PUMA 4000E
Series
NETWORK TESTING–ACCESS

The Complete Solution for E1 and Datacom Analyzer

EXFO
EXPERTISE REACHING OUT

The Puma 4000E is the ultimate field portable analyser for installing, maintaining and testing 2.048 Mbit/s PCM and data communications circuits. No other test set comes with as many features packed inside such a robust hand held package. With several models to choose from, you'll find the right Puma to meet your requirements.

Applications

The Puma 4000E Series will help your technicians find and fix problems fast. It can be used to test links that:

- Inter-connect a subscriber's PBX to the PSTN
- Connect mobile communications base stations to the network
- Provide private line connections for digital circuits
- Carry PCM voice traffic
- Transport frame relay, IP, ISDN, and other protocols
- Enable video conferencing
- Connect routers to wide area networks (WAN)

Live Monitoring of 2.048 Mbit/s Circuits

Two independent receiver ports on the Puma 4000E Series allow it to monitor both directions of an in-service E1 line. The activity in each time slot is detected and displayed on the Puma's graphic display. Channels that contain an idle pattern, bit-error-rate test (BERT) patterns, framing, signaling, or that are "in-use" are identified. Any channel can be highlighted using the Puma's up/down, left/right arrow keys. Users can then easily display more detail about the information in that channel (such as framing), or jump to a BER test. In addition, the Puma's built-in PCM coder/decoder and speaker can be used to listen to speech activity on the selected channel.

The "E1 Monitor" function of the Puma 4000E Series is very useful for locating time slots that contain BER patterns. Often, digital cross-connect systems (DCS) and add-drop multiplexors (ADMs) move the channel assignments around network locations.

Because the Puma 4000E Series' E1 monitor function does not take the customers' circuit out of service, it is an excellent first step to investigate a trouble report before initiating a customer visit.
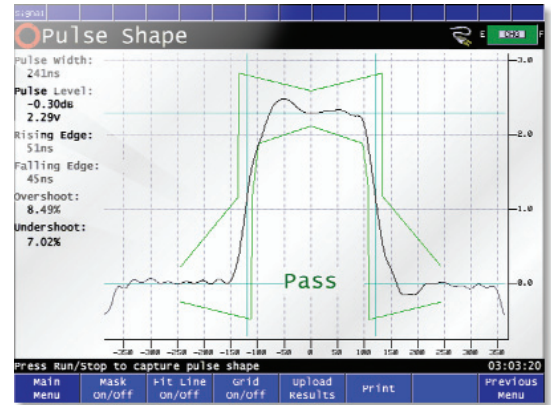
Monitoring a live E1 circuit

E1 PCM Circuits Analysis

E1 Errors and Alarms

The Puma 4000E Series has a comprehensive range of features that allow E1 circuit impairments to be located and identified whether they are caused by bad connections, faulty equipment, environmental effects, or data-specific errors.

The Puma's E1 capabilities are typically utilised in one of three areas:

- Out-of-service installation, commissioning and "bringing into service" acceptance testing – to verify the quality of the entire digital transmission path using industry standard stress test methods.

- Preventative maintenance – to alert field technicians of degrading service before it affects revenue-winning services, i.e., monitoring PCM signals for alarms, errors, clock slips, frequency and pulse shape. These tests are conducted while the circuit is in-service.

- Maintenance, troubleshooting and fault isolation of disrupted services – the Puma 4000E Series can be used to locate the source of the trouble quickly and efficiently using a combination of both in- and out-of-service testing. This type of testing ensures that all DACS and MUX equipment are correctly configured for the planned sequence of timeslots and that the integrity of these sequences are maintained across a network.

Example: Pulse mask measurement screen

Physical Layer Testing

The Puma 4000E has a number of features that allow field technicians to verify the physical layer. Bit rate stability, received level and frequency, as well as signal pulse shape are a few examples.

The Puma's pulse mask conformance measurement feature offers an immediate way for field service technicians to ensure that the E1 output from a re-generator, PABX or multiplexer is in compliance with the ITU-T recommendation mask.
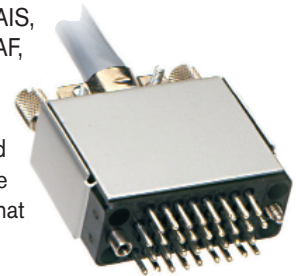
Drop and Insert BER Tests

The Puma 4000E Series supports full drop and insert testing. This allows m and n x 64 kbit/s services up to 2.048 Mbit/s to be tested. It also supports both contiguous and non-contiguous time slot assignments.

The Puma 4000E Series has two E1 transmit ports and two E1 receive ports for fully Bi-Directional Drop and Insert test modes. The user can select incoming channels to be dropped and for a test pattern to be inserted. The Puma can send, receive, drop, insert and perform error analysis simultaneously in this configuration.

Error, Alarm and Frame Analysis

The Puma 4000E Series monitors and counts CRC4, Code, E-bit and FAS errors, AIS indications, TS16 AIS, FAS, MFAS, distant FAS and distant MFAS alarms. The FAS and MFAS words are shown along with SiAF, SiNAF, RA, and Sa4 through Sa8 bytes. This monitoring capability is excellent for determining circuit performance without disturbing the traffic on live 2 Mbit/s lines.
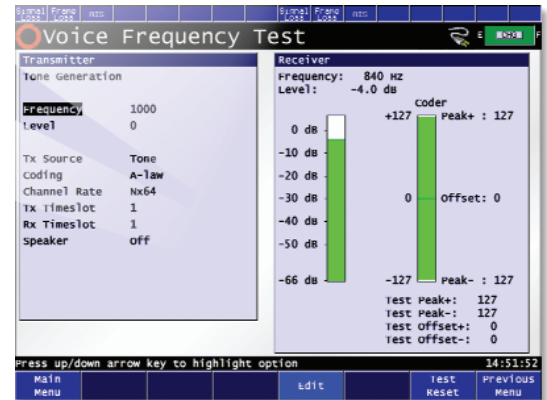
Monitoring FAS errors, AIS and FAS distant alarms enables the technician to sectionalise E1 circuits and therefore identify the source of errors. For example, the presence of a FAS distant Alarm indicates that there is a problem downstream of the current location, whereas the presence of an AIS Alarm indicates that a problem lies upstream.

VF Testing

Voice channels can be monitored in-service as a first level check of analog level and quality. This is achieved through the built-in PCM CODEC and speaker. For a more detailed audio channel analysis, test tones, which are digitally generated by the Puma are inserted and measured in a user-selected time slot. The Puma's audio measurements include: received level, received frequency, max (+) and min (-) peak code (A-law/G.711), coder offset, and peak coder offset: positive and negative.

This feature makes the Puma the ideal test set for testing the voice levels throughout the digital speech network. This allows echo cancellers, digital pads, and digital channel gain levels to be set correctly.

Example: Voice frequency analysis screen

ISDN PRI

Live Primary Rate ISDN Monitoring

It's easy to verify primary rate ISDN services with the Puma 4000E Series' ISDN monitoring option. Supported protocols include ISDN-PRI, DASS II, DPNSS, V5.1, V5.2 and Q.SIG. Full decodes are given in plain English and hex. The ISDN call statistics feature enables summary and statistical information to be extracted from the built-in ISDN monitoring logs. The call list screen shows the numbers for both calling and called parties involved in the connections, and both the inbound and outbound signaling can be viewed. To display the setup for a particular call, the technician can use the cursor keys to browse the packet log. The call data screen displays a summary of total calling activity for inbound and outbound signaling. Call categories that are displayed include: total, busy, fault, answered and unanswered. Calling and called party numbers are displayed along with the "Release Cause" and also Layer 2 and 3 packet statistics.

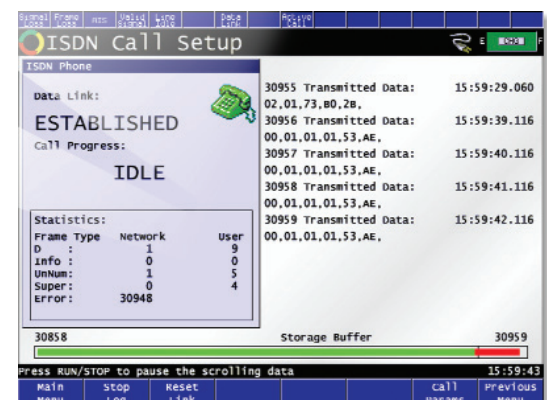## Place or Receive Primary Rate ISDN Calls

An ISDN call setup and analysis option enables field technicians to verify that an ISDN PRI link is functioning correctly. This feature emulates the functionality of an ISDN telephone; calls can be set up or received, and all data is displayed with a clear indication of the received and transmitted signaling.

Bit-Error-Rate Testing (BERT)

Testing of this nature is useful for verifying end-to-end digital "continuity", for isolating faults, and for performing acceptance tests. Using two Pumas, one at each end of the circuit, enables technicians to verify performance in both directions. Alternately, the Puma can perform loop back or round robin testing of the entire 2 Mbit/s signal or any configuration of looped back m and n x 64 kbit/s, contiguous or non-contiguous service. The Puma allows technicians to perform BER Tests over an entire 2.048 Mbit/s link using either a G.703 unframed or G.704 framed HDB3/AMI signal. The ability to inject errors in the pattern, framing and alarm bits allows the user to verify tests and examine error response.

The Puma 4000E Series has one of the most extensive ranges of test patterns available including: user selectable patterns (up to 32 bits), fixed 4 and 8 bit patterns (such as all 1's, all zeros, alternate 1's and 0's, etc.), QRSS, PRBS patterns from 2^3-1 to $2^{32}-1$, and patterns that conform to ITU-T O.151, O.152, O.153. The extensive list of test patterns makes the Puma compatible with existing test instruments and enables the network to be stressed intensively.

A variety of Puma 4000E Series models exist that can perform error rate performance testing over some or all of the following built-in interfaces (2 Mbit/s balanced and unbalanced, 64 kbit/s co-directional, contra-directional, TTL, V.35, V.24/ RS232C, V.36/RS449, RS530 and X.21).

Example: ISDN call setup screen

G.821, G.826, and M.2100 Results

The Puma 4000E Series' large LCD display allows all relevant BERT results including G.821, G.826, M.2100 and other measurements to be easily evaluated. Results can be stored, recalled and printed.

Discover Timing Problems

The Puma 4000E Series has a number of features that allow technicians to identify network timing and clock problems.

Example: G.821, G.826 and M.2100 result screens

Slips Analysis

Pattern Slips – When bit errors occur on a telecom or datacom system they can be due to interference, which causes bits to be corrupted. Alternatively, they can be due to an incorrectly configured clock that causes the data (pattern) to slip in relation to the clock. By detecting pattern slips as well as bit errors, the Puma enables the troubleshooter to determine if the problem is due to a burst of interference or incorrectly configured clocks.

Clock Slips – In a telecom system, it is important that the data is supplied at exactly the same rate as the network over which it is carried. Any variations in the data rate can mean that there is insufficient bandwidth for the data or the data may not be present when the network needs it. Most networks have buffers that allow for small variations between the clock rate of the data source and the network. If this buffer is exceeded, errors will occur. The Puma compares the clock rate of the input signal with a reference signal and displays the result as clock slips. This test displays the current position together with the maximum positive and negative excursions during the test. Since there is no need to know what data is being transported, this can be performed as an either an in-service or out-of-service test.

Frequency Offset

Marginal network components can be isolated with the frequency offset feature of the Puma 4000E. The Puma transmits a fixed offset, thus simulating the stress placed on network equipment when timing problems exist. This feature is also useful in telecommunications equipment production-testing applications.

Propagation (Round Trip) Delay

The Puma 4000E Series can measure propagation (round trip) delay at various points across the network and on any of the built-in interfaces: 2 Mbit/s, 64 kbit/s, co-directional, V.35, V.24, V.36/RS449, RS530, and X.21. The resolution is 1 micro second. In addition, the approximate copper equivalent distance is calculated. Differing time delays may result in retransmissions, time outs and degraded transmissions.
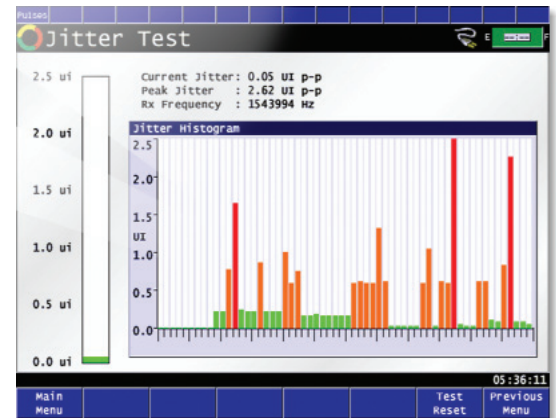
Pulse Mask Conformance

The Puma 4000E Series can capture and perform analysis on the pulses produced by E1 equipment. The pulse height and overall shape are displayed against the ITU-T pulse mask conformance template. This same measurement mode is used to ensure that E1 pulses are of a correct signal level.
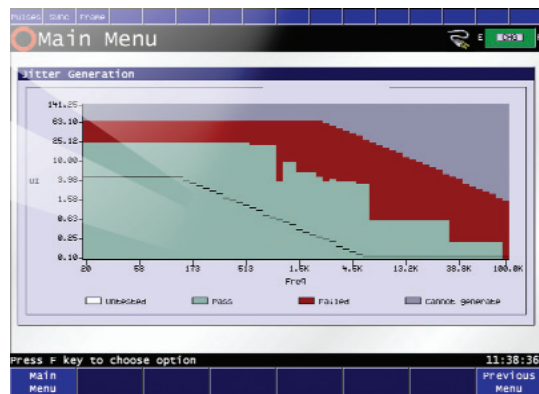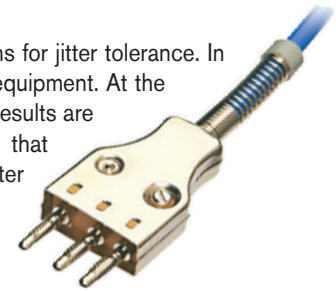
Jitter Measurement

The jitter measurement option is used for troubleshooting E1 links for timing and clock problems that may cause errors to occur. The Puma's display graphically shows the instantaneous amount of jitter over the preceding 60 seconds. From these measurements, histograms are built. Jitter measurements can be made while the link is live and in service by connecting to monitoring points on E1 equipment. Alternately, the Puma can terminate the line and measure the amount of jitter in an out-of-service fashion.

Example: Jitter measurement screen

Jitter Generation and Tolerance Testing

The Puma is able to graphically show that a piece of equipment meets the ITU-T recommendations for jitter tolerance. In this mode, the Puma generates a range of jittered test signals into the receiver on a piece of E1 equipment. At the same time, it evaluates the equipment's transmitted output for test pattern errors (BER). Pass/fail results are graphically displayed with the ITU-T mask superimposed. A manual mode can also be selected that allows a framed or unframed E1 test signal to be generated with a user-specified amount of jitter frequency and magnitude.

Example: Jitter tolerance screen

Datacom Analysis

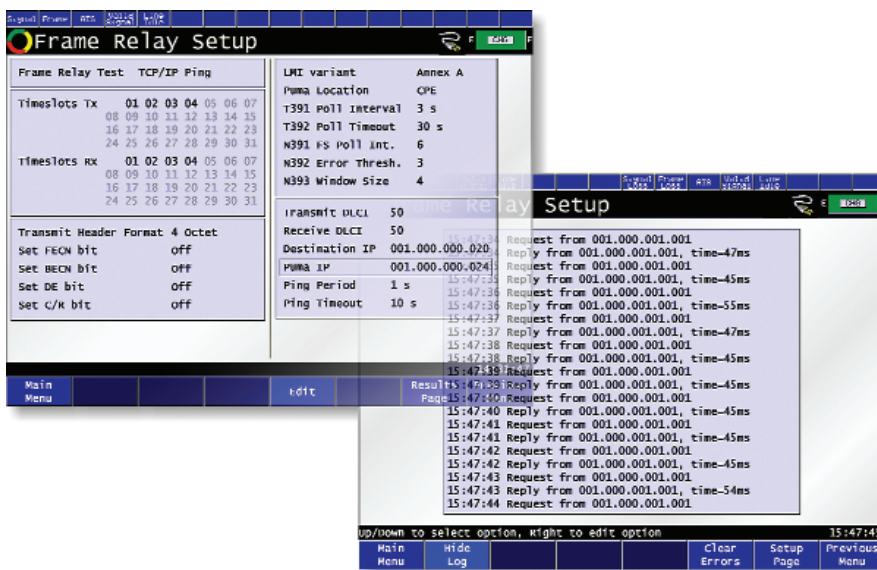## Verifying End-to-End Transmission

The data communications interfaces on the Puma 4000E series are menu-selectable as either DTE or DCE. The extensive range of patterns offered by the Puma 4000E series allows the network to work with existing test instruments. Using a Puma at each end of the circuit allows technicians to verify performance in both directions. The Puma 4000 records all relevant BERT results including G.821, G.826, and M.2100.

Loopback Testing

Loopback testing saves time and money. It enables installation and maintenance technicians to perform tests with just a single Puma. The user can initiate both local and remote loopbacks. Once established, bit error rate performance and other tests can be run.

Frame Relay Testing

Frame Relay links that are delivered via E1 or Datacom interfaces (such as V.35) are easily tested with the Puma 4000E Series. Fast frame relay connection confirmation tests, TCP/IP ping tests and end-to-end framed data tests can be performed. In addition, measurements of true committed information rate (CIR) throughput can be made. Frame relay forum (FRF), Annex A and Annex D variants are also supported. The Puma can function as NTE or CPE. For TCP/IP ping testing, both the Puma and remote IP addresses can be specified, as can the header sizes and CIR test packet size.
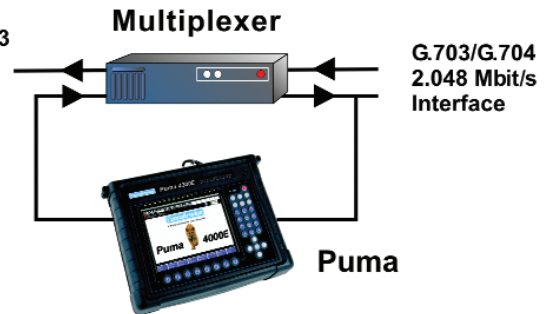

Example: TCP IP setup and IP ping result screens

Mux/Demux Testing

The Mux/Demux test mode allows in-service or out of service verification of primary multiplex or demulitplex functions to verify single or multiple time slot mappings of signals from tributary to aggregate. For Mux testing, a 64 kbit/s or n x 64 kbit/s BERT pattern signal can be generated from the sub E1 interface eg V.35 or X.21 and verified on the aggregate balanced or unbalanced 2.048 Mbit/s E1 interface, or visa versa for Demux testing.

2 Mbit/s multiplex analysis

HDSL Circuit Testing

These days, E1 services are often delivered using the more efficient coding technologies of HDSL. The Puma 4000E Series is used to perform the final installation and acceptance testing of E1 services that are delivered using HDSL, G.shdsl, SDSL, and other types of DSL.

As DSL technologies squeeze higher rate data over longer reach, it's vital to ensure that a stable E1 service is delivered. The Puma is used to perform BER tests that last anywhere from 15 minutes to several days. The Puma can determine once and for all if an intermittent E1 or data communications service exists.

The Puma 4000 Series is ideal for use in the field or in the lab

Custom Clocks

The Puma 4000E Series comes pre-programmed with user-selectable DTE/DCE clocks conforming to ITU-T recommendations; therefore no special knowledge or training is necessary to test standard systems. Where systems are configured to meet non-standard requirements, the Puma 4000E Series allows customization of clocking arrangements.

VT100 Terminal Emulation

The VT100 terminal emulation feature enables users to connect the Puma to RS232C/V.24 craft access ports on various types of network equipment. Using the Puma's integral keypad, users are able to navigate and select characters from a full virtual keyboard, thus allowing control messages to be composed and sent. The Puma's LCD screen displays any messages such as alarms, status and menu choices that are returned by the equipment.

DTMF/PULSE Call Set Up

The Puma 4000E can emulate a call set up sequence using the CAS bits in conjunction with DTMF or pulse dialing. The screen displays status and an event record. 'On hook' and 'Off hook' CAS patterns can be specified.
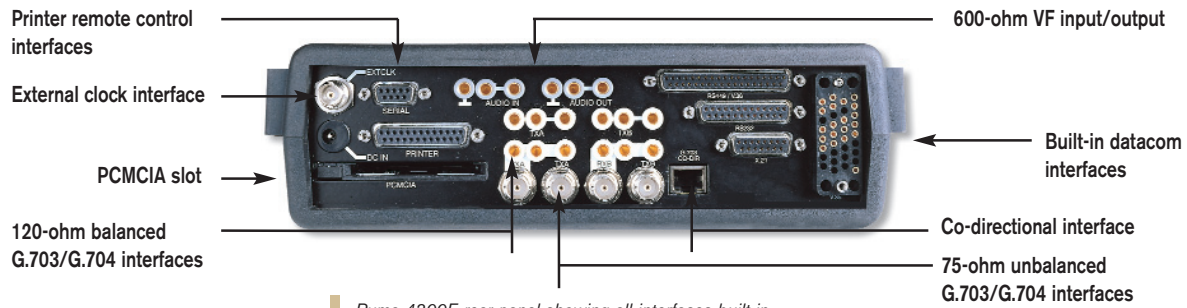
Feature Rich and Friendly

Every aspect of the Puma has been designed with intelligence. The optional, vivid full color or standard mono displays have exceptional resolution. Once the test mode is selected, the Puma reserves the upper portion of the display to provide labels for tri-colour LEDs that indicate the interface status. For example, if V.35 is selected, the display and LEDs will label and indicate the status of the V.35 interface pins irregardless of the current menu screen.

The Puma intelligently uses a set of icons to let the user know the status of the instrument such as the mains power being connected versus operation on internal battery power. Other icons indicate if the Puma's speaker is turned on or off. An intelligent "fuel gauge" shows how much time is left for battery operation. If the user selects a more power-hungry test, the battery's fuel gauge adjusts to the new current drain. These features and many more make the Puma the only choice for all of your E1 and datacom testing requirements.

Test Interfaces

The Puma 4000E Series offers unrivalled interface flexibility. Several models are available. The top of the line Puma 4300E comes complete with all commonly used telecom and datacom interfaces fully integrated into the design. This fully integrated approach does away with the need for special cables and cumbersome external adapters. The Puma is a truly complete and compact solution. The Puma 4000E Series of test instruments comes in a number of variants to meet your individual requirements and budget. Please refer to the Puma Series 4000E Options matrix (page 6) and Ordering matrix (back page) for more details.

Printer remote control interfaces
External clock interface
PCMCIA slot
120-ohm balanced G.703/G.704 interfaces

600-ohm VF input/output
Built-in datacom interfaces
Co-directional interface
75-ohm unbalanced G.703/G.704 interfaces

Puma 4300E rear panel showing all interfaces built-in

Remote Control with Puma-View Software

Technicians can use their notebook computers to run tests and store results with the Microsoft Windows based Puma-View software supplied by EXFO. This optional software application is a true MS Windows application that takes advantage of the graphical users interface, printer drivers, and the storage abilities provided by Microsoft operating systems.

Remote control with Puma-View software

Puma Services

Lifetime Software Updates

Specifications within the telecommunications industry are constantly changing. EXFO strives to ensure our software meets the current specifications and recommendations and offers free lifetime software updates. An update is a software enhancement, amendment or change that improves existing functionality. Please visit our website for more details.

Software upgrades where new functionality is made available are chargeable. Please refer to your local representative or service center for details.

Technical Support and Service

All portable test products are backed up with free-of-charge technical support for the life of the product. Please contact EXFO Europe at +44 2380 246 810 between the hours of 8:30 am and 5:15 pm GMT/BST Monday through Thursday, or between 8:30 am and 1:00 pm GMT/BST Friday.

Customers in the United States, Canada, Latin America, South America and Asia Pacific, please contact EXFO at 1-866-683-0155 from Monday through Friday between 8:00 am and 7:00 pm EST.

Warranty and Repair Service

Each test set is rigorously tested and calibrated to published and internationally traceable standards before they are shipped to you. All EXFO products carry a one-year parts and labor warranty. Extended warranty coverage packages are also available.

SPECIFICATIONS

	Puma 4200E	Puma 4220E	Puma 4300E	Puma 4340E	Puma 4400E
2 E1 interfaces 75-ohm (BNC)& 120-ohm (CF) transmitters & receivers	●		●		
2 E1 interfaces 75-ohm (BNC)& 120-ohm (RJ45) transmitters and receivers		single tx/rx only		single tx/rx only	●
G.703 Co-directional test interface	○	○	○	○	○
64 kbit/s Contra-directional testing					○
External clock	●		●		●
G.703 - 2 Mbit/s unframed testing	●	●	●	●	●
G.704 - 2.048 Mbit/s framed PCM-30/31/30C/31C	●	●	●	●	●
Framing analysis	●	●	●	●	●
m and n x 64 kbit/s testing	●	●	●	●	●
E1 line monitor with channel activity map	●	●	●	●	●
Alarm monitoring	●	●	●	●	●
Drop and insert BERT	●	●	●	●	●
Bi-directional drop and insert	●		●		●
CAS generation and monitoring	●	●	●	●	●
Internal clock, recovered clock	●	●	●	●	●
Auto-configure	●	●	●	●	●
Pulse mask/level analysis	○		○		○
Slips measurement	●		●		●
DTMF call setup	●	●	●	●	●
Mux/demux testing	●	●	●	●	●
Voice frequency testing	○	○	○	○	○
Built-in V.36/EIA-RS449 and EIA-530* sync interfaces to 10 Mbit/s (custom and ITU)			●		●
Built-in V.35, V.24 and X.21 sync interfaces			●	●	●
Clocking of V.35 to 10 Mbit/s (custom and ITU)			●	●	●
Clocking of V.24 to 10 Mbit/s (custom and ITU)			●	●	●
Clocking of X.21 to 10 Mbit/s (custom and ITU)			●	●	●
Built-in V.24 async testing to 460kbit/s			●	●	
TTL testing					○
Local and remote loops (Datacom)			●	●	●
Software-selectable DCE and DTE emulation			●	●	●
Extensive range of BERT patterns	●	●	●	●	●
G.821 result analysis	●	●	●	●	●
G.826 and M.2100 performance analysis	○	○	○	○	○
Histogram analysis display	●	●	●	●	●
Propagation delay measurement	●	●	●	●	●
Variable internal clock offset	●	●	●	●	●
Multilanguage support	●	●	●	●	●
Remote controllable	●	●	●	●	●
Test set-up and result storage	●	●	●	●	●
G.704 data link	●	●	●	●	●
Event logging	●	●	●	●	●
Serial parrallel printer support	●	serial	●	serial	●
PCMCIA card result storage	●		●		●
VT100 terminal emulator	●	●	●	●	●
ADSL modem testing			○	○	○
X.50 analysis			○	○	○
600ohm external audio (ip/op) connection	○		○	○	○
Frame relay turn-up testing	○	○	○	○	○
Dual BERT test (rackmount versions only)	○		○		○
Euro ISDN call setup and analysis	○	○	○	○	○
Monitor Euro ISDN (Q.931)	○		○		○
Monitor ISDN DASS II protocol	○		○		○
Monitor ISDN DPNSS	○		○		○
Monitor ISDN - Q.SIG	○		○		○
Monitor V5.1 & V.5.2	○		○		○
Jitter measurement	○	○	○	○	○
Jitter generation and tolerance test	○	○	○	○	○

ORDERING INFORMATION

The Puma 4000E is a series of products. The following chart lists available models and optional features at the time of printing; for more detailed information, see page 6. Please visit the EXFO website for announcements about future models and new options. For a price and delivery quotation, please contact your local EXFO representative.

Puma Variant	E1 Interfaces	Datacom Interfaces	G.703 Co-Directional	Rackmount Version
Puma 4220E	1	–	option	–
Puma 4200E	2	–	option	Yes
Puma 4340E	1	V24/V35/X21	option	–
Puma 4300E	2	V24/V35/X21/RS449	option	Yes
Puma 4400E	2	V24/V35/X21/RS449	option	–

For the Puma 4220E and 4340E variants, special packages tailored to the most common requirements are available that offer a price/performance advantage.

ACCESSORIES

Each Puma 4000 comes with an internal rechargeable NiMH battery pack, universal A.C. power adapter/battery charger and User's Guide. The following is a list of accessories that are available for the Puma.

Softpack carrying case. (Notebook Computer Style)

Detachable, fold-out stand

Small, battery-powered printer

PCMCIA memory card (4 MEG)

A variety of test cables

Hardpack carrying case

RELATED PRODUCTS

The EXFO Puma 4000A Series meets the North American and industry standard requirements of SONET STS-1, DS3, T1 and data communications testing.

Rugged Handheld Solutions

OPTICAL
- OTDRs
- OLTSs
- Power meters
- Light sources
- Talk sets

COPPER ACCESS
- ADSL/ADSL2+, SHDSL, VDSL test sets
- VoIP and IPTV test sets
- Ethernet test sets
- POTS test sets

Platform-Based Solutions

OPTICAL FIBER
- OTDRs
- OLTSs
- ORL meters
- Variable attenuators

DWDM TEST SYSTEMS
- OSAs
- PMD analyzers
- Chromatic dispersion analyzer

TRANSPORT AND DATACOM
- Next-generation SONET/SDH and OTN testers
- SONET/DSn (DS0 to OC-192) testers
- SDH/PDH (64 kbit/s to STM-64) testers
- T1/T3, E1 testers
- 10/100 Mbit/s and Gigabit Ethernet testers
- Fibre Channel testers
- 10 Gigabit Ethernet testers

EXFO Corporate Headquarters > 400 Godin Avenue, Quebec City (Quebec) G1M 2K2 CANADA | Tel.: 1 418 683-0211 | Fax: 1 418 683-2170 | info@EXFO.com

Toll-free: 1 800 663-3936 (USA and Canada) | www.EXFO.com

EXFO America	3701 Plano Parkway, Suite 160	Plano, TX 75075 USA	Tel.: 1 800 663-3936	Fax: 1 972 836-0164
EXFO Europe	Omega Enterprise Park, Electron Way	Chandlers Ford, Hampshire S053 4SE ENGLAND	Tel.: +44 2380 246810	Fax: +44 2380 246801
EXFO Asia	151 Chin Swee Road, #03-29 Manhattan House	SINGAPORE 169876	Tel.: +65 6333 8241	Fax: +65 6333 8242
EXFO China	No. 88 Fuhua, First Road, Central Tower, Room 801 Futian District	Shenzhen 518048, CHINA	Tel.: +86 (755) 8203 2300	Fax: +86 (755) 8203 2306
	Beijing New Century Hotel Office Tower, Room 1754-1755 No. 6 Southern Capital Gym Road	Beijing 100044 P. R. CHINA	Tel.: +86 (10) 6849 2738	Fax: +86 (10) 6849 2662

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In case of discrepancy, the Web version takes precedence over any printed literature.

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