JDSU ONT-500/ONT-600

40/100 G CFP-based Test Module

Key Features

- Supports protocols such as 40 GE, 100 GE, OTU3/OTU4 with or without Ethernet client, OTU3e1/3e2 bulk, and STL-256.4, and others
- Supports unframed BER testing for extensive 40 and 100 G bit rates
- Generates dynamic skew to verify receiver tolerance of changes to incoming skew
- Reports total BER and BER per wavelength with patented lambda-grouping feature
- Comprehensive test features help to develop and qualify CFP and QSFP+ transponders
- Comprehensive PCS and STL/OTL layer test features
- Covers MAC, VLAN, IPv4/IPv6, TCP/UDP, MPLS, and MAC-in-MAC testing needs
- Use to develop state-of-the-art single- or multi-stage multiplexers, with ODU0 and ODUflex to OTU3 and OTU4 to validate and test both TX and RX GMP for the DUT
- Fast, affordable equipment for OTN multichannel testing showing DUT performance under actual conditions while testing BER, service disruption time, and errors/alarms for each test channel.

Applications

- Component and transponder testing
- System integration of complex 40 and 100 GE and OTU3/OTU4 elements
- Service turn-up
- Developing and validating OTN features, IPs, and ASICs

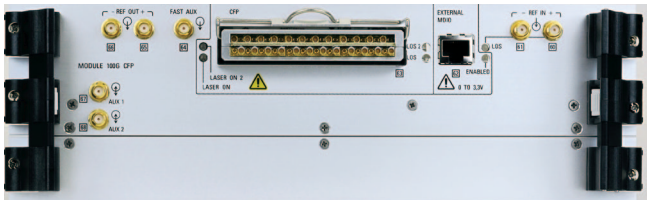
Key Benefits

- Provides peace of mind with maximum coverage of test scenarios
- Accelerates the development cycle with comprehensive test capabilities and insightful results
- Facilitates cross-functional collaboration with concurrent unit access via local and remote connections
- Preserves investment with the widest mapping and multiplexing support, and enables adding software licenses as test needs evolve
- Provides broad application range with optical and electrical connectivity (via adapter)
- Ensures test efficiency and consistency with intuitive GUI design and strong automation support
- Promotes good understanding of error performance with total bit-error ratio (BER) and BER per wavelength

Overview

Today's 40 and 100 GE and OTU3/OTU4 technologies require providers to meet the challenge of transitioning from proof of concept to an economically viable product. The technical discontinuities driven by 40 and 100 GE are formidable and require specific test and measurement equipment such as the ONT 40/100 G test solution JDSU specifically designed for developers, manufacturers, and installers of 40 and 100 GE and OTU3/OTU4 equipment. Its full scalability covers today's and tomorrow's challenges for hardware, firmware, and software development through manufacturing, installation, and turn-up.

Technical description



40/100 G test solution

Modular hardware

The heart of the power and flexibility of the 100 G test solution is the concept of the transponder carrier card. This card allows the critical high-speed differential electrical signals from the 40/100 G engine to interface with transponders, ICs, systems, or any other 100 G element being developed, tested, manufactured, and commissioned.

The signals are handed off to the device under test (DUT) via an adapter. The unit has a native CFP interface that supports both 40 and 100 G rates and is compliant with MSA 2.0. It also supports QSFP+ via an adapter. Electrical access is available by the optional electrical access CFP. This 10×10 G CFP module brings out the electrical I/O on SMA cables, see below for technical details.

40/100 G engine

The 40/100 G engine handles all the Ethernet/IP (L3 and below) requirements and contains, for example, a powerful array of BERTs, a MAC/IP core, and framers. It also contains low-noise synthesizers developed from our market-leading jitter solutions that allow precise control of the clocks across the fully required range. The engine is ready for 40 and 100 GE and OTU3/OTU4 applications and builds on our leadership in high-bit-rate transport and datacom test and measurement.

Comprehensive CFP support

The 40/100 G ONT has been tested and validated with all current CFPs including 40 G LR4, SR4, FR, and 100 G LR4, SR10, and 10x10 SANTUR. The unique features that are included in the physical layer option allow for deep analysis and verification at CFPs and QSFP+ (with optional adapter). The single-button frequency stress test allows for quick and efficient validation of basic CFP operation.

Application types

Unframed or raw BERT

This layer focuses on testing and validating the physical interface and photonic layer, which is especially critical in the transponder development and integration phase. Full-featured CFP and QSFP+ validation applications are available as options.

PCS (multi-lane) BERT

The PCS layer is key to allowing 40 and 100 G traffic to be effectively carried over the physical layer. In depth applications help validate and test all aspects of the PCS layer.

OTL (multi-lane) BERT

Available options provide the ability to support both OTL3.4 and OTL 4.10.

L2/L3 traffic

Ethernet and IP traffic are what 40 and 100 GE are all about. Powerful applications help fully test and stress every aspect of Layer 2 and Layer 3, which run parallel with our PCS and physical-layer applications, so when errors do occur, users can quickly identify the cause.

Interfaces and I/O

TX/RX clock rates

Rates	39.81 G (SDH/SONET), 41.25 G (40 G Ethernet), 43.018 G (OTU3), 44.57 G (OTU3e1), 44.58 G (OTU3e2), 100, 106, 108, 110 G unframed only available with BN 3061/92.52 physical layer validation, 103.12 G (100 G Ethernet), 111.81 G (OTU4)
Adjustable	In 0.1 ppm increments to ±500 ppm (Note: the actual transponder used may support a lower range)
Clock source	Internal reference, recovered from RX, external clock reference via clock module input or via high-speed sync clock input

CFP interface

According to	CFP 2.0 MSA
Reference clock	1/16 and 1/64 of electrical lane rate switchable
Power class	1, 2, and 3; class 4 depends upon actual transponder optical power output
Transponder MDIO	Internal (normal and relaxed), external, and off modes
Internal mode	Control by the ONT directly
Internal relaxed	Only basic and slow MDIO command are used
External mode	Control via a RJ45 connector on the module (optional with BN 3061/92.52)

General I/O

Fast trigger output

General purpose high-speed, low-jitter output	Control by the ONT directly
Nominal	600 mV into 50 Ω
Supported trigger	Fast clock with 1/4 clock rate single-ended via SMA
General purpose I/O triggers	Two with application-specific functions via SMA

TX clock output

1/16 or 1/64 of the electrical lane rate selectable for synchronization or trigger for eye diagrams

Nominal	1200 mV into 100 Ω differential via SMA
High-speed sync	Frequency locked to external clock at 1/16 or 1/64 of nominal electrical lane rate

TX clock input

Range	100 to 1000 mV into 100 Ω differential via SMA
Pull in range	> 100 ppm

Physical Layer

Unframed 4/10 channel BERT

Channels used	4 channels at 40 G rates, 10 channels at 100 G rates

Data rates supported

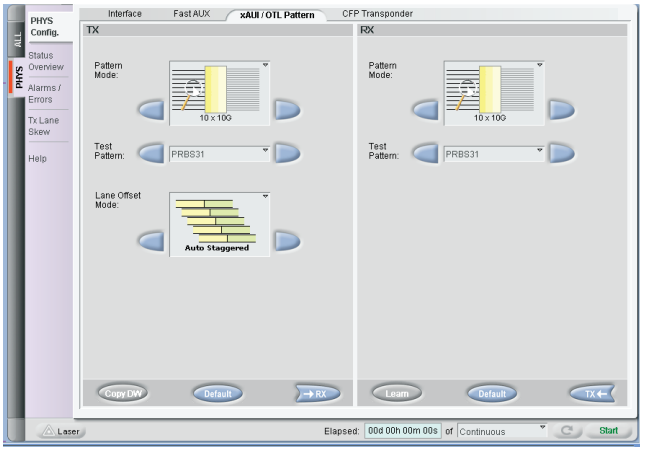
Applications	Bit rate (G)	Lane speed (G)
40 G		
OC-768	39.8131	9.95328
Ethernet	41.25	10.3125
OTU3	43.01841	10.7546
OTU3e1	44.57097	11.1427
OTU3e2	44.5833	11.14583
100 G		
Ethernet	103.125	10.3125
OTU4	111.8099	11.1809
Non-standard	100	10
Non-standard	106	10.6
Non-standard	108	10.8
Non-standard	110	11

TX

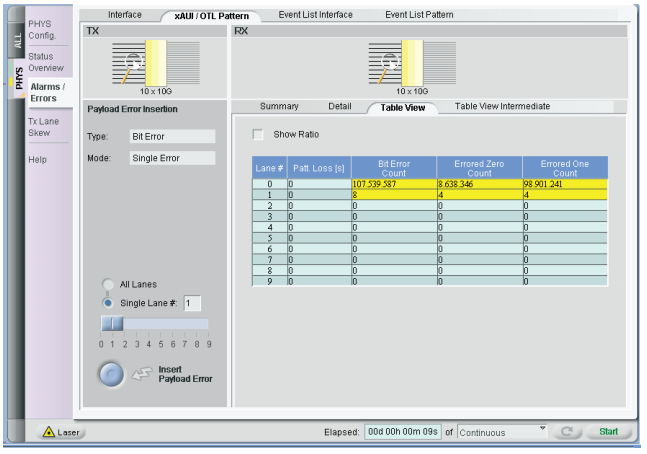
Patterns	2^7-1, 2^9-1, $2^{15}-1$, $2^{23}-1$, and $2^{31}-1$ PRBS normal and inverted, 32-bit data word, square wave
Channel clock	Common phase locked clock
Data word	Independently set for every channel
Channel pattern	Independently skewed for PRBS to give per channel offset
Skewing modes	Synchronous, staggered, user
Bit error generation	Selected channel, all channels

RX

Patterns	2^7-1, 2^9-1, $2^{15}-1$, $2^{23}-1$, and $2^{31}-1$ PRBS normal and inverted, 32-bit data word,
Error count	bit, 0 and 1, absolute, and ratio
Results	Summary, per channel
Error	Count and ratio, start/stop, and user-defined intermediate
Alarm	Pattern loss



Unframed 10×10.3 G BERT pattern configuration screen



Unframed 10×10.3 G BERT pattern tabular results screen

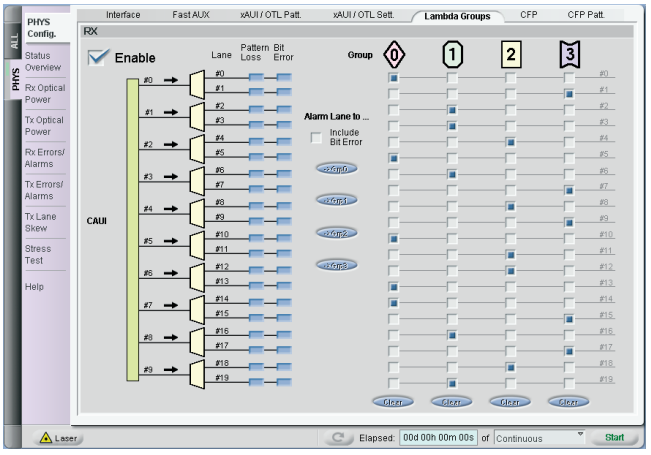
Unframed 20 channel BERT for 4 × 25 gear boxes

Test pattern mode	10 × (2 × 5 G) multiplexed onto physical 10 G lanes, or 20 channel PRBS on 10 physical lanes
Test pattern	2^7-1, 2^9-1, $2^{15}-1$, $2^{23}-1$, and $2^{31}-1$ PRBS normal and inverted, square wave
Results	Summary, per channel
Features as unframed 4/10 channel BERT	

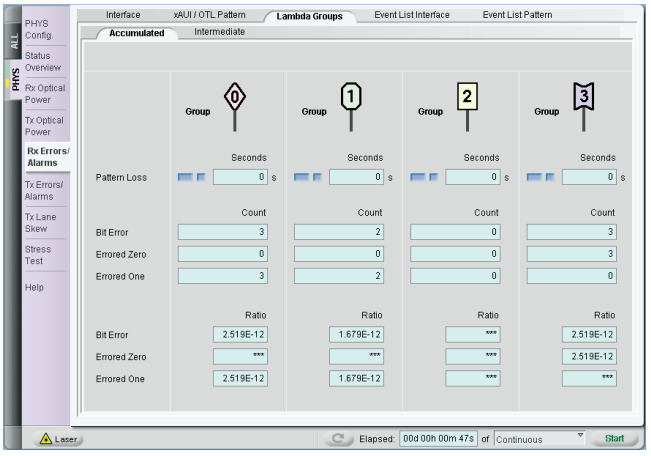
Per lambda mapping feature (optional with BN 3061/92.52 or 3076/92.52)

The 100 G BERT offers a unique feature that allows for grouping of the individual virtual lanes on a per-lambda basis greatly increasing the depth and breadth of testing that can be performed over the link.

Visibility	25 G optical lanes
Virtual lanes	Mapped onto different lambdas, based on gearbox in CFP module



Lambda groups setup screen



Lambda groups results screen

CFP validation and debug test application

The ONT supports comprehensive CFP (and QSFP+ with optional adapter) test and validation features, including the ability to monitor and manipulate MDIO (I^2C) registers in the optics, control, and monitoring of hardware module pins. Comprehensive monitoring of all important transponder parameters including optical power, temperature, status, voltage, and vendor information.

Dynamic skew application (BN 3061/94.56)

The unique dynamic skew application lets users control the skew on a per 'physical lane' basis with a resolution of 25 mUI across a range of ±32 UI.

PCS Testing

Each lane is clocked from common clock.

TX/RX scrambler	On/off independent (only available for L2/L3 layer testing)
TX ignore link faults	On/off (only available for L2/L3 layer testing)

Payload

As follows or client signal from higher-layer application.

Pattern mode	Virtual lane, aggregate

Virtual Lane mode

PRBS pattern	PRBS 2^7–1, 2^9–1, 2^{15}–1, 2^{23}–1, 2^{31}–1 normal and inverted
TX lane offset	Auto staggered, user-defined offset
User-defined offset	10 to 64 000 bits (depends on PRBS pattern)

Aggregate mode

Pattern	Scrambled idles

Error insertion

Supports simultaneous error and alarm insertion

Type	Invalid sync header, invalid alignment marker, user-defined alignment marker, BIP-8 error, Bit error (all lanes/single lane), block error
Range (depends on type)	All lanes, single lane
Trigger	Once, rate, burst once/cont.
Rate	9.9×10^{-3} to 1×10^{-10}
Burst	N events off, M events on
N, M	1 up to 16,777,215 events
Sync header value	Editable 0 or 3
Alignment marker M0, M1, M2	Editable 0 to 255
BIP error mask	Editable 0 to 255

Alarm insertion

Supports simultaneous error and alarm insertion

Type	LOBL (loss of block lock), LOAML (loss of alignment marker lock), HI BER (high bit error rate), local and remote fault, bit error (total, per lane)
Range (depends on type)	All lanes, single lane
Trigger (depends on type)	Continuous, burst once/cont.
Burst	N events off, M events on TX/RX
N, M	8 up to 134,217,720 events (local and remote fault)

Error evaluation

Type	Invalid sync header, invalid alignment marker loss of alignment marker event, BIP-8 error, BIP-8 bit error, LOBL event, HI BER event, local and remote fault event, bit error (total, per lane), errored zero (total, per lane), errored one (total, per lane), block error
Evaluation (depends on type)	Count, ratio, rate, seconds summary and per lane

Alarm evaluation

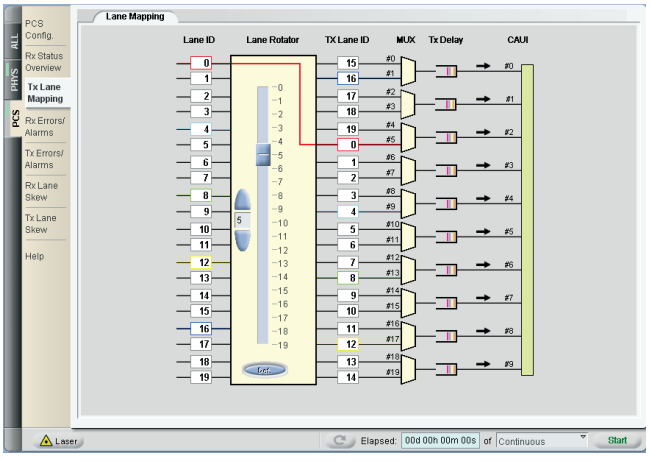
Type	LOBL, summary, per lane, LOAML, LOA (loss of alignment), HI BER, local and remote fault, link down (only available for higher-layer testing,) pattern loss
Evaluation	Seconds

Lane alignment marker insertion

For all virtual lanes	User-defined

PCS lane mapping

TX lane mapping	User-programmable (shift)

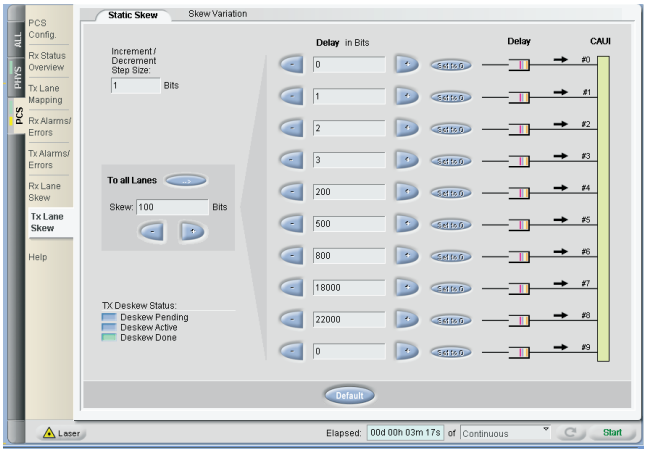


Lane rotator allows manual allocation and realignment of virtual lanes

Lane skew generation (optional with BN 3061/92.52)

Valid on physical layer, PCS, and OTL layers, even when running higher-layer applications, such as Ethernet or framed OTN.

Static skew per physical lane	0 to 64 000 bits
Resolution	1 bit per physical lane



Lane Skew generation screen. Allows for injecting large static skew into each of the physical lanes for validation of PCS receivers under extreme conditions.

Dynamic skew (for selected lanes, optional with BN 3061/94.56)

This mode requires an external clock to drive the reference clock input at line rate/16, for example, approximately 644 MHz for 100 GE).

Mode	Manual, triangle
Range	±32 UI
Settable resolution	25 mUI
Minimum skew rate	25 mUI/s
Maximum skew rate	1000 mUI/s

Analysis

Lane alignment marker	For all lanes
Lane ID	For all lanes
Lane skew	For all lanes (0 to 32 000 bits)
Lane skew variation	In bits and picoseconds

Block statistics 64B/66B

Transmit block types	Total, data, control
Receive block types	Total, data, control, good, errored
Evaluation (depends on type)	Count, ratio

40 and 100 GE MAC/IP Layer

Highlights

- Additional VPLS and MAC-in-MAC Ethernet frame formats
- Up to 256 traffic flows and independent receiver filters (optional)
- Up to 2 VLANs and 5 MPLS tags; in any combination
- Online hitless traffic control
- Real-time QoS, service disruption, and packet jitter analysis per flow
- IPv4/IPv6 (optional)
- Up to 16 traffic profiles
- IMIX and transmitter ramp traffic testing
- User defined preamble and header
- Automated throughput testing
- RFC 2544 Conformance testing

Interface

The 40 and 100 GE Ethernet/IP applications use the on-board CFP slot allowing for the use of IEEE-standards-compliant CFP optics and other types based on the CFP MSA 1.4 standard.

Basic Ethernet features

Supports one MAC flow for TX and RX.

Ethernet generator

Frame type	Ethernet II, SNAP, VPLS with inner and outer MAC, MAC-in-MAC 802.1ah
Ethertype	Editable value

VLAN tagging

Type	Available for all frame types single IEEE 802.1q, double (Q-in-Q) IEEE 802.1ad
Editable parameters	TPI, priority, CFI/DEI, VID

MAC addresses

Destination address	User-defined, multicast, broadcast
Source address	User-defined, factory default
MAC frame size	User-defined, Jumbo
Predefined values	64, 128, 256, 512, 1024, 1280, 1518, 2000, 9000, 9600, 10000 bytes
User-defined	64 to 10 kbytes
Dynamic frame size	Increment/decrement, random, maximum/minimum user-defined
Selectable increment step size	1 to 10 kbytes

VPLS framing

Inner frame structure

As per standard Ethernet frame, including MAC addresses, VLAN tags (2), frame type, Ethertype, and payload

Outer frame structure

Parameters	MAC addresses, frame type, Ethertype
Tunnel and VC label	Label, CoS, TTL
Control word	Reserved bits, sequence number

MAC-in-MAC 802.1ah framing

Inner frame structure

As per standard Ethernet frame including MAC addresses, VLAN tags (2), frame type, Ethertype, and payload

Outer frame structure (PBB/PBT)

Parameters	MAC addresses
B-Tag	TPI, VID, priority, DEI
I-Tag	TPI, SID, priority, DEI, NCA, Res1, Res2

Payload of MAC frames

Type	JDSU test frame, PRBS pattern
JDSU test frame	Time stamp and sequence number
Filling pattern	Editable digital word, PRBS 2^{31}–1
PRBS pattern	PRBS 2^{31}-1 and inverted

Up to 124 bytes of user payload are freely editable.

Flow control

Modes	Generation, emulation, analysis
Generation of PAUSE frames	Off, once, continuous
Once	Number of frames per shot 1 to 2^{16}
Pause frame interval	Editable 60 ns to 10 s
Pause quanta	Editable 0 to 64 k/0 to 0.335 ms
Emulation of flow control	Throttling on/off
Analysis of PAUSE frames	See analyzer

Traffic generator

Traffic control

Mode	Bandwidth-controlled, gap-controlled
Trigger	Continuous, once (bandwidth-controlled)
Continuous	Ongoing traffic as defined
Once	Triggers generation of programmed number of frames/bursts per flow (see traffic profiles—burst) All flows are started synchronously

Gap-controlled traffic

Gives users precise and direct control over the IPG sequence generated. Resolution of 1 byte.

Can be used in combination with multiple flows (option) IP/multi-streams, BN 3061/94.54.

Traffic profile for bandwidth-controlled traffic

Each flow must be associated with one of 16 independent traffic profiles. Supports online updates of traffic profiles.

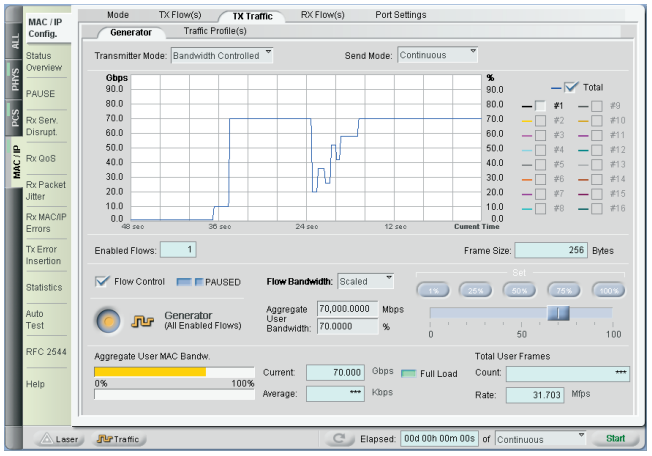
Traffic type	Constant, burst, back-to-back, ramp, IMIX
Frame size	Editable, fixed values, Dynamic increment/decrement, random
Back-to-back (enables maximum bandwidth by forcing the traffic to minimum inter-packet gap)	On/off

Constant mode

Bandwidth	Adjustable utilization in Mbps and %
Utilization accuracy	0.1%

Burst mode

Peak, sustained bandwidth	Adjustable utilization in Mbps and %
Burst size	1 to 64 k frames
Utilization accuracy	0.1%



Traffic profile for gap-controlled traffic

Traffic type	Constant IPG, increment/decrement IPG, random IPG
Frame size	Editable, fixed values, dynamic increment/decrement and random
IPG constant	8 to 2^{32} bytes
IPG increment/decrement start/stop	min to 2047 bytes
IPG step size	1 to 64 bytes
IPG random minimum/maximum values	min to 2047 bytes

MAC error insertion (any flow or per flow)

Error type	MAC, runt, oversized, FCS errored, invalid SFD
Triggering	Once, continuous, burst once/burst cont.
Rate	9.9×10^{-3} to 1×10^{-9}
Burst	M errored, N non-errored frames
M, N	1 to 2^{24} frames

MAC error insertion (per flow only)

Error type (test frame)	Loss, misinsertion, duplication, swapping
Error type (test pattern)	Bit error
Triggering	Once

Generator statistics

Bandwidth	Current and average, Mbps, %, plus graphics
Bytes total	Count
Frames total	Count and rate
Pause frames	Count, rate, ratio
MAC bandwidth per flow	Current and average in bps
Utilization per flow	Current and average in %
Bytes per flow	Count
Frames per flow	Count, rate, ratio

Ethernet analyzer

MAC flow filtering

The flow filter defines the parameters that particular flows must fulfill to pass the filter and for detailed analyzed. Others are not looped through to the per-flow analysis. Offers undefined as well as defined values.

Frame type	Ethernet II, SNAP, VPLS with inner and outer MAC, MAC-in-MAC 802.1ah
Ethertype	Editable value

VLAN tagging

Type	Available for all frame types, single IEEE 802.1q, double (Q-in-Q) IEEE 802.1ad
Editable parameters	TPI, priority, CFI/DEI, VID

MAC addresses

Destination address	Editable
Source address	Editable
VPLS framing	Supported, see Ethernet Generator
MAC-in-MAC framing	Supported, see Ethernet Generator

Total link analysis (Non-flow selective)

Error counts

MAC types	Errored , FCS errored, runt, oversized, invalid preamble, invalid SFD
Evaluation	Count, rate, ratio, seconds

MAC frame/byte counts

Bytes	Total
Frames	Total, good, errored, broadcast, multicast, pause
Evaluation (type dependent)	Count, rate, %, and graphics
Pause quanta and time	Last, min, max , count, rate, ratio

Bandwidth/utilization

Total used bandwidth and utilization

Bandwidth	Current, average in Mbps
Utilization (used bandwidth/link bandwidth)	Current, average in %

Frame size

Results	Min., max., average
Frame size distribution	Count, rate, ratio graphical display of results

Distribution classes	64, 65 to 127, 128 to 255, 256 to 511, 512 to 1023, 1024 to 2000, >2000

Analysis per flow

Evaluation of the traffic flows

Filtered In bandwidth

Bandwidth of all filtered flows

Bandwidth	Current, average in Mbps
Utilization (used bandwidth/link bandwidth)	Current, average in %

Bandwidth/utilization measurements per flow

Bandwidth of single filtered flows

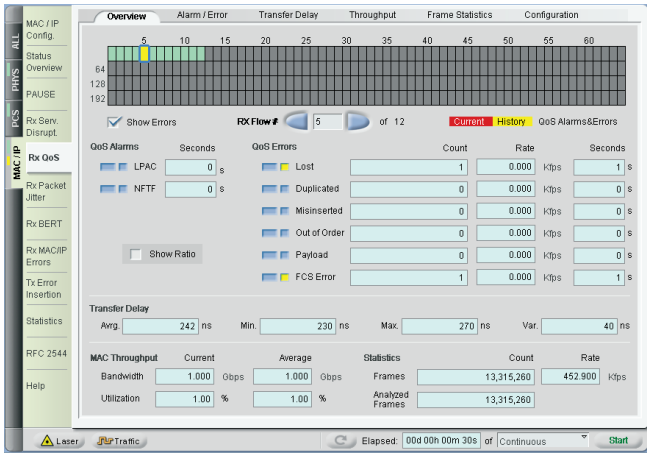
Types	Current MAC, current payload, average MAC, average payload
Bandwidth (used bandwidth/link bandwidth)	Mbps
Utilization (link)	in %

Frame counts per flow

Types	Bytes, frames
Evaluation	Count, rate, ratio

QoS measurements per flow

Graphical error/alarm matrix for all active flows with current and historical results. Results of particular flows are selectable.



QoS alarms	LPAC (loss of performance assessment capability) corresponds to "no sync of test frame possible" NFTF (no flow test frame)
QoS errors	Lost, duplicated, misinserted, out-of-order frames*
Evaluation (type dependent)	Count, rate, ratio, seconds
Throughput MAC/IP	Bandwidth, utilization in bps and %
Transfer delay	Min., max., average, variation (packet jitter)

Latency measurement resolution is 1 ns average and 10 ns per packet.

BERT measurements (single flow)

BERT alarms	LPAC corresponds to "no sync of test frame possible" pattern loss
BERT errors	Bit error
Evaluation (type dependent)	Count, rate, ratio, seconds Start/stop and user-defined intermediate

Service disruption measurements per flow

Graphical service disruption matrix for all active flows with "Threshold exceeded" and "Disruption" results. Results of particular flows are selectable.

Disruption results are given for any disruption that occurs above the disruption time threshold.

Port disruption (non-flow selective)

Disruption result	Longest

Flow selective

Disruption result	Shortest, longest, last
Parameters	Duration, size, type
Size	1 to 2^{32} frames
Type	Lost, duplication, out of order, misinsertion, time-out, link alarm

Disruption counters

Results	Total disruptions, disruptions exceeding threshold
Evaluation	Count, rate, seconds

Packet jitter analysis per flow

Packet jitter is usually caused by queuing and routing across or buffering in switched-transport networks. The final effect of high-packet jitter is the number of rejected packets.

Instantaneous jitter is defined as the difference between packet spacing of the transmitter compared to packet spacing of the receiver. Instantaneous jitter is a measure of jitter dynamics.

Instantaneous jitter	Current, peak, average, minimum in ns, hits in count values
Hit threshold editable	10 ns to 10 s

RFC 2544 conformance testing

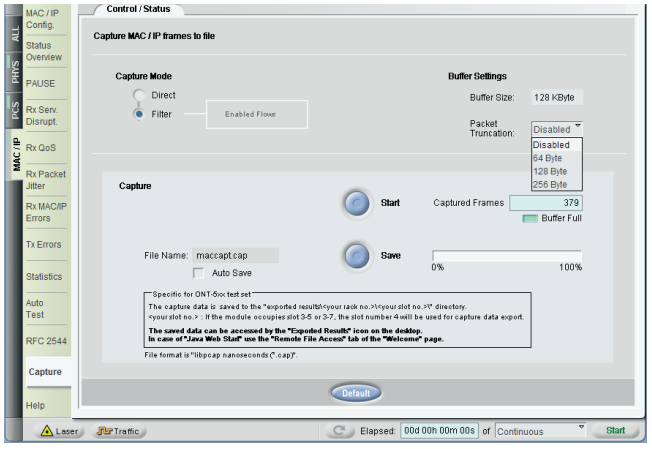
RFC 2544 addresses the need for service providers to perform QoS measurements in Ethernet and IP networks. Vendors are mandated to qualify the correct behavior of their IP/Ethernet equipment. The 40/100 G ONT lets users perform fully automated RFC 2544 testing at 40 and/or 100 GE rates, as applicable. In detail, it performs throughput, frame loss, round-trip delay and back-to-back (burstability) tests. The RFC 2544 is suitable for local and wide area networks (LAN and WAN) as well as OTN-mapped applications. All set up parameters for the four tests are editable on one page, and all the test results are also shown on one page.

Results throughput	Table graph, bar graph
Results frame loss	Table graph
Results latency, back to back	Table
Online parameters are shown during the measurement	Test, status, current frame length, remaining test time

* Payload, FCS

Packet capture

A 128 kB capture enables better capture and storage of traffic. The stored data is available for offline analysis using standard tools like Wireshark (not included). A range of filters can be used when capturing data.



Advanced packet features

Requires option BN 3061 or 3076/94.54 (IP/multi-streams)

MAC/IP multi-stream	Up to 256 fully independent streams with JDSU test frame payload

MPLS labeling (per flow)

Type	Available for Ethernet II and SNAP frames with IP header, multiple labels up to 5
Editable parameters	Label, CoS (class of service/exp), TTL
IPv4/IPv6	Supported for all frame types except VPLS and MAC-in-MAC

IPv4/IPv6/UDP/TCP settings (per flow)

IP types	IPv4, IPv6
IPv4 header	ToS, DSCP, flags, protocol, TTL source, and destination address
IPv6 header	Traffic class, flow label, next header, hop limit, source and destination address
UDP, TCP header	Source and destination ports

IPv4 error insertion (any flow or per flow)

Error type	Header error
Triggering	Once

Bandwidth/utilization measurements per flow

Types	Current IP, current TCP/UDP, average IP, average TCP/UDP
Bandwidth	Mbps

OTL Layer

40 G OTL3.4 and 100 G OTL4.10

Highlights

- OTL3.4 and OTL4.10 BERT
- Sophisticated OTL-layer testing with skew measurements
- Dynamic skew generation (optional)
- Support of lambda groups
- Real-time analysis per logical lane

Basic features

Payload of OTL frames

PRBS pattern	PRBS 2^9-1, $2^{23}-1$, $2^{31}-1$ normal and inverted

OTL alarm generation

Alarm types	LOFOTL, OOFOTL
Mode	Continuous (into all lanes, into selected lane)

OTL error insertion

OTL4 error types	FAS, LLM, MFAS, user-defined LLM, user-defined MFAS
OTL3 error types	FAS, MFAS, user-defined MFAS
Mode	Once, rate, burst once, burst cont. (into all lanes, into selected lane)
Rate	9.9×10^{-3} to 1.0×10^{-10}
Burst	M errored, N non-errored frames
M, N	1 to 16777215

User-defined error insertion

Mode	Invert, overwrite
LLM value	0 to 255
LLM mask	0 to 255
MFAS value	0 to 255
MFAS mask	0 to 255

Payload error insertion

Error type	Bit error
Triggering	Once, rate
Rate	1.0×10^{-2} to 1.0×10^{-10}

Lane mapping

TX lane mapper allows lane rotation at assigned OTL lane.

Static skew generation

Static skew	Delay in bits
Range	0 to 64000

Dynamic skew generation

Requirement	External clock source at lane speed/16
Mode	Manual, triangle
Skew (manual)	−32000 to 32000 in mUI
Latest peak (triangle)	−32000 to 32000 in mUI
Earliest peak (triangle)	−32000 to 32000 in mUI
Slope	10, 20, 50, 100, 200, 500, 1000 mUI/s
Applied lane	Any physical lane (0 to 9)
Mode	On, off

OTL4.10 lambda group configuration

Number of groups	4
Mode	Manual, apply per alarm lane

Total analysis (aggregate)

Graphical error/alarm matrix for all logical lanes with current and historical results.

OTL3.4 measurements

OTL alarms	LOFOTL, OOFOTL, LOR, OOR, OOMFAS, LOL, OOL, LL swap
OTL errors	FAS, MFAS
Evaluation (type dependent)	Count, ratio, seconds

OTL4.10 measurements

OTL alarms	LOFOTL, OOFOTL, LOR, OOR, OOLLM, OOMFAS, LOL, OOL, LL Swap
OTL errors	FAS, LLM, MFAS
Evaluation (type dependent)	Count, ratio, seconds

Maximum skew

Evaluation	Current max. skew in bits and picoseconds between earliest and latest lane

Analysis per logical lane

Lane ID

Evaluation	Current lane ID

OTL3.4 measurements per logical lane

Graphical error/alarm matrix for all logical lanes with current and historical results. Results of particular lanes are selectable. Alarms/errors are shown in a common table.

OTL alarms	LOFOTL, OOFOTL, LOR, OOR, OOMFAS
OTL errors	FAS, MFAS
Evaluation (type dependent)	Count, ratio, seconds

OTL4.10 measurements per logical lane

Graphical error/alarm matrix for all logical lanes with current and historical results. Results of particular lanes are selectable. Alarms/errors are shown in a common table.

OTL alarms	LOFOTL, OOFOTL, LOR, OOR, OOLLM, OOMFAS
OTL errors	FAS, LLM, MFAS
Evaluation (type dependent)	Count, ratio, seconds

Logical lane skew (delay)

Evaluation	Current skew (in bits and picoseconds)

Analysis per lambda group

OTL3.4 measurements per lambda group

Alarms	LOFOTL, OOFOTL, LOR, OOR, OOLLM, OOMFAS
Errors	FAS, MFAS
Evaluation (type dependent)	Count, ratio, seconds

OTL4.10 measurements per lambda group

Alarms	LOFOTL, OOFOTL, LOR, OOR, OOMFAS
Errors	FAS, LLM, MFAS
Evaluation (type dependent)	Count, ratio, seconds

Payload measurements (aggregate)

Payload alarms	Pattern loss
Payload errors	Bit error, errored one, errored zero
Evaluation (type dependent)	Count, ratio, seconds

40 G OTU3 and 100 G OTU4

- Standard and overclocked (optional) OTU3 and OTU4 rates
- Support of all TCM layers
- **Transfer delay** and **service disruption**
- Unique **FEC stress testing** with walking pattern
- Overhead byte capture

The functionality includes OTN framing as per G.709 with standard and/or overclocked rates.

The OTN applications support generation and analysis of OH bytes, errors, alarms, and FEC. Parameters and measurement results at the OTN and client layer are processed simultaneously.

OTN generator

Pattern	OTN test, higher layer test, and live traffic
OTN test pattern	PRBS: 2^{31}–1, 2^{23}–1, 2^{15}–1, 2^{11}–1, 2^{7}–1, 2^{31}–1 inv., 2^{23}–1 inv., 2^{15}–1 inv., 2^{11}–1 inv., 2^{7}–1 inv. (conforming to ITU-T O.150), and digital word 32 bit
Live Traffic mode ignores pattern loss and bit errors allowing for analysis of live traffic without trouble indication.	
Supports both stuffing and non-stuffing of payload bytes	

Client offset—stuffing

Adjust the asynchronous client offset within the ±65 ppm range to allow manipulation of the stuffing rate of the client.

Client stuffing generation (GMP): displays nominal and effective Cm value

Overhead (frame alignment/OTU/ODU/OPU)

- All bytes are statically programmable except for MFAS, SM BIP, PM BIP, and TCM1 ... 6 BIP
- Additional possibilities for SM TTI, PM TTI, and TCM1 ... 6 TTI (trail trace identifier):
  Sequence consisting of the SAPI (16 bytes),
  DAPI (16 bytes), and the operator-specified (32 bytes)
- User-designed payload structure identifier (PSI), payload type identifier clear text, and MSI support
- One OH byte can be selected for a freely defined sequence of 16/32/64/128/256 bytes
- FTFL free definable forward/backward (FW/BW) fault indication and operator identifier

Error insertion

Type	FAS, MFAS, SM BIP-8, SM BEI, PM BIP-8, PM BEI, TCMi BIP-8, TCMi BEI (i = 1 to 6), OMFI, LOMFI, OOMFI applicable only with OTU4, bit errors (only available with OTN test pattern)
Trigger	Single, rate, burst , burst continuous
Burst error	M frames errors, N frames error free, M and N = 0 to 2^{31}

Rate

Error name	Min rate	Max rate	Stepping
Random	1×10^{-10}	1×10^{-3}	Exponential
Bit	1×10^{-12}	1×10^{-3}	Exponential
FAS	4.9×10^{-12}	1×10^{-3}	0.1
MFAS	3.0×10^{-11}	1×10^{-3}	0.1
SM BIP	1×10^{-12}	6.6×10^{-5}	0.1
SM BEI	1×10^{-12}	6.6×10^{-5}	0.1
PM BIP	1×10^{-12}	6.6×10^{-5}	0.1
PM BEI	1×10^{-12}	6.6×10^{-5}	0.1
TCMi BIP	1×10^{-12}	6.6×10^{-5}	0.1
TCMi BEI	1×10^{-12}	6.6×10^{-5}	0.1
CRC-5	1×10^{-13}	1×10^{-2}	0.1
CRC-8	1×10^{-13}	1×10^{-2}	0.1
OMFI	3×10^{-11}	1×10^{-3}	0.1

BIP masks

The position and number of bit errors in the bytes can be selected.

Valid for SM BIP, PM BIP, TCMi BIP (i = 1 to 6)

BEI value

To stress the BEI evaluation of the DUT receiver the BEIs can be set to values from 0 to 15.
Valid for SM BEI, PM BEI, TCMi BEI (i = 1 to 6)

Alarm generation

Type	ODU-AIS, ODU-OCI, ODU-LCK, SM BDI, SM IAE, SM BIAE, PM-BDI, FW-SD, FW-SF, BW-SD, BW-SF, TCMi-LTC, TCMi-IAE, TCMi-BDI, TCMi-BIAE (i = 1 to 6), SM-TIM, PM-TIM, TCMi-TIM

Trigger

Continuous	All alarms
Burst once/burst continuous	All alarms except LOS, LOF, TIMS, OOF, OOM, SD, SF
Burst alarms	M frames with alarm, N frames no alarm, M and N = 0 to 2^{31}

OTU FEC

The FEC generation can be switched on and off. Using the OTU FEC field, FEC based on the Reed-Solomon (255,239) algorithm is performed on the generated frame. Data blocks consisting of 239 data bytes and 16 FEC field bytes enable detection of up to 16 byte errors or correction of 8 byte errors.

FEC error insertion modes

- FECcorrectable, FECuncorrectable
- FECstress: This extremely helpful function allows for maximum stress tests within a short time frame.
  Inserts the maximum number of errors possible that the DUT can correct into the OTU frame by a walking pattern that affects all bit positions in less than 2 seconds.

FECadvanced

FECadvanced lets users define the position for error insertion in the OTU frame letting them perform correction capability testing below and above the correction limit.

Selectable parameters	Row, subrow, errored bytes per subrow, start position in subrow, byte error mask

Analyzer OTN

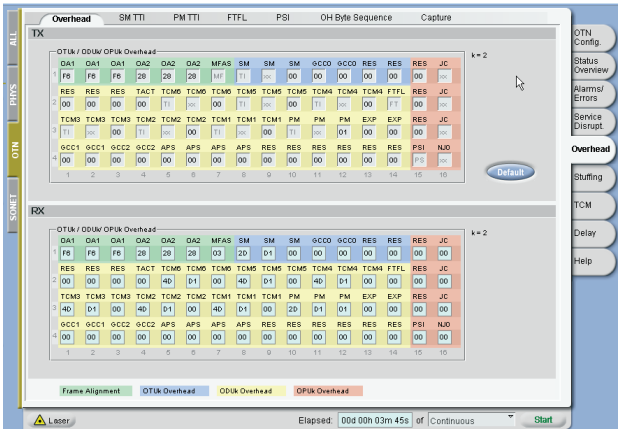
Stuffing of the client

Displays payload offset in ppm.

Display of nominal and effective payload rate and Cm value.

Stuffing counts

Positive, negative, sum count, duration of affected seconds.



Overhead evaluation (frame alignment/OTU/ODU/OPU)

- Displays the complete overhead
- SM TTI, PM TTI, TCM1 … 6 TTI display of the 64 byte ASCII sequence of SAPI, DAPI, and Operator field
- Capture and display one sequence of up to 256 bytes for a selectable OH byte
- Displays payload structure identifier (PSI) bytes, payload type identifier (PT) clear text, and MSI support
- Editable PT expectation value as mismatch criterion
- FTFL forward/backward (FW/BW) fault indication and operator identifier fields

Trace references

- Set of SAPI and DAPI expectation values in traces SM TTI, PM TTI, TCM1 … 6 TTI
- Select evaluation type of the received signal: SAPI or DAPI or SAPI/DAPI

General communication channel capture (GCC)

The management information between the network element and the termination equipment is transported in the GCCs in the OTN overhead. This feature enables the capture of transmitted information in real time.

Captured fields	GCC0, GCC1, GCC2, GCC1+2
Captured format	Raw
Capture size	up to 500 MB
Trigger	Manual

Error measurement

Validation of data for error measurement occurs after frame alignment, descrambling, and FEC computation and correction.

Error detection

Types	FAS, MFAS, SM BIP, SM BEI, PM BIP, PM BEI, TCMi BIP, TCMi BEI (i = 1 to 6), GMP CRC5/8, OMFI, bit error (only available for OTN test pattern), FECcorr. bit, FECcorr. code word, FECuncorr. code word

Alarm detection

Type	LOF, OOF, LOM, OOM, OTU-AIS, ODU-AIS, ODU-OCI, ODU-LCK, SM BDI, SM IAE, SM, BIAE, SM-TIM, PM-BDI, PM-TIM, FW-SD, FW-SF, BW-SD, BW-SF, TCMi-LTC, TCMi-BDI, TCMi-IAE, TCMi-BIAE, TCMi-TIM (i = 1 to 6), CSF, LOMF, OOMFI, CL-LOSS (client signal loss of synchronization), PT-MISM, pattern loss (only available for OTN test pattern)
Resolution	100 ms

Result display of errors and alarms

Numerical display

Displays count, ratio, and duration for each error

Displays duration for each alarm

Tabular display

Displays all results with time stamps

Criteria	Start, stop, duration, count

Graphical display

Displays all events as bar graphs versus time. Cursors allow for easy identification and zooming (in and out) on results. Filters enable event selection.

Time axis	Second, minute, hour

Service disruption test

To analyze service disruption times, the ONT generates a high-speed event list as a result of all detected events.

Sensor to trigger service disruption test, selectable:

Errors	MFAS, SM-BEI, PM-BIP, PM-BEI, bit errors
Alarms	LOS, LOM, OOM, SM-IAE, SM-BDI, SM-BIAE, ODU-AIS, ODU-OCI, ODU-LCK, PM-BDI
Event sample resolution	100 µs
Separation time	0.1 to 100000 ms

Separation time starts at the end of the last event and is used to determine if the following event is a continuation of the same disruption (event occurs within separation time) or the start of the next one (event occurs after separation time has elapsed).

Result display of disruptions

Numerical display

Total number of disruptions, begins with time stamp of first disruption and ends with a time stamp of last disruption.

Shortest disruption time (with time stamp)	
Longest disruption time (with time stamp)	

Average disruption time

Users can set service-disruption thresholds that range from 0 to 100,000 ms to identify when violations occur.

Tabular display

Service disruption events with start/stop times and duration.

Three logging modes are available (no logging; disruption events only; disruption and causing sensor events).

Intermediate bit error

In addition to the long-term bit error measurement, intermediate results are available.

Interval	1 to 3600 s
Results	Current/previous interval, count, and ratio

Additional features

- OTN multiplexing, ODU0/1/2/flex clients supported ODU0/1/2 supports selectable tributary time slots (1.25/2.5 G)
- Mapping of client signals with BMP, AMP, or GMP procedure (G.709)
- GMP alarms/errors generation/evaluation
- Stuffing with AMP/GMP mappings
- Extended offst range with GMP mapping
- Performance analysis G.8201/M.2401
  Concurrent evaluation on all ODU layers
- Trigger interfaces (not applicable with 100 G)

40 G and 100 G ONT Module
Short Description of OTN Options

OTU3 bulk (94.57)

OTU3 bulk option enables a bulk PRBS payload to be carried in an OPU3, ODU3, and into an OTU3 signal. Full monitoring and injection of alarms and errors as appropriate at each layer. Applications for delay, TCM, and others.

OTU3e1 bulk (94.58)

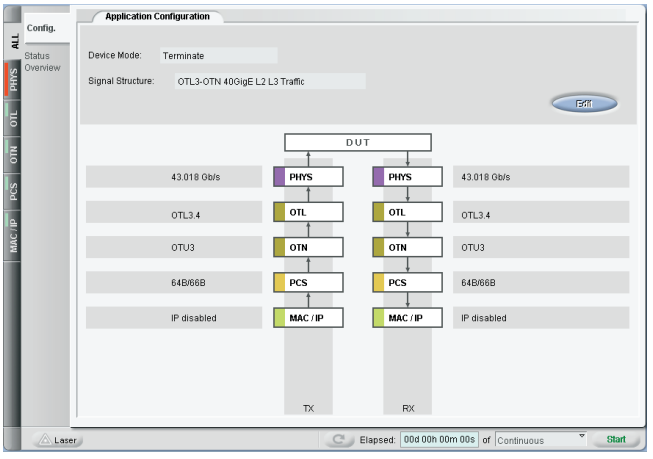
OTU3e1 bulk option enables a bulk PRBS payload to be carried in an OPU3e1, ODU3e1, and into an OTU3e1 (44.57 G) signal. Full monitoring and injection of alarms and errors as appropriate at each layer. Applications for delay, TCM, and others.

OTU3e2 bulk (94.59)

OTU3e2 bulk option enables a bulk PRBS payload to be carried in an OPU3e2, ODU3e2, and into an OTU3e2 (44.58 G) signal. Full monitoring and injection of alarms and errors as appropriate at each layer. Applications for delay, TCM, and others.

OTU3 with client (94.60)

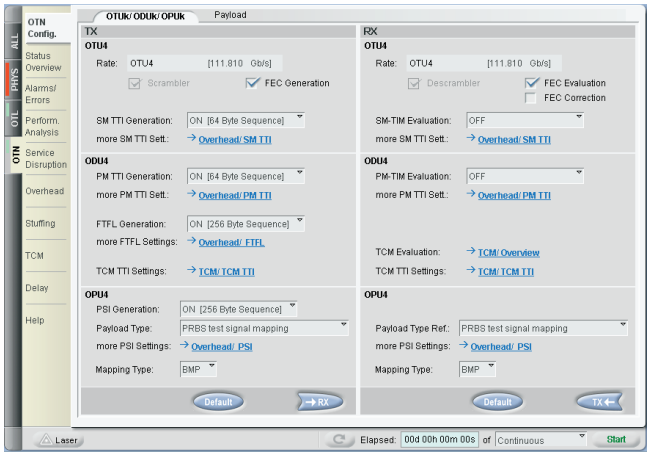
OTU3 with client enables a 40 G Ethernet client transcoded into an OPU3, ODU3, and into OTU3. Full control of 40 G Ethernet payload as well as monitoring and injection of alarms and errors as appropriate in each layer. Applications for TCM, delay, and service disruption, among others. Full monitoring and injection of alarms and errors as appropriate at each layer.



Example of a 40 GE client being transcoded into OTU3, full control of 40 GE payload and all other layers to the physical layer are possible.

OTU4 bulk (94.55)

OTU4 bulk option enables a bulk PRBS payload to be carried in an OPU4, ODU4, and into an OTU4 signal. Full monitoring and injection of alarms and errors as appropriate at each layer. Applications for delay, service disruption, and TCM, among others.



Example of OTU4 bulk control screen

OTU4 with client (94.53)

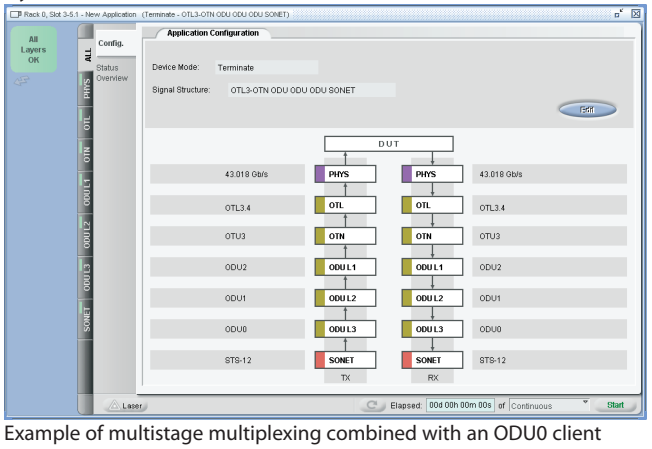
OTU4 with client enables a 100 G Ethernet client carried into an OPU4, ODU4, and into OTU4. Full control of 100 G Ethernet payload as well as monitoring and injection of alarms and errors as appropriate in each layer. Applications for TCM, delay, and service disruption, among others. Full monitoring and injection of alarms and errors as appropriate at each layer.

OTN enhanced multiplexing (94.61)

OTN enhanced multiplexing enables one level of lower-order multiplexing into the OTU3 and OTU4 signal. Applications for TCM, delay, and service disruptio, and others. Full monitoring and injection of alarms and errors as appropriate at each layer.

OTN multistage multiplexing (94.62)

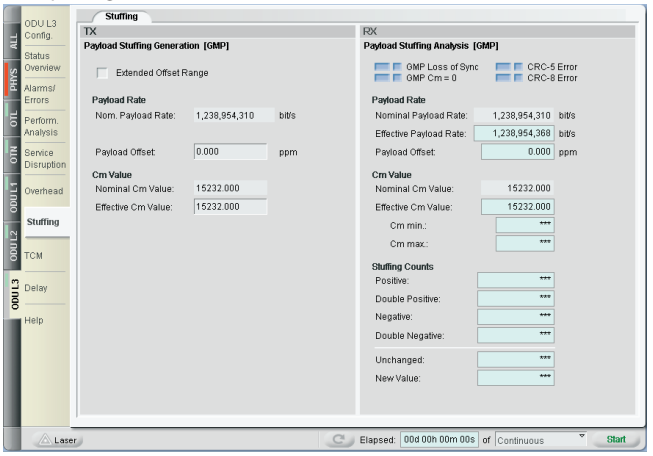
OTN multistage multiplexing allows for multiple levels of multiplexing into the OTU3 and OTU4 (for example, OTU1 into OTU2 into OTU3) and applications for TCM, delay, and service disruption, and others. Full monitoring and injection of alarms and errors as appropriate at each layer.



Example of multistage multiplexing combined with an ODU0 client carrying a SONET payload

ODU0 bulk (94.63)

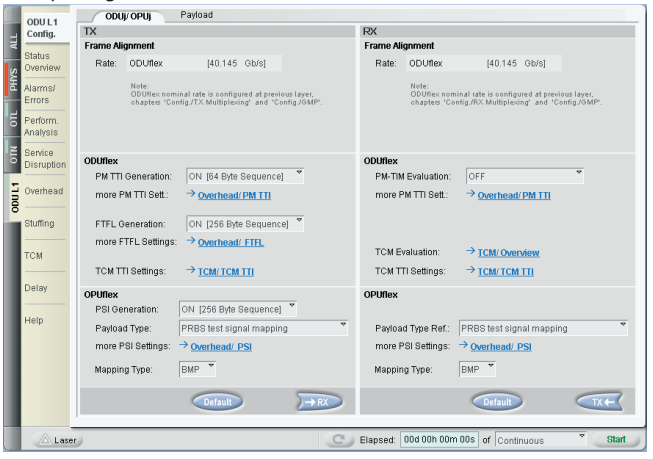
Enables the use of an ODU0 client with PRBS payload in the above multiplexing schemes.



ODU0 application showing some GMP information

ODUflex bulk (94.64)

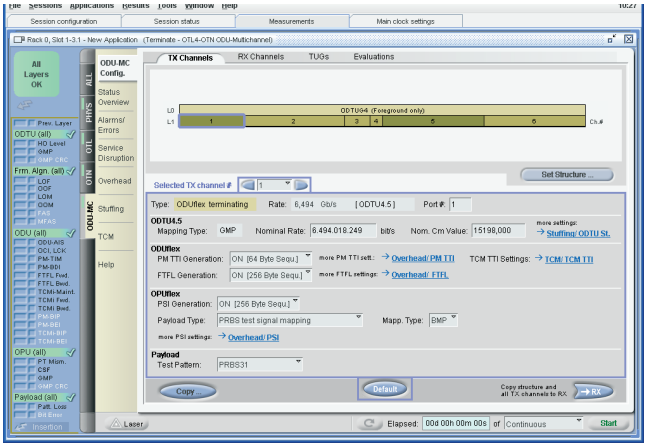
Enables the use of an ODUflex client with PRBS payload in the above multiplexing schemes.



ODUflex configuration main page

Multichannel (94.73)

The OTN multichannel option enables in-depth, parallel analysis of up to 32 individual channels (ODU0) in an OTU3 or OTU4, depending on enabled options. This powerful analysis application helps end users develop, troubleshoot, and validate complex OTN applications, such as cross-connects. Users can build signal structures and can select a wide range of channel types, such as ODU0s through ODUflex to ODU2e, with a fully monitored and generated bandwidth exceeding 40 G. Each channel has comprehensive high-resolution monitoring to fully control alarm and error generation,



Multichannel application with user building a signal structure that includes ODU0s and ODUflexes

OTN options—top-level dependencies

The OTN features on our 40/100 G platform have considerable breadth and depth, the range of options lets users scale applications to meet their needs. Some of the optional applications depend upon other options being installed. The following table helps determine these dependencies, if in doubt please consult your representative.

40 G (OTU3 applications)

Option/application	Dependencies
OTU3 bulk (94.57)	Unit must have 40 G base rate (either 92.51 or 94.51)
OTU3e1 bulk (94.58)	OTU3 bulk (94.57)
OTU3e2 bulk (94.59)	OTU3 bulk (94.57)
OTU3 with client (94.60)	OTU3 bulk (94.57)
OTN enhanced multiplexing (94.61)	OTU3 bulk (94.57)
OTN multistage multiplexing (94.62)	OTN enhanced multiplexing (94.61)
ODU0 bulk (94.63)	OTN enhanced multiplexing (94.61)
ODUflex bulk (94.64)	OTN enhanced multiplexing (94.61)

100 G (OTU4 applications)

Option/application	Dependencies
OTU4 bulk (94.55)	Unit must have 100 G base rate (either 92.50 or 94.50)
OTU4 with client (94.53)	Requires OTU4 bulk (94.55)
OTN enhanced multiplexing (94.61)	Requires OTU4 bulk (94.55)
OTN multistage multiplexing (94.62)	Requires OTN enhanced multiplexing (94.61)
ODU0 bulk (94.63)	Requires OTN enhanced multiplexing (94.61)
ODUflex bulk (94.64)	Requires OTN enhanced multiplexing (94.61)

SDH/SONET including the STL256.4 Layer

BN 3061/94.72 (requires enabling 40 G rates)

Highlights

STL 256.4 BERT

Sophisticated STL layer testing with skew measurements

Dynamic skew generation (optional)

Real-time analysis per logical lane

Basic features

Payload of STL frames

PRBS Pattern PRBS2^9–1, 2^{23}–1, 2^{31}–1 normal and inverted

OTL alarm generation

Alarm types LOFSTL, OOFSTL, STLAIS

Mode continuous (into all lanes, into selected lane)

OTL error insertion

STL error types	FAS, LLM, user-defined LLM
Mode	Once, rate, burst once, burst cont. (into all lanes, into selected lane)
Rate	9.9×10^{-3} to 1.0×10^{-10}
Burst	M errored, N non-errored frames
M, N	1 to 16,777,215

User-defined error insertion

Mode	Invert, overwrite
LLM value	0 to 255
LLM mask	0 to 255

Payload error insertion

Error type	Bit error
Triggering	Once, rate
Rate	1.0×10^{-2} to 1.0×10^{-10}

Lane mapping

TX lane mapper allows lane rotation at assigned STL lane.

Static skew generation

Static skew	Delay in bits
Range	0 to 64000

Dynamic skew generation

Requirement	External clock source at lanespeed/16
Mode	Manual, triangle
Skew (manual)	–32000 to 32000 in mUI
Latest peak (triangle)	–32000 to 32000 in mUI
Earliest peak (triangle)	–32000 to 32000 in mUI
Slope	10, 20, 50, 100, 200, 500, 1000 mUI/s
Applied lane	Any physical lane (0 to 9)
Mode	On, off

Total analysis (aggregate)

Graphical error/alarm matrix for all logical lanes with current and historical results.

STL 256.4 measurements

STL alarms	LOFSTL, OOFSTL, STLAIS, LOR, OOR, LOL, OOL, LL Swap STL errors FAS, LLM
Evaluation (type dependent)	Count, ratio, seconds

Maximum skew

Evaluation	Current max. skew in bits and picoseconds between earliest and latest lane
Tolerance	15600 bit per logical lane
Analysis per	Logical lane

Lane ID

Evaluation	Current lane ID

STL256.4 measurements per logical lane

Graphical error/alarm matrix for all logical lanes with current and historical results. Results of particular lanes are selectable. Alarms/errors are shown in a common table.

STL alarms	LOFSTL, OOFSTL, LOR, OOR, STLAIS
STL errors	FAS, LLM
Evaluation (type dependent)	Count, ratio, seconds

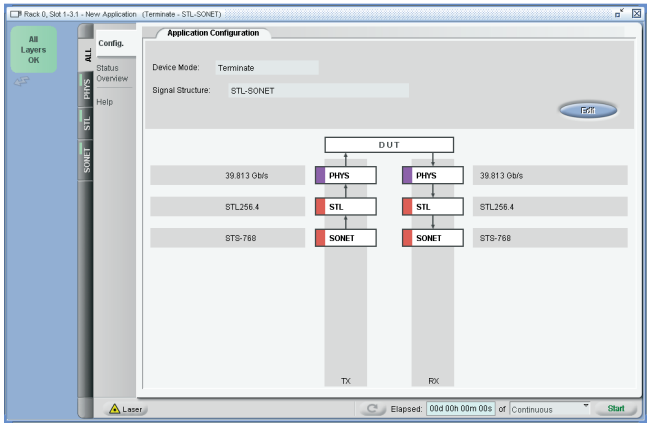
Logical lane skew (delay)

Evaluation	Current skew (in bits and picoseconds)

Payload measurements (aggregate)

Payload alarms	Pattern loss
Payload errors	Bit error, errored one, errored zero
Evaluation (type dependent)	Count, ratio, seconds

40 G SDH/SONET



SDH/SONET application

SDH/SONET testing

Generation/evaluation of STM-256 signal according to ITU-T G.707
Generation/evaluation of OC-768 signal according to ANSI T1.105

Mapping

SDH	VC-4-256c, VC-4-64c, VC-4-16c, VC-4-4c, VC-4, AU-3/VC-3
SONET	STS-768c SPE, STS-192c SPE, STS-48c SPE, STS-12c SPE, STS-3c SPE, STS-1 SPE

Generator

Generator modes

- Free definable foreground
- All channels identical
- Background selectable mapping, depending on foreground channel with definable path overhead and Null pattern as payload

Auto signal structure

Receiver analyses the signal structure (mapping, payload, traces) automatically for easy configuration of the test channel.

Test pattern	PRBS: 2^{31}–1, 2^{23}–1, 2^{15}–1, 2^{11}–1, 2^{31}–1 inv., 2^{23}–1 inv., 2^{15}–1 inv., 2^{11}–1 inv. (Conforming to ITU-T O.150)
Programmable word	Length 32 bits

Error insertion

Types

SDH	Random, FAS, B1, B2, B3, MS-REI, HP-REI, bit errors
SONET	Random, FAS, B1, B2, B3, REI-L, REI-P, bit errors
Trigger	Single, rates

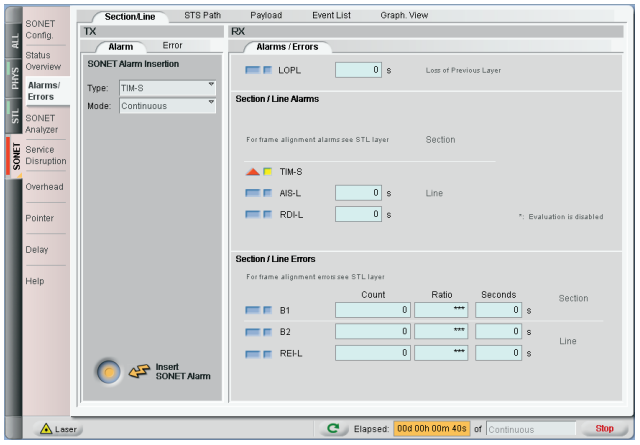
Error	Min rate	Max rate	Stepping	Mapping
Random	1×10^{-10}	1×10^{-3}	Exponential	—
B1	1×10^{-12}	1.61×10^{-6}	0.1	—
B2	1×10^{-12}	1×10^{-3}	0.1	—
MS-REI, REI-L	1×10^{-12}	1×10^{-3}	0.1	—
B3	1×10^{-12}	1.61×10^{-6}	0.1	STM-VC-4-256c, STS-1-768cSPE
B3	1×10^{-12}	1×10^{-3}	0.1	STM-VC-3, STS-1-SPE
HP-REI, REI-P	1×10^{-12}	1.61×10^{-6}	0.1	STM-VC-4-256c, STS-1-768cSPE
HP-REI, REI-P	1×10^{-12}	1×10^{-3}	0.1	STM-AU-3/VC-3, STS-1-SPE
Bit error	1×10^{-12}	1×10^{-3}	Exponential	—

Burst error once and continuous M errored frames followed by N error-free frames. All errors except random and bit errors
N, M = 1 to 8000000 or 125 µs to 1000 s

Alarm generation

Type:

SDH	RS-TIM, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-UNEQ, HP-TIM, HP-PLM, HP-RDI, HP-RDI-C, HP-RDI-S, HP-RDI-P
SONET	AIS-L, RDI-L, TIM-L, AIS-P, LOP-P, UNEQ-P, TIM-P, PLM-P, RDI-P, RDI-P-C, RDI-P-S, RDI-P-P, PDI-P
Trigger	TIMs on/off All others on/off or burst Burst once and continuous M frames with alarm ON, N frames with alarm OFF N, M = 1 to 800000 or 125 µs to 1000 s



Overhead generator

The stimulus of different overhead byte pattern is an important part of verification and interoperability testing. Network elements (NE) should respond in the defined manner and any responses then conveyed by a different overhead byte.

Statically programmable bytes

- A1-A2 unscrambled
- RSOH/SOH all bytes except B1
- MSOH/LOH all bytes except B2, H1 ... H3
- POH all bytes except B3

Display of overhead on the GUI.

Trace identifier

J0, J1 programmable 1 byte, 16 bytes with CRC or 64 byte sequence

Generation of pointer actions

Generation of pointer actions at the AU/STS level

- New pointer value setting with or without NDF
- Offset simulation in ppms
- Single, periodical and alternating pointer increment/decrement
- Pointer sequences with different types
- SS-bits definable

Analyzer

Test pattern	PRBS: 2^{31}–1, 2^{23}–1, 2^{15}–1, 2^{11}–1, 2^{31}–1 inv., 2^{23}–1 inv., 2^{15}–1 inv., 2^{11}–1 inv. (conforming to ITU-T O.150)
Programmable word	Length 32 bits

"Live traffic" mode ignores pattern loss and bit error that allows analysis of live traffic without trouble indication.

Error measurements

SDH	B1, B2, B3, MS-REI, HP-REI, Bit errors
SONET	B1, B2, B3, REI-L, REI-P, Bit errors

Alarm detections

SDH	MS-AIS, MS-RDI, RS-TIM, AU-AIS, AU-LOP, HP-TIM, HP-UNEQ, HP-PLM, HP-RDI, Pattern Loss
SONET	AIS-L, RDI-L, TIM-L, AIS-P, LOP-P, TIM-P, UNEQ-P, PLM-P, RDI-P, PDI-P, PLM-P, ERDI-P-Payload, ERDI-P-Server, ERDI-P-Connect, Pattern Loss
Resolution	100 ms

Result display of errors and alarms

Numerical display

Count, ratio, and duration are displayed for each error

Duration is displayed for each alarm.

Tabular display

Displays all results with time stamps.

Criteria	Start, stop, duration, count

Graphical display

Display of all events as bar graphs versus time. Cursors allow easy identification and zooming (in and out) on results. Filters enable event selection.

Time axis	Second, minute, hour

Intermediate bit error

In addition to the long-term bit error measurement, intermediate results are available.

Interval	1 s up to 3600 s,
Results	Current/previous interval, Count and ratio

Overhead analyzer

Display of Overhead on the GUI.

Message evaluation (TIM/PLM)

- J0, J1 1 byte, 16 bytes with CRC or 64 byte sequence
- J0, J1 clear text display
- TIM evaluation: exception value editable as criterion for TIM
- C2 signal label clear text selection
- PLM Evaluation: exception value editable as criterion for PLM

Service disruption test

To analyze service disruption times, the ONT generates a high-speed event list as a result of all detected events.

Sensor to trigger service disruption test is selectable.

Errors

SDH	STL-FAS, B1, B2, MS-REI, B3, HP-REI, bit errors/pattern loss
SONET	FAS, B1, B2, REI-L, B3, REI-P, bit errors/pattern loss

Alarms

SDH	LOS, STL-LOL, STL-OOF, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-UNEQ, HP-PLM, HP-RDI,
SONET	LOS, STL-LOL, STL-OOF, SEF, AIS-L, RDI-L, AIS-P, LOP-P, UNEQ-P, PLM-P, PDI-P, RDI-P
Event sample resolution	100 µs
Separation time	0.1 ms to 100000 ms

Separation time starts at the end of the last event. Separation time is used to determine if the following event is a continuation of the same disruption (event occurs within separation time) or the start of the next disruption (event occurs after separation time has elapsed).

Result display of disruptions

Numerical display

Total Number of disruptions, begin timestamp of first
Disruption, end timestamp of last disruption,
Shortest disruption time (with timestamp)
Longest disruption time (with timestamp)

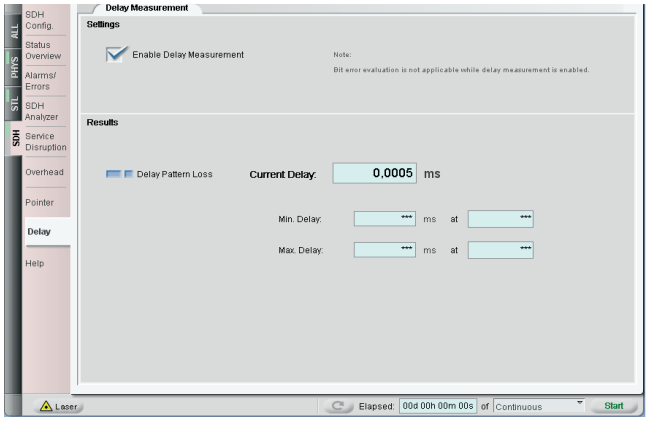
Average disruption time

The threshold to identify a violation of allowed service
Disruption time can be set in the range of 0 ms to 100000 ms

Tabular display

Service disruption events with start/stop times and duration.
Three logging modes available (no logging; disruption events only; disruption and causing sensor events)

Transfer delay analysis



Transfer delay measurements by special payload pattern in the Range of 0 to 40 s.
Transfer delay can be measured even between different ports within the same mainframe.

Numerical display

Current transfer delay with accuracy of 1 µs and
Resolution 100 ns
Minimum transfer delay (with timestamp)
Maximum transfer delay (with timestamp)

Pointer analysis

AU/STS Pointer

Numerical display

Value, count of increments, decrements, NDF.

Tabular display

Display of all events with time stamps

Criteria	Start, stop, duration, count

Performance monitoring

For SDH

Performance monitoring G.826

EB, BBE, ES, EFS, SES, and UAS are evaluated. Pass/fail assessments based on line length allocation of 0.1 to 100%.

The SES and UAS thresholds are user-programmable. Supports in-service measurement (ISM) of the near end and the far end of a selected path, as well as out-of-service (OOS) measurements.

Performance monitoring G.828 and G.829

The G.828 defines error performance parameters for international synchronous paths.

EB, BBE, ES, EFS, SES, and UAS are evaluated. Pass/fail assessments are based on a line length allocation of 0.1 to 100 percent.The SES and UAS thresholds are user-programmable. The SEP can be switched off for assessment. G.829 defines error performance events and block structures for SDH multiplex and regenerator sections.

For SONET

Evaluation of ES, EFS, SES, UAS and SEFS (GR 253, T1.231) ESA, ESB

Byte capture SOH/TOH

To analyze the SOH/TOH functions, it is necessary to capture individual bytes vs. time, allowing detection of errors or short term changes with frame level resolution. The capture function is started by a selectable trigger.

Values for one/two selected bytes are stored and can be accessed subsequently in a table of values.

Particularly in capturing the APS sequences, bytes K1 and K2 are displayed in clear text.

Selectable bytes for SOH/TOH	All bytes
Captured parameters	Byte value, number of frames and correspondent time
Storage depth of one byte or K1/K2 combination	
Post trigger	up to 256 value changes
Pre trigger	up to 256 value changes
Trigger conditions	Pre, post, center
Trigger events	User defined byte value, bit mask (compare, not compare, don't care)

Client Service Card for ONT 40/100 G CFP module

BN 3061 or 3076/92.60 (BN 3061 or 3076/88.60 for factory upgrade)

Overview

The client card for the ONT 40/100 G module is additional hardware that adds to the already considerable features of the base module, such as additional interfaces including a second CFP slot, two XFP slots, and an SFP slot, that allow the module to support dual 40/100 G CFP applications as well as 10 G (XFP) and 2.5 G (SFP).

The addition of a second CFP slot via the client card gives the ONT dual-port capability for both 40 G and 100 G services, leading to extremely cost-effective dual-port applications.

The client card is a factory upgrade for the 40/100 G CFP base unit, or it can be ordered together with a 40/100 G CFP base.

Target Applications

- Dual port 40/100 GE for production and SVT test
- Digital wrapper/dewrapper for validation of OTN functionality

Interfaces and I/O

The client card supports the following interfaces:

- CFP: single MSA 1.4-compliant CFP slot supports standard (and some non-standard 40 G and 100 G rates)
- XFP: dual XFP slots compatible with standard XFP-pluggable optics for 10 G rates
- SFP: single SFP slot supports standard SFP-pluggable optics for 2.5 G rates

The client service card has its own separate clock domain from the base

40/100 G module.

Supported data rates for unframed applications

Application	Bit rate (G)
CFP	
STM-256	39.81
40 GE	41.25
OTU3	43.018
OTU3e1	44.57
OTU3e2	44.85
Special (unframed)	100, 106, 108, 110
100 GE	103.125
OTU4	111.81
XFP	
STM-16/OC-192	9.953
10 GE	10.313
OTU2	10.709
OTU2 overclocked	11.049
OTU2 overclocked	11.095
SFP	
STM-16	2.488
OTU-1	2.666

Unframed (Raw) BERT

Support on all ports (only one XFP can be used at any time)

TX	
Patterns	2^7–1, 2^{11}–1, 2^{15}–1, 2^{23}–1, and 2^{31}–1 PRBS Normal and inverted 32 digital word and square wave
Bit error generation	Single error Rates for 10^{-2} to 10^{-11} with mantissa = 1
RX	
Patterns	2^7–1, 2^{11}–1, 2^{15}–1, 2^{23}–1, and 2^{31}–1 PRBS Normal and inverted 32 digital word and square wave
Error count	Absolute and ratio
Count	Absolute and ratio
Error	Count and ratio, start/stop, and timed measurements
Alarm detection	Pattern loss
Resolution	100 ms intervals

40 and 100 GE MAC/IP Layer

40 GE BN 3061/94.74

100 GE BN 3061/94.75

Highlights

- Sophisticated PCS-layer testing with dynamic block errors, coding statistics
- Additional VPLS and MAC-in-MAC Ethernet frame formats
- Up to 2 VLANs and 5 MPLS tags; in any combination
- Online hitless traffic control
- Real-time QoS, service disruption, and packet jitter analysis per flow
- IPv4/IPv6 (optional)
- Up to 8 traffic profiles
- IMIX and transmitter ramp traffic testing
- User defined preamble and header
- Automated throughput testing
- RFC 2544 Conformance testing

Interface

The 40 and 100 GE Ethernet/IP applications use the on-board CFP slot allowing for the use of IEEE-standards-compliant CFP optics and other types based on the CFP MSA 1.4 standard.

Basic Ethernet features

Supports one MAC flow for TX and RX.

Ethernet generator

Frame type	Ethernet II, SNAP, VPLS with inner and outer MAC, MAC-in-MAC 802.1ah
Ethertype	Editable value

VLAN tagging

Type	Available for all frame types single IEEE 802.1q, double (Q-in-Q) IEEE 802.1ad
Editable parameters	TPI, priority, CFI/DEI, VID

MAC addresses

Destination address	User-defined, multicast, broadcast
Source address	User-defined, factory default
MAC frame size	User-defined, Jumbo
Predefined values	64, 128, 256, 512, 1024, 1280, 1518, 2000, 9000, 9600, 10000 bytes
User-defined	64 to 10 kbytes
Dynamic frame size	Increment/decrement, random, maximum/minimum user-defined

VPLS framing

Inner frame structure

As per standard Ethernet frame, including MAC addresses, VLAN tags (2), frame type, Ethertype, and payload

Outer frame structure

Parameters	MAC addresses, frame type, Ethertype
Tunnel and VC label	Label, CoS, TTL
Control word	Reserved bits, sequence number

MAC-in-MAC 802.1ah framing

Inner frame structure

As per standard Ethernet frame including MAC addresses, VLAN tags (2), frame type, Ethertype, and payload

Outer frame structure (PBB/PBT)

Parameters	MAC addresses
B-Tag	TPI, VID, priority, DEI
I-Tag	TPI, SID, priority, DEI, NCA, Res1, Res2

Payload of MAC frames

Type	JDSU test frame, PRBS pattern
JDSU test frame	Time stamp and sequence number
Filling pattern	Editable digital word, PRBS 2^{31}–1
PRBS pattern	PRBS 2^{31}–1 and inverted

Up to 124 bytes of user payload are freely editable.

Flow control

Modes	Generation, emulation, analysis
Generation of PAUSE frames	Off, once, continuous
Once	Number of frames per shot 1 to 2^{16}
Pause frame interval	Editable 60 ns to 10 s
Pause quanta	Editable 0 to 64 k/0 to 0.335 ms
Emulation of flow control	Throttling on/off
Analysis of PAUSE frames	See analyzer

Traffic generator

Traffic control

Mode	Bandwidth-controlled, gap-controlled
Trigger	Continuous, once (bandwidth-controlled)
Continuous	Ongoing traffic as defined
Once	Triggers generation of programmed number of frames/bursts per flow (see traffic profiles—burst) All flows are started synchronously

Gap-controlled traffic

Gives users precise and direct control over the IPG sequence generated. Resolution of 1 byte.

Can be used in combination with multiple flows (option) IP/multi-streams, BN 3061/94.54.

Selectable increment step size	1 to 10 kbytes

PCS and Ethernet

40 GE and 100 GE only, supported by CFP slot on client card.
Each lane is clocked from common clock.

TX/RX scrambler	On/off independent (only available for L2/L3 layer testing)
TX ignore link faults	On/off (only available for L2/L3 layer testing)

Payload

As follows or client signal from higher-layer application.

Pattern mode	Virtual lane, aggregate

Virtual Lane mode

PRBS pattern	PRBS 2^7–1, 2^9–1, 2^{15}–1, 2^{23}–1, 2^{31}–1 normal and inverted
TX lane offset	Auto staggered, user-defined offset
User-defined offset	10 to 64 000 bits (depends on PRBS pattern)

Aggregate mode

Pattern	Scrambled idles

Error insertion

Supports simultaneous error and alarm insertion

Type	Invalid sync header, invalid alignment marker, user-defined alignment marker, BIP-8 error, Bit error (all lanes/single lane), block error
Range (depends on type)	All lanes, single lane
Trigger	Once, rate, burst once/cont.
Rate	9.9×10^{-3} to 1×10^{-10}
Burst	N events off, M events on
N, M	1 up to 16,777,215 events
Sync header value	Editable 0 to 3
Alignment marker M0, M1, M2	Editable 0 to 255
BIP-8 error mask	Editable 0 to 255

Alarm insertion

Supports simultaneous error and alarm insertion

Type	LOBL (loss of block lock), LOAML (loss of alignment marker), HI BER (high bit error rate), local and remote fault, bit error (total, per lane)
Range (depends on type)	All lanes, single lane
Trigger (depends on type)	Continuous, burst once/cont.
Burst	N events off, M events on TX/RX
N, M	8 up to 134,217,720 events (local and remote fault)

Error evaluation

Type	Invalid sync header, invalid alignment marker loss of alignment marker event, BIP-8 error, BIP-8 bit error, LOBL event, HI BER event, local and remote fault event, bit error (total, per lane), errored zero (total, per lane), errored one (total, per lane), block error
Evaluation (depends on type)	Count, ratio, rate, seconds summary and per lane

Alarm evaluation

Type	LOBL, summary, per lane, LOAML, LOA (loss of alignment), HI BER, local and remote fault, link down (only available for higher-layer testing) pattern loss
Evaluation	Seconds

Lane alignment marker insertion

For all virtual lanes	User-defined

PCS lane mapping

TX lane mapping	User-programmable (shift)

Basic Ethernet features

Supports one MAC flow for TX and RX.

Ethernet generator

Frame type	Ethernet II, SNAP, VPLS with inner and outer MAC, MAC-in-MAC 802.1ah
Ethertype	Editable value

VLAN tagging

Type	Available for all frame types single IEEE 802.1q, double (Q-in-Q) IEEE 802.1ad
Editable parameters	TPI, priority, CFI/DEI, VID

MAC addresses

Destination address	User-defined, multicast, broadcast
Source address	User-defined, factory default
MAC frame size	User-defined, Jumbo
Predefined values	64, 128, 256, 512, 1024, 1280, 1518, 2000, 9000, 9600, 10000 bytes
User-defined	64 to 10 kbytes
Dynamic frame size	Increment/decrement, random, maximum/minimum user-defined
Selectable increment step size	1 to 10 kbytes

VPLS framing

Inner frame structure

As per standard Ethernet frame, including MAC addresses, VLAN tags (2), frame type, Ethertype, and payload

Outer frame structure

Parameters	MAC addresses, frame type, Ethertype
Tunnel and VC label	Label, CoS, TTL
Control word	Reserved bits, sequence number

MAC-in-MAC 802.1ah framing

Inner frame structure

As per standard Ethernet frame including MAC addresses, VLAN tags (2), frame type, Ethertype, and payload

Outer frame structure (PBB/PBT)

Parameters	MAC addresses
B-Tag	TPI, VID, priority, DEI
I-Tag	TPI, SID, priority, DEI, NCA, Res1, Res2

Payload of MAC frames

Type	JDSU test frame, PRBS pattern
JDSU test frame	Time stamp and sequence number
Filling pattern	Editable digital word, PRBS 2^{31}–1
PRBS pattern	PRBS 2^{31}–1 and inverted

Up to 124 bytes of user payload are freely editable.

Flow control

Modes	Generation, emulation, analysis
Generation of PAUSE frames	Off, once, continuous
Once	Number of frames per shot 1 to 2^{16}
Pause frame interval	Editable 60 ns to 10 s
Pause quanta	Editable 0 to 64 k/0 to 0.335 ms
Emulation of flow control	Throttling on/off
Analysis of PAUSE frames	See analyzer

Traffic generator

Traffic control

Mode	Bandwidth-controlled, gap-controlled
Trigger	Continuous, once (bandwidth-controlled)
Continuous	Ongoing traffic as defined
Once	Triggers generation of programmed number of frames/bursts per flow (see traffic profiles—burst) All flows are started synchronously

Gap-controlled traffic

Gives users precise and direct control over the IPG sequence generated. Resolution of 1 byte.

Traffic profile for bandwidth-controlled traffic

Each flow must be associated with one of 8 independent traffic profiles. Supports online updates of traffic profiles.

Traffic type	Constant, burst, back-to-back, ramp, IMIX
Frame size	Editable, fixed values, Dynamic increment/decrement, random
Back-to-back (enables maximum bandwidth by forcing the traffic to minimum inter-packet gap)	On/off

Constant mode

Bandwidth	Adjustable utilization in Mbps and %
Utilization accuracy	0.1%

Burst mode

Peak, sustained bandwidth	Adjustable utilization in Mbps and %
Burst size	1 to 64 k frames
Utilization accuracy	0.1%

Traffic profile for gap-controlled traffic

Traffic type	Constant IPG, increment/decrement IPG, random IPG
Frame size	Editable, fixed values, dynamic increment/decrement and random
IPG constant	8 to 2^{32} bytes
IPG increment/decrement start/stop	min to 2047 bytes
IPG step size	1 to 64 bytes
IPG random minimum/maximum values	min to 2047 bytes

MAC error insertion (any flow or per flow)

Error type	MAC, runt, oversized, FCS errored, invalid SFD
Triggering	Once, continuous, burst once/burst cont.
Rate	9.9×10^{-3} to 1×10^{-9}
Burst	M errored, N non-errored frames
M, N	1 to 2^{24} frames

MAC error insertion (per flow only)

Error type (test frame)	Loss, misinsertion, duplication, swapping
Error type (test pattern)	Bit error
Triggering	Once

Generator statistics

Bandwidth	Current and average, Mbps, %, plus graphics
Bytes total	Count
Frames total	Count and rate
Pause frames	Count, rate, ratio
MAC bandwidth per flow	Current and average in bps
Utilization per flow	Current and average in %
Bytes per flow	Count
Frames per flow	Count, rate, ratio

Ethernet analyzer

MAC flow filtering

The flow filter defines the parameters that particular flows must fulfill to pass the filter and for detailed analyzed. Others are not looped through to the per-flow analysis. Offers undefined as well as defined values.

Frame type	Ethernet II, SNAP, VPLS with inner and outer MAC, MAC-in-MAC 802.1ah
Ethertype	Editable value

VLAN tagging

Type	Available for all frame types, single IEEE 802.1q, double (Q-in-Q) IEEE 802.1ad
Editable parameters	TPI, priority, CFI/DEI, VID

MAC addresses

Destination address	Editable
Source address	Editable
VPLS framing	Supported, see Ethernet Generator
MAC-in-MAC framing	Supported, see Ethernet Generator

Total link analysis (Non-flow selective)

Error counts

MAC types	Errored , FCS errored, runt, oversized, invalid preamble, invalid SFD
Evaluation	Count, rate, ratio, seconds

MAC frame/byte counts

Bytes	Total
Frames	Total, good, errored, broadcast, multicast, pause
Evaluation (type dependent)	Count, rate, %, and graphics
Pause quanta and time	Last, min, max , count, rate, ratio

Bandwidth/utilization

Total used bandwidth and utilization	
Bandwidth	Current, average in Mbps
Utilization (used bandwidth/link bandwidth)	Current, average in %

Frame size

Results	Min., max., average
Frame size distribution	Count, rate, ratio graphical display of results
Distribution classes	64, 65 to 127, 128 to 255, 256 to 511, 512 to 1023, 1024 to 2000, >2000

Analysis per flow

Evaluation of the traffic flows

Filtered in bandwidth

Bandwidth of all filtered flows	
Bandwidth	Current, average in Mbps
Utilization (used bandwidth/link bandwidth)	Current, average in %

Bandwidth/utilization measurements per flow

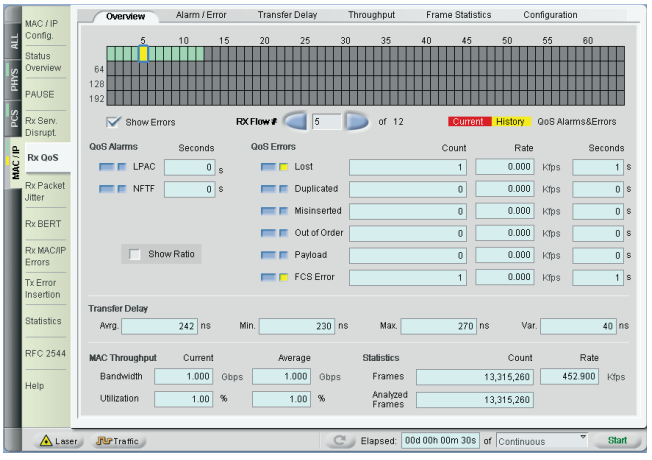
Bandwidth of single filtered flows	
Types	Current MAC, current payload, average MAC, average payload
Bandwidth (used bandwidth/link bandwidth)	Mbps
Utilization (link)	in %

Frame counts per flow

Types	Bytes, frames
Evaluation	Count, rate, ratio

QoS measurements per flow

Graphical error/alarm matrix for all active flows with current and historical results. Results of particular flows are selectable.



QoS alarms	LPAC (loss of performance assessment capability) corresponds to "no sync of test frame possible" NFTF (no flow test frame)
QoS errors	Lost, duplicated, misinserted, out-of-order frames
Evaluation (type dependent)	Count, rate, ratio, seconds
Throughput MAC/IP	Bandwidth, utilization in bps and %
Transfer delay	Min., max., average, variation (packet jitter)

Latency measurement resolution is 1 ns average and 10 ns per packet.

BERT measurements (single flow)

BERT alarms	LPAC corresponds to "no sync of test frame possible" pattern loss
BERT errors	Bit error
Evaluation (type dependent)	Count, rate, ratio, seconds Start/stop and user-defined intermediate

Service disruption measurements per flow

Graphical service disruption matrix for all active flows with "Threshold exceeded" and "Disruption" results. Results of particular flows are selectable.

Disruption results are given for any disruption that occurs above the disruption time threshold.

Port disruption (non-flow selective)

Disruption result	Longest

Flow selective

Disruption result	Shortest, longest, last
Parameters	Duration, size, type
Size	1 to 2^{32} frames
Type	Lost, duplication, out of order, misinsertion, time-out, link alarm

Disruption counters

Results	Total disruptions, disruptions exceeding threshold
Evaluation	Count, rate, seconds

Packet jitter analysis per flow

Packet jitter is usually caused by queuing and routing across or buffering in switched-transport networks. The final effect of high-packet jitter is the number of rejected packets.

Instantaneous jitter is defined as the difference between packet spacing of the transmitter compared to packet spacing of the receiver. Instantaneous jitter is a measure of jitter dynamics.

Instantaneous jitter	Current, peak, average, minimum in ns, hits in count values
Hit threshold editable	10 ns to 10 s

RFC 2544 conformance testing

RFC 2544 addresses the need for service providers to perform QoS measurements in Ethernet and IP networks. Vendors are mandated to qualify the correct behavior of their IP/Ethernet equipment. The 40/100 G ONT lets users perform fully automated RFC 2544 testing at 40 and/or 100 GE rates, as applicable. In detail, it performs throughput, frame loss, round-trip delay and back-to-back (burstability) tests. The RFC 2544 is suitable for local and wide area networks (LAN and WAN) as well as OTN-mapped applications. All set up parameters for the four tests are editable on one page, and all the test results are also shown on one page.

Results throughput	Table graph, bar graph
Results frame loss	Table graph
Results latency, back to back	Table
Online parameters are shown during the measurement	Test, status, current frame length, remaining test time

Applications on client services card can run concurrently with any application running on the base card.

Accessories

10 × 10 G electrical CFP interface (BN 3061/92.98)

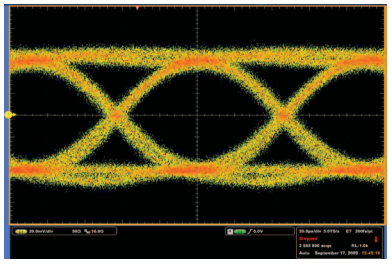
This adapter is designed to meet the needs of developers who want to be able to develop and debug CFP components and other non-standard optics.

The native electrical adapter brings out the CAUI-like interface on a SMA pigtailed cable allowing connectivity to prototype boards and systems. No control or power signals are brought out.

This is a passive adapter and, therefore, the electrical parameters are determined by the CAUI interface to which the adapter is connected.

The cable assembly is removable and can be replaced.

The ONT physical layer application (92.52) gives users control over the CAUI and XLAUI pre-emphasis and voltage swing, see below.



Electrical eye at 11.18 G at SMA connector at the end of the cable

Detail

Electrical signal accessed via high-density coax connector mounted on the front panel of the card. Pigtailed cables with the high-density coax connector on one end and SMA male connectors on the other are used to connect to the DUT.

Electrical signal	Differential with 20 RX and 20 TX lines (10 pairs in each direction). An additional pair brings out a CFP reference clock (electrical lane speed 1/16 or 1/64, user selectable).
Data rates	Supports all unframed rates
Cable length	~30 cm

TX

Fixed level	Differential with ~800 mV swing
Nominal impedance	100 Ω (differential)

- All lanes have fixed timing and are driven by the same reference clock.
- A degree of electrical pre-emphasis is offered to compensate for the length of cable and PCB trace. The exact drive length is a complex function of PCB material, layout, and ASIC I/O characteristics.

The physical layer application allows normal and high pre-emphasis on the TX signal at the CAUI.

RX

Electrical signal	Differential
Sensitivity range	400 – 1200 mV
Nominal impedance	100 Ω (differential).

QSFP adapter for CFP slot BN 3061/92.96

The QSFP+-to-CFP adapter is an adapter that allows the ONT 40/100 G solution to natively support QSFP+ 40 G optics. The adapter simply plugs into the CFP slot of an ONT 40/100 G and immediately the GUI adopts the physical layer as QSFP+ (from the normal CFP). All the validation and test features, such as transponder validation, dynamic skew, and peek/poke are retained and adapted to be directly applicable to QSFP+ optics. The adapter supports all appropriate 40 G data rates, from 39.81 to 44.58 G. This adapter is ideal for development, validation, and testing of 40 G QSFP+ optical modules.

It supports all optical modules up to power class 4 (3.5W), including both SR and LR optics. No support is offered for electrical QSFP+.

Support for 40 G optics, such as QSFP+, requires enabling 40 G rates (either 94.51 or 92.51) on the base unit and also requires physical layer validation (92.52) for transponder debug and validation.

Dimensions = as per CFP

QSFP+ MSA revision 3.5

QSFP+ power classes 1/2/3/4 (max QSFP+ power 3.5 W)

Electrical data interface XLPPI according to IEEE 802.3ba

QSFP+ temperature range 0 to 70°C

Requirements—ONT, supports ONT 40/100 G device only

ONT options required = 40 G rates in base unit (92.51 or 94.51)

Important:

The electrical interface card is laboratory-grade equipment and, therefore, has no specific ESD protection. Use extreme care and take full ESD precautions when handling cables.

Ordering information

ONT-500 Mainframes

BN 3075/01 ONT-503 Optical Network Tester

3-slot mainframe with 15-inch TFT display takes any combination of modules.

Please check number of slots required per module.

BN 3075/92.45	Carrying case
BN 3075/94.01	Calibration report

BN 3062/01 ONT-506 Optical Network Tester

6-slot mainframe with 15-inch TFT display takes any combination of modules.

Please check number of slots required per module.

BN 3075/92.45	Carrying case
BN 3075/94.01	Calibration report

BN 3061/01 ONT-512 Optical Network Tester

12-slot rack-mountable mainframe takes any combination of modules.

Please check number of slots required per module.

BN 3061/94.01	Calibration report
BN 3061/92.01	**Rack-mount kit** Required to affix the ONT-512 into the rack.

40/100 G CFP-based Test Solution for ONT-500

100 G Base Version

BN 3061/92.50	100 G Module CFP slot V2 supports unframed 100 G rates (100, 103.125, 106, 108, 110, and 111.8 G) and at 103.125 G supports PCS BERT and Ethernet. Requires 3 slots
BN 3061/94.51	Add 40 G rates to 100 G base Adds unframed bit rates at 39.81, 41.25, 43.01, 44.57, and 44.58 G and at 40 G supports Ethernet. Requires BN 3061/92.50

40 G Base Version

BN 3061/92.51	40 G Module CFP slot V2 Unframed bit rates at 39.81, 41.25, 43.01, 44.57, and 44.58 G and at 40 G supports Ethernet. Requires 3 slots
BN 3061/94.50	Add 100 G rates to 40 G base supports unframed 100 G rates (103.125 and 111.8 G) and at 103.125 G supports PCS BERT and Ethernet. Requires BN 3061/92.51

Hardware Options

BN 3061/92.52	Physical layer validation. Includes features such as skew generation, lambda mapping, VL rotation, and MDIO access. Requires BN 3061/92.50 or BN 3061/92.51
BN 3061/92.60	40/100 G client service card Requires BN 3061/92.50 or BN 3061/92.51

Upgrade Options

BN 3061/82.52	Physical layer validation application. Includes features such as skew generation, lambda mapping, VL rotation, and MDIO access. Factory upgrade Requires BN 3061/92.50 or BN 3061/92.51
BN 3061/88.60	40/100 G client service card upgrade for existing 40/100 G CFP solution. Requires BN 3061/92.50 or BN 3061/92.51 and mainframe with additional free slots.

Ordering information (Cont'd.)

ONT-600 Mainframes

BN 3076/01 ONT-603D Optical Network Tester

3-slot mainframe with high-end controller and display takes any combination of modules.

BN 3076/02 ONT-603H Optical Network Tester

3-slot mainframe with high-end controller takes any combination of modules.

BN 3076/03 ONT-603B Optical Network Tester

3-slot mainframe with basic controller takes any combination of modules.

BN 3076/04 ONT-606D Optical Network Tester

6-slot mainframe with high-end controller and display takes any combination of modules.

BN 3076/05 ONT-606H Optical Network Tester

6-slot mainframe with high-end controller takes any combination of modules.

BN 3076/06 ONT-606B Optical Network Tester

6-slot mainframe with basic controller takes any combination of modules.

BN 3076/07 ONT-612H Optical Network Tester

12-slot mainframe with high-end controller takes any combination of modules.

BN 3076/08 ONT-612B Optical Network Tester

12-slot mainframe with basic controller takes any combination of modules.

40/100 G CFP-based Test Solution for ONT-600

100 G Base Version

BN 3076/92.50	100 G Module CFP slot V2 supports unframed 100 G rates (100, 103.125, 106, 108, 110, and 111.8 G) and at 103.125 G supports PCS BERT and Ethernet. Requires 3 slots
BN 3061/94.51	Add 40 G rates to 100 G base Adds unframed bit rates at 39.81, 41.25, 43.01, 44.57, and 44.58 G and at 40 G supports Ethernet. Requires BN 3076/92.50

40 G Base Version

BN 3076/92.51	40 G Module CFP slot V2 Unframed bit rates at 39.81, 41.25, 43.01, 44.57, and 44.58 G and at 40 G supports Ethernet. Requires 3 slots
BN 3061/94.50	Add 100 G rates to 40 G base Supports unframed 100 G rates (103.125 and 111.8 G) and at 103.125 G supports PCS BERT and Ethernet. Requires BN 3076/92.51

Hardware Options

BN 3076/92.52	Physical layer validation. Includes features such as skew generation, lambda mapping, VL rotation, and MDIO access. Requires BN 3076/92.50 or BN 3076/92.51
BN 3076/92.60	40/100 G client service card Requires BN 3076/92.50 or BN 3076/92.51

Upgrade Options

BN 3076/82.52	Physical layer validation application. Includes features such as skew generation, lambda mapping, VL rotation, and MDIO access. Factory upgrade Requires BN 3076/92.50 or BN 3076/92.51
BN 3076/88.60	40/100 G client service card upgrade for existing 40/100 G CFP solution. Requires BN 3076/92.50 or BN 3076/92.51 and mainframe with additional free slots.

Ordering information (Cont'd.)

ONT-500 and ONT-600 Options

Software Options

BN 3061/94.50	100 G Ethernet Requires BN 3061/92.51 or BN 3076/92.51
BN 3061/94.51	40 G Ethernet Requires BN 3061/92.50 or BN 3076/92.50
BN 3061/92.52	Physical layer Requires BN 3061/92.50 or BN 3061/92.51 or BN 3076/92.50 or BN 3076/92.51
BN 3061/94.53	40/100 G OTU4 with client Requires BN 3061/94.55
BN 3061/94.54	IP/Multi-streams Application gives additional IP functionality including generation and monitoring of QoS with up to 256 streams. Requires BN 3061/92.50 or BN 3061/92.51 or BN 3076/92.50 or BN 3076/92.51
BN 3061/94.55	40/100 G OTU4 bulk Requires BN 3061/92.50 or BN 3076/92.50 or BN 3061/94.51
BN 3061/94.56	Skew variation Adds the ability to generate dynamic skew over a range of ±16 UI on the physical CAUI interface. Requires BN 3061/92.52
BN 3061/94.57	40/100 G OTU3 bulk Requires BN 3061/92.51 or BN 3076/92.51 or BN 3061/94.51
BN 3061/94.58	40/100 G OTU3e1 bulk Requires BN 3061/94.57
BN 3061/94.59	40/100 G OTU3e2 bulk Requires BN 3061/94.57
BN 3061/94.60	40/100 G OTU3 with client via transcoding Requires BN 3061/94.57
BN 3061/94.61	40/100 G OTN enhanced multiplexing Requires BN 3061/94.55 or BN 3061/94.57
BN 3061/94.62	40/100 G ONT multistage multiplexing Requires BN 3061/94.61
BN 3061/94.63	40/100 G OTN ODU0 bulk Requires BN 3061/94.61
BN 3061/94.64	40/100 G OTN ODUflex bulk Requires BN 3061/94.61
BN 3061/94.72	SDH/SONET including STL256.4 Requires BN 3076/92.51 or BN 3061/92.51 or 3061/94.51 (unit must have 40 G rates enabled)
BN 3061/94.73	Multichannel OTN Requires BN 3061/94.57 for 40 G OTU3 or BN 3061/94.55 for 100 G OTU4
BN 3061/94.74	40 GE for client service card Requires BN 3061/92.60, BN 3061/80.60, 3076/92.60, or 3076/80.60
BN 3061/94.75	100 GE for client service card Requires BN 3061/92.60 or 3076/92.60

Accessories

BN 3061/92.98	10 × 10 G electrical interface 10 × 10.3/11.18 G electrical access CFP with CAUI access, terminated via high density coax SMA connectors.
BN 3061/92.56	QSFP adapter for CFP slot QSFP+ adapter supporting 40 G rate QSFP+, power class 1/2/3/4. Requires BN 3061/92.52 or 3076/92.52 and any of these: 3076/92.51, 3061/92.51, or 3061/94.51

JDSU offers a wide range of optical power meters, sources, and attenuators. Contact your local sales representative for details.

Test & Measurement Regional Sales

NORTH AMERICA
TOLL FREE: 1 855 ASK-JDSU
1 855 275-5378

LATIN AMERICA
TEL: +1 954 688-5660
FAX: +1 954 3454668

ASIA PACIFIC
TEL: +852 2892 0990
FAX: +852 2892 0770

EMEA
TEL: +49 7121 86 2222
FAX: +49 7121 86 1222

www.jdsu.com/test