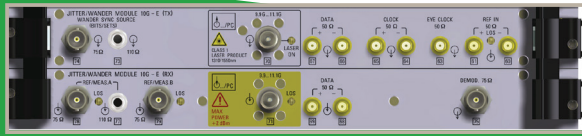




Module-E 10 G/2.5 G



Jitter Module 10 G-E



Jitter Module 2.5 G-D

Optical Network Tester (ONT)

Module-E and Jitter Modules

Today's market is facing tremendous new packet-based services growth such as VoIP and IPTV. This level of growth and the increase in end-user demand for direct Ethernet access is driving an urgent need for cost-effective high-speed Ethernet transmission systems.

All major operators view 10 Gigabit Ethernet (10 GE) as the key enabling technology in today's market and are, therefore, implementing it into their networks as LAN, WAN, or combined with OTN.

Manufacturers face major challenges in providing interface cards with capabilities for multiple technologies that can verify ports according to standards such as IEEE and ITU-T to guarantee that all network layers interface properly. Ethernet behavior changing from "best effort" to "carrier grade" requires more comprehensive testing.

The Module-E for the JDSU ONT platform addresses R&D and SVT lab needs with all of the necessary functionality for testing OTN/LAN/WAN/SDH/SONET/FC networks.

The ONT, together with its broad range of measurement modules, is ideal for testing both current and emerging technologies.

Key Benefits

- All-in-one solution that fully tests from the physical layer up to Layer 3 at 155 Mbps to 11.3 Gbps rates
- Maximizes value with deep OTN, Ethernet, GFP, and SDH/ SONET protocol coverage:
 - OTN OTU1/2/2e/1e, OTN multiplexing, ODU0 and ODUflex support, and ODU multichannel
 - LAN/WAN with 256 flows, multiple tags, IP, QoS, and BERT per flow
 - SDH/SONET with multichannel and VCat support
- Reduces CapEx with fully structured signals over all supported layers
- Complex traffic generation, deep analysis, and advanced error/alarm insertion ensures optimal system performance
- Terminate, Intrusive Through, and Non-intrusive Through modes ensure complete test coverage
- Jitter and wander testing from 155 Mbps to 11.1 Gbps for SyncE, OTN, OTL, SDH/SONET, and 10 G FC ensures standard compliance

Applications

- Network element design testing
- Network element production testing
- Network system verification

Compliance

- OTN ITU-T G.709
- LAN/WAN IEEE 802.3
- SDH ITU-T G.707
- SONET Telcordia GR-253-Core
- SyncE ITU-T G.8261, 8262, 8264
- Jitter/Wander ITU-T O.171-174

Application Highlights

Optical Interfaces

Choose either the XFP pluggable high-rate interface optics or built-in fixed optics at 1310 and 1550 nm. The low-rate interface is SFP pluggable optics. Tunable XFP optics are also supported.

Differential Electrical Interfaces

An added hardware option for the Jitter 10 G module provides differential electrical interfaces for all rates and signals from 9.95 to 11.32 Gbps.

Unframed Testing

All available rates are offered with unframed pattern and BERT capabilities. These functions are useful especially for qualifying components and DWDM links.

- Unframed BERT at 20 different rates: 155.52 and 622.08 Mbps, and 1.063, 1.25, 2.125, 2.488, 2.666, 4.25, 9.953, 10.000, 10.313, 10.519, 10.664, 10.709, 10.755, 11.049, 11.095, 11.181, 11.270, and 11.318 Gbps
- Unframed patterns: PRBS $2^{31}-1$, $2^{23}-1$, $2^{15}-1$, $2^{11}-1$, 2^7-1 and inverted, PRBS $2^{31}-1$ IEEE, DW 32 bits, square wave (Tx only), repeating ones/zeros editable 4 to 11 bits

OTN OTU2/OTU1 Testing

OTN OTU2/OTU1 testing supports OTU2/OTU1 applications including overlocked OTU2 rates for signal generation and analysis with deep signal manipulation (alarm, error, overhead), forward error correction (FEC) generation and analysis. Also supports comprehensive ODU multiplexing (ODU0, ODUflex, ODU1, and ODU2) with multistage multiplexing, as well as ODU multichannel capability.

- Standard and overlocked OTU2 rates
- GFEC
- Bulk and fully structured clients; LAN, WAN, and SDH/SONET
- ODU multichannel with parallel ODU0/1/flex mixed mappings generation and analysis
- Supports all TCM layers
- Overhead- and payload-based transfer delay
- Overhead byte multiframe sequence capture
- Service disruption tests with high-level detail
- Client offset stuffing control at each layer
- ODU0 with GE and SDH/SONET clients
- Captures GCC bytes and analyzes HDLC frames

GFP Testing

The GFP functionality encapsulates Ethernet MAC into ODU0/1/2/flex or SDH/SONET VCat, with implementation in accordance with ITU-T G.7041, G.707, and ANSI T1.105.02. Supports both GFP-F and GFP-T. GFP transparent mapping in accordance with ITU-T G.7041 Par.17.4.1 encapsulates both PCS and Ethernet MAC into OTU2.

- Generation and analysis of GFP frame types
- Core header processing
- Payload-type header processing
- Error and alarm processing
- PCS, LAN Layer 2/3 traffic, and MPLS/IP with full feature set
- GFP-F with extension header and full OAM support
- MPLS/IP directly into SDH/SONET via GFP

GE and 10 GE LAN Testing

Testing covers the generation and analysis of PCS and MAC/IP Layer traffic. Testing on GE and 10 GE can be a native line interface or a client signal mapped into OTN or SDH/SONET.

- PCS-layer testing with dynamic block errors and coding statistics
- VPLS and MAC-in-MAC Ethernet frame formats
- Up to 256 traffic flows and independent receiver filters as well as 16 independent traffic profiles
- Real-time QoS, service disruption, and packet jitter analysis per flow
- IPv4, IPv6, VLAN/Q-in-Q, MPLS, TCP, UDP frame structures
- RFC 2544 suite
- ESMC G.8264 sync message generation and analysis

10 G WAN Testing

- 10 GE WAN Layer 1 and Layer 2/3 traffic
- Full SDH/SONET feature set
- Full 10 GE LAN feature set

Fibre Channel Testing

The 1, 2, 4, and 10 G FC testing covers PCS and FC-2 layer traffic generation and analysis on a native line interface; also, 10 G FC can be mapped into OTU2f or OTU1f

- Single stream with constant traffic, bursty traffic, and full bandwidth support
- Implicit flow control login
- Credit buffer support

SDH/SONET Testing

The SDH/SONET functionality includes mappings down to VC-11/12 and VT-1.5/2 and can be a native interface or a client signal for ODU0/1/2.

- Full SDH/SONET testing for STM-1/STM-4/STM-16/STM-64 and OC-3/OC-12/OC-48/OC-192 with mappings down to VC-11/12 and VT-1.5/2
- Dynamic error/alarm insertion including bursts
- Full access to overhead bytes with byte capture
- Pointer sequence generation and analysis
- Service disruption tests with high-level detail
- Performance monitoring ITU-T G.826/828/829
- HO virtual concatenation (VCat) with mappings VC-4-nv, AU-3/VC-3-xv, and STS-1-xv
- HO multichannel (MC) covers STM-64/OC-192 signals with up to $64 \times$ VC-4/192 \times STS-1 SPE parallel generation and analysis for BER, service disruption, errors, and alarms
- LO multichannel covers 2.5 Gbps signals with up to 1008 VC12s or 1084 VT1.5s parallel generation and analysis for BER, service disruption, errors, and alarms; and 2.5 Gbps multichannel structure in STM-64/OC-192

Packet-over-SONET/SDH (PoS) Testing

The PoS application lets users check the physical layer (SDH/SONET) as well as IP network traffic with HDLC/PPP framing

- Signal structure
 - SONET mappings with PoS: STS-1/3c/12c/48c
 - SDH mappings with PoS: AU-4:VC-4, VC-4-4c/16c AU-3:VC-3
 - Fill patterns
 - HDLC/PPP like framing (RFC 1662)
 - CISCO HDLC
 - PoS measurements
 - Traffic parameters on the transmit side: frame size, frame rate, sustained bandwidth utilization
 - Traffic analysis on the receive side: frame rate, total frames received, analyzed test frames, link bandwidth, link utilization, average delay, delay variation
 - Error insertion: FCS errors, invalid frames, lost packets
 - Error measurement: all errors count, ratio, duration
 - Alarm detection: red, yellow, LPAC duration
-

Jitter and Wander Testing

Generates and analyzes jitter and wander according to these standards:

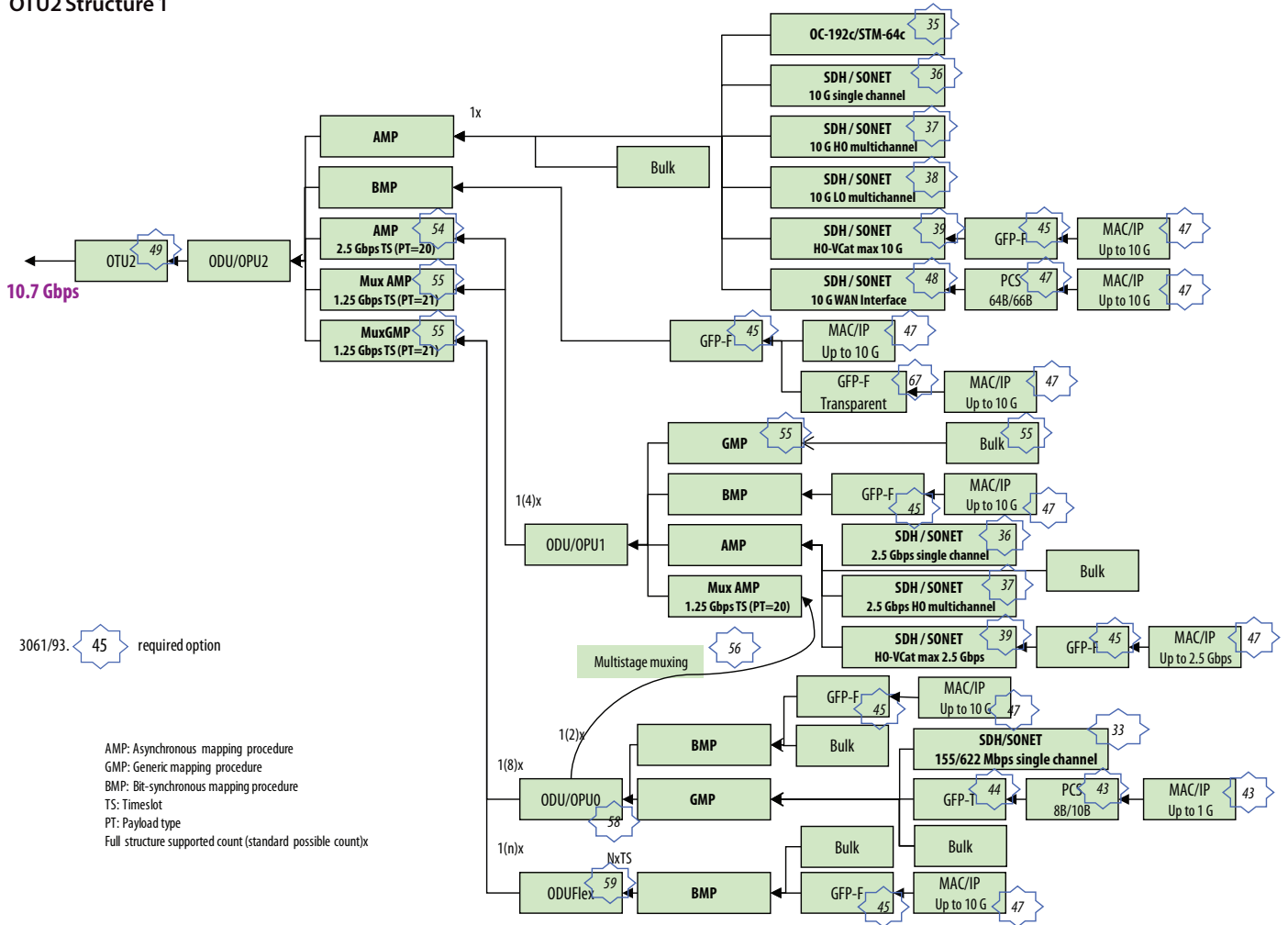
- ITU-T Recommendation O.172 including Appendixes VII and VIII with accuracy map support at 10 G
- ITU-T Recommendations O.173 and O.174
- ITU-T Recommendations G.825, G.8251, G.8261, and G.8262
- Telcordia GR-253
- ANSI Standards T1.101, T1.105, and T1.105.03

Jitter and wander testing includes:

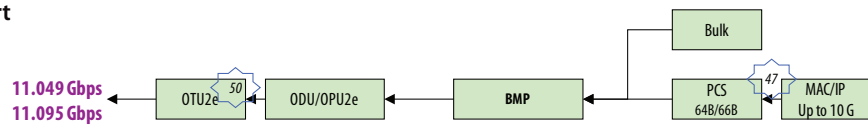
- Optical (dual-wavelength) and electrical jitter/wander testing at 155 and 622 Mbps and 1.25, 2.5, 2.7, 9.9, 10.3, 10.519, 10.709, 10.755, 11.049, 11.095, and 11.181 Gbps
 - Synchronous Ethernet G.8261/8262 support
 - Parallel measurement filters
 - Automatic modes for jitter/wander tolerance and transfer
 - Highest jitter receiver accuracy verified by using ITU-T O.172 Appendix VII/ VIII and support of accuracy maps
 - Graphical TIE, MTIE, TDEV analysis
 - TDEV/white noise, MTIE transient and sinusoidal wander generation
 - Wander for BITS/SETS (64 kHz, 1.5/2 MHz, DS1/E1) and 1 pps signals
 - Wander measurements on clock signals CC64 kHz, 1.5/2/6.3/10 MHz
-

Signal Structures

OTU2 Structure 1



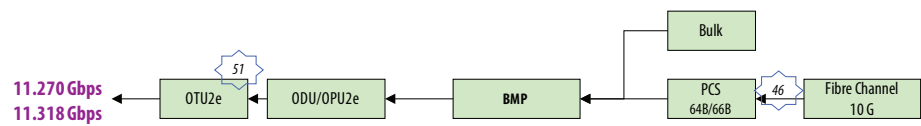
OTU2 Structure for MAC/IP Transport



ITU-T G.Sup43

3061/93. *xy* required option

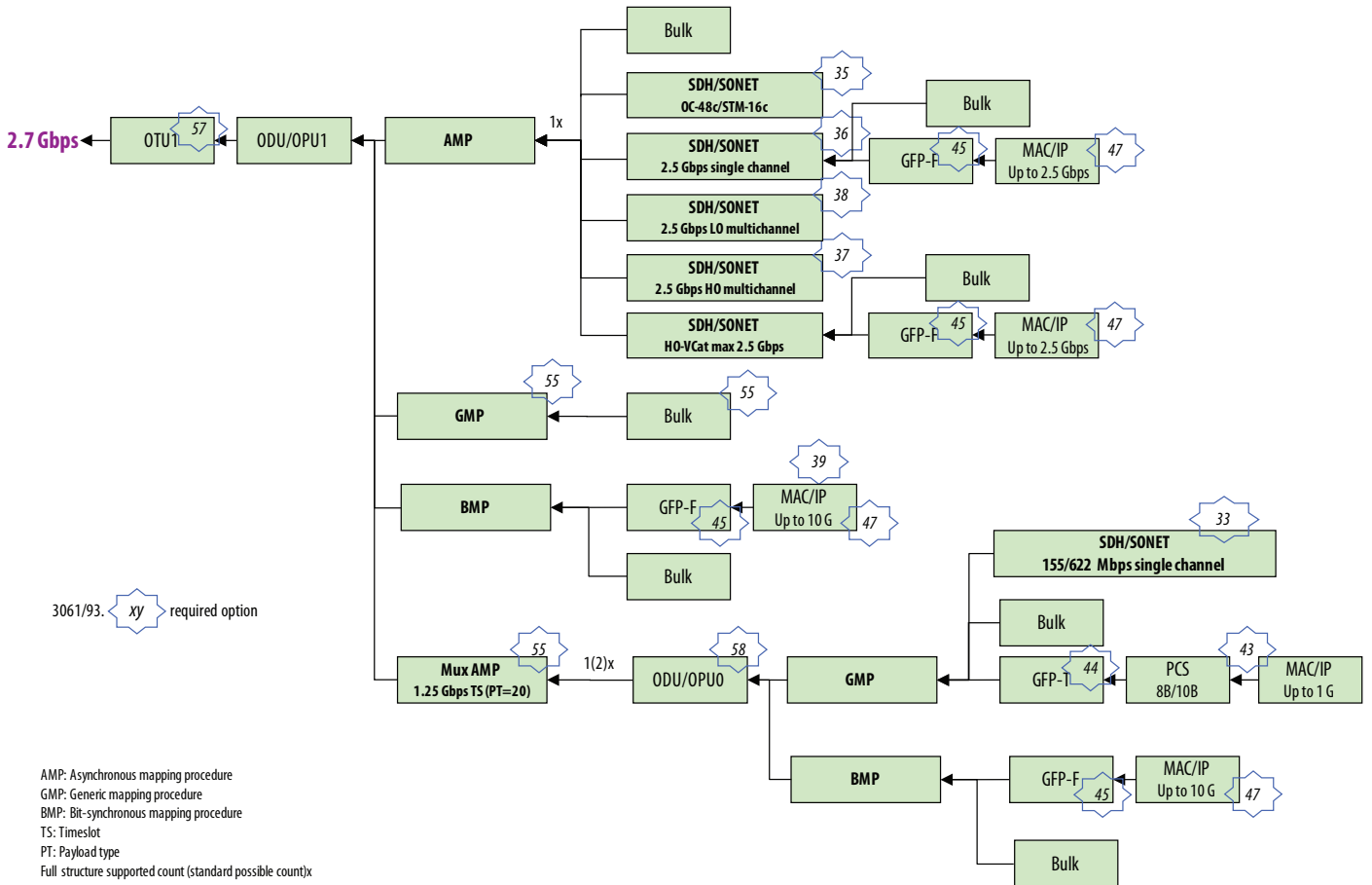
OTU2 Structure for FC Transport



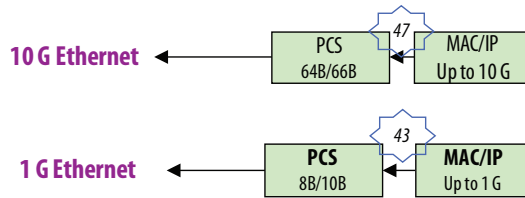
ITU-T G.Sup43

3061/93. *xy* required option

OTU1 Structures

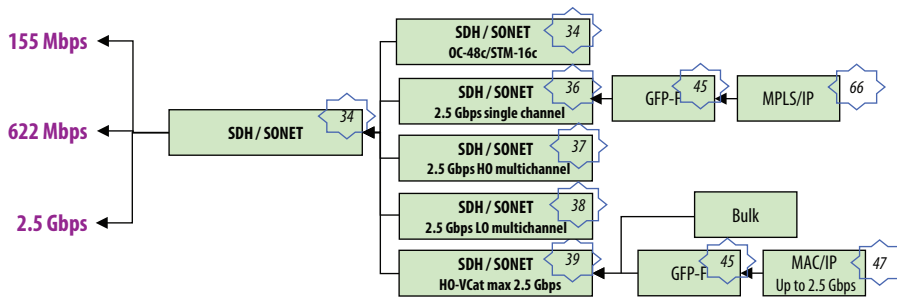
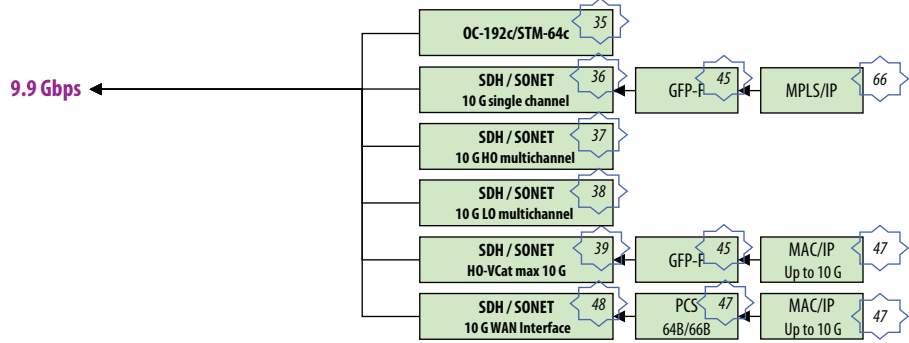


Ethernet Structures



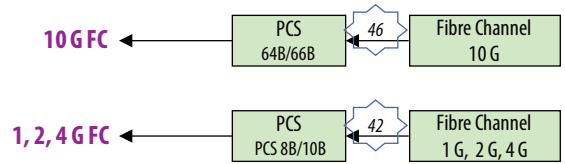
3061/93. xy required option

SDH/SONET Structures



3061/93. 45 required option

Fibre Channel Structures



3061/93. xy required option

Ordering Information

| Description | Part Number |
|---|-------------|
| Module-E 10 G/2.5 Gbps and Options | |
| Module E 10 G/2.5 Gbps XFP/SFP slot | 3076/92.05 |
| Module E 10 G/2.5 Gbps 1310/SFP slot | 3076/92.06 |
| Module E 10 G/2.5 Gbps 1310_1550/SFP slot | 3076/92.08 |
| OTN 10.7 Gbps | 3061/93.49 |
| OTN 11.05/11.1 Gbps | 3061/93.50 |
| OTN 11.27/11.32 Gbps | 3061/93.51 |
| OTN multiplexing OTU2 | 3061/93.54 |
| OTN multiplexing enhanced | 3061/93.55 |
| OTN multistage multiplexing | 3061/93.56 |
| OTN 2.7 Gbps | 3061/93.57 |
| OTN ODU0 | 3061/93.58 |
| OTN ODUflex | 3061/93.59 |
| OTN ODU multichannel | 3061/93.61 |
| OTN control plane enhancements | 3061/93.64 |
| GFP-T | 3061/93.44 |
| 10 G GFP-F | 3061/93.45 |
| 1 G Ethernet | 3061/93.43 |
| OTN transparent GFP-F mapped Ethernet | 3061/93.67 |
| 10 GE LAN | 3061/93.47 |
| 10 GE WAN | 3061/93.48 |
| 10 G Fibre Channel | 3061/93.46 |
| 1, 2, 4 G Fibre Channel | 3061/93.42 |
| ODU0 with SDH/SONET client | 3061/93.33 |
| Lower-rate SDH/SONET | 3061/93.34 |
| OC192c/STM-64c BERT | 3061/93.35 |
| SDH/SONET single channel | 3061/93.36 |
| Multichannel HO up to 10 G | 3061/93.37 |
| Multichannel LO | 3061/93.38 |
| 10 GVCat HO | 3061/93.39 |
| HDLC support to enable PoS | 3061/93.40 |
| MAC-in-MAC 802.1ah | 3061/93.60 |
| IPv6 | 3061/93.62 |
| ESMC G.8264 | 3061/93.63 |
| Capture MAC/IP | 3061/93.65 |
| MPLS/IP into STM-64c/OC192c | 3061/93.66 |

| Description | Part Number |
|---|-------------|
| Module-E 10 G/2.5 Gbps Jitter/Wander Modules and Options | |
| Jitter Module 10 G-E 1550 nm | 3076/90.75 |
| Jitter Module 10 G-E 1310/1550 nm | 3076/90.76 |
| Add Jitter 10.3 Gbps (10 GE) | 3076/90.70 |
| Add Jitter 10.5 Gbps (10 G FC) | 3076/90.63 |
| Add Jitter 10.7 Gbps (OTU2) | 3076/90.78 |
| Add Jitter 11.05/11.1 Gbps (OTU1e, OTU2e) | 3076/90.79 |
| Add Jitter 10.75 Gbps (OTL4.10) | 3076/90.81 |
| Add Jitter 11.18 Gbps (OTL4.10) | 3076/90.99 |
| Add 10 G differential electrical interfaces | 3076/90.77 |
| Wander 10 G | 3061/93.95 |
| Wander 10 G Expert | 3061/93.97 |
| Jitter Module 2.5 G-D 1550 nm | 3076/90.66 |
| Jitter Module 2.5 G-D 1310/1550 nm | 3076/90.67 |
| Add Jitter 2.7 Gbps | 3076/90.68 |
| Add Jitter 1.25 Gbps | 3076/90.69 |
| Wander up to 2.7 Gbps | 3061/93.92 |
| Wander Expert up to 2.7 Gbps | 3061/93.89 |
| Options Available with Jitter 10 G and Jitter 2.5 Gbps Modules | |
| Wander DS1/E1+bits | 3061/93.96 |
| Jitter DS1/E1+bits | 3061/93.90 |
| Bits Expert | 3076/90.74 |
| External Wander analysis | 3061/95.98 |
| Accessories | |
| XFP optics 850 nm | 3076/96.20 |
| XFP optics 1310 nm | 3076/96.21 |
| XFP optics 1550 nm | 3076/96.22 |
| SFP optics 850 nm | 3076/96.25 |
| SFP optics 1310 nm | 3076/96.26 |
| SFP optics 1550 nm | 3076/96.27 |
| SFP optics 1310 nm incl. 4 G FC | 3076/96.28 |



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