Optical Network Tester (ONT)

Module-E, Jitter Module

Module-E 10 G

Module-E 10 G/2.5 G

Jitter Module 10 G–E

Jitter Module 2.5 G–D

Applications

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

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

Key Benefits

- All-in-one solution that fully tests from the Physical Layer up to Layer 3 at 155 Mbps to 11.1 G rates
- Maximizes value with deep OTN, Ethernet, and SDH/ SONET protocol coverage:
  - OTN OTU1/2/2e/1e, ODU multichannel, OTN multiplexing, ODU0, and ODUflex support
  - 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
- Terminal, Intrusive Through, and Nonintrusive Through connectivity modes ensure complete test coverage
- Jitter and wander testing from 155 Mbps to 11.1 G for SyncE, OTN, OTL, SDH/SONET, and 10 G FC ensures standard compliance

Today's market is facing tremendous growth of new packet-based services 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 the needs of R&D and SVT labs with all of the necessary functionality for testing OTN/LAN/WAN/SDH/ SONET/FC networks at various wavelengths.

The ONT together with its broad range of measurement modules offers an ideal tool for testing both current and emerging technologies.

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Application Highlights

Optical Interfaces

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

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 G.

High-Speed Trigger Out

A special XFP pluggable can be used in conjunction with built-in optics or electrical interface to trigger high-speed output from an oscilloscope or other test equipment with high timing-accuracy requirements.

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 19 different rates: 155.52 and 622.08 Mbps, and 1.063, 1.25, 2.125, 2.488, 2.666, 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 G
- 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 overclocked 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 overclocked OTU2 rates
- Bulk and fully structured clients; LAN, SDH/SONET
- ODU multichannel with parallel generation and analysis of ODU0/1/flex mixed mappings
- Supports all TCM layers
- Transfer delay and service disruption tests
- Overhead byte multiframe sequence capture
- Client offset stuffing control

GFP Testing

The GFP functionality ecapsulates Ethernet MAC and maps/de-maps SDH/SONET virtual concatenation, ODU0, ODUflex, or OTU2 with implementation in accordance with ITU-T G.7041, G.707, and ANSI T1.105.02 GFP-F (frame-mapped Ethernet) and the following functionality:

- Generation and analysis of GFP frame types
- Core header processing
- Payload-type header processing
- Error and alarm processing
- LAN Layer 2/3 traffic with full feature set
- GFP-F with extension header and full OAM support.

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.

- Layer 1 BERT and Layer 2/3 traffic
- 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, 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

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

10 G FC Testing

Testing covers the generation and analysis of PCS- and FC-2-layer traffic. Testing on 10 G FC can be a native line interface or a client signal mapped into OTU2f or OTU1f.

- Features at the PCS layer are the same as 10 GE LAN
- 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 AU3/VC3 and STS 1 SPE 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 AU-3/AU-4, STS-1
- 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 parallel generation and analysis of up to 64 × VC-4/192 × STS-1 SPE for BER, service disruption, errors, and alarms

Jitter and Wander Testing

Generate and analyzes jitter and wander according to the following 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 G
- Synchronous Ethernet G.8261/8262 support
- Parallel measurement filters
- Automatic jitter 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

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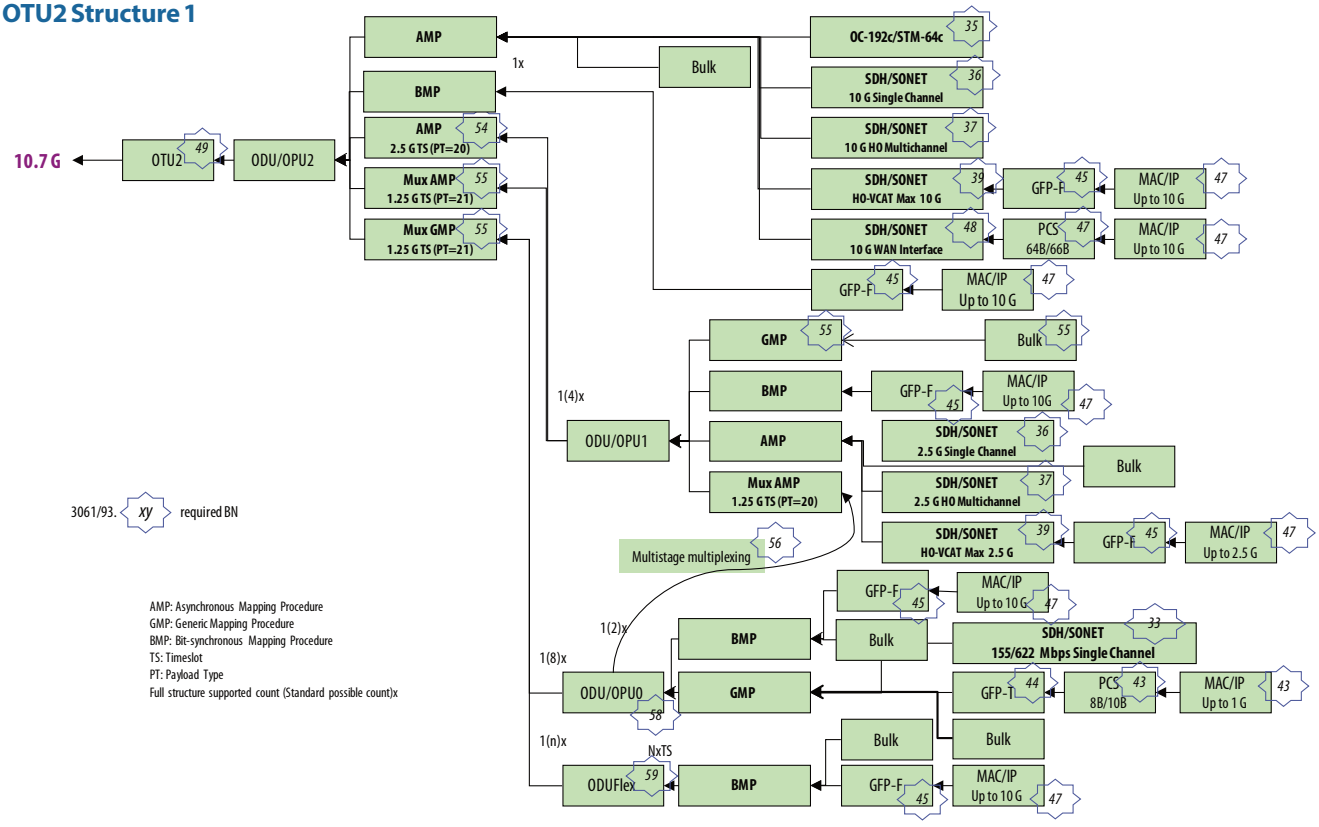
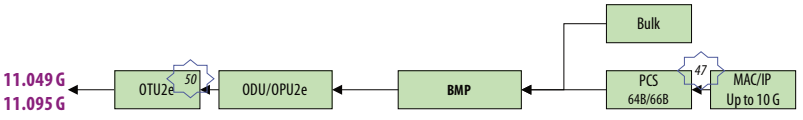
Signal Structures

OTU2 Structure 1

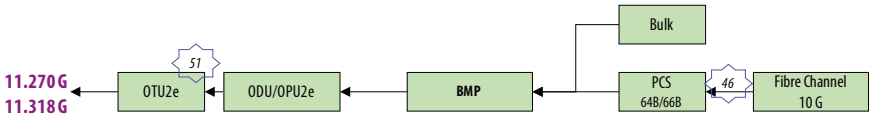


OTU2 Structure 2

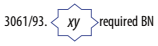


ITU-T G.Sup43

OTU2 Structure 3



ITU-T G.Sup43



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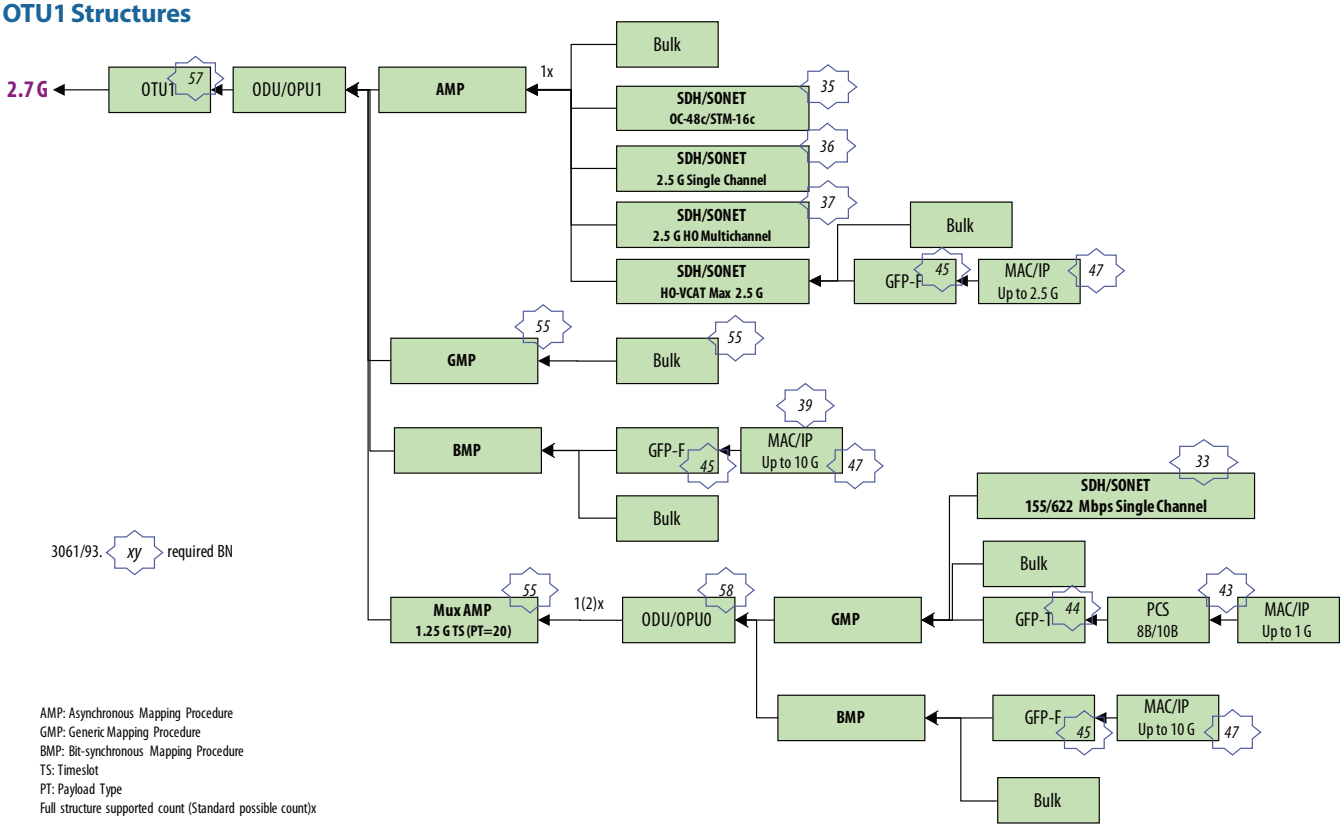
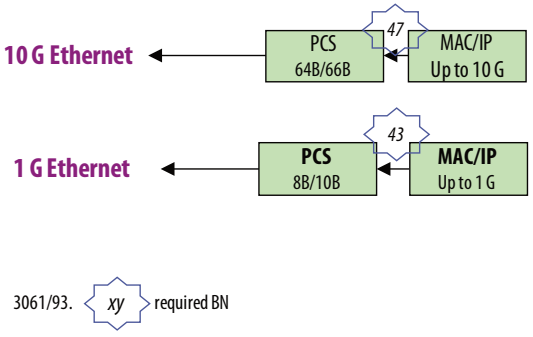
Signal Structures

OTU1 Structures



AMP: Asynchronous Mapping Procedure
GMP: Generic Mapping Procedure
BMP: Bit-synchronous Mapping Procedure
TS: Timeslot
PT: Payload Type
Full structure supported count (Standard possible count)x

Ethernet Structures



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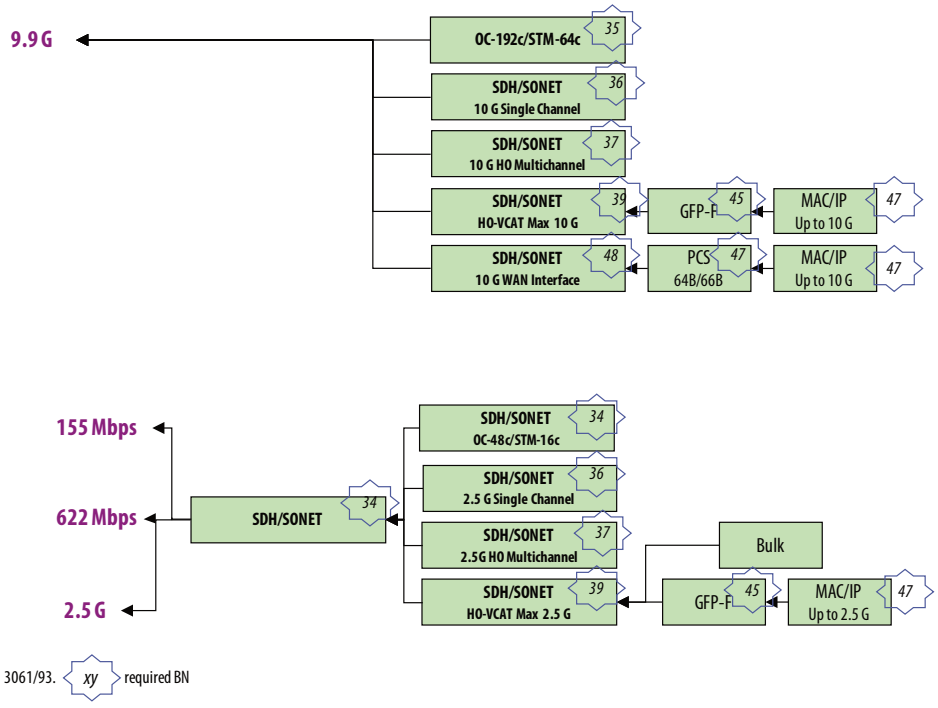
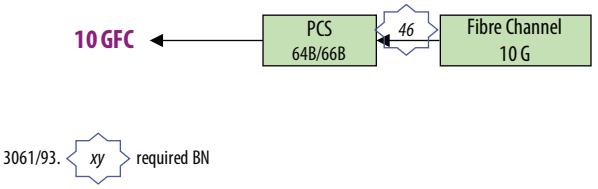
Signal Structures

SDH/SONET Structures



Fibre Channel Structures



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Ordering Information

Module-E 10 G/2.5 G and Options

Part Number	Description
3076/92.05	Module E 10 G/2.5 G XFP/SFP Slot 10 G/2.5 G, without fixed optics, unframed.
3076/92.06	Module E 10 G/2.5 G 1310/SFP Slot 10 G/2.5 G, 1310 fixed optics, unframed.
3076/92.08	Module E 10 G/2.5 G 1310_1550/SFP Slot 10 G/2.5 G, 1310 and 1550 fixed optics, unframed.
3061/93.34	Lower-Rate SDH/SONET Adds 155 Mbps - 2.5 G SDH/SONET line rates (concatenated with bulk payload) to 10 G and 2.5 G modules.
3061/93.35	OC192c/STM-64c BERT Adds 10 G SDH/SONET with bulk payload.
3061/93.36	SDH/SONET Single Channel Adds up to 10 G (mapped) structured SDH/SONET, including 10 G line rate, OC192c/STM64c, and lower-rate mapped signals. Also adds structured SDH/SONET to 3061/93.34. Adding the ability to map SDH/SONET into ODU0 requires 3061/93.33.
3061/93.37	Multichannel 10 G HO Adds SDH/SONET higher-order multi-channel capability to 3061/93.34 and 3061/ 93.35 or 36. Adding SDH/SONET in-depth single-channel capabilities requires 3061/93.36.
3061/93.39	10 G VCat HO Adds 10 G SDH/SONET higher-order virtual concatenation capabilities and also works with 2.5 G and lower line rates, if available.
3061/93.44	GFP-T Requires GFP-transparent mapping mode option to map 1 G Ethernet (3061/93.43) via GFP-T inside ODU0 (93.58).
3061/93.45	10 G GFP-F Requires GFP-framed mapping mode option to map Ethernet traffic (up to 10 G, 3061/93.47) via GFP-F into OTN/VCat/ODUflex.
3061/93.46	10 G Fibre Channel Adds 10 G FC (line rate) and client for 3061/93.51.
3061/93.49	OTN 10.7 G Adds OTN 10.7G line rate (bulk payload; SDH/SONET client not included).
3061/93.50	OTN 11.05/11.1 G Adds Ethernet over OTN overclocked line rates OTU1e and OTU2e (bulk payload; Ethernet client not included).
3061/93.51	OTN 11.27/11.32 G Adds FC over OTN line rates OTU1f and OTU2f (bulk payload; FC client not included).
3061/93.54	OTN Multiplexing OTU2 Adds ODU1 into 2.5 G timeslot-based OTU2 single-stage multiplexing to 3061/93.49.
3061/93.55	OTN Multiplexing Enhanced Adds single-stage 1.25 G timeslot-based ODU multplexing to 3061/93.49 or 93.57.
3061/93.56	OTN Multistage Multiplexing Adds multistage ODU multiplexing, such as ODU0 in ODU1 in OTU2, to 93.55.
3061/93.57	OTN 2.7 G Adds OTU1 line rate to 10 G/2.5 G Module-E.
3061/93.59	OTN ODUflex Adds ODUflex with bulk functionality to 3061/93.55.
3061/93.58	OTN ODU0 Adds ODU0 with bulk functionality to 3061/93.55.
3061/93.33	ODU0 with SDH/SONET Client Adds the ability to carry SDH inside 3061/93.58 and includes a SDH/SONET 622 Mbps and 155 Mbps client.
3061/93.61	OTN ODU Multichannel Adds ODU multichannel capability.
3061/93.47	10 GE LAN Native 10 GE line rate. Add mapped service with 93.50 option. Add GFP-F mapped service with options 93.45 and either 93.39 or 93.49.
3061/93.48	10 GE WAN 10 GE WAN line rate/service.
3061/93.43	1 G Ethernet 1 GE (line rate with 10/2.5 G Module-E. Add mapped service via GFP-T in ODU0 requires 93.58 and 93.44.
3061/93.60	MAC-in-MAC 802.1ah Adds MAC-in-MAC.
3061/93.65	Capture MAC/IP Adds MAC/IP capture functionality.
3061/93.62	IPv6 Adds IPv6 functionality.
3061/93.63	ESMC G.8264 Generates and emulates ESMC sync messages.
3061/92.20	XFP Optics 850 nm
3061/92.21	XFP Optics 1310 nm
3061/92.22	XFP Optics 1550 nm

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Ordering Information

Module-E 10 G/2.5 G Jitter/Wander Modules and Options

Part Number	Description
3076/90.75	Jitter 10 G-E 1550 nm Jitter module with fixed 1550 nm optics that also adds 9.95 G jitter (SDH/SONET) to Module-E.
3076/90.76	Jitter 10 G-E 1310 nm/1550 nm Jitter module with fixed 1310/1550 nm optics that also adds 9.95 G jitter (SDH/SONET) to Module-E.
3076/90.70	Jitter 10.3 G-E Adds 10.3 G (10 GE) jitter capability to the Jitter 10 G module.
3076/90.63	Jitter 10.5 G-E Adds 10.5 G (10 G FC) jitter capability to the Jitter 10 G module.
3076/90.78	Jitter 10.7 G-E Adds 10.7 G (OTU2) jitter capability to the Jitter 10 G module.
3076/90.79	Jitter 11.05/11.1 G-E Adds 11.05/11.1 G (OTU1e, OTU2e) jitter capability to the Jitter 10 G module.
3076/90.81	Jitter 10.75 G-E Adds 10.75 G (OTL3.4, unframed) jitter capability to the Jitter 10 G module.
3076/90.99	Jitter 11.18 G Adds 11.18 G (OTL4.10, unframed) jitter capability to the Jitter 10 G module.
3076/90.77	Jitter Module 10 G-E Electrical Interfaces Adds differential electrical interface to the Jitter 10 G module.
3061/93.95	Wander 10 G Adds the ability to generate TX sine wander and to analyze TIE/MTIE/TDEV for available 10 G jitter rates.
3061/93.97	Wander 10 G Expert Adds TX TDEV noise, WTF, phase transients, and ppb generation/measurement to available 10 G jitter rates.
3076/90.66	Jitter 2.5 G-D 1550 nm Lower-rate jitter module that adds 2.5 G jitter, by default, to Module-E 10 G/2.5 G.
3076/90.67	Jitter 2.5 G-D 1310/1550 nm Lower-rate jitter module adds 2.5 G jitter, by default, to Module-E 10 G/2.5 G.
3076/90.68	Jitter 2.7 G-D Adds 2.7 G (OTU1) jitter to the Jitter 2.5 G-D module.
3076/90.69	Jitter 1.25 G-D Adds 1.25 G (GigE) jitter to the Jitter 2.5 G-D module.
3061/93.92	Wander 2.5/2.7 G Adds the ability to generate TX sine wander and to analyze TIE/MTIE/TDEV to available lower-rate jitter.
3061/93.89	Wander 2.5/2.7 G Expert Adds TX TDEV noise, WTF, phase transients, and ppb generation/measurement to available lower-rate jitter.

Options Available with Jitter 10 G and Jitter 2.5 G Modules

Part Number	Description
3061/93.96	Wander DS1/E1+BITS Adds DS1/E1 MTIE/TDEV evaluation, SSM code/decode, sine modulation (also for clocks).
3061/93.90	Jitter DS1/E1+BITS Adds DS1/E1+BITS jitter measurement capability to the Jitter 10 G or Jitter 2.5 G modules.
3076/90.74	Wander BITS Expert Adds 1 pps support, 1 pps delay measurement via ext. converter, and wander measurements at clock signals.
3061/95.98	External Wander Analysis Windows software for in-depth MTIE/TDEV/FFO/FFD analysis of imported TIE datafrom any ONT jitter/wander module.

For additional options, please contact your JDSU representative.

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