cabling:** provides integration cabling to connect a WaveStar OLS bay/cabinet (with 2 equipped shelves) to two OT bays/cabinets. These cables are used in a 3 bay/cabinet arrangement. Labels are also included to indicate bay identity as “Bay 1” or “Bay 2.”

**(L173) WaveStar OLS 40G Integrated Bay/Cabinet (Triple 2) Integration Cabling:** provides integration cabling to connect a WaveStar OLS bay/cabinet (with 1 equipped shelf) to two OT bays/cabinets. These cables are used in a 3 bay/cabinet arrangement. Labels are also included to indicate bay identity as “Bay 1” or “Bay 2.”

**(L190) 4-Fiber Telemetry Feed-through Kit:** provides labels for the 4-fiber Telemetry Feed-through feature for an End Terminal. These labels are tabbed over the existing label indicating the telemetry circuit pack slots used in the shelf.

**(L300) DANTEL EMDU:** provides one DANTEL External Miscellaneous Discrete Unit kit.

**(L300) HARRIS EMDU:** provides one HARRIS External Miscellaneous Discrete Unit kit.

## **J-Drawing J68982D-1 (Integrated Bay Equipment)**

**(L1) Integrated Bay:** provides a three-shelf bay including an End Terminal shelf, an OT System Controller Shelf, an OT Complementary Shelf 1, heat baffles, fuse/power indicating panel, power filters, user panels, and cables.

**(C108138470) ST LBO Kit:** (R2.1 and later, up to 16λ) provides a kit of lightguide build-outs with ST connectors for a single bidirectional line. Includes all necessary LBOs for OA and TLM inputs and outputs. This kit is used in the WaveStar OLS 40G shelf.

**(C108138504) FC LBO Kit:** (R2.1 and later, up to 16λ) provides a kit of lightguide build-outs with FC connectors for a single bidirectional line. Includes all necessary LBOs for OA and TLM inputs and outputs. This kit is used in the WaveStar OLS 40G shelf.

**(C108371758) ST LBO Kit:** (R2.1 and later, up to 16λ) provides a kit of lightguide build-outs with ST connectors for a single bidirectional line. Includes all necessary LBOs for OAs only. This kit is used in the WaveStar OLS 40G shelf.

**Lightguide Jumper Kit:** provides 50-inch ST-to-ST lightguide jumpers and associated labels required for intrashelf connections on a single bidirectional line.

**Lightguide Jumper:** provides 50-inch ST-to-ST and LC-to-ST, and 20-inch LC-to-ST lightguide jumpers and associated labels that are required for intrashelf connections on a single bidirectional line.

**(L163) Lightguide Jumper Kit:** provides 50-inch ST-to-ST and LC-to-ST, and 20-inch LC-to-ST lightguide jumpers and associated labels that are required for intrashelf connections on a single bidirectional line.

**(L164) Lightguide Jumper Kit:** provides 50-inch ST-to-ST and LC-to-ST lightguide jumpers and associated labels that are required for intrashelf connections on one shelf.

**(L165) Lightguide Jumper Kit:** provides 50-inch ST-to-ST and LC-to-ST, and 20-inch LC-to-ST lightguide jumpers and associated labels that are required for intrashelf connections on one shelf.

**(L501) HARRIS EMDU:** provides one HARRIS External Miscellaneous Discrete Unit kit.

## **OT Package Descriptions**

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### **J-Drawing J69000C-1 (Optical Translator System)**

**(L1) OT Cabinet:** provides a cabinet with three shelves, two heat baffles, fuse panels, power filters, indicator strip, designation label strips, cables, rear cover (flat cover only), and doors.

**(L10) Miscellaneously-mounted OT Shelves:** provides three miscellaneously-mounted shelves. Each shelf is equipped with an interconnection panel, a fuse/power indicating panel, a designation label strip, an attached heat baffle, power filters, cables, and a front and rear cover (flat cover only).

**(L11) Miscellaneously-mounted System Controller OT Shelf:** provides one System Controller Shelf equipped with an interconnection panel, a fuse/power indicating panel, a designation label strip, an attached heat baffle, power filters, cables, and a front and rear cover (flat cover only).

**(L12) Miscellaneously-mounted Complementary OT Shelf 1:** provides one Complementary Shelf 1 equipped with an interconnection panel, a fuse/power indicating panel, a designation label strip, an attached heat baffle, power filters, cables, and a front and rear cover (flat cover only). This shelf should only be ordered to upgrade a system that contains L11.

**(L13) Miscellaneously-mounted Complementary OT Shelf 2:** provides one Complementary Shelf 2 equipped with an interconnection panel, a fuse/power indicating panel, a designation label strip, an attached heat baffle, power filters, cables, and a front and rear cover (flat cover only). This shelf should only be ordered to upgrade a system that contains L11 and L12.

**(L14) OT Bay:** provides three miscellaneously-mounted shelves. Each shelf is equipped with an interconnection panel, a fuse/power indicating panel, a designation label strip, an attached heat baffle, power filters, cables, and a front and rear cover (flat cover only) mounted in an ED-8C800-50, G1 network bay frame.

**(C108371741) ST LBO Kit:** (R2.1 and later, 16 $\lambda$ ) provides a kit of lightguide build-outs with ST connectors for use with OTs. Provides all necessary LBOs for a single OT input and output when working with an ODU (L51, L52).

**(C108371766) ST LBO Kit:** (R2.1 and later, 16λ) provides a kit of lightguide build-outs with ST connectors for use with OTPMs. Provides all necessary LBOs for a single OTPM input and output when working with an ODU (L51, L52).

**(C108371717) FC LBO Kit:** (R2.1 and later, 16λ) provides a kit of lightguide build-outs with FC connectors for use with OTUs. Provides all necessary LBOs for a single OT input and output when working with an ODU (L51, L52).

**(C108371725) FC LBO Kit:** (R2.1 and later, 16λ) provides a kit of lightguide build-outs with FC connectors for use with OTPMs. Provides all necessary LBOs for a single OTPM input and output when working with an ODU (L51, L52).

**(161) OT Shelf Label Kit:** provides OT shelf labels for Integrated Cabinet or Bay Triple 1 and Triple 2 applications.

**(L300) DANTEL EMDU:** provides one DANTEL External Miscellaneous Discrete Unit kit.

**(L301) HARRIS EMDU:** provides one HARRIS External Miscellaneous Discrete Unit kit.

See "Power Fuse" for descriptions of the individual circuit packs and units.

## **Circuit Pack/Unit Descriptions**

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This section defines the circuit packs used in WaveStar OLS 40G. For more information on circuit packs and units, refer to Chapter 4, “Product Description.”

### **WaveStar OLS 40G (J-Drawing J68982C-1)**

**(C107742439) OA, LEA7:** amplifies the optical signal and controls the pump lasers for both eight and sixteen wavelengths in Long Reach applications.

**(C107976367) OA, LEA104:** amplifies the optical signal and controls the pump lasers for sixteen wavelengths in Long Span applications.

**(C108680547) OA, LEA107B:** amplifies the optical signal and controls the pump lasers for sixteen wavelengths in Long Span Ethernet 1.25 Gb/s applications.

**(C108045394) OA, LEA105:** amplifies the optical signal and controls the pump lasers for sixteen wavelengths in Short Reach applications.

**(C108309949) OA, LEA7B:** In addition to the same functions as the LEA7 OA (Long Reach), this OA contains an optical monitor test port and filters that support either a 1532 nm or 1510 nm Optical Supervisory Channel (OSC).

**(C107272569) TLM, LDA1:** (Telemetry) provides a supervisory signal (155 Mb/s SONET OC-3-like signal) that is used for fault location and maintenance functions. This circuit pack also provides the customer maintenance signal and three orderwire channels.

**(C107273328) TOHCTL, LEA5:** (Tributary Overhead Controller) processes the SONET section overhead of the supervisory channel. TOHCTL interfaces with the TLM circuit pack to exchange DCC data. This is used with OLS software Release 3.1 and earlier releases.

**SYSCCTL, LEA1:** (System Controller) provides system level user and operations system interfaces and performs system wide maintenance and performance monitoring operations. SYSCCTL supports serial telemetry and X.25 interfaces.

**(C107786568) SYSMEM, LEA2:** (System Memory) provides memory support for SYSCCTL. User provisioned data and system software are stored in EPROMs on the SYSMEM circuit pack.

**(C107727828) OMU, 506A:** (Optical Multiplexer Unit) combines sixteen drop side signals ( $16\lambda$ ) into one optical signal called the optical line signal.

**(C109024430) OMU 506B:** (Optical Multiplexer Unit) combines sixteen drop side signals ( $16\lambda$ ) into one optical signal called the optical line signal. The new faceplate allows LC-type LBOs to be used to balance power. The 506B has a lower through loss than earlier model 506A.

**(C108032814) ODU, 606A:** (Optical Demultiplexer Unit) demultiplexes the optical line signal into sixteen drop side signals ( $16\lambda$  - no supervisory signal).

**(C108032822) ODU, 606B:** (Optical Demultiplexer Unit) demultiplexes the optical line signal into sixteen drop side signals ( $16\lambda$ ) plus an additional supervisory line signal.

**(C109024448) ODU 606C:** (Optical Demultiplexer Unit) demultiplexes the optical line signal into sixteen drop side signals ( $16\lambda$  - no supervisory signal). The 606C has a lower through loss than earlier model 606A.

**(C109038679) ODU 606D:** (Optical Demultiplexer Unit) demultiplexes the optical line signal into sixteen drop side signals ( $16\lambda$ ) plus an additional supervisory line signal. The 606D has a lower through loss than earlier model 606B.

#### **OT (J-Drawing J69000C-1)**

**(C108022823) QOTU 41S:** (Quad Optical Translator Unit) mounts up to four Optical Translator Port Modules (OTPM). Each OTPM regenerates the received signal. OTPMs 42A(1-16)B, 42B and 43A(1-16)B, 43B also re-time the received signal.

**(C108056284) OTCTL, LUD1:** (OT Controller) integrates the OTUs into the WaveStar OLS 40G control structure, combining WaveStar OLS 40G and OT into a single network element.

**OTPM, 42A(1-16)B:** (Optical Translator Port Module), (*See Table 7-18 for individual OTU comcodes*) these modules electrically regenerate a single input OC-12/STM-4 optical signal and insert the tone required by WaveStar OLS 40G onto that signal. The sixteen 42AxB OTPM codes support the sixteen  $1.5\mu\text{m}$  wavelengths on WaveStar OLS 40G systems with total dispersion not exceeding 10,900 ps/nm.

**(C108023334) OTPM, 42B:** (Optical Translator Port Module) electrically regenerates a single input OC-12/STM-4 optical signal and removes the tone required by WaveStar OLS 40G from that signal. The 42B OTPM code supports  $1.3\mu\text{m}$  wavelengths on WaveStar OLS 40G systems with total dispersion not exceeding 10,900 ps/nm. The 42B circuit packs are used on the receive end. Receive OTUs are not required for single-span systems

**OTPM, 43A(1-16)B:** (Optical Translator Port Module) these modules electrically regenerate a single input OC-3/STM-1 optical signal and insert the tone required by WaveStar OLS 40G onto that signal. The sixteen 43AxB OTPM code supports 1.5 $\mu$ m wavelengths on WaveStar OLS 40G systems with total dispersion not exceeding 10,900 ps/nm. (See Table 7-18 for individual OTPM comcodes.)

**(C108023359) OTPM, 43B:** (Optical Translator Port Module) electrically regenerates a single input OC-3/STM-1 optical signal and removes the tone required by WaveStar OLS 40G from that signal. The 43B OTPM code supports 1.3 $\mu$ m wavelengths on WaveStar OLS 40G systems with total dispersion not exceeding 10,900 ps/nm. The 43B circuit packs are used on the receive end. Receive OTUs are not required for single-span systems

**OTPM, 44A(1-16)B:** (Optical Translator Port Module) these modules electrically regenerate a single input low speed broadband 100-750 Mb/s optical signal and insert the tone required by WaveStar OLS 40G onto that signal. The sixteen 44AxB OTPM codes supports 1.5 $\mu$ m wavelengths on WaveStar OLS 40G systems with total dispersion not exceeding 10,900 ps/nm. (See Table 7-18 for individual OTPM comcodes.)

**(C108089467) OTPM, 44B:** (Optical Translator Port Module) electrically regenerates a single input low speed broadband 100-750 Mb/s optical signal and removes the tone required by WaveStar OLS 40G from that signal. The 44B OTPM code supports 1.3 $\mu$ m wavelengths on WaveStar OLS 40G systems with total dispersion not exceeding 10,900 ps/nm. The 44B circuit packs are used on the receive end. Receive OTUs are not required for single-span systems

**(C108128737) OTU, 41BB:** (Optical Translator Unit) electrically regenerates a single input OC-48/STM-16 optical signal and removes the tone required by WaveStar OLS 40G from that signal. The 41BB OTU code regenerates OC-48/STM-16 signals in the 1.3 $\mu$ m range for other SONET OC-48/SDH STM-16 receivers. The 41BB circuit packs are used on the receive end. Receive OTUs are not required for single-span systems.

**OTU, 41A(1-16)C:** (Optical Translator Unit) these circuit packs electrically regenerate a single input OC-48/STM-16 optical signal and insert the tone required by WaveStar OLS 40G onto that signal. These sixteen codes support sixteen wavelengths on WaveStar OLS 40G systems with total dispersion not exceeding 6800 ps/nm. (See Table 7-18 for individual OTU comcodes.)

**OTU, 41C(1-16)C:** (Optical Translator Unit) these circuit packs electrically regenerate a single input OC-48/STM-16 optical signal and insert the tone required by WaveStar OLS 40G onto that signal. These sixteen codes support sixteen wavelengths on WaveStar OLS 40G systems with total dispersion not exceeding 10,900 ps/nm. (See Table 7-18 for individual OTU comcodes)

**OTU, 41F(1-16):** (Optical Translator Unit) electrically regenerates a single input GbE optical signal and inserts the tone required by WaveStar OLS 40G onto that signal. The sixteen codes support sixteen wavelengths on WaveStar OLS 40G systems with total dispersion not exceeding 6,800 ps/nm.

**(C108329715) OTU, 41G:** (Optical Translator Unit) electrically regenerates a single input Ethernet 1.25 Gb/s optical signal and removes the tone required by WaveStar OLS 40G from that signal. The 41G OTU code regenerates Ethernet signals in the 1.3 $\mu$ m range for other Ethernet 1.25 Gb/s receivers.

#### **WaveStar OLS 40G (J-Drawing J68982D-1)**

For the Integrated Bay (J-Drawing J68982D-1), the same circuit packs in WaveStar OLS 40G (J-Drawing J68982C-1) and OT (J-Drawing J69000C-1) apply.

## **Cables**

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Refer to Chapter 4, “Product Description,” for a depiction of backplane cable connections by group number. This section contains information on the cables required for WaveStar OLS 40G equipment.

### **Intraoffice Electrical Non-transmission Cable Descriptions (WaveStar OLS 40G)**

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Refer to Chapter 4, “Product Description,” for a depiction of backplane cable connections by group number. The following intraoffice cables are used in WaveStar OLS 40G:

**Line orderwire cable**– provides voice communication (E2 byte) between adjacent WaveStar OLS 40G network elements.

**Section orderwire cable**– provides voice communication (E1 byte) between adjacent WaveStar OLS 40G network elements.

**Section user channel cable**– provides access to overhead section user channel bits.

**X.25 cable**– provides access to an OS interface.

**Serial telemetry cable**– connects WaveStar OLS 40G to a serial telemetry interface.

**Miscellaneous discrete cable**– connects WaveStar OLS 40G to a user definable set of monitor points.

**Office alarm cable**– connects WaveStar OLS 40G to the office alarms.

**Parallel telemetry cable**– connects WaveStar OLS 40G to a parallel telemetry interface.

**CIT DTE Interface cable**– provides a remote interface to WaveStar OLS 40G that is functionally similar to the CIT Data Communications Equipment (DCE) port. The port can be used to load software and perform system diagnostics.

**LAN cable**– connects the DB-15 appearance on the WaveStar OLS 40G interconnection panel to standard RJ-45 office hub equipment for internet access at the 10 Mb/s rate.

Refer to Chapter 4, “Product Description” for information on WaveStar OLS 40G integration cabling. Ordering information for integration cabling appears later in this chapter.

### **Intraoffice Electrical Non-transmission Cable Descriptions (OT)**

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Refer to Figure 4-35 in Chapter 4, “Product Description,” for a depiction of back-plane cable connections by group number. The following intraoffice cables are used in the OT:

**Office alarm cable**– connects the OT to the office alarms.

**Incoming signal failure cable**– connects the interconnection panel on each shelf to the External Miscellaneous Discrete Unit (EMDU). The cable relays any incoming signal LOS/LOF or B<sub>1</sub> parity errors detected by a Miscellaneous Discrete 2 (MD2) on an OT to the EMDU.

**Circuit pack failure cable**– connects the interconnection panel on each shelf to the External Miscellaneous Discrete Unit (EMDU). The cable relays any circuit pack failure conditions detected by a miscellaneous discrete 1 (MD1) on an OT to the EMDU.

**Power feeder failure alarm cable**– connects a power filter on an OT to an EMDU.

**Table 7-1. WaveStar OLS 40G Intraoffice Electrical Non-transmission Cables**

Cable	T-5G276-33 Figure *	ED-7G028-22 Cable Drawing†		Remarks
		Group	Length	
Line OW, section OW, section user channel cable	8, 10, 11	G471	25 ft.	
		G481	100 ft.	
		G451	150 ft.	
		G461	250 ft.	
X.25 cable	13	G625	20 ft.	
		G652	150 ft.	
		G662	250 ft.	
1st or 2nd serial telemetry cable	14	G201‡	as required	4000 ft. maximum
		G251	150 ft.	
		G261	250 ft.	
Miscellaneous discrete 1 and 2, office alarm, parallel telemetry cable	15, 16, 17, 18	G301	as required	
		G351	150 ft.	
		G361	250 ft.	
CIT interface cable	20	G725	20 ft.	
		G753	50 ft.	
		G754	100 ft.	
		G752	150 ft.	
		G755	250 ft.	

**Table 7-1. WaveStar OLS 40G Intraoffice Electrical Non-transmission Cables (Contd)**

Cable	T-5G276-33 Figure *	ED-7G028-22 Cable Drawing†		Remarks
		Group	Length	
LAN cable	13	G815	150 ft.	
		G816	300 ft.	

\* The T-5G276-33 figure is shipped with the WaveStar OLS 40G product and is needed for the installation process

† Refer to Chapter 4, "Product Description," for a depiction of backplane cable connections by ED-7G028-22 group number

‡ Use group 201 to connect from serial TLM 1 to the External Miscellaneous Discrete Unit.

**Table 7-2. OT Intraoffice Electrical Non-transmission Cables**

Cable	T-6G156-33 Figure *	ED-7G045-22 Cable Drawing		Remarks
		Group	Length	
Office alarm cable	5	G20	75 ft.	
		G2	150 ft.	
		G21	250 ft.	
Power feeder failure alarm cable†		G18	25 ft.	
		G17	150 ft.	
		G31	250 ft.	
System Controller Shelf incoming signal failure cable	6	G5	50 ft.	
		G4	150 ft.	
		G22	250 ft.	

**Table 7-2. OT Intraoffice Electrical Non-transmission Cables (Contd)**

Cable	T-6G156-33 Figure *	ED-7G045-22 Cable Drawing		Remarks
		Group	Length	
System Controller Shelf OTU circuit pack failure cable	7	G5	50 ft.	
		G4	150 ft.	
		G22	250 ft.	
Complementary Shelf 1 Incoming signal failure cable	12	G5	50 ft.	
		G4	150 ft.	
		G22	250 ft.	
Complementary Shelf 1 OTU circuit pack failure cable	13	G5	50 ft.	
		G4	150 ft.	
		G22	250 ft.	
Complementary Shelf 2 incoming signal failure cable	12	G5	50 ft.	
		G4	150 ft.	
		G22	250 ft.	
Complementary Shelf 2 OTU circuit pack failure cable	13	G5	50 ft.	
		G4	150 ft.	
		G22	250 ft.	

\* The T-5G276-33 figure is shipped with the WaveStar OLS 40G product and is needed for the installation process

† Power feeder failure alarm cable is used when an EMDU is present.

The items in Table 7-3 and Table 7-4 provide the assembly and wiring required for one 8-gauge, -48V power feeder.

**Table 7-3. WaveStar OLS 40G Power Cables\***

-48V Power Feeder Type	ED-9C103-22 Cable Drawing		Description
	Group	Length	
A	G37	15 ft.	Used to power 2 shelves in a bay or cabinet
B	G29	15 ft.	
A	G3	15 ft.	Used to power a miscellaneous-mounted shelf
B	G4	15 ft.	
A	G23	15 ft.	Used to power an Integrated Bay
B	G24	15 ft.	
B	G30	100 ft.	Used to power 2 shelves in a cabinet
A	G3	15 ft.	Used to power a miscellaneous-mounted shelf
A	G47	50 ft.	
A	G48	100 ft.	
B	G4	15 ft.	
B	G49	50 ft.	
B	G50	100 ft.	
A	G25	100 ft.	Used to power an Integrated Bay
B	G26	100 ft.	

\* Use Figure 1 for T-5G276-33.

**Table 7-4. OTU Power Cables**

-48V Power Feeder Type	T5G156-33 Figure	ED-9C103-22 Cable Drawing		List (Provided with)
		Group	Length	
A	1	G31	15 feet	L10, and L14
B	1	G25	100 feet	
A	1	G32	100 feet	
B	1	G26	100 feet	
A	2	G7	15 feet	L11, L12, and L13
B	2	G9	15 feet	
A	2	G7	15 feet	
A	2	G43	50 feet	
A	2	G44	100 feet	
B	2	G9	15 feet	
B	2	G45	50 feet	
B	2	G46	100 feet	

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## Fiber Optic Cables

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Table 7-5 provides a list of standard length fiber optic cables and their associated comcodes for use with WaveStar OLS 40G. The customizable cable length is also listed.

**Table 7-5. Minicord Single-mode LC to ST II+**

Length (ft.)	Comcode
1.67	108 108 705
4.2	108 108 713
10	108 108 853
25	108 108 887
50	108 108 937
75	108 108 945
100	108 108 960
custom	107 815 896

Refer to the *Lucent Technologies Fiber Optic Products* catalog (select code: 2492C) when ordering lightguide office cable. Additional comcodes are available from: **1-888-fiber-help**. To order copies of this catalog, use the following information:

**Non-Lucent personnel:** contact the National Telemarketing Center, 1-800-344-0223, ext. 3023

**Lucent personnel:** contact the Lucent Technologies Ordering Center (LTOC), 1-800-458-1761

The catalog is also available on-line at the following address:

<http://www.wr.lucent.com/ncs/fiberoptics/catalog/>

## **Power Fuse**

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The power fuse has a capacity of 10 amperes. When ordering this item, use the following comcode:

**Fuse:** 405749920

## **Power Meter Adapters**

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For testing purposes, an adapter needs to be attached to optical power meter equipment (EXfo) in order to measure the intensity of OA pump lasers. This adapter consists of a fiber jumper with an LC connector block (comprised of two LC connectors) on one end and an ST connector on the other end. The LC connector block attaches to the WaveStar OLS 40G and the ST connector attaches to the power meter.

When ordering the LC connector block, use the following comcode:

**LC connector block:** 108 072 489

## Related Framework

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The following points provide an overview of WaveStar OLS 40G Cabinet hardware and framework.

- The OLS provides front access for all office and user interfaces. All inter-office cables and fiber connections are possible from the front of the system.
- 120V AC power is needed near the cabinet to power a PC or charge a portable PC.
- Table 7-6 provides ordering information for recommended cable racking systems and end guards for WaveStar OLS 40G.

To order framework for the miscellaneous-mounted shelf, use the *Seismic Network Bay Frame Application, Planning and Ordering Guide* (065-215-200).

**Table 7-6. Related Cabinet Hardware**

Framework	Number	Group
Cable rack	ED-5D779-70	1B and G2 required per cabinet
End guard	ED-5D786-70	1A (2 required per cabinet)

## Related Products

This section describes products used with WaveStar OLS 40G.

### Ordering Cleaning Materials

All optical fiber connectors (ST, FT, LC, and SC), lightguide buildouts, and build-out blocks or equivalents should be cleaned before initial connections or re-connections are made (see the *WaveStar OLS 40G Release 7.0 User/Service Manual* for complete cleaning information). Table 7-7 lists cleaning materials recommended for all optical fiber connectors. Order these materials directly from **Speer Fiber Optics** at **1-908-359-1173**. The company address is: **18 Pierson Drive, Belle Mead, NJ, 08502**.

**Table 7-7. Cleaning Materials for Optical Fiber Connectors**

Vendor	Product Description	Supplier Order #
Speer Fiber Optics	CLETOP Cleaning Cassette	14100500
	CLETOP Replacement Reel	14100700
	CLETOP Sticks (200 sticks/box)	14100400

### Ordering METRAL Backplane Replacement Pins

Backplane pins sometimes bend or break from incorrect circuit pack insertion and removal. Table 7-8 and Table 7-9 provide information on pin types and pin replacement kits for WaveStar OLS 40G. Order these materials directly from **Berg Electronics** at **1-717-938-6711**. The company address is: **825 Old Trail Road, Etters, PA, 17319**.

**Table 7-8. METRAL Pin Ordering Information**

Pin Type (Kit Device Code)	Quantity per kit	Pin Length (mm)
88929-102	25	5.75/4.3
88929-106	25	5.75/13.6

**Table 7-8. METRAL Pin Ordering Information (Contd)**

Pin Type (Kit Device Code)	Quantity per kit	Pin Length (mm)
88929-119	25	8.00/4.3
88930-101	25	Blade

**Table 7-9. METRAL Pin Kit/Pin Tool Kit Ordering Information**

Product Name	Supplier Order #
METRAL pin replacement tool kit	MT-370-01

**Table 7-10. WaveStar OLS 40G/OT Equipment Locations and Pin Types**

Circuit Pack Slot	Backplane Location	Rows Using Pin Type: 88929-102	Rows Using Pin Type: 88929-106	Rows Using Pin Type: 88929-119	Rows Using Pin Type: 88930-101
<b>WaveStar OLS 40G Equipment</b>					
SYSMEM (LEA2)	20-604	1-18, 25-72, 97-156	19-24, 85-96	157-162	
SYSCTL (LEA1)	20-584	1-12, 49-72, 85-114, 127-150	151-156	157-162	
TOHCTL (LEA5)	20-554	19-66, 85-90, 97-102, 115-138	151-156	157-162	

**Table 7-10. WaveStar OLS 40G/OT Equipment Locations and Pin Types (Contd)**

Circuit Pack Slot	Backplane Location	Rows Using Pin Type: 88929-102	Rows Using Pin Type: 88929-106	Rows Using Pin Type: 88929-119	Rows Using Pin Type: 88930-101
OA (LEA7, LEA7B, LEA104, LEA107B, LEA105)	20-534, 20-434, 20-330, 20-230	1-12, 109-114, 121-150	151-156	157-162	
TLM (LDA1)	52-180, 52-230, 52-280, 52-330	19-42, 55-90	91-96	97-102	
USER PNL	45-557	1-12			
PWR A	50-597				1-12
PWR B	44-597				1-12
<b>OT Equipment</b>					
OTCTL (SYSMEM)*	20 - 605	1 - 72 85 - 156		157 - 162	
OTCTL (SYSCTL)*	20 - 565	1 - 72 85 - 156		157 - 162	
OTCTL (TOHCTL)*	20 - 525	1 - 12 19 - 66 85 - 156		157 - 162	
OT <sup>†</sup> (System Controller Shelf)	20 - 163 20 - 203 20 - 243 20 - 283 20 - 323 20 - 363 20 - 405 20 - 445 20 - 485 <sup>‡</sup>	1 - 12 85 - 156		157 - 162	

**Table 7-10. WaveStar OLS 40G/OT Equipment Locations and Pin Types (Contd)**

Circuit Pack Slot	Backplane Location	Rows Using Pin Type: 88929-102	Rows Using Pin Type: 88929-106	Rows Using Pin Type: 88929-119	Rows Using Pin Type: 88930-101
OT (Complementary Shelf 1 and 2)	20 - 163 20 - 203 20 - 243 20 - 283 20 - 323 20 - 363 20 - 405 20 - 445 20 - 485 20 - 525 20 - 565 20 - 605	1 - 12 85 - 156		157 - 162	
PWR A	39 - 184				1 - 12
PWR B	39 - 570				1 - 12

\* The OTCTL circuit pack occupies the SYSCTL, SYSTEMEM, and TOHCTL slots in the backplane.

†

‡ This slot is intentionally left blank.

## **Ordering the External Miscellaneous Discrete Unit (EMDU)**

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EMDUs provide user-settable functions for the control and monitoring of equipment collocated with WaveStar OLS 40G. Refer to Chapter 5, “Operations, Administration, Maintenance, and Provisioning” for more information.



**NOTE:**

You must use ED-7G028-22, G201 cable to connect an EMDU to the first serial telemetry port, SER TLM1 (P19).

These units are optional. You may order the units either directly from the manufacturer using the order numbers listed in the table, or from Lucent Technologies using the comcode numbers that are also listed.

Contact **Harris, Inc., Network Support Products** at **972-235-5292**. The company address is:

**1850 No. Greenview Ave.  
M/S 184  
Richardson, TX 75081**

Contact **Dantel, Inc.** at **1-209-292-1111**. The company address is:

**2991 No. Argyle Ave.  
Fresno, CA  
93727-1321**

Table 7-11 lists the available types of EMDUs. Note that these do not represent the EMDU kit. This table acts as an EMDU model number reference only. For kits, order by using the list number shown in the worksheets.

**Table 7-11. Ordering Information for External Miscellaneous Discrete Unit (EMDU)**

Supplier Name	Supplier Model Name	Supplier Order #	Lucent Comcode*
DANTEL	Alarm Control Block	Model No. 46220-00	407567924
	Mounting Bar	A25-00508-01	406863621
HARRIS	C-1000 Centurion	594 - T099 (Integrated Bay)	407845049
		594 - T043	407567932
	Strip Terminal		407809003

\* It is recommended that you use the Lucent Technologies comcode number when ordering.

### **DANTEL Orderwire Shelf**

The DANTEL orderwire shelf provides a 64 kb/s interface to WaveStar OLS 40G. It is shipped separately and does not mount in a WaveStar OLS 40G Cabinet.

The orderwire shelf is optional and is available from either Lucent Technologies or DANTEL, Inc. To order the shelf from Lucent Technologies, use the following information:

**Lucent comcode:** 407790286 Kit, DANTEL interface voice-data orderwire

To order the shelf from Dantel, use the following information:

**DANTEL Part #:** D18-05547-04

## WaveStar OLS 40G Circuit Pack/Unit Compatibility

Table 7-12 provides information on the compatibility of WaveStar OLS 40G equipment and software.

**Table 7-12. Slot/Circuit Pack/ Software Compatibility  
 (R7.0 -WaveStar OLS 40G)**

Slot	Supported Pack Codes	Quantity
<b>End Terminal (Shelf 1, Miscellaneous or Dual)</b>		
TLM 1A	LDA1	0 or 1
TLM 2A	LDA1	0 or 1
OMU/ODU 1A- 2B*	506A	0 or 1 per slot
	506B	
	606A	
	606B	
	606C	
	606D	
OA 1A - 2B	LEA7, LEA7B	1 - 4 total
	LEA104	
	LEA107B	
	LEA105	
TOHCTL	LEA5	1
SYSCTL	LEA1	1
SYSTEMEM	LEA2	1
<b>End Terminal (Shelf 2)</b>		
TLM 3A	LDA1	0 or 1
TLM 4A	LDA1	0 or 1

**Table 7-12. Slot/Circuit Pack/ Software Compatibility  
(R7.0 -WaveStar OLS 40G) (Contd)**

Slot	Supported Pack Codes	Quantity
OMU/ODU 3A - 4B*	506A	0 or 1 per slot
	606A	
	506B	
	606B	
	606C	
	606D	
OA 3A - 4B	LEA7, LEA7B	0 or 1 per slot
	LEA104	
	LEA105	
<b>Repeater Shelf (Shelf 1, Miscellaneous or Dual)</b>		
TLM 1A - 2B	LDA1	2 - 4 total
OA 1A - 2B	LEA7, LEA7B	2 - 4 total
	LEA104	
	LEA107B	
TOHCTL	LEA5	1
SYSCTL	LEA1	1
SYSTEMEM	LEA2	1
<b>Repeater Shelf (Shelf 2)</b>		
TLM 3A - 4B	LDA1	0 - 4 total
OA 3A - 4B	LEA7/LEA7B	0 - 4 total
	LEA104	

\* Equipment units (NOT circuit packs) go into these slots. Refer to SD5G276-01 and SD6G157-01 WaveStar OLS application schematics.

## Ordering Sample

This section contains examples of completed worksheets used to order equipment for a hypothetical network configuration. This information is provided as an illustrative aid to help you with the ordering procedure for WaveStar OLS 40G equipment.

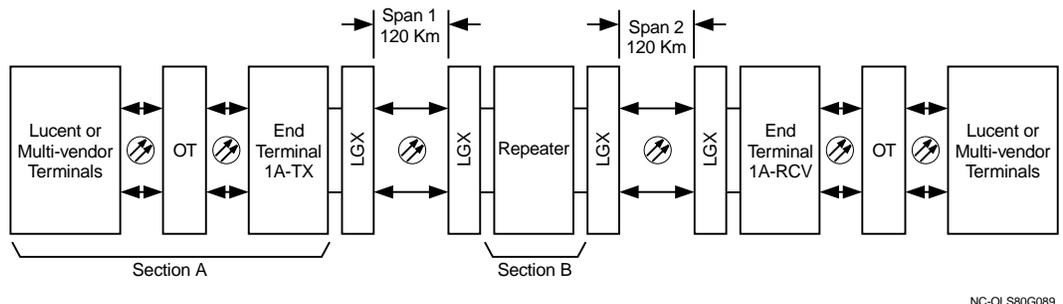
Figure 7-1 depicts the network configuration used for this example. Note that both Lucent-specific and multi-vendor terminals are indicated by the same box. This is meant to show how signals coming into an End Terminal can originate from either Lucent-specific or multi-vendor equipment



**NOTE:**

When using either multi-vendor equipment or an FT-2000 ADR Release 7.1 or earlier, an OTU is required to convert signals to WaveStar OLS 40G compatible optics.

The sample worksheets correspond to sections A and B in the figure.



NC-OLS80G089

**Figure 7-1. Sample Network Configuration Overview**

Figure 7-2 shows an enlarged view of Section A with further details of the network. Note how Lucent terminals do not require the OTU for transmitting signals to a WaveStar OLS 40G.

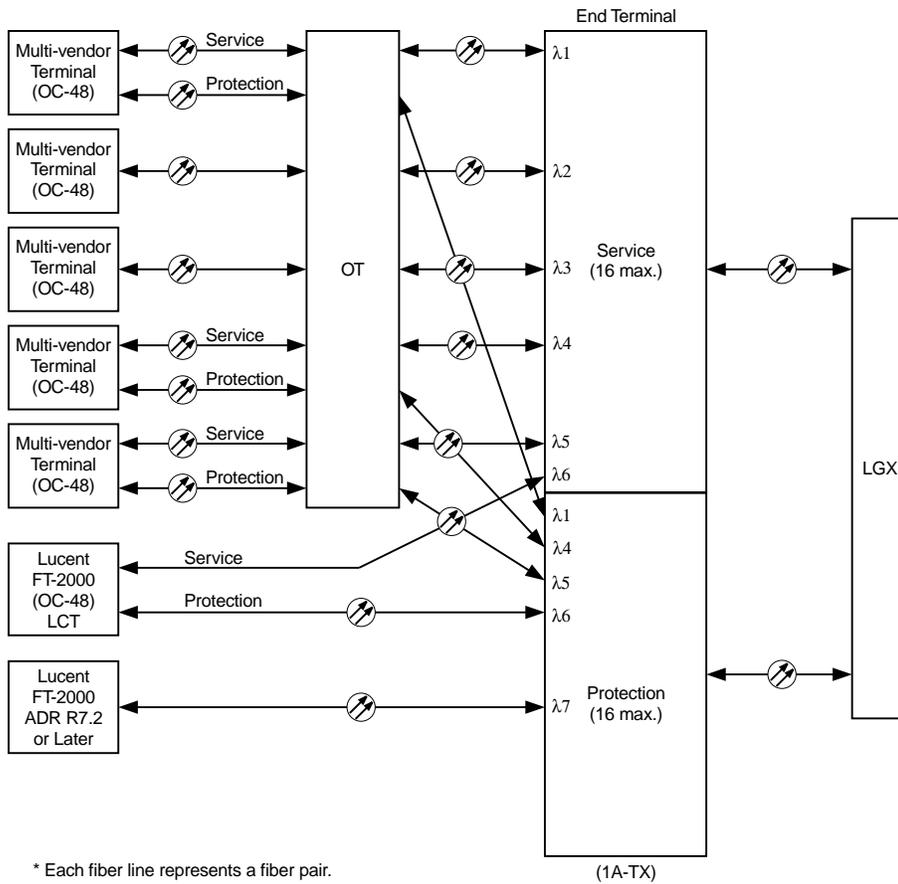


Figure 7-2. Sample Configuration, Section A (Enlarged)

## **Sample Network Assumptions**

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The following assumptions are used for the purpose of this example:

- An End Terminal bay, an Repeater bay, and an OT bay are required (bay frames allow for future expansion of the network)
- North American SONET version used
- 16 wavelength capability
- 2 bidirectional lines
- CD-ROM-based software generic
- OC-48 signal transmission only
- No customer maintenance signal is used; supervisory signal is present
- OTCTL circuit pack is used; no external miscellaneous discrete unit (EMDU) is needed

## **Sample Network Specifications**

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For this configuration, the following network specifications are used:

- Number of spans: **2**
- Distance per span: **120 km**
- Number of wavelengths used (future growth is planned): **11 (6 service, 5 protection)**
- Distance between OT and End Terminal (Section A): **50 ft**
- Distance between CIT and WaveStar OLS 40G: **20 ft**
- Distance between WaveStar OLS 40G and network hub (LAN) connection panel: **100 ft**
- Distance between End Terminal and Lightguide Cross Connect: **53 ft**
- Distance between Lightguide Cross Connect (LGX) and Repeater: **53 ft**

When considering span lengths and associated equipment (for example: Optical Amplifier circuit packs), refer to Chapter 6, “System Planning and Engineering” for system engineering rules.

## Sample Worksheets

The following worksheets are used to order components found in Section A and B of the network. Ordered items and explanations for each entry are shown in bold face text.



**NOTE:**

Depending on distance specifications, number of spans and wavelengths used in the system, and the physical deployment of the application, only certain components are needed from various equipment groups.

**Table 7-13. Dual End Terminal Sample Worksheet (J68982C-1)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Dual End Terminal</b>	Cabinet <b>Bay</b>	L2 or <b>L14</b>	"WaveStar OLS 40G Package Descriptions"
<b>Dual End Terminal Kit</b>	Quantity <u>  <b>1</b>  </u> (1 required per shelf)	<b>L103</b>	
<b>Circuit Packs/Units (J68982C-1)</b>			
Optical Amplifier circuit pack (OA, LEA7)-Long Reach	Quantity _____ (2 per optical line required)	C107742439	"Circuit Pack/Unit Descriptions"
Optical Amplifier circuit pack (OA, LEA104) - Long Span	Quantity <u>  <b>4</b>  </u> (2 per optical line required)	<b>C107976367</b>	<b>This OA handles 16 wavelength operation up to 3 spans over a distance of 136 km per span. The sample network utilizes 2 spans over a length below this maximum number. Therefore, this OA is used.</b>

**Table 7-13. Dual End Terminal Sample Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Optical Amplifier circuit pack (OA, LEA107B) - Long Span	Quantity _____ (2 per optical line required)	<b>C108680547</b>	<b>This OA handles 16 wavelength operation up to 3 spans over a distance of 136 km per span. The sample network utilizes 2 spans over a length below this maximum number. Therefore, this OA is used.</b>
Optical Amplifier circuit pack (OA, LEA105)-Short Reach	Quantity _____ (1 or 2 per optical line required)*	C108045394	
Optical Amplifier circuit pack (OA, LEA7B)- Long Reach	Quantity _____	C108309949	
<b>Telemetry circuit pack LDA1 - 155Mbps</b>	Quantity <u>  2  </u> (1 per optical line required; 2 additional packs per shelf needed for the 4-fiber Telemetry Feed-through feature)	<b>C107273328</b>	<b>This circuit pack is required for handling the supervisory channel.</b>  <b>Note that the 4-fiber Telemetry Feed-through feature is not selected. The sample network used here represents a single WaveStar OLS 40G management subnetwork only.</b>
<b>Tributary overhead controller circuit pack TOHCTL, LEA5</b>	Quantity <u>  1  </u> (2 per cabinet required)	<b>C108283328</b>	
<b>System controller circuit pack STSCTL, LEA1</b>	Quantity <u>  1  </u> (2 per cabinet required)	<b>C107272510</b>	
<b>System memory circuit pack LEA2</b>	Quantity <u>  1  </u> (2 per cabinet required)	<b>C107786568</b>	

**Table 7-13. Dual End Terminal Sample Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Optical Demultiplexer Unit (ODU, 606A 16λ, without supervisory channel)</b>	Quantity <u>  2  </u> (1 per optical line required for two-OA operation)	<b>C108032814</b>	<b>This ODU supports up to 16λ allowing for future growth. This satisfies the current wavelength capacity of the sample network.</b>
Optical Demultiplexer Unit (ODU, 606B 16λ, with supervisory channel)	Quantity _____ (1 per optical line required for single-OA operation)	C108032822	
<b>Optical Demultiplexer Unit (ODU, 606C 16λ, without supervisory channel)</b>	Quantity <u>  2  </u> (1 per optical line required for two-OA operation)	<b>C109024448</b>	<b>This ODU supports up to 16λ allowing for future growth. This satisfies the current wavelength capacity of the sample network.</b>
Optical Demultiplexer Unit (ODU, 606D 16λ, with supervisory channel)	Quantity _____ (1 per optical line required for single-OA operation)	C109038679	
<b>Optical Multiplexer Unit (OMU, 506A 16λ)</b>	Quantity <u>  2  </u> (1 per optical line required)	<b>C107727828</b>	<b>This OMU supports up to 16λ, allowing for future growth.</b>
<b>Optical Multiplexer Unit (OMU, 506B 16λ)</b>	Quantity <u>  2  </u> (1 per optical line required)	<b>C109024430</b>	<b>This OMU supports up to 16λ, allowing for future growth.</b>
<b>Lightguide Jumper Kits</b>			
			“WaveStar OLS 40G Package Descriptions”
<b>Lightguide jumper kit (for 16λ systems, two-OA operation)</b>	Quantity <u>  2  </u> (1 per optical line required)	<b>L162</b>	<b>This jumper kit supports 16λ and two-OA operation; the span distance in the sample network is long enough to require two OA circuit packs per line.</b>

**Table 7-13. Dual End Terminal Sample Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Lightguide jumper kit (for 16λ systems, single- OA operation)	Quantity _____ (1 per optical line required)	L163	
Lightguide jumper kit (for 16λ systems, two- OA/two-OA dual-facing applications)	Quantity _____ (1 per shelf required)	L164	
Lightguide jumper kit (for two-OA/single-OA, single- OA/two-OA, single- OA/single-OA dual-facing applications)	Quantity _____ (1 per shelf required)	L165	
Lightguide Office Cable			

**Table 7-13. Dual End Terminal Sample Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<p><b>Lightguide office cable (MS1LC-EP-?)</b></p>	<p>Quantity <u>80</u> (40 per optical line required for 16λ; 4 additional cables required for the 4-fiber telemetry feed through feature) Length <u>53 ft</u> Comcode: <u>107 815 896,</u> <u>107 132 698</u></p>		<p><b>These cables support 16λ. Note that the maximum amount per line has been ordered even though only 11 wavelengths are actually being used in the sample network. The remaining cables are held in preparation for future growth.</b></p> <p><b>This cable connects the end terminal to the lightguide cross connect (LGX)</b></p> <p><b>The comcodes listed here are the actual codes obtained from the <i>Fiber Optic Products</i> catalog (select code: 2492C)</b></p> <p><b>Here, the MS1LC-EP-? code represents a single-mode product. The cordage length can be customized and is connectorized with LC and ST assemblies to form the overall cable with the comcode that was entered. See “Sample Cabling Illustrations.”</b></p>

**Table 7-13. Dual End Terminal Sample Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Non-transmission Cables (ED-7G028-22)</b>			
Miscellaneous discrete 1 and 2, office alarm, parallel telemetry cable	Quantity _____ Length _____	G301, G351, G361	Table 7-1
<b>X.25 cable</b>	Quantity <u>  1  </u> Length <u>  100 ft  </u>	G652	<b>This cable connects a designated WaveStar OLS 40G site to an X.25 hub controlled by the OSS, turning the site into a gateway network element.</b>  <b>This cable is used to connect a WaveStar OLS 40G site to an end user computer running CenterLink software.</b>
<b>CIT interface cable</b>	Quantity <u>  1  </u> Length <u>  20 ft  </u>	G752	
Line OW, section OW, section user channel cable	Quantity _____ Length _____	G451, G461	
1st or 2nd serial telemetry cable	Quantity _____ Length _____	G201, G251, G261	

**Table 7-13. Dual End Terminal Sample Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>LBO Kits</b>			
			“WaveStar OLS 40G Package Descriptions”
<b>ST LBO kit (R2.1 and later)</b>	Quantity <u>  2  </u> (1 per optical line required)	C108138470	<b>ST LBOs are standard with Lucent equipment.</b>
FC LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required)	C108138504	
<b>Other</b>			
METRAL pin/tool kit	Quantity <u>  1  </u>  Supplier Order #: <b><u>MT-370-01</u></b>		Table 7-8 and Table 7-9 (Use telephone number provided)  <b>This kit is needed for any repairs made to backplane pin connectors (one per office)</b>
<b>CLETOP fiber cleaning materials</b>	Quantity <u>  1  </u>  Supplier Order #: <b><u>14100500</u></b>		Table 7-7 (Use telephone number provided)  <b>This kit is used for cleaning fiber optic connections (one per office)</b>
DANTEL EMDU kit or HARRIS EMDU kit	Quantity _____ Comcode _____  Supplier Order #: _____	L 300 or L301	Table 7-11

**Table 7-13. Dual End Terminal Sample Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
DANTEL orderwire shelf	Quantity _____ Comcode _____  Supplier _____ Order # _____		“DANTEL Orderwire Shelf”
<b>Software</b>	Quantity <u>  1  </u> Comcode _____ (use comcode if ordering an upgrade)	<b>L10, M7R, P7R, M9S, P9S, M10S, P10S,</b>	Table 7-26 and Table 7-27  <b>The lists chosen here include the CD-ROM ver- sion of the software (new system). The CD-ROM con- tains all customer documen- tation in electronic form (one copy per office).</b>
<i>Software Release Description</i> (additional)	Quantity _____ Comcode _____ (use comcode for addi- tional copies)		Table 7-27
<i>User Service Manual</i> (paper)	Quantity _____ Comcode _____ (ordered with diskette version of soft- ware; use comcode for additional copies)	F	Table 7-27

\* A particular Short Reach application may require either one or two OAs on an optical line. Refer to Chapter 3, “Applications”, and Chapter 6, “System Planning and Engineering.”

**Table 7-14. Dual Repeater Sample Worksheet (J68982C-1)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Dual Repeater</b>	Cabinet <b>Bay</b>	L2 <b>L14</b>	“WaveStar OLS 40G Package Descrip- tions”
Dual Repeater Kit	Quantity <u>  <b>1</b>  </u> (1 required per shelf)	L104	
<b>Circuit Packs/Units (J68982C-1)</b>			
Optical Amplifier circuit pack (OA)- Long Span	Quantity _____ (2 per optical line required)	C107273336	<p>“Circuit Pack/Unit Descriptions”</p> <p><b>This OA handles 16 wavelength opera- tion up to 3 spans over a distance of 136 km per span.</b></p> <p><b>This circuit pack is required for han- dling the supervi- sory channel.</b></p>
Optical Amplifier circuit pack (OA)- Long Reach	Quantity _____ (2 per optical line required)	C107742439	
Optical Amplifier circuit pack (OA, LEA104)- Long Span	Quantity <u>  <b>4</b>  </u> (2 per optical line required)	<b>C107976367</b>	
<b>Telemetry circuit pack, TLM, LDA1 (for 1532 nm operation</b>	Quantity <u>  <b>4</b>  </u> (2 per optical line required)	<b>C107272569</b>	
<b>Tributary overhead controller circuit pack TOHCTL, LEA5</b>	Quantity <u>  <b>1</b>  </u> (2 per cabinet/bay required)	<b>C108283328</b>	

**Table 7-14. Dual Repeater Sample Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>System controller circuit pack SYSCTL, LEA1</b>	Quantity <u>  1  </u> (2 per cabinet/bay required)	<b>C107272510</b>	
<b>System memory circuit pack SYSTEMEM, LEA2</b>	Quantity <u>  1  </u> (2 per cabinet/bay required)	<b>C107786568</b>	
<b>Lightguide Jumper Kits</b>			
Lightguide jumper kit	Quantity <u>  2  </u> (1 per optical line required)	<b>L161</b>	“WaveStar OLS 40G Package Descriptions”  <b>On a repeater site, this kit supports both 8 and 16 wave-length operation.</b>
<b>Lightguide Office Cable</b>			
<b>Lightguide office cable (MS1EP-EP-?)</b> “?” indicates length. Specify length required from the Lucent Technologies <i>Fiber Optic Products</i> catalog	Quantity <u>  16  </u> (8 per optical line required) Length <u>  53 ft  </u> Comcode: <u><b>107 306 409,</b></u> <u>          <b>107 306 367</b></u>		<i>Fiber Optic Products</i> catalog 2492C  <b>This cable connects the repeater to the lightguide cross connect (LGX).</b>  <b>The comcodes were obtained from the <i>Fiber Optic Products</i> catalog. See “Sample Cabling Illustrations.”</b>

**Table 7-14. Dual Repeater Sample Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Non-transmission Cables (ED-7G028-22)</b>			
Miscellaneous discrete 1 and 2, office alarm, parallel telemetry cable	Quantity _____ Length _____	G301, G351, G361	Table 7-1
<b>X.25 cable</b>	Quantity <u>  <b>1</b>  </u> Length <u>  <b>100 ft.</b>  </u>	G652	<b>This cable connects a designated WaveStar OLS 40G site to an X.25 hub controlled by the OSS, turning the site into a gateway network element.</b>
<b>CIT interface cable</b>	Quantity <u>  <b>1</b>  </u> Length <u>  <b>20 ft.</b>  </u>	G752	<b>This cable is used to connect a WaveStar OLS 40G site to an end user's computer running CenterLink software.</b>
Line OW, section OW, section user channel cable	Quantity _____ Length _____	G451, G461	
1st or 2nd serial telemetry cable	Quantity _____ Length _____	G201, G251, G261	

**Table 7-14. Dual Repeater Sample Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>LBO Kits</b>			
			“WaveStar OLS 40G Package Descriptions”
ST LBO kit (R2.1 and later)	Quantity <u>  2  </u> (1 per optical line required)	C108138470	<b>ST LBOs are standard with Lucent equipment.</b>
FC LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required)	C108138504	
<b>Other</b>			
<b>METRAL pin/tool kit</b>	Quantity <u>  1  </u> Supplier Order #: <u>  MT-370-01  </u>		Table 7-8 and Table 7-9 (Use telephone number provided)  <b>This kit is needed for any repairs made to backplane pin connectors. It is ordered directly from the supplier (one per office).</b>
<b>CLETOP fiber cleaning materials</b>	Quantity <u>  1  </u> Supplier Order #: <u>  14100500  </u>		Table 7-7 (Use telephone number provided)  <b>This kit is used for cleaning fiber optic connections (one per office).</b>

**Table 7-14. Dual Repeater Sample Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
DANTEL EMDU kit or HARRIS EMDU kit	Quantity _____ Comcode _____  Supplier Order # _____	L 300 or L301	Table 7-11
DANTEL orderwire shelf	Quantity _____ Comcode _____  Supplier Order # _____		“DANTEL Order- wire Shelf”
<b>Software</b>	Quantity <u>  <b>1</b>  </u> Comcode _____ (use comcode for upgrades)	<b>L10, M7R, P7R, M9S, P9S, M10S, P10S</b>	Table 7-26 and Table 7-27  <b>The lists chosen here include the CD- ROM version of the software (new sys- tem). The CD-ROM contains all cus- tomer documenta- tion in electronic form.</b>
<i>Software Release Description</i> (additional)	Quantity _____ Comcode _____ (use comcode for addi- tional copies)		Table 7-27
<i>User Service Manual</i> (paper)	Quantity _____ Comcode _____ (ordered with diskette version of soft- ware; use comcode for additional copies)	F	Table 7-27

**Table 7-15. OT Bay or Miscellaneously-mounted Application Sample Worksheet (J69000C-1)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Miscellaneously-mounted application <b>OT Bay</b>	Quantity _____	L10 or <b>L14</b>	“OT Package Descriptions”
<b>Circuit Packs (J69000C-1)</b>			
<b>OTCTL</b>	Quantity <u>  1  </u>	<b>C108056284</b>	<p>Table 7-28 and “Circuit Pack/Unit Descriptions”</p> <p><b>The OTCTL is used to communicate between the WaveStar OLS 40G 2G and OTU. When it is used, the EMDU and associated cabling from earlier releases is not needed.</b></p> <p><b>Two OTU circuit packs are required per wavelength (one per direction). The 41Ax circuit packs are used in the transmit direction only.</b></p>
<b>OTU 41A1C</b>	Quantity <u>  2  </u>	C108187949	
<b>OTU 41A2C</b>	Quantity <u>  1  </u>	C108187956	
<b>OTU 41A3C</b>	Quantity <u>  1  </u>	C108187964	
<b>OTU 41A4C</b>	Quantity <u>  2  </u>	C108187972	
<b>OTU 41A5C</b>	Quantity <u>  2  </u>	C108187980	
OTU 41A6C	Quantity _____	C108187998	
OTU 41A7C	Quantity _____	C108188004	
OTU 41A8C	Quantity _____	C108188012	
OTU 41A9C	Quantity _____	C108188020	
OTU 41A10C	Quantity _____	C108188038	
OTU 41A11C	Quantity _____	C108188046	
OTU 41A12C	Quantity _____	C108188053	
OTU 41A13C	Quantity _____	C108188061	
OTU 41A14C	Quantity _____	C108188079	
OTU 41A15C	Quantity _____	C108188087	
OTU 41A16C	Quantity _____	C108188095	
OTU 41BB	Quantity _____	C108128737	
OTU 41C1C	Quantity _____	C108188111	

**Table 7-15. OT Bay or Miscellaneously-mounted Application Sample Worksheet (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTU 41C2C	Quantity _____	C108188129	
OTU 41C3C	Quantity _____	C108188137	
OTU 41C4C	Quantity _____	C108188145	
OTU 41C5C	Quantity _____	C108188152	
OTU 41C6C	Quantity _____	C108188160	
OTU 41C7C	Quantity _____	C108188178	
OTU 41C8C	Quantity _____	C108188186	
OTU 41C9C	Quantity _____	C108188194	
OTU 41C10C	Quantity _____	C108188202	
OTU 41C11C	Quantity _____	C108188210	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTU 41C12C	Quantity _____	C108188228	
OTU 41C13C	Quantity _____	C108188236	
OTU 41C14C	Quantity _____	C108188244	
OTU 41C15C	Quantity _____	C108188251	
OTU 41C16C	Quantity _____	C108188269	
OTU 41F1	Quantity _____	C108584210	
OTU 41F2	Quantity _____	C108584228	
OTU 41F3	Quantity _____	C108584236	
OTU 41F4	Quantity _____	C108584244	
OTU 41F5	Quantity _____	C108584251	
OTU 41F6	Quantity _____	C108584269	
OTU 41F7	Quantity _____	C108584277	
OTU 41F8	Quantity _____	C108584285	

**Table 7-15. OT Bay or Miscellaneously-mounted Application Sample Worksheet (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTU 41F9	Quantity _____	C108584806	
OTU 41F10	Quantity _____	C108584814	
OTU 41F11	Quantity _____	C108584822	
OTU 41F12	Quantity _____	C108584830	
OTU 41F13	Quantity _____	C108584848	
OTU 41F14	Quantity _____	C108584855	Table 7-28 and “Circuit Pack/Unit Descrip- tions”
OTU 41F15	Quantity _____	C108584871	
OTU 41F16	Quantity _____	C108584277	
OTU 41G	Quantity _____	C108585928	
QOTU 41S	Quantity _____	C108022823	
OTPM 42A1B	Quantity _____	C108187063	
OTPM 42A2B	Quantity _____	C108187071	
OTPM 42A3B	Quantity _____	C108187089	
OTPM 42A4B	Quantity _____	C108187097	
OTPM 42A5B	Quantity _____	C108187105	
OTPM 42A6B	Quantity _____	C108187113	
OTPM 42A7B	Quantity _____	C108187121	

**Table 7-15. OT Bay or Miscellaneously-mounted Application Sample Worksheet (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTPM 42A8B	Quantity _____	C108187139	Table 7-28 and "Circuit Pack/Unit Descrip- tions"
OTPM 42A9B	Quantity _____	C108187147	
OTPM 42A10B	Quantity _____	C108187196	
OTPM 42A11B	Quantity _____	C108187204	
OTPM 42A12B	Quantity _____	C108187212	
OTPM 42A13B	Quantity _____	C108187220	
OTPM 42A14B	Quantity _____	C108187238	
OTPM 42A15B	Quantity _____	C108187246	
OTPM 42A16B	Quantity _____	C108187253	
OTPM 42B	Quantity _____	C108023334	
OTPM 43A1B	Quantity _____	C108187261	
OTPM 43A2B	Quantity _____	C108187279	
OTPM 43A3B	Quantity _____	C108187287	
OTPM 43A4B	Quantity _____	C108187295	
OTPM 43A5B	Quantity _____	C108187303	
OTPM 43A6B	Quantity _____	C108187311	
OTPM 43A7B	Quantity _____	C108187329	
OTPM 43A8B	Quantity _____	C108187337	
OTPM 43A9B	Quantity _____	C108187345	
OTPM 43A10B	Quantity _____	C108187352	
OTPM 43A11B	Quantity _____	C108187360	
OTPM 43A12B	Quantity _____	C108187378	
OTPM 43A13B	Quantity _____	C108187386	
OTPM 43A14B	Quantity _____	C108187394	

**Table 7-15. OT Bay or Miscellaneously-mounted Application Sample Worksheet (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTPM 43A15B	Quantity _____	C108187402	Table 7-28 and "Circuit Pack/Unit Descrip- tions"
OTPM 43A16B	Quantity _____	C108187410	
OTPM 43B	Quantity _____	C108023359	
OTPM 44A1B	Quantity _____	C108187436	
OTPM 44A2B	Quantity _____	C108187444	
OTPM 44A3B	Quantity _____	C108187451	
OTPM 44A4B	Quantity _____	C108187469	
OTPM 44A5B	Quantity _____	C108187477	
OTPM 44A6B	Quantity _____	C108187485	
OTPM 44A7B	Quantity _____	C108187493	
OTPM 44A8B	Quantity _____	C108187501	
OTPM 44A9B	Quantity _____	C108187519	
OTPM 44A10B	Quantity _____	C108187527	
OTPM 44A11B	Quantity _____	C108187535	
OTPM 44A12B	Quantity _____	C108187543	
OTPM 44A13B	Quantity _____	C108187550	
OTPM 44A14B	Quantity _____	C108187568	
OTPM 44A15B	Quantity _____	C108187584	
OTPM 44A16B	Quantity _____	C108187592	
OTPM 44B	Quantity _____	C108089467	

**Table 7-15. OT Bay or Miscellaneously-mounted Application Sample Worksheet (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Non-transmission Cables (ED-7G045-22)</b>			
Incoming signal failure cable	Quantity _____ Length _____	G5, G4, or G22	Table 7-2, Table 7-3, and Table 7-4
OTU circuit pack failure cable	Quantity _____ Length _____	G5, G4, or G22	
Office alarm cable	Quantity _____ Length _____	G20, G2, or G21	
Power feeder failure alarm cable	Quantity _____ Length _____	G18, G17, or G31	
<b>LBO Kits</b>			
			“OT Package Descriptions”
<b>ST LBO kit (R2.1 and later)</b>	Quantity <u>  10  </u> (1 per OTU or OTPM required)	<b>L122</b>	<b>ST LBOs are standard with Lucent equipment. Order one kit per line, order two additional kits as spares. This kit supports 16λ.</b>
FC LBO kit (R2.1 and later)	Quantity _____ (1 per OTU or OTPM required)**	L132	

**Table 7-15. OT Bay or Miscellaneously-mounted Application Sample Worksheet (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Other</b>			
<b>METRAL pin/tool kit</b>	Quantity <u>  <b>1</b>  </u>  Supplier Order # _____		Table 7-8 and Table 7-9 (Use telephone number provided)  <b>One per office.</b>
<b>CLETOP fiber cleaning materials</b>	Quantity <u>  <b>1</b>  </u>  Supplier Order # _____		Table 7-7 (Use telephone number provided)  <b>One per office.</b>

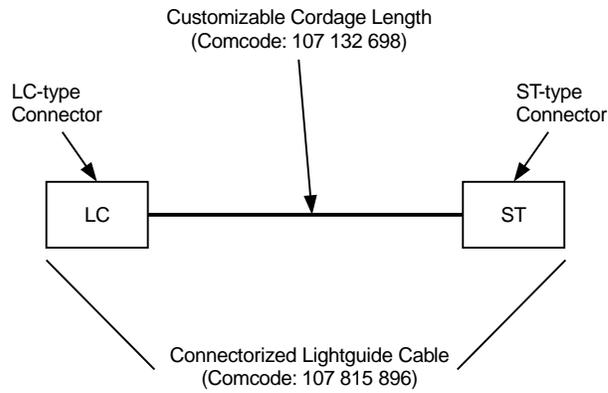
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## Sample Cabling Illustrations

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This section provides descriptive illustrations of various connections and comcode components. These components are used in the sample network but represent actual orderable items.

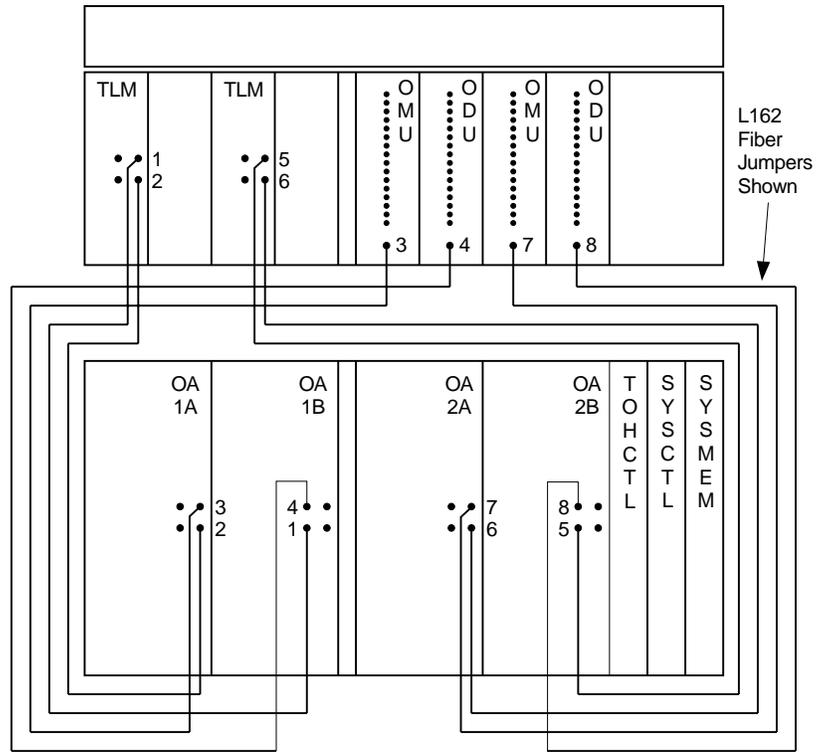
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NC-OLS80G091

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**Figure 7-3. Lightguide Office Cable Depiction**



L162  
 Fiber  
 Jumpers  
 Shown

- Point 1, TLM Connects to Point 1, OA 1B-RCV (Service Line)
- Point 2, TLM Connects to Point 2, OA 1A-TX (Service Line)
- Point 3, OMU Connects to Point 3, OA 1A-TX (Service Line)
- Point 4, ODU Connects to Point 4, OA 1B-RCV (Service Line)
- Point 5, TLM Connects to Point 5, OA 2B-RCV (Protection Line)
- Point 6, TLM Connects to Point 6, OA 2A-TX (Protection Line)
- Point 7, OMU Connects to Point 7, OA 2A-TX (Protection Line)
- Point 8, ODU Connects to Point 8, OA 2B-RCV (Protection Line)

NC-OLS80G092

**Figure 7-4. Intra-shelf Fiber Jumpers for 1A-TX End Terminal (L162)**

## **WaveStar OLS 40G Worksheets**

This section provides worksheets for ordering WaveStar OLS 40G packages. The worksheets list circuit packs and the associated number per line, along with other equipment such as cables, software, and lightguide build-outs (LBO) that are needed to form each package. Enter your selection, along with desired quantity and cable lengths, and enter the appropriate ordering comcode number (where applicable).

**Step 1** Use the appropriate worksheet table related to the package you want to order:

Miscellaneous-mounted End Terminal Shelf	Table 7-16
Miscellaneous-mounted Repeater Shelf	Table 7-17
Miscellaneous-mounted OT System Controller Shelf	Table 7-18
Miscellaneous-mounted OT Complementary Shelf 1 or 2	Table 7-19
Dual End Terminal Cabinet or Bay	Table 7-20
Dual Repeater Cabinet or Bay	Table 7-21
End Terminal and Repeater Combination	Table 7-22
Integrated Bay (Single)	Table 7-23
Integrated Cabinet (Double, super kit)	Page 7-122
Integrated Bay (Double, super kit)	Page 7-122
Integrated Cabinet (Triple 1, super kit)	Page 7-123
Integrated Bay (Triple 1, super kit)	Page 7-123
Integrated Cabinet (Triple 2, super kit)	Page 7-124
Integrated Bay (Triple 2, super kit)	Page 7-124
OT Bay or Miscellaneous-mounted Application	Table 7-24
OT Cabinet	Table 7-25

**Step 2** Follow the worksheet, selecting the number of circuit packs necessary for the product and number of optical lines you want.

**Step 3** Select the number of needed cables, lightguide build-outs (LBOs), and lightguide jumpers. Photocopy the worksheets to make copies.

**Table 7-16. Miscellaneously-mounted End Terminal Shelf (J68982C-1)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Miscellaneously-mounted End Terminal Shelf	Quantity _____  Newlook-2000 covers  Flat covers	L10 or L11	“WaveStar OLS 40G Package Descriptions”
Miscellaneously-mounted End Terminal Kit	Quantity _____ (1 required per shelf)	L106	
<b>Circuit Packs/Units (J68982C-1)</b>			
Optical Amplifier circuit pack (OA, LEA7)-Long Reach	Quantity _____ (2 per optical line required)	C107742439	“Circuit Pack/Unit Descriptions”
Optical Amplifier circuit pack (OA, LEA104)-Long Span	Quantity _____ (2 per optical line required)	C107976367	
Optical Amplifier circuit pack (OA, LEA107B)-Long Span	Quantity _____ (2 per optical line required)	C108680547	
Optical Amplifier circuit pack (OA, LEA105)-Short Reach	Quantity _____ (1 or 2 per optical line required)*	C108045394	
Optical Amplifier circuit pack (OA, LEA7B)- Long Reach	Quantity _____	C108309949	

**Table 7-16. Miscellaneously-mounted End Terminal Shelf (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Telemetry circuit pack, TLM, LDA1 for 1532 nm oper- ation or TLM	Quantity _____ (1 per optical line required; 2 additional packs per shelf needed for the Telemetry Feed-through feature)	C107272569	“Circuit Pack/Unit Descriptions”
Tributary overhead controller circuit pack, TOHCTL, LEA5	Quantity _____ (1 per shelf required)	C107273328	
System controller circuit pack SYSCTL, LEA1	Quantity _____ (1 per shelf required)	C107272510	
System memory circuit pack SYSMEM, LEA2	Quantity _____ (1 per shelf required)	C107786568	
Optical Demultiplexer Unit ODU 606A, 16λ, without supervisory channel	Quantity _____ (1 per optical line required for two-OA operation)	C108032814	
Optical Demultiplexer Unit ODU 606B, 16λ, with supervi- sory channel	Quantity _____ (1 per optical line required for single-OA operation)	C108032822	
Optical Demultiplexer Unit ODU 606C, 16λ, without supervisory channel	Quantity _____ (1 per optical line required for two-OA operation)	C109024448	
Optical Demultiplexer Unit ODU 606D 16λ, with supervi- sory channel	Quantity _____ (1 per optical line required for single-OA operation)	C108032822	
Optical Multiplexer Unit OMU 506A 16λ	Quantity _____ (1 per optical line required)	C107727828	
Optical Multiplexer Unit OMU 506B 16λ	Quantity _____ (1 per optical line required)	C109024430	

**Table 7-16. Miscellaneously-mounted End Terminal Shelf (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Lightguide Jumper Kits</b>			
Lightguide jumper kit (for 16λ systems, two-OA operation)	Quantity _____ (1 per optical line required)	L162	“WaveStar OLS 40G Package Descrip- tions”
Lightguide jumper kit (for 16λ systems, single-OA operation)	Quantity _____ (1 per optical line required)	L163	
Lightguide jumper kit (for 16λ systems, two-OA/two- OA Dual-Facing Shelf opera- tions)	Quantity _____ (1 per shelf required)	L164	
Lightguide jumper kit (for 16λ two-OA/single-OA, single-OA/two-OA, single-OA/single-OA dual-fac- ing applications)	Quantity _____ (1 per shelf required)	L165	
<b>Lightguide Office Cable</b>			
Lightguide office cable (MS1EP-EP-?) “?” indicates length. Specify length required from the Lucent Technologies catalog	Quantity _____ (4 additional cables required for the 4-fiber Telemetry Feed-through feature) Length _____ Comcode _____		<i>Fiber Optic Products Catalog 2492C</i>
Lightguide office cable (MS1LC-EP-?)	Quantity _____ (36 per optical line required for 16λ; 4 additional cables required for the 4-fiber Telemetry Feed-through feature) Length _____ Comcode _____		

**Table 7-16. Miscellaneously-mounted End Terminal Shelf (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Non-transmission Cables (ED-7G028-22)</b>			
Miscellaneous discrete 1 and 2, office alarm, parallel telemetry cable	Quantity _____ Length _____	G301, G351, G361	Table 7-1
X.25 cable	Quantity _____ Length _____	G652	
CIT interface cable	Quantity _____ Length _____	G752	
Line OW, section OW, section user channel cable	Quantity _____ Length _____	G451, G461	
1st or 2nd serial telemetry cable	Quantity _____ Length _____	G201, G251, G261	
LAN cable	Quantity _____ Length _____	G815, G816	

**Table 7-16. Miscellaneously-mounted End Terminal Shelf (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>LBO Kits</b>			
			“WaveStar OLS 40G Package Descriptions”
ST LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required)	C108138470	
ST LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required; for OAs only)	C107515561	
FC LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required)	C108138504	

**Table 7-16. Miscellaneously-mounted End Terminal Shelf (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Other</b>			
DANTEL EMDU kit or HARRIS EMDU kit	Quantity _____ Comcode _____  Supplier _____ Order # _____	L 300 or L301	Table 7-11
DANTEL orderwire shelf	Quantity _____ Comcode _____  Supplier _____ Order # _____		“DANTEL Order- wire Shelf”
METRAL pin/tool kit	Quantity _____  Supplier _____ Order # _____		Table 7-8 and Table 7-9 (Use telephone num- ber provided)
CLETOP fiber cleaning materials	Quantity _____  Supplier _____ Order # _____		Table 7-7 (Use telephone num- ber provided)
Software	Quantity _____ Comcode _____ (use comcode for upgrades)	M7R, P7R, M9S, P9S, M10S, P10S, L10	Table 7-26 and Table 7-27
<i>Software Release Description</i> (additional)	Quantity _____ Comcode _____ (use comcode for additional copies)		Table 7-27
<i>User Service Manual</i> (paper)	Quantity _____ Comcode _____ (ordered with diskette version of soft- ware; use comcode for additional copies)	F	Table 7-27

\* A particular Short Reach application may require either one or two OAs on an optical line. Refer to Chapter 3, “Applications”, and Chapter 6, “System Planning and Engineering.”

**Table 7-17. Miscellaneously-mounted Repeater Shelf  
(J68982C-1)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Miscellaneously-mounted Repeater Shelf	Quantity _____	L10 or L11	“WaveStar OLS 40G Package Descriptions”
Miscellaneously-mounted Repeater Kit	Quantity _____ (1 required per shelf)	L107	
<b>Circuit Packs/Units (J68982C-1)</b>			
Optical Amplifier circuit pack (OA, LEA7)-Long Reach	Quantity _____ (2 per optical line required)	C107742439	“Circuit Pack/Unit Descriptions”
Optical Amplifier circuit pack (OA, LEA104)-Long Span	Quantity _____ (2 per optical line required)	C107976367	
Optical Amplifier circuit pack (OA, LEA107B)-Long Span	Quantity _____ (2 per optical line required)	C1	
Optical Amplifier circuit pack (OA, LEA105)-Short Reach	Quantity _____ (1 or 2 per optical line required)*	C108045394	
Optical Amplifier circuit pack (OA, LEA7B)- Long Reach	Quantity _____	C108309949	
Telemetry circuit pack TLM; LDA1 for 1532 nm operation.	Quantity _____ (1 per optical line required; 2 additional packs per shelf needed for the 4-fiber Telemetry Feed-through feature)	C107272569	

**Table 7-17. Miscellaneously-mounted Repeater Shelf  
(J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Tributary overhead controller circuit pack TOHCTL, LEA5	Quantity _____ (1 per shelf required)	C107273328	“Circuit Pack/Unit Descriptions”
System controller circuit pack SYSCTL, LEA1	Quantity _____ (1 per shelf required)	C107272510	
System memory circuit pack SYSTEMEM, LEA2	Quantity _____ (1 per shelf required)	C107786568	
<b>Lightguide Jumper Kits</b>			
Lightguide jumper kit	Quantity _____ (1 per optical line required)	L161	“WaveStar OLS 40G Package Descriptions”
<b>Lightguide Office Cable</b>			
Lightguide office cable (MS1EP-EP-?) “?” indicates length. Specify length required from the Lucent Technologies catalog	Quantity _____ (1 per shelf required) Length _____ Comcode _____		<i>Fiber Optic Products Catalog 2492C</i>
<b>Non-transmission Cables (ED-7G028-22)</b>			

**Table 7-17. Miscellaneously-mounted Repeater Shelf  
 (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Miscellaneous discrete 1 and 2, office alarm, parallel telemetry cable	Quantity _____ Length _____	G301, G351, G361	Table 7-1
X.25 cable	Quantity _____ Length _____	G652	
CIT interface cable	Quantity _____ Length _____	G752	
Line OW, section OW, section user channel cable	Quantity _____ Length _____	G451, G461	
1st or 2nd serial telemetry cable	Quantity _____ Length _____	G201, G251, G261	

**Table 7-17. Miscellaneously-mounted Repeater Shelf  
(J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>LBO Kits</b>			
			“WaveStar OLS 40G Package Descrip- tions”
ST LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required)	C108138470	
ST LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required; for OAs only)	C107515561	
FC LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required)	C108138504	
<b>Other</b>			
DANTEL EMDU kit or HARRIS EMDU kit	Quantity _____ Comcode _____  Supplier Order # _____	L 300 or L301	Table 7-11
DANTEL orderwire shelf	Quantity _____ Comcode _____  Supplier Order # _____		“DANTEL Order- wire Shelf”
METRAL pin/tool kit	Quantity _____  Supplier Order # _____		Table 7-8 and Table 7-9 (Use telephone num- ber provided)

**Table 7-17. Miscellaneously-mounted Repeater Shelf  
 (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
CLETOP fiber cleaning materials	Quantity _____  Supplier Order # _____		Table 7-7 (Use telephone number provided)
Software	Quantity _____ Comcode _____ (use comcode for upgrades)	M7R, P7R, M9S, P9S, M10S, P10S, L10	Table 7-26 and Table 7-27
<i>Software Release Description</i> (additional)	Quantity _____ Comcode _____ (use comcode for additional copies)		Table 7-27
<i>User Service Manual</i> (paper)	Quantity _____ Comcode _____ (ordered with diskette version of software; use comcode for additional copies)	F	Table 7-27

**Table 7-18. Miscellaneously-mounted OT System Controller Shelf Worksheet  
(J69000C-1)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Miscellaneously-mounted OT System Controller Shelf	Quantity _____	L11	“OT Package Descriptions”
<b>Circuit Packs (J69000C-1)</b>			
OTCTL	Quantity _____	C108056284	“Table 7-28 and “Circuit Pack/Unit Descriptions”
OTU 41A1C	Quantity _____	C108187949	
OTU 41A2C	Quantity _____	C108187956	
OTU 41A3C	Quantity _____	C108187964	
OTU 41A4C	Quantity _____	C108187972	
OTU 41A5C	Quantity _____	C108187980	
OTU 41A6C	Quantity _____	C108187998	
OTU 41A7C	Quantity _____	C108188004	
OTU 41A8C	Quantity _____	C108188012	
OTU 41A9C	Quantity _____	C108188020	
OTU 41A10C	Quantity _____	C108188038	
OTU 41A11C	Quantity _____	C108188046	
OTU 41A12C	Quantity _____	C108188053	
OTU 41A13C	Quantity _____	C108188061	
OTU 41A14C	Quantity _____	C108188079	

**Table 7-18. Miscellaneously-mounted OT System Controller Shelf Worksheet  
 (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTU 41A15C	Quantity _____	C108188087	Table 7-28 and "Circuit Pack/Unit Descriptions"
OTU 41A16C	Quantity _____	C108188095	
OTU 41BB	Quantity _____	C108128737	
OTU 41C1C	Quantity _____	C108188111	
OTU 41C2C	Quantity _____	C108188129	
OTU 41C3C	Quantity _____	C108188137	
OTU 41C4C	Quantity _____	C108188145	
OTU 41C5C	Quantity _____	C108188152	
OTU 41C6C	Quantity _____	C108188160	
OTU 41C7C	Quantity _____	C108188178	
OTU 41C8C	Quantity _____	C108188186	
OTU 41C9C	Quantity _____	C108188194	
OTU 41C10C	Quantity _____	C108188202	
OTU 41C11C	Quantity _____	C108188210	
OTU 41C12C	Quantity _____	C108188228	
OTU 41C13C	Quantity _____	C108188236	
OTU 41C14C	Quantity _____	C108188244	
OTU 41C15C	Quantity _____	C108188251	
OTU 41C16C	Quantity _____	C108188269	
OTU 41F1	Quantity _____	C108584210	
OTU 41F2	Quantity _____	C108584228	
OTU 41F3	Quantity _____	C108584236	
OTU 41F4	Quantity _____	C108584244	

**Table 7-18. Miscellaneously-mounted OT System Controller Shelf Worksheet  
 (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTU 41F5	Quantity _____	C108584251	Table 7-28 and "Circuit Pack/Unit Descriptions"
OTU 41F6	Quantity _____	C10858469	
OTU 41F7	Quantity _____	C108584277	
OTU 41F8	Quantity _____	C108584285	
OTU 41F9	Quantity _____	C108584806	
OTU 41F10	Quantity _____	C108584814	
OTU 41F11	Quantity _____	C108584822	
OTU 41F12	Quantity _____	C108584830	
OTU 41F13	Quantity _____	C108584848	
OTU 41F14	Quantity _____	C108584855	
OTU 41F15	Quantity _____	C108584871	
OTU 41F16	Quantity _____	C108584877	
OTU 41G	Quantity _____	C108585928	
QOTU 41S	Quantity _____	C108022823	
OTPM 42A1B	Quantity _____	C108187063	
OTPM 42A2B	Quantity _____	C108187071	
OTPM 42A3B	Quantity _____	C108187089	
OTPM 42A4B	Quantity _____	C108187097	
OTPM 42A5B	Quantity _____	C108187105	
OTPM 42A6B	Quantity _____	C108187113	
OTPM 42A7B	Quantity _____	C108187121	

**Table 7-18. Miscellaneously-mounted OT System Controller Shelf Worksheet  
(J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTPM 42A8B	Quantity _____	C108187139	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTPM 42A9B	Quantity _____	C108187147	
OTPM 42A10B	Quantity _____	C108187196	
OTPM 42A11B	Quantity _____	C108187204	
OTPM 42A12B	Quantity _____	C108187212	
OTPM 42A13B	Quantity _____	C108187220	
OTPM 42A14B	Quantity _____	C108187238	
OTPM 42A15B	Quantity _____	C108187246	
OTPM 42A16B	Quantity _____	C108187253	
OTPM 42B	Quantity _____	C108023334	
OTPM 43A1B	Quantity _____	C108187261	
OTPM 43A2B	Quantity _____	C108187279	
OTPM 43A3B	Quantity _____	C108187287	
OTPM 43A4B	Quantity _____	C108187295	
OTPM 43A5B	Quantity _____	C108187303	
OTPM 43A6B	Quantity _____	C108187311	
OTPM 43A7B	Quantity _____	C108187329	
OTPM 43A8B	Quantity _____	C108187337	
OTPM 43A9B	Quantity _____	C108187345	
OTPM 43A10B	Quantity _____	C108187352	
OTPM 43A11B	Quantity _____	C108187360	
OTPM 43A12B	Quantity _____	C108187378	

**Table 7-18. Miscellaneously-mounted OT System Controller Shelf Worksheet  
(J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTPM 43A13B	Quantity _____	C108187386	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTPM 43A14B	Quantity _____	C108187394	
OTPM 43A15B	Quantity _____	C108187402	
OTPM 43A16B	Quantity _____	C108187410	
OTPM 43B	Quantity _____	C108023359	
OTPM 44A1B	Quantity _____	C108187436	
OTPM 44A2B	Quantity _____	C108187444	
OTPM 44A3B	Quantity _____	C108187451	
OTPM 44A4B	Quantity _____	C108187469	
OTPM 44A5B	Quantity _____	C108187477	
OTPM 44A6B	Quantity _____	C108187485	
OTPM 44A7B	Quantity _____	C108187493	
OTPM 44A8B	Quantity _____	C108187501	
OTPM 44A9B	Quantity _____	C108187519	
OTPM 44A10B	Quantity _____	C108187527	
OTPM 44A11B	Quantity _____	C108187535	
OTPM 44A12B	Quantity _____	C108187543	
OTPM 44A13B	Quantity _____	C108187550	
OTPM 44A14B	Quantity _____	C108187568	
OTPM 44A15B	Quantity _____	C108187584	
OTPM 44A16B	Quantity _____	C108187592	
OTPM 44B	Quantity _____	C108089467	

**Table 7-18. Miscellaneously-mounted OT System Controller Shelf Worksheet  
 (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Non-transmission Cables (ED-7G045-22)</b>			
Incoming signal failure cable	Quantity _____	G5, G4, or G22	Table 7-2, Table 7-3, and Table 7-4
OTU circuit pack failure cable	Quantity _____	G5, G4, or G22	
Office alarm cable	Quantity _____	G20, G2, or G21	
Power feeder failure alarm cable	Quantity _____	G18, G17, or G31	

**Table 7-18. Miscellaneously-mounted OT System Controller Shelf Worksheet (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>LBO Kits (J69000C-1)</b>			
ST LBO kit (R2.1 and later)	Quantity _____ (1 per OTU required)	C108371741	“OT Package Descriptions”
ST LBO kit (R2.1 and later)	Quantity _____ (1 per OTPM required)	C108371766	
FC LBO kit (R2.1 and later)	Quantity _____ (1 per OTU required)	C108371717	
SC LBO kit (R2.1 and later)	Quantity _____ (1 per OTPM required)	C108371725	
FC LBO kit (R2.1 and later)	Quantity _____ (1 per OTU required)	L129	
SC LBO kit (R2.1 and later)	Quantity _____ (1 per OTU required)	L130	

**Table 7-19. Miscellaneously-mounted OT Complementary Shelf 1 or 2 Worksheet (J69000C-1)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Miscellaneously-mounted OTU Complementary Shelf: 1 2	Quantity _____ Quantity _____	L12 L13	“OT Package Descriptions”
<b>Circuit Packs (J69000C-1)</b>			
OTCTL	Quantity _____	C108056284	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTU 41A1C	Quantity _____	C108187949	
OTU 41A2C	Quantity _____	C108187956	

**Table 7-19. Miscellaneously-mounted OT Complementary Shelf 1 or 2  
 Worksheet (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTU 41A3C	Quantity _____	C108187964	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTU 41A4C	Quantity _____	C108187972	
OTU 41A5C	Quantity _____	C108187980	
OTU 41A6C	Quantity _____	C108187998	
OTU 41A7C	Quantity _____	C108188004	
OTU 41A8C	Quantity _____	C108188012	
OTU 41A9C	Quantity _____	C108188020	
OTU 41A10C	Quantity _____	C108188038	
OTU 41A11C	Quantity _____	C108188046	
OTU 41A12C	Quantity _____	C108188053	
OTU 41A13C	Quantity _____	C108188061	
OTU 41A14C	Quantity _____	C108188079	
OTU 41A15C	Quantity _____	C108188087	
OTU 41A16C	Quantity _____	C108188095	
OTU 41BB	Quantity _____	C108128737	
OTU 41C1C	Quantity _____	C108188111	
OTU 41C2C	Quantity _____	C108188129	
OTU 41C3C	Quantity _____	C108188137	
OTU 41C4C	Quantity _____	C108188145	
OTU 41C5C	Quantity _____	C108188152	
OTU 41C6C	Quantity _____	C108188160	
OTU 41C7C	Quantity _____	C108188178	
OTU 41C8C	Quantity _____	C108188186	

**Table 7-19. Miscellaneously-mounted OT Complementary Shelf 1 or 2  
 Worksheet (J6900C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTU 41C9C	Quantity _____	C108188194	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTU 41C10C	Quantity _____	C108188202	
OTU 41C11C	Quantity _____	C108188210	
OTU 41C12C	Quantity _____	C108188228	
OTU 41C13C	Quantity _____	C108188236	
OTU 41C14C	Quantity _____	C108188244	
OTU 41C15C	Quantity _____	C108188251	
OTU 41C16C	Quantity _____	C108188269	
OTU 41F1	Quantity _____	C108584210	
OTU 41F2	Quantity _____	C108584228	
OTU 41F3	Quantity _____	C108584236	
OTU 41F4	Quantity _____	C108584244	
OTU 41F5	Quantity _____	C108584251	
OTU 41F6	Quantity _____	C10858469	
OTU 41F7	Quantity _____	C108584277	
OTU 41F8	Quantity _____	C108584285	
OTU 41F9	Quantity _____	C108584806	
OTU 41F10	Quantity _____	C108584814	
OTU 41F11	Quantity _____	C108584822	
OTU 41F12	Quantity _____	C108584830	
OTU 41F13	Quantity _____	C108584848	

**Table 7-19. Miscellaneously-mounted OT Complementary Shelf 1 or 2  
 Worksheet (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTU 41F14	Quantity _____	C108584855	Table 7-28 and "Circuit Pack/Unit Descriptions"
OTU 41F15	Quantity _____	C108584871	
OTU 41F16	Quantity _____	C108584877	"
OTU 41G	Quantity _____	C108585928	
QOTU 41S	Quantity _____	C108022823	
OTPM 42A1B	Quantity _____	C108187063	
OTPM 42A2B	Quantity _____	C108187071	
OTPM 42A3B	Quantity _____	C108187089	
OTPM 42A4B	Quantity _____	C108187097	
OTPM 42A5B	Quantity _____	C108187105	
OTPM 42A6B	Quantity _____	C108187113	
OTPM 42A7B	Quantity _____	C108187121	
OTPM 42A8B	Quantity _____	C108187139	
OTPM 42A9B	Quantity _____	C108187147	
OTPM 42A10B	Quantity _____	C108187196	
OTPM 42A11B	Quantity _____	C108187204	
OTPM 42A12B	Quantity _____	C108187212	
OTPM 42A13B	Quantity _____	C108187220	
OTPM 42A14B	Quantity _____	C108187238	
OTPM 42A15B	Quantity _____	C108187246	
OTPM 42A16B	Quantity _____	C108187253	
OTPM 42B	Quantity _____	C108023334	
OTPM 43A1B	Quantity _____	C108187261	

**Table 7-19. Miscellaneously-mounted OT Complementary Shelf 1 or 2  
 Worksheet (J6900C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTPM 43A2B	Quantity _____	C108187279	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTPM 43A3B	Quantity _____	C108187287	
OTPM 43A4B	Quantity _____	C108187295	
OTPM 43A5B	Quantity _____	C108187303	
OTPM 43A6B	Quantity _____	C108187311	
OTPM 43A7B	Quantity _____	C108187329	
OTPM 43A8B	Quantity _____	C108187337	
OTPM 43A9B	Quantity _____	C108187345	
OTPM 43A10B	Quantity _____	C108187352	
OTPM 43A11B	Quantity _____	C108187360	
OTPM 43A12B	Quantity _____	C108187378	
OTPM 43A13B	Quantity _____	C108187386	
OTPM 43A14B	Quantity _____	C108187394	
OTPM 43A15B	Quantity _____	C108187402	
OTPM 43A16B	Quantity _____	C108187410	
OTPM 43B	Quantity _____	C108023359	
OTPM 44A1B	Quantity _____	C108187436	
OTPM 44A2B	Quantity _____	C108187444	
OTPM 44A3B	Quantity _____	C108187451	
OTPM 44A4B	Quantity _____	C108187469	
OTPM 44A5B	Quantity _____	C108187477	
OTPM 44A6B	Quantity _____	C108187485	

**Table 7-19. Miscellaneously-mounted OT Complementary Shelf 1 or 2  
Worksheet (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTPM 44A7B	Quantity _____	C108187493	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTPM 44A8B	Quantity _____	C108187501	
OTPM 44A9B	Quantity _____	C108187519	
OTPM 44A10B	Quantity _____	C108187527	
OTPM 44A11B	Quantity _____	C108187535	
OTPM 44A12B	Quantity _____	C108187543	
OTPM 44A13B	Quantity _____	C108187550	
OTPM 44A14B	Quantity _____	C108187568	
OTPM 44A15B	Quantity _____	C108187584	
OTPM 44A16B	Quantity _____	C108187592	
OTPM 44B	Quantity _____	C108089467	

**Table 7-19. Miscellaneously-mounted OT Complementary Shelf 1 or 2  
Worksheet (J6900C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Non-transmission Cables (ED-7G045-22)</b>			
Incoming signal failure cable	Quantity _____	G5, G4, or G22	Table 7-2, Table 7-3, and Table 7-4
OTU circuit pack failure cable	Quantity _____	G5, G4, or G22	
Office alarm cable	Quantity _____	G20, G2, or G21	
Power feeder failure alarm cable	Quantity _____	G18, G17, or G31	
<b>LBO Kits (J6900C-1)</b>			
ST LBO kit (R2.1 and later)	Quantity _____ (1 per OPS required)	C108328816	“OT Package Descriptions”
ST LBO kit (R2.1 and later)	Quantity _____ (1 per OTU required)	C108371741	
ST LBO kit (R2.1 and later)	Quantity _____ (1 per OTPM required)	C108371766	
FC LBO kit (R2.1 and later)	Quantity _____ (1 per OPS required)	C108328824	
FC LBO kit (R2.1 and later)	Quantity _____ (1 per OTU required)	C108371717	
FC LBO kit (R2.1 and later)	Quantity _____ (1 per OTPM required)	C108371725	
SC LBO kit (R2.1 and later)	Quantity _____ (1 per OTPM required)	L129	
SC LBO kit (R2.1 and later)	Quantity _____ (1 per OTPM required)	L130	
<b>Other</b>			
FC LBO kit (R2.1 and later)	Quantity _____ (1 per OTPM required)	C108371725	“OT Package Descriptions”

**Table 7-19. Miscellaneously-mounted OT Complementary Shelf 1 or 2 Worksheet (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<i>Software Release Description</i> (additional)	Quantity _____ Comcode _____ (use comcode for additional copies)		Table 7-27
<i>User Service Manual</i> (paper)	Quantity _____ Comcode _____ (ordered with diskette version of software; use comcode for additional copies)	F	Table 7-27

**Table 7-20. Dual End Terminal Worksheet (J68982C-1)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Dual End Terminal	Cabinet Bay	L2 or L14	“WaveStar OLS 40G Package Descriptions”
Dual End Terminal Kit	Quantity _____ (1 required per shelf)	L103	

**Table 7-20. Dual End Terminal Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Circuit Packs/Units (J68982C-1)</b>			
Optical Amplifier circuit pack (OA, LEA7)-Long Reach	Quantity _____ (2 per optical line required)	C107742439	“Circuit Pack/Unit Descriptions”
Optical Amplifier circuit pack (OA, LEA104)-Long Span	Quantity _____ (2 per optical line required)	C107976367	
Optical Amplifier circuit pack (OA, LEA107B)-Long Span	Quantity _____ (2 per optical line required)	C108680547	
Optical Amplifier circuit pack (OA, LEA105)-Short Reach	Quantity _____ (1 or 2 per optical line required)*	C108045394	
Optical Amplifier circuit pack (OA, LEA7B)- Long Reach	Quantity _____	C108309949	
Telemetry circuit pack TLM; LDA1 for 1532 nm opera- tion	Quantity _____ (1 per optical line required; 2 additional packs per shelf needed for the Telemetry Feed- through feature)	C107272569	
Tributary overhead controller circuit pack TOHCTL, LEA5	Quantity _____ (1 per shelf required)	C107273328	
System controller circuit pack SYSCTL, LEA1	Quantity _____ (1 per shelf required)	C107272510	
System memory circuit pack SYSTEMEM, LEA2	Quantity _____ (1 per shelf required)	C107786568	
Optical Demultiplexer Unit ODU 16λ, without supervisory channel– 606A	Quantity _____ (1 per optical line required for two-OA operation)	C108032814	
Optical Demultiplexer Unit ODU 16λ, with supervisory channel– 606B	Quantity _____ (1 per optical line required for single-OA operation)	C108032822	

**Table 7-20. Dual End Terminal Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Optical Demultiplexer Unit ODU 16λ, without supervisory channel– 606C	Quantity _____ (1 per optical line required for two-OA operation)	C109024448	“Circuit Pack/Unit Descriptions”
Optical Demultiplexer Unit ODU 16λ, with supervisory channel– 606D	Quantity _____ (1 per optical line required for single-OA operation)	C109038679	
Optical Multiplexer Unit (OMU 16λ– 506A)	Quantity _____ (1 per optical line required)	C107727828	
Optical Multiplexer Unit (OMU 16λ– 506B)	Quantity _____ (1 per optical line required)	C109024430	
<b>Lightguide Jumper Kits</b>			
Lightguide jumper kit (for 16λ systems, two-OA opera- tion)	Quantity _____ (1 per optical line required)	L162	“WaveStar OLS 40G Package Descrip- tions”
Lightguide jumper kit (for 16λ systems, single-OA operation)	Quantity _____ (1 per optical line required)	L163	
Lightguide jumper kit (for 16λ systems, two-OA/two- OA dual-facing applications)	Quantity _____ (1 per shelf required)	L164	
Lightguide jumper kit (for 16λ two-OA/single-OA, single-OA/two-OA, single-OA/single-OA dual-fac- ing applications)	Quantity _____ (1 per shelf required)	L165	

**Table 7-20. Dual End Terminal Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Lightguide Office Cable</b>			
Lightguide office cable (MS1EP-EP-?) “?” indicates length. Specify length required from the Lucent Technologies catalog	Quantity _____ (20 per optical line required for 8λ; 4 additional cables required for the 4-fiber Telemetry Feed-through feature) Length _____ Comcode _____		<i>Fiber Optic Products Catalog 2492C</i>
Lightguide office cable (MS1LC-EP-?)	Quantity _____ (40 per optical line required for 16λ; 4 additional cables required for the 4-fiber Telemetry Feed-through) Length _____ Comcode _____		

**Table 7-20. Dual End Terminal Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Non-transmission Cables (ED-7G028-22)</b>			
Miscellaneous discrete 1 and 2, office alarm, parallel telemetry cable	Quantity _____ Length _____	G301, G351, G361	Table 7-1
X.25 cable	Quantity _____ Length _____	G652	
CIT interface cable	Quantity _____ Length _____	G752	
Line OW, section OW, section user channel cable	Quantity _____ Length _____	G451, G461	
1st or 2nd serial telemetry cable	Quantity _____ Length _____	G201, G251, G261	
LAN cable	Quantity _____ Length _____	G815, G816	

**Table 7-20. Dual End Terminal Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>LBO Kits</b>			
			“WaveStar OLS 40G Package Descrip- tions”
ST LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required)	C108138470	
ST LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required; for OAs only)	C107515561	
FC LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required)	C108138504	
SC LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required)	L116	
<b>Other</b>			
METRAL pin/tool kit	Quantity _____  Supplier Order # _____		Table 7-8 and Table 7-9 (Use telephone num- ber provided)
CLETOP fiber cleaning materials	Quantity _____  Supplier Order # _____		Table 7-7 (Use telephone num- ber provided)
DANTEL EMDU kit or HARRIS EMDU kit	Quantity _____ Comcode _____  Supplier Order # _____	L 300 or L301	Table 7-11

**Table 7-20. Dual End Terminal Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
DANTEL orderwire shelf	Quantity _____ Comcode _____  Supplier Order # _____		“DANTEL Orderwire Shelf”
Software	Quantity _____ Comcode _____ (use comcode for upgrades)	M7R, P7R, M9S, P9S, M10S, P10S, L10	Table 7-26 and Table 7-27
<i>Software Release Description</i> (additional)	Quantity _____ Comcode _____ (use comcode for additional copies)		Table 7-27
<i>User Service Manual</i> (paper)	Quantity _____ Comcode _____ (ordered with diskette version of software; use comcode for additional copies)	F	Table 7-26 and Table 7-27

\* A particular Short Reach application may require either one or two OAs on an optical line. Refer to Chapter 3, “Applications”, and Chapter 6, “System Planning and Engineering.”

**Table 7-21. Dual Repeater Worksheet (J68982C-1)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Dual Repeater	Cabinet Bay	L2 L14	“WaveStar OLS 40G Package Descriptions”
Dual Repeater Kit	Quantity _____ (1 required per shelf)	L104	
<b>Circuit Packs/Units (J68982C-1)</b>			

**Table 7-21. Dual Repeater Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Optical Amplifier circuit pack (OA, LEA7)-Long Reach	Quantity _____ (2 per optical line required)	C107742439	"Circuit Pack/Unit Descriptions"
Optical Amplifier circuit pack (OA, LEA104)-Long Span	Quantity _____ (2 per optical line required)	C107976367	
Optical Amplifier circuit pack (OA, LEA107B)-Long Span	Quantity _____ (2 per optical line required)	C108680547	
Optical Amplifier circuit pack (OA, LEA105)-Short Reach	Quantity _____ (1 or 2 per optical line required)*	C108045394	
Optical Amplifier circuit pack (OA, LEA7B)- Long Reach	Quantity _____	C108309949	
Telemetry circuit pack	Quantity _____ (1 per optical line required; 2 additional packs per shelf needed for the 4-fiber Telemetry Feed-through feature)	C107272569	
Tributary overhead controller circuit pack (TOHCTL)	Quantity _____ (1 per shelf required)	C107273328	
System controller circuit pack (SYSCTL)	Quantity _____ (1 per shelf required)	C107272510	
System memory circuit pack (SYSTEMEM)	Quantity _____ (1 per shelf required)	C107786568	
<b>Lightguide Jumper Kits</b>			
Lightguide jumper kit	Quantity _____ (1 per optical line required)	L161	"WaveStar OLS 40G Package Descriptions"
<b>Lightguide Office Cable</b>			

**Table 7-21. Dual Repeater Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Lightguide office cable (MS1EP-EP-?) “?” indicates length. Specify length required from the Lucent Technologies catalog	Quantity _____ (8 per optical line required) Length _____ Comcode _____		<i>Fiber Optic Products Catalog 2492C</i>
<b>Non-transmission Cables (ED-7G028-22)</b>			
Miscellaneous discrete 1 and 2, office alarm, parallel telemetry cable	Quantity _____ Length _____	G301, G351, G361	Table 7-1
X.25 cable	Quantity _____ Length _____	G652	
CIT interface cable	Quantity _____ Length _____	G752	
Line OW, section OW, section user channel cable	Quantity _____ Length _____	G451, G461	
1st or 2nd serial telemetry cable	Quantity _____ Length _____	G201, G251, G261	

**Table 7-21. Dual Repeater Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>LBO Kits</b>			
			“WaveStar OLS 40G Package Descrip- tions”
ST LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required)	C108138470	
ST LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required; for OAs only)	C107515561	
FC LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required)	C108138504	
<b>Other</b>			
METRAL pin/tool kit	Quantity _____  Supplier Order # _____		Table 7-8 and Table 7-9
CLETOP fiber cleaning materi- als	Quantity _____  Supplier Order # _____		Table 7-7 (Use telephone num- ber provided)
DANTEL EMDU kit or HARRIS EMDU kit	Quantity _____ Comcode _____  Supplier Order # _____	L 300 or L301	Table 7-11 (Use telephone num- ber provided)
DANTEL orderwire shelf	Quantity _____ Comcode _____  Supplier Order # _____		“DANTEL Order- wire Shelf”

**Table 7-21. Dual Repeater Worksheet (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Software	Quantity _____ Comcode _____ (use comcode for upgrades)	M7R, P7R, M9S, P9S, M10S, P10S, L10	Table 7-26 and Table 7-27
<i>Software Release Description</i> (additional)	Quantity _____ Comcode _____ (use comcode for additional copies)		Table 7-27
<i>User Service Manual</i> (paper)	Quantity _____ Comcode _____ (ordered with diskette version of software; use comcode for additional copies)	F	Table 7-27

\* A particular Short Reach application may require either one or two OAs on an optical line. Refer to Chapter 3, "Applications", and Chapter 6, "System Planning and Engineering."

**Table 7-22. End Terminal and Repeater Combination Worksheet  
(J68982C-1)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
End Terminal/Repeater	Cabinet Bay	L2 L14	“WaveStar OLS 40G Package Descriptions”
End Terminal/Repeater Kit	Quantity _____	L105	
Telemetry Feed-through kit*	Quantity _____	L190	
<b>Circuit Packs/Units (J68982C-1)</b>			
Optical Amplifier circuit pack (OA, LEA7)-Long Reach	Quantity _____ (2 per optical line required)	C107742439	“Circuit Pack/Unit Descriptions”
Optical Amplifier circuit pack (OA, LEA104)-Long Span	Quantity _____ (2 per optical line required)	C107976367	
Optical Amplifier circuit pack (OA, LEA107B)-Long Span	Quantity _____ (2 per optical line required)	C108680547	
Optical Amplifier circuit pack (OA, LEA105)-Short Reach	Quantity _____ (1 or 2 per optical line required) <sup>†</sup>	C108045394	
Optical Amplifier circuit pack (OA, LEA7B)- Long Reach	Quantity _____	C108309949	
Telemetry circuit pack	Quantity _____ (1 per optical line required [End Terminal shelf]; 2 per optical line required [Repeater shelf]; 2 additional packs per End Ter- minal shelf needed for 4-fiber Telemetry Feed-through)	C107272569	
Tributary overhead controller circuit pack (TOHCTL)	Quantity _____ (1 per shelf required)	C107273328	
System controller circuit pack (SYSCTL)	Quantity _____ (1 per shelf required)	C107272510	
System memory circuit pack (SYSMEM)	Quantity _____ (1 per shelf required)	C107786568	
Optical Demultiplexer Unit (ODU 16λ, without supervi- sory channel– 606A)	Quantity _____ (1 per optical line required for two-OA operation)	C108032814	

**Table 7-22. End Terminal and Repeater Combination Worksheet  
(J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Optical Demultiplexer Unit (ODU 16λ, with supervisory channel– 606B)	Quantity _____ (1 per optical line required for single-OA operation)	C108032822	“Circuit Pack/Unit Descriptions”
Optical Demultiplexer Unit ODU 16λ, without supervi- sory channel– 606C	Quantity _____ (1 per optical line required for two-OA operation)	C109024448	
Optical Demultiplexer Unit ODU 16λ, with supervisory channel– 606D	Quantity _____ (1 per optical line required for single-OA operation)	C109038679	
Optical Multiplexer Unit (OMU 16λ– 506A)	Quantity _____ (1 per optical line required)	C107727828	
Optical Multiplexer Unit (OMU 16λ– 506B)	Quantity _____ (1 per optical line required)	C109024430	

**Table 7-22. End Terminal and Repeater Combination Worksheet  
(J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Lightguide Jumper Kits</b>			
Lightguide jumper kit (for 16λ systems, two-OA operation)	Quantity _____ (1 per optical line required [for End Terminal])	L162	“WaveStar OLS 40G Package Descriptions”
Lightguide jumper kit (for 16λ systems, single-OA operation)	Quantity _____ (1 per optical line required [for End Terminal])	L163	
Lightguide jumper kit (for 16λ systems, two- OA/two-OA dual-facing applications)	Quantity _____ (1 per shelf required [for End Terminal])	L164	
Lightguide jumper kit (for two-OA/single-OA, single-OA/two-OA, single-OA/single-OA dual- facing applications)	Quantity _____ (1 per shelf required [for End Terminal])	L165	

**Table 7-22. End Terminal and Repeater Combination Worksheet  
 (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Lightguide Office Cable</b>			
Lightguide office cable (MS1LC-EP-?)	Quantity _____ (36 per optical line required for 16λ End Terminal; 8 per optical line for Repeater; 4 additional cables required for the 4-fiber Telemetry Feed-through on End Terminal) Length _____ Comcode _____		<i>Fiber Optic Products Cata- log 2492C</i>

**Table 7-22. End Terminal and Repeater Combination Worksheet  
(J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Non-transmission Cables (ED-7G028-22)</b>			
Miscellaneous discrete 1 and 2, office alarm, parallel telemetry cable	Quantity _____ Length _____	G301, G351, G361	Table 7-1
X.25 cable	Quantity _____ Length _____	G652	
CIT interface cable	Quantity _____ Length _____	G752	
Line OW, section OW, section user channel cable	Quantity _____ Length _____	G451, G461	
1st or 2nd serial telemetry cable	Quantity _____ Length _____	G201, G251, G261	
LAN cable	Quantity _____ Length _____	G815, G816	
<b>LBO Kits</b>			
ST LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required)	C108138470	“WaveStar OLS 40G Package Descriptions”
ST LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required; for OAs only)	C107515561	
FC LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required)	C108138504	

**Table 7-22. End Terminal and Repeater Combination Worksheet  
(J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Other</b>			
METRAL pin/tool kit	Quantity _____  Supplier Order # _____		Table 7-8 and Table 7-9 (Use telephone number pro- vided)
CLETOP fiber cleaning mate- rials	Quantity _____  Supplier Order # _____		Table 7-7 (Use telephone number pro- vided)
DANTEL EMDU kit or HARRIS EMDU kit	Quantity _____ Comcode _____  Supplier Order # _____	L300 or L301	Table 7-11
DANTEL orderwire shelf	Quantity _____ Comcode _____  Supplier Order # _____		"DANTEL Orderwire Shelf"
Software	Quantity _____ Comcode _____ (use comcode for upgrades)	M7R, P7R, M9S, P9S, M10S, P10S, L10	Table 7-26 and Table 7-27
<i>Software Release Description</i> (additional)	Quantity _____ Comcode _____ (use comcode for additional copies)		Table 7-27

**Table 7-22. End Terminal and Repeater Combination Worksheet  
 (J68982C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<i>User Service Manual</i> (paper)	Quantity _____ Comcode _____ (ordered with diskette version of software; use comcode for additional copies)		Table 7-27

\* 4-fiber Telemetry Feed-through does not apply to dual facing, or Single-OA applications.

† A particular Short Reach application may require either one or two OAs on an optical line. Refer to Chapter 3, "Applications", and Chapter 6, "System Planning and Engineering."

**Table 7-23. Integrated Bay (Single) Worksheet  
(J68982D-1)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Integrated Bay (Single)	Quantity _____	L1	“WaveStar OLS 40G Package Descriptions”
Telemetry Feed-through kit*	Quantity _____	L190	
<b>Circuit Packs/Units (J68982C-1)</b>			
Optical Amplifier circuit pack (OA, LEA7)-Long Reach	Quantity _____ (2 per optical line required)	C107742439	“Circuit Pack/Unit Descriptions”
Optical Amplifier circuit pack (OA, LEA104)-Long Span	Quantity _____ (2 per optical line required)	C107976367	
Optical Amplifier circuit pack (OA, LEA107B)-Long Span	Quantity _____ (2 per optical line required)	C108680547	
Optical Amplifier circuit pack (OA, LEA105)-Short Reach	Quantity _____ (1 or 2 per optical line required) <sup>†</sup>	C108045394	
Optical Amplifier circuit pack (OA, LEA7B)- Long Reach	Quantity _____	C108309949	
Telemetry circuit pack	Quantity _____ (1 per optical line required; 2 additional packs per shelf needed for the 4-fiber Telemetry Feed-through feature)	C107272569	
Tributary overhead control- ler circuit pack (TOHCTL, LEA5)	Quantity _____ (1 per shelf required)	C107273328	
System controller circuit pack (SYSCTL, LEA1)	Quantity _____ (1 per shelf required)	C107272510	
System memory circuit pack (SYSTEMEM, LEA2)	Quantity _____ (1 per shelf required)	C107786568	

**Table 7-23. Integrated Bay (Single) Worksheet  
(J68982D-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Optical Demultiplexer Unit (ODU 16λ, without supervi- sory channel– 606A)	Quantity _____ (1 per optical line required for two-OA operation)	C108032814	“Circuit Pack/Unit Descriptions”
Optical Demultiplexer Unit (ODU 16λ, with supervi- sory channel– 606B)	Quantity _____ (1 per optical line required for single-OA operation)	C108032822	
Optical Demultiplexer Unit ODU 16λ, without supervi- sory channel– 606C	Quantity _____ (1 per optical line required for two-OA operation)	C109024448	
Optical Demultiplexer Unit ODU 16λ, with supervisory channel– 606D	Quantity _____ (1 per optical line required for single-OA operation)	C109038679	
Optical Multiplexer Unit (OMU 16λ– 506A)	Quantity _____ (1 per optical line required)	C107727828	
Optical Multiplexer Unit (OMU 16λ– 506B)	Quantity _____ (1 per optical line required)	C109024430	

**Table 7-23. Integrated Bay (Single) Worksheet  
(J68982D-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Circuit Packs (J6900C-1)</b>			
OTCTL	Quantity _____	C108056284	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTU 41A1C	Quantity _____	C108187949	
OTU 41A2C	Quantity _____	C108187956	
OTU 41A3C	Quantity _____	C108187964	
OTU 41A4C	Quantity _____	C108187972	
OTU 41A5C	Quantity _____	C108187980	
OTU 41A6C	Quantity _____	C108187998	
OTU 41A7C	Quantity _____	C108188004	
OTU 41A8C	Quantity _____	C108188012	
OTU 41A9C	Quantity _____	C108188020	
OTU 41A10C	Quantity _____	C108188038	
OTU 41A11C	Quantity _____	C108188046	
OTU 41A12C	Quantity _____	C108188053	
OTU 41A13C	Quantity _____	C108188061	
OTU 41A14C	Quantity _____	C108188079	
OTU 41A15C	Quantity _____	C108188087	
OTU 41A16C	Quantity _____	C108188095	
OTU 41BB	Quantity _____	C108128737	
OTU 41C1C	Quantity _____	C108188111	
OTU 41C2C	Quantity _____	C108188129	
OTU 41C3C	Quantity _____	C108188137	
OTU 41C4C	Quantity _____	C108188145	
OTU 41C5C	Quantity _____	C108188152	
OTU 41C6C	Quantity _____	C108188160	
OTU 41C7C	Quantity _____	C108188178	

**Table 7-23. Integrated Bay (Single) Worksheet  
(J68982D-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTU 41C8C	Quantity _____	C108188186	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTU 41C9C	Quantity _____	C108188194	
OTU 41C10C	Quantity _____	C108188202	
OTU 41C11C	Quantity _____	C108188210	
OTU 41C12C	Quantity _____	C108188228	
OTU 41C13C	Quantity _____	C108188236	
OTU 41C14C	Quantity _____	C108188244	
OTU 41C15C	Quantity _____	C108188251	
OTU 41C16C	Quantity _____	C108188269	
OTU 41F1	Quantity _____	C108584228	
OTU 41F2	Quantity _____	C108584236	
OTU 41F3	Quantity _____	C108584244	
OTU 41F4	Quantity _____	C108584251	
OTU 41F5	Quantity _____	C10858469	
OTU 41F6	Quantity _____	C108584277	
OTU 41F7	Quantity _____	C108584285	
OTU 41F8	Quantity _____	C108584806	
OTU 41F9	Quantity _____	C108584814	
OTU 41F10	Quantity _____	C108584822	
OTU 41F11	Quantity _____	C108584830	
OTU 41F12	Quantity _____	C108584848	
OTU 41F13	Quantity _____	C108584855	
OTU 41F14	Quantity _____	C108584871	
OTU 41F15	Quantity _____	C108584877	

**Table 7-23. Integrated Bay (Single) Worksheet  
 (J68982D-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTU 41F16	Quantity _____	C108585928	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTU 41G	Quantity _____	C108584228	
QOTU 41S	Quantity _____	C108022823	
OTPM 42A1B	Quantity _____	C108187063	
OTPM 42A2B	Quantity _____	C108187071	
OTPM 42A3B	Quantity _____	C108187089	
OTPM 42A4B	Quantity _____	C108187097	
OTPM 42A5B	Quantity _____	C108187105	
OTPM 42A6B	Quantity _____	C108187113	
OTPM 42A7B	Quantity _____	C108187121	
OTPM 42A8B	Quantity _____	C108187139	
OTPM 42A9B	Quantity _____	C108187147	
OTPM 42A10B	Quantity _____	C108187196	
OTPM 42A11B	Quantity _____	C108187204	
OTPM 42A12B	Quantity _____	C108187212	
OTPM 42A13B	Quantity _____	C108187220	
OTPM 42A14B	Quantity _____	C108187238	
OTPM 42A15B	Quantity _____	C108187246	
OTPM 42A16B	Quantity _____	C108187253	
OTPM 42B	Quantity _____	C108023334	
OTPM 43A1B	Quantity _____	C108187261	
OTPM 43A2B	Quantity _____	C108187279	
OTPM 43A3B	Quantity _____	C108187287	
OTPM 43A4B	Quantity _____	C108187295	
OTPM 43A5B	Quantity _____	C108187303	
OTPM 43A6B	Quantity _____	C108187311	

**Table 7-23. Integrated Bay (Single) Worksheet  
 (J68982D-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTPM 43A7B	Quantity _____	C108187329	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTPM 43A8B	Quantity _____	C108187337	
OTPM 43A9B	Quantity _____	C108187345	
OTPM 43A10B	Quantity _____	C108187352	
OTPM 43A11B	Quantity _____	C108187360	
OTPM 43A12B	Quantity _____	C108187378	
OTPM 43A13B	Quantity _____	C108187386	
OTPM 43A14B	Quantity _____	C108187394	
OTPM 43A15B	Quantity _____	C108187402	
OTPM 43A16B	Quantity _____	C108187410	
OTPM 43B	Quantity _____	C108023359	
OTPM 44A1B	Quantity _____	C108187436	
OTPM 44A2B	Quantity _____	C108187444	
OTPM 44A3B	Quantity _____	C108187451	
OTPM 44A4B	Quantity _____	C108187469	
OTPM 44A5B	Quantity _____	C108187477	
OTPM 44A6B	Quantity _____	C108187485	
OTPM 44A7B	Quantity _____	C108187493	
OTPM 44A8B	Quantity _____	C108187501	
OTPM 44A9B	Quantity _____	C108187519	
OTPM 44A10B	Quantity _____	C108187527	
OTPM 44A11B	Quantity _____	C108187535	
OTPM 44A12B	Quantity _____	C108187543	
OTPM 44A13B	Quantity _____	C108187550	

**Table 7-23. Integrated Bay (Single) Worksheet  
 (J68982D-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTPM 44A14B	Quantity _____	C108187568	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTPM 44A15B	Quantity _____	C108187584	
OTPM 44A16B	Quantity _____	C108187592	
OTPM 44B	Quantity _____	C108089467	
<b>Lightguide Jumper Kits (for WaveStar OLS 40G Shelf)</b>			
Lightguide jumper kit (for 16λ systems, two-OA operation)	Quantity _____ (1 per optical line required)	L162	“WaveStar OLS 40G Package Descriptions”
Lightguide jumper kit (for 16λ systems, single-OA operation)	Quantity _____ (1 per optical line required)	L163	
Lightguide jumper kit (for 16λ systems, two- OA/two-OA dual-facing applications)	Quantity _____ (1 per shelf required)	L164	
Lightguide jumper kit (Dual-facing other than two- OA/single-OA, single- OA/two-OA, single-OA/sin- gle-OA dual-facing)	Quantity _____ (1 per shelf required)	L165	
<b>Lightguide Office Cable</b>			
Lightguide office cable (MS1EP-EP-?) “?” indicates length. Spec- ify length required from the Lucent Technologies cata- log	Quantity _____ (20 per optical line required for 8λ; 4 addi- tional cables required for the 4-fiber Telemetry Feed-through feature) Length _____ Comcode _____		<i>Fiber Optic Products Cata- log 2492C</i>

**Table 7-23. Integrated Bay (Single) Worksheet  
(J68982D-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Lightguide office cable (MS1LC-EP-?)	Quantity _____ (36 per optical line required for 16λ; 4 addi- tional cables required for the 4-fiber Telemetry Feed-through feature) Length _____ Comcode _____		<i>Fiber Optic Products Cata- log 2492C</i>
<b>Non-transmission Cables (ED-7G028-22)</b>			
Miscellaneous discrete 1 and 2, office alarm, parallel telemetry cable	Quantity _____ Length _____	G301, G351, G361	Table 7-1
X.25 cable	Quantity _____ Length _____	G652	
CIT interface cable	Quantity _____ Length _____	G752	
Line OW, section OW, sec- tion user channel cable	Quantity _____ Length _____	G451, G461	
1st or 2nd serial telemetry cable	Quantity _____ Length _____	G201, G251, G261	
LAN cable	Quantity _____ Length _____	G815, G816	
<b>Non-transmission Cables (ED-7G045-22)</b>			
Incoming signal failure cable	Quantity _____	G5, G4, or G22	Table 7-2, Table 7-3, and Table 7-4
OTU circuit pack failure cable	Quantity _____	G5, G4, or G22	
Office alarm cable	Quantity _____	G20, G2, or G21	
Power feeder failure alarm cable	Quantity _____	G18, G17, or G31	
<b>LBO Kits</b>			
<b>For WaveStar OLS 40G shelf:</b>			“WaveStar OLS 40G Package Descriptions” and “OT Pack- age Descrip- tions”

**Table 7-23. Integrated Bay (Single) Worksheet  
 (J68982D-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
ST LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required)	C108138470	
FC LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required)	C108138504	
ST LBO kit (R2.1 and later)	Quantity _____ (1 per optical line required; for OAs only)	C108371758	
<b>For OT shelf:</b>			
			“WaveStar OLS 40G Package Descriptions” and “OT Pack- age Descrip- tions”
ST LBO kit (R2.1 and later)	Quantity _____ (1 per OTU required)	C108371741	
ST LBO kit (R2.1 and later)	Quantity _____ (1 per OPS required)	C108328816	
FC LBO kit (R2.1 and later)	Quantity _____ (1 per OPS required)	C108328824	
FC LBO kit (R2.1 and later)	Quantity _____ (1 per OTU required)	C108371717	
ST LBO kit (R2.1 and later)	Quantity _____ (1 per OTPM required)	C108371766	
FC LBO kit (R2.1 and later)	Quantity _____ (1 per OTPM required)	C108371725	
<b>Other</b>			

**Table 7-23. Integrated Bay (Single) Worksheet  
(J68982D-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
HARRIS EMDU kit	Quantity _____ Comcode _____  Supplier Order # _____	L501	Table 7-11
METRAL pin/tool kit	Quantity _____  Supplier Order # _____		Table 7-8 and Table 7-9 (Use telephone number pro- vided)
CLETOP fiber cleaning materials	Quantity _____  Supplier Order # _____		Table 7-7 (Use telephone number pro- vided)
DANTEL orderwire shelf	Quantity _____ Comcode _____  Supplier Order # _____		"DANTEL Orderwire Shelf"
Software	Quantity _____ Comcode _____ (use comcode for upgrades)	M7R, P7R, M9S, P9S, M10S, P10S, L10	Table 7-26 and Table 7-27
<i>Software Release Description</i> (additional)	Quantity _____ Comcode _____ (use comcode for addi- tional copies)		Table 7-27
<i>User Service Manual</i> (paper)	Quantity _____ Comcode _____ (ordered with diskette version of soft- ware; use comcode for additional copies)	F	Table 7-27

\* 4-fiber Telemetry Feed-through does not apply to dual facing, or any Single-OA applications.

† A particular Short Reach application may require either one or two OAs on an optical line. Refer to Chapter 3, “Applications”, and Chapter 6, “System Planning and Engineering.”

**Table 7-24. OT Bay or Miscellaneously-mounted Application Worksheet (J69000C-1)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
Miscellaneously-mounted Application OT Bay	Quantity _____	L10 or L14	“OT Package Descriptions”
<b>Circuit Packs (J69000C-1)</b>			
OTCTL	Quantity _____	C108056284	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTU 41A1C	Quantity _____	C108187949	
OTU 41A2C	Quantity _____	C108187956	
OTU 41A3C	Quantity _____	C108187964	
OTU 41A4C	Quantity _____	C108187972	
OTU 41A5C	Quantity _____	C108187980	
OTU 41A6C	Quantity _____	C108187998	
OTU 41A7C	Quantity _____	C108188004	
OTU 41A8C	Quantity _____	C108188012	
OTU 41A9C	Quantity _____	C108188020	
OTU 41A10C	Quantity _____	C108188038	
OTU 41A11C	Quantity _____	C108188046	
OTU 41A12C	Quantity _____	C108188053	
OTU 41A13C	Quantity _____	C108188061	
OTU 41A14C	Quantity _____	C108188079	
OTU 41A15C	Quantity _____	C108188087	
OTU 41A16C	Quantity _____	C108188095	

**Table 7-24. OT Bay or Miscellaneously-mounted Application Worksheet  
(J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTU 41BB	Quantity _____	C108128737	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTU 41C1C	Quantity _____	C108188111	
OTU 41C2C	Quantity _____	C108188129	
OTU 41C3C	Quantity _____	C108188137	
OTU 41C4C	Quantity _____	C108188145	
OTU 41C5C	Quantity _____	C108188152	
OTU 41C6C	Quantity _____	C108188160	
OTU 41C7C	Quantity _____	C108188178	
OTU 41C8C	Quantity _____	C108188186	
OTU 41C9C	Quantity _____	C108188194	
OTU 41C10C	Quantity _____	C108188202	
OTU 41C11C	Quantity _____	C108188210	
OTU 41C12C	Quantity _____	C108188228	
OTU 41C13C	Quantity _____	C108188236	
OTU 41C14C	Quantity _____	C108188244	
OTU 41C15C	Quantity _____	C108188251	
OTU 41C16C	Quantity _____	C108188269	
OTU 41F1	Quantity _____	C108584228	
OTU 41F2	Quantity _____	C108584236	
OTU 41F3	Quantity _____	C108584244	
OTU 41F4	Quantity _____	C108584251	
OTU 41F5	Quantity _____	C10858469	

**Table 7-24. OT Bay or Miscellaneously-mounted Application Worksheet  
(J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTU 41F6	Quantity _____	C108584277	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTU 41F7	Quantity _____	C108584285	
OTU 41F8	Quantity _____	C108584806	
OTU 41F9	Quantity _____	C108584814	
OTU 41F10	Quantity _____	C108584822	
OTU 41F11	Quantity _____	C108584830	
OTU 41F12	Quantity _____	C108584848	
OTU 41F13	Quantity _____	C108584855	
OTU 41F14	Quantity _____	C108584871	
OTU 41F15	Quantity _____	C108584877	
OTU 41F16	Quantity _____	C108585928	
OTU 41G	Quantity _____	C108584228	
QOTU 41S	Quantity _____	C108022823	
OTPM 42A1B	Quantity _____	C108187063	
OTPM 42A2B	Quantity _____	C108187071	
OTPM 42A3B	Quantity _____	C108187089	
OTPM 42A4B	Quantity _____	C108187097	
OTPM 42A5B	Quantity _____	C108187105	
OTPM 42A6B	Quantity _____	C108187113	
OTPM 42A7B	Quantity _____	C108187121	
OTPM 42A8B	Quantity _____	C108187139	
OTPM 42A9B	Quantity _____	C108187147	

**Table 7-24. OT Bay or Miscellaneously-mounted Application Worksheet  
(J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTPM 42A10B	Quantity _____	C108187196	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTPM 42A11B	Quantity _____	C108187204	
OTPM 42A12B	Quantity _____	C108187212	
OTPM 42A13B	Quantity _____	C108187220	
OTPM 42A14B	Quantity _____	C108187238	
OTPM 42A15B	Quantity _____	C108187246	
OTPM 42A16B	Quantity _____	C108187253	
OTPM 42B	Quantity _____	C108023334	
OTPM 43A1B	Quantity _____	C108187261	
OTPM 43A2B	Quantity _____	C108187279	
OTPM 43A3B	Quantity _____	C108187287	
OTPM 43A4B	Quantity _____	C108187295	
OTPM 43A5B	Quantity _____	C108187303	
OTPM 43A6B	Quantity _____	C108187311	
OTPM 43A7B	Quantity _____	C108187329	
OTPM 43A8B	Quantity _____	C108187337	
OTPM 43A9B	Quantity _____	C108187345	
OTPM 43A10B	Quantity _____	C108187352	
OTPM 43A11B	Quantity _____	C108187360	
OTPM 43A12B	Quantity _____	C108187378	
OTPM 43A13B	Quantity _____	C108187386	
OTPM 43A14B	Quantity _____	C108187394	

**Table 7-24. OT Bay or Miscellaneously-mounted Application Worksheet  
(J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTPM 43A15B	Quantity _____	C108187402	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTPM 43A16B	Quantity _____	C108187410	
OTPM 43B	Quantity _____	C108023359	
OTPM 44A1B	Quantity _____	C108187436	
OTPM 44A2B	Quantity _____	C108187444	
OTPM 44A3B	Quantity _____	C108187451	
OTPM 44A4B	Quantity _____	C108187469	
OTPM 44A5B	Quantity _____	C108187477	
OTPM 44A6B	Quantity _____	C108187485	
OTPM 44A7B	Quantity _____	C108187493	
OTPM 44A8B	Quantity _____	C108187501	
OTPM 44A9B	Quantity _____	C108187519	
OTPM 44A10B	Quantity _____	C108187527	
OTPM 44A11B	Quantity _____	C108187535	
OTPM 44A12B	Quantity _____	C108187543	
OTPM 44A13B	Quantity _____	C108187550	
OTPM 44A14B	Quantity _____	C108187568	
OTPM 44A15B	Quantity _____	C108187584	
OTPM 44A16B	Quantity _____	C108187592	
OTPM 44B	Quantity _____	C108089467	

**Table 7-24. OT Bay or Miscellaneously-mounted Application Worksheet  
(J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Non-transmission Cables (ED-7G045-22)</b>			
Incoming signal failure cable	Quantity _____ Length _____	G5, G4, or G22	Table 7-2, Table 7-3, and Table 7-4
OTU circuit pack failure cable	Quantity _____ Length _____	G5, G4, or G22	
Office alarm cable	Quantity _____ Length _____	G20, G2, or G21	
Power feeder failure alarm cable	Quantity _____ Length _____	G18, G17, or G31	
<b>LBO Kits</b>			
			“OT Package Descriptions”
ST LBO kit (R2.1 and later)	Quantity _____ (1 per OPS required)	C108328816	
ST LBO kit (R2.1 and later)	Quantity _____ (1 per OTU required)	C108371741	
ST LBO kit (R2.1 and later)	Quantity _____ (1 per OTPM required)	C108371766	
FC LBO kit (R2.1 and later)	Quantity _____ (1 per OPS required)	C108328824	
FC LBO kit (R2.1 and later)	Quantity _____ (1 per OTU required)	C108371717	
FC LBO kit (R2.1 and later)	Quantity _____ (1 per OTPM required)	C108371725	
<b>Other</b>			

**Table 7-24. OT Bay or Miscellaneously-mounted Application Worksheet (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
METRAL pin/tool kit	Quantity _____  Supplier Order # _____		Table 7-8 and Table 7-9 (Use telephone number pro- vided)
CLETOP fiber cleaning materials	Quantity _____  Supplier Order # _____		Table 7-7 (Use telephone number pro- vided)

**Table 7-25. OT Cabinet Worksheet (J69000C-1)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OT Cabinet	Quantity _____	L1	“OT Package Descriptions”
<b>Circuit Packs (J69000C-1)</b>			
OTCTL	Quantity _____	C108056284	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTU 41A1C	Quantity _____	C108187949	
OTU 41A2C	Quantity _____	C108187956	
OTU 41A3C	Quantity _____	C108187964	
OTU 41A4C	Quantity _____	C108187972	
OTU 41A5C	Quantity _____	C108187980	
OTU 41A6C	Quantity _____	C108187998	
OTU 41A7C	Quantity _____	C108188004	

**Table 7-25. OT Cabinet Worksheet (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTU 41A8C	Quantity _____	C108188012	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTU 41A9C	Quantity _____	C108188020	
OTU 41A10C	Quantity _____	C108188038	
OTU 41A11C	Quantity _____	C108188046	
OTU 41A12C	Quantity _____	C108188053	
OTU 41A13C	Quantity _____	C108188061	
OTU 41A14C	Quantity _____	C108188079	
OTU 41A15C	Quantity _____	C108188087	
OTU 41A16C	Quantity _____	C108188095	
OTU 41BB	Quantity _____	C108128737	
OTU 41C1C	Quantity _____	C108188111	
OTU 41C2C	Quantity _____	C108188129	
OTU 41C3C	Quantity _____	C108188137	
OTU 41C4C	Quantity _____	C108188145	
OTU 41C5C	Quantity _____	C108188152	
OTU 41C6C	Quantity _____	C108188160	
OTU 41C7C	Quantity _____	C108188178	
OTU 41C8C	Quantity _____	C108188186	
OTU 41C9C	Quantity _____	C108188194	
OTU 41C10C	Quantity _____	C108188202	
OTU 41C11C	Quantity _____	C108188210	
OTU 41C12C	Quantity _____	C108188228	
OTU 41C13C	Quantity _____	C108188236	

**Table 7-25. OT Cabinet Worksheet (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTU 41C14C	Quantity _____	C108188244	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTU 41C15C	Quantity _____	C108188251	
OTU 41C16C	Quantity _____	C108188269	
OTU 41F1	Quantity _____	C108584228	
OTU 41F2	Quantity _____	C108584236	
OTU 41F3	Quantity _____	C108584244	
OTU 41F4	Quantity _____	C108584251	
OTU 41F5	Quantity _____	C10858469	
OTU 41F6	Quantity _____	C108584277	
OTU 41F7	Quantity _____	C108584285	
OTU 41F8	Quantity _____	C108584806	
OTU 41F9	Quantity _____	C108584814	
OTU 41F10	Quantity _____	C108584822	
OTU 41F11	Quantity _____	C108584830	
OTU 41F12	Quantity _____	C108584848	
OTU 41F13	Quantity _____	C108584855	
OTU 41F14	Quantity _____	C108584871	
OTU 41F15	Quantity _____	C108584877	
OTU 41F16	Quantity _____	C108585928	
OTU 41G	Quantity _____	C108584228	
QOTU 41S	Quantity _____	C108022823	
OTPM 42A1B	Quantity _____	C108187063	
OTPM 42A2B	Quantity _____	C108187071	
OTPM 42A3B	Quantity _____	C108187089	

**Table 7-25. OT Cabinet Worksheet (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTPM 42A4B	Quantity _____	C108187097	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTPM 42A5B	Quantity _____	C108187105	
OTPM 42A6B	Quantity _____	C108187113	
OTPM 42A7B	Quantity _____	C108187121	
OTPM 42A8B	Quantity _____	C108187139	
OTPM 42A9B	Quantity _____	C108187147	
OTPM 42A10B	Quantity _____	C108187196	
OTPM 42A11B	Quantity _____	C108187204	
OTPM 42A12B	Quantity _____	C108187212	
OTPM 42A13B	Quantity _____	C108187220	
OTPM 42A14B	Quantity _____	C108187238	
OTPM 42A15B	Quantity _____	C108187246	
OTPM 42A16B	Quantity _____	C108187253	
OTPM 42B	Quantity _____	C108023334	
OTPM 43A1B	Quantity _____	C108187261	
OTPM 43A2B	Quantity _____	C108187279	
OTPM 43A3B	Quantity _____	C108187287	
OTPM 43A4B	Quantity _____	C108187295	
OTPM 43A5B	Quantity _____	C108187303	
OTPM 43A6B	Quantity _____	C108187311	
OTPM 43A7B	Quantity _____	C108187329	
OTPM 43A8B	Quantity _____	C108187337	
OTPM 43A9B	Quantity _____	C108187345	

**Table 7-25. OT Cabinet Worksheet (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
OTPM 43A10B	Quantity _____	C108187352	Table 7-28 and “Circuit Pack/Unit Descriptions”
OTPM 43A11B	Quantity _____	C108187360	
OTPM 43A12B	Quantity _____	C108187378	
OTPM 43A13B	Quantity _____	C108187386	
OTPM 43A14B	Quantity _____	C108187394	
OTPM 43A15B	Quantity _____	C108187402	
OTPM 43A16B	Quantity _____	C108187410	
OTPM 43B	Quantity _____	C108023359	
OTPM 44A1B	Quantity _____	C108187436	
OTPM 44A2B	Quantity _____	C108187444	
OTPM 44A3B	Quantity _____	C108187451	
OTPM 44A4B	Quantity _____	C108187469	
OTPM 44A5B	Quantity _____	C108187477	
OTPM 44A6B	Quantity _____	C108187485	
OTPM 44A7B	Quantity _____	C108187493	
OTPM 44A8B	Quantity _____	C108187501	
OTPM 44A9B	Quantity _____	C108187519	
OTPM 44A10B	Quantity _____	C108187527	
OTPM 44A11B	Quantity _____	C108187535	
OTPM 44A12B	Quantity _____	C108187543	
OTPM 44A13B	Quantity _____	C108187550	
OTPM 44A14B	Quantity _____	C108187568	
OTPM 44A15B	Quantity _____	C108187584	
OTPM 44A16B	Quantity _____	C108187592	
OTPM 44B	Quantity _____	C108089762	

**Table 7-25. OT Cabinet Worksheet (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
<b>Non-transmission Cables (ED-7G045-22)</b>			
Incoming signal failure cable	Quantity _____ Length _____	G5, G4, or G22	Table 7-2, Table 7-3, and Table 7-4
OTU circuit pack failure cable	Quantity _____ Length _____	G5, G4, or G22	
Office alarm cable	Quantity _____ Length _____	G20, G2, or G21	
Power feeder failure alarm cable	Quantity _____ Length _____	G18, G17, or G31	
<b>LBO Kits (J69000C-1)</b>			
			“OT Package Descriptions”
ST LBO kit (R2.1 and later)	Quantity _____ (1 per OPS required)	C108328816	
ST LBO kit (R2.1 and later)	Quantity _____ (1 per OTU required)	C108371741	
ST LBO kit (R2.1 and later)	Quantity _____ (1 per OTPM required)	C108371766	
FC LBO kit (R2.1 and later)	Quantity _____ (1 per OPS required)	C108328824	

**Table 7-25. OT Cabinet Worksheet (J69000C-1) (Contd)**

DESCRIPTION	SELECTION/ QUANTITY	COMCODE/ LIST/GROUP	REFERENCE
FC LBO kit (R2.1 and later)	Quantity _____ (1 per OTU required)	C108371717	“OT Package Descriptions”
FC LBO kit (R2.1 and later)	Quantity _____ (1 per OTPM required)	C108371725	
<b>Other</b>			
CLETOP fiber cleaning materials	Quantity _____  Supplier _____		Table 7-7 (Use telephone number provided)
METRAL pin/tool kit	Quantity _____  Supplier _____ Order # _____		Table 7-8 and Table 7-9 (Use telephone number provided)

## **WaveStar OLS 40G Super Kits**

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This section contains ordering information for WaveStar OLS 40G super kits. Use the ED number (shown in the heading) when ordering these kits. Use Table 7-16 and Table 7-24 to order WaveStar OLS 40G and OTU circuit packs and cables separately. The components of each super kit are listed.

### **Integrated Cabinet (Double) Super Kit (ED-8C903-40, G1)**

---

This is a super kit that includes the following:

- One J-Drawing J68982C-1, L2 and L103
- One J-Drawing J69000C-1, L1
- Cables for connecting two cabinets
- System controller\* circuit packs
- L171 integration cabling.

Use Table 7-16 and Table 7-24 to order WaveStar OLS 40G and OTU circuit packs and cables separately.

### **Integrated Bay (Double) Super Kit (ED-8C903-40, G2)**

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This is a super kit that includes the following:

- One J-Drawing J68982C-1, L14
- One J-Drawing J69000C-1, L14
- Associated cables for connecting two bays
- System controller\* circuit packs
- L171 integration cabling.

---

\*. System controller circuit packs: L30, L35, L40 (J-Drawing J68982C-1) and L50 (J-Drawing J69000C-1)

Use Table 7-16 and Table 7-24 to order WaveStar OLS 40G and OTU circuit packs and cables separately.

### **Integrated Cabinet (Triple 1) Super Kit (ED-8C903-40, G3)**

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This is a super kit that includes the following:

- One J-Drawing J68982C-1, L2 and L10
- Two J-Drawing J69000C-1, L1
- One L161 cables for connecting three cabinets
- System controller\* circuit packs
- L172 integration cabling.

Use Table 7-16 and Table 7-24 to order WaveStar OLS 40G and OTU circuit packs and cables separately.

### **Integrated Bay (Triple 1) Super Kit (ED-8C903-40, G4)**

---

This is a super kit that includes the following:

- One J-Drawing J68982C-1, L14
- Two J-Drawing J69000C-1, L14
- One J-Drawing J69000C-1, L161
- Associated cables for connecting three bays
- System controller\* circuit packs
- L172 integration cabling.

Use Table 7-16 and Table 7-24 to order WaveStar OLS 40G and OTU circuit packs and cables separately.

---

\*. System controller circuit packs: L30, L35, L40 (J-Drawing J68982C-1) and L50 (J-Drawing J69000C-1)

### **Integrated Cabinet (Triple 2) Super Kit (ED-8C903-40, G5)**

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This is a super kit that includes the following:

- One J-Drawing J68982C-1, L2
- One J-Drawing J68982C-1, L103
- Two J-Drawing J69000C-1, L1
- One J-Drawing J69000C-1, L161
- Associated cables for connecting three bays
- System controller\* circuit packs
- L173 integration cabling.

Use Table 7-16 and Table 7-24 to order WaveStar OLS 40G and OTU circuit packs and cables separately.

### **Integrated Bay (Triple 2) Super Kit (ED-8C903-40, G6)**

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This is a super kit that includes the following:

- One J-Drawing J68982C-1, L14
- One J-Drawing J68982C-1, L101
- Two J-Drawing J69000C-1, L14
- One J-Drawing J69000C-1, L161
- Associated cables for connecting three bays
- System controller\* circuit packs
- L173 integration cabling.

Use Table 7-16 and Table 7-24 to order WaveStar OLS 40G and OTU circuit packs and cables separately.

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\*. System controller circuit packs: L30, L35, L40 (J-Drawing J68982C-1) and L50 (J-Drawing J69000C-1)

## Software and Documentation

Table 7-26 provides list numbers for new system/upgrade orders of WaveStar OLS 40G Release 7.0 software and documentation. The software and documentation is shipped with the equipment or separately. The media (CD-ROM code) contains the software, electronic documentation, and peripheral software tools.

**Table 7-26. New System/Upgrade Software and Documentation Ordering (J-Drawing J68982CS-1)**

Description	CD-ROM Code
Software Release Description (SRD)	109074484
Release 7.0-OLS software for Initial Installation (CD-ROM)	109082859
Release 7.0-OLS software for Upgrades from R3.0.X (CD-ROM)	109082867
Release 7.0-OLS software for Upgrades from R3.X.0 (CD-ROM)	109082875

The information in Table 7-27 is used when ordering additional copies of Release 7.0 software and documentation.

**Table 7-27. Additional Software and Documentation Ordering (J-Drawing J68982CS-1)**

User Service Manual Comcode	Spare Software CD-ROM Comcode
109074492	109082883

The WaveStar OLS 40G Release 7.0 CD-ROM contains the following:

- CD-ROM Browser
- CenterLink Online Tour
- CenterLink-CIT software
- Release 7.0-WaveStar OLS 40G Cmd Set/NE software
- Release 7.0-WaveStar OLS 40G SmartManual
- User documentation
- Adobe Acrobat Reader 4.0

## OTU/OTPM Circuit Pack Compatibility

The circuit pack information in Table 7-28 applies to the specified shelves in all OTU/OTPM applications.

**Table 7-28. OTU/OTPM Slot/Circuit Pack Compatibility  
(Release 7.0-WaveStar OLS 40G)**

Shelf	Slot	Supported Pack Codes	Quantity
System Controller Shelf	OTU (1-8)	41A(1-16)C, 41BB, 41C(1-16)C  41F(1-16) and 41G	
	QOTU	41S	0 - 4
	OTPMs*	42A(1-16)B, 42B, 43A(1-16)B, 43B, 44A(1-16)B, and 44B	0 - 16 (up to 4 per 41S)
	OTCTL	LUD1	0 - 1
Complementary Shelf 1	OTU (9-20)	41A(1-16)C, 41BB, 41C(1-16)C  41F(1-16) and 41G	
	QOTU	41S	0 - 6
	OTPMs*	42A(1-16)B, 42B, 43A(1-16)B, 43B, 44A(1-16)B, and 44B	0 - 24 (up to 4 per 41S)
Complementary Shelf 2	OTU (21-32)	41A(1-16)C, 41BB, 41C(1-16)C  41F(1-16) and 41G	
	QOTU	41S	0 - 6
	OTPMs*	42A(1-16)B, 42B, 43A(1-16)B, 43B, 44A(1-16)B, and 44B	0 - 24 (up to 4 per 41S)

\* OTPM circuit packs are installed into 41S slots.

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## WaveStar OLS 40G-to-OTU Control Cabling

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This section describes the cables that are used to connect WaveStar OLS 40G and OTU equipment. The resulting connections form Integrated Bay/Cabinet packages in Double, Triple 1, and Triple 2 arrangements.

### WaveStar OLS 40G Cabling for Double and Triple 1 Arrangements (ED-7G028-22)

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Table 7-29 lists different cable lengths used to support a WaveStar OLS bay/cabinet connected to an OT bay/cabinet configuration.

**Table 7-29. Cabling Information for WaveStar OLS 40G Double and Triple 1 Arrangements**

---

Cable Type (ED-7G028-22)	Length	Group #
LAN	20 ft.	G801
	100 ft.	G851
	200 ft.	G853
Reset-and-equipage	20 ft.	G802
	100 ft.	G852
	200 ft.	G854

**WaveStar OLS 40G Cabling for Triple 2 Arrangement (ED-7G028-22)**

Another integrated arrangement, the Triple 2, consists of a WaveStar OLS shelf connected to two OTU Controller Shelves in a 3-bay arrangement. Table 7-30 lists cable lengths for this configuration.

**Table 7-30. Cabling Information for WaveStar OLS 40G Triple 2 Arrangements**

<b>Cable Type (ED-7G028-22)</b>	<b>Length</b>	<b>Group #</b>
LAN Cable 1 (WaveStar OLS 40G-to-OT)	20 ft	G801
	100 ft	G851
	180 ft	G855
LAN Cable 2 (WaveStar OLS 40G-to-OT)	20 ft	G806
	100 ft	G807
	180 ft	G809
Dual Reset-and-Equipage	20 ft	G812
	100 ft	G813
	180 ft	G814
Miscellaneous	20 ft	G803
	100	G804
	200	G805



**NOTE:**

The sum of the lengths of LAN cable 1 and LAN cable 2 must not exceed 200 feet.

Possible LAN cable combinations that are permitted with this configuration are listed in Table 7-31.

**Table 7-31. Possible LAN Cable Combinations**

LAN Cable 1	LAN Cable 2	Total Length	Permitted?
G801	G806	40 ft	Yes
G801	G807	120 ft	Yes
G801	G809	200 ft	Yes
G851	G806	120 ft	Yes
G851	G807	200 ft	Yes
G851	G809	280 ft	No
G855	G806	200 ft	Yes
G855	G807	280 ft	No
G855	G809	360 ft	No



**NOTE:**

Careful preparation should be taken to insure a proper distance between WaveStar OLS 40G, OT 1, and the eventual OT 2. The total cable length of LAN Cable 1 and the eventual LAN Cable 2 should not exceed 200 ft.

The appropriate dual reset-and-equipage cable should be chosen based on the maximum distance between the WaveStar OLS 40G and either OT 1 or OT 2.

The OT integration cables are orderable by ED and Group number and can also be ordered as kits. Table 7-32 lists the various kits and associated cable lengths that are available.

**Table 7-32. Integration Cabling Information**

Kit # (J68982C-1)	Application	Cable* (ED-7G028-22)	Quantity	Cable
L171	WaveStar OLS 40G Integrated Bay/Cabinet (Double) package	G853	1	LAN
		G854	1	Reset-and-Equipage
L172†	WaveStar OLS 40G Integrated Bay/Cabinet (Triple 1) package	G853	2	LAN
		G854	2	Reset-and-Equipage
L173†	WaveStar OLS 40G Integrated Bay/Cabinet (Triple 2) package	G855	1	LAN
		G805	1	Miscellaneous
		G806	1	LAN
		G814	1	Dual Reset-and-Equipage

\* These cables are standard with L171, L172, and L173 kits.

† L172 and L173 contain a single label kit (comcode: 848123089) that provides correct identification of OT bays. If WaveStar OLS 40G is upgraded to integrate a second OT bay, this label kit must be ordered. If the cables are ordered by ED and Group number, this label kit must also be ordered for any application integrating two OT bays.

Consider the following points when ordering integration cabling:

- If specific cable lengths are needed that are not provided in kits L171, L172, and L173, order individually using the ED and Group numbers found in Table 7-29, Table 7-30, and Table 7-31.
- If an Integrated Bay/Cabinet-Double equipment package is installed initially and it later becomes necessary to add the additional OT bay/cabinet, order the appropriate upgrade cables (LAN 2, miscellaneous, and dual reset-and-equipage cables) by ED and Group number. These cables replace the reset-and-equipage cable that was already installed.

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# Product Support

# 8

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# Product Support

# 8

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This chapter describes how Lucent Technologies supports WaveStar OLS 40G. Support includes engineering and installation services, technical support, documentation support, and training.

## **Engineering and Installation Services**

The Lucent Technologies Customer Support and Operations (CS&O) organization is committed to providing customers with quality product support services. Whether you need assistance in engineering, installation, normal system maintenance, or disaster recovery, the support staff will provide you with the quality technical support you need to get your job done. Each segment of the CS&O organization regards servicing the customer as its highest priority and understands your obligation to maintain quality service for your customer.

Within the CS&O organization, the Engineering and Installation Services group provides a highly skilled force of support personnel to provide customers with quality engineering and installation services. These engineering and installation specialists use state-of-the-art technology, equipment, and procedures to provide customers with highly competent, rapid response services. These services include analyzing your equipment request, preparing a detailed specification for manufacturing and installation, creating and maintaining job records, installing the equipment, and testing and turning over a working system. When the CS&O organization provides job records and installs the equipment, operationally effec-

tive changes to the system are automatically identified and applied to the system at no additional cost.

The Engineering and Installation Services group provides the customer with an individually tailored, quality-tested job that meets both our published high standards and the customer's operational requirements. The group ensures that the customer's system order is integrated into a complete working system tailored to office conditions and preferences. This process provides for the customer's complete needs. It includes provisions for cabling, lighting, power equipment, and ancillary connections to local and/or remote alarm systems. The group also responds to any customer changes that occur during installation.

All equipment engineered and installed by Lucent Technologies is thoroughly tested and integrated into a reliable system at cut-over. Once approved by Lucent Technologies' rigorous Quality Assurance Test group, the system is turned over to the customer.

The Quality Assurance Test group also provides any specialized engineering and installation services required for unusual or highly individualized applications. These specialized services may include engineering consultations and database preparation. Your local account executive can provide more information about these services.

## **Technical Support**

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Assistance in maintaining your installed system is available through the North American Regional Technical Assistance Center (NARTAC) and Customer Technical Support (CTS). As shown in Figure 8-1, your single point of contact is the NARTAC. NARTAC personnel troubleshoot field problems twenty-four hours a day over the phone and, if necessary, on site. For technical assistance, simply call **1-800-CAL-RTAC (1-800-225-7822)**. One call guarantees support. You can also call this number to provide comments on the WaveStar OLS 40G or to suggest enhancements.

NARTAC provides the following technical support services:

- Tracks and maintains visible ownership of all reported customer assistance requests, from inception through resolution
- Analyzes and diagnoses reported problems
- Communicates actions, plans, and problem status to the reporting customer
- Provides restoration and recovery services

- Provides preventative and/or circumvention measures
- Initiates action to establish modification requests (MRs) for design issues
- Writes technical bulletins
- Provides technical assistance to installers

NARTAC organizations are supported by a centralized Customer Technical Support (CTS) for transmission products. CTS maintains a close relationship with Bell Laboratories to expedite resolutions and maintain contact with the development community. This association provides continuous accessibility to every phase in a product life cycle and ensures a prompt resolution to all inquiries.

Technical support is available through Customer Technical Support (CTS).

Lucent Technologies' CTS organization is the first point of contact for technical support. Each segment of the CTS organization is committed to providing customers with quality product support services and regards the customer as its highest priority. To contact CTS, please call +1-630-224-4672: Prompt 2.

The CTS team maintains direct contact with Lucent Technologies' development and manufacturing organizations to ensure prompt resolution of all assistance requests.

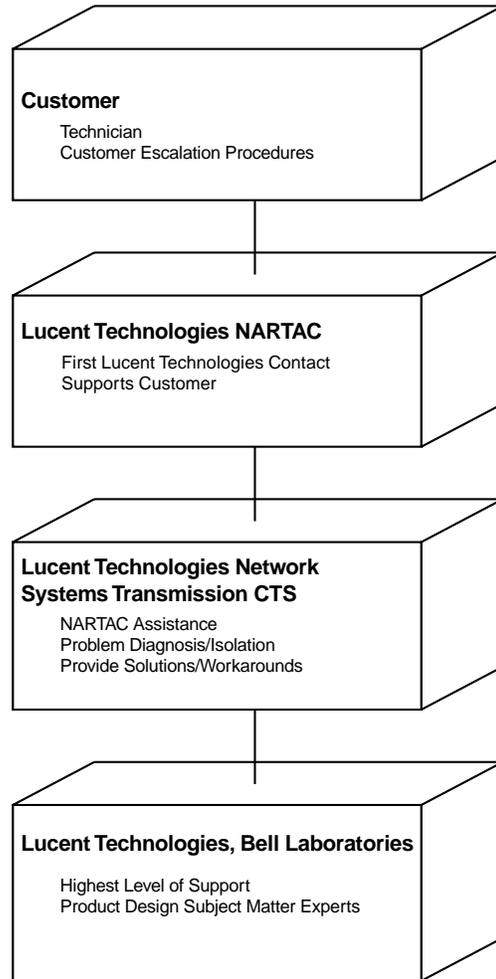
The CTS organization provides the following technical support services:

- Manages customer assistance requests
- Supports first service applications (FSAs), customer lab evaluations (CLEs), and initial customer applications (ICAs)
- Develops software release descriptions, installation manuals, engineering change procedures (ECP), method of procedures (MOPs), modification implementation procedures (MIPs)
- Provides installation and NARTAC training

The CTS organization provides an on-line system, the Customer Assistance Request Entry System (CARES), to track all customer assistance requests. CTS CARES communicates details about assistance requests, product bulletins, and other critical information to customer sites. The CTS CARES web site is available at <http://www-cares.web.lucent.com/>.

To obtain a login to CARES, please call 1-800-225-4672 or +1-630-224-4672.

For additional information about technical support, please contact your Lucent Customer Support Team



NC-OLS80G093

**Figure 8-1. Product Support**

## **Documentation Support**

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The Lucent Technologies Customer Training and Information Products (CTIP) organization provides a customer comment form in the front of this guide. Please use the form to report errors or to make suggestions about this document. If the form is missing, please send or fax your comments to:

Lucent Technologies  
Customer Training and Information Products  
Building 21, Room 3B-09  
1600 Osgood Street  
North Andover, MA 01845

Fax Number: (978) 960-6835

## **Training Support**

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For course information, refer to “Training” in the “About This Document” preface.

## **Warranty Support**

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Lucent Technologies provides a limited 5-year hardware warranty for this product. For more information, contact your local Lucent Technologies account executive.

## **Account Executive Support**

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If you encounter difficulties in any area of product support, your local account executive serves as a single point of contact.



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# Quality Statements and Technical Specifications

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# Quality Statements and Technical Specifications

# 9

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This chapter contains quality statements and technical specifications for the WaveStar OLS 40G and the Optical Translator Unit (OTU). Telcordia *Technical Reference 253* (GR 253) is the basis for this information.

## **WaveStar OLS 40G Quality and Reliability**

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Reliability is a key ingredient of a product's life cycle, beginning with the earliest planning stage and continuing into a wide range of functional areas. These areas include product architecture, design and simulation, documentation, prototyping, design change control, manufacturing and product testing (including 100% screening), product quality assurance, product field performance, and product field return management. Each stage in the product's life cycle relies on people and processes that contribute to product reliability growth with customer satisfaction as the primary goal.

Using critical elements to ensure the product's reliability, product development requires strict adherence to the following guidelines:

- Design standards
- Design and test practices
- Comprehensive qualification programs

- System-level reliability integration
- Reliability audits and predictions
- Development of assurance standards for the manufactured product.

During manufacturing and field deployment, the reliability of WaveStar OLS 40G is further enhanced by the following processes:

- Pre-manufacturing
- Qualification
- Accelerated product testing
- Production screening
- Product quality tracking
- Failure mode analysis
- Feedback and corrective actions.

Independent quality representatives are also present at manufacturing locations to ensure “Shipped Product Quality”.

### **Maintainability Specifications**

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WaveStar OLS 40G requires no periodic maintenance. Continuous performance monitoring allows WaveStar OLS 40G to detect problems before they become service-affecting.

### **Warranty**

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The terms and conditions of sale include a five-year warranty on WaveStar OLS 40G with OT hardware and a one-year warranty on software.

## **Technical Specifications**

---

This section contains technical specifications for WaveStar OLS 40G.

### **Optical Connector Interfaces**

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WaveStar OLS 40G Optical Amplifier (OA), telemetry circuit packs (TLM), Optical Multiplexer Units (OMU), Optical Demultiplexer Units (ODU), Optical Translator Units (OTU), and Optical Translator Port Modules (OTPM) use ST<sup>®</sup>, FC, LC, or SC lightguide connectors.

### **Transmission Medium**

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The following types of transmission media can be used with WaveStar OLS 40G:

- Standard single-mode fiber (SSMF)
- Non-zero dispersion-shifted fiber (for example: TrueWave<sup>®</sup>).

### **Lightguide Jumpers**

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Single-mode lightguide jumpers are used on the OA and telemetry/supervisory circuit packs. Multi-mode lightguide jumpers are used with the telemetry/customer maintenance signal. Refer to Chapter 7, “Ordering”, for information on ordering lightguide jumpers.

### **Optical Safety (BRH Classification)**

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WaveStar OLS 40G meets the Class 1 optical safety standard.

### **Operating Wavelength**

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The operating wavelength range for WaveStar OLS 40G is 1550 nm ± 6 nm.

### **Optical Dispersion**

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Refer to “Engineering Rules” in Chapter 6, “System Planning and Engineering.”

### **Optical Return Loss**

---

The optical return loss for WaveStar OLS 40G is > 40 dB.

### **Optical Reflections Tolerance**

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The OA ports within WaveStar OLS 40G tolerate up to -27 db of reflection.

### **Low Voltage Cut-off**

---

If a period of low voltage coming into the WaveStar OLS 40G occurs, the system cuts off when a power filter input of -38.5 V DC  $\pm$  1 V is detected. The system restarts when a power filter input of -43 V DC  $\pm$  1 V is detected.

### **Optical Line Rate**

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WaveStar OLS 40G supports an optical line rate of up to 40 Gb/s.

### **Capacity**

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The WaveStar OLS 40G has a capacity of 768 DS3 equivalents (516,096 two-way voice circuits per fiber pair), allowing up to four fiber pair per cabinet.

### **Transmission Standards Compliance**

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WaveStar OLS 40G meets single-mode interoffice digital fiber optic systems requirements and objectives as specified in *Telcordia GR 253* and *TR 499*.

Table 9-1 shows OA spacing for the WaveStar OLS 40G.

**Table 9-1. Minimum and Maximum OA Spacing**

OA Spacing Parameter		<math>10^{-9}</math> accumulated error rate for systems up to 400 kilometers (250 miles)
Long Span systems	Max	35 dB
	Min	22 dB
Long Reach systems	Max	22 dB
	Min	17 dB

Table 9-2 lists the OMU/ODU insertion loss for WaveStar OLS 40G.

**Table 9-2. OMU/ODU Insertion Loss**

Code	Specification
506A	$\leq 15$ dB
506B	$\leq 8$ dB
606A	$\leq 12$ dB
606B	$\leq 12$ dB
606C	$\leq 8$ dB
606D	$\leq 8$ dB

### Cable Access

WaveStar OLS 40G uses connectorized cabling that utilizes commercially available connectors. All customer access is front-oriented.

## **Power Specifications**

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For power planning information on WaveStar OLS 40G and OT, refer to Chapter 6, "System Planning and Engineering." Table 9-3 shows WaveStar OLS 40G and OT power specifications.

**Table 9-3. WaveStar OLS 40G and OT Power Specifications**

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<b>Description</b>	<b>Specification</b>
Voltage Range	-42.75 to -60 V DC
Power Feeders	Two -48 V power feeders ("A" and "B") required
Fuse Size (per shelf)	10 amperes

**Dimensions**

Table 9-4 lists the physical dimensions of WaveStar OLS 40G and OT components.

**Table 9-4. WaveStar OLS 40G/OT Physical Dimensions**

Equipment	Height	Width	Depth
<b>WaveStar OLS 40G</b>			
Cabinet*	72.0 in. (183 cm)	34.0 in. (86 cm)	24.0 in. (61 cm)
Shelf (Cabinet)	28.5 in. (72.4 cm)	19.6 in. (50 cm)	11.0 in. (28.0 cm)
Heat Baffle (Cabinet)	3.0 in. (7.5 cm)	19.6 in. (50 cm)	11.0 in. (28.0 cm)
Shelf (Miscellaneously-mounted)	31 in. (80 cm)	19.6 in. (50 cm)	11.0 in. (28.0 cm)
<b>OT</b>			
OT Cabinet	72.0 in. (183.0 cm)	34.0 in. (86.0 cm)	24.0 in. (61.0 cm)
OT Shelf (Cabinet)	17.7 in. (45.0 cm)	19.6 in. (50.0 cm)	11.0 in. (28.0 cm)
OT Heat Baffle (Cabinet)	3.0 in. (7.5 cm)	19.6 in. (50.0 cm)	11.0 in. (28.0 cm)
OT Shelf (Miscellaneously-mounted)	20.7 in. (52.5 cm)	19.6 in. (50.0 cm)	11.0 in. (28.0 cm)

\* The color of WaveStar OLS 40G cabinets and miscellaneous-mounted shelves is central office white. The color of cabinet end guards, cable racks, and lower door frame is office soft blue.

Table 9-5 lists the dimensions of WaveStar OLS 40G and OTU circuit pack.

**Table 9-5. WaveStar OLS 40G/OTU Circuit Pack Dimensions**

Equipment	Height	Width	Depth
<b>WaveStar OLS 40G</b>			
SYSCTL	14 in. (35.6 cm)	1.2 in. (3.0 cm)	8 in. (20.0 cm)
SYSTEM	14 in. (35.6 cm)	0.8 in. (2.0 cm)	8 in. (20.0 cm)
OA (All)	14 in. (35.6 cm)	4 in. (10.0 cm)	8 in. (20.0 cm)
TOHCTL (LEA5)	14 in. (35.6 cm)	0.8 in. (2.0 cm)	8 in. (20.0 cm)
OMU (All)	9 in. (22.8 cm)	2 in. (5.0 cm)	6 in. (15.0 cm)
ODU (All)	9 in. (22.8 cm)	2 in. (5.0 cm)	6 in. (15.0 cm)
TLM (All)	9 in. (22.8 cm)	2 in. (5.0 cm)	8 in. (20.0 cm)
<b>OTU</b>			
OTCTL	13.2 in. (33.6 cm)	4.8 in. (12 cm)	9.3 in. (23.6 cm)
OTUs (All) 41A(1-16)C, 41BB, 41C(1-16)C, 41F(1-16), and 41G	13.2 in. (33.6 cm)	1.6 in. (4.0 cm)	9.3 in. (23.6 cm)
QOTU 41S	13.2 in. (33.6 cm)	3.2 in. (8.0 cm)	9.3 in. (23.6 cm)
OTPMs (All) 42A(1-16)B, 42B, 43A (1-16)B, 43B, 44A(1-16)B, 44B	15.3 in. (13.5 cm)	1.2 in. (3.0 cm)	8.1 in. (20.6 cm)

**Floor Loading Specifications**

Table 9-6 shows floor loads for WaveStar OLS 40G and OT.

**Table 9-6. WaveStar OLS 40G/OT Floor Loads\***

Configuration	End Terminal		Repeater	
	Weight (lbs)	Weight per sq. ft.	Weight	Weight per sq. ft.
<b>WaveStar OLS 40G</b>				
Miscellaneously-mounted Shelf	95		90	
1-Shelf equipped Cabinet	568	45.4	564	45.1
2-Shelf Cabinet	615	49.2	608	48.6
2-Shelf Bay	330	43.5	322	42.5
3-Shelf Integrated Bay	373	49.1		
<b>OT</b>				
Fully-equipped OT Cabinet	700	56.0		
Fully-equipped Miscellaneously mounted System Controller Shelf	64			
Fully-equipped Miscellaneously mounted Complementary Shelf	74			
3-Shelf OT Bay	342	45.0		

\* Miscellaneously-mounted shelves do not have an absolute weight per square foot. Because they can be installed in different equipment arrangements, their weight per square foot is subject to change.

## Environmental Specifications

Table 9-7 shows the various temperatures and humidity levels at which WaveStar OLS 40G can operate.

**Table 9-7. Operating Temperature/Humidity Values**

Operating Condition	Temperature/Humidity
Normal Operating Temperature	5°C to 40°C (41° to 104°F)
Short-Term* Operating Temperature	-5°C to 50°C (23° to 122°F)
Normal Operating Humidity†	5% to 85%
Short-Term* Operating Humidity†	5% to 90%
Max. Operating Temperature Change Rate	1°C/min. (1.8° F/min.)

\* Short-term refers to a period of up to 96 consecutive hours and a total of 15 days in one year.

† Non-condensing.

The following environmental specifications pertain to WaveStar OLS 40G and OT:

- Earthquake and vibration, fire resistance, and airborne contaminant requirements meet *GR-63-CORE Issue 1, October 1995* standards
- Electrostatic, electromagnetic, electrical grounding, and safety requirements meet *GR-1089-CORE Issue 1, November 1994* standards
- Electromagnetic compatibility (EMC) requirements meet *GR-1089-CORE*
- UL® listed and CSA® certified.

**Handling and Transportation Constraints**

Table 9-8 shows WaveStar OLS 40G tolerance ranges for various handling and transportation conditions.

**Table 9-8. Handling and Transportation Tolerance Ranges**

Condition	Tolerance Range
Vibration & Shock	Complies with <i>GR-63-CORE, Issue 1, Oct 1995</i>
Temperature (Transport/Storage)	- 40 °C to 70°C (40°F to 158°F)
Relative Humidity (Transport/Storage)	5% to 95%
Storage/Shipment (Altitude)	-200 ft to 40,000 ft (-61m to 12,133m)

**Reliability Specifications**

Table 9-9 lists failures-in-time (FIT) rates for WaveStar OLS 40G and OTU circuit packs.

**Table 9-9. WaveStar OLS 40G/OTU Circuit Pack FIT Rates per Telcordia RPP\***

Description	Code	FIT
<b>WaveStar OLS 40G</b>		
SYSCTL	LEA1	3387
SYSTEMEM	LEA2	7118
TOHCTL	LEA5	2549
ODU (16λ)	606A	3443
ODU (16λ)	606B	3694
ODU (16λ)	606C	3443
ODU (16λ)	606D	3694
OMU (16λ)	506A	2141

**Table 9-9. WaveStar OLS 40G/OTU Circuit Pack FIT Rates per Telcordia RPP\* (Contd)**

Description	Code	FIT
<b>WaveStar OLS 40G</b>		
OMU (16λ)	506B	2141
OA	LEA7, LEA7B, LEA104, LEA107B, and LEA105	16,848
TLM	LDA1	6625
<b>OTU</b>		
OTCTL	LUD1	2723
OTU (OC-48/STM-16)	41A(1-16)C, 41C(1-16)C	7272
OTU (OC-48/STM-16)	41BB	6772
OTU (Ethernet 1.25 Gb/s)	41F(1-16)	7272
OTU (Ethernet 1.25 Gb/s)	41G	6772
QOTU	41S	2129
OTPM (OC-12/STM-4)	42A(1-16), 42B	6000
OTPM (OC-3/STM-1)	43A(1-16), 43B	3000
OTPM (LSBB, 100-750 Mb/s)	44A(1-16), 44B	6000

\* Based on Method I of the *Reliability Prediction Procedure for Electronic Equipment*, Issue 5, December 1995.

**Hardware Unavailability**

Hardware unavailability is based on *Reliability Prediction Procedure for Electronic Equipment*, Issue 5, December 1995 and a mean-time-to-repair (MTTR) of less than or equal to two hours. Table 9-10 shows WaveStar OLS 40G and OT channel unavailability.

**Table 9-10. Channel Unavailability (min/year/channel)**

Description	Value
<b>WaveStar OLS 40G</b>	
1 Line (Dual Facing) End Terminal	0.003
2 Line* End Terminal	0.003
2 Line* Repeater	0.002
<b>OT</b>	
OC-48/STM-16 Channel (OT)	0.00027
Ethernet 1.25 Gb/s, 16 Channel (OT)	0.00027
OC-12/STM-4 Channel (OTPM)	0.00015
LSBB, 100-750 Mb/s Channel (OTPM)	0.00015
OC-3/STM-1 Channel (OTPM)	0.00004

\* Based on ADM protection.

Table 9-11 shows telemetry channel unavailability (min/year/channel) for WaveStar OLS 40G.

**Table 9-11. Telemetry Channel Unavailability**

---

Protection	End Terminal	Repeater
Independent	42	49
1 + 1	0.0017	0.0023

**Silent Failure Unavailability**

---

There is no silent failure unavailability for End Terminals, Repeaters, the OT, or OTPMs.

**Mean-Time-Between-Maintenance**

Table 9-12 shows the mean-time-between-maintenance activity for WaveStar OLS 40G. These values are based on the *Lucent Technologies Reliability Information Notebook, 7th edition, August 1995*.

**Table 9-12. Mean-Time-Between-Maintenance Activity**

Equipment	Mean Time (months)
<b>WaveStar OLS 40G</b>	
2 Line End Terminal	42
2 Line Repeater	40
Integrated Bay (Single)	19
Integrated Bay/Cabinet (Double)	14
Integrated Bay/Cabinet (Triple 1)	7
Integrated Bay/Cabinet (Triple 2)	9
<b>OT</b>	
OT Complementary Shelf (full)	58
OT System Controller Shelf (full, no controller circuit packs)	85
OT Cabinet (fully equipped, 3 shelves)	22

## **Infant Mortality and Design Life**

WaveStar OLS 40G equipment has an infant mortality rate of  $\leq 1.6$  multiplied by the steady state failure rate. The equipment's design life is 25 years.

## **Optical Signal Output Power from OTU/OTPMs**

The output power of each optical signal wavelength from an OTU/OTPM must meet the ranges given in Table 9-13, which are verified to 0.7 dB accuracy. The table provides output power specifications for OC-48/STM-16, Ethernet 1.25 Gb/s, OC-12/STM-4/, low speed broadband (LSBB) 100-750 Mb/s, and OC-3/STM-1 signal wavelengths. This table reflects optical signal power in the 1.5 $\mu$  range entering the OMU. This signal power can originate from either Lucent Technologies, WaveStar OLS-compatible terminals or non-Lucent terminals. For non-Lucent terminals, the appropriate signal characteristics enter the OMU from an OTU or OTPM located between the OMU and the originating terminal.

The power of the customer maintenance signal (part of the supervisory channel) coming into the WaveStar OLS 40G is covered in "Customer Maintenance Signal" later in this chapter. For installation and acceptance purposes, use a calibrated power meter. Adjust your calculations to take into account any power meter inaccuracy.

**Table 9-13. OTU/OTPM Optical Power Output Specifications (1.5μ)**

Signal*	Wavelength (nm)	Power (dBm) (± 0.7 dB)			
		OC-48/ STM-16 and GbE	OC-12/ STM-4	LSBB 100-750 Mb/s	OC-3/ STM-1
1	1549.32	-4.0	-7.0	-7.0	-10.0
2	1550.92	-5.3	-8.3	-8.3	-11.3
3	1552.52	-6.5	-9.5	-9.5	-12.5
4	1554.13	-7.2	-10.2	-10.2	-13.2
5	1555.75	-7.7	-10.7	-10.7	-13.7
6	1557.37	-8.2	-11.2	-11.2	-14.2
7	1558.98	-8.0	-11.0	-11.0	-14.0
8	1560.61	-6.5	-9.5	-9.5	-12.5
9	1548.52	-2.0	-5.0	-5.0	-8.0
10	1550.12	-4.6	-7.6	-7.6	-10.6
11	1551.72	-5.8	-8.8	-8.8	-11.8
12	1553.33	-6.8	-9.8	-9.8	-12.8
13	1554.94	-7.4	-10.4	-10.4	-13.4
14	1556.56	-7.9	-10.9	-10.9	-13.9
15	1558.17	-8.1	-11.1	-11.1	-14.1
16	1559.79	-7.2	-10.2	-10.2	-13.2
Supervisory Channel	1532.0				
Supervisory Channel	1510.0				

\* Each signal (1-16) is handled by a respective 41A(1-16)C, 41C(1-16)C, 41F(1-16), 42A(1-16), 43A(1-16), and 44A(1-16) circuit pack.

Table 9-14 provides optical signal specifications for optical signal power in the 1.3μ range exiting the ODU.

**Table 9-14. Optical Signal Specifications for 1.3μ OTU/OTPM**

Circuit Pack Code	Wavelength Range (nm)		Power Range (dBm)	
	min	max	min	max
41BB	1280	1335	-2.0	+2.5
42B	1280	1335	-2.5	+2.0
43B	1280	1335	-7.0	0
44B (low setting)	1280	1335	-7.0	0
44B (high setting)	1280	1335	-2.5	+2.0
41G	1280	1335	-2.0	+2.5



**NOTE:**

When using LBOs on the input of add-side OTUs and OTPMs, select an optical LBO that can attenuate the input signal to a value that is between -12 and -22dB.

**Optical Signal Input Power to OTU/OTPMs**

Table 9-15 provides the receive input power range for the OTU/OTPMs used in the WaveStar OLS 40G.

**Table 9-15. OTU/OTPM Input Power Range**

Signal Rate	Circuit Pack Code	Receive Power Range (dBm)	
		min	max
OC-48/STM-16	41A(1-16)C, 41C(1-16)C	-27	-11
	41BB	-27	-10
OC-12/STM-4/	42A(1-16)B	-28	-11
	42B	-30.5	-8
OC-3/STM-1	43A(1-16)B	-33	-11
	43B	-34	-7
LSBB 100-750 Mb/s	44A(1-16)B	-28	-11
	44B	-30.5	-8
GbE	41F(1-16)	-27	-11
	41G	-27	-10

**OA Output Power**

OA output power depends on the number of equipped input wavelengths, the channel rate of each wavelength, the number of spans, and the OA type; it is adjusted automatically by software whenever these variables change. Provided as a general guideline for OA power levels, Table 9-16 lists output power values, assuming a 0 dB output lightguide build-out (LBO).

**Table 9-16. Output Power (dBm)**

No. of Optical Channels Equipped	LEA7/LEA7B OA	LEA104/LEA107B OA	LEA105 OA
0	11.9	11.9	8.1
1	12.4	12.4	8.6
2	12.4	12.4	9.1
3	13.8	13.8	10.8
4	14.5	14.5	11.8
5	15.2	15.2	12.7
6	15.8	15.8	13.3
7	16.0	16.0	13.9
8	16.5	16.5	14.1
9	16.5	17.0	14.6
10	16.5	17.5	15.1
11	16.5	17.9	15.5
12	16.5	18.3	15.7
13	16.5	18.6	15.7
14	16.5	18.9	15.7
15	16.5	19.0	15.7
16	16.5	19.0	15.7

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## Outside Plant Loss

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Table 9-17 shows minimum and maximum plant loss values for the OA.

**Table 9-17. Plant Loss Between OA Sites**

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OA Standard Performance	Loss Between OA Sites	
	Min (dB)	Max (dB)
Long Reach Systems (eight-span) (LEA7, LEA7B)	17	22
Short Reach Systems (one-span) (LEA105)	14	18
Long Span Systems (five-span) (LEA104, LEA107B)	26	30

**Tone Frequencies**

Table 9-18 shows approximate tone frequencies used for each wavelength.

**Table 9-18. Tone Frequencies**

Optical Channel	Wavelength (nm)	Approximate Tone Frequency (KHz)
1	1549.32	5
2	1550.92	7
3	1552.52	9
4	1554.13	11
5	1555.75	15
6	1557.37	17
7	1558.98	19
8	1560.61	21
9	1548.52	23
10	1550.12	24
11	1551.72	25
12	1553.33	26
13	1554.94	27
14	1556.56	28
15	1558.17	29
16	1559.79	30
Supervisory Channel	1532.0	13
Supervisory Channel	1510.0	13

### **Optical Signal-to-Noise Ratio (SNR)**

The worst case minimum SNR without a pump failure that WaveStar OLS 40G system output can tolerate is 20.0 db. The worst case minimum with one pump failure is 16.5 db.

## Customer Maintenance Signal

The customer maintenance signal has an IS-3 Intermediate Reach (IR) and Short Reach (SR) interface. It is an STS-3 rate and format signal with a growth increment of one IS-3 per telemetry circuit pack, a scrambled NRZ format line code, and a protection ratio of 0 x 1 (circuit pack plus line). Table 9-19 shows the optical interface specifications for this signal. This customer maintenance signal is available with the LDA1 TLM only.

**Table 9-19. Optical Interface Specifications**

Parameter	IS-3
Minimum Wavelength	1270 nm
Maximum Wavelength	1380 nm
Spectral Width	170 nm
Maximum Transmitter Power	- 14.0 dBm
Minimum Transmitter Power	- 20.8 dBm
Maximum Received Power	- 14.0 dBm
Receiver Sensitivity	- 30.8 dBm
Minimum System Gain*	10 dB
Optical Path Penalty <sup>†</sup>	1.0 dB
Connector Loss <sup>‡</sup>	1.5 dB
Un-allocated Margin	2.0 dB
Minimum Loss Budget	0.0 dB
Maximum Loss Budget	5.5 dB
Maximum Span Length	See Chapter 6, "System Planning and Engineering" for engineering rules

\* The minimum system gain represents aging, temperature, and manufacturing tolerances.

† Optical path penalty includes effects of dispersion, reflection, and jitter that occur on the optical path.

‡ One connector (0.75dB) on each end is assumed.

The IS-3 interface is dispersion-limited and can interwork with an [OC-3/STM-1](#) interface or an IS-3 interface over multi-mode fiber, subject to the distance limitations in Table 9-20.

**Table 9-20. IS-3 Interface Distance Limitations**

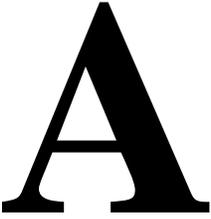
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Fiber Bandwidth (MHz-km)	Distance (km)
1000	3.4
800	3.3
500	2.7
300	1.9



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# Circuit Pack Sparing



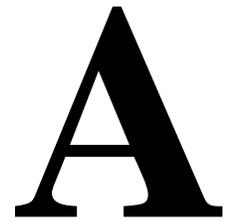
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■ Circuit Pack Sparing Lead Time	A-1
Sparing Examples	A-2
■ Ordering Spare Circuit Packs and Fuses	A-7



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# Circuit Pack Sparing



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This section provides information on circuit pack sparing for WaveStar OLS 40G. Circuit pack comcodes and CLEI codes are also provided. Note that these numbers are subject to change.

## Circuit Pack Sparing Lead Time

**Lead time**, also called turnaround time, is the elapsed time from the point a circuit pack is known to fail at a given service location to the point when a repaired or new one arrives at the location where spare circuit packs are stocked (centralized or local). This replenishment facilitates a spare circuit pack level consistent with the circuit pack population that is in-service. You can use sparing information for 10-day and 64-day lead times for up to 20,000 circuit packs in-service.

Lead time should not be confused with Mean Time to Repair (typically, two to four hours), which is the time elapsed from when a circuit pack is known to fail in service to when a spare circuit pack is placed in service to replace the failed pack.

## **Sparing Examples**

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This section provides guidelines to help you determine how many spare circuit packs or units to order for WaveStar OLS 40G. The following procedure shows how to use Table A-1, Figure A-1, and Figure A-2 in this chapter to determine how many spare circuit packs to order to maintain 99.9% service continuity for either a 10-day or 64-day lead time.

1. Refer to Table A-1 and determine the circuit pack FIT rate. For example, the circuit pack FIT rate for SYSMEM (LEA2) is 1600.
2. Select the chart corresponding to one of the following lead times:
  - 10-day lead time– Figure A-1
  - 64-day lead time– Figure A-2
3. Refer to the chart and select the curve that represents the nearest circuit pack FIT rate. For example, the nearest curve for a FIT rate of 1149 (SYSMEM circuit pack) is 1000.
4. Follow the curve to the intersection with the vertical line that represents the number of circuit packs in service at a given location. For example, 100 circuit packs in service.
5. The horizontal line immediately above the intersection represents the minimum number of circuit pack spares recommended for that location. For example, with 100 circuit packs in service at Location A, the FIT rate is 1149 and the lead time is 10 days (see Figure A-1). In this case, you would need to order and stock two spare circuit packs at Location A.

**Table A-1. Circuit Pack FIT Rates for WaveStar OLS 40G/OTU**

<b>Description</b>	<b>Code</b>	<b>FIT*</b>
<b>WaveStar OLS 40G</b>		
SYSCTL	LEA1	1374
SYSTEM	LEA2	1149
TOHCTL	LEA5	969
ODU (16λ)	606A	403
ODU (16λ)	606B	430
ODU (16λ)	606C	403
ODU (16λ)	606D	430
OMU (16λ)	506A	247
OMU (16λ)	506B	247
OA	LEA7, LEA7B, LEA104, LEA107B, LEA105	4724
TLM	LDA1	1414
<b>OTU</b>		
OTCTL	LUD1	802

**Table A-1. Circuit Pack FIT Rates for WaveStar OLS 40G/OTU**

<b>Description</b>	<b>Code</b>	<b>FIT*</b>
OTU	41A(1-16)C, 41BB, 41C(1-16)C  41F(1-16), 41G	2000
QOTU	41S	300
OTPM (OC-12/STM-4)	42A(1-16), 42B	1500
OTPM (OC-3/STM-1)	43A(1-16), 43B	1000
OTPM (LSBB, 100-750 Mb/s)	44A(1-16), 44B	1500

\* Based on the Lucent Technologies *Reliability Information Notebook*, 7th Edition, August 1995.

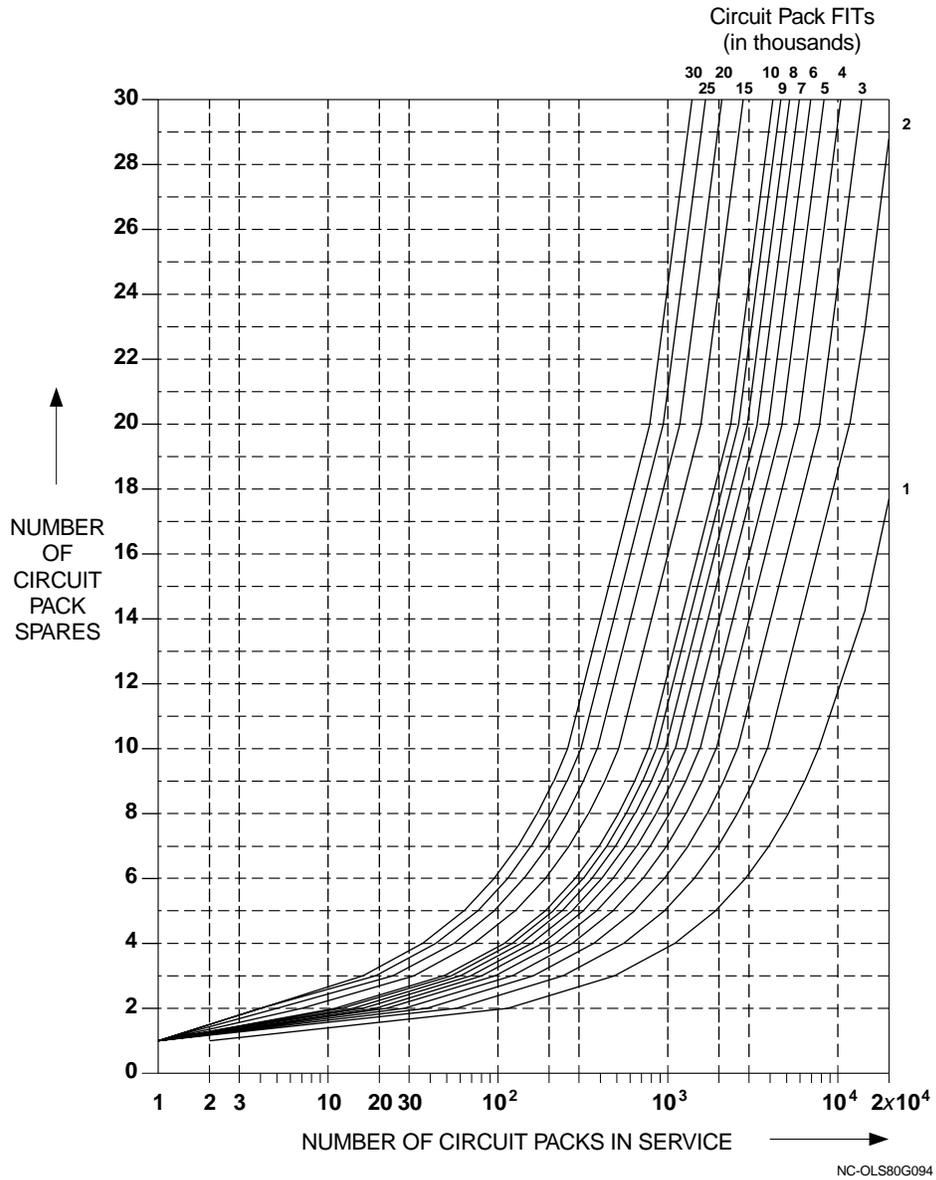


Figure A-1. Sparing Chart -- 10-Day Lead Time

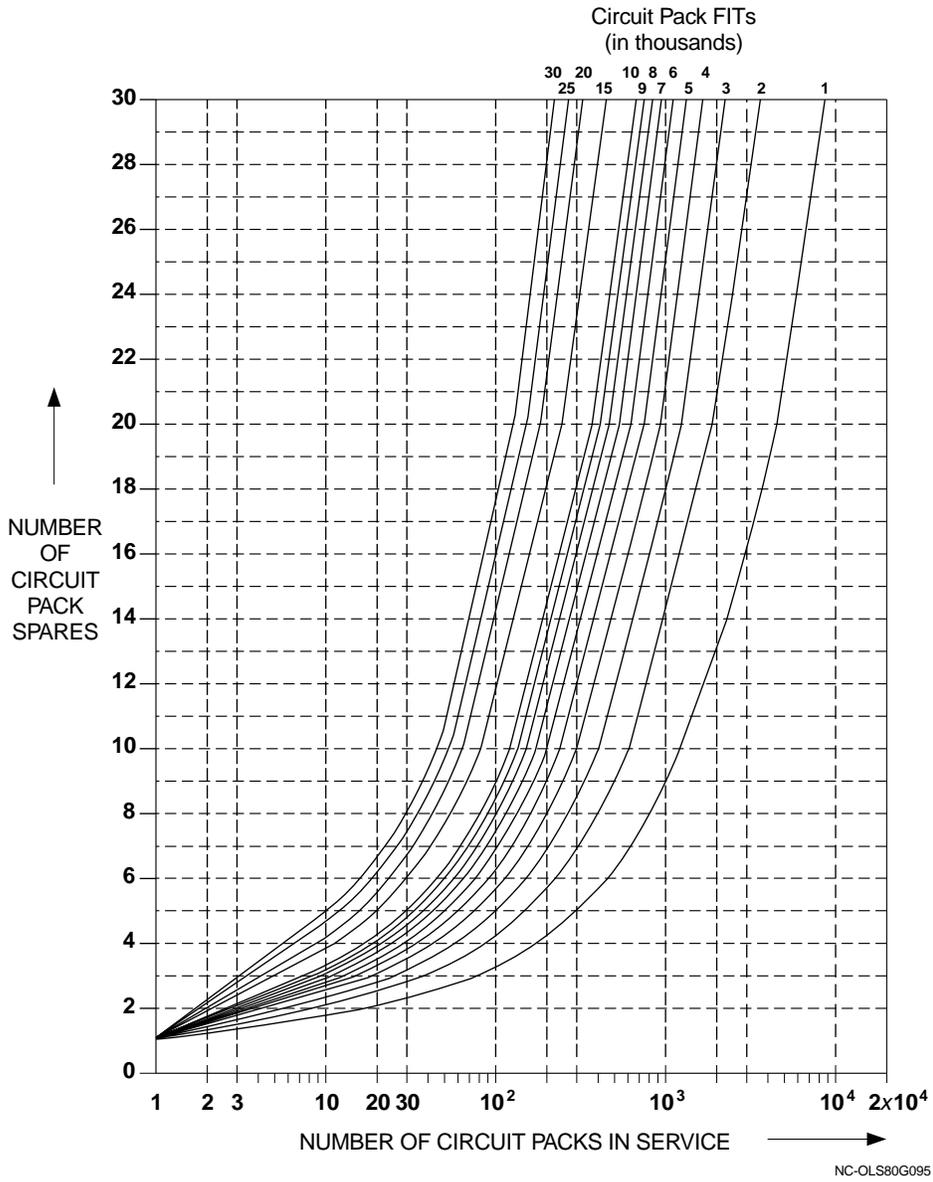


Figure A-2. Circuit Pack Sparing Chart -- 64-Day Lead Time

## Ordering Spare Circuit Packs and Fuses

Table A-2 provides comcodes for ordering spare circuit packs.

**Table A-2. Circuit Pack Comcodes\***

Circuit Pack	Code	Comcode	CLEI
<b>WaveStar OLS 40G</b>			
SYSCTL	LEA1	C107272510	SNC3SH0A
SYSTEMEM	LEA2	C107786568	SNC3TJTA
TOHCTL	LEA5	C107273328	SNC2S00B
TLM	LDA1	C107272569	SNC2R00B
OMU (16λ)	506A	C107727828	SNC5ED0D
OMU (16λ)	506B	C109024430	FHUMDB0GAA
ODU (16λ)	606A	C108032814	FHUM2B0G
ODU (16λ)	606B	C108032822	FHUM2BAG
ODU (16λ)	606C	C109024448	FHUMEB0GAA
ODU (16λ)	606D	C109038679	FHUMEBBGAA
OA (Long Reach)	LEA7	C107742439	SNC7RROC
OA (Long Span)	LEA104	C107976367	SNPQB18AAA
OA Long Span	LEA107B	C108680547	SNAPDS0AAA
OA (Short Reach)	LEA105	C108045394	SNPQB2EA
OA (Long Reach)	LEA7B	C108309949	SNC7RR3C
<b>OTU/QOTU/OTPM</b>			
OTCTL	LUD1	C108056284	LGR1JN0EAA

**Table A-2. Circuit Pack Comcodes\* (Contd)**

<b>Circuit Pack</b>	<b>Code</b>	<b>Comcode</b>	<b>CLEI</b>
OTU	41A1C	C108187949	SNOTABAA
OTU	41A2C	C108187956	SNOTACAA
OTU	41A3C	C108187964	SNOTADAA
OTU	41A4C	C108187972	SNOTAEAA
OTU	41A5C	C108187980	SNOTAFAA
OTU	41A6C	C108187998	SNOTAGAA
OTU	41A7C	C108188004	SNOTAHAA
OTU	41A8C	C108188012	SNOTAJAA
OTU	41A9C	C108188020	SNOTAKAA
OTU	41A10C	C108188038	SNOTALAA
OTU	41A11C	C108188046	SNOTAMAA
OTU	41A12C	C108188053	SNOTANAA
OTU	41A13C	C108188061	SNOTAPAA
OTU	41A14C	C108188079	SNOTARAA
OTU	41A15C	C108188087	SNOTASAA
OTU	41A16C	C108188095	SNOTATAA
OTU	41BB	C108128737	SNP2V0XD
OTU	41C1C	C108188111	SNOTBBAA
OTU	41C2C	C108188129	SNOTBCAA
OTU	41C3C	C108188137	SNOTBDAA
OTU	41C4C	C108188145	SNOTBEAA
OTU	41C5C	C108188152	SNOTBFAA
OTU	41C6C	C108188160	SNOTBGAA
OTU	41C7C	C108188178	SNOTBHAA
OTU	41C8C	C108188186	SNOTBJAA

**Table A-2. Circuit Pack Comcodes\* (Contd)**

Circuit Pack	Code	Comcode	CLEI
OTU	41C9C	C108188194	SNOTBKAA
OTU	41C10C	C108188202	SNOTBLAA
OTU	41C11C	C108188210	SNOTBMAA
OTU	41C12C	C108188228	SNOTBNAA
OTU	41C13C	C108188236	SNOTBPAA
OTU	41C14C	C108188244	SNOTBRAA
OTU	41C15C	C108188251	SNOTBSAA
OTU	41C16C	C108188269	SNOTBTAA
OTU	41F1	C108584210	SNO1CM0AAB
OTU	41F2	C108584228	SNO1CN0AAB
OTU	41F3	C108584236	SNO1CP0AAB
OTU	41F4	C108584244	SNO1CR0AAB
OTU	41F5	C108584251	SNO1CS0AAB
OTU	41F6	C10858469	SNO1CT0AAB
OTU	41F7	C108584277	SNO1CU0AAB
OTU	41F8	C108584285	SNO1CV0AAB
OTU	41F9	C108584806	SNO1CW0AAB
OTU	41F10	C108584814	SNO1CX0AAB
OTU	41F11	C108584822	SNO1CY0AAB
OTU	41F12	C108584830	SNO1CZ0AAB
OTU	41F13	C108584848	SNO1C10AAB
OTU	41F14	C108584855	SNO1C20AAB
OTU	41F15	C108584871	SNO1C30AAB
OTU	41F16	C108584877	SNO1C40AAB
OTU	41G	C108585928	SNO1C50AAB

**Table A-2. Circuit Pack Comcodes\* (Contd)**

<b>Circuit Pack</b>	<b>Code</b>	<b>Comcode</b>	<b>CLEI</b>
QOTU	41S	C108022823	SNC6101E
OTPM	42A1B	C108187063	SNC670RE
OTPM	42A2B	C108187071	SNC670SE
OTPM	42A3B	C108187089	SNC670TE
OTPM	42A4B	C108187097	SNC670UE
OTPM	42A5B	C108187105	SNC670VE
OTPM	42A6B	C108187113	SNC670WE
OTPM	42A7B	C108187121	SNC670XE
OTPM	42A8B	C108187139	SNC670YE
OTPM	42A9B	C108187147	SNC670GE
OTPM	42A10B	C108187196	SNC670HE
OTPM	42A11B	C108187204	SNC670JE
OTPM	42A12B	C108187212	SNC670KE
OTPM	42A13B	C108187220	SNC670LE
OTPM	42A14B	C108187238	SNC670ME
OTPM	42A15B	C108187246	SNC670NE
OTPM	42A16B	C108187253	SNC670PE
OTPM	42B	C108023334	SNC670ZE
OTPM	43A1B	C108187261	SNC660RE
OTPM	43A2B	C108187279	SNC660SE
OTPM	43A3B	C108187287	SNC660TE
OTPM	43A4B	C108187295	SNC660UE
OTPM	43A5B	C108187303	SNC660VE
OTPM	43A6B	C108187311	SNC660WE
OTPM	43A7B	C108187329	SNC660XE

**Table A-2. Circuit Pack Comcodes\* (Contd)**

<b>Circuit Pack</b>	<b>Code</b>	<b>Comcode</b>	<b>CLEI</b>
OTPM	43A8B	C108187337	SNC660YE
OTPM	43A9B	C108187345	SNC660GE
OTPM	43A10B	C108187352	SNC660HE
OTPM	43A11B	C108187360	SNC660JE
OTPM	43A12B	C108187378	SNC660KE
OTPM	43A13B	C108187386	SNC660LE
OTPM	43A14B	C108187394	SNC660ME
OTPM	43A15B	C108187402	SNC660NE
OTPM	43A16B	C108187410	SNC660PE
OTPM	43B	C108023359	SNC660ZE
OTPM	44A1B	C108187436	SNP2TYED
OTPM	44A2B	C108187444	SNP2TYFD
OTPM	44A3B	C108187451	SNP2TYGD
OTPM	44A4B	C108187469	SNP2TYHD
OTPM	44A5B	C108187477	SNP2TYJD
OTPM	44A6B	C108187485	SNP2TYKD
OTPM	44A7B	C108187493	SNP2TYLD
OTPM	44A8B	C108187501	SNP2TYMD
OTPM	44A9B	C108187519	SNP2TYND
OTPM	44A10B	C108187527	SNP2TYPD
OTPM	44A11B	C108187535	SNP2TYRD
OTPM	44A12B	C108187543	SNP2TYSD
OTPM	44A13B	C108187550	SNP2TYTD
OTPM	44A14B	C108187568	SNP2TYUD

**Table A-2. Circuit Pack Comcodes\* (Contd)**

<b>Circuit Pack</b>	<b>Code</b>	<b>Comcode</b>	<b>CLEI</b>
OTPM	44A15B	C108187584	SNP2TYVD
OTPM	44A16B	C108187592	SNP2TYWD
OTPM	44B	C108089467	SNP2TYXD

\* Optical Translator Units (OTUs), Optical Translator Port Modules (OTPMs), the Quad Optical Translator Unit (QOTU), and Optical Amplifier (OA) circuit packs require a list number when ordered as spares.

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# Glossary

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## Numerics

### 1A-TX

1A-Transmit. A dual or end terminal whose optical amplifier “A” lines are used in the transmit direction.

### 1A-RCV

1A-Receive. A dual or end terminal whose optical amplifier “A” lines are used in the receive direction.

### 1A-TX-THRU

1A-Transmit (Telemetry Feed-through).

### 1A-RCV-THRU

1A-Receive (Telemetry Feed-through).

### 0x1 Line Operation

A 0x1 protection system having one bidirectional service line and no protection line.

### 1+1 Line Protection

A protection system having two bidirectional lines. The transmitting terminal transmits the same payload on two lines. The receiving terminal monitors two lines and chooses one as the working line, the other as the standby line. When a protection switch occurs, the receiving terminal selects the signal from the standby line causing the standby line to become the working line, and the original working line to become the standby line. The status of the lines remains the same (nonrevertive) after the fault clears.

### 1x1 Line Protection

A protection system having two bidirectional lines, one of which is designated the service line, while the other is designated the protection line. The service line normally carries traffic. When a protection switch occurs, the protection line is selected to carry traffic. When the fault clears, the original service line reverts to its original status as the working line. Also see *Revertive Switching*.

---

## A

### ABN

Abnormal (condition)

**ACO**

Alarm Cutoff — A push-button switch on the indicator strip that can be used to retire an audible office alarm.

**AGNE**

Alarm Gateway Network Element

**AID**

Access Identifier — A unique identifier used to address equipment slots and ports, as well as facility tributaries, that are defined for the WaveStar OLS 40G architecture.

**AIS**

Alarm Indication Signal — A code transmitted downstream in a digital network indicating that an upstream failure has been detected and alarmed if the upstream alarm has not been suppressed.

**APSD**

Automatic Power Shutdown — A safety procedure automatically performed by the WaveStar OLS 40G when a loss of optical power occurs. APSD powers down the Optical Amplifier to safe, Class 1 levels then restarts it once the system has been repaired or links have been re-established.

**Asynchronous**

Refers to network elements that are not timed from references traceable to a single Stratum-1 source.

**AUTO**

Automatic — One possible state of a port or slot. When a port is in the AUTO state and a good signal is detected, the port automatically enters the IS (in-service) state. When a slot is in the AUTO state and a circuit pack is detected, the slot automatically enters the EQ (equipped) state.

---

**B**

**BCLAN**

Board Controller Local Area Network — The internal local area network that provides communications between the Line Controller circuit pack and board controllers on the circuit packs associated with a high speed line.

**Bidirectional Line**

A transmission path consisting of 2 fibers that handle traffic in both the transmit and receive directions.

**Bidirectional Switch**

Protection switching performed in both the transmit and receive directions.

---

## C

### CIT

Craft Interface Terminal — A personal computer that meets WaveStar OLS 40G minimum requirements and has Interface-2000 software installed.

### Closed Ring Network

A network formed of a ring-shaped configuration of systems

### CMS

See customer maintenance signal

### CO

Central Office

### Collocated

Located in the same Central Office

### CR

Critical (alarm)

### CS&O

Lucent Technologies Customer Support and Operations

### Current Value

The value currently assigned to a provisionable parameter.

### Customer Maintenance Signal

A 155Mb/s optical signal originating from customer supplied equipment, and used for customer maintenance activities. It is carried as part of the supervisory signal.

### CV

Coding Violation

---

## D

### Data

A collection of system parameters and their associated values.

### dB

Decibels

### DCC

Data Communications Channel — The embedded overhead communications channel in the SONET line. This is used for end-to-end communications and maintenance. It carries alarm, control, and status information between network elements in a SONET network.

**DCE**

Data Communications Equipment — The equipment that provides the signal conversion and coding between the data terminating equipment and the line. The DCE may be separate equipment or a part of the data terminating equipment.

**DDM-2000**

Lucent Technologies' SONET-ready network multiplexer that can function as a lightwave terminal. It is designed primarily for loop feeder and interoffice applications that will work in existing asynchronous as well as the emerging SONET networks.

**Demultiplexing**

A process applied to a multiplexed signal for recovering signals combined within it and for restoring the distinct individual channels of these signals.

**Dispersion**

Time-broadening of a transmitted light pulse

**Divergence**

When the OA provides unequal amplification of incoming wavelengths, the result is a power divergence between wavelengths.

**Doping**

The addition of impurities to a substance in order to attain desired properties.

**DRAM**

Dynamic Random Access Memory

**Drop Side Signal**

An optical signal suitable for transmission over WaveStar OLS 40G, an [OC-48/STM-16](#) signal.

**DS3**

Digital Signal Level 3 (44.736 Mb/s)

**DSNE**

Directory Service Network Element — A designated network element that is responsible for administering a database that maps network element names (TIDs) to addresses [NSAPs (network service access points)]. There can be one DS-NE per ring.

**DTE**

Data Terminating Equipment — The equipment that originates data for transmission and accepts transmitted data.

**Dual Cabinet**

A cabinet in which each shelf is an independent WaveStar OLS 40G network element.

**Dual-facing Shelf**

Operations capability for 2-fiber applications which allows the DCC to go from one End Terminal (one subnetwork) through to the other collocated end terminal (separate subnetwork), thereby extending the WaveStar OLS 40G operations domain.

**Dual Ring Interworking**

A configuration of two ring networks that share two common nodes. DRI permits a circuit with one termination in one ring and one termination in another ring to survive a loss-of-signal failure of the shared node that is currently carrying service for the circuit.

**DUAL**

An end terminal configuration that supports east-west transmission.

**DWDM**

Dense Wavelength Division Multiplexing

---

**E**

**EC-1**

Electrical Carrier level-1 signal — An STS-1 signal that has been shaped and encoded for transmission over electrical media.

**ECI**

Equipment Catalog Item

**EEPROM**

Electrically Erasable Programmable Read-Only Memory

**EMC**

Electromagnetic Compatibility

**EMDU**

External Miscellaneous Discrete Unit

**EMI**

Electromagnetic Interference — High-energy, electrically induced magnetic fields that cause data corruption in cables passing through the fields.

**End Terminal**

The WaveStar OLS 40G equipment that terminates ten optical line signals.

**EQ**

Equipped — A memory administrative state for slots.

**Erbium**

A soft rare earth element used in metallurgy and nuclear research.

**Erbium Doped Fiber Amplifier (EDFA)**

An amplifier that performs by having a light signal pass through a section of erbium- doped fiber and using the laser pump diode to amplify the signal.

**ES**

Errored Seconds — A performance monitoring parameter.

## **ESD**

Electrostatic Discharge

## **ET**

End Terminal — Equipment that terminates optical line signals.

## **Express Traffic**

In a WAD site, wavelengths going between two co-located WaveStar OLS 40G end terminals without going through an LCT.

---

# **F**

## **FE ACTY**

Far-End Activity

## **FEBE**

Far-End-Block Error — An indication returned to the transmitting terminal that an errored block has been detected at the receiving terminal. A block is a specified grouping of bits.

## **FERF**

See RDI.

## **FIT**

Failures in Time — Circuit pack failure rates per 10<sup>9</sup> hours as calculated using the method described in *Reliability Prediction Procedure for Electronic Equipment*, Issue 4, September 1992.

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# **G**

## **Gb/s**

Gigabits per second

## **GHz**

Gigahertz — 10<sup>9</sup> cycles per second

## **GNE**

Gateway Network Element — A network element that passes information between other network elements and operations systems through a data communication network.

---

# **H**

## **Hazard Level**

Output power level of an WaveStar OLS 40G system or device that poses safety risks to personnel. For 1550 nm wavelengths, hazard levels are defined as follows:  
Level 1 =  $\leq 10$  dBm

Level 3A=  $\leq 17$  dBm,  
Level 3B=  $\leq 27$  dBm  
Level 4 =  $> 27$  dBm.

---

## I

### IEC

International Electrotechnology Commission or Interexchange Carrier

### IR

Intermediate Reach

### IS

In Service — A memory administrative state for ports. IS refers to a port that is fully monitored and alarmed.

### ITCO

Independent Telephone Company

### IXC

Interexchange Carrier

---

## J

### Jitter

Jitter is defined as short-term variations of the significant instants of a digital signal from their ideal positions in time.

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## K

### Krypton line

1547.82 nm —wavelength used in a standard laser source.

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## L

### Large Capacity Terminal

A 4-fiber, OC-48/STM-16 multiplexer with add-drop capability. LCTs support standard SONET ring or span protection switching, and can be used with WaveStar OLS 40G to increase transport capacity.

**LBC**

Laser bias current

**LBFC**

Laser backface currents

**LBO**

Lightguide Build-Out — An adapter for the lightguide fiber jumpers between the LGX, WaveStar OLS 40G, and OT equipment. It is also used on equipment within the network element. It performs signal attenuation and guarantees the proper signal level to WaveStar OLS 40G and OT equipment.

**LCT**

FT-2000 [OC-48](#) Lightwave System Large Capacity System

**Lead time**

The amount of time that passes between placement of a product order and receipt of the product.

**LEC**

Local exchange carrier

**LED**

Light-emitting diode

**LGX**

Lightguide cross-connect.

**Line**

**1.** An optical transmission line. In T1/Bellcore terminology, “line” refers to a transmission medium, together with the associated high speed equipment, required to provide the means of transporting information between two consecutive network elements; one originates the line signal while the other terminates it. **2.** “Line” also indicates a fiber pair. When used in this document, the following is assumed: 1 line = 2 fibers, 4 line = 8 fibers.

**Local Traffic**

All wavelengths being added/dropped through LCTs or OTs at a WAD site.

**LOF**

Loss of Frame

**Long Reach**

The capability to concatenate 7 or 8 spans between end terminals before regeneration is required

**Long Span**

Single span between terminal sites with a distance greater than 80 km.

**LOS**

Loss of Signal

**LSBB**

Low Speed Broadband. Refers to 150-750 Mb/s signal rates.

---

## **M**

### **μm**

Micrometer

### **Menu**

A set of possible values for a parameter.

### **Midspan Meet**

The capability to interface between two lightwave terminals of different vendors. This applies to high speed optical interfaces.

### **MJ**

Major (alarm)

### **MN**

Minor (alarm)

### **MTBF**

Mean Time Between Failures

### **MTBMA**

Mean Time Between Maintenance Activities

### **Multiplexing**

The process of combining several distinct digital signals into a single composite digital signal.

---

## **N**

### **NARTAC**

North American Regional Technical Assistance Center

### **NE**

Network Element

### **NE ACTY**

Near-End Activity

### **NEBS**

Network Equipment-Building System

### **NGLN**

Next Generation Lightwave Network

### **nm**

Nanometer (10<sup>-9</sup> meters)

**NMA**

Network Monitoring and Analysis System

**NMON**

Not Monitored — A memory administrative state for ports.

**Non-revertive switching**

In non-revertive switching, a working and stand-by line exist on the network. When a protection switch occurs, the standby line is selected to support traffic, thereby becoming the working line. The original working line then becomes the stand-by line. This status remains in effect even when the fault clears. That is, there is no automatic switch back to the original status. Also see **1+1 Line Protection**.

**NRZ**

Non-return to zero

**NSA**

Nonservice Affecting

**NSAP Address**

Network Service Access Point Address — An automatically assigned number that uniquely identifies a Network Element for the purposes of routing DCC messages.

---

**O**

**O&M**

Operation and Maintenance

**OALAN**

Overhead Access Local Area Network — The internal local area network that provides communications between the System Controller circuit pack and the Overhead Controller circuit pack.

**OAM&P**

Operations, Administration, Maintenance, and Provisioning

**OC, OC-n**

Optical Carrier — The optical signal that results from an optical conversion of an STS signal; that is, OC-1 from STS-1 and OC-n from STS-n.

**ODU**

Optical Demultiplexer — takes the WaveStar OLS 40G optical signal and separates it into the eight [OC-48/STM-16](#) signals.

**OMU**

Optical Multiplexer Unit— takes up to eight [OC-48/STM-16](#) signals and combines them into a single signal

**OOF**

Out-of-Frame

**Open Ring Network**

Network formed of a point-to-point configuration of systems.

**Operations Interface**

Any interface providing you with information on the system behavior or control. These include the equipment LEDs, interface strip, CIT, office alarms, and all telemetry interfaces.

**Operations Interworking**

The capability to access, operate, provision, and administer remote systems through craft interface access from any site in a SONET network or from a centralized operations system.

**Optical Channel**

A [OC-48/STM-16](#) wavelength within an optical line signal. There are eight such wavelengths, or channels, in one line signal.

**Optical Line Build-out (LBO)**

An attenuator placed between FT-2000 [OC-48/STM-16](#) Lightwave systems and the LGX (or equivalent). It guarantees the optical level will be below the receiving equipment's maximum received power requirements.

**Optical Line ID**

A portion of the supervisory signal that identifies optical lines to prevent misconnections between sites.

**Optical Line Signal**

A multiplexed optical signal containing eight wavelengths or channels.

**Optical Line System**

A lightwave transmission system that multiplexes up to eight wavelengths, transmits the resulting multiplexed signal, and then demultiplexes the signal at the other end.

**Optical Section**

See Span.

**Optical Translator (OT)**

A unit that electrically regenerates any incoming [OC-48/STM-16](#), [OC-12/STM-4](#), and [OC-3/STM-1](#) wavelength in the 1.3-1.5 micrometer range into a specific outgoing wavelength of the same, respective rate.

**Optical WAD**

See Wavelength Add/Drop.

**Orderwire**

A section of the supervisory signal that is used for communication between sites.

**Original Value Provisioning**

The original values are preprogrammed at the factory. These values can be overridden using local or remote provisioning.

## **OS**

Operations System — A central computer-based system used to provide operations, administration, and maintenance functions.

## **OTCTL**

Optical Translator Controller

## **OTPM**

Optical Translator Port Module

## **OTU**

Optical Translator Unit

---

## **P**

### **Parallel Telemetry**

A set of alarms and status information reported to an operations center.

### **Parameter**

A characteristic of the system that affects its operation.

### **Platform**

In WaveStar OLS 40G, a platform is a family of equipment and software configurations designed to support a particular application.

### **PM**

Performance Monitoring — Measures the quality of service and identifies any degrading or marginally operating systems (before an alarm would be generated).

### **POH**

Path Overhead — Overhead assigned to and transported with the payload until the payload is demultiplexed. It is used for functions that are necessary to transport the payload.

### **Preprovisioning**

The capability to provision a slot before installing a circuit pack.

### **Proactive Maintenance**

Refers to the process of detecting degrading conditions not severe enough to initiate protection switching or alarming, but indicative of an impending signal fail or signal degrade defect.

### **Protection Switching**

The switching of traffic from a malfunctioning line to one that is working.

### **PROTN**

Protection

### **Provisioning**

Assigning a value to a system parameter.

**PWR**

Power

---

**R**

**RCV**

Receive

**RDI**

Remote defect indicator — [Previously called far-end-receive failure (FERF)] An indication returned to a transmitting terminal that the receiving terminal has detected an incoming section failure.

**Repeater Terminal**

In WaveStar OLS 40G, a bidirectional terminal consisting of a pair of optical amplifiers and the corresponding telemetry packs.

**Reactive Maintenance**

Refers to discovering defects/failures and then clearing them.

**Regeneration**

The process of reconstructing a digital signal to eliminate the effects of noise and distortion.

**Revertive Switching**

In revertive switching, there is a service and protection line or circuit pack. When a protection switch occurs, the protection line or circuit pack is selected. When the fault clears, service reverts to the original service line. See 1x1 Line Protection.

**RF**

Radio Frequency

**RFI**

Remote failure indication — (Previously called yellow signals.) A signal that alerts upstream STS-1 path terminating equipment that a down stream failure has been alarmed along the STS-1 path. This action prevents multiple alarms from being activated for the same failure and ensures that craft will be dispatched to the correct location of the failure.

**RPP**

Reliability Prediction Procedure

**RT**

Remote Terminal

---

**S**

**SA**

Service Affecting

**SD**

Signal Degrade

**SDH**

Synchronous Digital Hierarchy — a European standard

**SEFS**

Severely Errored Frame Seconds — A performance-monitoring parameter.

**SES**

Severely Errored Seconds — A performance-monitoring parameter.

**SESP**

P-bit Severely Errored Seconds — A performance-monitoring parameter.

**SF**

Signal Fail

**Short Reach**

The capability to concatenate up to 3 spans between end terminals before regeneration is required

**Single-ended Operations**

The single-ended operations capability provides operations support from a single location to remote network elements (NEs) in the same SONET subnetwork. With this capability you can perform operations, administration, maintenance, and provisioning on a centralized basis. The remote NEs can be those that are specified for the current release.

**Site Address**

The unique address for each regenerator or terminal in a repeatered span.

**SNR**

Signal to Noise ratio; the relative strength of signal compared to noise.

**SONET**

Synchronous Optical Network

**Span**

An uninterrupted bidirectional fiber section between two network elements.

**Span Growth**

A type of growth in which one wavelength is added to all lines before the next wavelength is added.

**Span Loss**

Loss (in dB) of optical power due to the span transmission medium (includes fiber loss and splice losses).

**SPE**

Synchronous Payload Envelope — A 125-microsecond frame structure composed of STS path overhead and bandwidth for the payload.

**STM-n**

Synchronous Transport Module level n — the basic building block of SDH.

**STS, STS-n**

Synchronous Transport Signal — The basic logical building block signal with a rate of 51.840 Mb/s for an STS-1 signal and a rate of n times 51.840 Mb/s for an STS-n signal.

**STS-1E**

Now referred to as EC-1. A signal typically carried by coaxial cables from one equipment location to another. The term EC-1 refers to the organization and data rate of the signal and also to the voltage template the signal must conform to and the impedances for which the voltage template is valid.

**STS1E**

Interface Circuit Pack — The FT-2000 OC-48 Lightwave System STS1E Interface circuit pack interfaces with up to three bidirectional STS-1 signals.

**Subnetwork**

A group of interconnected/interrelated network elements. The most common connotation is a SONET network in which the network elements have data communications channel connectivity.

**Supervisory Signal**

An optical signal originating with the telemetry circuit pack that is used to communicate maintenance information.

**Synchronous**

Refers to network elements that are timed from references traceable to a single Stratum-1 source.

**Synchronous Network**

The synchronization of transmission systems with payloads to a master (network clock that can be traced to a single reference clock).

**SYSCTL**

System Controller circuit pack.

**SYSTEMEM**

System Memory circuit pack.

---

**T**

**T1X1 and T1M1**

The ANSI committees responsible for telecommunications standards.

**TA**

Technical Advisory

**TABS**

Telemetry Asynchronous Byte Serial (Protocol)

**TCA**

Threshold-Crossing Alert — A condition set when a counter exceeds a user-selected high or low threshold. A TCA does not generate an alarm but is available on demand through the CIT.

### **Telemetry Feed-through**

Operations capability for 4-fiber applications which allows the DCC to go from one End Terminal (one subnetwork) through to the other collocated end terminal (separate subnetwork), thereby extending the WaveStar OLS 40G operations domain.

### **THz**

Terrahertz ( $10^{12}$  Hz)

### **THRU**

Telemetry Feed-through end terminal designation.

### **TID**

Target Identifier — A provisionable parameter used to identify an FT-2000 [OC-48/STM-16](#) Lightwave network element. Typically, the TID is the common language location identifier (CLLI™) of the FT-2000 1x1 End Terminal, FT-2000 Add/Drop-Rings Terminal, and FT-2000 Repeater Bays.

### **TL1**

Transaction Language 1 — A machine-to-machine communications language that is a subset of CCITT's human-machine language.

### **TLM**

Telemetry circuit pack

### **TOHCTL**

Tributary Overhead Controller.

### **Tone**

An AM signal in the 5 - 30 kHz range that is superimposed on the drop side signal for power measurements.

### **TrueWave® Fiber**

Non-zero dispersion-shifted fiber manufactured by Lucent Technologies (previously referred to as DEB fiber).

### **TSO**

Technical Support Organization

### **TX**

Transmit

---

## **U**

### **UAS**

Unavailable Seconds

### **Upgrade**

An upgrade is the addition of new capabilities (features). This requires new software and may require new hardware.

---

## V

### Value

A number, text string, or other menu selection associated with a parameter.

---

## W

### Wavelength Add/Drop (WAD)

The process of adding and dropping wavelengths to provide more efficient transmission. For example, a central office contains two or more end terminals, some wavelengths can be added and dropped locally while others go express between the end terminals by means of OTs.

### Wavelength Blocking

At a WA/D site with branching, if a wavelength goes express between two co-located end terminals, that wavelength can only be added or dropped at the third co-located end terminal. Wavelength interchange permits the wavelength on the third end terminal to be converted into an available wavelength at the other two end terminals.

### Wavelength Growth

A type of growth in which all eight wavelengths are added to a single line before more lines are added.

### Wavelength Interchange

The ability to change the wavelength associated with an [OC-48/STM-16](#) signal into another wavelength.

### Wavelength Section

The path followed by an STS48 from its creation to its termination.

### WaveStar OLS 40G End Terminal

Terminal equipment consisting of a co-located Optical Multiplexer Unit (OMU) and Optical Demultiplexer Unit (ODU) for bidirectional transmission, Optical Amplifiers (OA), and WaveStar OLS 40G Telemetry packs.

### WaveStar OLS 40G Repeater Terminal

Bidirectional terminal consisting of a pair of Optical Amplifiers (OA) and the corresponding WaveStar OLS 40G telemetry packs.

### WaveStar OLS 40G Subnetwork

All dual-facing end terminals and WaveStar OLS 40G Repeaters interconnected with each other. The dual-facing shelf feature extends the access domain beyond the end terminals.

### WaveStar OLS 40G System

Two End Terminals and the Repeaters between them.

### **Wideband Communications**

Voice, data, and/or video communications at digital rates from DS0 to DS1 rates (64Kb/s to 1544Kb/s)

---

## **X**

### **X.25**

Communications protocol.

---

## **Z**

### **Zero Code Suppression**

A technique used to reduce the number of consecutive zeros in a line-codes signal (B3ZS for DS3 signals).

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