Acterna ANT-20
Advanced Network Tester – SONET

The test solution that sets the pace in analyzing digital communications systems

- ***Multi-rate transmission testing from DS1 to OC-48c***
- ***Modular platform offering SONET, DSn, SDH and ATM capabilities***
- ***Built-in Pentium PC and Windows 98 user interface for easy processing of test results***
- ***Complemented by a lot of easy-access, automated test features***
- ***Large, color screen plus graphical results presentation***

Edition: April 2001

As digital communications networks expand, the number of network operators is growing too, and not just due to providers merging across boarders. Different networks such as Cellular networks, CATV and Internet are converging too. Nowadays, customers demand next-to-perfect network availability, and a top-level transmission quality has become a given.

ANT-20: Flexibility with sure future viability

The ANT-20 Advanced Network Tester can be individually adapted to the latest test requirements and still leave room for handling possible future needs. The instrument thus meets the everchanging requirements of the operators and manufacturers of modern communications networks. The modular hardware and software concept means that the ANT-20 test functions are easily adapted to cover a new scenario.
Always ready for new standards, higher bitrates and the intelligent system components of the future the ANT-20 is at the forefront of network installation and manufacturing applications.

Superior ease of use

The ANT-20 is built around the standard Microsoft® Windows™ graphical user interface and a large display screen, combining comprehensive test facilities with superior ease of use. The instrument is operated right on screen using a mouse or the optional touchscreen. The graphical user interface facilitates rapid, application-oriented instrument settings together with simultaneous display of major parameters and test results.

Save time and money through automation

Test automation is particular important for acceptance measurements and in development and production of network elements. The test sequencer is a test automation software package that runs directly on the ANT-20's built-in PC. Without any programming backround, you can still easily create test sequences to meet your own specific needs.

ACTERNA™
The Keepers of Communications

Configuration Guide

ANT-20 SONET (up to 2.5 Gbit/s)

			Please select
	ANT-20 SONET	BN 3035/42	☐
	Touchscreen	BN 3035/93.11	☐
SONET page 4–9	**Mapping DS1 – VT1.5**	BN 3035/90.10	☐
	Mapping DS2 – VT6	BN 3035/90.11	☐
	Mapping DS3 – STS-1SPE	BN 3035/90.12	☐
	Mapping E1 – VT2	BN 3035/90.13	☐
	Mapping STS-3c – BERT	BN 3035/90.03	☐
	Extended OH Analysis (APS capture, TCM)	BN 3035/90.15	☐
	Drop & Insert/Through mode	BN 3035/90.20	☐
	Mux/Demux M13	BN 3035/90.32	☐
SDH page 9	**Mapping E1 – C12**	BN 3035/90.01	☐
	Mapping E3 – C3	BN 3035/90.02	☐
	Mapping E4 – C4 (and STS-3c)	BN 3035/90.03	☐
	Mapping DS1 – C11/C12	BN 3035/90.04	☐
	Mapping DS3 – C3	BN 3035/90.05	☐
	Mapping DS2 – C2	BN 3035/90.06	☐
	Mux/Demux 64k/140M	BN 3035/90.30	☐
	BERT 2/8/34/140	BN 3035/90.33	☐
Optic page 10–13	**OC-1/3, 1310 nm**	BN 3035/90.43	☐
	OC-1/3, 1550 nm	BN 3035/90.44	☐
	OC-1/3, 1310/1550 nm	BN 3035/90.45	☐
	OC-1/3/12, 1310 nm	BN 3035/90.46	☐
	OC-1/3/12, 1550 nm	BN 3035/90.47	☐
	OC-1/3/12, 1310/1550 nm	BN 3035/90.48	☐
	OC-48, 1550 nm	BN 3035/91.53	☐
	OC-48, 1310 nm	BN 3035/91.54	☐
	OC-48, 1310/1550 nm	BN 3035/91.59	☐
	Package OC-1/3/12/48, 1310 nm	BN 3035/91.17	☐
	Package OC-1/3/12/48, 1550 nm	BN 3035/91.18	☐
	Package OC-1/3/12/48, 1310/1550 nm	BN 3035/91.19	☐
	Package OC-1/3/12, 1310 nm & OC-48, 1550 nm	BN 3035/91.23	☐
	Optical Power Splitter	BN 3035/90.49	☐
CONCAT. page 11–13	**OC-12c BERT**	BN 3035/90.90	☐
	OC-12c ATM	BN 3035/90.91	☐
	OC-12c Virtual Concatenation	BN 3035/90.92	☐
	OC-48c BERT	BN 3035/90.93	☐

		Please select	
Package Jitter/Wander up to 155 Mbit/s	BN 3035/91.29	☐	**Jitter/ Wander**
Package Jitter/Wander up to 622 Mbit/s	BN 3035/91.31	☐	
Jitter Generator up to 155 Mbit/s	BN 3035/90.81	☐	page 14 – 18
Jitter Meter up to 155 Mbit/s	BN 3035/90.82	☐	
Jitter Generator 622 Mbit/s	BN 3035/90.83	☐	
Jitter Meter 622 Mbit/s	BN 3035/90.84	☐	
Wander Generator up to 622 Mbit/s	BN 3035/90.85	☐	
Wander Analyzer up to 622 Mbit/s	BN 3035/90.86	☐	
MTIE/TDEV Analyzer	BN 3035/95.21	☐	
ATM Package PVC & SVC	BN 3035/91.81	☐	**ATM**
ATM Basic Module	BN 3035/90.70	☐	page 19 – 24
ATM SVC Broadband Modul	BN 3035/90.80	☐	
ATM mapping STS-1	BN 3035/90.71	☐	
ATM mapping E4	BN 3035/90.72	☐	
ATM mapping DS3-HEC + DS3-PLCP	BN 3035/90.73	☐	
ATM mapping E3	BN 3035/90.74	☐	
ATM mapping E1	BN 3035/90.75	☐	
ATM mapping DS1	BN 3035/90.76	☐	
ATM mapping VC-3	BN 3035/90.77	☐	
Test Sequencer CATS BASIC	BN 3035/95.90	☐	**AUTO**
Test Sequencer CATS PROFESSIONAL	BN 3045/95.95	☐	page 25
V.24/RS232 Remote Control Interface	BN 3035/91.01	☐	**Remote**
GPIB/IEEE Remote Control Interface	BN 3035/92.10	☐	page 25
TCP/IP Remote Control Interface	BN 3035/92.11	☐	
Remote Operation	BN 3035/95.30	☐	

Specifications

ANT-20 SONET

ANT-20 mainframe BN 3035/42

Includes:

- Generator and analyzer for electrical STS-1 and STS-3 signals allowing:
  - Simulation and evaluation in the TOH/POH
  - Generation and analysis of errors and alarms
  - Pointer generator and analyzer
  - DSn analysis
- Generator and analyzer for bit error rate tests (BERT) at 6 Mbit/s with unframed, 1.5 and 45 Mbit/s with framed and unframed test patterns
- One selectable mapping
- 1 extension slot
- Ethernet and USB interface

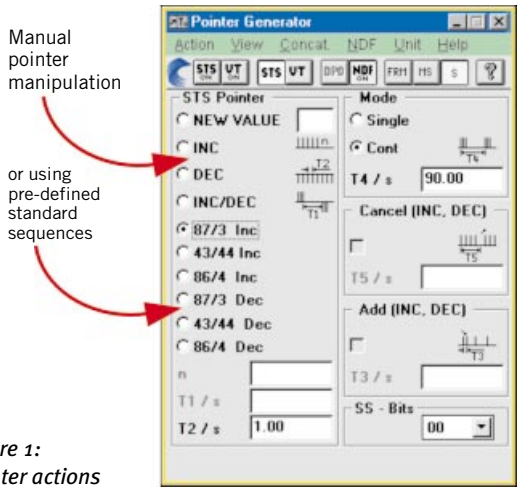


Figure 1:
Pointer actions

Generator unit

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

Synchronisation 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-3 output signal

Generation of a STS-3 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.

STS-1 output signal

Generation of a STS-1 signal conforming to Telcordia GR-253, ANSI T1.105a

Mappings

One selectable STS-1 mapping is included in the basic instrument. Other mappings can be added as needed.
Content of the selected tributary:
– Framed or unframed DS1 or DS3 test pattern
– M13 multiplex signal (with M13 MUX/DEMUX option)
– External DS1 or DS3 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.

Generation of pointer actions (Figure 1)

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

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, K2, N1 and N2)

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 parity errors
frame errors, REI-L, REI-P, 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 ..... 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 ..... LOS, LOF, AIS-L, RDI-L, LOP-P,
AIS-P, UNEQ-P, PLM-P, RDI-P, RDIEPP,
RDIEPS, RDIEPC, PDI-P
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

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.

Programmable word

Length ..... 16 bits

Receiver unit

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 ..... 15 5520 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 chapter Optical Interfaces for details.

STS-3 receive signal

(for signal structure, see under generator unit)
The ANT-20 demultiplexes one selectable STS-1 tributary from STS-3 and feeds it to the internal processor for evaluation.

STS-1, 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

Automatic modes

Autoconfiguration

Automatically sets the ANT-20 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 SONETsignal. The ANT-20 receiver checks for alarms in the receive signal, the SONETstructure 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.

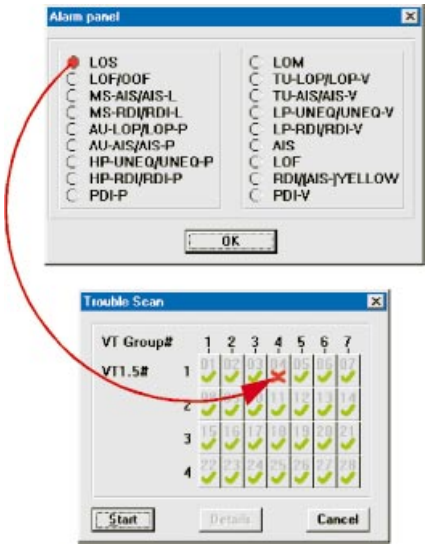


Figure 2: Trouble scan

Automatic TROUBLE SCAN function (Figure 2)

The TROUBLE SCAN function permits sequential testing of all VT1.5 or VT2 channels in a SONETsignal. The ANT-20 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.

AutoScan function (Figure 3)

This automatic "AutoScan" function allows you to rapidly check the signal structure, the mapping used, the trace identifier and the payload – even with mixed mapped signals.
The ANT-20 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. All the displayed results can be printed out.

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 SONETsignal. The ANT-20 receiver checks for alarms in the receive signal, the SDH 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.

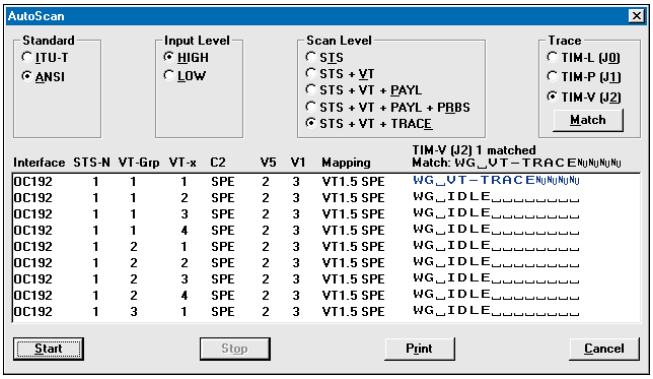


Figure 3: AutoScan

Measurement types

Error measurements

Error types . . . . . B1, B2, B3 parity errors
frame errors, REI-L, REI-P, 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 4)

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

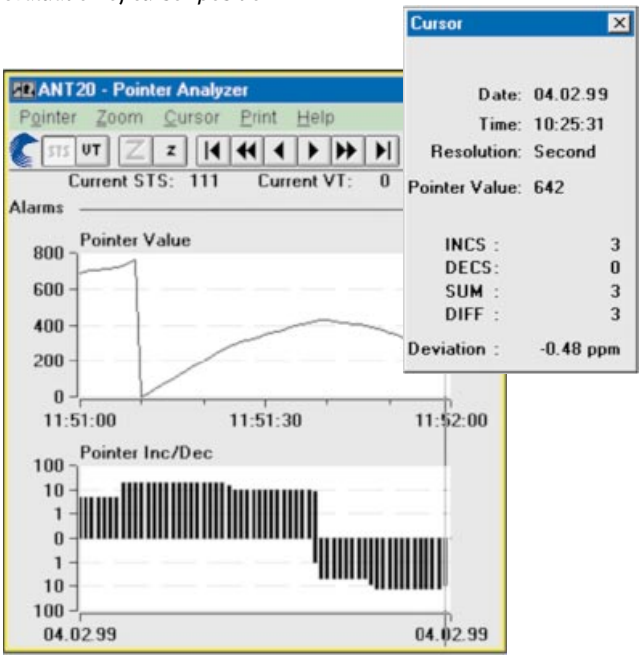
Clock frequency measurement

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-20 measures the time taken to transmit the test pattern from the generator through the section under test and back to the receiver.

Figure 4: Graphic pointers. Display showing additional evaluation of cursor position



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
Additionally, for DS1, DS3. . . . . .LSS, AIS, RAI (YELLOW), IDLE (DS3), FEAC (DS3)

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 Identifier
– J0 . . . . . display of 1 byte or 16-byte ASCII sequence
– J1, J2 . . . . . display of 16 or 64-byte ASCII sequence

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
Memory capacity . . . . . up to 1 million entries (approx. 100 days at 7 entries per minute)

Acustic indication of Errors and Alarms
Beeper upon any detected error and alarm

Off-line analysis software
The software runs on standard PCs and permits comprehensive analysis of stored ANT-20 results. After loading the results, the ANT-20 settings during the measurement and the stored results can be accessed. Zoom and filter functions allow detailed evaluations. The processed results can be exported in CSV format for importing into other programs such as Excel or Winword for producing documentation.

Results 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 5)
Display of errors, pointer operations/values and alarms as bargraphs vs. time
Units, time axis. . . . . seconds, minutes, 15 minutes, hours, days

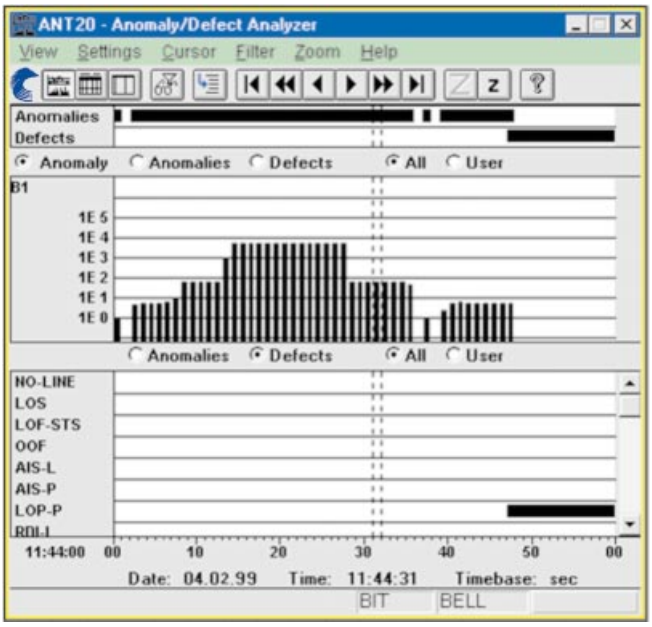


Figure 5: Histogram results display

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

Result printout
ANT-20 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

Instrument operation
ANT-20 is operated using the standard Microsoft® Windows™ graphical user interface. Operation is menu-controlled using the mouse or optional touchscreen. A trackball can also be connected if desired.

Application selection and storage
ANT-20 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-20 via floppy disk. Easy to use filter functions allow quick selection of the desired application.

Display
A large display screen is available for the ANT-20:
Color TFT screen (touchscreen optional) . . . . . 10.4″, 256 colors
Resolution . . . . . .640 × 480 pixels (VGA standard)

Built-in PC
ANT-20 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-20 saves all data. As soon as the AC line voltage is reestablished, 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 to 104° F (+5 to +40 °C)
Storage and transport range . . . . . –4 to 158° F (–20 to +70 °C)

Dimensions (w × h × d) in mm . . . . . approx. 320 × 350 × 170
in inches . . . . . approx. 12.6 × 13.8 × 6.7

Weight . . . . . approx. 10 kg/22 lb

Options

Touchscreen BN 3035/93.11
Upgrade for color display screens

VT1.5 and STM-0 mapping BN 3035/90.10
DS1 in STS-1 and 1.5 Mbit/s in STM-0
Modes . . . . . asynchronous, byte synchronous (floating)
Error insertion and measurement
Additional error types . . . . . BIP-V, REI-V

Alarm generation, dynamic
Alarm types . . . . . LOP-V, AIS-V, LOM, UNEQ-V, RDI-V, RDIEVP, RDIEVS, RDIEVC, RFI-V, PDI-V, PLM-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

Alarm generation, static (on/off) and evaluation
Alarm types . . . . . LOP-V, AIS-V, LOM, UNEQ-V, PLM-V, TIM-V, RDI-V, RDIEVP, RDIEVS, RDIEVC, RFI-V
Alarm detection only . . . . . NDF-V

VT6 SPE mapping BN 3035/90.11
(6 Mbit/s unframed/Bulk in STS-1)

STS-1 SPE and STM-0 mapping BN 3035/90.12
Errors and alarms as for mainframe instrument

VT2 SPE and STM-0 mapping BN 3035/90.13
E1 in STS-1 and 2 Mbit/s in STM-0
Modes . . . . . asynchronous, byte synchronous (floating)
Error insertion and alarm generation as for VT1.5 SPE mapping.

OC-12c/STM-4c Bit Error Tester BN 3035/90.90
OC-12c/STM-4c ATM Testing BN 3035/90.91
OC-12c/STM-4c Virtual Concatenation BN 3035/90.92
Concatenated containers in both contiguous and virtual forms are now widely used in networks in order to meet the demands for ever higher bandwidths. The BERT option tests the performance of transmission paths.
The ATM testing option extends the applications of the ATM module (BN 3035/90.70). The Virtual Concatenation option provides the facilities for dealing with these new multiplexing techniques.

OC-48c/STM-16c Error Test (Bulk) BN 3035/90.93
requires one of the following Optics Modules:
BN 3035/91.53 to BN 3035/91.59
The quality of a 2.5 Gbit/s path can be determined very simply using a bit error rate test across the concatenated container. This is used for connectivity tests when lining up new paths between ATM switches and terabit routers via OC-192/STM-64 systems. This measurement is also used when commissioning DWDM tributaries.
The test signal fills the entire STS-48c SPE or VC-4-16c.

Extended Overhead Analysis BN 3035/90.15

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

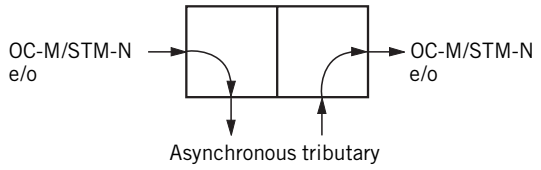
APS time measurement
In synchronous networks, a defined maximum switch-over time is necessary for the traffic in case of a fault.
To verify compliance with this requirement, the ANT-20 measures the switch-over time with 1 ms resolution.
The result can be printed.

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 . . . . . $< 2 \times 10^{-4}$

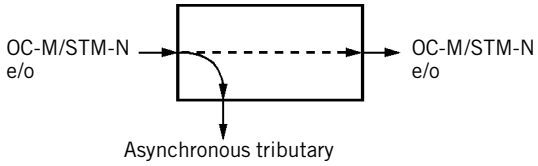
Drop & Insert BN 3035/90.20

This option provides the following functions:

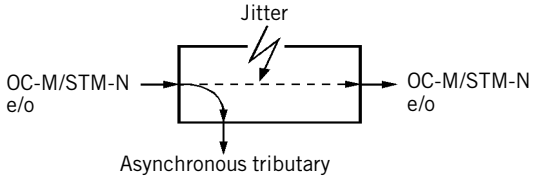
1. Generator and receiver operate independently
as mapper and demapper. The DS1/DS3 signal from a selected channel is dropped from the receive signal and output to a connector. An external or internal DS1/DS3 signal is inserted into the transmit signal.



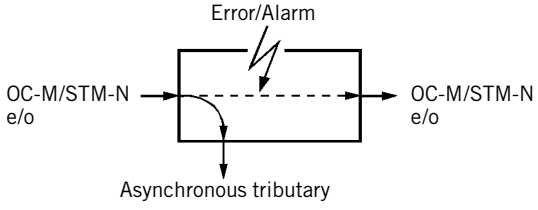
2. Through mode: The received signal is looped through the ANT-20 and re-transmitted (generator and receiver coupled). The DS1/DS3 signal from a selected channel may be dropped from the receive signal and output to a connector. An internal DS1/S3 signal may be inserted into the transmit signal. The ANT-20 can operate here as an active signal monitor without affecting the signal.



3. Through mode jittering: The looped-through DS1/DS3 or SONET signal can also be jittered using the Jitter Generator option. This applies to all jitter frequencies up to 622 Mbit/s depending on the jitter option fitted.



4. Error insertion in through mode: The looped-through synchronous signal can be manipulated if required:
- Overwriting bytes in the TOH (except B1, B2, H1 to H3)
- Error insertion
- Alarm generation by programming the TOH



5. Block and Replace (B&R)
For this function, the ANT-20 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-20 from the ring. By inserting specific errors, the error thresholds of the APS mechanism in the system can be tested.

Additional input and output
for tributary signals . . . . . 75 Ω, coaxial BNC;
line codes as for mainframe instrument
Input and output
for balanced tributary signals. . . . . use balanced connectors
on mainframe

M13 MUX/DEMUX chain BN 3035/90.32

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 (requires option BN 3035/90.34) and is available as payload in mappings (requires option BN 3035/90.12 or BN 3035/90.05)
Alarms and errors can be generated and analyzed.

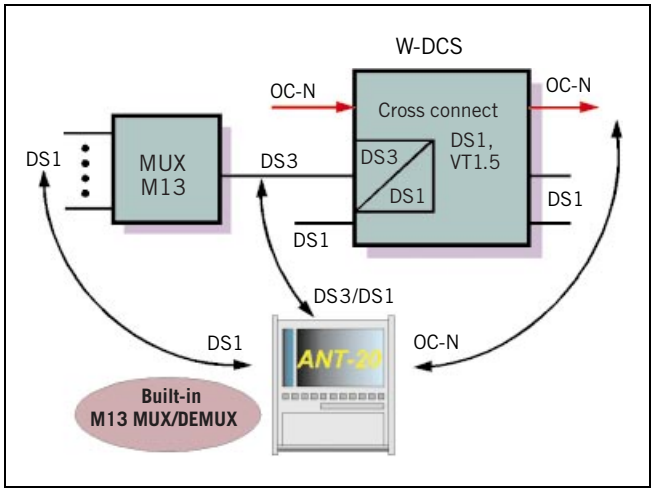


Figure 6: Testing hybrid systems with M13 MUX/DEMUX

64k/140M MUX/DEMUX chain BN 3035/90.30

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 options BN 3035/90.01 to 90.03 or BN 3035/90.13). Alarms and errors can be generated and analyzed.

BERT (2, 8, 34, 140 Mbit/s) BN 3035/90.33

Signal structure and interfaces for generator and receiver:
Framed and unframed test patterns
Additionally, for coaxial input/output
Bit rate, line code . . . . . .2048, 8448, 34368 kbit/s, HDB3
Bit rate, line code . . . . . .139264 kbit/s, CMI
Additionally, for balanced input/output
Bit rate, line code . . . . . 2048 kbit/s, HDB3

Optical Interfaces

All of 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. All optical interface options include the required number of test adapters.

Optical Modules up to 155 Mbit/s

Optical OC-1/3, STM-0/1, 1310 nm **BN 3035/90.43**

Optical OC-1/3, STM-0/1, 1550 nm **BN 3035/90.44**

Optical OC-1/3, STM-0/1, 1310 & 1550 nm **BN 3035/90.45**

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 three options for adapting to the required wavelength:
Wavelength . . . . . 1310 nm, 1550 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 . . . . . –8 to –28 dBm (–8 to –34 dBm typ.)

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

155 Mbit/s electrical interface
for connecting the ANT-20 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 3035/90.46**

Optical OC-1/3/12, STM-0/1/4, 1550 nm **BN 3035/90.47**

Optical OC-1/3/12, STM-0/1/4, 1310 & 1550 nm **BN 3035/90.48**

Bit rate of TX and RX signal . . . . . 155 520 kbit/s, 622 080 kbit/s
additionally, for STS-1/STM-0 mappings . . . . . 51840 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 three options for adapting to the required wavelength:
Wavelength . . . . . 1310 nm, 1550 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 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.

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
with STS-3c mapping option BN 3035/90.03, or ATM Module Option BN 3035/90.70
– one internally generated STS-3c 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 main-frame 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 STM-4 . . . . . MS-REI
for OC-12 . . . . . REI-L

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 4.8×10^6 and n = 2 to 8001 frames or 0.2 s to 600 s

Alarm generation, dynamic
Alarm types for STM-4 . . . . . LOF, MS-AIS, MS-RDI
for OC-12 . . . . . LOF, AIS-L, RDI-L
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 STM-4 . . . . . MS-AIS, MS-RDI, RS-TIM
for OC-12 . . . . . AIS-L, RDI-L, TIM-L
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, STM-1/-4, OC-1/3/12 . . . . . −8 to −28 dBm (−8 to −34 dBm)

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

The ANT-20 demultiplexes one selectable STM-1 or STS-3c/STS-1 tributary from the STM-4 or OC-12/OC-3 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 STM-4 . . . . . MS-AIS, MS-RDI, RS-TIM
for OC-12 . . . . . AIS-L, RDI-L, TIM-L

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-20 to STM-1/OC-3 and STM-4/OC-12 monitor points

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

Concatenated Mappings 622 Mbit/s

Option OC-12c/STM-4c BERT BN 3035/90.90
Only in conjunction with BN 3035/90.46 or BN 3035/90.47 or BN 3035/90.48

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

Option OC-12c/STM-4c Virtual Concatenation BN 3035/90.92

Only in conjunction with BN 3035/90.90 or BN 3035/90.91

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 3035/90.91

Only in conjuction with BN 3035/90.70 and BN 3035/90.46 or BN 3035/90.47 or BN 3035/90.48

See chapter “ATM options” for further detail.

Optical Modules up to 2488 Mbit/s

All optical packages include 4 optical adapters, STM-16c/OC-48c, STM-4c/OC-12c are not included.

Optical OC-1/3/12/48, STM-0/1/4/16, 1310 nm **BN 3035/91.17**

Optical OC-1/3/12/48, STM-0/1/4/16, 1550 nm **BN 3035/91.18**

Optical OC-1/3/12/48, STM-0/1/4/16, 1310 & 1550 nm **BN 3035/91.19**

Optical OC-1/3/12, STM-0/1/4, 1310 nm OC-48, STM-16, 1550 nm **BN 3035/91.23**

Optical Modules 2488 Mbit/s

Optical STM-16, OC-48, 1310 nm **BN 3035/91.54**

Optical STM-16, OC-48, 1550 nm **BN 3035/91.53**

Optical STM-16, OC-48, 1310/1550 nm switchable **BN 3035/91.59**

One 2.5 Gbit/s module can be fitted in the extension slot of the ANT-20.

The optical interfaces meet the specifications of ITU-T Recommendation G.957 (Table 4) and Telcordia TA-NWT-000253 I.6 (Table 4–9, 4–10).
Classes S-16.2, L-16.2, L-16.3 (ITU-T) or IR-2, LR-2, LR-3 (Telcordia) are fulfilled at 1550 nm; classes S-16.1, L-16.1 (G.957) or IR-1, LR-1 (Telcordia) 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 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
– 4 identical STM-4c (Option BN 3035/90.90 required)
– one STM-4c tributary (Option BN 3035/90.90 required) and 3 × UNEQ/non specific

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 3035/90.03 required)
– one STS-3c tributary (Option BN 3035/90.03 required) and 15 × UNEQ/non specific
– 4 identical STS-12c (Option BN 3035/90.90 required)
– one STS-12c tributary (Option BN 3035/90.90 required) and 3 × UNEQ/non specific

Contents of STM-16/OC-48 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 STM-16 ..... MS-REI
for OC-48 ..... REI-L
Single error or error rate ..... 2×10^{-3} to 1×10^{-10}

Alarm generation, dynamic
Alarm types for STM-16 ..... LOF, MS-AIS, MS-RDI
for OC-48 ..... LOF, AIS-L, RDI-L
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 STM-16 ..... MS-AIS, MS-RDI
for OC-48 ..... AIS-L, RDI-L

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

SOH/TOH 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

Concatenated Mapping 2488 Mbit/s

Option OC-48c/STM-16c BERT — BN 3035/90.93
Only in conjunction with BN 3035/91.53 to /91.59

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

Solutions for 10 Gbit/s

With the new ANT-10Gig we provide a 10 Gbit/s solution which covers STM-64 as well as OC-192. The ANT-10Gig allows testing at the highest line bit rate and in all mappings below and offers optionally all testing down to n × 64 kbit/s.

For detailed information please refer to data sheet "ANT-10Gig".

Further options

Optical Power Splitter (90%/10%) BN 3035/90.49

The Optical Power Splitter is built into the ANT-20.
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

OLA-15 Optical Attenuator (Variable) BN 2239/01

One application of OLA-15 is in line-up of optical links, where line interruptions are simulated for bit error testing. The device is also useful when measuring the sensitivity of optical receivers. With its wide variable attenuation range and highly accurate and reproducible attenuation settings, the OLA-15 is an ideal companion to the ANT-20.

Calibrated at . . . . . 1310 and 1550 nm
Attenuation range . . . . . 3 to 60 dB
Resolution . . . . . 0.05 dB

See OLA-15 data sheet for details.

Jitter and Wander Options

Standards

Jitter generation and jitter/wander analysis are in accordance with
- 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
- Telcordia GR-253, GR-499
- ANSI T1.101, T1.102, T1.105.03

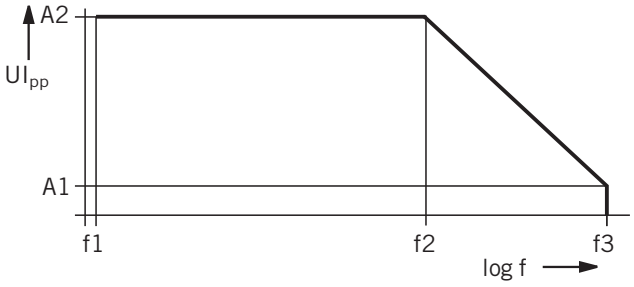
O.172 Jitter Generator up to 155 Mbit/s — BN 3035/90.81

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				27 k	3 500
44 736				35 k	4 500
51 840	0.5	64	0.1	27 k	3 500
139 264				39 k	5 000
155 520				39 k	5 000
622 080 *	1.0	256		20 k	5 000

* Requires option BN 3035/90.83

Modulator input (also for BN 3035/90.83)
75 Ω, BNC socket
Voltage required . . . . . 0 to 2 Vpp

Error limits . . . . . as per O.172

O.172 Jitter Generator 622 Mbit/s — BN 3035/90.83

Only in conjunction with the following options:
Jitter Generator BN 3035/90.81 and Optical Interface BN 3035/90.46 to /90.48

Jitter modulation of STM-4/OC-12 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 (BN3035/90.20) 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

O.172 Jitter Meter up to 155 Mbit/s — BN 3035/90.82

Bit rates
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 . . . . . 40, 60, 100, 400, 800, 1300, 3500, 5000 kHz
Filter characteristics . . . . . as per ITU-T 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

O.172 Jitter Meter 622 Mbit/s — BN 3035/90.84

Only in conjunction with the following options:
Jitter Meter BN 3035/90.82 and Optical Interface BN 3035/90.46 to /90.48

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) . . . . . 0.25 V/UIpp
Range II (0 to 80 UIpp) . . . . . 0.025 V/UIpp
Range III (0 to 800 UIpp) . . . . . 0.0025 V/UIpp

Jitter Analysis

Current values (continuous measurement)
- Peak jitter value ..... in UI_{pp}
- Positive peak value ..... in UI_{+p}
- Negative peak value ..... in UI_{-p}

Maximum value (gated measurement)
- Maximum peak jitter value ..... in UI_{pp}
- Maximum positive peak value ..... in UI_{+p}
- Maximum negative peak value ..... in UI_{-p}

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

The ANT-20 retains phase synchronicity even when pointer jitter occurs (phase tolerance to O.172).

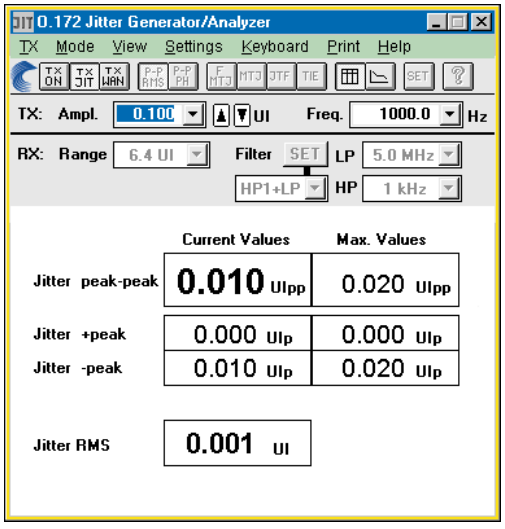


Figure 7: Jitter peak-to-peak/RMS measurement

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

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.

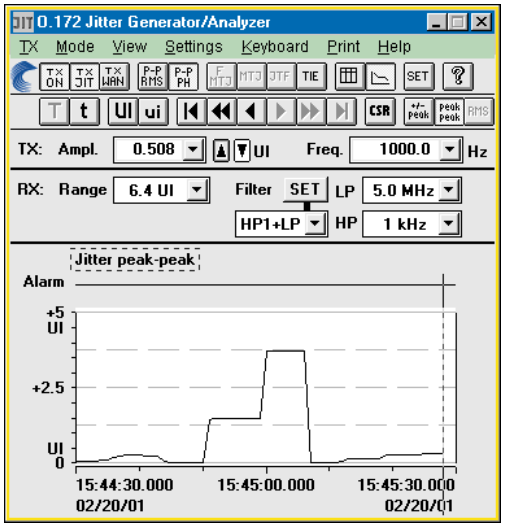


Figure 8: Jitter versus time display

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-20 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

G.958 (or G.783 rev.), T1.105.03, GR-253, GR-499
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.

O.172 Wander Generator up to 622 Mbit/s — BN 3035/90.85

Only in conjunction with Jitter Generator option BN 3035/90.81 for up to 155 Mbit/s and BN 3035/90.83 for 622 Mbit/s

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

O.172 Wander Analyzer up to 622 Mbit/s — BN 3035/90.86

Only in conjunction with Jitter Meter option BN 3035/90.82 for up to 155 Mbit/s and BN 3035/90.84 for 622 Mbit/s

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

For all bit rates up to 622 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 $\pm 10^6$ s
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 $\pm 10\%$

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

Accessory: "Acterna TSR-37 Rubidium Timing Signal Reference" for wander applications, see end of chapter

Wander Analysis

For options BN 3035/90.86 and BN 3035/90.89

Time Interval Error (TIE)

to O.172 . . . . . numerical and graphical
Sampling rates . . . . . see under O.172 Wander Analyzer for up to 622 Mbit/s

MTIE is additionally determined as a continually updated numerical value.

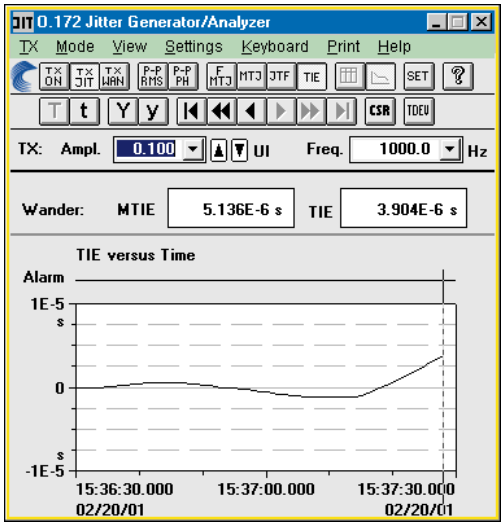


Figure 9: On-line wander testing (TIE)

To prevent data loss or premature termination of long term measurements, the ANT-20 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.

O.172 MTIE/TDEV Off-line Analysis Software BN 3035/95.21

This option provides extended off-line statistical analysis facilities for the results of wander measurements.

TIE values results obtained using the ANT-20 are analyzed according to ETSI ETS 300 462, EN 302 084, ITU-T O.172, G.810 to G.813, ANSI T1.101, Telcordia GR-1244.

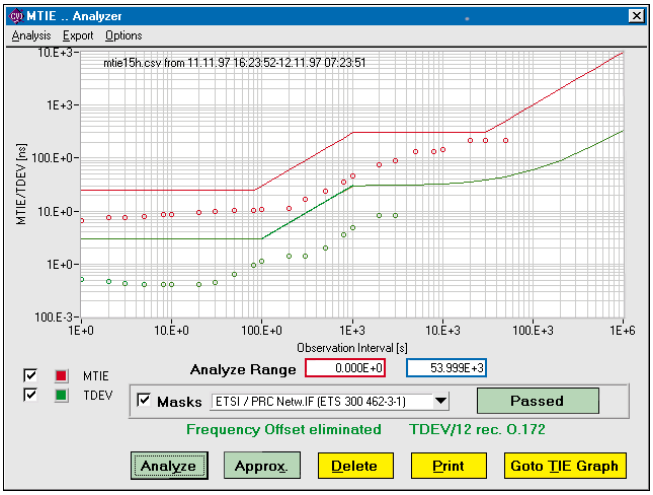


Figure 10: Display of MTIE/TDEV results and comparison against masks.

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 option 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.

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)

(part of option BN 3035/95.21)

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-20 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)

(part of option BN 3035/95.21)

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

"Acterna TSR-37 Rubidium Timing Signal Reference" . . . . . 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 622 Mbit/s.

Automatic determination of selective Jitter Transfer Function, JTF

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

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-20 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 G.735 to G.739, G.751, G.758 or T1.105.03 and GR-253. 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-20 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.

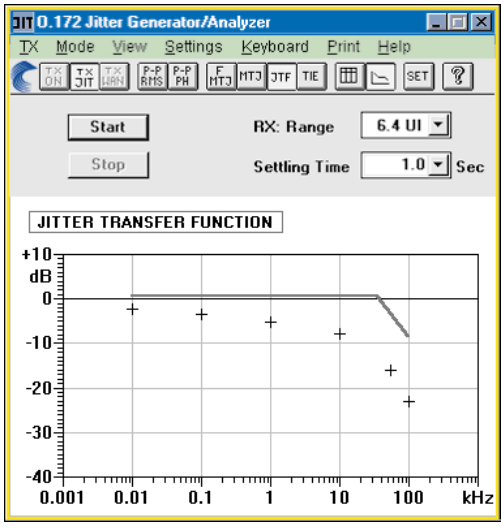


Figure 11: Jitter Transfer testing results

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

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

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”.

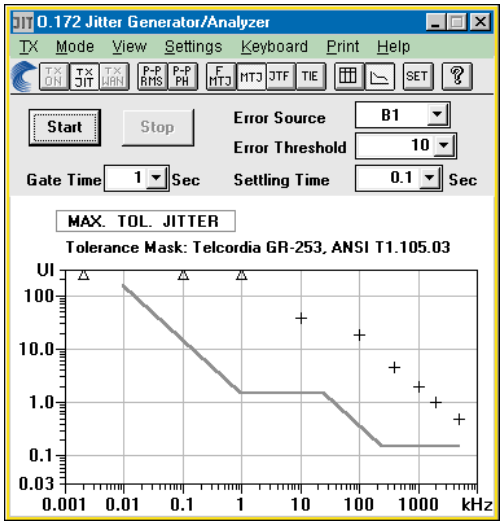


Figure 12: Maximum Tolerable Jitter testing

Automatic determination of Maximum Tolerable Jitter, MTJ

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

The ANT-20 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-20 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-20 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, ITU-T G.783 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-20 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

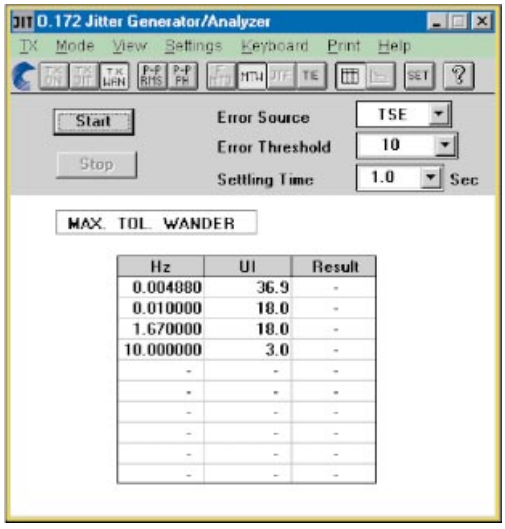


Figure 13: Maximum Tolerable Wander result display

The ANT-20 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-20.

- 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

ATM module **BN 3035/90.70**

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-20 is set on-line. Settings are made directly with a control (Figure 15) 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-20 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-20 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.

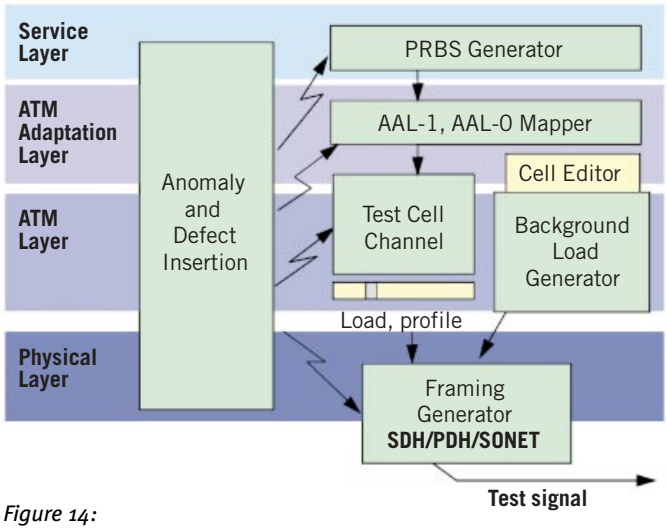


Figure 14: ATM-BERT generator configuration

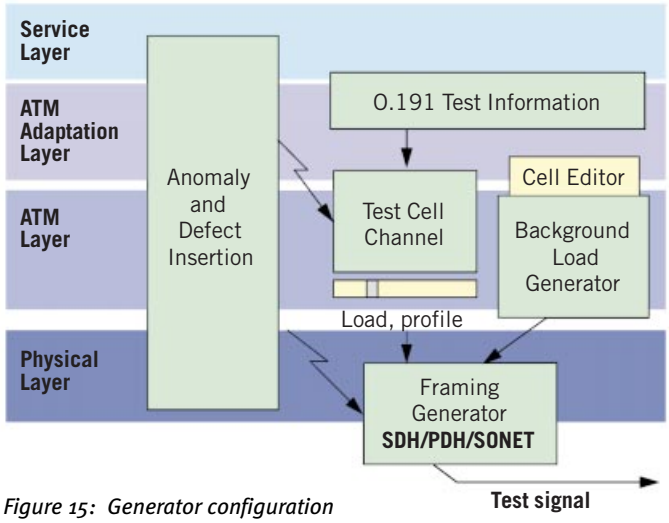


Figure 15: Generator configuration for performance measurement

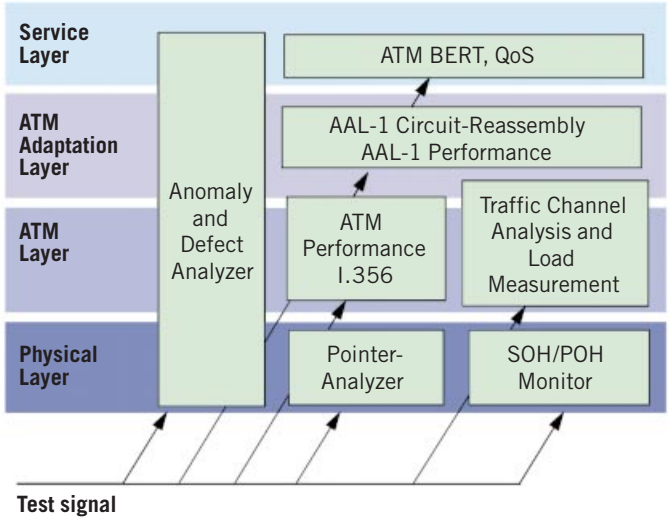


Figure 16: Analyzers in the ANT-20 – A hierarchical overview

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/sec, %

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 10000 cell times
Constant Bit Rate (CBR), setting range . . . . . 0.01% to 100%
Variable Bit Rate (VBR), 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-20 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-20 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/sec, %
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

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-20 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.

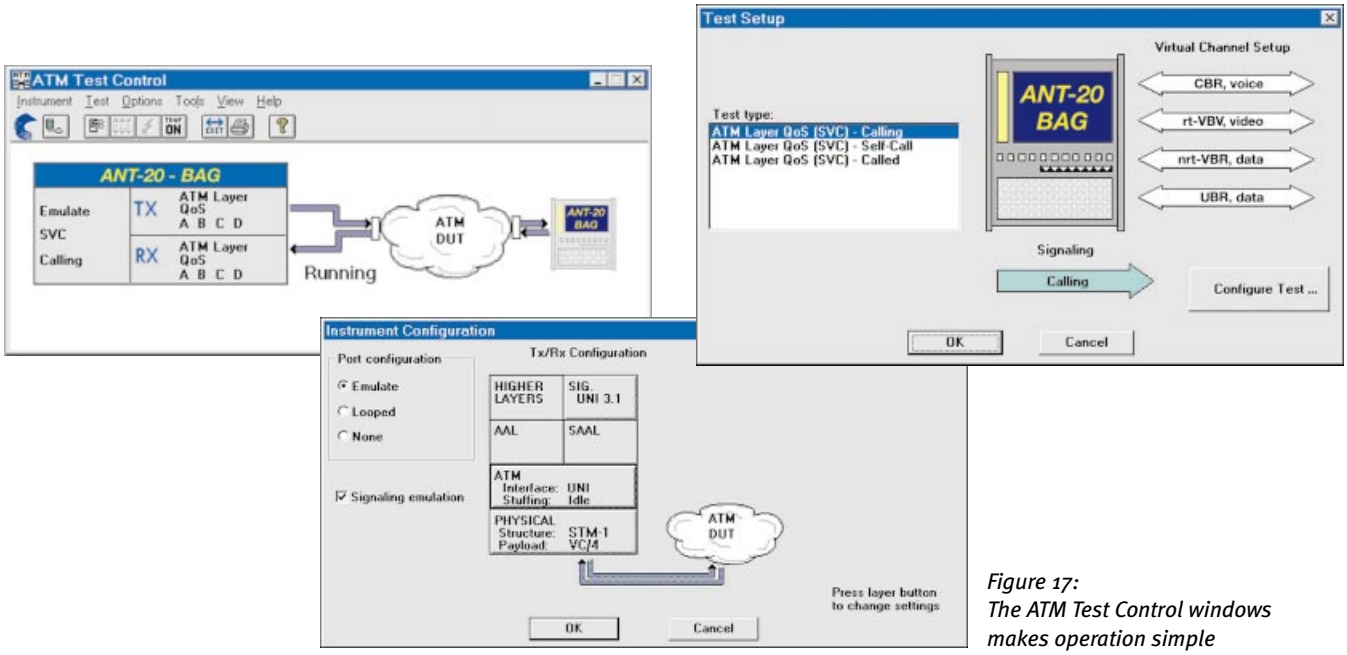


Figure 17:
The ATM Test Control windows makes operation simple

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-20 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.

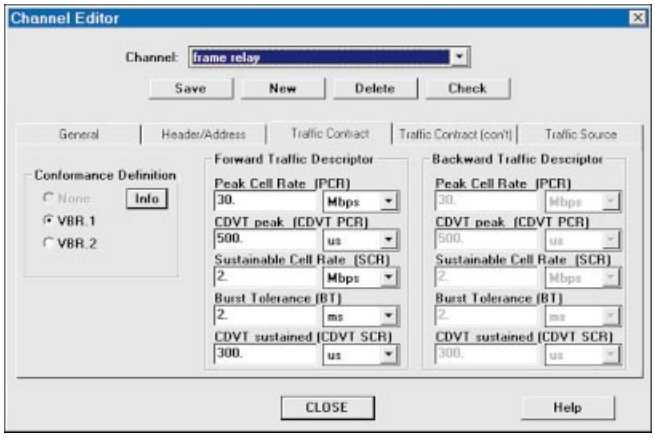


Figure 18: Channel Editor: Setting the traffic descriptor

ATM QoS test with 4 different SVCs

The ANT-20 with BAG can perform SVC and PVC tests on up to 4 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-20 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.

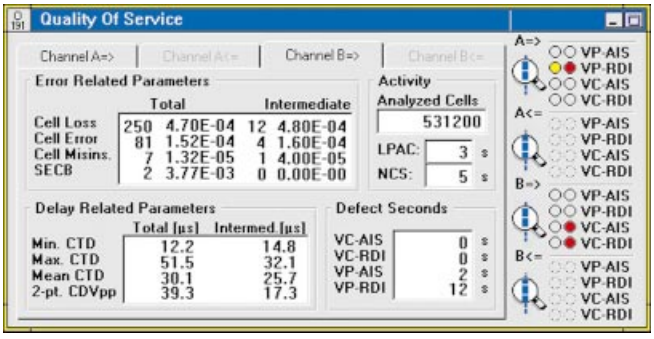


Figure 19: ATM test results for a real-time measurement on channel A

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.

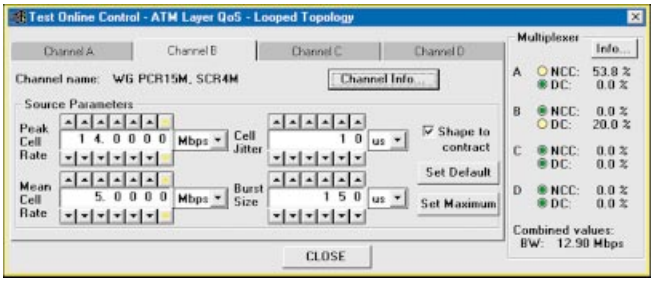


Figure 20: Soft-LED indication of multiplex results

Professional record of results

The ANT-20 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-20 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.

ATM Mappings

The ATM mapping options provide further frame structures for interfaces conforming to ITU-T G.804/832/707 and 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 available:

E4 (140 Mbit/s) ATM mapping — BN 3035/90.72

Bit rate ..... 139 264 kbit/s

E3 (34 Mbit/s) ATM mapping — BN 3035/90.74

Bit rate ..... 34 368 kbit/s

E1 (2 Mbit/s) ATM mapping — BN 3035/90.75

Bit rate ..... 2048 kbit/s

STM-1/VC3 ATM mapping — BN 3035/90.77

Bit rate ..... 155 520 kbit/s

STS-1/STS-3 ATM mapping — BN 3035/90.71

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 — BN 3035/90.73

PLCP-based mapping
HEC-based mapping
Bit rate ..... 44 736 kbit/s

DS1 (1.5 Mbit/s) ATM mapping — BN 3035/90.76

Bit rate ..... 1544 kbit/s

OC-12c/STM-4c ATM testing BN 3035/90.91

Only in conjunction with BN 3035/90.70 and BN 3035/90.46
or BN 3035/90.47 or BN 3035/90.48

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-20 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, M errors in N 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 ATM channel can be switched ON/OFF
Header ..... freely definable
Payload ..... 1 fill byte freely settable
CBR ..... 449 Mbit/s

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/sec, %

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-20 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-20 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-20 (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".

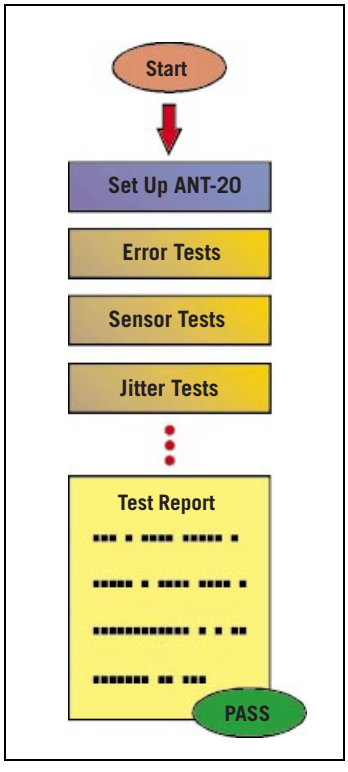


Figure 21: Automatic test sequences with the ANT-20

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-20 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-20 from a Windows PC. The complete ANT-20 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.

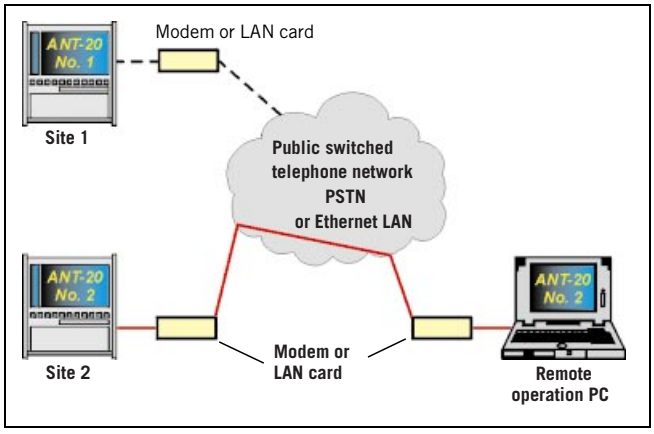


Figure 22: Remote operation of the ANT-20

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.

Ordering Information

ANT-20 Advanced Network Tester, SONET version

(Includes one selectable STS-1 mapping)
With color TFT display **BN 3035/42**

Options

Touchscreen	BN 3035/93.11
CPU RAM expansion to 128 MB	BN 3035/92.25

STS-1 mappings

VT1.5 SPE/STM-0 (1.5 Mbit/s in STS-1)	BN 3035/90.10
VT6 SPE (6 Mbit/s in STS-1)	BN 3035/90.11
STS-1 SPE/STM-0 (45 Mbit/s in STS-1)	BN 3035/90.12
VT2 SPE/STM-0 (2 Mbit/s in STS-1)	BN 3035/90.13
STS-3c SPE (140 Mbit/s in STS-3)	BN 3035/90.03

If you order more than 2 additional mappings you can get a discount. Please refer to the price list.

Extended Overhead Analysis
BN 3035/90.15

Drop & Insert
BN 3035/90.20

M13 Mux/Demux
BN 3035/90.32

Optical interfaces
The following options, BN 3035/90.43 to /90.48, are alternatives.

Optical OC-1/3, STM-0/1, 1310 nm	BN 3035/90.43
Optical OC-1/3, STM-0/1, 1550 nm	BN 3035/90.44
Optical OC-1/3, STM-0/1, 1310 & 1550 nm	BN 3035/90.45
Optical OC-1/3/12, STM-0/1/4, 1310 nm	BN 3035/90.46
Optical OC-1/3/12, STM-0/1/4, 1550 nm	BN 3035/90.47
Optical OC-1/3/12, STM-0/1/4, 1310 & 1550 nm	BN 3035/90.48

The options BN 3035/91.53, /91.54, /91.59 are alternatives.

Optical OC-48, STM-16, 1310 nm	BN 3035/91.54
Optical OC-48, STM-16, 1550 nm	BN 3035/91.53
Optical OC-48, STM-16, 1310/1550 nm switchable	BN 3035/91.59

OC-12c/STM-4c Options

OC-12c/STM-4c Bit Error Tester requires Optical Module BN 3035/90.46, /90.47 or /90.48	BN 3035/90.90
OC-12c/STM-4c ATM Testing requires Optical Module BN 3035/90.46, /90.47 or /90.48 and ATM Module BN 3035/90.70	BN 3035/90.91
OC-12c/STM-4c Virtual Concatenation requires BN 3035/90.90 or /90.91	BN 3035/90.92

OC-48c/STM-16c Option

OC-48c/STM-16c Bit Error Tester (Bulk)	BN 3035/90.93

Optical Packages
include optical interfaces from 52 Mbit/s to 2488 Mbit/s and four optical adapters – please select; not included STM-16c/OC-48c, STM-4c/OC-12c

Optics OC-1/3/12/48, STM-0/1/4/16, 1310 nm includes BN 3035/90.46, /91.54	BN 3035/91.17
Optics OC-1/3/12/48, STM-0/1/4/16, 1550 nm includes BN 3035/90.47, /91.53	BN 3035/91.18
Optics OC-1/3/12/48, STM-0/1/4/16, 1310 & 1550 nm includes BN 3035/90.48, /91.59	BN 3035/91.19
Optics OC-1/3/12, 1310 nm, STM-0/1/4, OC-48, STM-16, 1550 nm includes BN 3035/90.46, /91.53	BN 3035/91.23

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

Optical power splitter (90%/10%)
BN 3035/90.49

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

O.172 Jitter Generator up to 155 Mbit/s	BN 3035/90.81
O.172 Jitter Meter up to 155 Mbit/s	BN 3035/90.82
O.172 Jitter Generator 622 Mbit/s requires BN 3035/90.81	BN 3035/90.83
O.172 Jitter Meter 622 Mbit/s requires BN 3035/90.82	BN 3035/90.84
O.172 Wander Generator up to 622 Mbit/s requires BN 3035/90.81 for up to 155 Mbit/s and /90.83 for 622 Mbit/s	BN 3035/90.85
O.172 Wander Analyzer up to 622 Mbit/s requires BN 3035/90.82 for up to 155 Mbit/s and /90.84 for 622 Mbit/s	BN 3035/90.86
O.172 MTIE/TDEV Off-line Analysis requires BN 3035/90.86 for up to 622 Mbit/s	BN 3035/95.21

O.172 Jitter and wander packages

O.172 Jitter/Wander Packet up to 155 Mbit/s includes MTIE/TDEV offline analysis	BN 3035/91.29
O.172 Jitter/Wander Packet up to 622 Mbit/s includes MTIE/TDEV offline analysis	BN 3035/91.31

ATM functions

ATM module for STM-1/STS-3c	BN 3035/90.70
ATM Broadband Analyzer/Generator module	BN 3035/90.80
ATM PVC & SVC Testing package includes BN 3035/90.70 and /90.80	BN 3035/91.81

Additional ATM mappings
(requires ATM module BN 3035/90.70 or BN 3035/90.80)

E4 (140 Mbit/s) ATM mapping[1)]	BN 3035/90.72
E3 (34 Mbit/s) ATM mapping[1)]	BN 3035/90.74
E1 (2 Mbit/s) ATM mapping[1)]	BN 3035/90.75
STS-1 (51 Mbit/s) ATM mapping	BN 3035/90.71
DS3 (45 Mbit/s) ATM mapping[2)]	BN 3035/90.73
DS1 (1.5 Mbit/s) ATM mapping[2)]	BN 3035/90.76
VC-3 ATM mapping in STM-1 (AU-3/AU-4)	BN 3035/90.77

1) For SONET versions BN 3035/42 and BN 3038/12, option BN 3035/90.33 is required
2) For SDH versions BN 3035/41 and BN 3038/11, option BN 3035/90.34 is required

OC-12c/STM-4c ATM Testing — BN 3035/90.91
requires Optical Module BN 3035/90.46, /90.47 or /90.48 and ATM Module BN 3035/90.70

SDH/PDH functions

STM-1 mappings	
C12 (2 Mbit/s in STM-1, AU-3/AU-4)	BN 3035/90.01
C3 (34 Mbit/s in STM-1, AU-3/AU-4)	BN 3035/90.02
C4 (140 Mbit/s in STM-1 and STS-3c)	BN 3035/90.03
C11 (1.5 Mbit/s in STM-1, AU-3/4, TU-11/12)	BN 3035/90.04
C3 (45 Mbit/s in STM-1, AU-3/AU-4)	BN 3035/90.05
C2 (6 Mbit/s in STM-1, AU-3/AU-4)	BN 3035/90.06
STM-0 mappings (see STS-1 mappings)	
PDH functions	
BERT 2/8/34/140 Mbit/s	BN 3035/90.33
PDH 64k/140M MUX/DEMUX chain	BN 3035/90.30
PDH 64k/140M DEMUX chain	BN 3035/90.31

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	BN 960/00.08
Soft case	BN 3035/92.02
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

ANT-20 product family

ANT-20SE *– combination and parallel operation of all bit rates up to OC-48 with jitter/wander up to 2.5 Gbit/s and ATM in a single unit. Now also with OC-192 optical interfaces.*

ANT-10Gig *– is a subset of the ANT-20SE. This test solution handles OC-192c/STM-64c, taking you one step further into the future. It offers access to all standard interfaces from 1.5 Mbit/s up to 10 Gbit/s.*

ANT-20 *– Compact and handy for field work. It offers one extension slot for OC-48, Jitter up to OC-12 or Comprehensive ATM testing.*

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