

UX400-40G Module

OTN/SDH/SONET Testing



VePAL UX400

Universal Test Platform



Next Generation Modular Platform for Transport, Carrier Ethernet, Mobile Backhaul, and Legacy Testing

VeEX® UX400 is the industry's most flexible, compact, and future-proof test solution for OTN, SDH, SONET, PDH, T-Carrier, Carrier Ethernet, Mobile Backhaul, Core, and Storage Area Networks¹.



40G Transport Test Module

The UX400-40G module, with its physical interface for OTU3, STM-256 and OC-768 testing, adds to the UX400's full range of link and service testing capabilities for a complete DS1 to OTU4, in a single compact unit.

Installation, commissioning, monitoring and maintenance of OTN, SDH, SONET client side interfaces are simplified thanks to a combination of intuitive features and powerful test functions.

Fast troubleshooting and comprehensive analysis of transmission problems can be performed using intrusive, non-intrusive and monitoring test modes. Novice users will benefit from the easy-to-use auto-configuration and tributary scan test modes, while experienced users will appreciate the array of advanced features such as overhead monitoring and bytecontrol, pointer test sequences, path trace generation, Tandem Connection Monitoring and much more.

Module Highlights

- Single-slot test module
- UX400 platform supports two UX400-40G modules operating simultaneously
- Built-in 40G optical port
- SCPI-based remote control and scripting commands
- OTN testing for OTU3 client interfaces
- SDH/SONET testing for STM-256/OC-768 client interfaces
- Single BERT
- Optical power and frequency measurement
- Service Disruption and APS measurements
- Round trip delay measurements
- Path trace and pointer generation and analysis
- Overhead monitoring and byte decoding
- Tandem Connection Monitoring
- OTU2 with SDH/SONET payloads
- SDH/SONET mapping down to VC12/VT2 and VC11/VT1.5
- Transmit frequency offset
- SDH/SONET Payload through and monitoring modes

¹ Test interfaces, data rates, mappings, transmission protocols, and features depend on the availability of individual test modules

Test Interfaces

Optical*

Test Rates

- OTU3 43.01 Gbps
- STM-256 39.81 Gbps
- OC-768 39.81 Gbps

Built-in optical test port

- Connectors: LC-UPC with safety latch
- Line coding: NRZ

*The 40G NRZ SFF test module supports 39.8, 43.0 Gbps bit rates for short reach (VSR) optical link lengths of up to 2 km.

Transmitter

Wavelength: 1550 nm

Output Power: 0 to 3 dBm

Eye Diagram: ITU-T G.693 compliant

Laser Safety: Class 1 Laser product, IEC 60825-1 Edition 1.2,
FDA/CDRH, 21 CFR 1040

Jitter Output: ITU-T G.8251

Receiver

Wavelength: 1290 to 1610 nm

Max Input Power: 3 dBm

Sensitivity: -7 dBm

Jitter Tolerance: ITU-T G.8251 compliant

Optical Power Measurement: ± 2 dB accuracy, 0.01 dB resolution

Operating temperature range: -10°C to 70°C

TX Clock Source**

Internal: ± 3.5 ppm stability per ITU-T G.812

Recovered: from incoming RX signal

Tx Frequency Offset

- ± 50 ppm
- Steps of 0.01 ppm

External Clock Input

- Connector: 75 Ohm BNC
- 2 MHz, 2 Mbps (AMI, HDB3)
- Terminated, Monitor, Bridge

System's High-stability 1 PPS Clock

- GPS clock (UX400 platform option)
- Atomic Rb Clock (UX400 platform option)

**Rb clock can be disciplined by the GPS if both options are present.
Check UX400 Platform datasheet for details.

Measurement Clock Reference**

Internal: ± 3.5 ppm stability per ITU-T G.812

External Clock Input

- Connector: 75 Ohm BNC
- 2 MHz, 2 Mbps (AMI, HDB3)
- Terminated, Monitor, Bridge

System's High-stability 1 PPS Clock

- GPS clock (UX400 platform option)
- Atomic Rb Clock (UX400 platform option)

OTN Functions

Key Features

- OTU3 (43.01 Gbps)
- Synchronous and asynchronous mapping of SONET/SDH payloads
- OTU, ODU, OPU overhead manipulation and monitoring
- OTU, ODU, OPU, TCMi layer alarms/errors generation and analysis
- OTU, ODU, TCMi trace messages
- Forward error correction (FEC) testing
- Tandem Connection Monitoring
- Frequency offset generation of bit rates by ± 50 ppm

OTN

Standards: ITU-T G.709, ITU-T G.798, ITU-T G.872

Test rates

- OTU3 (43.01 Gbps)

Payload types

- ODU3-Bulk (test pattern)
- ODU3-STM-256 or OC-768, synchronous and asynchronous, including all supported mappings

OTU Layer

Errors: OTU-FAS, OTU-MFAS, OTU-BEI, OTU-BIP-8

Alarms: LOF, OOF, LOM, OOM, OTU-AIS, OTU-TIM, OTU-BDI,
OTU-IAE

Trace Generation: 64-byte Trail Trace Identifier (TTI)

ODU Layer

Errors: ODU-BIP-8, ODU-BEI

Alarms: ODU-AIS, ODU-OCI, ODU-LCK, ODU-TIM, ODU-BDI

Trace Generation: 64-byte Trail Trace Identifier (TTI)

OPU Layer

Alarms: OPU-PLM

Payload Type (PT): Generates and displays received PT value

Tandem Connection Monitoring (TCM)

TCMi Monitoring (1 through 6)

- LTC, AIS, OCI, LCK, BDI, BIAE, IAE; count
- IEC, BEI; count and rate

Trace Identifier Monitoring and Generation

- Programmable SAPI, DAPI and User traces
- Copy trace from RX
- TIM monitoring: ON and OFF

Forward Error Correction (FEC)

Errors: FEC-Correctable, FEC-Uncorrectable

OTN Alarm Generation

Physical: LOS

OTU: LOF, OOF, LOM, OOM, AIS, IAE, BDI, TIM

ODU: AIS, OCI, LCK, BDI, TIM

OPU: PLM

TCMi: OCI, AIS, LCK, BDI, IAE, BIAE, LTC

Modes: Continuous, Burst (0.1s to 100s)

OTN Error Insertion

OTU: FAS, MFAS, BIP, BEI, Correctable FEC, Uncorrectable FEC

ODU: BIP, BEI

TCMi: BIP, BEI

Modes: Single, Burst (1 to 1000), Rate

SDH/SONET Functions

SDH/SONET signals can be used as physical layer or as OTU3 payloads, and can even contain multiplexed clients, providing all the flexibility to address complex test scenarios.

Key Features

- STM-256 (39.81 Gbps)
- OC-768 (39.81 Gbps)
- Bulk VC/STS/VT payloads
- Overhead manipulation and monitoring
- Alarms/errors generation and analysis
- Service Disruption and APS
- One-way Delay (dual mode)
- Round Trip Delay
- Tributary Scan
- Tandem Connection Monitoring
- Pointer Test Sequences

Operating Modes

Terminate mode (Normal)

Payload Through mode (Intrusive)

- Monitors all errors and alarms as the signal passes through the test set
- Modification of SOH bytes
- Alarm Generation and Error Insertion

Line Through mode (transparent)

- Monitors all errors and alarms, as the entire signal passes through the test set, without modifying overhead bytes or the payload

Signal Structure

VC-n, STS-n or VT-n container equipped with

- Bulk: Test sequence (patterns) per ITU-T O.181

SDH Mappings

According to ITU-T G.707

- C-11 (Bulk)
- C-12 (Bulk)
- C-3 (Bulk) via AU-3 or AU-4
- C-4 (Bulk)
- C-4-4c (Bulk)
- C-4-16c (Bulk)
- C-4-64c (Bulk)
- C-4-256c (Bulk)

SDH Overhead Analysis and Generation

Network Architectures supported

- Linear (per ITU-T G.783)
- Ring (per ITU-T G.841)

Analysis – Decode and Display

SOH/POH bytes in hexadecimal, binary or ASCII formats

- S1 synchronization status
- C2 HP signal label
- J0 trace identifier (1 or 16 bytes) in ASCII format
- J1 trace identifier (16 or 64 bytes) in ASCII format
- J2 trace identifier (16 or 64 bytes) in ASCII format
- K1, K2 APS Control
- V5 LP signal label

Generation - Programmable Bytes

RSOH

- J0 trace: 1 byte (hex), 16-byte ASCII sequence with CRC-7

MSOH

- K1, K2 APS bytes per ITU-T G.783 and G.841
- S1 synchronization status message

HO-POH (VC-4, VC-3)

- J1 trace: 16-byte ASCII with CRC-7 or 64-byte ASCII sequences
- C2 signal label
- H4 Sequence/Multiframe Indicator

- G1 (bit 5): End-to-end path status (RDI generation)

- K3 (bits 1-4) APS signaling

LO-POH (VC-3)

- J1 trace: 16-byte ASCII with CRC-7 or 64-byte ASCII sequences
- C2 signal label

- G1 (bit 5): End-to-end path status (RDI generation)

- K3 (bits 1-4) APS signaling

LO-POH (VC-12, VC-11)

- V5 (bits 5-7) LP signal label

- J2 trace: 16-byte ASCII with CRC-7 or 64-byte ASCII sequences

- K4 (bits 3-4) LP APS signaling

SONET Mappings

According to Telcordia GR-253/ANSI T1.105

- VT-1.5 (Bulk)
- VT-2 (bulk)
- STS-1 SPE (Bulk)
- STS-3c SPE (Bulk)
- STS-12c SPE (Bulk)
- STS-48c SPE (Bulk)
- STS-192c SPE (Bulk)
- STS-768c SPE (Bulk)

SONET Overhead Analysis and Generation

Network Architectures supported

- Linear (per ITU-T G.783)
- Ring (per ITU-T G.841)

Analysis – Decode and Display

SOH/POH bytes in hexadecimal, binary or ASCII formats

- S1 synchronization status
- C2 STS path signal label
- J0 trace identifier (1 or 16 bytes) in ASCII format
- J1 trace identifier (16 or 64 bytes) in ASCII format
- J2 trace identifier (16 or 64 bytes) in ASCII format
- K1, K2 APS Control
- V5 VT path signal label

Generation - Programmable Bytes

Section Overhead

- J0 trace: 1 byte (hex), 16 -byte ASCII sequence with CRC-7

Line Overhead

- K1, K2 APS bytes per ITU-T G.783 and G.841
- S1 synchronization status message

STS-POH (STS-N SPE, STS-1 SPE)

- J1 trace: 16-byte ASCII with CRC-7 or 64-byte ASCII sequences
- C2 signal label

- H4 Sequence/Multiframe Indicator

- G1 (bit 5): End-to-end path status (RDI generation)

- K3 (bits 1-4) APS signaling

STS-POH (STS-1 SPE)

- J1 trace: 16 byte ASCII with CRC-7 or 64 byte ASCII sequence
 - C2 signal label
 - G1 (bit 5): End-to-end path status (RDI generation)
 - K3 (bits 1-4) APS signaling
- VT-POH (VT-1.5, VT-2)
- V5 (bits 5-7) VT signal label
 - J2 trace: 16-byte ASCII with CRC-7 or 64-byte ASCII sequences
 - K4 (bits 3-4) VT APS signaling

SDH/SONET Alarms**Monitoring and Detection**

- SDH: LOS, LOF, OOF, RS-TIM, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-UNEQ, HP-PLM, HP-TIM, HP-RDI, TU-LOM, TU-AIS, TU-LOP, LP-UNEQ, LP-PLM, LP-TIM, LP-RDI, LP-RFI
- SONET: LOS, LOF-S, LOF-S, SEF-S, AIS-L, RDI-L, AIS-P, LOP-P, UNEQ-P, PLM-P, TIM-P, RDI-P, LOM-V, AIS-V, LOP-V, UNEQ-V, PLM-V, TIM-V, RDI-V, RFI-V

Generation

- SDH: LOS, LOF, MS-AIS, MS-RDI, RS-TIM, AU-LOP, AU-AIS, HP-UNEQ, HP-PLM, HP-RDI, HP-TIM, TU-LOM, TU-LOP, TU-AIS, LP-UNEQ, LP-PLM, LP-RDI, LP-RFI, LP-TIM
- SONET: LOS, LOF, AIS-S, RDI-S, TIM-S, TIM-P, LOP-P, AIS-P, UNEQ-P, PLM-P, RDI-P, LOM-V, LOP-V, AIS-V, UNEQ-V, PLM-V, RDI-V, RFI-V, TIM-V
- Modes: Continuous, Burst (0.1s to 100s)

SDH/SONET Errors**Detection**

- SDH: FAS, B1, B2, MS-REI, B3, HP-REI, LP-BIP, LP-REI, slips and bit errors
- SONET: FAS, S-BIP, L-BIP, REI-L, P-BIP, REI-P, REI-V, BIP-V, and bit errors

Insertion

- SDH: FAS, B1, B2, MS-REI, B3, HP-REI, LP-REI, LP-BIP, and bit errors
- SONET: FAS, BIP-S, BIP-L, REI-L, BIP-P, REI-P, REI-V, BIP-V, slips and bit
- Mode: Single, Burst (1 to 1000), and Rate

Common Functions & Measurements**Test Patterns**

The following test sequences can be generated to fill the payload

- PRBS: $2^{31}-1$, $2^{23}-1$, $2^{20}-1$, $2^{15}-1$, $2^{11}-1$, 2^9-1
- Fixed: 0000, 1111, 1010, 1100, 1in8, 2in8
- User: 32-bit Programmable sequences

Signal and Frequency Measurement**Signal level**

- Optical power in dBm

Frequency (Line)

- Resolution: 1 bit/s (bps)

Frequency Offset

- Resolution: 0.1 ppm
- Current, Minimum and Maximum
- Payload

Round Trip Delay

Available for SDH and SONET

Measurement Range: 10 μ s to 10 seconds

Resolution: \pm 10 μ s

Events Log

Date and time stamped record of all events occurred during a test, presented in tabular format

Includes event name, time, duration and count/severity

Histograms and Bar Graphs

Histogram: Display of related Errors and Alarms versus time

Bar Graph: Error or Alarm severity versus time

Resolution: Seconds, minutes, hours and days

Soft LED Indicators

Fixed indicators for Signal, Framing, Pattern and Errors/Alarms
Display historical events and conditions

Measurement Options**Service Disruption and APS Testing****SDH Sensors**

- LOS, LOF, FAS
- B1, MS-AIS, MS-RDI, MS-REI, B2, AU-AIS, AU-LOP, B3, HP-RDI, HP-REI, TU-AIS
- LSS

SONET Sensors

- LOS, LOF, FAS
- S-BIP, AIS-L, RDI-L, REI-L, L-BIP, AIS-P, LOP-P, P-BIP, RDI-P, REI-P, AIS-V
- LSS

Pass/Fail range: 15 to 200 ms

Gate Time: 20 to 4000 ms

Resolution: 1 ms

Test Modes: Single and Continuous

SDH/SONET APS Byte (K1/K2) capture and decode

Pointer Analysis and G.783 Test Sequences

Pointer movements monitoring and generation for SDH and SONET Monitor

- Current value, increments, decrements, sum, difference
- New Data Flags (NDF)
- Tributary frequency offset (ppm of AU/TU or STS/VT)

Generation

- Pointer sequences: ITU-T G.783, Telcordia GR-253
- Pointer Types: AU, TU, STS, VT
- Single pointer, increment, decrement, or increment/decrement
- Sequence: Basic, Single Alternating, Regular Additive, Regular Cancel, Double Alternating, Burst, Transient Burst, 87/3, 87/3 Additive, 87/3 Cancel, Periodic Additive, Periodic Cancel
- Programming of SS bits
- Adjustments: Increment, Decrement, New Value
- Parameters: N, T1, T2, T3, T4

Tandem Connection Monitoring (TCM)

Generation and analysis of N1 and N2 bytes

Errors generated: TC-IEC, TC-BIP, TC-REI, OEI

Alarms generated: TC-RDI, TC-UNEQ, TC-LTC, TC-AIS, TC-ODI

Detection, display, analysis and storage of events

- TC-IEC, TC-AIS, TC-REI, TC-RDI, TC-OEI, TC-LTC, TC-UNEQ, TCODI, TC-TIM
- Analysis and generation of APId (Access Point Identifier)

Ordering Information

Z22-00-005P	UX400 40G Test Module Single port, LC connector Internal mapping from 155 Mbps to 40G
Z22-00-008P	UX400 40G Test Module Single port, LC connector Internal mapping from 155 Mbps to 40G and OTU3e

Software Options

499-05-215	OTU3 Testing
499-05-216	40G Low Rate Mapping support (from VT1.5/VT2)
499-05-217	40G PDH payloads (E3, E1, DS3, DS1) support (requires 499-05-216)
499-05-218	40G Service Disruption and APS
499-05-219	40G Tandem Connection Monitoring
499-05-220	40G ITU-T G.783 Pointer Test Sequences

General

Power Consumption	32 watts (max)
Environmental	
Operating temperature	0 to 40°C (32 to 104°F)
Storage temperature	-20 to 70°C (-4 to 158°F)
Humidity	5% to 90% non-condensing

ROHS compliant and Lead Free per Directive 2002/95/EC

**Some of the test rates, mappings, features and functions described in this document are optional, may be linked to, or require the support of other software options.*

