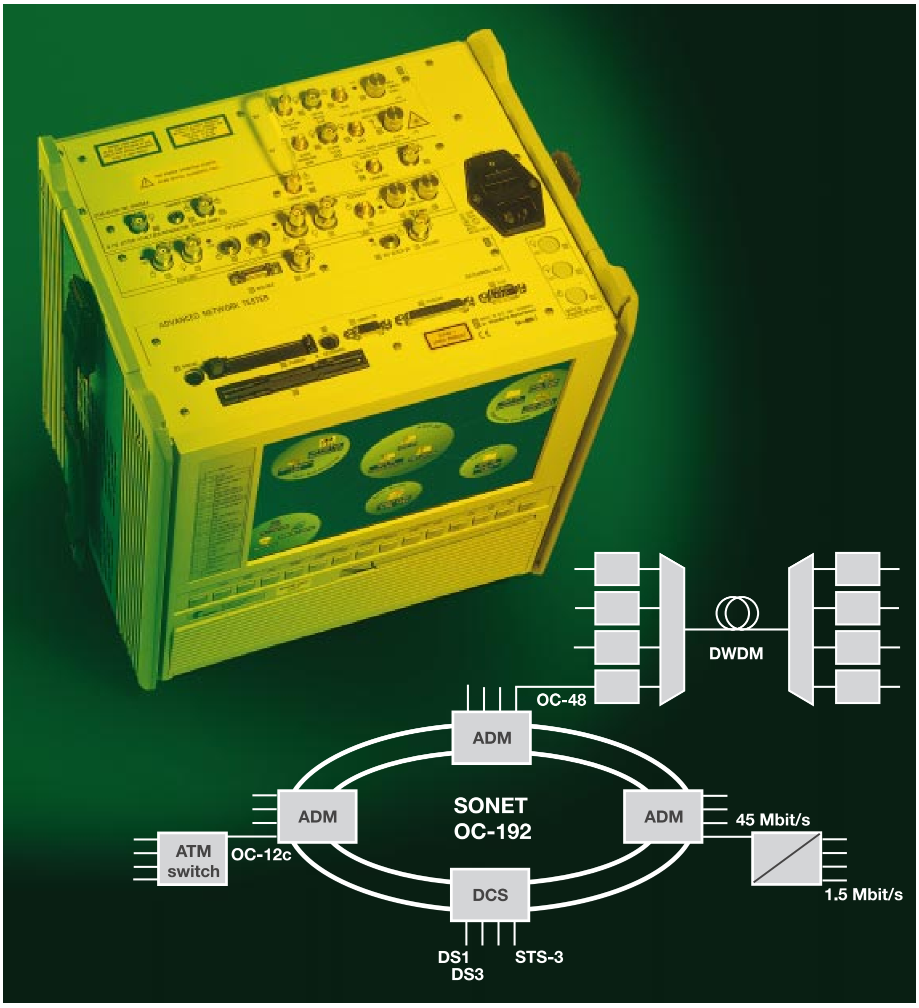
Acterna ANT-10Gig

Advanced Network Tester – SONET version



OC-192/STM-64

For analyzing digital communications systems

Optional:
Complete BERT solution
n × 64 kbit/s up to 10 Gbit/s

- ***OC-192 and STM-64 optical and electrical interface in a portable instrument***
- ***Jitter & Wander testing at 10 Gbit/s***
- ***Tributaries: STS-1 with all standard mappings, and STS-3c, STS-12c, STS-48c, STS-192c SPE, STM-4c, STM-16c, STM-64c***
- ***Access to all TOH/SOH bytes***
- ***Errors, alarms, pointers***
- ***Internal and external simulation and analysis of overhead bytes***
- ***BERT and V.11 interface for DCC***
- ***High output power 0 dBm***
- ***Receiver with optical power level display***

Edition: May 2001

Now with jitter testing at 10 Gbit/s and OC-192c

Realizing future trends

Recent years have been characterized by a dramatic increase in communications services using networks that are becoming more and more global. The Internet is a particularly high growth area. Two different technologies have developed side by side to handle the increased demand for bandwidth.

One is time-division multiplexing (TDM) of synchronous channels to give higher bit rates, the other is optical multiplexing of a large number of synchronous systems to be carried by a single fiber (DWDM). The basic idea behind both methods is to make the best possible use of available fiber capacity.

10 Gbit/s in a portable test solution

The ANT-10Gig is a subset of the ANT-20SE. It provides a unique, compact and convenient solution for OC-192/STM-64 including jitter and wander testing.

It can resolve signal structures right up to the OC-192/STM-64 level and analyze them down to 64 kbit/s. Access to all standardized mapping structures is possible, including mixed structures, e.g. DS1 in STM-1 or E1 in STS-1.

The ANT-10Gig also allows testing of all currently used concatenated signal structures up to OC-192c/STM-64c.

Configuration Guide ANT-10Gig

Section	Option	Order No.	
Mainframe page 3–10	**ANT-10Gig – SONET – Mainframe** includes OC-192, STS-3c, STS-12c, STS-48c and STS-192c BERT, STS-1 mappings, Extended overhead analysis	BN 3060/36	☐
SONET page 11	Electrical Interfaces at 10 Gbit/s*	BN 3060/91.48	☐
	Add SDH	BN 3060/90.04	☐
	Add BERT SDH only (interfaces 2/8/34/140 Mbit/s)	BN 3060/90.33	☐
	Drop & Insert/Through mode	BN 3060/90.10	☐
	Mux/Demux M13	BN 3060/90.12	☐
	Mux/Demux 64k/140M	BN 3060/90.11	☐
Optic page 12–14	OC-1/3, 1310 nm	BN 3060/91.01	☐
	OC-1/3, 1310/1550 nm	BN 3060/91.02	☐
	OC-1/3/12, 1310 nm	BN 3060/91.11	☐
	OC-1/3/12, 1310/1550 nm	BN 3060/91.12	☐
	OC-48, 1310 nm	BN 3060/91.51	☐
	OC-48, 1550 nm	BN 3060/91.50	☐
	OC-48, 1310/1550 nm	BN 3060/91.52	☐
	OC-1/3/12/48, 1310 nm Package	BN 3060/91.17	☐
	OC-1/3/12/48, 1550 nm Package	BN 3060/91.18	☐
	OC-1/3/12/48, 1310/1550 nm Package	BN 3060/91.19	☐
	OC-1/3/12, 1310 nm + OC-48, 1310/1550 nm Package	BN 3060/91.20	☐
	Optical Power Splitter	BN 3060/91.05	☐
CONCAT. page 13	OC-12c ATM	BN 3060/90.91	☐
	OC-12c Virtual Concatenation	BN 3060/90.92	☐
Jitter/ Wander page 15–20	Jitter/Wander up to 155 Mbit/s Package	BN 3060/91.30	☐
	Jitter/Wander up to 622 Mbit/s Package	BN 3060/91.31	☐
	Jitter at 10 Gbit/s	BN 3060/91.60	☐
	Wander Analyzer at 10 Gbit/s (requires BN 3060/91.60)	BN 3060/91.61	☐
	Wander Generator at 10 Gbit/s** (requires BN 3060/91.60, and either BN 3035/90.81 or BN 3060/91.30 or BN 3060/91.31)	BN 3060/91.62	☐
ATM page 21–26	ATM Basic (PVC)	BN 3060/90.50	☐
	ATM Comprehensive (PVC/SVC)	BN 3060/90.51	☐
	Add ATM SONET (mappings)	BN 3060/90.53	☐
	Add ATM SDH (mappings)	BN 3060/90.52	☐
AUTO page 27	Automatic Test Sequencer CATS BASIC	BN 3035/95.90	☐
	Automatic Test Sequencer CATS PROFESSIONAL	BN 3035/95.95	☐
Remote page 27	V.24/RS 232 Remote Control Interface	BN 3035/91.01	☐
	GPIB/IEEE Remote Control Interface	BN 3035/92.10	☐
	TCP/IP Remote Control Interface	BN 3035/92.11	☐
	Remote Operation	BN 3035/95.30	☐

* This option must be ordered with the mainframe as a subsequent upgrade is not possible
** Please note that the options STM-16/OC-48 and Wander Generator at 10 Gbit/s are mutually exclusive.

Specifications

ANT-10Gig (Mainframe)

The ANT-10Gig Mainframe includes:

- Mainframe, touchscreen
- OC-192 with mappings STS-1, STS-3c, STS-12c, STS-48c and STS-192c SPE BERT
- STM-64 with mappings STM-4c, STM-16c and STM-64c BERT
- Mappings for STS-1 : DS1, DS2, E1, DS3
- Electrical Interfaces: STS-1, STS-3c, DS1, DS3
- Ringtesting: OH Capture and APS
- Two optical adaptors to be selected
- Ethernet and USB interface

Generator OC-192

The transmitter of the optical interface meets the specification of Telcordia GR-1377 (Table 4-4, 4-5, 4-6) Parameter: SR-2, LR-2 (a&c), IR-2, IR-3 and ITU-T G.691 (Table 5A, 5B) Application code: S-64.2b, S-64.3b, S-64.5b and I-64.2r, I-64.2, I-64.3, I-64.5, S-64.3a, S-64.5a with additional optical attenuator 1 to 3 dB.

Optical interface

Wavelength . . . . 1550 nm
Output level . . . . 0 dBm ±1 dB
Line code . . . . scrambled NRZ

Clock generator

Internal, accuracy . . . . ±2 ppm
Offset. . . . . ±50 ppm
Synchronization from external signal

Generation of OC-192 signal

Compliant to Telcordia GR-253:
One test channel STS-1 SPE with standard mappings or STS-12c BERT or STS-48c BERT, others unequipped or same as test channel.
Additionally generation of STM-64 signal compliant to ITU-T G.707:
One test channel STM-4c BERT or STM-16c BERT, others unequipped or same as test channel

Contents of OC-192 overhead bytes

For all bytes
except B1, B2, H1 to H3 . . . . statically programmable
For bytes E1, E2, F1, D1 to D3 and D4 to D12. . . . . test pattern
external data via V.11
For bytes K1, K2 . . . . external data via V.11
For J0 byte . . . . 16 byte sequence ASCII with CRC

Byte sequence m in n in p for bytes of first 48 STS1 TOH

m times (1 to 2 000 000 000) byte A
followed by n times (1 to 2 000 000 000) byte B
sequence repetition p (1 to 65 000)

Error insertion

Error types B1, B2, REI-L . . . . single and rate
Burst errors: m anonalies in n periods . . . . $m = 1$ to 4.8×10^6
and $n = 2$ to 8001 frames or 0.2 s to 600 s

Alarm generation

Alarm types
LOS, LOF, AIS-L, RDI-L, TIM-S . . . . on/off

Dynamic alarms m alarms in n frames

LOF, AIS-L, RDI-L . . . . $m = 1$ to $n-1$, $n_{max} = 8000$
or active = 0 to 60 s, passive = 0 to 600 s

Generator clock [102]

Output voltage (peak-peak) . . . . 250 mV
Connector/Impedance . . . . SMA/50 Ω

Frame trigger [100]

Output voltage (open circuit) . . . . CMOS
Connector/Impedance . . . . BNC/approx. 50 Ω

Analyzer OC-192

The receiver of the optical interface meets the specification of Telcordia GR-1377 (Table 4-4, 4-5) Parameter: SR-2, IR-2, IR-3 and ITU-T G.691 (Table 5A, 5B) Application code: S-64.2b, S-64.3b, S-64.5b, I-64.2r, I-64.2, I-64.3, I-64.5

Optical interface

Wavelength . . . . 1520 to 1580 nm
Sensitivity . . . . –15 to 0 dBm
Line code . . . . scrambled NRZ
Display of optical input level . . . . –15 to –8 dBm
Offset range . . . . ±500 ppm

Demultiplexing of OC-192 signal

Compliant to Telcordia GR-253:
Evaluation of one selectable channel STS-1 SPE down to the mapped tributary or STS-12c SPE or STS-48c SPE.
Additionally demultiplexing of STM-64 signal compliant to ITU-T G.707:
Evaluation to one selectable channel STM-4c or STM-16c.

Generator Unit DSn/SONET

Digital outputs

Interfaces to Telcordia GR-253, TR-TSY-000499, ANSI T1.102

75 Ω coaxial output, adapter jack selectable from Versacon 9 adapter system
Bit rates and line codes

- DS1 . . . . 1544 kbit/s; B8ZS, AMI, CMI
- DS2 . . . . 6312 kbit/s; B8ZS, CMI
- DS3 . . . . 44 736 kbit/s; B3ZS, CMI
- STS-1 . . . . 51 840 kbit/s; B3ZS, CMI
- STS-3 . . . . 155 520 kbit/s; CMI

100 Ω balanced output, Bantam jack
Bit rate and line codes

- DS1 . . . . 1544 kbit/s; B8ZS, AMI, CMI

Output pulses

- DS1 . . . . DSX-1 compatible
- DS2 . . . . rectangular
- DS3, STS-1 . . . . HIGH, LOW, DSX-3

Bit rate offset. . . . . ±500 ppm
Step size . . . . 0.001 ppm

Clock

Internal clock generation
at all of the bit rates listed above.
Clock stability. . . . . ±2 ppm

Synchronization to external signals
via 100 Ω balanced input, Bantam jack:

- Reference clock . . . . 1544 kHz and 2048 kHz
- 1544 kbit/s (B8ZS), 2048 kbit/s (HDB)

or

- Receive signal

Clock outputs

- Clock output at frequency of generator signal, approx. 400 mV (when terminated into 75 Ω), BNC jack.

STS-1 and STS-3 output signal

Generation of a STS-3/STS-1 signal conforming to Telcordia GR-253, ANSI T1.105
The STS-3 signal consists of one internal STS-1 tributary signal with the remaining two tributaries filled with UNEQ.
The STS-1 signal consists of one selectable mapping.

Content of the selected tributary:

- Framed or unframed DS1, DS3 or E1 test pattern
- M13 multiplex signal (with M13 MUX/DEMUX option)
- External DS1, DS3 or E1 signal (with D&I option)
- Test pattern without stuffing bits (bulk signal to O.181)

Content of non-selected tributaries. . . . . framed PRBS $2^{11}-1$
The various mappings are described along with the options.

STS-1 mappings

VT1.5 SPE mapping

DS1 in STS-1
Modes . . . . asynchronous, byte synchronous (floating)

VT6 SPE mapping

(6 Mbit/s unframed/Bulk in STS-1)

STS-1 SPE mapping

DS3 in STS-1

VT2 SPE mapping

E1 in STS-1
Modes . . . . asynchronous, byte synchronous (floating)

STS-3 mapping

BERT in STS-3c (and 140 Mbit/s in STM-1)

Generation of pointer actions (Figure 2)

Generation of pointer actions at the STS-1 and VT levels simultaneously.

- Pointer sequences to T1.105.03 with programmable spacing
- Pointer increment/decrement (continuously repeated)
- Single pointer
- Pointer value setting with or without NDF

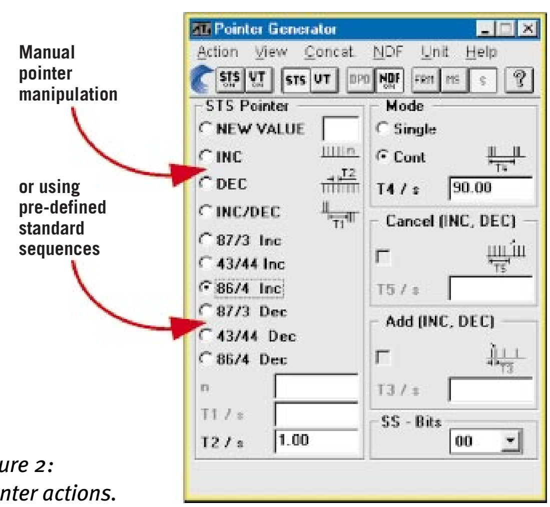


Figure 2:
Pointer actions.

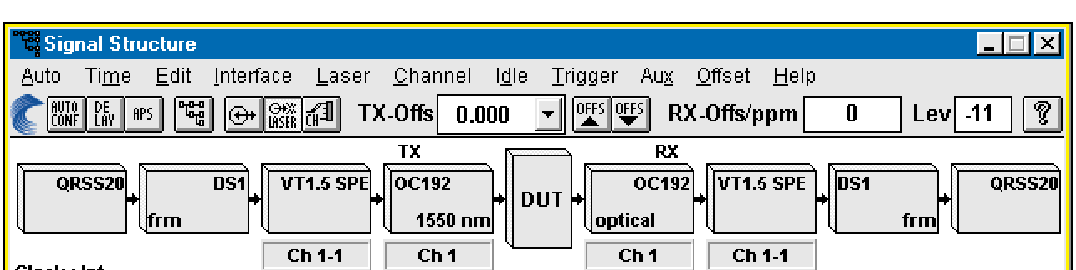


Figure 1:
Signal structure.

Content of TOH and POH bytes

The content of all bytes with the exception of B1/B2/B3 and H1 to H4 is programmable with any byte or a user defined byte-sequence p in m in n (p frames in m frames and the entire sequence repeated n times) can be inserted.
Bytes E1, E2, F1, F2, and byte groups D1 to D3 and D4 to D12:
- Transmission of a PRBS with bit error insertion (selectable in signal structure)
- Insertion of an external data signal (via V.11 interface; also for K1 and K2)

Trace identifier

J0, J1, J2 . . . . programmable 16 byte ASCII sequence with CRC
J1, J2, additionally . . . . programmable 64 byte ASCII sequence

H4 byte . . . . 4 or 48 byte sequence

Error insertion

Error types . . . . B1, B2, B3, BIP-V parity errors, frame errors, REI-L, REI-P, REI-V, bit errors in test pattern, BPV (single errors)
Triggering
Single error or error ratio . . . . 2×10^{-3} to 1×10^{-10}
for B1, B3, REI-P, REI-V . . . . 2×10^{-4} to 1×10^{-10}
for bit errors . . . . 1×10^{-2} to 1×10^{-10}

Step size for mantissa and exponent 1
Burst error: m anomalies in n periods
For FAS, B1, B2, B3, REI-L, REI-P . . . . $m = 1$ to 4.8×10^6 and $n = 2$ to 8001 frames or 0.2 s to 600 s

Alarm generation

Dynamic
Alarm types . . . . LOF, AIS-L, RDI-L, LOP-P, AIS-P UNEQ-P, RDI-P, RDIEPP, RDIEPS, RDIEPC, PDI-P, LOP-V, AIS-V, LOM, UNEQ-V, RDI-V, RDIEVP, RDIEVS, RDIEVC, RFI-V, PDI-V
m alarms in n frames . . . . $m = 1$ to $n-1$, $n_{max} = 8000$
or
t1 alarm active,
t2 alarm passive . . . . t1 = 0 to 60 s, t2 = 0 to 600 s

Static (on/off)
Alarm types . . . . LOS, LOF, AIS-L, TIM-L, RDI-L, LOP-P, AIS-P, UNEQ-P, PLM-P, TIM-P, RDI-P, RDIEPP, RDIEPS, RDIEPC, PDI-P LOP-V, AIS-V, LOM, UNEQ-V, PLM-V, TIM-V, RDI-V, RDIEVP, RDIEVS, RDIEVC, RFI-V

DS1, DS2 and DS3 output signals

Signal structures
- Unframed test pattern
- Framed test pattern (only DS1, DS3)
  DS1 frame structure . . . . SF, ESF
  DS3 frame structure . . . . M13, C parity

Error insertion
Bit errors in test pattern . . . . error rate, single error
BPV . . . . single error
DS1 F bit (LOF) . . . . single error, 2 in 4, 2 in 5, 2 in 6
CRC-6 (ESF) . . . . single error, error rate
DS3 F bit (LOF) . . . . single error, 2 in 2, 2 in 3, 3 in 3, 3 in 15, 3 in 16, 3 in 17
P parity, CP parity, FEBE . . . . single error, error rate
Error rate . . . . 1×10^{-2} to 1×10^{-9}

Alarm insertion
DS1 . . . . LOF, AIS, YELLOW
DS3 . . . . LOF, AIS, YELLOW, IDLE, FEAC

FEAC Far-End Alarm and Control Signals

To test that FEAC alarm and status information is correctly transmitted, the relevant signal codes can be selected and inserted into the DS3 C-bit frame format.

Test patterns

Pseudo-random bit sequences
PRBS: 2^{11}–1, 2^{15}–1, 2^{20}–1, QRSS 20, 2^{11}–1 inv., 2^{15}–1 inv., 2^{20}–1 inv., 2^{23}–1 inv., 2^{31}–1, 2^{31}–1 inv. for OC-12c and OC-48c

Programmable word
Length . . . . 16 bits

Receiver Unit DSn/SONET

Digital inputs

Interfaces to . . . . Telcordia GR-253, TR-TSY-000499, ANSI T1.102
75 Ω coaxial input; adapter jack selectable from Versacon 9 adapter system
Bit rates and line codes
  DS1 . . . . 1544 kbit/s; B8ZS, AMI, CMI
  DS2 . . . . 6312 kbit/s; B8ZS, CMI
  DS3 . . . . 44 736 kbit/s; B3ZS, CMI
  STS-1 . . . . 51 840 kbit/s; B3ZS, CMI
  STS-3 . . . . 155 520 kbit/s; CMI

100 Ω balanced input, Bantam jack
Bit rate and line codes
  DS1 . . . . 1544 kbit/s; B8ZS, AMI, CMI
Input levels
  DS1 . . . . DSX-1 compatible
  DS3, STS-1 . . . . HIGH, LOW, DSX-3
Clock recovery pulling range . . . . ±500 ppm

Selectable input gain, CMI coded . . . . 15 to 23 dB
  B3ZS, B8ZS, HDB3, AMI coded . . . . 15 to 26 dB
Selectable adaptive equalizers for DS3, STS-1 . . . . 450 ft
  DS1 . . . . 1310 ft

Monitor input for STS-3 and STS-12 NRZ signals
See ANT-10Gig Optical Interfaces data sheet for details.

STS-1, STS-3, DS1 and DS3 receive signals

Signal structures as for generator unit

Trigger output

75 Ω BNC connector, HCMOS signal level
Pulse output for received bit errors, transmit frame trigger, transmit pattern trigger or 2048 kHz reference clock.

Concatenated Mappings

OC-12c/STM-4c BERT

Contiguous concatenation signal structure to ANSI T1.105.02 and G.707.

Error measurement to O.150
Test pattern PRBS-31, IPRBS-31, PRBS-23, IPRBS-23, PRBS-20, PRBS-15, IPRBS-15

Programmable word
Length .... 16 bits

Error insertion
Bit errors in test pattern, single error or
error ratio .... 1×10^{-2} to 1×10^{-9}

Error measurement and alarm detection
Bit errors and AIS in test pattern

OC-48c/STM-16c BERT

Contiguous concatenation signal structure to ANSI T1.105.02 and G.707.

Error measurement to O.150
Test pattern PRBS-31, IPRBS-31 PRBS-23, IPRBS-23

Programmable word
Length... 16 bits

Error insertion
Bit errors in test pattern, single error or
error ratio .... 1×10^{-3} to 1×10^{-9}

Alarm generation:
AU-AIS, AIS-C1...AIS-C16,
AU-LOP, LOP-C1...LOP-C16

Error measurement and alarm detection:
AU-AIS, AU-LOP
Bit errors

Automatic Protection Switching
Sensor: MS-AIS, AU-AIS

OC-192c/STM-64c BERT

Contiguous concatenation signal structure to ANSI T1.105.02 and G.707.

Error measurement to O.150
Test pattern PRBS-31, IPRBS-31

Programmable word
Length... 16 bits

Error insertion
Bit errors in test pattern, single error or
error ratio .... 1×10^{-3} to 1×10^{-9}

Alarm generation .... AU-AIS, AU-LOP

Error measurement and alarm detection
AU-AIS, AU-LOP
Bit errors

Automatic Modes

Autoconfiguration

Automatically sets the ANT-10Gig to the input signal. The routine searches at the electrical and optical interfaces for the presence of standard asynchronous and STS-N/OC-N signals (GR-253, ANSI T1.102) and the payload contents in channel 1.

Automatic SCAN function

The SCAN function permits sequential testing of all VT1.5 or VT2 channels in a SONET signal. The ANT-10Gig receiver checks for alarms in the receive signal, the SONET structure and all channels and for synchronization of the selected test pattern in all channels. The results (OK/not OK) for each channel are entered in a matrix. The generator runs simultaneously and can be used to stimulate the device under test.

Automatic TROUBLE SCAN function (Figure 3)

The TROUBLE SCAN function permits sequential testing of all VT1.5 or VT2 channels in a SONET signal. The ANT-10Gig receiver checks for alarms in the receive signal, the SONET structure and all channels. The results (OK/not OK) for each channel are entered in a matrix. A detailed alarm history can be displayed by selecting a channel from the matrix. Only the receive channels are altered during a TROUBLE SCAN.

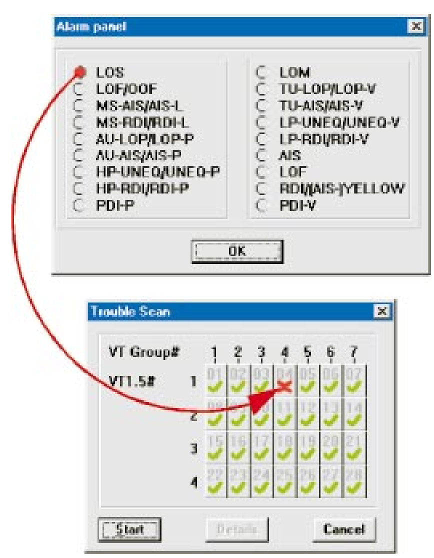


Figure 3: Trouble scan.

Automatic SEARCH function

Channel shifts in the payload may occur when measuring complex network elements, depending on the configuration of the device under test. The SEARCH function permits rapid automatic location of the test channel (VT1.5 or VT2 with defined PRBS) in the payload of a SONET signal. The ANT-10Gig receiver checks for alarms in the receive signal, the SONET structure and all channels and for synchronization of the selected test pattern in all channels. The results (OK/not OK) for each channel are entered in a matrix. An OK result indicates that the corresponding channel contains the signal searched for. Only the receive channels are altered during a SEARCH.

AutoScan function (Figure 4)

This automatic "AutoScan" function allows you to rapidly check the signal structure, the mapping used and the payload – even with mixed mapped signals.
The ANT-10Gig receiver analyzes the incoming received signal and provides a clear overview of all the signals present in the composite receive signal. The variable scan depth setting allows even complex signal structures to be resolved and displayed clearly. Even Trace Identifiers are evaluated. All the displayed results can be printed out.

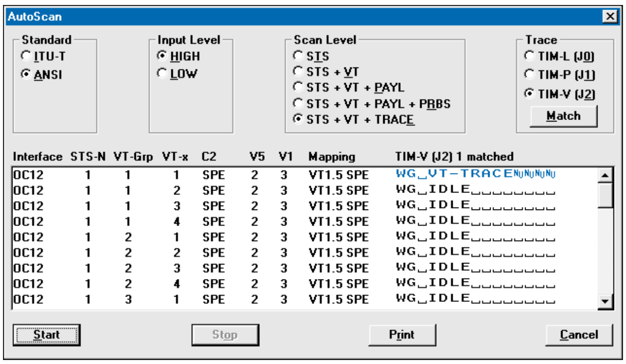


Figure 4: AutoScan.

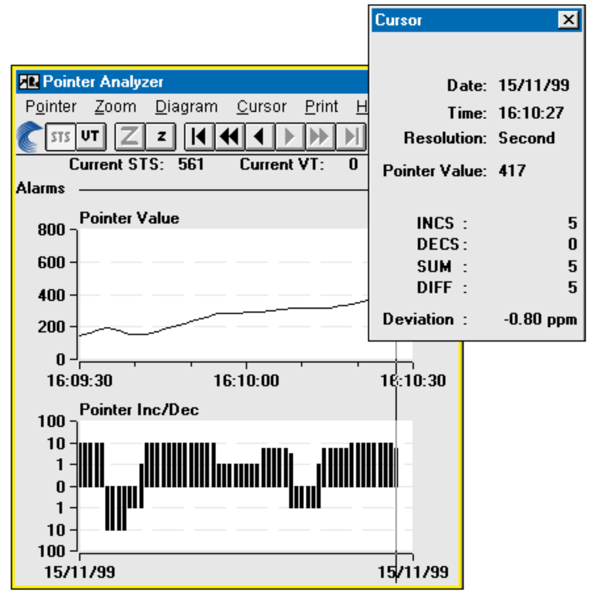


Figure 5: Graphic pointers. Display showing additional evaluation of cursor position.

Measurement Types

Error measurements

Error types . . . . B1, B2, B3, BIP-V parity errors
frame errors, REI-L, REI-P, REI-V, bit errors in test pattern, BPV

Additionally, for
DS1 . . . . CRC errors
DS3 . . . . P-parity errors, CP-parity errors, FEBE

Error Count, Error Rate, Intermediate Errors

Performance analysis

ES, SES, EFS, SEFS, UAS are evaluated

In-Service Measurements (ISM)
Simultaneous ISM of the near-end and far-end of a selected path
– Near-end . . . . B1, B2, B3, BIP-V, CRC-6
– Far-end . . . . REI-L, REI-P, REI-V

DS1, DS3 events . . . . F bit, parity, FEBE, C parity

Out-of-Service measurements (OOS)
OOS evaluation using bit errors in test pattern

Analysis of STS-1 and VT pointer actions (Figure 5)

Display of
– Number of pointer operations: Increment, Decrement,
Sum (Increment + Decrement),
Difference (Increment – Decrement)
– Pointer value

Clock frequency measurement

The deviation of the input signal clock frequency from the nominal frequency is displayed in ppm.

Delay measurement

Delay measurements are used for aligning satellite hops and testing the maximum permitted delay times for storage exchange and cross-connect systems and for checking the loop circuits in regenerators.
The ANT-10Gig measures the time taken to transmit the test pattern from the generator through the section under test and back to the receiver. The measurement is made on the test patterns in a selected channel, or in the tributaries (SONET; bulk signal or asynchronous), or on the selected channel of the lowest hierarchy level of asynchronous multiplex systems.
To avoid ambiguities in the measurement, two measurement times are provided.

Measurement range
Bit rates from 34 to 155 Mbit/s . . . . 1 µs to 1 s
Bit rate 1.5 Mbit/s . . . . 10 µs to 5 s

Alarm detection

All alarms are evaluated and displayed in parallel
Alarm types . . . . LOS, OOF, LOF
Additionally, for STS . . . . AIS-L, RDI-L, AIS-P, LOP-P,
NDF-P, RDI-P, UNEQ-P, TIM-P, PLM-P
LOP-V, AIS-V, LOM, UNEQ-V, PLM-V, TIM-V, RDI-V,
NDF-V, RDIEVP, RDIEVS, RDIEVC, RFI-V
Additionally, for DS1, DS3 . . . . LSS, AIS, RAI (YELLOW),
IDLE (DS3), FEAC (DS3)

Measurement interval

Variable . . . . 1 second to 99 days
Measurement start . . . . manual or automatic timer
(user setting)
Measurement stop . . . . manual or automatic timer
(user setting)

Memory for errors, pointer operations and alarms

Resolution of error events and pointers . . . . 1 s
Alarm resolution . . . . 100 ms

TOH and POH evaluation

Display of complete TOH and POH, e.g. interpretation of APS information in K1 and K2

For the bytes E1, E2, F1, F2 and byte groups D1 to D3 and D4 to D12:
- BERT using test pattern from the generator unit
- Output of the data signal via the V.11 interface (also for K1, K2)

For the Trace Identifiers
J0 . . . . display of 1 byte or 16-byte ASCII sequence
J1, J2 . . . . display of 16 or 64-byte ASCII sequence

Ring testing – Byte capture TOH and POH

To analyze the TOH/POH functions, it is necessary to capture individual bytes vs. time, allowing detection of errors or short-term changes with frame-level precision.
The Capture function is started by a selectable trigger. Values for a selected byte are stored and can be accessed subsequently in a table of values.
Particularly in capturing the **APS sequences,** the bytes (K1, K2) are displayed as an abbreviation of the standard commands.
The function also allows recording of the N1 or N2 bytes for evaluation of **"Tandem Connection"** information.
H4 sequences can also be analyzed very easily.
The results can be printed or exported.

Capture bytes for
STS-1/3/3c, el. & opt. . . . . all TOH/POH bytes
OC-N, el. & opt. . . . . all TOH/POH bytes, except A1, A2, B1

Storage depth for
a byte 266
K1, K2 200
Trigger events . . . . AIS-L, AIS-V, AIS-P, RDI-L, LOP-P, editable value in trigger byte
Capture resolution . . . . frame precision

Ring testing – APS time measurement

In synchronous networks, a defined maximum switch-over time is necessary for the traffic in case of a fault.
To verify compliance with this requirement, the ANT-10Gig measures the switch-over time with 1 ms resolution.
The result can be printed.

Criteria for the
time measurement . . . . AIS-L, AIS-V, AIS-P, bit error
Max. measurement time . . . . 2 s
Resolution . . . . 1 ms
Allowable error rate for user signal . . . . $< 2 \times 10^{-4}$

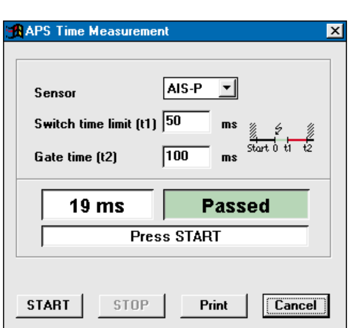


Figure 6: APS time measurement.

Result Display and Instrument Operation

Numerical display
Display of absolute and relative values for all error types
Intermediate results . . . . every 1 s to 99 min

Graphical display (histogram) (Figure 7)
Display of errors, pointer operations/values and alarms as bargraphs vs. time
Units, time axis . . . . seconds, minutes, 15 minutes, hours, days

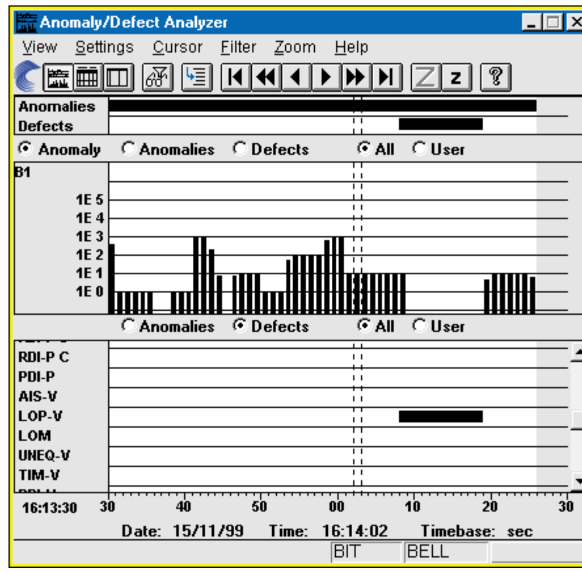


Figure 7: Histogram results display

Tabular display
Display of all alarm and error events with time stamp

Result printout
ANT-10Gig supports a variety of dot-matrix, inkjet and laser printers (Windows Print Manager)

Printer interfaces
Serial V.24/RS232
Parallel . . . . Centronics/EPP/IEEE P 1284

Result export
Results are stored in a database and can be processed using standard PC software

Instrument operation
ANT-10Gig is operated using the standard Microsoft® Windows™ graphical user interface. Operation is menu-controlled using the trackball or optional touchscreen. A mouse can also be connected if desired.

Application selection and storage
ANT-10Gig includes an applications library to which customer-specific applications can be added.
All applications are stored internally and can be copied to any other ANT-10Gig via floppy disk.
Easy to use filter functions allow quick selection of the desired application.

Touchscreen Display

Color TFT screen . . . . 10.4″, 256 colors
Resolution . . . . 640 × 480 pixels (VGA standard)
The touchscreen allows very easy point and shoot operation.

Built-in PC

ANT-10Gig uses a Pentium PC as internal controller so that standard PC applications can also be run on the instrument.
RAM capacity . . . . 64 MB
LS 120 drive . . . . 3.5″, 120 MB
Hard disk drive . . . . 6 GB
USB Interface, 10/100 Mbit/s Ethernet interface are included

Keyboard

Full keyboard for text input, extended PC applications and future requirements. The keyboard is protected by a fold back cover.
An additional connector is provided for a standard PC keyboard.

External display connector

Simultaneous display with built-in screen
Interface . . . . VGA standard

PCMCIA interface

Type . . . . PCMCIA 2.1 types I, II and III
The PCMCIA interface provides acces to GPIB, LANs, etc., via adapter cards.

Power outage function

In the event of an AC line power failure during a measurement, ANT-10Gig saves all data. As soon as the AC line voltage is re-established, the measurement is resumed. Previous results are retained and the time of the power failure is recorded along with other events.

General specifications

Power supply (nominal range of use)

AC line voltage . . . . 100 to 127 V and 220 to 240 V
AC line frequency . . . . 50/60 Hz
Power consumption (all options fitted) . . . . max. 230 VA
Safety class to IEC 1010-1 . . . . class I

Ambient temperature

Nominal range of use . . . . 41 °F to 104 °F (+5 °C to +40 °C)
Storage and transport range. . . . . . . −4 °F to 158 °F (−20 °C to +70 °C)

Dimensions (w × h × d) in mm . . . . approx. 320 × 350 × 280
in inches . . . . approx. 12.6 × 13.8 × 11

Weight . . . . approx. 15 kg / 33 lb

Options

Electrical interfaces at 9953 Mbit/s BN 3060/91.48

This option must be ordered with the mainframe as a subsequent upgrade is not possible.

Generator unit

Output level (peak-peak) ... 400 to 600 mV
Connector/impedance ... SMA/50 Ω

Receiver unit

Input level (peak-peak) ... 100 to 600 mV
Connector/impedance ... SMA/50 Ω

Clock

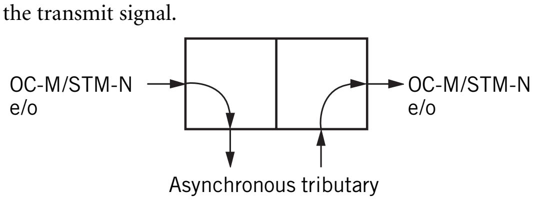
Frequency ... 9953.28 MHz
Tx output level (peak-peak) ... ≥ 50 mV
Rx output level (peak-peak) ... ≥ 70 mV
Connector/impedance ... SMA/50 Ω

Drop & Insert BN 3060/90.10

This option provides the following functions:

1. Generator and receiver operate independently

as mapper and demapper. The DS1/DS3 signal from a selected channel is dropped from the receive signal and output to a connector. An external or internal DS1/DS3 signal is inserted into the transmit signal.



2. Through mode with jitter injection, error insertion and overwriting of TOH bytes:

The received signal is looped through the ANT-10Gig and re-transmitted (generator and receiver coupled). The looped-through synchronous signal can be manipulated if required:

- Overwriting bytes in the TOH (except B1, B2, H1 to H3)
- Overwriting of B3 byte at 10 Gbit/s
- Anomaly insertion
- Defect generation by programming the TOH
- Jitter injection (Jitter options requires)

3. Block and Replace (B&R)

For this function, the ANT-10Gig is looped into the working fiber of a ring. B&R allows replacement of a synchronous tributary (e.g. STS-1 including TOH, POH and payload) in a OC-N signal. This can then be measured by the ANT-10Gig from the ring. By inserting specific errors, the error thresholds of the APS mechanism in the system can be tested.

M13 MUX/DEMUX chain BN 3060/90.12

M13 multiplexers are used in North America in hybrid networks and synchronous system cross-connects.
This option provides n × DS0 to DS3 multiplex and demultiplex functions. The output signal is fed to the electrical interface and is available as payload in mappings. Alarms and errors can be generated and analyzed.

For further details, refer to the M13 Multiplex/Demultiplex data sheet.

64k/140M MUX/DEMUX chain BN 3060/90.11

This option provides n × 64 kbit/s to 140 Mbit/s multiplex and demultiplex functions. The output signal is fed to the electrical interface and is available as payload in mappings (requires option “Add SDH” BN 3060/90.04). Alarms and errors can be generated and analyzed.

For further details, refer to the 64k/140M Multiplex/Demultiplex data sheet.

Add SDH BN 3060/90.04

C12 mapping (2 Mbit/s in STM-1, AU-3/AU-4)

Modes ... asynchronous, byte synchronous (floating)
Error insertion and measurement
Additional error types ... BIP2 parity errors, LP-REI

Alarm generation, dynamic

Alarm types ... TU-LOP, TU-AIS, TU-LOM, LP-UNEQ, LP-RDI, LP-RDIEP, LP-RDIES, LP-RDIEC, LP-RFI
m alarms in n frames ... m = 1 to n–1, n_{max} = 8000
or
t1 alarm active,
t2 alarm passive ... t1 = 0 to 60 s, t2 = 0 to 600 s

Alarm generation, static (on/off) and evaluation

Alarm types ... TU-LOP, TU-AIS, TU-LOM, LP-UNEQ, LP-PLM, LP-TIM, LP-RDI, LP-RDIEP, LP-RDIES, LP-RDIEC, LP-RFI
Alarm detection only ... TU-NDF

C3 mapping (34 Mbit/s in STM-1, AU-3/AU-4)

Error insertion and measurement
Additional error types ... LP-B3, LP-REI

Alarm generation, dynamic

Alarm types ... TU-LOP, TU-AIS, LP-UNEQ, LP-RDI, LP-RDIEP, LP-RDIES, LP-RDIEC, LP-RFI
m alarms in n frames ... m = 1 to n–1, n_{max} = 8000
or
t1 alarm active,
t2 alarm passive ... t1 = 0 to 60 s, t2 = 0 to 600 s

Alarm generation, static (on/off) and evaluation

Alarm types ... TU-LOP, TU-AIS, LP-UNEQ, LP-PLM, LP-TIM, LP-RDI, LP-RDIEP, LP-RDIES, LP-RDIEC, LP-RFI
Alarm detection only ... TU-NDF

C11 mapping (1.5 Mbit/s in STM-1, AU-3/AU-4)

Selectable via TU-11 or TU-12
Errors and alarms as for C12 mapping

C3 mapping (45 Mbit/s in STM-1, AU-3/AU-4)

Errors and alarms as for C3 mapping

C2 mapping (6 Mbit/s unframed/Bulk in STM-1)

BERT (2, 8, 34, 140 Mbit/s)

Signal structure and interfaces for generator and receiver:
Framed and unframed test patterns
Additionally, for coaxial input/output
Bit rate, line code ... 2048, 8448, 34 368 kbit/s, HDB3
Bit rate, line code ... 139 264 kbit/s, CMI
Additionally, for balanced input/output
Bit rate, line code ... 2048 kbit/s, HDB3

Optical Options

All the optical interfaces are intended for single-mode fibers. Acterna offers a complete line of optical test adapters. Select one test adapter each for the generator and receiver from the ordering information in this data sheet. In addition to 10 Gbit/s, ANT-10Gig provides all optical interfaces from OC-1/STM-0 to OC-48/STM-16. This includes SDH and SONET signal generation, error and alarm insertion, and TOH/SOH manipulation.

Optical Modules up to 155 Mbit/s

Optical OC-1/3, STM-0/1, 1310 nm BN 3060/91.01

Optical OC-1/3, STM-0/1, 1310 & 1550 nm BN 3060/91.02

Bit rate of TX and RX signal . . . . 155 520 kbit/s
additionally, for STS-1/STM-0 mappings . . . . 51 840 kbit/s
Line code. . . . . scrambled NRZ

Generator unit

The generator meets the requirements of Telcordia GR-253, ANSI T1.105.06 (ITU-T Rec. G.957, Tables 2 and 3). Classes LR-1, LR-2, LR-3 (L1.1, L1.2 and L1.3) are covered.

There are two options for adapting to the required wavelength:
Wavelength . . . . 1310 nm,
1310 & 1550 nm (switchable in the instrument)

Output level . . . . 0 dBm +2/–3 dB
with 1310 & 1550 nm option . . . . 0 dBm +2/–3.5 dB

Receiver unit

The receiver unit meets the specifications of Telcordia GR-253, ANSI T1.105.06 (ITU-T Rec. G.957) and fulfills classes IR-1, IR-2 (S1.1 and S1.2).

Wavelength range . . . . 1100 to 1580 nm
Input sensitivity . . . . –28 to –8 dBm
(–34 to –8 dBm typ.)

Display of optical input level
Resolution . . . . 1 dB

155 Mbit/s electrical interface
for connecting the ANT-10Gig to STM-1/STS-3 monitor points
Line code. . . . . scrambled NRZ
Input voltage (peak-peak) . . . . 0.2 to 1 V
Unbalanced input
Connector/impedance . . . . SMA /50 Ω

Optical Modules up to 622 Mbit/s

Optical OC-1/3/12, STM-0/1/4, 1310 nm BN 3060/91.11

Optical OC-1/3/12, STM-0/1/4, 1310 & 1550 nm BN 3060/91.12

Bit rate of TX and
RX signal. . . . . 155 520 kbit/s, 622 080 kbit/s
additionally, for STS-1/STM-0 mappings . . . . 51 840 kbit/s
Line code . . . . scrambled NRZ

Generator unit

The generator meets the requirements of Telcordia GR-253, ANSI T1.105.06 (ITU-T Rec. G.957, Tables 2 and 3). Classes LR-1, LR-2, LR-3 (L1.1, L1.2, L1.3, L4.1, L4.2 and L4.3) are covered.

There are two options for adapting to the required wavelength:
Wavelength . . . . 1310 nm,
1310 & 1550 nm (switchable in the instrument)

Output level . . . . 0 dBm +2/–3 dB
with 1310 & 1550 nm option . . . . 0 dBm +2/–3.5 dB

Generation of OC-12 TX signal
in instruments with STS-1 mappings

The OC-12 TX signal consists of
- one internally generated STS-1 tributary signal with the other 11 tributaries filled with UNEQ or
- one internally generated STS-3c tributary signal with the other three tributaries filled with UNEQ (with STS-3c mapping option or ATM Basic Option BN 3060/90.50).

Generation of STM-4 TX signal
in instruments with STM-1 mappings

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

Contents of the OC-12/STM-4 overhead bytes
For all bytes except B1, B2 and H1 to H3:
- the content of each byte is statically programmable or a user defined byte-sequence p in m in n (p frames in m frames and the entire sequence repeated n times) can be inserted.

For the E1, E2, F1 bytes and the DCC channels
D1 to D3 and D4 to D12:
- Transmission of a test pattern with bit error insertion (see mainframe for pattern selection)
- Insertion of an external data signal (via the V.11 interface)

For the K1, K2, N1, N2 bytes:
- Insertion of the data signal via the V.11 interface

For the J0 bytes:
- Transmission of a 16-byte sequence, with CRC

Error insertion
Error types . . . . B1 and B2 parity error
additionally, for OC-12 . . . . REI-L
for STM-4 . . . . MS-REI

Triggering
Single errors or error ratio . . . . 2×10^{-3} to 1×10^{-10}
for B1 parity errors. . . . . 2×10^{-4} to 1×10^{-10}

Burst error: m anomalies in n periods
For FAS, B1, B2, B3, REI-L, REI-P . . . . m = 1 to 4.8 × 106 and
n = 2 to 8001 frames or 0.2 s to 600 s

Alarm generation, dynamic
Alarm types for OC-12 . . . . LOF, AIS-L, RDI-L
for STM-4 . . . . LOF, MS-AIS, MS-RDI
m alarms in n frames . . . . m = 1 to n-1, n_{max} = 8000
or
t1 alarm active, t2 alarm passive . . . . t1 = 0 to 60 s,
t2 = 0 to 600 s

Alarm generation, static (on/off)
Alarm types . . . . LOS, LOF
additionally, for OC-12 . . . . AIS-L, RDI-L, TIM-L
for STM-4 . . . . MS-AIS, MS-RDI, RS-TIM
Insertion on/off

Receiver unit

The receiver unit meets the specifications of Telcordia GR-253, ANSI T1.105.06 (ITU-T Rec. G.957) and fulfills classes IR-1, IR-2, LR-1, LR-2, LR-3 (S1.1, S1.2, S4.1, S4.2, L4.1, L4.2 and L4.3).

Wavelength range . . . . 1100 to 1580 nm
Input sensitivity, OC-1/3/12 STM-1/-4, ... –28 to –8 dBm
(–34 to –8 dBm typ.)

Display of optical input level
Resolution . . . . 1 dB

The ANT-10Gig demultiplexes one selectable STS-3c/STS-1 or STM-1 tributary from the OC-12/OC-3 or STM-4 RX signal and feeds it to the internal processor for evaluation.

Measurement types
Error measurements
Error types . . . . B1 parity error,
B2 parity error of all STM-1/STS-1/STS-3c signals,
MS-REI/REI-L
Alarm detection
Alarm types . . . . LOS, LOF, OOF, LTI
additionally, for OC-12 . . . . AIS-L, RDI-L, TIM-L
for STM-4 . . . . MS-AIS, MS-RDI, RS-TIM

Overhead evaluation
- Display of the complete overhead of a selectable STM-1/STS-1/STS-3c signal

For the E1, E2, F1 bytes and the DCC channels D1 to D3 and D4 to D12:
- BERT using a test pattern from the generator unit
- Output of the data signal via the V.11 interface

For the K1, K2, N1, N2 bytes:
- Data signal output via the V.11 interface

For the J0 byte:
- Display of 15-byte sequences in ASCII.

155/622 Mbit/s electrical interface
For connecting the ANT-10Gig to OC-3/STM-1 and OC-12/STM-4 monitor points

Line code . . . . scrambled NRZ
Input voltage (peak-peak) . . . . 0.2 to 1 V
Coaxial input
Connector/impedance . . . . SMA/50 Ω

Concatenated Mappings

Option OC-12c/STM-4c Virtual Concatenation BN 3060/90.92

Signal structure
STM-4 to ITU-T G.707
Virtual concatenation with 4 AU-4 pointers

Generation of pointer actions
Manipulations on pointer #1 see mainframe
Setting of delta values for pointers #2, #3, #4

Pointer analysis
For pointer #1 . . . . see mainframe
Delta values (maximum, minimum) . . . . ±40
for pointers #2, #3, #4

POH generation/analysis
POH #1 . . . . see mainframe
POH #2, #3, #4 . . . . static setting of all bytes
except B3
Automatic B3 generation for VC-4 #1, #2, #3, #4

Option OC-12c/STM-4c ATM-Testing BN 3060/90.91

Only in conjuction with BN 3060/90.50 and BN 3060/91.11 or BN 3060/91.12

See chapter “ATM options” for further details.

Optical Modules 2488 Mbit/s

Optical OC-48, STM-16, 1310 nm BN 3060/91.51

Optical OC-48, STM-16, 1550 nm BN 3060/91.50

Optical OC-48, STM-16, 1310/1550 nm switchable BN 3060/91.52

One 2.5 Gbit/s module can be fitted in the extension slot of the ANT-10Gig.

The optical interfaces meet the specifications of Telcordia TA-NWT-000253 I.6 (Table 4–9, 4–10) and ITU-T Recommendation G.957 (Table 4).
Classes IR-2, LR-2, LR-3 (Telcordia) or S-16.2, L-16.2, L-16.3 (ITU-T) are fulfilled at 1550 nm; classes IR-1, LR-1 (Telcordia) or S-16.1, L-16.1 (G.957) are fulfilled at 1310 nm.

Generator

Optical interfaces
Wavelengths . . . . 1310 nm, 1550 nm
or 1310/1550 nm switchable
Output level at 1310 nm and 1550 nm . . . . 0 dBm +0/–2 dB
Line code. . . . . scrambled NRZ

Electrical interfaces
Line code. . . . . scrambled NRZ
Output voltage (peak-peak). . . . . ≥0.6 V
Connector/impedance . . . . SMA/50 Ω

Clock generator
Internal, accuracy . . . . ±2 ppm
Offset. . . . . ±50 ppm
Synchronization from external signal as for mainframe

Generation of OC-48 TX signals
in instruments with STS-1/STS-3c mappings

The OC-48 signal consists of one or more internally generated tributaries plus several tributaries filled with UNEQ (or non-specific UNEQ)
- 48 identical STS-1
- one STS-1 tributary and 47 × UNEQ/non specific
- 16 identical STS-3c (Option BN 3060/90.02 required)
- one STS-3c tributary (Option BN 3060/90.02 required) and 15 × UNEQ/non specific
- four identical STS-12c (Option BN 3060/90.90 required)
- one STS-12c tributary (Option BN 3060/90.90 required) and 3 × UNEQ/non specific

Generation of STM-16 TX signal
in instruments with STM-1 mappings

The STM-16 signal consists of one or more internally generated tributaries plus several tributaries filled with UNEQ (or non-specific UNEQ)
- 16 identical STM-1
- one STM-1 tributary and 15 × UNEQ/non specific
- four identical STM-4c (Option BN 3060/90.90 required)
- one STM-4c tributary (Option BN 3060/90.90 required) and 3 × UNEQ/non specific

Contents of OC-48/STM-16 overhead bytes
For all bytes except B1, B2 and H1 through to H3:
- the contents of the bytes in all SOH/TOH are statically programmable

For the bytes E1, E2, F1 and the DCC channels D1 to D3 and D4 to D12:
– Transmission of a test pattern and bit error insertion (see mainframe for pattern selection)
– Insertion of an externally-generated data signal (via V.11 interface)

For the K1, K2, N1, N2 bytes:
– Insertion of an external data signal via the V.11 interface

For the J0 byte:
– Transmission of a 16-bit sequence with CRC

Error insertion

Error types . . . . B1, B2 parity errors
Single error or error rate B1 . . . . 2×10^{-5} to 1×10^{-10}
B2 . . . . 2×10^{-3} to 1×10^{-10}
additionally, for OC-48 . . . . .REI-L
for STM-16 . . . . MS-REI
Single error or error rate . . . . 2×10^{-3} to 1×10^{-10}

Alarm generation, dynamic

Alarm types for OC-48 . . . . LOF, AIS-L, RDI-L
for STM-16 . . . . LOF, MS-AIS, MS-RDI
m alarms in n frames . . . . m = 1 to n - 1, n_{max} = 8000
or
t1 alarm active, t2 alarm passive . . . . t1 = 0 to 60 s,
t2 = 0 to 600 s

Alarm generation, static (on/off)

Alarm types . . . . LOS, LOF
additionally, for OC-48 . . . . .AIS-L, RDI-L
for STM-16 . . . . MS-AIS, MS-RDI

Receiver

Optical interfaces

Wavelength . . . . .1260 to 1580 nm
Line code. . . . . scrambled NRZ
Sensitivity . . . . –28 dBm to –8 dBm
Input overload . . . . >–8 dBm

Display of optical input level
Range . . . . –30 dBm to –8 dBm
Resolution . . . . 1 dB

Electrical interfaces

Line code . . . . scrambled NRZ
Input voltage (peak-peak) . . . . 0.3 to 1 V
Connector/impedance . . . . SMA/50 Ω

A selectable STM-1, STS-1 or STS-3c channel is fed to the internal evaluation circuits by demultiplexing from the input signal.

Error measurement

Error types . . . . B1 parity error, MS-REI,
B2 parity sum error over
all STM-1/STS-1/STS-3c channels
Evaluation (bit/block errors) . . . . error rate, count
Error event resolution . . . . 1 s

Alarm detection

Alarm typs . . . . LOS, LOF, OOF
additionally, for OC-48 . . . . AIS-L, RDI-L, TIM-L
for STM-16 . . . . MS-AIS, MS-RDI, RS-TIM
Alarm event resolution. . . . . 100 ms

TOH/SOH evaluation

Display of complete overhead

For the bytes E1, E2, F1 and the DCC channels D1 to D3 and D4 to D12:
– BERT using test pattern from generator unit
– Output of the data signal via the V.11 interface

For the K1, K2, N1, N2 bytes:
– Data signal output via the V.11 interface

For the J0 byte:
– Display of 15-byte sequences in ASCII format

DWDM Laser

Optical OC-192, STM-64, 15xy nm Special DWDM lasers to G.692 — BN 3060/91.49

Lasers with precisely defined wavelengths in the 1550 nm range are used specifically for DWDM applications. The ANT-10Gig can be fitted with a selected laser source conforming to ITU-T G.692 for such applications.

Further Options

Optical Power Splitter (90%/10%) — BN 3060/91.05

The optical power splitter is built into the ANT-10Gig.
Three optical test adapters are required to operate it, please indicate your choice.

The optical power splitter provides an optical monitor point.
The input signal is passed through to the output transparently.

Light energy forwarded . . . . .approx. 90% (–0.45 dB)
Light energy coupled out . . . . approx. 10% (–10 dB)

The optical power splitter operates in the following ranges:
Wavelengths . . . . 1260 to 1360 nm and 1500 to 1600 nm

Jitter and Wander Options

As an alternative to the OC-48/STM-16 option, jitter applications up to 622 Mbit/s or wander at 10 Gbit are possible with the ANT-10Gig. The modules are optimized for compliance with the latest standard (O.172) and assure reliable jitter and wander measurements, useful when analyzing pointer jitter in 10 Gbit/s systems, for example. ANT-10Gig is particularly adept at wander analysis. The graphical MTIE wander analyses require no external computing resources and allow rapid verification of the synchronicity of a SDH network. Jitter/wander components are available for all built-in bit rates up to 622 Mbit/s and for 10 Gbit/s.

Standards

Jitter generation and jitter/wander analysis are in accordance with:
– Telcordia GR-253, GR-499, GR-1244
– ANSI T1.101, T1.102, T1.105.03,T1.403, T1.404, T1.105.09
– ITU-T G.783, G.823, G.824, G.825, O.171, O.172
– ETSI ETS 300 462-1 to -6, ETS 300 417-1-1, EN 302 084

O.172 Jitter/Wander up to 155 Mbit/s BN 3060/91.30

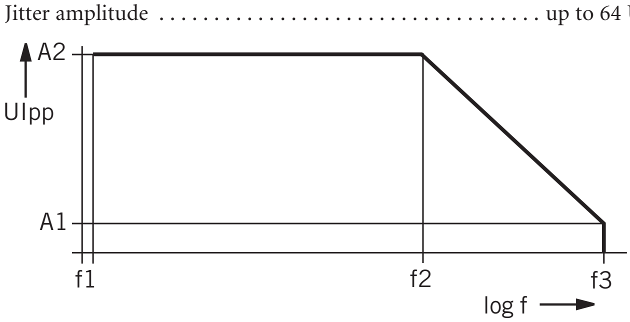
Jitter generator

Fully complies with or exceeds the requirements of ITU-T O.172.

Bit rates
Generates jitter at all bit rates included in the mainframe configuration up to 155 520 kbit/s.

TX signals .... all test patterns and frame structures included in the mainframe configuration

Built-in modulation generator (sinewave) .... 0.1 Hz to 5 MHz
External modulation .... 0 Hz to 5 MHz
Jitter amplitude .... up to 64 UI



Clock rate/kHz	A1	A2	f1/Hz	f2/Hz	f3/kHz
1 544				625	80
2 048				1560	200
6 312				940	120
8 448				6250	800
34 368	0.5	64	0.1	27 k	3500
44 736				35 k	4500
51 840				27 k	3500
139 264				39 k	5000
155 520				39 k	5000
622 080 *	1.0	256		20 k	5000

* Requires option BN 3060/91.31

Modulator input
75 Ω, BNC socket
Voltage required .... 0 to 2 Vpp

Error limits .... as per O.172

Jitter Analyzer

Jitter measurement at all bit rates included in the mainframe configuration up to 155 520 kbit/s.

Built-in filters
High-pass filters .... 0.1, 2, 4, 10, 20, 40, 100, 200, 400, 500, 700 Hz, 1, 3, 8, 10, 12, 18, 20, 30, 65, 80, 250 kHz
Low-pass filters.................. 4 0, 60, 100, 400, 800, 1300, 3500, 5000 kHz
Filter characteristics .... as per O.172

Measurement ranges
Peak-peak
- Range I, resolution .... 0 to 1.6 UIpp, 1 mUIpp
- Range II, resolution .... 0 to 20 UIpp, 10 mUIpp
- Range III, resolution .... 0 to 200 UIpp, 100 mUIpp

RMS
- Range I, resolution .... 0 to 0.8 UIpp, 1 mUIpp
- Range II, resolution .... 0 to 10 UIpp, 10 mUIpp
- Range III, resolution .... 0 to 100 UIpp, 100 mUIpp

Measurement accuracy .... as per O.172

Demodulator output
75 Ω, BNC socket
Range I (0 to 1.6 UIpp) .... 1 V/UIpp
Range II (0 to 20 UIpp) .... 0.1 V/UIpp
Range III (0 to 200 UIpp) .... 0.01 V/UIpp

Wander Generator

Fully complies with or exceeds the requirements of ITU-T O.172

Bit rates
Wander generation at all implemented bit rates up to 155 Mbit/s according to the equipment level of the instrument.
Amplitude range .... up to 200 000 UI
Frequency range .... 10 µHz to 10 Hz
Accuracy .... as per O.172
Resolution .... 1 µHz

Wander Analyzer

Fully complies with or exceeds the requirements of ITU-T O.172

For all bit rates up to 155 Mbit/s according to the equipment level of the instrument.
Other sampling rates in addition to the 30/s rate are available for detailed analysis versus time:
Sampling rate – low-pass filter –
test duration .... 1/s - 0.1 Hz - 99 days
30/s - 10 Hz - 99 h
60/s - 20 Hz - 99 h
300/s - 100 Hz - 5000 s
Amplitude range .... ±1 ns to ±1 µs
Measurement accuracy .... as per O.172

Accessory: “Standard Frequency Source” for wander applications, see end of chapter

O.172 Jitter/Wander up to 622 Mbit/s BN 3060/91.31

Jitter Generator

Jitter modulation of STM-4 TX signals.
Built-in modulation generator (sinewave) .... 0.1 Hz to 5 MHz
External modulation .... 0 Hz to 5 MHz
Jitter amplitude .... up to 256 UI

Jitter modulation of externally-generated signals in Through mode

Externally-generated signals can be jittered in Through mode when the D&I option is included.
This applies to all bit rates included in the mainframe configuration at the appropriate electrical and optical interfaces.
Built-in modulation generator (sinewave) .... 0.1 Hz to 5 MHz
External modulation .... 0 Hz to 5 MHz
Jitter amplitude .... as for jitter generator in UIpp

Jitter Analyzer

Measurement range

Peak-peak
Range I, resolution .... 0 to 6.4 UIpp, 1 mUIpp
Range II, resolution .... 0 to 80 UIpp, 10 mUIpp
Range III, resolution .... 0 to 800 UIpp, 100 mUIpp

RMS
Range I, resolution .... 0 to 3.2 UIpp, 1 mUIpp
Range II, resolution .... 0 to 40 UIpp, 10 mUIpp
Range III, resolution .... 0 to 400 UIpp, 100 mUIpp
Measurement accuracy .... as per O.172

Demodulator output

75 Ω, BNC socket
Range I (0 to 6.4 UIpp) 0.25V/UIpp
Range II (0 to 80 UIpp) 0.025V/UIpp
Range III (0 to 800 UIpp) 0.0025V/UIpp

Wander Generator

Fully complies with or exceeds the requirements of ITU-T O.172

Bit rates
Wander generation at all implemented bit rates up to 622 Mbit/s according to the equipment level of the instrument.
Amplitude range .... up to 200 000 UI
Frequency range .... 10 μHz to 10 Hz
Accuracy .... as per O.172
Resolution...1 μHz

Wander Analyzer

Fully complies with or exceeds the requirements of ITU-T O.172

Other sampling rates in addition to the 30/s rate are available for detailed analysis versus time:
Sampling rate – Low-pass filter –
Test duration .... 1/s - 0.1 Hz - 99 days
30/s - 10 Hz - 99 h
60/s - 20 Hz - 99 h
300/s - 100 Hz - 5000 s
Amplitude range .... ±1 ns to ±1 μs
Measurement accuracy .... as per O.172

Reference signal input

Frequencies .... 1.544, 2.048, 5, 10 MHz
Bit rates .... 1.544, 2.048 Mbit/s
Balanced 110 Ω connector .... Bantam
Clock input voltage
(sine or square wave) .... 1.0 to 6.5 Vpp
HDB3/B8ZS input voltage ....±3 V ±10%

Coaxial 75 Ω connector ....BNC
Clock input voltage
(sine or square wave) .... 1.0 to 5 Vpp
HDB3/B8ZS input voltage .... ±2.37 V ±10%

Accessory: “Standard Frequency Source” for wander applications, see end of chapter

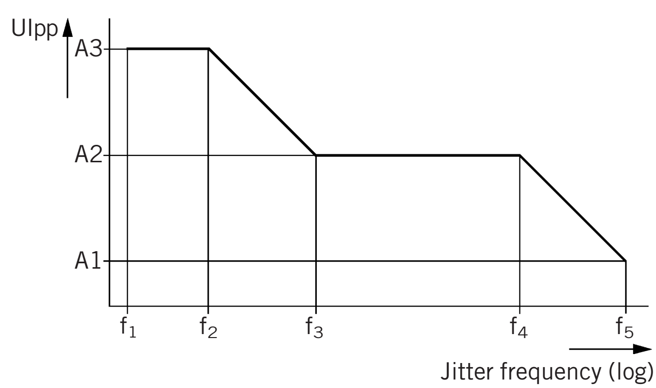
O.172 Jitter/Wander at 9953 Mbit/s

Jitter at 9953 Mbit/s BN 3060/91.60
Wander Analyzer at 9953 Mbit/s BN 3060/91.61
Wander Generator at 9953 Mbit/s BN 3060/91.62

Jitter Generator

Fully complies with or exceeds the requirements of ITU-T O.172.

Bit rate .... 9 953 280 kbit/s
Maximum offset.. ±50 ppm
Built-in modulation generator.......................... sine wave
or external .... 0.1 Hz to 80 MHz
Jitter amplitude .... up to 3200 UIpp



Amplitude in UIpp			Frequency in Hz				
A1	A2	A3	f_1	f_2	f_3	f_4	f_5
0.5	20	3200	0.1	12.5	2 k	2 M	80 M

Modulator input

75 Ω, BNC socket
Modulation frequency .... 0.1 Hz to 80 MHz
Input voltage range............................... 0 to 2.0 Vpp

Error limits ....as per ITU-T O.172

Jitter Analyzer

Bit rate .... 9 953 280 kbit/s

Measurement ranges

Peak-peak
Range I, resolution......................0 to 4 UIpp, 1 mUIpp
Range II, resolution ....0 to 40 UIpp, 10 mUIpp
Range III, resolution .... 0 to 3200 UIpp, 100 mUIpp
RMS
Range I, resolution......................0 to 2 UIpp, 1 mUIpp
Range II, resolution ....0 to 20 UIpp, 10 mUIpp
Range III, resolution .... 0 to 1600 UIpp, 100 mUIpp

Measurement accuracy............................ as per O.172

Built-in filters
as per ITU-T O.172, G.825, G.813, Telcordia GR-1377, ANSI T1.101, T1.105.03

High-pass filters .... 10 kHz, 12 kHz, 20 kHz, 50 kHz and 4 MHz
Low-pass filters .... 10 kHz, 80 MHz
The high-pass filters can be switched off.
Frequency range without high-pass filter
Measurement range I .... 100 Hz
Measurement range II .... 10 Hz
Measurement range III .... 10 Hz

Demodulator output
75 Ω, BNC socket
Output voltage
Measurement range I (0 to 4 UIpp) .... 0.5 V/UIpp
Measurement range II (0 to 40 UIpp) .... 50 mV/UIpp
Measurement range III (0 to 3200 UIpp) ....0.625 mV/UIpp

Wander Generator
Requires option BN 3035/90.81 or BN 3060/91.30
Fully complies with or exceeds the requirements of ITU-T O.172.

Bit rate .... 9 953 280 kbit/s
Amplitude range .... 0.1 UI to 320 000 UI
Frequency range .... 10 µHz to 10 Hz
Accuracy .... as per O.172
Resolution .... 1 µHz

Wander Analyzer
Fully complies with or exceeds the requirements of ITU-T O.172

Other sampling rates in addition to the 30/s rate are available for detailed analysis versus time:
Sampling rate – low-pass filter –
test duration .... 1/s – 0.1 Hz – 99 days
30/s – 10 Hz – 99 h
60/s – 20 Hz – 99 h
300/s – 100 Hz – 5000 s
Amplitude range .... ±1 ns to ±1 µs
Measurement accuracy............................ as per O.172

Reference signal input
Frequencies........................... 1.544, 2.048, 5, 10 MHz
Bit rates .... 1.544, 2.048 Mbit/s

Balanced 110 Ω connector
Clock input voltage
(sine or square wave) .... 0.65 to 6.5 Vpp
HDB3/B8ZS input voltage.........................±3 V ±10%

Coaxial 75 Ω connector
Clock input voltage
(sine or square wave) .... 0.5 Vpp to 5 Vpp
HDB3/B8ZS input voltage...................... ±2.37 V ±10%

For "Standard Frequency Source" accessory for wander applications, see end of section

Jitter Analysis

Current values (continuous measurement)
Peak jitter value .... in UIpp
Positive peak value .... in UI+p
Negative peak value .... in UI–p

Maximum value (gated measurement)
Maximum peak jitter value .... in UIpp
Maximum positive peak value .... in UI+p
Maximum negative peak value .... in UI–p

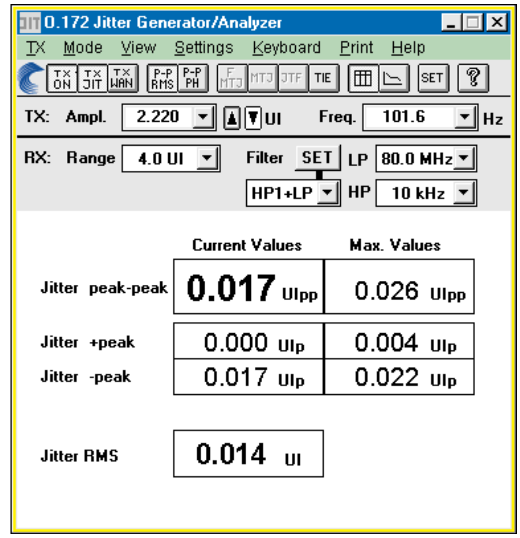


Figure 8: Jitter peak-to-peak/RMS measurement.

Result averaging (switchable) .... 1 to 5 s

The ANT-10Gig retains phase synchronicity even when pointer jitter occurs (phase tolerance to O.172).

Phase hits
The instrument detects when the programmable threshold for positive and negative jitter values is exceeded.
The result indicates how often this threshold was exceeded.
Setting range for positive and negative thresholds
(depending on measurement range) .... 0.1 up to the half measurement range

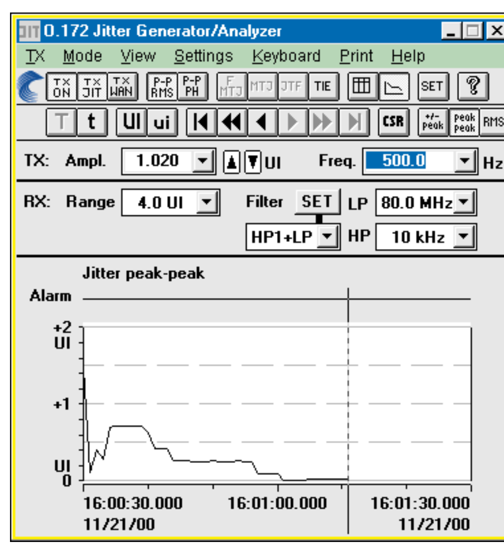


Figure 9: Jitter versus time display.

Jitter versus time
This function is used to record variations of jitter with time.
It allows the positive and negative peak values or peak-to-peak values to be displayed versus time.
Measured values have one second resolution. Measurement duration is up to 99 days.
By simultaneously evaluating alarms and errors, corellations between events can be quickly identified.

Clock jitter measurement
The ANT-10Gig can also measure the jitter on the clock signals (square-wave) at standard bit rates. All built-in bit rates with electrical interfaces up to 155 Mbit/s can be measured.

RMS measurement
T1.105.03, GR-253, GR-499, G.958 (or G.783 rev.)
The RMS value is measured on-line and displayed in UI.
The peak jitter and RMS values can be displayed simultaneously; a graph versus time is available for long-term analysis. An RMS filter preset is available.

Jitter Analysis

Time Interval Error (TIE)

to O.172 . . . . numerical and graphical
Sampling rates . . . . see under O.172 Wander Analyzer

MTIE is additionally determined as a continually updated numerical value.

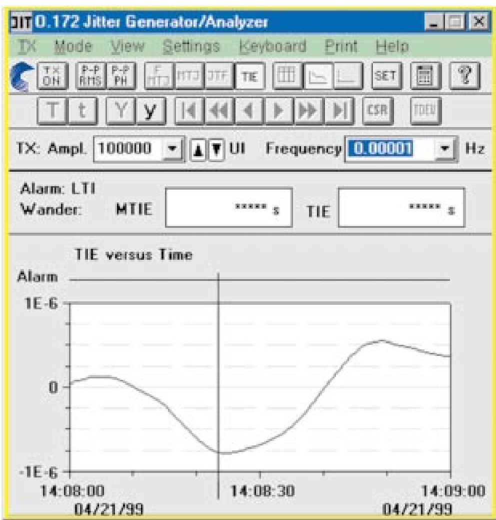


Figure 10: On-line wander testing.

To prevent data loss or premature termination of long term measurements, the ANT-10Gig checks the remaining space on the hard disk before the start of the measurement. If necessary, the selected measurement time can be adjusted.
The TIE values are recorded and are then available for subsequent off-line MTIE/TDEV evaluations. The values are also saved in .csv format for documentation or further analysis.

Wander Analysis MTIE/TDEV Off-line Analysis Evaluation

This software provides extended off-line statistical analysis facilities for the results of wander measurements.
TIE values results obtained using the ANT-10Gig are analyzed according to ANSI T1.101, Telcordia GR-1244, ETSI ETS 300 462, EN 302 084, ITU-T O.172, G.810 to G.813.

Network synchronization quality is presented graphically using the MTIE (maximum time interval error) and TDEV (time deviation) parameters. To ensure correct assessment, the tolerance masks for PRC (primary reference clock), SSU (synchronization supply unit), SEC (synchronous equipment clock) or PDH can be superimposed.

The results and masks can be printed out with additional user-defined comments.

This software allows several TIE results to be displayed simultaneously.

Decisive details during long term measurements disappear in the multitude of results. An effective zoom function is available for detailed wander characteristic analysis.

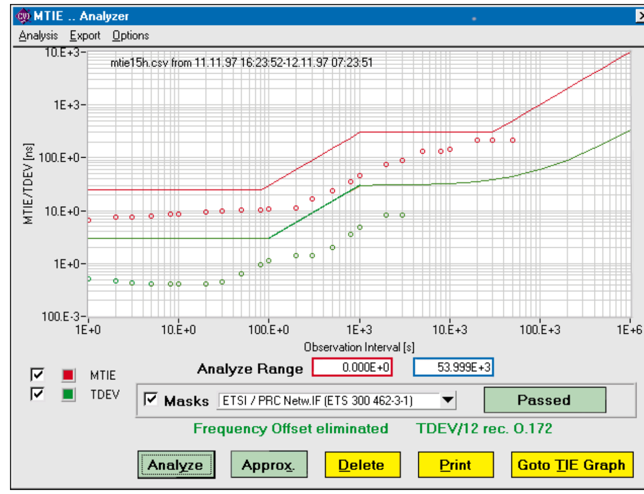


Figure 11: Display of MTJE/TDEV results and comparison against masks.

Result printout and export

The results can be printed out and stored internally or on floppy disk. The file format allows further processing using standard PC software.

Frequency offset and frequency drift rate (ANSI T1.101)

To ensure reliable operation when a clock source is in holdover mode, the frequency characteristics must not exceed specific deviation limits relative to an absolute reference source.
To verify this data, the ANT-10Gig determines the following over the selected measurement interval:
Frequency offset . . . . in ppm
Frequency drift rate . . . . in ppm/s

MRTIE – Relative MTIE (G.823 and EN 302 084)

If the reference is unavailable (too far away) when analyzing the wander of asynchronous signals, the MTIE analysis may have a superimposed frequency offset.
This offset depends on the difference between the signal and local reference clocks.
The MRTIE measurement subtracts the frequency offset from the result so that the "actual" wander characteristic is shown.

Accessory for wander analysis
Standard frequency source . . . . see end of chapter

Automatic Measurements

The following automatic measurements can be run for all standard bit rates and interfaces included in the mainframe configuration (electrical/optical) up to 2488 Mbit/s.

Automatic determination of selective Jitter Transfer Function, JTF

Telcordia GR-499, GR-253, ANSI T1.105.03, ITU-T G.958

The jitter transfer function indicates the ratio of the jitter amplitude at the output of the device under test to that at the input at various frequencies. This determines whether the device under test reduces or amplifies input jitter and at which frequencies. After a calibration measurement to minimize intrinsic errors, the ANT-10Gig outputs a pre-selected jitter amplitude at various frequencies and measures selectively the jitter amplitude at the output of the device under test. The ratio of the amplitudes in dB is the jitter transfer function.

The preselected amplitudes correspond to the mask for maximum permitted input jitter. The jitter frequencies and amplitudes can also be edited. The calibration values can be saved and used again for other measurements.

Additional measurement mode

– Transfer MTJ results:
  An MTJ measurement is first performed. The measured amplitude values can then be used automatically as generator values for the JTF measurement.

The results can be displayed in tabular and graphical form. The graphical display includes the standard tolerance masks specified in T1.105.03 and GR-253 or G.735 to G.739, G.751, G.758. The distance of the measurement points from the tolerance masks indicates the degree to which the device under test meets the requirements of the standard.

Tolerance mask violations during the measurement are indicated in the numerical table.

Freely programmable tolerance masks

The existing tolerance masks for the ANT-10Gig can be altered as required to suit requirements that do not conform to specific standards. The new values selected for jitter frequency and jitter gain/loss are stored when the application is saved.

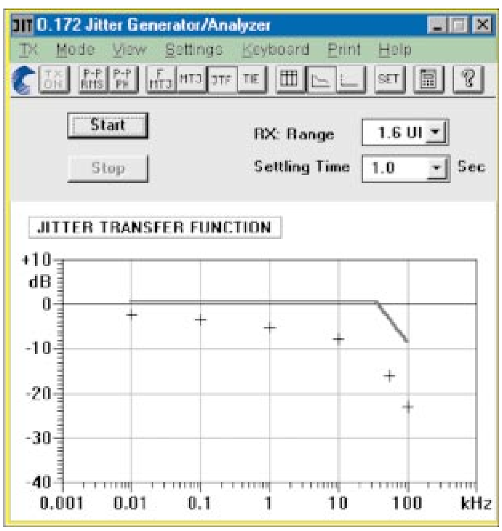


Figure 12: Jitter Transfer testing results.

Automatic limit testing of Maximum Tolerable Jitter (Fast Maximum Tolerable Jitter F-MTJ)

ANSI T1.403, T1.404, T1.105.03, Telcordia GR-253, GR-499, ITU-T G.823, G.824, G.825, G.958

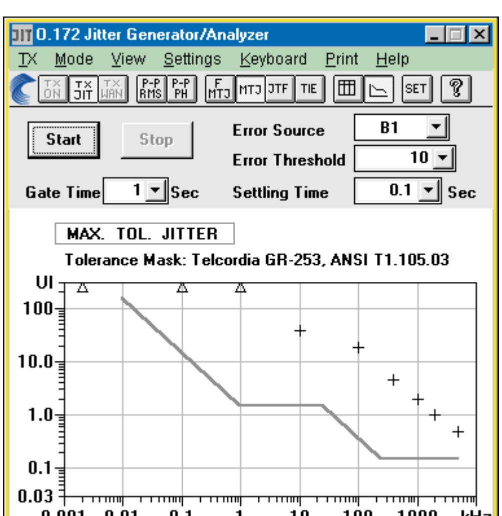


Figure 13: Maximum Tolerable Jitter testing.

This extremely fast measurement tests the device under test for conformance to the standard tolerance mask limits for maximum tolerable jitter.

Jitter frequencies . . . . up to 10 fixed frequencies corresponding to standard tolerance mask

Detection criteria . . . . TSE (bit error), code error, B2, B3, REI, RDI
Error threshold . . . . 0 to 999 999 errors
Settling time . . . . 0.1 to 99.9 s

The editable frequency/amplitude values are set sequentially and the test pattern monitored for the permitted bit error count by the receiver. The result of each measurement is shown in a table as the status message “OK” or “FAILED”.

Automatic determination of Maximum Tolerable Jitter, MTJ

ANSI T1.403, T1.404, T1.105.03, Telcordia GR-253, GR-499, ITU-T G.823, G.824, G.825, G.958

The ANT-10Gig automatically determines the maximum jitter amplitude tolerated by the device under test at each jitter frequency.
Jitter frequencies . . . . 20 freely selectable frequencies
Detection criteria . . . . TSE (bit error), code error, B2, B3, REI, RDI
Error threshold . . . . 0 to 999 999 errors
Settling time . . . . 0.1 to 99.9 s
Gating time . . . . 1 to 60 s

The maximum permissible jitter amplitude is determined precisely and quickly using a successive method. The ANT-10Gig determines the exact limit value. The method is derived from long experience in the performance of jitter tolerance tests and is recognized by leading systems manufacturers.

The frequency/amplitude result pairs can be displayed in tabular and graphical form.

The graphical display includes the standard tolerance masks. The distance of the measurement points from the tolerance masks indicates the degree to which the device under test meets the requirements of the standard.

Tolerance mask violations during the measurement are indicated in the numerical table.

Freely programmable tolerance masks

The existing tolerance masks for the ANT-10Gig can be altered as required to suit requirements that do not conform to specific standards. The new values selected for jitter frequency and amplitude are stored when the application is saved.

Automatic pointer sequences for analyzing combined jitter

(available with CATS Test Sequencer option)

Among other things, T1.105.03 defines various pointer sequence scenarios for testing combined jitter (mapping and pointer jitter) at network elements.

These sequences are normally selected manually and the jitter measured. ANT-10Gig allows simple automation of these sequences. The entire sequence is started and the maximum pointer jitter determined with a single key press. This saves considerable time spent in setting up the test and executing the measurement.

Automatic limit testing of Maximum Tolerable Wander, MTW

ITU-T G.823, G.824

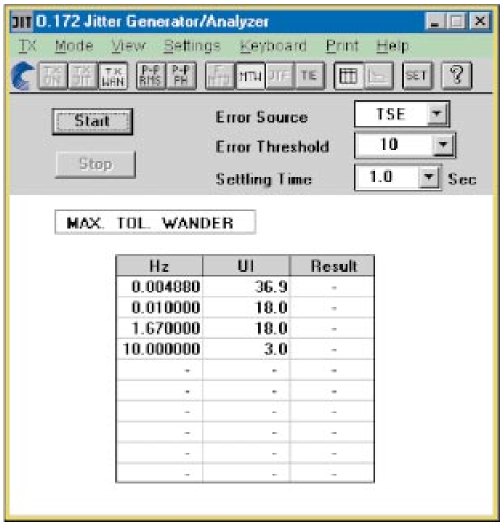


Figure 14: Maximum Tolerable Wander result display.

The ANT-10Gig tests the device under test for conformance to the standard tolerance mask limits for maximum tolerable wander.

Measurement points .... up to 10 frequency/amplitude values
Detection criteria .... TSE (bit error), alarms
Frequency range .... 10 µHz to 10 Hz, step 1 µHz
Amplitude range .... 0.1 to 200 000 UI, step 0.1 UI

The result of each measurement is shown in a table with an “OK” or “FAILED” message.

Accessory

Acterna TSR-37 DA 3700/00
Rubidium Timing Signal Reference

The TSR-37 is a powerful reference source to quickly measure and test the synchronization quality of PDH/SDH/SONET digital networks. MTIE and TDEV measurements for up to 1000 seconds can be easily performed without a GPS reference. Coupled with the optional GPS-FC, the range of observation time can be largely extended to meet specific requirements.
Provides the reference clock for wander analysis using the ANT-10Gig.

- PDH/SDH/SONET wander measurement source
- Accuracy at 25 °C: $+5 \times 10^{-11}$ without GPS
  $< 1 \times 10^{-11}$ with GPS
- 12 Outputs; framed and unframed:
  5 MHz, 10 MHz, 2.048 kHz, 1.544 kHz, E1, T1
- Compact, robust & lightweight
- External autocalibration input
- Input for GPS or Cesium reference

See Acterna TSR-37 data sheet for details.

ATM Options

With its ATM options, ANT-10Gig enables commissioning tests on newly installed ATM links. The major error- and delay-related performance parameters can be quickly and reliably verified in this manner. Using the flexible cell generator, policing functions can be easily checked. Bit error analyses and alarm flow diagnostics allow a fast assessment of whether links are working properly.
ATM cells can be generated for all bit rates up to OC-12c/STM-4c.

ATM Basic — BN 3060/90.50

General

Adjustable test channel from 0 to 150 Mbit/s

In ATM network elements, user channels are monitored with the UPC (usage parameter control). The sensors of the control instance can be quickly checked if the bandwidth of a test channel exceeds the set threshold in the network element. For all measurements, the test channel in the ANT-10Gig is set on-line. Settings are made directly with a control (Figure 16) which shows the bandwidth in Mbit/s, Cells/s or %. This makes it easy to simulate CBR (Constant Bit Rate) sources. For each interface, the load setting has a range from 0.01% to 100%. This corresponds to the load conditions which can occur in the real world.

Load profiles

A test channel can be generated with typical load profiles in order to stress network elements or simulate source profiles. In burst mode, for example, the burst load, burst length and burst period parameters can be used to simulate a video signal whose key Figures correspond to a real-life signal.

Background load generator

To make a real-time measurement under loaded conditions, additional background load can be simulated to supplement the test channel (foreground traffic). The ATM channels are defined using an editor. The user specifies the repetition rate of the load cell and a sequence of empty cells. Load channels can be transmitted continuously as a sequence. The load generator can also be used separately with the test channel switched off. In this case, the channels and profiles can be user-specified.

Determining Cell Delay Variation

The ANT-10Gig includes very powerful tools for measuring delay parameters. Once a precise measurement has been made, subsequent measurements usually require only a low-resolution display to allow rapid pass/fail assessment. Delay values are displayed by the ATM Traffic Analyzer as a histogram with a minimum class width equal to 160 ns (maximum 335 ms).
As a result, delay fluctuations are shown graphically with the same resolution. An adjustable offset can be used to maintain measurement accuracy even if the delay values are high, e.g. over international links.

F4/F5 OAM alarm flow

In accordance with I.610 and the ATM forum standard, the status of ATM paths and channels is transmitted in the OAM cell stream (fault management). The ANT-10Gig generates the alarms VP-AIS, VC-AIS or VP-RDI, VC-RDI for the foreground channel. The receiver simultaneously detects alarms and error messages in the channel and path.

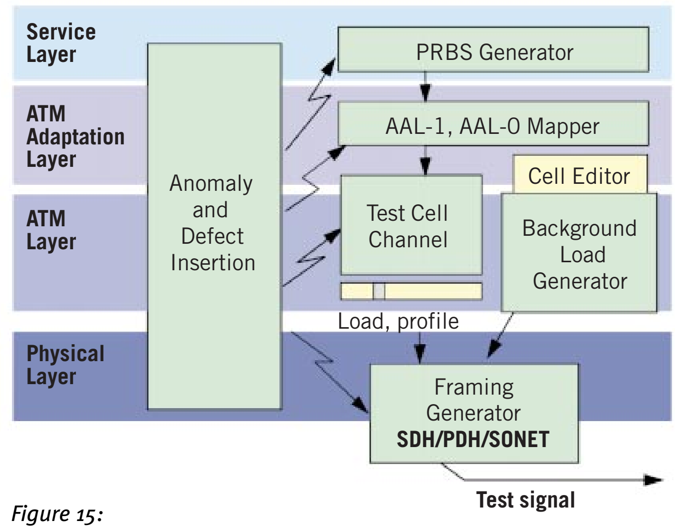


Figure 15: ATM-BERT generator configuration.

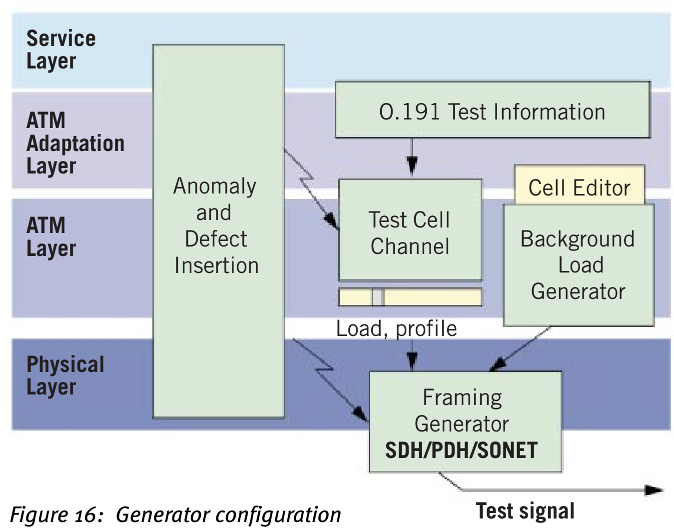


Figure 16: Generator configuration for performance measurement.

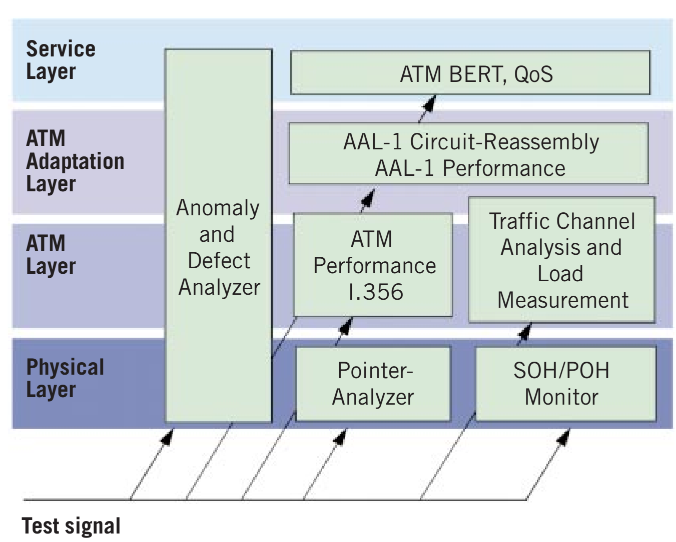


Figure 17: Analyzers in the ANT-10Gig – A hierarchical overview.

The ATM module comprises:
- Generation and analysis of ATM cell streams
- ATM layer cell transfer performance as per ITU-T I.356, O.191
- AAL-1 segmentation/reassembly for circuit emulation
- STM-1/STS-3c with C4 ATM mapping, ITU-T G.707, ANSI T1.105/107
- F4/F5 fault management OAM flow for AIS and RDI as per ITU-T I.610, ATM forum UNI 3.1

Generator unit

Bit rates of the framed cell streams .... 155.520 Mbit/s
Cell scrambler $X^{43}+1$ (ITU-T) .... can be switched on and off

Test cell channel
Adjustable from .... 0 to 149.760 Mbit/s
Header setting .... editor
Load setting in .... Mbit/s, Cells/s, %

Test cells, payload pattern
AAL-0, pseudo-random
bit sequences (PRBS) .... $2^{11}-1$, $2^{15}-1$, $2^{23}-1$
AAL-1, pseudo-random
bit sequences (PRBS) .... $2^{11}-1$, $2^{15}-1$, $2^{23}-1$
Programmable word, length .... 16 bits
Test pattern for ATM performance analysis, with
Sequence number .... 3 bytes
Time stamp .... 4 bytes
Error correction CRC-16

Load profiles
Equidistant, setting range .... 1 to 10 000 cell times
CBR
Constant bit rate, setting range .... 0.01% to 100%
VBR
Variable bit rate, settings
Peak cell rate .... 1% to 100%
Mean cell rate .... 1% to 100%
Burst size................................. 1 to 1023 cell times
Burst period .... 2 to 32 767 cell times

Error insertion
Physical layer as with ANT-10Gig basic instrument
ATM layer, AAL:
- Correctable and non-correctable header errors
- AAL-0, cell payload bit errors
- AAL-1, sequence number errors
- AAL-1, SAR-PDU bit errors
- AAL-1 SNP, CRC errors
- AAL-1 SNP, parity errors

Triggering .... single errors, error ratio, n errors in m cells

Alarm generation
Physical layer as with basic instrument, also:
Loss of cell delineation .... LCD
ATM layer (for selected test cell channel):
OAM F4/F5 fault flow .... VP AIS, VP RDI, VP AIS+VC AIS, VC AIS, VC RDI, VP RDI+VC RDI

Background load generator
For programming user-defined cell sequences. The sequences can be transmitted at a selectable repetition rate.
Editor .... 200 ATM channels
Header.. user-selectable
Payload .... 1 filler byte, user-selectable

Circuit emulation
(for selected test cell channel)
Generation of
an asynchronous channel....................... 1544, 2048, 6312, 8448, 34 368, 44 736 kbit/s, 2048 kbit/s with PCM30 frame structure
ATM channel segmentation .... AAL-1, ITU-T I.363

Receiver unit
Bit rates of framed cell streams .... 155.520 Mbit/s
Cell scrambler $X^{43}+1$ (ITU-T)........... can be switched on and off

Measurement types

Error measurement (anomalies), statistics
Detection of the following error types:
- Correctable and non-correctable header errors
- AAL-0, cell payload bit errors
- AAL-1, sequence number errors
- AAL-1, SAR-PDU bit errors
- AAL-1 SNP, CRC errors
- AAL-1 SNP, parity errors

ATM performance analysis
- Cell error ratio
- Cell loss ratio
- Cell misinsertion rate
- Mean cell transfer delay
- 2-point cell delay variation
  measured between minimum and maximum cell transfer delay values
- Cell transfer delay histogram
  Number of classes.................................. 128
  Minimum class width .... 160 ns
  Maximum class width............................. 335 ms
  Settable offset .... 0 to 167 ms
  Offset step width................................. 2.5 µs

Alarm detection (defects)
Physical layer as with ANT-10Gig basic instrument, also:
Loss of cell delineation.................................. LCD
ATM layer (for selected test cell channel):
OAM F4/F5 fault flow .... VP AIS, VP RDI, VC AIS, VC RDI

User channel analysis
Concurrent X-Y chart (load vs. time) for:
- All user cells
- Average cell rate of a selected cell channel
- Peak cell rate of a selected cell channel

Display units .... Mbit/s, Cells/s, %
Channel utilization histogram
- All user cells ("assigned cells")
- A selected cell channel ("user cells")

Cell distribution of a selected cell channel with classification by:
- User cells
- F5 OAM flow
- F4 OAM flow
- User cells with CLP = 1

Circuit reassembly
(for selected test cell channel)
Reassembly .... AAL-1, ITU-T I.363
Error measurement on an
asynchronous channel .... 1544, 2048, 6312, 8448, 34 368, 44 736 kbit/s, 2048 kbit/s with PCM30 frame structure

includes the function of ATM BASIC BN 3060/90.50 and Broadband Analyzer Generator Module (BAG)

Selection of ready-to-run applications and graphics-supported test settings

The graphical method for making test settings is unique. The way that the ANT-10Gig is connected to the device under test, the protocol layers and settings included in the test, or the ATM services to be tested can be quickly and easily seen. Users can select from a range of pre-defined test setups or customize their own. Pre-defined ATM channels can be selected from a database or new channels added. Additionally, all characteristics and parameters for each channel are also stored, for example: traffic type, circuit type, header, traffic contract, traffic source. An editor program is provided for defining the test circuits.

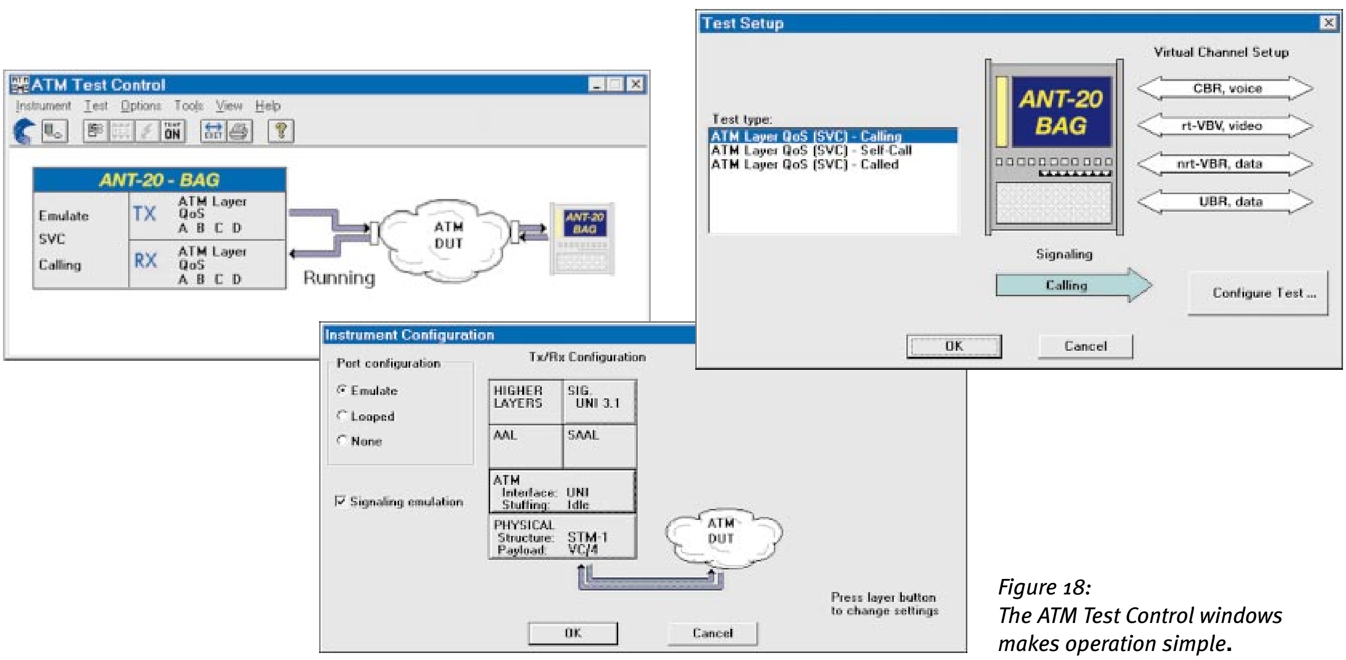


Figure 18: The ATM Test Control windows makes operation simple.

Direct testing of all contract parameters

Some of the main tasks facing measurement services are determining whether users are keeping to traffic contracts and how they are doing so, and establishing how the network handles such contracts. These questions can only be answered by means of a test that allows all the major service parameters to be set and measured.

For such applications, the Broadband Module includes an editor that permits all of the contract parameters for the various ATM services to be set for the first time.
For terminal emulation, all contract characteristics and of the traffic model used for the test can be defined with the Channel Editor.

After starting the measurement, the ANT-10Gig generates test traffic using the selected parameters. This allows direct demonstration of the way that the ATM network handles the user traffic and whether the agreed network resources were in fact available.

The source parameters can be varied on-line during the measurement. This makes it possible to detect policing errors or incorrect network access threshold settings quickly and easily.

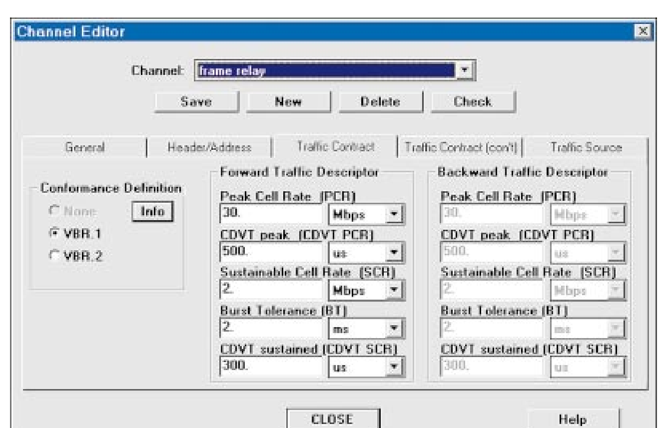


Figure 19: Channel Editor: Setting the traffic descriptor.

ATM QoS test with four different SVCs

The ANT-10Gig with BAG can perform SVC and PVC tests on up to four circuits simultaneously. Multi-channel services, such as those used for multimedia applications, can thus be simulated.
Any channel type can be selected from the database or newly defined for each channel.
Real-time measurements conform to the ITU-T O.191 standard which defines the test cell format and the test algorithm. Important source parameters can be regulated on-line during the test.
The results are clearly displayed, with graphics elements used to indicate defects or highlight status information.

Signalling analysis

Sequence errors in the signalling protocol adversely affect correct management of ATM services. They can be detected by recording and displaying all channel states and changes of state in chronological order with timestamp information. The ANT-10Gig constantly monitors the states of the SVCs being tested. The protocol can thus be checked for correctness and any errors detected rapidly. The connection set up time is measured for all test channels.

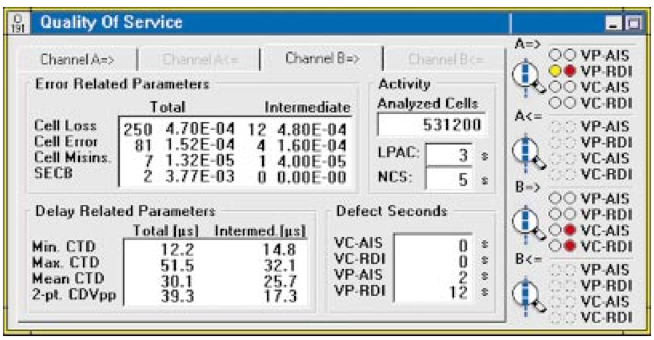


Figure 20: ATM test results for a real-time measurement on channel A.

Traffic management and contract optimization

Traffic shaping (single/dual leaky bucket) can be switched on for each ATM channel, even on-line during the measurement.
In addition, the following are displayed per channel with soft LEDs:

– Non Conforming Cells (NCC)
– Dropped Cells (DC)

Using this information it is possible to check whether the UPC (Usage Parameter Control) functions of the network are working and are implemented in compliance with the standard.
At the same time, the degree of utilization of the traffic contracts can be determined.
Using the facilities for simulating all relevant source parameters with up to four competing channels, it is possible to optimize the contract parameters in the network.

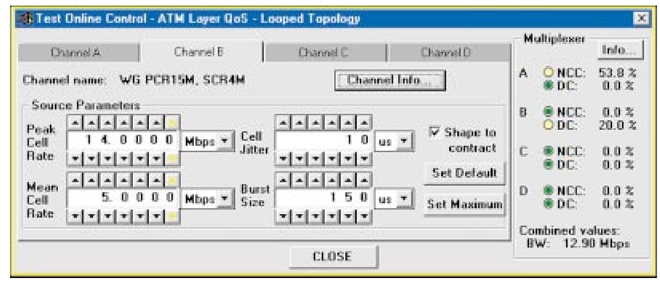


Figure 21: Soft-LED indication of multiplex results.

Professional record of results

The ANT-10Gig generates a professional record of instrument settings and test results that is output from a standard printer.
The record can be used for various purposes, e.g.:

– Guarantee documentation
– Acceptance documentation
– Installation record
– Evidence of adherence to contract, etc.

In other words, the ANT-10Gig handles the entire process from measurement through to producing a permanent record of the results.

Broadband Analyzer/Generator

The module includes software test functions for

– ATM Test Controller
– ATM Test Results
– ATM Channel Explorer
– STM-1/STS-3c with C4/SPE ATM mapping to ITU-T G.707, I.432 and ANSI T1.105/107

ATM test controller

Instrument port configurations

Emulation . . . . SVCs, PVCs
Looped signal . . . . PVCs

Test cell channels

4 test channels
settable from . . . . 0 to 149.760 Mbit/s
Header setting. . . . . via editor
Load setting in . . . . kbit/s, Mbit/s, cells/s
Test cell format . . . . to ITU-T O.191

ATM service categories

Switched circuits and permanent circuits for:
Constant Bit Rate . . . . CBR
Real-time Variable Bit Rate . . . . rt-VBR
Non real-time Variable Bit Rate . . . . nrt-VBR
Deterministic Bit Rate . . . . DBR
Statistical Bit Rate . . . . SBR
Unspecified Bit Rate . . . . UBR

Signalling emulation

Terminal emulation at the UNI as per ITU-T and ATM Forum recommendations
Protocol types. . . . . UNI 3.0
UNI 3.1
Q.2931
Q.2961

Test types. . . . . Self-call, 2 SVCs
Calling, 4 SVCs
Called, 4 SVCs

ATM channel editor
Traffic contract:
Direction type . . . . . . unidirectional
bi-directional symmetrical,
bi-directional asymmetrical

Traffic descriptor
Peak Cell Rate . . . . . . PCR
Cell Delay Variation Tolerance peak . . . . . . CDVT peak
Sustainable Cell Rate . . . . . . SCR
Burst Tolerance . . . . . . BT
Cell Delay Variation Tolerance sustained . . . . . . CDVT sustained
Source parameters . . . . . . Cell clumping,
Burst size
Mean cell rate
Peak cell rate

On-line channel settings
- Peak cell rate
- Cell clumping
- Mean cell rate
- Burst size

Traffic management
User-selectable shaping
CBR . . . . . . Single leaky bucket
DBR . . . . . . Single leaky bucket
rt-VBR . . . . . . Dual leaky bucket
nrt-VBR . . . . . . Dual leaky bucket
SBR . . . . . . Dual leaky bucket
UBR . . . . . . Dual leaky bucket

Error insertion
- Correctable and uncorrectable header errors
- Cell loss
- Cell error
- Cell misinsertion
- Severely errored cell blocks

Alarm generation
ATM layer alarms (for all test channels):
OAM F4/F5 fault flow . . . . . . VP AIS, VP RDI, VC AIS, VC RDI

ATM test results

Measurement modes
ISM . . . . . . In-Service Measurement
OOS . . . . . . Out-of-Service measurement

Receiver status (ISM, OOS)
Signal load, bandwidth
Correctable and uncorrectable header errors
Errored seconds . . . . . . LCD, physical layer defects

ATM Quality of Service (QoS) for 4 SVCs or 4 PVCs
- Cell error ratio
- Cell loss ratio
- Cell misinsertion rate
- Mean cell transfer delay
- Maximum cell transfer delay
- Minimum cell transfer delay
- 2-point cell delay variation
- Severely errored cell block ratio

Errored seconds . . . . . . VP AIS, VP RDI, VC AIS, VC RDI
Activity . . . . . . Analyzed cells, Not connected seconds (SVCs),
Loss of performance assessments capability seconds

Alarm detection, defects (ISM, OOS)
ATM layer alarms (for selected test cell channel):
OAM F4/F5 fault flow . . . . . . VP AIS, VP RDI, VC AIS, VC RDI

Signalling analysis
Channel set-up time
Channel status with interpretation and timestamp
Representation of ATM QoS for the SVC after clearing down the circuit.

ATM channel explorer (ISM, OOS)

Channel search:
Automatic determination of up to 1000 ATM channels with indication of:
Channel number . . . . . . VPI, VCI
Explicit forward congestion
Indication BandWidth (%) . . . . . . CI-BW
CLP = 1 BandWidth (%) CLP1-BW
Average BandWidth . . . . . . AvBW
Current BandWidth . . . . . . CuBW
Aging (switchable function)
Sorts out inactive channels from the activity list.

AAL analysis:
Automatic determination of AAL type for 1000 ATM channels.
Graphic display of distribution.

Trouble scan:
Automatic determination of VC AIS, VC RDI, VP AIS and VP RDI in up to 1000 ATM channels.

Add ATM SONET BN 3060/90.53

The ATM mapping options provide further frame structures for interfaces conforming to ANSI T1.105/107.
Corresponding physical layer measurement functions are offered by the mapping options for the interfaces. These include error and alarm insertion, error measurement and alarm detection.

The following ATM mappings are included:

STS-1/STS-3 ATM mapping
Bit rate
STS-1 . . . . . . 51 840 kbit/s
STS-3 (3 × STS-1) . . . . . . 155 520 kbit/s

DS3 (45 Mbit/s) ATM mapping and STS-1 DS3 ATM mapping
PLCP-based mapping
HEC-based mapping
Bit rate . . . . . . 44 736 kbit/s

DS1 (1.5 Mbit/s) ATM mapping
Bit rate . . . . . . 1544 kbit/s

Add ATM SDH BN 3060/90.52

The ATM mapping options provide further frame structures for interfaces conforming to ITU-T G.804/832/707.
Corresponding physical layer measurement functions are offered by the mapping options for the interfaces. These include error and alarm insertion, error measurement and alarm detection.

The following ATM mappings are included:

E4 (140 Mbit/s) ATM mapping
Bit rate . . . . . . 139 264 kbit/s

E3 (34 Mbit/s) ATM mapping
Bit rate .... 34 368 kbit/s

E1 (2 Mbit/s) ATM mapping
Bit rate .... 2048 kbit/s

STM-1/VC3 ATM mapping
Bit rate .... 155 520 kbit/s

OC-12c/STM-4c ATM testing BN 3060/90.91

Only in conjunction with BN 3060/90.50 and BN 3060/91.11 or BN 3035/91.12

Signal structure (TC sublayer) contiguous concatenation to T1.646, I.432 and af-phy-0046.000
Cell scrambler $X^{43}+1$ (ITU-T) .... can be switched off

Test cell channel
Adjustable from .... 0 to 149.760 Mbit/s
Header setting .... editor
Load setting in .... Mbit/s, Cells/sec, %

Test cells, pay load pattern
AAL-0, pseudorandom bit sequences
(PRBS) .... $2^{11}-1$, $2^{15}-1$, $2^{23}-1$
AAL-1, pseudorandom bit sequences
(PRBS) .... $2^{11}-1$, $2^{15}-1$, $2^{23}-1$
Programmable word, length .... 16 bits
Test cells for ATM performance analysis:
Sequence number .... 3 bytes
Timestamp .... 4 bytes
Error checking CRC-16

Load profiles
Equidistant, setting range .... 4 to 40 000 cell times +1
CBR
Constant, setting range........................... 0.01% to 25%
VBR
Peak cell rate ....1% to 25%
Mean cell rate .... 1% to 25%
Burst size .... 4 to 4092 cell times
Burst period .... 8 to 131 068 cell times

Error insertion
Physical layer like basic ANT-10Gig instrument
ATM layer, AAL:
- Correctable and non-correctable header errors
- AAL-0, cell payload bit error
- AAL-1, sequence number error
- AAL-1, SAR-PDU bit error
- AAL-1 SNP, CRC error
- AAL-1 SNP, parity error

Resolution:
Single error, error ratio, N errors in M cells

Alarm generation
Loss of Cell Delineation .... LCD
ATM layer (for any selected cell channel):
OAM F4/F5 fault flow:
VP AIS, VP RDI, VP AIS+VC AIS
VC AIS, VC RDI, VP RDI+VC RDI
Background load generator
1 channel can be switched ON/OFF
Residual bandwidth .... up to 599.040 Mbit/s
Header is freely definable

Circuit emulation
Generation of asynchronous channels:
1.544, 2.048, 6.312, 8.448, 34.368, 44.736 kbit/s, 2.048 kbit/s with PCM30 frame structure
ATM channel segmentation .... AAL-1, ITU-T I.363

Error measurement, anomalies, statistics
Detection of following error types:
- Correctable and non-correctable header errors
- AAL-0, cell payload bit error
- AAL-1, sequence number error
- AAL-1, SAR-PDU bit error
- AAL-1 SNP, CRC error
- AAL-1 SNP, parity error

ATM performance analysis
- Cell error ratio
- Cell loss ratio
- Cell misinsertion rate
- Mean cell transfer delay
- 2-point cell delay variation
  Measured between greatest and smallest value of cell transfer delay
- Cell transfer delay histogram:

Number of classes....................................... 128
Min. class width .... 160 ns
Max. class width .... 335 ms
Adjustable offset .... 0 to 167 ms
Offset steps .... 2.5 µs

Alarm detection, defects (ISM, OoS)
Loss of Cell Delineation .... LCD
ATM layer (for any selected cell channel):
OAM F4/F5 fault flow:
VP AIS, VP RDI, VC AIS, VC RDI

Traffic channel analysis
Time chart simultaneously for
- All traffic cells
- Average cell rate of any selected cell channel
- Peak cell rate of any selected cell channel

Display in .... Mbit/s, Cells/s, %

Channel utilization histogram
- All assigned cells
- One selected cell channel (user cells)

Cell distribution in traffic channel
Classification of one selected cell channel by
- User cells
- F5 OAM flow
- F4 OAM flow
- User cells with CLP = 1

Circuit reassembly
Reassembly .... AAL-1, ITU-T I.363
Error measurement on asynchronous channels:
1.544, 2.048, 6.312, 8.448, 34.368, 44.736 kbit/s,
2.048 kbit/s with PCM30 frame structure

AUTO – Remote

ANT-10Gig applications in the remote controlled production environment

V.24/RS232 Remote Control Interface BN 3035/91.01

Remote control of instrument functions using SCPI command structure

Interface V.24/RS232

GPIB (PCMCIA) Remote Control Interface BN 3035/92.10

Remote control of instrument functions using SCPI command structure. A GPIB adapter card for the ANT-10Gig PCMCIA interface is supplied with this option

Interface . . . . GPIB

TCP/IP Remote Control Interface BN 3035/92.11

Remote control of instrument functions using SCPI command structure

Interface . . . . 10/100 Mbit/s Ethernet

LabWindows driver BN 3038/95.99

Simplifies creation of remote-control programs for automated testing using LabWindows.
The driver can be used with options BN 3035/91.01 and BN 3035/92.10.

Test Sequencer CATS BASIC BN 3035/95.90

The Test Sequencer is the ideal tool for rapid, simple adaptation and automatic performance of complete test sequences on the ANT-10Gig (CATS = Computer Aided Test Sequencer). This saves time where repetitive tests are required in the production, installation and monitoring of SDH, SONET and ATM network elements.
The comprehensive test case library includes solutions for various applications, such as BERTs, alarm sensor tests, jitter, offset and pointer tests and monitoring ATM quality of service (QoS) parameters. Once created, test sequences are started with a single mouse click. A report in ASCII format for documentation purposes is compiled during the measurement. All test cases are pre-defined and ready to run. They can also be easily customized.

More information is found in the data sheet "Test Automation and Remote Control".

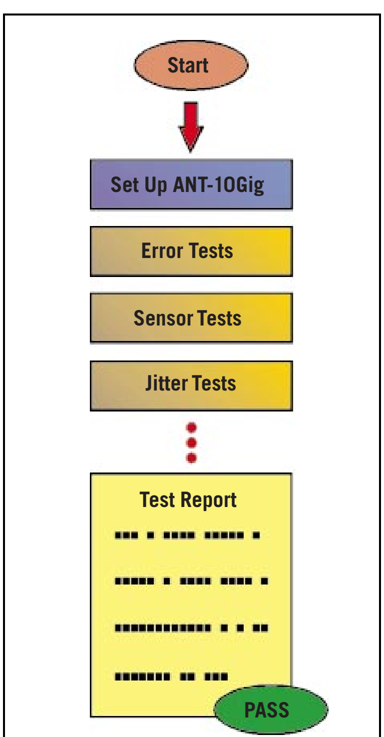


Figure 22: Automatic test sequences with the ANT-10Gig.

Test Sequencer CATS PROFESSIONAL BN 3035/95.95

In many cases, especially in Design Verification, R&D, Regression Testing, Manufacturing and Conformance Testing it is not sufficient to automate a single test set. Rather, the software application has to deal with a number of test sets from different vendors, and in most cases it is also necessary to include the 'System under Test' into an automated setup.
The CATS PROFESSIONAL package is designed to make it easy to integrate the ANT-10Gig into such test environments, by making existing CATS test routines available in such a way that they will run not only in a self-contained manner, but also as ready-made 'plug-ins' into the customer's own test solution.

Remote Operation BN 3035/95.30

These options allow operation of the ANT-10Gig from a Windows PC. The complete ANT-10Gig user interface is transferred to the PC screen via modem or LAN link. This means that all the functions of the instrument can be used from any remote location. The results are simply transferred to the controlling PC for further processing. Applications include troubleshooting networks or centralized operation of test instrumentation and devices in the production and system test environment.

The package provides remote operation via a PCMCIA or external modem (V.24/RS232) which must be purchased separately or provides remote operation via a Ethernet Socket.

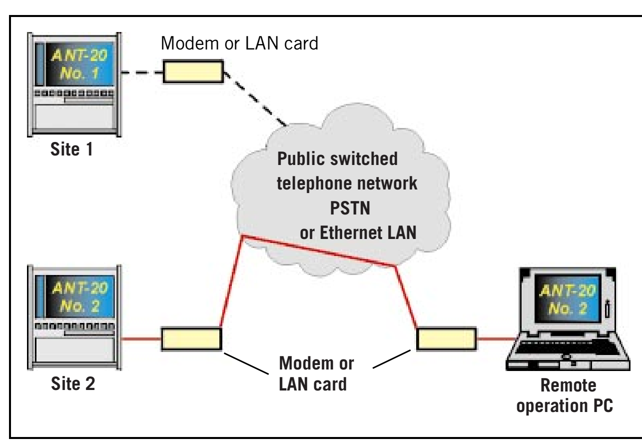


Figure 22: Remote operation of the ANT-10Gig.

Ordering Information

ANT-10Gig – SONET version BN 3060/36

Includes:
- Mainframe, touchscreen
- OC-192/STM-64 combined with STS-12c SPE, STS-48c SPE and STS-192c, STM-4c, STM-16c, STM-64c
- Mappings for STS-1: DS1, E1, DS3, DS2
- Electrical interfaces: STS-1, STS-3c, DS1, DS3, DS2
- APS, TCM analysis, OH capture, OH sequencing
- Two optical adaptors to be selected

Options

Electrical Interfaces at 9953 Mbit/s — BN 3060/91.48
Please order with the mainframe.
Not possible to upgrade later on.

Add SDH — BN 3060/90.04
STM-1 mappings
C3 (34 Mbit/s in STM-1, AU-3/AU-4)
C4 (140 Mbit/s in STM-1)
C11 (1.5 Mbit/s in STM-1, AU-3/-4, TU-11/-12)
C3 (45 Mbit/s in STM-1, AU-3/AU-4)
C2 (6 Mbit/s in STM-1, AU-3/AU-4)
BERT (2, 8, 34, 140 Mbit/s)

Add SDH BERT only — BN 3060/90.33
(interfaces 2, 8, 34, 140 Mbit/s)

Drop & Insert — BN 3060/90.10

M13 MUX/DEMUX chain — BN 3060/90.12

PDH 64k/140M MUX/DEMUX chain — BN 3060/90.11

Optical Interfaces
include two optical adapters – please select.
The following options BN 3060/91.01 to /91.12 are alternatives.

Optical OC-1/3, STM-0/1, 1310 nm	BN 3060/91.01
Optical OC-1/3, STM-0/1, 1310 & 1550 nm	BN 3060/91.02
Optical OC-1/3/12, STM-0/1/4, 1310 nm	BN 3060/91.11
Optical OC-1/3/12, STM-0/1/4, 1310 & 1550 nm	BN 3060/91.12

The options BN 3060/91.50 to /91.52 are alternatives.

Optical OC-48/STM-16, 1310 nm	BN 3060/91.51
Optical OC-48/STM-16, 1550 nm	BN 3060/91.50
Optical OC-48/STM-16, 1310/1550 nm switchable	BN 3060/91.52

OC-12c/STM-4c Options
OC-12c/STM-4c ATM Testing — BN 3060/90.91
requires Optical Module BN 3060/91.11 or /91.12 and ATM BASIC BN 3060/90.50
OC-12c/STM-4c Virtual Concatenation — BN 3060/90.92

Optical Packages
include optical interfaces from 52 Mbit/s to 2488 Mbit/s and four optical adapters – please select.

Optics OC-1/3/12/48, STM-0/1/4/16, 1310 nm	BN 3060/91.17
Optics OC-1/3/12/48, STM-0/1/4/16, 1550 nm	BN 3060/91.18
Optics OC-1/3/12/48, STM-0/1/4/16, 1310 & 1550 nm	BN 3060/91.19
Optics OC-1/3/12, STM-0/1/4, 1310 nm Optics OC-48/STM-16, 1550 nm	BN 3060/91.20

Optical Attenuator (plug-in) — BN 2060/00.61
SC-PC, 1310 nm, 15 dB

Optical Power Splitter (90%/10%) — BN 3060/91.05
includes three optical adapters

Optical Test Adapters

ST type (AT&T)	BN 2060/00.32
HMS-10/A, HFS-13/A (Diamond)	BN 2060/00.34
HMS-10, HFS-13 (Diamond)	BN 2060/00.35
"Keyed Biconic", Twist-Proof (AT&T)	BN 2060/00.37
D4 (NEC)	BN 2060/00.40
DIN 47256	BN 2060/00.50
FC, FC-PC (NTT)	BN 2060/00.51
E 2000 (Diamond)	BN 2060/00.53
SC, SC-PC (NTT)	BN 2060/00.58

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

O.172 Jitter and Wander Packages
O.172 Jitter/Wander Package up to 155 Mbit/s — BN 3060/91.30
Includes MTIE/TDEV offline analysis
O.172 Jitter/Wander Package up to 622 Mbit/s — BN 3060/91.31
Includes MTIE/TDEV offline analysis
O.172 Jitter at 9953 Mbit/s — BN 3060/91.60
O.172 Wander Analyzer at 9953 Mbit/s — BN 3060/91.61
Includes MTIE/TDEV offline analysis
Requires Jitter 10 Gbit/s BN 3060/91.60
O.172 Wander Generator — BN 3060/91.62
Requires Jitter at 10 Gbit/s BN 3060/91.60 and either Jitter Generator at 155 Mbit/s BN 3035/90.81 or BN 3060/91.30 or BN 3060/91.31

ATM Functions

ATM BASIC for STM-1/STS-3c — BN 3060/90.50

ATM Comprehensive — BN 3060/90.51
(includes ATM BASIC and BAG)

Add ATM SDH — BN 3060/90.52
(requires ATM module BN 3060/90.50 or BN 3060/90.51)
E4 (140 Mbit/s) ATM mapping
E3 (34 Mbit/s) ATM mapping
E1 (2 Mbit/s) ATM mapping
VC-3 ATM mapping in STM-1 (AU-3/AU-4)

Add ATM SONET — BN 3060/90.53
(requires ATM module BN 3060/90.50 or BN 3060/90.51)
STS-1 (51 Mbit/s) ATM mapping
DS3 (45 Mbit/s) ATM mapping
DS1 (1.5 Mbit/s) ATM mapping

OC-12c/STM-4c ATM Testing — BN 3060/90.91
requires Optical Module BN 3060/91.11 or /91.12

Remote Control Interfaces

V.24/RS232 Remote Control Interface	BN 3035/91.01
GPIB Remote Control Interface	BN 3035/92.10
TCP/IP Remote Control Interface	BN 3035/92.11
LabWindows CVI driver	BN 3038/95.99

Remote Operation
Remote Operation — BN 3035/95.30

Test Automation

Test Sequencer CATS BASIC	BN 3035/95.90
Test Sequencer CATS PROFESSIONAL	BN 3035/95.95

Calibration Report

BN 3060/94.01

(Calibration is carried out in accordance with quality management system certified to ISO 9001.)

Accessories

Transport case for ANT-10Gig	BN 3035/92.03
External keyboard (UK/US)	BN 3035/92.04
Decoupler (-20 dB, 1.6/5.6 jack plug)	BN 3903/63
TKD-1 probe, 48 to 8500 kbit/s	BN 822/01
Acterna TSR-37 Rubidium Timing Signal Reference	DA 3700/00
Acterna PenBERT mini PCM monitor (E1)	BN 4555/11
(see Acterna PenBERT data sheet for details)	

Training courses

Location: 72800 Eningen u.A., Germany
Information about availability and other locations available on request.

"SDH/SONET troubleshooting"	BN 3035/89.01
"Synchronization"	BN 3035/89.02
"Solving Jitter Problems"	BN 3035/89.03
"SDH/SONET Quality of Service"	BN 3035/89.04
"Optimizing Your SDH/SONET Network"	BN 3035/89.05
"Turning up ATM Services"	BN 3035/89.30
"ATM Traffic Management"	BN 3035/89.31
"ATM Quality of Service"	BN 3035/89.32