

TestPad 2000™

2416 SDH Field Services Module



Product Highlights

- First battery-operated, hand-held 2M to STM-16 network test solution on the market
- Automated testing features minimize training costs and testing complexity
- Weighs only 2.5 kg—ideal for mobile technicians
- Engineered for the field with rugged construction, lightweight design, and battery-powered operation
- Easy-to-use touch screen graphical user interface (GUI) simplifies and expedites testing
- Modular TestPad 2000 architecture enables up-to-date support for established and emerging technologies in a single platform
- Dual PCMCIA slots support easy installation of future upgrades and bring added testing functionality and versatility

Application Highlights

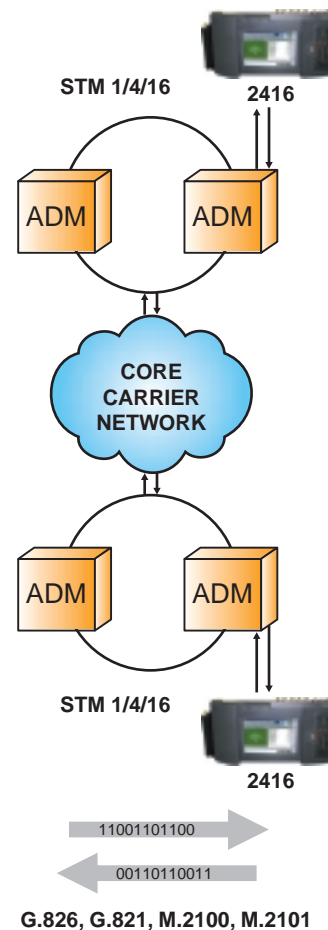
- STM-16 and below tributary line card turn-up and bandwidth commissioning ensure quality of service and avoid finger-pointing issues at STM-64 rings
- STM-16 ring field installation and turn-up (STM-1/4/16c) allows timely network deployment
- Verifies DSL networks at STM-1/4 lines to assess end-to-end connectivity
- DWDM system BER testing sectionalizes problems between DWDM and SDH networks
- Ensures quality of service with field testing procedures that include optical power-level measurement, stand-alone loopback testing, automatic protection switching (APS) testing at PDH rates, power attenuation testing, add-drop multiplexer (ADM) continuity testing, and performance analysis

Acterna's 2416 SDH Field Services Module for the TestPad 2000 offers a superior balance of size and performance among STM-16 test sets. The rugged 2416 redefines STM-16 testing by enabling faster, easier, and more reliable turn-up of STM-16 rings in a mobile environment, thereby accelerating deployment and revenue generation, as well as reducing operational costs. With minimal training, both experienced and novice technicians can efficiently use the feature-rich 2416's solution to support the entire test, analysis, and measurement spectrum from 2M to STM-16c.

Function Highlights

- **BER Testing from 2M to STM-16c**—Verifies transmission quality of the network with ITU-T and ANSI-compliant BERT pattern.
- **Defect and Anomalies Generation and Analysis**—Generates and assesses SOH, HP, and LP defects and anomalies to maintain service quality.
- **SDH Overhead Manipulation and Interpretation**—Manipulates and interprets SOH, HP, and LP overhead bytes.
- **Performance Analysis**—Analyzes network performance based on ITU-T G.821, M.2100, and M.2101 standards.
- **Round-Trip Delay Measurements**—Delivers round-trip delay measurements on looped-back circuits to help locate faults.
- **Auto-Protection Switching (APS) Testing**—Ensures the switch-over time required is within recommended parameters.
- **Remote Control Operation**—Runs and monitors the test set from a remote location and reduces the time spent travelling between test sites.
- **Scripting Capabilities**—Creates time-saving personalized scripts for activities such as test repetition.
- **Result Export, Storage, and Print**—Stores results internally on an event log, or exports externally via a PCMCIA card; prints results via serial connections.
- **Histograms Provide Interpretation of Results**—Offers a time-analysis histogram of events to track circuit activity.
- **Operating Modes**—Offers Terminate, Through, and Mux modes of operation.
- **2M View**—Reports 30x64k channel activity and receives byte and signaling bits—all in one view, including Nx64k fractional E1 testing.

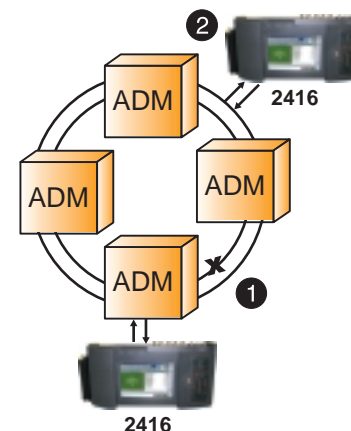
Performance Analysis

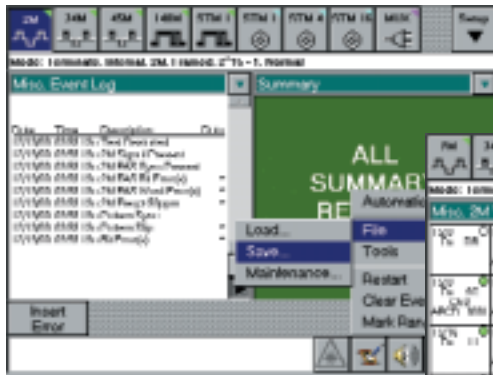


APS Switch-Over Measurement

Switch over initiated by:

1. Physically interrupting one of the signals
2. Using another test set in Through mode to insert errors until the network switches over to back up





Sample Event Log Display

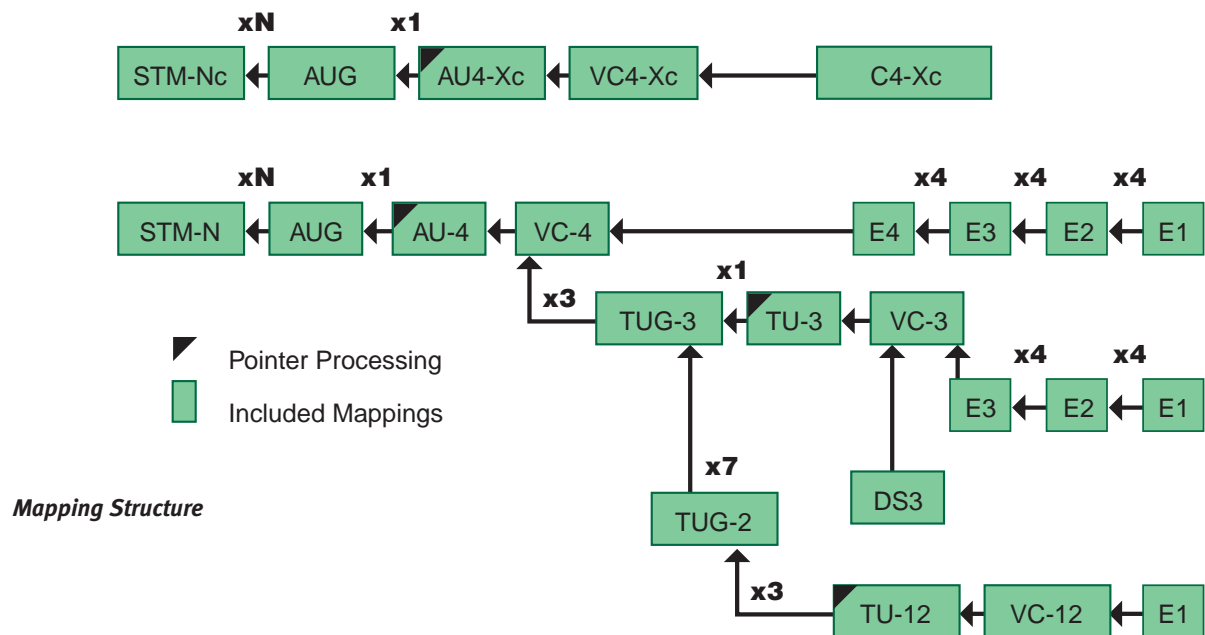
The 2416 presents data in easy-to-interpret graphical views



Sample 2M View

Features

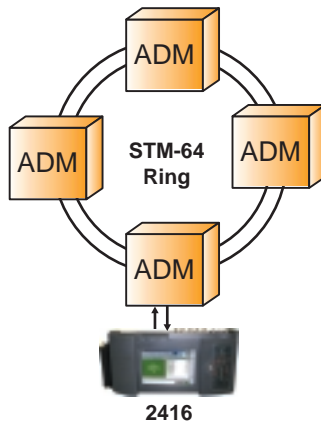
- SDH rates: STM-1, STM-4/4c, STM-16/16c
- PDH rates: E1, E3, DS3, and E4
- 1310 and 1510 nm wavelengths
- Mapping structure
- RS-232 serial port
- Multi-language support



Applications

Turn Up and Commission SDH Rings and Tributary Line Cards

When turning up a new SDH network, a thorough, six-step test should be performed prior to commissioning service. Each time new tributary service is commissioned to customers, a customized quick test is also recommended. Committing sufficient testing time early in the process can later save many hours in troubleshooting the network. In addition, for buyers of the bandwidth, testing verifies that they receive the level of service they have purchased. For sellers of the bandwidth, testing ensures the quality of the service offered.



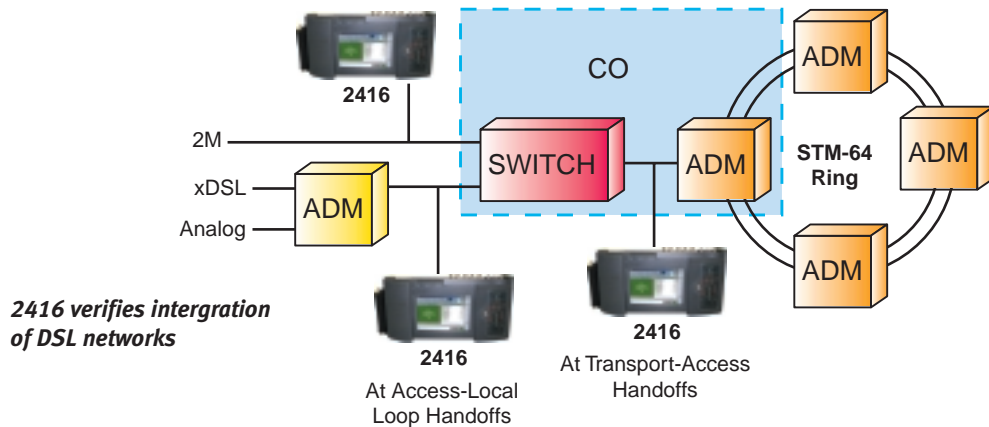
Testing at an STM-16 or below tributary

The 2416 performs the following six steps to ensure that a thorough test is completed:

- **Optical Power Attenuation Testing**—Verifies that the timing configuration is sustainable and the signal is clean to the recommended bit error rate by analyzing an attenuated signal of the SDH terminal's equipment. (External attenuator required.)
- **Terminal Loopback Testing**—Generates and analyzes defects and anomalies as the ADM is looped back to assess functionality before the ADM is connected to the network.
- **Ring Continuity Testing**—Verifies end-to-end bidirectional connectivity by performing BERT at SDH or PDH rates around an SDH ring.
- **APS Testing**—Measures the time it takes for the SDH equipment to switch to protection mode to ensure that the result falls below the industry-accepted minimum.
- **Performance Analysis**—Maintains compliance with ITU-T standards by monitoring network performance.
- **Optical Power Measurement**—Ensures that the optical power level is not too high or low by measuring the SDH terminal equipment's optical signal. Helps avoid intermittent saturation of the receiver on the far end.

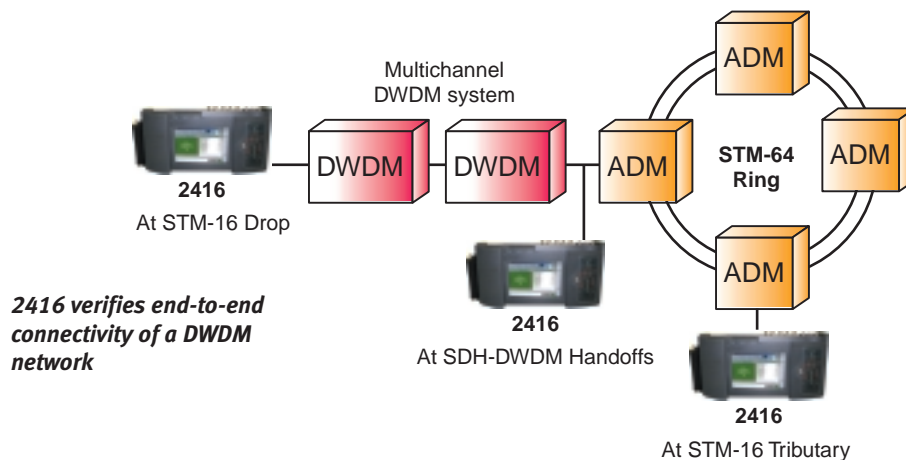
Test DSL Network Integration

DSL networks are being rapidly deployed to offer high bandwidth for end users. To keep up with increasing demand, SDH technology is used for transporting DSL traffic. To ensure high-quality customer service, full integration of the DSL network and SDH network must be verified. The 2416 conducts BER testing at SDH handoffs to sectionalize problems in an integrated DSL and SDH network.



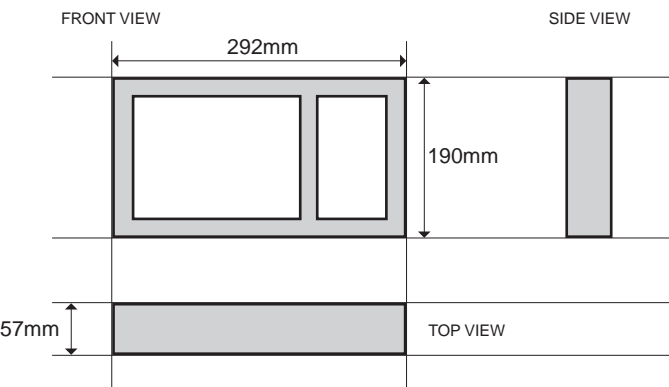
Test DWDM Network End-To-End Connectivity

DWDM networks are being used today to deliver terabit point-to-point connections among SDH rings. To sectionalize problems and verify end-to-end connectivity, the 2416 conducts BER testing at SDH ring drops, DWDM drops, or SDH-DWDM hand-off points.



Technical Specifications

PHYSICAL CHARACTERISTICS



Overall dimensions7.5 x 11.5 x 2.25 in.
(19 x 29.2 x 5.7 cm)

Weight5 lbs. (2.5 kg), with battery

ENVIRONMENT
Temperature Range

Operating32° F to 113° F
0° C to 45° C
Storage.....-4° F to 158° F
-20° C to 70° C

Humidity10% to 90% relative humidity,
non-condensing

POWER REQUIREMENTS

AC adapter50 to 60 Hz
110 to 240 VAC
Charging time1.5 hour maximum
Battery type10.8 V Nickel-Metal-Hydride (NiMH)
Operating time15 minutes

DISPLAY

6-inch diagonal graphic LCD color display

NETWORK INTERFACE CONNECTORS

Reference clock BNC 2.048 Mbp/s E1 or 2.048 MHz square
E1, E3, DS3 Receive BNC
E1, E3, DS3 Transmit BNC
E1 Transmit Balanced Twin-Ax
E1 Receive Balanced Twin-Ax
E4, STM-1e Receive BNC
E4, STM-1e Transmit BNC
STM-1, STM-4, STM-16 Receive Optical
STM-1, STM-4, STM-16 Transmit High Optical
STM-1, STM-4, STM-16 Transmit Low Optical

PDH SPECIFICATIONS

Output Signals

Rates75 ohm unbalanced output, BNC: 2M, 34M,
45M, 140M
120 ohm balanced output, Twin-Ax: 2M
Line codes2M and 34M: HDB3, AMI
45M: B3ZS
140M: CMI

Internal clock generation (at all rates)
4.6 ppm over 3 years

Clock sync to external signals (via 75 ohm unbalanced
input, BNC): Reference Clock at 2M, 2M (HDB3), or
Receive Signal

Error injectionPDH: Code, BIT, Frame
(FAS, MFAS), CRC, Pattern Slip
45M: Code, BIT, Frame, Parity, C-Bit Parity, Pattern Slip

Alarm generation, static (on/off):
Alarm types: LOF, AIS, RDI

Test Patterns.....PRBS: 211-1, 215-1, 220-1, 223-1,
2¹¹-1, 2¹⁵-1, 2²⁰, 2²³-1, 2²³-1 (inv)
223-1 (inv), All Ones, All Zeroes, 1:1, 1:3, 1:4, 1:7

Programmable.....User Programmable (up to 32 bits),
Long User Programmable (up to 2048 bytes)

FramingFAS, FAS CRC, MFAS, MFAS CRC,
Unframed, C-Bit, M-13

Input Signals

Rates 75 ohm unbalanced input,
BNC: 2M, 34M, 45M, 140M
120 ohm balanced input, Twin-Ax: 2M

Line codes2M and 34M: HDB3, AMI
45M: B3ZS
140M: CMI

Clock recovery pulling range..... ± 100 ppm

Selectable protected monitor point (PMP) gain
20, 23, 26, 30 dB resistive +6 dB cable loss

Bridge modeProvides > 10 times the line
impedance for E1 line interface.

Measurement Types

Error measurement
PDH: Code, BIT, CRC Error Count and Rate, REBE
Count, FAS Bit Error Count and Rate, FAS Word
Error Count and Rate, MFAS Word Error Count and
Rate, FAS Sync Loss Count, MFAS Sync Loss Count,
Pattern Slip Count and Seconds

45M: Code, BIT, Frame Error Count, Rate and
Seconds, Frame Sync Loss Count, Near End OOF
Seconds, Far End OOF Seconds, Parity Error Count,
Rate and Seconds, C-Bit Parity Error Count, Rate and
Seconds, FEBE Count

Input signal measurement.....2M: 120 ohm +6 to -32
dBnom, 75 ohm +6 to -32 dBnom
34M: 75 ohm +3 to -32 dBnom
45M: 75 ohm +3 to -32 dBnom
140M: 75 ohm +3 to -32 dBnom
2M ref clock: 0 to -6 dBnom

Frequency measurement range ± 100 ppm

Alarm detection
PDH: LOS, LOF, AIS, TS-16 AIS, MFAS Distance
Alarm, FAS Distant Alarm, Loss of Pattern Sync
45M: LOS, C-Bit Parity Error, Frame, R-AIS, AIS, Far
End Alarm, Idle, Loss of Pattern Sync

Alarm generation...PDH: AIS, MFAS-AIS (2M), R-AIS
45M: AIS, R-AIS, Far End Alarm, Idle, FEBE

Measurement intervalContinuous or Timed

Round-trip delay ...2M, 8M, 34M, 45M: 1microsecond
to 10 seconds

Evaluation to ITU-T, Recommendation G.821.....
ES, EFS, SES, DM, UAS
The SES and DM thresholds are user-settable

Evaluation to ITU-T, Recommendation G.826:
EB, BBE, ES, EFS, SES, and UAS The SES Error Block
threshold is user-settable Simultaneous in-service
measurement of near end of a selected path: FAS at
140/34/8 or 2 Mb/s, CRC-4, 45M Parity, 45M frame
bit errors out-of-service measurement adds the use of
bit errors in the test pattern for PDH

Evaluation of PDH to ITU-T, Recommendation M.2100:
ES, EFS, SES, and UAS

Simultaneous in-service measurement of near end of
a selected path: 2MFAS, 8MFAS, 34MFAS, 140MFAS,
CRC-4, 45M parity errors, 45M frame bit errors

Out-of-service measurement adds the use of bit errors
in the test pattern for PDH

SDH SPECIFICATIONS

Output Signals

RatesSTM-16, STM-4, STM-1

The generation of STM-4 TX signal consists of four
identical STM-1 tributary signals or one internally
generated STM-1 tributary signal with the other three
filled with UNEQ.

MappingsVC-12, VC-3(E3), VC-3(DS3), VC-4

Line code.....STM-1e: CMI
STM-1/4/16: NRZ

Wavelength: 1310 nm, 1310 and 1550 nm (switchable)

Output level1310 nm or 1550 nm
High Pwr: +2.0 to -4.3 dBnom
Low Pwr: -8.0 to -15.0 dBnom

StructureAU-4-16c, AU-4-4c, AU-4/VC-4,
AU-4/VC-3 (E3), AU-4/VC-3 (DS3), AU-4/VC-12

SynchronizationInternal, Recovered, 2M
Reference Clock

Error injection
VC-4: B1, B2, B3 parity errors, FAS, MS-REI, VC-
4REI, bit errors in test pattern, code errors (single
errors)

VC-12: additional BIP2, B3 parity errors, VC-12REI,
VC-12BIP

VC-3: additional VC-3B3, VC-3REI

Alarm generation
VC-4: LS, LOF, MS-AIS, MS-RDI, AU-LOP, AU-AIS,
VC-4RDI

VC-12: TU-12LOP, TU-12AIS, VC-12RDI, VC-12RFI
VC-3: TU-3LOP, TU-3AIS, TU-3RDI

TriggeringSingle error or error rate:
 1×10^{-2} to 1×10^{-9}
Step size for exponent is 1

Trace identifierJ0, J1, J2: Programmable 16 byte
ASCII sequence with CRC
J1, J2, additionally: Programmable 64 byte
ASCII sequence

Test patterns $2^{23}-1$, $2^{31}-1$, Auto, $2^{23}-1$ (inv),
 $2^{31}-1$ (inv)

APS switch-over timeMeasured on a PDH drop
for linear and ring-mode, 1 ms accuracy

Pointer controlIncrement, Decrement, NDF
Generation of pointer actions at the AU
and TU levels simultaneously

Input Signals

Input sensitivity-8.0 to -28.0 dBnm

Input overload protection> -6 dBm

Display of optical input levelResolution: 1 dB

Protected Monitor Point (PMP) Attenuation (STM-1e):
20, 23, 26, 30 dB resistive +6 dB cable loss

Measurement Types

APS timeCriteria for measurement: Loss of frame
sync and analysis rate
Max. measurable switch-over time: 127 ms
Resolution: 1 ms

Error measurement
B1, B2, B3 Count and Rate, FAS Word Error Count
and Rate, OOF Count, LOF Count, MS REI Count
and Rate, AU-LOP Count, VC-4REI Count and Rate,
TU-12LOP Count, VC-12REI Count and Rate, CMI
Code Error Count and Rate, BIT, Slip Count

Frequency measurement range± 100 ppm

Input signal measurement
Optical: Optical power meter: -6 dBnm to -28 dBnm
Electrical: +3 dBnm to -32 dBnm

Alarm detectionLOS, OOF, LOF, MS-AIS,
MS-RDI, AU-AIS, AU-LOP, AIS, RDI, VC-4RDI
All alarms are evaluated and displayed in parallel

Measurement intervalContinuous and Timed

PointerAnalysis of AU and TU pointer action:
Increment, Decrement, and Pointer Value

SOH and POHDisplay of key SOH and POH
bytes, including interpretation of APS information
in K1 and K2

Trace identifier
J0: Display of 16 byte ASCII sequence
J1, J2: Display of 16 or 64 byte ASCII sequence

Evaluation to ITU-T, Recommendation G.821
ES, EFS, SES, DM, UAS
The SES and DM thresholds are user-settable.

Evaluation to ITU-T, Recommendation G.826.....
EB, BBE, ES, EFS, SES, and UAS
The SES Error Block threshold is user-settable.
Out-of-service measurement adds the use of
bit errors in the test pattern for SDH.

Evaluation to ITU-T, Recommendation M.2101.....
ES, EFS, SES, and UAS
Simultaneous in-service measurement of near end
of a selected path: B1, B2SUM, B3, BIP8, BIP2
Out-of-service measurement adds the use of bit
errors in the test pattern for SDH.

RESULTS DISPLAY SPECIFICATIONS

Event log.....Display of all alarm and error events
with time stamp.
Resolution of error events and pointers: 50 ms
Memory capacity: 500 lines

Numerical displayDisplay of count (absolute)
and rate (relative) values for all error types.
Display update rate: 1 second

Histogram printPrint errors, pointer
operations/values and alarms as bar graphs vs. time
Units, time axis: 1 to 1440 minutes

Result printout.....Manual triggered or timed print
Serial: V.24/RS 232

Result export.....Results can be stored on a
PCMCIA card in ASCII format

Ordering Information

User Interface Module

2000-V3

TestPad 2000 with color display (includes kickstand, AC adapter/charger, hanging strap, and printer cable)

Application Modules

Part Number	BN Number	Description
2416-STM1-13FC	BN C2416-001	E1/E3/DS3/E4/STM-1e/o-1310 nm FC Connector
2416-STM1-13SC	BN C2416-002	E1/E3/DS3/E4/STM-1e/o-1310 nm SC Connector
2416-STM1-13ST	BN C2416-003	E1/E3/DS3/E4/STM-1e/o-1310 nm ST Connector
2416-STM1-DFC	BN C2416-004	E1/E3/DS3/E4/STM-1e/o Dual Wavelength FC Connector
2416-STM1-DSC	BN C2416-005	E1/E3/DS3/E4/STM-1e/o Dual Wavelength SC Connector
2416-STM1-DST	BN C2416-006	E1/E3/DS3/E4/STM-1e/o Dual Wavelength ST Connector
2416-STM4-13FC	BN C2416-007	E1/E3/DS3/E4/STM-1e/o/STM-4-1310 nm FC Connector
2416-STM4-13SC	BN C2416-008	E1/E3/DS3/E4/STM-1e/o/STM-4-1310 nm SC Connector
2416-STM4-13ST	BN C2416-009	E1/E3/DS3/E4/STM-1e/o/STM-4-1310 nm ST Connector
2416-STM4-DFC	BN C2416-010	E1/E3/DS3/E4/STM-1e/o/STM-4 Dual Wavelength FC Connector
2416-STM4-DSC	BN C2416-011	E1/E3/DS3/E4/STM-1e/o/STM-4 Dual Wavelength SC Connector
2416-STM4-DST	BN C2416-012	E1/E3/DS3/E4/STM-1e/o/STM-4 Dual Wavelength ST Connector
2416-STM16-13FC	BN C2416-013	E1/E3/DS3/E4/STM-1e/o/STM-4/STM-16-1310 nm FC Connector
2416-STM16-13SC	BN C2416-014	E1/E3/DS3/E4/STM-1e/o/STM-4/STM-16-1310 nm SC Connector
2416-STM16-13ST	BN C2416-015	E1/E3/DS3/E4/STM-1e/o/STM-4/STM-16-1310 nm ST Connector
2416-STM16-DFC	BN C2416-016	E1/E3/DS3/E4/STM-1e/o/STM-4/STM-16 Dual Wavelength FC Connector
2416-STM16-DSC	BN C2416-017	E1/E3/DS3/E4/STM-1e/o/STM-4/STM-16 Dual Wavelength ST Connector

Upgrades

Note: The connector type for the application module received will be the same for the upgraded module.

Part Number	BN Number	Description
2416-STM1-STM1D-U2	BN C2416-019	STM-1 Single to STM-1 Dual
2416-STM1-STM4-U2	BN C2416-020	STM-1 Single to STM-4 1310 nm
2416-STM1-STM4D-U2	BN C2416-021	STM-1 Single to STM-4 Dual
2416-STM4-STM4D-U2	BN C2416-022	STM-4 Single to STM-4 Dual
2416-STM1-STM16-U2	BN C2416-023	STM-1 Single to STM-16 1310 nm
2416-STM4-STM16-U2	BN C2416-024	STM-4 Single to STM-16 1310 nm
2416-STM1-STM16D-U2	BN C2416-025	STM-1 Single to STM-16 Dual
2416-STM1D-STM16D-U2	BN C2416-026	STM-1 Dual to STM-16 Dual
2416-STM4-STM16D-U2	BN C2416-027	STM-4 Single to STM-16 Dual
2416-STM4D-STM16D-U2	BN C2416-028	STM-4 Dual to STM-16 Dual
2416-STM16-STM16D-U2	BN C2416-029	STM-16 Single to STM-16 Dual
2416-STM1D-STM4D-U2	BN C2416-030	STM1 Dual to STM-4 Dual

Additional Application Modules Available

Optical Modules

2510 10-Gig Field Services Module
2310 SONET Field Services Module

Access Modules

2209 T1/T3 Field Services Module
2230 E1 Data Communications Analyzer
2207 T1/T3 Wireless Field Services Module

Copper Modules

2109 Copper Analyzer Module
2357 DSL Broadband Services Module

Optional Accessories

AC-31705 External Battery Charger
AC-31891 Hanging Strap
BA-014081 Replacement Battery
CC-44605 Carrying Case, Large, Soft
CC-451-58 Carrying Case, Multi-module, Soft

Note: Specifications, terms, and conditions are subject to change without notice.

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